

268. Universal Joint Drive Shaft Assembly
(Rzeppa)

a. Disassembly.

- (1) Clean drive shaft and universal joint assembly. Clean drive shaft and universal joint assembly in mineral spirits paint thinner or dry-cleaning solvent to remove grease from joint. As soon as inspection and wear limit checks are completed, all parts to be used again must immediately be coated with oil to prevent damage from rust.
- (2) Check universal joint for excessive play or backlash. To determine if excessive play or backlash exists in the universal joint, place assembly in vise, with vise jaws gripping outer drive shaft just ahead of universal joint. Use soft metal protectors in jaws of vise. Firmly grasp inner drive shaft and attempt to twist the joint in both directions. If excessive play or backlash is evident in universal joint, all parts must be replaced.
- (3) Remove universal joint spacer. Remove two setscrews (fig. 353) from universal joint spacer and slide spacer off inner drive shaft.
- (4) Remove ball retainer. Remove locking wire (fig. 354) from slotted head screws. Remove the three slotted head screws and slide ball retainer of inner drive shaft away from the ball race.



Figure 353. Universal joint spacer removal

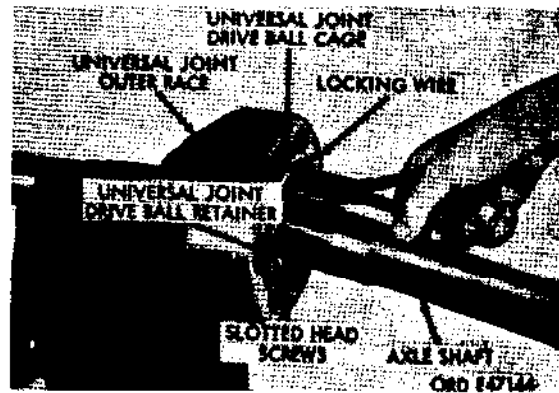


Figure 354. Locking wire removal

- (5) Remove inner drive shaft from universal joint ball race. Remove inner drive shaft from universal joint ball race. Remove retaining ring and ball retainer from inner drive shaft.
- (6) Remove pilot pin. Withdraw pilot pin (fig. 355) from universal joint bell.

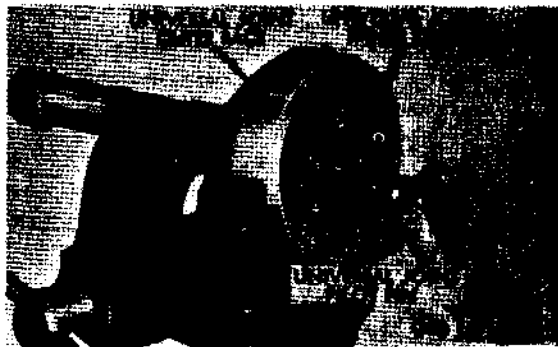


Figure 355. Removing pilot pin

- (7) Remove universal joint balls (fig. 356). Tilt ball race in universal joint bell until one universal joint ball can be lifted out. Then tilt the ball race until the next ball can be removed, and continue until all the balls are removed.
- (8) Remove inner shaft pilot. Turn ball cage and ball race assembly completely over and remove inner shaft pilot (fig. 357).
- (9) Remove ball cage and ball race (fig. 358). Roll the ball cage and ball race

assembly at right angles to universal joint bell with the two elongated openings in cage in line with opposite teeth in universal joint bell. Then lift ball cage and ball race from universal joint bell.

- (10) Separate ball race from ball cage. (fig. 359). To separate ball race from ball cage, turn race at right angle to cage, align tooth on race with elongated hole in cage and roll race from cage.
- (11) Remove outer spacing washer (fig. 360). Remove outer spacing washer (A) from outer drive shaft (B). Washer is a pressed fit and must be removed with care to prevent damage to outer drive shaft.

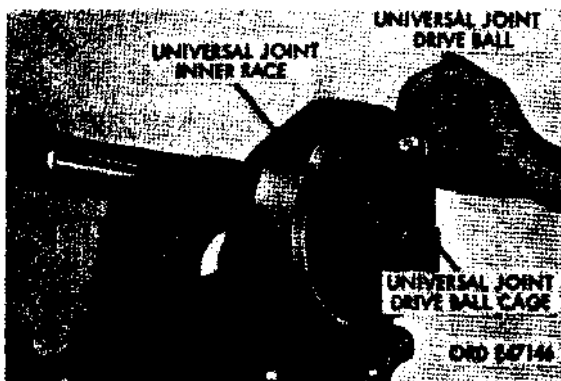


Figure 356. Universal joint drive ball removal

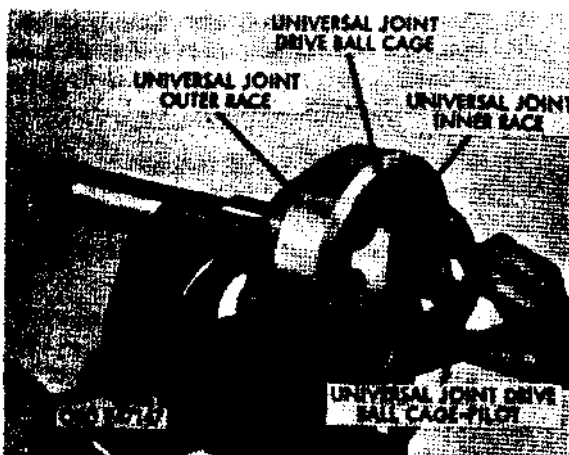


Figure 357. Removing universal joint drive ball cage pilot

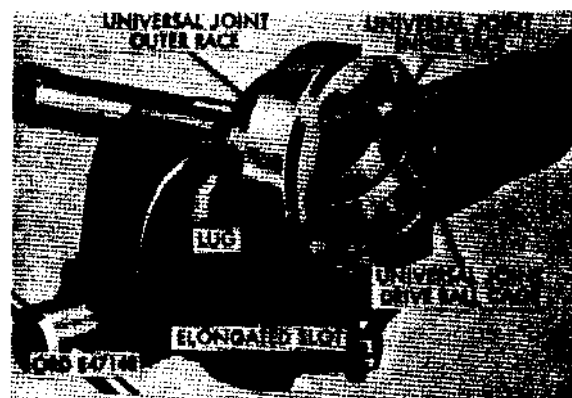


Figure 358. Removing ball cage and inner race

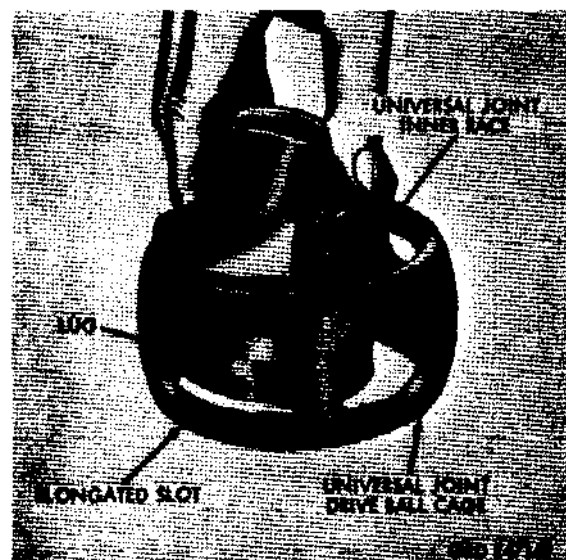


Figure 359. Separating inner ball race from ball cage

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Use dry-cleaning solvent or mineral spirits paint thinner to thoroughly clean splines on drive shafts. Thoroughly clean the universal joint bell, balls, ball race, and ball cage.
- (2) Inspection and repair. Inspect ball cage and ball race for excessive wear or cracks. Check balls for cracks, chips, or rough spots. Use micrometer to check balls for out-of-round condition. Examine splines for damage or twist.

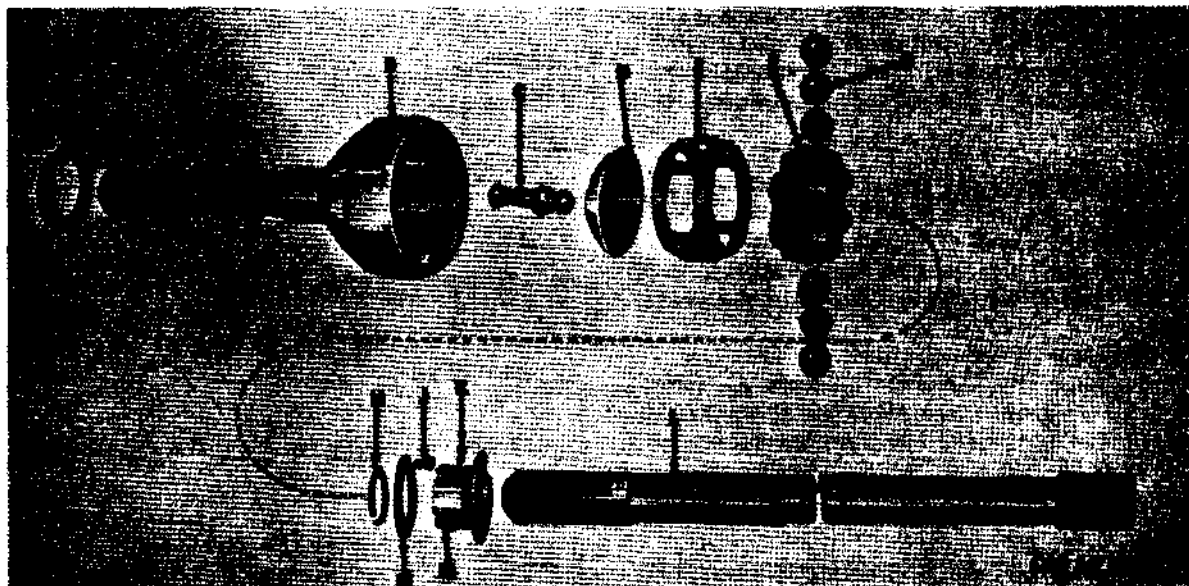


Figure 360. Universal joint (RZEPPA) - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|-----------------------|------------|------------------------------|
| A | Washer, spacing | H | Ring, retaining, inner shaft |
| B | Shaft, drive, outer | J | Screw, sltd-hd |
| C | Pin, pilot | K | Screw, set |
| D | Pilot, inner shaft | L | Shaft, drive, inner, left |
| E | Cage, ball | M | Spacer, universal joint |
| F | Race, ball | N | Retainer, ball |
| G | Ball, universal joint | | |

Figure 360. Universal joint (RZEPPA) - exploded view - legend

Replace any defective parts. If necessary to replace outer spacing washer (A, fig. 360) on outer drive shaft, remove old washer. Press new outer spacer washer onto outer drive shaft. Make certain chamfered side of bore faces universal joint bell or yoke. Further repair of the universal joint drive shaft assembly is a matter of replacing the defective parts.

c. Assembly. Before assembling, be sure all parts are serviceable and free of all defects. Obtain new parts to be used in place of damaged or worn parts.

Note. Key letters in this paragraph refer to figure 360 unless otherwise indicated.

- (1) Lubricate all parts to facilitate assembly.

- (2) Place outer drive shaft (B) in a vise equipped with soft jaws, with bell end of shaft up. Do not grip shaft in vise at machined surfaces.
- (3) Place ball race (F) in ball cage (E) by inserting one tooth of race through rectangular opening in cage and rolling it into place. Race must fit freely in cage.
- (4) Hold ball race and ball cage assembly so that the rectangular openings in cage align with two opposite teeth in universal joint bell. Lower into place in bell. Turn cage and race into position in bell, and make sure all parts turn freely.
- (5) Turn ball cage (E) and ball race (F) in universal joint bell so that drilled holes

in race are down. Install inner shaft pilot (D). Again, turn cage and race with pilot turning into bottom of bell and align grooves in race with openings in cage. Align cage and race assembly with grooves in bell.

- (6) Tilt ball race (F) and ball cage (E) so that one universal joint ball (G) can be inserted into race through openings in cage. Rotate ball race enough to permit installing another ball in groove adjacent to first ball. Continue until all six balls are installed.
- (7) Turn ball race (F) so that side with drilled holes is flush with edges of universal joint bell. Insert pilot pin (C) through ball race (F) and inner shaft pilot (D), with flat end of pin down.
- (8) Slide inner shaft retaining ring (H) onto outer end of inner drive shaft (L) and in groove on splines. Insert splines of drive shaft into splines of ball race (F) vertically so that pilot pin (C) will be centered and contact center of inner drive shaft.
- (9) Slide ball retainer (N) over end of inner drive shaft (L) and position retainer on ball race (F). Install three slotted head screws (J) and tighten firmly. Thread wire through drilled heads of slotted head screws and twist ends of wire together.
- (10) Slip universal joint spacer (M) over inner drive shaft (L), flanged end away from universal joint. Align notches in spacer with slotted head screws (J) to allow spacer to contact ball retainer (N). Pull inner drive shaft until inner shaft retaining ring (H) is firmly against ball retainer (N). Then slide universal joint spacer (M) tight against ball retainer, tighten both set screws (K) in spacer securely and thread locking wire through drilled holes in setscrews. Twist ends of locking wire together to secure assembly in place.

269. Differential Carrier Assembly

a. Disassembly.

- (1) Remove differential carrier assembly (fig. 361). Punch an index mark on

each differential carrier cap, and another mark directly opposite on the differential carrier to ensure proper installation. Remove the locking wire from differential bearing cap bolts (T). Remove the cap screw (U) that attaches differential bearing adjusting ring lock (V) to differential bearing caps (W and S) and remove lock. Remove bolts (T). Remove differential bearing caps (S and W). Lift differential carrier assembly and differential bearing adjusting rings from carrier.

- (2) Remove companion flanges (B and Z, fig. 362). Remove cotter Pins (BB and GG) from slotted nuts (A, and AA) and remove slotted nuts. Pull companion flanges (B and Z) from hypoid pinion and through shaft (S) with a suitable puller.
- (3) Remove hypoid pinion and through shaft (S, fig. 362). Remove cap screws (FF) and lockwashers (EE) that attach front bearing cage cover (D) to front bearing cage (M), and remove front bearing cage cover (D) and front bearing cage gasket (L). Remove cap screws (CC) and lockwashers (DD) that attach rear bearing cover (X) to carrier and remove cover, rear bearing spacer (V), and rear cover gasket (W) from carrier. Tap on rear end of through shaft until front bearing cage (M) is forced off carrier, then lift hypoid pinion and through shaft assembly from carrier. Remove rear bearing (U) from carrier with a suitable remover. Remove rear bearing race (T) from through shaft with a suitable puller.
- (4) Remove hypoid pinion front bearing cage from through shaft (fig. 362). Place hypoid pinion and through shaft (S) in vise (equipped with soft jaws) and remove front bearing locknut (F), front bearing lockwasher (G), and front bearing adjusting nut (H). Using a soft hammer, tap lightly on front bearing cage (M) to remove front outer bearing cone (J) from through shaft, and remove bearing cage from through shaft. Remove front bearing spacer (P). Pull front inner bearing cone (R) from shaft, using a suitable puller.
- (5) Remove hypoid pinion bearing cups from cage (fig. 362). Using bearing

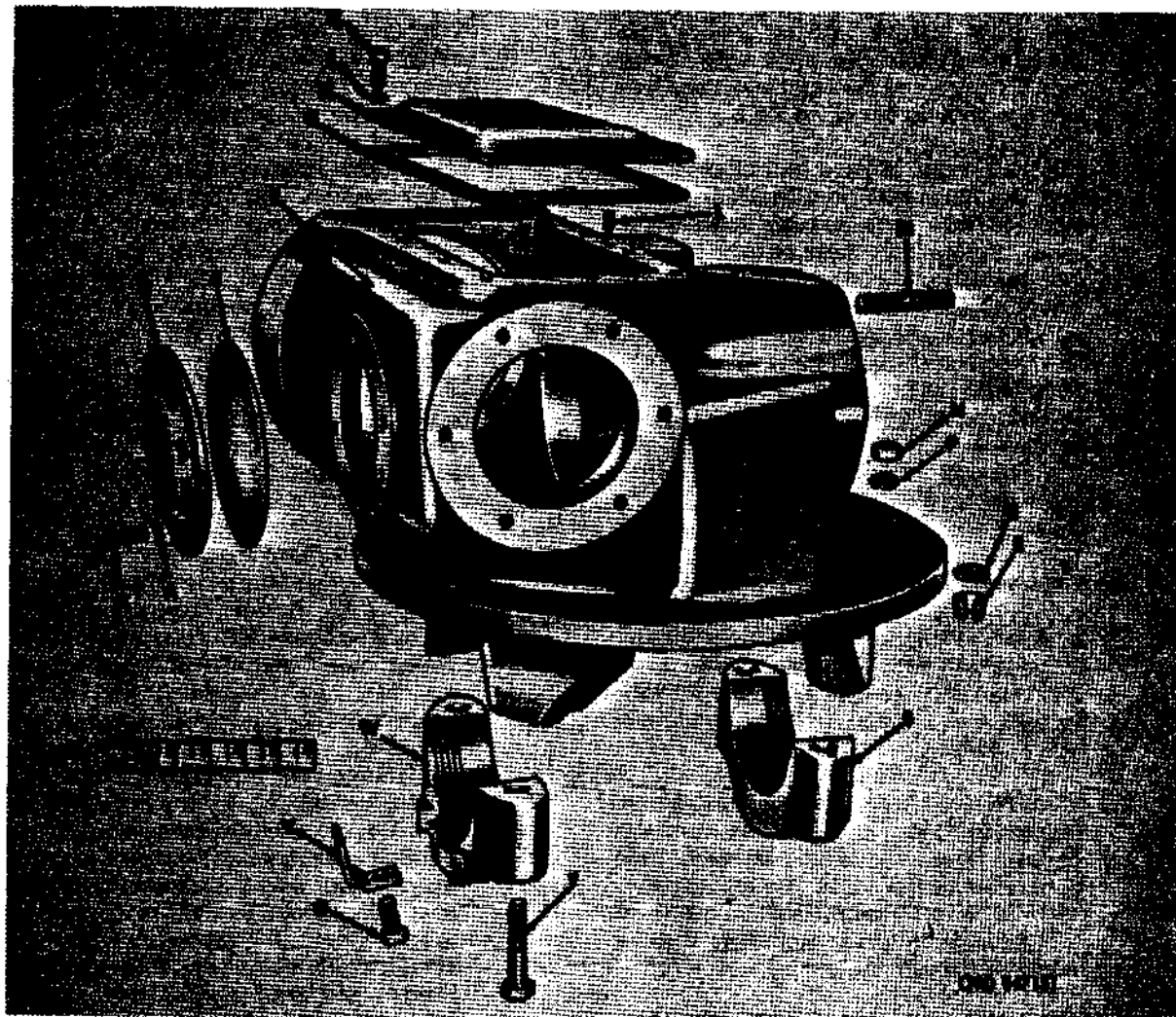


Figure 361. Differential carrier - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|----------------------|------------|--|
| A | Lockwasher | M | Outer bearing cover stud |
| B | Cap screw | N | Nut |
| C | Air vent | P | Lockwasher |
| D | Side cover | Q | Lockwasher |
| E | Side cover gasket | R | Adapter sleeve |
| F | Differential carrier | S | Differential bearing cap (right) |
| G | Top cover gasket | T | Differential bearing cap bolt |
| H | Top cover | U | Cap screw |
| J | Lockwasher | V | Differential bearing adjusting ring lock |
| K | Cap screw | W | Differential bearing cap (left) |
| L | Setscrew | | |

Figure 361. Differential carrier - exploded view - legend

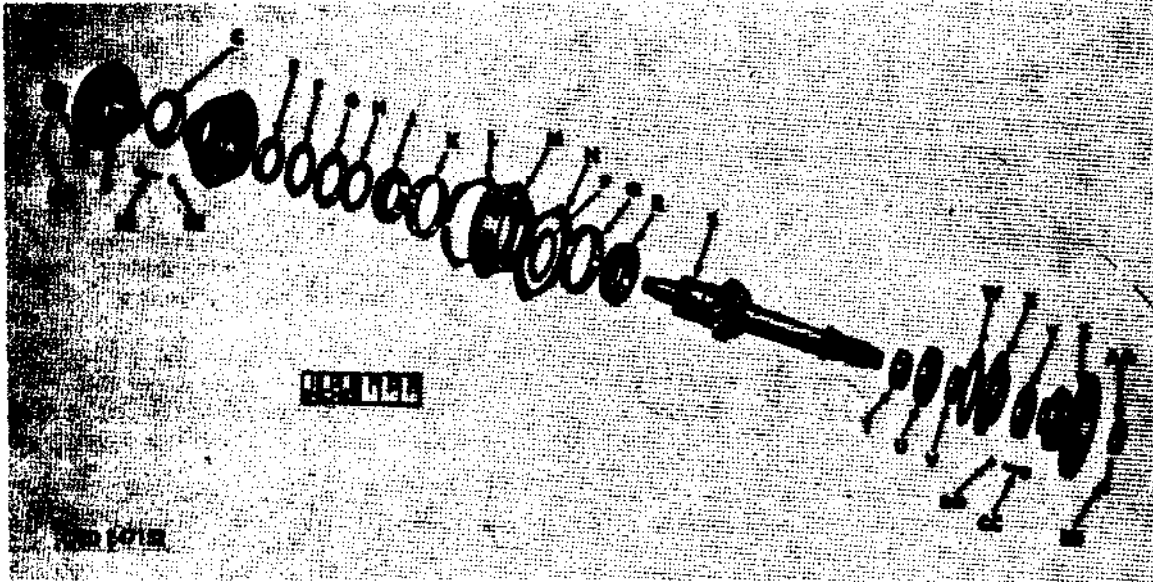


Figure 362. Hypoid pinion assembly - exploded view

| Key | Item | Key | Item |
|-----|-------------------------------|-----|---------------------------------|
| A | Slotted nut | S | Hypoid pinion and through shaft |
| B | Companion flange | T | Rear bearing race |
| C | Companion flange dust slinger | U | Rear bearing |
| D | Front bearing cage cover | V | Rear bearing spacer |
| E | Oil seal | W | Rear cover gasket |
| F | Front bearing locknut | X | Rear bearing cover |
| G | Front bearing lockwasher | Y | Oil seal |
| H | Front bearing adjusting nut | Z | Companion flange |
| J | Front outer bearing cone | AA | Slotted nut |
| K | Front outer bearing cup | BB | Cotter pin |
| L | Front bearing cage gasket | CC | Cap screw |
| M | Front bearing cage | DD | Lockwasher |
| N | Front bearing cage shim | EE | Lockwasher |
| P | Front bearing spacer | FF | Cap screw |
| Q | Front inner bearing cup | GG | Cotter pin |
| R | Front inner bearing cone | | |

Figure 362. Hypoid pinion assembly - exploded view - legend

remover and replacer 5120-795-0159, press front outer bearing cup (K) from front bearing cage (M). Use a small punch to move front inner bearing cup (Q) from its seat in cage. This will permit full contact between bearing cup and the shoulders on bearing remover. Complete disassembly of pinion bearing cage by pressing front inner bearing cup (Q) from cage with a suitable remover.

- (6) Remove hypoid pinion from through shaft carefully. Support hypoid drive firmly on arbor press and press through shaft from pinion. Remove key from shaft.
- (7) Remove differential carrier side cover (fig. 361). Remove cap screws (B) and lockwasher (A) securing side cover (D) to differential carrier (F) and remove side cover (D). Remove and dis-

card side cover gasket (E). Remove air vent (C) from cover.

- (8) Remove helical drive pinion outer bearing cover (fig. 363). Remove nuts (Q) and lockwashers (R) holding outer bearing cover (P) and outer bearing cage (G) to carrier assembly. Remove cover and outer bearing cover shims (N). Tie shims to cover to facilitate adjustment when assembling.
- (9) Remove helical drive pinion outer bearing cage (fig. 361). Remove locking wire from the cap screws (S) that attach bearing retaining washer (M). Using suitable puller screws in threaded holes of outer bearing cage (G), pull outer bearing cage out of carrier assembly. Remove outer bearing cage shims (F) and tie to bearing cage to facilitate correct assembly, and aid in securing desired tooth contact between hypoid pinion and hypoid drive gear (A) at assembly.
- (10) Disassemble helical drive pinion outer bearing cage (fig. 363). Using suitable adapter, press outer bearing cups (H and L) and outer bearing cones (J and K) from outer bearing cage (G).
- (11) Remove helical drive pinion from hypoid drive gear. Position differential carrier assembly on press with side cover hole facing up. Place two iron spacers between rear face of hypoid drive gear (fig. 364) and carrier assembly. Using a suitable adapter, press helical drive pinion from hypoid drive gear.
- (12) Disassemble helical drive pinion (fig. 363). Remove key (T) and bearing spacer (D) from helical drive pinion (E).
- (13) Remove hypoid drive gear. Remove setscrew (L, fig. 361) from carrier top cover surfaces. Using a long punch or drift, place end of punch in recess or notch provided in opposite sides of bearing sleeve (B, fig. 363). Drive bearing sleeve from carrier. Do not permit bearing sleeve to become cocked in carrier case, as damage to

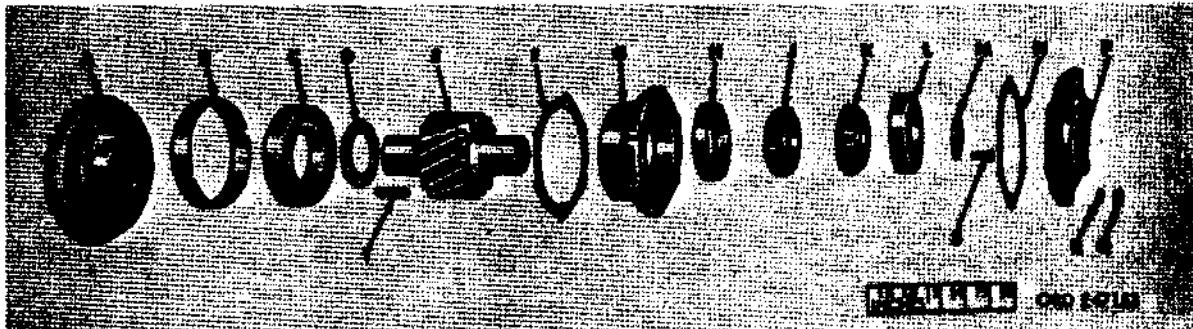


Figure 363. Helical drive pinion assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|-------------------------|------------|--------------------------|
| A | Hypoid drive gear | K | Outer bearing cone |
| B | Bearing sleeve | L | Outer bearing cup |
| C | Inner bearing | M | Bearing retaining washer |
| D | Bearing spacer | N | Outer bearing cover shim |
| E | Helical drive pinion | P | Outer bearing cover |
| F | Outer bearing cage shim | Q | Nut |
| G | Outer bearing cage | R | Lockwasher |
| H | Outer bearing cup | S | Cap screw |
| J | Outer bearing cone | T | Key |

Figure 363. Helical drive pinion assembly - exploded view - legend

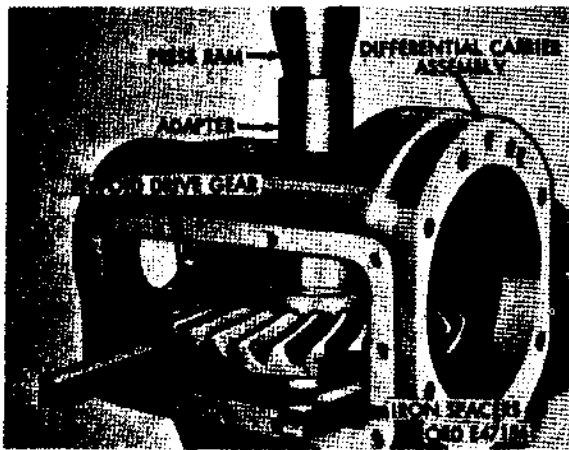


Figure 364. Pressing hypoid drive gear from helical drive pinion

case will result. Avoid difficulty in this operation by driving sleeve alternately at one recess and then the other. Drive sleeve only enough to obtain sufficient clearance between sleeve and shoulder in carrier, and then use bearing remover and replace 5120-795-0159 to remove sleeve and hypoid drive gear.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean all parts thoroughly with dry-cleaning solvent or mineral spirits paint thinner. Apply a light grade of oil to all polished surfaces to prevent rusting.

(2) Inspection and repair.

- (a) Differential carrier. Check differential carrier for cracks or distortion. Inspect stud threads and cap screw hole threads for damage. Replace studs if broken or damaged. Clean up damaged threads of carrier with a tap. Replace carrier if differential adjusting ring threads are damaged beyond repair.

Note. Carrier and caps cannot be replaced as separate items.

- (b) Hypoid drive and pinion gears. Examine the hypoid drive and pinion gears carefully for chipped, cracked, or scored teeth. Gears with broken,

chipped, cracked, or excessively worn teeth must be replaced. Small defects such as nicks, scores, or burs may be corrected with a fine stone.

Note. The hypoid drive and pinion gears are matched gears. If necessary to replace either gear, both gears must be replaced.

Replace a hypoid pinion gear front outer or inner bearing cone if any of the rollers are missing, pitted, corroded, or discolored due to overheating. Replace hypoid pinion gear front inner or outer bearing cups that are cracked, chipped, pitted or discolored due to overheating. Replace a hypoid pinion front bearing cage cover if damaged. Replace the oil seals if worn or damaged.

(c) Helical pinion gear and related parts.

Replace a helical pinion gear if the teeth are broken, chipped, or visibly worn. Small nicks may be polished with a fine stone. Replace a helical pinion gear if the threaded holes in end of shaft are stripped or damaged beyond repair. Replace the outer bearing cone or cups if worn or damaged. Replace the outer bearing cage if cracked or damaged. Replace the inner bearing or bearing sleeve if worn or damaged.

c. Assembly.

Note. When replacing differential gears on the chassis truck M139C and M139D, be sure to order a complete axle set to meet specified gear ratios (10.26- to 1.00).

- (1) Install pinion front bearing cups (fig. 362). Press front outer bearing cup (K) and front inner bearing cup (Q) into front bearing cage (M) until firmly seated.
- (2) Install hypoid pinion front inner bearing cone (fig. 362). Press front inner bearing cone (R) on hypoid pinion and through shaft (S) until seated against the pinion gear.
- (3) Assemble hypoid pinion front bearing cage on pinion (fig. 362). Place front

bearing cage (M) over front inner bearing cone (R), with the hub side of cage facing in. Install front bearing spacer (P) on hypoid pinion and through shaft (S). Install front outer bearing cone (J), with the small diameter of cone facing toward cage. Install front bearing adjusting nut (H) (nut with dowel), on hypoid pinion and through shaft (S). Tighten to approximately 500 pound-feet torque. Slip front bearing lockwasher (G) into position over dowel on front bearing adjusting nut. It may be necessary to remove lockwasher and turn nut in order to get hole in lockwasher to index with dowel on adjusting nut. Install front bearing locknut (F) and tighten to 500 pound-feet torque.

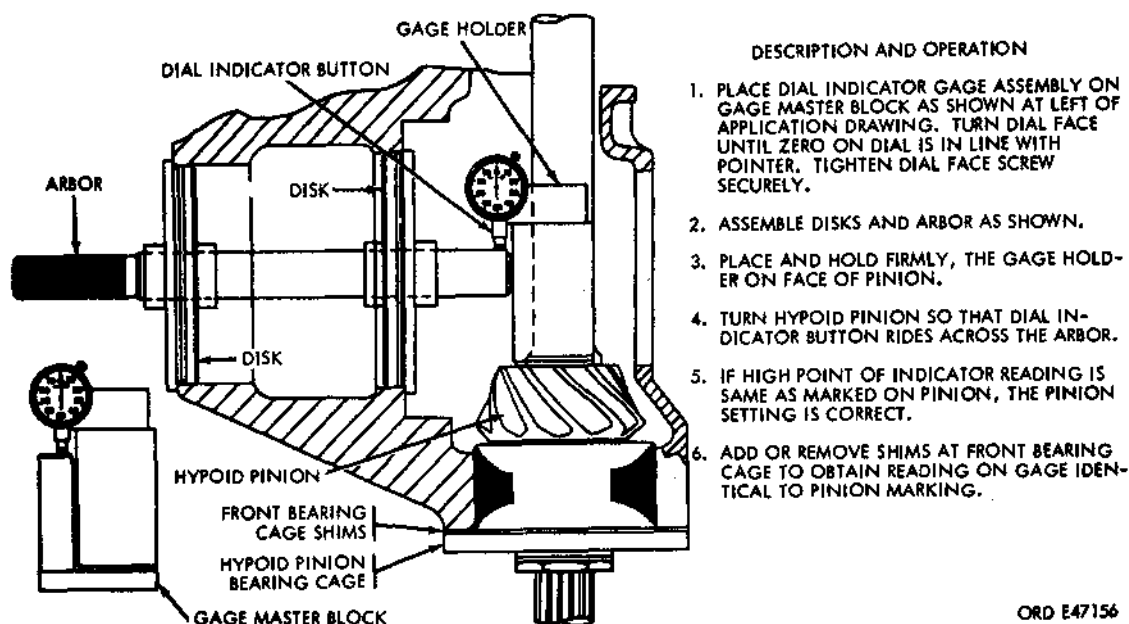
- (4) Adjust hypoid pinion bearing preload (fig. 365). Use bearing preload tester 6670-347-5022 to check hypoid pinion front bearing preload reading. When new bearings and cups are used, correct bearing preload should be 12- to 18-inch-pounds maximum. When original bearings are used, the bearing preload should be 4- to 8-inch-pounds maximum. If correct preload is not secured on initial adjustment, remove front bearing locknut (F, fig. 362), front bearing lockwasher (G, fig. 362), front bearing adjusting nut (H, fig. 362), and front outer bearing cone (J, fig. 362). This will permit removal of front bearing spacer (P, fig. 362) which controls the bearing preload



Figure 365. Checking hypoid drive pinion bearing preload

adjustment. Select the correct spacer in the following manner. If initial preload reading was too low, select a thinner spacer or reduce thickness of old spacer by rubbing on crocus cloth, laid on a face plate or upon a piece of plate glass. If preload reading was too high, select a thicker spacer. Install outer bearing cone, bearing adjusting nut, lockwasher and locknut as specified above and again take a bearing preload reading.

- (5) Install hypoid pinion rear bearing (fig. 362). Install rear bearing cover (X) in carrier. Use a suitable remover and replacer and install rear bearing race (T) on end of through shaft.
- (6) Install hypoid pinion shaft assembly in carrier (fig. 362).
 - (a) Install front bearing cage shims (N) which control gear lash, and which were tied to bearing cage at time of disassembly. Place shims in position on pinion side of front bearing cage (M). Carefully aline openings in shims with oil passage in bearing cage.
 - (b) Install hypoid pinion and through shaft assembly in carrier through front bearing cage opening of through shaft chamber. Aline rear bearing race (T), (installed in c above) with center of rear bearing (U). Continue installation of hypoid drive pinion assembly until front bearing cage (M) is seated against carrier and rear bearing race (T) is in position in rear bearing (U).
- (7) Adjust hypoid pinion to correct location in carrier.
 - (a) The hypoid pinion is adjusted for proper location in relationship to the hypoid drive gear, using gage 4910-795-0104 as shown in figure 366. The adjustment is made after the hypoid pinion preload is established as outlined above, and with the hypoid drive gear end bearing assembly out of the differential case. The hypoid pinion and through shaft and the front bearing cage assembly are temporarily installed in the dif-



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Figure 366. Locating hypoid drive pinion using gage 4910-795-0104

ferential case with the front bearing shims (N, fig. 362) located between the differential case and front bearing cage. Use of the old shim pack will provide a starting point to secure the correct reading.

- (b) The gage holder of gage 4910-795-0104 is placed on the gage master block (fig. 366) for the purpose of setting the dial indicator to zero. This establishes the basic or nominal dimension to which the gears were manufactured or cut. Any variation from this nominal dimension will be found marked on the tooth end of the hypoid pinion. The hypoid pinion must be moved in (minus) or out (plus) so that the marking shown on the dial indicator matches the marking on the hypoid pinion. Add or remove front bearing cage shims (N, fig. 362) between the differential case and hypoid front bearing cage (M, fig. 362) to attain the correct dial gage reading.
- (c) After locating the hypoid pinion, the hypoid pinion and through shaft assembly, together with the front bearing cage, must be removed from the

differential case and the hypoid drive gear assembly installed.

(8) Install helical drive pinion assembly.

Note. The key letters noted in parentheses are in figure 363, except where otherwise indicated.

- (a) Place hypoid drive gear (A) in press and press inner bearing (C) onto hub of hypoid drive gear.
- (b) Place carrier assembly in press with outer bearing cage side down. Position sleeve (B) in carrier assembly with notches in sleeve towards shoulder of bore. Align setscrew hole in sleeve with setscrew hole in carrier. Press sleeve into carrier bore until it seats firmly against shoulder in carrier assembly, using remover and replacer 5120-795-0159.
- (c) Turn carrier assembly over, with the outer bearing cover opening up. Support hypoid drive gear (A) with suitable sleeve or adapter. Slide bearing spacer (D) over keyway end of helical drive pinion (E). Install

key (T) in keyway in pinion shaft, and coat this end of shaft with white lead pigment. Insert helical drive pinion (E) through outer bearing cage opening in carrier assembly. Aline key with keyway in hypoid drive gear, and press pinion into gear. Position inner bearing (C) in bearing sleeve (B).

(d) Press outer bearing cup (H) in outer bearing cage (G). Place outer bearing cones (J and K) in outer bearing cage with large diameters together. Press remaining outer bearing cup (L) into outer bearing cage.

(e) Place original outer bearing cage shims (F), which control gear backlash and which were tied to outer bearing cage at time of disassembly, in position over studs. Be sure oil passage in shims is toward top of carrier assembly and alined with oil recess on inside of carrier. Place outer bearing cage assembly over end of helical drive pinion (E). Aline oil recess in bearing cage with oil recess in carrier mentioned above, and press bearing cage onto pinion shaft and into carrier.

(f) Position original outer bearing cover shims (N), which control outer bearing cone preload, and which were tied to outer bearing cover (P) at time of disassembly over studs (M, fig. 361), next to outer bearing cage (G). Be sure oil passage in shims is alined with oil hole in top of outer bearing cage. Place outer bearing cover (P) in position over studs with oil passage alined with oil hole in cage and shims. Install lockwashers (R) and nuts (Q) and tighten firmly.

(g) Using bearing preload tester 6670-347-5922 check bearing preload reading as shown in figure 363. For new bearings, cups, and cones, the correct preload should be 12- to 18-inch-pounds maximum. When the original or used bearings are being assembled, the bearing preload should be 4- to 8-inch pounds maximum. If correct preload is not obtained at first trial, remove shims (N) to increase bearing preload or

add shims to decrease bearing preload. When specified bearing preload is obtained, make sure nuts (Q) are tight.

(h) Place new differential carrier side cover gasket (E, fig. 361) and differential carrier side cover (D, fig. 361) in position on differential carrier (F, fig. 361). Install lockwashers (A, fig. 361) and cap screws (B, fig. 361) to secure cover to carrier. Tighten cap screws securely. Install air vent (C, fig. 361) in cover.

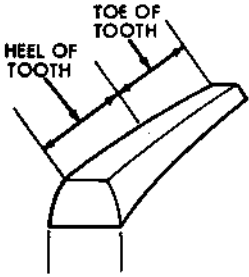
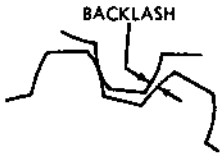
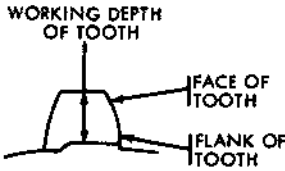
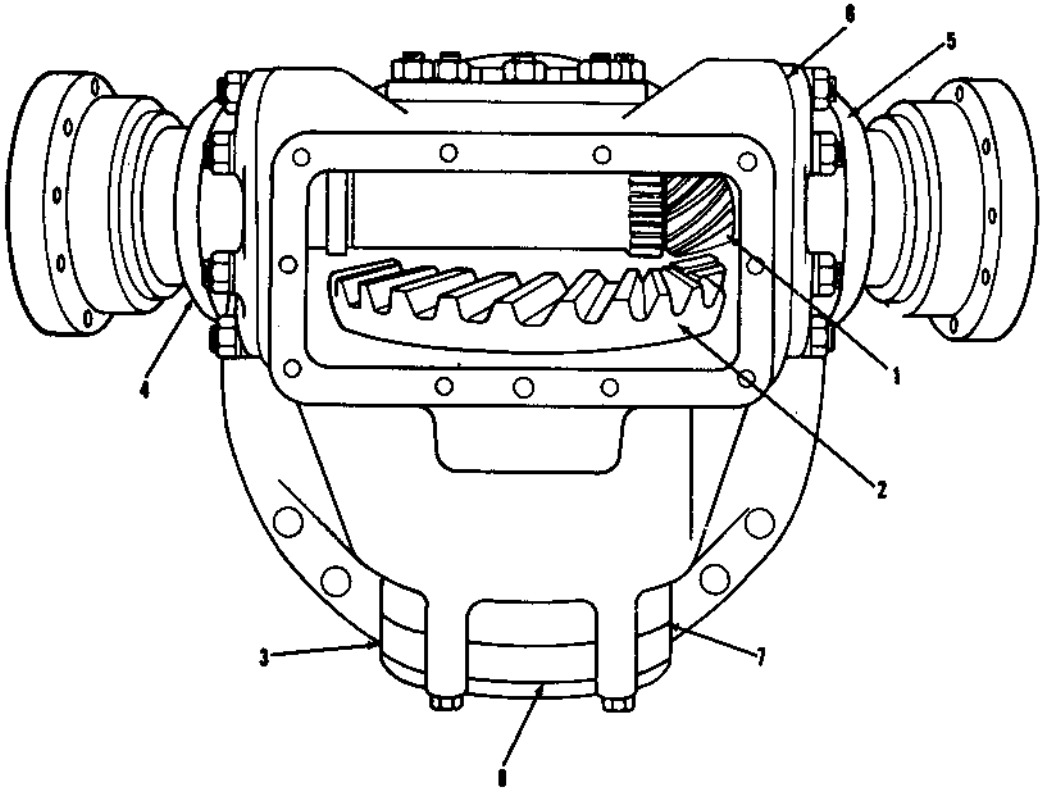
(i) Position the hypoid pinion end through shaft assembly; then adjust the location of hypoid drive gear to obtain correct tooth contact. Refer to figures 368 and 369 for correct procedure. Coat two or three teeth of the hypoid pinion with Prussian blue. Turn the hypoid pinion by hand and check the hypoid drive gear for tooth contact pattern.

(j) Position front bearing cage gasket (L, fig. 362) against front bearing cage (M). Aline gasket to avoid obstructing oil passages. Place front bearing cage cover (D) and oil seal (E) over gasket. Install the cap screws (FF) and lockwashers (EE) to secure cover assembly and tighten screws.

(k) Install rear cover gasket (W) and rear bearing cover (X) on carrier assembly and tighten cap screws.

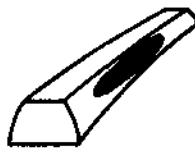


Figure 367. Checking helical pinion bearing preload



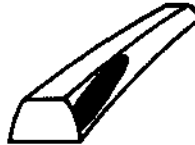
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Figure 368. Hypoid gear and pinion tooth contact



A—CORRECT TOOTH CONTACT

Shows approximately 80% gear contact and centered on hypoid gear.



B—SHORT HEEL CONTACT

Tooth breakage will result—correction—add shims at (7). Remove shims at (6) to secure 0.006 to 0.012 inch backlash. NOTE: Several adjustments of both the hypoid drive gear and hypoid pinion may be necessary before correct contact and backlash are established.



C—SHORT TOE CONTACT

Tooth breakage will result—correction—Remove shims at (7). Add shims at (6) to secure 0.006 to 0.012 inch backlash. NOTE: Several adjustments of both the hypoid drive gear and hypoid pinion may be necessary before correct contact and backlash are established.



D—LOW NARROW TOOTH CONTACT

Gears will be noisy—correction—Remove shims at (6). Add shims at (7) to secure 0.006 to 0.012 inch backlash. NOTE: Several adjustments of both the hypoid drive gear and hypoid pinion may be necessary before correct contact and backlash are established.



E—HIGH NARROW TOOTH CONTACT

Gears will be noisy—correction—Add shims at (6). Remove shims at (7) to secure 0.006 to 0.012 inch backlash. NOTE: Several adjustments of both the hypoid drive gear and hypoid pinion may be necessary before correct contact and backlash are established.

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Figure 369. Hypoid gear and pinion tooth contact adjustment

- (1) If companion flange dust slinger (C) has been removed from companion flanges, install new slinger on flange. Place companion flange (B) on front end of hypoid pinion and through shaft (S), using a suitable replacer. Push flange into position on shaft. Repeat this operation to install companion flange (Z). Do not fail to lubricate oil seals (E and Y) before companion flanges are assembled to shaft. Complete assembly of flanges by installing slotted nuts in position and secure with new cotter pins.

Caution: Never drive flanges into position on through shaft as damage to pinion bearings will result.

- (2) Remove the cotter pin (Q) from slotted nuts (P). Remove slotted nuts (P) and bolts (V) from differential case.
- (3) Tap each half of differential case (D and K) with a soft hammer to separate them from differential drive gear (U).
- (4) Remove the differential spider (G) with spider gears (T) and spider gear thrust washers (R) from whichever half of differential case remains.
- (5) Lift differential side gears (F and H) and differential side gear thrust washers (E and J) from each half of differential cases (D and K).

b. Cleaning, Inspection and Repair.

270. Differential Assembly

a. Disassembly (Fig. 370).

- (1) Punch an index mark on each half of differential case to assure original relative position when assembling.

- (1) Clean all parts in dry-cleaning solvent or mineral spirits paint thinner.
- (2) Inspection and repair. Replace a helical drive gear that is chipped, broken, or visibly worn. Replace all four spi-

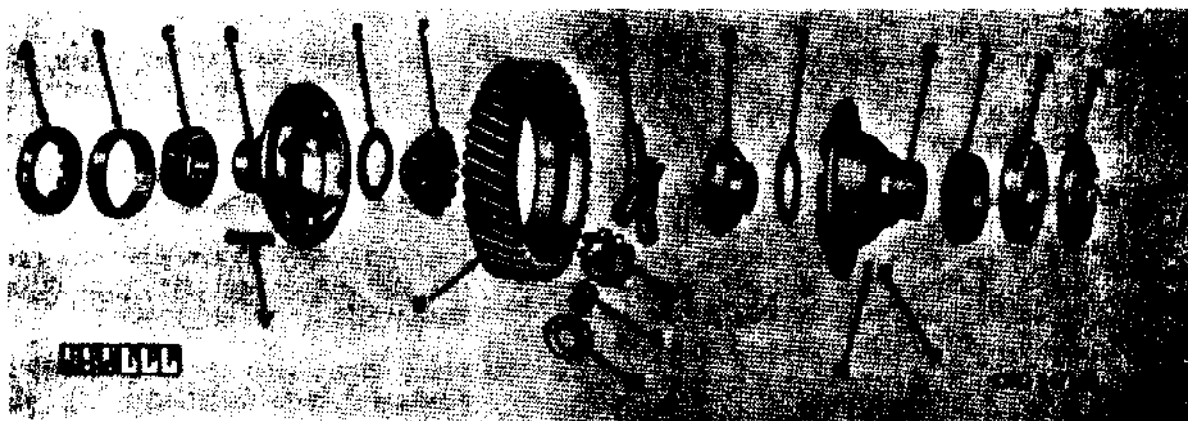


Figure 370. Differential assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|--------------------------------------|------------|--------------------------------|
| A | Differential bearing adjusting ring | L | Differential bearing cone |
| B | Differential bearing cup | M | Differential bearing cup |
| C | Differential bearing cone | N | Differential bearing adjusting |
| D | Differential case | P | Slotted nut |
| E | Differential side gear thrust washer | Q | Cotter pin |
| F | Differential side gear | R | Spider gear thrust washer |
| G | Spider | S | Spider gear bearing |
| H | Differential side gear | T | Spider gear |
| J | Differential side gear thrust washer | U | Differential drive gear |
| K | Differential case | V | Bolt |

Figure 370. Differential assembly - exploded view - legend

der gear thrust washers if any are worn or scored. Replace both differential side gear thrust washers if either is worn or scored. Position the spider gears on the spider. If any looseness is noted between spider and gears, replace the spider gear bearings and/or spider. Position the spider in the differential case. If any radial movement is noted, replace spider and/or case, whichever is at fault. Replace a differential case if scored. Replace both differential side gears if either gear is visibly worn, broken or chipped. Replace differential bearing cones if any of the rollers are missing, pitted, corroded, or discolored due to overheating. Replace differential bearing cups that are cracked, pitted, corroded, or discolored due to overheating. Replace a differential bearing adjusting ring if the threads are stripped, or if the rings are broken or damaged.

- (a) Spider gear bearing (bushing type) replacement. Press old spider gear bearing (bushing type) from spider gear. Carefully press new bearing into gear. Burnish bearing as shown (fig. 371) with burnisher,
- (b) Differential bearing cone replacement. Using a puller that will grasp the inner race of differential cone, and an adapter that will seat on differential case, pull the bearing cone off the differential case. Place the

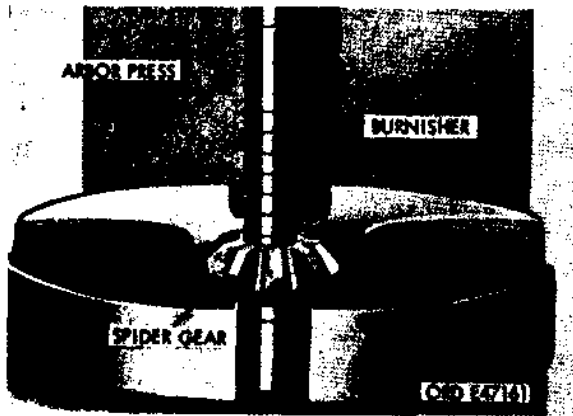


Figure 371. Burnishing differential spider gear bearing

differential case in a press. Press the bearing cone onto the differential case, making sure all pressure is exerted on inner race of bearing cone.

c. Assembly.

Note. The key letters noted in parentheses are in figure 370.

- (1) Both halves of differential case (Dad K) were marked for correct assembly at time of disassembly (par. 270a). Note that differential case mounting flange inside differential drive gear (U) is off center. Lay differential case (D) on bench with flange side up and place differential side gear thrust washer (E) and differential side gear (F) into differential case (D).
- (2) Assemble the four spider gears (T) on spider (G) with a spider gear thrust washer (R) on top (or outside) of each spider gear.
- (3) Place spider (G), spider gears (T), and spider gear thrust washers (R) into differential case (D), meshing spider gear teeth with those of differential side gear (F) already in position in differential case.
- (4) Place the other differential side gear (H) and differential side gear thrust washer (J) on spider gears (T).
- (5) Place differential drive gear (U) in position on differential case (D), with recess side of gear up, and aline bolt holes.
- (6) Install differential case (K) on the differential drive gear (U), making sure index marks made at time of disassembly (par.270a) are alined. Install the bolts (V) through differential case (D). Install and tighten slotted nuts (P). Install new cotter pins (Q) to secure each slotted nut,
- (7) Lift differential assembly Into differential carrier.
- (8) Install differential bearing cups (B and M) on differential bearing cones (C and L). Use a short bar inserted

- through differential side gear to lift differential assembly slightly while placing bearing cups in position. This will prevent injury to hands while performing this operation.
- (9) Position differential carrier caps on differential carrier, according to index mark made at time of disassembly (par.270a). Install a differential bearing cap bolt and tighten just enough to hold cap in place (fingertight). Install other carrier cap and bolt.
 - (10) Install differential bearing adjusting rings (A and N). After adjusting rings have been started, tighten the cap bolts just enough to hold bearing differential caps snugly, but still permit turning the adjusting rings. Use a wrench to tighten adjusting rings alternately until both rings are threaded into case and caps equally.
 - (11) Using dial indicator at side face of differential gear, adjust differential assembly to zero side play in differential bearings. Rotate assembly several revolutions to assure normal bearing contact. Check differential side play and again adjust to zero if necessary. If runout exceeds 0.008 inch, remove differential assembly and check cause of runout.
 - (12) Tighten adjusting rings one notch each after zero end play has been established to secure the correct bearing preload. Tighten the four differential bearing cap bolts. Install differential bearing adjusting ring locks and cap screws. Install locking wire in differential carrier cap bolts and cap screws to secure assembly in place.
 - (13) Refer to figure 361 as reference for installing differential carrier top cover gasket (G), top cover (H), lock washers (J), and cap screw (K).

Section V. TESTS AND ADJUSTMENTS

271. Leakage

Install a suitable air pressure gage in ventilating valve hole in carrier case side cover. Using a suitable adapter attach air line to filler plug hole. Fill axle with air to pressure of 15 psi and shut off supply.

Caution: Do not permit air pressure to exceed 15 psi. Observe gage. Air must not escape faster than 5 pounds in 45 seconds. If air escapes too rapidly, tighten all cap screws and nuts and test again. Remove air line and gage and install ventilating valve in carrier side cover.

272. Lubricate Axle Assembly

If differential was not filled with type and quantity of lubricant as directed at time differential was assembled to housing, add the lubricant at this time. Remove square socket pipe plug and be sure universal joint housings are filled with recommended lubricant. Rotate the pinion shaft to make certain there is no binding in the gear train. Be sure wheel bearings were properly lubricated at time of installation.

273. Front Wheel Alinement

After front axle is installed on the truck, correct wheel alinement must be maintained,

Refer to TM 9-2320-211-20 for alinement procedure.

274. Testing and Adjusting Steering Knuckle End Play

a. Attach dial indicator to axle housing. Movable point should be directly over center line of king pin, and touching the top of steering arm on left side of vehicle, or plate on right side of vehicle. A feeler gage may be substituted for dial indicator under a similar set-up.

b. Raise front axle from ground.

c. Reading on indicator should read between 0.005 and 0.013.

d. A lesser reading indicates top spacer is too thick.

e. If reading is over 0.013, top spacer is too thin. In either case, steering arm or plate must be removed and reassembled with new spacers of proper thickness to obtain required clearance. Upper and lower steering plates must be properly torqued prior to checking clearance.

Section VI. SERVICEABILITY STANDARDS

275. General

The serviceability standards included herein give the minimum, maximum, and key clearances of new or repaired parts. All measurements are given in inches unless otherwise indicated. In the "Size and fit of new parts" column, the letter "L" indicates

a loose fit (clearance) and the letter "T" indicates a tight fit (interference).

276. Serviceability Standards

Serviceability standards for the front axle assembly are in table XV below.

Table XV. Serviceability Standards - Front Axle Assembly

| Fig. No. | Ref. letter | Point of measurement | Size and fit of new parts |
|------------------------------------|-------------|---|---------------------------|
| <u>STEERING KNUCKLE</u> | | | |
| 372 | C | Inside diameter of steering knuckle bushing | 1.500 to 1.501 |
| 372 | D | Steering knuckle pin | 1.4985 to 1.4990 |
| 372 | C-D | Clearance of steering knuckle pin in bushing | 0.001 to 0.0025 |
| <u>FRONT AXLE SPINDLE</u> | | | |
| 372 | A | Front spindle bushing | 2.249 to 2.251 |
| 372 | B | Outer drive shaft | 2.234 to 2.231 |
| 372 | A-B | Clearance of outer drive shaft in bushing | 0.015 to 0.020 |
| <u>DIFFERENTIAL CASE AND GEARS</u> | | | |
| 375 | C | Differential spider | 1.129 to 1.122 |
| 375 | D | Differential spider pinion bushing | 1.127 to 1.129 |
| 375 | D-C | Clearance of differential spider to bushing | 0.004 to 0.007 |
| <u>BACKLASH</u> | | | |
| 374 | E | Helical drive gear to helical drive pinion | 0.007 to 0.014 |
| 375 | | | |
| <u>BEARINGS</u> | | | |
| 374 | D to A | Inner helical drive pinion bearing to hypoid drive gear | 0.006T to 0.0011L |
| 374 | C to B | Inner helical drive pinion bearing to bearing sleeve | 0.0020L to 0.0042L |
| 374 | G to F | Outer helical pinion bearing cone to helical drive pinion | 0.000 to 0.0015T |
| 373 | A to C | Outer hypoid drive pinion bearing cone to hypoid drive pinion | 0.0002L to 0.0022L |
| 373 | B to D | Inner hypoid drive pinion bearing cone to hypoid drive pinion | 0.0010T to 0.0025T |
| 373 | E to F | Hypoid pinion shaft rear bearing to hypoid drive pinion shaft | 0.0006T to 0.0013T |
| 373 | G | Hypoid pinion shaft rear bearing to carrier | 0.0005L to 0.0007T |
| 375 | A to B | Differential bearing cone to differential case | 0.0015T to 0.0035T |

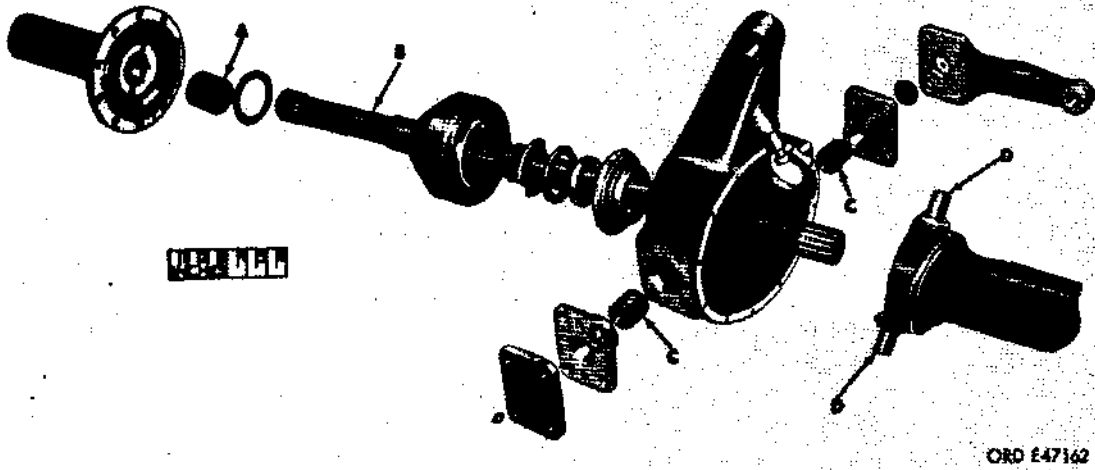


Figure 372. Serviceability standard points of measurement for steering knuckle

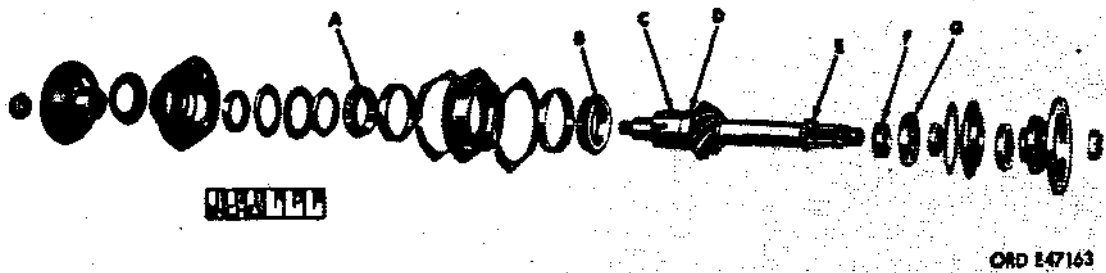


Figure 373. Serviceability standard points of measurement for pinion shaft assembly

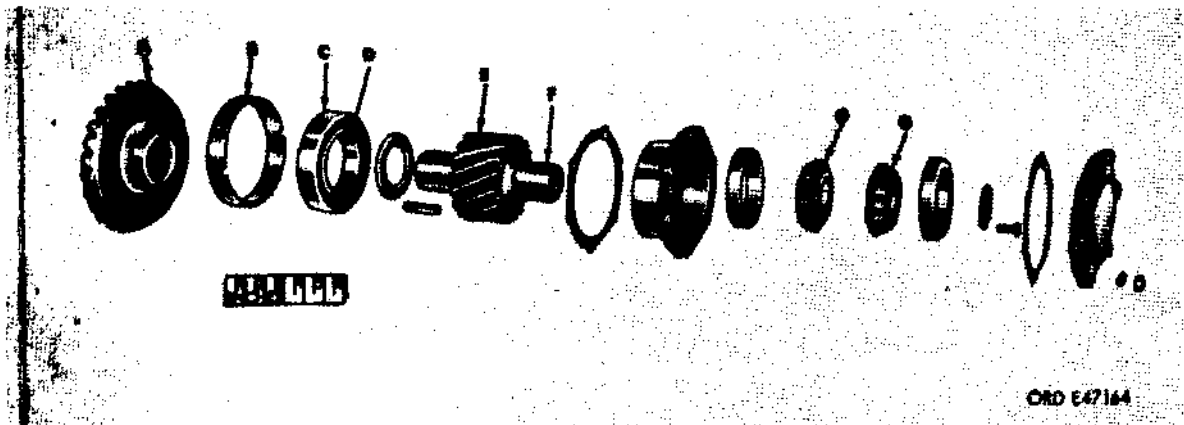


Figure 374. Serviceability standard points of measurement for helical shaft assembly

REAR SUSPENSION

Section I. DESCRIPTION AND DATA

277. Description

a. General. The rear suspension assembly is a tandem hookup using six identical torque rod assemblies (fig. 376), two upper and four lower. The load is equalized between axles by full-floating springs which oscillate on a cross shaft. Transverse movement of axles is prevented by spring guide brackets on axle housings. Driving and braking forces are transmitted to the frame by the six torque rod assemblies which also maintain correct vertical position of axles and prevent weight transfer between axles.

b. Rear Axles.

- (1) General. Both rear axles are identical and are hypoid, double-reduction, full-floating type. Each rear axle consists of the housing, differential and carrier assembly, and axle shafts. Power is transmitted from the transfer by a propeller shaft to the forward rear axle differential carrier assembly, and to the rear-rear axle differential and carrier assembly by a second propeller shaft (fig. 376) that connects both axles.

- (2) Housing assembly. The rear axle housing assembly is one-piece con-

struction with a center opening for mounting the differential and carrier assembly. The forged steel outer ends are welded in position; brake backing plates are riveted to the outer ends.

- (3) Differential and carrier assembly. The differential and carrier assembly for the rear axles is the same as that used for the front axle. Refer to paragraph 259h for description and operation.

- (4) Rear axle shafts. The axle shafts are all of equal length. They have 16 splines on the inner end and are integral with the drive flange.

c. Spring Seat Connecting Tube and Rear Spring Seats.

- (1) Spring seat connecting tube. The spring seat connecting tube supports the spring seats and center ends of lower torque rods by means of connecting tube brackets. Rear suspension support brackets are riveted and bolted to frame side rails.
- (2) Spring seats. Spring seats are mounted on the outer ends of spring seat connecting tube. Spring seats hold springs securely at the center section and oscillate freely on the tube.

d. Torque Rods. Each torque rod assembly consists of torque rod and two ball assemblies. Three torque rods are attached to each rear axle, and transmit driving and braking forces to frame. Upper and lower rods are installed on the right side of the rear suspension assembly, and lower rods only on left side. All torque rods are identical.

278. Data

Manufacturer Timken-Detroit
 Model M-240-C-3
 Gear ratio (M134C and M139D) . . . 6.443 to 1
 (M134C and M139D) 10.26 to 1
 Lubricant capacity 12qt
 Spring centers 39-3/4 in.
 Type . . double-reduction, hypoid, full-floating

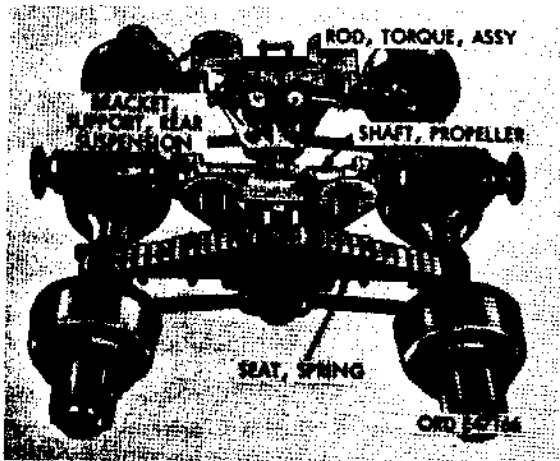


Figure 376. Rear suspension assembly

Section II. TROUBLESHOOTING

279. Axle Differential and Carrier Assemblies

a. Troubleshooting Before Removal or Operation.

- (1) General. Do not operate the vehicle prior to completing the procedures given in this paragraph.
- (2) Inspect for lubricant leaks. Visually inspect gasket joints and oil seals for evidence of lubricant leakage. Leakage at gasket joints may be caused by loose cap screws or a defective gasket. Tighten all cap screws. If leakage still continues, replace gasket, preferably without removing the component from the vehicle.
- (3) Inspect for damaged bearings or gears. Raise one wheel of axle and rotate forward and reverse. Inspect for excessive play or backlash in gears. Pay particular attention to hypoid pinion drive shaft for excessive wear. Note any irregularities during the inspection.

b. Troubleshooting Before Removal and During Operation.

- (1) General. If the inspections in the preceding paragraph do not reveal causes of failure and the vehicle is operable, then troubleshoot it.
- (2) Gear backlash. Start vehicle slowly in forward motion and depress and release accelerator alternately. If backlash is present, a distinct clash

will be audible at differential as torque is relieved and applied. Refer to paragraph 289c for differential and carrier assembly repair.

- (3) Damaged or worn bearings. Start vehicle slowly in forward motion and note any unusual axle noises. A constant rumble or chatter of the differential is, in all probability, due to worn or damaged bearings.

c. Troubleshooting After Removal and Before Operation.

- (1) General. After the component has been removed from the truck or if it has been received already removed, further inspection is necessary. If the differential alone has been received for a preliminary check before being installed in the vehicle or if the operation has not been satisfactory due to unknown causes, then test it as described below.
- (2) Inspection. Visually inspect the differential and carrier assembly for lubricant leakage and cracks or damaged case or covers.
- (3) Gear teeth worn. Disassemble differential and carrier assembly (par. 289c) and replace worn gears.
- (4) Damaged or worn bearings. Disassemble differential and carrier assembly (par. 289c) and replace damaged or worn bearings.

Section III. REMOVAL AND INSTALLATION

280. Wheels and Tires

Refer to TM 9-2320-211-20.

281. Rear Axle Assembly

a. Removal (Forward Rear Axle).

- (1) Place truck on a level surface and block front wheels to prevent truck from rolling. Raise rear end of truck

and place a support stand under each spring seat (fig. 377).

- (2) Remove wheel and tire assemblies from both ends of axle assembly to be removed (TM 9-2320-211-20).
- (3) Unscrew connector securing brake-line hose to tee connection at frame rear suspension cross member, and remove line from tee (fig. 378). Re-

move brake line hose clamps from upper torque rod, and remove hose from rod.

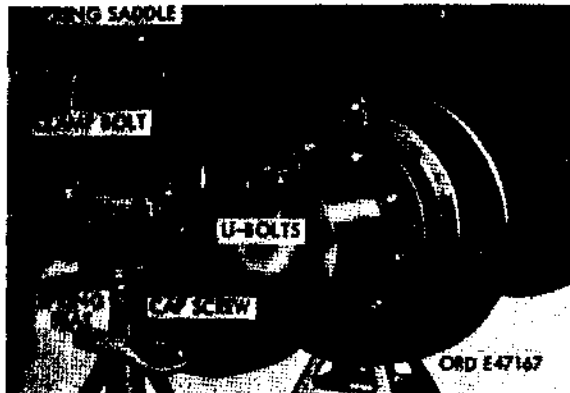


Figure 377. Rear suspension assembly raised for axle removal

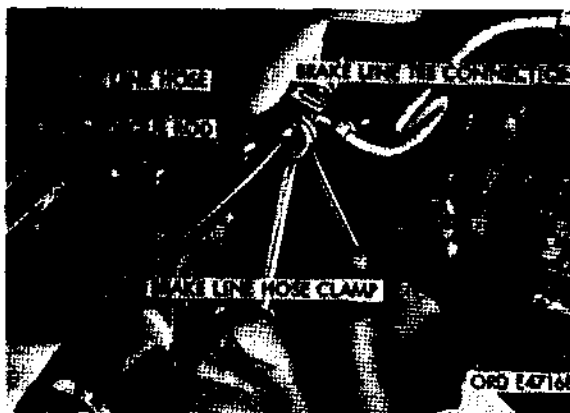


Figure 378. Disconnecting hydraulic brake line hose

- (4) Disconnect adapter flange on rear end of transfer-to-forward-rear-axle propeller shaft from companion flange at front of forward-rear axle differential (par. 261). Disconnect adapter flange on front end of forward-rear-axle-to-rear-rear-axle propeller shaft from companion flange on rear of forward-rear axle differential.
- (5) Remove four nuts and lockwashers from four bolts securing upper torque

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rod bracket (fig. 379) and clamping plate to right end of axle housing. Remove the clamping plate from underside of axle housing. Remove the two front bolts and the right rear bolt from the torque rod bracket.

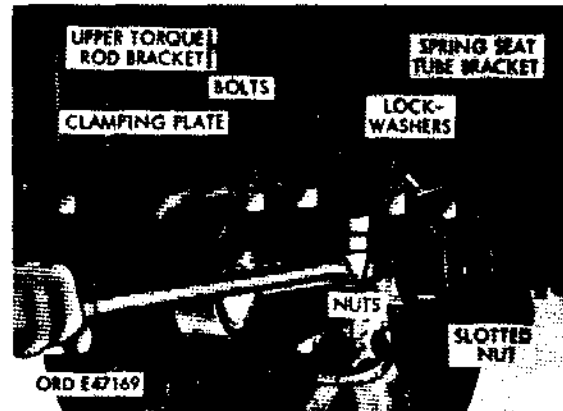


Figure 379. Disconnecting upper torque rod

- (6) Remove brake-line tee from mounting bracket. Raise upper torque rod clear of axle, and support in raised position with a short bar placed between frame side rails. Wire brake-line tee mounting bracket and left rear torque-rod bracket bolt to upper torque rod (refer to fig. 380).

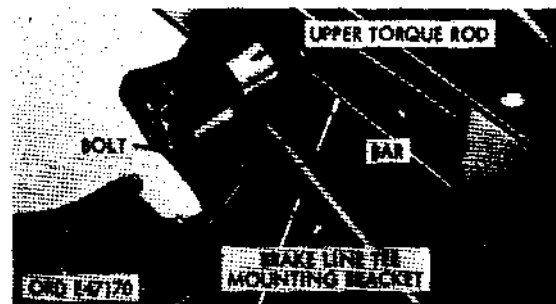


Figure 380. Upper torque rod positioned for forward - rear axle removal

- (7) Remove cotter pin and slotted nut securing front end of lower torque rod to bracket at underside of right end of axle housing. Rap bracket sharply to loosen tapered stud in torque rod bracket and, using a bar, pry torque

rod from bracket. Repeat above operation to remove left torque rod from bracket on underside of left end of axle housing. Refer to figure 381.

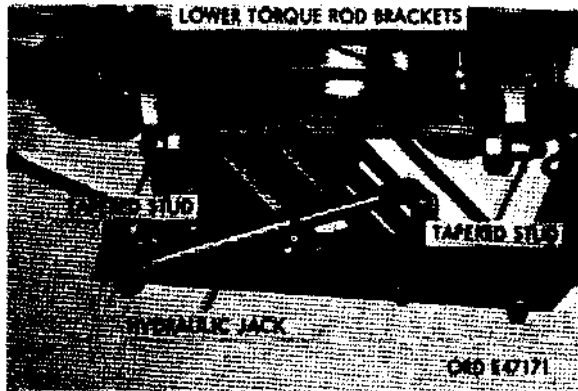


Figure 381. Lower torque rods disconnected

- (8) Position hydraulic jack with axle fixture under the forward rear axle. Raise axle on hydraulic jack enough to release front ends of rear springs in spring guide brackets, and roll axle on hydraulic jack toward front of truck.
- (9) Lower hydraulic jack sufficiently to allow removal of axle from under truck. Pull jack with axle assembly sideways and out from under side of truck. Refer to figure 382.



Figure 382. Removing forward - rear axle assembly

b. Installation (Forward Rear Axle).

- (1) With forward rear axle supported by hydraulic jack in lowered position, push jack and axle assembly under side of truck. Raise axle on jack until front ends of rear springs are alined with spring guide brackets on top of axle housing. Push axle toward rear of truck so that spring ends enter guide brackets.
- (2) Remove wire securing brake-line tee mounting bracket and left-rear-torque rod bracket bolt to torque rod. Remove bar securing upper torque rod in raised position. Position torque rod bracket on top of axle housing. This will secure axle in position and permit removal of hydraulic jack. Lower hydraulic jack and remove from under truck. Install the two front bolts and the right rear bolt in torque-rod bracket holes. Install clamping plate on bolts from underside of axle housing and install four lockwashers and nuts on the four bracket mounting bolts. Tighten nuts.
- (3) Insert tapered stud at front end of lower right torque rod through torque rod bracket on underside of axle housing. Install slotted nut on stud and tighten nut to 350 to 400 pound-feet torque. Install cotter pin in end of stud. Repeat above operations to connect lower left torque rod to bracket on underside of left end of axle housing. Refer to figure 381.
- (4) Connect adapter flange on rear end of transfer to-forward-rear-axle propeller shaft to companion flange at front of forward-rear axle differential (par. 262). Connect adapter flange of front end of forward-rear-axle-to-rear rear-rear-axle propeller shaft to companion flange on rear of forward-rear axle differential.
- (5) Position brake line at tee connection on frame rear suspension cross member and tighten connector. Position brake hose on upper torque rod and install two clamps. Refer to figure 378.

- (6) Bleed rear wheel brakes. Refer to TM 9-2320-211-20.
- (7) Install wheel and tire assemblies. Refer to TM 9-2320-211-20.
- (8) Lubricate axle assembly and propeller shaft universal joints. Refer to LO 9-2320-211-20.
- (9) Raise rear end of truck, remove support stand under each spring seat, and lower rear end of truck.

Note. Procedures for removal and installation of the rear-rear axle as-

TM 9-2320-211-35
sembly are the same as those for the forward-rear axle assembly.

282. Torque Rods

Refer to TM 9-2320-211-20.

283. Springs

Refer to TM 9-2320-211-20.

284. Spring Seats

Refer to TM 9-2320-211-20.

Section IV. DISASSEMBLY INTO AND ASSEMBLY FROM SUBASSEMBLIES

285. Wheels and Tires

Refer to TM 9-2320-211-20.

286. Rear Axle Assembly

a. Hub and Drum Assembly and Brake Components. Refer to TM 9-2320-211-20.

b. Torque Rod and Spring Guide Brackets. Refer to TM 9-2320-211-20.

c. Carrier and Differential Assembly.

(1) Removal.

(a) Drain lubricant.

(b) Remove 18 nuts and lockwashers holding differential and carrier assembly to axle housing assembly. Remove four axle to differential split dowels and withdraw assembly from housing. Remove and discard gasket.

(2) Installation.

(a) Install new gasket.

(b) Position assembly in housing and install six axle to differential split dowels. Install 18 nuts and lockwashers to secure carrier assembly to axle.

(c) Fill to proper level with lubricant (LO 9-2320-211-20).

Note. The differential and carrier assembly on the M139C and M139D contains a gear ratio different from that of the other vehicles. When a gear set is required for the differential on the M139C or M139D, requisition the 10:26 to 1 ratio gears. When in need of a housing the complete standard housing assembly used on the M139 will be issued. The axle gears with the 10:26 to 1 ratio gears on the existing M139D front axle which house the strut assembly and brackets will have to be removed from the old housing and installed on the new one.

287. Springs

No disassembly is required.

Section V. REPAIR

288. Wheels and Tires

Refer to SM 9-1-2600.

289. Rear Axle

a. Hub and Drum Assembly and Brake Components. The hub and drum assembly and brake components require replacement if damaged. Refer to TM 9-2320-211-20.

b. Torque Rod and Spring Guide Brackets. The torque rod and spring guide brackets also require replacement if damaged.

c. Carrier and Differential Assembly.

(1) Disassembly (fig. 383).

(a) Install differential and carrier assembly in suitable stand or holding

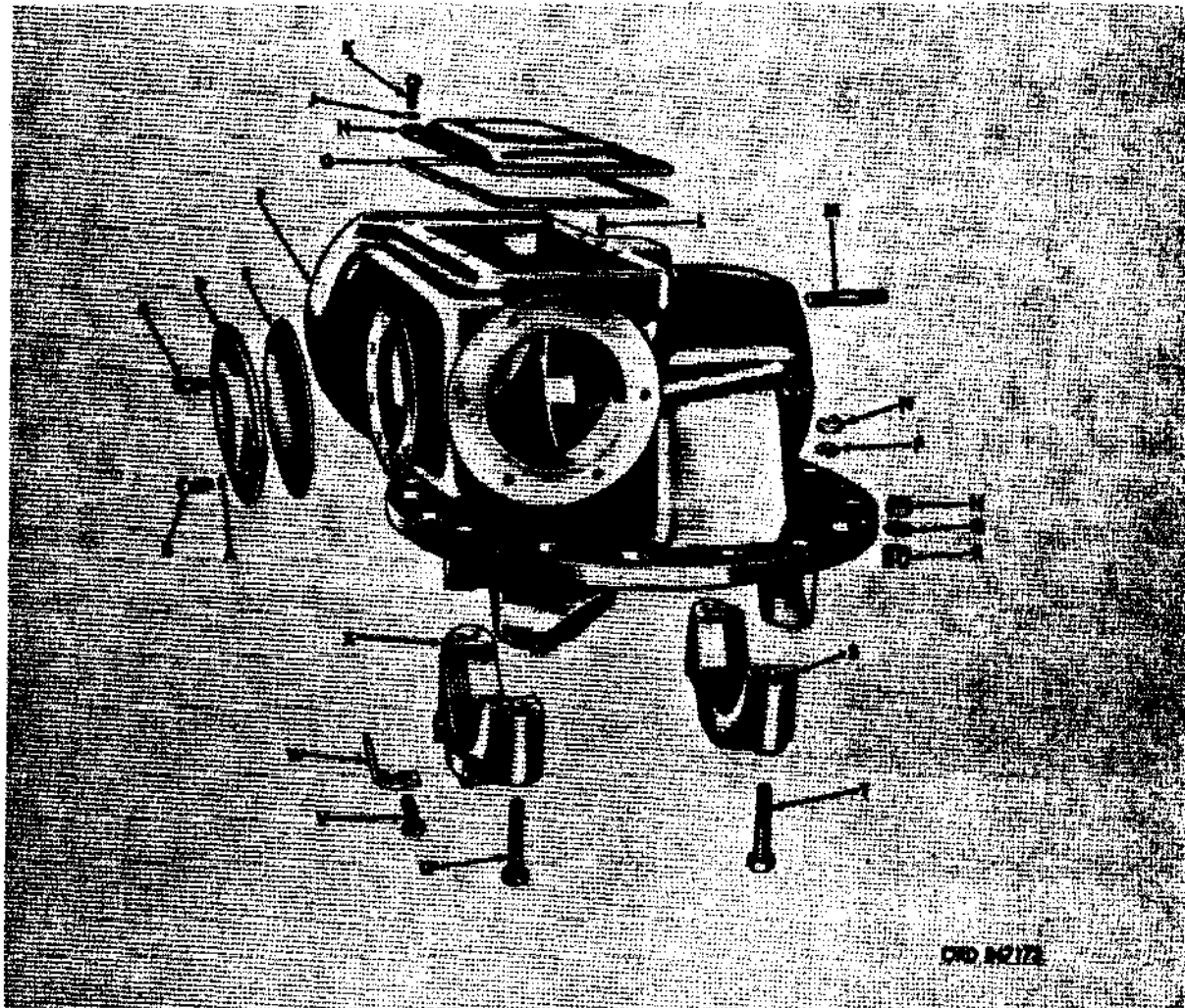


Figure 383. Carrier assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|----------------------------|------------|--|
| A | Washer, lock | M | Stud |
| B | Screw, cap | N | Nut, hex |
| C | Vent, air, assembly | P | Washer, lock |
| D | Cover, side, carrier | Q | Washer, lock, ext-teeth |
| E | Gasket, carrier side cover | R | Dowel, split |
| F | Carrier, assembly | S | Cap, carrier |
| G | Gasket, carrier top cover | T | Bolt |
| H | Cover, top carrier | U | Bolt |
| J | Washer, lock | V | Screw, cap |
| K | Screw, cap | W | Lock, differential bearing adjusting nut |
| L | Screw, set | X | Cap carrier |

Figure 383. Carrier assembly - exploded view - legend

fixture to prevent injury and to facilitate the disassembly and assembly operations.

- (b) Remove locking wire. Remove four bolts (T and U), from carrier caps (S and X) and two cap screws (V) from differential bearing adjusting nut locks (W). Caps and carrier assembly must be punch marked to ensure installation in their original position. Lift caps from carrier assembly. Remove differential bearing adjusting nuts (refer to A and N, fig. 384).
- (c) Using a short bar, lift each side of case assembly slightly and remove differential bearing cups (refer to (B and M, fig. 384). This will permit removal of assembly without interference. Lift differential case assembly from carrier.

- (d) Remove differential case halves (D and K) and helical drive gear (T) from carrier assembly (refer to F, fig. 383). Mark differential case halves to ensure assembly in original relative positions. Remove locking wire from eight hex bolts (U) holding ring gear to case. Remove bolts and slotted nuts (P) and remove helical drive gear (T). Refer to figure 384.
- (e) To disassemble differential case, remove two differential side gears (F and H), two side gear thrust washers (E and J), four spider pinion assemblies (Q), four spider pinion thrust washers (S), and differential spider (G) (refer to fig. 384).
- (f) Use adapter 5120-795-0112 and universal puller to remove differential bearing cones from differential case halves.

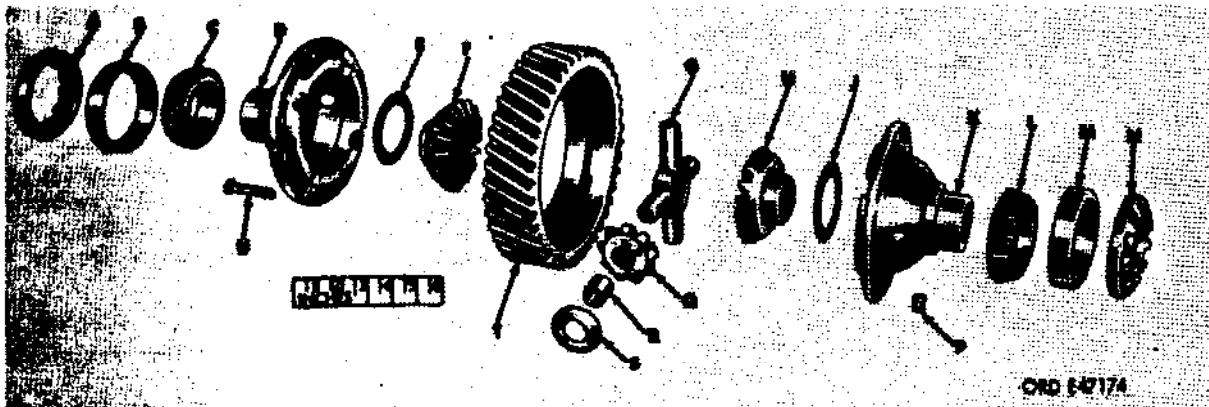


Figure 384. Differential case and helical drive gear assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|--------------------------------------|------------|--------------------------------------|
| A | Nut, adjusting, differential bearing | L | Cone, differential bearing |
| B | Cup, differential bearing | M | Cup, differential bearing |
| C | Cone, differential bearing | N | Nut, adjusting, differential bearing |
| D | Case, differential (half) | P | Nut, slotted |
| E | Washer, thrust, side gear | Q | Pinion, spider, assembly |
| F | Gear, side, differential | R | Bearing, bushing type |
| G | Spider, differential | S | Washer, thrust, spider pinion |
| H | Gear, side, differential | T | Gear, drive, helical |
| J | Washer, thrust, side gear | U | Bolt, hex |
| K | Case, differential (half) | | |

Figure 384. Differential case and helical drive gear assembly - exploded view - legend

- (g) Remove cotter pins (AA and GG) and slotted nuts (A and Z), from each end of the hypoid pinion drive shaft (S). Pull companion flanges (B and Y) from pinion drive shaft splines, using universal puller. Refer to figure 385.
- (h) Remove eight cap screws (FF) and lockwashers (EE), from hypoid pinion front bearing cage cover (D), and remove cover assembly and hypoid pinion outer bearing gasket. Refer to figure 385.
- (i) Remove eight cap screws (BB) and lockwashers (CC) from hypoid pinion rear bearing cover (W), and remove cover assembly and hypoid pinion rear bearing gasket (V). Refer to figure 385.
- (j) Using a punch, drive the hypoid pinion oil seals (E and X) from front and rear hypoid pinion front and rear bearing cage covers (D and W). Refer to figure 385.
- (k) Using a soft hammer, tap lightly on end of hypoid pinion drive shaft (S) opposite hypoid pinion outer bearing cage (M) and remove shaft from carrier assembly (F, fig. 383). Remove hypoid pinion cage shims (N). Tie shims to hypoid pinion front bearing cage cover (D) to facilitate correct assembly and assist in securing correct pinion setting. Refer to figure 385.
- (l) Using remover and replacer 5120-795-0079, drive rear hypoid pinion bearing (T) from carrier. Remove hypoid pinion bearing inner race from hypoid pinion drive shaft (S). Refer to figure 385.
- (m) Place hypoid pinion drive shaft (S) in vise (equipped with soft jaws) and remove outer hypoid-bearing adjusting nut (F), hypoid pinion bearing adjusting nut washer (G), and inner hypoid pinion-bearing adjusting nut (H). Using a soft hammer tap lightly on hypoid pinion outer bearing cage (M) to remove hypoid pinion outer bearing cone (J) from shaft and permit removal of bearing cage from shaft. Remove hypoid pinion bearing spacer (DD). Pull hypoid pinion inner bearing cone (Q) from shaft, using a suitable puller. Refer to figure 385.
- (n) Using bearing remover and replacer 5120-795-0159, press hypoid pinion outer bearing cup (K) from hypoid pinion outer bearing cage (M). Use a small punch to dislodge hypoid pinion inner bearing cup (P) from its seat in cage. This will permit full contact between bearing cup and the shoulders on bearing remover. Complete disassembly of pinion bearing cage by pressing inner cup from cage with remover. Refer to figure 385.
- (o) Support hypoid drive pinion (R) firmly on arbor press and press hypoid pinion drive shaft (S) from pinion. Remove key from shaft. Refer to figure 385.
- (p) Remove eight cap screws (B) and lockwashers (A) securing carrier side cover (D) to carrier assembly (F) and lift off cover. Remove and discard carrier side cover gasket (E). Remove air vent assembly (C) from cover. Refer to figure 383.
- (q) Remove six hex-nuts (Q) and lockwashers (R) holding helical pinion outer bearing cover (P) and helical pinion outer bearing cage (G) to carrier assembly. Remove cover and helical pinion cage shims (N). Tie shims to cover. Refer to figure 386.
- (r) Remove locking wire from the three hex-head screws (S) holding bearing assembly lock to end of helical drive pinion (E). Remove cap screws and bearing retaining washer (M). Using suitable puller or two puller screws in threaded holes of helical pinion outer bearing cage (G), pull bearing off helical drive pinion and cage out of carrier assembly. Remove helical pinion cage shims (F) and tie to bearing cage to facilitate correct assembly and aid in securing desired

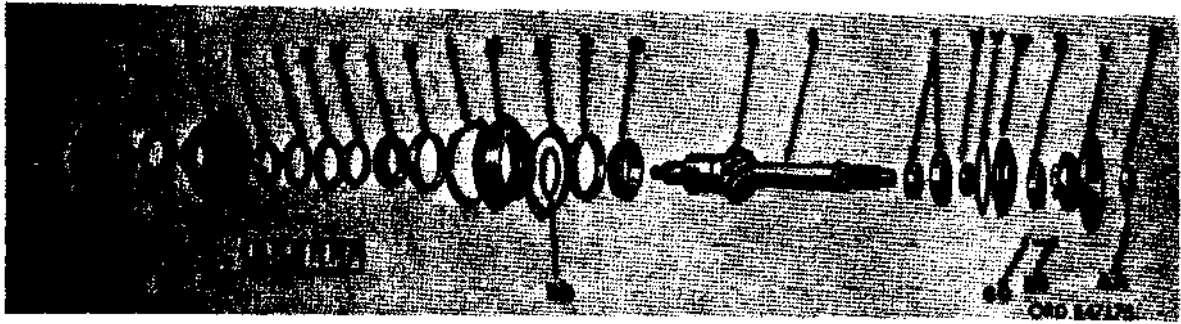


Figure 385. Hypoid drive pinion - exploded view

| Key | Item | Key | Item |
|-----|--|-----|--|
| A | Nut, slotted | Q | Cone, hypoid pinion inner bearing |
| B | Flange, companion | R | Pinion, drive hypoid |
| C | Slinger, dust | S | Shaft, drive, hypoid pinion |
| D | Cover, hypoid pinion front bearing cage | T | Bearing, hypoid pinion, rear |
| E | Seal, oil, hypoid pinion | U | Spacer, hypoid pinion rear bearing |
| F | Nut, adjusting, hypoid pinion bearing, outer | V | Gasket, hypoid pinion rear bearing cover |
| G | Washer, hypoid pinion bearing adjusting nut | W | Cover, hypoid pinion rear bearing |
| H | Nut, adjusting, hypoid pinion bearing, inner | X | Seal, oil, hypoid pinion |
| J | Cone, hypoid pinion outer bearing | Y | Flange, companion |
| K | Cup, hypoid pinion outer bearing | Z | Nut, slotted |
| L | Gasket, hypoid pinion front bearing cage | AA | Pin, cotter |
| M | Cage, hypoid pinion outer bearing | BB | Screw, cap |
| N | Shim, hypoid pinion cage | CC | Washer, lock |
| P | Cup, hypoid pinion inner bearing | DD | Spacer, hypoid pinion bearing |
| | | EE | Washer, lock |
| | | FF | Screw, cap |
| | | GG | Pin, cotter |

Figure 385. Hypoid drive pinion - exploded view - legend

- tooth contact between hypoid drive pinion (R, fig. 385) and hypoid drive gear (A). Refer to figure 386.
- (s) Using adapter 5120-795-0112, press helical pinion outer bearing cups (H and L) and cones (J and K) from helical pinion outer bearing cage (G). Refer to figure 386.
- (t) Position differential carrier assembly on press, inspection hole up. Place two soft iron spacers between rear face of hypoid drive gear (fig. 387) and case. Using a suitable adapter, press helical drive pinion from hypoid drive gear.
- (u) Remove key (T) and helical pinion bearing spacer (D) from helical drive pinion (E). Refer to figure 386.
- (v) Remove hypoid drive gear (A, fig. 386) from carrier assembly by applying a short pry bar between rear face of gear and carrier alternately on opposite sides of drive gear. Use suitable puller equipment to remove inner helical pinion bearing (C) from hypoid drive gear (A).
- (w) Remove setscrew (L, fig. 383) from carrier top cover surface. Using a long punch or drift, place end of

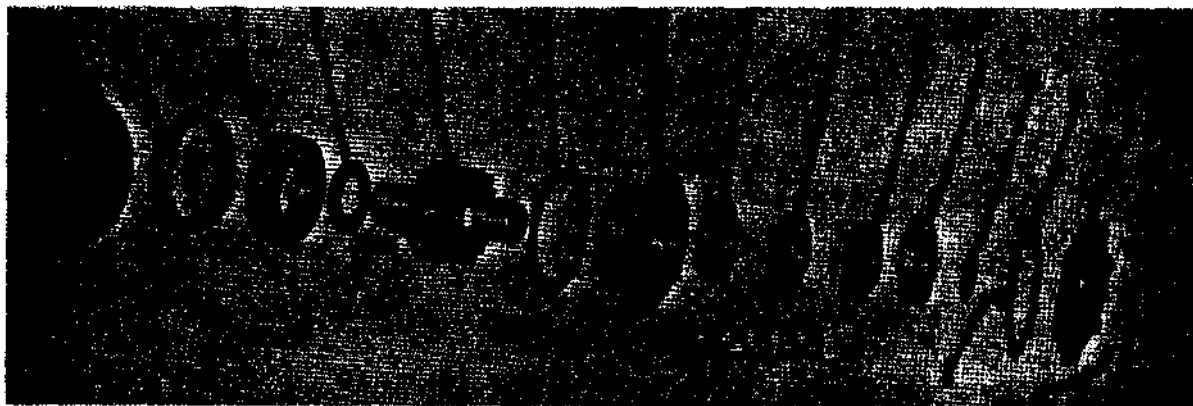


Figure 386. Helical drive pinion - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|------------------------------------|------------|-------------------------------------|
| A | Gear, drive, hypoid | K | Cone, helical pinion outer bearing |
| B | Sleeve, helical pinion bearing | L | Cup, helical, pinion outer bearing |
| C | Bearing, helical pinion, inner | M | Washer, retaining, bearing |
| D | Spacer, helical pinion bearing | N | Shim, helical pinion cage |
| E | Pinion, drive, helical | P | Cover, helical pinion outer bearing |
| F | Shim, helical pinion cage | Q | Nut, hex |
| G | Cage, helical pinion outer bearing | R | Washer, lock |
| H | Cup, helical pinion outer bearing | S | Screw, hex-head |
| J | Cone, helical pinion outer bearing | T | Key |

Figure 386. Helical drive pinion - exploded view - legend

punch in recess or notch provided in opposite sides of helical pinion bearing sleeve (B, fig. 386). Drive bearing sleeve from carrier. Do not permit bearing sleeve to become cocked in carrier case, as damage to case will result. Avoid difficulty in this operation by driving sleeve alternately at one recess and then the other. Drive sleeve only enough to secure sufficient clearance between sleeve and shoulder in carrier and then use bearing remover and replacer 5120-795-0159 to remove sleeve.

(2) Cleaning, inspection, and repair.

(a) Cleaning. Clean differential case and carrier assembly thoroughly with dry cleaning solvent or mineral spirits paint thinner, giving special attention to oil passages. Use a suitable scraper to remove portions of old gaskets and gasket cement from

carrier. If available, steam may be used to advantage for removing accumulations of grease and dirt after solvent has been applied. Rinse all parts in solvent and blow dry with compressed air. If steam is not available, use a solution of one part grease cleaning compound to four parts of dry-cleaning solvent, mineral spirits paint thinner, or kerosene. After cleaning, use cold water to rinse off any solution which remains. Clean hypoid pinion driver shaft, helical drive pinion, and gears thoroughly with dry-cleaning solvent or mineral spirits paint thinner. Dry with compressed air. Soak bearing cones in dry-cleaning solvent or mineral spirits paint thinner. After soaking to loosen lubricant turn rollers slowly while immersed, to remove all traces of old lubricant. If bearing is not thoroughly clean, repeat soaking and turning operation until all bearing surfaces are free of old lubricant. Dry with compressed

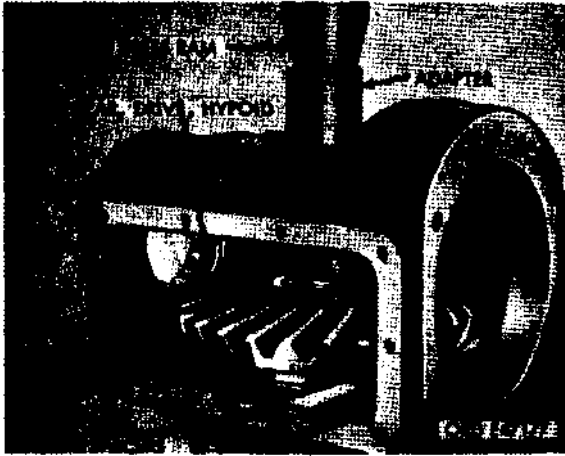


Figure 387. Pressing hypoid drive gear from helical drive pinion

air. Direct compressed air across bearing in such a manner that it does not spin the bearing.

- (b) Inspection. Check carrier assembly for cracks or distortion. Inspect stud threads and cap screw hole threads for damage. Replace if defects are found. Inspect helical pinion bearing sleeve for scored or worn condition. Replace sleeve if scored or excessively worn (par. 293). Inspect outer and inner hypoid pinion bearing adjusting nuts and carrier assembly for crossed or damaged threads. If damaged, replace adjusting nuts.

Note. Carrier and caps cannot be replaced as separate items.

Apply clean engine oil (OE) to cones. Turn bearing rollers slowly. Cones must turn freely and smoothly if they are to be used again. Replace any cone which is pitted, scored, chipped, rough or excessively worn (par. 293). Inspect bearing cups for cracks, chipped spots, pitted spots, or wear caused by contact with bearing rollers. Replace damaged or worn cups. Examine all gears and pinions carefully for chipped, cracked or scored teeth. Gears with broken, chipped, cracked, or excessively worn teeth must be replaced. Small

defects such as nicks, scores, or burrs may be corrected with a hone. If any one of the differential side gears or spider pinions must be replaced, replace all six in order to avoid noise and wear which would result from mating worn with new parts. Inspect bushing-type bearing in spider pinions for excessive wear, rough spots, or damage. Replace bearing if defects are found. Inspect spider pinion and side gear thrust washers for excessive wear. If damaged or worn excessively, replace the washers. Inspect each differential case flange face for runout. Place dial indicator against flange face (surface on differential case that mounts to helical drive gear) to check. If not within specified limits of 0.002 inch, repair case as instructed in (c) below. It is advisable to replace the hypoid pinion oil seals and the inner drive shaft universal joint oil seal at time of complete disassembly. However, if new seals are not available and oil seal is found to be in good condition, the old seal may be used. Replace seal if defects are found. Refer to c (1)(j) above for removal of hypoid pinion oil seals. Use seal replacer 5120-795-0152 to install pinion shaft oil seal in hypoid front bearing cage covers. Refer to c (3)(r) below for replacement of inner hypoid oil seal. Use adapter to press new oil seal into retainer.

- (c) Repair. If bushing-type bearing (R, fig. 384) must be replaced, use arbor press and with bearing remover and replacer 5120-795-0089, press bearing out of spider pinion assembly (Q fig. 384). Use bearing remover and replacer 5120-795-0089 and press new bearing into pinion and burnish with burnisher 5120-795-0088. If differential case flange face runout is not within specified limits of 0.002 inch, place each half of differential case (D and K, fig. 384) in lathe and remove sufficient metal from flange to correct excessive runout. Metal must be cut on a true plane, removing only enough metal to bring runout within specified limits. After

machining, remove burrs and clean thoroughly.

(3) Assembly.

- (a) Install hypoid pinion outer bearing cup (K) in hypoid pinion bearing cage (M) on flange side of cage with thick side of cup toward cage shoulder. Install hypoid pinion inner bearing cup (P) in bearing cage from other side of cage with thick side of cup toward cage shoulder. Use remover and replacer 5120-795-0159 to assemble bearing cups to cage. Refer to figure 385.
- (b) If hypoid drive pinion (R) has been removed from hypoid pinion drive shaft (S), press hypoid pinion inner bearing cone (Q) onto hypoid drive pinion (R) with large radius of bearing toward gear. Install key in pinion drive shaft. Coat long spline end of hypoid pinion drive shaft (S) with white lead pigment and press pinion and bearing assembly onto shaft (gear end first). Continue pressing operation until pinion is firmly seated against shoulder on shaft. Install inner race of rear hypoid pinion bearing (T) on opposite end of shaft, large radius of inner race toward pinion end of shaft.
- (c) Place hypoid pinion outer bearing cage assembly over hypoid pinion inner bearing cone (Q), flange side out. Install hypoid pinion bearing spacer (DD). Install hypoid pinion outer bearing cone (J), small radius of cone toward cage. Install inner hypoid pinion bearing adjusting nut (H) (nut w/dowel) on hypoid drive pinion (R). Tighten to approximately 500 lb.-ft. torque. Slip hypoid pinion bearing adjusting nut washer (G) into position over dowel on inner adjusting nut. It may be necessary to remove and turn washer in order to get hole in washer to index with dowel. Install outer hypoid pinion bearing adjusting nut (F) and tighten to 500 lb.-ft. torque. Use bearing preload tester 6670-347-5922 to secure pinion bearing preload reading (fig.

388). When new bearings and cups are used, correct bearing preload should be 12 to 18 lb.-in. maximum. When original bearings are used, the bearing preload should be 4 to 8 lb.-in. maximum. If correct preload is not secured on initial adjustment, remove adjusting nuts, washer, and outer bearing. This will permit removal of hypoid pinion spacer (DD) which controls the bearing preload adjustment. Select the correct spacer in the following manner. If initial preload reading was too low, select a thinner spacer or reduce thickness of old spacer by rubbing on crocus cloth laid on a face plate or upon a piece of plate glass. If preload reading was too high, select a thicker spacer. Use micrometers to measure original spacer, new spacer, or modified spacer so that exact variation in bearing adjustment is known. Install outer bearing cone, bearing adjusting nuts, and washers as specified above and again take a bearing preload reading. Increasing thickness of spacer reduces bearing preload and decreasing thickness increases preload.

- (d) Install rear hypoid pinion bearing outer race assembly (T, fig. 385) in carrier assembly opposite pinion

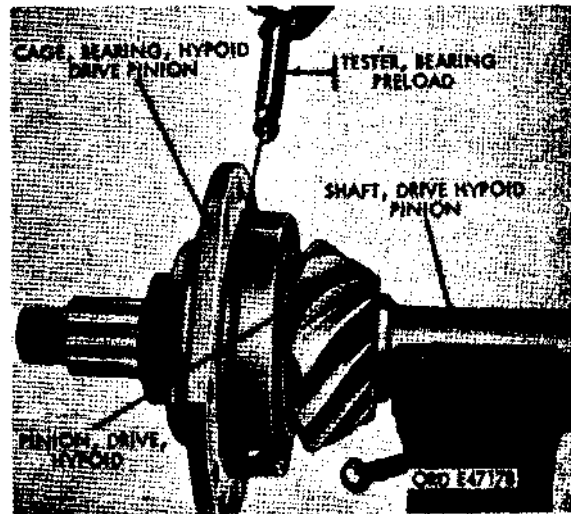


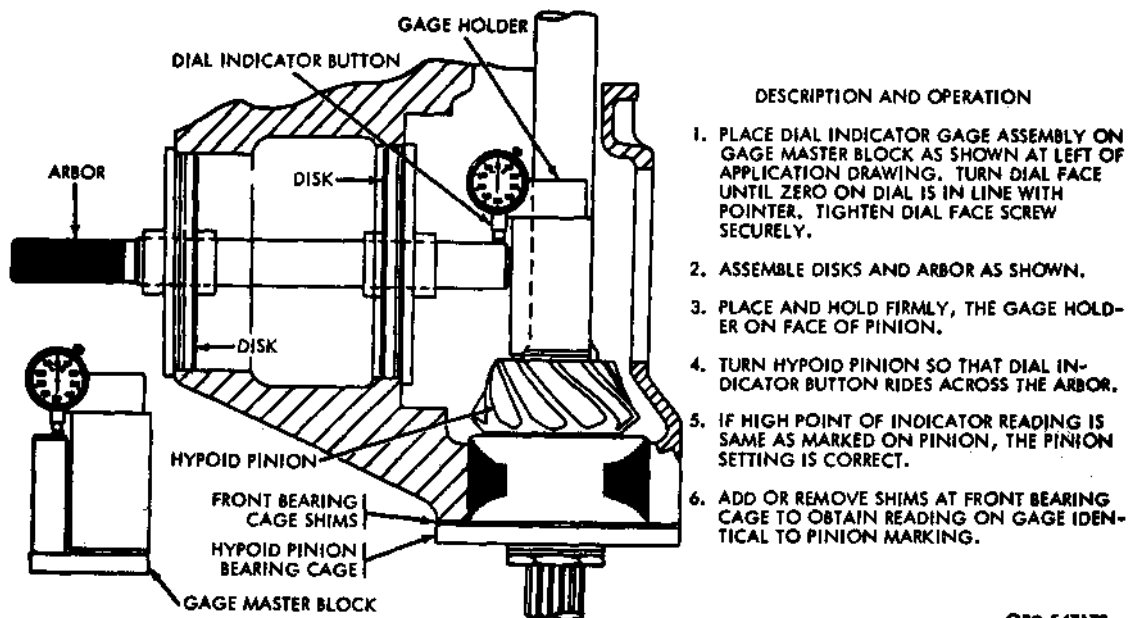
Figure 388. Checking hypoid drive pinion bearing preload

outer bearing cage. Use remover and replacer 5120-795-0079.

- (e) Install hypoid pinion cage shims (N) which control gear lash, and which were tied to bearing cage at time of disassembly. Place shims in position on pinion side of hypoid pinion outer bearing cage (M, fig. 385). Carefully align openings in shims with oil passages in bearing cage. Install hypoid pinion shaft assembly in carrier assembly (F, fig. 383) through pinion bearing cage end of through-shaft chamber. Align rear hypoid pinion bearing inner race with center of roller bearing outer race assembly. Continue installation of hypoid drive pinion assembly until hypoid pinion outer bearing cage (M, fig. 385) is seated against carrier and rear hypoid pinion bearing inner race is in position in bearing outer race assembly.
- (f) The hypoid drive pinion is adjusted for proper location in relationship to the hypoid drive gear, using gage 4910-195-0104 (fig. 389). The adjust-

ment is made after the hypoid drive pinion preload is established and with the hypoid drive gear and bearing assembly out of the differential case. The hypoid drive pinion, shaft, and cage assembly is temporarily installed in the differential case with the hypoid pinion cage shims (N) located between the differential case and hypoid pinion bearing cage. Use of the old shim pack will provide a starting point to secure the correct reading.

- (g) The gage holder for gage 4910-795-0104 is placed on the gage master block (fig. 389) for the purpose of setting the dial indicator to zero. This establishes the basic or nominal dimension to which the gears were manufactured or cut. Any variation from this nominal dimension will be found marked on the tooth end of the hypoid drive pinion. The hypoid drive pinion must be moved in (minus) or out (plus) so that the marking shown on the dial indicator matches the marking on the hypoid drive pinion. Add or remove hypoid pinion cage shims (N, fig. 385) be-



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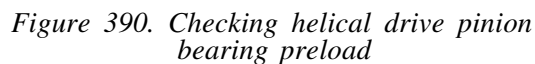
Figure 389. Tool application for hypoid drive pinion

tween the differential case and hypoid pinion outer bearing cage to attain the correct dial gage reading.

- (h) After locating the hypoid drive pinion, the hypoid drive pinion and shaft assembly, together with the cage, must be removed from the differential case and the hypoid drive gear and bearing case assembly installed.
- (i) Place hypoid drive gear (A) on press, and press inner helical pinion bearing (C) onto hub of drive gear. Refer to figure 386.
- (j) Place carrier assembly on press, helical pinion outer bearing cage side down. Position helical pinion bearing sleeve (B) in carrier assembly with notches in sleeve toward shoulder of bore. Aline screw hole in sleeve with screw hole in carrier. Press sleeve into carrier bore until it seats firmly against shoulder in carrier assembly, using remover and replacer 5120-795-0159. Refer to figure 386.
- (k) Turn carrier assembly over, helical pinion outer bearing cover opening up. Support hypoid drive gear (A) with suitable sleeve or adapter. Slide helical pinion bearing spacer (D) over keyway end of helical drive pinion (E). Install key (T) in keyway in pinion, and coat this end of shaft with white lead pigment. Insert helical drive pinion (E) through pinion outer bearing cage opening in carrier assembly. Aline key with keyway in hypoid drive gear, and press pinion into gear. Position inner helical pinion bearing (C) in helical pinion bearing sleeve (B). Refer to figure 386.
- (l) Install helical pinion outer bearing cup (H) in helical pinion outer bearing cage (G). Place cage on bench with outer flange end up. Place helical pinion outer bearing cones (J and K) in bearing cage with large diameters together. Install helical pinion outer bearing cup (L), using bearing replacer 5120-795-0082 to

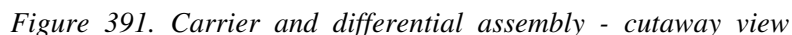
install both bearing cups. Refer to figure 386.

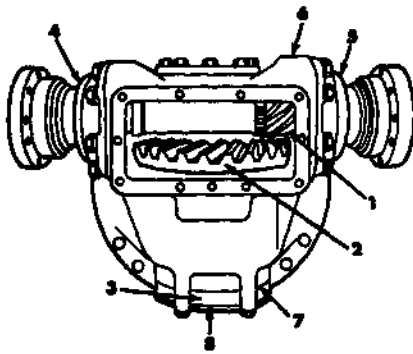
- (m) Place original helical pinion cage shims (F), which control gear backlash and which was tied to bearing cage at time of disassembly, in position over long studs (M, fig. 383). Be sure oil passage cutout in shims is toward top of carrier assembly and alined with oil recess on inside of carrier. Place helical pinion outer bearing cage assembly over end of helical drive pinion (E). Aline oil recess in bearing cage with oil recess in carrier and press bearing cage onto pinion and into carrier. Refer to figure 386.
- (n) Position original helical pinion cage shims (N), which control helical pinion outer bearing cones (J and K) preload, and which were tied to cover at time of disassembly, over long studs (M, fig. 383) next to helical pinion outer bearing cage (G). Be sure oil passage cutout is alined with oil hole in top of cage. Place helical pinion outer bearing cover (P) in position over studs with oil passage alined with oil hole in cage and shims. Install six lockwashers (R) and hex-nuts (Q), and tighten firmly. Using bearing preload tester 6870-347-5922 (fig. 390), check bearing preload reading. For new bearings, cups, and cones, the correct preload should be 12 to 18 lb.-in. maximum. When the original or used bearings are being assembled, the bearing preload should be 4 to 8 lb.-in. maximum. If correct preload is not obtained at first trial, refer to figure 387 for bearing adjustment points. When specified bearing preload is obtained, be sure cap screws are tight. Refer to figure 385.
- (o) Place new carrier side cover gasket (E) and carrier side cover (D) in position on carrier. Install eight lockwashers (A) and cap screws (B) holding cover to carrier. Tighten cap screws securely. Install air vent assembly (C) in cover. Refer to figure 383.
- (p) Position the hypoid drive pinion and cage assembly; then adjust the lo-



cation of hypoid drive gear to obtain correct tooth contact. Refer to figure 392 for correct procedure. Coat two or three teeth of the hypoid drive pinion with Prussian blue. Turn the hypoid drive pinion by hand and check

- (q) Press hypoid pinion oil seal into hypoid pinion front bearing cage cover. Seal is installed from inside of cover with replacer 5120-795-0152.
- (r) Press hypoid pinion oil seal (X) into hypoid pinion rear bearing cover (W) with replacer 5120-795-0152. Refer to figure 385.
- (s) Position hypoid pinion front bearing cage gasket (L) against hypoid pinion outer bearing cage (M). Aline gasket to avoid obstructing oil passages. Place hypoid pinion front bearing cage cover (D) and seal assembly over gasket. Insert, eight cap screws (FF) and lockwashers (EE), and install cover assembly. Tighten cap screws with 78 to 88 lb.-ft. torque. Refer to figure 385.



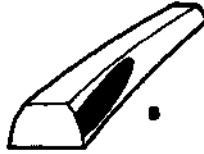


1. HYPOID DRIVE PINION
2. HYPOID DRIVE GEAR
3. HELICAL PINION OUTER BEARING CAGE
4. HYPOID PINION REAR BEARING COVER
5. HYPOID PINION FRONT BEARING CAGE COVER
6. HYPOID PINION CAGE SHIMS
7. HELICAL PINION CAGE SHIMS
8. HELICAL PINION CAGE SHIM

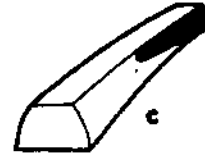
ALWAYS ADD OR REMOVE SHIMS OF EQUAL THICKNESS AND NUMBER WHEN CORRECTING HYPOID DRIVE AND PINION GEAR TOOTH CONTACT.



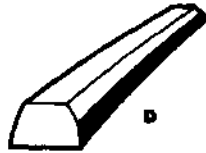
CORRECT TOOTH CONTACT
SHOWS BLUE OVER TWO-THIRDS OF TOOTH (CENTERED).



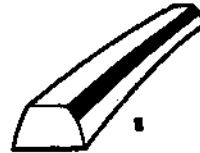
INCORRECT TOOTH CONTACT
SHOWS BLUE AT HEEL OF TOOTH
CAUSES TOOTH BREAKAGE.
CORRECTION-ADD SHIMS AT (7).
REMOVE SHIMS AT (6) TO
SECURE CORRECT BACKLASH.



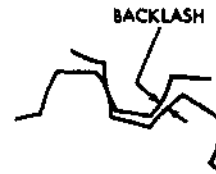
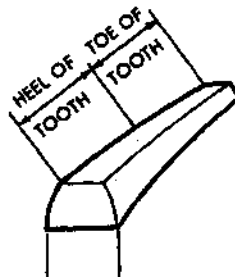
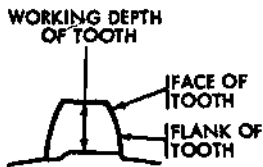
INCORRECT TOOTH CONTACT
SHOWS BLUE AT TOE OF TOOTH
CAUSES TOOTH BREAKAGE.
CORRECTION-ADD SHIMS AT (7).
REMOVE SHIMS AT (6) TO
SECURE CORRECT BACKLASH.



INCORRECT TOOTH CONTACT
SHOWS BLUE AT FLANK OF TOOTH
GEARS WILL BE NOISY.
CORRECTION-REMOVE SHIMS AT (6).
ADD SHIMS AT (7) TO
SECURE CORRECT BACKLASH.



INCORRECT TOOTH CONTACT
SHOWS BLUE AT FACE OF TOOTH
GEARS WILL BE NOISY.
CORRECTION-ADD SHIMS AT (6).
REMOVE SHIMS AT (7) TO
SECURE CORRECT BACKLASH.



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Figure 392. Hypoid drive gear and pinion tooth contact

- (t) Install hypoid pinion rear bearing cover gasket (V) and cover (W) over rear of shaft and secure in place with six cap screws (BB) and lockwashers (CC) on carrier assembly. Tighten cap screws to 25 to 35 lb.-ft. torque.
 - (u) If dust slinger (C) has been removed from companion flanges (B and Y), install new slinger on flange. Place companion flange (B) on pinion bearing cage end of hypoid pinion drive shaft (S), using differential companion flange replacer 5120-795-0155. Push flange into position on shaft. Repeat this operation to install companion flange (Y), being sure that hypoid pinion rear bearing spacer (U) has been installed. Do not fail to lubricate seals before flanges are assembled to shaft. Complete assembly of flanges by installing slotted nut (A) on front flange, tighten to 800 lb.-ft. torque, and lock nut in position with cotter pin (GG). Repeat operation at rear flange, install nut (Z), tighten to specified torque, and secure with cotter pin (AA).
- Caution:** Never drive flanges into position on through shaft as damage to pinion bearings will result.
- (v) Press differential bearing cone (C) onto differential case (D) and press differential bearing cone (L) onto differential case (K). Apply pressure to inner race of bearings only. Install bearings with large side of cone against case (fig. 384).
 - (w) Both differential cases (D and K) were marked for correct assembly at time of disassembly. Note that differential case mounting flange inside of helical drive gear (T, fig. 384) is off center. Select case that mounts on highest side of inside flange in drive gear. Lay differential case on bench with flange side up and place one side gear thrust washer (E, fig. 384) and one differential side gear (F, fig. 384) into differential case (D, fig. 384).
 - (x) Assemble four spider pinion assemblies (Q) on differential spider (G)

with a spider pinion thrust washer (S) on top (or outside) of each pinion (fig. 384).

- (y) Place differential spider (G), spider pinion assembly (Q), and spider pinion thrustwasher (S) into case, meshing pinion teeth with those of differential side gear (F) already in position in differential case (fig. 384).
- (z) Place other differential side gear (H) and side gear thrust washer (J) on spider assembly (fig. 384).
- (aa) Place helical drive gear (T) in position on differential case (D), with recess side of gear up, and align bolt holes (fig. 384).
- (bb) Install other side of differential case (K, fig. 384) on helical drive gear (T, fig. 384), making sure marks made at time of disassembly (par. 289c) are aligned. Install eight hex bolts (U, fig. 384) from high side of helical drive gear ((w) above). Install and tighten slotted nuts (P) to 115 lb.-ft. torque. Install locking wire and thread wire through all bolts and twist ends to secure in place (fig. 384).
- (cc) Lift differential case assembly into carrier assembly (F, fig. 383). Install assembly with differential slotted nuts (P, fig. 384) toward hypoid pinion drive shaft.
- (dd) Install tapered differential bearing cups (B and M, fig. 384) on differential bearing cones (C and L, fig. 384). Use a short bar inserted through differential side gear to lift differential assembly slightly while placing bearing cups in position. This will prevent injury to hands while performing this operation.
- (ee) Position one carrier cap (S, fig. 383) on carrier assembly (F, fig. 383) according to marking made at time of disassembly. Install two bolts (T, fig. 383) and tighten just enough to hold cap in place (fingertight).

Install other carrier cap (X, fig. 383). Secure with two bolts (U, fig. 383) fingertight only.

(ff) Install differential bearing adjusting nuts (A and N, fig. 384). After adjusting nuts have been started, tighten the four bolts (T and U, fig. 383) just enough to hold bearing cups snugly, but still permit turning the adjusting nuts. Use a spanner wrench to tighten adjusting nuts alternately until both nuts are threaded into case and cap equally. Using dial indicator at side face of helical drive gear (T, fig. 384), adjust differential assembly to zero end play in differential bearings. Rotate assembly several revolutions to assure normal bearing contact. Check differential end play and adjust to zero if necessary. Check drive gear runout with dial indicator. If runout exceeds 0.008 inch, remove differential assembly and check for cause.

(gg) Tighten adjusting nuts one notch each from 0.000-inch end play to secure the correct differential bearing preload. Tighten four bolts (T and U, fig. 383) to 300 lb.-ft. torque. Install differential bearing adjusting nut locks (W, fig. 383) and cap screws (V, fig. 383). Install locking wire in carrier cap bolts and adjusting nut lock cap screws to secure assembly in place.

(hh) Refer to figure 383 as reference for installing carrier top cover gasket (G), carrier top cover (H), ten lockwashers (J), and ten cap screws (K). Tighten cap screw to 25 to 35 lb.-ft. torque.

290. Springs (Fig. 393)

a. General. The rear springs (fig. 393) are semielliptic type, mounted with the arch up. They are attached to the rear suspension assembly by U-bolts (E). The spring leaves are held together as an assembly by a center bolt (BB). Leaves are alined with four spring leaf

clips (H and K). The ends of springs rest on axle housing and are free to slide in guide bracket (B and Q) with plate assemblies. Rear spring assemblies require no repair unless inspection indicates broken or wear on leaves.

b. Disassembly (Fig. 393). Place rear spring assemblies in vise or install heavy C-clamps, clamping assembly near center bolts (BB) to hold leaves compressed together. Remove nut, bolt, and spacer from spring leaf clips (H and K). Remove nuts from center bolts (BB). Release vise or C-clamps to allow leaves to spread. Remove center bolts (BB) and disassemble leaves.

c. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean all spring leaves thoroughly with dry-cleaning solvent or mineral spirits paint thinner. Use wire brush and remove all rust and corrosion from spring leaves.
- (2) Inspection and repair. Inspect all spring leaves for cracks and breaks. Replace defective leaves. Replace center bolts at time of each repair.

d. Assembly.

- (1) Spring leaves (fig. 393). Make sure that all rust has been removed from spring leaves. Apply a small amount of powdered graphite to each side of spring leaves. Assemble leaves, starting with the longest spring leaf. Aline holes for center bolt.
- (2) Install center bolts. Place the assembled spring leaves in arbor press or install heavy C-clamps. Compress leaves tightly together, and install center bolts.

Note. Keep spring holes alined for center bolts (BB).

291. Spring Seats

Refer to TM 9-2320-211-20.

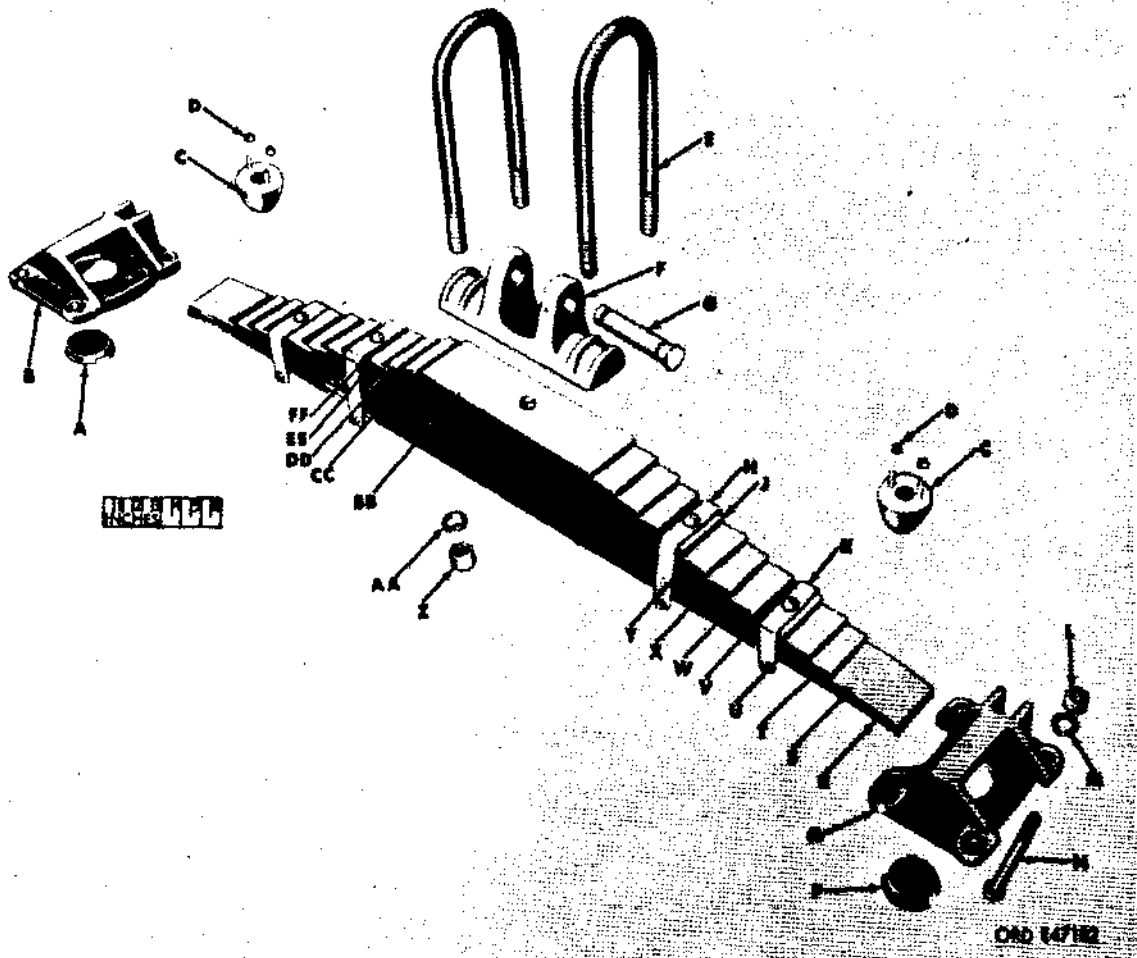


Figure 393. Rear spring and mounting parts - exploded view

| Key | Item | Key | Item |
|-----|-----------------------------|-----|--------------|
| A | Plate, spring guide, bottom | R | Leaf, spring |
| B | Bracket, guide | S | Leaf, spring |
| C | Bumper, rubber | T | Leaf, spring |
| D | Nut, hex | U | Leaf, spring |
| E | Bolt, U- | V | Leaf, spring |
| F | Saddle, spring | W | Leaf, spring |
| G | Pin, lifting, spring saddle | X | Leaf, spring |
| H | Clip, spring leaf | Y | Leaf, spring |
| J | Leaf, spring | Z | Nut, hex |
| K | Clip, spring leaf | AA | Washer, lock |
| L | Nut, hex | BB | Bolt, center |
| M | Washer | CC | Leaf, spring |
| N | Bolt, hex | DD | Leaf, spring |
| P | Plate, spring guide, bottom | EE | Leaf, spring |
| Q | Bracket, guide | FF | Leaf, spring |

Figure 393. Rear spring and mounting parts - exploded view - legend

Section VI. SERVICEABILITY STANDARDS

292. General

The serviceability standards included herein give the minimum, maximum, and key clearances of new or repaired parts. In the "Size and fit of new parts" column, the letter "L" indicates a loose fit (clearance) and the letter "T" indicates a tight fit (interference).

All measurements in inches unless otherwise indicated.

293. Serviceability Standards

Table XVI below gives the serviceability standards for the rear suspension system.

Table XVI. Serviceability Standards - Rear Suspension System

| Fig. No. | Ref. letter | Point of measurement | Size and fit of new parts |
|---|-------------|---|---------------------------|
| <u>DIFFERENTIAL CASE AND GEARS</u> | | | |
| 394 | C | Differential spider | 1.123 to 1.122 |
| 394 | D | Differential spider pinion bushing | 1.127 to 1.129 |
| 394 | D-C | Clearance of differential spider to bushing | 0.004 to 0.007 |
| <u>BACKLASH</u> | | | |
| 395 | E | Helical drive gear to helical drive pinion | 0.007 to 0.014 |
| 394 | | | |
| <u>BEARINGS</u> | | | |
| 395 | D to A | Inner helical drive pinion bearing to hypoid drive gear | 0.006T to 0.0011L |
| 395 | C to B | Inner helical drive pinion bearing to bearing sleeve | 0.0020L to 0.0042L |
| 395 | G to F | Outer helical pinion bearing cone to helical drive pinion | 0.000 to 0.0015T |
| 396 | A to C | Outer hypoid pinion bearing cone to hypoid drive pinion | 0.0002L to 0.0022L |
| 396 | B to D | Inner hypoid drive pinion bearing cone to hypoid drive pinion | 0.0010T to 0.0025T |
| 396 | E to F | Hypoid pinion shaft rear bearing to hypoid drive pinion shaft | 0.0005T to 0.0013T |
| 396 | G | Hypoid pinion shaft rear bearing to carrier | 0.0005L to 0.0007T |
| 394 | A to B | Differential bearing cone to differential case | 0.0015T to 0.0035T |

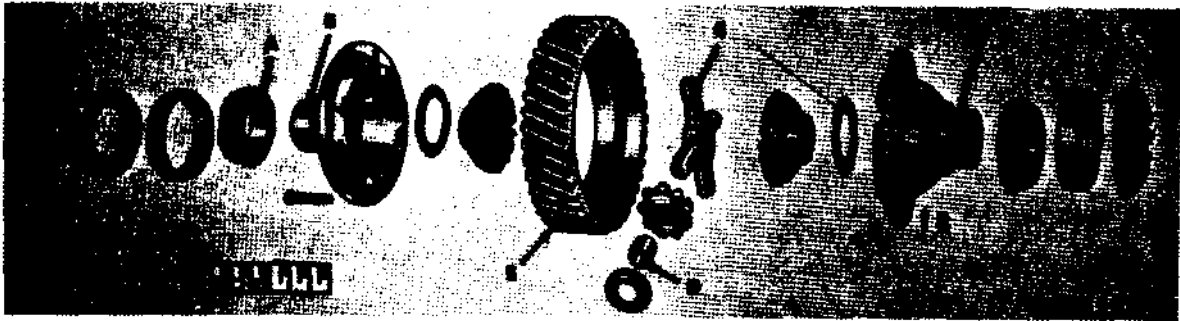


Figure 394. Serviceability standard points of measurement for differential assembly

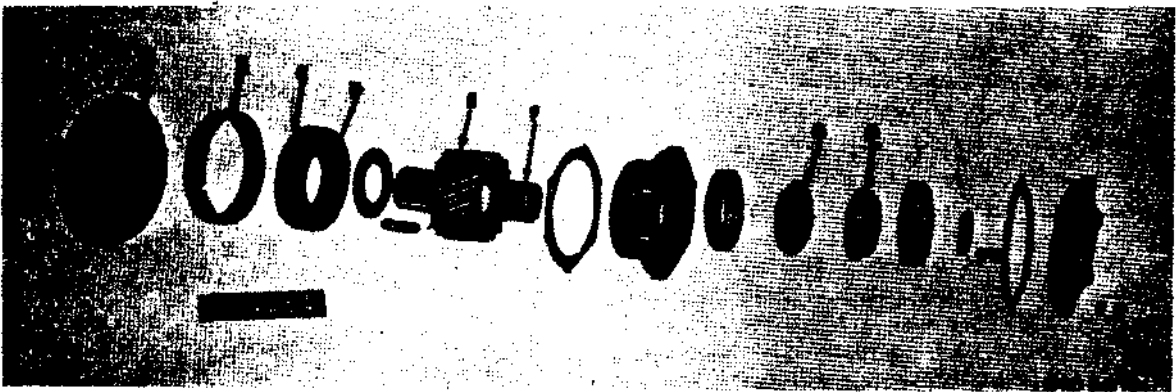


Figure 395. Serviceability standard points of measurement for helical shaft assembly

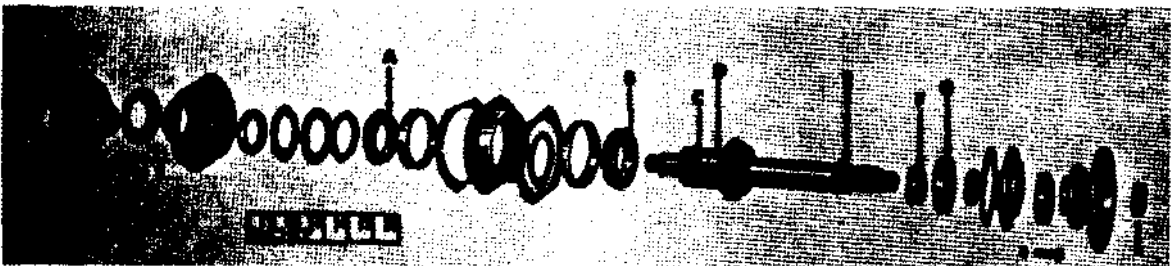


Figure 396. Serviceability standard points of measurement for pinion shaft assembly

CHAPTER 22

WRECKER CRANE M62

Section I. DESCRIPTION AND DATA

294. Description

a. General. The hydraulically operated crane mounted on the rear of the chassis of the medium wrecker truck M62 consists primarily of the assemblies described in (b) through (t) below. The complete crane can be replaced as a single unit, provided hoisting equipment having a capacity of approximately 8000 pounds is available. However, the illustrations and replacement instructions contained in this section refer to replacement of the individual units and assemblies comprising the crane.

b. Hydraulic Pump and Relief Valve. The flange-mounted vane-type hydraulic pump (fig. 397) is bolted to the hydraulic pump adapter (fig. 398) mounted on the rear of the power divider. The hydraulic pump output shaft coupling (fig. 398) is keyed to the power-divider output shaft and to the hydraulic-pump shaft. The adjustable relief valve assembly (fig. 397) is connected to the hydraulic pump outlet port. The purpose of this valve is to protect the crane hydraulic system from excessive (above 1200 psi) pump pressures.

c. Base Plate and Pivot Post Assembly. The base plate and pivot post assembly, as

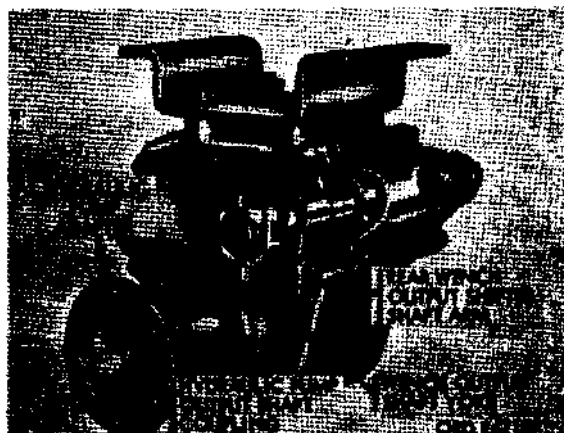


Figure 398. Rear view of power divider removed from vehicle

referred to in this paragraph, consists of the crane base plate (fig. 399), pivot post (fig. 399), shipper support (fig. 400), swivel valve assembly (fig. 401), and operator's compartment and control valve bank assembly (fig. 401). The combined weight of these units is approximately 3500 pounds. The base plate is bolted to the crane body, which is bolted to the left and right frame side rails. The pivot post, which is hollow, is internally sup-



Figure 397. Hydraulic reservoir with power divider, pump, and relief valve removed from vehicle (M62)

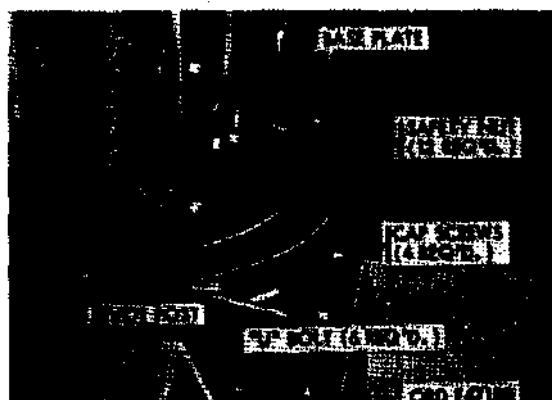


Figure 399. Lower end of pivot post and base plate

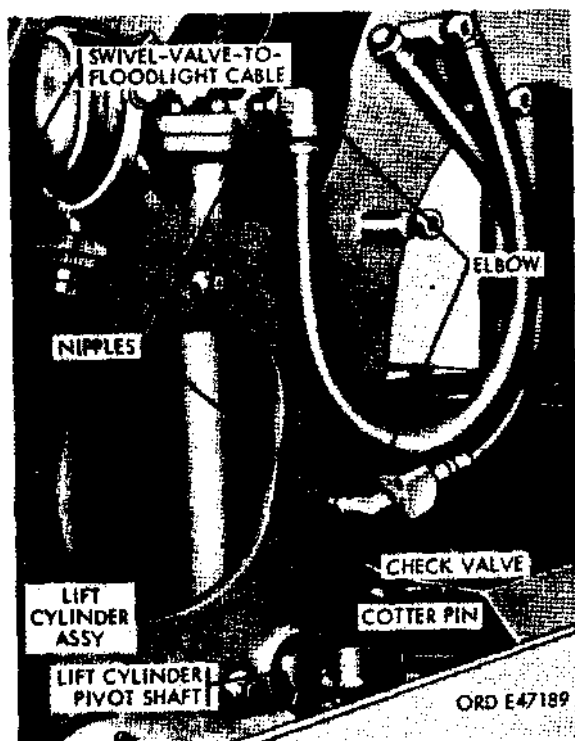


Figure 400. Left side of pivot post shipper support, and boom lift cylinder.

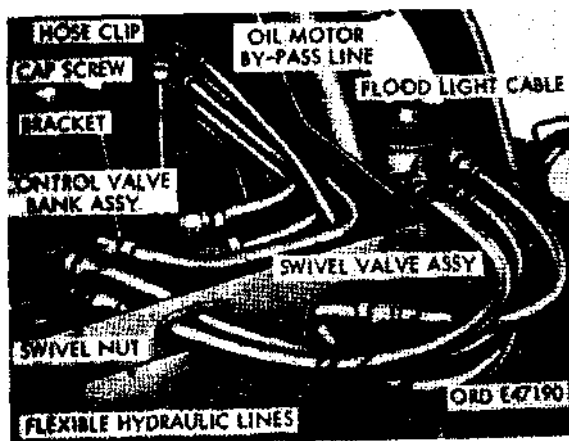


Figure 401. Front view of operator's compartment and control valve bank assembly.

ported at the top and bottom by tapered roller bearings, which are installed on a tubular support member attached to the base plate. The pivot post support cap (fig. 402) bolted to the top of the pivot post support, anchors the pivot post to the support while permitting the pivot post to rotate freely on its vertical axis. The shipper support, on which the boom and ship-

per assembly ((f) below) are pivoted, is bolted to mounting bosses cast on the sides of the pivot post. For description of the swivel valve, refer to (e) below. For description of the control valve bank refer to (j) below.

d. *Swing Motor* (fig. 403). The swing motor mounted on the rear of the base plate consists of a pair of double-acting hydraulic cylinders. The front end of both piston rods is connected to the pivot post drive pinion crank. The drive pinion at the lower end of the crank drives the ring gear at the bottom of the pivot post through an idler gear. The rear end of both cylinders is anchored by a pin to a bracket welded to the base plate. A spring-loaded valve spool inside the cylinder bodies, which is actuated by a lever operating against a roller attached to the base plate, controls the flow of hydraulic oil through the cylinder.

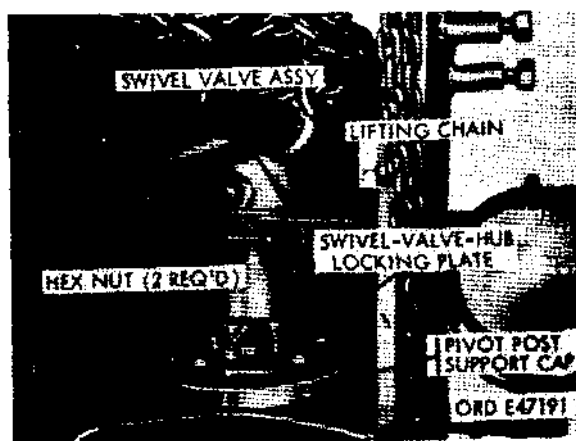


Figure 402. Front view of upper end of pivot post with swivel in raised position.

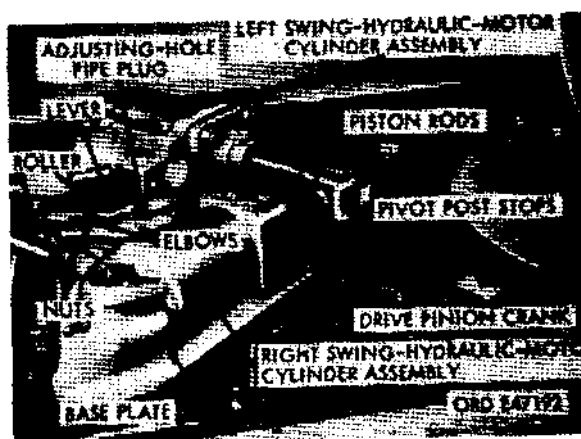


Figure 403. Hydraulic swing motor (M62).

e. Swivel Valve Assembly (figs. 401 and 402). The swivel valve assembly (fig. 401) is installed on top of the pivot post support cap (fig. 402) with its lower end extending into the pivot post support. A locking plate secures the valve assembly to the support cap. The swivel valve assembly permits 360° rotation of the crane without twisting or breaking the hydraulic lines from the pump to the driving motor, hoist hydraulic oil motor ((*i*) below), boom lift cylinder ((*g*) below), boom crown cylinder ((*h*) below), and control valve bank assembly ((*j*) below).

f. Boom and Shipper Assembly. The boom and shipper assembly consists of the boom (fig. 404) and shipper, which are telescoping tubular steel members having a rectangular-shaped cross section, held together by the boom crowd cylinder ((*h*) below). The rear end of the shipper is pivoted on a pin (fig. 405) installed at the top of the shipper support, which permits raising and lowering the front end of the boom. Weight of the shipper and boom assembly is approximately 2150 pounds. Although the boom and shipper assembly removal pro-

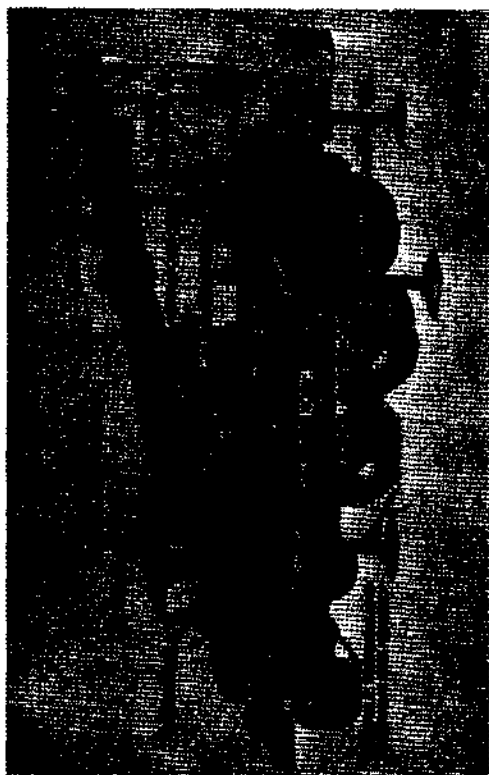


Figure 404. Medium wrecker truck M62 with outriggers down and shipper brace rigged.



Figure 405. View of right end of shipper pivot pin installed in shipper support.

cedures (para 315) in this chapter require removal of the boom hoist hydraulic oil motor and cable drum ((*i*) below) before removal of the boom and shipper assembly, both assemblies can be removed as a single unit.

g. Boom Lift Cylinder. The boom lift cylinder (fig. 400) is vertically mounted to the rear of the pivot post. The lower end of the cylinder is pivoted on a shaft installed between the sides of the shipper support. The upper end of the lift-cylinder piston rod is pivoted on a shaft installed between the sides of the shipper. Weight of the boom lift cylinder is approximately 265 pounds. By using overhead hoisting equipment to raise the front end of the boom to its position of maximum elevation, the boom lift cylinder can be removed without removal of the boom and shipper assembly. However, the boom lift cylinder removal procedures (para 316) in this section require removal of the shipper and boom assembly.

h. Boom Crowd Cylinder. The boom crowd cylinder (fig. 406) is mounted horizontally inside the boom and shipper assembly. The rear end of the crowd-cylinder piston rod is secured to the anchor (welded to the rear end of the shipper) by two nuts and a locking plate. A collar welded to the crowd cylinder at a point midway between the ends is secured to the boom by two pins inserted through the sides of the boom and the collar.

i. Boom Hoist Hydraulic Oil Motor and Cable Drum Assembly. The boom hoist hydraulic oil motor and cable drum assembly (fig. 404) is bolted to the rear of the shipper. Either the oil

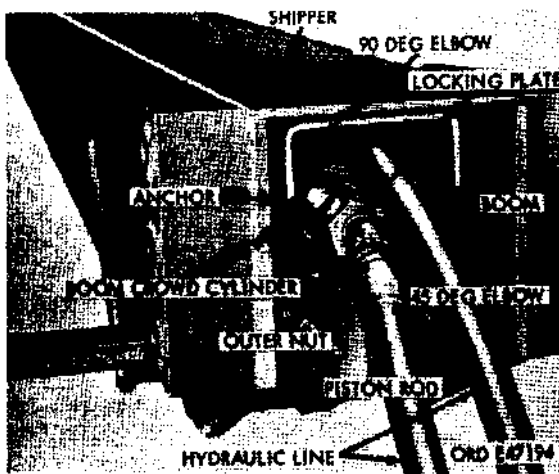


Figure 406. Rear view of boom and shipper assembly with cable drum removed

motor or the cable drum can be removed separately. However, the removal procedures (par. 318) in this chapter cover removal of both assemblies as a single unit. Weight of the boom hoist hydraulic oil motor and cable drum assembly is approximately 730 pounds.

j. Control Valve Bank Assembly. The control valve bank assembly (fig. 407) is bolted to a shelf at the front of the operator's compartment. Wrecker crane operating instruction and caution plates are mounted on the control valve bank cover.

k. Hydraulic Lines and Fittings. The tubing used in the crane hydraulic lines is of butt-welded steel construction and the fittings are Ermeto flareless. Flexible lines are high-pressure-type rubber hose with swaged on couplings.

l. Hydraulic Reservoir and Equipment Box (fig. 404). The hydraulic reservoir and equipment box assembly is bolted to brackets attached to the frame side rails. Although the reservoir and equipment box removal procedures (par. 321) require removal of the power divider, hydraulic pump, and relief valve before removal of the reservoir and equipment box, these assemblies can be removed with the reservoir as a single unit.

m. Crane Body (Fig. 404). The crane body is bolted at the rear to the left and right frame side rails by two U-bolts, one at each side. The

front of the crane body is bolted to two brackets, one on each side, attached to the left and right frame side rails. The approximate weight of the crane body, including the outriggers, is 2100 pounds. The base plates and pivot assembly must be removed before the crane body can be removed. However, the crane body can be removed without first removing the rear winch assembly, in which case the approximate weight of the body and winch assembly is 3700 pounds.

n. Hydraulic System. The wrecker crane hydraulic system (fig. 408) is completely sealed except for the breather-type reservoir filler cap. A bayonet-type oil level gage attached to a square-head pipe plug is installed in the top of the reservoir.

o. Clutch Control Valve. The clutch control valve is a two-way air valve connected in the compressed air system (fig. 413) between the air supply line and the roto chamber ((p) below). The valve is bolted to a bracket attached to the front of the wrecker body floor plate. When the valve lever is in the DISENGAGE position, compressed air is permitted to pass through the valve and control-valve-to roto-chamber air line into the rear end of the roto chamber.

p. Roto Chamber. The roto chamber is a single-acting air cylinder having a spring-loaded piston, which causes the piston to move to and remain at the rear end of the cylinder whenever the clutch control valve lever is in the ENGAGE position. The front end of the roto chamber push rod is connected by an

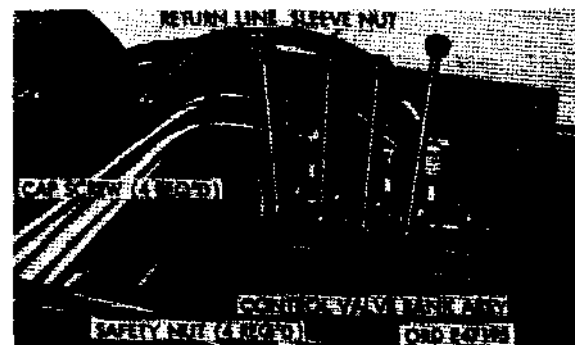


Figure 407. Rear view of operator's compartment and control valve bank assembly with cover removed (M62)

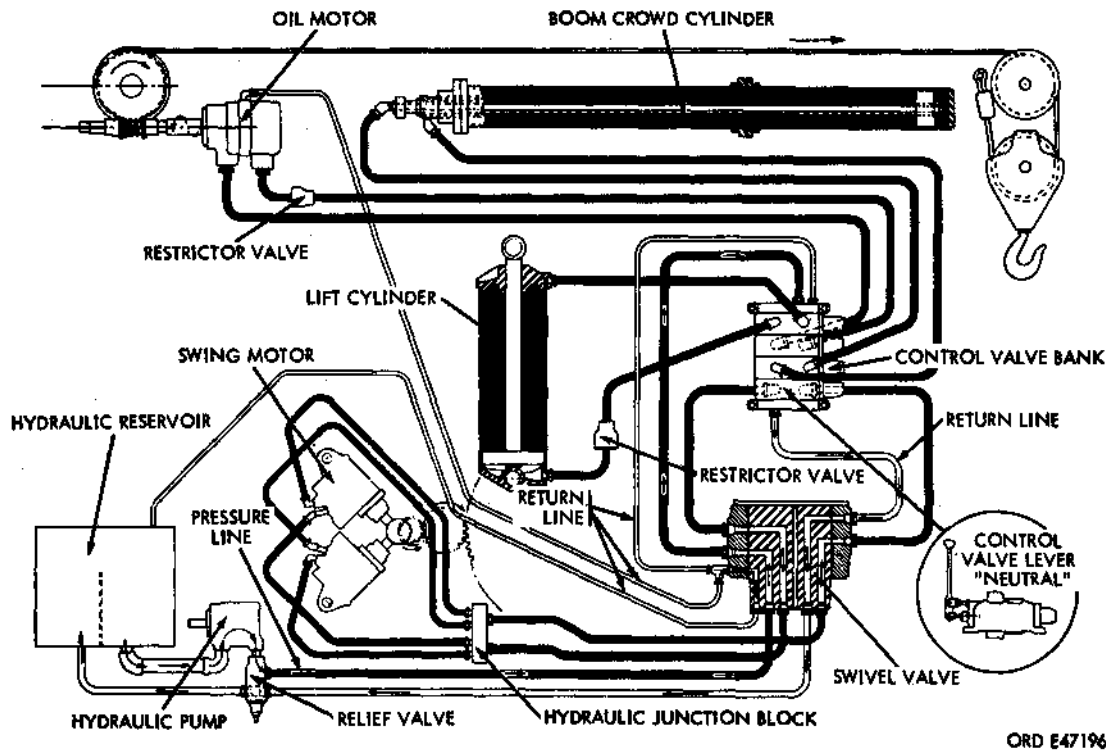


Figure 408. Crane hydraulic system (M62)

adjustable yoke and pin to the clutch release outer lever. Compressed air admitted into the rear end of the roto chamber through the clutch control valve ((o) above) causes the piston inside the roto chamber to move forward. This causes the push rod and outer lever to contact and push the clutch release inner lever forward, thereby disengaging the clutch.

q. Power Divider Assembly. The power divider assembly (figs. 398 and 411) is a single speed gear box with one input (drive) shaft and two output shafts. It is mounted by a bracket to the bottom of the hydraulic reservoir (fig. 397). The drive shaft yoke (fig. 411) is connected by a propeller shaft and universal joint to the power takeoff mounted on the rear of the transfer. The winch output shaft yoke (fig. 398) is connected by a universal joint to the front end of the rear winch front propeller shaft. The hydraulic pump output shaft is connected by a coupling (fig. 398) to the hydraulic pump input shaft. When the hydraulic pump control lever is in the DISENGAGE position, the air passages inside the governor-valve control

valve (fig. 413) are arranged so that the engine speed governor (fig. 413) is controlled by the governor valve (fig. 413) mounted on the rear of the distributor drive housing. This valve is adjusted to govern the engine speed at 2950 rpm (maximum no-load speed) for truck operation. When the hydraulic pump control lever is in the ENGAGE position, the air passages inside the governor-valve control valves are arranged so that the engine speed governor is controlled by the governor valve (W, fig. 417) mounted on the front of the power divider. This valve is adjusted to govern the engine speed at 1600 rpm (no-load) for crane operation. The power divider, hydraulic pump, and relief valve are removed from the vehicle as a single unit.

r. Power Divider Controls. The power divider controls consist of the rear winch control linkage and hydraulic pump control linkage. The hydraulic pump control linkage is comprised of the hydraulic pump control lever (fig. 414), rear control rod (fig. 415), relay lever (fig. 416), front control rod (K, fig. 417), and governor-valve-control-valve control rod

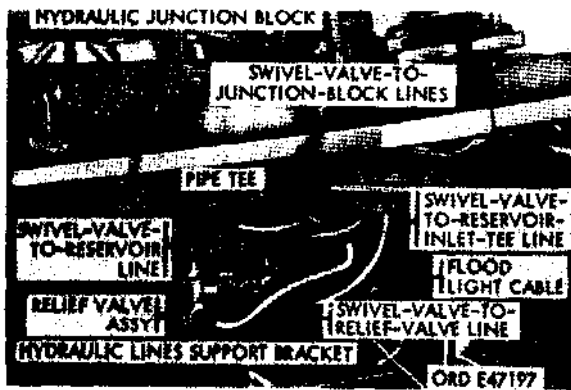


Figure 409. Left front view of base plate and pivot post assembly partially removed (M62)

(G, fig. 417). The rear end of the rear control rod is connected to the lower end of the control lever (fig. 418) by a yoke and pin. The front end of the rear control rod is connected to the left lever of the relay lever assembly by a yoke and pin. The rear end of the front control rod is connected to the right lever of the relay lever assembly by a yoke and pin. The front end of the front control rod (fig. 411) is connected to the pump-output-shifter-shaft arm and to the rear end of the governor-valve-control rod. The front end of the governor-valve-control rod is connected to the valve lever (U, fig. 417).

s. Rear Winch. The rear-mounted winch is power driven from a power divider mounted behind the transfer case and has a direct maximum pulling capacity of 45,000 pounds on the

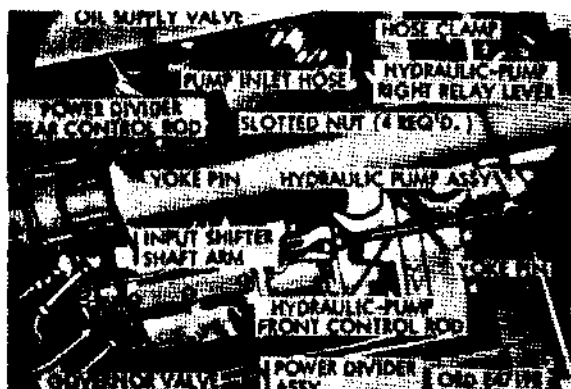


Figure 410. Bottom view of right side of power divider installed (M62)

first layer of cable. The winch is equipped with a cable level wind and a cable tensioner (fig. 414) to assure proper winding of cable. The winch is worm-gear and power must be used when paying out cable. An adjustable automatic brake is provided on the winch drive worm for holding purposes. Controls for operating the winch are mounted on the body directly behind the winch. For operating instructions refer to TM 9-2320-211-10.

t. Power Train. The power train (fig. 412) consists of those units which are mounted beneath the wrecker crane and transmit driving torque to the wrecker crane and rear-mounting winch. Initially, the power is taken from the truck's own transfer by means of a flange-mounted power takeoff. Power is then transmitted to the power divider where it can be used for driving either the crane or rear-mounted winch. Drive shaft and universal joints are used between the various units. A drive sprocket and chain is used in the drive line to the rear-mounted winch. The large drive shaft is supported by a drive sprocket bearing assembly and pillow block.

295. Data

a. Wrecker Crane.

Make Austin-Western
Type hydraulic
Manufacturer's number AWR-HCF-1830
Capacity rating 5 ton

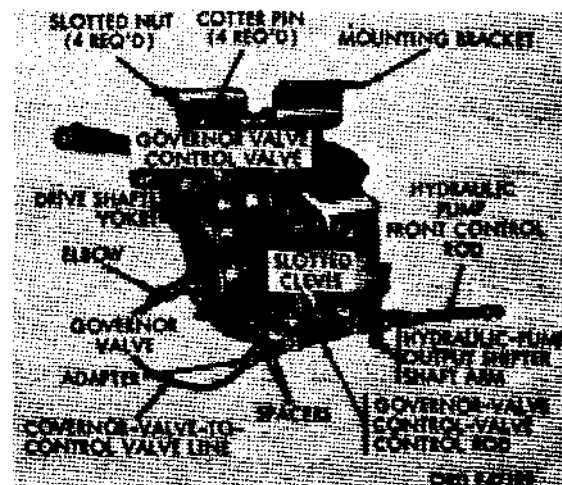


Figure 411. Front view of power divider removed from vehicle

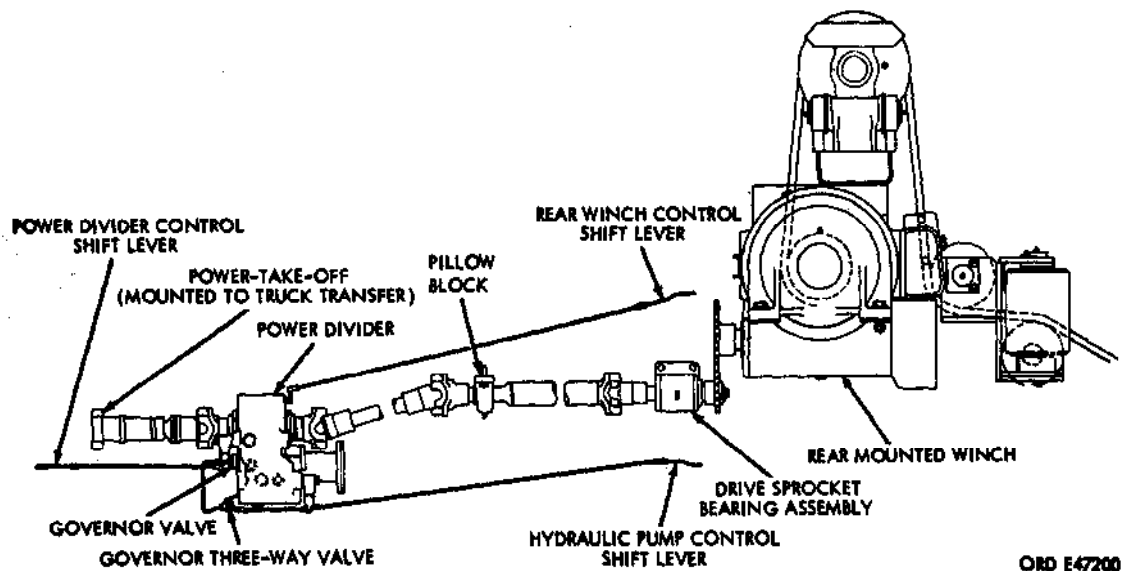


Figure 412. Schematic diagram of power train

b. Clutch Control Valve.

Make Bendix-Westinghouse
Manufacturer's number BWE-225004

c. Roto Chamber.

Make Bendix-Westinghouse
Ordnance number 7413932
Manufacturer's number BWE-224875

d. Hydraulic Pump.

Make Vickers
Type vane
Manufacturer's number VKR-U-430-36-1C-11
Ordnance number 7409847

e. Relief Valve.

Make Hydreco
Ordnance number 7409855
Manufacturer's number HDE-VR-5-C

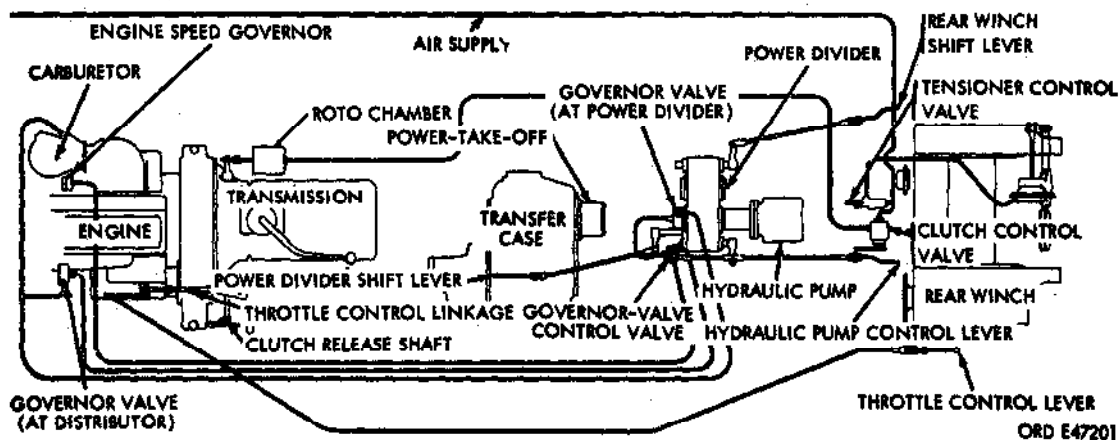


Figure 413. Wrecker crane air lines (M62)

f. Swivel Valve.

Make Auetin-Western
 Ordnance number 7409923
 Manufacturer's number. AWR-HCU-242

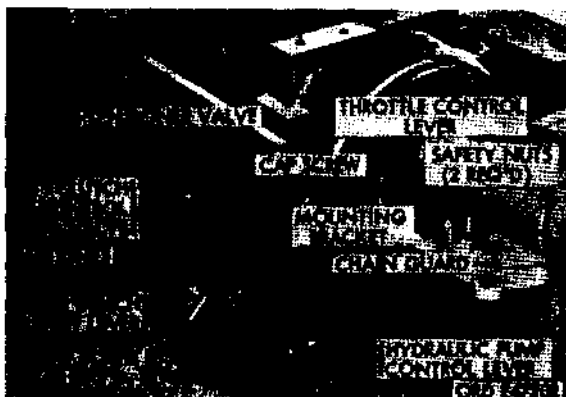


Figure 414. Rear winch controls



Figure 415. Right side view of underside of crane base plate removed from vehicle - M62



Figure 416. Rear view of forward end of wrecker body with crane removed - M62

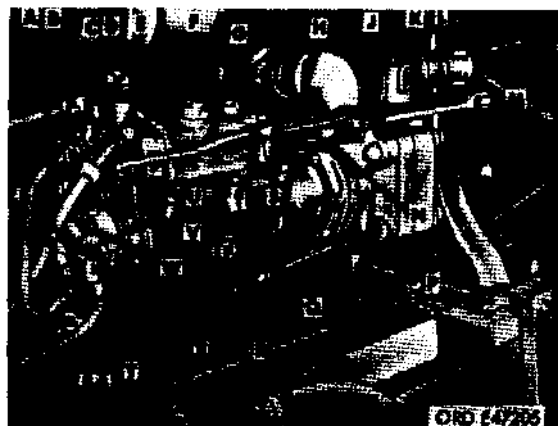


Figure 417. Left side view of rear end of wrecker body with floor plate raised - M62

KeyItem

| | |
|----|--|
| A | Control-valve-to-governor line |
| B | Governor-valve-to-control-valve line |
| C | Safety nut |
| D | Adapter |
| E | Governor-valve control valve |
| F | Control-valve mounting bracket |
| G | Control-valve control rod |
| H | Slotted clevis |
| J | Nut |
| K | Hydraulic-pump front control rod |
| L | Hydraulic-pump right relay lever |
| M | Pillow block |
| N | Hydraulic-pump-output-shifter-shaft arm |
| P | Rear-winch right relay lever |
| Q | Rear-winch-front-control-rod adjustable yoke |
| R | Winch-output shifter shaft arm |
| S | Yoke |
| T | Nut |
| U | Control valve lever |
| V | Cap screws |
| W | Governor valve |
| X | Adjusting hole plug |
| Y | Nut |
| Z | Elbows |
| AA | Carburetor -to-governor-valve line |
| BB | Governor-valve -to-control valve line |

Figure 417. Left side view of rear end of wrecker body with floor plate raised - M62 - legend

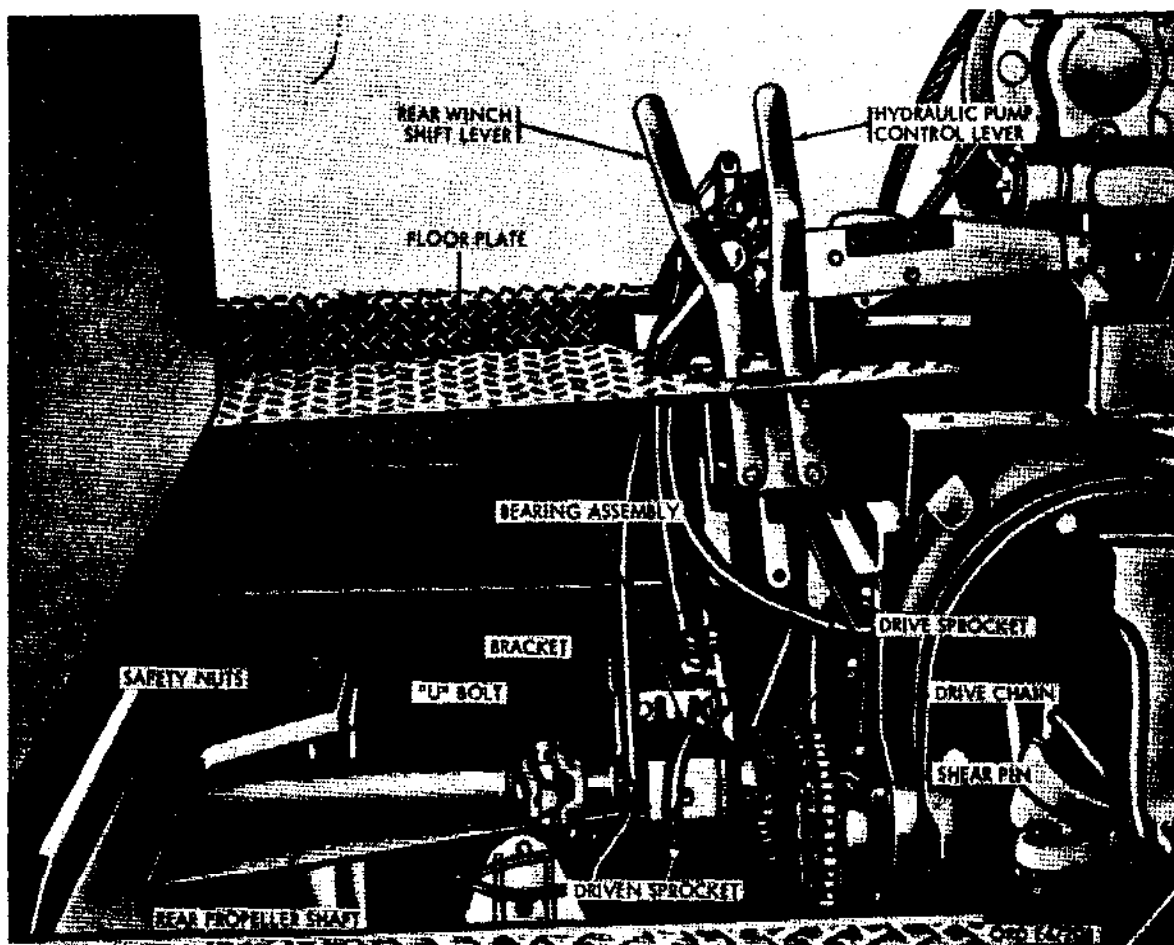


Figure 418. Left side view of rear end of wrecker body with floor plate raised - M62

g. Swing Motor.

| | |
|-----------------------|----------------|
| Make | Austin-Western |
| Ordnance number | 7409871 |
| Manufacturer's number | AWR-HCU-244 |

h. Boom Hoist Hydraulic Motor.

| | |
|-----------------------|-----------------------|
| Make | Vickers |
| Type | vane |
| Ordnance number | 7409635 |
| Manufacturer's number | VKR-M2-540-150-6FC-11 |

i. Control Valve Bank Assembly.

| | |
|-----------------------|----------------|
| Make | Austin-Western |
| Ordnance number | 8330173 |
| Manufacturer's number | AWR-HCU-310 |

j. Power Takeoff.

| | |
|-----------------------|-------------------------|
| Manufacturer | Timken Detroit Axle Co. |
| Manufacturer's number | TD-P138A |

k. Power Divider.

| | |
|-----------------------|--------------------------|
| Manufacturer | Gar Wood Industries Inc. |
| Manufacturer's number | GW-M308098 |
| Ordnance number | 7413950 |

l. Pillow Block.

| | |
|-----------------------|---------------------------|
| Manufacturer | Stephens-Adamson Mfg. Co. |
| Manufacturer's number | SAH-NP24 |
| Ordnance number | 7409905 |

m. Drive Sprocket Bearing Assembly.

| | |
|-----------------------|--------------------------|
| Manufacturer | Gar Wood Industries Inc. |
| Manufacturer's number | GW-M305897 |
| Ordnance number | 7409904 |

Section II. TROUBLESHOOTING

296. Purpose

Note. Information in this section is for use of Ordnance maintenance personnel in conjunction with and as a supplement to the troubleshooting section in the pertinent operator's manual. It provides the continuation of instructions where a remedy in the operator's manual refers to Ordnance maintenance personnel for corrective action.

Operation of a deadlined vehicle without a preliminary examination can cause further damage to a disabled component and possible injury to personnel. By careful inspection and troubleshooting such damage and injury can be avoided and, in addition, the causes of faulty operation of a vehicle or component can often be determined without extensive disassembly.

297. General Instructions and Procedures

This chapter contains inspection and troubleshooting procedures to be performed while a disabled component is still mounted in the vehicle and after it has been removed.

a. The inspection made while the component is mounted in the vehicle are, for the most part, visual and are to be performed before attempting to operate the vehicle. The object of these inspections is to avoid possible damage or injury and also to determine the conditions of and, when possible, what is wrong with the defective component.

b. The troubleshooting performed while the component is mounted in the vehicle is that which is beyond the normal scope of using organization. These troubleshooting operations are used to determine if the fault can be remedied without removing the component from the vehicle and also, when subsequent removal is necessary, to indicate when repair can be made without complete disassembly of the component.

Note. Thoroughly check for oil leakage of each component while mounted in the vehicle as all units operate under 1200 psi during normal operation. This pressure cannot be applied after removal.

c. Inspection after the component is removed from the vehicle, is performed to verify the diagnosis made when the component was in the vehicle, to uncover further defects, or to determine faults if the component alone is received by the Ordnance establishment. This inspection is particularly important in the last

case because it is often the only means of determining the trouble without completely disassembling the component.

298. Lift Cylinder

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 296 for the purpose of these inspections.

(2) Detailed procedures.

(a) Inspect for oil leakage. Visually inspect all gasket joints, oil seals, and fittings for evidence of oil leakage. Leakage at gasket joints may be caused by loose mounting bolts or defective gaskets. Tighten all mounting bolts where leakage has occurred. If mounting bolts are tight and leakage continues, install new gasket (par. 333). When possible, replace gaskets without removing unit from the vehicle.

(b) Inspect for damaged castings. Visually inspect the cylinder and head for damaged or cracked castings. Replace all damaged castings.

(3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not reveal causes of failure, and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Boom will not raise. Start the wrecker crane in operation and pull the boom control valve to UP position. Should the boom fail to raise, check oil level in reservoir and for oil leakage at connectors. If no leakage is evident, reservoir contains proper oil level, and pump is delivering proper

pressure (par. 294), replace lift cylinder (par. 316).

- (b) Scored or damaged piston rod. Place the boom in the extreme UP position and note any damaged or scored condition of the piston rod. If damage is evident, replace (par. 333).

- (c) Piston rod bushings worn. Replace bushings (par. 333).

- (3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

- (1) General. After the left cylinder has been removed from the wrecker crane or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.

- (2) Detailed procedures.

- (a) Piston rod bushings worn. Replace bushings (par. 333).

- (b) Piston rod scored. Replace (par. 333).

- (c) Cracked cylinder or casting. Replace defective component (par. 333).

- (d) Defective gaskets or packing. Disassemble and replace defective gaskets and packing (par. 333).

- (e) Evidence of internal damage. Rebuild the lift cylinder assembly (par. 333).

299. Swivel Valve

a. Troubleshooting Before Removal or Operation.

- (1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 296 for the purpose of these inspections.

- (2) Detailed procedures.

- (a) Inspect for oil leakage. Visually inspect for oil leakage (par. 297b).

- (b) Inspect for damaged castings. Visually inspect swivel valve body and inner hub for cracks or other damage. Note any defective threads at hydraulic line connections. If damage is evident, replace (par. 314).

- (3) Further procedures. If these inspections do not disclose the fault, and the wrecker is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

- (1) General. If the inspections in d above do not reveal causes of failure, and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 298a for the purpose and scope of those troubleshooting procedures.

- (2) Detailed procedures.

- (a) Inspect for oil leakage. With the wrecker crane in operation and the hydraulic system at operating pressures, inspect all hose connections and gasket joints. Tighten connections or replace damaged connections and gaskets as required (par. 334).

- (b) Defective castings. Replace swivel valve body and inner hub (par. 334).

- (3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation

- (1) General. After the swivel valve has been removed from the wrecker crane or if it has been received already removed, further inspections necessary. Refer to paragraph 297c for purposes and scope of these procedures.

- (2) Detailed procedures.

- (a) Inspect for oil leakage. With the swivel valve removed, leakage inspections are limited as the unit operates under 1200 psi in the system. Tighten hose connections and swivel valve cap.

- (b) Excessively worn or damaged inner hub. Replace swivel valve body and inner hub (par. 334).

- (c) Damaged swivel valve body. Replace swivel valve body and inner hub (par. 334).

300. Swing Motor

a. Troubleshooting Before Removal or Operation.

- (1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 296 for the purpose of these inspections.
- (2) Detailed procedures.
 - (a) Inspect for oil leakage. See paragraph 298a.
 - (b) Damaged or cracked components. Inspect for damaged or cracked swing motor body. For cracked bodies, damaged or scored piston rods, the swing motor must be rebuilt (par. 338).
- (3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

- (1) General. If the inspections in a above do not reveal causes of failure, and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.
- (2) Detailed procedures.
 - (a) Inspect for oil leakage. Start the wrecker crane and operate the swing motor. Inspect for leakage at piston rods and hydraulic line connections. If leakage is still evident after tightening, replace gaskets (par. 338).
 - (b) Damaged motor bodies and scored piston rods. Inspect piston rods for scored condition while swing motor is in operation. Note any irregularities of operation. Replace damaged components (par. 338).
 - (c) Sticking control valve spool. Revolve the pivot post of the wrecker crane and note if control valve actuating lever of the swing motor is in con-

stant contact with roller on base plate. If this lever does not contact roller at all times, remove spool (par. 338) and check for dirt or burs.

- (d) Irregularity of operation. Swing motor out of timing. Time swing motor (par. 351).

- (3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

- (1) General. After the swing motor has been removed from the wrecker crane or if it has been received already removed, further inspection is necessary. Refer to paragraph 297b for purpose and scope of these procedures.
- (2) Detailed procedures.
 - (a) Inspect for oil leakage. With the swing motor removed, oil leakage inspection is limited. See paragraph 298a.
 - (b) Defective castings and covers. Thoroughly inspect covers and bodies for cracks or damaged screw threads. Defective units must be replaced (par. 338).
 - (c) Scored piston rods. Replace piston rods (par. 338).
 - (d) Sticking control valve spool. Disassemble and check for dirt or burs (par. 338).

301. Control Valve Bank

a. Troubleshooting Before Removal or Operation.

- (1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 297a. for the purpose of these inspections.
- (2) Detailed procedures.
 - (a) Inspect for oil leakage. Visually inspect all hydraulic flexible line connections, gaskets, and castings for evidence of oil leakage.

(b) Control valve spool sticking Operate each control valve and note any sticking or irregularities in their operation. Generally a binding condition in any of the control valves maybe removed by backing off one turn the hex-head cap screw and hex nut which hold the control valve front cover to the control valve body. If binding condition still persists, remove the sticking spool and inspect for displaced chevron seals, dirt, burs, or scored condition. Damaged spool requires replacement of body and spool (para.)

(c) Control valve body. Inspect control valve **body** for cracks, defective threads, and sealing between bodies. Replace valve body and spool if either is found defective (par. 336).

(3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not reveal causes of failure, and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Inspect for oil leakage. If the visual inspections (par. 298a) do not reveal leakage, start the wrecker crane and operate each control lever of the control valve bank. Thorough inspection must be made at this time while the system is under full pressure. If any leaks are evident, after operating all four control valves, remove control valve spool from any defective unit and replace damaged seals or gaskets (par. 336).

(b) Defective valve bodies and spools. Inspect in same manner as (a) above and if found defective the control valve bank must be rebuilt (par. 336).

(9) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the control valve bank has been removed from the vehicle or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.

(2) Detailed procedures.

(a) Oil leakage. After thorough cleaning **of** the complete control valve bank, inspect all gasket joints and seals for damage or evidence of leakage. Replace any defective seals and gaskets (par. 336).

(b) Control valve bodies and spools. Check each spool for scored condition or burs at edges. Replace body and spools in pairs if damage is evident (par. 336). Inspect threads at hydraulic line connections and general condition of each component.

302. Hydraulic Oil Motor

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the wrecker crane prior to completing the procedures "given in this paragraph. Refer to paragraph 297a for purpose of these inspections.

(2) Detailed procedures.

(a) Inspect for oil leakage. Visually inspect the hydraulic oil motor for evidence of oil leakage around motor housing and flexible lines. Tighten any connections or mounting bolts feed leaking (par. 330).

(b) Inspect for defective castings. Visually inspect cover, cam ring, and body for defective castings or damaged threads. Defective components must be replaced (par. 330).

(3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

- (1) General. If the inspections in a above do not reveal causes of failure and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

- (a) Oil leakage. Operate the hydraulic oil motor under full load and watch for oil leakage at connectors, lines, and body gaskets. Defective gaskets must be replaced (par. 330).

- (b) Inspect cover, cam ring, and body. During operation, check for evidence of cracks in castings and leaks around fittings. Defective components must be replaced (par. 330).

- (c) Motor will not turn. This may be due to dirt, seized components, or other internal damage. Rebuild motor (par. 330).

- (3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

- (1) General. After the hydraulic oil motor has been removed from the wrecker crane or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.

(2) Detailed procedures.

- (a) Motor will not turn. Rebuild hydraulic oil motor (par. 330).

- (b) Damaged motor body, cover, or cam ring. Thoroughly clean the complete assembly and inspect screw threads at line connections. Replace any defective or damaged components (par. 330).

- (3) Drive shaft loose in pump. Loose drive shaft may be due to worn bearings. Install new bearings (par. 330). If any other irregularities are noted while turning the drive shaft, motor must be disassembled (par. 330) to locate the cause.

- (4) Inspection after disassembly of hydraulic motor. Check the condition of

the cam ring. The internal contour must be smooth. Any distortion or roughness on this surface will require replacement of the ring. Revolve bearings and if any indication of roughness is present, replace bearings. Pay particular attention to sealing edges of oil seal. Replace any damaged seals (par. 330).

303. Hydraulic Pump

a. Troubleshooting Before Removal or Operation.

- (1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 297a for purpose of these inspections.

- (2) Detailed procedures. Inspect the hydraulic pump in the same manner as described in paragraph 302, hydraulic oil motor.

- (3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

- (1) General. If the inspections in a above do not reveal causes of failure, and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

- (a) Inspect for oil leakage. See paragraph 302a.

- (b) Pump will not turn. Adjust pump control linkage (see TM 9-837).

- (c) Pump speed erratic. Shift linkage at governor 3-way valve out of adjustment. Adjust linkage (TM 9-837).

- (d) Noisy hydraulic pump (cavitation). Check oil level in reservoir and make certain oil supply valve is open.

- (3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

- (1) General. After the hydraulic pump has been removed from the wrecker crane or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.
- (2) **Detailed procedures. Troubleshoot the hydraulic pump in the same manner as prescribed for the hydraulic oil motor (par. 302).**

304. Hoist Drum and Worm and Drive Gear Set

a. Troubleshooting Before Removal or Operation.

- (1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 297a for the purpose of these inspections.
- (2) Detailed procedures.
 - (a) Inspect for lubricant leakage. Check the gear case for lubricant leakage at gasket joints. Tighten all mounting bolts and if leakage is still evident, install new gaskets (par. 331).
 - (b) **Inspect cable drum and mountings. Visually inspect drum mounting to shipper. Also check for any defects in the drum and whether cable properly follows cable grooves. Any defective components must be replaced or rebuilt (par. 331).**
- (3) Further procedures. If these inspections do not disclose the fault, and the vehicle is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

- (1) General. If the inspections in a above do not reveal cause of failure and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.
- (2) Detailed procedures.
 - (a) Hoist drum will not turn. Prepare the wrecker crane for operation and

operate the hoist control lever to UP or DOWN position. If the drum does not turn, check hydraulic system.

- (b) Hoist drum turns and cable slips. Remove cable from drum and tighten hoist cable wedge in drum.
- (c) Noise worm and gear. Gear noise is usually due to lack of lubricant. Check lubricant level. If the gear case has proper lubricant level and noise is still present, rebuild hoist drum and worm and drive gear set (par. 331).
- (3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

- (1) General. After the hoist drum and worm and drive gear set has been removed from the wrecker crane or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.
- (2) Detailed procedures.
 - (a) Inspect gear case and hoist drum. Thoroughly clean the gear case, drum housing and drum, and inspect for cracked or damaged castings. Cracked castings must be replaced (par. 331).
 - (b) Excessive wear at worm. Turn the worm and note any excessive clearance or faulty alignment between worm and drive gear. Adjust worm and drive gear set (par. 331).
 - (c) Loose or worn bearings. Install new bearings (par. 331).
 - (d) Lubricant leakage at hoist drum hub. Install new seal (par. 331).

305. Base Plate and Pivot Post Assembly

a. Troubleshooting Before Removal or Operation.

- (1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 297a for the purpose of these inspections.

- (2) Detailed procedures. Troubleshooting of the base plate and pivot post assembly before operation is limited to visual inspection of the components. Check for defective weld, cracked posts, or support plates. Check for proper lubrication of the ring gear. Repair broken welds if inspection warrants.
- (3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

- (1) General. If the inspections in a above do not reveal causes of failure and the wrecker crane is operable, start the wrecker crane and continue to troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.
- (2) Detailed procedures.
 - (a) Excessive end play in pivot post. With the wrecker crane in operation, swing the boom to the right and left. Excessive looseness in pivot post will require adjustment of pivot post bearings (par. 356).
 - (b) Shipper supports loose at pivot post. Tighten shipper support bolts (par. 312).
 - (c) Inspection of ring gear, pivot bearings, drive pinion, and idler gear. Any irregularities noticed during operation pertaining to the internal parts will require disassembly for further inspection (par. 335).
- (3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

- (1) General. After the base plate and pivot post assembly has been removed from the truck or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for the purpose and scope of these procedures.

- (2) Detailed procedures.

- (a) Bearings and cups. Inspect bearing cups for pitted, scratched, or scored condition. Replace any defective bearings and cups (par. 335).
- (b) Drive pinion, idler gear, and ring gear. Inspect drive pinion, idler gear, and ring gear for broken, cracked, or chipped teeth. Replace defective gears (par. 335).
- (c) Base plate and pivot post. Inspect base plate for defective welds or cracks. Minor defects can be repaired by welding. Also check pivot posts for cracks or other defects and replace as inspection warrants (par. 335).

306. Shipper and Boom Assembly

a. Troubleshooting Before Removal or Operation

- (1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 297a for the purpose of these inspections.
- (2) Detailed procedures.
 - (a) Oil leakage. Inspect the boom cylinder for oil leakage, paying particular attention to the hydraulic line connections.
 - (b) Boom. Check boom for cracked welds or bent condition. Defective welds can be repaired by welding. Replace boom if damage is excessive (par. 332).
 - (c) Rollers. Inspect the boom rollers for worn or damaged condition. Replace defective rollers (par. 332).
 - (d) Pivot shafts and pins. Inspect the pivot shafts and pins for excessive wear and replace if inspection warrants (par. 332).
- (3) Further procedures. If these inspections do not disclose the fault and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

- (1) **General.** If the inspections in a above do not reveal causes of failure and the wrecker crane is operable, start the wrecker crane and continue to troubleshoot it. Refer to paragraph 297*b* for the purpose and scope of these troubleshooting procedures.
- (2) **Detailed procedures.**
 - (a) **Boom will not extend or retract.** Operate the crowd control lever to EXTEND and RETRACT position. If boom does not respond, check oil level in the hydraulic system. Note any binding of the boom in the shipper. Bent boom or shipper must be replaced (par. 332).
 - (b) **Excessive looseness at boom rollers.** Inspect the boom rollers for free turning or defective bearings. Replace defective parts (par. 332).
 - (c) **Boom will not respond to control valve.** The shipper and boom must be disassembled (par. 332) and further inspection is necessary.
 - (3) **Further procedures.** If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

- (1) **General.** After the shipper and boom assembly has been removed from the wrecker crane, or if it has been received already removed, further inspection is necessary. Refer to paragraph 297*c* for purpose and scope of these procedures.
- (2) **Detailed procedures.**
 - (a) **Boom cylinder.** Inspect the boom cylinder and piston rod for nicks, scratches, or scoring. Check the cylinder head seals and gaskets for evidence of leakage. Inspect piston cups for worn condition, and the piston for looseness on end of piston rod. Also note any broken welds. Replace or repair damaged components (par. 332).
 - (b) **Boom rollers.** Inspect boom rollers for wear or damaged bearings. Pitted or worn bearings must be replaced (par. 332).

- (c) **Boom.** Turn the boom sheaves and note condition of needle bearings. Replace defective bearings and sheaves (par. 332). Broken welds on the boom may be repaired by welding.
- (d) **Shipper.** Inspect shipper pivot shaft bushings for wear or scoring. Replace damaged bushings. Examine rear bottom roller for excessive wear and replace damaged bearings or worn shaft (par. 332). Examine hoist drum and worm and drive gear mounting brackets on the rear for broken welds. Repair by welding.

307. Wrecker Body Outriggers, and Oil Reservoir

a. Troubleshooting Before Removal or Operation.

- (1) **General.** Do not operate the vehicle prior to completing the procedures given in this paragraph. Refer to paragraph 297*a* for the purpose of these inspections.
- (2) **Detailed procedures.**
 - (a) **Oil leakage.** Inspect the oil reservoir for leakage at welds. Minor cracks at welds can be repaired.
 - (b) **Wrecker body and outriggers.** Inspect the wrecker body and outriggers for damaged or bent condition. Minor damage may be repaired. Any extensive damage will require replacement of the damaged components.
 - (3) **Further procedures.** If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

- (1) **General.** If the inspections in the preceding paragraph do not reveal causes of failure and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297*b* for the purpose and scope of these troubleshooting procedures.
- (2) **Detailed procedures.** Visually inspect the wrecker body, outriggers, and oil reservoir during operation and note any distortion or damaged welds not revealed before operation. Repair or

replace damaged components as inspection warrants.

- (3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c. below.

c. Troubleshooting After Removal and Before Operation.

- (1) General. After the wrecker body, outriggers, and oil reservoir have been removed from the vehicle, or if they have been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.
- (2) Detailed procedures. After thoroughly cleaning the complete assemblies, further troubleshooting is limited to visual inspection of the components. Check closely for damage not revealed during procedures covered in a and b above. Repair minor broken welds and straighten bent sheet metal. Major damage to any component will require replacement of the component (par. 339).

308. Roar Mounted Winch

a. Troubleshooting Before Removal or Operation.

- (1) General. Do not operate the rear mounted winch prior to completing the procedure given in this paragraph. Refer to paragraph 297a for the purpose of these inspections.
- (2) Detailed procedures. Troubleshooting before removal or operation is limited to visual inspection of the complete assembly. Check the mounting bolts, alignment, and general condition of the winch assembly. Replace any damaged components.
- (3) Further procedures. If these inspections & not disclose the fault, and the rear mounted winch is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

- (1) General. If the inspections in a above do not reveal causes of failure and the rear mounted winch is operable, then

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troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.

- (2) Detailed procedures.

- (a) Winch drum will not turn. This condition can be caused by linkage out of adjustment or shear pin failure. Adjust linkage or replace shear pin as necessary. Refer to TM 9-2320-211. 20.
 - (b) Noisy operation. Check lubricant level (LO 9-2320-211-12).
 - (c) Excessive heat of brake case. Adjust automatic brake (par. 42).
 - (d) Winch fails to hold load. This condition is caused by the automatic brake lining becoming excessively worn or in need of adjustment. Adjust brake (par. 42) or replace brake band assembly.
 - (e) Broken drive chain. Replace broken link.
- (3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

- (1) General. After the rear-mounted winch has been removed from the vehicle or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.
- (2) Detailed procedures.
 - (a) Oil leakage at gear case. Replace gaskets.
 - (b) Drive worm will not turn. Disassemble and replace defective components (par. 337).
 - (c) Drum turns on drum shaft. Disassemble and replace drum.
 - (d) Miscellaneous inspections. Inspect the rear-mounted winch after it has been removed, paying particular attention to cracked or damaged castings. Make sure bearings are free in level wind rollers. Rebuild the assembly as inspection indicates (par. 337).

309. Wrecker Power Train

a. Troubleshooting Before Removal or Operation.

- (1) General. Do not operate the vehicle prior to completing the procedures given in this paragraph. Refer to paragraph 297a for the purpose of these inspections.
- (2) Detailed procedures.
 - (a) Power divider. Inspect the power divider for oil leakage. Visually inspect gasket joints and seals on power divider. Tighten all mounting bolts and if leakage continues, disassemble and replace gaskets or seals (par. 343).
 - (b) Drive sprockets bearing assembly. Visually inspect the bearing assembly for general overall condition. If evidence of excessively worn bearings is found, replace damaged components (par. 346).
 - (c) Pillow block. Visually inspect the pillow block for cracked castings and general overall condition. Repair or replace defective parts.
 - (i) Drive shafts. Check the universal joints on the drive shafts. Repair or replace defective drive shafts.
- (3) Further procedures. If these inspections do not disclose the fault, and the vehicle is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

- (1) General. If the inspections in a. above do not disclose causes of failure, and the vehicle is operable, then troubleshoot it. Refer to paragraph 297b for the propose and scope of these troubleshooting procedures.
- (2) Detailed procedures.
 - (a) Drive line will not turn. Shift linkage out of adjustment. Must linkage.
 - (b) Adjust speed erratic. Adjust governor at power divider.
 - (c) Noisy drive line. Check lubricant level in power divider. (See lubrication chart.) Also inspect universal

joint journal bearings for looseness or worn condition. Replace as inspection indicates.

- (d) Lubricant leakage. After operation inspect gasket joints and seals for leakage. Replace leaking seals and gaskets (par. 343).
- (e) High temperature in pillow block or drive sprocket bearing assembly. High temperature is usually an indication of lack of lubricant. (See lubrication chart.)
- (3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

- (1) General. After the power divider, drive sprocket bearing assembly, drive shafts, and pillow block have been removed from the vehicle, or if they have been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.
- (2) Power divider.
 - (a) Lubricant leakage. Inspect gasket joints and seals for darnage and lubricant leakage and replace ae required (par. 343).
 - (b) Internal defects. Shift the power divider into the various ranges and turn by hand. Note any roughness, such as scored shafts, loose bearings, burred or chipped gear teeth. Any defects noted on internal parts during inspection will require disassembly and rebuild of the power divider (par. 343).
- (9) Drive shafts. Inspect drive shafts for bent condition. Also note universal joints bearing journals for excessive wear. Replace damaged components.
- (4) Pillow block. Inspect bearing in pillow block for free rotation. If bearing binds, replace (par. 342). Also inspect for cracked castings or broken condition. If defects are noted, replace (par. 342).

(5) Drive sprocket bearing assembly.

(a) Housing. Inspect housing for cracks or breaks. Replace if any are detected (par. 346).

(b) Shaft. Inspect shaft for cracks or damaged splines. Replace if inspection warrants (par. 346).

(c) Bearings. Rotate shaft and check for scored or seized condition of bearings. Defective bearings must be replaced (par. 346).

(d) Oil seals. Inspect oil seal contact material to see that it is pliable and shows no evidence of burning. Replace defective seals (par. 346).

Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

310. General

a. This section contains information for the guidance of personnel performing major repair work on the 5-ton, 6 x 6, wrecker truck, M62. It provides an assembly line procedure for the disassembly of the hydraulic crane into its major components. It designates what constitutes a major component and also identifies the points of connection between major components.

b. Before cleaning or washing, inspect the entire wrecker crane and rear winch for cracks, leaks, and loose or shifted parts or assemblies, as these will be more evident if surfaces are soiled or dusty. Take note of any defects for later use in repair operations.

311. Hydraulic Pump and Relief Valve

a. Removal (Fig. 419).

- (1) Remove power divider assembly (par. 327).
- (2) Remove six cap screws and lockwashers securing hydraulic pump and relief valve assembly to pump adapter at rear of power divider.
- (3) Remove pump to relief valve hydraulic piping, with hydraulic pump assembly attached, from relief valve.
- (4) Remove relief-valve-to-reservoir hydraulic piping from relief valve.
- (5) Remove reservoir-to-pump hydraulic piping from pump.
- (6) Remove pump-to-relief-valve hydraulic piping from pump.

b. Installation (Fig. 419).

- (1) Install pump-to-relief -valve hydraulic piping in pump outlet port.
- (2) Install reservoir-to-pump hydraulic piping in pump inlet port.
- (3) Install relief -valve-to-reservoir hydraulic piping in relief valve output port.
- (4) Install relief valve, with relief-valve-to-reservoir hydraulic piping attached on pump -to - relief-valve hydraulic piping.
- (5) Position new gasket on pump flange, align key on pump shaft with keyway in hydraulic pump output shaft coupling, and position pump on adapter at rear of power divider. Install six cap screws with lockwashers in holes



Figure 419. Removing hydraulic pump and relief valve assembly from power divider (M62)

in adapter and pump flanges, and tighten screws.

- (6) Install power divider assembly (par. 327)

312. Base Plate and Pivot Post Assembly

a. Removal.

- (1) Remove boom and shipper assembly (par. 315).
- (2) Remove boom lift cylinder (par. 316).
- (3) Remove swing motor (par. 313).
- (4) Remove eight cap screws (fig. 414) and lockwashers securing floor plate to crane body. Remove two cap screws (fig. 420) and safety nuts securing floor plate to support bracket. Remove two cap screws (fig. 414) and safety nuts securing mounting bracket to crane body.
- (5) Remove cotter pin and yoke pin securing rear-winch rear control rod (fig. 415) to lower end of rear winch shift lever (fig. 418) and remove rod from lever.
- (6) Remove cotter pin and yoke pin securing hydraulic-pump rear control rod (fig. 415) to lower end of hydraulic pump control lever (fig. 418), and remove rod from lever.
- (7) Remove cotter pin and yoke pin securing rear-winch rear control rod

(fig. 415) to rear-winch left relay lever (fig. 416), and remove rod from lever.

- (8) Remove cotter pin and yoke pin securing hydraulic-pump rear control rod (fig. 415) to hydraulic-pump left relay lever (fig. 416), and remove rod from lever.
- (9) Raise floor plate (fig. 418) to permit access to base plate rear U-bolts, and prop plate in raised position
- (10) Remove 12 safety nuts (fig. 399) from six U-bolts and remove two cap screws and lockwashers securing base plate to crane body.
- (11) Disconnect rear-winch front propeller shaft (fig. 416) from rear-winch rear propeller shaft (fig. 415). Refer to paragraph 327.
- (12) Disconnect rear propeller shaft from bearing assembly (fig. 418). Refer to paragraph
- (13) Disconnect swivel - valve - to- relief - valve line (fig. 409) from relief valve outlet, and disconnect swivel-valve-to-reservoir-inlet-tee line from pipe tee at relief valve.
- (14) Disconnect swivel-valve-to-reservoir line (fig. 409) from reservoir inlet coupling (fig. 416), remove clamp securing line to top of relief valve, and remove line from valve.
- (15) Disconnect floodlight cable (fig. 409) from wiring harness.
- (16) Remove hex-nut from cap screw (fig. 421) securing base plate to hydraulic lines support bracket (fig. 409).
- (17) Place a chain under the operator's compartment and between the shipper support (fig. 421), and using overhead hoisting equipment, remove base plate and pivot post assembly from crane body.
- (18) Remove slip yoke from splined end of rear-winch rear propeller shaft (fig. 415), and remove shaft from pillow block and cross members welded to underside of base plate.
- (19) Remove rear-winch rear control rod and hydraulic-pump rear control rod

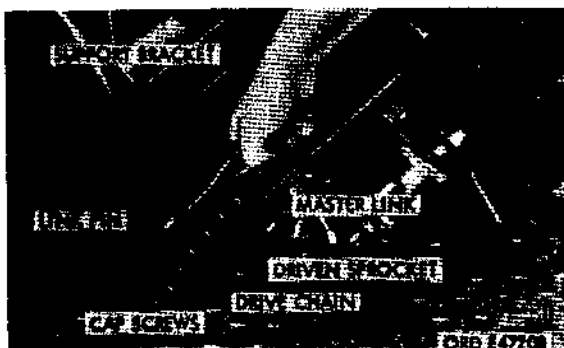


Figure 420. Separating rear winch drive chain (M62)

from cross members welded to underside of base plate (fig. 415).

b. Installation.

- (1) Insert rear-winch rear control rod (fig. 415) and hydraulic-pump rear control rod through holes in right end of cross members, and position rods on underside of base plate.
- (2) Insert rear-winch rear propeller shaft (fig. 415) through holes in left end of cross members, and position shaft on underside of base plate with splined end of shaft extending through pillow block.
- (3) Using overhead hoisting equipment, lift base plate and pivot post assembly into position on crane body and guide base plate mounting U-bolts (fig. 399) through holes in base plate.
- (4) Install 12 safety nuts (fig. 399) on the six U-bolts, and install four cap screws with lockwashers in holes in baseplate and crane body. Tighten nuts and screws.
- (5) Place hydraulic lines over support bracket (fig. 409), and secure bracket to base plate with cap screw (fig. 421) and hex-nut.

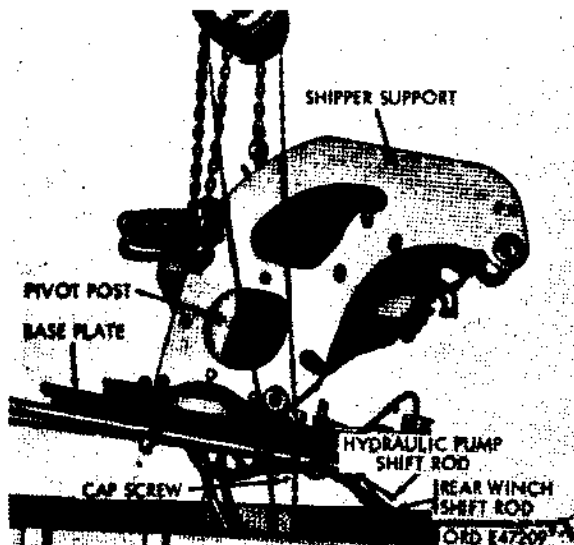


Figure 421. Removing base plate and pivot post assembly from crane body (M62)

- (6) Connect floodlight cable (fig. 409) to wiring harness.
- (7) Connect swivel - valve - to - reservoir line (fig. 409) to reservoir inlet coupling (fig. 416), position line at top of relief valve (fig. 409) and secure with clamp.
- (8) Connect swivel-valve-to-relief-valve line (fig. 409) to relief valve outlet, and connect swivel-valve-to-reservoir-inlet-tee line to pipe tee at relief valve.
- (9) Connect rear-winch rear propeller shaft (fig. 418) to yoke at bearing assembly.
- (10) Slide slip yoke on splined end of rear propeller shaft (fig. 415) and connect yoke to rear-winch front propeller shaft (fig. 416). Refer to paragraph 327.
- (11) Remove prop supporting floor plate (fig. 418) in raised position, and position floor plate on crane body. Secure with eight cap screws (fig. 414) and lockwashers.
- (12) Secure floor plate to support bracket (fig. 420) with two cap screws and safety nuts, and secure mounting bracket (fig. 414) to crane body with two cap screws and safety nuts.
- (13) Position hydraulic-pump rear control rod (fig. 415) on hydraulic-pump left relay lever (fig. 416), and secure with yoke pin and cotter pin.
- (14) Position hydraulic-pump rear control rod on lower end of hydraulic pump control lever (fig. 418), and secure with yoke pin and cotter pin.
- (15) Position rear-winch rear control rod (fig. 415) on rear-winch left relay lever (fig. 416), and secure with yoke pin and cotter pin.
- (16) Position rear-winch rear control rod on lower end of rear winch shift lever (fig. 418), and secure with yoke pin and cotter pin.
- (17) Install swing motor (par. 313).
- (18) Install boom lift cylinder (par. 316).

- (19) Install boom and shipper assembly para. 315).
- (20) Lubricate hydraulic crane and rear winch drive (LO 9-2320-211-12).

313. Swing Motor

a. Removal.

- (1) Rotate pivot post and boom assembly 900 to the left so that boom is extended over right side of truck
- (2) Remove eight cap screws (fig. 422) and lockwashers securing swing motor cover to crane body, and lift cover from body.
- (3) Cut locking wire, remove two cap screws securing piston rod retaining plate (fig. 423) to drive pinion crank, and remove plate from crank.
- (4) Unscrew four nuts (fig. 423) securing hydraulic lines to elbows installed in swing - hydraulic - motor cylinder assemblies, and remove lines from elbows.

Note. Place identification tags on lines and elbows to facilitate swing motor installations

- (5) Loosen two locknuts (fig. 423) and set-screws securing pivot pins in mounting brackets welded to base plate, and



Figure 422. View of lower section of crane revolving structure

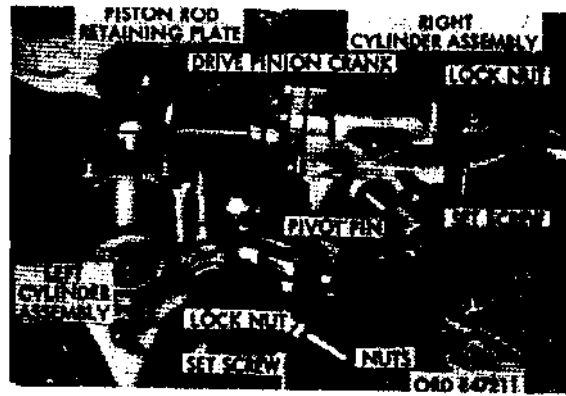


Figure 423. Ramming piston retaining plate from drive pinion crank (M62)

drive pins from cylinder bodies and brackets, and remove from underside of base plate,

- (6) Pivot each of the cylinder assemblies on the drive pinion crank to free cylinder bodies from the mounting brackets. Lift the two cylinder assemblies together from the drive pinion crank. Pull the piston rods apart to separate the cylinder assemblies.

b. Installation.

- (1) Position right cylinder piston rod over left cylinder piston rod, and install piston rods on drive pinion crank (fig. 423).
- (2) Position piston rod retaining plate (fig. 423) on crank, secure with two cap screws, and install new locking wire.
- (3) Pivot both cylinder assemblies on the drive pinion crank, and align pivot pin bores in cylinder bodies with holes in mounting brackets. Install pivot pins (fig. 423) in holes in cylinder bodies and mounting brackets, and secure with setscrews. Tighten the two set-screw locknuts.
- (4) Position four hydraulic lines at elbows installed in left and right cylinder assemblies, and tighten connector nuts (fig. 423).
- (5) Time swing motor (refer to par. 351).

- (6) Position swing motor cover (fig. 422) on crane body, and secure with eight cap screws and lockwashers.

314. Swivel Valve

a. Removal.

- (1) Disconnect floodlight cable (fig. 401) from connector at rear of floodlight.
- (2) Disconnect oil motor bypass line (fig. 424) at hoist oil motor. Loosen cap screw (fig. 401) securing hose clip to bracket, and remove oil motor bypass line from clip and bracket.
- (3) Using overhead hoisting equipment, raise the shipper and boom assembly to the extreme upward position.

Note. When raising boom, hold boom control lever in "UP" position to permit the oil in the lift cylinder to bypass.

- (4) Disconnect four flexible hydraulic lines (fig. 401) and one return line (fig. 407) at control valve bank assembly.

Note. Place identification tags on hydraulic lines and control valve bank elbows to facilitate swivel valve installation.

- (5) Loosen two hex-nuts (fig. 402), and slide swivel-valve-hub locking plates out of groove in swivel valve.

Note. One locking plate is installed at front and rear of swivel valve assembly.

- (6) Disconnect floodlight cable (fig. 409) from wiring harness.
- (7) Disconnect two swivel-valve-to-junction-block lines (fig. 409) at junction block
- (8) Disconnect swivel-valve-to-relief-valve lines (fig. 409) and swivel-valve-to-reservoir-inlet-tee line at relief valve.
- (9) Disconnect swivel-valve-to-reservoir line (fig. 409) from reservoir inlet coupling (fig. 416), remove clamp securing to top of relief valve (fig. 409), and remove line from valve.

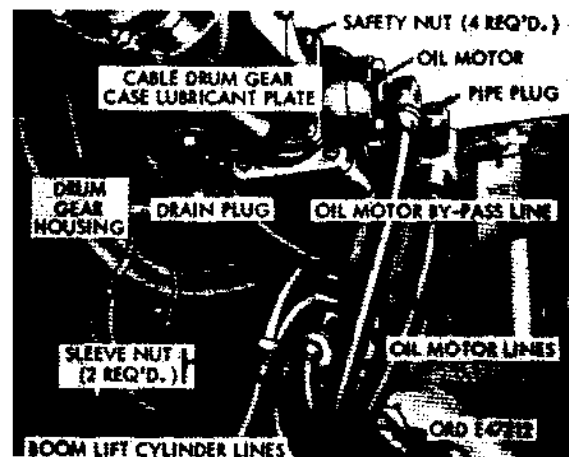


Figure 424. Disconnecting boom hoist hydraulic oil motor lines

- (10) Using overhead hoisting equipment, lift swivel valve assembly (fig. 402), together with hydraulic lines, from pivot post, and remove from vehicle.

b. Installation.

- (1) Using overhead hoisting equipment, support swivel valve assembly (fig. 402) over pivot post and feed floodlight cable and hydraulic lines attached to bottom of swivel valve through center of pivot post.
- (2) Lower swivel valve assembly into position on top of pivot post support cap (fig. 402), and engage the two locking plates in groove in swivel valve. Tighten locking plate retaining nuts.
- (3) Connect four flexible hydraulic lines (fig. 401) and one return line (fig. 407) at control valve bank assembly.
- (4) Position oil motor bypass line (fig. 401) on bracket on left side panel in operator's compartment, and secure with clip. Tighten clip retaining cap screw.
- (5) Connect oil motor bypass line (fig. 424) to hoist oil motor.
- (6) Connect floodlight cable (fig. 401) to connector at rear of floodlight.
- (7) Connect swivel - valve - to - reservoir line (fig. 409) to reservoir inlet coupling.

- (8) Connect swivel - valve-to-relief-valve line (fig. 409) to relief-valve outlet and connect swivel-valve-to-reservoir-inlet-tee line, to pipe tee at relief valve.
- (9) Connect two swivel-valve-to-junction-block lines (fig. 409) at junction block.
- (10) Connect floodlight cable (fig. 409) to wiring harness.
- (11) Remove overhead hoisting equipment from boom and shipper assembly, and lower boom.

315. Boom and Shipper Assembly

a. Removal

- (1) Secure boom to shipper with a chain (fig. 425) to prevent boom from rolling out of shipper during removal of assembly.
- (2) Remove boom hoist hydraulic oil motor and cable drum (par. 318).
- (3) Using overhead hoisting equipment, raise the shipper and boom assembly to expose the lift cylinder pivot shaft (fig. 426).

Note. When raising boom, hold boom control lever in "UP" position to permit the oil in the lift cylinder to bypass.

- (4) Loosen locknut (fig. 426) and setscrew and drive cut lift cylinder pivot shaft.

- (5) Lower boom and shipper assembly to the horizontal position, and remove overhead hoisting equipment.

Note. When lowering boom, hold boom control lever in "DOWN" position to permit the oil in the lift cylinder to bypass.

- (6) Attach a chain sling to boom and shipper assembly (fig. 425), and using overhead hoisting equipment, raise hoist chain or cable just enough to support weight of boom and shipper assembly.
- (7) Position a container to catch oil drainage from boom crowd cylinder, and disconnect two boom crowd cylinder hydraulic lines (fig. 405) at sleeve nuts. Insert corks or plugs in lines to prevent oil leakage.
- (8) Remove safety nut (fig. 405) and hex-head bolt securing shipper pivot pin to shipper support, and drive pin from shipper support and from shipper.
- (9) Lift boom and shipper assembly from shipper support (fig. 425), and remove from vehicle.

b. Installation.

- (1) Using overhead hoisting equipment and chain sling (fig. 425), lift boom and shipper assembly into position between sides of shipper support.
- (2) Aline pivot pin holes in shipper with holes in shipper support, and insert



Figure 425. Removing boom and shipper assembly (M62)



Figure 426. Removing lift cylinder pivot shaft (M62)

shipper pivot pin (fig. 405) in holes. Aline hole through right end of pin with holes in shipper support, insert hex-head bolt (fig. 405) through holes, and install safety nut on bolt.

Note. A nut is welded to left end of pivot pin to facilitate alining holes for hex-head bolt.

- (3) Remove overhead hoisting equipment and chain sling from boom and shipper assembly, attach hoist to front end of boom and raise boom to expose lift cylinder pivot shaft holes,
 - (4) Aline pivot shaft bore in upper end of lift cylinder piston rod (fig. 426) with pivot shaft holes in shipper, and install lift cylinder pivot shaft (fig. 426). Tighten locknut and setscrew on underside of shipper.
 - (5) Remove plugs from the two boom crowd cylinder hydraulic lines (fig. 405), and connect lines at sleeve nuts.
 - (6) Lower boom and shipper assembly to the horizontal position, and remove hoist.
- Note.** When lowering boom, hold boom control lever in "DOWN" position to permit the oil in the lift cylinder to bypass.
- (7) Remove chain securing boom to shipper.
 - (8) Install boom hoist hydraulic oil motor and cable drum (par. 318).
 - (9) Lubricate hydraulic crane. (Refer to LO 9-2320-211-12.)

316. Boom Lift Cylinder

a. Removal.

- (1) Disconnect two boom lift cylinder lines (fig. 424) at sleeve nuts directly below boom hoist hydraulic oil motor.
- (2) Using overhead hoisting equipment, raise the boom and shipper assembly to the extreme upward position.
- (3) Loosen locknut (fig. 426) and setscrew, and drive out lift cylinder pivot shaft.

- (4) Remove the two lift cylinder lines, with nipples (fig. 400) and elbows attached, from lift cylinder ports.
- (5) Remove cotter pin (fig. 400), and drive lift cylinder pivot shaft from shipper and lower end of cylinder.
- (6) Using a chain hoist (fig. 427), lift the boom lift cylinder from shipper support, and remove from vehicle.

b. Installation.

- (1) Using a chain hoist (fig. 427), lift the boom lift cylinder into position between the sides of the shipper support.
 - (2) Aline pivot shaft bore in lower end of cylinder (fig. 400) with holes in sides of shipper support, and install lift cylinder pivot shaft. Install cotter pin in end of shaft.
 - (3) Install lift cylinder lines, with nipples (fig. 400) and elbows, in lift cylinder ports.
- Caution: The check valve installed in line connected to lower cylinder port restricts dropping speed of the load. Be sure that tie lines are installed as shown in figure 400.
- (4) Aline pivot shaft bore in upper end of lift cylinder piston rod (fig. 426) with



Figure 427. Removing boom lift cylinder

pivot shaft holes in shipper, and install lift cylinder pivot shaft. Tighten locknut and setscrew on underside of shipper.

- (5) Lower boom and shipper assembly to the horizontal position, and remove overhead hoisting equipment.
- (6) Connect the two boom lift cylinder lines (fig. 424) at sleeve nuts directly below boom hoist hydraulic oil motor.
- (7) Lubricate upper lift cylinder pivot shaft. (Refer to LO 9-2920-211-12.)

317. Boom Crowd Cylinder

a. Removal.

- (1) Remove boom and shipper assembly (par. 315), and place on suitable supports.
- (2) Remove overhead hoisting equipment, chain, sling (fig. 425), and boom-to-shipper chain.
- (3) Remove 45° elbow (fig. 406) with hydraulic line attached from piston rod.
- (4) Bend lip on locking plate. (fig. 406) away from outer nut, and remove outer nut, locking plate, and inner nut (located between locking plate and cylinder anchor) from piston rod.
- (5) Pull boom (fig. 428) from shipper only far enough to attach a chain sling, attach sling, and support with overhead hoisting equipment.



Figure 428. Removing boom from shipper

Caution: When pulling boom from shipper to attach sling, support front (sheave) end of boom to prevent tilting which could cause serious injury to personnel.

- (6) Pull boom from shipper, place boom on suitable supports, and remove hoist and chain sling.
- (7) Remove cotter pins (fig. 429) and crowd - cylinder - collar-to-boom, and pull cylinder from bmm far enough to permit attaching a chain sling.
- (8) Attach chain sling (fig. 429) and overhead hoisting equipment to crowd cylinder, and remove cylinder from boom.
- (9) Remove 90° elbow (fig. 429) with hydraulic line attached from crowd cylinder.

b. Installation.

- (1) Install 90° elbow (fig. 429) with hydraulic line attached in port on top of crowd-cylinder head.
- Note.** Elbow and line cannot be installed after cylinder is anchored in boom.
- (2) Supporting crowd cylinder with chain sling (fig. 429) and overhead hoisting equipment, slide cylinder into position inside boom. Remove hoist and chain sling.
 - (3) Aline holes in crowd-cylinder collar (fig. 429) with holes in sides of boom

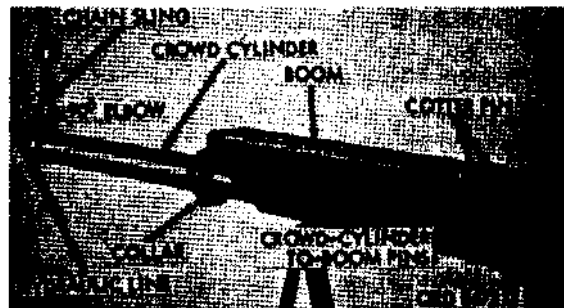


Figure 429. Removing boom crowd cylinder from boom

and install the two crowd-cylinder-to-boom pins. Secure pins with two cotter pins.

- (4) Attach chain sling (fig. 418) to boom and support boom with overhead hoisting equipment. Insert end of boom in shipper, and slide boom inside shipper as far as it will go, guiding piston rod through hole in anchor (fig. 406) at rear of shipper,
- (5) Install inner nut on piston rod (fig. 406) and tighten. Install locking plate and outer nut on piston rod. Tighten outer nut, and bend lip on locking plate against nut.
- (6) Install 45° elbow (fig. 406) with hydraulic line attached in end of piston rod.
- (7) Secure boom (fig. 425) to shipper with a chain to prevent boom from rolling out of shipper during installation of assembly, end attach a chain sling to shipper. Attach overhead hoisting equipment to sling, and support boom and shipper assembly.
- (8) Install boom and shipper assembly (par. 315).

318. Boom Hoist Hydraulic Oil Motor and Cable Drum

a. Removal.

- (1) Remove hoist cable from drum (c below).
- (2) Attach a chain sling (fig. 430) to oil motor and cable drum assembly, attach overhead hoisting equipment to sling, and just support weight of assembly with hoist.
- (3) Disconnect two oil motor lines (fig. 424) at sleeve nuts, and disconnect oil motor bypass line at oil motor.

Note. Place identification tags on oil lines to facilitate oil motor and cable drum installation.

- (4) Remove three cap screws (fig. 430) and lockwashers securing right end of cable drums to shipper.

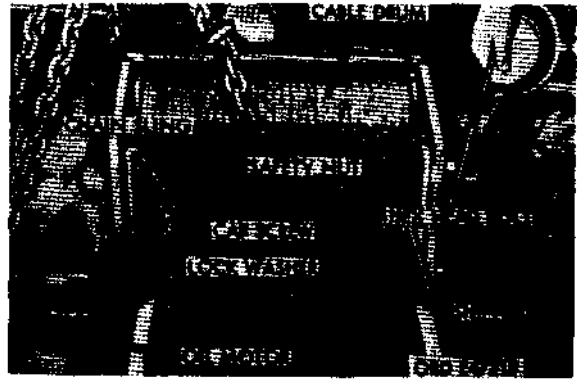


Figure 430. Removing boom hoist hydraulic oil motor and cable drum

- (5) Remove three safety nuts (fig. 420) and hex-head bolts securing left end of cable drum to shipper, lift oil motor and drum assembly from shipper, and remove from vehicle.

b. Installation.

- (1) Using overhead hoisting equipment, lift boom hoist hydraulic oil motor and cable drum (fig. 430) into position at rear of shipper.
- (2) Aline mounting holes in left end of cable drum with holes in shipper (fig. 430), and insert three hex-head bolts through holes. Install three safety nuts on bolts and tighten.
- (3) Install three cap screws (fig. 430) with lockwashers in holes in shipper and right end of cable drum, and tighten screws.
- (4) Remove overhead hoisting equipment end chain sling from oil motor and cable drum.
- (5) Connect two oil motor lines (fig. 424) at sleeve nuts, and connect oil motor bypass line to oil motor.

c. Hoist Cable Removal.

- (1) Unwind hoist cable from drum. Refer to TM 9-2320-211-10.
- (2) Drive cable wedge from drum, and remove cable from boom and boom sheaves.

d. Hoist Cable Installation.

- (1) Thread hoist cable around boom sheaves, position on top of boom and shipper assembly, end insert end of cable in hole in drum. Secure cable to drum with cable wedge.
- (2) Wind hoist cable on drum. Refer to TM 9-2920-211-10.

319. Control Valve Bank

a. Removal.

- (1) Remove four cap screws and lock-washers securing control valve bank cover to operator's cab, and remove cover from cab.
- (2) Disconnect all hydraulic lines from control valve bank (fig. 407) at sleeve nuts.

Note. Place identification tags on all hydraulic lines and connections to facilitate control valve bank installation

- (3) Remove four cap screws (fig. 407) and safety nuts securing control valve bank to cab, and lift bank from cab.

Note. The control valve bank is mounted in the cab on two mounting straps.

b. Installation.

- (1) Position control valve bank (fig. 407) on mounting straps in crane operator's cab, end secure with four cap screws and safety nuts.
- (2) Connect all hydraulic lines at sleeve nuts (fig. 407). Refer to paragraph 320.
- (3) Position control valve bank cover in cab over control valve bank and secure with four cap screws and lock-washers.

320. Hydraulic Lines and Fittings

a. Removal. Unscrew sleeve nut at both ends of flexible line or tube, remove clamps or brackets securing line or tube to crane, where used, and remove line or tube from vehicle.

Caution: Before disconnecting any hydraulic line, place identification tag on line and its corresponding port to prevent incorrect installation of hydraulic lines and crane components.

b. Installation. Position flexible line or tube on crane, secure with clamps or brackets where provided, and connect both ends of line or tube as given in (1) or (2) below.

- (1) Using wrench, tighten all flexible-line sleeve nuts.
- (2) Pull tube-fitting sleeve nuts up fingertight, then give nut a one-eighth turn only with a wrench.

Note. When installing new tubes and fittings, never tighten over two turns after sleeve has shuddered in body of fitting. Otherwise, the sleeve and tubing will be distorted, which will prevent a leak-proof seal.

321. Hydraulic Reservoir and Equipment Box

a. Removal.

- (1) Remove power divider assembly (par. 327).
- (2) Disconnect swivel-valve-to-reservoir line (fig. 409) from reservoir inlet coupling (fig. 416).
- (3) Remove four safety nuts (fig. 431), two on each side, securing hydraulic reservoir and equipment box to mounting brackets attached to left and right frame side rails.

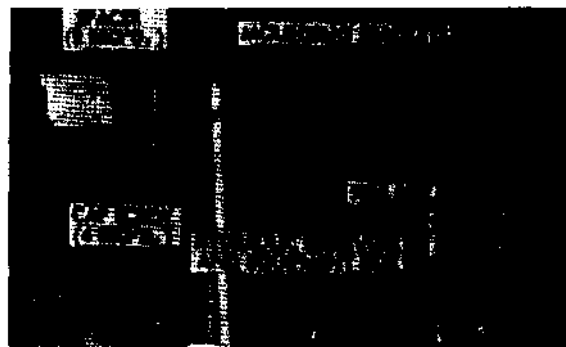


Figure 431. Hydraulic reservoir and equipment box mounting at tight side rail

- (4) Attach a chain sling (fig. 432) and overhead hoisting equipment to reservoir, and lift reservoir from mounting brackets and remove from vehicle.

Note. Be careful not to lose spacers (fig. 432).

- (5) Remove four cap screws (fig. 432), two at each end, from reservoir.

b. Installation.

- (1) Insert four cap screws (fig. 432), two at each end, in holes in reservoir and equipment box.
- (2) Make sure that spacers (fig. 432) are in position on mounting brackets and, using chain sling and -hoist, position hydraulic reservoir and equipment box on brackets.
- (3) Install four safety nuts (fig. 431), two at each side, on cap screws. Tighten nuts.
- (4) Connect swivel - valve - to - reservoir line (fig. 409) to reservoir inlet coupling (fig. 416).
- (5) Install power divider assembly (par. 327).

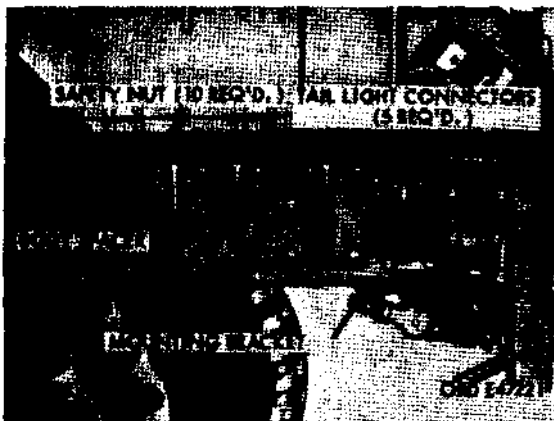


Figure 433. Crane body mounting at rear of left frame side rail (M62)

322. Crane Body

a. Removal.

- (1) Remove base plate and pivot post assembly (par. 312).
- (2) Remove six safety nuts (fig. 416) and cap screws, securing hydraulic pump and rear winch relay levers and bracket to crane body, and remove levers and bracket from body,
- (3) Loosen hose clamp securing reservoir inlet hose (fig. 416) to inlet pipe at rear of reservoir, and remove hose from pipe. Turn elbow 45° to allow clearance for removal of crane body.
- (4) Remove four safety nuts (fig. 416) from two U-bolts securing rear of crane body to left and right frame side rails.
- (5) Remove ten safety nuts (fig. 433), five from each side, securing front of crane body to mounting brackets bolted to rear of left and right frame side rails.
- (6) Disconnect five bayonet-type taillight cable connectors (fig. 433), three at left rear corner of vehicle and two at right rear corner. Remove two clamps securing taillight cables to each side of crane body, and pull cables and connectors through body.
- (7) Attach a chain sling (fig. 434) and overhead hoisting equipment to crane body, and lift body from vehicle.

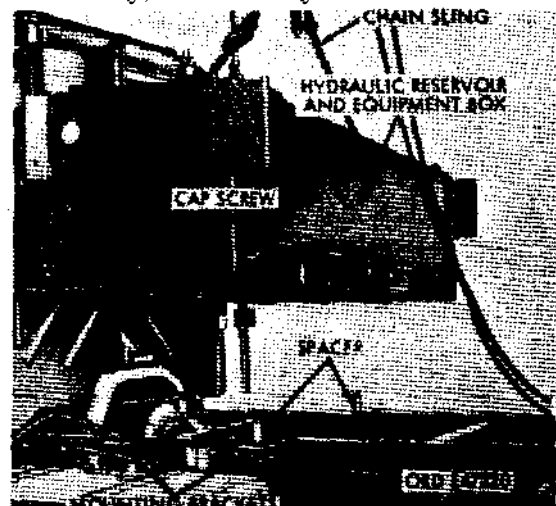


Figure 432. Removing hydraulic reservoir and equipment box (M62)

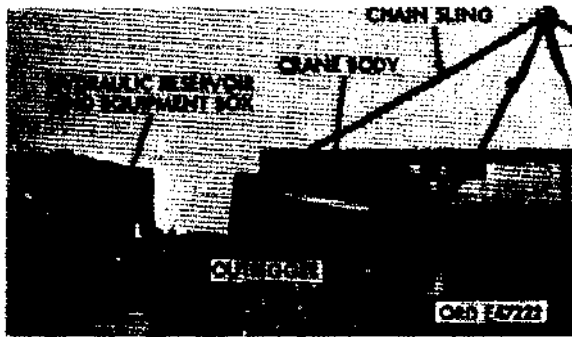


Figure 434. Removing crane body

b. Installation

- (1) Using chain sling (fig. 434) and hoist, lift crane body into position on truck chassis.

Not.. Before lowering body, make sure that body spacers (fig. 433) are in position on frame side rails, and aline U-bolts (fig. 416) with holes in body.

- (2) Install ten safety nuts (fig. 433), five on each side, on hex-head bolts extending through body and brackets bolted to left and right frame side rails.
- (3) Pull taillight cables through crane body, and secure with two clamps to each side of body. Connect five bayonet-type taillight cable connectors (fig. 433), three at left rear corner of vehicle and two at right rear corner.
- (4) Install four safety nuts (fig. 416) on the two U-bolts at rear of crane body, and tighten nuts 100 to 150 pound-feet torque.
- (5) Position hydraulic pump and rear winch relay levers (fig. 416) and bracket on rear of crane body, and secure with six safety nuts and cap screws.
- (6) Turn elbow (fig. 416) 45° to aline reservoir inlet hose with inlet sleeve on front of reservoir, install hose on sleeve, and tighten hose clamp.
- (7) Install base plate and pivot post assembly (par. 312).

323. Floodlights, Cables, and Switches

a. Floodlights.

(1) Lamp unit replacement (fig. 435).

- (a) Remove three screws securing door to floodlight body, and pull door and lamp unit assembly from body.
- (b) Loosen two terminal screws on back of lamp unit, remove two cables from terminals, and remove door and lamp unit assembly from floodlight
- (c) Remove four springs securing lamp unit to door, and remove lamp unit from door. Discard lamp unit.
- (d) Insert new lamp unit in door, and secure with four retaining springs.
- (e) Position door and lamp unit assembly in front of floodlight body, and insert cable terminals under lamp unit terminal-screw heads. Tighten terminal screws.
- (f) Insert lamp unit in floodlight body, aline door-mounting screw holes, and

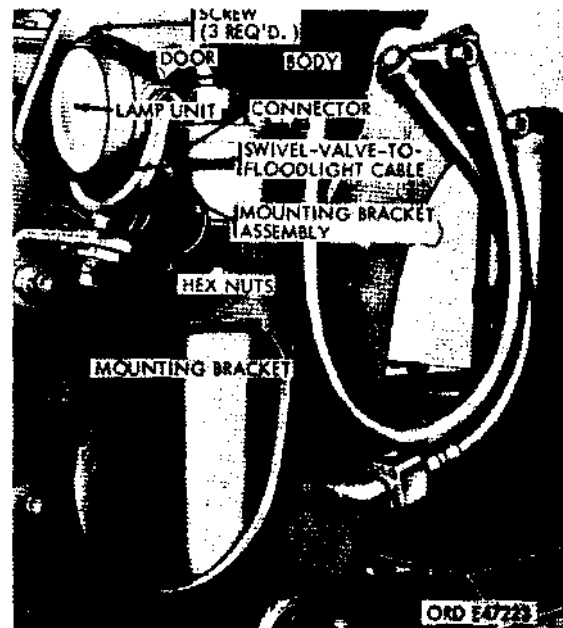


Figure 435. Floodlight mounted on left side of shipper support (M62)

cure door to body with three screws,

(2) *Floodlight switch removal.*

- (a) Remove floodlight lamp unit ((1) (a) and (b) above).
- (b) Disconnect two bayonet-type connectors (fig. 435) securing floodlight cables to rear of floodlight.
- (c) Remove two screws securing contact bracket and switch assembly to inside of floodlight body (fig. 435). Remove bracket and switch assembly (with cables) from body.
- (d) Pull switch cable plug-type terminal from contact bracket socket.
- (e) Disconnect switch cable bayonet-type connector from lamp unit cable connector.
- (f) Remove two screws and lockwashers securing switch assembly to contact bracket, and remove switch assembly from bracket.

(3) *Floodlight switch installation,*

- (a) Position floodlight switch assembly on contact bracket, and secure with two screws and lockwashers.
- (b) Insert switch cable plug-type terminal in contact bracket socket.
- (c) Connect switch cable bayonet-type connector to lamp unit cable connector.
- (d) Position contact bracket and switch assembly in floodlight body (fig. 435), and secure bracket to body with two screws.
- (e) Connect two floodlight cable bayonet-type connectors (fig. 435) to connectors at rear of flood light.
- (f) Install floodlight lamp unit ((1) (e) and (f) above).

(4) *Floodlight removal* (floodlight mounted at shipper support, illustrated) (fig. 435).

- (a) Disconnect two bayonet-type connectors securing floodlight cables to rear of floodlight.

- (b) Remove two hex-nut and plain washer securing floodlight mounting bracket assembly to mounting bracket bolted to shipper support. Remove floodlight assembly from mounting bracket.

(5) *Floodlight installation* (floodlight mounted at shipper support, illustrated) (fig. 435).

- (a) Insert floodlight mounting bracket stud through hole in mounting bracket bolted to shipper support, and install plain washer and two hex-nuts on stud.

- (b) Connect two floodlight cable bayonet-type connectors to connectors at rear of floodlight.

b. Floodlight Cables. For removal and installation procedures, refer to TM 9-2320-211-20.

c. Floodlight Switch (at Instrument Panel). For removal and installation procedures, refer to TM 9-2320-211-20.

324. Hydraulic System

a. Draining. Whenever the oil in the hydraulic system is to be removed, it will be necessary to drain all hydraulic lines and cylinders as well as the hydraulic reservoir. To completely drain the system, refer to LO 9-2320-211-12.

b. Filling. Refer to LO 9-2320-211-12.

325. Clutch Control Valve

(fig. 414)

a. Removal.

- (1) Remove two air lines from elbows at left end of clutch control valve.

Note. Place identification tags on both lines to facilitate installation of valve.

- (2) Remove two capscrews and safety nut securing valve to mounting bracket, and remove valve from bracket.

b. Installation.

- (1) Position clutch control valve on rear of mounting bracket, and secure with two capscrews and safety nuts.
- (2) Connect the two air lines to elbows at left end of valve.

326. Roto Chamber

(fig. 436)

a. Removal.

- (1) Remove cotter pin and yoke pin securing push rod yoke on front end to clutch release outer lever, and remove yoke from lever.
- (2) Unscrew nut securing air line to rear of roto chamber, and remove line from roto chamber.
- (3) Remove two capscrews and lockwashers securing roto chamber mounting bracket to upper right side of transmission, and remove roto chamber and bracket assembly from transmission.
- (4) Remove two nuts and lockwashers at front of mounting bracket, and remove roto chamber from bracket.

b. Installation.

- (1) Insert the two studs on front end of roto chamber in mounting holes in front end of mounting bracket, and install two nuts and lockwashers on studs. Tighten nuts.
- (2) Position roto chamber and mounting bracket assembly at upper right side of transmission, and secure with two capscrews and lockwashers.
- (3) Position air line at rear of roto chamber, and tighten connector nut.
- (4) Position roto chamber push rod yoke on upper end of outer lever, and secure with yoke pin and cotter pin.
- (5) Check roto chamber adjustment (para 352), and adjust roto chamber, if necessary.

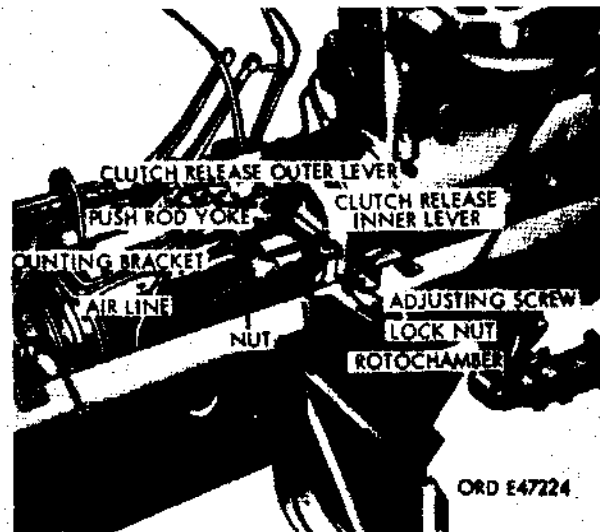


Figure 436. View of roto chamber.

327. Power Divider Assembly

a. Governor Valve.

(1) Removal.

Note. The key letters noted in parentheses are in figure 417, except where otherwise indicated.

- (a) Unscrew two nuts securing governor-valve-to-control-valve line (B) and carburetor-to-governor-valve line (AA) to governor-valve (W) inlet and outlet port elbows, and remove lines from elbows.

Note. Place identification tags on lines to facilitate governor valve installation.

- (b) Unscrew two nuts (Y) and remove two lockwashers from studs securing governor valve (W) to front of power divider. Remove valve from studs.

(2) Installation.

- (a) Turn shaft inside governor valve so that slot in end of shaft will be aligned with key on front end of hydraulic pump output shaft when governor valve is installed on power divider.
- (b) Slide governor valve (W) on mounting studs on front of power divider, and secure with two lockwashers and nuts (Y).

- (c) Position carburetor - to- governor-valve line (AA) and governor-valve-to-control-valve line (B) at governor-valve inlet and outlet port elbows, and tighten connector nuts.

- (d) Adjust governor valve (par. 354).

b. Governor Valve Control Valve.

(1) Removal.

- (a) Unscrew three nuts securing control-valve-to-governor line (A), governor-valve -to-control-valve line (B), and governor-valve-to-control-valve line (BB) to control-valve (E) inlet and outlet port elbows (Z) and adapter (D), and remove lines from elbows and adapter.
- (b) Remove cotter pin from end of control-valve control rod (G), and remove control rod from control valve lever (u).
- (c) Remove two cap screws (V) and lockwashers securing mounting bracket (F) to front of power divider, and remove bracket and control valve assembly from power divider.
- (d) Remove two safety nuts (C) from cap screws securing control valve (E) to mounting bracket, and remove two cap screws, control valve, and two spacers (fig. 411) from bracket.

(2) Installation

- (a) Insert two cap screws through hole in mounting bracket control valve (F), install two spacers (fig. 411) and governor-valve control valve (E) on cap screws, and secure with two safety nuts (C).
- (b) Position bracket and control valve assembly on front of power divider, and install two cap screws (V) with lockwashers in holes in bracket and power divider.
- (c) Insert front end of control-valve control rod (G) in hole in lower end of control valve lever (U), and install cotter pin in end of rod.

- (d) Position control-valve-to-governor line (A) at control-valve outlet port elbow (Z), position governor-valve-to-control-valve line (B) at control-valve inlet port adapter (D), and position governor-valve-to-control-valve line (BB) at control-valve inlet port elbow (Z). Tighten the three connector nuts.

c. Power Divider.

(1) Removal.

- (a) Loosen hose clamp securing reservoir inlet hose (fig. 416) to inlet pipe at rear of. reservoir, and remove hose from pipe. Turn elbow 45° to allow clearance for removal between relay lever assemblies.
- (b) Remove cotter pin and yoke pin securing rear-winch-front- control- rod yoke (fig. 416) to rear-winch right relay lever, and remove yoke from lever.
- (c) Disconnect swivel - valve - to- relief-valve line (fig. 409) from relief valve outlet, and disconnect swivel-valve-to-reservoir-inlet-tee line from pipe tee at relief valve.
- (d) Remove clamp securing swivel-valve-to-reservoir line (fig. 409) to top of relief valve and remove Une from valve.
- (e) Close oil supply valve (fig. 410) at underside of hydraulic reservoir.
- (f) Loosen two hose clamps securing pump inlet hose (fig. 410) to reservoir outlet.
- (g) Remove cotter pin and yoke pin (fig. 410) securing hydraulic-pump-front control-rod yoke to hydraulic-pump right relay lever, and remove yoke from lever.
- (h) Disconnect power-takeoff-to-power divider propeller shaft from drive shaft yoke (fig. 411) at front of power divider.

- (j) Disconnect rear-winch front propeller shaft (fig. 416) from winch output shaft yoke (fig. 398) at rear of power divider.
 - (j) Remove cotter pin and yoke pin (fig. 410) securing power-divider-rear-control-rod yoke to input shifter shaft arm, and remove yoke from arm.
 - (k) Unscrew nut securing carburetor-to-governor-valve line (AA) to governor-valve (W) inlet port elbow, and remove line from elbow.
 - (l) Unscrew nut securing governor-valve-to-control-valve line (BB) to control-valve inlet port elbow (Z) and remove line from elbow.
 - (m) Unscrew nut securing control-valve-to-governor line (A) to control-valve outlet port elbow (Z) and remove line from elbow.
 - (n) Support power divider, pump, and relief valve assembly, and remove four cotter pins and slotted nuts (fig. 410) securing power divider mounting bracket (fig. 411) to studs on bottom of reservoir. Remove power divider, pump, and relief valve assembly from under vehicle.
 - (o) Remove hydraulic pump from pump adapter at rear of power divider (par. 311).
 - (p) Remove governor valve from front of power divider (a(1) (b) above).
 - (q) Remove governor-valve control valve from front of power divider (b(1) above).
 - (r) Remove four cotter pins (fig. 411) and slotted nuts from studs securing mounting bracket to power divider, and remove bracket from studs.
 - (s) Remove cotter pin, clevis pin, and washer securing hydraulic-pump-front-control-rod slotted clevis (fig. 411) to hydraulic-pump-output shifter shaft arm, and remove clevis, with control-valve control rod attached, from arm.
 - (t) Remove cotter pin and yoke pin securing rear-winch-front-control-rod yoke (Q) to rear-winch output shifter shaft arm (R) and remove yoke from arm.
- (2) Installation
- (a) Position rear-winch-front-control-rod adjustable yoke (Q) on rear-winch output shifter shaft arm (R) and secure with yoke pin and cotter pin.
 - (b) Position hydraulic-pump-front-control-rod slotted clevis (fig. 411), with governor-valve-control-valve control rod attached, on left side of hydraulic-pump output shifter shaft arm, and secure with clevis pin and cotter pin.
 - (c) Position mounting bracket (fig. 411) on studs on top of power divider, and secure with four slotted nuts and cotter pins.
 - (d) Install governor-valve control valve on front of power divider (b(2) (a) through (c) above).
 - (e) Install governor valve on front of power divider (a(2) (a) and (b) above).
 - (f) Position governor-valve-to-control-valve line (fig. 411) at governor-valve outlet port elbow and at control-valve inlet port adapter, and tighten connector nuts.
 - (g) Install hydraulic pump on pump adapter at rear of power divider (par.311).
 - (h) Position power divider, pump, and relief valve assembly under vehicle, and secure power-divider mounting bracket to studs on underside of hydraulic reservoir with four slotted nuts (fig. 310) and cotter pins.
 - (i) Position control-valve - to- governor line (A) at control-valve inlet port elbow (Z) and tighten connector nut.
 - (j) Position governor-valve - to-control valve line (BB) at control-valve inlet port elbow (Z), and tighten connector nut.

- (k) Position carburetor - to - governor-valve line (AA) at governor-valve inlet port elbow (Z), and tighten connector nut.
- (l) Position power-divider - rear - control-rod yoke on input shifter shaft arm (fig. 410), and secure with yoke and cotter pin.
- (m) Connect rear-winch front propeller shaft (fig. 416) to winch output shaft yoke (fig. 398) at rear of power divider.
- (n) Connect power - takeoff - to - power-divider propeller shaft to drive shaft (fig. 411) at front of power divider
- (o) Position hydraulic-pump-front-control-rod yoke on hydraulic-pump right relay lever (fig. 410), and secure with yoke pin and cotter pin.
- (p) Install pump inlet hose (fig. 410) on reservoir outlet, and tighten two hose clamps.
- (q) Position swivel-valve - to - reservoir line (fig. 409) at top of relief valve and secure with clamp.
- (r) Connect swivel-valve - to - relief-valve line (fig. 409) to relief valve outlet, and connect swivel-valve - to - reservoir-inlet-tee line to pipe tee at relief valve.
- (s) Position rear-winch - front-control-rod yoke (fig. 416) on rear-winch right relay lever, and secure with yoke pin cotter pin.
- (t) Turn elbow (fig. 416) 45° to align reservoir inlet hose with inlet sleeve on front of reservoir, install hose on sleeve, and tighten hose clamp securely.
- (u) Open oil supply valve (fig. 410) at underside of hydraulic reservoir.
- (v) Adjust hydraulic pump control linkage (par. 353).
- (w) Adjust rear winch control linkage. Refer to TM 9-2320-211-20.

- (x) Check governor valve adjustment, and adjust valve, if necessary (par. 354).

328. Power Divider Controls

Note. The key letters noted in parentheses are in figure 417, except where otherwise indicated.

a. Hydraulic Pump Control Linkage.

(1) Removal

(a) Hydraulic pump front control rod.

1. Remove cotter pin and yoke pin securing front control rod (K) to hydraulic-pump right relay lever (L) and remove rod from lever.
2. Loosen nut (J), and turn control rod from clevis (H).

(b) Relay levers. Refer to paragraph 322.

(c) Hydraulic pump rear control rod.

1. Remove base plate and pivot post assembly (par. 312).
2. Pull hydraulic-pump rear control rod (fig. 415) from underside of base plate.

(2) Installation.

(a) Hydraulic pump rear control rod.

1. Insert hydraulic-pump rear control rod (fig. 415) holes in cross members welded to underside of base plate.
2. Install base plate and pivot post assembly (par. 312).

(b) Relay levers. Refer to paragraph 322.

(c) Hydraulic pump front control rod.

1. Install threaded end of hydraulic-pump front control rod (K) in clevis (H).
2. Adjust hydraulic pump control linkage (par. 353).

b. Rear Winch Control Linkage.

(1) Removal.

(a) Rear winch front control rod.

1. Remove cotter pin and yoke pin securing rear - winch - front - control-rod adjustable yoke(Q) to winch output shifter shaft arm (R), and remove yoke from arm.
2. Remove cotter pin and yoke pin securing rear-winch front control rod to rear-winch right relay lever (P), and remove rod from lever.

(b) Relay levers. Refer to paragraph 322.

(c) Rear winch rear control rod.

1. Remove base plate and pivot post assembly (par. 312).

2. Pull rear-winch rear control rod (fig. 415) from underside of base plate.

(2) Installation

(a) Rear winch rear control rod.

1. Insert rear-winch rear control rod (fig. 415) through holes in cross members welded to underside of base plate.
2. Install base plate and pivot post assembly (par. 312).

(b) Relay levers. Refer to paragraph 322.

(c) Rear winch front control rod.

1. Position rear-winch-front-control-rod yoke on rear-winch right relay lever (P), and secure yoke pin and cotter pin.
2. Adjust rear winch control linkage Refer to TM 9-2320-211-20.

Section IV. REPAIR OF MAJOR COMPONENTS

329. General

Because the various units of the wrecker crane and power train are so closely related end interconnected, it is not practical to remove the wrecker crane as a single unit. For this reason, the disassembly and assembly of the wrecker crane, follow closely the procedures used for the original assembly.

330. Hydraulic Oil Motor (Fig. 437)

a. Disassembly.

- (1) Disassemble the hydraulic oil motor (fig. 438) by removing the four hex-head cap screws (A) and plain washers (B) to release the cover. When the cover (C) is removed, the pressure plate, spring washer (D), and two O-ring gaskets (X) will also be removed. Remove the two shuttle valve retaining pins (W) to remove the two shuttle valve ball seats (E) and the two shuttle valve balls (V) from the pressure plate (F). Lift the cam ring (fig. 439), locating pins (J), rotor, and vanes from the body and drive shaft assembly. Do not re-

move rocking beams, pins, or bushings from rotor.

- (2) Removal of drive shaft and ball bearings. To remove the drive shaft and ball bearing assemblies from the body, first remove the snap ring (fig. 440). Tap on exposed or splined end of drive shaft with soft hammer to remove drive shaft (M) and ball bearing assembly (N) from the body (fig. 440). Use a suitable flat surfaced tool end tap cut oil seal (L) by tapping from the inside. Check the relative position of this oil seal before removal so that it can be replaced by a new one at reassembly. The ball bearing assembly (R) at inner recess of body (K) may now be removed.

b. Cleaning, Inspection and Repair.

- (1) **Cleaning.** Immerse all parts except the sealed ball bearing assembly in clean dry-cleaning solvent or mineral spirits paint thinner. Soak long enough to loosen all old lubricant and to be sure oil passageways are not plugged. Blow dry with compressed air and protect from any dust or dirt.

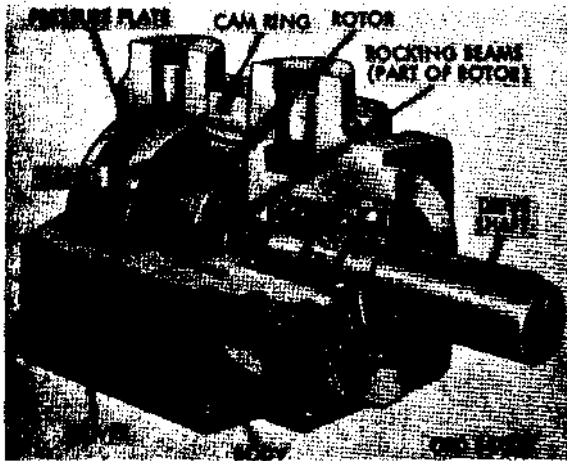


Figure 437. Hydraulic oil motor
(cutaway view)

Note. Handle all parts carefully to avoid any nicks or burs on machined surfaces.

- (2) Inspection and repair. Inspect the condition of both ball bearing assemblies. The larger of the two is permanently sealed and requires no further lubrication, while the smaller is lubricated by the hydraulic fluid. Check for wear by slowly rotating each bearing under load. If any indication of roughness exists, the bearing should be replaced. Check the condition of the cam ring. The internal contour of this part must be smooth and if distortion or roughness exists on this surface, the cam ring must be replaced. Vanes must be free of nicks or burs and if cam ring is replaced, vanes must also be replaced. Check the condition of the shuttle valve balls and their seats. If these show evidence of wear (damaged or pitted surface on the balls or worn face of the seat), replace with new parts. New oil seal and O-ring gaskets must be used at assembly.

c. Assembly (Fig. 438).

- (1) General. Special care must be taken to avoid nicks and burs when assembling the hydraulic oil motor. Avoid the entrance of any grit or dirt into the unit. Add a small amount of No. 10W engine oil into motor and temporarily seal openings until motor is once again mounted on the vehicle.

- (2) Procedure. Use a flat surfaced tool and press ball bearing assembly (R) into body (K). Apply pressure to outer race to seat bearing squarely. Similarly, press oil seal (L) into body noting that the three small oil holes located on the face of the seal and, adjacent to the seal inside diameter, will face toward the inside of the motor when installed. Press ball bearing assembly (N) onto drive shaft (M). Be sure that pressure is applied to inner race only. Install bearing and drive shaft assembly into body and insert snap ring (P). Insert locating pins (J) and new O-ring gasket (S) into face of body. Place 12 vanes (T) into rotor assembly (H) and note that radius end of vanes will contact the cam ring (G). Slide rotor and vanes into cam ring and engage ends of rocking beams on both sides of rotor with inner ends of vanes, so that all vanes will be held outward against the cam ring. Align and install cam ring, rotor, and vanes assembly to locating pins on body (fig. 434). Be sure that rotation arrows on cam ring have not been changed. Insert two shuttle valve balls (V) and two shuttle ball seats (E) into pressure plate (F) and secure in place with two shuttle valve retaining pins (W). Place spring washer (D) and O-ring gasket (X) on pressure plate (F). Install in cover (C) and align cover to the assembled body and cam ring. Secure cover with four hex-head cap screws (A) and plain washers (B). Tighten cap screws to torque specifications prescribed in paragraph

331. Hoist Drum and Worm and Drive Gear (Fig. 441)

a. Disassembly. Refer to figure 442.

- (1) General. No special tools beyond normal maintenance shop facilities are required for disassembling the hoist drum and worm and drive gear set (fig. 441). An overhead crane will be of great help in this operation.

Caution: These are heavy parts and more than ordinary care should be exercised to avoid personal injury that might be caused by careless handling.

- (2) Remove drum bearing cap (fig. 443). Remove four safety nuts and lift off

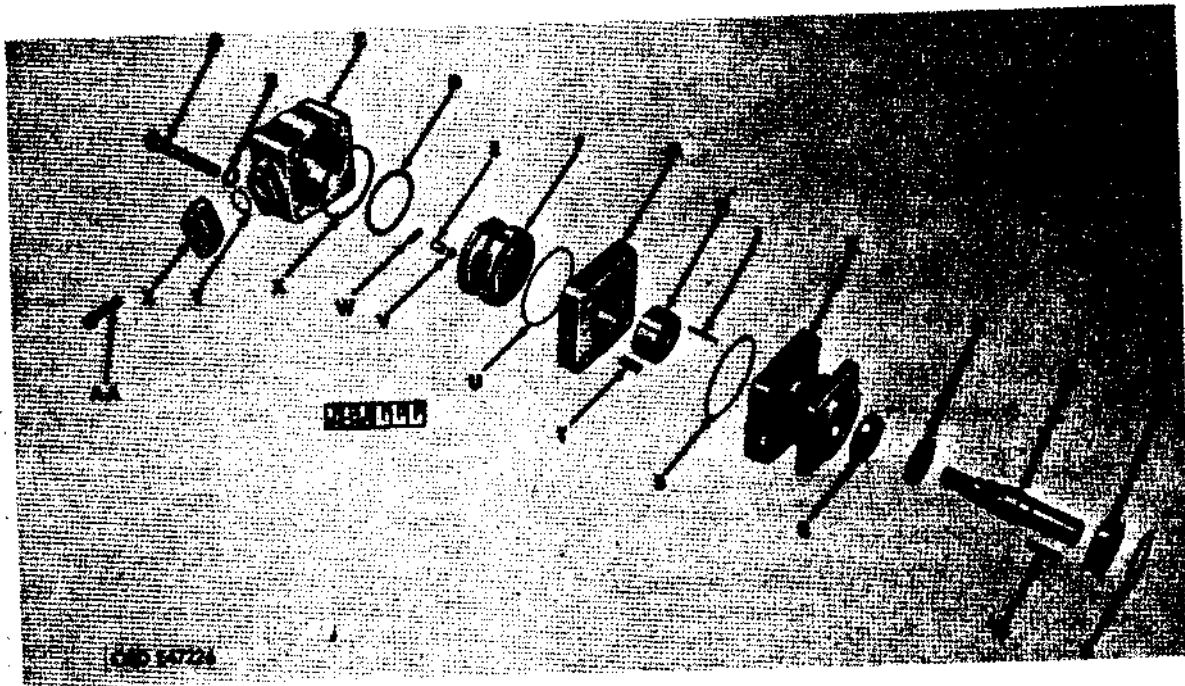


Figure 438. Hydraulic oil motor - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---|------------|-------------------------------|
| A | Screw, cap, hex-hd | N | Bearing, ball, assy |
| B | Washer, plain | P | Ring, snap |
| C | Cover | Q | Key |
| D | Washer, spring | R | Bearing, ball, assy |
| E | Seat, ball, shuttle valve | S | Gasket, O-ring |
| F | Plate, pressure | T | Vane |
| G | Ring, cam | U | Gasket, O-ring |
| H | Rotor, with rocking beams, pins, and bushing, assy | V | Ball, shuttle valve |
| J | Pin, locating | W | Pin, retaining, shuttle valve |
| K | Body | X | Gasket, O-ring |
| L | Seal, oil | Y | Gasket, O-ring |
| M | Shaft, drive | Z | Flange |
| | | AA | Screw, cap, hex-hd |

Figure 438. Hydraulic oil motor - exploded view - legend

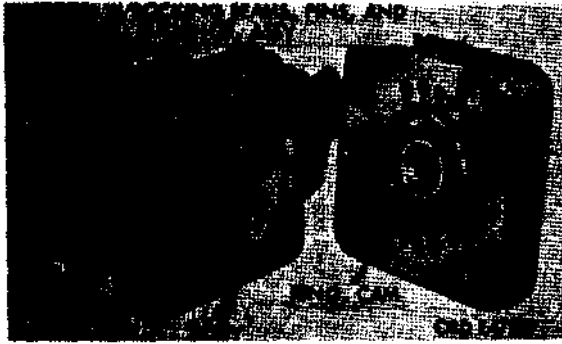


Figure 439. Cam ring and motor separated from body

drum bearing cap and drum bearing-cap gasket from side of drum housing.

(3) Separate hoist drum from worm and drive gear set.

- (a) Remove drive shaft nut (fig. 443) and drive shaft bearing washer.
- (b) Fasten chain hoist around drum housing at shaft end and raise housing from ground sufficiently to loosen shaft from drum and housing. If some difficulty is encountered in freeing shaft from drum, tap on end of shaft with a soft hammer and raise drum and housing from worm and drive gear

set (fig. 438). Hoist drum will roll out of drum housing as soon as shaft is clear.

(4) Disassemble worm and drive gear set

- (a) Remove six safety nuts (C) and take off gear case bearing cap (D), gasket (E), and shims (fig. 442).
- (b) Remove six safety nuts and take off worm bearing cap (fig. 445) and gasket.
- (c) Remove eight safety nuts and take off gear case cover (fig. 446) and gasket.
- (d) Lift out drive gear (M), shaft (AX), spacers (AW and AY), and bearing cones (AV and L) assembly.
- (e) Place a brass drift on the forward end of worm and tap the drift with hammer to drive the worm bearings, slingers, shims, gasket, and cage assembly from the gear case. Discard gaskets. Figure 447 shows worm partially removed from case.
- (f) Mount worm (AL), bearings, slingers, and cage assembly in an arbor press and press worm, slinger, and bearings from worm bearing cage (fig. 448).

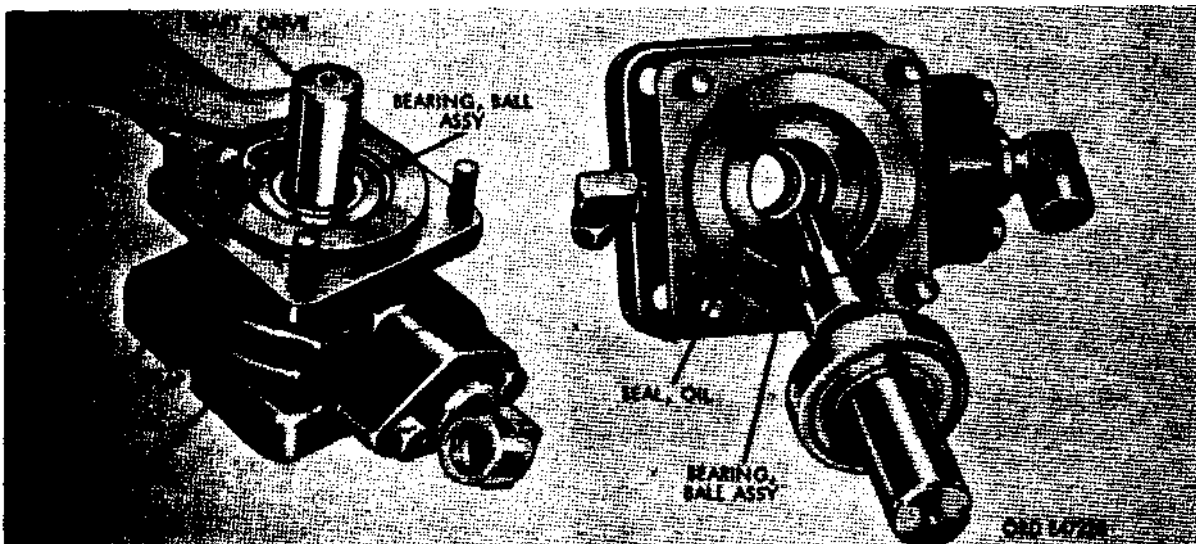


Figure 440. Removing drive shaft and bearing

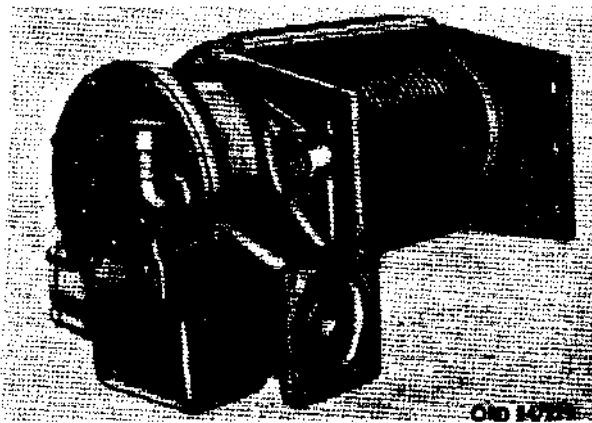


Figure 441. Hoist drum and worm and drive gear set

- (g) The condition of the remaining parts will determine whether further disassembly is necessary. If disassembly is necessary, this may be accomplished with a suitable puller and adapter.
- (h) No special cleaning is required other than to soak all parts in dry-cleaning solvent or mineral spirits paint thinner. Be sure bearings are free of all old lubricant to facilitate inspection. Blow dry with compressed air.

Caution: Never spin bearings with compressed air as damage to the finely machined surfaces will result.

b. Inspection and Repair.

- (1) The parts used in the hoist drum and worm and drive gear set are built to withstand severe usage. However, each part should be gone over thoroughly to check for defects. The gear case should be checked for cracks or stripped screw threads in the case. The worm and drive gear if visibly worn, must be replaced.
- Not.. The worm and drive gear is a matched set and if either part is worn both parts must be replaced
- (2) Check ball bearing assemblies for wear and replace if balls or races are worn or pitted. Check rollers and races of drive-gear bearing cone assemblies for

wear and replace if found defective. Inspect drive shaft for worn splines or stripped screw threads. Replace if defective. If old oil seal was removed from gear case, it shall be replaced. Check other miscellaneous parts for defects and replace any damaged part.

c. Assembly. Refer to figure 442.

- (1) General. The assembly of this unit will require the same attention to avoiding personal injury or damage to parts as was pointed out in the disassembly. Be particularly careful to avoid the entrance of dirt into the assembly. The use of No. 10 SAE engine oil (OE) on sliding fits and screw threads will greatly facilitate assembly.
- (2) Install bearings and worm in worm bearing cage. Place worm bearing assemblies (R and X) back-to-back on arbor press so that inner race will be supported. Place worm bearing oil slinger (Q) on top of bearings with recessed side toward bearing. Insert splined end of worm (AL) into slinger and bearings and press worm into place. Install special locknut (S) flat side down on worm and tighten securely. Lock in place with special lockwasher (W) and special locknut (T), flat side up.
- (3) Similarly, mount bearing assembly (AP) in press with oil slinger (AM) on top, and insert keyed end of worm (AL) into slinger and bearing. Press shaft into place. Support worm bearing cage (Y), flanged side up, on arbor press and insert worm and bearing assembly, keyed end down, into cage. Use an adapter to press on the outside race of worm bearing assembly (X) and press assembly into cage.
- (4) Install worm, bearings, and cage assembly into gear case. If worm bearing cage studs (AS) were removed from gear case (CC), make sure all six studs are securely in place. Position bearing cage shim (AT) and new worm bearing gasket (P) over worm bearing cage (Y) and install worm, bearings, and worm bearing cage into gear case. Mine worm bearing cage with stud in

gear case and tap into place. Use new worm bearing gasket (P) and install worm bearing cap (U). Secure with six safety nuts (V). Tighten to torque specifications Appendix I.

- (5) Install drive gear shaft and bearing cone assembly into gear case. If drive gear bearing cup (AU) has been removed, install cup by tapping into place with soft hammer until seated securely in the gear case. If drive gear (M) has been removed from drive shaft (AX), press shaft into gear, noting that gear will be returned to the same position from which it was removed. Be careful not to bur splines. Place left-hand drive gear bearing spacer (AW) and bearing cone (AV) onto shaft and install into gear case. Place right-hand drive gear bearing spacer (AY) and drive gear bearing cone (L) on end of shaft. If drive gear bearing cup (AZ) has been removed from gear case cover (BA), install cup. If gear case cover studs have been removed from gear case, install six gear case cover studs (N) around upper circumference of gear case drive gear opening, and two inspection hole cover studs (BC) into two lower stud holes. Aline new gear case cover gasket (K) and gear case cover (BA) on gear case and secure with six safety nuts (J). Allow two safety nuts (J) and inspection hole cover (BE) to remain disassembled until final adjustment has been made (par. 355). Insert six studs (H) into gear case cover (BA) and turn down tight. Install new gear case bearing cap gaskets (E), gear case bearing cap shims (F), and gear case cover with six safety nuts (C). Install 90° street elbow (BH) into gear case cover (BA), gear case filler tube (B), and filler tube breather cap (A).
- (6) Assemble drive shaft bearing seal. Assemble drive shaft bearing seal (DD), drive shaft bearing seal cage (AJ), new drive gear bearing gasket (EE), and drive gear bearing shims (FF). If studs (AK) were removed from gear case, install six studs (AK) and tighten securely. Install drive shaft bearing seal cage (AJ), to gear case with six safety nuts (AH). Tighten nuts securely.
- (7) Install hoist drum and drum housing. Place hoist drum (AC) into drumhousing (AG) and secure in position by inserting drive shaft (AX) end of the assembled worm and drive gear set through the drum and housing. If the four studs (PP) were removed from drum housing, be sure these are securely in place and install new drum bearing cage gasket (QQ).
- (8) Install bearing assembly. If bearing assembly (SS) has been removed, use an arbor press to position bearing drum bearing cage (RR). Position bearing so that sealed side will face toward drum when installed, and also be sure that pressure is applied to outer race while installing in cage. Install drive shaft bearing spacer (YY), flat side down on end of drive shaft, and aline bearing and cage assembly on studs. Place drive shaft bearing washer (XX) and drive shaft nut (TT) on end of drive shaft and draw down until secure. Install new drum bearing cap gasket (WW) and drum bearing cap (UU) and secure with four safety nuts (W). Install square head pipe plug (AR) in gear case (CC). Refer to LO 9-2320-211-12 for correct lubricant and capacity.

332. Shipper and Boom Assembly

a. Disassembly.

(1) Removing boom from shipper.

- (a) Remover 45° elbow with hose assembly from end of piston rod. Bend lip on piston rod lockplate (fig. 449) from piston rod nut and remove both nuts and plate.
- (b) Pull boom from shipper only far enough to attach a chain sling. Attach chain to an overhead hoist and remove boom from shipper (fig. 450).

Caution: When extending boom from shipper to attach chain, boom must be supported at sheave end to prevent tilting which could cause serious injury to personnel.

(2) Removing boom cylinder from boom (fig. 451).

- (a) Remove cotter pins from cylinder collar pins and remove pins.

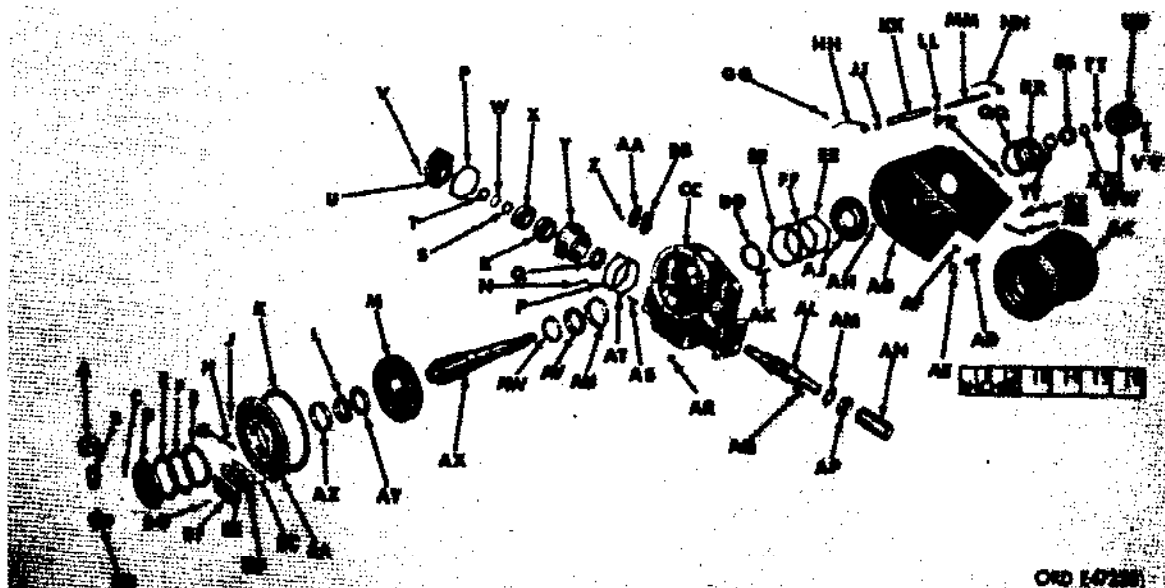


Figure 442. Hoist drum and worm and drive gear set - exploded view

| Key | Item | Key | Item |
|-----|-------------------------------|-----|---------------------------------|
| A | Cap, breather, filler tube | DD | Seal, drive shaft bearing |
| B | Tube, filler, gear case | EE | Gasket, drive gear bearing |
| C | Nut, safety | FF | Shims, drive gear bearing |
| D | Cap, bearing, gear case | GG | Scraw, hex-hd, machine |
| E | Gasket, gear case bearing cap | HH | Spring, cable guide, right hand |
| F | Shims, gear case bearing cap | JJ | Bushing, cable guide |
| G | Plug, pipe, sq-hd | KK | Roller, cable guide |
| H | Stud | LL | Bushing, cable guide |
| J | Nut, safety | MM | Shaft, cable guide |
| K | Gasket, gear case cover | NN | Spring, cable guide, left hand |
| L | Cone, bearing, drive gear | PP | Stud |
| M | Gear, drive | QQ | Gasket, drum bearing cap |
| N | Stud, gear case cover | RR | Cage, bearing drum |
| P | Gasket, worm bearing | SS | Bearing, assembly |
| Q | Slinger, oil, worm bearing | TT | Nut, drive shaft |
| R | Bearing, worm assembly | UU | Cap, drum bearing |
| S | Nut, lock, special | VV | Nut, safety |
| T | Nut, lock, special | WW | Gasket, drum bearing cap |
| U | Cap, worm bearing | XX | Washer, drive shaft bearing |
| V | Nut, safety | YY | Spacer, drive shaft bearing |
| W | Washer, lock special | ZZ | Screw, cap, hex-hd |
| X | Bearing, worm, assembly | AB | Wedge, cable |
| Y | Cage, worm bearing | AC | Drum, hoist |
| Z | Screw, cap, assembly | AD | Screw, cap, hex-hd |
| AA | Cover, inspection hole | AE | Washer, lock |
| BB | Gasket, inspection hole cover | AF | Nut, safety |
| CC | Case, gear | AG | Housing, drum |

Figure 442. Hoist drum and worm and drive gear set - exploded view - legend

| Key | Item | Key | Item |
|-----|--------------------------------|-----|--|
| AH | Nut, safety | AV | Cone, bearing |
| AJ | Cage, drive shaft bearing seal | AW | Spacer, drive gear bearing, left hand |
| AK | Stud | AX | Shaft, drive |
| AL | Worm | AY | Spacer, drive gear bearing, right hand |
| AM | Slinger, oil | AZ | Cup, bearing, drive gear |
| AN | Coupling, drum drive | BA | Cover, gear case |
| AP | Bearing, assembly | BC | Stud, inspection hole cover |
| AQ | Key, cable drum drive coupling | BD | Gasket, inspection hole cover |
| AR | Plug, pipe, sq-hd | BE | Cover, inspection hole |
| AS | Stud, worm bearing cage | BF | Plate, drum case lubrication |
| AT | Shim, bearing cage | BG | Screw, cap, assembly |
| AU | Cup, bearing, drive gear | BH | Elbow, street |

Figure 442. Hoist drwm and worm and drive gear set - exploded view - legend - continued



Figure 443. Drum bearing cap removed

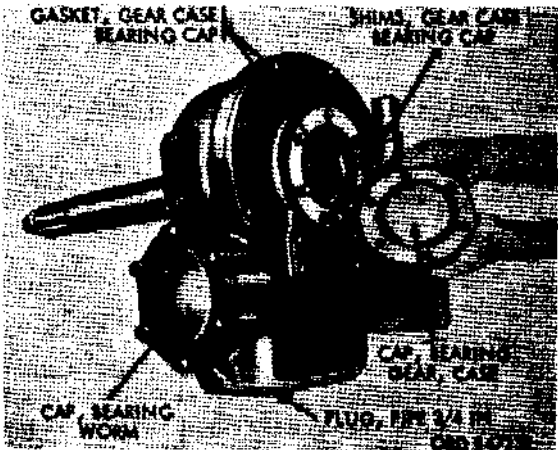


Figure 445. Gear case bearing cap removed

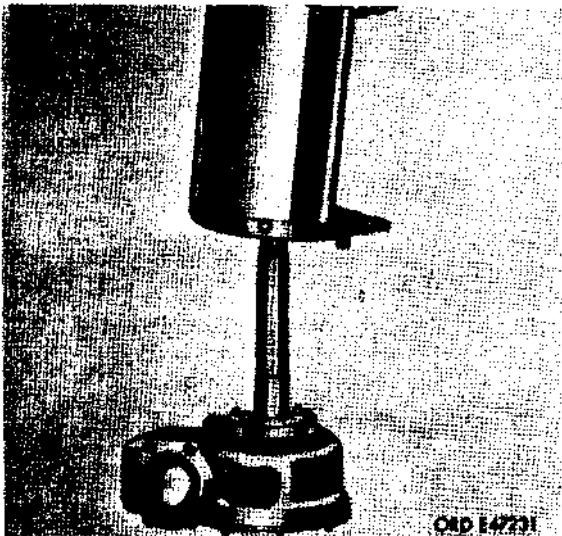


Figure 444. Separating hoist drum from worm and drive gear set

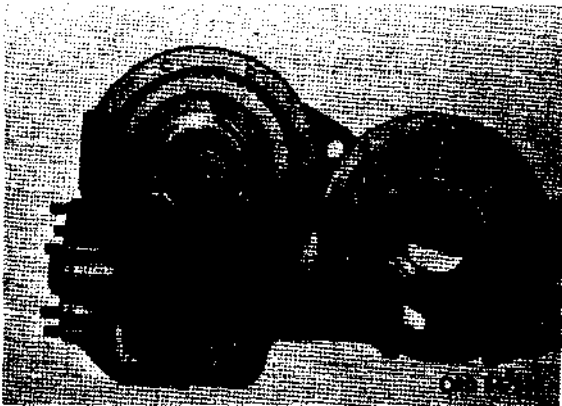


Figure 446. Gear case cover and worm bearing cap removed

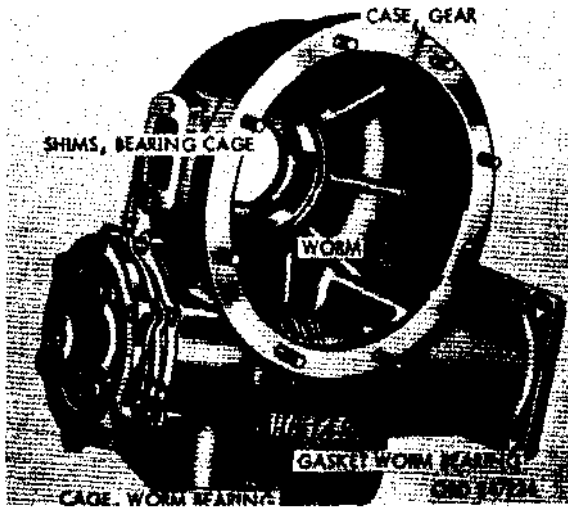


Figure 447. Worm partially removed from gear case

(b) Attach a chain to support boom cylinder. Remove boom cylinder from boom.

(3) Disassembly of boom cylinder.

(a) Remove cotter pins and four slotted nuts from cylinder head (fig. 452), and separate piston rod with cylinder head from boom cylinder.

(b) Remove twopistonnuts, piston rod cup spreaders, piston rod cups, and one piston rod cup spacer (fig. 453) from piston rod.

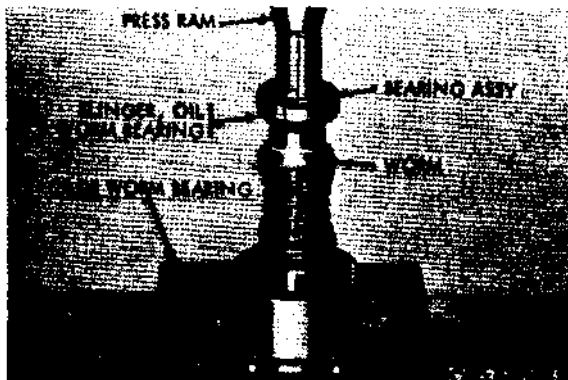


Figure 448. Removing worm and bearings from worm bearing cage



Figure 449. Disconnect points from boom removal

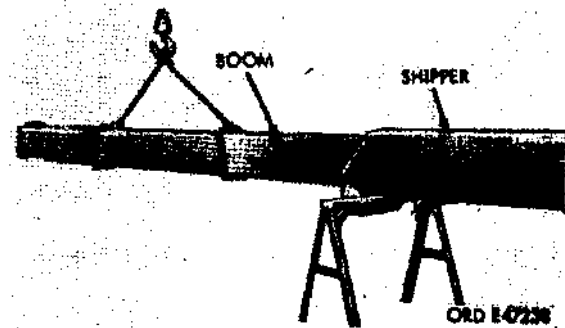


Figure 450. Removing boom from shipper

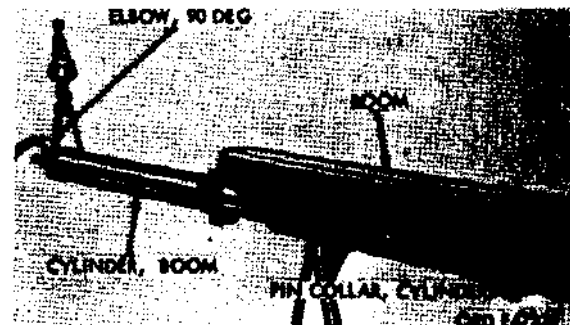


Figure 451. Removing boom cylinder from boom

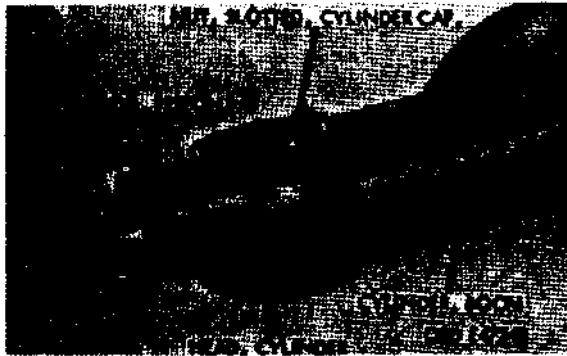


Figure 452. Removing cylinder head

- (c) Slide cylinder head to piston end of piston rod and remove cylinder head snap ring, washer, piston rod leather wiper, felt wiper, and O-ring gasket from cylinder head (fig. 454). Remove cylinder head O-ring gasket (fig. 454) from cylinder head.

(4) Disassembly of shipper.

- (a) Remove four cap screws and lockwashers from each front bottom roller cap. Remove front bottom roller cap end shims from each side of shipper (fig. 455).

Note. Keep each shim pack intact to facilitate final assembly.

- (b) Install puller on front bottom roller bearing cone and remove bearing. Remove opposite bearing in same manner.
- (c) Remove front bottom roller (fig. 455) with collars and shims from shipper.



Figure 453. Piston assembly

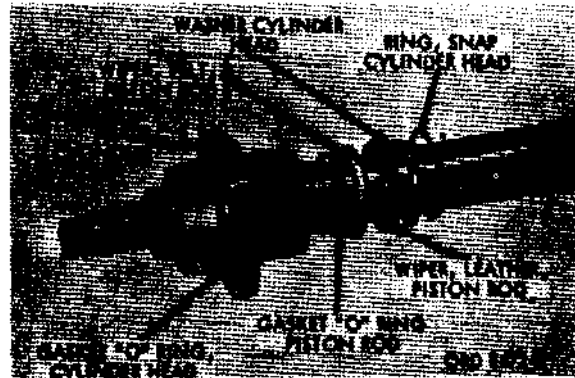


Figure 454. Cylinder head and seal assembly

Note. Keep each shim pack intact to facilitate final assembly.

- (d) Remove cap screw and lockwasher from rear bottom roller shaft. Remove shaft and rear bottom roller (fig. 456) from shipper.
- (e) Do not remove rear bottom roller bushings unless inspection warrants replacement. To remove, use suitable adapter and press bushing from roller.
- (f) Remove three cap screws and lockwashers on each side of upper roller housing (fig. 457) and remove housing assembly from shipper.



Figure 455. Front bottom roller cap and shims installed

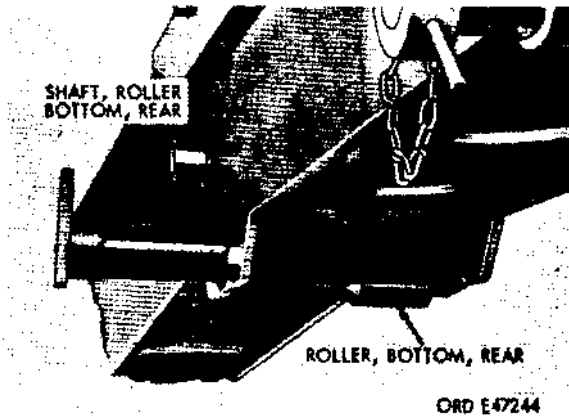


Figure 456. Rear bottom roller and shaft partially removed

- (g) Remove four cap screws and lockwashers from upper roller cap. Remove upper roller cap, shims, and bearing cone from upper roller bushing (fig. 458). Remove opposite cap and bearing in same manner.

Note. Keep each bearing shim pack intact to facilitate final assembly.

- (h) Remove upper rollers (fig. 458) and upper roller pin from housing. Slide upper rollers and upper roller shims from pin. Do not remove upper roller bearing cap from roller unless inspection warrants replacement.

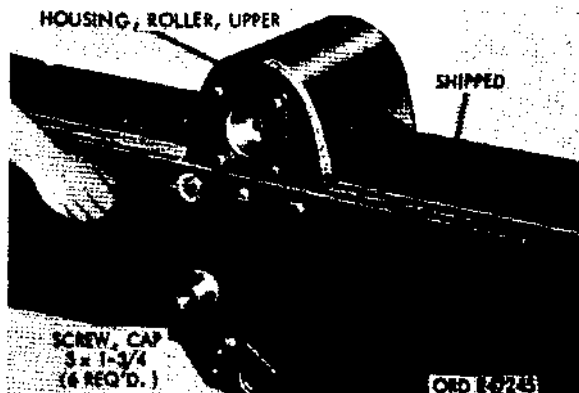


Figure 457. Removing upper roller housing assembly

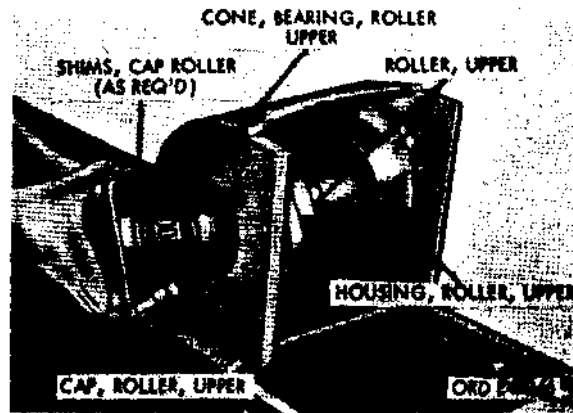


Figure 458. Removing upper roller cap, shims and bearing

Note. Keep each shim pack intact to facilitate assembly.

- (i) Use suitable adapter and remove shipper pivot shaft bushings (CC and DD, fig. 459) from shipper, if inspection warrants replacement.

(5) Disassembly of boom and crane block sheave (fig. 461).

- (a) Remove cap screw and lockwasher securing boom sheave pin to boom. Remove two boom sheaves, four needle bearings (E, F, J and K), and washers (B, C, G and L) from boom (fig. 461).
- (b) Remove pin clip (R), and drive boom cable anchor pin (S) from boom.
- (c) Remove pin clips (Z) and crane block cable anchor pin (EE) from crane block. Remove tapping screw (BB) and block washer, crane block sheave pin (AA), crane block sheave (FF), crane block sheave bearings (V and W), and sheave washers (X and GG) from crane block.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Use a stiff bristle brush and **clean** all parts with mineral spirits **paint** thinner. Rinse bearings in clean mineral spirits paint thinner and cover bearings to protect from dirt.

(2) Inspection and repair.

- (a) Bearings. Inspect bearings for pitted, scored, or scratched condition. Replace any defective bearings.
- (b) Rollers. Inspect rollers for worn or damaged condition. Replace worn or damaged rollers.
- (c) Boom. Inspect boom for cracked welds or bent condition. In general, defective welds can be repaired by welding. If not, replace boom.
- (d) Pin assemblies. Inspect pins for worn condition and replace defective pins.
- (e) Cylinder. Inspect bore of cylinder for scratches or scoring. Replace damaged cylinder.
- (f) Piston rod. Inspect piston rod for nicks or scratches. Remove slight nicks or scratches with a soapstone or fine mill file. Replace piston rod if distorted or damaged.
- (g) Shipper. Inspect shipper for cracked welds bent condition Defective welds can be repaired by welding. Replace shipper if bent, twisted, or damaged.

c. Assembly.

(1) Boom cylinder assembly (fig. 462).

- (a) Install piston rod wiper spring (R) on leather wiper (S).
- (b) Position piston rod O-ring gasket (P), felt wiper (Q), leather wiper (S), and cylinder head washer (T) in cylinder head (L). Secure with cylinder head snap ring (U). Position cylinder head O-ring gasket (K) on cylinder head.
- (c) Slide cylinder head (L) on piston rod (v). Assemble piston rod cup spreaders (E and J), cups (F and H), and cup spacer (G) on piston rod as shown in figure 453. Secure with piston rod nuts (D and C).
- (d) Install four cylinder head studs (A) in boom cylinder (B). Apply a coat

of light engine oil to piston and install piston and piston rod assembly in boom cylinder. Secure cylinder head (L) to boom cylinder with four cylinder cap slotted nuts (M) and lock with new cotter pins (N).

(2) Assemble shipper (fig. 459).

(a) Assemble front and rear bottom rollers.

- 1. Position bottom roller collar shims (L and N) and front bottom roller collars (K and P) on front bottom roller (M). Position roller with collar and shims in end of shipper (D) and install bottom roller bearing cones (G and R) one each end of roller as shown in figure 455.
- 2. Use suitable adapter and press bottom roller bearing cup (H) in front bottom roller cap (J). Install bottom roller bearing cup (S) in front bottom roller cap (T) in the same manner.
- 3. Position bottom roller cap shims (Q) as removed, and front bottom roller cap (T) on shipper (D), and secure with four cap screws (W) and lockwashers (V). Follow same procedure for installing bottom roller cap shims (F) and front bottom roller cap (J).
- 4. If bushings were removed, press rear bottom roller bushing (MM and NN) in each end of rear bottom roller (LL). Position roller in shipper (D) and secure with rear bottom roller shaft (KK). Secure shaft with cap screws (HH) and lockwashers (JJ).
- 5. Use suitable adapter and install shipper pivot shaft bushings (CC and DD) in each side of shipper (D).

(b) Assemble upper roller (fig. 463).

- 1. Use suitable adapter and press upper roller bearing cup (V) in upper roller (U) and upper roller bearing cup (N) in upper roller (P).

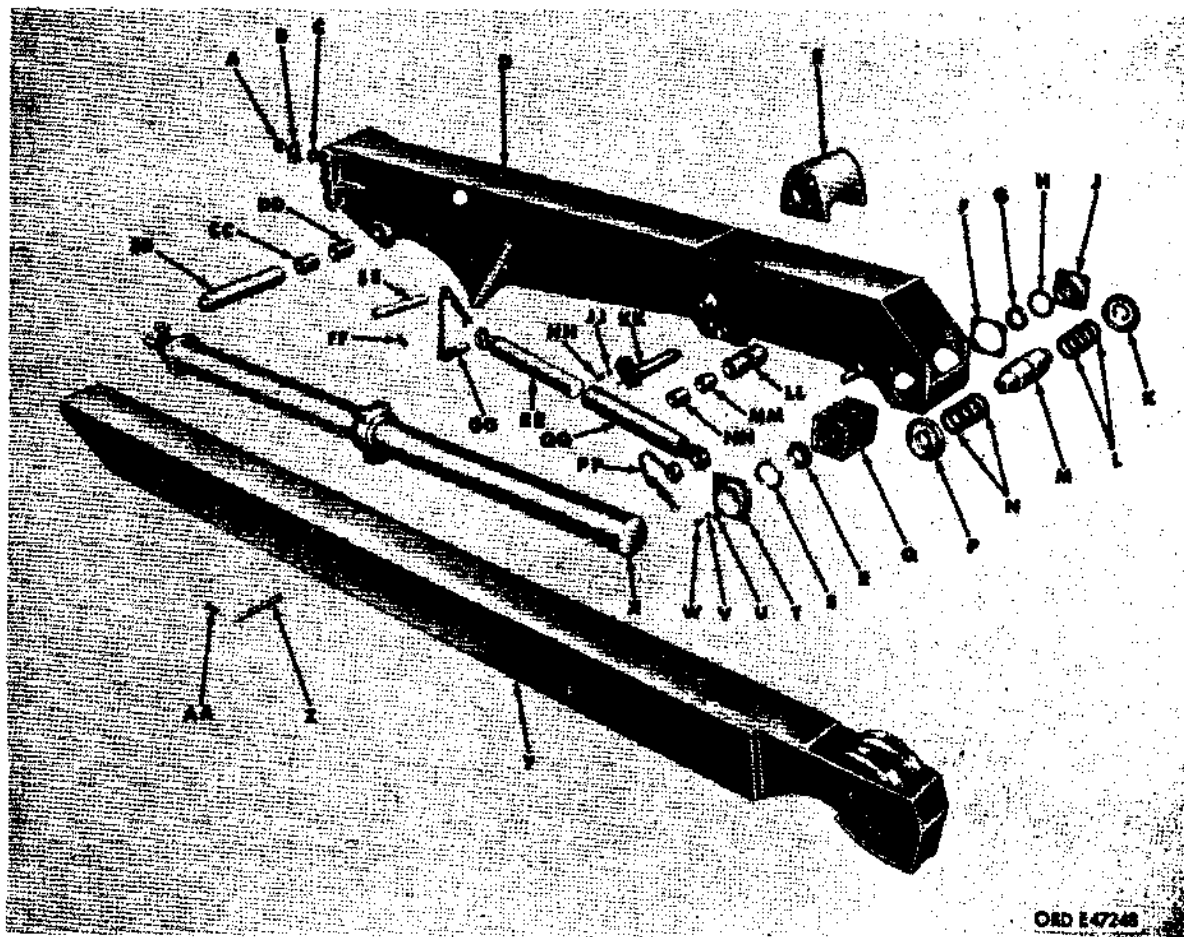


Figure 459. Shipper and boom assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|-------------------------------|------------|--------------------------------|
| A | Nut, piston rod | R | Cone, bearing, bottom roller |
| B | Plate, lock, piston rod | S | Cup, bearing, bottom roller |
| C | Nut, piston rod | T | Cap, roller, bottom, front |
| D | Shipper | U | Fitting, lubricating |
| E | Housing, roller, upper | V | Washer, lock |
| F | Shims, cap, bottom roller | W | Screw, cap |
| G | Cone, bearing, bottom roller | X | Cylinder, boom |
| H | Cup, bearing, bottom roller | Y | Boom |
| J | Cap, roller, bottom, front | Z | Pin, collar, cylinder |
| K | Collar, roller, bottom, front | AA | Pin, cotter |
| L | Shim, collar, bottom roller | BB | Pin, pivot, shipper |
| M | Roller, bottom, front | CC | Bushing, shaft, pivot, shipper |
| N | Shim, collar, bottom roller | DD | Bushing, shaft, pivot, shipper |
| P | Collar, roller, bottom, front | EE | Shaft, pivot, lift cylinder |
| Q | Shims, cap, bottom roller | FF | Screw, set, sq-hd |

Figure 459. Shipper and boom assembly - exploded view - legend

| Key | Item | Key | Item |
|-----------|-------------------------------|-----|-------------------------------|
| GG | Pin, brace, shipper | NN | Bushing, roller, bottom, rear |
| HH | Screw, cap | PP | Collar, pin, brace, shipper |
| J J | Washer, lock | QQ | Brace, shipper, female |
| KK | Shaft, roller, bottom, rear | RR | Brace, shipper, male |
| LL | Roller, bottom, rear | SS | Fitting, lubrication |
| MM | Bushing, roller, bottom, rear | | |

Figure 459. Shipper and boom assembly - exploded view - legend - continued

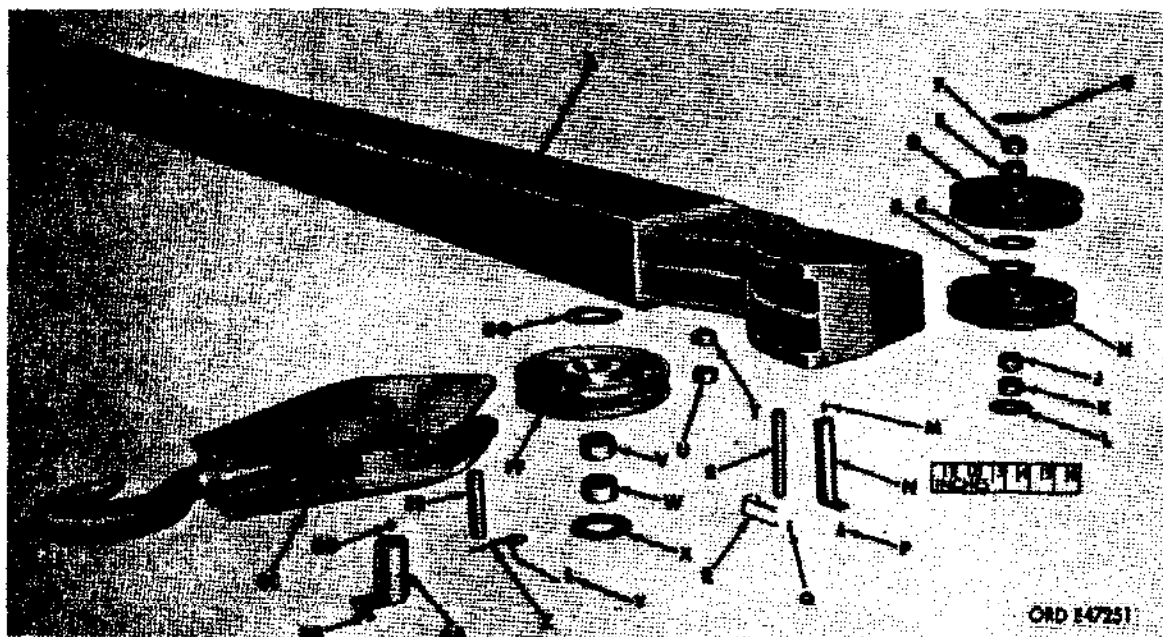


Figure 460. Boom and crane block sheaves - exploded view

| Key | Item | Key | Item |
|-----|-------------------------------|-----------|---------------------------------|
| A | Boom | S | Pin, anchor, cable boom |
| B | Washer, sheave, boom | T | Spacer, sheave, boom |
| C | Washer, sheave, boom | U | Spacer, sheave, boom |
| D | Sheave, boom | V | Bearing, sheave, crane block |
| E | Bearing, needle, sheave, boom | W | Bearing, sheave, crane block |
| F | Bearing, needle, sheave, boom | X | Washer, sheave, crane block |
| G | Washer, sheave, boom | Y | Screw, tapping |
| H | Sheave, boom | Z | Clip, pin |
| J | Bearing, needle, sheave, boom | AA | Pin, sheave, crane block |
| K | Bearing, needle, sheave, boom | BB | Screw, tapping |
| L | Washer, sheave, boom | CC | Block, crane |
| M | Fitting, lubricating | DD | Fitting, lubricating |
| N | Pin, sheave, boom | EE | Pin, anchor, cable, crane block |
| P | Bolt, hex-hd, w/washer | FF | Sheave, crane block |
| Q | Screw, tapping, hex-hd | GG | Washer, sheave, crane block |
| R | Clip pin | | |

Figure 460. Boom and crane block sheaves - exploded view - legend

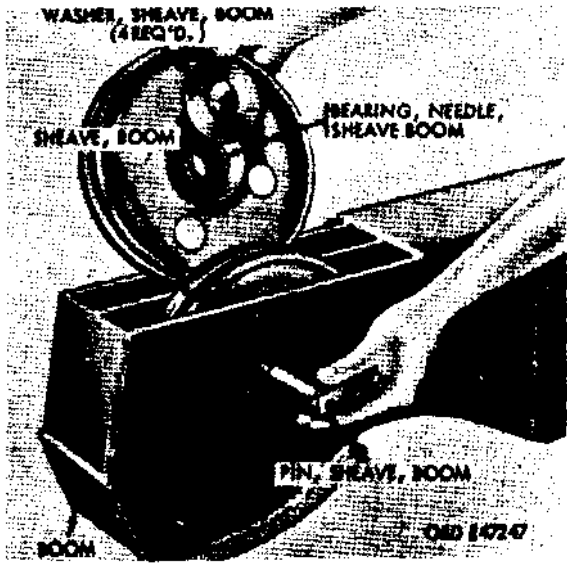


Figure 461. Removing boom sheave pin, sheaves, and bearings

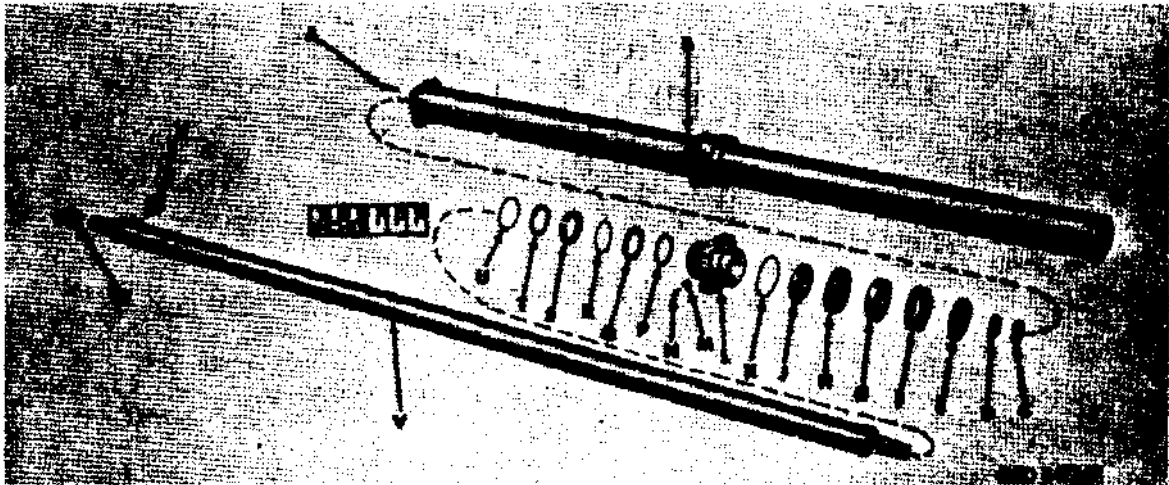


Figure 462. Boom cylinder assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---------------------------|------------|-------------------------------|
| A | Stud, cylinder head | H | Cup, piston rod |
| B | Cylinder, boom | J | Spreader, cup, piston rod |
| C | Nut, piston rod | K | Gasket, O-ring, cylinder head |
| D | Nut, piston rod | L | Head, cylinder |
| E | Spreader, cup, piston rod | M | Nut, slotted, cylinder cap |
| F | Cup, piston rod | N | Pin, cotter |
| G | Spacer, cup, piston rod | P | Gasket, O-ring, piston rod |

Figure 462. Boom cylinder assembly - exploded view - legend

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|----------------------------|------------|---------------------------|
| Q | Wiper, felt, piston rod | U | Ring, snap, cylinder head |
| R | Spring, wiper, piston rod | V | Rod, piston |
| S | Wiper, leather, piston rod | W | Elbow, 45 degree |
| T | Washer, cylinder head | X | Elbow, 90 degree |

Figure 462. Boom cylinder assembly - exploded view - legend - continued

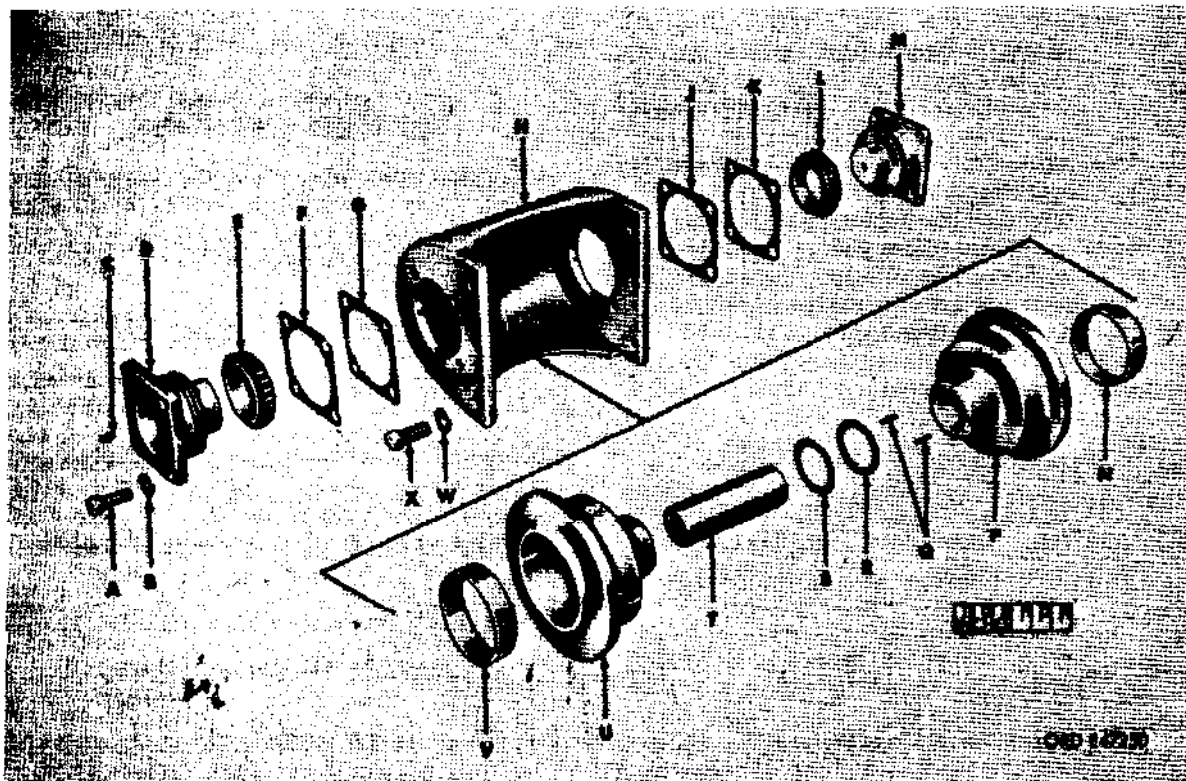


Figure 463. Upper roller assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|------------------------------|------------|------------------------------|
| A | Washer, lock | M | Cap, roller, upper |
| B | Screw, cap | N | Cup, bearing, roller, upper |
| C | Fitting, lubricating | P | Roller, upper |
| D | Cap, roller, upper | Q | Pin, dowel, roller, upper |
| E | Cone, bearing, roller, upper | R | Shim, spacing, roller, upper |
| F | Shim, cap, roller, upper | S | Shim, spading, roller, upper |
| G | Shim, cap roller, upper | T | Shaft, roller, upper |
| H | Housing, roller upper | U | Roller, upper |
| J | Shim, roller, upper | V | Cup, bearing, roller, upper |
| K | Shim, Shim, roller, upper | W | Washer, lock |
| L | Cone, bearing, roller, upper | X | Screw, cap |

Figure 463. Upper roller assembly - exploded view - legend

2. Install upper roller dowel pins (Q) in upper roller (P) and position spacing shims (S and R) on dowel pins. Install upper rollers (P and U) on shaft (T). Align dowel pin holes in upper roller (U) with dowel pins on roller (P) and butt end of rollers together.
3. Place upper rollers (U and P) assembled on shaft (T) into upper roller housing (H). Position upper roller cap shims (F and G), bearing cone (E), and cap (D), and secure to housing with four cap screws (B) and lockwashers (A). Assemble upper roller cap (M), bearing cone (L), and shims (J and K) in same manner as described for opposite cap and bearing. Secure upper roller housing (H) on shipper with four cap screws (X) and lockwashers (W). Lubricate according to lubrication instructions in LO 9-2320-211-12.

(c) Assemble boom and crane block sleeve (fig. 460).

1. Install boom sheave needle bearings (E and F) in sheave (D) and needle bearings (J and K) in sheave boom (H). Position boom sheaves with bearings in end of boom (A). Position boom sheave washers (B, C, G, and L) on each side of sheaves. Install boom sheave pin (N) in boom through sheaves. Secure pin with hex-head bolt with washer (P). Install boom cable anchor pin (S) in boom (A) and secure each end of pin with pin clip (R).
2. Install crane block sheave bearings (V and W) in crane block sheave (FF). Place sheave with bearing in crane block (CC). Position crane block sheave washers (X and GG) on each side of sheave in block. Install crane block sheave pin (M) in block through sheave. Secure pin with tapping screw (BB) and lockwasher. Install crane block cable anchor pin (EE) in block and secure pin on each end with pin clip (Z).

(d) Install boom cylinder in boom.

1. Install hose assembly (fig. 449) with 90° elbow (fig. 451) on side of piston rod, as hose cannot be installed after cylinder is anchored in boom.

2. Support boom cylinder with a chain hoist end position in boom (fig. 451). Anchor cylinder by installing cylinder collar pins (fig. 451) through collar on cylinder. Secure pins with two new cotter pins.

(e) Install boom in shipper.

1. Attach boom with a chin sling. Pick up boom with an overhead hoist and insert end of boom in shipper (fig. 450). Slide boom into shipper until boom cylinder is seated against cylinder anchor in shipper.
2. Install piston rod nut, lockplate, and nut (fig. 449) on end of piston rod assembly and tighten securely. Bend lip on lockplate to secure nut.

333. Lift Cylinder

a. Disassembly. It will not be necessary to disassemble the lift cylinder assembly (fig. 464) unless it is known to be defective. If disassembly is necessary, extreme care must be exercised to avoid damage to the highly polished surfaces of the cylinder assembly. Do not remove oil seal or bushings unless inspection reveals that replacement is necessary.

(1) Remove lift cylinder piston and rod (fig. 465).

- (a) Remove 12 safety nuts (D) and remove lift cylinder head (E) with piston and rod from lift cylinder (Q).

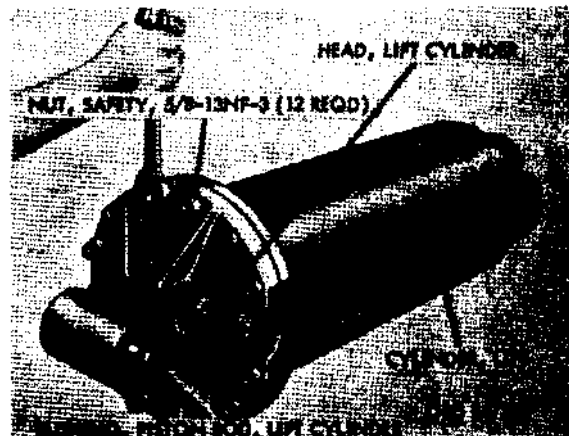


Figure 464. Lift cylinder assembly

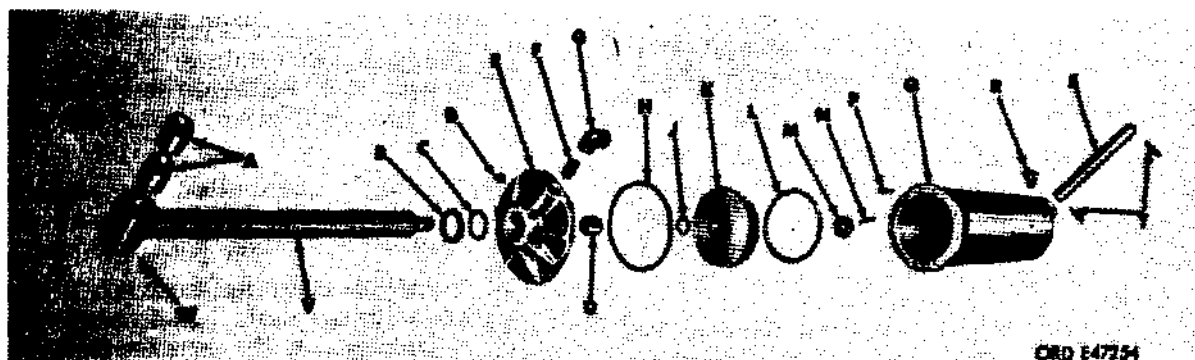


Figure 465. Lift cylinder assembly - exploded view

| Key | Item | Key | Item |
|-----|-------------------------------|-----|----------------------|
| A | Bushing, piston rod | M | Nut, piston rod |
| B | Seal, head | N | Pin, cotter |
| C | Packing, O-ring type | P | Stud |
| D | Nut, safety | Q | Cylinder, lift |
| E | Head, lift cylinder | R | Elbow, 90 deg |
| F | Nipple | S | Shaft, pivot |
| G | Elbow, 90 deg | T | Pin, cotter |
| H | Gasket, O-ring, outer, head | U | Bushing, head |
| J | Gasket, O-ring, inner, piston | V | Rod, piston |
| K | Piston, lift cylinder | W | Fitting, lubricating |
| L | Gasket, O-ring, outer, piston | | |

Figure 465. Lift cylinder assembly - exploded view - legend

- (b) Insert screwdriver or similar tapered tool under piston outer O-ring gasket (L) and remove gasket from lift cylinder piston (fig. 466).

Not.. Care must be exercised to avoid damage to O-ring gasket and piston during this removal operation.

- (c) Remove cotter pin (fig. 466) and piston rod nut (M) from stub end of piston rod (V). Slide lift cylinder piston (K) from rod.
- (d) Use a small screwdriver or similar tapered tool and remove piston inner O-ring gasket (J) from the inner diameter of piston.
- (e) To remove lift cylinder piston rod bushings (A), use suitable adapter and press out both bushings.
- (2) Disassemble lift cylinder head.
- (a) Remove head outer O-ring gasket (H) from cylinder head (E).

- (b) Using a small screwdriver, remove O-ring type packing (C) from inner diameter of lift cylinder head.

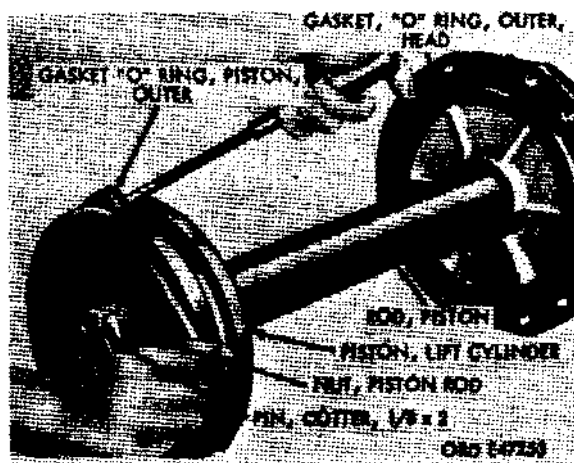


Figure 466. Removing O-ring gasket from lift cylinder piston

- (c) To remove lift cylinder head seal(B), use a pinch bar and pry out seal.

Note. This seal will be damaged during removal. Be sure replacement seal is available.

- (d) A split-type bushing is used for the inner diameter of the lift cylinder head. Use a small chisel to collapse bushing and remove with a pair of vise grip pliers.

Note. Before removing bushing, be certain replacement bushing is available.

b. Cleaning, Inspection and Repair.

- (1) **Cleaning.** Clean all parts in mineral spirits paint thinner or dry-cleaning solvent. Blow dry with compressed air. Apply a coat of light engine oil to the highly polished surfaces to prevent rust.

- (2) **Inspection and repair.**

- (a) **O-ring gaskets.** Inspect O-ring gaskets for cuts, scratches, or indications of wear. Replace damaged gaskets.
- (b) **Bushings.** Inspect bushings for excessive wear. Replace bushings if worn.
- (c) **Piston and rod.** Inspect piston and rod for scratches, nicks, or burrs. Remove scratches with a soapstone or fine mill file. Replace if scratches are still evident or if piston and rod are damaged beyond repair.
- (d) **Cylinder and cylinder head.** Inspect Cylinder for scratches and nicks. Remove with a soapstone or fine mill file. If scratches and nicks are still evident, replace. Inspect cylinder head for cracked or broken condition. Replace as inspection warrants.
- (e) **Oil seal.** The metal cased oil seal normally is a long-life part. Inspect the tMn, featheredge which contacts piston rod to be sure it is intact. Replace seal if defects are found.

c. Assembly.

- (1) **Assemble lift cylinder head (fig. 465).**
 - (a) Position lift cylinder head (E) in press, with machined surface aide up, and press head bushing (U) into head.
 - (b) Turn lift cylinder head over and position head seal (B). Use a suitable adapter and press seal into head.
 - (c) Install o-ring type packing (c) into lift cylinder head. Install head outer O-ring gasket (H) on outer diameter of lift cylinder head.
- (2) **Install lift cylinder piston and rod.**
 - (a) Position piston rod (V) in press and press piston rod bushings (A) into piston rod, one from each side.
 - (b) Install piston inner O-ring gasket (J) into inner diameter of lift cylinder piston (K).
 - (c) Slide lift cylinder head (E) onto piston rod (V) so that machined surface side of head is toward piston end of rod.
 - (d) Slide lift cylinder piston (SC) on end of piston rod (V) and install piston rod nut (M). Insert new cotter pin (N) to secure nut.
 - (e) Install piston outer O-ring gasket (L) on outer diameter of lift cylinder piston (K).
 - (f) Apply a coat of light oil to wall of lift cylinder (Q) and to piston outer O-ring gasket (L). Insert lift cylinder piston with piston rod in cylinder and align holes in lift cylinder head (E) with studs (P) in cylinder. Install twelve safety nuts (D) and tighten according to torque specifications Appendix I.

334. Swivel Valve

a. Disassembly (Fig. 467).

- (1) General. Although the swivel valve (fig. 468) is one of the most essential units furnished with the wrecker crane, it is one of the most simple units in con-

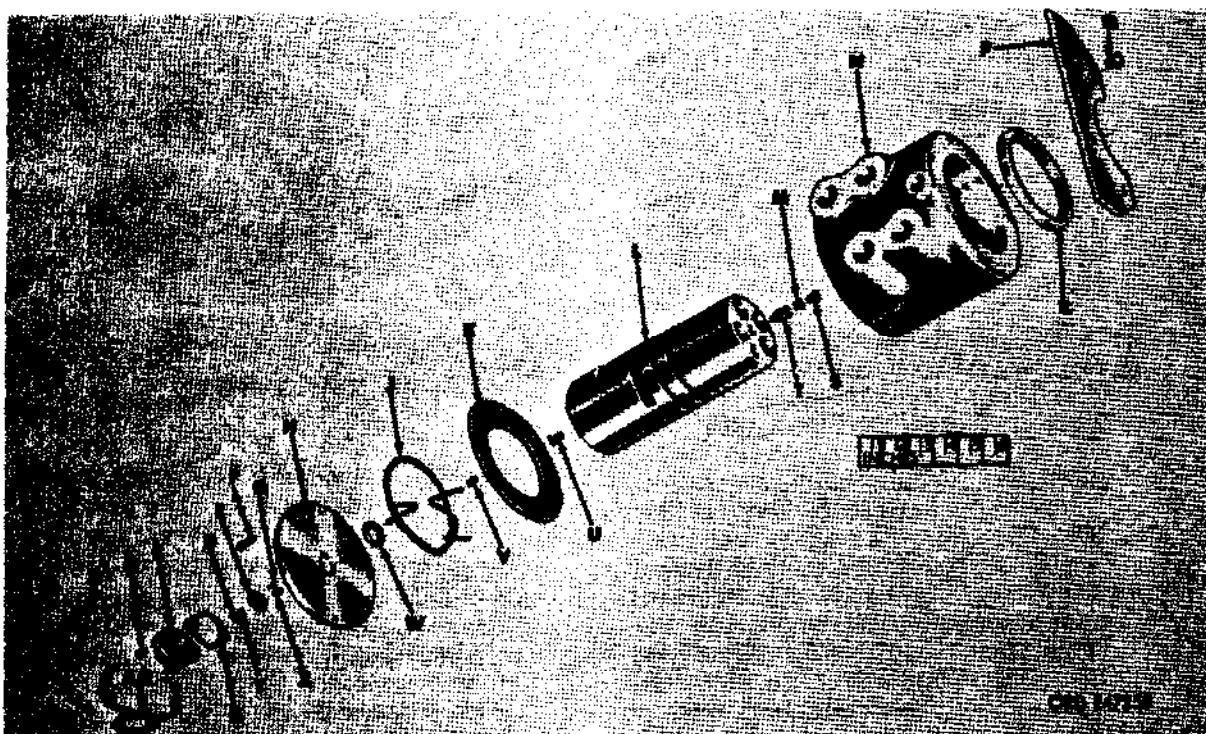


Figure 467. Swivel valve assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|-------------------------------|------------|------------------------------|
| A | Cable, upper, spotlight, assy | P | Guide, swivel valve |
| B | Screw, cap | Q | Screw, cap, hex-M, w/washer |
| C | Cap, collector | R | Seal, oil, body |
| D | Nut, contact, collector | S | Grommet, terminal connector |
| E | Insulator, collector cap | T | Shell, male connector |
| F | Screw, cap, hex-hd, w/washer | U | Cup, spring |
| G | Screw, machine | V | Spring, light cable |
| H | Cap, swivel valve | W | Seal, light cable |
| J | Cable, lower spotlight, assy | X | Screw, contact, collector |
| K | Gasket, cap | Y | Washer, lock, internal tooth |
| L | Hub, inner | Z | Gasket, collector cap |
| M | Bushing, terminal connector | AA | Cable, collector, assy |
| N | Body, swivel valve | | |

Figure 467. Swivel valve assembly - exploded view - legend

struction. Self-lubricated by the oil which it helps to deliver, this unit will require little servicing. If grit or dirt is kept from entering the hydraulic system, the swivel valve will last the life of the crane. For this reason, when disassembling the unit, take special care to prevent the entrance of dirt or foreign matter and protect the finished surfaces from any nicks or burs.

Warning: When disassembling the swivel valve, handle parts carefully to avoid possible personal harm. The accidental sliding of the sharply machined edges together might easily cause a painful injury.

Procedure.

- (a) Remove two cap screws and lock-washers and lift off collector cap

(fig. 469) and collector cap gasket (Z). The collector cap (C) enables electric current to pass through the swivel valve to the spotlight mounted on the crane. When cap is removed, it will then be possible to remove spotlight lower cable assembly (fig. 468) by threading up through the inner hub (L) of the swivel valve. If collector cap is defective, remove collector cable assembly (fig. 468).

- (b) Remove eight hex-head cap screws with washer (F) and lift off swivel valve cap (fig. 470) and gasket (K). Also, remove four hex-head cap screws or washer (Q) and swivel valve guide (fig. 468) from base of swivel valve. With these parts removed, the inner hub (fig. 470) may be removed. The inner hub (L) must be removed from the top of the swivel valve, since the openings in the inner hub will cut against the body oil seal (fig. 468) in the base of the swivel valve body (N) if the hub is removed from the bottom.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. If cleaning is required, parts may be cleaned by immersing them in clean dry-cleaning solvent or mineral spirits paint thinner. The swivel valve parts are precision parts and extra care must be practiced in handling. Metal-to-metal contact must be avoided and every precaution possible taken to protect the machined surfaces. If parts are not to be assembled immediately, apply a thin coat of oil and protect from dust and dirt.



Figure 468. Swivel valve with cable assembly

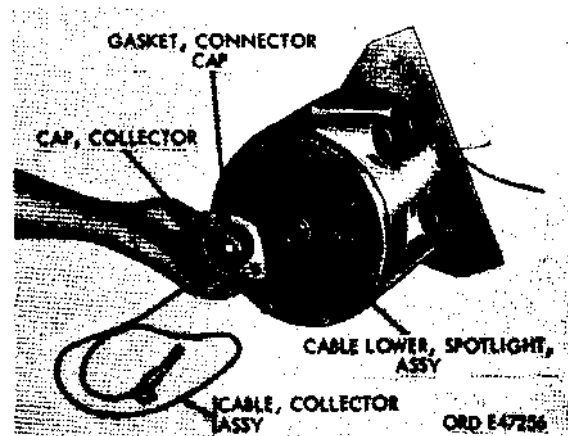


Figure 469. Removing collector cap from swivel valve

- (2) Inspection and repair. Check for nicks or burs on the finely machined surfaces of the swivel valve body and the inner hub. If these defects are not serious, a soapstone or fine mill file may be used to remove them. Parts having deep nicks or burs must be replaced. For checking wear between swivel valve body and inner hub, refer to serviceability standards (par. 358). Inspect the screw threads in both the swivel valve body and the base of the inner hub for cross threading. If threads cannot be repaired, the parts must be replaced. Inspect the oil seal thoroughly and if frayed or worn, replace. Be sure swivel valve cap is not cracked or damaged in any way. Check the electrical cable and replace if frayed or worn. Electrical connec-

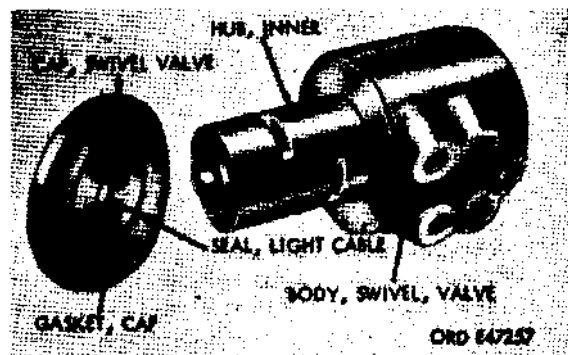


Figure 470. Cap and inner hub removed from swivel valve body

tions in connector cap must be clean and bright.

Note. The swivel valve body and inner hub are matched parts. If either part must be replaced, the matching part must also be replaced.

c. Assembly (Fig. 467).

- (1) The assembly of the swivel valve must be accomplished with the same attention and care to protect the various parts as was pointed out in the disassembly procedure. Keep hands and clothes free of dirt or grit while assembling and give strict attention to personal safety.
- (2) Place swivel valve body (N) top down on a bench and, if body oil seal (R) has been removed, install new body oil seal. Insert inner hub (L), large end first, into swivel (N) valve body. Place swivel valve guide (P) into groove provided around inner hub and secure guide to swivel valve body with four hex-head cap screws with washer (Q). Turn assembly unit over and place swivel valve cap gasket (K) and swivel cap on top of swivel valve body. Secure with eight hex-head cap screws with washer (F). Tighten to torque specifications (Appendix I).
- (3) Insert spring cup (U), light cable spring (V), and light cable seal (W) into center of swivel valve cap (H). Thread spotlight lower cable assembly (J) down through these installed parts so that contact end will rest against light cable spring (V). Install male connector shell (T), terminal connector bushing (M), and terminal connector grommet (S) to opposite end of spotlight lower wire. With terminal assembly. If collector cap (C) has been disassembled, insert collector cable assembly (AA) through collector cap opening and secure to collector cap insulator (E) with collector contact screw (X), internal-tooth lockwasher (Y), and collector contact nut (D). Secure insulator to collector cap with two screws (G).
- (4) Place collector cap gasket (Z) and collector cap assembly in position on swivel valve cap and secure with two hex-head cap screws (B).

335. Pivot Post and Base Plate Assembly

a. Disassembly. Due to the excessive weight of the pivot post and base plate, an overhead hoist must be provided to aid in disassembly. The base plate should be positioned on blocks approximately eight inches from the floor to give access to underneath side.

Warning: Extreme care must be exercised during disassembly to avoid serious injury to personnel.

- (1) Remove pivot post and shipper support.
 - (a) Remove ten safety nuts and cap strewn and two cap screws and lockwashers from shipper support (fig. 471). Remove support from pivot post.
 - (b) Remove two hex-nuts, external-tooth lockwashers, plain washers, and locking plates, and six safety nuts which secure pivot post support cap. Remove pivot post support cap and spacing shims (fig. 472). Keep shim pack intact for assembly.
 - (c) Remove 18 cap screws with washers. Remove pivot post gear shield and gear shield felt from base plate (fig. 473).
 - (d) Attach chain hoist to pivot post and lift high enough to permit removal of bearing cone. Remove bearing cone (fig. 474). Continue lifting pivot post until it is free from pivot post support (fig. 475).

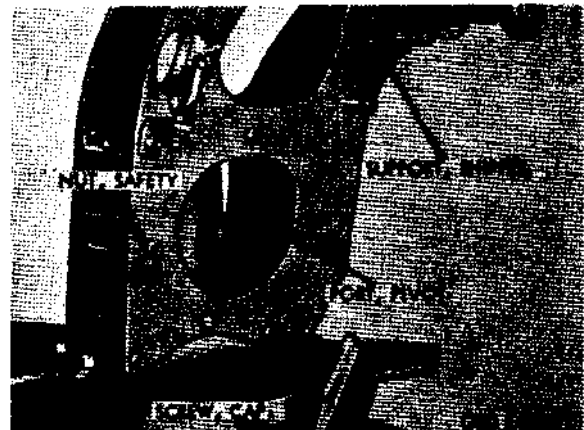


Figure 471. Disconnect points for shipper support removal

- (e) It is unnecessary to remove bearing cup in base of pivot post unless inspection warrants replacement. If inspection reveals replacement is needed, remove two lubricating fittings on base of of pivot post. The tapped holes for fittings are in line with the bearing cup. Insert a drift punch (fig. 476) in each hole and tap alternately until cup is removed.

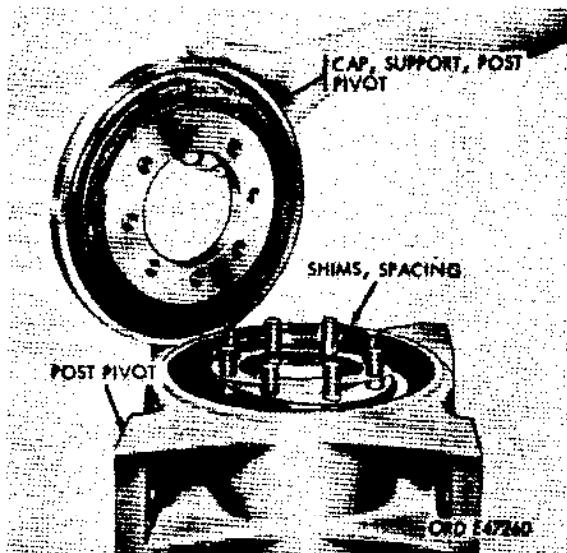


Figure 472. Removing pivot post support cap and spacing shims



Figure 473. Removing pivot post gear shield from base plate

- (f) It is unnecessary to remove bearing cup in swivel valve end of pivot post unless inspection warrants replacement. If inspection reveals replacement of cup is needed, use suitable puller and remove bearing cup from pivot post.

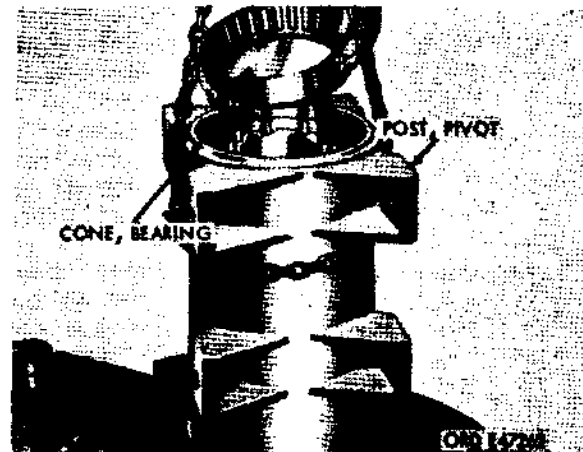


Figure 474. Removing bearing cone from pivot post

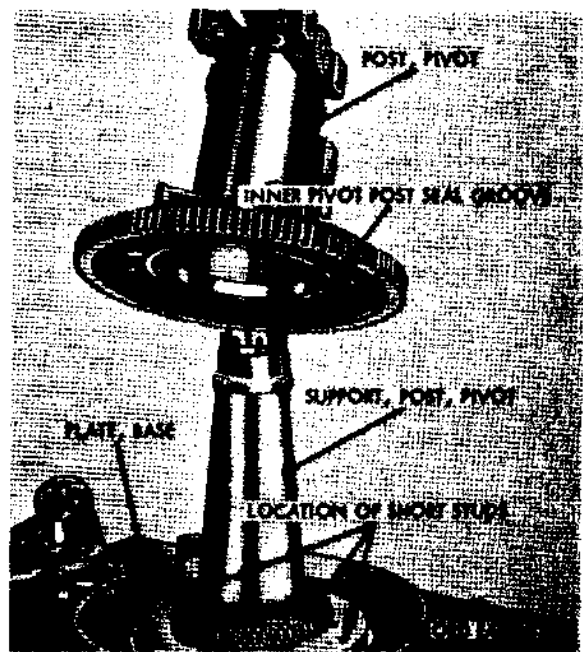


Figure 475. Removing pivot post from base plate

(2) Removal of drive pinion and pivot post support (fig. 477).

- (a) Remove 13 safety nuts and three hex-nuts securing pivot post support to base plate. Attach on overhead hoist to pivot post support and remove from base plate.
- (b) Remove two cap screws (X) securing retaining plate (V) and spacer shims (R, S, T, and U) to drive pinion idler gear shaft, and four cap screws and lockwashers securing drive pinion lower bearing cover and gasket to base plate. Remove two cap screws securing drive pinion adjusting plate and spacing shims to drive pinion (fig. 478). Remove plate and shims.
- (c) Remove four cap screws and lockwashers from idler gear housing cover. Remove idler gear housing cover, gasket, and felt. Remove drive pinion, drive pinion crank, and bearing cone. Also remove drive pinion idler gear shaft, drive pinion idler gear, and bearing cone assembly from base plate (fig. 479).
- (d) Support drive pinion crank in arbor press and press drive pinion from drive pinion crank. Remove bearing

cone from drive pinion crank. It is not necessary to remove bearing cups from base plate unless inspection (b below) reveals replacement is required.

- (e) Remove bearing cones (C and P) from each side of drive pinion idler gear (L). It is not necessary to remove bearing cups (D and N) in drive pinion idler gear unless inspection warrants replacement of gear or cups. If inspection reveals replacement of cups or gear is necessary, remove two cups and snap rings from gear.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Due to the heavy gear lubricant is used to lubricate the drive pinion, drive pinion idler gear, and welded-on ring gear at base of the pivot post, steam clean all parts to remove oil lubricant.

(2) Inspection and repair.

- (a) Base plate. Inspect base plate for defective welds or cracks. Minor weld failures can be repaired by re-welding. If other cracks are evident, replace base plate.
- (b) Pivot post. Inspect ring gear on base of pivot post for broken, cracked, or chipped teeth. Replace pivot post if any of these conditions are found.
- (c) Bearings and cups. Inspect bearings and cups for pitted, scratched, or scored condition. Replace bearing or cup if any of these conditions exist.
- (d) Drive pinion and idler gear. Inspect drive pinion and idler gear for broken, cracked, or chipped teeth. Replace defective gears.

c. Assembly. Before proceeding with the final assembly of the base plate and pivot post assembly, bearing adjustments must be made individually and without gear contact of mating part as outlined in paragraph 356. Use shim packs as therein prescribed to maintain specified bearing preloads.

Note. Bearing adjustments require temporary assembly and removal of the adjusted parts. Pack all tapered roller bearings with

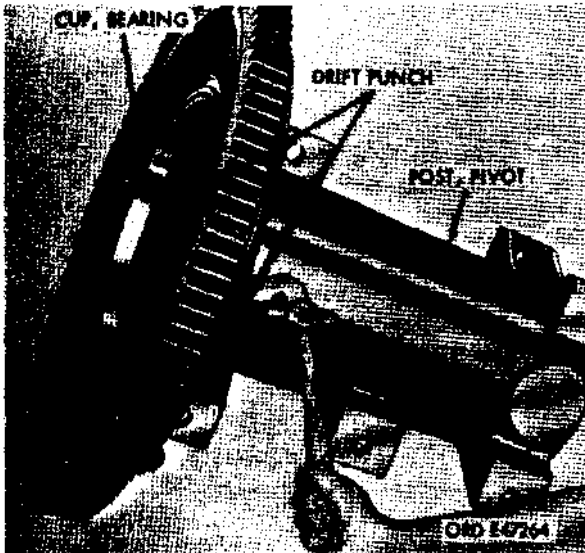


Figure 476. Removing bearing cup from base of pivot post

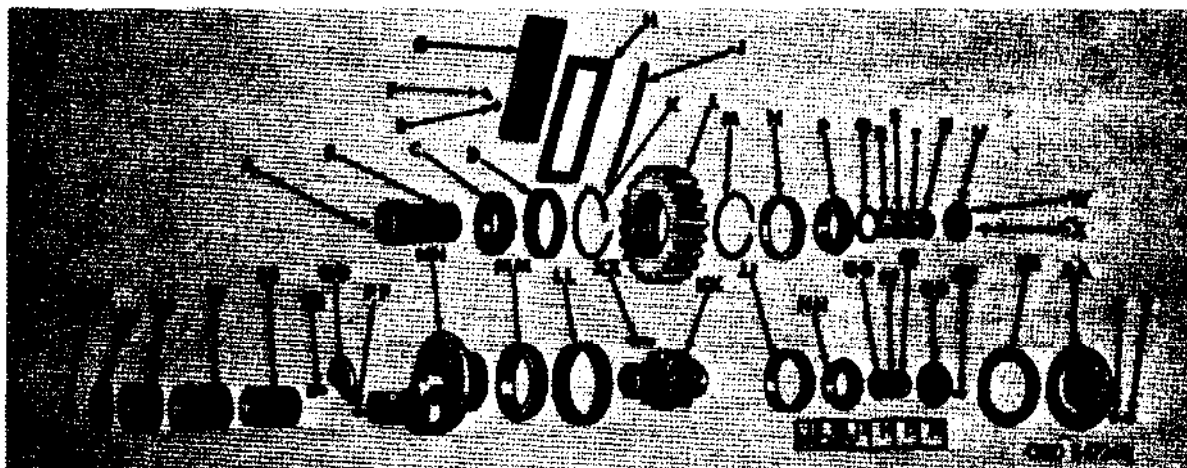


Figure 477. Drive pinion and idler gear - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---|------------|---|
| A | Fitting, lubricating | Z | Washer, lock |
| B | Shaft, gear, idler, pinion, drive | AA | Cover, bearing, lower, pinion, drive |
| C | Cone, bearing | BB | Gasket, cover, bearing, lower, pinion drive |
| D | Cup, bearing | CC | Screw, cap |
| E | Washer, lock | DD | Plate, adjusting, pinion, drive |
| F | Screw, cap | EE | Shim, spacing |
| G | Cover, housing, gear, idler | FF | Shim, spacing |
| H | Gasket, cover, housing, gear, idler | GG | Shim, spacing |
| J | Felt, cover, housing, gear, idler | HH | Cone, bearing |
| K | Ring, snap, bearing, gear, idler, pinion, drive | JJ | Cup, bearing |
| L | Gear, idler, pinion, drive | KK | Pinion, drive |
| M | Ring, snap, bearing, gear, idler, pinion, drive | LL | Cup, bearing |
| N | Cup, bearing | MM | Cone, bearing |
| P | Cone, bearing | NN | Crank, pinion, drive |
| Q | Washer, spacing | PP | Fitting, lubricating |
| R | Shim, spacing | QQ | Plate, retaining, pinion, drive |
| S | Shim, spacing | RR | Screw, cap |
| T | Shim, spacing | SS | Bushing |
| U | Shim, spacing | TT | Bushing |
| V | Plate, retaining | UU | Bushing |
| W | Pin, dowel | VV | Plate, retaining |
| X | Screw, cap | WW | Screw, special |
| Y | Screw, cap | XX | Key, Woodruff |

Figure 477. Drive pinion and idler gear - exploded view - legend

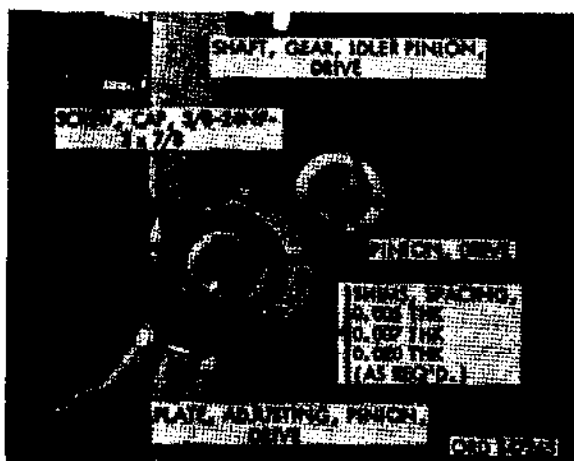


Figure 478. Removing drive pinion adjusting plate and spacing shims

artillery and automotive grease before final assembly.

(1) Install drive pinion idler gear (fig. 477).

- (a) Install drive pinion idler gear bearing snap rings (K and M), on inner diameter of drive pinion idler gear (L). If bearing cups were removed, press bearing cups (D and N) in drive pinion idler gear (L). Position bearing cones (C and P) in cups.
- (b) Install spacing washer (Q) in the bore for idler gear shaft, located in base Plate (J, fig. 480). Position drive pinion idler gear (L), with bearing assemblies, in gear housing of base plate (J, fig. 480) and insert drive pinion idler gear shaft (B) as shown in figure 473. Aline bore of idler gear with shaft and install shaft through gear in base plate.
- (c) Aline spacing shims (R, S, T, and U), as established in paragraph 356, with retaining plate (V) and insert two cap screws (X) through shims and plate. On the underside of base plate (J, fig. 480), aline retaining plate with dowel pin (W) and secure to drive pinion idler gear shaft (B) with two cap screws (X). Install lubricating fitting (A) on upper end of idler gear shaft.

(2) Install drive pinion and crank (fig. 477).

- (a) If inspection revealed that replacement of bearing cups (LL and JJ) was necessary, install new bearing cup in bore for drive pinion on top and bottom side of base plate (J, fig. 480).
 - (b) Install upper bearing cone (MM) on drive pinion crank (NN). Install Woodruff key (XX) on drive pinion (KK). Aline pinion and key with keyway on drive pinion crank and press these parts together. Position and aline drive pinion retaining plate (QQ) on drive pinion crank and secure to drive pinion with two special cap screws (RR).
 - (c) Position drive pinion (KK) with drive pinion crank (NN) in base plate (J, fig. 480). Install bearing cone (HH) from underside of base plate on drive pinion Aline spacing shims (EE, FF, and GG), as established in paragraph 356 with drive pinion adjusting plate (DD). Insert two cap screws (CC) through shims and adjusting plate and secure to drive pinion.
- (3) Install pivot post support and pivot post (fig. 480).
- (a) There are 16 studs installed in the the pivot post support to mount it to



Figure 479. Pivot post drive pinion and drive pinion idler gear removed

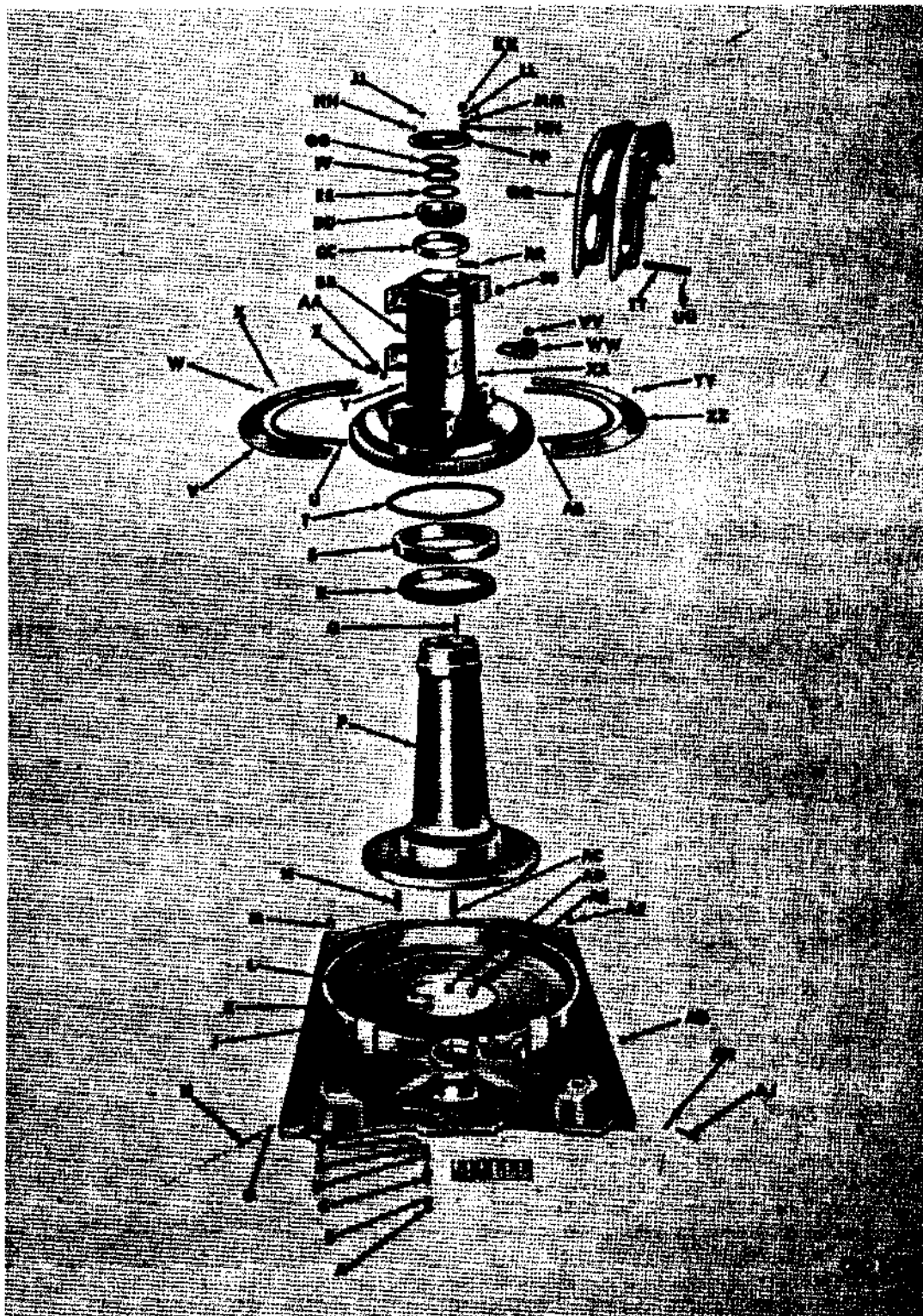


Figure 480. Pivot post and base plate - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---------------------------|------------|----------------------------------|
| A | Nut, jam | EE | Shim, spacing, 0.005 thk |
| B | Nut, hex | FF | Shim, spacing, 0.007 thk |
| C | Pin | GG | Shim, spacing, 0.020 thk |
| D | Roller | HH | Fitting, lubricating |
| E | Washer | JJ | Nut, safety |
| F | Pin cotter | KK | Nut, hex |
| G | Nut, jam | LL | Washer, ext-tooth |
| H | Screw, set, special | MM | Washer, plain |
| J | Plate, base | NN | Plate, locking, swivel valve hub |
| K | Nut, hex | PP | Cap, support, post, pivot |
| L | Washer | QQ | Support, shipper |
| M | Nut, safety | RR | Screw, cap, special |
| N | Stud, mounting | SS | Nut, safety |
| P | support, post, pivot | TT | Shaft, anchor, lift cylinder |
| Q | stud | UU | Pin, cotter |
| R | Cone, bearing | VV | Nut, safety |
| S | cup, bearing | WW | Plate, stop |
| T | Seal, poet, pivot, inner | XX | Fitting, lubricating |
| U | Felt, shield, gear | YY | Fitting, lubricating |
| V | shield, gear, poet, pivot | ZZ | Shield, gear, post, pivot |
| W | Screw, cap, w/washer | AB | Felt, shield, gear |
| X | Fitting, lubricating | AC | Stud, mounting |
| Y | Fitting, lubricating | AD | Plug, pipe, sq-M |
| Z | Screw, cap | AE | Nut, safety |
| AA | Washer, lock, reed, 1 in. | AF | Nut, safety |
| BB | Post, pivot | AG | Fitting, lubricating |
| CC | cup, bearing | AH | Nut, jam |
| DD | cone, bearing | AJ | Screw, set, special |

Figure 480. Pivot post and base plate - exploded view - legend

the base plate. Three of these studs are slightly shorter than the others in order to provide clearance. For installation position of short mounting studs, refer to figure 475.

- (b) Install 13 mounting studs (AC) and three mounting studs (N) on bottom side of pivot post support (P). Attach on overhead hoist to pivot post support and position on base plate (J). Install 13 safety nuts (AE) on long mounting studs and three hex-nuts (K) on short mounting studs. Tighten according to torque specification table in Appendix I.
- (c) Install bearing cone (R) at base of pivot post support (P). Position bearing cup (S) in pivot post (BB). Tap cup lightly around edges with a soft hammer until it is seated in pivot post. Make sure cup does not become cocked. Install bearing cup (CC) in swivel valve end of pivot post in same

manner. Install inner pivot post seal (T) in groove (fig. 475) in base of pivot post. Install eight studs (Q) in swivel valve end of pivot post support, for securing pivot post support cap.

- (d) Attach an overhead hoist to pivotpost (BB) and position over pivot post support (P). Lower pivot post until it is about 4 inches from being seated. While suspended over pivot post support, tilt pivot post enough to engage its ring gear teeth with drive pinion idler gear (L, fig. 477). Continue lowering pivot post until seated on bearing cone (R).
- (e) Position and install bearing cone (DD) in swivel valve end of pivot post (BB). Aline spacing shims (EE, FF, and GG) with pivot post support cap (PP). Position cap with shims, as adjusted in paragraph 356, on studs (Q). Install two swivel valve hub locking plates (NN), plain washers (MM), external-

tooth lockwasher (LL), hex-nuts (KK), and six safety nuts (JJ) to secure cap. Install two lubricating fittings (HH).

- (f) Position shipper support (QQ) on pivot post (BB) and secure with ten special cap screws (RR), safety nuts (SS), two cap screws (Z), and medium lockwashers (AA).
- (g) Position gear shield felt (U and AB) and pivot post gear shield (V and ZZ) on base plate (J). Install 18 cap screws with washers (W) to secure shields.

Note. Prepack ring gear with artillery and automotive grease before assembling pivot post gear shield to base plate.

336. Control Valve Bank (Fig. 481)

a. Disassembly (Fig. 482).

- (1) General. The control valve bank assembly (fig. 481) has been carefully assembled and will require a minimum

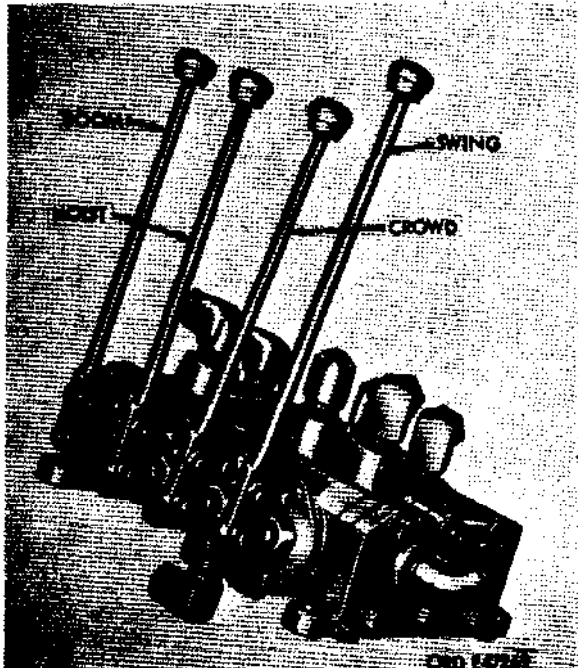


Figure 481. Control valve bank assembly

of servicing. The oil seals in the valve spool end shall be replaced if damaged. Any accumulation of dirt around the ends of the spool shall be removed. The tie rods used to bolt the separate valves together are set with a torque wrench. 85 pounds-feet of torque is used for the two center rods and 120 pounds-feet of torque is used for the four end rods.

- (2) Disassemble control valve bank assembly. Remove six hex-nuts and nuts and lockwashers from end of control valve bank assembly and remove control-valve bank end cover (fig. 483). Separate valve bank into individual control valves.

(3) Disassemble individual control valve.

- (a) Remove four cap screws (W) and washers and lift off control valve end cover (TT) and gasket (fig. 484).
- (b) Compress spring slightly and remove horseshoe-type washer (fig. 484), spacer, spring, and plain washer from rear end of (swing) control valve spool.
- (c) Remove cotter pins from the two lever retaining pins and take off control valve lever (P) and linkage from front end. of control valve. Remove cap screw (H) beneath control valve spool and eyebolt (R) above control valve spool. Take off control valve spool, front cover (F).
- (d) Slide control valve spool together with adapter ring (Z), chevron ring (M), and three chevron seals (E), out through front end of control valve body (fig. 485).
- (e) Remove control valve spool yoke (fig. 485) and locking nut (Y) from end of (swing) control valve spool (D).
- (f) Disassemble each control valve as described in (a) through (e) above.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. The control valve bank assembly must be treated with care. A clearance of 0.0002 to 0.0004-inch

exists between the control valve spool and the control valve body. When handling the control valve spool, be sure to prevent scratches, nicks, or burs. Immerse parts in clean dry-cleaning solvent or mineral spirits and wash away dirt. Note particularly the chamber into which the control valve spool slides and be sure all oil passages are open.

- (2) Inspection and repair. Examine the control valve spool to be sure there are no scratches, nicks, or burs. Slight defects may be removed with a fine mill file or soapstone, but if spool is of questionable service, it must be replaced. Refer to paragraph 358 for serviceability standards. Examine the control valve body for cracks, nicks, and burrs on machined surfaces. Cracked or damaged control valve body must be replaced.

Note. Control valve spool and control valve body must be replaced in matched sets.

c. Assembly (Fig. 482).

- (1) General. Before beginning the assembly control valve bank assembly, be sure that all parts are free of any grit.
- (2) Assemble hydraulic control valve.
 - (a) Turn control valve spool yoke (J) and locking nut (Y) into end of control valve (swing) spool (D). Tighten securely. Insert control valve spool into control valve body (BB) and push through until just enough space is left on spool to arrange three chevron seals (E), adapter ring (Z), and chevron ring (AA), as shown in figure 479. Completely push spool into place in body, install control valve spool front cover (F), and secure with hex-head cap screw (H), special eyebolt (R), and one locking nut (W).
 - (b) Assemble control valve lever (P) to control valve spool yoke and eyebolt and secure in place with three rod end pins (K, L, and M), two control valve links (N and S), and three new cotter pins (T, V, and X). Place con-

trol valve spring washer (XX), sleeve (RR), and spring (WW) on end of control valve spool, which extends out the rear end of control valve body. Compress spring sufficiently to secure spool, and associated parts, with horseshoe-type washer (SS).

- (c) Install control valve end cover (TT) and gasket (VV), and secure with four cap screws (UU).
 - (d) Tighten to torque specification Appendix I. Each of the four control valves is assembled in like manner. Control valve bodies and spools are not interchangeable, and must be kept in the same position in the valve bank for the function they are to control. Be sure to note the function of the control valve being replaced and order the parts accordingly.
- (3) Assemble control valve bank assembly (fig. 482). The assembling of the control valve bank assembly will require special attention so as to place control valves in the same position in the valve bank from which they were removed. When these units were originally assembled, precompressed gaskets were used. To accomplish this in the field, the following steps must be taken. Place control valve body gasket (C) between each control valve and the control valve bank end covers (B and QQ). Insert the five valve body tie rods (A) and one drilled valve body tie rod (ZZ) through the complete assembly, and secure tie rods at each end with 12 tie-rod washers (AB) and hex-nuts (AC and LL). Alternately tighten nuts on ends of tie rods so that control valve bank assembly will be drawn up evenly. Tighten two center rods to 85 pounds-feet of torque and 120 pounds-feet for the four end rods. Allow valve bank to set overnight and then check nuts to see if nuts are still at previous torque setting. Install five palnuts (AE and NN) to each end of tie rods and wire seals (AD and MM) to ends of drilled valve body tie rod (ZZ). If the two pipe plugs (HH and AF) were removed coat each with a hardening type sealing compound (Litharge or PermatexNo. 1) and install into valve bank end covers.

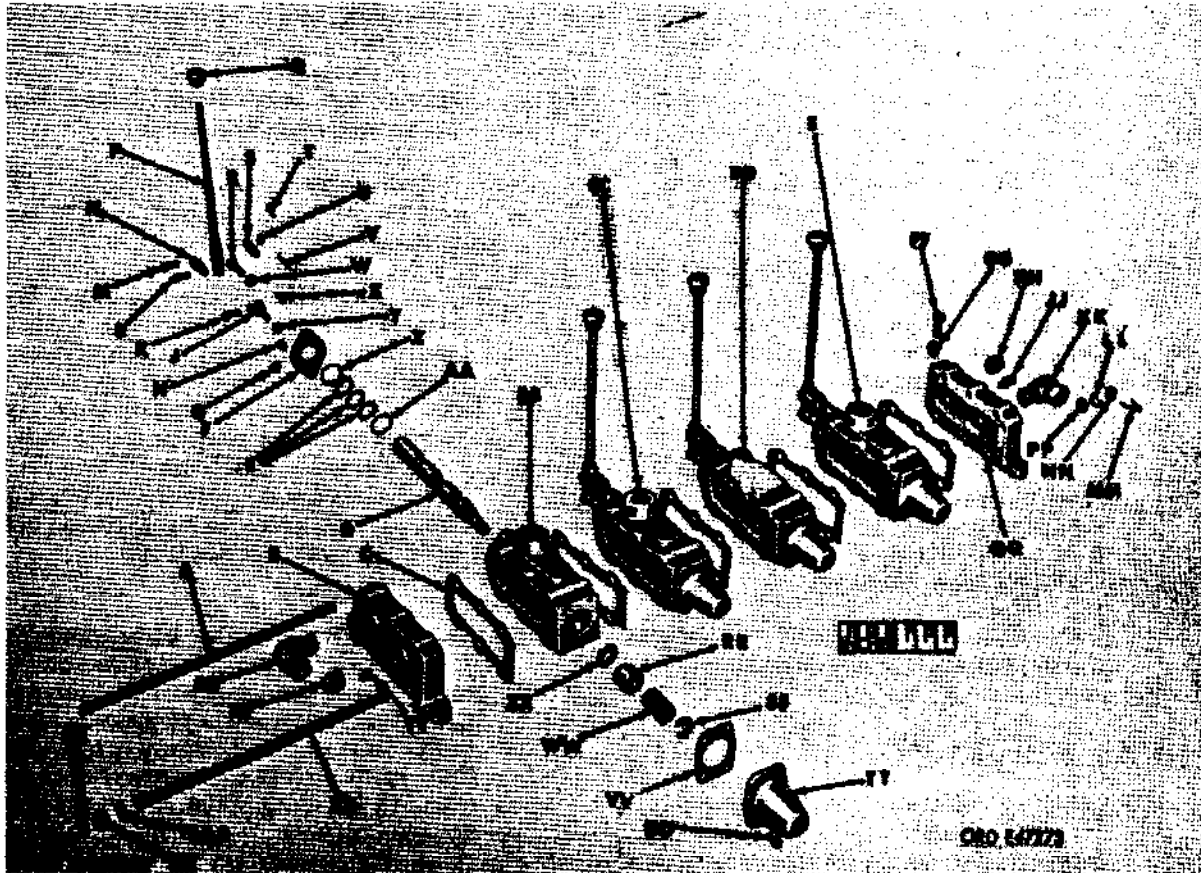


Figure 482. Control valve bank assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|-----------------------------------|------------|----------------------------------|
| A | Rod, tie, valve body | T | Pin, cotter |
| B | Cover, end, control valve bank | U | Washer, plain od |
| C | Gasket, control valve body | V | Pin, cotter |
| D | Spool, control valve (swing) | W | Nut, locking |
| E | Seal, chevron | X | Pin, cotter |
| F | Cover, front, control valve spool | Y | Nut, locking |
| G | Washer, lock | Z | Ring, adapter |
| H | Screw, cap, hex-hd | AA | Ring, chevron |
| J | Yoke, control valve spool | BB | Body, control valve |
| K | Pin, rod end | CC | Valve, control, assembly (crowd) |
| L | Pin, rod end | DD | Valve, control, assembly (hoist) |
| M | Pin, rod end | EE | Valve, control, assembly (boom) |
| N | Link, control valve | FF | Bolt |
| P | Lever, control valve | GG | Nut, safety |
| Q | Ball, control valve lever | HH | Plug, pipe, 1 in. |
| R | Bolt, eye, special | JJ | Adapter, bypass line |
| S | Link, control valve | KK | Elbow, 90 deg. |

Figure 482. Control valve bank assembly - exploded view - legend

| Key | Item |
|-----|----------------------------------|
| LL | Nut, hex |
| MM | Seal, wire |
| NN | Palnut |
| PP | Washer, plain |
| QQ | Cover, end, control valve bank |
| RR | Sleeve |
| SS | Washer, horseshoe-type |
| TT | Cover, end, control valve |
| UU | Screw, cap |
| VV | Gasket, end cover, control valve |

| Key | Item |
|-----|---------------------------------|
| WW | Spring |
| XX | Washer, control valve spring |
| YY | Plug, pipe |
| ZZ | Rod, tie, valve body (drilled) |
| AB | Washer, tie rod |
| AC | Nut, hex |
| AD | Seal, wire |
| AE | Palnut |
| AF | Plug, pipe |
| AG | Elbow, 90 deg, end <i>cover</i> |

Figure 482. Control valve bank assembly - exploded view - legend continued

337. Rear Winch (Fig. 486)

a. Disassembly.

- (1) Drain lubricant. Remove drain plug from gear case, and drain lubricant. It is not necessary to remove wire rope assembly from drum unless inspection warrants replacement. If wire rope is not removed, an overhead means of lifting the assembly must be used to facilitate disassembly.
- (2) Remove and disassemble level wind (fig. 487).
 - (a) Remove four cap screws (DD), lock-washers (MM), and lift level wind assembly from winch.
 - (b) Loosen four jam nuts (NN) and turn setscrews (PP) in trolley frame (AJ). Remove trolley frame from trolley track (EE).

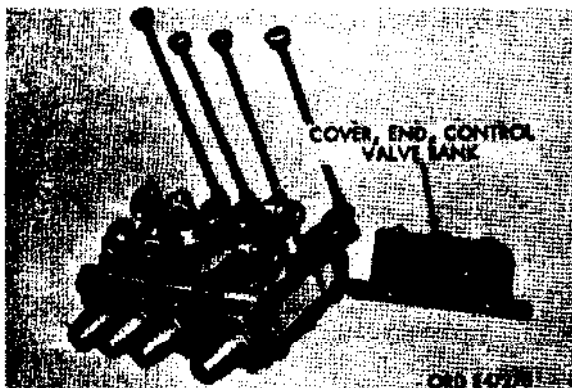


Figure 483. Control valve bank end cover separated from control valve bank assembly

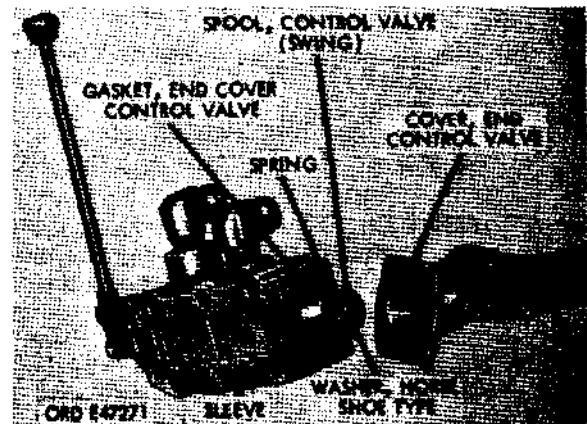


Figure 484. Removing control valve end cover

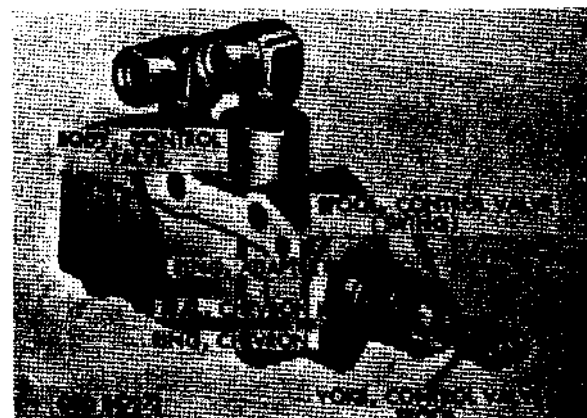


Figure 485. Control valve spool and chevron seals removed

- (c) Remove four cap screws (B) and lockwashers (A) securing cable guard (AZ). Remove cable guard.
- (d) Use suitable snap ring pliers and remove two snap rings (K and AR) from swivel sheave shaft (J). Remove shaft with dowel pin (H) and, at the same time, remove swivel sheave (AY), two swivel sheave bearing spacers (F and AW), and plain washers (E and AX) from swivel sheave frame (AQ). Remove swivel sheave sleeve (D) and needle bearing (C) from bore of sheave.
- (e) Loosen safety nut (AV) and remove nut, plain washer (AU), and felt washer (AT) from upper end of swivel sheave frame shaft (AS). Lift up on swivel sheave frame shaft (AS) and remove from trolley frame (AJ). Loosen safety nut (AK) on lower end of shaft and remove nut and shaft from bottom side of trolley frame. Remove inner and outer swivel sheave thrust bearing ball race (AN and AL) and swivel sheave thrust bearing balls (AM) from trolley.

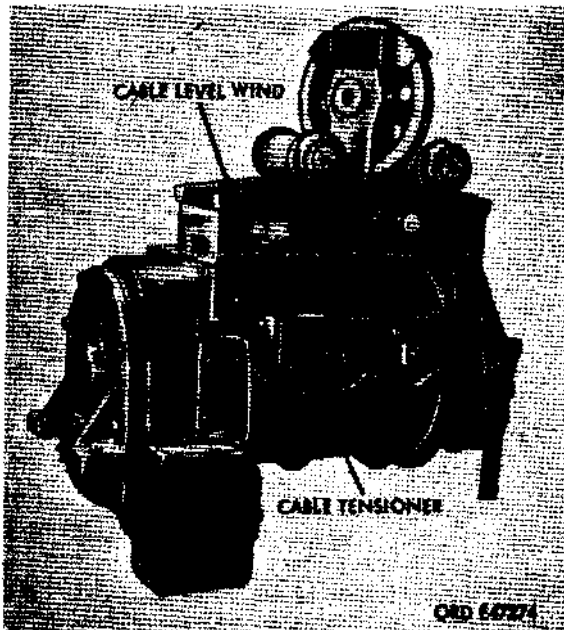


Figure 486. Rear mounted winch

Note. It is not necessary to remove needle bearing (AP) from swivel sheave frame (AQ) unless inspection warrants replacement of bearing.

- (f) Remove lubricating fittings (T and YY), snap rings (S and ZZ), and plain washers (R and AB) from ends of trolley axle (AH). Slide trolley wheels (P and AD) and plain washers (L and AG) from trolley axle. Remove felt washers (M and Q) and needle bearing (N) from trolley wheel (P). Remove felt washers (AC and AF) and needle bearing (AE) from trolley wheel (AD). Remove trolley axle (AH) from trolley frame (AJ). Remove trolley axle (CC) in same manner as trolley axle (AH).
- (3) Remove and disassemble cable tensioner (fig. 488).
- (a) Remove four hex-head cap screws (A) and lockwashers (FF) at gear case end, and four hex-head cap screws (A), lockwashers (FF), and two hex-nuts (DD) at end frame and remove tensioner assembly.
 - (b) Remove cotter pin (N) from pin (P), and cotter pin (Q) from pin (R). Remove pins and tension sheave lever (M).
 - (c) Remove two hex-head cap screws (L), lockwashers (FF), and hex-nuts (DD), from right tension frame bracket (K). Use the same procedure for removing left tension frame bracket (B).
 - (d) Remove cotter pin (J) and lubricating fittings (D and F) from tension sheave pins (E and G). Remove tension sheave pin (G), plain washers (S and X), and tension sheave adjusting frame (H) from tension sheave frame (C). Remove felt washers (W and T) and needle bearing (V) from tension sheave (U). Remove tension sheave (BB) in same manner as tension sheave (U).
 - (e) Remove four hex-head cap screws, (fig. 488) lockwashers, and one hex-nut (DD fig. 488) and remove tension channel.

(4) End frame assembly (fig. 489).

- (a) Support drum and wire rope with a chain hoist and lift off end frame.
- (b) Remove plain thrust washer and slide end frame bearing sleeve and bushing-type bearing from end frame.

Note. Do not remove oil seal unless inspection warrants replacement. If inspection warrants replacement of bearing, use suitable adapter and press bearing from sleeve.

(5) Gear case assembly.

- (a) Remove drum and wire rope assembly (fig. 490). Turn gear case on end with drum in a vertical position. Attach a chain around drum and wire rope. With the use of an overhead hoist, lift up on drum. Use a wooden block on end of drum shaft and tap until drum is free on shaft. Remove drum from shaft.
- (b) Drum shaft keys (fig. 483). Remove two square keys and plain thrust washers from drum shaft.
- (c) Removal of sprocket and drive worm bearing cap (fig. 490). Drive out shear pin from sprocket and remove sprocket from drive worm. Remove four hex-head cap screws and lock-washers from drive worm bearing cap. Remove cap and gasket.

Note. Do not remove oil seat in drive worm bearing cap unless inspection warrants replacement,

(d) Gear case cover (fig. 491).

1. Remove six cap screws and lock-washers and two machine screws from gear case cover. Remove gear case cover and gasket.
2. A bushing-type bearing is used in the gear case cover. Do not remove bearing unless inspection warrants replacement. To remove, collapse bearing and remove from gear case cover.

Note. Be sure replacement bearing is available before removing, as damage to bearing will occur during removal.

- (e) Automatic brake. Refer to paragraph 41.

b. Cleaning, Inspection, and Repair.(1) Cleaning.

- (a) Clean all metal parts in mineral spirits paint thinner or dry-cleaning solvent. Use a stiff brush to remove accumulation of dirt or hardened lubricant. Be sure all oil and lubricant passages are open and clean. Keep brake band and lining dry.

- (b) Blow ball bearings dry with compressed air.

Note. Do not spin bearings with the compressed air. Turn bearings slowly with fingers as air is directed at right angles to bearing assembly.

If the bearings are not thoroughly clean after this operation, place them in a pan of clean mineral spirits paint thinner or dry-cleaning solvent, and allow them to remain there until all solid particles are loosened and lubricant dissolved.

(2) Inspection.

- (a) Bearings. Inspect each ball bearing for rough or scored balls. Replace if balls are damaged. Apply engine oil to acceptable bearing assemblies and cover to protect against dust and dirt. Inspect bore of all bushing-type bearings and replace if scored or excessively worn, as outlined in serviceability standards (par. 358).
- (b) Gear case and end frame. Inspect gear case and end frame for cracks and damaged threads in tapped holes. Repair or replace defective parts.
- (c) Drum shaft, gear, and drive worm. inspect drum shaft for scoring and excessive wear. Inspect drum shaft gear teeth and drive worm. If any of the teeth are broken, chipped, or badly scored, and drive worm is damaged, the worm or gear must be replaced.

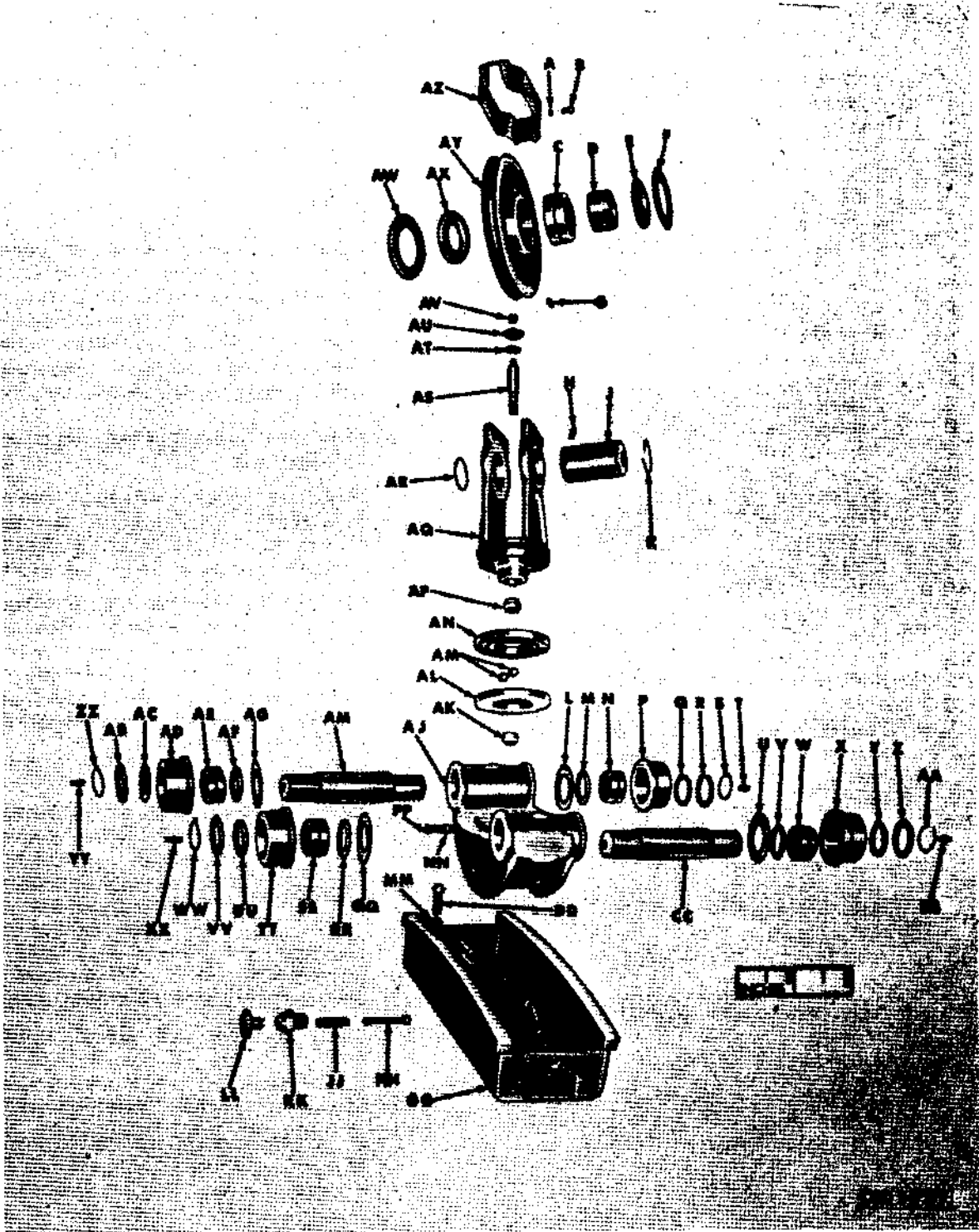


Figure 487. Cable level wind - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|------------------------------------|------------|--|
| A | Washer, lock | PP | Screw, set |
| B | Screw, cap | QQ | Washer, plain |
| C | Bearing, needle | RR | Washer, felt |
| D | Sleeve, sheave, swivel | SS | Bearing, needle |
| E | Washer, plain | TT | Wheel, trolley |
| F | Spacer, bearing, sheave, swivel | UU | Washer, felt |
| G | Fitting, lubricating | VV | Washer, plain |
| H | Pin, dowel | WW | Ring, snap |
| J | Shaft, sheave, swivel | XX | Fitting, lubricating |
| K | Ring, snap | YY | Fitting, lubricating |
| L | Washer, plain | ZZ | Ring, snap |
| M | Washer, felt | AB | Washer, plain |
| N | Bearing, needle | AC | Washer, felt |
| P | Wheel, trolley | AD | Wheel, trolley |
| Q | Washer, felt | AE | Bearing, needle |
| R | Washer, plain | AF | Washer, felt |
| S | Ring, snap | AG | Washer, plain |
| T | Fitting, lubricating | AH | Axle, trolley |
| U | Washer, plain | AJ | Frame, trolley |
| V | Washer, felt | AK | Nut, safety |
| W | Bearing, needle | AL | Race, ball, bearing, thrust, sheave, swivel, outer |
| X | Wheel, trolley | AM | Bell, bearing, thrust, sheave, swivel |
| Y | Washer, felt | AN | Race, ball, bearing, thrust, sheave, swivel, inner |
| Z | Washer, plain | AP | Bearing, needle |
| AA | Ring, snap | AQ | Frame, sheave, swivel |
| BB | Fitting, lubricating | AR | Ring, snap |
| CC | Axle, trolley | AS | Shaft, frame, sheave, swivel |
| DD | Screw, cap | AT | Washer, felt |
| EE | Track, trolley | AU | Washer, plain |
| FF | Bolt, hex-head | AV | Nut, safety |
| GG | Nut, jam | AW | Spacer, bearing, sheave, swivel |
| HH | Poppet, lock, frame, trolley | AX | Washer, plain |
| JJ | Spring, compression | AY | Sheave, swivel |
| KK | Nut, poppet, lock, frame, trolley | AZ | Guard, cable |
| LL | Knob, poppet, lock, frame, trolley | | |
| MM | Washer, lock | | |
| NN | Nut, jam | | |

Figure 487. Cable level wind - exploded view - legend

- (d) Drive worm brake. Inspect brake surface or drive worm brake disk. If surface is scored or rough, it must be replaced. Inspect brake band assembly. If lining is oil soaked, or worn it must be replaced.
- (e) Wire rope. Inspect wire rope for broken or frayed strands. Inspect clamp chain and hook for damage. Replace defective parts.
- (f) Oil seals. Normally, metal-cased oil seals are long-life parts and may be reused if in good condition. Inspect seal contact material to make sure it is pliable and shows no evi-

dence of burning. Inspect the thin featheredge which contacts the rotating parts to make sure it is intact. Replace seals if defects are found.

(3) Repair

- (a) General. Remove nicks and burs from machined gasket surfaces. Pay particular attention to oil seal contact surfaces. Use a fine mill file to repair surfaces.
- (b) Drive worm brake lining. Remove oil lining and rivets. Install rivets at each end of band first, then alternately until all rivets are installed.

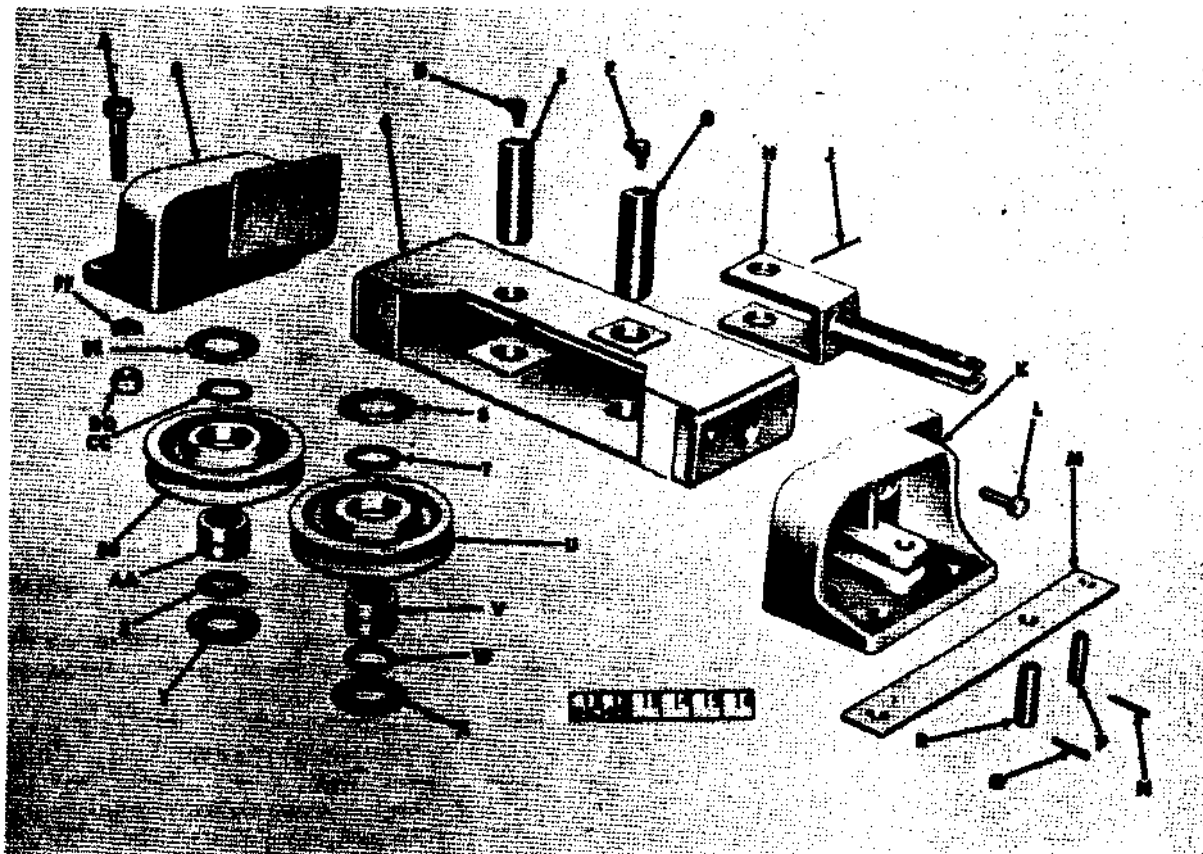


Figure 488. Cable tensioner - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|-----------------------------------|------------|-----------------------------------|
| A | Screw, cap, hex-head | R | Pin |
| B | Bracket, frame, tension, left | S | Washer, plain, 1.260 id, 2-1/2 od |
| C | Frame, sheave, tension | T | Washer, felt |
| D | Fitting, lubricating | U | Sheave, tension |
| E | Pin, sheave, tension | V | Bearing, needle |
| F | Fitting, lubricating | W | Washer, felt |
| G | Pin, sheave, tension | X | Washer, plain |
| H | Frame, adjusting, sheave, tension | Y | Washer, plain |
| J | Pin, cotter | Z | Washer, felt |
| K | Bracket, frame, tension, right | AA | Bearing, needle |
| L | Screw, cap, hex-head | BB | Sheave, tension |
| M | Lever, sheave, tension | CC | Washer, felt |
| N | Pin, cotter | DD | Nut, hex |
| P | Pin | EE | Washer, plain |
| Q | Pin, cotter | FF | Washer, lock |

Figure 488. Cable tensioner - exploded view - legend

- (c) Drum shaft and gear. To install new drum shaft gear, support gear at hub and position drum shaft in gear. Be sure keys in shaft are properly seated and aligned with keyway in gear hub. Press shaft through gear until keys have entered gear hub.

c. Assembly (Fig. 488).

(1) Assemble cable tensioner.

- (a) Install needle bearing (V) in tension sheave (U). Position felt washers (T and W) on each side of bearing.
- (b) Position lever end of tension sheave adjusting frame (H) in end of tension sheave frame (C). Also position tension sheave (U) and plain washers (S and X) in tension sheave frame. Secure tension sheave (U) and tension sheave adjusting frame (H) with tension sheave pin (G), and install new cotter pin (J) in tension sheave pin. Assemble tension sheave (BB) in same manner as tension sheave (U).
- (c) Position right tension frame bracket (K) on end of tension sheave frame (C), and secure with two hex-head cap screws (L), lockwashers (FF), and hex-nuts (DD). Position left tension frame bracket (B) and secure in same manner.
- (d) Position tension sheave lever (M) to right tension frame bracket (K) and install pin (R) to secure in place. Install new cotter pins (Q) at each end of pin (R). Insert pin (P), which connects tension sheave lever (M) to tension sheave adjusting frame (H), and secure pin with two new cotter pins (N).

(2) Assemble level wind (fig. 487).

- (a) Position trolley axle (AH) in trolley frame (AJ). Install needle bearing (AE), with felt washers (AC and AF) on each side of bearing in trolley wheel (AD). Position plain washer (AG), trolley wheel with bearing and felt washers, and plain washer (AB) on end of trolley axle (AH). Install snap ring (ZZ) to secure wheel on axle. Install needle bearing (N) with

felt washers (M and Q) on each side of bearing in trolley wheel (X). Position plain washer (L), trolley wheel with bearing and felt washers, and plain washer (R) on opposite end of trolley axle (AH). Install snap ring (S) to secure wheel in axle. Follow same procedure for installing trolley axle (CC).

- (b) Install outer-swivel-sheave thrust bearing ball race (AL) in trolley frame (AJ). Position 45 swivel sheave thrust bearing balls (AM) on outer race and install inner-swivel-sheave thrust bearing ball race (AN) over bearing balls. Install swivel sheave frame shaft (AS) in trolley frame and secure at lower end with safety nut (AK). If needle bearing (AP) was removed, install new bearing in swivel sheave frame (AQ). Position swivel sheave frame over swivel sheave frame shaft (AS), in trolley frame (AJ) and install felt washer (AT), plain washer (AU), and safety nut (AV).
- (c) Install swivel sheave sleeve (D) in needle bearing (C). Install bearing in swivel sheave (AY). Position and align sheave in swivel sheave frame (AQ). At the same time, position plain washers (E and AX) and swivel sheave bearing spacer (F and AW) on each side of swivel sheave (AY) in swivel sheave frame. Install swivel sheave shaft (J) in frame through sheave. Install snap rings (K and AR), one at each end of shaft. Position swivel sheave cable guard (AZ) and secure with four cap screws (B) and lockwashers (A).

(3) Install drum shaft gear (AM) and drive worm (P) (fig. 492).

- (a) Install two square keys (T and NN) in drum shaft (V). Position plain thrust washer (AL) and drum shaft gear (AM) on shaft. Align keyways in gear with keys and press shaft into the gear.
- (b) If bushing-type bearing (R) was removed from gear case (Q), press new bearing into place. Position drum shaft (V) with gear in case. After

shaft and gear are positioned in case, slide plain thrust washer (S) onto end of shaft and next to case. Install two square keys (U and MM) in shaft.

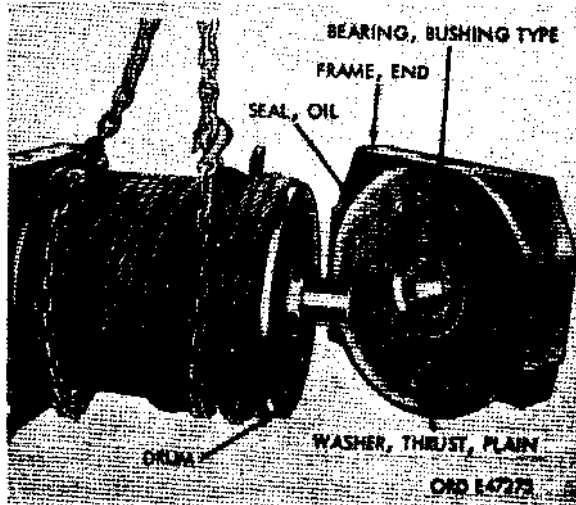


Figure 489. Removing end frame assembly

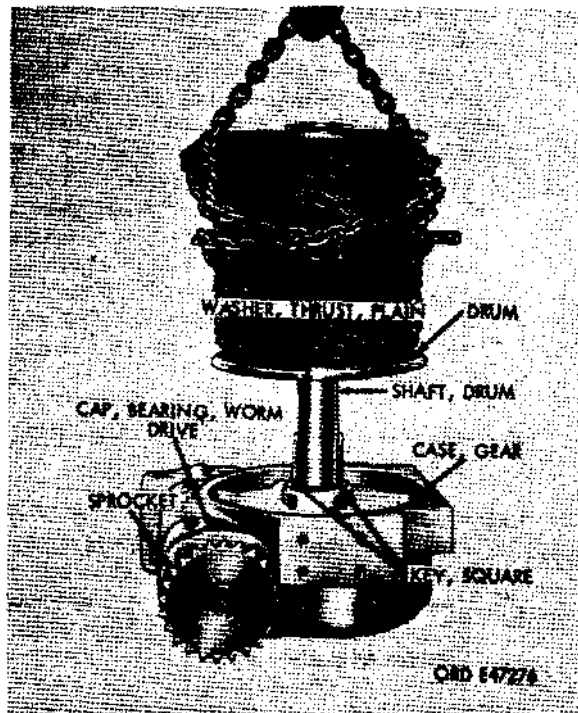


Figure 490. Removing drum assembly from drum shell

(c) Install ball bearing (N) on sprocket end of drive worm (P). Slide drive worm into gear case (Q) and while sliding worm into case, enmesh drive worm threads with drum shaft gear (AM) and tap bearing into position. If oil seal (M) was removed, install new oil seal in drive worm bearing cap (F).

(d) Position drive-worm bearing cap gasket (E) and drive-worm bearing cap (F) to gear case (Q). Secure cap with four cap screws (H) and lockwashers (G). Install sprocket (L) on end of drive worm and secure with shear pin (J) and new cotter pin (K).

(e) Install ball bearing (QQ) on opposite end of drive worm (P). If oil seal (RR) was removed, install new seal in drive worm brake case (SS). Position drive-worm brake case gasket (PP) and brake case to gear case (Q) and secure with four cap screws (AH) and lockwashers (AJ). Position square key (AK) in drive worm and align keyways of drive-worm brake disk (TT) with the key. Install brake disk on drive worm. Secure disk with bearing retaining washer (UU), cap screw (WV) and lockwasher (VV).

(f) Position drive-worm brake band (XX) over drive-worm brake disk (TT) and **install compression spring (AC).**



Figure 491. Gear case cover removed

Place plain washer (ZZ) on cap screw (YY). Place O-ring gasket (AB) on cap screw and install screw through drive-worm brake case (SS), compression spring (AC), and lugs on drive-worm brake band (XX). Tighten screw sufficiently to hold brake band. Position drive-worm brake case cover (AE) with gasket (AG) to drive-worm brake case. Install two hex-head screws with external-tooth lockwashers (AD) and four flat - head screws with external-tooth lockwashers (AF) to secure cover.

- (g) If bushing-type bearing (AP) was removed from gear case cover (C), press in new bearing. Install plain thrust washer (AL) on gear end of drum shaft (V). Position gear case cover (C) and gasket (D). Install six cap screws (A), six lockwashers (B), and two machine screws (AU), securing cover.

(4) Install seals and bearings (fig. 492).

- (a) If oil seals (W and LL) were removed, install new seal in end of drum (X) and end frame (FF). Install dowel pin (GG) in bore of end frame (FF). If bushing-type bearing (JJ) was removed from end frame bearing sleeve (HH), press new bearing into sleeve.
- (b) Position drum (X) on drum shaft (V) and align keyways in bore of drum with square keys (U and MM) on shaft. Align and install end frame bearing sleeve (HH) with dowel pin (GG), previously installed ((a) above), in end frame (FF).
- (c) Position plain thrust washer (KK) on drum shaft (V) and install end frame (FF). Position tension channel (Z) and secure with cap screw (EE), hex-nut (CC), lockwasher (DD), three cap screws (BB), and lockwashers (AA).

- (5) Install cable tensioner. Position cable tensioner assembly on front of winch end install eight cap screws (A, fig. 488), lockwashers (FF, fig. 488) and two hex-nuts (DD, fig. 488) to secure in place.

- (6) Install level wind. Position level wind on winch and secure with four cap screws (DD, fig. 487) and lockwashers (MM, fig. 487).

338. Swing Motor

a. Disassembly.

- (1) General. The cylinder assemblies of swing motor (fig. 493) are removed from the base plate as one assembly. Separation procedure of the cylinder assemblies is described in (2) below. Disassembly procedures for both cylinder assemblies are identical; however, only the right cylinder disassembly is illustrated.
- (2) Separation of cylinder assemblies. Position piston rod ends of cylinder assemblies in press. Support cylinder assemblies with rod ends in line with ram on press. Use suitable adapter and press sleeve and bushing (fig. 493) from yoke end of piston rod.

Warning: The shape and weight of each cylinder assembly make it difficult to handle. Extreme care must be exercised when separating cylinder assemblies to avoid serious injury to personnel. Use suitable adapter and press bushing from sleeve.

- (3) Disassembly of right cylinder assembly.

Note. The key letters noted in parentheses are in figure 498 unless otherwise indicated.

- (a) Remove control-valve spool end plug (S), gasket (R), and control valve spool spring (Q) from right cylinder body (M). Remove control valve spool (fig. 494) from valve chamber in right cylinder body.
- (b) Remove actuating - lever - adjusting screw end plug (fig. 495), gasket (GG), and pipe plug (HH) from valve chamber in right cylinder body.
- (c) Use a thin wall socket wrench and remove cap screws (NN) and lockwasher (MM) from valve actuating lever (KK).

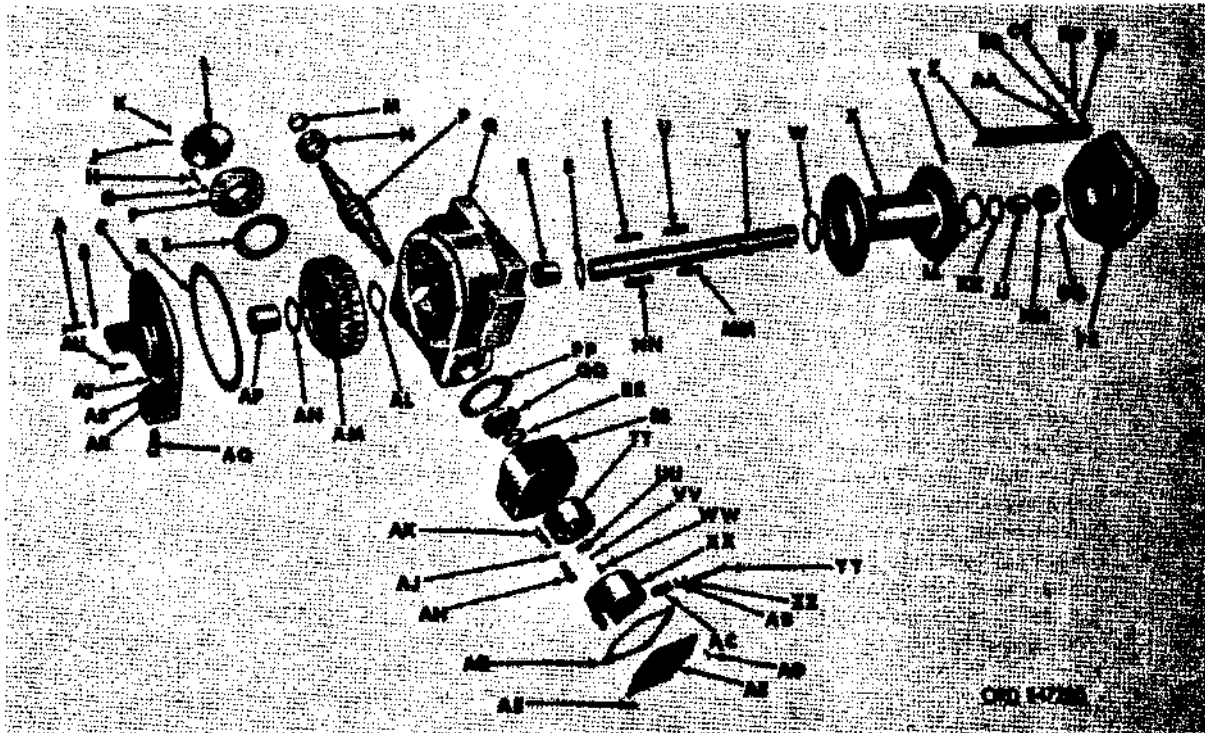


Figure 492. Rear mounted winch - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|-----------------------------------|------------|----------------------------------|
| A | Screw, cap | AA | Washer, lock |
| B | Washer, lock | BB | Screw, cup |
| C | Cover, case gear | CC | Nut, hex |
| D | Gasket, cover, case, gear | DD | Washer, lock |
| E | Gasket, cap, bearing, worm, drive | EE | Screw, cap |
| F | Cup, bearing, worm, drive | FF | Frame, end |
| G | Washer, lock | GG | Pin, dowel |
| H | Screw, cap | HH | Sleeve, bearing, frame, end |
| J | Pin, shear | JJ | Bearing, bushing-type |
| K | Pin, cotter | KK | Washer, thrust, plain |
| L | Sprocket | LL | Seal, oil |
| M | Seal, oil | MM | Key, square |
| N | Bearing, ball | NN | Key, square |
| P | Worm, drive | PP | Gasket, case, brake, worm, drive |
| Q | Case, gear | QQ | Bearing, ball |
| R | Bearing, bushing-type | RR | Seal, oil |
| S | Washer, thrust, plain | SS | Case, brake, worm, drive |
| T | Key, square | TT | Disk, brake, worm, drive |
| U | Key, square | UU | Washer, retaining bearing |
| V | Shaft, drum | VV | Washer, lock |
| W | Seal, oil | WW | Screw, cap |
| X | Drum | XX | Band, brake, worm, drive |
| Y | Screw, set, hex-socket | YY | Screw, cap |
| Z | Channel, tension | ZZ | Washer, plain |

Figure 492. Rear mounted winch - exploded view - legend

| Key | Item | Key | Item |
|-----|---|-----|-----------------------|
| AB | Gasket, O-ring | AK | Key, square |
| AC | Spring, compression | AL | Washer, thrust, plain |
| AD | Screw, hex-head, w/external-tooth lockwasher | AM | Gear, shaft, drum |
| AE | Cover, case, brake, worm, drive | AN | Washer, thrust, plain |
| AF | Screw, flat-head, w/external-tooth lockwasher | AP | Bearing, bushing-type |
| AG | Gasket, cover, case, brake, worm, drive | AQ | Screw, cap |
| AH | Screw, cap | AR | Washer, mounting |
| AJ | Washer, lock | AS | Washer, lock |
| | | AT | Nut, hex |
| | | AU | Screw, machine |

Figure 492. Rear mounted winch - exploded view - legend - continued

- (d) Before removal of right control valve lever with shaft (LL), shaft must be marked with right cylinder body (M) to facilitate aligning serrations for proper reassembly of shaft to valve actuating lever (KK). Position valve actuating lever in a vertical position and mark shaft with body. Tap shaft with a soft hammer and remove control valve lever with shaft from body. This operation will permit valve actuating lever to rest at the bottom of the valve chamber. Remove lever O-ring gaskets (J and JJ) from body.

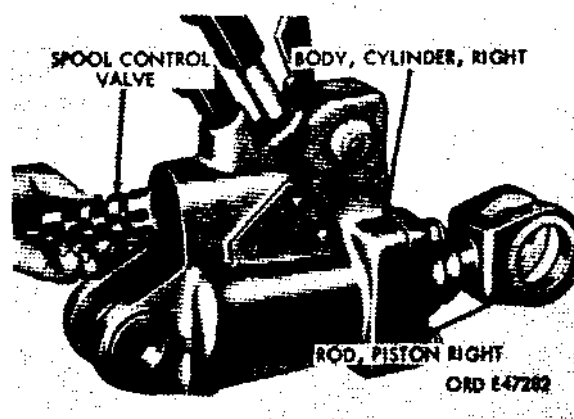


Figure 494. Removing control valve spool

(4) Piston and cylinder body cap.

- (a) Remove four locknuts and hex-nuts (fig. 495) from cylinder body cap (C). Remove cylinder body cap, cap gasket, piston, and right piston rod from right cylinder body (fig. 496).

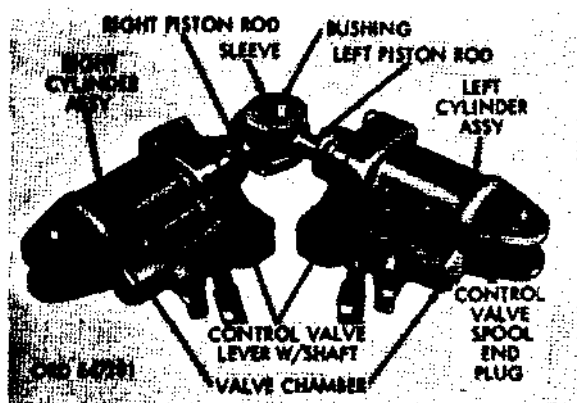


Figure 493. Swing motor - bottom view

- (b) Remove cotter pin (H), slotted hex-nut (G), and piston (F) from piston rod.
- (c) Insert a tapered tool under piston O-ring gasket (fig. 496) and remove gasket from piston (F).
- (d) Remove piston rod cap (Z), piston rod wiper (X), felt washer (W), felt washer retainer (V), chevron seal ring (U), and five chevron seals (T) from cylinder body cap (fig. 497).
- (e) Use suitable adapter and press pivot pin bushings (N) from right cylinder body (M).
- (f) Follow same procedure for disassembling left cylinder assembly.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean all parts in mineral spirits paint thinner or dry-cleaning

solvent. Apply a coat of light engine oil to the machined surface of cylinder body to prevent rusting.

(2) Inspection and repair.

- (a) Cylinder body. Inspect cylinder bore for scratches, nicks, or burrs. Remove with soapstone or fine mill file. Replace cylinder if damage is beyond repair.
- (b) o-ring gaskets. Inspect gaskets for scratches, flat spots, and indications of wear. Replace gaskets if any of these conditions exist.
- (c) Piston and rod. Inspect piston and rod for scratches, nicks, or burrs. Remove scratches with a soapstone. Use a fine mill file and remove nicks and burrs. Replace piston and rod if damage is beyond repair.
- (d) Chevron seals. Inspect chevron seals for scratches and nicks. If either of these conditions is found, replace seals.
- (e) Control valve spool. Inspect control valve spool for nicks and scratches. Use a soapstone or fine mill file and remove slight nicks and scratches. Inspect oil passages in spool to see that they are not plugged. Clean passages. Inspect spool for evidence of wear.

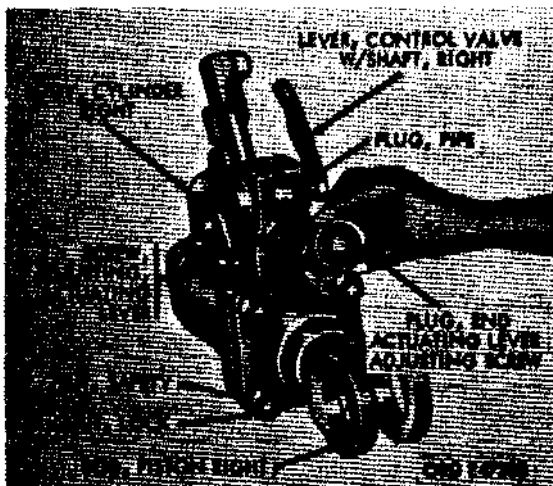


Figure 495. Remove actuating lever adjusting screw end plug

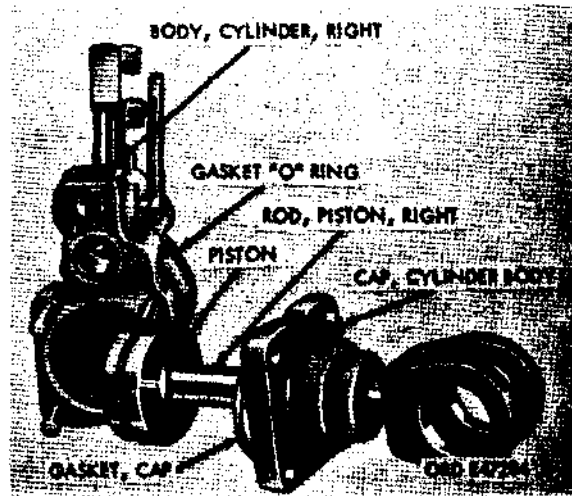


Figure 496. Piston and rod removed from right cylinder body

c. Assembly.

(1) Assemble valve assembly (fig. 498).

- (a) The bore in the cylinder body for right control valve lever with shaft (LL) is recessed for installation of two O-ring gaskets. Install valve-actuating-lever O-ring gasket (JJ) on lever side of right cylinder body (M) and valve-actuating-lever O-ring gasket (J) in recess on opposite side of cylinder body.
- (b) Position valve actuating lever (KK) in position in valve chamber of right

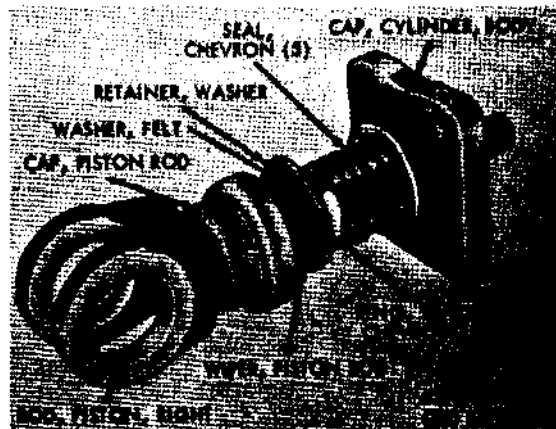


Figure 497. Piston rod and cylinder body cap assembly

cylinder body (M). Insert shaft of right control valve lever with shaft (LL) in cylinder body and align aligning mark on shaft of right control valve lever with aligning mark on cylinder body. Press right control valve lever with shaft (LL) into cylinder body. Install cap screw (NN) and lockwasher (MM) on valve actuating lever (KK) to secure lever to shaft. Install actuating - lever - adjusting screw jam nut (QQ) on actuating lever adjusting screw (PP) and install on actuating lever. Install actuating - lever - adjusting screw end plug (FF), gasket (GG), and pipe plug (HH) in cylinder body.

- (c) Install control valve spool (P) in valve chamber of right cylinder body (M). Insert control valve spool spring (Q) in cylinder body and secure with control-valve-spool end plug gasket (R) and end plug (S).

(2) Install piston and rod assembly.

- (a) Position piston rod wiper spring (Y) on piston rod wiper (X). Install piston rod cap (Z), piston rod wiper (X), felt washer (W), felt washer retainer (V), chevron seal ring (U), five chevron seals (T), and cylinder body cap (C) on right piston rod (AA). Install piston rod cap on cylinder body cap.
- (b) Position piston (F) on right piston rod (AA) and install slotted hex-nut (G). Insert new cotter pin (H) in end of rod to secure nut.
- (c) Install piston O-ring gasket (E) on outer diameter of piston (F).
- (d) Install four studs (K) in right cylinder body (M). Position cap gasket (D) in cylinder body. Apply a coat of light engine oil to the outer surface of piston (F) and piston O-ring gasket (E). Insert piston in cylinder body and install four hex-nuts (B) and locknuts (A) to secure cylinder body cap (C) to cylinder body.
- (e) Use suitable adapter and press pivot pin bushings (N) into right cylinder body (M).

(3) Connect cylinder assemblies (fig. 493).

- (a) Use suitable adapter and press bushing into sleeve.
- (b) Position pin end of left piston rod in clevis end of right piston rod. Press sleeve with bushing into ends of piston rods to connect cylinder assemblies together.

339. Wrecker Body and Outriggers

a. Disassembly.

- (1) General. The wrecker body is of all welded steel construction and disassembly is limited to removal of the four outrigger assemblies (fig. 499) and the upper, lower, and vertical cable guide rollers (fig. 500). Replacement of the wrecker body necessitates removal of the complete wrecker crane and rear mounted winch.

(2) Outriggers (fig. 499).

- (a) Remove two cap screws and lockwashers from outrigger stop, and remove stop.
- (b) Remove outrigger pin and remove the outrigger assembly.

Caution: With outrigger stop removed, the complete outrigger assembly must be supported during removal operation.

- (c) Proceed in the same manner as outlined in (a) and (b) above and, remove the other three outrigger assemblies.

(3) Cable guide rollers.

- (a) Upper rollers (fig. 501). Remove two cap screws (A) and lockwashers (B) from keeper plate (C) and remove plate. Drive roller shaft (E) out and lift roller (G) with bearings, felt washers (D and J), and roller thrust washers (K and M) from mounting bracket.
- (b) Vertical rollers (fig. 502). Remove two cap screws (B) and lockwashers (c) from keeper plate (D) at upper end of roller shaft (E). Use a pinch

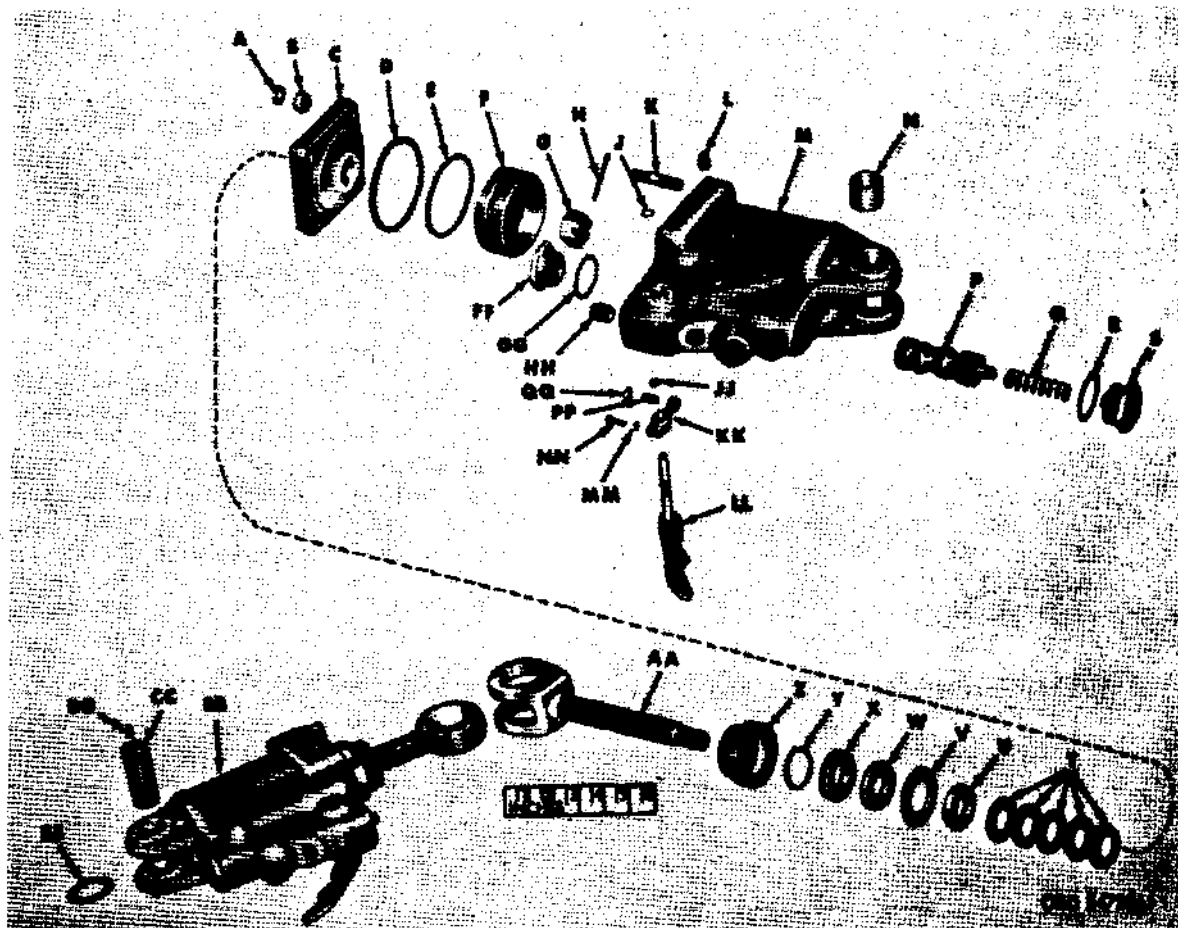


Figure 498. Swing motor - right cylinder assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---------------------------------------|------------|--|
| A | Nut, lock | P | Spool, control valve |
| B | Nut, safety | Q | Spring, control valve spool |
| C | Cap, cylinder body | R | Gasket, plug, end, control valve spool |
| D | Gasket, cap | S | Plug, end, control valve spool |
| E | Gasket, O-ring, piston | T | Seal, chevron |
| F | Piston | U | Ring, chevron seal |
| G | Nut, hex, slotted | V | Retainer, felt washer |
| H | Pin, cotter | W | Washer, felt |
| J | Gasket, O-ring, valve actuating lever | X | Wiper, piston rod |
| K | Stud, cylinder | Y | Spring, piston rod wiper |
| L | Plug, pipe | Z | Cap, piston rod |
| M | Body, cylinder, right | AA | Rod, piston, right |
| N | Bushing, pivot pin | BB | Cylinder, assembly |

Figure 498. Swing motor - right cylinder assembly - exploded view - legend

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|--|------------|---|
| CC | Pin, pivot, mounting, cylinder | JJ | Gasket, O-ring, valve-actuating-lever |
| DD | Fitting, lubricating | KK | Lever, valve actuating |
| EE | Shim, mounting, cylinder | LL | Lever, control valve, w/shaft, right |
| FF | Plug, end, actuating-lever-adjusting screw | MM | Washer, lock |
| GG | Gasket, plug, end, actuating-lever-adjusting screw | NN | Screw, cap |
| HH | Plug, pipe | PP | Screw, adjusting, actuating lever |
| | | QQ | Nut, jam, actuating-lever-adjusting-screw |

Figure 498. Swing motor - right cylinder assembly - exploded view - legend continued

bar and pull shaft from the roller assembly. Remove roller assembly with roller thrust washers (G and N), felt washers (H and M), and roller bearing assemblies (J and L). Remove two cap screws (S) and lockwashers (R) from filler plate (Q) and remove roller shaft spacer (P). Remove both vertical rollers in the same manner.

- (c) Lower roller (fig. 501). Remove two cap screws (A) and lockwashers (B) from keeper plate (C) and remove lower roller shaft (E). Lift out roller (G) with roller bearing assemblies (F and H), felt washers (D and J), and roller thrust washer (K).

Note. The two vertical rollers must be removed before lower roller (fig. 500) can be removed.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean outriggers with mineral spirits paint thinner or dry-cleaning solvent, paying particular attention to the screw jacks. Clean cable guide rollers, bearings, and thrust washers. Clean wrecker body thoroughly.

(2) Inspection

- (a) Outriggers. Inspect outriggers for defective threads on screw jacks. Check for bent or damaged condition of components. Pay particular attention to welds and note for cracks or damage.

- (b) Cable guide rollers. Inspect cable guide rollers for defective welds or damaged bores. Check thrust washers for scoring and wear. Place roller



Figure 499. Removing outrigger assembly

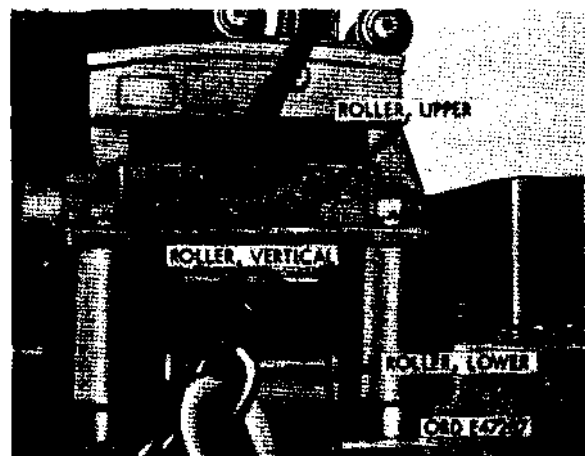


Figure 500. Rear winch cable guide rollers

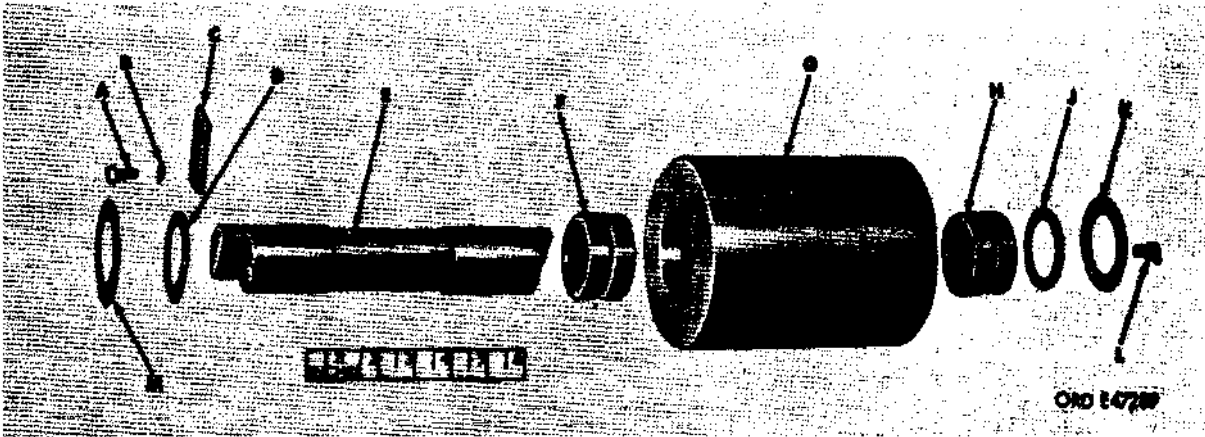


Figure 501. Lower cable guide roller - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---------------------------|------------|---------------------------|
| A | Screw, cap | G | Roller |
| B | Washer, lock | H | Bearing, roller, assembly |
| C | Plate, keeper | J | Washer, felt |
| D | Washer, felt | K | Washer, thrust, roller |
| E | Shaft, rolled, lower | L | Fitting, lubr |
| F | Bearing, roller, assembly | M | Washer, thrust, roller |

Figure 501. Lower cable guide roller - exploded view - legend

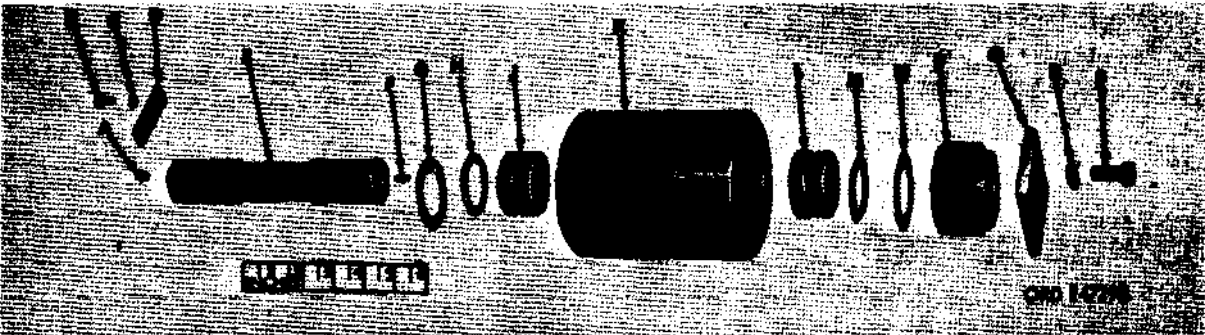


Figure 502. Vertical cable guide roller - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|------------------------|------------|---------------------------|
| A | Fitting, lubrication | H | Washer, felt |
| B | Screw, cap | J | Bearing, roller, assembly |
| C | Washer, lock | K | Roller |
| D | Plate, keeper | L | Bearing, roller, assembly |
| E | Shaft, roller | M | Washer, felt |
| F | Fitting, lubrication | N | Washer, thrust, roller |
| G | Washer, thrust, roller | P | Spacer, roller shaft |

Figure 502. Vertical cable guide roller - exploded view - legend

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---------------|------------|-------------|
| Q | Plate, filler | S | Screw, cap |
| R | Washer, lock | | |

Figure 502. Vertical cable guide roller - exploded view - legend - continued

bearing assemblies on roller shafts and make sure they turn free and are not scored.

- (c) Wrecker body. Inspect condition of all welds, paying particular attention to the cable guide roller brackets at the rear. Also inspect outrigger tubes for cracked welds or other damage.

(3) Repair.

- (a) Outriggers. Repairs are limited to welding and depending on extent of damage, straightening or replacing bent component.
- (b) Cable guide rollers. Repairs consist chiefly of replacing the damaged components. The rollers can be welded if cracks are evident in the old welds.
- (c) Wrecker body. Limited damage to wrecker body can be repaired by straightening or welding. Extensive damage to the body will require replacement of the complete assembly.

c. Assembly.

- (1) Outriggers (fig. 499). Attach suitable hoisting equipment and lift outrigger assembly into wrecker body outrigger tube. Position outrigger stop on body and secure with two cap screws and lockwashers. Secure outrigger assembly to body with outrigger pin.
- (2) Cable guide rollers.
- (a) Lower roller (fig. 501). Position roller bearing assemblies (F and H) in each end of roller (G). Place felt washers (D and J) and roller thrust washers (M and K) on each end of roller. Place the roller assembly in bracket at rear of wrecker body and install lower roller shaft (E). Posi-

tion keeper plate (C) in slot of shaft and secure with two cap screws (A) and lockwashers (B).

- (b) Upper roller. Assemble upper roller in the same manner as the lower roller (a) above, with the exception of using roller shaft (E, fig. 502) in place of roller shaft (E, fig. 501).

- (c) Vertical rollers (fig. 502). Position roller shaft spacer (P) on bracket and secure with filler plate (Q), two lockwashers (R), and cap screws (S). Assemble roller bearing assemblies (J and L), felt washers (H and M), and roller thrust washers (G and N) in roller (K). Position the roller assembly in the wrecker body roller bracket and install roller shaft (E). Secure shaft with keeper plate (D), two lockwashers (C) and cap screws (B). The left and right vertical rollers are assembled in the same manner.

340. Hydraulic Reservoir and Stowage Compartments

a. Disassembly and Assembly. The hydraulic reservoir and stowage compartments do not require disassembly as they are of welded sheet metal construction.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean all surfaces with mineral spirits paint thinner or dry-cleaning solvent.
- (2) Inspection and repair.
- (a) Inspection. Check for cracked welds.
- (b) Repair. Repair is limited to welding.

341. Power Takeoff

a. Disassembly (Fig. 505).

- (1) Remove four hex-head bolts (Q) and medium lockwashers (R) and lift the oil pump body (S) from the case (fig. 503).

- (2) Remove 90° elbow (P), releasing inlet check ball (N) and inlet ball spring (M).
- (3) Remove outlet ball plug (K), releasing outlet, ball spring (L) and outlet check ball (J).
- (4) Remove shaft nut (A) and flange washer (B) and remove companion flange.

Note. Shaft nut should be loosened before removal of the power takeoff from transfer case.

- (5) Remove four hex-head bolts (Z), medium lockwashers (Y), and remove bearing cap (fig. 504).
- (6) Remove oil pump plunger (G) from cam on shaft (U) and pull shaft assembly from case (fig. 504).
- (7) Press shaft ball bearing (F) from shaft (U) and remove shaft snap ring (fig. 504).
- (8) If inspection (b below) warrants replacement, press oil seal assembly (C) from bearing cap (D).

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean all parts thoroughly with mineral spirits paint thinner or dry-cleaning solvent.

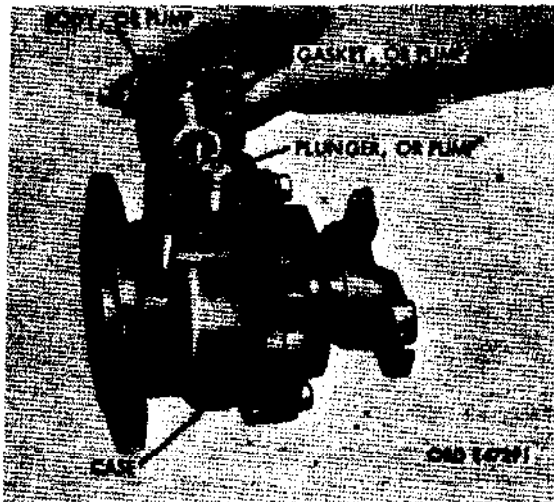


Figure 503. Removing power takeoff oil pump body

(2) Inspection and repair.

(a) Inspection. Check oil pump body and plunger for evidence of wear and scoring. Place oil pump plunger in body and check for smoothness of operation. Inspect splines on shaft and shaft coupling sleeve for excessive wear. Inspect oil seal for worn or feathered edges. Check case for cracks or damaged bolt holes.

(b) Repair. Repairs are limited and for the most part will require replacement of the defective component. Small nicks and burs may be removed with a fine mill file. Defective oil seals are replaced by removing the old seal assembly and pressing a new seal into the bearing cap.

c. Assembly (Fig. 505).

- (1) If the oil seal assembly (C) was removed from the bearing cap (D), press new seal into cap.
- (2) Press the shaft ball bearing (F) on shaft (U), making certain the inner hub of bearing is supported during this operation.
- (3) Install shaft snap ring (V) on shaft (U) and position shaft coupling sleeve (W) on shaft.
- (4) Position oil pump plunger (G) in case (T) and place shaft with bearing assembly in case. Place oil pump plunger (G) on cam groove in shaft (U).

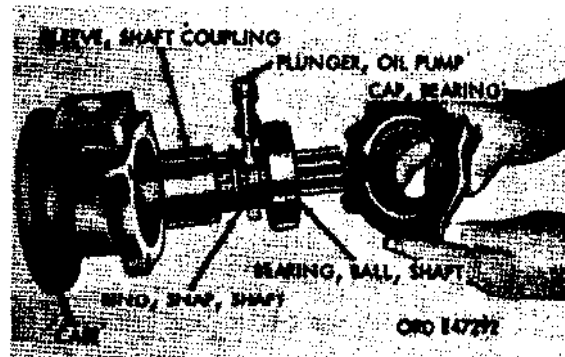


Figure 504. Power takeoff case components removed

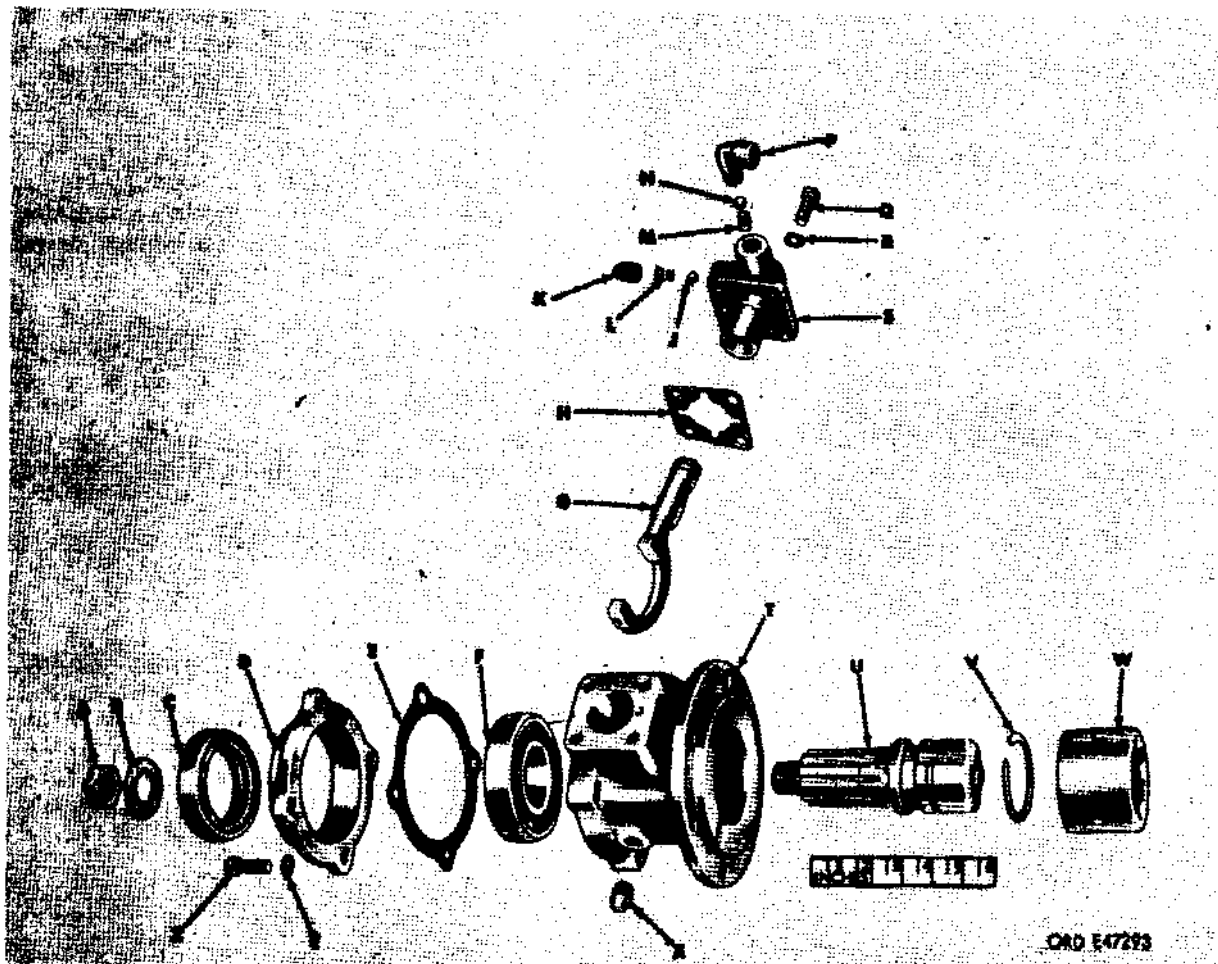


Figure 505. Power takeoff (M62) - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|----------------------|------------|-------------------------|
| A | Nut, shaft | N | Ball, check inlet |
| B | Washer, flange | P | Elbow, 90 degree |
| C | Seal, oil, assy | Q | Bolt, hex-hd |
| D | Cap, bearing | R | Washer, lock |
| E | Gasket, cap, bearing | S | Body, oil pump |
| F | Bearing, ball, shaft | T | Case |
| G | Plunger, oil pump | U | Shaft |
| H | Gasket, oil pump | V | Ring, snap, shaft |
| J | Ball, check, outlet | W | Sleeve, shaft coupling |
| K | Plug, outlet ball | X | Plug, pipe, case, sq-hd |
| L | Spring, outlet ball | Y | Washer, lock |
| M | Spring, inlet ball | Z | Bolt, hex-hd |

Figure 505. Power takeoff (M62) - exploded view - legend

- (5) Position new bearing cap gasket (E) on case (T) and align holes with bearing cap (D). Install four hex-head bolts (Z), four lockwashers (Y), and tighten securely. Loosely assemble shaft nut (A) and flange washer (B). Tighten nut securely after installing companion flange.
- (6) Place outlet check ball (J) and outlet ball spring (L) in oil pump body (S) and secure with outlet bell plug (K).
- (7) Install inlet ball spring (M) and inlet check ball (N) in oil pump body (S) and secure with 90° elbow (P).
- (8) Position oil pump gasket (H) on case (T), and position oil pump body assembly over plunger (G) and onto case.
- (9) Install four hex-head bolts (Q), four medium lockwashers (R), and tighten securely.
- (10) For installation of power takeoff to the transfer case, refer to paragraph 152.

Warning: Be sure to fill power takeoff case (T) with correct lubricant to square-head pipe plug (X); level for the initial lubrication.

342. Pillow Block

a. Disassembly.

- (1) Loosen and remove lubricating valve and adapter from pillow block housing (fig. 506). Invert pillow block to remove locking pin.
- (2) Rotate pillow block bearing in pillow block housing one-half turn. Turn bearing to a horizontal position as shown in figure 507 and remove from housing.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean bearing and housing in mineral spirits paint thinner or dry-cleaning solvent and blow dry with compressed air.
- (2) Inspection and repair.
 - (a) Bearing. Inspect bearing for free rotation. If bearing binds or does not rotate freely, replace bearing.

- (b) Pillow block housing. Inspect housing for cracks or broken condition. If defects are found, replace housing.

c. Assembly (Fig. 508).

- (1) Position pillow block bearing (A) in a horizontal position as shown in figure 508 and install in pillow block housing (F). Turn bearing to a vertical position and rotate one-half turn
- (2) Insert locking pin (E), adapter (D), and lubricating valve (C) in pillow block housing (F).
- (3) Lubricate the pillow block See instructions given in LO 9-2320-211-12.

343. Power Divider (Fig. 509)

a. Disassembly.

- (1) General. Thorough inspection of the power divider after removal from the vehicle will reveal the condition of the unit. Check particularly for leaks around covers, caps, or seals. Before disassembly, clean all outside surfaces with mineral spirits paint thinner or dry-cleaning solvent.
- (2) Remove hydraulic pump adapter and coupling (fig. 510).
 - (a) Take out six hex-head cap screws and lockwashers.



Figure 506. Removing lubricating valve, adapter, and locking pin

- (b) Remove square-socket pipe plug from top side of hydraulic pump adapter to provide access to setscrew beneath plug (fig. 510).
 - (c) Remove the setscrew from the coupling.
 - (d) Slide hydraulic pump adapter and pump coupling from pump output shaft
 - (e) Remove pump coupling from hydraulic pump adapter.
- (3) Remove and disassemble case covers.
- (a) Remove four hex-head cap screws and takeoff winch, output shifter shaft cover (fig. 511), and cover gasket.
 - (b) Remove hex-head cap screw which fastens sliding gear fork (refer to M, fig. 518) to winch output shifter shaft (refer to Q, fig. 518). Remove poppet ball spring retainer (refer to E, fig. 518), and take out poppet ball compression spring (refer to F, fig. 518) and shifter shaft poppet ball (refer to G, fig. 518).
 - (c) Slide out winch output shifter shaft from cover.
 - (d) The removal (fig. 511) and disassembly of the input- and pump-output shifter shaft cover is essentially the same as for the winch output shifter shaft ((a) through (c) above).
- (4) Bearing covers and caps (fig. 512). Remove hex-head cap screws, lockwashers, bearing covers, and bearing caps, and discard gaskets.

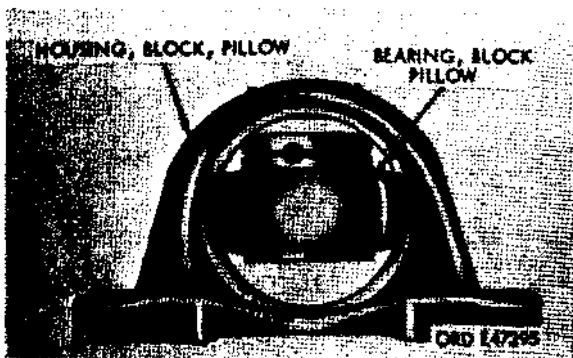


Figure 507. Positioning pillow block bearing for removal

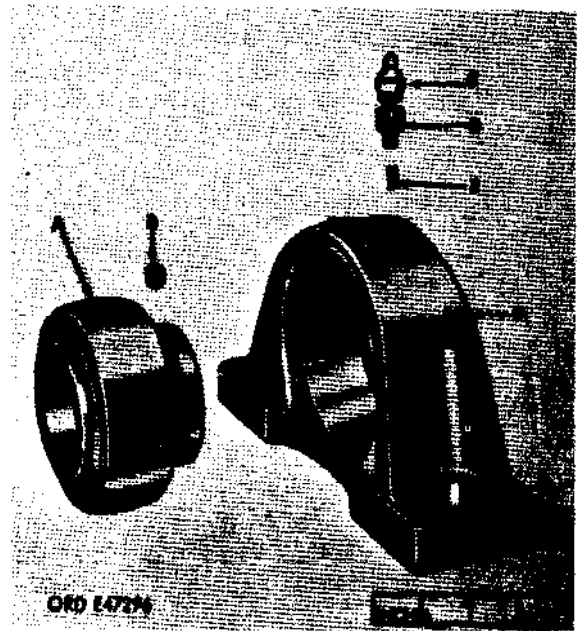


Figure 508. Pillow block - exploded view

| <u>Key</u> | <u>Item</u> |
|------------|-------------------------------|
| A | Bearing, block, pillow |
| B | Screw, set |
| C | Valve, lubricating |
| D | Adapter |
| E | Pin, locking |
| F | Housing, block, pillow |

Figure 508. Pillow block - exploded view - legend

- (5) Remove shaft and bearing (fig. 513).
- (a) Use a brass drift and tap on forward end of winch output shaft to drive shaft and ball bearing assembly to the rear.
 - (b) Continue tapping on end of shaft until shaft is also free of ball bearing assembly on front end of shaft.
 - (c) The other ball bearing assembly remaining on shaft is removed by placing shaft and bearing assembly in an arbor press. Position bearing so that inner race will be supported, and then press out shaft.

(6) Remove pump output shaft and bearing (fig. 514).

(a) In a similar manner to (5) above, drive pump output shaft to rear, and remove from case.

(b) Remove ball bearing assembly from pump output shaft as in (5) (c) above.

(7) Remove input shaft (fig. 515).

(a) Turn power divider case on its side and block up so that input shaft may be tapped out to rear, using brass drift and hammer.

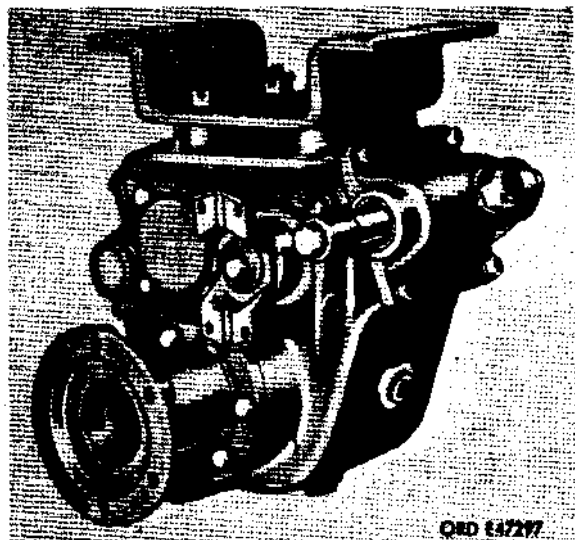


Figure 509. Power divider - right rear view



Figure 510. Hydraulic pump adapter and coupling removal

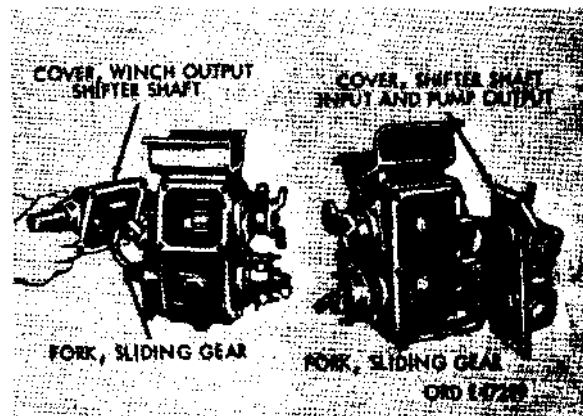


Figure 511. Case covers and shifter shafts removed



Figure 512. Bearing covers and caps removed

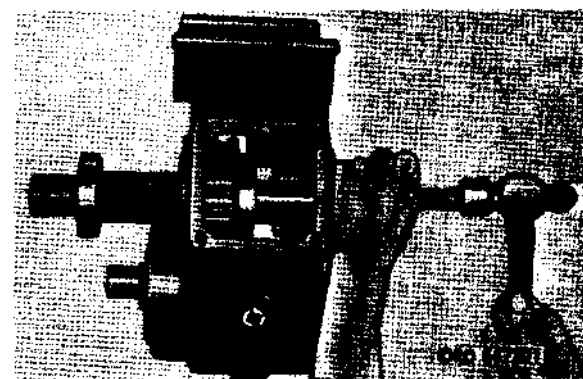


Figure 513. Removing winch output shaft and bearings

- (b) Support the input shaft gear inside of case and tap input shaft out of bearings, gears, and case.
- (c) Remove ball bearing assembly from input shaft as in (5) (c) above.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. No specialized cleaning is required for these parts other than to immerse them in mineral spirits paint thinner or dry-cleaning solvent. Soak long enough to remove all old lubricant, then blow dry with compressed air. Keep parts protected from dust or dirt.
- (2) Inspection.
 - (a) Bearings. Inspect bearings assemblies for scored spots, chips, or cracks. Replace if worn or damaged in any way.
 - (b) Gears. Inspect gear teeth and internal splines of sliding gears for chipped places, galled spots, or excessive wear. If any defects are noted, parts must be replaced.
 - (c) Case and covers. Carefully inspect case and covers for cracks, warpage, or stripped screw threads. If damaged in this manner, parts must be replaced.

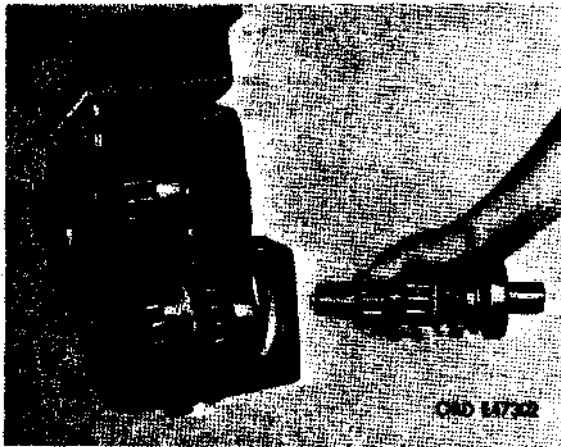


Figure 514. Pump output shaft and bearings removed

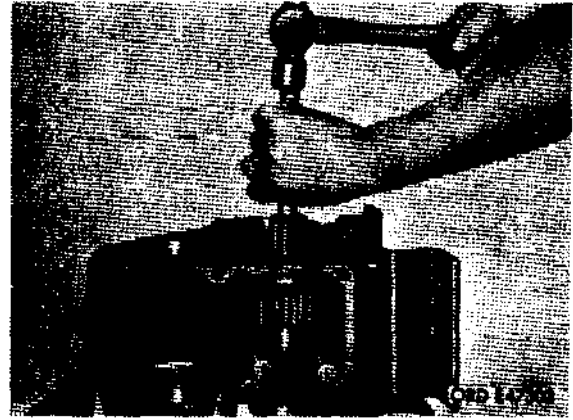


Figure 515. Removing input shaft

- (d) Shafts. Inspect shaft splines for twists, chips, or wear. If any evidence of wear or damage exists, parts must be replaced.
- (e) Shifter shafts and forks. Make sure that sliding gear forks fit securely on the shifter shafts, and that shafts and forks are not cracked or broken.
- (f) Oil seals. Inspection of oil seals in the shifter shaft covers and bearing caps may be accomplished without complete removal. However, make sure that lips of seals are not worn or frayed, and that they contact firmly around the shafts. If seals are removed, they must be replaced.
- (3) Repair. Repairs to the power divider will for the most part, be a matter of replacing defective parts and using new gaskets and seals. However, slight nicks or burs may be removed from the various parts with a fine mill file or soapstone. Damage beyond this will necessitate part replacement.

c. Assembly.

- (1) General. All moving parts such as gears, shafts, and bearings must be prelubricated at assembly, with seasonal grade gear oil (GO). This will prevent the possibility of scoring before lubricant in the case is circulated to all parts. Refer to LO 9-2320-211-12 for lubrication recommendations. Take special care to prevent the entry of dirt into the finished assembly.

(2) Install input shaft (fig. 516).

- (a) Press needle bearing assembly (AS) into bore of input shaft gear (U).
- (b) Use a soft hammer and tap ball assembly (AT) into front end of power divider case (RR) at input shaft opening.
- (c) Hold input shaft gear with input shaft thrust washers (V and AR) on each side, inside of case. Then, insert input shaft (W), splined end first, through bore of input shaft gear and thrust washers into previously installed bearing.
- (d) Slide input shaft sliding clutch (X) and ball bearing assembly (Y) onto shaft, and use soft hammer to tap bearing into place in case.

(3) Install pump output shaft (fig. 516).

- (a) Use a soft hammer and tap ball bearing assembly (ZZ) into front of power divider case at pump output shaft opening.
- (b) Place thrust washer (UU) on hydraulic pump output shaft (QQ) and press roller bearing assembly (W), bearing spacer (XX), end roller bearing assembly (YY) onto shaft and next to thrust washer.
- (c) Hold drive gear (WW) with thrust washer (AG) on front side of gear, inside of case, and insert hydraulic pump output shaft with bearings on shaft, through bore of gear and thrust washer, end into bearing.
- (d) Place sliding clutch (TT) and ball bearing assembly (NN) onto rear end of shaft, and tap bearing into position in case.

(4) Install winch output shaft (fig. 516).

- (a) Tap ball bearing assembly (H) into rear of power divider case at winch output shaft opening.
- (b) Hold winch output shaft sliding gear (F) inside of case and insert winch output shaft (G), splined end first, through bore of gear and into bearing.

- (c) Slide ball bearing assembly (E) onto shaft and tap into place in case.

(5) Install bearing covers and cages (fig. 516). Bearing covers (C and AA), governor valve adapter (AE), and bearing caps (N and AU) are all assembled in a similar manner. Oil seals (M, AF, AQ, and LL), if removed, must be inserted in bearing caps before installing on shafts. Maintain end play of 0.010-inch minimum to 0.033-inch maximum when installing bearing caps. Use new bearing cover gaskets (D, L, and Z), bearing cap gasket (AN), governor valve adapter gasket (AB), and adapter gasket (HE) when assembling end. If necessary, use additional gaskets to secure the correct end play. Also pack space between bearing cap (AU) and ball bearing assembly (AT) with grease (GAA) to prelubricate this point.

(6) Assemble and install input and pump output shifter shafts and cover (fig. 517).

- (a) If shifter shaft oil seals (E and T) were removed, install new seals in the input and pump output shifter shaft cover (J).
- (b) Slide input shifter shaft (D) and hydraulic-pump output shifter shaft (U) into cover, taking care not to damage seals.
- (c) Secure shifter shafts in cover with shifter shaft poppet balls (BB and HE), poppet ball compression springs (DD and KK), and poppet ball spring retainers (FF and JJ).
- (d) Fasten sliding gear forks (M and Q) to shifter shafts with hex-head cap screws (P and R) and external-tooth lockwashers (N and S).
- (e) Install dust plugs (K and GG).
- (f) Use a new shifter shaft cover gasket (L). Secure assembled input and pump output shifter shaft cover (J) to power divider case (RR, fig. 516), with two hex-head cap screws (EE), six hex-head cap screws (Z), and eight lockwashers (Y and CC).

(7) Assemble and install winch output shifter shaft cover (fig. 518).

- (a) Install new shifter shaft oil seals (H and P) into winch output shifter shaft cover (N), if inspection revealed that replacement was necessary.
- (b) Slide winch output shifter shaft (Q) through oil seals taking special care to protect seal.
- (c) Secure shifter shaft in cover with shifter shaft poppet ball (G), poppet ball compression spring (F), and poppet ball spring retainer (E).
- (d) Fasten sliding gear fork (M) to shifter shaft with one hex-head cap screw (K) and external-tooth lockwasher (L).
- (e) Use a new cover gasket (J) and secure assembled winch-output shifter shaft cover (N) to power divider case (RR, fig. 516), with four hex-head cap screws (D), and medium lockwasher (C).

(8) Install shifter shaft arms. If shifter shaft arms (A and X, fig. 517 and B, fig. 518) were removed, secure these to shifter shaft with hex-head cap screws (B and W, fig. 517, and A, fig. 518), and medium lockwashers (C and V, fig. 517, and R, fig. 518).(9) Install hydraulic pump adapter and coupling (fig. 516).

- (a) Insert pump coupling (KK) into hydraulic pump adapter (DD).
- (b) Use a new adapter gasket (HH) and slide hydraulic pump adapter and pump coupling over hydraulic pump output shaft (QQ) and up to power divider case.
- (c) Locate opening in coupling through opening in adapter, and secure coupling to hydraulic pump output shaft with hex socket setscrew (JJ).
- (d) Install headless-square socket pipe plug (GG) into opening in hydraulic pump adapter.

- (e) Secure hydraulic pump adapter to power divider case with six hex-head cap screws (EE) and lockwashers (FF).

Caution: Be sure that drain and fill plugs are tight and lubricant is at specified level as prescribed in LO 9-2320-211-12 before initial operation.

344. Hydraulic Pumpa. Disassembly (Fig. 522).

- (1) Disassembly of the hydraulic oil pump (fig. 519) is accomplished by removing the four cap screws (A) and plain washers (T) that hold the pump cover in place. This will release the pump cover (B), the pressure plate (C), O-ring gaskets, and the pump ring (fig. 520). Discard O-ring gaskets (R). In addition to the cap screws, the pump ring is held in place by two locating pins (F) which are a slip fit in the pump ring and pump body. Make a note of the relative position of rotor (E), vanes (Q), and pump ring (D), so that they may be returned to this same location upon assembly.
- (2) To remove pump shaft from pump body, remove the snap ring that holds the outer-bearing assembly in place and tap on the splined or rotor end of the pump shaft, or stand the splined end on a soft block and press downward on the unit. The outer-bearing assembly and pump shaft (fig. 521) will be removed by this action.
- (3) The outer-bearing assembly (H) is a press fit and to remove from pump shaft (L) use an arbor press. The oil seal is pressed in place and removal will cause its destruction. The small inner-bearing assembly (G) is a very close fit into the pump body (N). Its removal is accomplished by tapping with a drift punch from the pump ring side of the body.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Immerse all parts except the sealed ball bearing assembly, in dry-cleaning solvent or mineral spirits

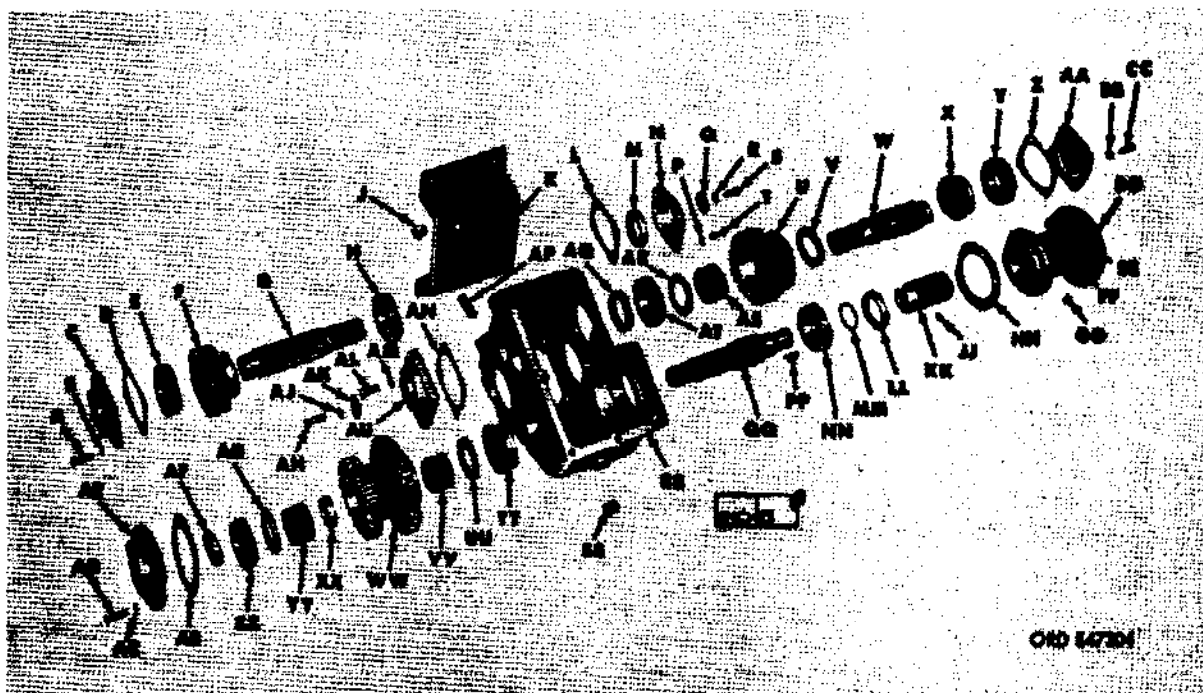


Figure 516. Power divider with mounting bracket assembly - exploded view

| Key | Item | Key | Item |
|-----|-----------------------------------|-----|-------------------------------------|
| A | Screw, cap, hex-head | Z | Gasket, bearing cover |
| B | Washer, lock | AA | Cover, bearing |
| C | Cover, bearing | BB | Washer, lock |
| D | Gasket, bearing cover | CC | Screw, cap, hex-head |
| E | Bearing, ball, assembly | DD | Adapter, hydraulic pump |
| F | Gear, sliding, winch output shaft | EE | Screw, cap, hex-head |
| G | Shaft, winch output | FF | Washer, lock |
| H | Bearing, ball, assembly | GG | Plug, pipe, square-socket, headless |
| J | Nut, slotted | HH | Gasket, adapter |
| K | Bracket | JJ | Screw, set, hex socket |
| L | Gasket, bearing cover | KK | Coupling, pump |
| M | Seal, oil | LL | Seal, oil |
| N | Cap, bearing | MM | Seal, static, pump coupling |
| P | Washer, lock | NN | Bearing, ball, assembly |
| Q | Washer, plain | PP | Key, Woodruff |
| R | Washer, lock | QQ | Shaft, hydraulic pump output |
| S | Screw, cap, hex-head | RR | Case, power divider |
| T | Screw, cap, hex-head | SS | Plug, pipe |
| U | Gear, input shaft | TT | Clutch, sliding |
| V | Washer, thrust, input shaft | UU | Washer, thrust |
| W | Shaft, input | VV | Bearing, roller, assembly |
| X | Clutch, sliding, input shaft | WW | Gear, drive |
| Y | Bearing, ball, assembly | XX | Spacer, bearing |

Figure 516. Power divider with mounting bracket assembly - exploded view - legend

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|--------------------------------|------------|-----------------------------|
| YY | Bearing, roller, assembly | AK | Washer, plain |
| ZZ | Bearing, ball, assembly | AL | Screw, cap, hex-head |
| AB | Gasket, governor valve adapter | AM | Washer, lock |
| AC | Washer, lock | AN | Gasket, bearing cap |
| AD | Screw, cap, hex-head | AP | Stud |
| AE | Adapter, governor valve | AQ | Seal, oil |
| AF | Seal, oil | AR | Washer, thrust, input shaft |
| AG | Washer, thrust | AS | Bearing, needle, assembly |
| AH | Screw, cap, hex-head | AT | Bearing, ball, assembly |
| AJ | Washer, lock | AU | Cap, bearing |

Figure 516. Power divider with mounting bracket assembly - exploded view - legend - continued

paint thinner. Soak long enough to loosen all oil lubricant, and make sure oil passageways are not plugged. Blow dry with compressed air and protect from any dust or dirt.

Note. Handle all parts carefully to avoid any nicks or burs on machined surfaces.

- (2) Inspection and repair. Examine each part carefully to make sure there are no cracks. Check the machined surfaces to be certain there are no nicks or burs. The oil seal must have no frayed edges and lips must seal around shaft firmly. Except for the replacing of defective parts, few repairs can be performed on this unit. Slight nicks, burs, or scratches may be removed with fine mill file, soapstone, or crocus cloth.

c. Assembly (Fig. 522).

- (1) The same attention to avoiding nicks and burs must be practiced while assembling the hydraulic oil pump as was practiced for the disassembly. Take special care to avoid the entrance of any grit or dirt into the assembled unit and as soon as assembly is completed, add a slight amount of No. 10W engine oil (OE) into unit. Seal openings until hydraulic vane-type pump is again mounted on the vehicle.
- (2) Install inner-bearing assembly (G) into pump body (N) and make sure it is firmly seated. Insert pump shaft seal (M) and solidly seat with an adapter

that contacts only the outside diameter of the seal. Also make certain the sealing lip of the seal will face the outer-bearing assembly (H). Press the outer-bearing assembly into pump shaft (L). Make sure that pressure is applied to the inner race only when pressing bearing onto shaft. Insert two locating pins (F) and new O-ring gasket (P) into face of pump body. Place pump ring (D), vanes (Q), and rotor (E) onto pump body.

- (3) Make certain the pump ring, vanes, and rotor are correctly assembled in relation to each other for the desired rotation. Also note that the radius edge of the vanes faces the pump ring. Install pressure plate (C) into the pump cover (B) and at the same time place spring (S) between pressure plate and pump cover. Make sure the spring is retained in correct location, and install new O-ring gasket (R) into recess in pump cover around pressure plate and place cover on pump body. Secure pump cover to pump body with four hex-head cap screws (A) and plain washers (T). Tighten cap screws as prescribed in torque specifications, Appendix I.

345. Controls and Linkage

a. Disassembly. After removal there is little disassembly of the controls and linkage.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean all parts with mineral spirits paint thinner or dry-cleaning solvent.

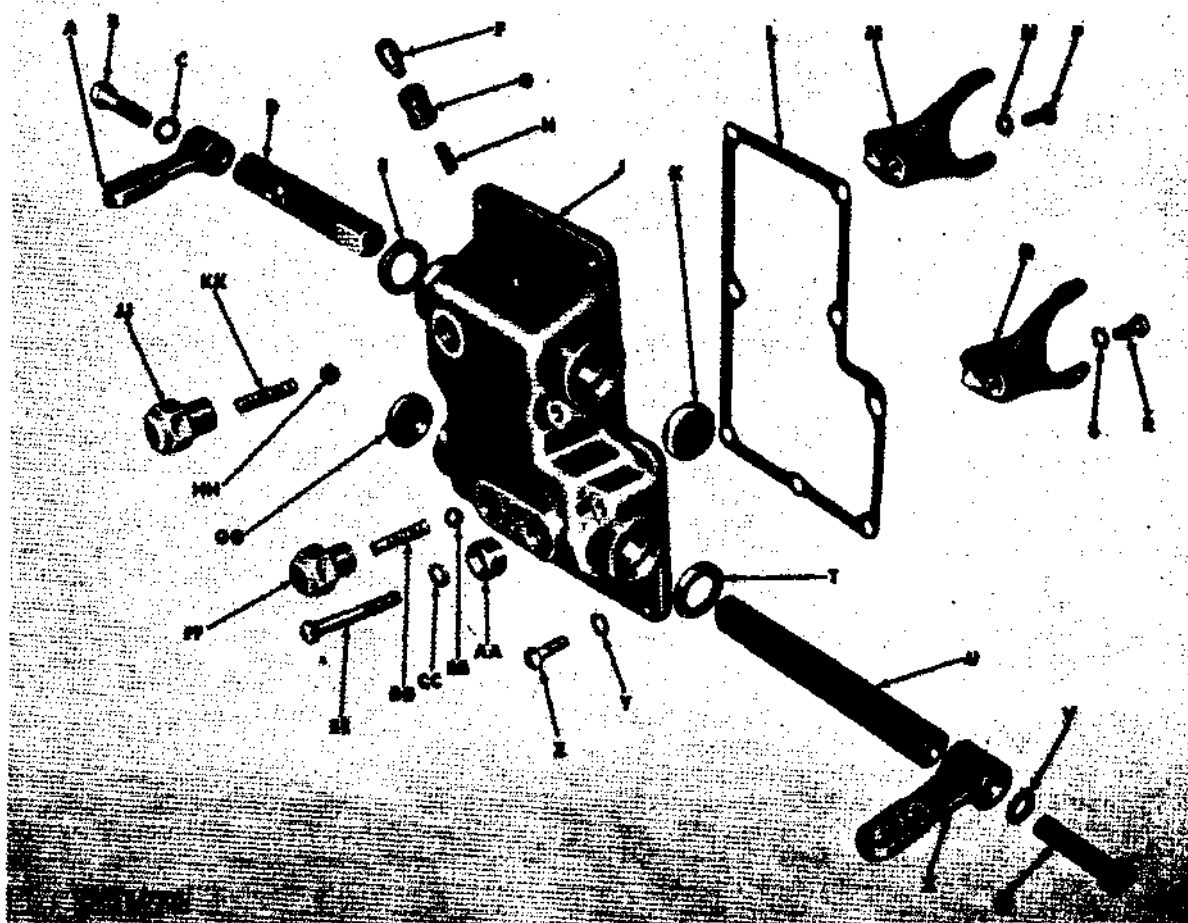


Figure 517. Input and pump output shifter shafts and cover - exploded view

| Key | Item | Key | Item |
|-----|---|-----|---------------------------------------|
| A | Arm, shifter shaft | P | Screw, cap, hex-head |
| B | Screw, cap, hex-head | Q | Fork, sliding gear |
| C | Washer, lock | R | Screw, cap, hex-head |
| D | Shaft, shifter, input | S | Washer, lock, ext-tooth |
| E | Seal, oil, shifter shaft | T | Seal, oil shifter shaft |
| F | Vent, air | U | Shaft, shifter, hydraulic pump output |
| G | Coupling, pipe | V | Washer, lock |
| H | Nipple, pipe | W | Screw, cap, hex-head |
| J | Cover, shifter shaft, input and pump output | X | Arm, shifter shaft |
| K | Plug, dust | Y | Washer, lock |
| L | Gasket, shifter shaft cover | Z | Screw, cap, hex-head |
| M | Fork, sliding gear | AA | Plug, pipe |
| N | Washer, lock, ext-tooth | BB | Ball, poppet, shifter shaft |
| | | CC | Washer, lock |

Figure 517. Input and pump output shifter shafts and cover - exploded view - legend

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|----------------------------------|------------|----------------------------------|
| DD | Spring, compression, poppet ball | HH | Ball, poppet, shifter shaft |
| EE | Screw, cap, hex-head | JJ | Retainer, poppet ball spring |
| FF | Retainer, poppet ball spring | KK | Spring, compression, poppet ball |
| GG | Plug, dust | | |

Figure 517. Input and pump output shifter shafts and cover - exploded view - legend - continued

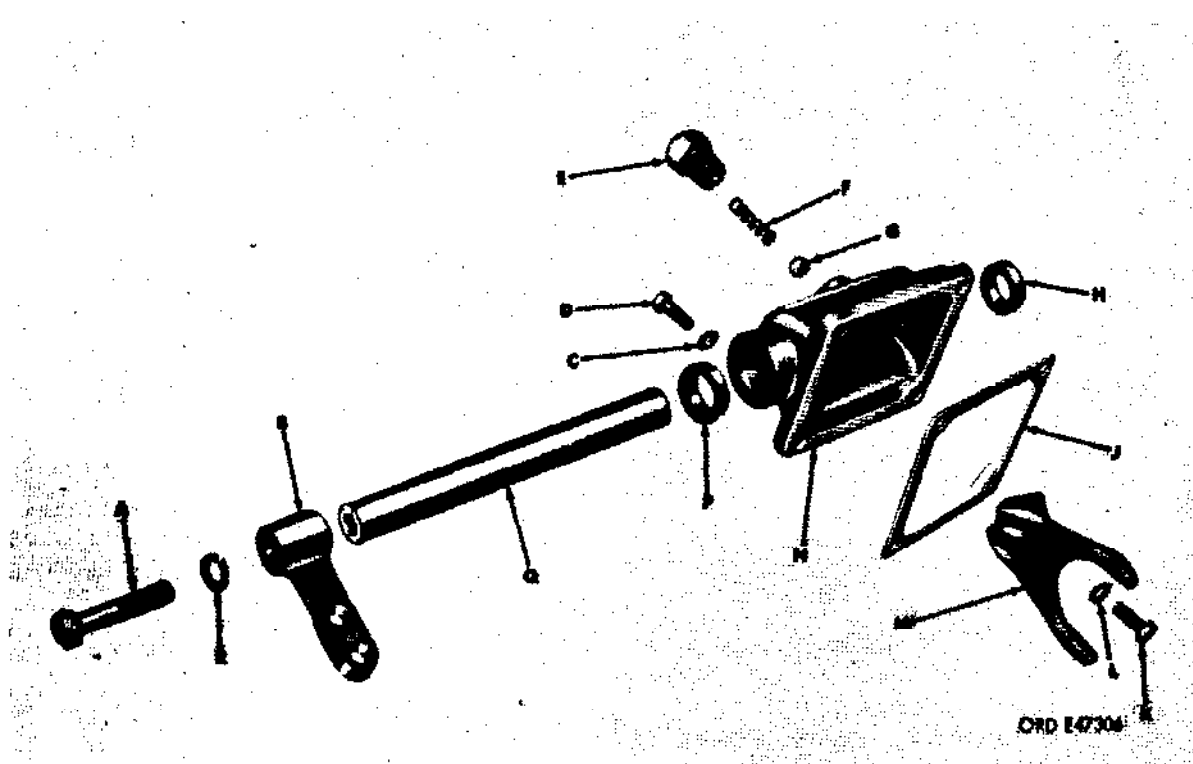


Figure 518. Winch output shifter shaft and cover - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---------------------------------|------------|-----------------------------------|
| A | Screw, cap, hex-head | J | Gasket, cover |
| B | Arm, shifter shaft | K | Screw, cap, hex-head |
| C | Washer, lock | L | Washer, lock, ext-tooth |
| D | Screw, cap, hex-head | M | Fork, sliding gear |
| E | Retainer, poppet ball spring | N | Cover, winch-output shifter shaft |
| F | Spring, compression poppet ball | P | Seal, oil shifter shaft |
| G | Ball, poppet, shifter shaft | Q | Shaft, shifter, winch output |
| H | Seal, oil, shifter, shaft | R | Washer, lock |

Figure 518. Winch output shifter shaft and cover - exploded view - legend

- (2) Inspection and repair. Because of their construction, controls and linkage require only a visual inspection for bends or cracks. Repair is limited to straightening bent linkage or replacement. Adjustment of bent linkage is covered in paragraph 85.

346. Drive Sprocket Bearing Assembly

a. Disassembly.

- (1) Make a note of relative position of sprocket end of shaft with bearing housing, so that shaft may be returned to this same position at reassembly.
- (2) Remove cap screw, lockwashers, plain washer, end drive sprocket (fig. 523) from drive sprocket shaft.
- (3) Remove four cap screws and lockwashers from bearing cap. Remove bearing cap, spacer, oil seal, and cap gasket from bearing housing (fig. 524).

Note. It is not necessary to remove bearing oil seal from bearing cap unless inspection warrants replacement.

To remove oil seal, drive out seal, using suitable removing tool.

- (4) Repeat procedure for removing opposite bearing cap from housing.
- (5) Remove drive sprocket shaft with ball bearings from bearing housing (fig. 525).

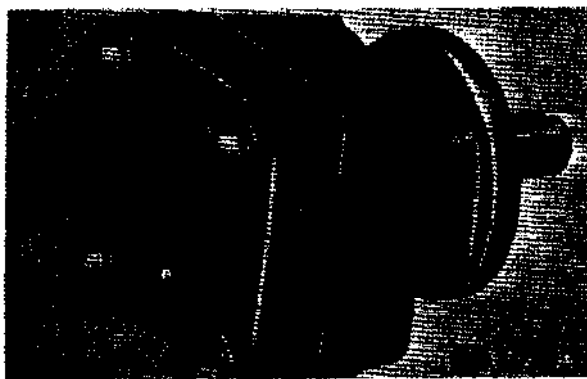


Figure 519. Hydraulic oil pump



Figure 520. Hydraulic pump with cover removed

It is not necessary to remove bearings from shaft unless inspection warrants replacement of bearings or shaft.

To remove bearings, position shaft and bearings in press and press shaft from bearings.

- (6) Clean all parts in mineral spirits paint thinner or dry-cleaning solvent. Blow dry with compressed air. Rinse bearings in clean mineral spirits paint thinner and wrap in a cloth to protect the bearings from foreign particles.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean all parts with mineral spirits paint thinner or dry-cleaning solvent.
- (2) Inspection and repair.
 - (a) Housing. Inspect bearing housing for cracks or breaks. Replace bearing housing if cracks or breaks are detected.



Figure 521. Pump shaft and outer bearing removed

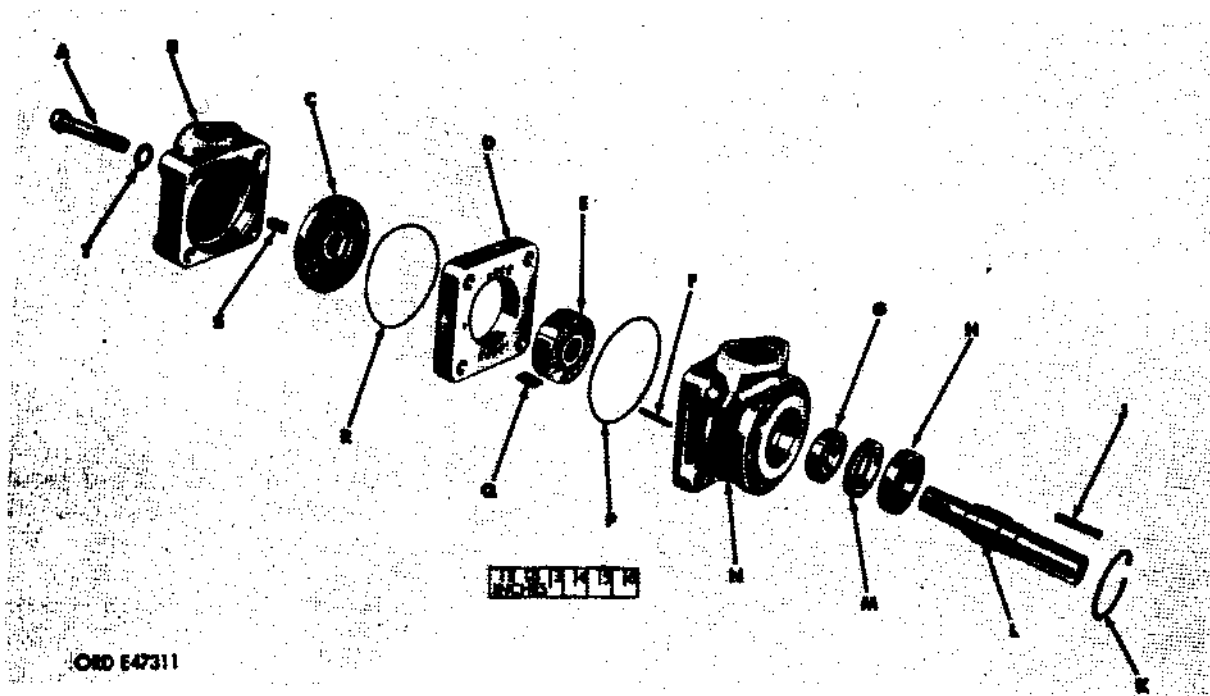


Figure 522. Hydraulic oil pump - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|--|------------|----------------------------------|
| A | Screw, cap, hex-head, 3/4-10NC-3 x 4-1/2 | K | Ring, snap |
| B | Cover, pump | L | Shaft, pump |
| C | Plate, pressure | M | Seal, pump shaft |
| D | Ring, pump | N | Body, pump |
| E | Rotor | P | Gasket, O-ring |
| F | Pin, locating | Q | Vane |
| G | Bearing, inner, assy | R | Gasket, O-ring |
| H | Bearing, outer, assy | S | Spring |
| J | Key, square, 1/4 x 1/4 x 2 | T | Washer, plain 49/64 id 1-5/16 od |

Figure 522. Hydraulic oil pump - exploded view - legend

(b) Shaft. Inspect drive sprocket shaft for damaged splines or cracks. Replace drive sprocket shaft if these conditions are found.

(c) Bearings. Inspect bearings for seized or scored condition. Replace damaged bearings.

(d) Oil seals. Inspect oil seal contact material to make sure it is pliable and shows no evidence of burning. Inspect thin featheredge which contacts rotating part to make sure it is intact. Replace seal if defects are found.

c. Assembly (Fig. 526).

- (1) If inspection revealed that replacement of ball bearings (F and N) was necessary, press new bearings on drive sprocket shaft (G). Position shaft with bearings in bearing housing (K).
- (2) If bearing oil seal (E) was removed, use suitable adapter and install new oil seal in bearing cap (C). Follow same procedure for installing bearing oil seal (P) in bearing cap (R).
- (3) Position bearing spacer (CC) in bearing cap (C). Install bearing cap gasket (D)

and bearing cap on bearing housing (K) and secure with four cap screws (A) and lockwashers (B). Follow same procedure for installing bearing spacer (Y), bearing cap gasket (Q), and bearing cap (R). Secure with four cap screws (T) and lockwashers (S).

- (4) Install drive sprocket (U) on tapped end of drive sprocket shaft (G) and secure with plain washer (V), lockwasher (W), and cap screw (X). Tighten to torque specification Appendix I.
- (5) Lubricate the drive sprocket bearing assembly according to instructions in LO 9-2320-211-12.

347. Hydraulic Hose

The hydraulic hoses, used on the crane assembly, are of double rayon braid, and double wire braid rubber coated construction. The hoses are amply strong to withstand pressures encountered. Hoses are assembled at the factory with wedged couplings and if leaks do occur, new hose assemblies must be used.

348. Restricted Valve (Fig. 527)

a. Disassembly. Remove four cap screws and washers from restrictor valve head and remove head and restrictor valve seat from body. Remove restrictor valve head O-ring gasket from head.

b. Cleaning, Inspection and Repair.

- (1) **Cleaning.** Clean all parts in mineral spirits paint thinner or dry-cleaning solvent.
- (2) **Inspection and repair.**
 - (a) **Body and head.** Inspect threads in body and head for damage. Replace if threads are damaged.

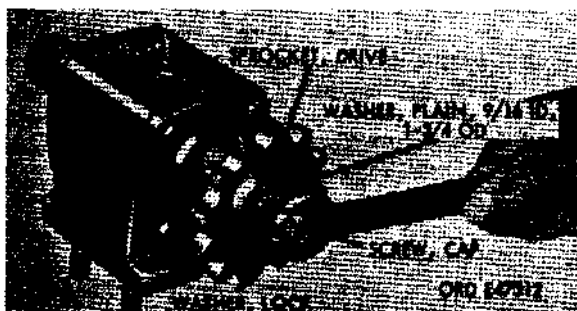


Figure 523. Removing drive sprocket

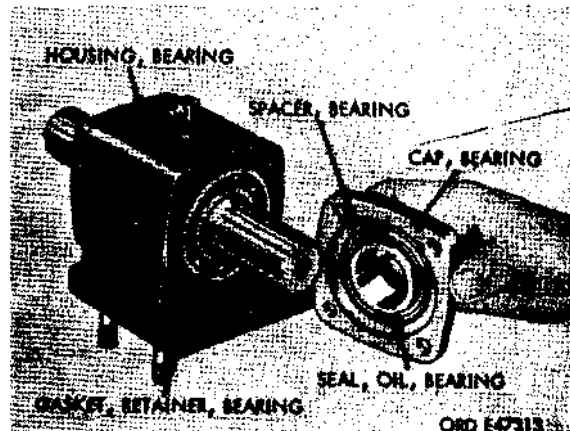


Figure 524. Removing bearing cap, oil seal, and spacer

(b) O-ring gasket. Inspect O-ring gasket for scratches and cuts. Replace defective gasket.

(c) Seat. Inspect seat for free movement in body. Replace seat if not free.

c. Assembly. Install restrictor valve seat (fig. 527) in body. Position restrictor valve head O-ring gasket in head and secure head to body with four socket head cap screws and external-tooth lockwashers.

349. Relief Valve (Fig. 528)

a. Disassembly (Fig. 529).

- (1) The relief valve setting is made at the factory and if valve is disassembled, a pressure gage must be used to reset valve.

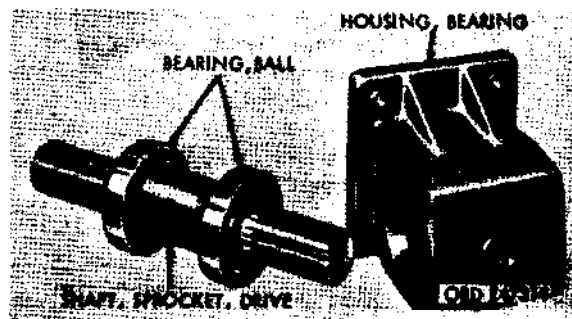


Figure 525. Removal of drive sprocket shaft and bearings from bearing housing

Note. If a pressure gage is not available, do not attempt to disassemble this unit.

- (2) Remove capnut (A), locknut (B), and adjusting setscrew (C) from relief valve retainer (D).
- (3) Remove relief valve retainer (D), O-ring packing (E), spring seat (F), guide spring (G), and relief valve plunger (H) from relief valve body (K).
- (4) Remove machine screw (N), gasket (M), and setscrew (L), and slide plunger sleeve (J) from relief valve body (K).

b. Cleaning, Inspection and Repair.

- (1) **Cleaning.** Clean all parts in mineral spirits paint thinner or dry-cleaning solvent. Blow dry with compressed air.

(2) Inspection and repair.

- (a) **Body.** Inspect body for cracks and damaged threads. If inspection warrants replacement of body, replace with a new relief valve assembly.
- (b) **Plunger, sleeve, and spring.** Inspect plunger and sleeve for nicks or scratches. Remove slight nicks and scratches with a soapstone or fine mill file. Inspect spring for broken condition. If inspection warrants replacement of any of these parts, obtain relief valve repair kit 8327028.

c. Assembly (Fig. 529).

- (1) Position plunger sleeve (J) in relief valve body (K). Secure with setscrew (L), gasket (M), and machine screw (N).

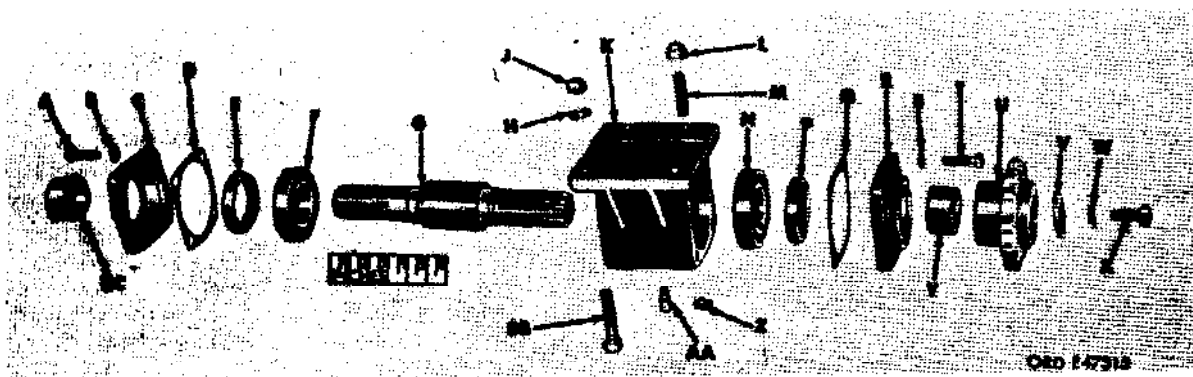


Figure 526. Drive sprocket bearing assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|------------------------|------------|----------------------|
| A | Screw, cap | Q | Gasket, cap, bearing |
| B | Washer, lock | R | Cap, bearing |
| C | Cap, bearing | S | Washer, lock |
| D | Gasket, cap, bearing | T | Screw, cap |
| E | Seal, oil, bearing | U | Sprocket, drive |
| F | Bearing, ball | V | Washer, plain |
| G | Shaft, sprocket, drive | W | Washer, lock |
| H | Washer, lock | X | Screw, cap |
| J | Nut, hex | Y | Spacer, bearing |
| K | Housing, bearing | Z | Fitting, lubricating |
| L | Nut, safety | AA | Elbow |
| M | Stud | BB | Screw, cap |
| N | Bearing, ball | CC | Spacer, bearing |
| P | Seal, oil, bearing | | |

Figure 526. Drive sprocket bearing assembly - exploded view - legend

- (2) Place relief valve plunger (H), guide spring (G), and spring seat (F) in relief valve body (K). Position O-ring packing (E) on relief valve retainer (D) and install on body. Install adjusting setscrew (C) in retainer and secure with locknut (B) and capnut (A).

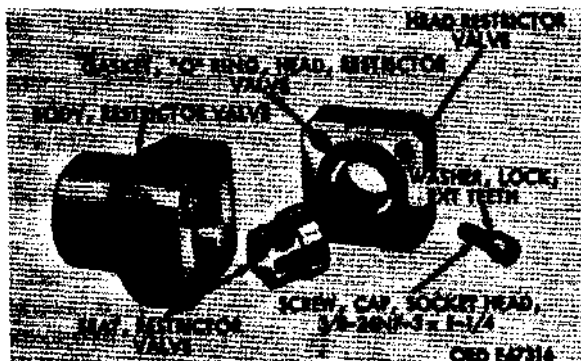


Figure 527. Restrictor valve assembly



Figure 528. Relief valve assembly

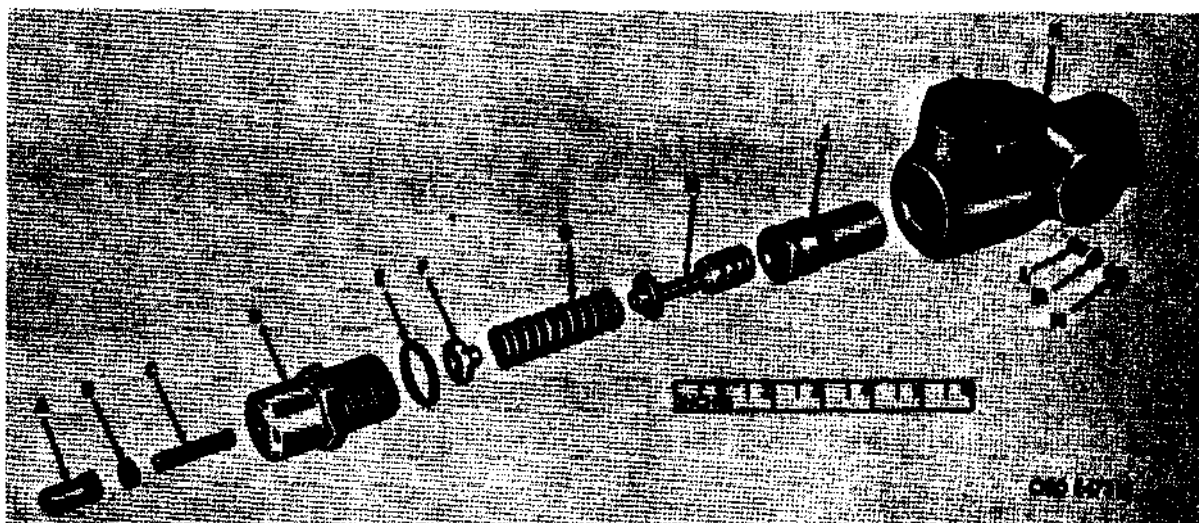


Figure 529. Relief valve assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|------------------------|------------|-----------------------|
| A | Nut, cap | H | Plunger, relief valve |
| B | Nut, lock | J | Sleeve, plunger |
| C | Screw, set, adjusting | K | Body, relief valve |
| D | Retainer, relief valve | L | Screw, set |
| E | Packing, O-ring | M | Gasket |
| F | Seat, spring | N | Screw, machine |
| G | Spring, guide | | |

Figure 529. Relief valve assembly - legend

Section V. TESTS AND ADJUSTMENTS

350. Hydraulic Pump and Relief Valve Assembly

a. Relief Valve Test.

- (1) Remove pipe plug from elbow at boom hoist hydraulic motor, and install hydraulic pressure gage in hole in elbow.

Note. Install gage so that it can be read from crane operator's compartment.

- (2) Lower hoist cable hook to ground to prevent fouling of hoist cable block with boom sheaves while testing relief valve.
- (3) With the boom fully retracted, move the crowd control lever to the RETRACT position, and move the hoist control lever to the UP position.
- (4) Holding the crowd and hoist control levers in positions described above, observe pressure indicated on hydraulic pressure gage. The pressure indicated on the gage is the pressure at which the relief valve is opening. If gage indicates incorrect relief valve setting (more or less than 1200 psi), adjust relief valve (b. below).

Caution: Do not adjust relief valve so that opening pressure exceeds 1200 psi as too high a relief valve setting will materially shorten the life of the crane hydraulic system components.

b. Relief Valve Adjustment.

- (1) Remove clamp securing swivel-valve-to-reservoir line (fig. 409) to top of relief valve, and remove line from valve.
- (2) Remove blind nut (fig. 528) from relief valve adjusting setscrew, and loosen jam nut on setscrew.
- (3) Using a screwdriver, turn setscrew as necessary to obtain the correct relief valve setting of 1200 psi.

Note. Turning the setscrew clockwise increases the pressure required to open the relief valve. Turning the setscrew counterclockwise decreases the relief valve opening pressure.

- (4) After correct relief valve setting is obtained, hold setscrews and tighten jam nut. Install blind nut (fig. 528) on setscrew.

Note. Be sure that jam nut and blind nut are tight on setscrew so that parts will not loosen during operation.

- (5) Position swivel - valve - to - restrictor line (fig. 409) at top of relief valve, and secure with clamp (fig. 409).

351. Timing Swing Motor

Note. The key letters noted in parentheses are in figure 530, except where otherwise indicated.

- a. Remove swing motor cover (par. 313).

b. Rotate pivot post and boom assembly until right swing-hydraulic-motor cylinder assembly (fig. 403) is in the dead center position (piston rod fully retracted). When cylinder is correctly positioned, the centering hole (H) in the rim of the drive pinion crank (fig. 403) is aligned with the centering hole in the base plate (under the crank).

c. Install a pin in centering holes in crank and base plate to prevent movement of piston (K), and stop engine.

d. Place identification tags on the two hydraulic lines connected to the elbows (fig. 403) installed in valve chamber ports (A and C). Unscrew two nuts (fig. 403), and remove the lines from the elbows.

e. Remove the adjusting-hole pipe plug (fig. 403) from the top of the control valve body.

f. Remove the front control-valve body plug (F) from the control valve body.

g. Loosen adjusting-screw jam nut (E) on actuating-lever adjusting screw (G).

h. Attach a compressed air hose to control valve body at adjusting-hole pipe plug (B), and adjust air pressure as low as possible.

i. Using a screwdriver, turn adjusting screw (G) until the amount of air blown from the two valve chamber ports (A and C) is equal. This indicates that the control valve spool (D) is in the NEUTRAL position (center of its range of travel) when the piston (K) is on dead center.

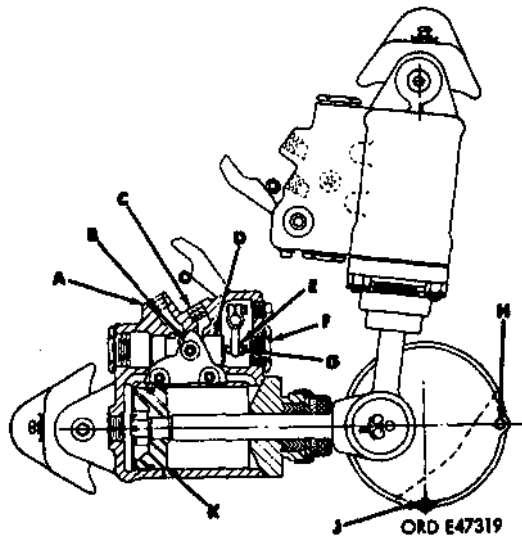


Figure 530. Swing motor timing diagram (M62)

| Key | Item |
|-----|---------------------------------|
| A | Valve chamber port |
| B | Adjusting-hole pipe plug |
| C | Valve chamber port |
| D | Control valve spool |
| E | Adjusting-screw jam nut |
| F | Front control-valve body plug |
| G | Actuating-lever adjusting screw |
| H | Centering hole |
| J | Centering hole |
| K | Piston |

Figure 530. Swing motor timing diagram (M62) - legend

j. Hold adjusting screw to prevent it from turning, and tighten jam nut on screw.

k. Remove compressed air hose from control valve body, and install adjusting-hole pipe plug (fig. 403) in body.

l. Install front control-valve body plug (F) in control valve body.

m. Position the two hydraulic lines at elbows (fig. 403) installed in valve chamber ports, and tighten connector nuts.

n. Remove pin from centering hole (H) in rim of drive pinion crank and from baseplate.

o. Rotate pivot post and boom assembly until left swing-hydraulic-motor cylinder assembly (fig. 403) is in the dead center position. When cylinder is correctly positioned, the centering hole (J) in rim of drive pinion crank is aligned with centering hole in base plate (under crank).

p. Install a pin in centering holes in crank and base plate to prevent movement of piston (K), and stop engine.

q. Adjust left swing-hydraulic-motor cylinder assembly ((d) through (n) above).

Note. Adjusting-hole pipe plug for left cylinder assembly is installed on underside of control valve body.

Caution: Be sure to remove pin from centering holes in drive crank and base plate after completing timing procedures.

352. Rotor Chamber Adjustment (Fig. 531)

a. Check clutch pedal free travel and adjust, if necessary.

b. Loosen locknut on adjusting screw installed in clutch release outer lever.

c. Turn adjusting screw until clearance between adjusting-screw head and upper end of inner lever is between three thirty-seconds and one-fourth inch. Figure 531 illustrates point of measurement between adjusting-screw head and inner lever.

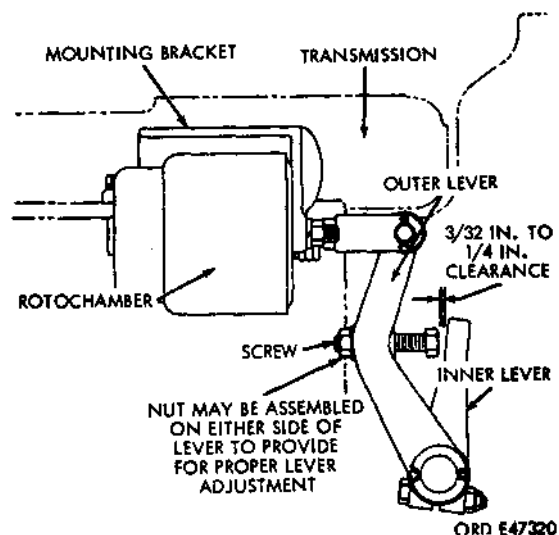


Figure 531. Roto chamber adjustment diagram

d. Hold adjusting screw to prevent it from turning, and tighten locknut.

353. Hydraulic Pump Control Linkage Adjustment (Refer to Fig. 417)

a. Remove cotter pin and yoke pin securing hydraulic-pump front control rod (K) to hydraulic-pump right relay lever (L), and remove rod from lever.

b. Place hydraulic pump control lever (fig. 414) in DISENGAGE position, and secure lever with locking hinge attached to wrecker body floor plate.

c. Remove cotter pin securing control-valve control rod (G) to control valve lever (U), and remove rod from lever.

d. Loosen nut (J) on front control rod (K).

e. Using front control rod, pull output shifter shaft arm (N) as far as possible toward rear of vehicle (to DISENGAGE position).

Note. Total travel of arm from ENGAGED to DISENGAGE position is five-eighths of an inch.

f. With clevis (H) moved as far as possible toward rear of vehicle, so that pin securing clevis to output shifter shaft arm is against front end of clevis slot, turn front control rod (K) in clevis until front control rod yoke can be connected to hydraulic-pump right relay lever.

Note. If linkage is so far out of adjustment that this cannot be done, adjust hydraulic-pump rear control rod (fig. 415), using adjustable yoke securing rear control rod to lower end of hydraulic pump control lever (fig. 418).

g. Position front control rod yoke on relay lever, and secure with yoke pin and cotter pin.

h. Holding control rod, tighten nut(J) against clevis (H).

i. Move control valve lever (U) as far as possible toward rear of vehicle.

j. Loosen nut (T) on control-valve control rod (G), and turn control rod in yoke (S) until front end of rod can be inserted in hole in lower end of lever.

k. Insert control rod end through hole in control valve lever, and install cotter pin in end of rod.

l. Holding control rod, tighten nut (T) against yoke (S).

354. Governor Valve Adjustment

a. Start engine.

b. After engine coolant temperature reaches normal operating range power divider.

c. Pull throttle control all the way out and leave in LOCKED OUT position. Observe engine speed (rpm) indicated by tachometer, which is the engine speed at which the governor valve (W) mounted on the power divider controls the engine speed governor.

d. Stop engine.

e. If engine governed speed (no-load) indicated by c above is not within range of satisfactory governor operation (1550 to 1650 rpm when governor is controlled by governor valve at power divider), adjust governor valve at power divider f through k below.

f. Remove adjusting-hole plug seal, and remove plug (X) from side of governor valve housing.

g. Place the transmission gearshift lever in "5" gear position, place the transfer shift lever in neutral position, and place the power divider control lever in ENGAGE position. With the ignition switch off, crank engine by small increments (by momentarily depressing starter button) until adjusting screw inside governor is alined with adjusting hole.

h. Insert a screwdriver in the adjusting hole and turn the adjusting screw clockwise to increase engine governed speed or counter-clockwise to decrease engine governed speed. One full turn of the adjusting screw in either direction will result in a change in the engine governed speed of approximately 150 rpm.

i. Install plug (X) in adjusting hole, and check governor valve adjustment by repeating a through d above.

j. If necessary, repeat 1 through 4 above until governor valve adjustment is satisfactory.

k. Attach a new locking wire and lead seal to the adjusting hole plug and the fin on the control valve housing adjacent to the adjusting hole.

355. Worm and Drive Gear

a. Adjustment.

- (1) The worm and drive gear set has been adjusted at the factory and should require adjusting only after repair. For this reason, special care should be taken to retain the same tooth contact as established at original manufacture, whenever the worm and drive gear set undergoes major repair. The two adjustments which affect tooth contact are end position of the worm and side position of the gear. As a general rule the shim pack removed at disassembly, when used intact in the assembly, will provide the correct tooth contact.
- (2) Method of checking adjustment (fig. 442). As soon as the worm and drive gear set has been assembled in the gearcase to the correct relative position, the adjustment for tooth contact is checked as follows:
 - (a) Lightly paint both sides of teeth of drive gear (M) with Prussian blue. Usually, coating about five to six teeth is sufficient for checking purposes. When the worm (AL) is rotated, the Prussian blue is squeezed away by the contact of the teeth, leaving bare areas the exact size, shape, and location of the contacts. Sharper contact readings can be obtained by applying a small amount of resistance to the drive shaft (AX) when rotating the worm. Rotate the worm by hand in the direction it will run when under full load, letting the blued teeth pass through the worm threads several times. Worm threads should now show a bearing reading on the drive side for approximately three-quarters of the length of the worm thread. Center of threads should be as near to dead center of gear as possible.
 - (b) Rotate the worm again, but mesh this time with unblued teeth of the drive gear. The gear teeth should now indi-

cate a bearing reading in the center of each tooth, and covering approximately one-half of the tooth width, looking from the rear on the drive side. The coat side of the threads and teeth should also show very nearly the same reading as the drive side, when similarly checked by reversing the rotation.

b. Procedure for Making Adjustment (Fig. 442). If the worm and drive gear set is not correctly aligned, it should be adjusted by removing or adding shims. This is done in the following manner:

- (1) If the worm is out of end position (not centered under axis of drive gear), bearing cage shims (AT) should be added or removed as necessary between the worm bearing cage (Y) and the gearcase (CC).
- (2) If the drive gear is out of side position, shims (F or FF) should be added on one side and an equal amount removed on the other side so that the drive gear will be centered directly over the worm when meshed.
- (3) Shim or gasket thickness between the bearing cap (D) and the gearcase (CC) should be such that drive gear bearing cones (L and AV) are given a light preload: Preload should be 0.005-to 0.001-inch on each bearing.
- (4) After a short run under full load, recheck the adjustment, using the procedures as outlined in b above. Worm and drive gear set adjustment will be correct if a bearing reading shows for approximately three-quarters of the width of the drive gear teeth and the full length of the worm thread.

356. Drive Pinion, Idler Gear, and Pivot Post Bearings

a. General. Bearing adjustments must be made individually without drag or gear contact with mating part. Pivot post seals must be removed to establish a proper preload adjustment.

Note. Keep all shim packs intact for final assembly.

b. Drive Pinion Idler Gear Adjustment (Fig. 477).

- (1) Assemble drive pinion idler gear (L) with bearings in housing of base plate as outlined in paragraph 335. Adjust bearings by removing or adding spacing shims (R, S, T, and U) until a very slight drag is felt when the idler gear is revolved.
- (2) Remove the idler gear assembly and keep the shim pack intact for final assembly.

c. Drive Pinion and Crank (Fig. 477).

- (1) Assemble drive pinion (KK) and drive pinion crank (NN) with bearings in housing of base plate as described in paragraph 335. Adjust bearings by removing or adding spacing shims (EE, FF, and GG) until a very slight drag is felt when the drive pinion is revolved.
- (2) Removal of the drive pinion and crank, after the adjustment, is not required.

d. Pivot Post and Support (Fig. 480).

- (1) The pivot post bearings must be adjusted with the drive pinion idler gear

removed from the base plate. The pivot post gear shields (V and ZZ), gear shield felt (U and AB), and inner pivot post seal (T) must not be assembled, to avoid drag for bearing preload adjustment.

- (2) Assemble pivot post and bearings to pivot post support as outlined in paragraph 335, omitting inner post seal (T).
- (3) Attach a rope to one of the large studs, used for mounting the stop plate (WW), and feed rope down into the gear shield felt groove of the pivot post (BB). Attach a scale to the rope. Adjust bearings by removing or adding spacing shims (EE, FF, and GG) under the pivot post support cap (PP), until a 12-to15-pound pull is required on the scale to turn the pivot post.
- (4) The pivot post must then be removed for installation of the inner pivot seal (T). Keep the shim pack intact for final assembly.
- (5) After all adjustments are made and size of shim packs is determined, assemble as described in paragraph 335.

Section VI. SERVICEABILITY STANDARDS

357. General

The serviceability standards give the minimum, maximum, and key clearances of new or repaired parts. They also give wear limits which indicate that point to which a part or parts may be worn before replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear Limits" column, or damaged from corrosion will be approved for service. An asterisk

(*) in the "Wear limits" column indicates that the part or parts should be replaced when worn beyond the limits given in the "Size and fit of new parts" column, the letter L indicates a loose fit (clearance) and the letter T indicates a tight fit (interference). All dimensions are in inches, unless otherwise indicated.

358. Serviceability Standards

Table XIV below gives the serviceability standards for the wrecker crane assembly.

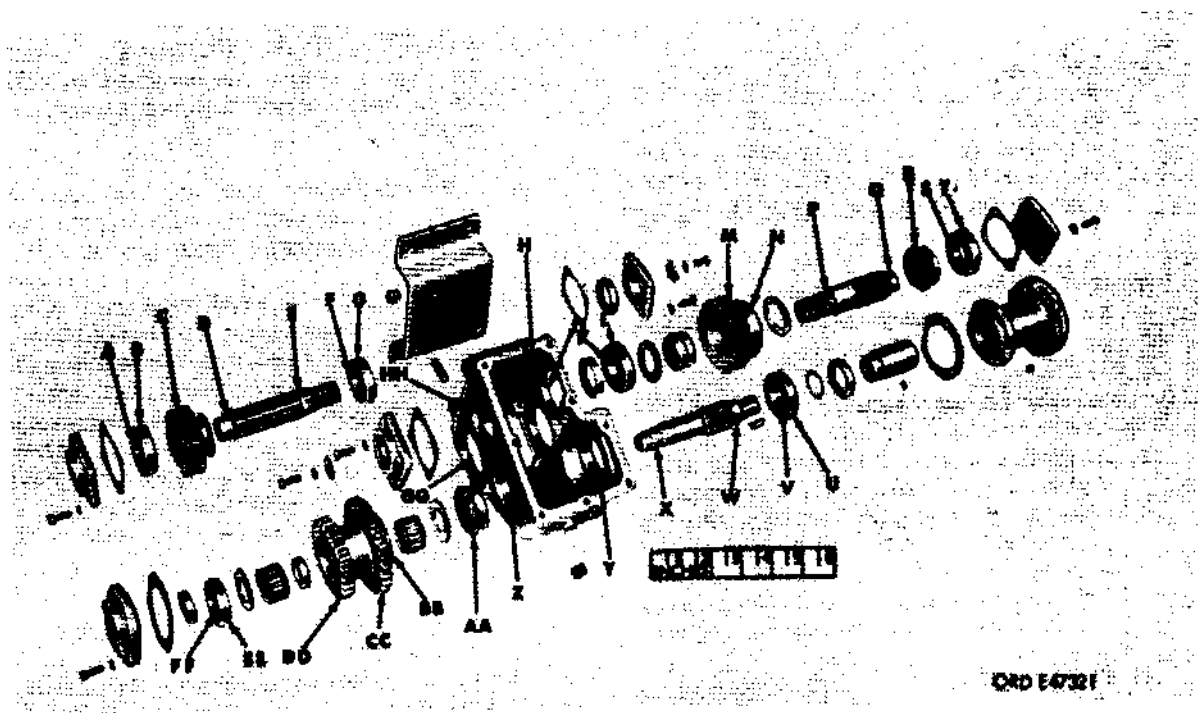


Figure 532. Power divider shafts and gears tolerances

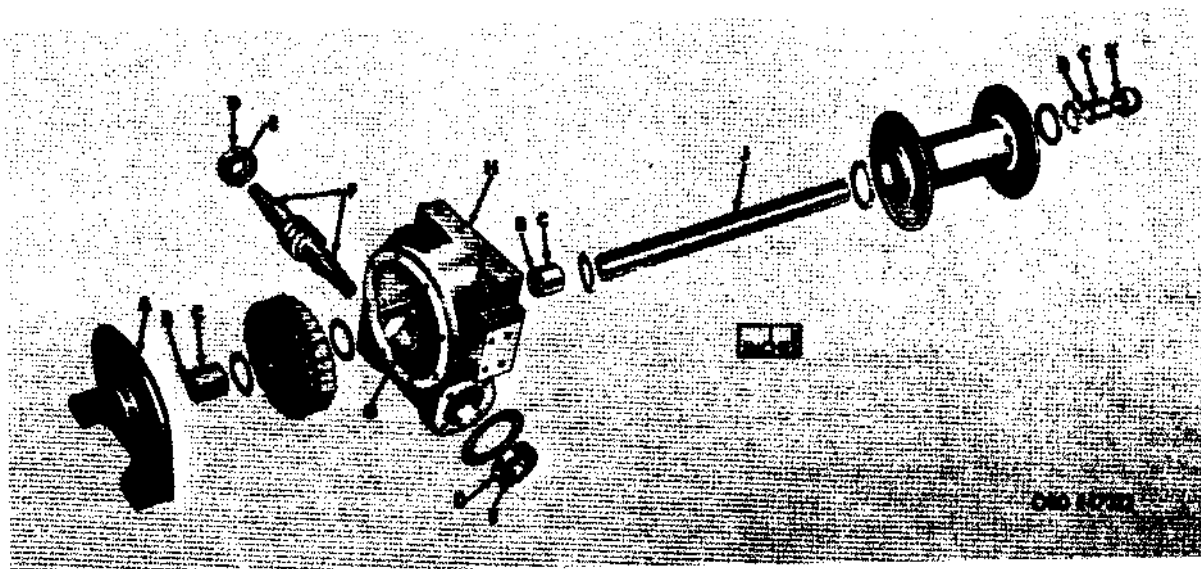


Figure 533. Rear mounted winch tolerances

Table XVII. Serviceability Standards - Wrecker Crane Assembly

| Fig. No. | Ref letter | Point of measurement | Size and fit of new parts | Wear limits |
|--|------------|---|---|-------------|
| POWER DIVIDER | | | | |
| Input and Pump Output Shifter Shaft and Cover | | | | |
| 517 | DD | Compression spring (pump output shift shaft) | Free length 1-21/32 in. compressed to 1 in. 38 lb | |
| 517 | KK | Compression spring (input shifter shaft) | Free length 1-21/32 in. compressed to 1 in. 38 lb | |
| Winch Output Shifter Shaft and Cover | | | | |
| 518 | F | Compression spring (winch output shifter shaft) | Free length 1-21/32 in. compressed to 1 in. 38 lb | |
| 532 | D | Winch output gear shaft | 1.5747-1.5752 | 1.5732 |
| 532 | A | Winch output gear bearing id | 1.5744-1.5748 | (*) |
| 532 | D-A | Bearing to shaft clearance | 0.0001L-0.0008T | 0.0011L |
| 532 | GG | Output gear bearing bore in case | 3.1495-3.1503 | 3.1513 |
| 532 | B | Output gear bearing od | 3.1491-3.1496 | (*) |
| 532 | GG-B | Bearing to case clearance | 0.0012L-0.0001T | 0.0022 |
| 532 | F | Winch output gear bearing id | 1.5744-1.5748 | (*) |
| 532 | E | Winch output gearshaft | 1.5747-1.5752 | 1.5737 |
| 532 | F-E | Bearing to shaft clearance | 0.0001L-0.0008T | 0.0011L |
| 532 | G | Winch output gear bearing od | 3.1491-3.1496 | (*) |
| 532 | H | Winch output gear bearing bore in case | 3.1495-3.1503 | 3.1513 |
| 532 | H-G | Bearing to case clearance | 0.0012L-0.0001T | 0.0022 |
| 532 | K | Input gearshaft bearing id | 1.5743-1.5748 | (*) |
| 532 | P | Input gearshaft | 1.5747-1.5752 | 1.5737 |
| 532 | K-P | Bearing clearance on shaft | 0.0001L-0.0009T | 0.0011L |
| 532 | L | Input gearshaft bearing od | 3.1491-3.1496 | (*) |
| 532 | HH | Input gear bearing bore in case | 3.1495-3.1503 | 3.1513 |

Table XVII. Serviceability Standards - Wrecker Crane Assembly - Continued

| Fig. No. | Ref. letter | Point of measurement | Size and fit of new parts | Wear limits |
|---|-------------|---|---------------------------|-------------|
| POWER DIVIDER - Continued | | | | |
| Winch Output Shifter Shaft and Cover - Continued | | | | |
| 532 | HH-L | Bearing to case clearance | 0.0012L-0.0001T | 0.0022 |
| 532 | S | Input gearshaft bearing id | 1.5743-1.5748 | (*) |
| 532 | Q | Input gearshaft | 1.5757-1.5752 | 1.5732 |
| 532 | S-Q | Bearing clearance on shaft | 0.0001L-0.0009T | 0.0011L |
| 532 | T | Input gearshaft bearing od | 3.1491-3.1498 | (*) |
| 532 | J | Input gear bearing bore in case | 3.1495-3.1503 | 3.1513 |
| 532 | T-J | Bearing to case clearance | 0.0012L-0.0001T | 0.0022 |
| 532 | V | Pump output shaft bearing id | 1.5744-1.5748 | (*) |
| 532 | W | Pump output shaft | 1.5747-1.5752 | 1.5732 |
| 532 | V-W | Bearing clearance on shaft | 0.0001L-0.0008T | 0.0011L |
| 532 | U | Pump output shaft bearing od | 3.1491-3.1496 | (*) |
| 532 | Y | Pump output bearing bore in case | 3.1495-3.1503 | 3.1513 |
| 532 | U-Y | Bearing to case clearance | 0.0012L-0.0001T | 0.0022L |
| 532 | FF | Pump output shaft bearing id | 1.3775-1.3780 | (*) |
| 532 | X | Pump output shaft | 1.3779-1.3784 | 1.3764 |
| 532 | FF-X | Bearing fit on shaft | 0.0001L-0.0009T | 0.0011L |
| 532 | EE | Pump output shaft bearing od | 2.8341-2.8346 | (*) |
| 532 | Z | Pump output bearing bore in case | 2.8345-2.8353 | 2.8363 |
| 532 | EE-Z | Bearing to case clearance | 0.0012L-0.0001T | 0.0022 |
| Gear Backlash | | | | |
| 532 | C-M | Winch output gear to input shaft gear | 0.006-0.010 | 0.035 |
| 532 | DD-M | Power divider drive gear to input shaft gear | 0.006-0.010 | 0.035 |
| 532 | CC-C | Power divider drive gear to winch output gear | 0.006-0.010 | 0.035 |

Table XVII. Serviceability Standards - Wrecker Crane Assembly - Continued

| Fig. No. | Ref. letter | Point of measurement | Size and fit of new parts | Wear limits |
|----------------------------------|-------------|--|---------------------------|-------------|
| POWER DIVIDER - Continued | | | | |
| Gear Backlash - Continued | | | | |
| 532 | N-R | Input shaft sliding clutch to input shaft gear | 0.006-0.010 | 0.035 |
| 532 | AA-BB | Power divider sliding clutch to power divider drive gear | 0.006-0.010 | 0.035 |
| REAR MOUNTED WINCH | | | | |
| Drum Shaft and Bearings | | | | |
| 533 | J | Drum shaft | 2.998-3.000 | 2.983 |
| 533 | B | Drum shaft bearings id | 3.002-3.005 | 3.020 |
| 533 | B-J | Drum shaft to bearing clearance | 0.002L-0.007L | 0.020L |
| 533 | A | End cover bearing bore | 3.250-3.251 | (*) |
| 533 | H | Gear case bearing bore | 3.250-3.251 | (*) |
| 533 | K | End frame bearing sleeve id | 3.250-3.251 | (*) |
| 533 | C | Drum shaft bearing od | 3.256-3.258 | (*) |
| 533 | A,H, K-C | Bearing fits in end cover, gear-case, and sleeve bores | 0.005T-0.008T | (*) |
| Drive Worm and Bearings | | | | |
| 533 | E | Drive worm bearing id | 2.3616-2.3622 | (*) |
| 533 | F | Drive worm | 2.3615-2.3625 | 2.3595 |
| 533 | E-F | Drive worm bearing fit on worm | 0.0007L-0.0009T | 0.0017L |
| 533 | D | Drive worm bearing od | 5.1173-5.1181 | (*) |
| 533 | G | Gearcase bearing bore | 5.1179-5.1191 | 5.1201 |
| 533 | G-D | Bearing fit in gear case bore | 0.0018L-0.0002T | (*) |
| HYDRAULIC VALVES | | | | |
| Swivel Valve | | | | |
| 467 | L | Inner hub | 4.750 | |
| 467 | N | Body | 4.750-4.7503 | |

Table XVII. Serviceability Standards - Wrecker Crane Assembly - Continued

| Fig. No. | Ref. letter | Point of measurement | Size and fit of new parts | Wear limits |
|-------------------------------------|-------------|---|---------------------------|-------------|
| HYDRAULIC VALVES - Continued | | | | |
| Swivel Valve - Continued | | | | |
| | N-L | Clearance after matching hub and body | 0.0005L-0.0006L | |
| Control Valve | | | | |
| | D | Spool | 1.3755 | |
| | BB | Body | 1.3757 | |
| | BB-D | Clearance after matching spool and body | 0.0004L-0.0007L | |
| Swing Motor Control Valve | | | | |
| | P | Spool | 1.3755 | |
| | M | Body | 1.3757 | |
| | M-P | Clearance after matching spool to body | 0.0004L-0.0007L | |

Note. Parts shown above are available only in matching pairs. For this reason, the clearance between parts after matching will be the only limits given. Wear between parts is negligible and parts should only be replaced if scored or cut by abrasives which might enter the hydraulic system.

CHAPTER 23

WRECKER CRANE M246

Section I. DESCRIPTION AND DATA

359. Description

a. General. The hydraulically operated crane, mounted on the rear of the chassis of the tractor wrecker truck M246, consists primarily of the assemblies described in b through n below. The complete crane can be replaced as a single unit, provided hoisting equipment having a capacity of approximately 8000 pounds is available. However, the illustrations and replacement instructions contained in this section refer to replacement of the individual units and assemblies comprising the crane.

b. Hydraulic Pump and Relief Valve Assembly. The flange-mounted vane-type hydraulic pump (fig. 534) is bolted to a bracket attached to the underside of the rear outrigger frame tube. The pump is driven by a propeller shaft (fig. 534) extending from the power takeoff on the rear of the transfer to the pump input shaft. The adjustable relief valve (fig. 534) is connected to the hydraulic pump outlet port. The purpose of this valve is to protect the crane hydraulic system from excessive (above 1200 psi) pump pressures.

c. Base Plate and Pivot Post Assembly. The base plate and pivot post assembly, as referred to in this paragraph, consists of the crane base plate (fig. 535), pivot post, shipper support, swivel valve (fig. 401), and operator's cab and control valve bank assembly (fig. 401). The combined weight of these units is approximately 3920 pounds. The base plate is bolted to both the crane body and to the truck frame. The pivot post, which is hollow, is internally supported at the top and bottom by tapered roller bearings, which are installed on a tubular support member attached to the base plate. The pivot post support cap (fig. 402), bolted to the top of the pivot post support, anchors the pivot post to the support while permitting the pivot post to rotate freely on its vertical axis. The shipper support, on which the boom and shipper assembly (f below) are pivoted, is bolted to mounting bosses cast on the sides of the pivot post. For description of the swivel

valve, refer to paragraph 294e. For description of the control valve bank, refer to paragraph 294j.

d. Swing Motor and Drive Gearcase. The flange-mounted vane-type hydraulic swing motor (fig. 536) is secured to the drive gearcase by six safety nuts installed on studs screwed into the motor housing. The drive gearcase is secured to the crane base plate by three safety nuts installed on studs screwed into the gearcase. The swing motor drive shaft is connected to the drive worm inside the gearcase by a keyed coupling. Although the procedures in this section cover removal of the swing motor and drive gearcase as a unit, the swing motor can be removed without removing the drive gearcase.

e. Swivel Valve. Refer to paragraph 294e.

f. Boom and Shipper Assembly. The boom and shipper assembly consists of the boom, boom extension, and shipper, which are telescoping tubular steel members having a rectangular shaped cross section, held together by two boom-extension retaining pins and the boom crowd cylinder (h below). The rear end of the shipper is pivoted on a pin (fig. 405)

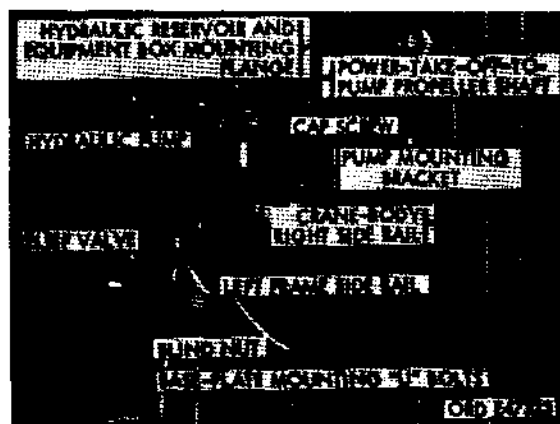


Figure 534. Bottom view of hydraulic pump and relief valve assembly installed M246

installed at the top rear of the shipper support, which permits raising and lowering the front end of the boom. Weight of the shipper and boom assembly is approximately 2620 pounds. Although the boom and shipper removal procedures (par. 367) require removal of the boom hoist hydraulic oil motor and cable drum before removal of the boom and shipper assembly, both assemblies can be removed as a single unit.

g. Boom Lift Cylinder. Refer to paragraph 294g.

h. Boom Crowd Cylinder. Refer to paragraph 294h.

i. Boom Hoist Hydraulic Oil Motor and Cable Drum Assembly. Refer to paragraph 294i.

j. Control Valve Bank. Refer to paragraph 294j.

k. Hydraulic Lines and Fittings. Refer to paragraph 294k.

l. Hydraulic Reservoir and Equipment Box. The hydraulic reservoir and equipment box (fig. 536) is secured to the crane body by four cap screws installed through holes in the top

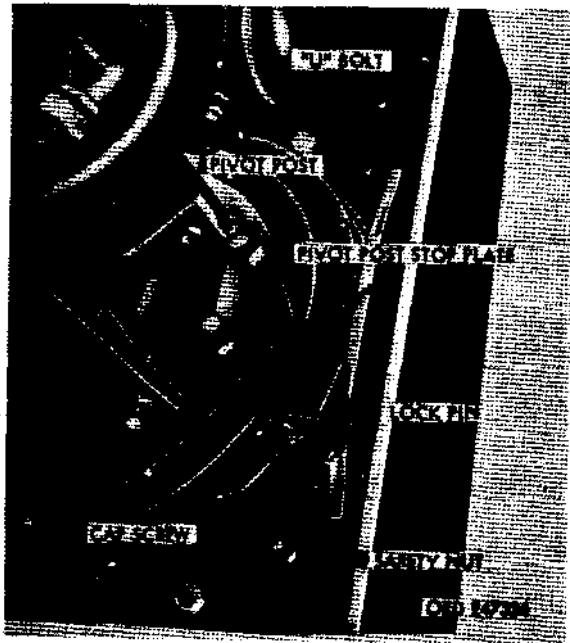


Figure 535. Lower section of crane pivot post and base plate (M246) - left rear view



Figure 536. Crane hydraulic swing motor (M246)

flange of the crane-body side rails (fig. 534) and into tapped blocks welded to the top side of the hydraulic-reservoir-and-equipment-box mounting flanges. Weight of the reservoir and equipment box is 185 pounds.

m. Crane Body. The crane body (fig. 537) is bolted to the truck frame (after removal of the base plate and pivot post assembly) by four cap screws and safety nuts, installed two on each side through brackets bolted to the truck frame. In addition, the fifth wheel approach plates at the front of the crane body are bolted to the top flange of the truck frame side rails by six cap screws and safety nuts, three on each side. The approximate weight of the crane body, including the outriggers, is 2200 pounds.

n. Hydraulic System. The wrecker crane hydraulic system (fig. 538) is completely sealed except for the breather-type reservoir filler cap. A bayonet-type oil level gage attached to a square-head pipe plug is installed in the top of the reservoir.

360. Data

a. Wrecker crane.

Make Austin-Western
Type hydraulic
Capacity rating 5 ton

b. Hydraulic pump.

Make. Vickers
Type vane

c. Relief valve.

Make Hydreco

d. Swivel valve.

Make Austin-Western

e. Swing hydraulic oil motor.

Make Vickers

f. Boom hoist hydraulic oil motor.

Make Vickers

Type vane

g. Control valve bank assembly.

Make Austin-Western

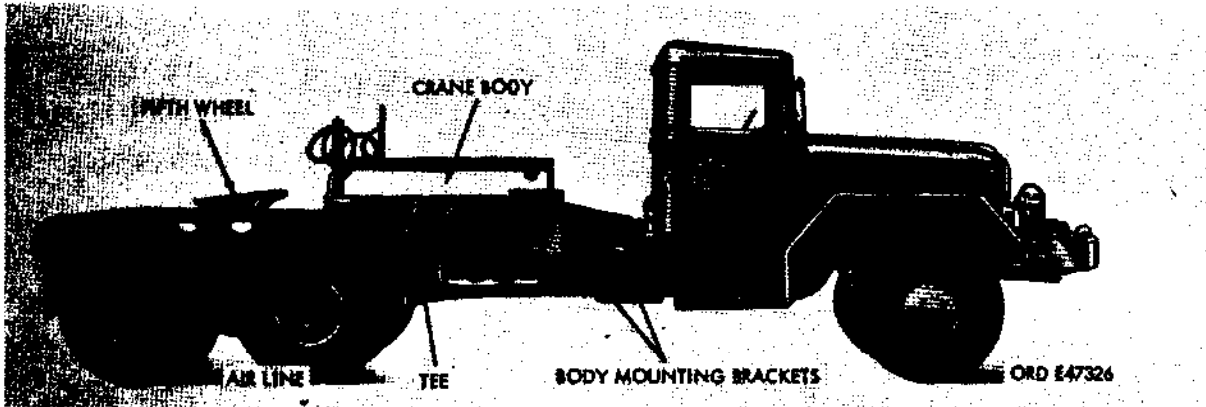


Figure 537. Right side view of tractor wrecker truck M246 with hydraulic crane and reservoir removed

Section II. TROUBLESHOOTING

361. General

Troubleshooting is a systematic isolation of defective components by means of an analysis of vehicle trouble symptoms, testing to determine the defective component, and applying the remedies.

362. Troubleshooting Procedures

Troubleshooting procedures for the Wrecker Crane M246 are the same as those for the Wrecker Crane M62. Refer to paragraph 296 for this information.

Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

363. Hydraulic Pump and Relief Valve Assembly

a. Removal.

- (1) Disconnect swivel-valve-to-relief-valve line (fig. 539) from relief valve outlet port.
- (2) Disconnect swivel-valve-to-reservoir-inlet-tee line (fig. 539) from tee at relief valve.

- (3) Loosen two hose clamps securing reservoir inlet hose (fig. 539) to sleeve on bottom of reservoir, and remove hose from sleeve.
- (4) Loosen two hose clamps securing pump inlet hose (fig. 539) to oil supply valve outlet port.
- (5) Remove power takeoff-to-pump propeller shaft (fig. 534) from pump propeller shaft (TM 9-2320-211-20).

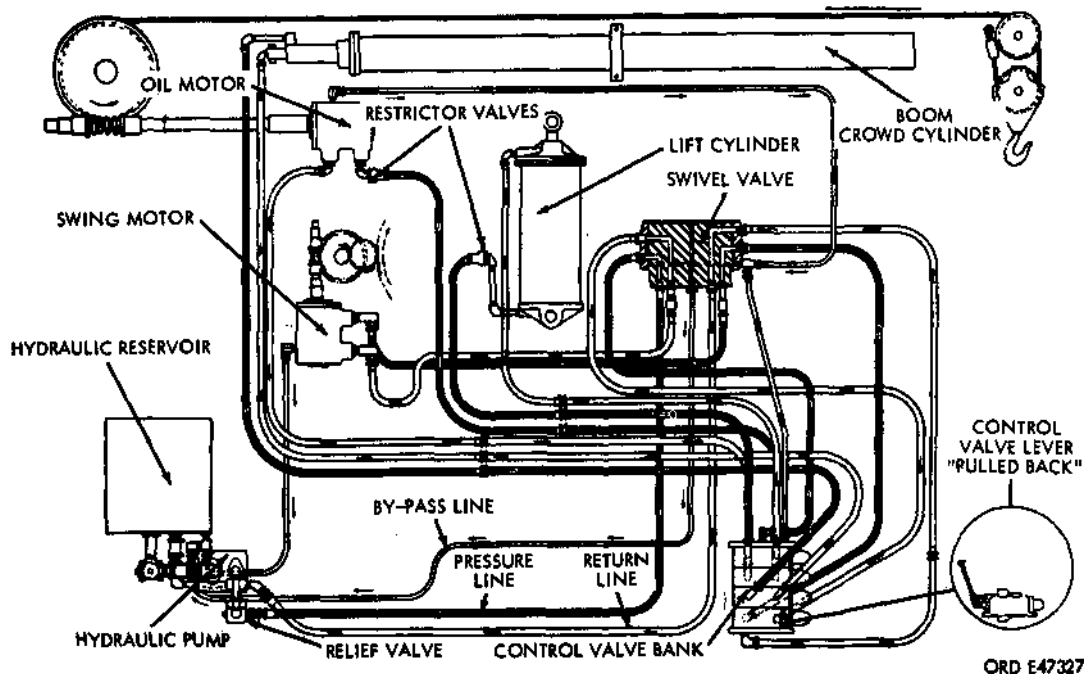


Figure 538. Crane hydraulic system M246

- (6) Remove six cap screws (fig. 534) and lockwashers securing pump-to-pump-mounting bracket, pull pump from bracket, sliding pump inlet hose (fig. 539) from oil supply valve outlet port, and remove hydraulic pump and relief valve assembly from vehicle.
- (7) Remove reservoir-to-pump piping from pump inlet port.
- (8) Remove pump-to-relief-valve piping from pump outlet port.
- (9) Remove pump-to-relief-valve piping from relief valve inlet port.
- (10) Remove relief-valve-to-reservoir piping from relief valve outlet port.
- (4) Install reservoir-to-pump piping in pump inlet port.
- (5) Position pump and relief valve assembly under front outrigger frame tube, and secure pump (fig. 539) to pump mounting bracket with six cap screws and lockwashers. Tighten cap screws.
- (6) Install power-takeoff-to-pump propeller shaft (fig. 534) on pump drive shaft (TM 9-2320-211-20).
- (7) Connect swivel-valve-to-reservoir-inlet-tee line (fig. 539) to tee at relief valve.
- (8) Connect swivel-valve-to-relief-valve line (fig. 539) to relief valve outlet port.

b. Installation

- (1) Install relief-valve-to-reservoir piping in relief valve outlet port.
- (2) Install pump-to-relief-valve piping in relief valve inlet port.
- (9) Install pump-to-relief-valve piping in pump outlet port.
- (9) Install reservoir inlet hose (fig. 539) on sleeve at bottom of reservoir, and tighten the two hose clamps.
- (10) Install pump inlet hose (fig. 539) on oil supply valve outlet port, and tighten the two hose clamps. Open oil supply valve.

364. Base Plate and Pivot Post Assembly

a. Removal.

- (1) Remove boom and shipper assembly (par. 367).
- (2) Remove boom lift cylinder (par. 368).
- (3) Remove swing motor and drive gearcase (par. 365), and drop swing-motor-to-reservoir line (fig. 536) through hole in crane base plate.
- (4) Remove 16 safety nuts (fig. 535) from 8 U-bolts securing base plate to crane body side rails and truck frame side rails.
- (5) Remove four cap screws (fig. 535) and lockwashers securing base plate to crane body.
- (6) Disconnect floodlight cable at bayonet-type connector clipped to top of frame cross member under crane base plate.
- (7) Disconnect swivel-valve-to-relief-valve line (fig. 538) from relief valve outlet port.
- (8) Disconnect swivel-valve-to-reservoir-inlet-tee line (fig. 539) from tee at relief valve.
- (9) Disconnect swivel-valve-to-reservoir line (fig. 538) from tee on bottom of reservoir.

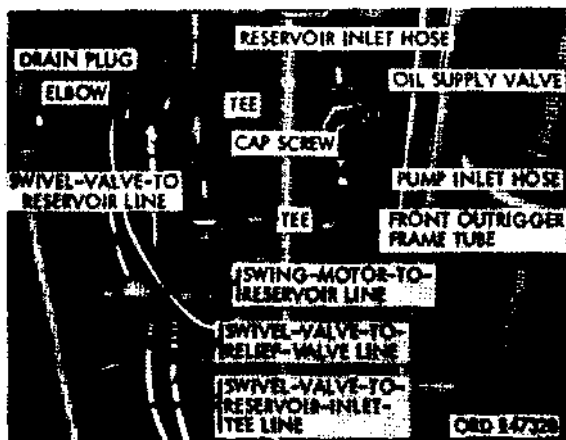


Figure 539. Front bottom view of hydraulic pump and relief valve assembly installed M246

- (10) Place a chain under the operator's cab and between the shipper support (fig. 421), and using overhead hoisting equipment, lift base plate and pivot post assembly from crane body.

b. Installation.

- (1) Using overhead hoisting equipment, lift base plate and pivot post assembly into position on crane body, guiding base plate mounting U-bolts (fig. 534) through holes in base plate. Remove hoisting equipment.
- (2) Connect swivel-valve-to-reservoir line (fig. 539) to tee on bottom of reservoir.
- (3) Connect swivel-valve-to-reservoir-inlet-tee line (fig. 539) to tee at relief valve.
- (4) Connect swivel-valve-to-relief-valve line (fig. 539) to relief valve outlet port.
- (5) Connect floodlight cable to bayonet-type connector clipped to top of frame cross member under crane base plate.
- (6) Install 16 safety nuts (fig. 535) or 8 U-bolts, and tighten.
- (7) Install four cap screws (fig. 535) and lockwashers in holes in base plate and crane body side rails.
- (8) Insert swing-motor-to-reservoir line (fig. 539) through hole in crane base plate, and install swing motor and drive gearcase (par. 365).
- (9) Install boom lift cylinder (par. 368).
- (10) Install boom and shipper assembly (par. 367).
- (11) Lubricate hydraulic crane (refer to LO 9-2320-211-12).

365. Swing Motor and Drive Gearcase

a. Removal.

- (1) Disconnect swing-motor-to-reservoir line (fig. 536) from elbow on rear of swing motor.

- (2) Disconnect two swivel-valve-to-swing-motor lines (fig. 536) from elbows on front of swing motor.
- (3) Remove three safety nuts (one at left side and two at right side) from studs securing drive gearcase to crane base plate, and remove swing motor and drive gearcase from vehicle.
- (4) Remove six safety nuts (fig. 536) securing swing motor to drive gearcase, and remove motor from gearcase.

b. Installation.

- (1) Aline key on swing-motor drive shaft with keyway in coupling on drive worm, position swing motor (fig. 536) on drive gearcase, and secure with six safety nuts. Tighten nuts (on motor mounting studs).
- (2) Position drive gearcase on crane base plate, with studs on bottom of case entering holes in baseplate, and secure with three safety nuts.
- (3) Connect two swivel-valve-to-swing-motor lines (fig. 536) at elbows on front of swing motor.
- (4) Connect swing-motor-to-reservoir line (fig. 536) at elbow on rear of swing motor.

366. Swivel Valve

a. Removal.

- (1) Disconnect floodlight cable from connector at rear of floodlight (TM 9-2320-211-20).
- (2) Disconnect oil motor bypass line (fig. 424) at hoist oil motor. Loosen cap screw (fig. 401) securing hose clip to bracket, and remove oil motor bypass line from clip and bracket.
- (3) Using overhead hoisting equipment, raise the shipper and boom assembly to the extreme upward position.

Note. When raising boom, hold boom control lever in up position to permit the oil in the lift cylinder to bypass.

- (4) Disconnect four flexible hydraulic lines (fig. 401) and one return line (fig. 407) at control valve bank assembly.

Note. Place identification tags on hydraulic lines and control valve bank elbows to facilitate swivel valve installation

- (5) Loosen two hex nuts (fig. 402), and slide swivel-valve-hub locking plates out of groove in swivel valve.

Note. One locking plate is installed at front and rear of swivel valve assembly.

- (6) Disconnect floodlight cable at bayonet-type connector clipped to top of frame cross member under crane base plate.
- (7) Disconnect two swivel-valve-to-swing-motor lines (fig. 536) from elbows on front of swing motor.
- (8) Disconnect swivel-valve-to-relief-valve line (fig. 539) from relief valve outlet.
- (9) Disconnect swivel-valve-to-reservoir-inlet-tee-line (fig. 539) from tee at relief valve.
- (10) Disconnect swivel-valve-to-reservoir line (fig. 539) from tee at bottom of reservoir.
- (11) Using overhead hoisting equipment, lift swivel valve assembly (fig. 402) together with hydraulic lines and floodlight cable, from pivot post, and remove from vehicle.

b. Installation

- (1) Using overhead hoisting equipment, support swivel valve assembly (fig. 402) over pivot post and feed floodlight cable and hydraulic lines attached to bottom of swivel valve through center of pivot post.
- (2) Lower swivel valve assembly into position on top of pivot post support cap (fig. 402), and engage the two locking plates in groove in swivel valve. Tighten locking plate retaining nuts.
- (3) Connect four flexible hydraulic lines (fig. 401) and one return line (fig. 407) at control valve bank assembly.

- (4) Position oil motor bypass line (fig. 401) on bracket on left side panel in operator's compartment, and secure with clip. Tighten clip retaining cap screw.
- (5) Connect oil motor bypass line (fig. 424) to hoist oil motor.
- (6) Connect floodlight cable to connector at rear of floodlight (TM 9-2320-211-20).
- (7) Connect two swivel-valve-to-swing-motor lines (fig. 536) at elbows on front of swing motor.
- (8) Connect floodlight cable to bayonet-type connector clipped to top of frame cross member under crane base plate.
- (9) Connect swivel-valve-to-reservoir line (fig. 539) at tee on bottom of reservoir.
- (10) Connect swivel-valve-to-reservoir-inlet-tee line (fig. 539) at tee at relief valve.
- (11) Connect swivel-valve-to-relief-valve line (fig. 539) to relief valve outlet port.
- (12) Remove overhead hoisting equipment from boom and shipper assembly, and lower boom.

367. Boom and Shipper Assembly

- a. Removal. Refer to paragraph 315a.
- b. Installation. Refer to paragraph 315b.

368. Boom Lift Cylinder

- a. Removal. Refer to paragraph 316a.
- b. Installation. Refer to paragraph 316b.

369. Boom Crowd Cylinder

- a. Removal. Refer to paragraph 317a.
- b. Installation. Refer to paragraph 317b.

370. Boom Hoist Hydraulic Oil Motor and Cable Drum

- a. Removal. Refer to paragraph 318a.
- b. Installation. Refer to paragraph 318b.

371. Control Valve Bank

- a. Removal. Refer to paragraph 319a.
- b. Installation. Refer to paragraph 319b.

372. Hydraulic Lines and Fittings

- a. Removal. Refer to paragraph 320a.
- b. Installation. Refer to paragraph 320b.

373. Hydraulic Reservoir and Equipment Box

a. Removal.

- (1) Disconnect swivel-valve-to-reservoir line (fig. 539) at tee on bottom of reservoir.
- (2) Disconnect swing-motor-to-reservoir line (fig. 539) at elbow on bottom of reservoir.
- (3) Loosen two hose clamps securing reservoir inlet hose (fig. 539) to sleeve on bottom of reservoir, and remove hose from sleeve.
- (4) Loosen two hose clamps securing pump inlet hose (fig. 539) to oil supply valve outlet port, and remove hose from valve.
- (5) Remove four cap screws and lockwashers (from inside of crane body side rails) securing reservoir mounting flanges (fig. 534) to crane body side rails.
- (6) Attach a chain sling and overhead hoisting equipment to reservoir, and lift reservoir from crane body and remove from vehicle.

b. Installation.

- (1) Using chain sling and hoist, position hydraulic reservoir and equipment box on crane body, and align holes in crane body side rails (fig. 534) with holes in reservoir mounting flanges. Install four cap screws with lockwashers in mounting holes, and tighten.
- (2) Slide pump inlet hose (fig. 539) on oil supply valve outlet port, and tighten the two hose clamps.

- (3) Slide reservoir inlet hose (fig. 539) on sleeve at bottom of reservoir, and tighten the two hose clamps.
- (4) Connect swivel-valve-to-reservoir line (fig. 539) at tee on bottom of reservoir.
- (5) Connect swing-motor-to-reservoir line (fig. 539) at elbow on bottom of reservoir.

374. Crane Body

a. Removal.

- (1) Remove base plate and pivot post assembly (par. 364).
- (2) Remove fifth wheel. (Refer to TM 9-2320-211-20.)
- (3) Remove hydraulic pump and relief valve assembly (par. 363).
- (4) Drain air reservoir (TM 9-2320-211-20).
- (5) Disconnect both ends of air line (fig. 537) connecting elbow (fig. 540) at base of trailer hose and cable supports to tee (fig. 537) at truck-frame side rails. Remove clips securing air lines to crane body, and remove lines.
- (6) Remove trailer coupling receptacle from bracket attached to front outrigger frame tube. (Refer to TM 9-2320-211-20.)
- (7) Remove trailer coupling receptacle at base of right trailer hose and cable support. (Refer to TM 9-2320-211-20.)
- (8) Disconnect five bayonet-type taillight cable connectors, three at left rear corner of vehicle and two at right rear corner.
- (9) Remove four cap screws and safety nuts securing rear of crane body (fig. 537) to brackets, two on each side of vehicle, bolted to frame side rails.
- (10) Remove six cap screws and lockwashers, located under fifth wheel approach plates (fig. 541) three on each side, securing front of crane body to truck-frame side rails.



Figure 540. Front view of left trailer hose and cable support M246

- (11) Attach a chain sling and overhead hoisting equipment to crane body, and remove body from vehicle.

b. Installation.

- (1) Using a chain sling and overhead hoisting equipment, lift crane body into position on truck-frame side rails, and align mounting holes.
- (2) Install six cap screws and lockwashers under fifth wheel approach plates (fig. 541) in holes in crane-body side rails and truck-frame side rails. Tighten cap screws.
- (3) Install four cap screws and safety nuts through holes in rear of crane body (fig. 537) and brackets bolted to truck-frame side rails. Tighten cap screws and nuts.
- (4) Connect five bayonet-type taillight cable connectors, three at left rear corner of vehicle and two at right rear corner.
- (5) Install trailer coupling receptacle at base of right trailer hose and cable support. (Refer to TM 9-2320-211-20.)

- (6) Install trailer coupling receptacle at bracket attached to front outrigger frame tube. (Refer to TM 9-2320-211-20.)
- (7) Position air lines (fig. 537) on left and right sides of crane body, and secure to body with clips. Connect both lines to elbow (fig. 540) at base of trailer hose and cable supports and to tee (fig. 537) at truck-frame side rails.
- (8) Install hydraulic pump and relief valve assembly (par. 363).
- (9) Install fifth wheel. (Refer to TM 9-2320-211-20.)
- (10) Install base plate and pivot post assembly (par. 364).

375. Floodlights, Cables, and Switches

a. Floodlights.

- (1) Lamp-unit replacement. (Refer to TM 9-2320-211-20.)
- (2) Floodlight switch removal. (Refer to TM 9-2320-211-20.)
- (3) Floodlight switch installation. (Refer to TM 9-2320-211-20.)
- (4) Floodlight removal. (Refer to TM 9-2320-211-20.)
- (5) Floodlight installation. (Refer to TM 9-2320-211-20.)

b. Floodlight Cables.

- (1) Removal. Refer to TM 9-2320-211-20.
- (2) Installation. Refer to TM 9-2320-211-20.

c. Floodlight Switch (at Instrument Panel).

- (1) Removal. Refer to TM 9-2320-211-20.
- (2) Installation. Refer to TM 9-2320-211-20.

376. Hydraulic System

a. Draining. Refer to paragraph 324a.

b. Filling. Refer to LO 9-2320-211-12.



Figure 541. Front view of right front corner of crane body

Section IV. REPAIR

377. Hydraulic Pump and Relief Valve Assembly

Refer to paragraph 344 for repair procedures.

378. Base Plate and Pivot Post Assembly

Refer to paragraph 335 for repair procedures.

379. Swing Motor and Drive Gearcase

Refer to paragraph 338.

380. Swivel Valve

Refer to paragraph 334.

381. Boom and Shipper Assembly

Refer to paragraph 332.

382. Boom Lift Cylinder

Refer to paragraph 333.

383. Boom Crowd Cylinder

Refer to paragraph 332.

384. Boom Hoist Hydraulic Oil Motor and Cable Drum Assembly

Refer to paragraph 330.

385. Control Valve Bank

Refer to paragraph 336.

386. Hydraulic Lines and Fittings

Refer to paragraph 347.

387. Hydraulic Reservoir and Equipment Box

Refer to paragraph 340.

388. Crane Body

Refer to paragraph 339.

Section V. TESTS AND ADJUSTMENTS

389. General

Tests and adjustments required for the Wrecker Crane M246 are the same as those required for the Wrecker Crane M62.

390. Tests and Adjustments

Refer to Chapter 22 Section V for complete and detailed instructions.

Section VI. SERVICEABILITY STANDARDS

391. General

The serviceability standards for the Wrecker Crane M246 are the same as those for the Wrecker Crane M62.

392. Serviceability Standards

Refer to paragraph 357 for complete serviceability standards.

CHAPTER 24

WRECKER CRANE M543, M543A2

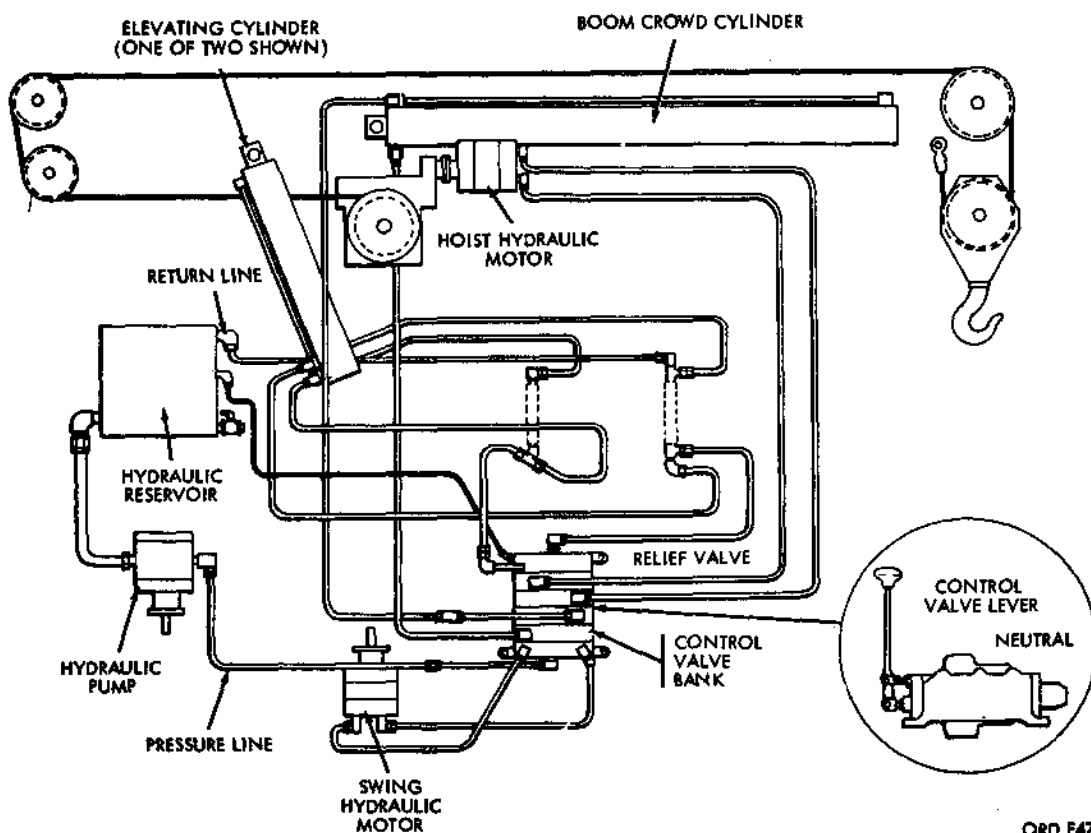
Section I. DESCRIPTION AND DATA

393. Description

a. General. This chapter is written specifically for the wrecker crane, rear mounted winch, and wrecker crane power train for the 5-ton, 6 x 6 medium wrecker truck M543, M543A2 (figs. 18 and 19). This wrecker equipment is mounted on a six-wheeled drive truck and the hydraulic system is powered by the truck engine. Refer to TM 9-2320-211-20 for detailed description of truck chassis.

b. Wrecker Crane. The wrecker crane consists of that part of the wrecker unit which

is mounted above the truck chassis with the exception of the rear mounted winch. The various functions of the wrecker crane are dependent on all of the hydraulic and mechanical units which are built into the crane. Figure 542 is a schematic diagram of the complete hydraulic system. The power for the wrecker crane is supplied by the truck power plant through a bevel gearbox hydraulic pump. This pump forces fluid under pressure to each of the hydraulic actuated units. The control of the various functions is in the control valve bank. From here the fluid is directed under high pressure to operate any of



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Figure 542. Schematic diagram of hydraulic system

the following: the elevating cylinders for raising or lowering the boom, the boom crowd cylinder for extending or retracting the boom, the swing motor for revolving the crane, and the hoist motor for winding and unwinding the hoist cable. A special cone-type worm and drive gear transmits the power for turning the hoist drum and revolving the crane. The complete crane can be replaced as a single unit provided that hoisting equipment having a capacity of approximately 8000 pounds is available. The illustrations, replacement, and repair instructions contained in this section refer to the individual units and assemblies comprising the crane. Refer to paragraph 294 o through s, for description of clutch control valve, rotochamber, power-divider assembly, power divider controls and rear winch assembly.

c. Hydraulic Pump and Bevel Gearbox. The gear-type hydraulic pump (fig. 547) is bolted to the hydraulic pump adapter mounted on the turntable assembly and is driven by the bevel gearbox mounted below the truck body. The hydraulic pump shaft is driven by a splined flexible coupling connected to the output shaft of the bevel gearbox. The bevel gearbox is driven by a universal shaft from the power divider.

d. Swing Hydraulic Motor and Gearbox. The swing hydraulic motor and gearbox (fig. 548) are mounted on the rear of the turntable assembly. The hydraulic motor drives the gear-

box pinion which engages and drives against the bull gear bolted to the turntable. The swing motor has a 57 gallon-per-minute capacity.

e. Boom Assembly. The boom assembly (fig. 543) consists of the inner boom and outer boom which are telescoping tubular steel members having a rectangular shaped cross section, held together by the boom crowd cylinder. The rear end of the outer boom is pivoted on a pin which permits raising and lowering the front end of the boom assembly.

f. Boom Elevating Cylinders. The boom elevating cylinders (fig. 543) are vertically mounted on each side of the boom. These are single-acting types of cylinders whose pistons are extended by hydraulic pressure to elevate the boom. The pistons are retracted by the weight of the boom when the pressure is released.

g. Boom Crowd Cylinder. The boom crowd cylinder (fig. 543) is mounted horizontally inside the boom and shipper assembly. This is a double-acting ram and the piston works in either direction under hydraulic pressure to extend or retract the boom.

h. Boom Hoist Hydraulic Motor and Cable Drum Assembly. The boom hoist hydraulic motor and cable drum assembly (fig. 543) is bolted to the underside of the shipper assembly at the approximate middle. An automatic brake,

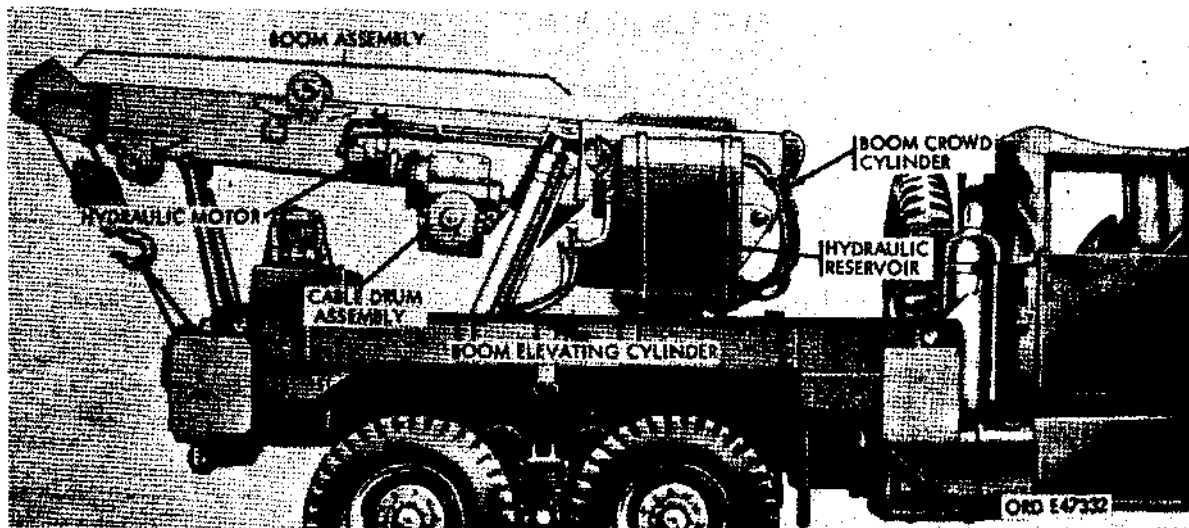


Figure 543. Crane and body assembly

which is attached to the rear end of the drive (worm gear) shaft of the cable drum assembly sustains the hoist load whenever the delivery of power to the drive shaft is interrupted. The hoist hydraulic motor has a 42 gallon-per-minute capacity.

i. *Control Valve Bank Assembly.* The control valve bank assembly (fig. 544) is bolted to a shelf at the front of the operator's station. This assembly consists of four spring-centered valve spool sections with an inlet body at one end and an outlet body with an adjustable relief valve at the other end. Each spring-centered valve spool section is actuated by a control lever. Hydraulic oil flows from the pressure inlet of one section to the hydraulic cylinder of motor to be operated, and returns to the section through the discharge port to the pressure inlet of the next section.

j. *Hydraulic Reservoir.* The hydraulic reservoir (fig. 543) is attached to the turntable frame. A bayonet-type oil level gage attached to the filler cap is installed in the top of the reservoir.

k. *Operator's Station.* The operator's station is of all welded steel construction. A metal frame and paulin, is provided for operator's protection (fig. 545). The operator's seat, backrest and controls are mounted in the operator's station. A guard bolted to the operator's station next to the boom protects operator from accidentally contacting boom as it raises and lowers.

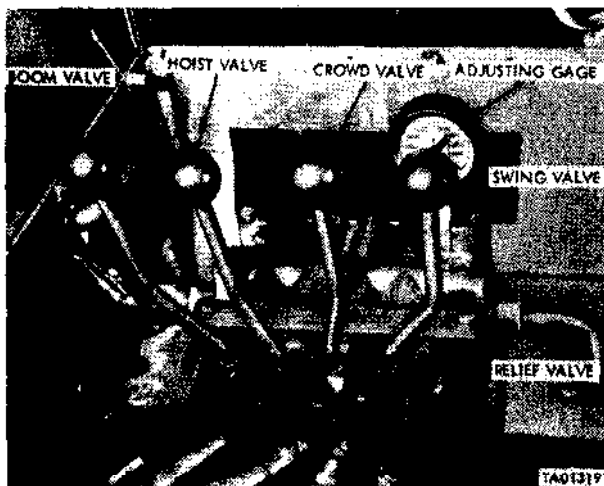


Figure 544. Control valve bank assembly, shown with cover removed and adjusting pressure gage installed.

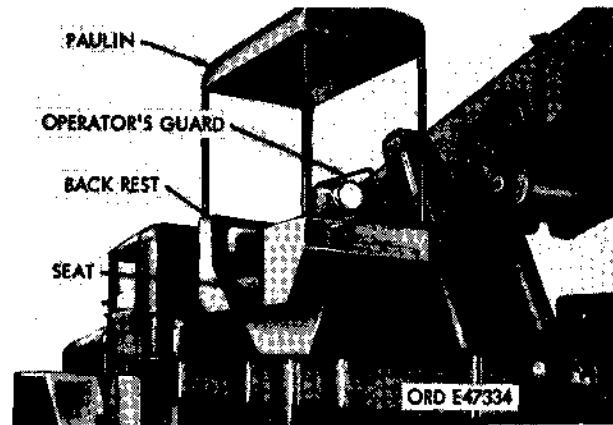


Figure 545. Operator's Station.

394. Data

a. Wrecker Crane.

Make Gar Wood
Type hydraulic
Manufacturer's number GW-3005200
Capacity rating 10,000 lb

b. Clutch Control Valve.

Make Bendix-Westinghouse
Manufacturer's number BWE-225004

c. Roto Chamber.

Make Bendix-Westinghouse
Manufacturer's number BWE-224951

d. Hydraulic Pump.

Make Gar Wood
Type gear
Manufacturer's number GW-2048342

e. Swing Motor.

Make Gar Wood
Type gear
Manufacturer's number GW-2048340

f. Hoist Motor.

Make Gar Wood
Type gear
Manufacturer's number GW-2048341

g. Hoist Winch.

Make Gar Wood
 Type horizontal drum
 Power source hoist hydraulic motor
 Manufacturer's number GW-3005456
 Cable size 1/2 inch, 6 x 9 cable, 95 ft. 5 in. lg

h. Control Valve Bank Assembly.

Make Parker-Hannifin
 Manufacturer's number VDSP24-DDDS22

i. Elevating Cylinder.

Make Gar Wood
 Manufacturer's number GW-2046069

j. Boom Crowd Cylinder.

Make Gar Wood
 Manufacturer's number GW-2046068

Section II. TROUBLESHOOTING

395. General

Troubleshooting procedures and tests are used to locate the malfunction, provide information, and designate the corrective procedures to be taken. Each symptom of trouble or malfunction given for an individual unit or system helps to simplify

the repair of the unit or system involved.

396. Troubleshooting Procedures

Troubleshooting procedures applicable to the Wrecker Crane M543 and M543A2 are identical to those used for the Wrecker Crane M62. Refer to paragraph 296 for the troubleshooting procedures.

Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

397. Engine Governor Override Solenoid

Procedures for removal and installation of engine governor override solenoid are covered in TM 9-2320-211-20.

398. Floodlight Assembly

Procedures for removal and installation of the floodlight assembly are covered in TM 9-2320-211-20.

399. Slipping Assembly

NOTE

The key letters shown below in parentheses refer to figure 546 unless otherwise indicated.

a. Removal.

- (1) Remove hydraulic pump assembly (para 401).
- (2) Remove brushes from slipping assembly (TM 9-2320-211-20).
- (3) Remove brush support plate with wiring

from hydraulic pump support.

(4) Disconnect the three connectors of the wire and ring assemblies (C, E, and F) located under crane body at bevel gearbox (J) and tag to facilitate installation.

(5) Lift insulating rings (B and D) and wire and ring assemblies (C, E, and F) from insulating ring support (M), pulling wires through grommet (N) in flanged plate of bevel gearbox (I).

b. Installation.

(1) Assemble wire and ring assemblies (C, E, and F) and insulating rings (B and D) on to the insulating ring support (M).

(2) Pull wires through grommet (H) in flanged plate of bevel gearbox and connect the three connectors of the wire and ring assemblies (C, E, and F) to proper mating connectors under crane body at bevel gearbox.

(3) Install brush support plate with wiring to hydraulic pump support.

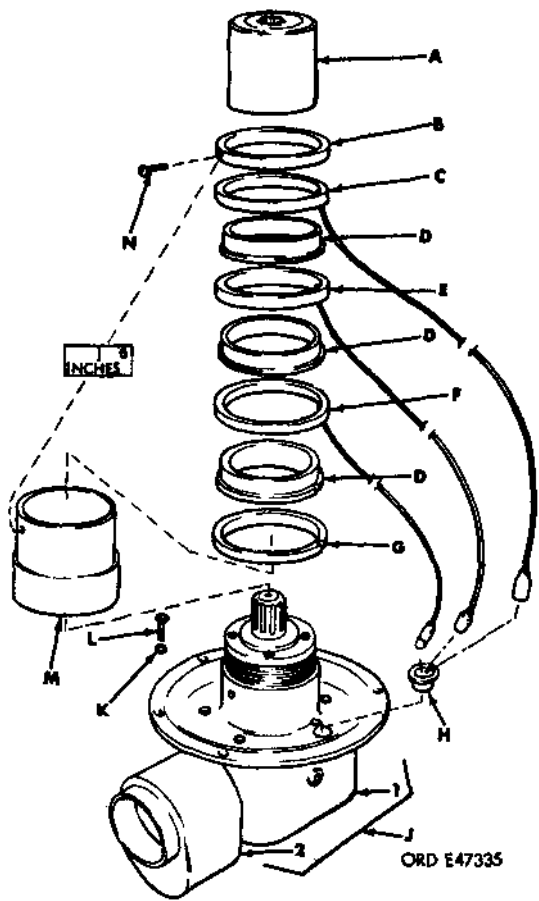


Figure 546. Slipring and insulator assembly - removal and installation

| Key | Item | Key | Item |
|-----|------------------------------|-----|------------------------|
| A | Coupling | J | Bevel gearbox assembly |
| B | Insulating retainer ring | 1. | Bevel gearbox |
| C | Wire and ring, hot | 2. | Seal housing |
| D | Insulating ring | K | Lockwasher |
| E | Wire and ring, hot, solenoid | L | Cap screw |
| F | Wire and ring, ground | M | Insulating ring |
| G | Insulating ring | N | Screw |
| H | Grommet | | |

Figure 546. Slipring and insulator assembly - removal and installation - legend

- (4) Install brushes for slipring assembly (TM 9-2320-211-20).

(5) Install hydraulic pump assembly (par. 401).
- tank Remove drain plug from bottom of tank to drain tank completely.

(2) Disconnect hydraulic lines at tank as shown in figure 347, views A and B.

(3) Remove bolts from tank straps (fig. 547, view B) and remove tank.

400. Hydraulic Oil Reservoir Tank Assembly

a. Removal.

- (1) Connect hose to drain valve (fig. 547, view A) and drain hydraulic oil from

b. Installation. Reverse procedure in a above, and fill tank to proper level with hydraulic oil (LO 9-2320-211-12).

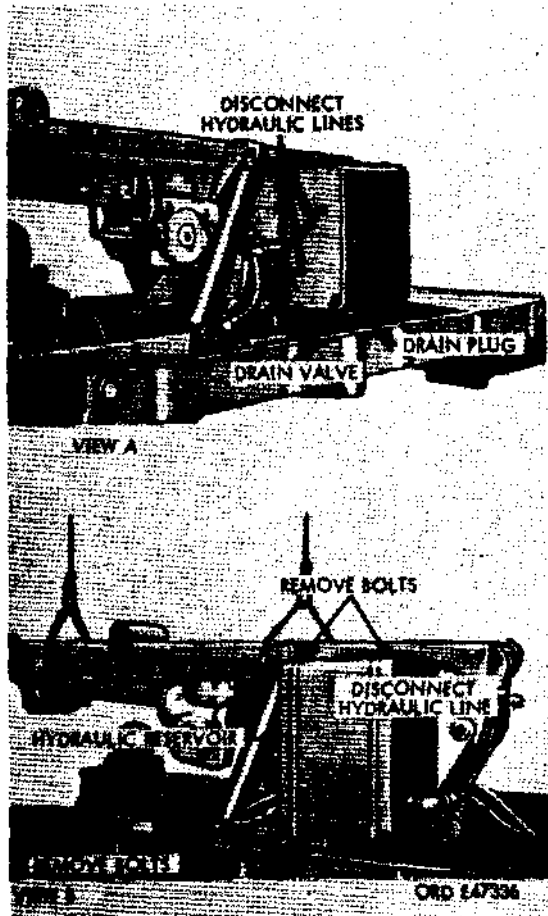


Figure 547. Hydraulic oil reservoir tank - removal and installation

Caution: Be sure plug is replaced in drain valve of tank.

401. Hydraulic Oil Pump Assembly

a. Removal.

- (1) Drain hydraulic oil reservoir tank (par. 400) and disconnect hoses (par. 402).
- (2) Remove four cap screws that fasten pump to pump support (fig. 548), and remove pump assembly.
- (3) Remove pump coupling from bevel gearshaft.

b. Installation. Reverse procedure in a above and fill tank to proper level (LO 9-2320-211-12).



Figure 548. Hydraulic pump - removal and installation

402. Swing Hydraulic Motor and Gearbox

a. Removal.

- (1) Disconnect the two hydraulic hoses to the motor as shown in figure 549. Some oil may be lost. Have a container available in which to place disconnected hoses.
- (2) Remove the four cap screws that attach motor to swing gearbox as shown in figure 549 and remove motor assembly.
- (3) Remove the six cap screws securing gearbox to turn table and remove gearbox.

b. Installation. Reverse procedure in a above and refill hydraulic oil tank to proper level (LO 9-2320-211-12).

403. Hoist Hydraulic Motor (Fig. 550)

a. Removal.

- (1) Disconnect two hydraulic lines to the motor as shown in figure 550.
- (2) Remove four cap screws attaching motor to hoist gearbox as shown in figure 550 and remove motor assembly.

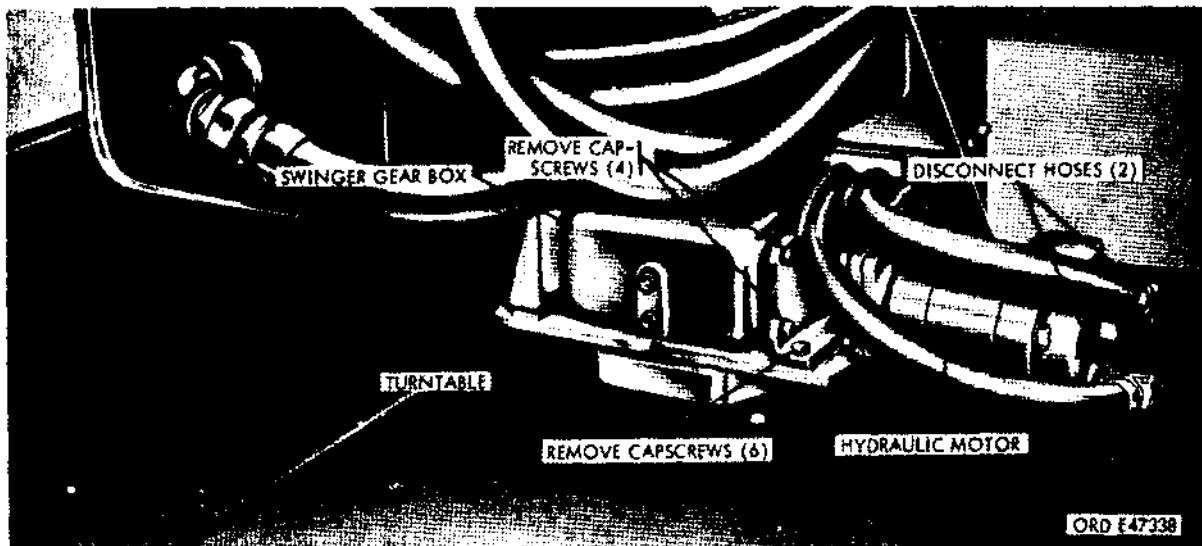


Figure 549. Removing and installing swinger hydraulic motor and gearbox

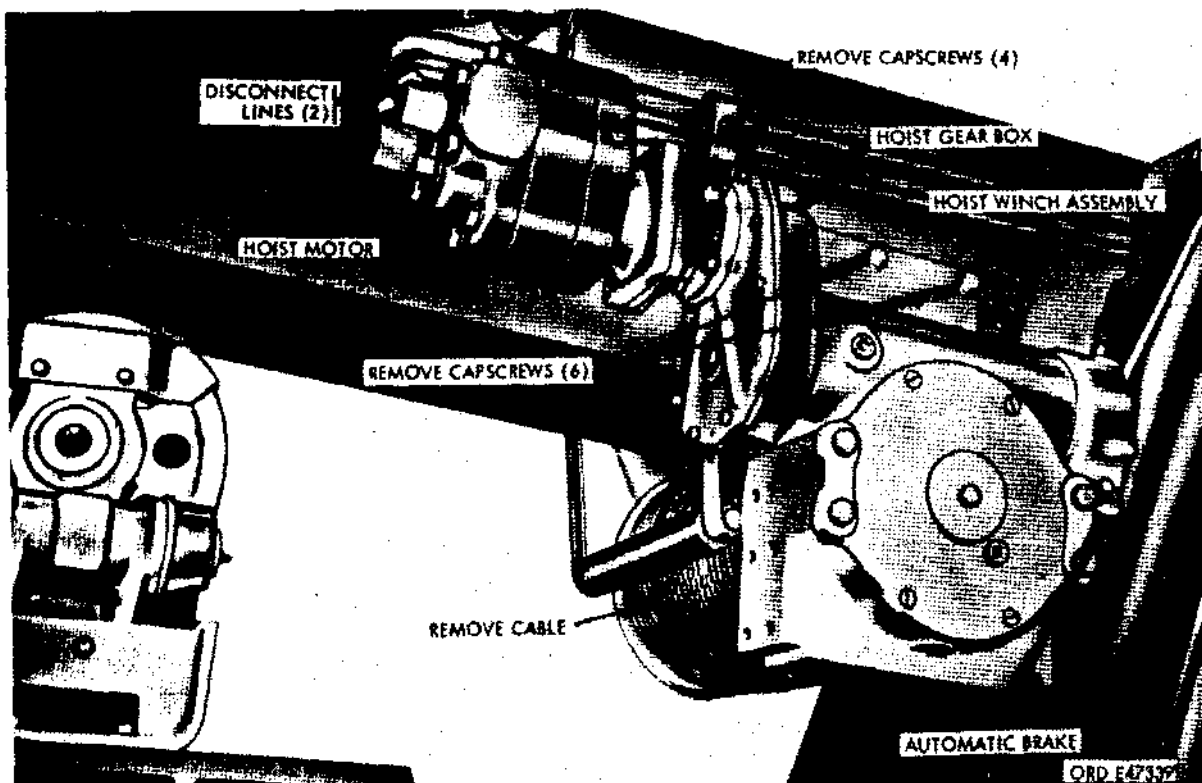


Figure 550. Removing and installing hoist hydraulic motor and hoist winch assembly

b. Installation. Reverse procedure in a above.

404. Boom Elevating Cylinder (Fig. 551)

a. Removal.

- (1) Disconnect hydraulic lines at cylinder port openings near bottom of elevating cylinder.
- (2) Use overhead hoisting equipment, or block boom assembly in a slightly raised or vertical position.
- (3) Remove bolt and pin (fig. 551) from upper end of cylinder. Remove cotter pin and drive out lower pin from cylinder.
- (4) Using chain hoist, lift elevating cylinder clear and remove from vehicle.

Note. It may be necessary to retract cylinder (force piston rod "in") slightly to provide clearance to remove cylinder.

- (5) Repeat above procedure for cylinder on opposite side.

b. Installation.

- (1) Using chain hoist, lift elevating cylinder and place in position on vehicle as shown in figure 551.

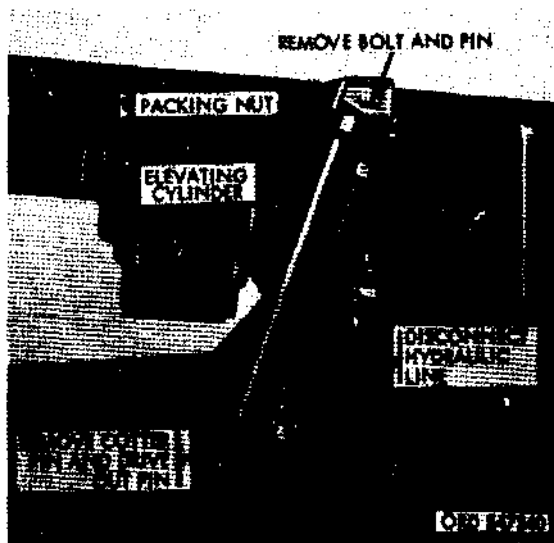


Figure 551. Boom elevating cylinder - removal and installation

- (2) Aline lower holes of turn table and cylinder, install lower pin for cylinder and secure with cotter pin.
- (3) Aline upper end of cylinder, install pin and secure with bolt.
- (4) Connect hydraulic lines at cylinder port openings and unhook overhead hoisting equipment used to secure boom assembly.
- (5) Repeat above procedure for cylinder on opposite side.

405. Boom Crowd Cylinder

a. Removal.

- (1) Outer boom assembly must first be removed to remove cylinder assembly from inner boom. Refer to paragraph 406.
- (2) Remove inner boom assembly from outer boom assembly. Refer to paragraph 423.
- (3) Remove cotter pin from cylinder pin and remove pin.
- (4) Attach a chain to support boom cylinder. Remove cylinder from boom as shown in figure

b. Installation.

- (1) Attach a chain hoist to boom crowd cylinder. Lift and position cylinder assembly in inner boom as shown in figure 552.

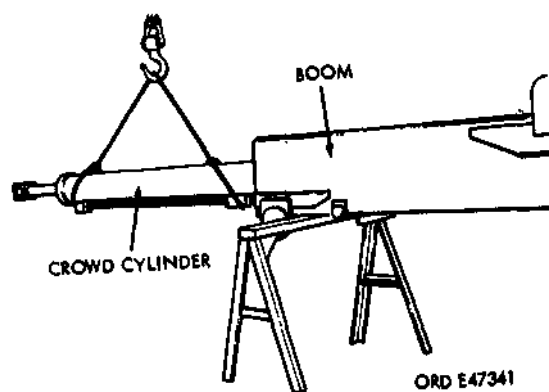


Figure 552. Removing and installing crowd cylinder in boom

(2) Install pin in end of cylinder and secure with cotter pin (fig. 552).

(3) Install inner boom assembly in outer boom. Refer to paragraph 423.

(4) Install boom assembly (par. 406).

406. Boom Assembly

a. General. The boom assembly consists of the inner boom, outer boom, boom rollers, crowd cylinder, hoist winch assembly, cable, sheaves and necessary hydraulic lines and fittings to connect and operate these components

b. Removal (Fig. 553).

(1) Remove cable from hoist winch drum (refer to TM 9-3220-211-20).

NOTE

Failure to maintain tension on cable while drum is turning will cause the cable to become snarled on the drum and in the boom structure.

(2) Disconnect hydraulic lines to crowd cylinder and hoist winch hydraulic motor as shown in figure 553.

(3) Disconnect boom floodlight cable at connector (refer to TM 9-2320-211-20).

(4) Attach a suitable lifting device to boom assembly as shown in figure 553.

(5) Remove upper pins from elevating cylinders and remove pivot pin from foot end of boom and turntable. Boom assembly is now free to be lifted from turntable.

CAUTION

Secure inner boom to outer boom with chain or other suitable means to prevent inner boom from extending when assembly is tilted, which could cause injury to personnel.

c. Installation.

CAUTION

Secure inner boom, to outer boom with chain, or other suitable means to prevent inner boom from extending when the assembly is lifted, which could cause injury to personnel.

(1) Attach a suitable lifting device to boom assembly and lift into position on turntable as shown in figure 553.

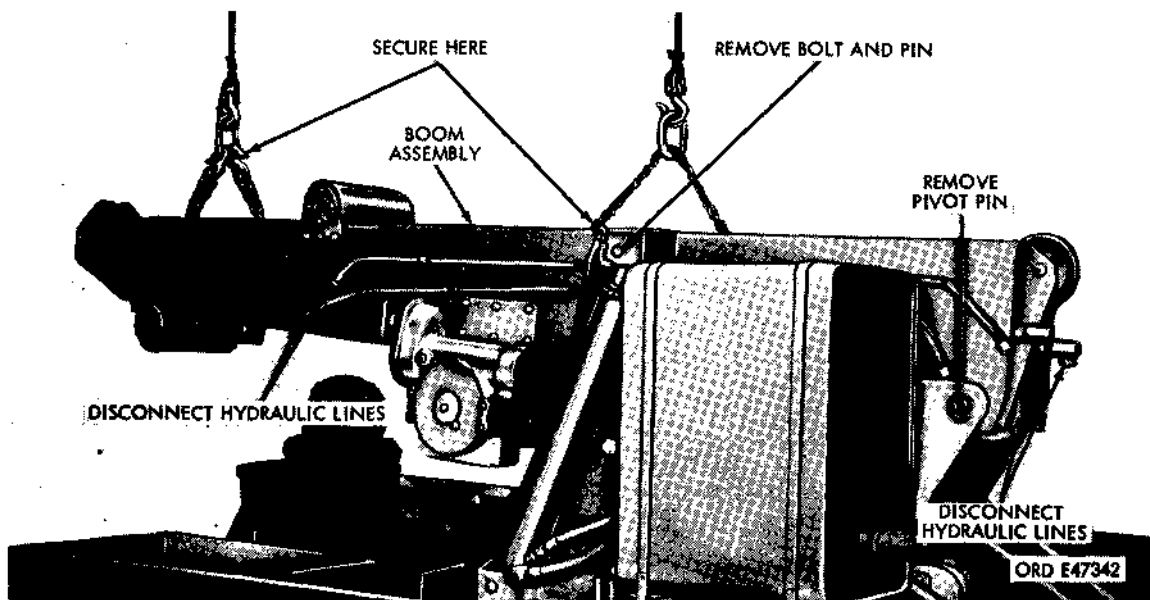


Figure 553. Removing and installing boom assembly.

(2) Position elevating cylinders and install upper pins to secure elevating cylinders and install pivot pin in foot end of boom securing it to the turntable (fig. 553).

(3) Connect boom floodlight cable to connector (refer to TM 9-2320-211-20).

(4) Connect hydraulic lines to crowd cylinder and hoist winch hydraulic motor as shown in figure 553.

(5) Install cable on hoist winch drum (refer to TM 9-2320-211-20).

per roller assembly and remove assembly (fig. 553).

(4) Remove the six screws securing the lower roller assembly and remove assembly (fig. 553).

c. Installation.

(1) Install the upper roller assembly and secure with six screws (fig. 553).

(2) Install the lower roller assembly and secure with six screws (fig. 553).

(3) Install the inner boom (para 423).

(4) Install the boom assembly (para 406).

407. Boom Roller Assemblies

a. General. The inner boom rolls on two roller assemblies (fig. 553) mounted on the outer boom. These assemblies are identical in design and construction.

b. Removal.

(1) Remove boom assembly (para 406).

(2) Remove inner boom (para 423).

(3) Remove the six screws securing the up-

408. Control Valve Bank Assembly

a. Removal.

(1) Disconnect all oil lines. Refer to TM 9-2320-211-20.

(2) Remove four capscrews (30, fig. 566) nuts (28), and lockwashers (27) securing control valve bank assembly (1) to gondola and remove control valve bank.

b. Installation. Reverse procedures in *a* above.

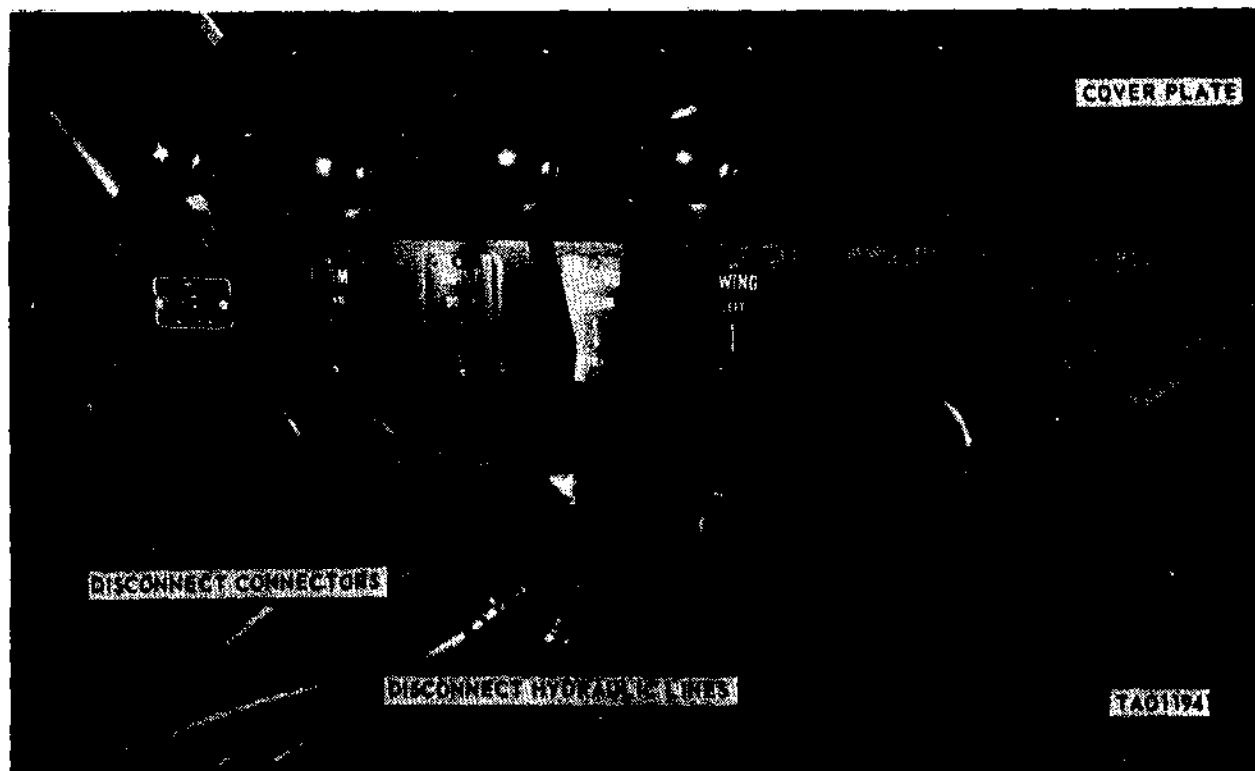


Figure 554. Control valve bank assembly (M543, M543A1, M543A2).

*a. Removal.***NOTE**

The key letters shown in parentheses refer to figure 567 unless otherwise indicated.

(1) Remove propeller shaft to bevel gearbox (TM 9-2320-211-20).

(2) Remove the six bolts (A), and lockwashers (B), that attach drive housing (E), and seal housing (W) assemblies to power divider and remove from under vehicle.

b. Installation. Reverse procedures in *a* above.

NOTE

To install the control valve bank, mounting brackets FSN 5340-491-0329 and FSN 5340-491-0331 must be requisitioned as a separate item. These brackets do not come with the control valve bank.

410. Bevel Gearbox*a. Removal.***NOTE**

The key letters shown in parentheses refer to figure 568 unless otherwise indicated.

(1) To remove bevel gearbox assembly it is first necessary to remove the complete boom assembly (para 406) from the turntable.

(2) Remove hydraulic pump (para 401).

(3) Disconnect electrical cables to slipring assembly at connectors, located at bevel gearbox beneath truck body.

(4) Remove the six bolts (B) and lockwashers (C) and remove pump support.

(5) Remove turntable assembly (para 412).

(6) Remove propeller shaft to bevel gearbox (TM 9-2320-211-20).

(7) Provide a suitable device to lift bevel gearbox assembly and remove the six cap screws that secure

bevel gearbox to crane body. Lift gearbox assembly up, and maneuver back, out of understructure, and remove from crane body.

b. Installation.

(1) Attach a suitable lifting device and lift bevel gearbox assembly into position over the mounting hole in the crane body. Slowly lower and maneuver bevel gearbox into position through the opening in the crane body and secure with the six bolts (DD, fig. 568).

(2) Install propeller shaft to bevel gearbox (TM 9-2320-211-20).

(3) Install turntable assembly (para 412).

(4) Install pump support and secure with six bolts (B) and lockwashers (C).

(5) Connect electrical cables to slipring assembly at connectors located at bevel gearbox beneath truck body.

(6) Install hydraulic pump (para 401) and install boom assembly (para 406).

411. Hoist Winch Assembly

(Fig. 550)

a. General. The hoist winch assembly consists of the speed reduction gearbox, the hoist worm gearbox with automatic brake assembly, and the winch drum.

b. Removal.

(1) Remove cable from hoist drum (TM 9-2320-211-20).

(2) Remove hoist hydraulic oil motor from gearbox (para 403).

(3) Using a suitable lifting device, secure hoist winch assembly so the six cap screws (fig. 550) may be removed from the winch side plates.

(4) Hoist winch assembly may now be removed from boom.

c. Installation. Reverse procedure in *b* above.

412. Turntable and Swing Drive

a. General. The turntable and swing drive consist of the turntable base plate with bull gear bearing, side plates, and swing gearbox as shown in figure 555.

b. Removal (Turntable Assembly).

- (1) Remove boom assembly (para 406).
- (2) Remove hydraulic oil reservoir tank (para 400).
- (3) Remove boom elevating cylinders (para 404).
- (4) Remove operator's station (para 413).
- (5) Remove swing drive gearbox (para 402).
- (6) Remove hydraulic pump (para 401).
- (7) Remove hydraulic pump support (para 410).
- (8) Remove side plates from turntable base plate as shown in figure 555.

(9) Remove socket head cap screws that attach bull gear bearing to body assembly. These cap screws are reached through hole (fig. 556) in turntable. Remove a cap screw, then turn turntable until next cap screw is accessible through hole.

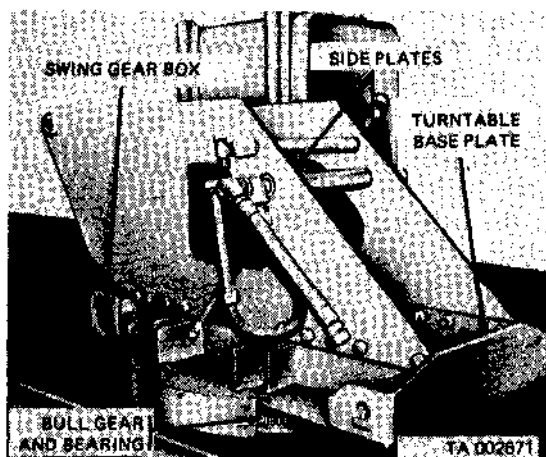


Figure 555. Turntable and swing drive assembly.

(10) Attach overhead lifting device as shown in figure 556 and remove turntable base plate from body.

c. Installation.

(1) Attach overhead lifting device to turntable base plate assembly, and lift into position on vehicle body as shown in figure 556.

(2) Aline holes and install socket head cap screws that attach bull gear bearing to body assembly. These cap screws are installed through the hole (fig. 556) in turntable. Install a cap screw, then turn turntable until next cap screw hole is accessible through hole in turntable.

NOTE

The socket head cap screws that attach bull gear bearing to body assembly must be torqued to 170 to 160 foot pounds.

(3) Install side plates to turntable base plate as shown in figure 555.

(4) Install hydraulic pump support (para 410) and install hydraulic pump (para 401).

(5) Install swing drive gearbox (para 402).

(6) Install operator's station (para 413), the boom elevating cylinders (para 404).



Figure 556. Removing and installing turntable base plate assembly.

and the hydraulic oil reservoir tank (par. 400).

- (7) Install boom assembly (par. 406).

413. Operator's Station

a. Removal.

- (1) Remove control valve bank assembly (par. 408).
- (2) Remove floodlight assembly (TM 9-2320-211-20).
- (3) Remove guard (fig. 545) by raising it up and removing from sockets mounted to operator's station.

- (4) Move hydraulic lines clear for removal of operator's station.

- (5) Disconnect solenoid override switch (TM 9-2320-211-20).

- (6) Secure a suitable lifting device to the operator's station and take up slack so it will not shift.

- (7) Remove cap screws anchoring operator's station to turntable side plates and remove operator's station.

b. Installation. Install in reverse procedure of a above.

Section IV. REPAIR OF MAJOR COMPONENTS

414. Engine Governor Override Solenoid

Repair consists of replacement of a damaged or unsatisfactory solenoid unit.

415. Floodlight Assembly

a. Repair. Repair of the floodlight assembly consists only of replacement of a damaged or unsatisfactory unit. For switch replacement refer to TM 9-2320-211-20.

b. Cleaning. Clean light body and door assembly with mineral spirits paint thinner or dry-cleaning solvent. Clean electrical parts with soap and water. Dry all parts thoroughly.

c. Inspection. Inspect light body and door assembly for cracks or evidence of leakage. Replace body or door if damaged. Check to be sure sockets, cables, and connectors are in good condition. Check switch assembly for damaged or unsatisfactory condition. Replace damaged or unsatisfactory parts where necessary.

416. Hydraulic Oil Reservoir Tank

The hydraulic oil reservoir requires little or no disassembly; only cleaning, inspection, and repair as follows:

a. Cleaning.

- (1) Flush the tank several times with an approved cleaning solvent. Hot water or steam under pressure will loosen excess scale or sediment. Make sure

all scale sediment is drained from tank.

- (2) Clean all parts except gaskets in mineral spirits paint thinner or dry-cleaning solvent. Dry all parts thoroughly.

b. Inspection.

- (1) To test for leaks, plug all outlets except the filler opening.
- (2) Insert an airhose in the filler neck and cover the opening.
- (3) Submerge the tank in water and apply 5-psi air pressure through the filler opening. Leaks will be indicated by bubbles.
- (4) Fill the tank with water and weld or braze any leaks.

Warning: Never repair a defective or damaged tank near an open flame. Be sure tank is filled with water before welding or brazing any leaks.

- (5) Inspect all washers, screws, and nuts for damage. Replace damaged parts.
- (6) Fill tank to proper level after installation (refer to LO 9-2320-211-12).

417. Hydraulic Oil Pump

a. Disassembly (Fig. 557).

- (1) Remove the eight bolts (A and Z) and flat washers (B) holding rear cover

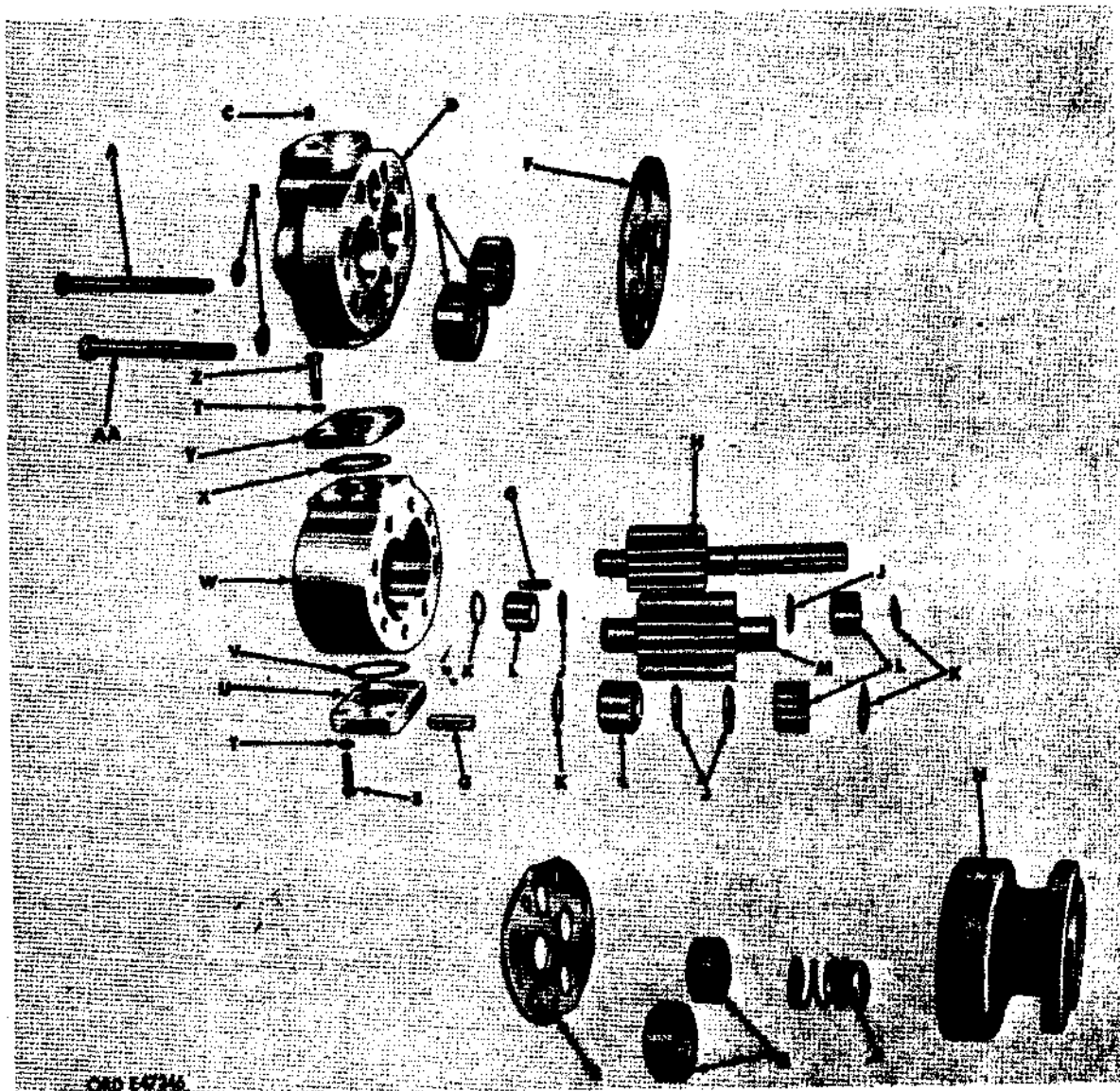


Figure 557. Hydraulic oil pump assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|-------------------|------------|--------------------|------------|-------------|
| A | Bolt | K | Snap ring | T | Lockwasher |
| B | Washer | L | Bearing inner race | U | Adapter |
| C | Pipe plug | M | Gearshaft, driven | V | O-ring |
| D | Rear cover | N | Front cover | W | Body |
| E | Bearing, LH | P | Seal | X | O-ring |
| F | Wear plate, LH | Q | Bearing, RH | Y | Adapter |
| G | Dowel pin | R | Wear plate, RH | Z | Bolt |
| H | Gear shaft, drive | S | Bolt | AA | Bolt |
| J | Spacer | | | | |

Figure 557. Hydraulic oil pump assembly - exploded view - legend

- (D) and front cover (N) to pump body (W). The covers (D and N) are now held on by dowel pins (G).
- (2) Use a small block of wood and tap alternately against the top, bottom and sides of the inner edges of the front cover (N). This will allow removal of the cover without injuring the alloy metal wear plate (R).
 - (3) Use a small block of wood and tap right wear plate (R) from body. Remove drive and driven shaft right-hand bearings (Q) and seal (P) from cover (N). It is not necessary to remove dowel pins (G) from body (W), unless inspection (d below) indicates replacement is necessary.
 - (4) Remove drive gearshaft (H) and driven-gearshaft (M) assemblies from body (W). Remove snap rings (K) and remove inner bearing races (L) and spacers (J) from gearshafts (H and M).
 - (5) Tap rear cover (D) and left wear plate (F) loose from pump body (W), using a small block of wood. Remove drive and driven shaft, left-hand bearings (E), and pipe plug (C) from cover (D).
 - (6) Remove bolts (S and Z), washers (T), and remove adapters (U and Y) and O-rings (V and X) from body (W).

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Wash all parts, using dry-cleaning solvent or mineral spirits paint thinner. Dry the parts except the bearings, using dry compressed air.

Caution: Bearings must not be dried or spun with compressed air.

(2) Inspection and repair.

- (a) Inspect pump covers and pump body mating surfaces for raised metal caused by dents or scratches. Bores in covers and body must be clean and smooth. Replace body and covers if defective. Inspect dowel pins in body for damage, and replace if necessary.
- (b) Check surfaces of gear teeth carefully and replace gearshafts showing surface cracks.
- (c) Inspect drive shaft and driven shaft for scratches or raised metal. Remove raised metal with fine mill file. Replace gearshafts, if necessary,
- (d) Inspect faces of wear plates for nicks, burs, dents or distortion. Replace defective or excessively worn parts. If wear plates show wear exceeding 0.003 inch, they must be replaced.
- (e) Turn bearings slowly to determine if any roughness is present in bearings. Inspect inside and outside diameter of bearings for scoring or pitting. Replace defective bearings.
- (f) Inspect drive shaft oil seal assembly for damaged seat or spring. Replace seals, if defective in any way.

c. Assembly (Fig. 557).

- (1) Install pipe plug (C) in rear cover (D).
Note. Dip all O-rings and seals in clean hydraulic oil before assembling.
- (2) Install O-rings (V and X), adapters (U and Y), with bolts (S and Z) and washers (T) to body (W). Install dowel pins (G) in body (W) if they were removed.
- (3) Install spacers (J), inner bearing races (L) on drive gearshaft (H) and on driven gearshaft (M) and secure with snap rings (K).
- (4) Install drive gearshaft (H) and driven gearshaft (M) in pump body (W). Position wear plates (F and R) on dowel pins in body with relief recesses in plates away from covers.
Note. Relief recesses in wear plates must be directly opposed. The bronze sides of the plates must face in, toward the gears, when the assembly is completed.
- (5) Position seal assembly (P) in drive shaft bore of front cover (N) and install right-hand bearings (Q).
- (6) Install rear cover (D), on body (W), with body notch toward rear cover, mating inner race ends of gearshafts with bearings in cover.

- (7) Install front cover (N) on body (W), inserting long end of drive gearshaft (H) through seal (P) and mating inner race ends of gearshafts with bearings in cover. Secure covers with the eight bolts (A and Z) and flat washers (B). Tighten bolts alternately.

418. Sliprings

a. Disassembly. There is no disassembly of the sliprings.

b. Cleaning, Inspection, and Repair.

- (1) **Cleaning.** Clean sliprings and insulation rings with mineral spirits paint thinner or dry-cleaning solvent. If necessary to clean electrical parts, use soap and water. Dry parts thoroughly.
- (2) **Inspection** Inspect Sliprings and insulator rings for cracks and evidence of electrical leakage and shorting between slipring. Check sliprings where brushes make contact for glazed or

worn surface that may cause malfunction. Check soldered connection of cables to sliprings and check cable connectors.

- (3) **Repair.** If individual cables are broken or unsoldered to slipring, and slipring is in good condition, repair by soldering in correct position to slipring. Replace any damaged or unsatisfactory parts where necessary.

419. Swing Hydraulic Oil Motor

a. General. The hydraulic motor used to power the gearbox and the hydraulic motor on the hoist winch are identical in design and construction. Maintenance procedures are the same for each motor.

b. Disassembly (Fig. 558).

- (1) Remove the eight bolts (S and T) and flat washers (R) holding front cover (A) and rear cover (Q) to motor body (M). The covers (A and Q) are now held on by dowel pins (B).

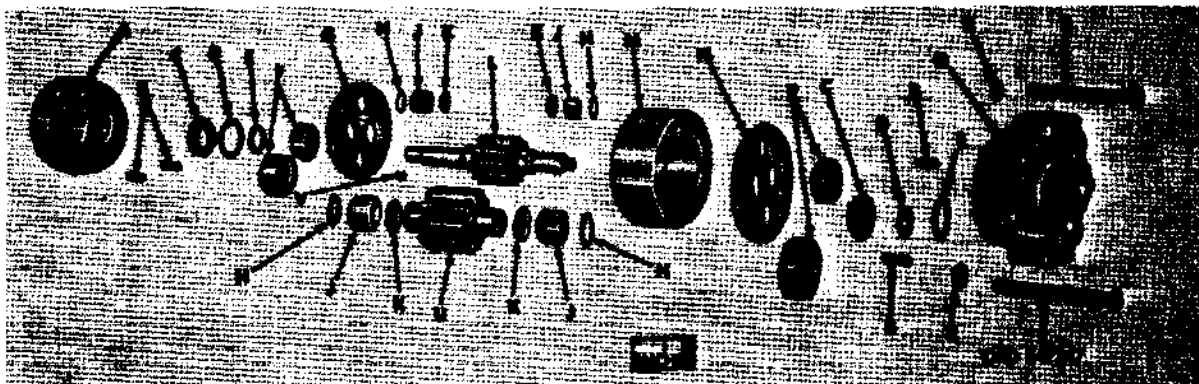


Figure 558. Hydraulic motor assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---------------------|------------|-------------------|
| A | Front cover | L | Gearshaft, drive |
| B | Dowel pin | M | Body |
| C | Oil seal adapter | N | Wear plate, RH |
| D | O-ring, inner | P | Bearing, RH |
| E | O-ring, outer | Q | Rear cover |
| F | Bearing, LH | R | Washer |
| G | Wear plate, LH | s | Bolt |
| H | Snap ring | T | Bolt |
| I | Bearing, inner race | u | Gearshaft, driven |
| K | Spacer | v | Key |

Figure 558. Hydraulic motor assembly - exploded view - legend

- (2) Use a small block of wood and tap alternately against the top, bottom and sides of the inner edges of the front cover (A). This will allow removal of the cover without injuring the alloy metal wear plate (G).
- (3) Use a small block of wood and tap left wear plate (G) from body. Remove drive and driven shaft left hand bearings (F) and oil seal adapter (C) with O-rings (D and E) from cover (A). It is not necessary to remove dowel pins (B) from body (M), unless inspection (b)(2) below indicates replacement is necessary.
- (4) Remove drive gearshaft (L) and driven gearshaft (U) assemblies from body (M). Remove snap rings (H) and remove inner bearing races (J) and spacers (K) from gearshafts (L and U).
- (5) Tap rear cover (Q) and right wear plate (N) loose from motor body (M), using a small block of wood. Remove drive and driven shaft right-hand bearings (P) and oil seal adapter (C) with O-rings (D and E) from rear cover (Q).

c. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts with mineral spirits paint thinner or dry-cleaning solvent. Dry thoroughly before inspection or installing. Apply a coat of light engine oil to highly polished surfaces to prevent rust.

(2) Inspection

- (a) Motor body and covers. Inspect motor body and cover mating surfaces for raised metal caused by dents or scratches. Bores in body and covers must be clean and smooth. Replace body and covers if defective. Inspect dowel pins in covers for damage and replace if necessary.
- (b) Drive and driven gearshafts. Check surfaces of gear teeth carefully and replace gearshafts showing surface cracks. Inspect shafts for scratches or raised metal. Remove raised metal with a fine mill file. Replace defective gearshafts.

(c) Wear plates. Inspect faces of wear plates for nicks, burs, dents, or distortion. Wear plates showing wear exceeding 0.003 inch must be replaced. Replace defective parts.

(d) Drive and driven shaft ball bearings. Turn bearings slowly to determine if any roughness is present in bearings. Inspect inside and outside diameter of bearings for scoring or pitting. Replace defective bearings.

(e) Drive shaft oil seal assemblies. Inspect drive shaft oil-seal assemblies for damaged O-rings. Replace O-rings, if defective in any way.

d. Assembly (Fig. 558).

- (1) Install oil seal adapter (C) with O-rings (D and E) in drive shaft bore of front cover (A). Install bearings (F) in cover.
- (2) Install the other oil seal adapter (C) with O-rings (D and E) in bore of rear cover (Q) and install bearings (P),

Note. Dip all O-rings and seal rings in clean hydraulic oil before assembling.

- (3) Install dowel pins (B) in motor body (M), if they were removed. Install spacers (K), inner bearing races (J) on drive gearshaft (L) and driven gearshaft (U) and secure with snap rings (H).
- (4) Install drive gearshaft (L) and driven gearshaft (U) assemblies in motor body (M). Position wear plates (G and N) on dowel pins in body with relief recesses in plates away from covers.

Nets. Relief recesses in wear plates must be directly opposed end the bronze side of the plate face in, toward the gears, when the assembly is completed.
- (5) Install rear cover (Q) on body (M) with body notch toward rear cover, mating inner race ends of gearshafts with bearings in cover.
- (6) Install front cover (A), on body (M) inserting long end of drive gearshaft

(L) through seal (C) and mating inner race ends of gearshafts with bearings in cover. Secure covers with the eight bolts (S and T) and flat washers (R). Tighten bolts alternately.

420. Boom Hoist Hydraulic Motor

Refer to paragraph 419 for repair of the boom hoist hydraulic motor.

421. Boom Elevating Cylinder

a. General. It will not be necessary to disassemble the boom elevating cylinder unless it is known to be defective. The cylinder packing may be replaced without complete disassembly by following procedures in b below. If further disassembly is required for replacement of parts, follow procedures outlined in c below.

b. Boom Elevating Cylinder Packing.

(1) Removal (Fig. 551).

(a) Raise boom assembly to a slightly vertical position and block, or secure with overhead hoist in this position.

(b) Relieve all hydraulic pressure from elevating cylinders by actuating control lever.

(c) Loosen packing nut and slide back on piston rod to expose packing.

(d) With screwdriver or similar tool, dig out all old packing and remove from cylinder.

Note. Exercise care so as not to scratch or mar piston rod's polished surface.

(2) Installation.

(a) Coat new packing set with grease and install in cylinder head around piston rod.

Note. Packing comes in sets. Each ring is split to allow easy installation. Be sure to stagger joints around piston rod to assure a tight seal.

(b) Be sure packing set is firmly seated, then slide packing nut down and

tighten. Tighten to 1/8-inch clearance between packing nut and cylinder head. This clearance provides for further tightening or adjusting after use.

(c) Remove blocking or hoist equipment used to hold boom in upward position.

c. Disassembly (Fig. 559).

(1) Loosen and unscrew cylinder head (B1, view A) from cylinder body (A), using spanner wrench 5120-713-2624.

(2) Pull out piston-rod assembly (B) from cylinder body (A), view (A).

(3) Remove lockwire (D7, view B) from piston rod nut (D8) and remove nut.

(4) Remove washer (D6), retainer (D5), U-cup (D4), O-ring (D1) and piston (D3) from piston rod (B).

(5) Slide cylinder head and packing assembly (C) off piston rod, being careful not to damage wiper strip (C1) when passing over threads at end of piston rod.

(6) Remove packing nut (C2), packing (C3), O-ring (C6) and piston rod bushing (C4) from cylinder-head (C5).

(7) Remove piston ring (D2) from piston (D3).

d. Cleaning, Inspection, and Repair.

(1) **Cleaning.** Clean all metal parts with **dry-cleaning solvent or mineral spirits** paint thinner. Thoroughly dry before inspection or installing. Apply a coat of light engine oil to highly polished surfaces to prevent rust.

(2) **Inspection.** Inspect all parts and **replace any found to be damaged. It is** always advisable to install new O-rings when repairing cylinder.

(3) **Repair.** Repair is limited to replacement of parts and packing except for removing scratches, nicks, or burs from piston rod and piston with a fine mill file.

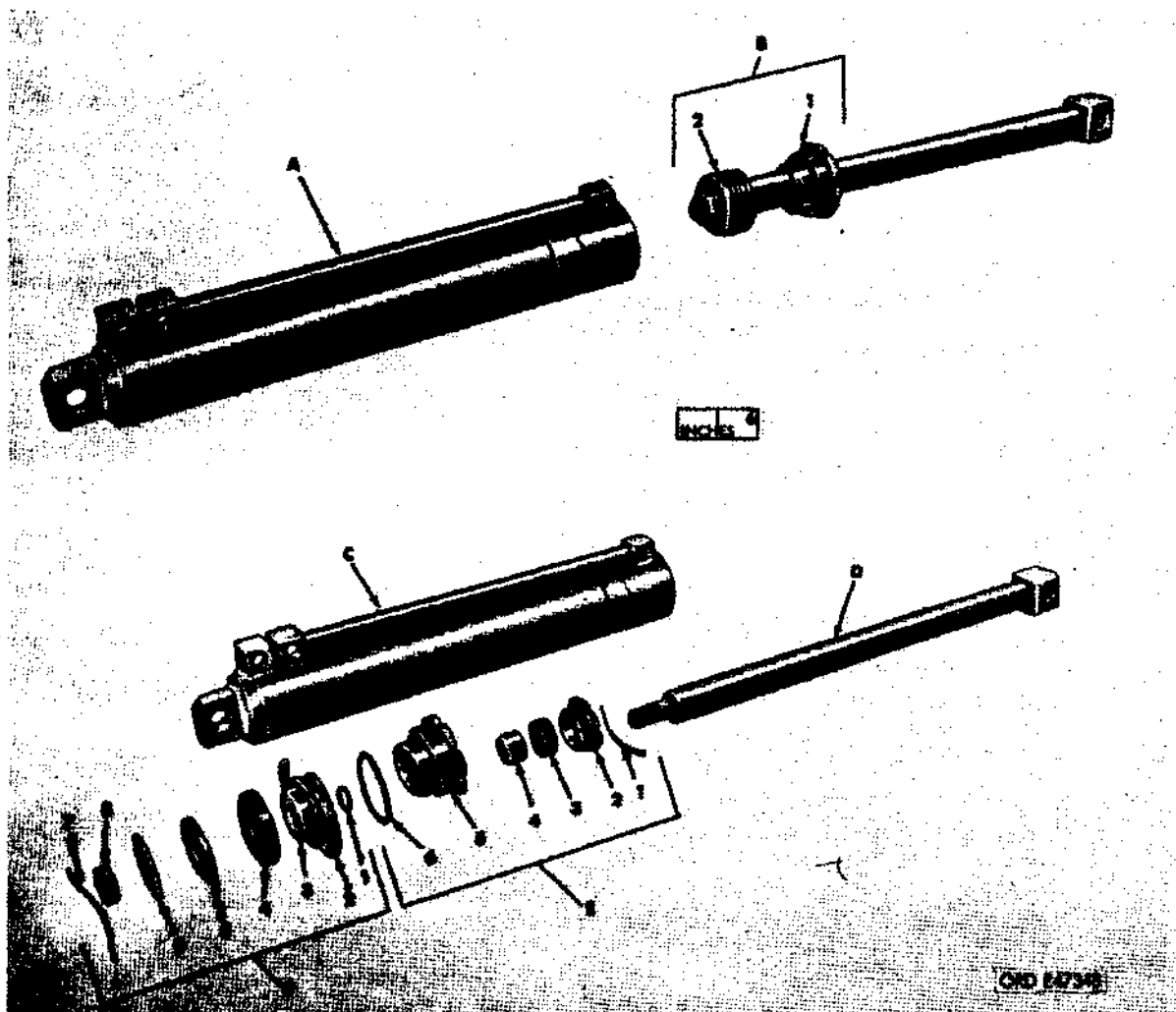


Figure 559. Boom elevating cylinder - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|----------------------------|------------|-------------------|
| A | Cylinder body | | 5 - Cylinder head |
| B | Piston rod assembly | | 6 - O-ring |
| | 1 - Cylinder head assembly | F | Piston assembly |
| | 2 - Piston assembly | | 1 - O-ring |
| C | Cylinder | | 2 - Piston ring |
| D | Piston rod | | 3 - Piston |
| E | Cylinder head assembly | | 4 - 'U' cup |
| | 1 - Wiper strip | | 5 - Retainer |
| | 2 - Packing nut | | 6 - Washer |
| | 3 - Packing | | 7 - Lockwire |
| | 4 - Piston rod bushing | | 8 - Nut |

Figure 559. Boom elevating cylinder - exploded view - legend

e. Assembly.

- (1) Install bushing (C4, view 3, fig. 559) in cylinder head (C5), using bushing replacer guide 5120-792-1612 and handle 5120-601-2234 as shown in figure 560.
- (2) Install packing nut (C2) and packing (C3) on piston rod (B) (b above).
- (3) Slide cylinder head on to piston rod (B), being careful not to damage wiper strip (C1) when passing over threads at end of piston rod. Install O-ring (C6) on cylinder head (C5).
- (4) Install O-ring (D1), piston (D3) with ring (D2), U-cup (D4), retainer (D5), washer (D6), and nut (D8) on piston rod.
- (5) Tighten nut and secure with lockwire (D7).
- (6) Insert piston assembly in cylinder body and tighten cylinder head securely with spanner wrench 5120-713-2624.

422. Boom Crowd Cylinder

a. General. It will not be necessary to disassemble the boom crowd cylinder unless it is known to be defective. Replacement of the cylinder packing may be accomplished by following the procedures outlined in b below. If further disassembly is required, follow procedures outlined ins below.

b. Boom Crowd Cylinder Packing.

(1) Removal.

- (a) Loosen packing nut and slide back on piston rod to expose packing.

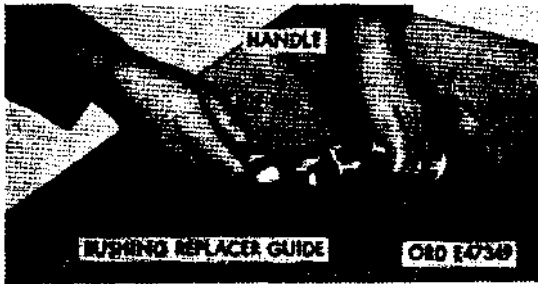


Figure 560. Using busher replacer guide 5120-792-1612 and handle 5120-601-2234

- (b) With screwdriver or similar tool, dig out all old packing and remove from cylinder.

Note. Exercise care so as not to scratch or mar piston rod's polished surface.

(2) Installation.

- (a) Coat new packing set with grease and install in cylinder head around piston rod.

Note. Packing comes in sets. Each ring is split to allow easy installation. Be sure to stagger joints around piston rod to assure a tight seal.

- (b) Be sure packing set is firmly seated, then slide packing nut down and tighten. Tighten to 1/8-inch clearance between packing nut and cylinder head. This clearance provides for further tightening or adjusting after use.

c. Disassembly (Fig. 561).

- (1) Loosen and unscrew cylinder head (C) from cylinder body (A) using spanner wrench 5120-713-2624.
- (2) Pull out piston-rod assembly from cylinder body.
- (3) Remove lockwire (D10) from piston-rod nut (D9) and remove nut.
- (4) Remove washer (D8), washer retainers (D7 and D2), U-cups (D8 and D3), piston (D5) and O-ring (D1) from piston rod (B).
- (5) Slide cylinder head and packing assembly (C) off piston rod, being careful not to damage wiper strip (C1) when passing over threads at end of piston rod.
- (6) Remove packing nut (C2), packing (C3), O-ring (C6) and piston rod bushing (C4) from cylinder head.
- (7) Remove piston ring (D4) from piston (D5).

d. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean all metal parts with dry-cleaning solvent or mineral spirits paint thinner. Thoroughly dry before inspection or installation. Apply a coat of light engine oil to highly polished surfaces to prevent rust.
- (2) Inspection. Inspect all parts and replace any found to be damaged. Install new O-rings when repairing cylinder.
- (9) Repair. Repair is limited to replacement of parts and packing except for removing scratches, nicks, or burs from piston rod and piston with a fine mill file.

e. Assembly.

- (1) Install bushing (C4) in cylinder head (C5) using bushing replacer guide 5120-702-1612 and handle 5120-601-2234.

- (2) Install packing nut (C2) and packing (C3) on piston rod (B). (Refer to b above.)
- (3) Slide cylinder head on to piston rod (B), being careful not to damage wiper strip (C1) when passing over threads at end of piston rod. Install O-ring (C6) on cylinder head (C5).
- (4) Install O-ring (D1), piston (D5) with rings (D4), U-cups (D3 and D6), washer retainers (D2 and D7), washer (D8), and nut (D9) on piston rod as shown in figure 561.

423. Boom Assemblya. Disassembly.

Note. Key letters shown in parentheses refer to figure 562 except where otherwise indicated

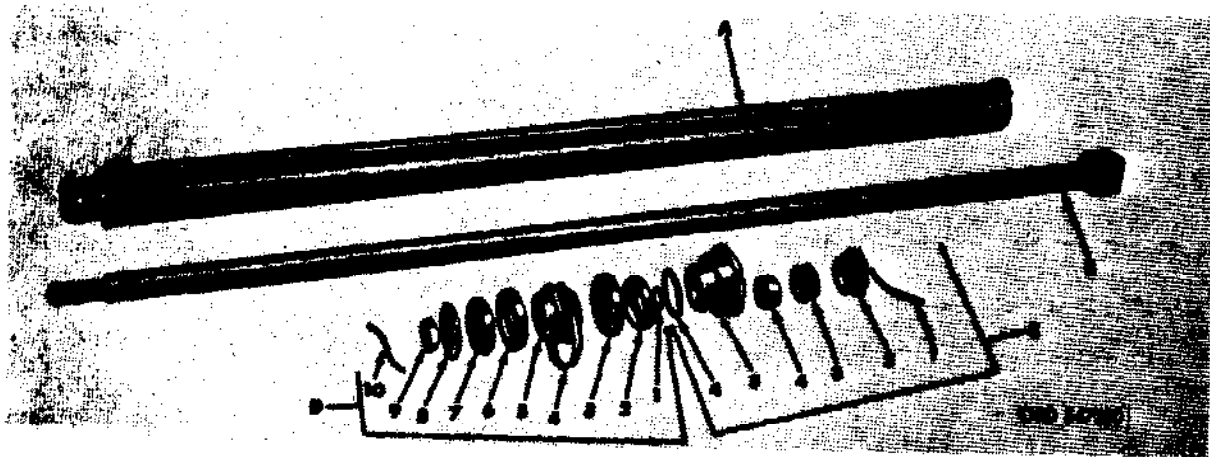
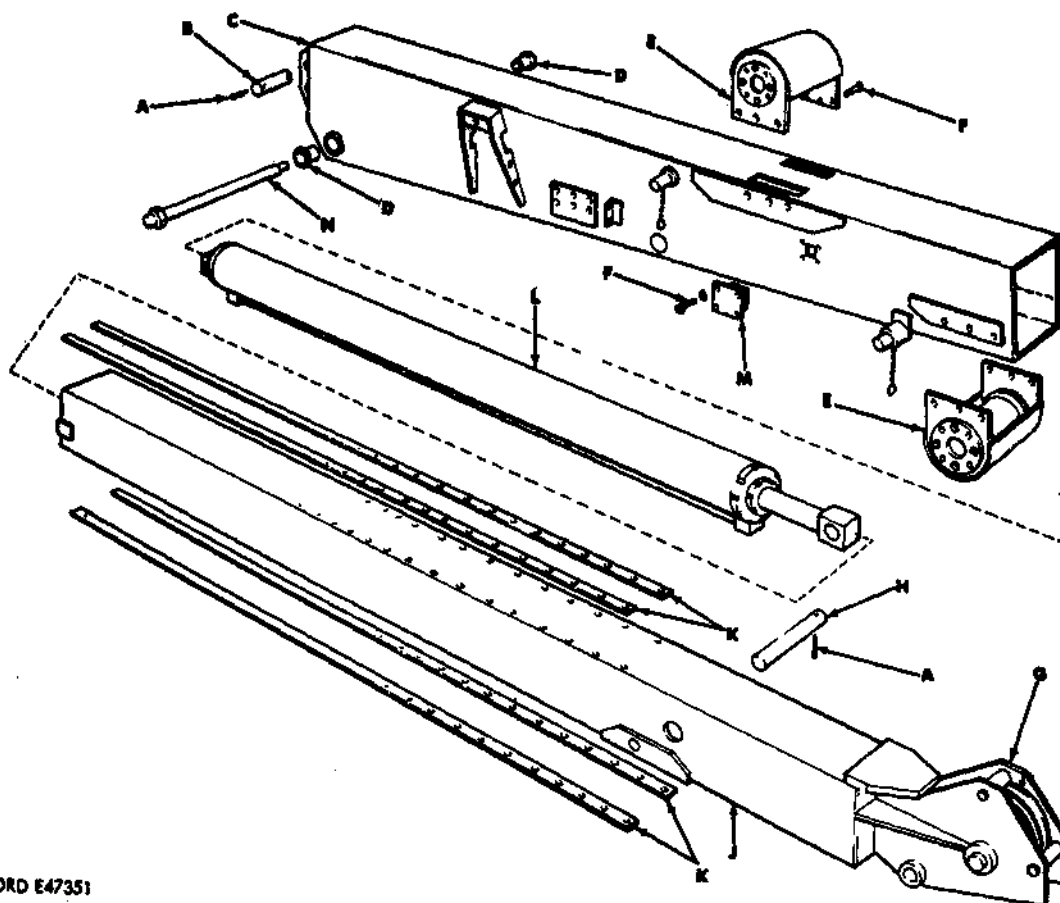


Figure 561. Boom crowd cylinder - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|------------------------|------------|-------------|
| A | Cylinder body | 2- | Retainer |
| B | Piston rod | 3- | u-cup |
| C | Cylinder head assembly | 4- | Piston ring |
| | 1 - Wiper strip | 5- | Piston |
| | 2- Packing nut | 6- | U-cup |
| | 3- Packing | 7- | Retainer |
| | 4- Piston rod bushing | 8- | Washer |
| | 5- Cylinder head | 9- | Nut |
| | 6- O-ring | 10- | Lockwire |
| D | Piston assembly | | |
| | 1- o-ring | | |

Figure 561. Boom crowd cylinder - exploded view - legend



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Figure 562. Boom assembly - exploded view

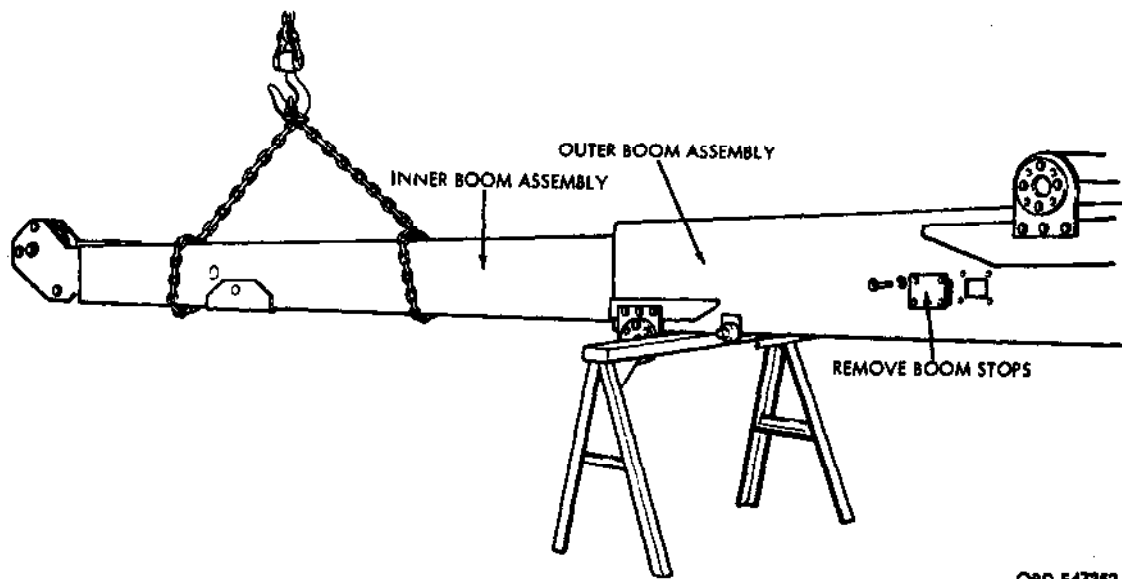
| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|-----------------|------------|----------------|
| A | cotter pins | H | Pin |
| B | Pin | J | Inner boom |
| C | Outer boom | K | Boom tracks |
| D | Bushing | L | Crowd cylinder |
| E | Roller assembly | M | Boom stop |
| F | Cap screw | N | Pivot pin |
| G | Sheaves | | |

Figure 562. Boom assembly - exploded view - legend

- (1) Remove cotter pin (A) and pin (B) anchoring the crowd cylinder (L) in the outer boom (C). Remove boom stops (M) from outer boom.
- (2) Pull inner boom from outer boom only far enough to attach a chain sling. Attach chain to an overhead hoist and remove inner boom assembly from inter boom as shown in figure 563.

Caution: When extending inner boom from outer boom to attach chain, inner boom must be supported at sheave end to prevent tilting, which could cause injury to personnel.

- (3) Remove boom roller assemblies (E) from outer boom.
- (4) Remove hoist winch assembly from outer boom.



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Figure 563. Removing and installing inner boom assembly

- (5) Remove cotter pin (A) and drive cut pin (H), securing piston rod end of crowd cylinder to inner boom. Remove crowd cylinder as shown in figure 17.
 - (6) Remove cable sheaves (G) from head end of inner boom.
 - (7) Remove boom tracks (K) from inner boom.
- b. Cleaning, Inspection and Repair.
- (1) **Cleaning.** Clean all parts with dry-cleaning solvent, or mineral spirits paint thinner. Thoroughly dry before inspection or installation.
 - (2) Inspection and repair.
 - (a) Inspect inner and outer booms for cracked welds or bent conditions. In general, defective welds can be repaired by welding. If not, replace defective or excessively damaged parts.
 - (b) Inspect inner boom tracks for cracks or breaks, and replace damaged parts as necessary.
 - (c) Inspect pins and replace if defective.
 - (d) Inspect cable sheaves for cracks, breaks, or damaged cable grooves.
 - (e) Inspect cable sheave bushings and pins for damage. Replace all damaged parts.
 - (f) Disassemble, clean, inspect, and repair crowd cylinder assembly (par. 432).
 - (g) Disassemble, clean, inspect, and repair boom roller assemblies (par. 424).
 - (h) Disassemble, clean, inspect, and repair hoist winch assembly (par. 425).
- c. Assembly.
- (1) Install boom tracks (K, fig. 562) and cable sheaves (G) to inner boom.
 - (2) Install crowd cylinder in inner boom (fig. 563) (L, fig. 562) to inner boom with pin (H) and secure with cotter pins (A).
 - (3) Install hoist winch assembly on outer boom. (Refer to par. 411.)
 - (4) Install boom roller assemblies (E, fig. 562) to outer boom.
 - (5) Attach overhead hoisting device and install inner boom assembly in outer boom as shown in figure 563. With inner boom in full retracted position, install boom stops.

- (6) Secure anchor end of crowd cylinder (L, fig. 562) to outer boom (C) with pin (B) and secure with cotter pin (A).

424. Boom Rollor Assembly

a. Disassemble . Disassemble boom roller assemblies as shown in figure 564.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean all parts in mineral spirits paint thinner or dry-cleaning solvent. Dry all parts thoroughly before inspection or installation.

(2) Inspection.

(a) Inspect bearings for pitted, scored, or scratched condition. Replace any defective bearings.

(b) Inspect flanged roller for damaged condition. Replace damaged rollers.

(c) Inspect shafts and flanged eccentric mountings for cracks, breaks, or other damage. Replace defective parts.

(d) Inspect housing assembly for cracks or breaks in weld. In general, defective welds can be repaired by welding. If not, replace defective or damaged parts.

(3) Repair. Replace damaged rollers.

c. Assembly. Assemble boom roller assembly as shown in figure 564.

425. Hoist Winch Assembly

a. Disassembly.

(1) Disassemble the winch drum as shown in view B, figure 565.

(2) Disassemble the hoist worm gearbox as shown in view C, figure 565.

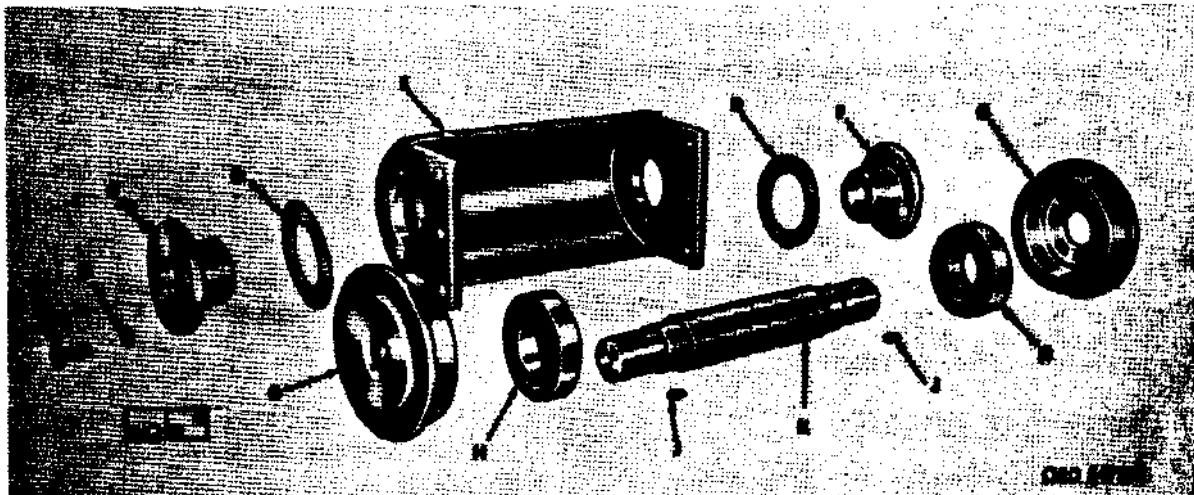


Figure 564. Boom roller assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|------------------|------------|------------------|
| A | Bolt | F | Mounting cap, RX |
| B | Lockwasher | G | Roller |
| c | Mounting cap, LH | H | Ball bearing |
| D | Shim | J | woodruff key |
| E | Frame | K | Shaft |

Figure 564. Boom roller assembly - exploded view - legend

NOTE

Place identification marks on side of automatic brakecase (RR) and gearcase (R) with a center punch, so that during assembly brakecase will be installed on proper end of gearcase.

(3) Disassemble the speed reduction gearbox as shown in view A, figure 565.

b. Cleaning, Inspection, and Repair.

(1) *Cleaning.* Clean all metal parts in a dry-cleaning solvent, or mineral spirits paint thinner. Thoroughly dry before inspection or installation.

(2) *Inspection.*

(a) Inspect drum shaft gear and worm for broken, chipped, or scored teeth. If worm or shaft is damaged, it must be replaced.

(b) Inspect drum shaft for nicks or burs. A damaged shaft must be replaced.

(c) Inspect drum bushing-type bearings for cracks and scoring, and replace if defective.

(d) Inspect ball bearings for pitted, scored, or scratched condition. Replace if damaged in any way.

(e) Carefully inspect worm gearcase and cover for cracks, warpage, or stripped screw threads. If damaged in this manner, parts must be replaced.

(f) Inspect braking surface of automatic brake disk, and replace disk if surface is scored. Inspect brake band assembly for worn-out brake lining. Lining must be replaced if worn down to head of rivets or if oil soaked.

(g) Inspect automatic brakecase for cracks or breaks. If defective it must be replaced.

(h) Inspect speed reduction gearbox for cracks, breaks or damage. If defective it must be replaced.

(i) Inspect speed reduction gears for cracked or damaged teeth. Defective parts must be replaced.

(j) Inspect bearings and shafts for cracks, breaks, and scoring.

(3) *Repair.* Repairs to the hoist winch assembly will for the most part be a matter of replacing defective parts, and using new gaskets and seals. However, slight nicks or burs may be removed from the various parts with a fine mill file. Damage beyond this will necessitate replacement.

c. Assembly.

(1) Assemble hoist worm gearbox as shown in view C, figure 565. Install automatic brakecase assembly (RR, view C, fig. 565), making sure identification marks placed on gearcase and brakecase to aid in proper installation are aligned.

(2) Check worm gear end play between shoulder or worm gear (XX, view C) and bushing (T, view C). If end play is less than 0.005 inch, add sufficient number of cover gaskets (AB, view C) so that end play will be greater than 0.005 inch, but less than 0.015 inch,

(3) Assemble winch drum as shown in view B, figure 565. Shim between support valve (BB, view B) and retaining washer (CC, view B) and allow 1/64-inch running clearance at both ends.

(4) Assemble speed reduction gearbox shown in view A, figure 565.

(5) Adjust automatic brake (refer to TM 9-2320-211-20).

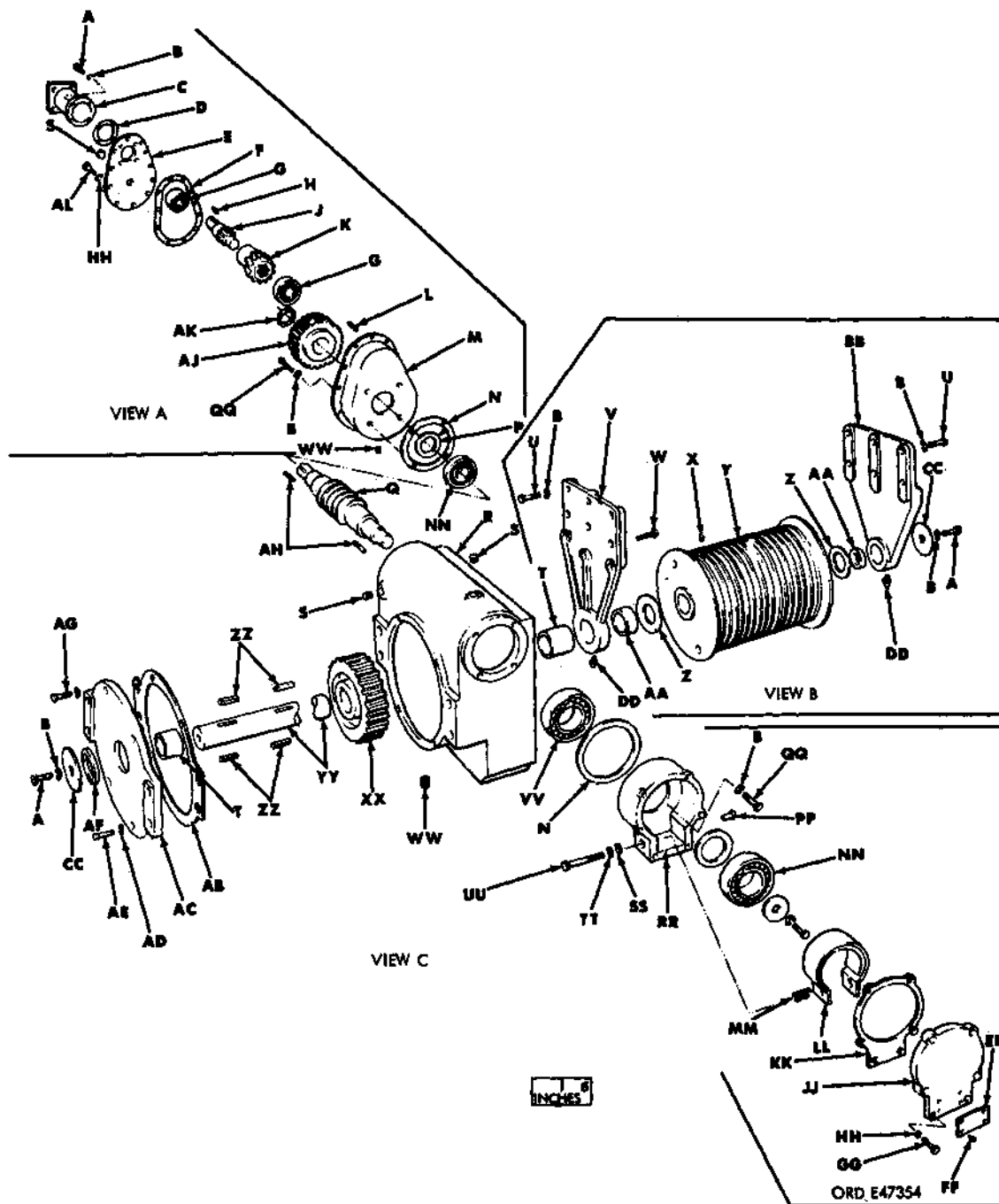


Figure 565. Hoist winch assembly-exploded view.

| | |
|-------------------------------|-----------------------------|
| A-Bolt (6 reqd) | FF-Rivet (4 reqd) |
| B- Washer, lock (15 reqd) | GG-Bolt (6 reqd) |
| C-Adapter | HH-Washer, lock (6 reqd) |
| D-Gasket | JJ-Cover |
| E-Cover | KK-Gasket |
| F-Gasket | LL-Brake band |
| G-Bearing (2 reqd) | MM-Spring brake |
| H-Key | NN-Drum, brake |
| J-Shaft input | PP-Plug, expansion |
| K-Gear | QQ-Bolt (8 reqd) |
| L-Pin, dowel (2 reqd) | RR--Case auto. brake |
| M-Case, gear | SS--O-ring |
| N-Gasket | TT--Washer, lock |
| P-Seal, oil | UU--Bolt |
| Q--Worm hoist lh | VV-Bearing (2 reqd) |
| R--Case, gear | WW-Plug magnetic (2 reqd) |
| S--Plug, pipe (4 reqd) | XX-Worm gear lh |
| T--Bushing (2 reqd) | YY-Shaft, drum |
| U--Bolt | ZZ-Key (4 reqd) |
| V-Support, drum | AB-Gasket (4 reqd) |
| W -Screw, mach. | AC-Cover, gear case |
| X-Screw, sh | AD-Washer, lock (4 reqd) |
| Y-Drum, hoist | AE-Bolt (4 reqd) |
| Z-Washer, thrust (2 reqd) | AF-Seal, oil |
| AA-Bushing (2 reqd) | AG-Screw, mach. |
| BB-Support, drum | AH-Key (2 reqd) |
| CC-Washer, retaining | AJ--Gear |
| DD-Fitting, lub (2 reqd) | AK-Snap ring |
| EE-Plate, data | AL-Bolt, (10 reqd) |

Figure 565. Hoist winch assembly-exploded view.

426. Control Valve Bank**a. Disassembly (Fig. 566)**

(1) Remove eight pins (9) and rings (8) securing four operating handles (3, 5, 6, and 7) to base (34) and control valve bank (10) and remove operating handles.

(2) Remove four knobs (4) from each operating handle (3, 5, 6, and 7).

(3) Remove four screws (2), nuts (25), and lockwashers (27) securing brace (34), right control bracket (14), and left control bracket (29) to control valve bank (10). Remove brackets and brace.

(4) Remove nipple (33) and nipple adapter (31) from control valve bank (10) and discard preformed packing (32).

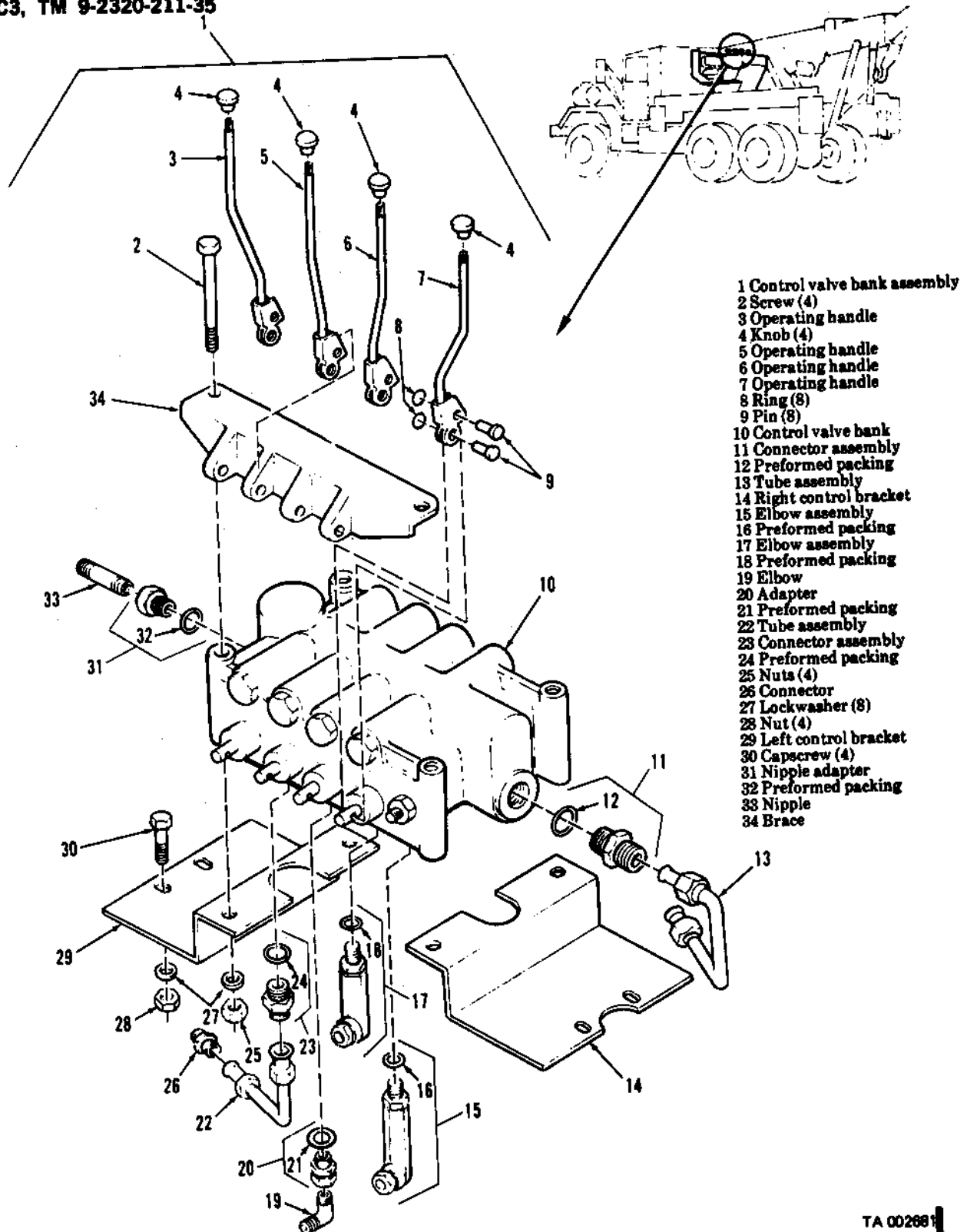
(5) Remove tube assembly (13) and connector assembly (11) from control valve bank (10) and discard preformed packing (12).

(6) Remove connector (26), tube assembly (22), and connector assembly (23) from control valve bank (10) and discard preformed packing (24).

(7) Remove elbow (19) and adapter assembly (20) from control valve bank (10) and discard preformed packing (21).

(8) Remove elbow assembly (15) from control valve bank (10). Discard preformed packing (16).

(9) Remove elbow assembly (17) from control valve bank (10) and discard preformed packing (18).



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Figure 566. Control valve bank assembly (M543, M543A1, M543A2) - exploded view.

NOTE

Thoroughly clean the exterior of the control valve bank before starting disassembly. All spring centered valve spools in the control valve bank are removed and disassembled in a similar manner. Three spools are stamped with a "D" (double action) on the shank at the control handle end. The fourth spool is stamped with an "S" (single action) and is located next to the oil outlet port in the control valve bank.

(10) Remove spool cap (1, fig. 566.1) and valve spool assembly (11) from control valve bank (31).

NOTE

Valve spools are handlapped precision fit in the body and are not interchangeable. Control valve spools and control valve body are replaced as a complete assembly.

(11) Clamp spool in a soft jawed vise with an improvised spring compression tool and remove snapring (3), outer spacer (2), spring (4), travel limit washer (5), and inner spacer (2) from spool (11).

(12) Using special tool 5120-150-5950, remove seal (10), retainers (6 and 9), and preformed packings (7 and 8) from control valve bank (31).

(13) Remove two check valve caps (32), springs (38), and poppets (39) from control valve bank.

NOTE

Do not remove check seat sleeve (40) from control valve bank (31). Check valve parts should be identified so that they will be returned to original positions at reassembly.

(14) Remove preformed packings (33, 35, and 37) and back-up rings (34 and 36) from check valve cap (32).

NOTE

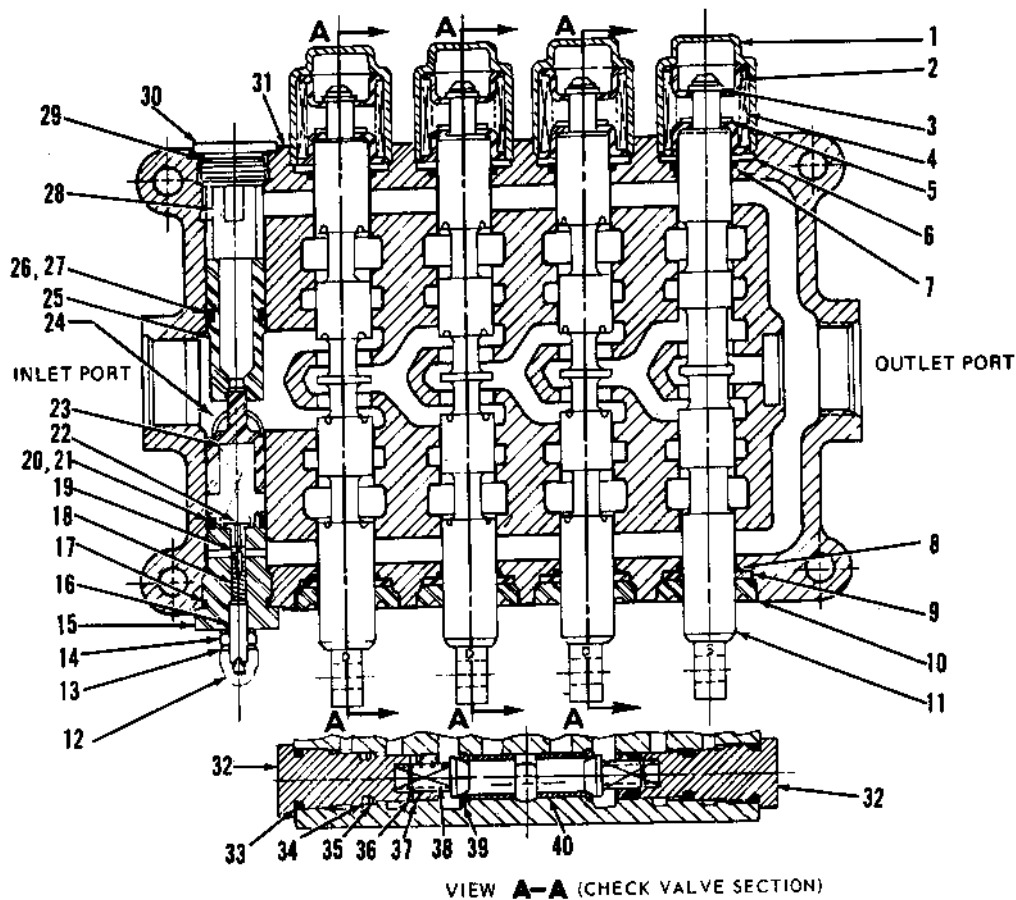
All check valves in the control valve bank are removed and disassembled in a similar manner. Check valves located adjacent to valve spools (11) marked with a "D" (double action) are identical. The check valve located by the valve spool marked "S" (single action) contains one spring (38) and poppet (39). All other components the same as the "D" type spools.

(15) Remove acorn nut (12), two seals (13), jam nut (14), and adjusting screw (16) from valve cap (15).

(16) Remove valve cap (15) and take off preformed packings (17 and 21) and back-up ring (20). Do not remove pilot seat (22) from cap.

(17) Remove pilot plunger spring (18), pilot plunger (19), and poppet spring (23).

(18) Remove relief valve plug (30), preformed packing (29), drain sleeve (28), relief seat adapter (25), seat preformed packing (26), and back-up ring (27) from control valve bank (31).



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- | | |
|---------------------------|--------------------------|
| 1 Spool cap (4) | 21 Preformed packing |
| 2 Spacer (8) | 22 Pilot seat |
| 3 Snapring (4) | 23 Poppet spring |
| 4 Spring (4) | 24 Poppet assembly |
| 5 Travel limit washer (4) | 25 Relief seat adapter |
| 6 Retainer (4) | 26 Preformed packing |
| 7 Preformed packing (4) | 27 Back-up ring |
| 8 Preformed packing (4) | 28 Drain sleeve |
| 9 Retainer (4) | 29 Preformed packing |
| 10 Seal (4) | 30 Relief valve plug |
| 11 Spool assembly (4) | 31 Control valve bank |
| 12 Acorn nut | 32 Cap (8) |
| 13 Seal (2) | 33 Preformed packing (8) |
| 14 Jamnut | 34 Back-up ring (8) |
| 15 Valve cap | 35 Preformed packing (8) |
| 16 Adjusting screw | 36 Back-up ring (16) |
| 17 Preformed packing | 37 Preformed packing (8) |
| 18 Pilot plunger spring | 38 Spring (7) |
| 19 Pilot plunger | 39 Poppet (7) |
| 20 Back-up ring | 40 Check seat sleeve (7) |

Figure 566.1. Control valve bank disassembly and assembly.

b. Cleaning, Inspection, and Repair.

(1) Clean all parts in drycleaning solvent or mineral spirits paint thinner.

(2) Inspect control valve bank and spools for deep scratches, grooves, and excessive wear. Spools should fit without perceptible side clearance. Replace complete unit if damage is evident.

(3) Inspect the check valve poppet and its seating face in the control valve bank for grooves or defects which may cause leakage. Check the poppet for free movement in the cap bore. If the poppet appears to be faulty, replace complete unit. Small nicks and grooves can be removed from the poppet seating face in the body by lapping poppet in the body seat using a fine grain grinding compound. Lap seat sufficiently to remove all defects. Clean seat thoroughly to remove all traces of grinding compound. Extreme care should be exercised to keep poppet concentric in bore when lapping in seat face.

(4) Inspect the relief valve plunger and seat for ridges or scoring which may cause improper seating and leakage. Replace parts if worn or damaged.

(5) Inspect seat adapter for ridges and scoring which may cause leakage. Replace parts when worn or damaged.

(6) Discard all preformed packings. Replace when reassembling the control valve.

(7) Use repair parts kits as appropriate.

c. Assembly.

(1) Control valves.

(a) To reassemble spring centered spool, clamp the spool (11) in a soft jawed vise, place inner spring spacer (2), travel limit washer (5), spring (4), and outer spring spacer (2) on spool. Compress spring and install new snapring. Make sure snapring is fully seated in groove before releasing spring tension.

(b) Install preformed packing retainer (6) and preformed packing (7) on spool assembly and install spool and spool cap (1) in control valve bank.

(c) Install preformed packing (8), retainer (9), and seal (10) in other end of control valve bank over the eye end of the spool and secure using special tool.

(d) Repeat above procedures for remaining control valves.

(2) Check valve.

(a) Install preformed packings (33, 35, and 37), and back-up rings (34 and 36) on cap (32). Place spring (38) in poppet (39) and install complete assembly in control valve bank.

(b) Screw cap assembly into control valve bank until it bottoms.

(3) Relief valve.

(a) Install preformed packing (26) and back-up ring (27) on relief seat adapter (25) and install assembly in control valve bank.

(b) Install drain sleeve (28) in control valve bank against relief seat adapter.

(c) Install preformed packing (29) on relief valve plug (30) and install assembly in control valve bank.

NOTE

Drain sleeve (28) should go in control valve bank far enough to expose two or three full threads. Installing relief valve plug (30) at this point sets the relief seat adapter (25) to the proper depth.

(d) Install poppet (24) so that the plunger shaft points towards the relief seat adapter. Place poppet spring (23) inside of poppet assembly.

(e) Install pilot seat (22) in cap (15). Place preformed packing (21) and back-up ring (20) on cap (15). Insert pilot plunger (19) into spring (18) and install assembly into bore of cap (15) with pilot plunger (19) pointing towards pilot seat (22).

(f) Install preformed packing (17), adjusting screw (16), jamnut (14), and seal (13) in cap (15).

(g) Reassemble the remainder of the control valve bank by reversing the procedures in paragraph 427a. (1) through (9).

d. Installation. Install the control valve bank by reversing procedures given in paragraph 408.

e. Pressure Relief Valve Adjustment.

(1) Remove 1/8 inch pipe plug located on top of valve bank at right side.

(2) Install a hydraulic pressure gage 4910-627-7043 (0-2000 psi) into pipe plug hole.

(3) Remove acorn nut (12) and seal (13) located to the right of the swing motor lever. After removing the nut and preformed packing, the adjusting screw (16) will be visible. Loosen adjusting screw jamnut (14).

(4) Start engine and engage hydraulic pump. Allow approximately 10 minutes for hydraulic system to warm up.

(5) Extend boom to maximum and hold against stop temporarily and observe pressure reading. Reading should be between 1210 and 1215 psi.

(6) If pressure reading is incorrect, turn the adjusting screw clockwise to increase pressure and counterclockwise to decrease.

(7) When correct pressure is attained, hold adjusting screw while tightening jamnut.

(8) Replace acorn nut and preformed packing.

427. Seal Housing and Drive Housing on Power Divider

a. General. After removal of the seal housing and drive housing from the vehicle, disassembly is as follows in b below.

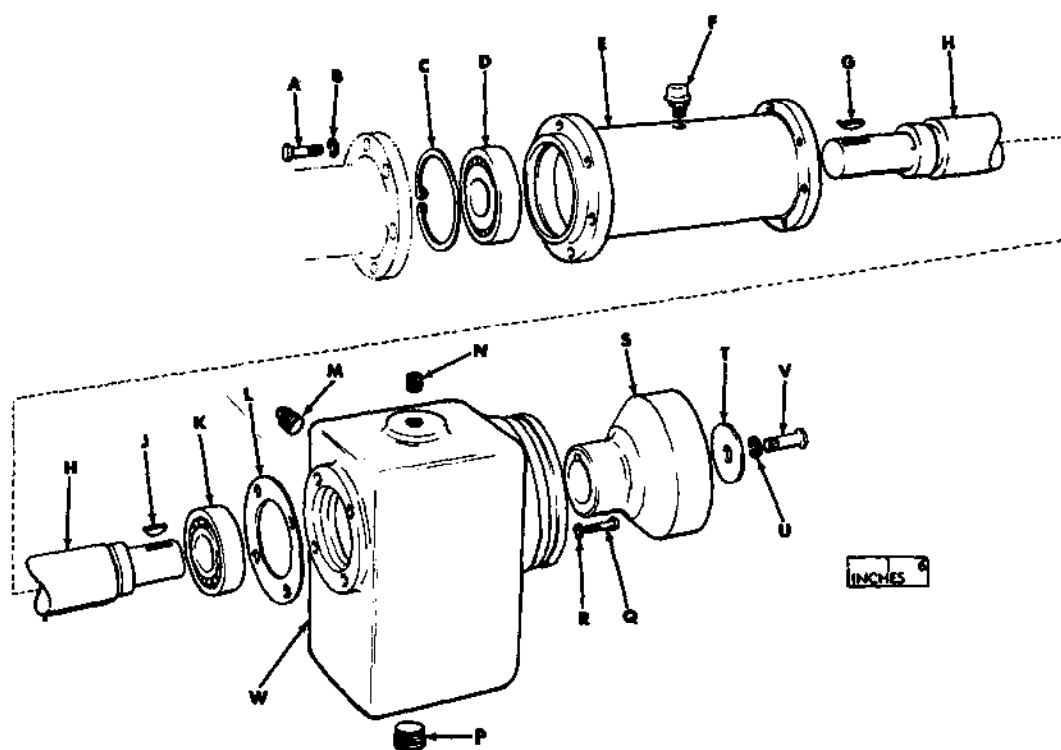
b. Disassemble (Fig. 567).

(1) Remove retaining ring (C) and bearing (D) from drive housing (E).

(2) Remove air vent (F) and Woodruff keys (G) and (J) from drive shaft (H).

(3) Remove bearing (K) and gasket (L). Remove pipe plugs (M), (N), and (P).

(4) Remove bolt (V), lockwashers (U), and retaining washer (T) from yoke fitting.



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- | | |
|------------------------|------------------------|
| A—Bolt, 3/8-24 x 1-1/2 | M—Pipe plug, 3/4 |
| B—Lockwasher, 3/8 | N—Pipe plug, 1/8 |
| C—Ring, retaining | P—Pipe plug, mag., 3/4 |
| D—Bearing | Q—Bolt, 3/4-24, 1-1/2 |
| E—Housing, drive | R—Lockwasher, 3/8 |
| F—Air vent | S—Fitting yoke |
| G—Key | T—Washer, retaining |
| H—Drive shaft | U—Lockwasher |
| J—Key | V—Bolt, 1/2-20 x 1 |
| K—Bearing | W—Housing, seal |
| L—Gasket | |

Figure 567. Seal housing and drive housing-exploded view.

(S). Remove bolt (Q) and lockwasher (R).

c. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts with dry-cleaning solvent or mineral spirits paint thinner. Dry all parts thoroughly before inspection. or installation.

(2) Inspection and repair.

(a) Inspect bearings for scored spots, chips, or cracks. Replace bearings if found to be damaged in any way.

(b) Inspect drive shaft, fitting yoke and keys for cracks, breaks, or signs of damage. Replace damaged parts.

(c) Inspect seal housing and drive housing for cracks, breaks, or stripped bolt threads. If damaged, parts must be replaced.

d. Assembly (Fig. 567).

(1) Install fitting yoke (S) to seal housing (W) with bolts (Q) and lockwashers (R). Position retaining washer (V) and secure with bolt (V) and lockwasher (U).

(2) Install pipe plugs (M), (N), and (P).

(3) Position gasket (L), bearing (K), and Woodruff key (J) on drive shaft (H). Position Woodruff key (G), bearing (D), and retainer ring (C) and secure with bolts (A) and lockwashers (B).

428. Bevel Gearbox

a. Disassembly. Disassemble bevel gearbox as-shown in figure 568.

Note. Bevel gears are right and left hand, and their position on the respective shafts should be noted for proper assembly.

b. Cleaning, Inspection, and Repair.

(1) **Cleaning.** Clean all parts with mineral spirits paint thinner or dry-cleaning solvent. Dry thoroughly before inspection or installation.

(2) Inspection.

(a) Inspect bearings for scored spots, chips or cracks. Replace a defective, or damaged part.

(b) Inspect bevel gear teeth for chipped places or excessive wear. If any defects are noted, parts must be replaced.

(c) Carefully inspect case and cover for cracks, warpage, or stripped screw threads. If damaged in this manner, parts must be replaced.

(d) Inspect shafts and shaft splines for twists, chips or damage. If any evidence of damage exists, parts must be replaced.

(3) Repair. Repairs to the bevel gearbox will for the most part be a matter of replacing defective parts, and using new gaskets and seals. However, slight nicks, or burs may be removed from the various parts with a fine mill file. Damage beyond this will necessitate part replacement.

c. Assembly. Assemble bevel gearbox as shown in figure 568.

Note. The bevel gears are right and left hand and must be assembled on the proper shaft as shown in figure 568.

429. Turntable Assembly

a. Disassembly.

(1) Turn turntable base plate over (bull gear bearing up, fig. 569) and remove cap screws anchoring bull gear bearing to base plate.

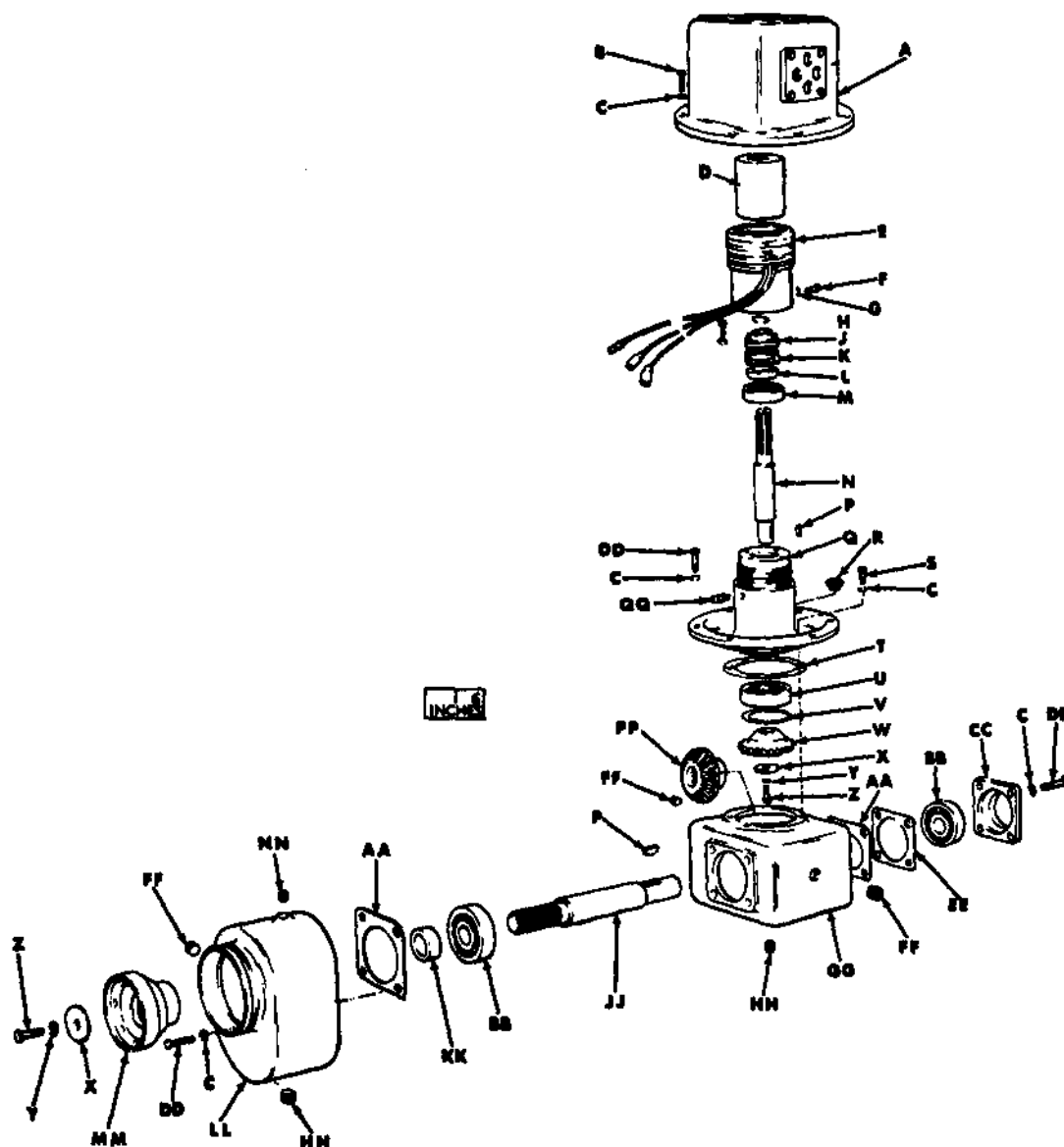
(2) Remove bull gear bearing from turntable base plate.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts with dry-cleaning solvent or mineral spirits paint thinner. Dry parts thoroughly. Coat bull gear and bearing assembly, with a light coat of oil to prevent rusting.

(2) Inspection and repair.

(a) Inspect turntable base plate for cracks, breaks, or signs of distortion or warpage. Defective welds can be repaired by welding. If turntable is found to be warped or distorted it should be replaced.



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Figure 568. Bevel gearbox assembly - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|----------------------------------|------------|--------------------|
| A | Pump support | H | Ring retaining |
| B | Bolt | J | Cover, seal |
| C | Washer, lock | K | Gasket |
| D | Coupling assembly | L | oil seal |
| E | Support insulating ring assembly | M | Bearing |
| F | Bolt | N | Shaft, pump drive |
| G | Washer, lock | P | Key |

Figure 568. Bevel gearbox assembly - exploded view - legend

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|------------------------|------------|------------------------|
| Q | Cover, bevel gearbox | D D | Bolt |
| R | Grommet, rubber | E E | Shim |
| s | Bolt | F F | Plug |
| T | Gasket | G G | Case, bevel gear |
| u | Bearing | H H | Plug, magnetic |
| v | Ring, retaining | J J | Shaft, input |
| w | Gear, spiral miter, LH | KK | Spacer |
| x | Washer | L L | Housing, drive seal |
| Y | Washer | M M | Yoke, fitting |
| Z | Bolt | N N | Plug |
| A A | Gasket | PP | Gear, spiral miter, RH |
| B B | Bearing | Q Q | Fitting vent |
| c c | Cover | | |

Figure 568. Bevel gearbox assembly - exploded view - legend - continued



Figure 569. Removing and installing bull gear bearing to turntable base plate

- (b) Inspect bull gear bearing for cracked, broken, or damaged gear teeth. Carefully inspect bearing for pitted, scored or cracked balls and replace if bull-gear bearing is found to be in any way defective.

c. Assembly. Assemble turntable by reversing procedures in a above.

430. Swing Drive Gearbox

a. Disassembly. Disassemble swing drive gearbox as shown in figure 570.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean all parts with mineral spirits paint thinner or dry-cleaning solvent. Dry thoroughly before inspection or installation.

(2) Inspection.

- (a) Inspect each bearing assembly for rough or scored condition. Replace if damaged.
- (b) Inspect gearcase, end caps, and cover for cracks, breaks, or signs of damage. Replace damaged or defective parts.
- (c) Inspect pinion shaft for cracked or broken teeth. Replace if damaged.
- (d) Inspect worm gear and drive worm for broken, chipped, or badly scored teeth. Replace if damaged.
- (e) Inspect thrust bushings and thrust washers for scoring or damage, and replace defective parts.

- (3) Repair. Repairs to the swing drive gearbox will for the most part be a matter of replacing defective parts, and using new gaskets and seals. However, slight nicks or burs may be

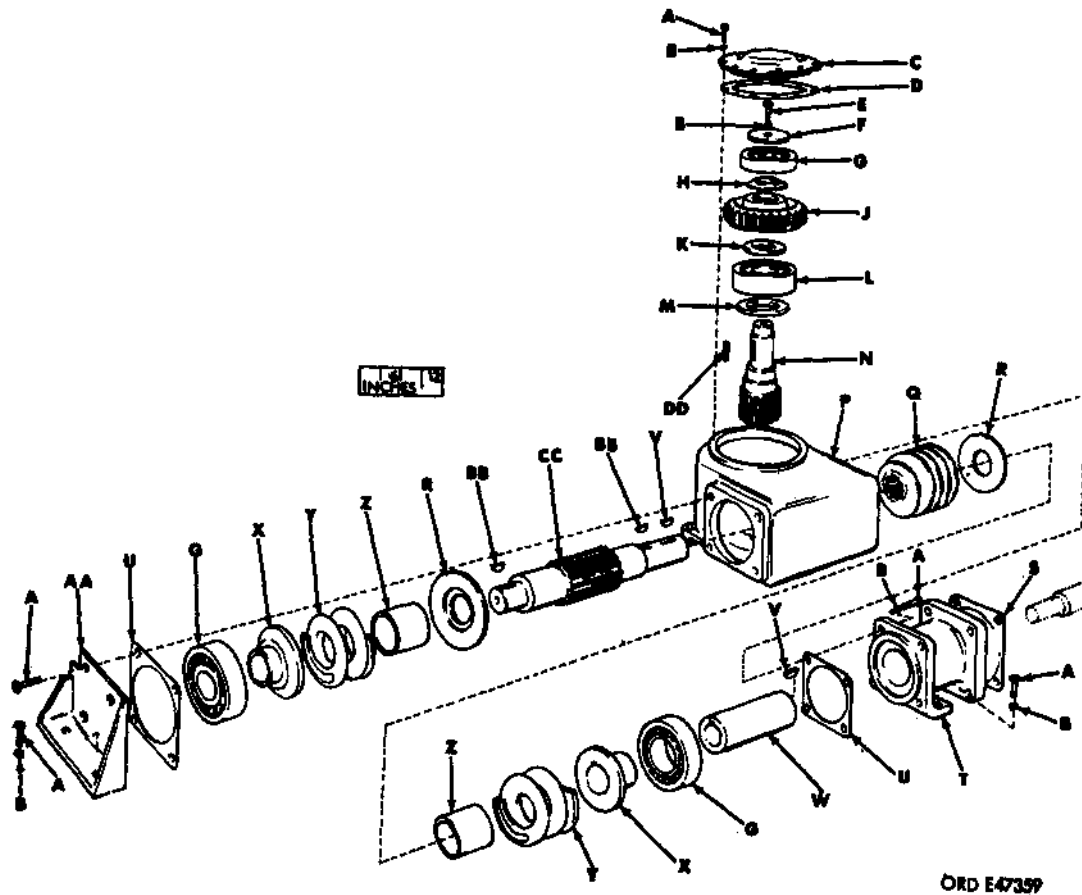


Figure 570. Swing drive gearbox - exploded view

| Key | Item | Key | Item |
|-----|------------------------------|-----|--------------------------|
| A | Bolt (14 reqd) | Q | Worm, rh |
| B | Washer, lock, 1/2" (15 reqd) | R | Washer, spring(2 reqd) |
| C | Cover, gear case | S | Gasket |
| D | Gasket | T | End cap, motor mtg |
| E | Bolt | U | Gasket (2 reqd) |
| F | Washer, retaining | V | Key (2 reqd) |
| G | Bearing, ball (3 reqd) | W | Coupling |
| H | Washer, thrust | X | Bushing, thrust (2 reqd) |
| J | Gear, worm, rh | Y | Spring (2 reqd) |
| K | Washer | Z | Spacer (2 reqd) |
| L | Bearing ball | AA | End cap, gearcase |
| M | Seal, oil | BB | Key (2 reqd) |
| N | Shaft, swing pinion | CC | Shaft, swing worm |
| P | Case, swing gear | DD | Key |

Figure 570. Swing drive gearbox - exploded view - legend

removed from the various parts with a fine mill file. Damage beyond this will necessitate replacement.

c. Assembly. Assemble swing drive gear-box as shown in figure 570.

431. Operator's Station (Fig. 545)

a. Disassembly.

- (1) Unbolt backrest from operator's station.
- (2) Remove seat from operator's station

b. Cleaning and Inspection.

- (1) Cleaning. Clean all parts with mineral spirits paint thinner or dry-cleaning

solvent. Dry thoroughly before inspection or installation

(2) Inspection.

(a) Inspect operator's station for dents, rips, distortion or broken welds. Straighten, weld or repair as necessary. Replace a badly damaged operator's station,

(b) Inspect seat and backrest for general condition of covering and padding. A badly damaged part should be replaced.

c. Assembly. Assemble in reverse of a above.

Section V. TESTS AND ADJUSTMENTS

432. Boom Roller Adjustment

Refer to TM 9-2370-211-20.

433. Engine Governor Override Solenoid

a. Start engine (TM 9-2320-211-10). After engine coolant temperature reaches normal operating range, engage power divider with transmission in "4" (fourth) gear.

b. Pull throttle control all the way out and leave in "LOCKED OUT" position. Observe engine speed (rpm) indicated by tachometer, which is the engine speed at which the governor valve mounted on the power divider controls the engine speed governor. Stop engine.

c. If engine governed speed (no-load) indicated by (b) above is not within range of satisfactory governor operation (1600 to 1700 rpm when governor is controlled by governor valve at power divider), adjust governor valve **at power divider ~~g~~ through ~~e~~ below.**

(f) (5)

- (1) Remove adjusting hole plug seal, and remove plug from side of governor valve housing.

(2) Place the transmission gearshift lever in "4" gear position, place the transfer shift lever in neutral position, and place the power divider control lever in "ENGAGE" position. With the ignition switch off, crank engine in small increments (by momentarily depressing starter button), until adjusting screw inside governor is allined with adjusting hole.

(3) Insert a screwdriver in the adjusting hole and turn the adjusting screw clockwise to increase engine governed speed, or counterclockwise to decrease engine governed speed. One full turn of the adjusting screw in either direction will result in a change in the engine governed speed of approximately 150 rpm.

(4) Install plug in adjusting hole, and check governor valve adjustment by repeating (1) through (4) above.

(5) Attach a new locking wire and lead seal to the adjusting hole plug and the fin on the control valve housing adjacent to the adjusting hole.

Section VI. SERVICEABILITY STANDARDS

434. General

Construction details of the wrecker crane M62 and wrecker crane M543 and M543A2 are similar.

435. Serviceability Standards

Refer to wrecker crane M62 Serviceability Standards (par. 359).

CHAPTER 25

FRAME AND RELATED PARTS

Section I. DESCRIPTION AND DATA

436. Description

a. General. The frame and related parts consist of those parts which support the vehicle and tie the various units together. The frame (figs. 571 and 572) consists of left and right side members (fig, 571) which are pressed steel channel sections. To these sections, the cross members, gussets, brackets, reinforcements, and rear engine mounts are riveted. The related parts which are included with the frame are as follows:

b. Brake Devices. The various devices of the brake system which are mounted to the frame are the master cylinder and the air hydraulic cylinder.

c. Clutch and Brake Pedal Shaft. The clutch and brake pedal shaft is supported by the lever supporting bracket which is mounted on the left side member of the frame.

d. Exhaust Pipe, Tailpipe, and Muffler. The exhaust pipe, tailpipe, and muffler are supported to the frame and must be removed when ever repairs to the frame are necessary.

e. Front Bumper, Rear Bumperettes, and Lifting Shackles. The bumper, bumperettes,

and lifting shackles are bolted directly onto the frame.

f. Fuel Tank The fuel supply is stored in fuel tanks, which are held up by two mounting supports, bolted to the frame. Tanks are held in supports by two straps, and are shielded by protector plate fastened to the fuel tank mounting supports.

g. Pintle. The pintle is fastened to a mounting bracket bolted to the rear cross member. The pintle includes a locking device, which secures the hook when in a closed position.

h. Piping. The pipes included with and mounted on the frame are pipes for the compressed air lines, the hydraulic brake lines, and the ventilation lines. Clips are used to mount piping to frame.

1. Spare Wheel Carrier. The model M41 (cargo) has a spare wheel carrier welded to the cargo body 'at the Inside front end of the body. Two hinged clamp bolts maintain the spare wheel and tire in an upright position. The M51 has a spare wheel carrier mounted directly behind the cab. This carrier is supported by two brackets which are bolted to the frame. The spare wheel and tire are held in an upright position by a clamp and clamp bolt.

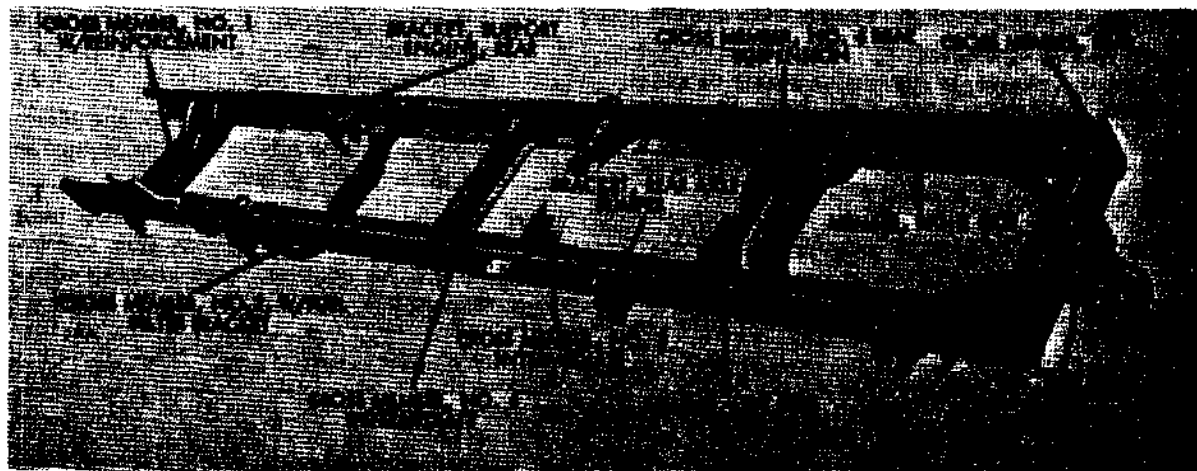


Figure 571. Frame and mounting brackets

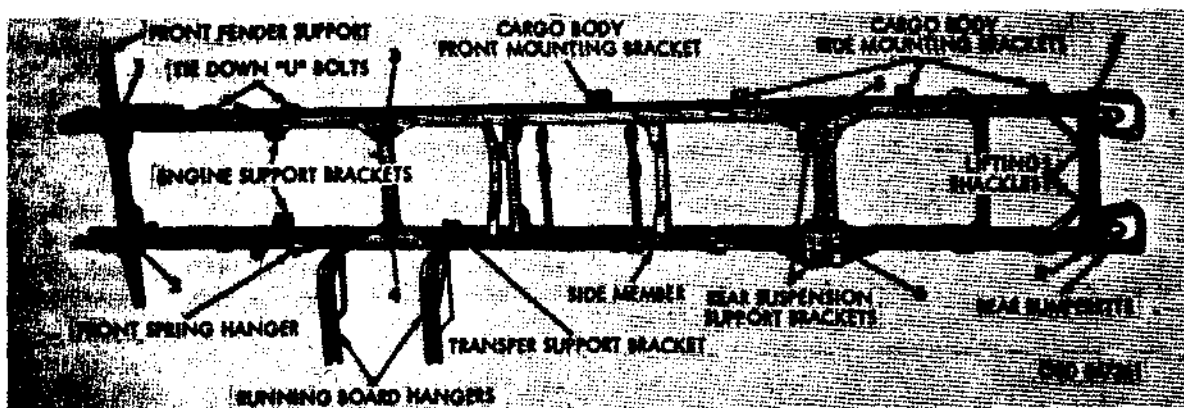


Figure 572. Vehicle frame - bottom view

j. Wiring Harness. The wiring harness is secured to the frame with clips.

Length w/o winch 249-5/16 in.
Number of cross members 6

k. Running Boards. The running boards are pressed steel and are bolted to braces extending from the frame side members.

c. M139 (Chassis) Frame.

437. Data

a. M41 (Cargo) Frame.

Channel dimensions 9 x 3 x 5/16 in.
Length w/winch 300-13/16 in.
Length w/o winch 285 - 7/16 in
Number of cross members 7

Channel dimensions 9 x 3 x 5/16 in.
Length w/winch 350-9/16 in.
Length w/o winch 344-3/16 in.
Number of cross members 8

b. M51, M51 A2 (Dump) Frame.

Channel dimensions 9 x 3 x 5/16 in.
Length w/winch 264-11/16 in.

d. M52, M52A2 (Tractor) Frame.

Channel dimensions 9 x 3 x 5/16 in.
Length w/winch 264-11/16 in.
Length w/o winch 249-5/16 in.
Number of cross members 6

Section II. REMOVAL AND INSTALLATION OF ASSOCIATED PARTS

438. Brake Devices

a. Removal.

- (1) Master cylinder. For removal, refer to TM 9-2320-211-20.
- (2) Air-hydraulic cylinder. For removal, refer to TM 9-2320-211-20.

b. Installation.

- (1) Master cylinder. For installation, refer to TM 9-2320-211-20.
- (2) Air-hydraulic cylinder. For installation, refer to TM 9-2320-211-20.

439. Brake and Clutch Pedal Shaft

- a. Removal. Refer to TM 9-2320-211-20.
- b. Installation. Refer to TM 9-2320-211-20.

440. Exhaust Pipe, Tailpipe, and Muffler

- a. Removal. Refer to TM 9-2920-211 -20 for removal of the exhaust pipe, tailpipe, and muffler.
- b. Installation Refer to TM 9-2320-211-20 for installation of the exhaust pipe, tailpipe and **muffler.**

441. Front Bumper and Rear Bumperettes and Lifting Shackles

a. Removal.

- (1) Front bumper bar. Remove bolts and nuts securing each bumper bar gusset to frame, and remove gussets and bumper bar.
- (2) Rear bumperettes. Remove bolts and nuts securing each bumperette to frame rear cross member, and remove bumperettes.
- (3) Lifting shackles. Refer to TM 9-2320-211-20 for removal of the lifting shackles.

b. Installation.

- (1) Lifting shackles. Refer to TM 9-2320-211-20 for installation of the lifting shackles.
- (2) Rear bumperettes. Aline bolt holes and secure each bumperette to frame with bolts and self-locking nuts.
- (3) Front bumper bar. Aline bolt holes in gussets with holes in frame, and secure each gusset to frame with bolts and self-locking nuts.

442. Fuel Tank

For removal and installation of fuel tank refer to TM 9-2320-211-20.

443. Pintle

Refer to TM 9-2320-211-20 for removal and installation of the pintle.

444. Piping

a. Removal.

- (1) Compressed air lines. Disconnect compressed air lines at the fittings, remove retaining clips, and take out piping from frame.
- (2) Hydraulic brake lines. After disconnecting hydraulic lines from the brake devices, remove clips holding line to cross members and frame, and remove hydraulic lines.

- (3) Ventilation lines. Disconnect ventilation lines from master cylinder, air hydraulic cylinder, and fuel tank. Remove retaining clips holding ventilation lines in place on frame and take out lines.

b. Installation Connect the compressed air lines, hydraulic brake lines, and ventilation lines to their respective units. Fasten piping to frame with clips, bolts, nuts, and lockwashers.

445. Spare Wheel Carrier

& Removal.

- (1) Spare wheel carrier (M51, M51A2) dump. Remove four cap screws and four safety nuts, two each for each mounting bracket and lift off spare wheel carrier assembly with tool box.
- (2) Spare wheel carrier M41 cargo. Remove two hinged clamp-bolt-nuts located inside front end of cargo body, releasing spare tire. A removable section in cargo rack is provided for convenience of removing spare tire assembly from body.

b. Installation.

- (1) Spare wheel carrier (M51) dump. Position spare wheel carrier on frame of truck so that it will be directly behind cab. Aline holes of mounting bracket with holes in frame and install bolts and nuts. Tighten nuts securely.
- (2) Spare wheel carrier (M41) cargo. Position carrier at mounting bracket inside front end of cargo body and install two retaining nuts on hinged clamp bolts and tighten securely.

446. Wiring Harness

a. Removal.

- (1) All electrical cables and harnesses are removed in essentially the same manner. Disconnect the cable (single or multiple) at both ends, remove cable from clamps securing it to the various points on the vehicle, and remove cable.

- (2) To disconnect plug- and receptacle-type connectors, unscrew the connector retaining nut, and pull the plug from the receptacle. To disconnect bayonet-type connectors, rotate one of the connector halves counterclockwise, and pull connector apart.

b. Installation. For installation of wiring harness, refer to TM 9-2320-211-20.

447. Side Members, Cross Members, Supports, and Brackets

a. Removal. Side members, cross members, supports and brackets that are damaged or broken must be replaced. Cut off and drive out all rivets from parts to be replaced. Remove parts to be replaced.

b. Installation. Install new parts to be replaced using new rivets to secure in place.

448. Frame.

a. Removal. Refer to TM 9-2320-211-20.

b. Installation Raise and support frame assembly high enough to permit installation of axles (refer to TM 9-2320-211-20).

449. Running Boards

a. Removal.

- (1) Remove four self-locking nuts and bolts securing running board to running board braces, and remove running board.
- (2) Repeat process and remove the other running board in the same way.

b. Installation. Position running boards on running board braces and align bolt holes. Secure each running board to braces with four bolts and self-locking nuts.

Section III. REPAIR

450. Brake Devices

a. Disassembly.

- (1) Master cylinder. Refer to paragraph 238a.
- (2) Air-hydraulic cylinder. Refer to paragraph 239.

b. Cleaning, Inspection, and Repair.

- (1) Master cylinder. Refer to paragraph 238b
- (2) Air-hydraulic cylinder. Refer to paragraph 239.

c. Assembly.

- (1) Master cylinder. Refer to paragraph 238c.
- (2) Air-hydraulic cylinder. Refer to paragraph 239.

451. Clutch and Brake Lever Shaft

a. Disassembly. Refer to TM 9-2320-211-20.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Refer to paragraph 236.
- (2) Inspection. Inspect the lever supporting bracket which is mounted on the left side member of the frame. Refer to paragraph 236.
- (3) Repair. Refer to paragraph 236.

c. Assembly. Refer to TM 9-2320-211-20.

452. Exhaust Pipe, Tailpipe, and Muffler

Refer to TM 9-2320-211-20.

453. Front Bumper, Roar Bumperettes, and Lifting Shackles

a. Disassembly. Refer to paragraph 441.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean all parts in mineral spirits paint thinner. Dry with compressed air.
- (2) Inspection.
 - (a) Inspect front bumper bar for cracks, bends, distortion, and other damage.

Inspect gussets for cracks and other damage.

(b) Inspect rear bumperettes for cracks, bends, and distortion.

(c) Inspect each *shackle* bracket for cracks and wear at pinhole. Inspect pin for wear.

(3) Repair.

(a) Straighten bends, and repair cracks by welding. Replace bumper bar if it cannot be made serviceable. Replace damaged gussets.

(b) Replace bumperettes if they cannot be made serviceable.

(c) Replace shackle brackets if cracked or worn. Replace pin if worn. Replace unserviceable shackle.

c. Assembly. Refer to paragraph 441.

454. Fuel Tank (Fig. 573)

Note. It is not necessary to disassemble fuel tank unless inspection reveals damage.

a. Disassembly. Remove drain plug from bottom of tank. Remove screws from vent cover assembly and fuel tank sending unit and remove from tank. Discard oil gaskets. Remove filler cap and lift out filler pipe sleeve from tank.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean outside of tank with dry-cleaning solvent or mineral spirits

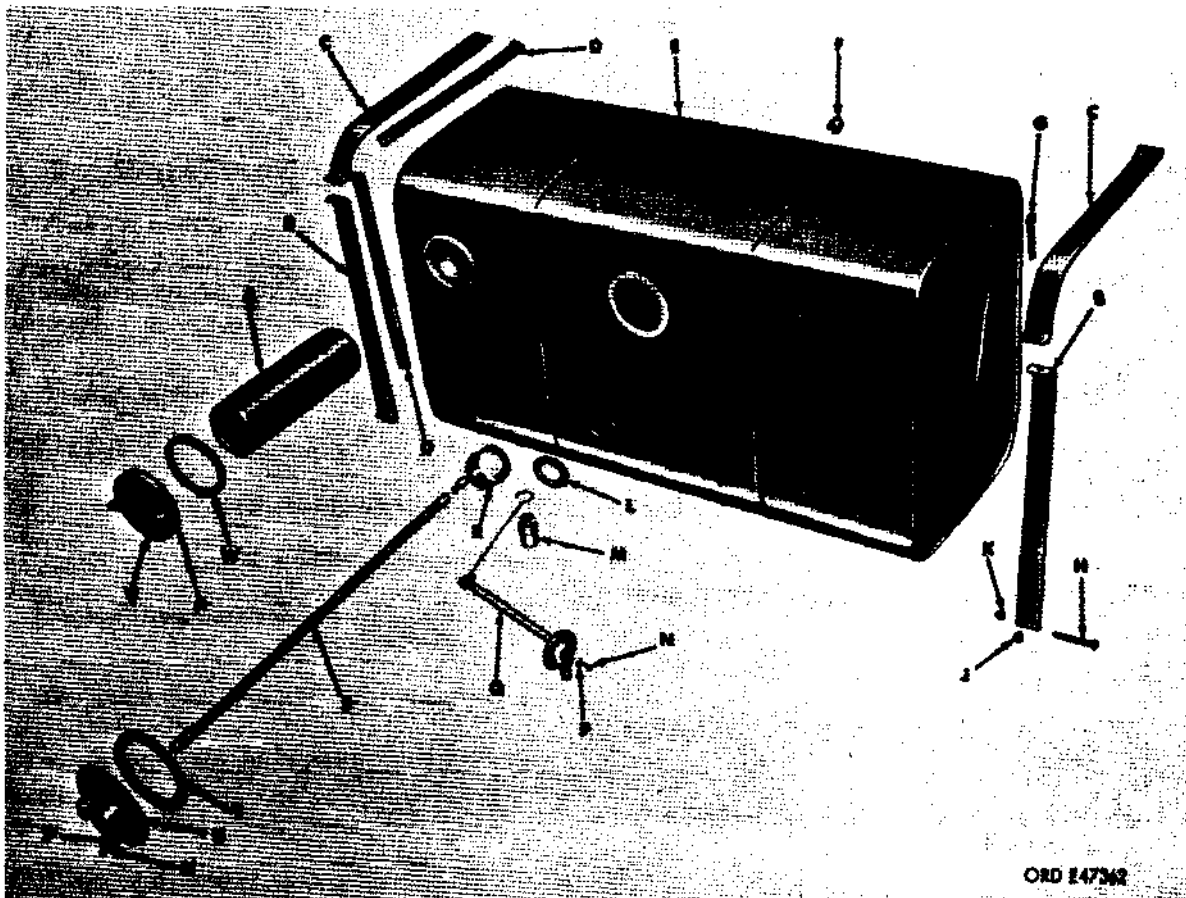


Figure 573. Fuel tank - exploded view

paint thinner. Wash filter with paint thinner. Remove sediment from interior of tank, using small amount of mineral spirits paint thinner,

- (2) Inspection. Inspect tank for cracks or damage. Tank may be tested for leaks by plugging all openings, except one, and applying air pressure of 6 psi. Inspect filler cap end sleeve for dam-

- (3) Re air. Small leaks by welding. Replace defective parts.

Warning: Do not attempt repressurize unless tank has been cleaned and properly treated to expel all inflammable or explosive fumes. Merely draining tank does not make it safe for welding. An "empty" tank can be more dangerous than a full one. Before repressurizing, thoroughly steam tank or use other approved method to completely remove all fumes.

c. Assembly. Install filler pipe sleeve and filler cap with a new gasket. Place anew gasket on vent cover and install vent and filler assembly in position on tank. Align holes, install screws and washers, and tighten. Position new gasket on fuel tank sending unit assembly and place assembly on tank. Install screws and washers end tighten. Install drain plug in bottom of tank.

455. Pintle (Fig. 574)

a. Disassembly. It is necessary to completely disassemble the pintle to remove it from the frame. Refer to TM 9-2320-211-20 for disassembly procedures.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean all parts in dry-cleaning solvent or mineral spirits paint thinner.
- (2) Inspection. Inspect shaft on hook for **signs of** excessive wear or damage. Inspect hook, lock and latch for damage.
- (3) Repair. Remove raised metal or scores **with** fine stone. Replace latch chain if missing or broken. Replace defective parts.

c. Assembly.

- (1) Place outer bracket (one with lubricating fitting) on shaft end of hook and insert shaft through frame.
- (2) Place inner bracket on shaft inside frame with the flat side of bracket against frame. Install bolts attaching brackets to frame, being sure the lubricating fitting is on the bottom.
- (3) Install safety nuts and tighten securely. Install plain washer, slotted nut, and cotter pin on end of shaft.
- (4) Position hook lock on hook and install special bolt, jam nut, and cotter pin. Position latch spring and hook latch in lock and press pin in place.

456. Piping

a. Disassembly. Refer to paragraph 444. After removal, no further disassembly is required.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Flush with warm water and **soapsuds.**
- (2) Inspection and repair.
 - (a) Check fuel lines and fittings to see that they are in good condition and securely supported. Check for leaks and replace if damaged. Inspect vent line for security of attachment.
 - (b) Check brake lines, assemblies, and fittings underneath the truck to see that they are properly supported, securely connected, and not chafing or leaking. Replace if damaged.

457. Spare Wheel Carrier (M51, M51A2)

a. Disassembly. Disassembly of spare wheel carrier is not necessary as the carrier is welded together and no mechanical devices are involved.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean carrier with mineral spirits paint thinner. Dry with compressed air.

- (2) Inspection and repair. Inspect carrier for cracks, breaks, or damage. Repair cracks and breaks by welding.

458. Frame

a. Disassembly.

Note. The disassembly of the frame is considered complete when all associated parts have been removed. No cross members, gussets, brackets, reinforcements, or engine mounts will be removed unless inspection reveals that replacement or repair is necessary.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Use dry-cleaning solvent or mineral spirits paint thinner to clean

grease or dirt from all parts of the frame. Steam may be used to remove heavy accumulation of dirt or grease after dry-cleaning solvent or mineral spirits paint thinner has been applied. If steam is not available, a solution of one part grease cleaning compound to four parts of dry-cleaning solvent or mineral spirits paint thinner may be used for dissolving grease. After cleaning, use cold water to rinse off any solution which remains.

(2) Inspection.

- (a) Inspect frame side members for any cracks, bends, or misalignment. Inspect cross members for cracks or

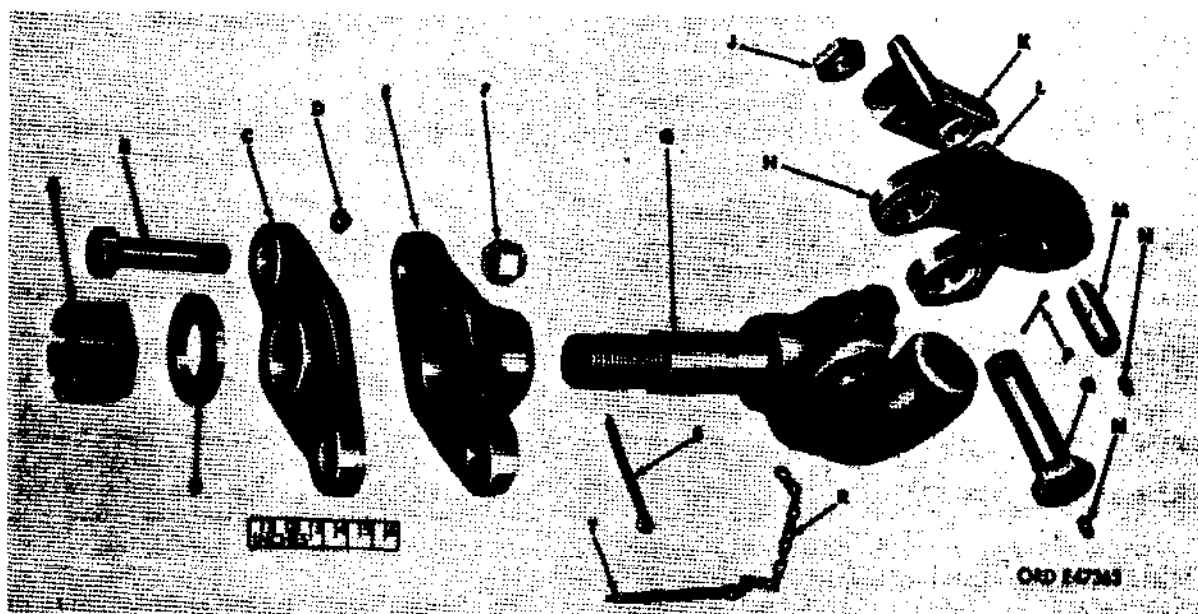


Figure 574. Pintle - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|----------------------|------------|----------------------|
| A | Nut, slotted | L | Spring, latch |
| B | Bolt, hex-head | M | Pin, latch |
| C | Bracket, outer | N | Fitting, lubricating |
| D | Fitting, lubricating | P | Pin, cotter |
| E | Bracket, inner | Q | Bolt, special |
| F | Nut, safety | R | Chain, latch |
| G | Hook | s | Pin, cotter |
| H | Lock, hook | T | Pin, cotter |
| J | Nut, jam | u | Washer, plain |
| K | Latch, hook | | |

Figure 574. Pintle - exploded view - legend

damage. Inspect riveted joints for cracks or broken rivets. Inspect all bolted brackets and supports for cracks or damage. Inspect running-board hangers and running boards for damage.

- (b) Check the frame for misalignment as follows: measure and compare the distance between 1 and 4, and 2 and 3 of figure 572. Similarly, measure and compare the distance between points 3 and 6, 4 and 5, 5 and 8, and 6 and 7. Measurement between the pairs of points designated shall be constant to within one-eighth of an inch. Variation in excess of one-eighth of an inch indicates distortion of side frames, or **damaged cross members, causing misalignment.**

(8) Repair.

- (a) The use of heat is not recommended when straightening frames. Where possible, straightening should be done cold and with pressure. Frame side members, which are bent or buckled sufficiently to show strain after straightening, must be repaired or replaced.
- (b) No established rides can be made on the necessity, length, or kinds of reinforcement to install on frame members which have been bent, broken, or cracked. Reinforcement can be made with channel, angle, or flat stock. Use **electric arc welding when reinforcing damaged side members.** Do not weld on gussets of frame, or edges of frame members as this will weaken the frame and encourage development of new cracks.
- (c) Cross members, brackets, or gussets that are damaged or broken must be replaced. Cut off all rivets to remove bolts from Parts to be replaced. Install new part and use new rivets or bolts to secure in position.

459. Side Members, Cross Members, Supports, and Brackets

- a. Disassembly. Refer to paragraph 447.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Refer to paragraph 458b.(1).

(2) Inspection

- (a) Inspect side members for cracks, bends, and distortion.
- (b) Inspect cross members for cracks, bends, and for missing rivets at points of attachment to side members.
- (c) Inspect all bolted and riveted supports and brackets, including transverse cab support member; spring hangers; rear suspension support brackets, running board, fuel tank, and front fender supports; and shock absorber, engine, transfer, and body mounting brackets for cracks, bends, and for loose bolts or rivets at attachment points.

(S) Repair.

Caution: Do not weld or apply heat to frame side rails or cross members. Any method of welding will destroy heat treatment of frame, causing metal adjacent to weld to be weakened.

- (a) Straighten bent side and cross frame members if possible.
- (b) Repair cracked members by welding, using plate or angle stock for reinforcing damaged sections.
- (c) Replace frame members which cannot be repaired,
- (d) Straighten bent supports and brackets.
- (e) Repair damaged items by welding, but replace items that are damaged severely.
- (f) Replace loose or missing rivets. Replace missing bolts. Tighten loose bolts.

c. Assembly. Refer to paragraph 447.

460. Running Boards

a. Disassembly. Refer to paragraph 449,

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean running boards with soap and water, using stiff brush to remove accumulations of grease and dirt. Dry with compressed air.

- (2) Inspection. After running boards have been thoroughly cleaned, inspect for dents, distortion, cracks, loose welds, and holes.

- (3) Repair. Remove dents, using suitable sheet metal working tools. Repair cracks, and broken welds by welding. Patch holes with material of same thickness as that to which it is applied and of sufficient size to lap approximately two inches all around the hole. paint surface after repair. Replace parts damaged beyond repair.

CHAPTER 25.1 (Added) EXPANSIBLE VAN BODY M291A2 AND M291A2C

Section I SCOPE AND DESCRIPTION**460.1. Scope**

These sections provide the procedure for the replacement of mechanical and electrical components on the expansible van body. For other repair procedures of the expansible van body components, refer to TM 9-2320-211-20.

460.2. Description

For a description of the expansible vans M291A2 and M291A2C, refer to TM 9-2320-211-20, and changes thereto.

Section II REMOVAL, REPAIR AND INSTALLATION**460.3. Retractable Beam Drive Shaft and Sprockets**

Note. The key letters noted in parentheses refer to figure 574.1, except where otherwise indicated.

a, General. The procedure below covers the replacement of an individual retractable beam drive shaft. Use the same procedure to replace the other shaft.

b. Removal.

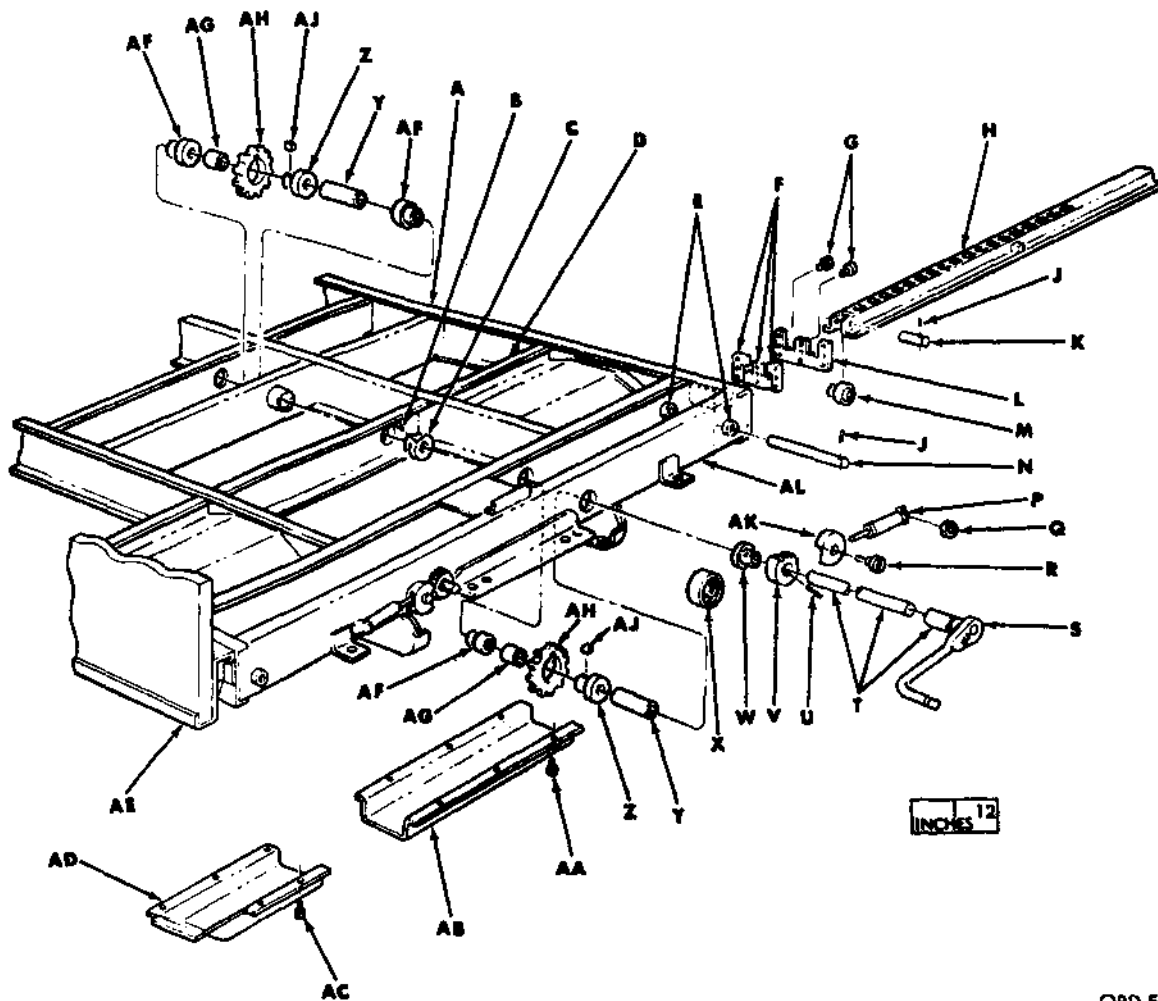
- (1) Remove six screws (AA) from each of the sprocket box covers (AB) and remove the covers.
- (2) Remove 30 rivets from each of the protective covers under the center of the expansible van body and remove the covers.
- (3) Make a careful note of the arrangement of the bushings (C, AF), sprockets (AH) and spacers (AG, Y) on the shaft (T). Notice that there are four bushings (C) with setscrews (B), located in the transverse frame members (D) midway between the operating mechanism boxes (AL), and nine bushings (AF) without setscrews, located in the sidewalls of the operating mechanism boxes (AL).
- (4) Using the retractable beam drive shaft wrench (S), rotate the shaft (T) until the

setscrews (B) in the bushings (C) are accessible for removal.

- (5) Loosen the setscrews (B) in each of the four bushings (C).
- (6) Examine the shaft for burs, nicks or corrosion which would hamper easy withdrawal. Remove or reduce the burs, nicks or corrosion with a file or emery cloth. Lubricate the entire shaft to facilitate withdrawal.
- (7) Attach a suitable pulling device to the drive shaft locking ratchet (V). Be careful not to damage the ratchet teeth.
- (8) Station one man under the van body to remove the components from the shaft as it is withdrawn from the body. Pull the shaft out slowly, releasing one component at a time from the front end of the shaft.

Caution: If the shaft is to be reused, do not bend or strain the shaft. It must be kept absolutely straight at all times.

- (9) Remove the pulling device from the ratchet.
- (10) Drive out the taper pin (U) securing the ratchet (V) and the ratchet hub bushing (W) to the shaft (T) and remove the ratchet and ratchet hub bushing.



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Figure 574.1. Expansible van body retractable beam operating mechanism—exploded view.

| Key | Item | Key | Item |
|-----|-------------------------------|-----|----------------------------|
| A | Underframe assembly | U | Ratchet locking pin |
| B | Setscrew | V | Ratchet |
| C | Bushing, setscrew type | W | Ratchet hub bushing |
| D | Transverse frame member | X | Beam support roller |
| E | Support roller shaft bushing | Y | Spacer, long |
| F | Seal assembly | Z | Sprocket hub |
| G | Screw | AA | Cover screw |
| H | Retractable beam | AB | Sprocket box cover |
| J | Cotter pin | AC | Cover screw |
| K | Beam end roller shaft | AD | Roller compartment cover |
| L | Seal retaining plate | AE | Van body movable side |
| M | Beam end roller | AF | Bushing, non-setscrew type |
| N | Support roller shaft | AG | Spacer, short |
| P | Lock assembly | AH | Sprocket |
| Q | Nut | AJ | Sprocket key |
| R | Screw | AK | Pawl |
| S | Retractable beam shaft wrench | AL | Operating mechanism box |
| T | Retractable beam shaft | | |

c. Installation.

Note. If the retractable beams (par. 460.5) or retractable beam rollers (pars. 460.4 and 460.6) are to be replaced, this should be done before the drive shaft and sprockets are installed.

- (1) Examine the entire length of the retractable beam drive shaft (T) for burs, nicks or other defects which would prevent easy insertion. Bevel the forward end of the shaft slightly with a fine-tooth file to permit easy insertion of the bushings (B, AF) and the sprocket and hub assemblies (AH, Z).
- (2) If the retractable beams (H) have been , replaced, make sure they are all in correct position to receive the sprocket teeth.
- (3) Raise the shaft into position, providing adequate support to prevent sagging or bending. Keep the shaft straight at all times.
- (4) Lubricate about two feet of the portion of the shaft being inserted.
- (5) Station a man under the van body to assemble a set of bushings (AF), sprocket and hub assembly (AH, Z), and spacers (AG, Y) and hold them in position in the operating mechanism box (AL). Use figure 574.1 and legend as a guide.
- (6) Push the shaft slowly through the van body frame (A) and the bushings, spacers and sprocket hub until the front end of the shaft protrudes beyond the front of the operating mechanism box.
- (7) Install a setscrew-type bushing (C) on the shaft, with the setscrew (B) facing downward to facilitate tightening. Do not tighten the setscrew at this time.
- (8) Repeat steps (4), (5), (6) and (7) until the end of the shaft is flush with the end of the final forward bushing.

Caution: As the components are added to the shaft, increased pushing resistance will be encountered. If the shaft comes to an abrupt stop, do not use excessive force. Investigate each component for nicks, burs, or misalignment. Make necessary corrections before proceeding with the installation of the shaft.

- (9) Install the ratchet (V) and hub (W) on the rear end of the shaft (T) so that all

the taper pin holes are aligned and the ratchet teeth face the pawl (AK) when the van body sides are fully retracted. Secure the ratchet to the shaft with a No. 6 taper pin (U).

Note. If a new shaft is being installed, it may be necessary to ream the taper pin hole in the shaft with a No. 6 taper pin reamer for a tight fit.

- (10) Adjust all four setscrew-type bushings (C) to allow 1/16- to 1/8-inch end play on the retractable beam drive shaft (T).
- (11) Lubricate all moving parts with GAA at assembly. Operate the mechanism several times to see that it is operating properly. Make readjustments where necessary.
- (12) Install all covers removed in b(1) above.

460.4. Retractable Beam Support Roller

a. *General.* The retractable beam support roller may be replaced without removing the retractable beam or the retractable beam drive shaft.

b. *Removal (Fig. 574.1).*

- (1) Remove seven screws (AC) from the roller compartment cover (AD) and remove the cover from the roller compartment.
- (2) Remove the cotter pin (J) from each end of the support roller shaft (N).
- (3) Raise retractable beam (H) slightly to relieve the weight on the support roller (X).
- (4) Slide the support roller shaft (N) from the support roller.

c. *Installation (Fig. 574.1)*

- (1) Lubricate the support roller shaft (N) with a thin layer of GAA grease.
- (2) Position the support roller (X) under the retractable beam (H), with hub aligned along the axis of the support roller shaft (N).
- (3) Raise the retractable beam (H) slightly to relieve the weight on the support roller (X).
- (4) Slide the support roller shaft (N) through the support roller hub (X) into the shaft bushings (E) on each side of the operating mechanism box (AL).
- (5) Install a new cotter pin (J) in the hole provided near each end of the roller shaft (N).

- (6) Install the cover (AD) on the roller compartment with seven screws (AC).

460.5. Retractable Beam

a. General. The expansible van body movable side is supported solely by the five retractable beams. Replace the retractable beams one at a time so that the side is supported by the remaining four retractable beams. All ten retractable beams are replaced by using the same procedure.

b. Removal.

- (1) Expand the van body movable side (fig. 574.2) to its extreme outward limit (refer to TM 9-2320-211-10 and changes thereto).
- (2) Remove the retractable beam drive shaft and sprockets (par. 460.3).
- (3) Support the van body movable side assembly with suitable hoisting equipment, slings and/or jacks.
- (4) Remove the retractable beam support roller (par. 460.4).
- (5) Remove nine screws (G, fig. 574.1) from the retaining plate (L) and remove the retaining plate (L) and seals (F) from the van body under frame (A).
- (6) Separate the end of the retractable beam from the lower frame of the van body movable side (fig. 574.2) with a welding torch.
- (7) Lower the outer end of the beam (H) sufficiently to clear the bottom of the movable side and withdraw it from the body underframe (A).

c. Installation.

Note. If the retractable beam end roller (par. 460.6) is to be replaced, this should be done before the retractable beam is installed.

- (1) Position the retractable beam (with end roller installed) in alinement with the entry slot at the lower edge of the van body underframe (fig. 574.2).
- (2) Insert the retractable beam about halfway into the underframe.
- (3) Weld the protruding end of the retractable beam to the frame of the van body side,
- (4) Install the seals (F, fig. 574.1) and retaining plate (L) to the retractable beam entry slot (fig. 574.2) with nine screws (G, fig. 574.1).

- (5) Install the retractable beam support roller (par. 460.4).
- (6) Remove the supporting equipment (*b*(3) above) from the van body movable side.
- (7) Install the retractable beam drive shaft and sprockets (par. 460.3).
- (8) Operate the retracting mechanism several times to see that all parts are alined properly. Make adjustments where necessary.

460.6. Retractable Beam End Roller

Note. The key letters noted in parentheses refer to figure 574.1, except where otherwise indicated,

a. General. The retractable beam end roller (M), can be replaced only when the retractable beam has been removed from the van body underframe assembly. When a replacement of the retractable beam is made, inspect the end roller carefully and replace roller (M) and shaft (K) if excessive wear is noted.

b. Removal.

- (1) Remove the retractable beam (par. 460.5).
- (2) Remove the cotter pin (J) from each end of the roller shaft (K).
- (3) Slide the end roller shaft (K) from the end roller (M) and remove the roller and shaft.

c. Installation.

- (1) Lubricate the end roller shaft (K) with a thin layer of GAA grease.
- (2) Position the end roller (M) between the split end of the retractable beam (H) with the roller hub alined with the roller shaft holes.
- (3) Slide the end roller shaft (K) through the shaft holes in the retractable beam and the end roller (M).
- (4) Install a new cotter pin (J) in the hole provided near each end of the end roller shaft.
- (5) Install the retractable beam (par. 460.5).

460.7. Electrical Wiring Harness, 24-Volt

a. General. The 24-volt wiring circuits include only the wiring for the exterior blackout and clearance lights. The 24-volt wiring harness is routed as shown in figure 574.3.

b. Removal.

- (1) Remove the clearance and blackout lights. Refer to TM 9-2320-211-20, and changes thereto.

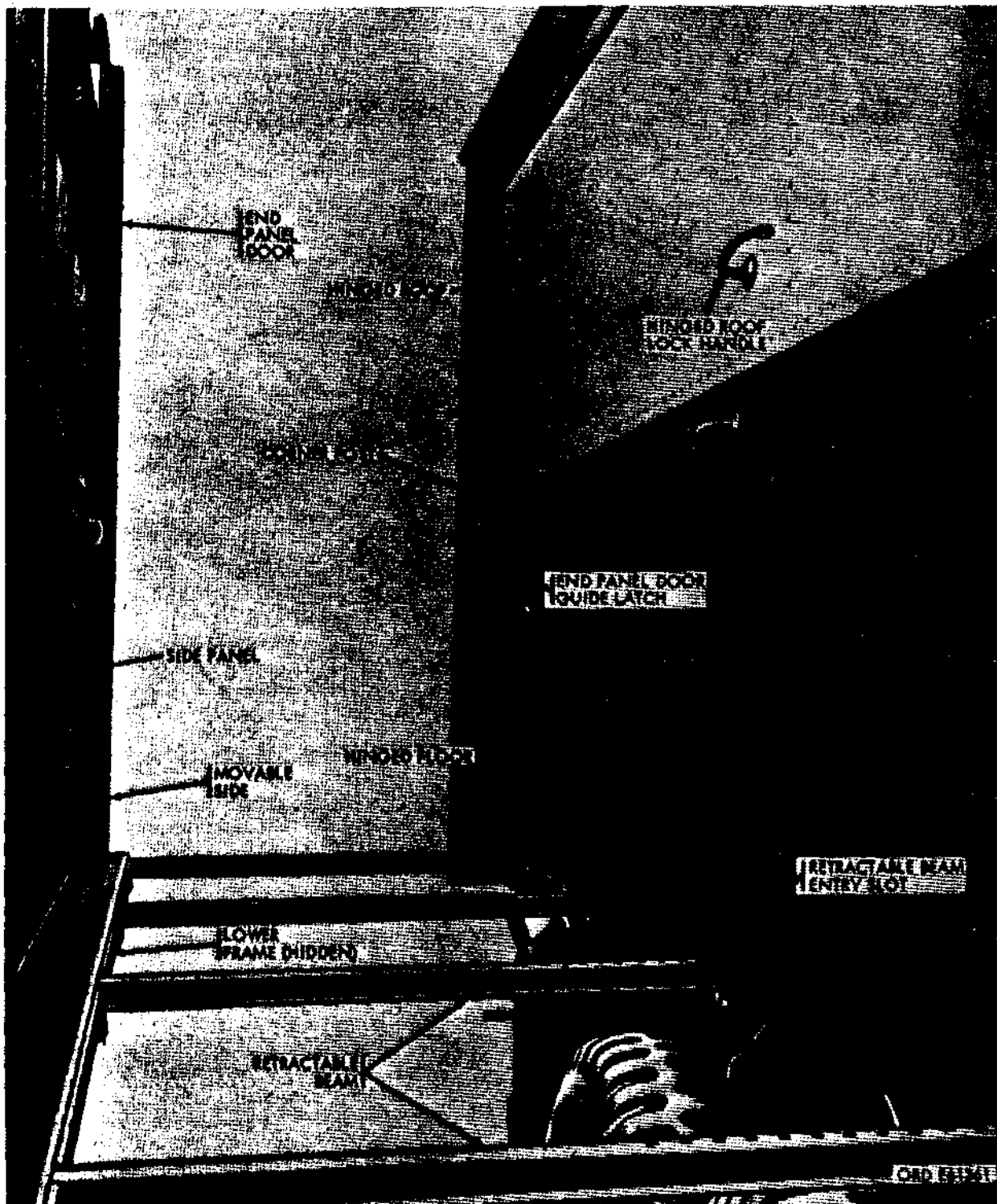
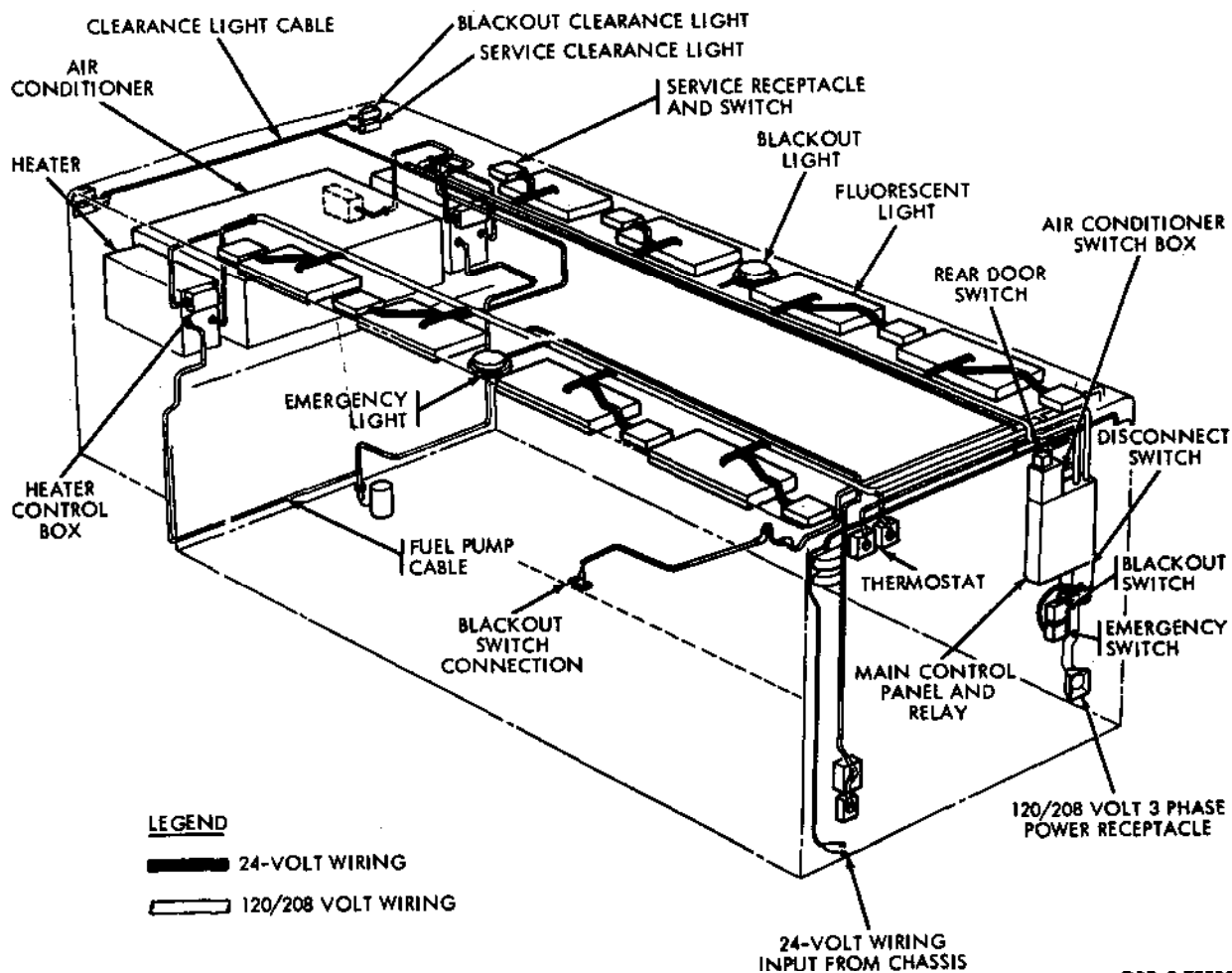


Figure 574.2. Expansible van body retractable beams and movable side.

- (2) Disconnect the harness connector at each blackout and clearance light.
- (3) Remove portions of the interior wall or roof where necessary to gain access to the wiring harness.
- (4) If the harness is to be re-used, pull the harness out carefully. Tie a stout cord to

each end to provide a means of pulling in the replacement harness.

- (5) If the harness is being discarded and a new harness is being installed, cut the old harness at strategic points so that it may be used as pull-wires for the installation of the new harness.



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Figure 574.3. Expansible van body wiring harness routing.

c. Installation.

- (1) Using figure 574.3 as a guide, place the harness in the approximate position for installation.
- (2) Using the cords installed in b(4) above, or portions of the old harness prepared in b(5) above, pull the new harness into place.

Caution: Be very careful not to cut or serape the insulation on the new harness.

- (3) Connect the harness connectors to the clearance and blackout lights.
- (4) Install the clearance and blackout lights on the body. Refer to TM 9-2320-211-20, and changes thereto.
- (5) Refer to TM 9-2320-211-20, and changes

thereto, for the test procedure to determine if the lights are operating properly,

460.8. Electrical Wiring Harness, 110/208-Volt

a. *General.* The 110/208-volt wiring system is distributed through the van body by means of three main wiring harnesses. These consist of the left-hand 110-volt wiring harness, the right-hand 110-volt wiring harness, and the blackout circuit wiring harness. Figure 574.3 shows the routing of the main branches of the three wiring harnesses.

b. Removal.

- (1) Refer to TM 9-2320-211-20, and changes thereto, for a troubleshooting procedure to determine which portion of the wiring is defective.

Caution: After troubleshooting has been completed, disconnect all sources of electrical power to the van body before proceeding further.

- (2) Remove portions of the interior wall or roof to gain access to the wiring harness.
- (3) Disconnect all equipment attached to the harness. Observe whether circuit number tabs are still attached. Replace missing tabs or tag the unmarked wires for future identification.
- (4) Remove all clamps and holding hardware, and remove the harness from the wiring channels.

c. *Repair.* Refer to TB ORD 650 for a repair procedure for wiring harnesses,

d. Installation,

- (1) Using Figure 574.3 as a guide, place the harness in the approximate position for installation.
- (2) Feed the harness into the ducts or wiring channels so that it is well protected and all wires will reach the terminals to which they will be connected. Install all clamps and holding hardware removed in b(4) above.

Caution: Be very careful not to cut, pinch, or scrape the insulation on the new harness.

- (3) Connect the harness wires to the terminals of the van body auxiliary equipment. Be sure to match the circuit number tabs on

each wire to the numbers on the equipment terminals. Tighten all connections securely.

- (4) Make sufficient tests to determine that all electrical equipment is operating properly.
- (5) Install the portions of the interior wall or roof removed in b(2) above.

460.9. Electrical Control Switch Boxes (Fig. 574.4)

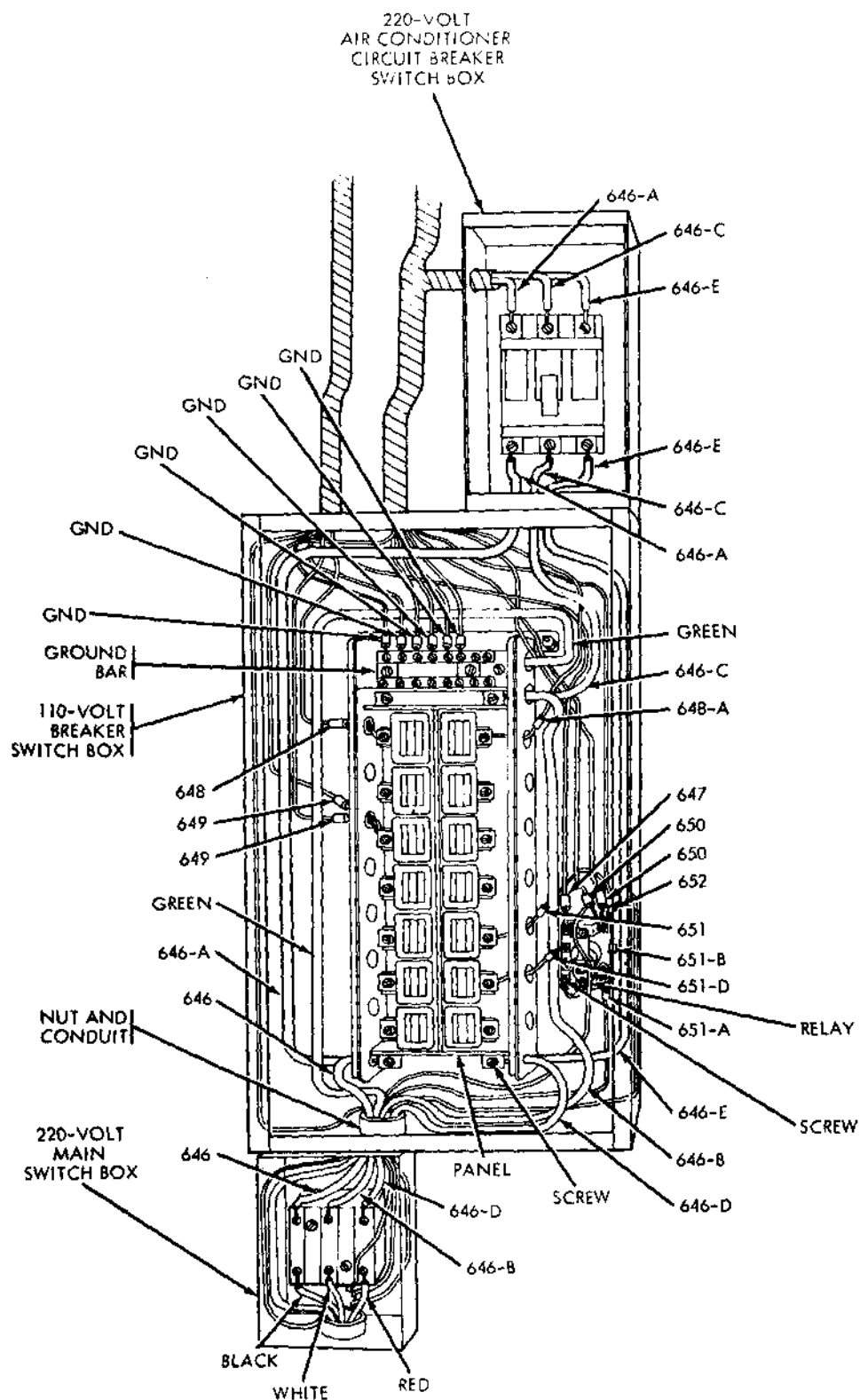
a. *General.* Three control switch boxes are mounted on the rear wall of the van body adjacent to the right rear door. Refer to TM 9-2320-211-20, and changes thereto, for a complete description of these units.

Warning: Disconnect all external power supply cables before removal of any electrical components.

b. Removal.

Note. The three control switch boxes are interlocked by means of pipe nipples and wiring. Removal must be accomplished in the sequence shown in (1) through (11) below.

- (1) Disconnect all sources of electrical power to the van body.
- (2) Remove four screws securing the cover of the air conditioner circuit breaker box, and remove the cover (fig. 574.5).
- (3) Remove two screws and open the large door of the 110-volt circuit breaker box.
- (4) Open the door of the main power switch.
- (5) Remove the door blackout switch bracket (fig. 574.4) from the air conditioner circuit breaker box.
- (6) Disconnect and remove the wires and cables from the air conditioner circuit breaker box.
- (7) Remove the four screws securing the air conditioner circuit breaker box to the wall, and the locknut and pipe nipple between the air conditioner circuit breaker box and the 110-volt circuit breaker box. Remove the air conditioner circuit breaker box.
- (8) Disconnect and remove the wires and cables from the 120-volt circuit breaker box. Observe whether circuit number tabs are still attached. Replace missing tabs or tag the wires for future identification.
- (9) Remove the four screws securing the 110-volt circuit breaker box to the wall, and the locknut and pipe nipple between the



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Figure 574.4. Expansible van body electrical control and switch boxes—removal and installation.

110-volt circuit breaker box and the main switch box. Remove the 110-volt circuit breaker box.

- (10) Disconnect and remove the wires and cables from the main switch box.
- (11) Remove the four screws securing the main power switch box to the wall, and the locknut securing the box to the entrance conduit. Remove the main power switch box.

c. *Installation.* Install the main power switch box, the 110-volt circuit breaker box and the air conditioner circuit breaker box in the reverse order of removal. Make sure all connections are tight and bare wire ends do not touch any metallic parts of the boxes.

460.10. Power Entrance Receptacle

a. Removal.

- (1) Disconnect all external power sources to the van body.
- (2) Disconnect the three entrance wires (black, white, and red) in the main power switch box (fig. 574.5). Disconnect the green entrance wire in the 120-volt circuit breaker box.
- (3) Remove four bolts, nuts and lockwashers securing the power entrance receptacle to the rear wall of the van body (fig. 574.5).
- (4) Unscrew the locking nut securing the power entrance conduit to the power entrance receptacle.
- (5) Remove the van interior and van exterior components of the power entrance receptacle, pulling the power entrance cable out of the power entrance conduit.

b. *Installation.* Install the power entrance receptacle in the reverse order of removal. Make sure all connections are tight, and bare wire ends do not touch any metallic parts of the boxes or receptacle.

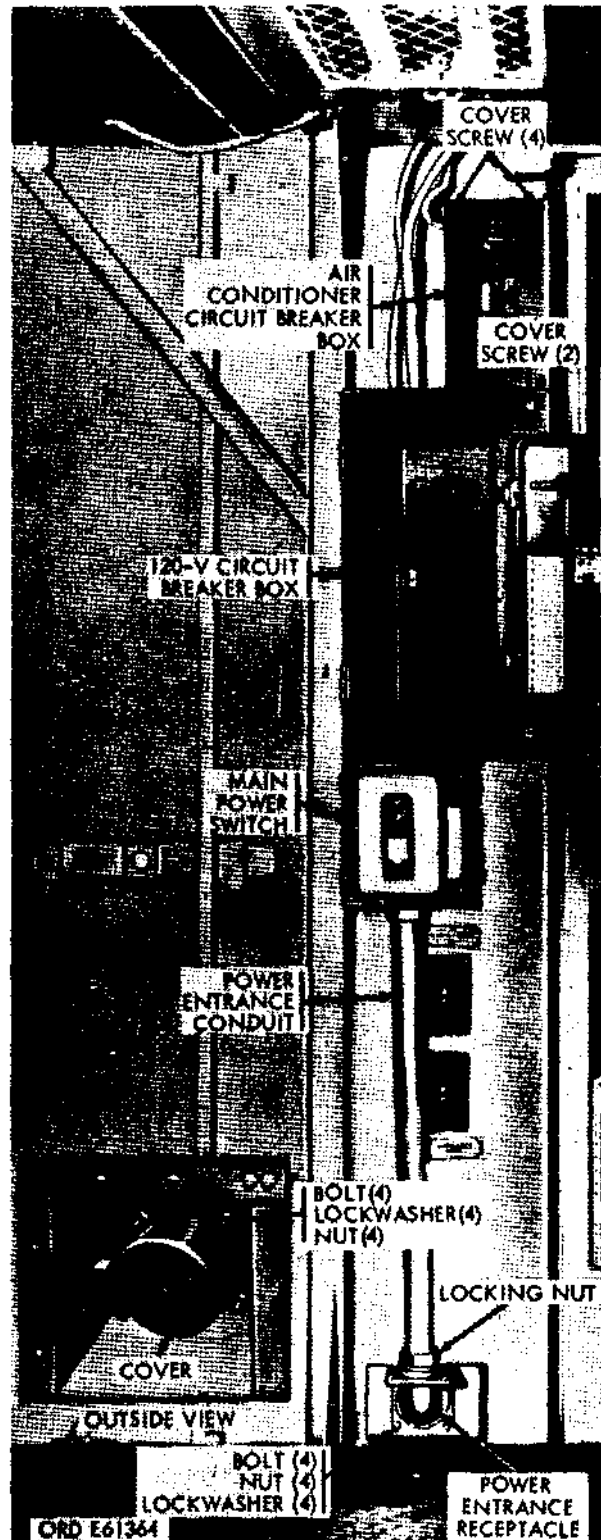


Figure 574.5 110/208-volt power entrance receptacle, control and switch boxes.

CHAPTER 26

SPECIAL PURPOSE EQUIPMENT (KITS)

Section I. INTRODUCTION

461. Scope

This chapter contains field and depot maintenance instructions for deep-water fording and winterization equipment including necessary kits designed for use on the 5-ton 6 x 6 vehicles covered by this manual. No instructions for modifying the vehicle are included herein. Refer to the pertinent modification work order for prior preparation of the vehicle before attempting any installation. This chapter also contains a description of the major units of each kit and their function in relation to other components of the vehicle. Further, the major components of each kit are listed herein.

Note. These listings are not to be used for requisitioning proposes. Refer to TM 9-2320-211-35P for initial requisitioning of kits or repair parts in support of kit-equipped vehicles.

462. Authorization

a. Installation of kits is authorized under criteria defined in SB 9-16 for winterization kits, and SB 9-155 for the deep-water fording kit.

b. Records of unit replacement of components of this equipment should be kept separate from those pertaining to the basic vehicle, and

turned in with the equipment when removed for inspection, repair, or returned to stock.

co Disposal and requisitioning of parts removed from vehicle and/or not used from kit are to be in accordance with AR 755-5.

463. Service Upon Receipt of Material

a. Inspection and Cleaning.

- (1) When a new or reconditioned kit is received, determine if it has been properly prepared for service and that all necessary parts are present. Inspect all assemblies, subassemblies, and parts for proper assembly and condition. If any exterior surfaces are coated with rust-preventive compound, remove the compound with dry cleaning solvent or mineral spirits paint thinner.
- (2) Ordinary deficiencies disclosed during preliminary inspection, servicing, or during installation will be corrected by maintenance personnel performing the installation.

b. Correction of Deficiencies. Serious deficiencies detected in the equipment, which occur under the circumstances indicated in AR-700-38, should immediately be reported in accordance with TM 38-750.

Section II. PERSONNEL (GASOLINE) HEATER KIT

464. Description and Data

a. Description

- (1) General. The 978 series personnel heater kits are supplied for use in areas where the normal temperatures during the coldest period of the year is 5°F. and lower. In addition to the heater, heat controls, and accessories covered in this section, these kits also contain all mounting parts, ducts, fuel lines, and other equipment required for in-

dividual installations. Personnel heaters provide uncontaminated, heated air and are used primarily to supply heat to the crew compartment, engine oil pan, battery box, and to the windshield defrosters.

(2) Gasoline burning heater (fig. 575).

- (a) The Model 978 heater has a rated heat output of 20,000 BTU per hour and is of the fuel metering type.

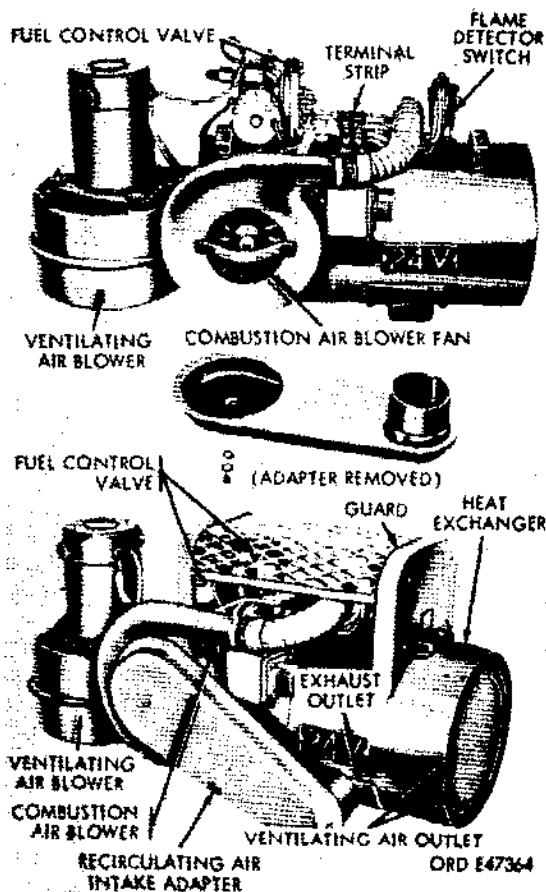


Figure 575. Personnel heater model

978 MR-24

- (b) For operation, the heater requires fuel under pressure of 1 to 15 pounds per square inch, electric current for ignition, and a flow of combustion and ventilating air.
- (c) The heater is of sealed, all welded, stainless steel construction. The combustion air, ventilating air, and exhaust passages are completely separated so that products of combustion cannot enter the ventilating air stream. The necessary connections for fuel and electric current are outside the heater housing.
- (d) Principal components of the heater are: The heat exchanger, heater housing, flame detector switch, fuel control valve, standpipe and vaporizer pad, fuel preheater, igniter, overheat

switch, combustion air blower assembly, ventilating air blower assembly, terminal strip, and recirculating combustion air inlet adapter.

(3) Heat exchanger (fig. 576).

(a) The heat exchanger is made of stainless steel and consists of a cylinder-shaped central chamber and an outer chamber which encases the central chamber. The two chambers are connected at the top by a slot that extends the full length of the exchanger, and at the bottom by a small opening which serves as a drain tube in the event any gasoline should accumulate in the exchanger.

(b) One end of the exchanger contains the igniter pocket which has openings for the igniter and fuel standpipe. Two tubes extend from the exchanger and provide passage for the combustion air at the top and exhaust gases at the

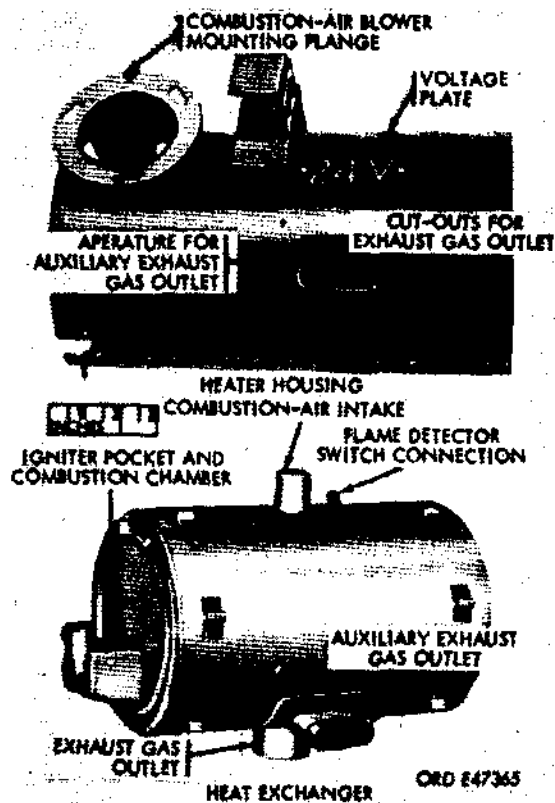


Figure 576. Heater housing and heat exchanger

bottom. The exhaust tube is connected to the outer chamber while the combustion air tube extends into the portion of the central chamber, known as the combustion chamber.

- (c) The combustion chamber is located inside the central chamber near the igniter pocket. It consists of a stainless steel cone with a semicircular baffle welded inside.
 - (d) A steel baffle, between the combustion chamber and the rod of the flame detector switch prevents the direct flame from striking the flame detector rod to prolong service life.
 - (e) The heat exchanger of the Model 978-MR heaters has an auxiliary exhaust outlet at right angles to the regular outlet on the bottom of the heat exchanger. This is an oval tube which is welded into the side of the heat exchanger, for use with the recirculating combustion air intake adapter (see fig. 575).
- (4) Heater housing (fig. 576). The one-piece heater housing fits around the heat exchanger. A formed edge extends the full length of the housing at the center-line of the exhaust tube, to simplify removal and replacement.

(5) Igniter (fig. 577).

- (a) The igniter which screws into the igniter well, is a resistance coil of

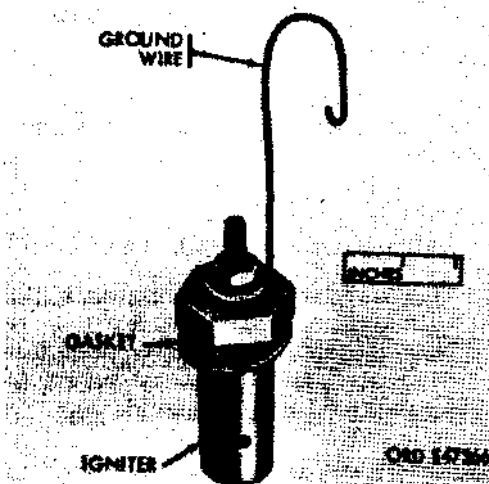


Figure 577. Igniter

the "glow plug" type that heats red hot when current is passed through it.

- (b) The igniter is a 6 volts DC unit. On 12- and 24-volt heaters, a series dropping resistor is used to reduce the voltage to the proper value. In this way, the igniter is interchangeable on all models.
- (6) Flame detector switch (fig. 578).
- (a) The flame detector switch consists of a quartz rod encased in a metal tube with a mounting bracket, which supports a microswitch and adjusting spring.
 - (b) The quartz rod and tube extend into the central chamber of the heat exchanger where they are subjected to the heat of the flame. The heat causes the tube to expand and allows the quartz rod, which does not expand, to move downward and release the pressure on the microswitch button.
- (7) Overheat switch (fig. 578). The overheat switch will automatically close the shutoff solenoid of the fuel control valve

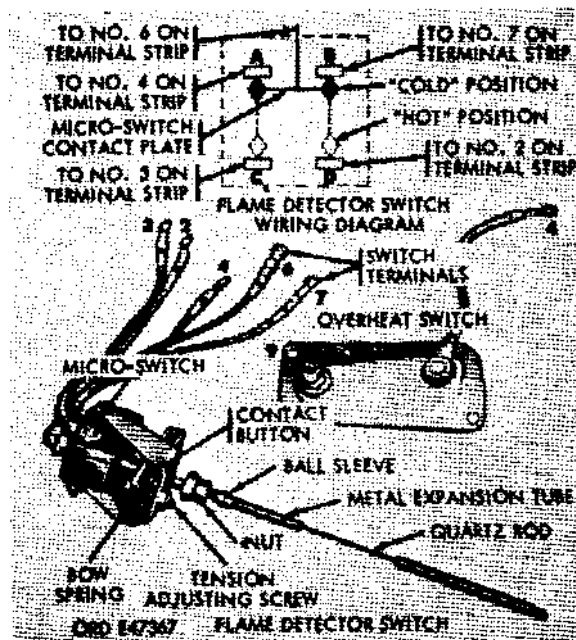


Figure 578. Flame detector switch and overheat switch

and stop the fuel flow in the event the heater becomes overheated. It consists of a fixed contact point and a M-metal blade which is mounted directly in the ventilating air stream.

- (8) Fuel control valve (fig. 579). The fuel control valve consists of a valve body, pressure regulator, two solenoid-operated valves and an orifice or metering plate. purpose is to control and meter the quantity of fuel flowing into the heat exchanger. (Refer to TM 9-8662.)
- (9) Standpipe and vaporizer wick (fig. 580). The fuel valve standpipe connects the fuel valve (fig. 575) to the igniter pocket in the heat exchanger (fig. 575). The vaporizer wick is a stainless steel wire mesh pad and is partially threaded into the heat exchanger end of the standpipe. When the standpipe is screwed into the igniter pocket, the pad extends inside where it is saturated by the fuel flowing from the valve to the exchanger.

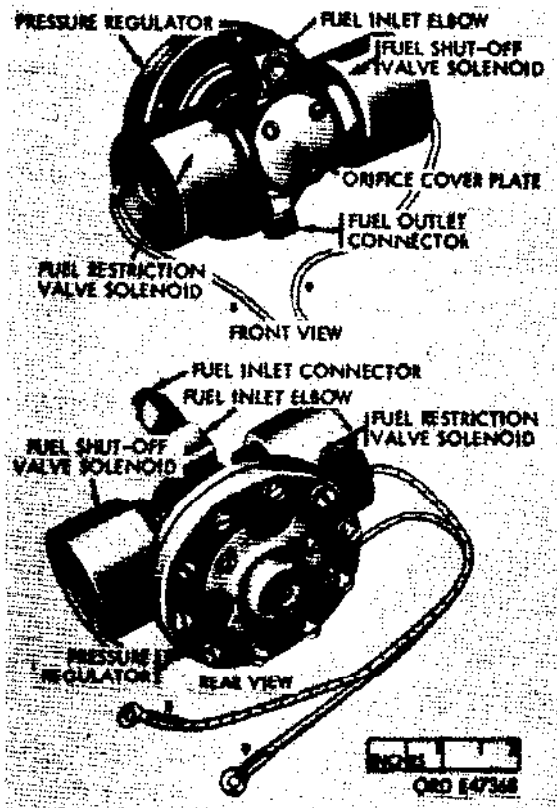


Figure 579. Fuel control valve

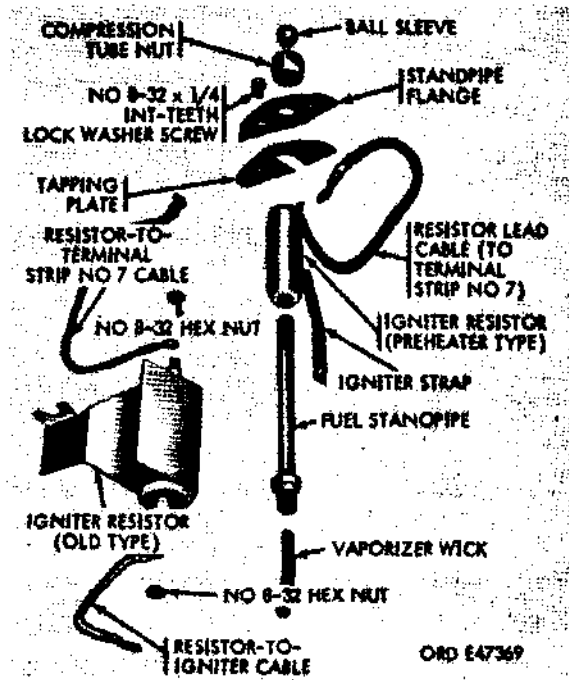


Figure 580. Standpipe and vaporizer wick

- (10) Combustion air blower assembly (fig. 581). The combustion air blower assembly consists of a motor, blower wheel and housing. It is designed to supply the proper amount of air to maintain the correct fuel-air ratio. The blower assembly can be removed from the heater housing in one piece due to the type of mounting provided. An adapter is used to effect recirculation of exhaust gases (fig. 575).
- (11) Ventilating air blower assembly. The ventilating air blower assembly (fig. 581) which consists of a heavy-duty, ball bearing, 1/40 H.P. motor, "squirrel cage"-type blower and housing, is mounted on the upstream end of the heater by means of four studs on the heater housing. This blower assembly provides a ventilating air flow of approximately 6 pounds per minute. The blower is suppressed to prevent interference with radio equipment.
- (12) Terminal strip (fig. 582). A terminal strip consisting of six terminals, is provided on top of the heater housing to facilitate disassembly.

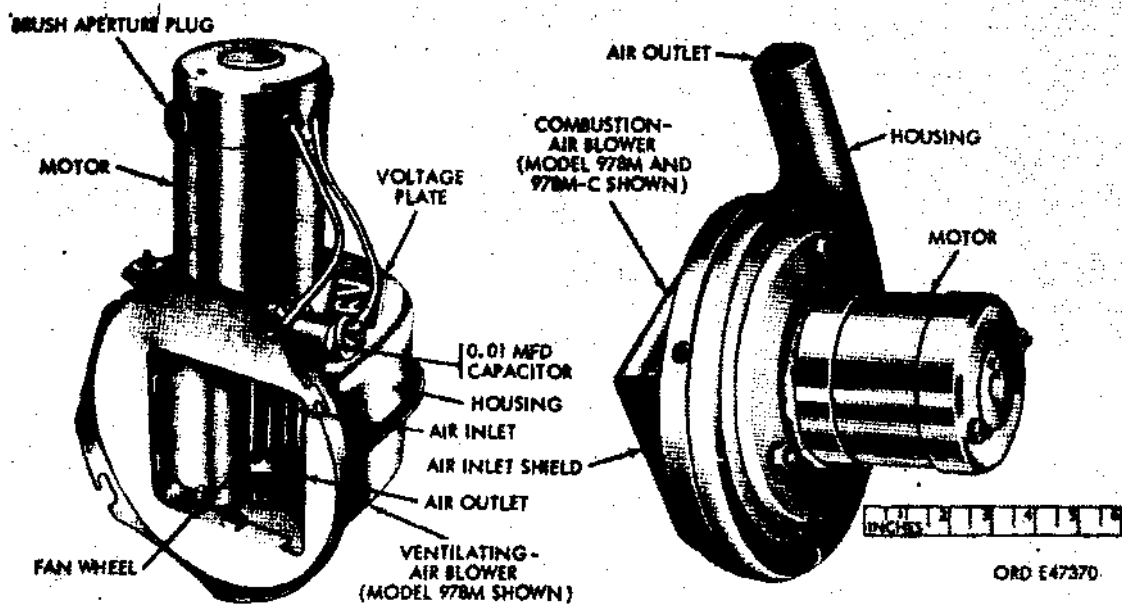


Figure 581. Ventilating-air and combustion-air blowers

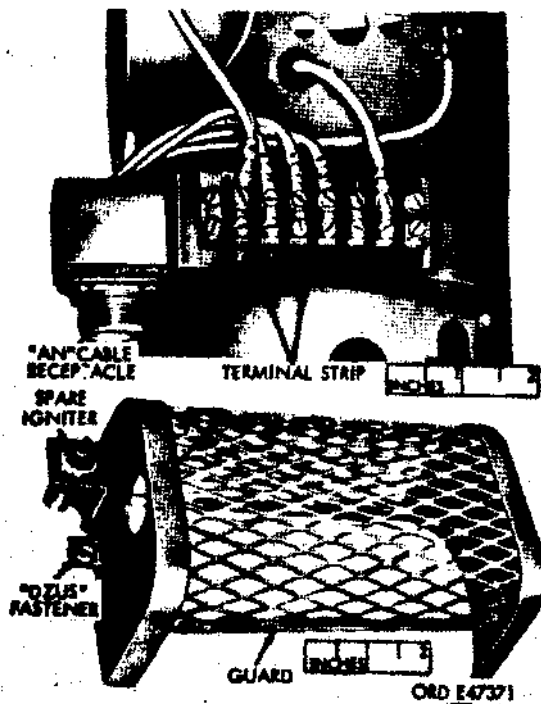


Figure 582. Terminal strip and guard

(13) Protective cover guard. A heavy mesh protective cover guard (fig. 582) is secured to the top heater heater housing by means of two Dzus fasteners. This cover protects the heater components located on the top of the housing. The heater wiring diagram is mounted inside the cover.

(14) Control box (fig. 583).

(a) The control box contains a heater switch, HI-LO switch, and a circuit breaker to protect the heater assembly. On installations which contain a safety valve, a safety prime switch is used in addition to the other switches. The HI-LO switch is omitted if a thermostat is used to regulate temperature. If an electric fuel pump is used, the prime switch also starts the fuel pump when placed in the prime position.

(b) This box is designed so that the electrical receptacle can be mounted on the back or on the bottom of the box by relocating the mounting screws and grommet without unsoldering wires.

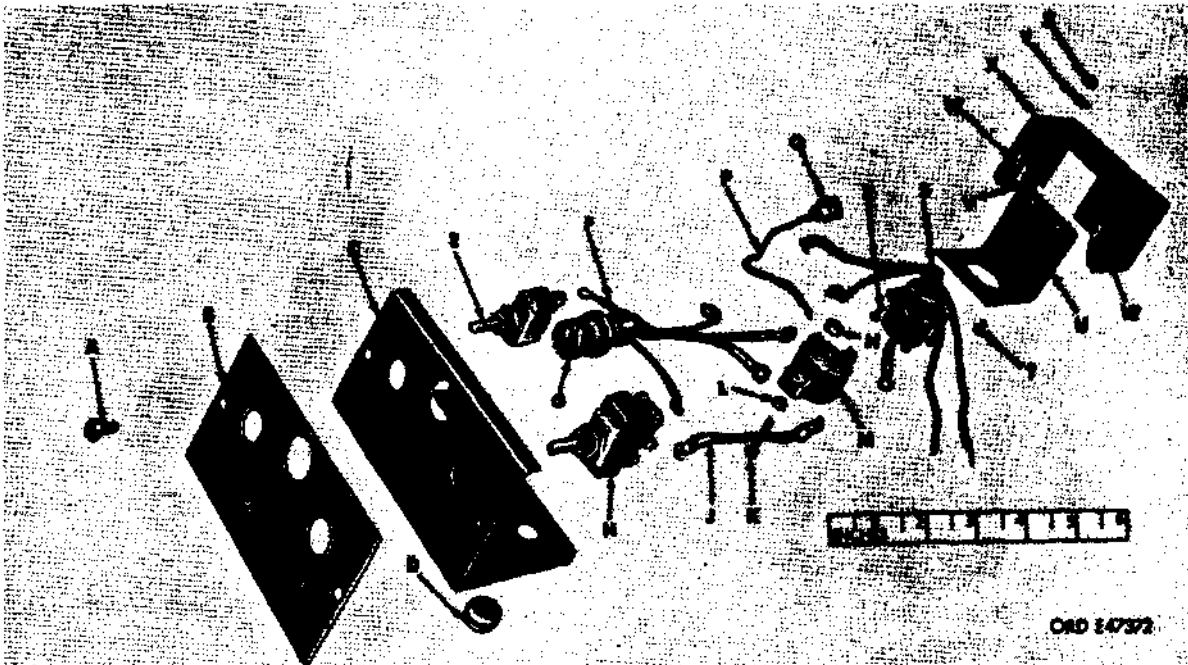


Figure 583. Heater control box-exploded view

(15) Safety Valve. The safety Valve (fig. 584) consists of a shutoff solenoid and a casting, which houses a large diaphragm and spring. The safety valve provides just the initial flow of fuel for ignition. Additional fuel to sustain combustion is received only after the shut-off solenoid of the safety valve is energized when the ventilating air blower comes on.

Note. Latest type control box (fig. 582) with press-to-test indicator light does not have safety valve reset switch because the safety valve has been eliminated.

b. Data.

Weight approx 23 lb
 Dimensions:
 Width approx 8-1/4 in.
 Length approx 18-1/2 in.
 Height approx 9-3/4 in.
 Electrical supply 24 V DC
 Current consumption:
 Starting load 11 amp
 Operating 2.5 amp
 Fuel . . . any automotive or aviation gasoline
 Fuel pressure. 1 to 15 lb-sq in.
 Fuel consumption:
 High heat 1 gal/4 hr

LoWheat 1 gal/8hr
 Heat output:
 High heat 20,000 BTU/hr
 LoWheat 10,000 BTU/hr

465. General Installation Instructions

a. Complete illustrated installation instructions are packed in each kit. Use the instructions

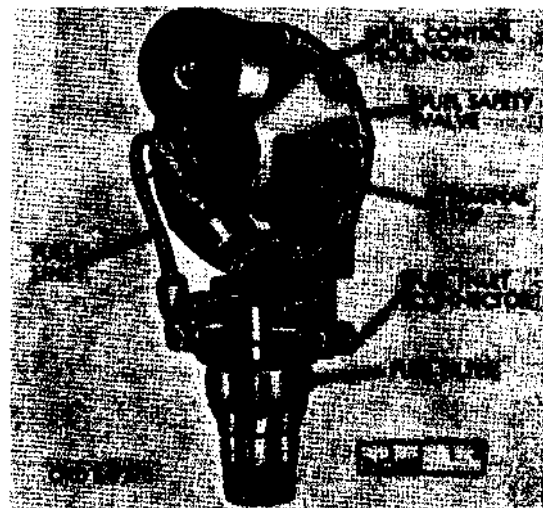


Figure 584. Fuel safety valve and fuel filter

tion booklet as a reference when making a specific installation, since there may be variations due to engineering changes. Differences in individual kits may occur, even though the kits bear the same Ordnance numbers and were designed for the same vehicle.

b. If it is anticipated that the winterization equipment will subsequently be removed from the vehicle at the same station where installed,

store the empty boxes and cartons for use in future shipments or storage. In repacking, all fuel apertures in tubes and accessories should be plugged to prevent entrance of foreign matter.

466. Installation of Heater Kit Components (Fig. 585)

a. Install Heater Fuel Line (Fig. 586). Connect the heater fuel line to the fuel pump outlet

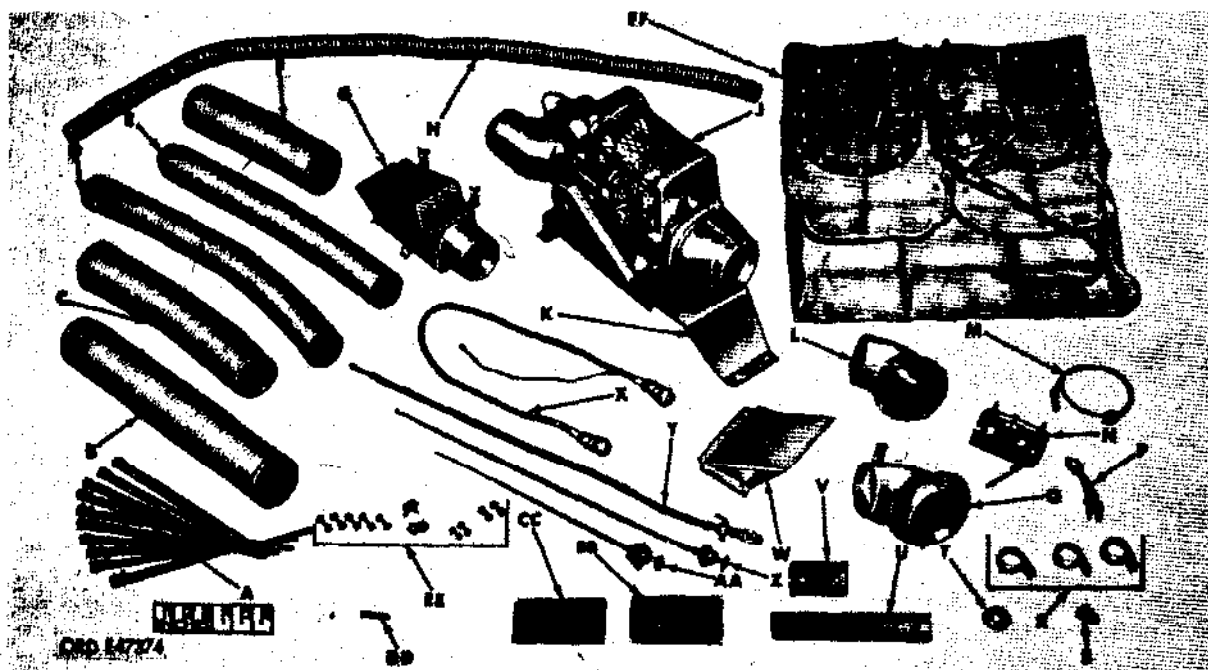


Figure 585. Personnel heater kit components

| Key | Item | Key | Item |
|-----|---|-----|---|
| A | Heat duct clamps | S | 3/8-inch tube x 3/8-inch male pipe end |
| B | 22-1/2-inch heat duct | T | Wiring harness grommet |
| C | 19-1/2-inch heat duct | U | Fender brace |
| D | 29-inch defroster duct | V | Control cable mounting bracket |
| E | 26-inch defroster duct | W | Air inlet hood |
| F | 14-inch heat duct | X | Heater wiring harness |
| G | Heat diverter with four 1/4-20 x 3/4 screws, lockwashers and nuts | Y | Heater main fuel line with shutoff cock, bushing, and tee |
| H | 70-inch heater exhaust tube | Z | Diverter heat control cable |
| J | Personnel heater | AA | Adapter heat control cable |
| K | Heater mounting plate | BB | Heater operating instructions plate |
| L | 90-degree elbow adapter | CC | Heater wiring diagram plate |
| M | Control box cable | DD | Cotter pin |
| N | Heater control box | EE | Attaching hardware |
| P | Y-connector | FF | Brush guard cover |
| Q | Heat duct adapter | | |
| R | Exhaust tube clamps | | |

Figure 585. Personnel heater kit components - legend

by performing the procedure given in paragraphs (1) to (4) below.

Note. If heat is required without operating vehicle engine, an electric fuel pump must be installed. For instructions see paragraph 477.

- (1) Disconnect the engine fuel line at the outlet of the fuel pump (fig. 586). Remove the tee from the heater main fuel line (fig. 585) and install it in the outlet of the fuel pump, turning the side outlet up, as shown in figure 586.
- (2) Install the inverted flared tube connector (fig. 586) in the side of the tee and connect the engine fuel line to the connector.
- (3) Remove the bushing and shutoff cock from the heater main fuel line (Y, fig. 585) and install in the tee (fig. 586).
- (4) Attach threaded end of the heater main fuel line (fig. 585) to the shutoff cock (fig. 586) leaving the other end free.

b. Install Heater Mounting Plate and Exhaust Tube.

- (1) Lower the hood left-side panel. Using the dimensions shown in figure 587, locate and drill a 5/16-inch hole near the hinge. Install the heater mounting plate

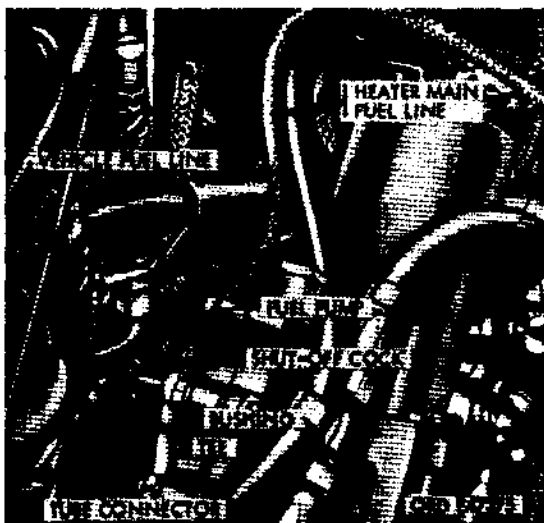


Figure 586. Heater main fuel line connected to fuel pump outlet

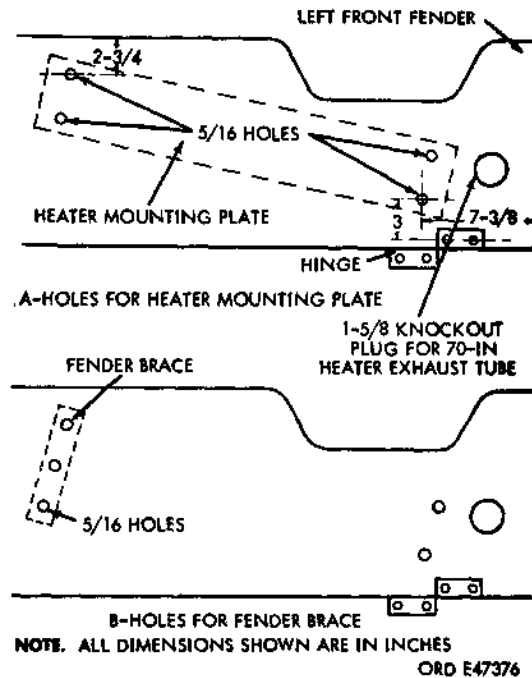


Figure 587. Holes in fender for heater mounting plate and fender brace

with a screw through this hole, within-clined surface on plate toward rear of vehicle; then pivot the forward end of the plate to bring the inside mounting screw hole of the plate 2-3/4-inches from the edge of the fender, as shown in A, figure 588. With the mounting plate in this position, mark the three remaining holes and remove the plate.

- (2) Use the fender brace (U, fig. 585) as a template and locate the fourth hole in the front fender, as shown in B, figure 587. Drill the four holes with a 5/16-inch drill.
- (3) Remove the 1-5/8-inch knockout plug for 70-inch heater exhaust tube (A, fig. 587).
- (4) Secure the 70-inch heater exhaust tube elbow (H, fig. 585) on the bottom of the heater mounting plate with a new cotter pin (DD, fig. 585), as shown in figure 588. Pass the end of the exhaust tube through the 1-5/8-inch hole in the left front fender and attach the fender brace and heater mounting plate to the fender

with five 1/4-20 x 1 external-teeth lockwasher, and hex-head screws and nuts (fig. 588). Place the fender brace underneath the fender, at the left end of the mounting plate.

- (5) Run the heater exhaust tube down and around the inside edge of the fender and over the running board hanger. Drill two 5/32-inch holes at the approximate locations shown in figure 588 and secure the exhaust tube at these two points with two exhaust tube clamps (R, fig. 585) and 1/4-20 x 5/8-external-teeth lockwasher screws. Secure the third exhaust tube clamp at the right corner of the heater mounting plate, using the existing 1/4-20 x 1-external-teeth lockwasher screw and nut (fig. 588).

c. Install 90-Degree Elbow Adapter. Remove the four lockwasher screws and nuts from the 90-degree elbow adapter (L, fig. 585).

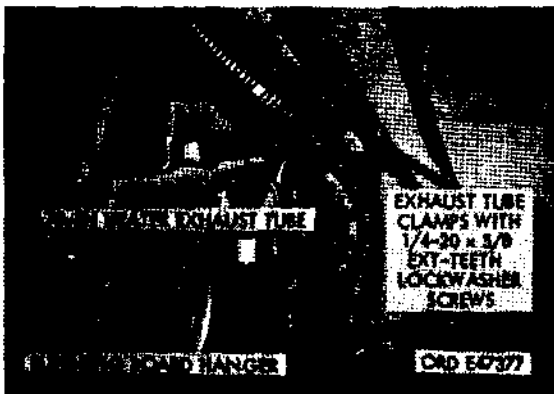
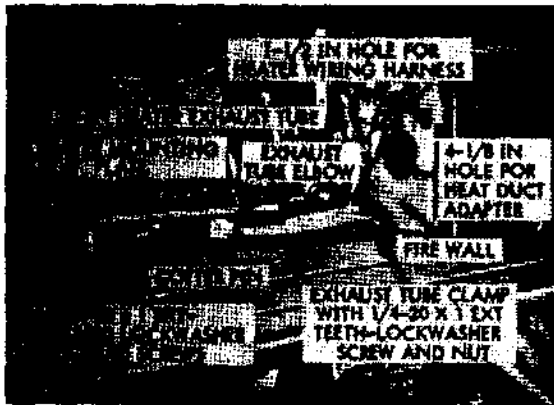


Figure 588. Heater mounting plate and heater exhaust tube installed

Remove the knockout plug from the hood left-side panel, position the adapter on inside of panel, over the 4-1/8-inch hole, with elbow straight back toward the heater, and locate the four holes. Drill the holes with a No. 7 drill. Secure the elbow adapter with the air screen, to the hood left-side panel with the four external-teeth lockwasher, screws and nuts (fig. 589).

d. Install Air Inlet Hood (Fig. 589). Position the air inlet hood (W, fig. 585) on Outside of hood left-side panel, over the 4-1/8-inch hole, so that the inlet faces forward and locate three holes. Drill the three 5/16-inch holes and secure inlet hood to panel with three 1/4-20 x 5/8 external-teeth lockwasher, screws and nuts.

e. Install Heat Duct Adapter (Q, Fig. 585).

- (1) Remove the 4-1/8-inch knockout plug from the left side of the firewall (fig. 588).
- (2) Remove the two external-teeth lockwasher screws and nuts from the heat duct adapter (Q, fig. 585) and fit the crimped end through the 4-1/8-inch hole, from the inside of the cab, as shown in figure 589. Turn the adapter so that it faces to the right and about 300 upward in the cab, as shown in figure 590. Use the elbow to locate and drill two 0.177 holes (No. 16 drill) and secure the elbow to the firewall with the two No. 8-32 x 1-1/2 external-teeth lockwashers, screws and nuts (fig. 590).

f. Install Personnel Heater and Ducts (Fig. 591).

- (1) Place the personnel heater (J, fig. 585) on the heater mounting plate, position the heater spacer and heater holddown clamp, and secure with the two clamp bolts; install heater retaining clamp (fig. 589).
- (2) Connect the heater-to-filter fuel line from the outlet of the heater fuel filter.
- (3) Attach the 22-1/2-inch heat duct (B, fig. 585) to the 90-degree elbow adapter and the air inlet adapter with a heat duct clamp (A, fig. 585) at each end, as shown in figure 591.

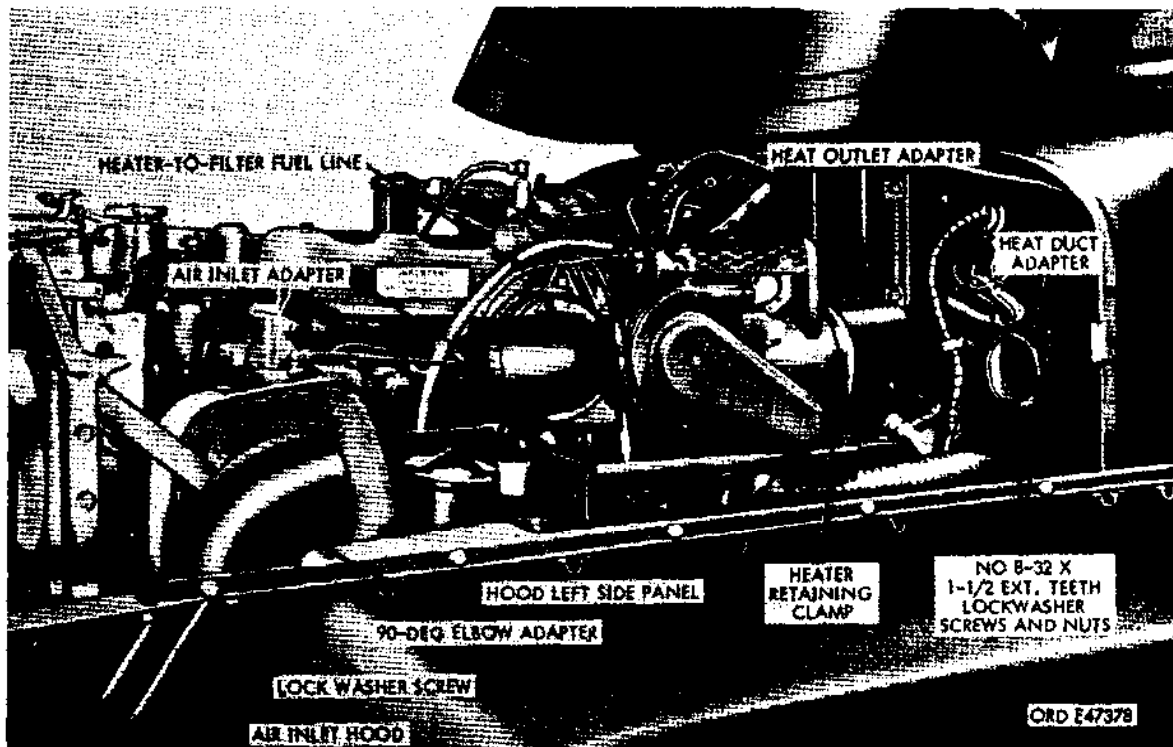


Figure 589. Air inlet hood, elbow adapter, personnel heater and air adapter installed

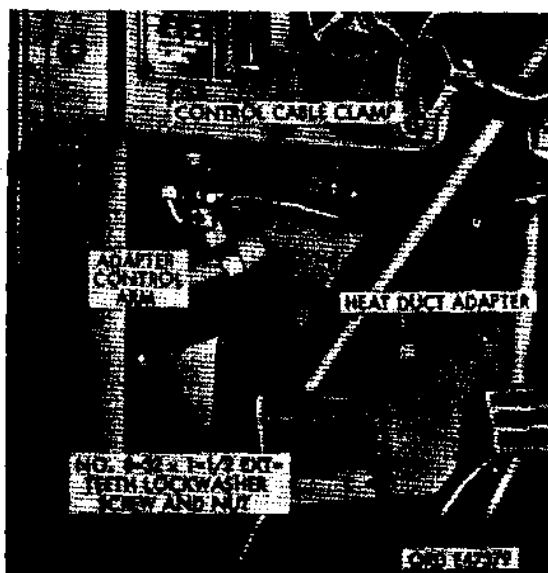


Figure 590. Heat duct adapter installed

- (4) Attach the free end of the heater main fuel line (MN, fig. 585) to the inlet of the heater fuel filter (WW, fig. 585).
- (5) Attach the 14-inch heat duct (F, fig. 585) to the heat outlet adapter and to the inlet of the heat duct adapter with a heat duct clamp at each end, as shown in figure 591.

g. Install Heat Diverter (G, Fig. 585).

- (1) Using the dimensions shown in figure 592, drill four 9/32-inch holes in the firewall.

Caution: Be extremely careful when drilling, to avoid damage to cables or other components attached to the engine side of the firewall.

- (2) Secure the heat diverter (Q, fig. 593) to the firewall with four 1/4-20 x 3/4-screws, lockwashers, and nuts (S, fig. 593).

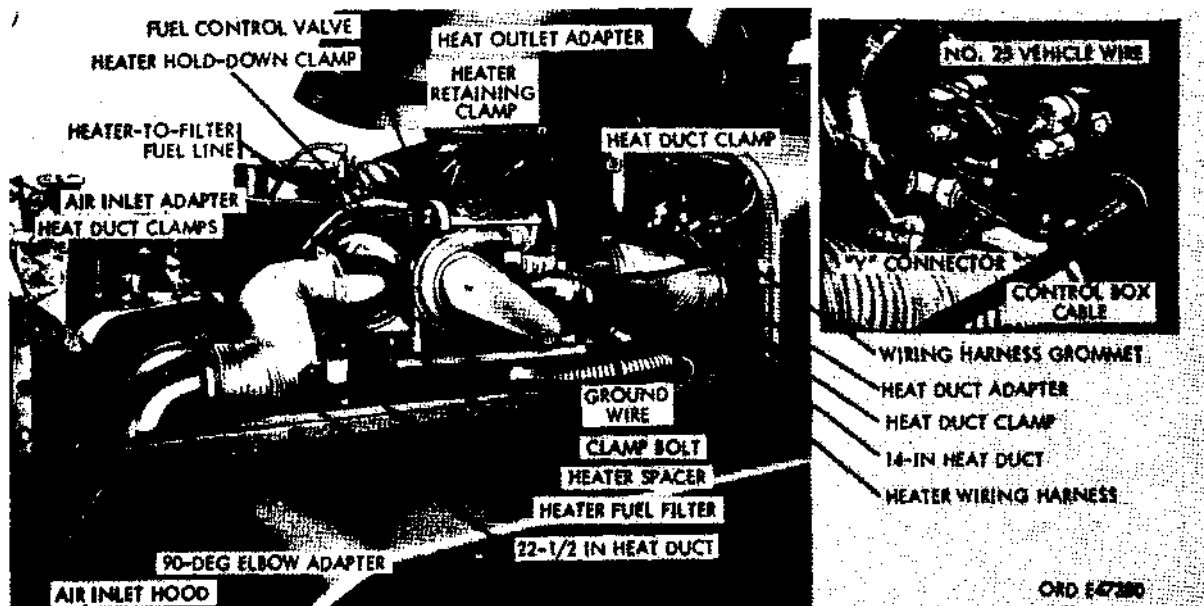


Figure 591. Personnel heater, heat ducts, and wiring harness installed

- (3) Secure the 19-1/2-inch heat duct (T, fig. 593) to the heat duct adapter and to the heat diverter with a heat duct clamp at each end, as shown in figure 593.

h. Install Defroster Heat Ducts. Secure the 29-inch defroster duct (D, fig. 585) to the right diverter outlet and to the left defroster nozzle, and the 26-inch defroster duct (E, fig. 585) to the left diverter outlet and to the right defroster nozzle with two heat duct clamps at each end, as shown in figure 593. The defroster ducts are crossed.

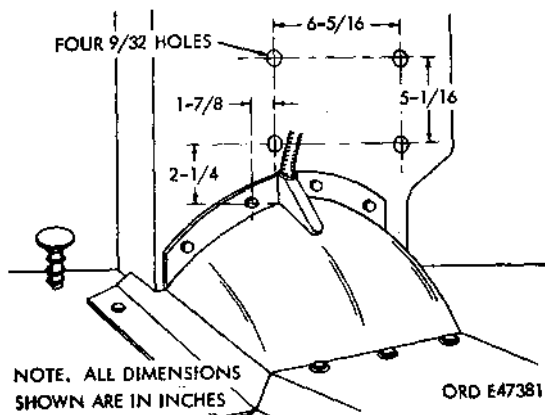


Figure 592. Location of heat diverter mounting holes

i. Install Control Cables.

- (1) Using the dimensions shown in figure 594, drill two 5/16-inch holes in the underedge of the instrument panel and attach the control cable mounting bracket (V, fig. 585) with two No. 2 10-32 x 5/8-screws and nuts (M, fig. 593).
- (2) Insert the diverter heat control cable (Z, fig. 585) through the left hole in the bracket and connect it to the diverter control arm (P, fig. 593). Push the control knob fully in and position the cable

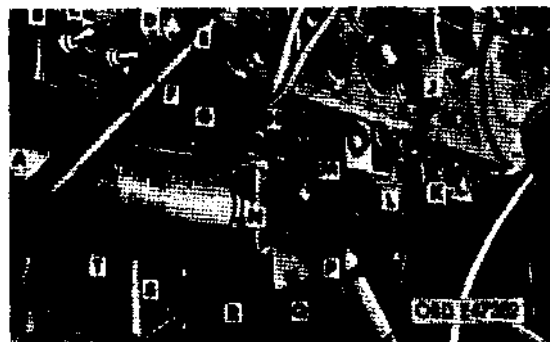


Figure 593. Heat diverter, defroster heat ducts, control box, and control cables installed

in the control cable clamp so that the control arm is on the extreme right and tighten the control cable clamp (N, fig. 593).

- (3) Insert the adapter heat control cable (AA fig. 585) in the right hole of the mounting bracket and connect the end of this cable to the adapter control arm (fig. 590). Push the control knob fully in and position the cable in the control cable clamp so that the butterfly in the adapter is closed when the control knob is pushed all the way in and tighten the control clamp (fig. 590).

Not.. Due to variation in length of the control cables, it may be necessary to lengthen the cable by unrolling the loop, which is formed at the end of the cable, or by rolling up additional wire to shorten the cable. This operation is done with long-nose pliers. If necessary, the end of the wire can be clipped off and anew loop formed when the cable cannot be shortened sufficiently by rolling up the existing loop.

j. Install Heater Control Box (N, Fig. 585).

- (1) Using the dimensions shown in figure 594, drill two 5/16-inch holes in the underedge of the instrument panel.

Caution: Be careful when drilling the second hole, to avoid damage to the windshield wiper tube.

- (2) Attach the heater control box (N, fig. 585) with the two screws (furnished with the box), as shown in figure 593.

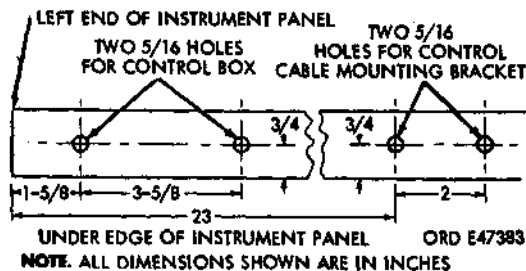


Figure 594. Location of mounting holes for control cable, mounting bracket and control box

k. Install Wiring Harness and Instruction Plates (X, Fig. 585).

- (1) Remove the knockout plug from the 1-1/2-inch hole for the heater wiring harness in the firewall (fig. 588). Install the wiring harness grommet (T, fig. 585) in this hole, as shown in figure 591.
- (2) Plug the HEATER end of the heater wiring harness into the receptacle on the heater, pass it through the wiring harness grommet (fig. 591) and plug the CONTROL BOX end into the receptacle on the heater control box (B, fig. 593).
- (3) Pass the control box cable (fig. 591) through the wiring harness grommet into the cab and plug the connector into the fitting that hangs from the heater control box (B, fig. 593).
- (4) On the engine side of the firewall, break the vehicle No. 25 wire (fig. 591) at the Douglas connector on the firewall, install the Y-connector (P, fig. 585) in this line, and then attach the control box cable (M, fig. 585) to the Y-connector.
- (5) Attach the ground wire (fig. 591) from the heater wiring harness to the heater mounting plate, using the same lock-washer screw that secures the 70-inch heater exhaust tube clamp (fig. 588).
- (6) Mount the heater operating instructions plate (BB, fig. 585) and heater wiring diagram plate (CC, fig. 585) on the inside of the left-side door, using the No. 10-32 x 3/8 self-tapping screws.

l. Procedure.

- (1) Type (or hand print) on white paper, in red capital letters the following:

WARNING:

DO NOT OPERATE HEATER IF EXHAUST FUMES ARE DETECTED

- (2) On or near the personnel heater control panel, cover an area the size of the typed warning notice with varnish FSN 8010-263-3196 and allow to dry until tacky.

- (3) Place warning notice on varnished area and press smooth and allow to dry.
- (4) Apply a coat of varnish over the warning notice.

m. Install Brush Guard Cover (Fig. 595).

- (1) Place the brush guard cover (FF, fig. 585) over the brush guard, as shown in figure 595. Use the metal grommets on the cover to locate mounting loop positions.
- (2) Drill mounting screw holes with a 11/64-inch drill and secure the loops to the brush guard with the self-tapping screws provided in the kit.
- (3) Fit the brush guard cover over the mounting loops and lace the strip through the loops. Secure the strips at the ends, as shown in figure 595.
- (4) Fold the cover back at the two sides of the radiator shell and locate and drill two 1/4-inch holes for the two retaining springs at each side. Hook the springs into the holes to secure the cover, as shown in figure 595.

- (5) Install the two remaining springs at the other end of the cover.

Note. When the personnel heater is in operation, the springs are released and hooked onto the brush guard cover at a convenient point so that the air inlet hood of the personnel heater installation will not be covered.

n. Application of Ignition Insulation Compound. As a protection against moisture, which adversely affects the electrical system, ignition insulation compound should be applied as prescribed in (1) and (2) below.

- (1) Thoroughly clean and remove all moisture from the exterior of spark plugs, wiring, and all exposed terminals and connections of the electrical system.
- (2) Spray thoroughly and carefully with ignition insulation compound the interior of the engine compartment, including exterior of engine, carburetors, fuel pump, air cleaners, spark plugs, generator regulator, generator,

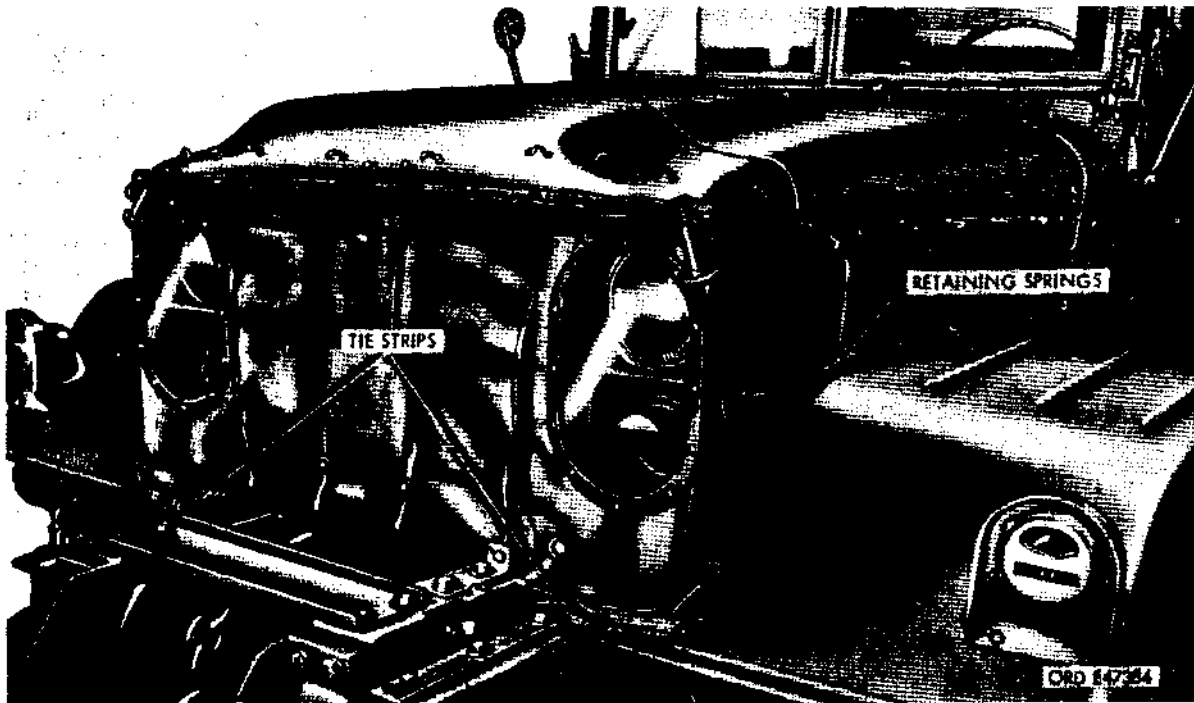


Figure 595. Brush guard cover installed

starter, engine manifolds, and all components within the engine compartment. Spray all components of the kit after completion of tests (par. 467).

Note. It is recommended that the spark plugs and high-tension cables be sprayed with ignition insulation compound a second time, after first application has dried, to assure a thorough seal against penetration of moisture.

467. Installation, Tests and Adjustments

a. Bleeding Fuel Line. Bleed the heater fuel line by starting the engine and loosening the fuel line at the inlet of the heater fuel control valve. Tighten the fitting as soon as fuel starts to flow from the line.

b. Initial starting. After bleeding the fuel line, start the heater as prescribed in (1) through (4) below.

- (1) Turn the HI-LO switch (C, fig. 593) to HI position.
- (2) Turn heater switch (F, fig. 593) to START position and hold in this position until the indicator light (D, fig. 593) glows and then snap the switch to RUN position,
- (3) Within two minutes, warm air should be felt at the heat diverter outlet.
- (4) After the heater has been in full operation for three or four minutes, turn the heater switch off. Burning in the heater will stop within 45 seconds, but the fans will continue to operate for about two minutes to cool and purge the heater.

c. Operating Heater. After the heater has been started and checked the first time (a and b above), it will only be necessary to start the engine and turn the heater switch on for sub-

sequent starts, if shutdown periods are not sufficiently long to chill the system. If the heater fails to start in this manner, repeat the initial starting procedure (b above).

Note. If heater does not ignite after three attempts to start, no more attempts should be made to start the heater; heater requires servicing.

d. Stopping Heater.

- (1) Snap the heater switch to OFF position.
- (2) Burning in the heater will stop within 45 seconds but the fans will continue to operate for about two minutes to cool and purge the heater.

468. Removal of Heater Unit

Remove the heater unit by reversing paragraph 466 (a) through (m).

Note. Holes left in vehicle after permanent removal of heater are to be covered with improvised closures.

469. Disassembly of Heater Unit

See TM 9-8662 for disassembly of heater unit.

470. Cleaning Inspection, and Repair of Heater Unit

See TM 9-8662 for cleaning, inspection and repair of the heater.

471. Assembly of Water Unit

See TM 9-8662 for assembly of heater unit.

472. Troubleshooting

Refer to TM 9-8662 for troubleshooting procedures.

Section III. FUEL PREHEATER KIT

473. Description

Refer to TM 9-8662.

474. Cleaning, Inspection, and Repair

Refer to TM 9-8662.

475. Test and Adjustment

Refer to TM 9-8662.

Section IV. ELECTRIC FUEL PUMP

476. Description

a. The electric fuel pump is used when the heater is required to operate without operating the engine.

b. The pump is located in the heater fuel supply line, between the hand operated shut-off valve and the fuel filter (fig. 596).

c. Two different types of electric fuel pumps are used with 978 series personnel heaters. They are the Stewart-Warner Model and the Bendix-Eclipse Model (fig. 597).

477. Installation and Removal

a. Installation.

- (1) Install one end of fuel line into vehicle fuel filter on the left side of the frame cross member (fig. 598) and the other into the electric fuel pump.

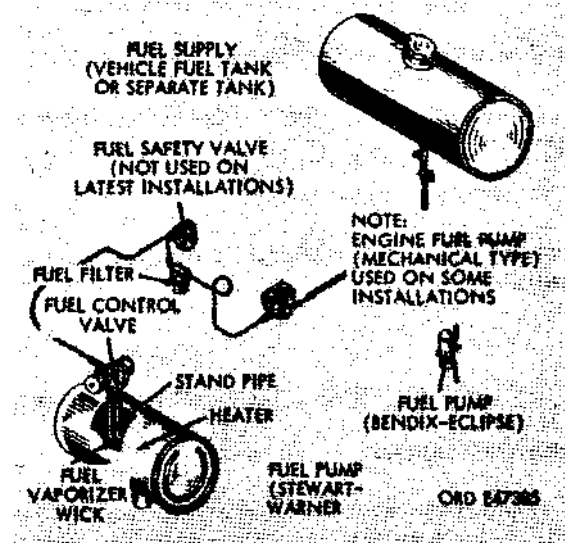


Figure 596. Schematic view of fuel system

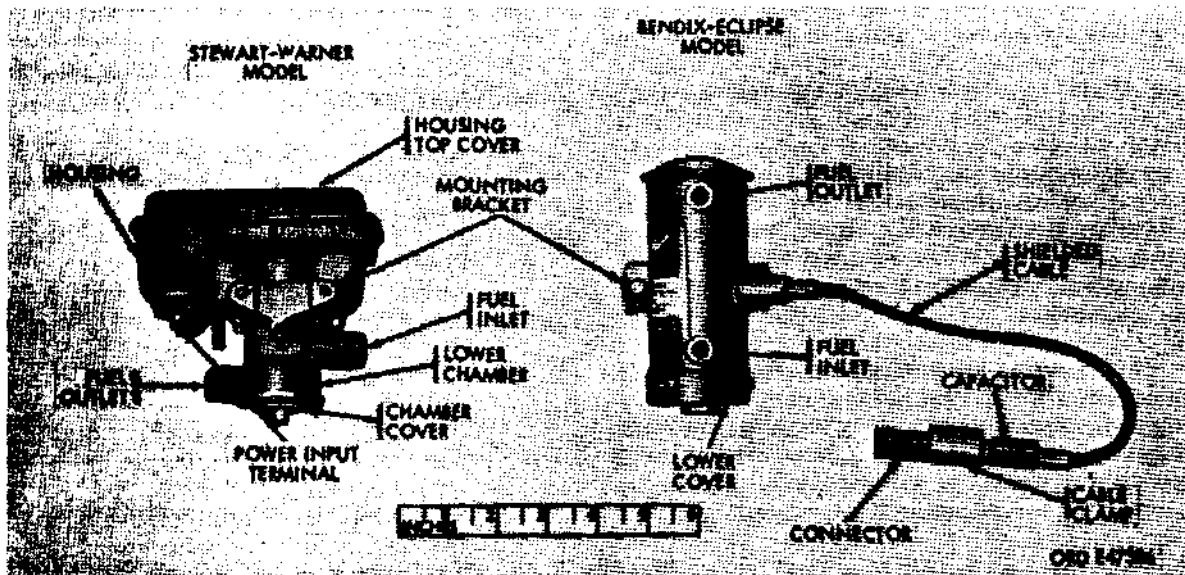


Figure 597. Electric fuel pumps

- (2) Connect the heater main fuel line to the electric fuel pump, then proceed with instructions contained in paragraph 466,

b. Removal. Remove the electric fuel pump by reversing the installation procedures.

478. Repair

Refer to TM 9-8662 for disassembly, inspection and repair of electric fuel pumps.

479. Tests and Adjustments

Refer to TM 9-8662 for tests and adjustments.

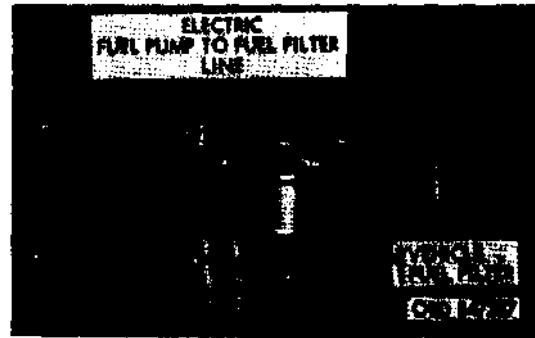


Figure 598. Installation and removal of electric fuel pump

Section V. PERSONNEL (HOT WATER) HEATER KIT

480. Description

a. The personnel (hot water) heater kit (fig. 599) is for use in areas where the normal ambient temperature is from 40° to -20°F.

b. The kit is to be installed by Ordnance maintenance units or by troop units under supervision of ordnance mechanics.

c. The personnel heater is a blower-type hot water heater. It is bolted to the top of the left fender splash shield in the engine compartment (fig. 600). Heated sir is distributed from the heater to vehicle cab and/or windshield defroster by a blower end heat diverter. Heat is controlled by AIR and DEFROSTER knobs on the instrument panel, which in turn operate butterfly or damper valves in the heater outlet adapter elbow, and heater divert-er assembly.

d. A canvas winterfront radiator cover is supplied with the kit to rechice flow of air to engine compartment. An adjustable aperture flap in the cover permits manual regulation of cold sir through the radiator as conditions demand, in accordance with the engine temperature gage.

e. Complete illustrated installation instructions are packed in each kit. Use the instruction booklet as a reference when making a specific installation since there may be variations due to engineering changes. Differences in individual kits bear the seine Ordnance numbers and were designed for the same vehicle.

f. For other instructions pertaining to win-terization equipment, installation instructions, and methods, refer to TM 9-207.

481. Installation of Hot Water Heater Kit

a. Under Hood Operations.

Note. Before starting heater kit installation, refer to figure 599 to become familiar with and to identify the parts referred to throughout the installation procedure.

- (1) Raise the hood and lock in place. Disconnect negative and positive battery cables.

Warning: Always disconnect ground cable first. When two ground cables are used, both cables must be disconnected prior to working on equipment where shorting of cables may occur. Incorrect cable replacement sequence is extremely dangerous. Accidental contact of cable replacing tool with vehicle, causes a direct short resulting in arcing and instant heating of tool to red heat. This can cause painful burns on bends and serious damage to tools, vehicle, and battery. Moreover, the shorted battery may explode, spraying hot acid over the surrounding area.

- (2) Open radiator drain cock and allow coolant to drain into a suitable container.

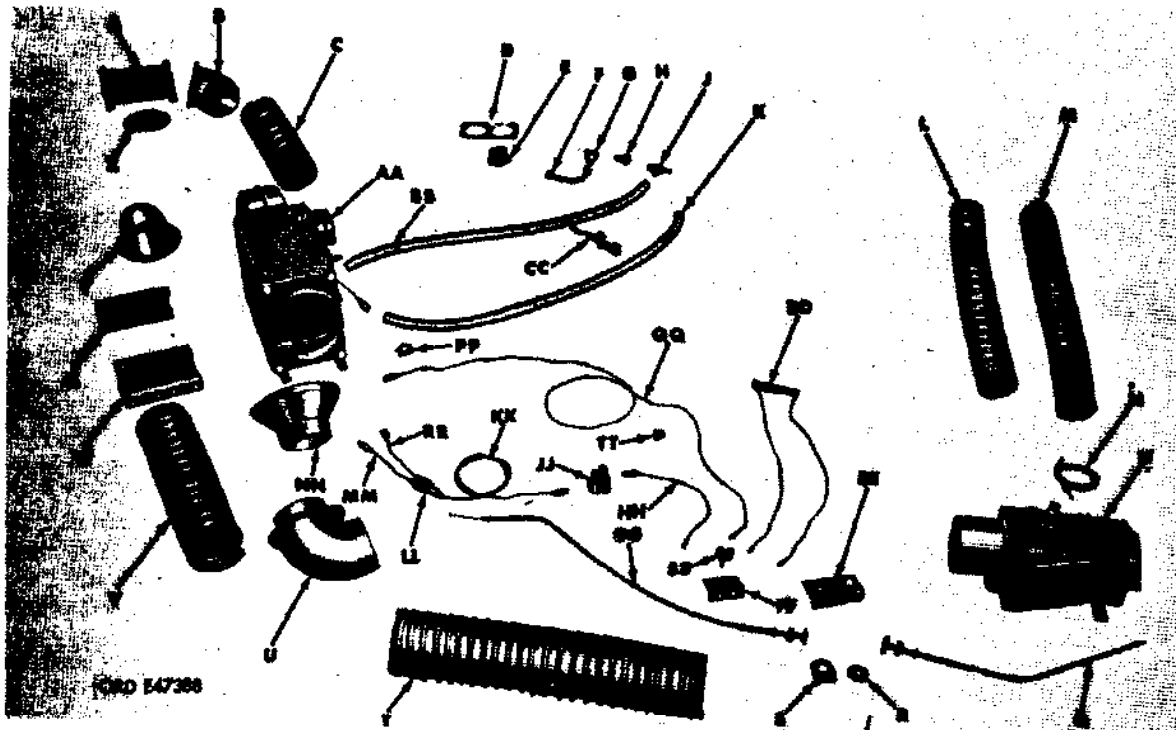


Figure 599. Personnel heater kit (hot water)

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|-----------------|------------|-----------------|
| A | Hood | x | Bracket |
| B | Adapter | Y | Adapter |
| c | Duct | z | Screen |
| D | Gasket | A A | Heater unit |
| E | Thermostat | B B | Hose |
| F | Tube | c c | clamp |
| G | Tee | D D | Resistor |
| H | Elbow | E E | Control bracket |
| J | Cock | F F | Bracket |
| K | Hose | G G | Control cable |
| L | Defroster duct | H H | Cable assembly |
| M | Defroster duct | J J | Circuit breaker |
| N | clamp | K K | Cable |
| P | Diverter | L L | Connector |
| Q | Defroster cable | M M | Cable |
| R | Nameplate | N N | Adapter |
| S | Nameplate | PP | clamp |
| T | Duct | Q Q | Cable |
| u | Adapter | R R | Cable |
| v | Duct | SS | Heater switch |
| w | Bracket | T T | Bushing |

Figure 599. Personnel heater kit (hot water) - legend

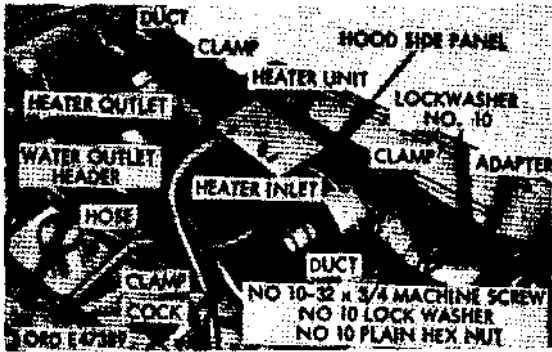


Figure 600. Heater installed

- (3) Remove the 4-1/8-inch knockout plug from the forward end of hood left side panel. Hold adapter (B, fig. 599) in place on inner side of panel with the outlet opening toward firewell (fig. 600) and inlet opening aligned with hole in panel. Using adapter as a template, mark and drill four 13/64-inch holes. With screen (Z, fig. 599) between side panel and adapter (B, fig. 599) secure adapter to panel with four No. 10 machine screws, lockwashers, and nuts.
- (4) Center hood (fig. 601) over screen on side panel and mark location of three mounting holes. Drill three 5/16-inch holes in side panel. Secure hood to side panel with three 1/4 x 5/8 machine screws, lockwashers, and hex-nuts.
- (5) Secure brackets (W and X, fig. 599) to heater unit (AA, fig. 599) with four 5/16 x 1 machine screws, lockwashers, and hex-nuts (fig. 603).

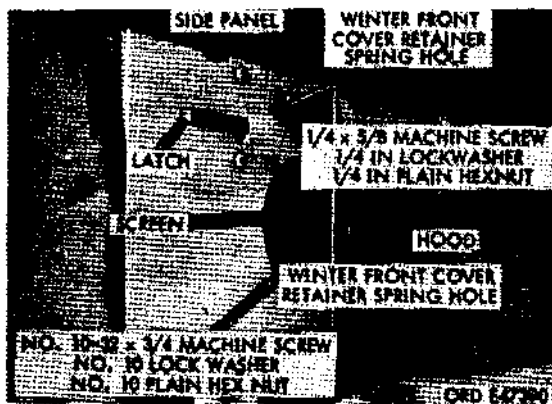


Figure 601. Side panel with hood installed

- (6) Secure adapter (Y, fig. 599) to front of heater unit (AA, fig. 599) with four 1/4 x 3/8 machine screws, lockwashers, and hex-nuts. Secure adapter (NN, fig. 599) to rear of heater unit with four No. 8 X 1 tapping screws and lockwashers (fig. 603).
- (7) Place the hood side panel in the lowered position. Locate and drill a 5/16-inch hole on the left front fender as shown in figure 602.
- (8) Position heater unit on fender so that hole in outer end on rear mounting bracket (fig. 603) is aligned with 5/16-inch hole in fender. Insert machine screw through bracket and hole for use as a pilot. Raise hood side panel and lock in place. With pilot screw in place, position heater unit so that adapter on front of heater is aligned with adapter on hood side panel. Using the mounting brackets as a template, mark the location of the three remaining mounting holes on fender. Remove heat and drill three 5/16-inch holes.
- (9) Position heater unit on fender and secure with four 5/16 x 1 machine screws, lockwashers, and hex-nuts (fig. 603).
- (10) Remove water outlet tube that connects air compressor and water pump (fig. 604). Remove connector from water pump. Coat the threads of tee, elbow, and cock with a suitable sealing compound and install them in the water pump as shown in figure 604. Coat connector with sealing compound and install in the

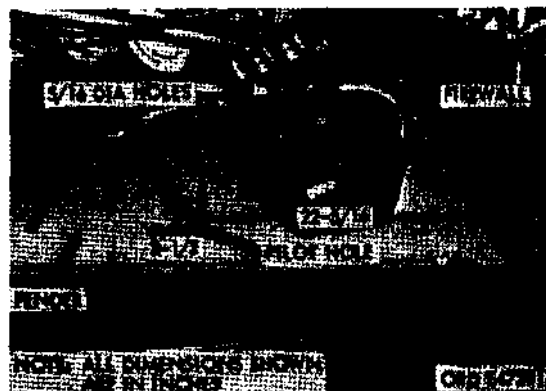


Figure 602. Locating heater unit

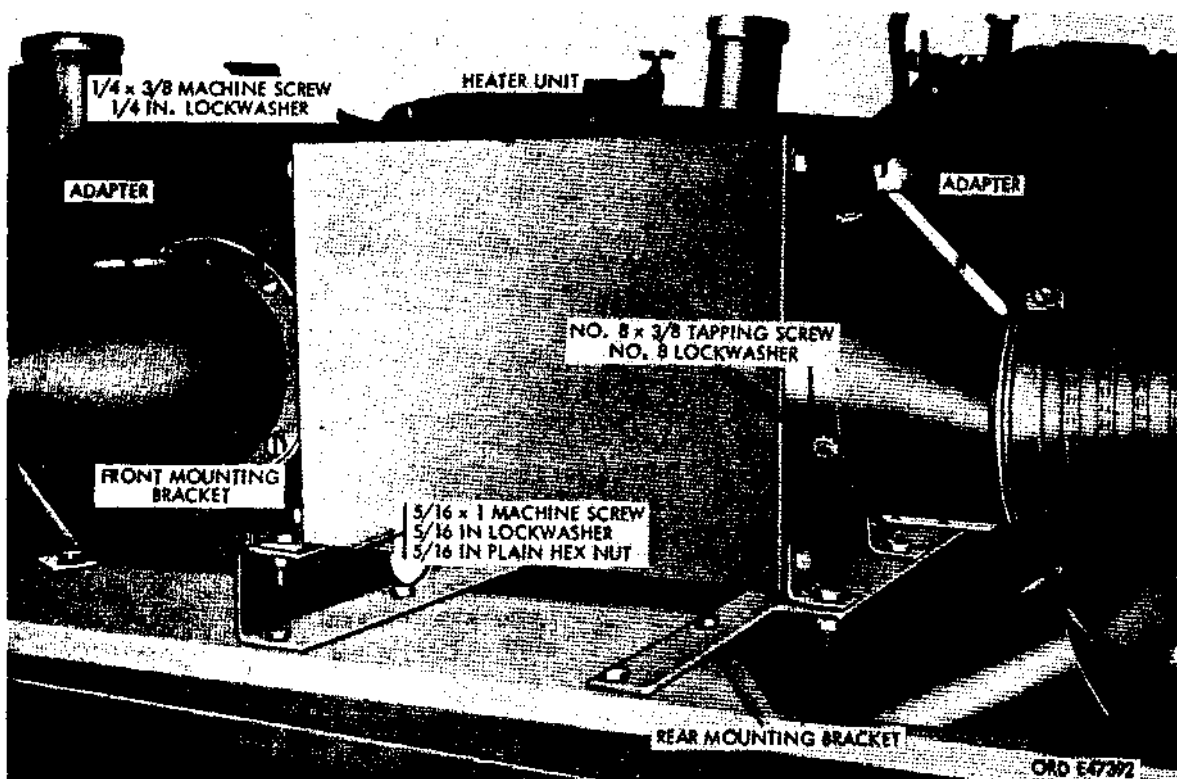


Figure 603. Heater unit installed

tee. Install new water outlet tube (fig. 604) between air compressor and water pump.

- (11) Remove plug from water outlet header. Coat bushing and cock (fig. 604) with

sealer and install in water outlet header.

- (12) Cut both lengths of hose to 36 inches. Connect one hose to heater unit inlet and to cock on water outlet header (fig. 600). Secure hose with two clamps. Connect the remaining hose to the header outlet and to the cock located on the water pump (fig. 604) in the same manner.
- (13) Remove the upper nut and lockwasher from engine lifting eye (fig. 605). Secure hose clamp to cylinder block with nut and lockwasher. Secure hose to clamp as shown in figure 605.
- (14) Install thermostats (E, fig. 599) and gasket (D, fig. 599) in accordance with instructions contained in TM 9-2320-211-20.

b. In the Cab Operation.

- (1) Remove the two knockout plugs (fig. 606) from left side of firewall. Make

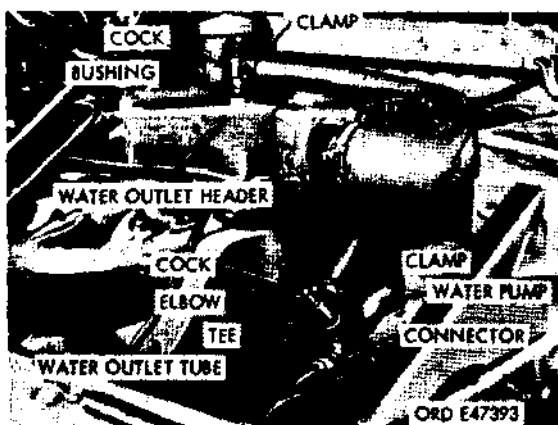


Figure 604. Heater hose connections

a layout on the firewall as shown in figure 607 and drill four 9/32-inch holes for mounting the diverter.

Caution: Use extreme care when drilling to avoid damage to cables or other components attached to engine side of firewall.

- (2) Hold the resistor approximately 10 inches above the floor and just to the right of the air lines—ad mark location of the two mounting holes on firewall. Drill two 3/32-inch holes. Secure the resistor to firewall with two No. 6 x 1/2 tapping screws (fig. 608).

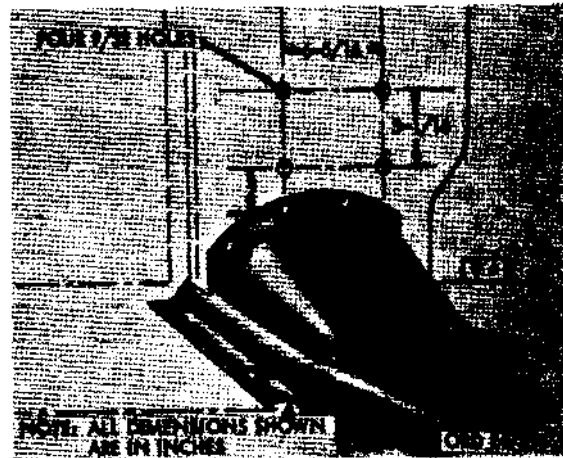


Figure 607. Diverter mounting hole layout

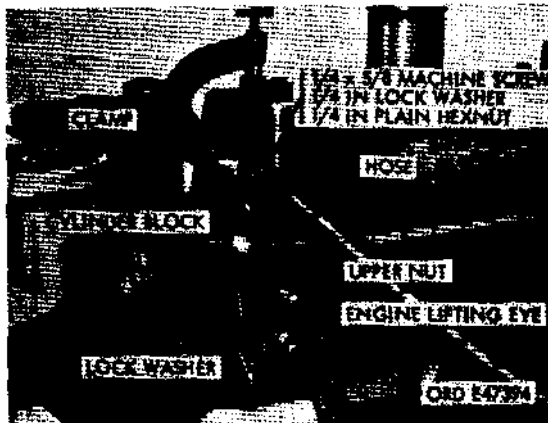


Figure 605. Hose clamp installed

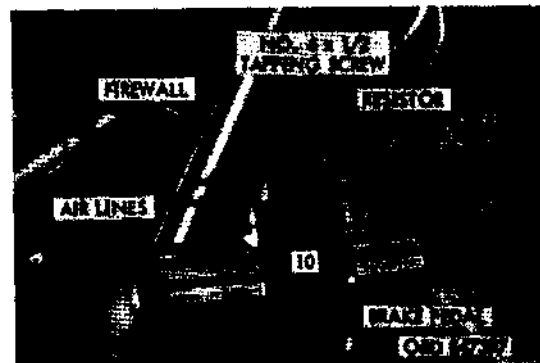


Figure 608. Resistor installed

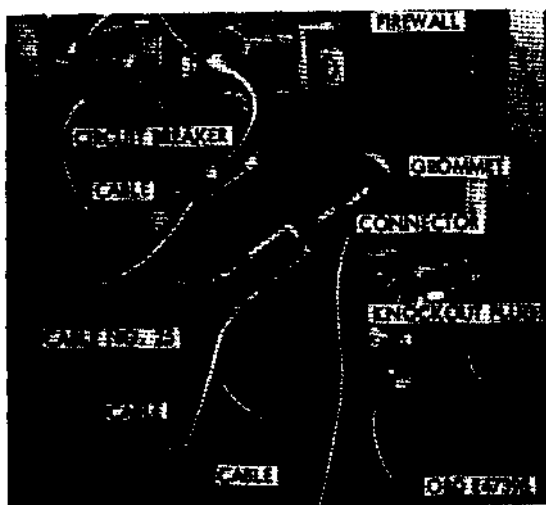


Figure 606. Knockout plugs on firewall

- (3) Make a layout on instrument panel for control mounting bracket heater switch, mounting bracket and circuit breaker as shown in figure 609. Drill one hole for each bracket and circuit breaker, then mount the brackets and circuit breaker and use as a template to drill another mounting hole. Secure circuit breaker to rear side of instrument panel with No. 8 x 7/8 machine screws, lockwashers, and nuts.
- (4) Secure control bracket to instrument panel (fig. 610) with two No. 10 X 5/8 machine screws and nuts. Secure switch bracket to instrument panel with two 1/4 x 1/2 machine screws, lockwashers and nuts.

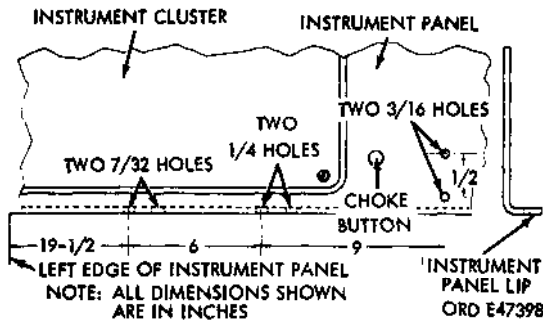


Figure 609. Layout for installing switch brackets and circuit breaker

- (5) Position adapter on firewall at approximately 30° angle as shown in figure 611. Using adapter as a template, drill two holes through the firewall with a No. 16 drill. Secure adapter to firewall with two No. 8 x 1-1/4 machine screws, lockwashers, and nuts.
- (6) Secure diverter (fig. 610) to firewall with four 1/4 x 3/4 machine Screws, lockwashers, and nuts.
- (7) Slip defroster duct (M, fig. 599) over right outlet on diverter end over end of left defroster nozzle. Install defroster duct (L, fig. 599) in the same manner, except connecting it to the left outlet on diverter and on the right defroster nozzle. Secure ducts to defroster nozzles and diverter outlets with clamps (fig. 599).

- (8) Connect duct to adapter (fig. 611) and to diverter (fig. 610) and secure with Clamps.
- (9) Remove nut and lockwasher from control cable (GG, fig. 599). Slip nameplate (S, fig. 599) onto cable, then thread cable through left hole in control bracket (EE, fig. 599) and secure with nut and lockwasher. Move the control arm forward to close valve in adapter (fig. 611). Push control cable in all the way. Connect cable to control arm and secure with clamp.
- (10) Remove nut and lockwasher from defroster cable (Q, fig. 599). Slip nameplate (R, fig. 599), onto cable, then thread cable through right hole in control bracket (E, fig. 599) and secure with nut and lockwasher. Move control arm on diverter (fig. 610) to the right as far as possible. Push defroster cable in all the way. Connect cable to control arm and secure with clamp.
- (11) Remove nut and lockwasher from heater switch (SS, fig. 599). Hold heater switch in bracket (fig. 610), slip lockwasher onto switch and secure switch with the nut.
- (12) Install duct (V, fig. 599) between outlet on heater unit and adapter on firewall, Secure duct with clamps (N, fig. 599).
- (13) Install duct between adapter on hood side shield and front end of heater (fig. 601). Secure duct with two clamps.

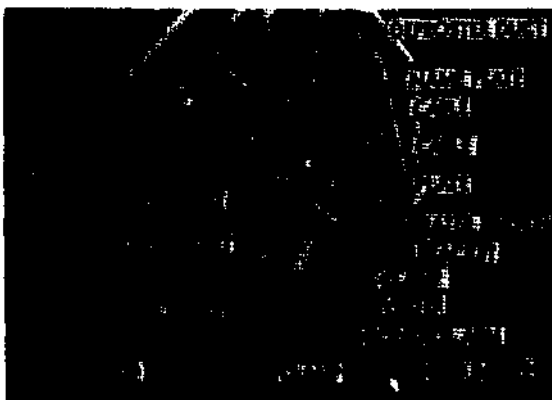


Figure 610. Heater controls

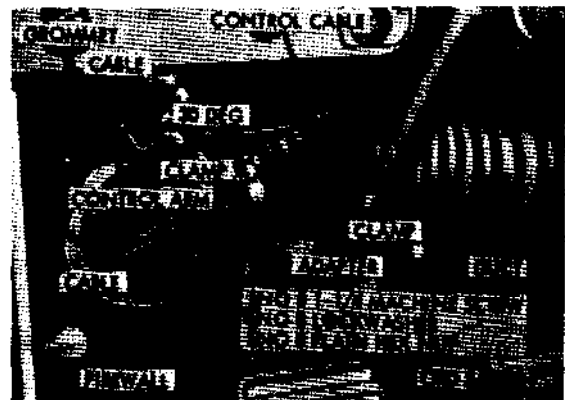


Figure 611. Duct mounted on firewall

c. Wiring Operations.

- (1) Connect cable (QQ, fig. 599) to socket on heater tit. Thread other end of cable through 1-1/2-inch hole in firewall and connect to heater switch (fig. 612).
- (2) Connect cable (KK fig. 599) to single end of connector (LL, fig. 599). Connect cable (RR and MM, fig. 599) to double end of connector. Thread cable on single end of connector through the 1-1/2-inch hole in firewall (engine side of cab side) and connect to terminal on circuit breaker (fig. 612). Fit grommet in firewall (fig. 606).
- (3) Connect resistor leads to high and low sides of heater switch (fig. 612).
- (4) Connect cable (HE, fig. 599) to center pole heater switch and other end to circuit breaker (fig. 612).
- (6) Disconnect cable No. 25 (fig. 606) from circuit breaker and connect it to cable leading from connector (LL, fig. 599). Connect other cable leading from connector (LL, fig. 599) to the circuit breaker from which No. 26 cable was disconnected.

d. Radiator Winterfront Installation.

- (1) Position winterfront cover (fig. 613) on brush guard. Using metal grommets in the cover as a template, mark the location of the mounting loop positions on the top of brush guard and on the fenders.

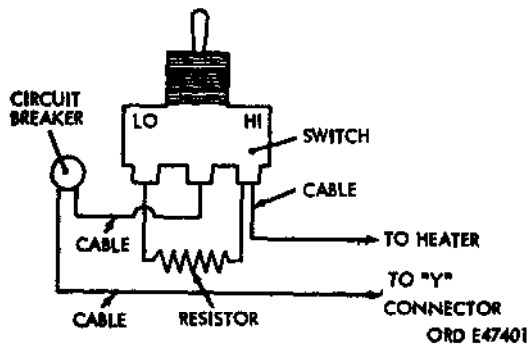


Figure 612. Wiring diagram



Figure 613. Winterproof cover assembly installed

- (2) Using a No. 27 drill and the mounting loops as a template, drill the necessary holes. Secure mounting loops to fenders and top of brush guard with No.8 x 1/2-tapping screws (fig. 614).

Note. On the late production vehicles, the hood holddown hooks are mounted on brush guard. On this type of installation, the mounting loops directly above the holddown hooks are eliminated and the cover must be cut as shown in figure 613, and the edges must be sewed to prevent fraying of material.

- (8) Fit the cover over the mounting loops and lace the tie strips through the mounting loops. Secure the ends of tie strips with the buckles provided.

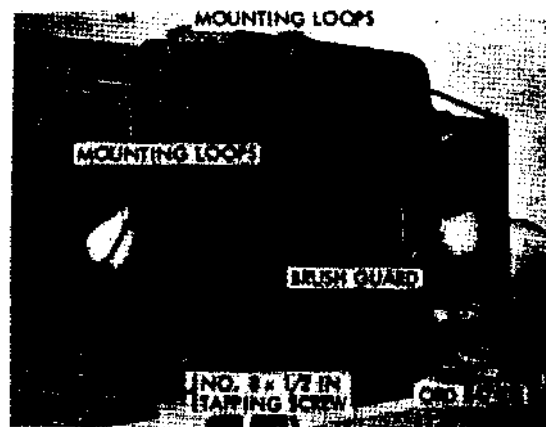


Figure 614. Mounting loops installed

- (4) Fold each side of cover back over side panel (fig. 615). Pull each winterfront cover retaining spring backward to apply tension on cover. Locate and drill four 1/8-inch holes for retaining springs. Attach springs to holes.

e. Preparations for Service.

- (1) Fill cooling system as detailed in TM 9-2320-211-10.
- (2) Connect battery cables.
- (3) Open cock on water outlet header and water pump (fig. 604). Operate engine until coolant reaches normal operating temperature. Open air bleed valve on heater unit (fig. 616) to expel all air from the cooling system. Close valve when a steady stream of water flows from valve.
- (4) Replenish coolant in cooling system.

482. Test and Adjustment

a. General. Follow instructions on cable nameplate to see that when the defroster knob is pulled all the way out, the damper closes completely to direct the heated air onto the windshield. Push the knob all the way in to test the opening of the heat outlet to make certain that the heated air flows directly into the cab.

b. Radiator Winterfront Adjustments.

- (1) During "standby" periods, the radiator winterfront should be completely closed.
- (2) During vehicle operation, the driver should note the reading on the engine temperature gage. To perform the work for which it is designed in an efficient and economical manner, the engine must operate at temperatures of 180°F. Extreme cold will adversely affect engine performance by preventing the coolant from attaining the desired temperature.
- (3) Keep the radiator winterfront cover closed until the engine temperature increases above 180°F.
- (4) If temperature exceeds 180°F., raise the aperture flap on winterfront and strap in position (fig. 613). If temperature continues to increase after flap is fully open, remove cover completely to prevent overheating. If the temperature continues above 180°F., refer to TM 9-837.
- (5) When winterfront cover is removed, it must be stowed carefully in the vehicle for further use. The retaining springs must be securely attached to the flap.

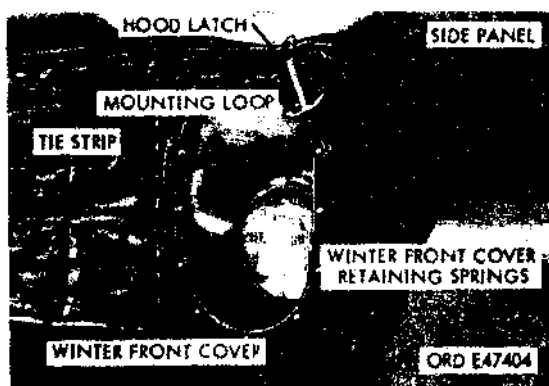


Figure 615. Winterfront cover retaining springs

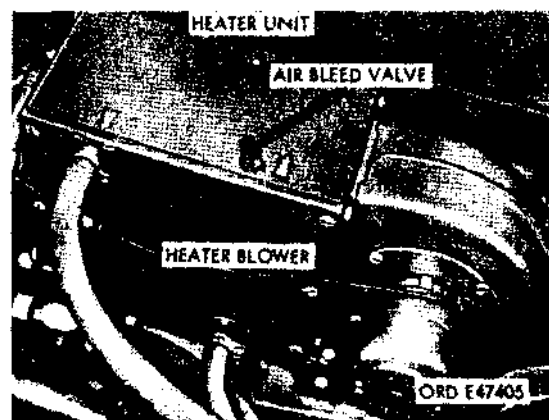


Figure 616. Heater assembly installed

Section VI. ALCOHOL EVAPORATOR KIT

483. Description

a. The alcohol evaporator (fig. 617) is used to protect an air brake system from freezing during service in below freezing temperatures. The alcohol evaporator permits vaporized alcohol to be drawn into the air brake system.

b. The alcohol evaporator is connected to the air compressor intake manifold (fig. 618) and consists of a filler cap, strainer, tube and glass or metal receptacle to hold methyl alcohol.

484. General Installation Instructions

Be sure to inspect the alcohol evaporator kit before installation for signs of cracks or damage.

485. Installation of Alcohol Evaporator Kit

a. Hold the evaporator mounting bracket (U, fig. 618) on the upper right side of the fan shroud, flush with the top, and drill three 5/16 - inch holes in the fan shroud. Install the evaporator mounting bracket with three 1/4-inch bolts, lockwashers, and nuts.

b. Mount the alcohol evaporator jar and vaporator jar bracket (V, fig. 618) on the evaporator mounting bracket with three 1/4-inch bolts, lockwashers, and nuts.

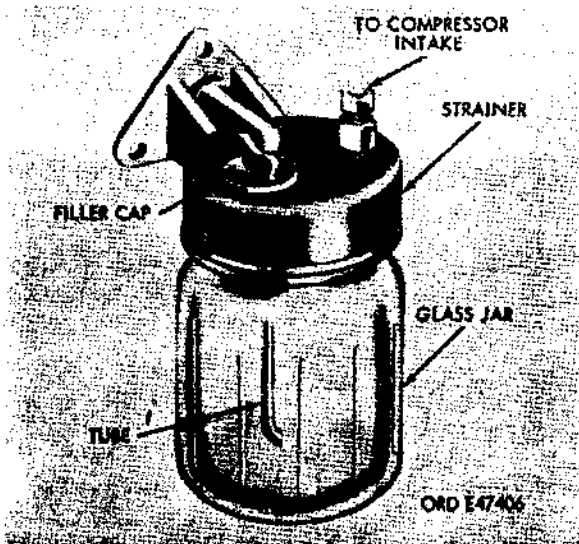


Figure 617. Alcohol evaporator

c. Remove the small plate from the lower front end of the air compressor and install the small adapter plate (A, fig. 618).

d. Uncoil the evaporator-jar-to-air compressor tube (E, fig. 618) and cut off a section approximately 34 inches long.

e. Install tube fittings and connect one end of the 34-inch tube to the evaporator jar bracket, form a vibration loop, and connect the other end to the small adapter plate on air compressor. Tighten all connections.

486. Removal of Alcohol Evaporator Kit

a. Loosen tube fitting connecting alcohol evaporator from small adapter plate (A) on air compressor intake manifold. *Disconnect and remove* evaporator-jar - to- air compressor tube (E) and small adapter plate.

b. Remove the evaporator mounting bracket (U, fig. 618) from the upper right side of the fan shroud. Remove the evaporator jar bracket (V, fig. 618) from the evaporator mounting bracket and remove the alcohol evaporator jar.

487. Disassembly of Alcohol Evaporator Kit (Fig. 617)

Unscrew glass jar from strainer body and discard gasket. Remove retaining ring and strainer from body. Unscrew filler cap and discard gasket. Remove tubing connector and evaporator tube from body.

488. Cleaning and Inspection

a. Cleaning. Wash all parts with dry-cleaning solvent or mineral spirits paint thinner.

b. Inspection. Inspect strainer body for cracks or damage and replace if defects are found. Check the evaporator tube and be sure it is not plugged or restricted with foreign matter. Glass jar must be replaced if any cracks are found.

489. Assembly of Alcohol Evaporator Kit

Place strainer in body and secure with retaining ring. Install evaporator tube and tubing connector. Install new gasket in body and screw glass jar in place. Install filler cap with new gasket.

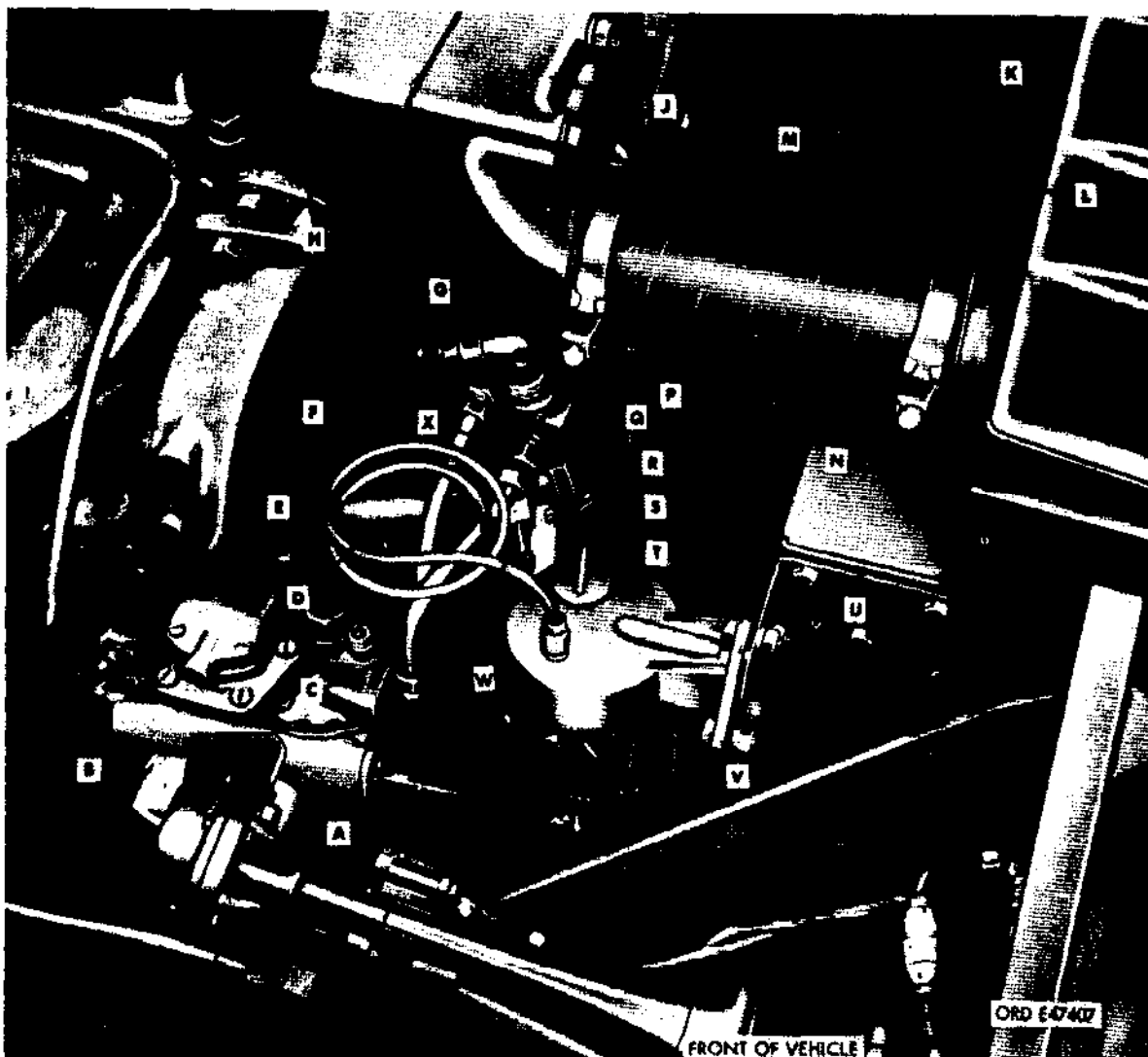


Figure 618. Alcohol evaporator installed

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---|------------|--------------------------------------|
| A | Adapter plate | M | Hose clamps |
| B | Air compressor | N | Radiator inlet hose |
| C | 1/2-inch line from air compressor to aquastat | P | Water pump |
| D | 83-inch coolant hose | Q | Aquastat |
| E | Evaporator line | R | Bypass hose clamp |
| F | Front heater aquastat wire | S | Shutoff cock |
| G | Aquastat connector | T | Bypass hose |
| H | Water manifold | U | Evaporator mounting bracket |
| J | Thermostat housing | v | Evaporator jar bracket |
| K | Radiator stayrod bracket | W | Hose clamp |
| L | Fan shroud | x | 3/8 x 1/2-inch flared tube connector |

Figure 618. Alcohol evaporator installed - legend

Section VII. HARD-TOP CLOSURE KIT

490. Description

a. The hard-top closure kit is for use in areas where the normal temperature range during the coldest period for the year is -25°F. to 65°F. or lower. It is installed in conjunction with the power plant heater kit.

b. The hard-top closure kit (figs. 610 and 620) consists of a back panel, roof panel, two rubber strip seals, end attaching hardware.

491. Preliminary Preparation of Vehicle

a. Remove the cab top paulin as prescribed in (1) through (3) below.

(1) Release lashing rope from side handles and from lashing hooks at rear of cab. Release paulin from fastener studs in side roof rails and slip paulin off channels in pillar post assemblies. Throw paulin over windshield and pull paulin edge off channel of windshield, as shown in figure 621.

(2) Remove the side-roof rails and the crossbars (fig. 622).

(3) Place paulin, side-roof rails and crossbars in storage.

b. Remove buttons at top of each windshield post. Retain for possible future use.

c. Drill two 7/16-inch holes clear through windshield frame upper panel, 21-7/8 inches each way from center of windshield frame post, using the existing 0.199-inch hole, as a guide.

492. Installation of Hard-top Closure Kit

a. The kit is installed by Ordnance maintenance units or by troop units under the supervision of ordnance mechanics.

b. The sequence of operations given herein is the result of trial installations; however, deviation from strict adherence thereto to suit individual conditions is permissible. When interference is encountered in the installation of the kit because of the peculiar shape of the vehicle due to modifications or damage, afield expedient may be resorted to by the installation personnel to correct the particular interference.



Figure 619. 5-Ton 6 x 6 cargo truck M-41 with hard-top enclosure kit installed

c. Back panel (fig. 623) will be installed as prescribed in (1) and (2) below.

- (1) Place a rubber strip seal on the cab body so that the holes in the seal and cab body aline.
- (2) Install the back panel so that the bolt holes in the panel, seal, and cab body aline and secure with fourteen 1/4-20 x 3/4-bolts, plain washers, and safety nuts. Do not tighten the bolts.

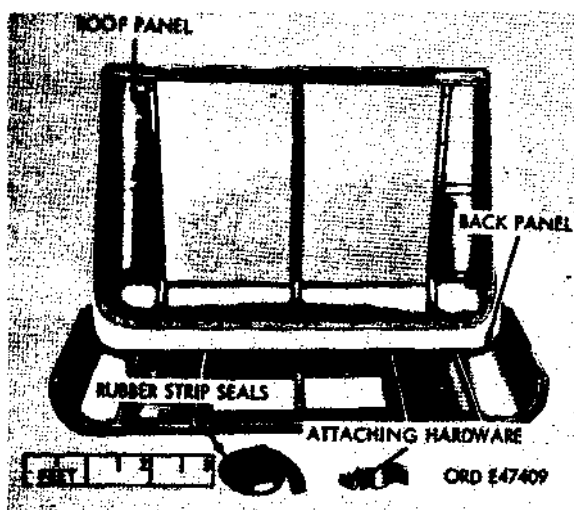


Figure 620. Hard-top closure kit components



Figure 621. Removing cab top paulin from windshield channel

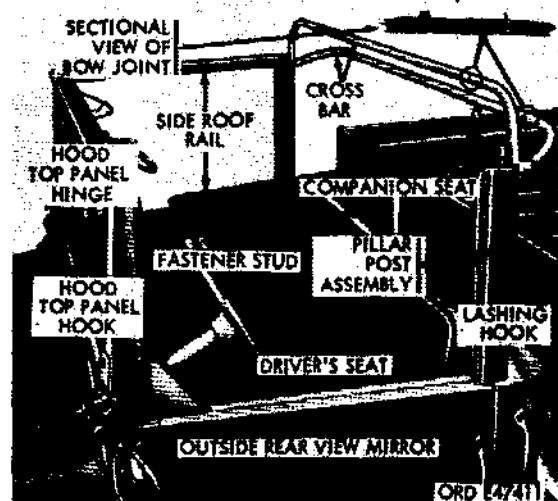


Figure 622. Removing cab top from the vehicle

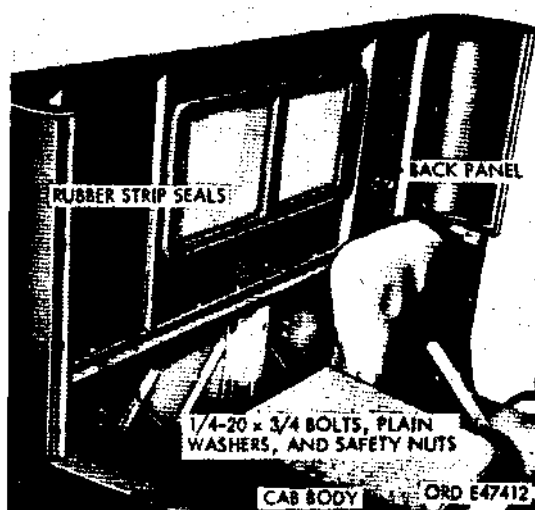


Figure 623. Back panel installed

d. Roof panel (fig. 624) will be installed as prescribed in (1) through (6) below.

- (1) Place a rubber strip seal on top of the back panel (fig. 623) so that the holes in the seal and the back panel aline.
- (2) Install the roof panel so that the bolt holes in the seal and panels aline and the front edge of the roof rests on the windshield header.

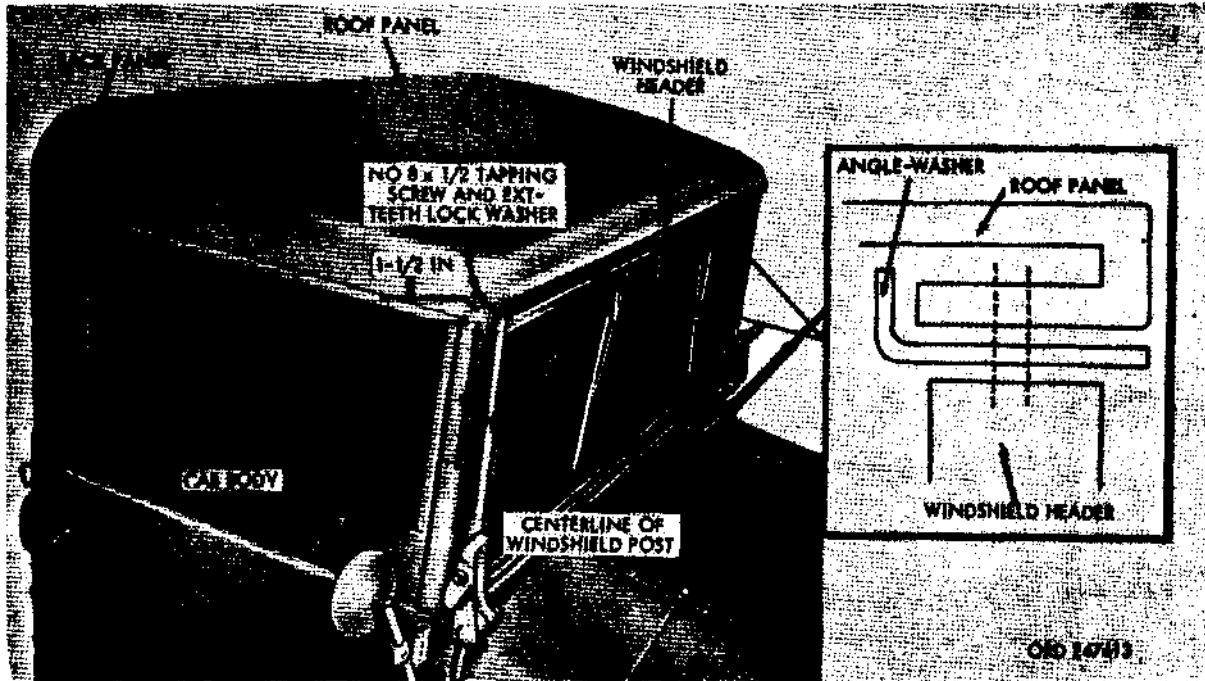


Figure 624. Roof panel installed

- (3) Secure the roof panel to the back panel with fourteen 1/4-20 x 3/4 bolts, 28 plain washers (14 bearing against roof panel and 14 against back panel), and 14 safety nuts. Do not tighten the bolts.
- (4) Close the cab windows and fit roof panel to top of window doorframe and to windshield posts. Install the two angle washers between the roof panel and the windshield header so that the hole in each washer aligns with the bolt holes in the roof panel and windshield header, and the flange on each washer faces up under the roof panel.
- (5) Secure the front of the roof panel to the windshield header (fig. 624) with two 3/8-24 x 2 bolts and safety nuts. Adjust windshield, if necessary. Do not tighten the bolts.
- (6) Drill a hole, with a No. 17 drill, on each side of the roof panel, along centerline of windshield post and 1-1/2 inches above bottom edge of roof panel. Secure roof panel to the windshield posts with two No. 8 x 1/2 tapping external-teeth lockwashers.

493. Tests and Adjustments

- a. Inspect interior and exterior panels for scratches, dents or abrasions to prevent corrosion or possible harm to the body.
- b. Check rubber strip seals for air leaks. Trim overhang of rubber strip seals.
- c. Inspect all bolts, nuts, and attaching parts for security of attachment and tightness.
- d. Check door operation; adjust if necessary.

494. Removal of Hard-top Closure Kit

a. Roof Panel (Fig. 624).

- (1) Remove the two No. 8 x 1/2 tapping screws and the two external-teeth lockwashers from windshield posts. Remove the two safety nuts and bolts to loosen roof panel from windshield header. Remove the two anglewashers between the roof panel and the windshield header.
- (2) Remove the safety nuts, bolts, and washers that fasten the roof panel to

the back panel. Remove the roof panel from the windshield header and back panel and remove the rubber strip seal.

b. Back Panel (Fig. 623).

- (1) Remove the safety nuts, washers and bolts securing back panel to cab body.
- (2) Lift back panel off cab body and remove robber seal.

c. Install Buttons. Install buttons previously removed from vehicle to top of each windshield post. Install crossbars, side roof rails, and paulin to vehicle.

495. Inspection, Cleaning and Repair

a. Use mineral spirits paint thinner or dry-cleaning solvent to clean or wash gresse from all metal parts of hard-top enclosure kit. Use a soap solution of one-fourth pound of soap chips to a gallon of hot water to clean the rubber strip seals and for all general cleaning purposes.

b. Inspect the roof and back panel for chips, cracks and concentricity. Check panels for concentricity. If warped or otherwise damaged beyond minor repair, replace with new component.

Section VIII. POWER PLANT HEATER KIT

496. Description

a. Power Plant Heater Kit.

- (1) Kit. The Power"plant heater kit is for use only in areas where the normal temperature during the coldest period of the year is -25°F. and lower.
- (2) General. The chief components of the power plant heater kit are described in (3) through (7) below and are illustrated in figures 625, 626, 627, and 629.
- (3) Engine thermostats. The standard bellows-type thermostats, which start to open within 140° to 155°F. and are fully open at 170°F., are replaced by either bellows or element-type engine thermostats that start to open at 180°F.
- (4) Slave receptacle. The slave receptacle serves to receive the plug of the service cable leading from the cold-darting aid kit (slave kit), when auxiliary battery starting power is needed. Boosting of batteries may be required in subzero temperatures, particularly when batteries are "cold-soaked" from long exposure.

Nat.. The slave receptacle was installed on early vehicles only; if required for later vehicles, it will be supplied separately.

- (5) Engine heaters. Two electrically operated heaters, using gasoline from the vehicle fuel system, are mounted on the

frame in the battery compartment of the vehicle. These heat the coolant to facilitate starting and to maintain near-normal engine operating temperature during standby periods. Exhaust gases from the front heater pass through tubing to the oil pan shroud for warming the crankcase lubricant; exhaust gases from the rear heater pass through tubing to the transmission housing for warming the transmission lubricant. The heaters are not designed for use while the vehicle is in motion, but for overnight or standby heating of the coolant and the crankcase lubricant when the engine is stopped.

Caution: This type of heater must not be used in closed areas occupied by personnel.

- (6) Battery box and accessories. The battery box and cover are provided with complete interior insulation and heating pad to maintain batteries at temperatures necessary for normal input and output voltages of the battery. Separate lines attached to the battery box heating pad and engine block permit heated coolant to circulate through the heating pad in the battery of the batter box.
- (7) Covers. Covers are attached to the engine hood, brush guard, and the hood right-and-left-side panels to help retain heat in the engine compartment. These covers do not interfere with the opening of the hood.

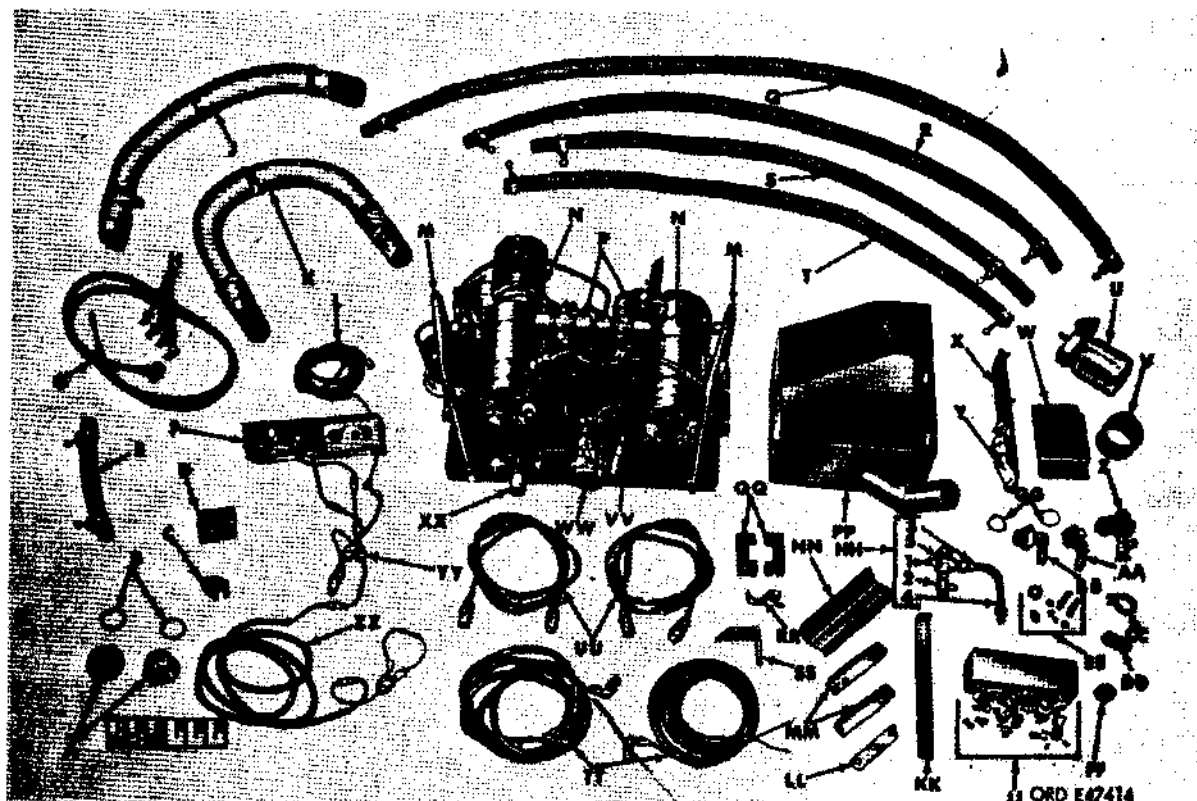


Figure 625. Power plant heater components

| <u>Key</u> | <u>item</u> | <u>Key</u> | <u>Item</u> |
|------------|--|------------|---|
| A | Engine thermostats | T | 51-in. coolant hose |
| B | Thermostat rubber gaskets | U | Alcohol evaporator jar and evaporator jar bracket |
| C | Tube retainer | V | Evaporator-to-air compressor tube |
| D | Harness grommet | W | Power plant heater instruction plate |
| E | 11-1/2-in. coolant hose | X | Coolant hose support |
| F | Heater control boxes | Y | Hose clamps |
| G | Heater fuel line with tee | Z | Aquastat, shutoff cock, bushing, and switch element |
| H | Harness clamps | A A | Bushing with 45-degree hose connection |
| J | 31-in. rear heater exhaust tube, clamp, and mounting bracket | B B | Bushing with 90-degree hoses connection |
| K | 33-in. front heater exhaust tube | C C | 1-1/4-in. rubberized clamp |
| L | Fuel pump power lead | D D | Large adapter plate |
| M | Carrying handles | E E | Evaporator attaching parts |
| N | Engine heaters | F F | Small adapter plate |
| P | Fuel control valves | | |
| Q | 83-in. coolant hose | | |
| R | 62-in. coolant hose | | |
| S | 50-in. coolant hose | | |

Figure 625. Power plant heater components - legend

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|-------------------------------|------------|--------------------------------------|
| G G | Bushing rubber gaskets | PP | Oil pan shroud |
| H H | Aquastat with line assembly | Q Q | Grommet retainers |
| | 1- Aquastat | R R | 1-1/2-in. harness clamp |
| | 2- Shutoff cock | SS | Evaporator mounting bracket |
| | 3- 3/8 x 1/2 connector | T T | Front and rear heater aquastat wires |
| | 4- 1/2-in. line | U U | Engine heater control cables |
| | 5- Switch element nut | V V | Accessory bracket |
| JJ | Attaching hardware | WW | Fuel pump |
| K K | Oil-pan-shroud mounting strap | x x | Fuel filter |
| L L | Pivot bar | Y Y | "Y" -connector |
| MM | Leg extensions | Z Z | Heater power leads |
| NN | Heat shield | | |

Figure 625. Power plant heater components - legend - continued

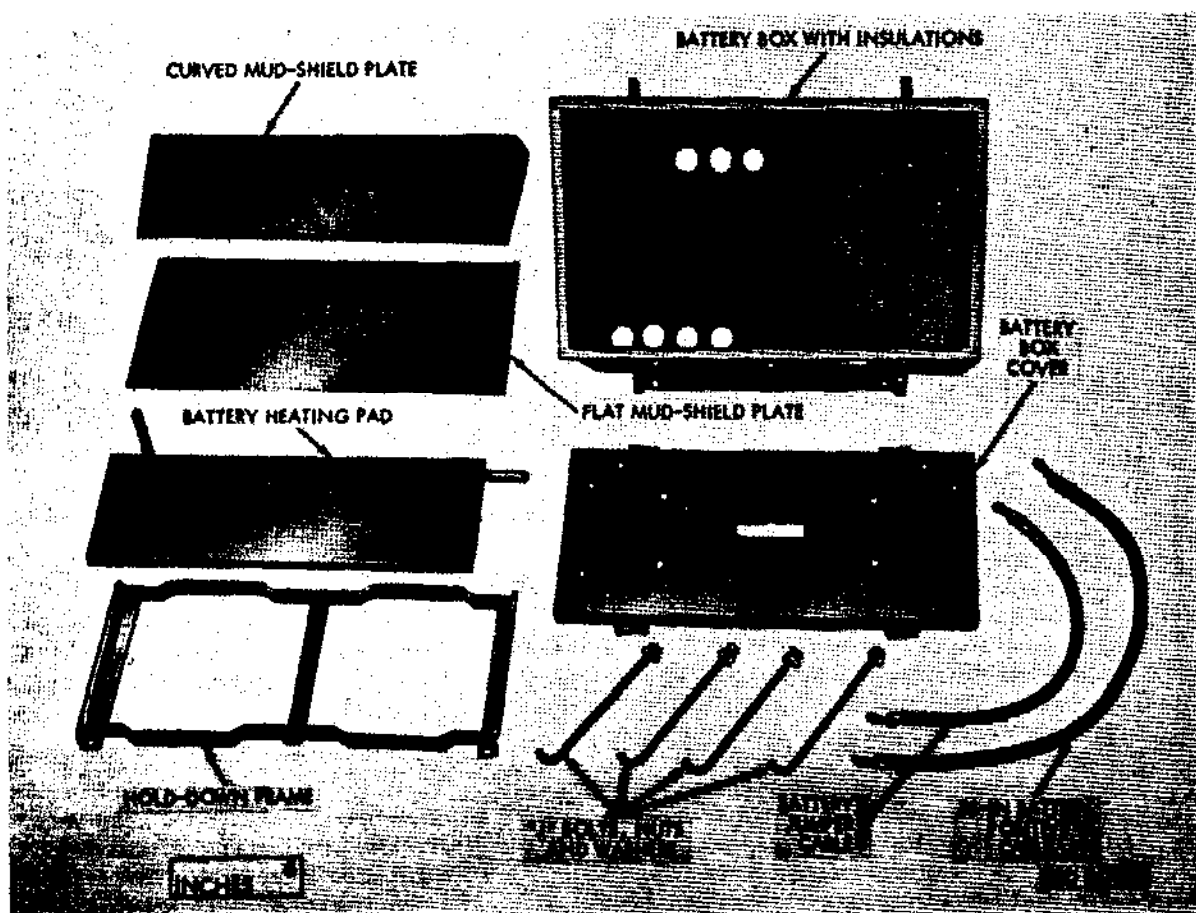


Figure 626. Battery box components

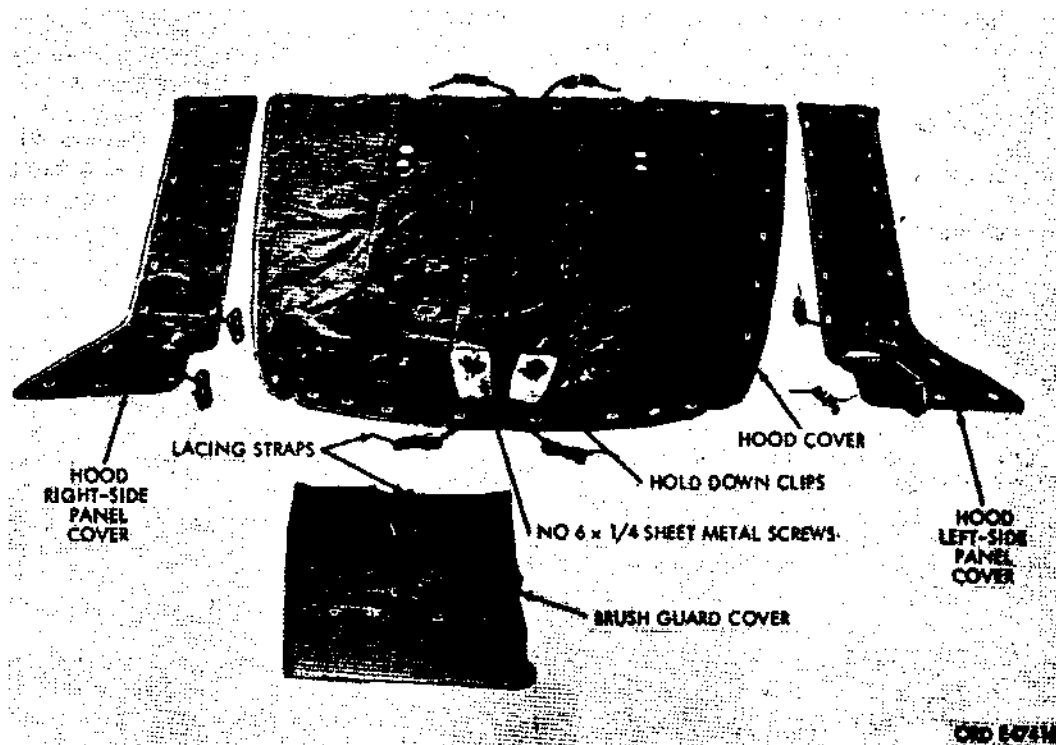


Figure 627. Brush guard, hood, and hoodside panel covers

b. Cold-starting Aid Kit (Slave Kit) M40 (Fig. 628).

- (1) This portable unit, commonly called "Slave Kit," is not a part of the arctic winterization kit, but is provided for troop units equipped with winterization equipment (SB 9-16).
- (2) The slave kit is designed to provide an auxiliary source of electrical energy to aid in starting engines in ambient temperatures as low as -70°F. by providing booster starter current when vehicle batteries are cold and of low charge. A slave receptacle is provided to receive the cable from the slave kit.
- (9) The slave kit also provides heat through a duct to the engine compartment, storage batteries, improperly lubricated sealed bearing, and other locations, where lubricant may have congealed or ice may have formed sufficiently to impede proper functioning.

- (4) For full description and use of the slave kit, refer to TB ORD 390 and SB 9-16.

497. Preliminary Preparation of the Vehicle for Extreme Cold Weather Operations

Note. Except in case of initial installation of complete arctic winterization kit, some or all of these preparations may have been accomplished when the personnel heater kit and hard-top closure kit were installed.

a. Chassis and Power Train.

- (1) In general, all comparatively heavy lubricants specified for temperate zones will be completely eliminated and lubricants especially provided for sub-zero temperatures will be substituted. In some cases, parts are to be left with normal temperate zone lubricant, as in the case of the clutch throw out bearings. Transmission, transfer, differentials, steering gear, and universal joints will

all be thoroughly flushed of all old, temperate zone lubricants and filled with lubricants specified for subzero operation. Partial disassembly to accomplish this work is authorized; complete disassembly will be avoided unless absolutely necessary.

- (2) As soon as the vehicle is completely arctic lubricated, it will be marked in accordance with SR 748-30-10.

b. Engine and Accessories.

- (1) The engine will be flushed several times in order to force all possible old, temperate zone lubricants out of all orifices, pockets, and bearing surfaces of the lubrication system. All lubricant and collected grit must be removed from the armature shafts, Bendix drive, clutch sliding sleeve surfaces, and points involving gear meshing. Gaps at sparkplugs and distributor must be reduced to function satisfactorily under extreme cold conditions.
- (2) Test fan belts for condition and degree of brittleness and for proper tension.

Tension should be less than for normal service conditions.

- (3) Test wiring for condition and degree of brittleness, as shown by cracked insulation and a lack of flexibility. Spray all exposed terminals and cable ends with ignition insulation compound, using care not to coat any contact surfaces (par. 466N).
- (4) Inspect distributor cap, coil, and other plastic items for cracks and accumulation of ice.

c. Storage Batteries. For operation in sub-zero weather, lead-acid type storage batteries will be in good condition and in a fully charged state, i.e., 1.275 to 1.300 specific gravity, readings adjusted to a battery solution temperature of 80°F. A fully charged battery will not freeze at -80°F., but a discharged battery will freeze at 10°F.

d. Cooling System.

- (1) Before introducing antifreeze solution into the engine cooling system for the first time, flush the radiator and water

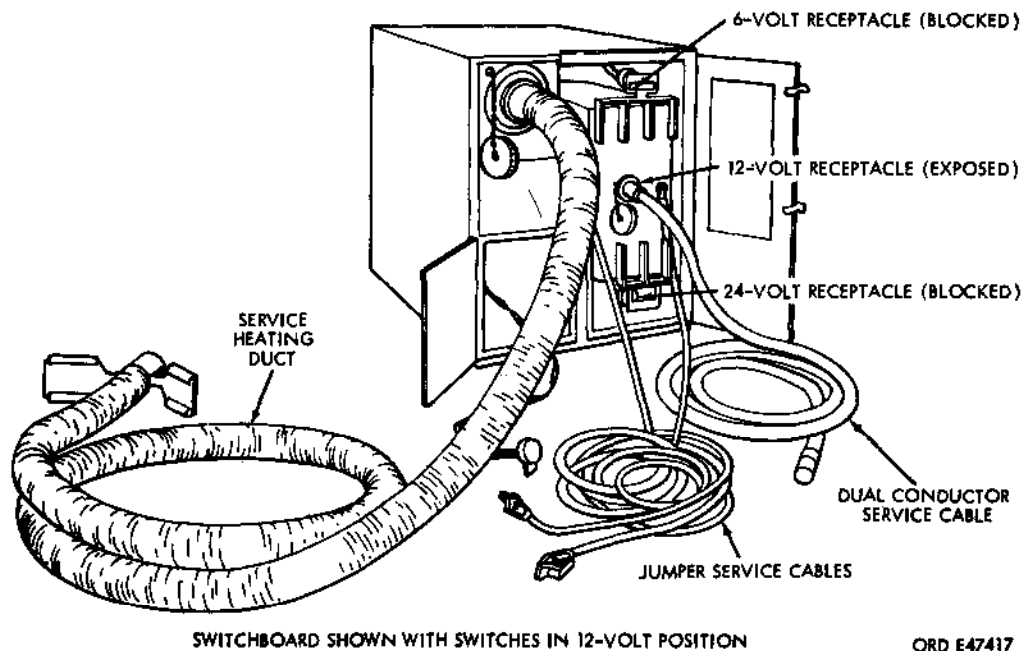
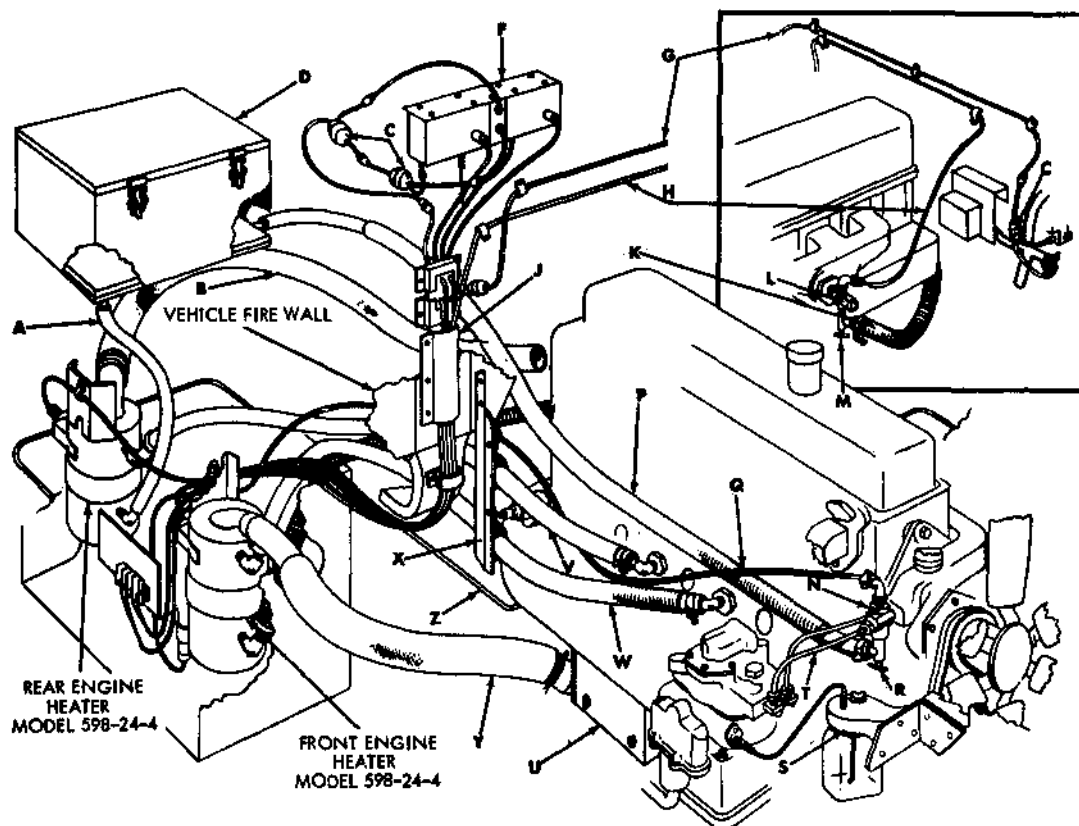


Figure 628. Cold-starting aid kit (slave kit) M40

jackets thoroughly in a reverse direction to normal flow (TM 9-2858). Add water and engine cooling system cleaning compound, start engine, and allow the mixture to circulate at fast idling

speed for about 30 minutes. Disconnect the hoses, as necessary to flush in a reverse direction to normal flow, both the radiator and the cylinder water jackets. Connect the hoses, replacing



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Figure 629. Power plant heater kit - installation view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---------------------------------|------------|----------------------------------|
| A | 11-1/2-in. coolant hose | N | Front heater aquastat |
| B | 31-in. rear heater exhaust tube | P | 83-in. coolant hose |
| C | "Y" connectors | Q | Front heater aquastat wire |
| D | Battery box | R | Front coolant shutoff cock |
| E | Fuel pump wire | S | Alcohol evaporator |
| F | Heater control boxes | T | Air-pump-to-compressor tube |
| G | Rear heater power lead | U | Oil pan shroud |
| H | Rear heater aquastat wire | V | 51-in. coolant hose |
| J | Heat shield | W | 50-in. coolant hose |
| K | 62-in. coolant hose | X | Coolant hose support |
| L | Rear heater aquastat | Y | 33-in. front heater exhaust tube |
| M | Rear coolant shutoff cock | Z | Heater fuel line |

Figure 629. Power plant heater kit - installation view - legend

any that are not in good condition and using a light coating of liquid cement when installing. Make certain that the water pump is in good condition. Look for signs of leaks at the cylinder-head gasket or coolant fittings. Check the radiator core, upper and lower tanks, drain cock, and all connections for assurance of continuous service under hot engine, arctic weather conditions.

- (2) Use ethylene glyco-type antifreeze compound, diluted with water in correct proportion for the anticipated temperature range, when temperatures not lower than -25°F. are anticipated. Use arctic antifreeze compound when temperatures as low as -65°F. are anticipated. In an emergency, when no antifreeze compound is available, denatured alcohol may be used as an antifreeze in the cooling system.
- (3) Drain the entire cooling system (TM 9-2320-211-20).
- (4) Remove the two engine thermostats (TM 9-2320-211-20).

e. Shock Absorbers.

- (1) Remove the shock absorbers (TM 9-2320-211-20).
- (2) Disassemble the shock absorbers, clean, fill with petroleum base hydraulic oil and assemble.
- (3) Install the shock absorbers.

f. Air Cleaner. Remove air cleaner (TM 9-2320-211-20).

g. Batteries and Battery Box.

- (1) Remove the two batteries (TM 9-2320-211-20).
- (2) Discard battery box.
- (3) Remove the four hanger bolts from the top inner sides of the running board hangers (fig. 630).

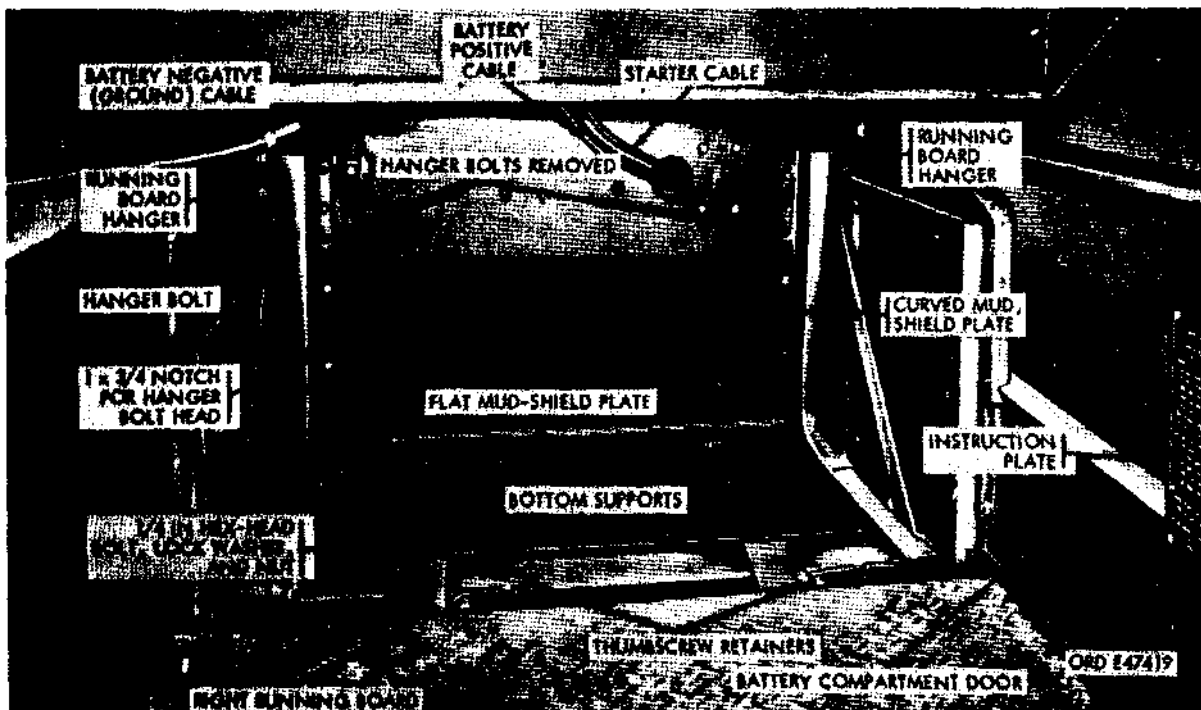


Figure 630. Mud-shield plates installed in original battery compartment

h. Assistant Driver's (Companion) Seat. Remove seat (TM 9-2320-211-20).

498. Installation of Power Plant Heater Kit

a. Mud-shield Plates.

(1) Curved mud-shield plate.

(a) Position the curved mud-shield plate (fig. 626) in the battery compartment, against the running board hangers, so that the curve at the bottom of the plate rests inside the curve of the running board hangers (fig. 630). Scribe the location of the hanger bolt head on the plate, cut out a notch 1-inch wide by 3/4-inch deep, and install hanger bolt (fig. 630).

(b) Using the holes in the plate as a template scribe and drill four 5/16-inch holes through running board hangers and install the four 1/4-inch hex-head bolts, lockwashers, and nuts (fig. 630).

(2) Flat mud-shield plate.

(a) Position the flat mud-shield plate (fig. 626) on the two bottom supports in the battery compartment, with edges equally spaced, as shown in figure 630.

(b) Using the holes in the plate as a template scribe and drill four 5/16-inch holes through the bottom supports, and install the four 1/4-inch hex-head bolts, lockwashers, end nuts (fig. 630).

b. Battery Box

(1) Remove the three oblong knockout plugs from the floor of cab (fig. 631).

Note. If there are no oblong knockout plugs, use dimensions shown in figure 631 to locate holes.

(2) Remove the knockout plug from the right side of transmission tunnel rear section (fig. 631).

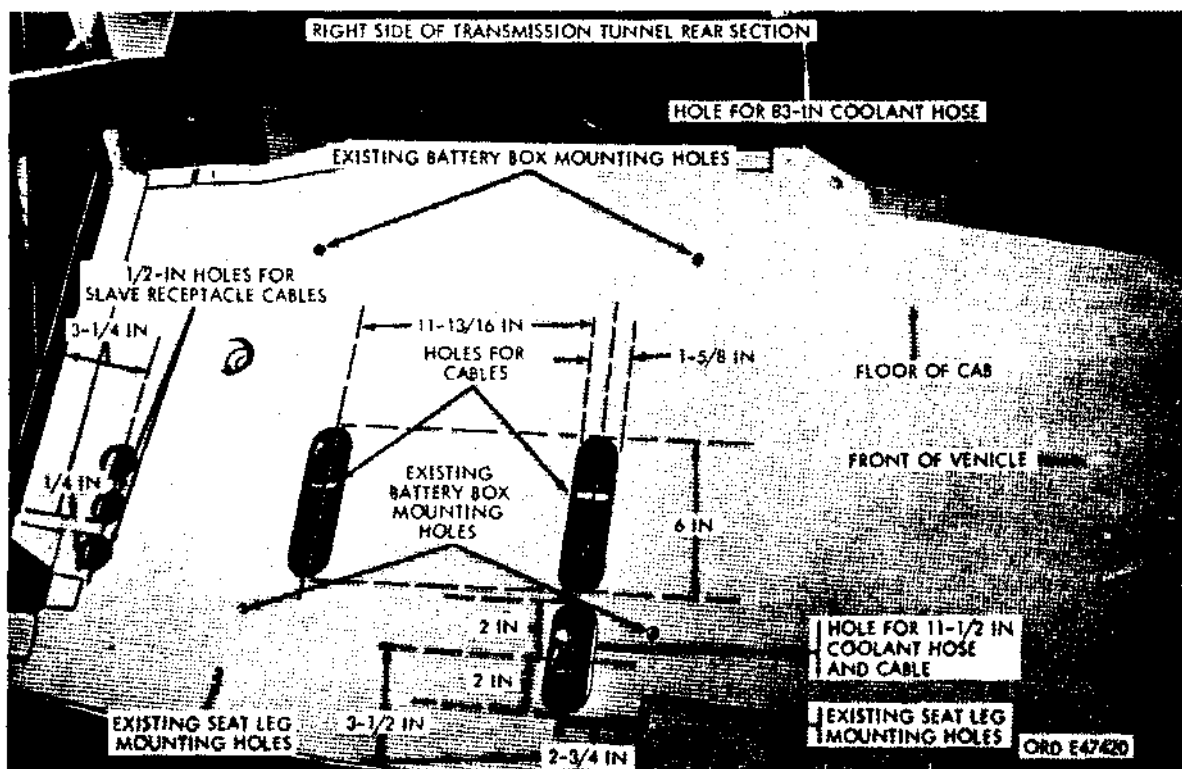


Figure 631. Holes for coolant hoses and cables in floor of cab

- (3) Remove the two knockout plugs from the slave receptacle cable holes on the floor of cab (fig. 631).

Note. If there are no knockout plugs, use the dimensions shown in figure 631 to locate the holes.

- (4) Position the battery box (fig. 626) on the floor where assistant driver's seat was removed so that the holes in battery box are over the holes in the floor, as shown in figure 632.
- (5) Remove a hose clamp from one end of the 83-inch coolant hose (Q, 625) and place the clamp between the right side of transmission tunnel rear section and the battery box (fig. 632), in line with the coolant hose holes in the box and rear section.

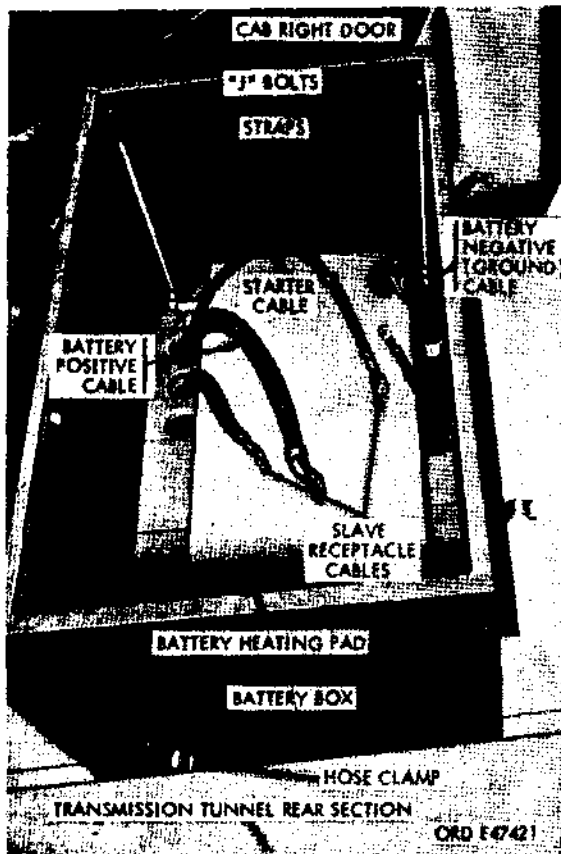


Figure 632. Battery box installed

- (6) Secure the battery box through the existing battery box mounting holes in floor cab, using the four 3/8 x 1 bolts and lockwashers supplied with the battery box. Install insulations in battery box.
- (7) Remove 33-inch positive battery cable coming from the brake solenoid and connect the 36-inch cable furnished in the kit.
- (8) Slide the battery heating pad (fig. 626) into the battery box so that the hose connection on the end of the pad passes through the opening in the left end of the box and also through the hose clamp between battery box and transmission tunnel rear section (fig. 632).
- (9) Hook the four "J" bolts to the straps at the corners on the bottom of the battery box (fig. 632).
- (10) Pass all battery cables from battery compartment up through the holes in floor of cab and through the bottom of the battery box, as shown (fig. 632).
- (11) Place all battery cables out of the way and install the two batteries in the battery box, with the positive (+) terminal posts toward the front, as shown (fig. 633).
- (12) Install the original hold down frame over the batteries and the "J" bolts and secure with the 3/8-inch plain washers, lockwashers, and nuts (fig. 633).

Caution: Do not tighten the nuts on the "J" bolts excessively.

- (13) Install the terminal post lugs on the battery posts and connect battery cables to the lugs on the batteries (fig. 633).
- (14) Connect the original 6-inch battery jumper cable to the positive (+) and negative (-) terminal posts of the batteries (fig. 633).

Caution: Be sure the lugs and the cable terminals do not touch any part of the battery box or holddown frame.

- (15) Latch the battery box cover (fig. 626) to the battery box (fig. 634).

c. Engine Heaters and Accessory Bracket.

- (1) Remove the 3-inch knockout plug from battery compartment front panel (fig. 635). If there is no knockout plug, cut out a 3-inch hole, using the dimensions shown (fig. 635).
- (2) Lift the engine heaters and accessory bracket by the carrying handles (M, fig. 625) and hold in battery compartment, aligning the two top holes in the accessory bracket with the top holes in the running board hanger and install hanger bolts, internal-external teeth lockwashers, and nuts (A, fig. 636). Install the two bottom hanger bolts, internal-external teeth lockwashers, and nuts. Tighten all nuts securely,
- (3) Remove the two heater carrying handles from the accessory bracket and discard.

Note. The twin heaters are identified as front engine heater (I, fig. 636) and rear engine heater (C, fig. 636).

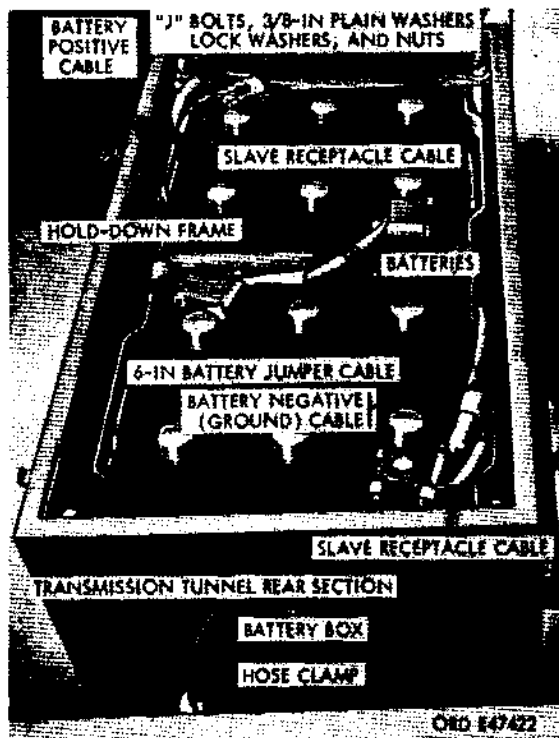


Figure 633. Battery box with batteries installed

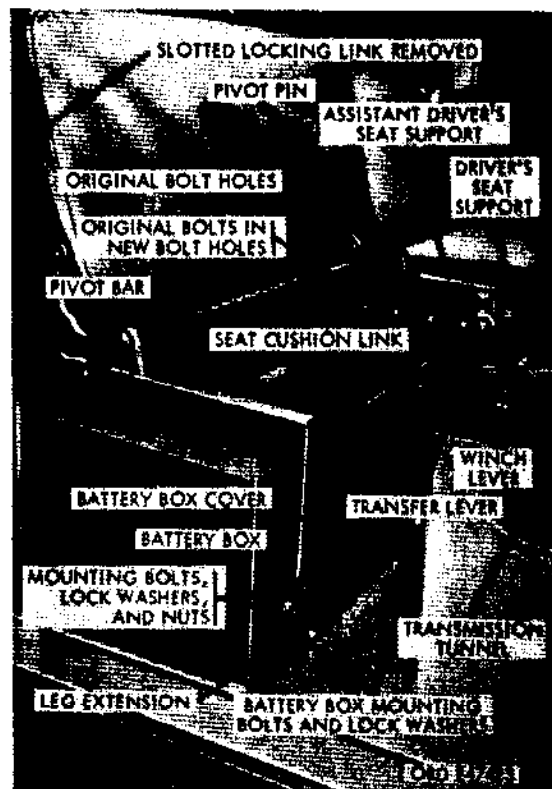


Figure 634. Battery box with cover and assistant driver's seat installed

d. Oil Pan Shroud and Engine Heater Exhaust Tubes.(1) Oil pan shroud.

- (a) Relocate the 1/4-inch holes in oil pan shroud mounting strap (KK, fig. 625) according to dimensions shown in figure 637. Secure strap to oil pan shroud (fig. 637).
- (b) Remove the nuts and lockwashers from the two lower studs of the oil pan inspection plate on the right side of oil pan. Remove oil pan bolt and lockwasher on left side of oil pan (fig. 637).
- (c) Position shroud over oil pan, with the two lower studs passing through the two holes in right side of shroud. Secure oil pan shroud mounting strap at left side of oil pan with oil pan bolt and lockwasher (fig. 637).

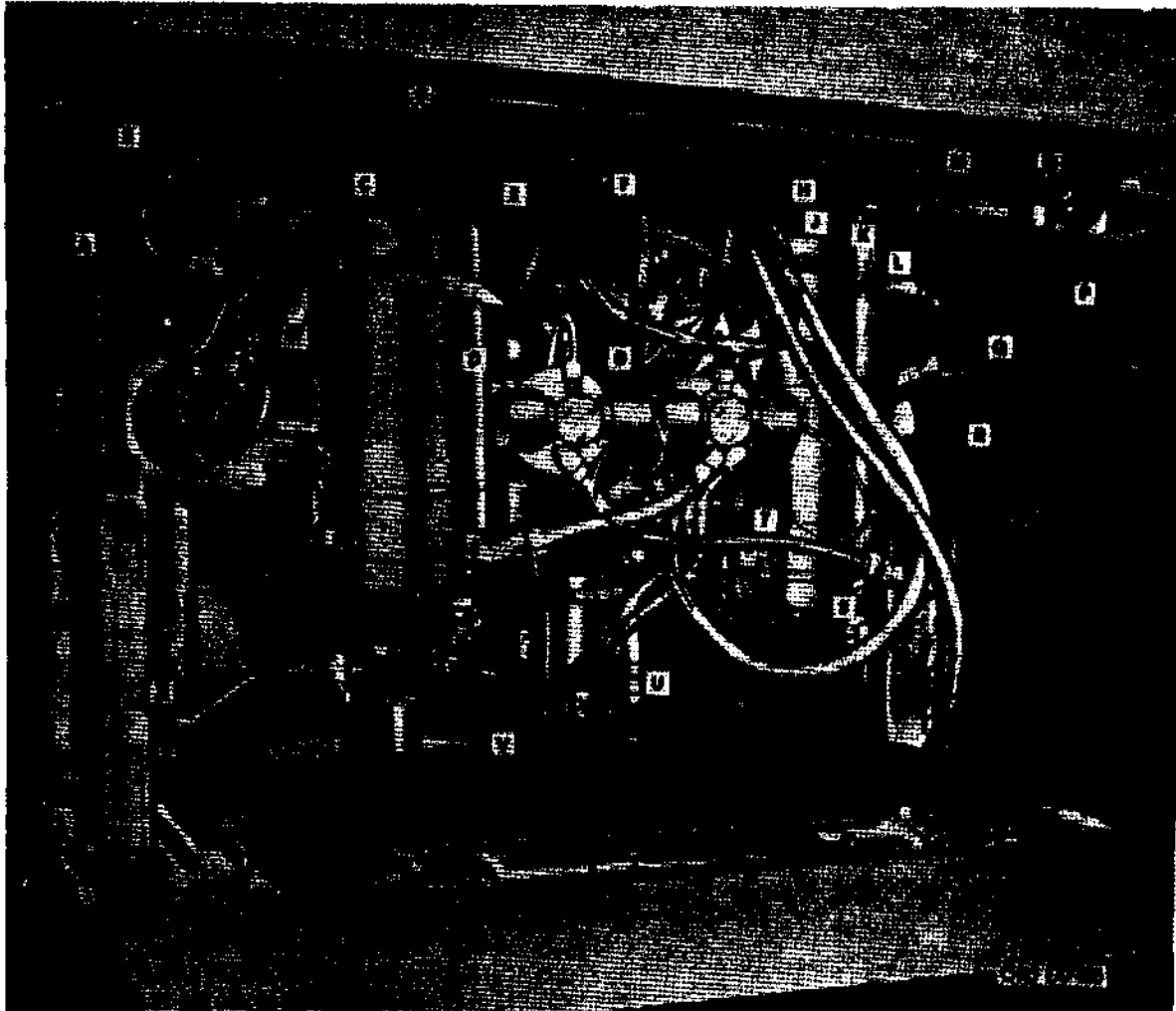


Figure 636. Engine heaters installed

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---|------------|---|
| A | Hanger bolts, internal-external teeth lockwashers, and nuts | M | 1/8 x 3 cotter pin |
| B | Rear heater control cable | N | 33-inch front heater exhaust tube |
| C | Rear engine heater | P | Battery compartment front panel |
| D | Lower hose connection | Q | Front heater upper hose connection |
| E | Upper hose connection | R | Front heater lower hose connection |
| F | 11-1/2-inch coolant hose | S | Fuel pump power lead |
| G | Front heater control cable | T | Terminal strip |
| H | Front heater wire support and 1-1/2-inch clamp | U | Heater fuel pump |
| J | Front heater aquastat wire | V | Heater fuel filter |
| K | Rear heater aquastat wire | W | Heater fuel line |
| L | Front engine heater | X | Accessory bracket |
| | | Y | Rear heater wire support and harness clamps |

Figure 636. Engine heaters installed - legend

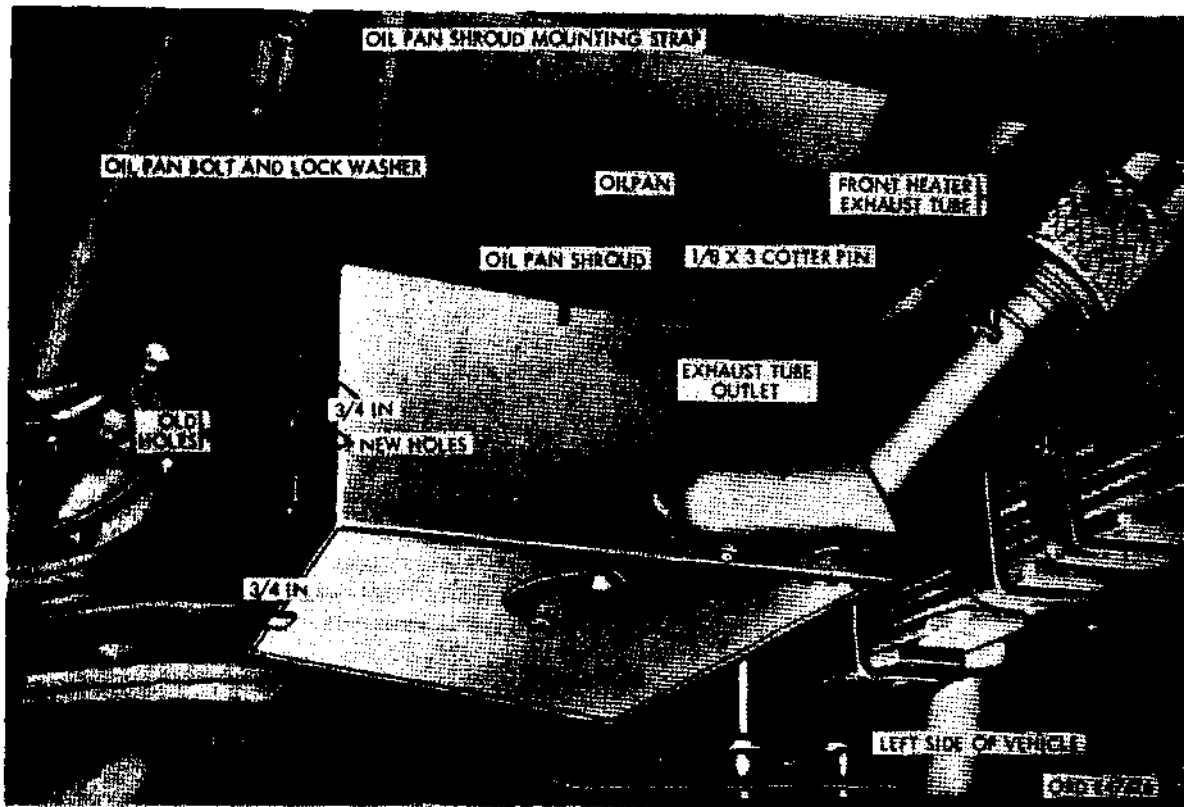


Figure 637. Engine oil-pan shroud and end of front heater exhaust tube installed

- (2) Water pump-to-air compressor line. Disconnect the 1/2-inch coolant line from the water pump and the air compressor on the right side of the engine and discard line.
- (3) Front heater aquastat.
 - (a) Remove the shutoff cock, 1/2-inch line, and switch element from aquastat with line assembly (HH, fig. 625).

Caution: Handle switch element carefully.

Note. In some kits, the shutoff cock and 1/2-inch line may not be assembled to the aquastat.

- (b) Screw the male pipe end of the aquastat into the water pump (fig. 641) in place of the original 1/2-inch line and install switch element.

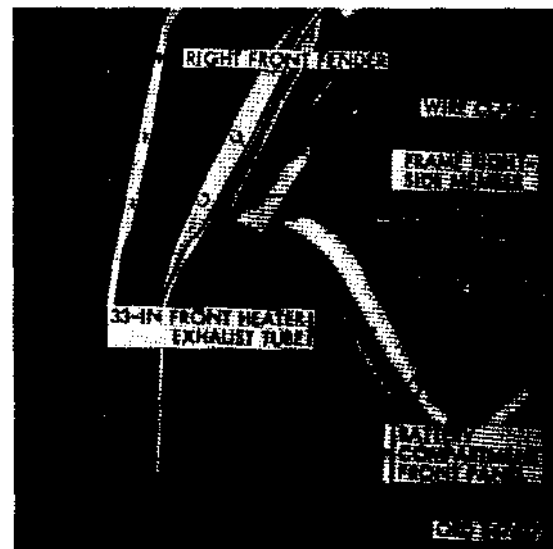


Figure 638. Front heater exhaust tube installed through panel hole

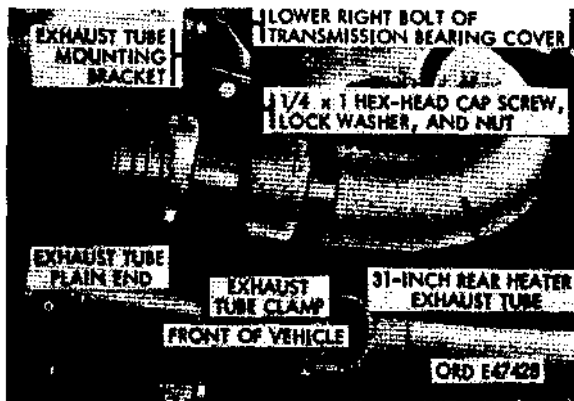


Figure 639. Rear heater exhaust tube installed under transmission housing

- (c) Install the shutoff cock (HH, fig. 625) in bottom opening of aquastat housing (fig. 641). Shutoff cock outlet must face rearward.
- (d) Install the 3/8 x 1/2 flared tube connector (HH, fig. 625) in opening of aquastat (fig. 641). Tighten connector.
- (e) Install the 1/2-inch line (HH, fig. 625) between the aquastat housing and air compressor (fig. 641).
- (4) Coolant hose from battery heating pad to right heater aquastat.
 - (a) Remove transmission tunnel front section, as shown (fig. 642).
 - (b) Remove the hose clamp from one end of the 83-inch coolant hose (Q, fig. 625) working from right-hand side of engine, pass the end without the hose clamp between the exhaust manifold and the engine block, rearward underneath the tunnel to the left of the gear shift lever (fig. 642), between the transfer and winch levers under the transmission tunnel rear section, through the hole in the right side of the transmission tunnel rear section and hose clamp (fig. 633) and slip end of hose on hose connection of battery heating pad. Connect forward end of coolant hose to the shutoff cock on aquastat (fig. 641). Tighten hose clamps (figs. 633 and 641).
- (5) Coolant hoses from heaters to engine block.

- (a) Remove the rear pipe plug from the right side of the engine block and install bushing rubber gasket (GG, fig. 625) and bushing with 90° hose connection (BB, fig. 625), as shown (fig. 643).
- (b) Pass one end of the 50-inch coolant hose (T, fig. 625) rearward from the 90° hose connection, then outward between the bottom of the cab floor and the frame right-side member, and into the heater compartment and connect this end to the upper hose connection of the front engine heater (L, fig. 636). Connect the forward end of the coolant hose to the 90° hose connection on right side of engine block (fig. 643).
- (c) Remove the front pipe plug from the right side of the engine block and install bushing rubber gasket (GG, fig. 625) and bushing with 45° hose connection (AA, fig. 625), as shown (fig. 643).
- (d) Pass one end of the 51-inch coolant hose (U, fig. 625) rearward from the 45° hose connection, outward between the bottom of the cab floor and the frame right-side member and into the heater compartment and connect this end of the upper hose connection of the rear engine heater (C, fig. 636). Connect the forward end to the 45° hose connection on right side of engine block (fig. 643).
- (6) Rear heater aquastat.
 - (a) Remove the 1-inch pipe plug from the outer side of the water manifold and to the rear of the ignition distributor.

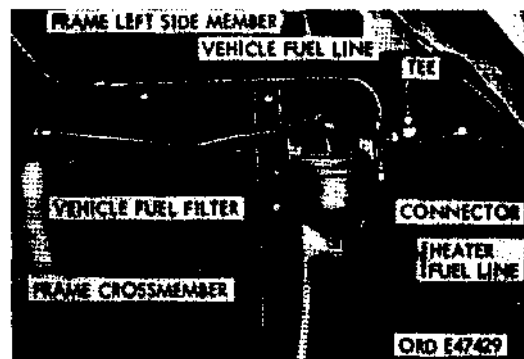


Figure 640. Heater fuel line connection at vehicle fuel filter

Note. Remove the No. 6 spark plug lead at the distributor.

- (b) Remove switch element from aquastat (Z, fig. 625).

Caution: Handle switch element carefully.

- (c) Screw the bushing with aquastat (Z, fig. 625) in place of the 1-inch pipe plug as shown in figure 644. Connector nut should be on top. Install switch element.

(7) Coolant hose from front heater to aquastat.

- (a) Pass one end of the 62-inch coolant hose (R, fig. 625) from the aquastat rearward behind the rear end of engine block, across the top of the flywheel housing (fig. 642) between the bottom of the cab floor and the frame right-side member, and into the heater compartment and connect the end of the coolant hose to the lower hose connection of the front engine heater (L, fig. 636). Connect the other end of the coolant hose to the shutoff cock on the aquastat (fig. 644). Tighten hose clamps.

- (b) Install the transmission tunnel front section.

(8) Coolant hose support.

- (a) Drill two 5/16-inch holes in firewall, using the dimensions shown in figure 642, and secure the coolant hose support (X, fig. 625) and hose clamps (Y, fig. 625) with two 1/4-inch bolts, lockwashers, and nuts as shown (figs. 642 and 645).
- (b) Clamp the 50-inch coolant hose and the 51-inch coolant hose to the coolant hose support (fig. 645).

h. Assistant Driver's Seat (Fig. 634).

- (1) Secure a leg extension (MM, fig. 625) to each seat leg at the right end of the seat frame.
- (2) Place seat frame in the raised position over battery box.

- (3) Install the four original bolts through the bolt holes along the lower edge of the assistant driver's seat support and through the original bolt holes in the driver's seat support and secure with lockwashers and nuts.

Note. If there is only an upper set of bolt holes in the assistant driver's seat support, hold the support level in the new position, scribe through the four bolt holes in the driver's seat support, remove the support, and drill new bolt holes. The 5/16 x 3/8-hex-head bolt for the seat cushion pivot and the new bar furnished in the kit are not needed for this installation.

- (4) Remove the slotted locking link from right end of seat and return to stock.
- (5) Attach the leg extensions to the floor of the cab.
- (6) Place seat cushion in position in seat frame and insert pivot pins in place at each end of seat cushion. Secure seat cushion link at left end of the seat to the cushion brace.

i. Aquastat Wires (Fig. 646).

(1) Front heater aquastat wire.

- (a) Pass the two-terminal end of the front heater aquastat wire (TT, fig. 625) (wire is tagged No. 2) from the front heater aquastat rearward between the engine block and the exhaust manifold, down between the cab floor and the frame right-side member, and into the engine heater compartment. Connect the two-terminal leads of the aquastat wire to the two lower front terminal posts of the terminal strip (T, fig. 636).
- (b) Attach the electrical connector on the other end of the aquastat wire to the top of the aquastat (fig. 641).
- (c) Clamp the aquastat wire to the coolant hose support with a harness clamp (fig. 645). The upper hose clamp bolt in the coolant hose support is also used to mount the harness clamp.

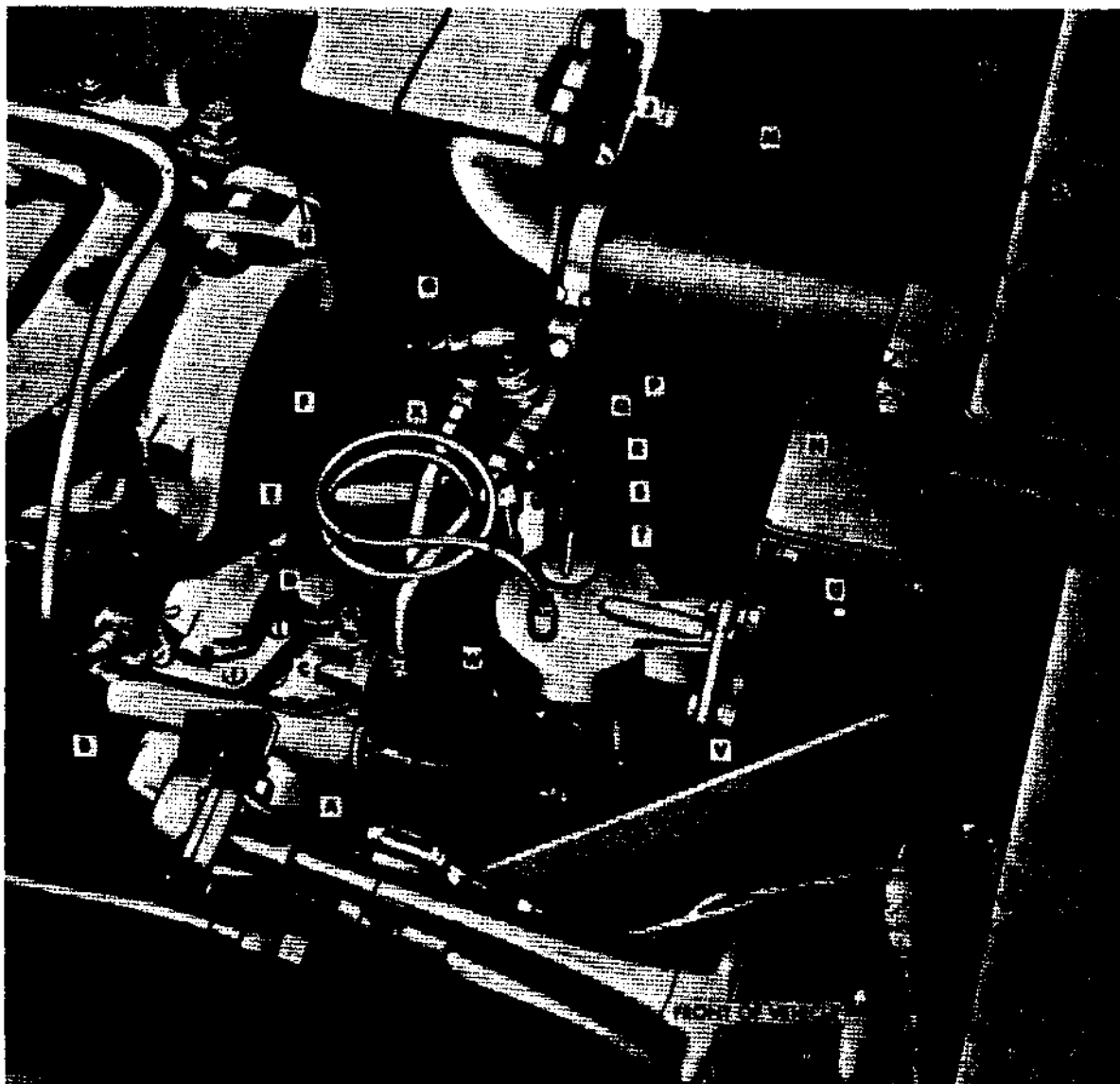


Figure 641. Engine thermostat housing, front heater aquastat, and alcohol evaporator installed

| Key | Item | Key | Item |
|-----|---|-----|--------------------------------------|
| A | Adapter plate | M | Hose clamps |
| B | Air compressor | N | Radiator inlet hose |
| C | 1/2-inch line from air compressor to aquastat | P | Water pump |
| D | 83-inch coolant hose | Q | Aquastat |
| E | Evaporator line | R | Bypass hose clamp |
| F | Front heater aquastat wire | S | Shutoff cock |
| G | Aquastat connector | T | Bypass hose |
| H | Water manifold | U | Evaporator mounting bracket |
| J | Thermostat housing | V | Evaporator jar bracket |
| K | Radiator stay rod bracket | W | Hose clamp |
| L | Fan shroud | X | 3/8 x 1/2-inch flared tube connector |

Figure 641. Engine thermostat housing, front heater aquastat, and alcohol evaporator installed - legend

(2) Rear heater aquastat wire.

- (a) Pass the two-terminal end of the left aquastat wire (TT, fig. 625) (wire is tagged No. 1) from the aquastat on the left side of the engine, rearward to the

firewall, along the front of the firewall to the right side of the engine, then downward and rearward between the cab floor and the frame right-side member, and into the heater compartment. Connect the two terminal leads

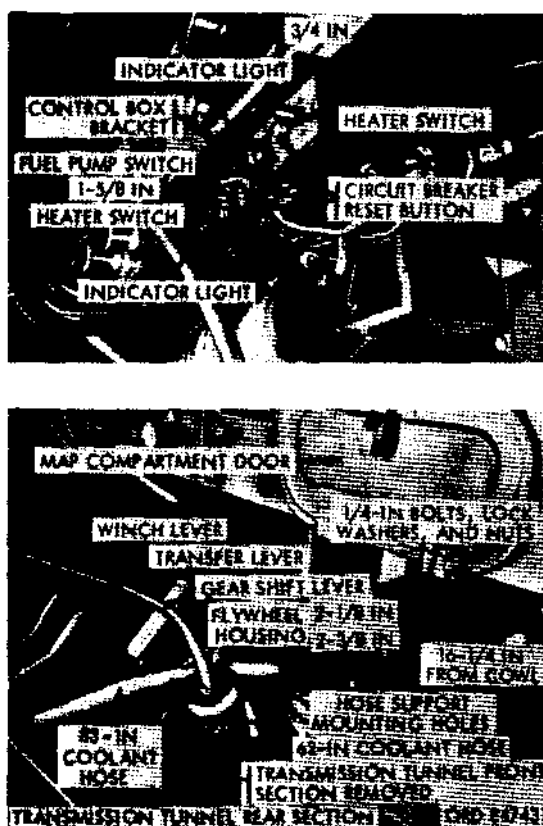


Figure 642. Left and right coolant hose passing over flywheel housing

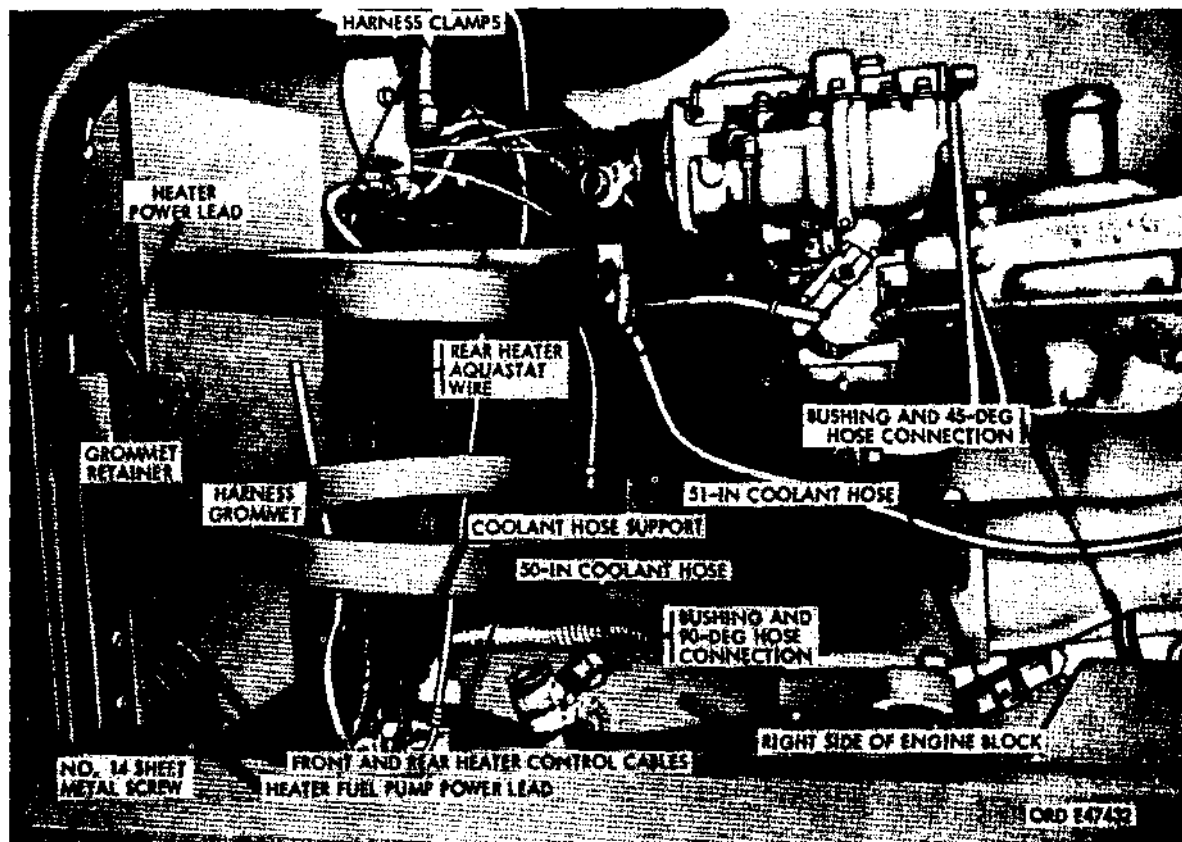


Figure 643. Front and rear coolant hose connections installed on right side of engine block

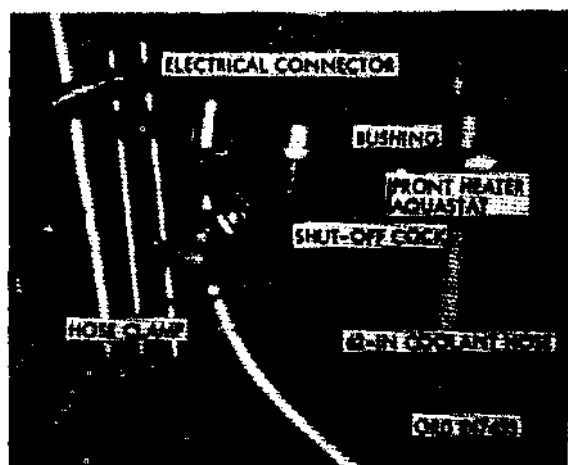


Figure 644. Aquastat installed on left side of engine

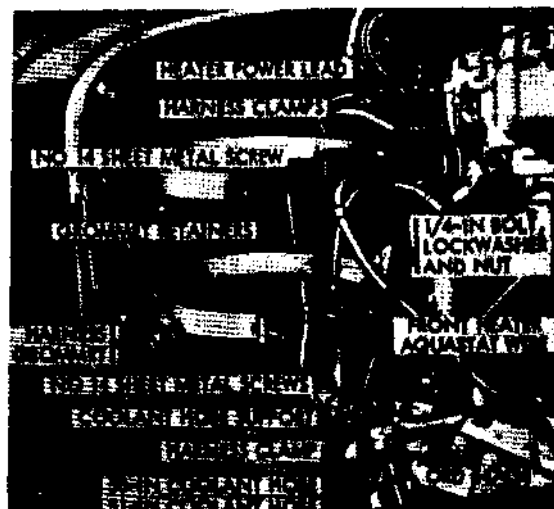


Figure 645. Coolant hose support installed

of the aquastat wire to the lower rear terminal posts of the terminal strip (T, fig. 636).

- (b) Place two harness clamps over the aquastat wire, as shown in figure 642, scribe holes and drill two 1/8-inch holes through firewall, and secure harness clamps with two No. 14 sheet metal screws.
- (c) Attach the electrical connector on the other end of the aquastat wire to the top of the aquastat (fig. 644).

j. Heater Control Boxes and Electrical Connections.

(1) Control boxes.

- (a) Reposition the heater control boxes on the control box bracket so that right heater control box with fuel pump switch panel is 3/4-inch and left heater control box is 1-5/8 inches back of

lip on control box bracket (fig. 642). Hold the control box bracket, with two heater control boxes, on the bottom flange of the instrument panel, leaving at least 1/2-inch clearance between the right edge of the control box and the left edge of the glove compartment door (fig. 642), and scribe and drill four 7/32-inch mounting holes in the bottom of the instrument panel.

- (b) Attach the control box bracket and the boxes, to the bottom flange with two No. 10 screws.

(2) Electrical connections (fig. 646).

- (a) Check the location of the 2-inch knock-out plug on the right-hand side of the firewall. If the plug is in the lower right corner, near the lower supporting band (fig. 647), proceed as in (b) below; if the plug is between the air cleaner mounting brackets (fig. 647), proceed as in (c) below.

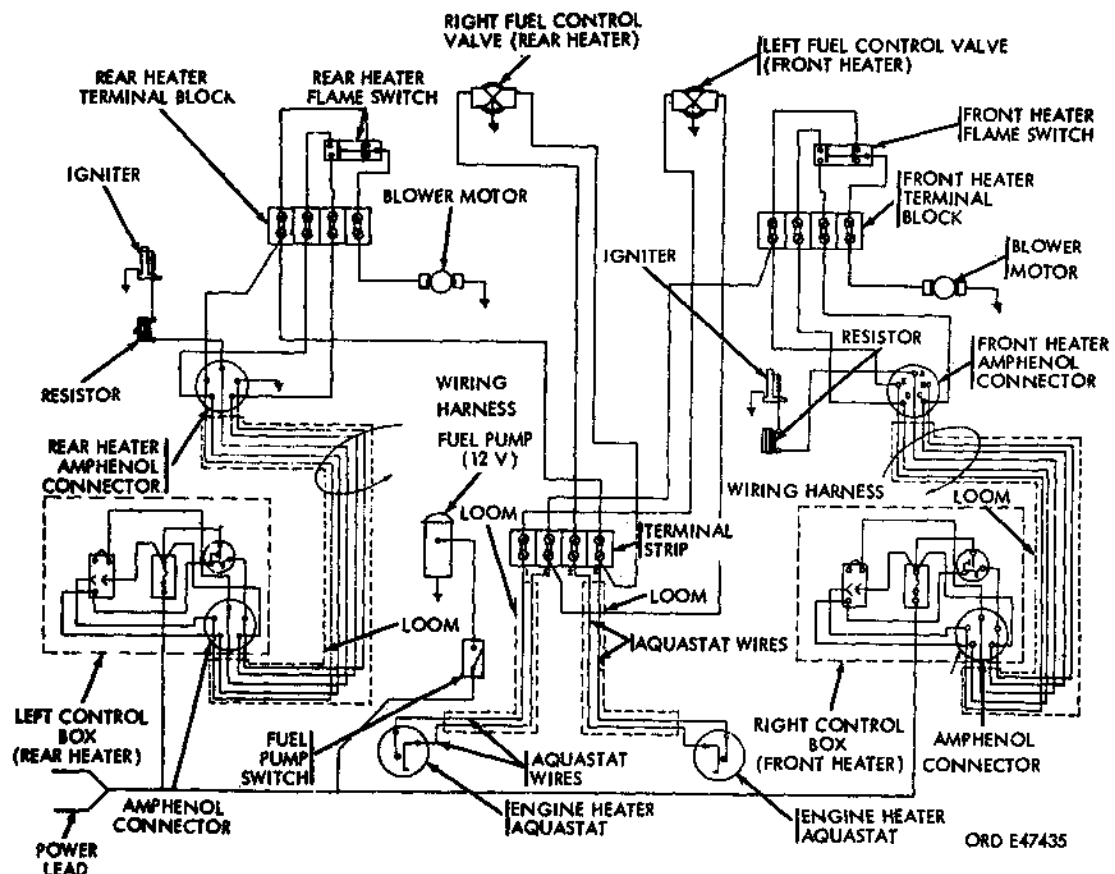


Figure 646. Wiring diagram

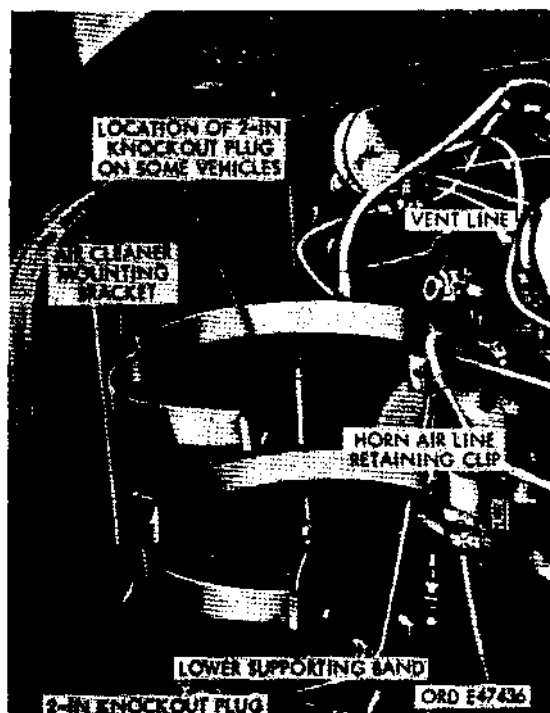


Figure 647. Location of 2-inch knockout plugs on right side of firewall

- (b) Remove the knockout plug, pass the heater fuel pump power lead, front and rear heater power cables, and heater power lead through the 2-inch hole, and clamp all four cables to the firewall with a 1-1/2-inch clamp, bolt, and nut, as shown in figure 648. Fit the harness grommet (D, fig. 625) to the four cables passing through the 2-inch hole, drill four No. 8 holes in firewall, using the grommet retainers (QQ, fig. 625) as templates, and attach the grommet retainers with four No. 14 sheet metal screws (fig. 643). Hold the heat shield (NN, fig. 625) as a template over the four cables and the 2-inch hole, drill three No. 8 holes in firewall, and secure the heat shield with three No. 14 sheet metal screws (fig. 648). Pass the heater power lead alongside the firewall, drill No. 8 holes at three locations, and secure lead with three harness clamps and No. 14 sheet metal screws (fig. 645). Use a 1-1/4-inch rubberized clamp to attach the three cables to the fender splash pan.

Remove the knockout plug from firewall, between air cleaner mounting brackets, pass the heater fuel pump power lead, front and rear heater power cables, and heater power lead through the 2-inch hole and clamp all four cables to the bottom of the map compartment with a 1-1/2-inch clamp bolt, and nut. Fit the harness grommet (D, fig. 625) to the four cables passing through the 2-inch hole, drill four No. 8 holes in firewall, using the grommet retainers (PP, fig. 625) as templates, and attach the grommet retainers with four No. 14 sheet metal screws (fig. 649). Hold the heat shield (NN, fig. 625) as a template over the four cables about 1-1/2-inches below the 2-inch hole, drill three No. 8 holes, and attach the heat shield with three No. 14 sheet metal screws (fig. 649). Pass the heater power lead alongside the firewall, drill No. 8 holes at three locations, and secure lead with three harness clamps and No. 14 sheet metal screws (fig. 645). Use a 1-1/4-inch rubberized clamp to secure the cables passing through the heat shield and also rear heater aquastat power wire to the firewall (fig. 649)

- (d) Disconnect the Douglas connector from the vehicle wire No. 15 (No. 37 on early vehicles) at the circuit

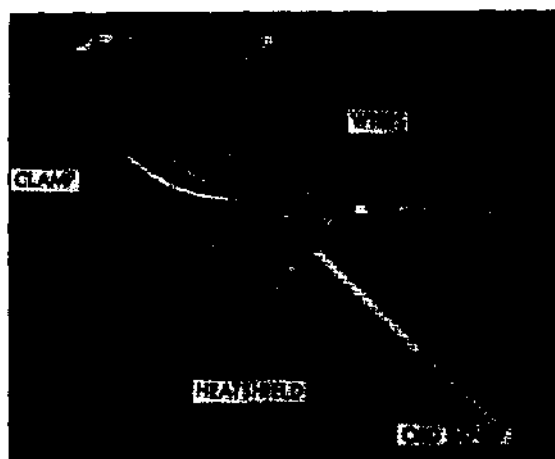


Figure 648. Wire secured to firewall and heat shield installed

breaker on left-hand side of firewall and connect one end of the "Y"-connector to the circuit breaker and the other end to the connector on the vehicle wire No. 15 (or No. 37) as shown (fig. 650).

- (e) Pass the front and rear heater control cables and the heater fuel pump power lead rearward between the cab floor and the frame right-hand member into the engine compartment.
- (f) Connect the rear heater control cable to the rear engine heater and the front heater control cable to the front engine heater. Pass the heater fuel pump power lead through the grommet and hole in the fuel control valve bracket and connect it to the Douglas connector on the heater fuel pump (U, fig. 636).
- (g) Attach the front and rear heater control cables, front and rear heater aquastat wires, and heater fuel pump lead to the rear side of the front heater wire support (H, fig. 636) with a 1-1/2-inch clamp. Clamp rear heater control cables to the rear heater wire support (Y, fig. 636) with a harness clamp (RR, fig. 625).

k. Operating Instruction Plate and Air Filter.

- (1) With the operating instruction plate (in kit) as a template positioned approximately on the center of the inside of

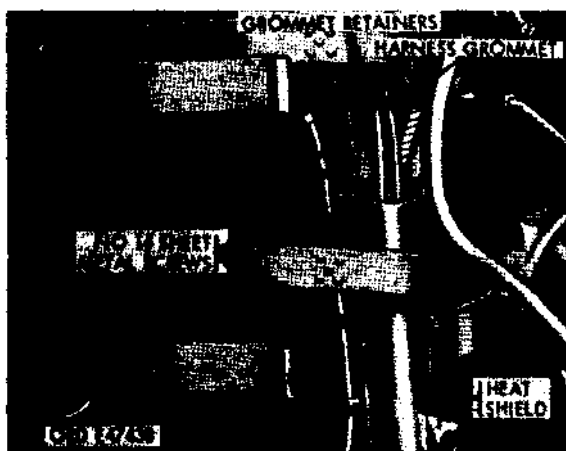


Figure 649. Heat shield harness grommet, and retainers installed

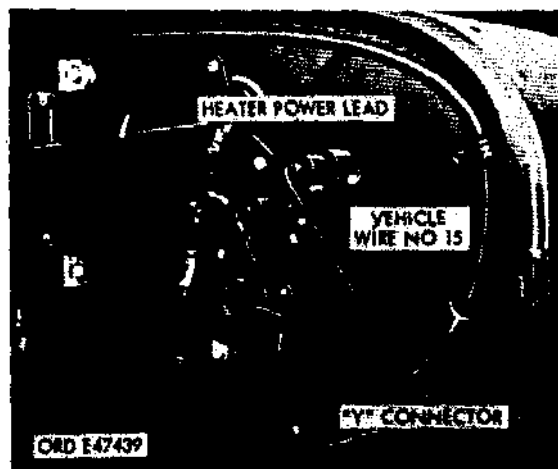


Figure 650. "Y" connections.

the heater compartment door, drill four 3/16-inch holes. Attach the plate to the door.

- (2) Install the vehicle air cleaner and connect all air lines (TM 9-2320-211-20).

L. Slave Receptacle. Remove the slave receptacle cover plate from right-rear corner of cab body and install the slave receptacle.

m. Installation of Hood Covers (Figs. 651 and 652).

- (1) Place the hood cover (fig. 627) on engine hood, and mark the location of each grommet on the edge of hood.
- (2) Place the hood side panel covers (fig. 627) against the side panels and mark the location of the grommets on the side panels.
- (3) Place the brush guard cover against brush guard and mark location of grommets.
- (4) Using a tie-down clip (fig. 627) at location of each grommet, scribe and drill mounting holes with a 1/8-inch drill.
- (5) Mount the tie-down clips with No. 6 x 1/4 sheet metal screws (fig. 627).
- (6) Mount the covers in place and lace the tie straps through the tie-down straps.

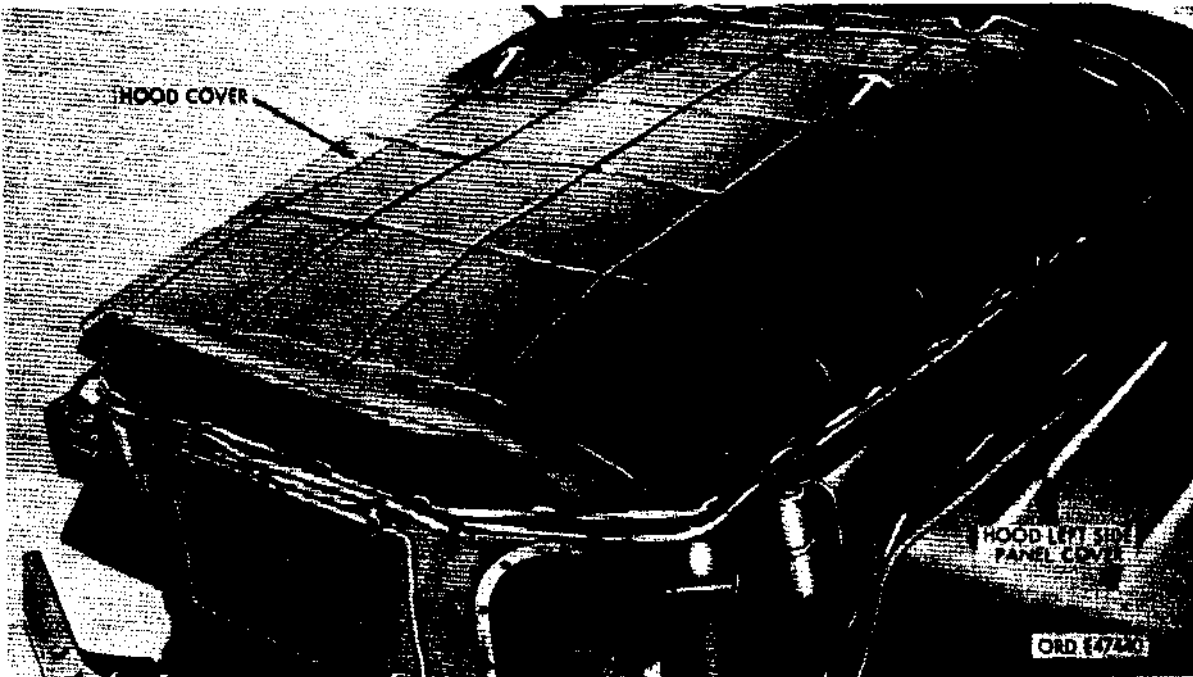


Figure 651. Hood cover brush guard cover, and hood left-side panel cover installed

Note. Fold under the left end of brush guard cover to clear air inlet for personnel heater.

- (7) Test the hood opening, with cover in place.

499. Application of Ignition Insulation Compound

See paragraph 466n for application of ignition insulation compound.

500. Tests and Adjustments

a. Operating Cautions.

- (1) Do not attempt to operate the engine heater until the cooling system is filled with coolant. Immediately after installation of the kit, run the vehicle engine to assure complete removal of any air which may have been trapped in the cooling system.
- (2) When filling the cooling system, be sure that the shutoff cocks in the engine heater's coolant system are open to allow the engine heater and the battery heating pad to fill with coolant. Remove the 1/4-inch pipe plug from the top of the water pump housing to bleed air from the pump.
- (3) The shutoff cocks in the coolant lines of the engine heater system must be open at all times when the engine heaters are operating. The shutoff cocks must be closed whenever the vehicle is operating in ambient temperatures above the minimum recommended in the locality of operations. This avoids overheating the battery.
- (4) The vehicle fuel tank should be filled with arctic grade fuel and the shutoff cock at filter should be open. The storage batteries should be charged and properly connected.
- (5) Each control box operates one heater only; do not start both heaters at the same time.
- (6) Heater compartment door must be open when heaters are operating. Close the door when heaters are not in operation.

b. To Start (One Heater Only).

- (1) Press in circuit breaker reset button (fig. 642).
- (2) Check electrical circuit by pressing in knob on indicator light (fig. 642).
- (3) Move fuel pump switch (fig. 642) to ON position.
- (4) Hold heater switch (fig. 642) in START position until indicator light glows.
- 5) Move heater switch to RUN position.

c. Failure to Start. If either heater fails to start within 5 minutes, stop the heater (**d** below). Heater will require servicing.

d. Stop Heater.

- (1) Move fuel pump switch to OFF position.
- (2) Move heater switch to OFF position and wait for indicator light to go out.

e. Manual Ignition. In the event of failure of the electric igniter, the heater can be ignited manually. Proceed as outlined in (1) through (7) below.

- (1) Hold the heater switch in START position for 1 to 2 minutes and then move to OFF position.
- (2) Unlatch and lower the cover on heater to expose the burner.
- (3) Turn and remove igniter plate (resistor retainer) at bottom of burner.
- (4) Soak a small piece of waste, rag, or asbestos in gasoline.
- (5) Light the improvised torch with a match, push up into burner bowl, and immediately install igniter plate.
- (6) Move heater switch to START position and hold until indicator light glows.
- (7) Move heater switch to RUN position and heater will operate normally.

501. Removal of Power Plant Heater Unit (Fig. 636)

Note. The key letters noted in parentheses are in figure 625 except where otherwise indicated.

a. Disconnect Electrical Connections.

Note. A 5-wire cable from the control panel to the heater, with multiple conductor connectors at each end, permits removal of either the heater or the control panel without disturbing the control installation.

- (1) Remove 5-wire engine heater control cables (UU, fig. 625) from front and rear engine heaters.
- (2) Disconnect the heater fuel pump power lead (L) from heater fuel pump (WW) and from No. 1 terminal on terminal strip (T, fig. 636).
- (3) Disconnect the two-terminal ends of the front heater aquastat wire (TT, fig. 625) from the two lower front terminal posts of the terminal strip (T, fig. 636).
- (4) Disconnect the two-terminal leads of the rear heater aquastat wire (tagged No. 1) from the lower terminal posts of the terminal strip (T, fig. 636).

b. Disconnect Coolant Lines.

- (1) 11-1/2-inch coolant hose (E, fig. 625). Loosen hose clamps and disconnect hose from rear engine heater.
- (2) 50-inch coolant hose (S). Disconnect end of 50-inch coolant hose from upper hose connection of the front engine heater (L, fig. 636).
- (3) 51-inch coolant hose (U, fig. 625). Disconnect 51-inch coolant hose from the upper hose connection of the rear engine heater (C, fig. 636).
- (4) 62-inch coolant hose (R). Loosen hose clamp to permit removal of the 62-inch coolant hose from front engine heater (L, fig. 636).

c. Disconnect Exhaust Tubes.

- (1) 31-inch rear heater exhaust tube (J, fig. 625). Pull out cotter pin, and remove exhaust tube from top outlet of rear engine heater (C, fig. 636).



Figure 652. Brush guard cover and hood right-side panel cover installed

- (2) 33-inch front heater exhaust tube (K, fig. 625). Pull out 1/8 x 3-inch cotter pin (M, fig. 636) and slip 33-inch front heater exhaust tube from top outlet of front engine heater.

d. Disconnect Fuel Line (G, Fig. 625). Loosen heater fuel line (W, fig. 636) at heater fuel filter (V, fig. 636) and detach from filter.

e. Remove Engine Heaters (N, Fig. 625). Remove four nuts, four internal-external-teeth lockwashers, and four hanger bolts (A, fig. 636) to free the accessory bracket (W, fig. 625) from the running board. Lift out engine heaters by the carrying handles (M) and remove heater unit from the running board of the vehicle.

502. Disassembly of Power Plant Heater Unit

See TM 9-8662 for disassembly of power plant heater.

503. Inspection, Cleaning, and Repair of Heater Unit

See TM 9-8662 for inspection, cleaning and repair of heater unit.

504. Assembly of Power Plant Heater Unit

See TM 9-8662 for assembly of power plant heater unit.

505. Troubleshooting

Refer to TM 9-8662 for troubleshooting procedures on power plant heater.

Section IX. DEEP-WATER FORDING KIT

506. Description

a. The deep-water fording kit provides for engine air intake and exhaust gases above expected water level to enable the vehicle to ford

hard-bottom water crossings up to five feet in depth (fig. 653).

b. Deep-water fording kite (fig. 654) installed on vehicles being used for a single fording operation may be removed and disposed of in accordance with AR 755-5.

c. Installation of kits is authorized under criteria defined in SB 9-155 for the deep-water kit.

507. Installation of Air Cleaner Extension (Fig. 655)

Note. Refer to TM 9-238 before installation.

a. Diesel.

(1) Install air cleaner inlet tube hose (fig. 654).

(a) Unclasp the three air cleaner cover fasteners (fig. 655) on the air cleaner, located on the right front fender of the vehicle. Twist cover upwards one-third of a turn, moving cover from indicated normal position to fording position as indicated on air cleaner.

(b) Slip the air cleaner inlet tube hose over the flange of the open end of the air cleaner cover but do not tighten the two hose clamps (fig. 654) until the air cleaner inlet tube is installed.

(2) Install air cleaner inlet tube (fig. 654). Push the metal air cleaner inlet tube (fig. 655) inside the rubber air cleaner inlet tube hose and secure the metal

tube to the rubber hose with the two inlet tube hose clamps.

(3) Install air cleaner inlet tube cap (fig. 654). Slide the cap (fig. 658) on top of the air cleaner inlet tube and tighten clamp with clamp nut to secure cap to air cleaner inlet tube.

(4) Install air cleaner inlet tube support bracket (fig. 654).

(a) Loosen the two air cleaner clamps (fig. 655) one on each side of the air cleaner cover, so that the air cleaner inlet tube support bracket can slide under the air cleaner clamps mounted on the fender. Tighten the clamp nuts.

(b) Secure upper section of the support bracket to air cleaner inlet tube but do not tighten bottom clamp until the support brace is installed.

(5) Install air cleaner inlet tube support brace (fig. 655). Bolt one end of the support brace (fig. 655) to the gun mount bracket and extend the brace out so that it touches lower clamp of support bracket and bolt this end of the brace to the clamp. Now tighten both clamps.

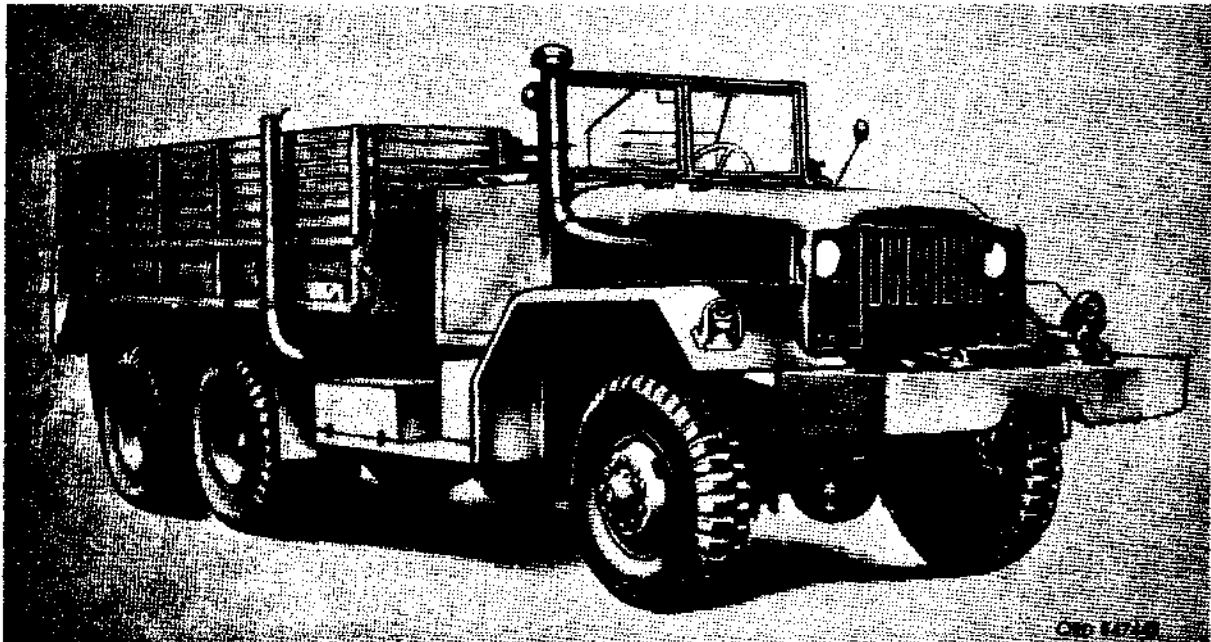
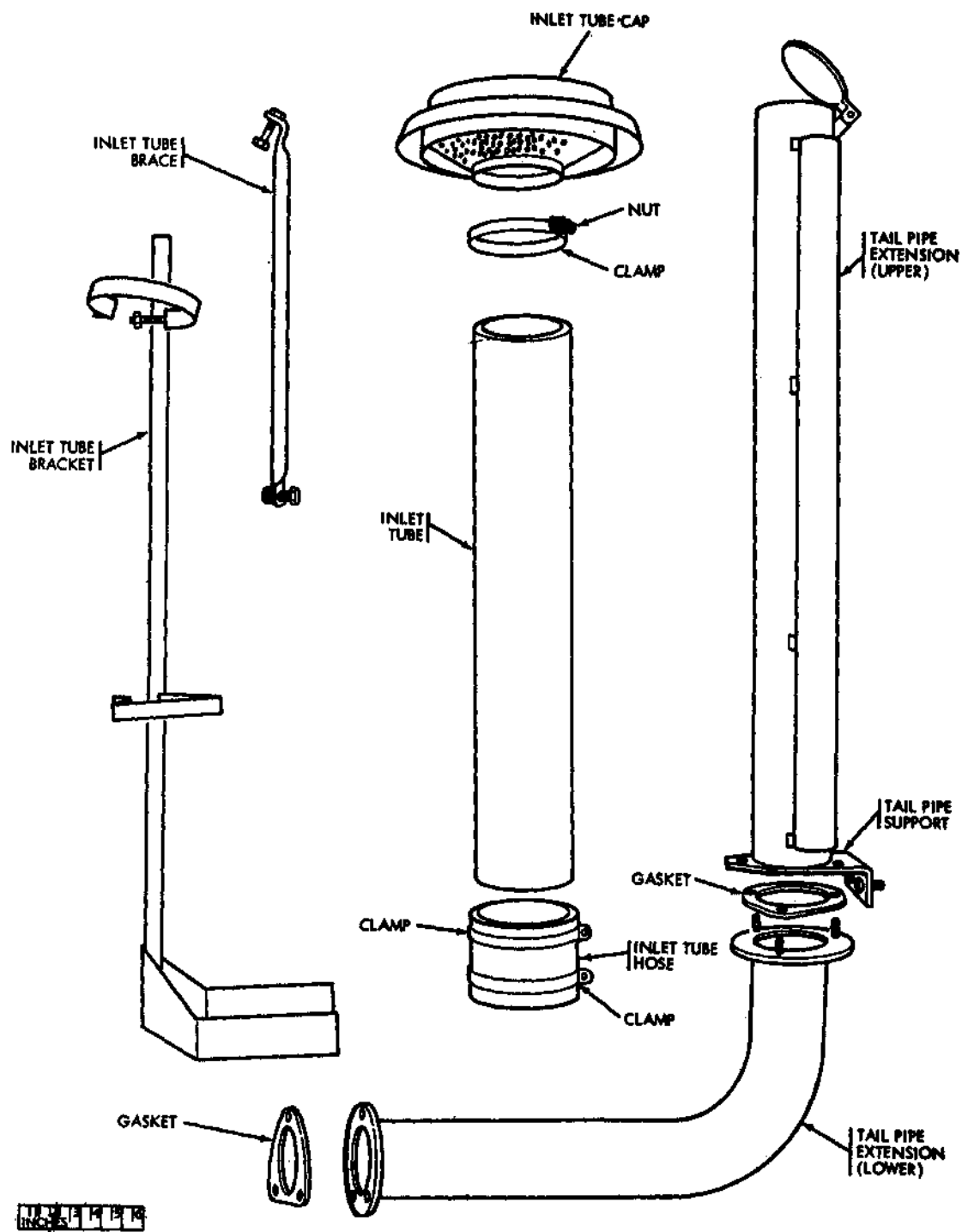


Figure 653. Deep-water fording kit installed - gasoline engine wheeled vehicle



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Figure 654. Air cleaner and tailpipe extensions - diesel

inlet extension on the gasoline engine wheeled vehicle.

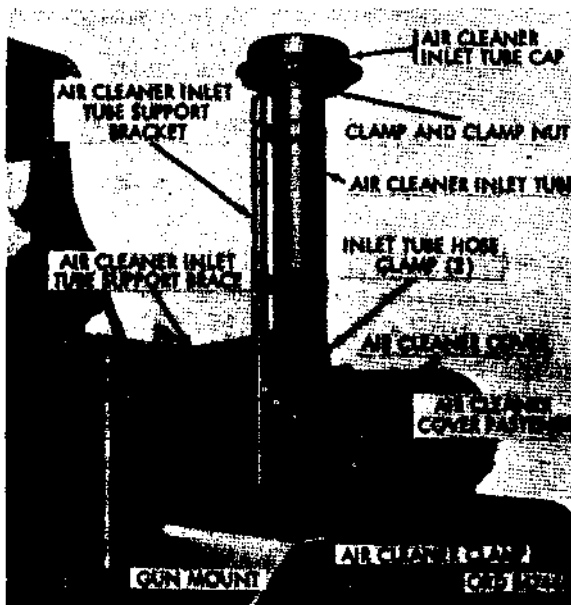


Figure 655. Air cleaner extension installed - diesel

b. Gasoline Engine (Fig. 656).

- (1) Install air cleaner air inlet extension (fig. 656). Slide the three clamps on the air cleaner air inlet extension but do not tighten. Install lower end of extension on air cleaner inlet neck and secure with vent pipe clip.
- (2) Install bottom section of air cleaner extension support assembly to gun mount panel and the top section to the air inlet extension and secure the assembly using two connector clamps for the top as shown (fig. 656).
- (3) Install air inlet cap assembly on air cleaner extension assembly by tightening the cap on the extension assembly.

Note. The right side hood panel must remain open when using the air cleaner

508. Installation of Tailpipe Extension (Fig. 659)

a. Install Exhaust Tailpipe Extension (Lower End) (Fig. 657). Attach flange of tailpipe extension (lower end) to flange of vehicle exhaust tube using a new gasket and secure firmly with three hex-head bolts, three hex locknuts and three plain washers.

b. Install Exhaust Tailpipe Extension (Upper End) (Fig. 658).

- (1) Position the tailpipe support of the tailpipe extension to the two 13/22-inch drilled holes (fig. 657) on the vehicle and secure to the vehicle using two 3/8-24-hex-head bolts, two 3/8-24-hex-head locknuts and two plain washers.
- (2) Install tailpipe extension (upper section) to tailpipe extension (lower section) at the tailpipe support (fig. 658) using a new gasket and three hex-head bolts, three hex-head locknuts and three plain washers.

509. Tests and Adjustments

a. Air Cleaner Inlet Tube.

- (1) Check air cleaner inlet tube for security of attachment to body.
- (2) Check for tightness of connection to air cleaner.

b. Exhaust Tailpipe Extensions.

- (1) Check exhaust tailpipe extension (upper section) for security of attachment of body.
- (2) Check exhaust tailpipe extension (lower section) for watertight connections.

Section X. ELECTRIC BRAKE KIT

510. Description

a. General. The electric brake kit for the 5-ton, 6 x 6, trucks has been designed as an accessory on trucks utilized as prime movers

for trailers or towed artillery equipped with electric brakes. Since the kit has been designed for installation on more than one type of vehicle, some of the brass fittings, standard hardware, and brackets are discarded at time of installa-

tion of the kit. The installations are similar, differing mainly in the location of the controller assembly and the rheostat and the manner in which the main harness is installed.

b. Controller Assembly and Rheostat. The two main components of the electric brake kit are the controller assembly (C) and the rheostat (F) (fig. 660).

- (1) The controller assembly is waterproof, 24-volt capacity, and air operated. It transmits an electric current to M and N terminals (figs. 665 and 666) of the truck trailer receptacle. The controller is mounted inside of the left side frame member just rear of the cab (fig. 662).

- (2) The rheostat has a 24-volt capacity and regulates electric current to the controller. The rheostat setting corresponds to the capacity of the electric brake system on the towed or trailer load. The rheostat is mounted on instrument panel flange and to right of steering column (fig. 664).

511. Installation of Controller and Rheostat on 5-ton Trucks

Note. The operations sequence herein resulted from a trial installation and may be altered slightly if previous modification or damage to the vehicle causes interference.

- a.** Open air reservoir drain cocks.

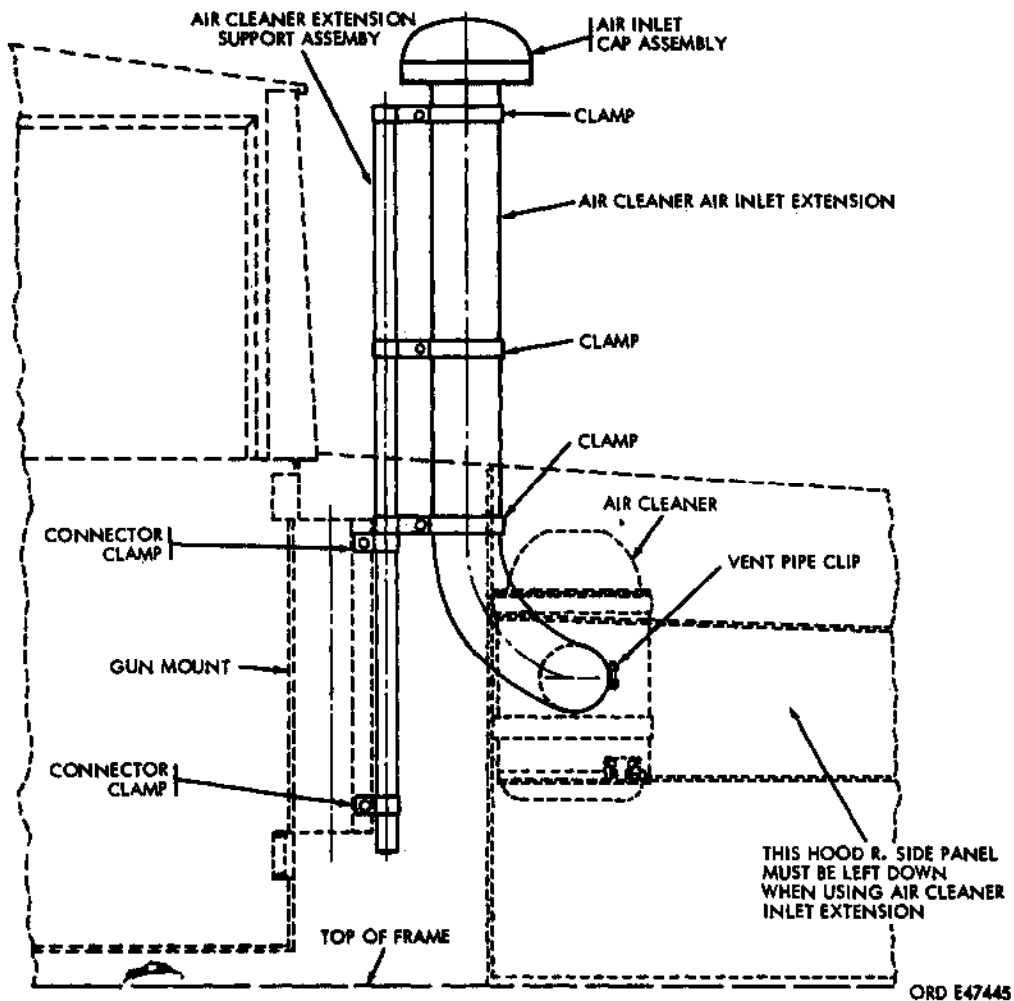


Figure 656. Air cleaner air inlet extension installed - gasoline engine wheeled vehicle

b. Extend threads on controller studs 3/8-inch, using 3/8-16UNC die.

Note. If die is unavailable, use plain washers as spacers between controller and frame member.

c. Drill four 13/32-inch diameter holes in left side frame member as shown in table (fig. 661).

Note. Fuel tank (fig. 661) must be removed to drill holes in medium wrecker truck M62.

d. Install controller mounting bracket (Q) on frame member (fig. 662), using four 3/8-inch



Figure 657. Exhaust tailpipe extension (lower section) installed

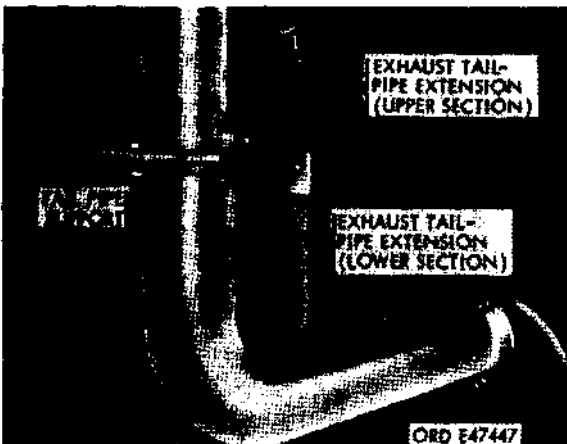


Figure 658. Exhaust tailpipe extensions installed - upper and lower sections

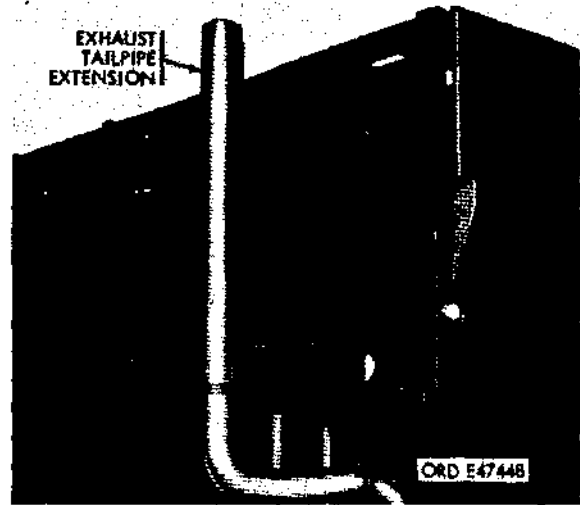


Figure 659. Tailpipe extension installed

machine bolts and self-locking nuts. Install controller (C) on mounting bracket, using the three existing nuts and washers on controller studs.

e. Cut out 1-1/8-inch section from existing air line as shown (fig. 661).

Caution: Be sure to cut from airline and not hydraulic line.

f. Install 3/8-inch tee (U, fig. 660) to air line and to controller, using pipe (B, fig. 660) and 3/8-inch connector (V, fig. 660).

g. Drill two 9/32-inch diameter holes in flange on instrument panel as shown in table (fig. 663). Install rheostat mounting bracket (H, fig. 660) on instrument panel, using two 1/4 x 1/2-inch machine bolts and self-locking nuts.

h. Install rheostat (E, fig. 660) on mounting bracket, first removing operating lever, retaining nut, lockwasher, and nameplate from rheostat to facilitate installation. Be sure positioning pin (fig. 664) is inserted in small hole at bottom of bracket and nameplate.

i. Close air reservoir drain cocks.

j. In accordance with provisions of AR 755-5 or AR 755-10, as applicable, return following components of kit to stock:

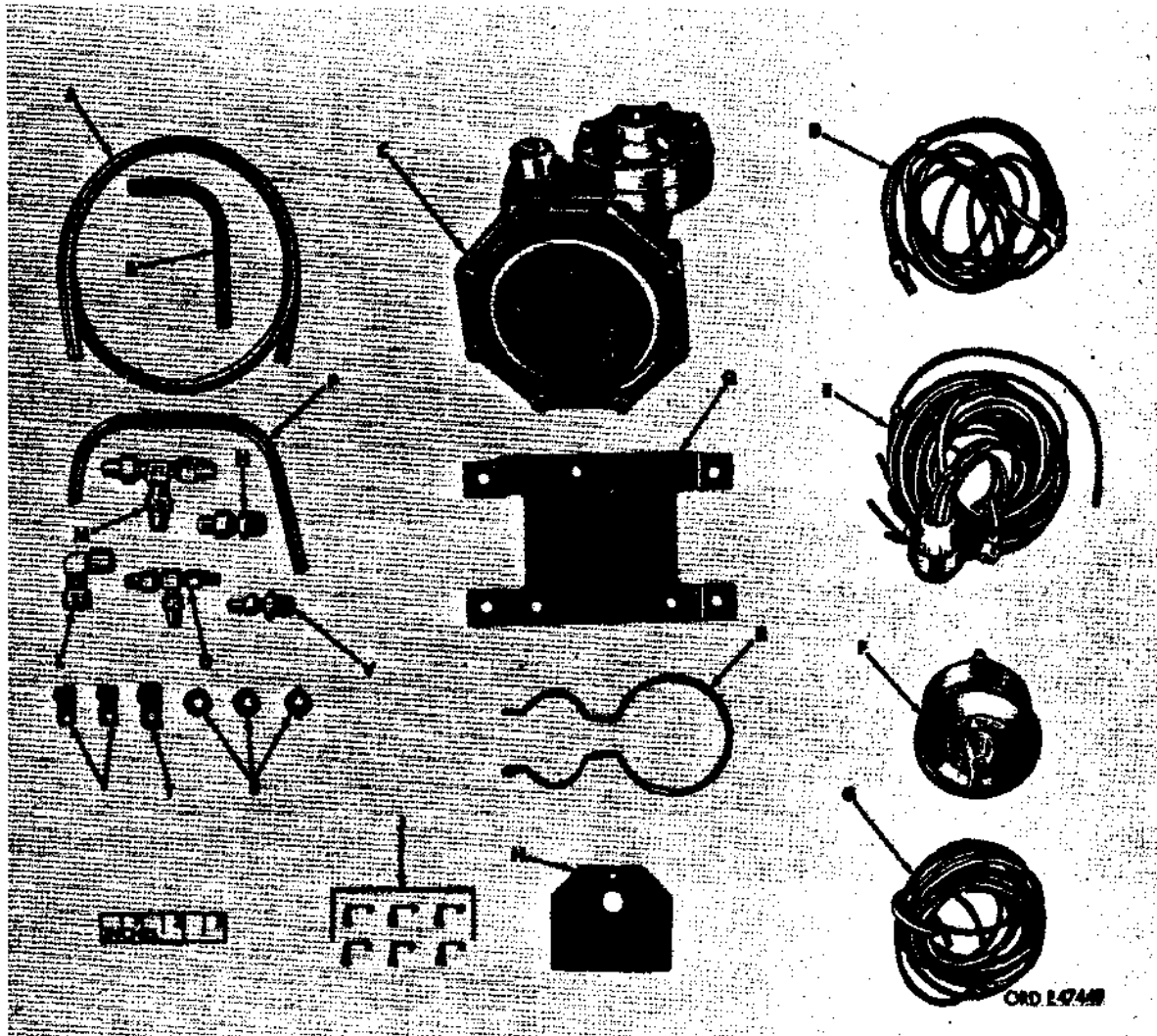


Figure 660. Principal components of kit

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|---------------------------|------------|-----------------------------|
| A | Controller tube | L | 1/2-in. tube elbow |
| B | Connector pipe | M | 1/2-in. tee assembly |
| C | Controller assembly | N | 1/2-in. connector |
| D | Rheostat harness | P | Controller tube |
| E | Controller cable | Q | Controller mounting bracket |
| F | Rheostat | R | Rheostat mounting bracket |
| G | Cable | S | Spacer washer |
| H | Rheostat mounting bracket | T | No. 8 closed clamp |
| J | Cable splicer | U | 3/8-in. tee assembly |
| K | Retaining clip | V | 3/8-in. connector |

Figure 660. Principal components of kit - legend

| TABLE | |
|--|------------|
| MAJOR ITEM | DIMENSIONS |
| ALL 5 TON TRUCKS EXCEPT M52, M62 & M246 | 18-3/16 |
| MEDIUM WRECKER TRUCK M62 | 26-3/16 |
| TRUCK TRACTOR M52 & TRACTOR WRECKER TRUCK M246 | 13-5/16 |

NOTE: ALL DIMENSIONS SHOWN
ARE IN INCHES

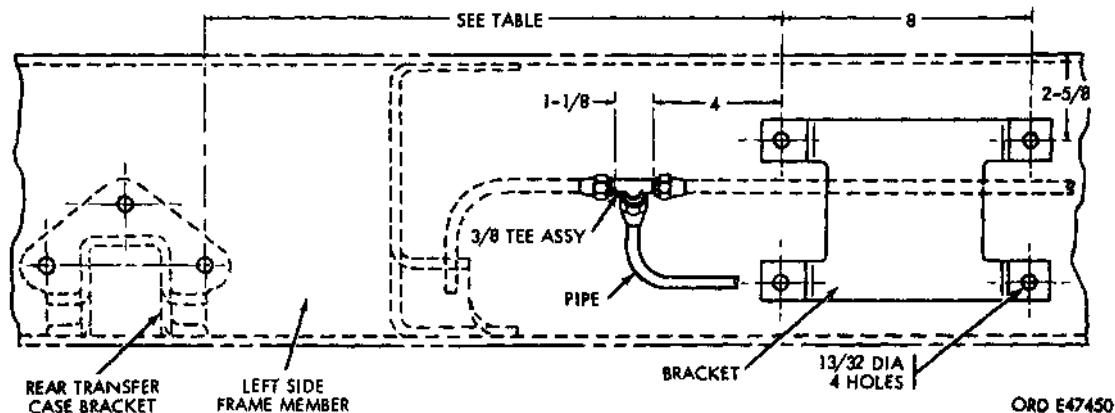


Figure 661. Bracket installation details

| Name | Qty. | | |
|---|------|---|---|
| BOLT, MACHINE: hex-hd, low-carb-S, cd- or zn-pltd, 5/16-18NC-2A x 1 | 2 | NUT, PLAIN, HEXAGON: S, cd- or zn-pltd, 5/16-18UNC-2B, 1/2 w, 17/64 thk | 2 |
| BOLT, MACHINE: hex-hd, med-carb-S, cd- or zn-pltd, 1/4-28UNF-2A x 5/8 | 2 | NUT, SELF-LOCKING, HEXAGON: S, cd- or zn-pltd, 1/4-28UNF-3B, 7/16 w, 5/16 thk | 2 |
| BRACKET: mounting, rheostat | 1 | TEE: tube, stght, compression, ball sleeve, air service, br, 1/2-in., assy | 1 |
| CLAMP: closed, cushioned, No. 8, 1/8 dia, 3/8 bolt | 1 | TUBE: air line tee-to-controller | 2 |
| CLIP: retaining, harness | 2 | WASHER, FLAT: S, cd- or zn-pltd, 11/92 id, 11/16 od, 0.065 thk | 4 |
| CONNECTOR: tube, compression, ball sleeve, air service, 1/2-in. tube, 1/2-in. male pipe end, assy | 1 | WASHER, LOCK: ext-teeth, S, cd- or zn-pltd, 5/16-in. bolt size | 2 |
| ELBOW: tube, compression, safety sleeve, 90-deg, 1/2-in. male pipe end, assy | 1 | WASHER: special spacer | 3 |

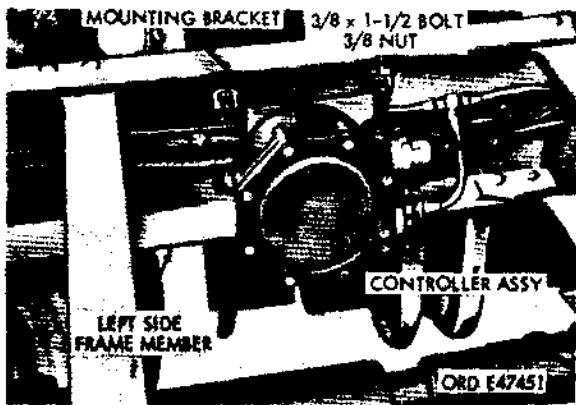


Figure 662. Controller installed

512. Wiring Procedure for All Trucks Except Truck Tractors M52, M52A1, M52A2 and Tractor Wrecker M246

- a. Cut off two shortest leads marked 53 (fig. 665) from rheostat-to-controller cable (E, fig. 660) at molded splice and tape ends to make waterproof. Connect cable to controller.
- b. Disassemble trailer receptacle located at rear of truck. Remove terminal pins (M and N, fig. 665) and solder to two remaining short leads of controller cable (E). Install leads in receptacle, making sure controller

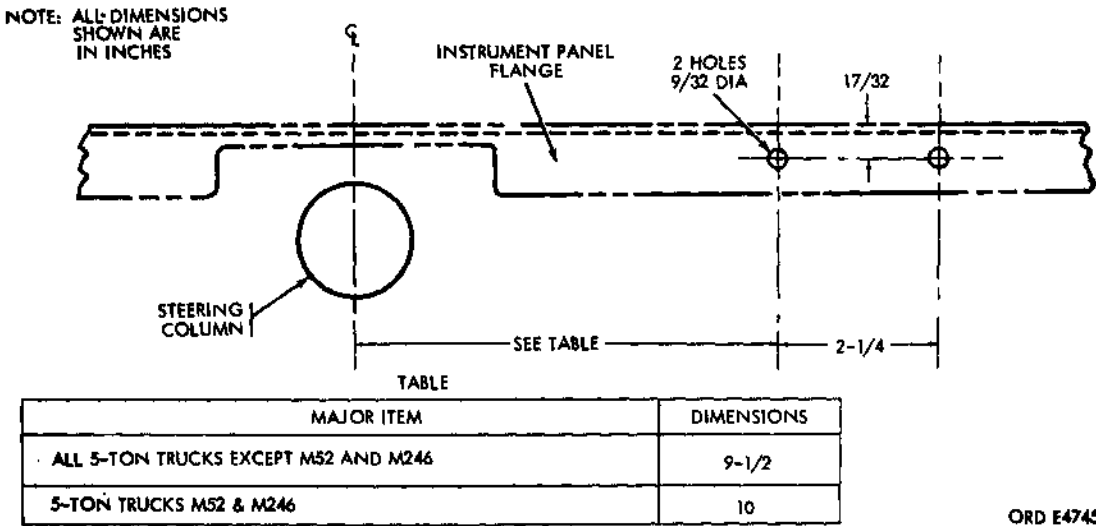
terminals (B and C, fig. 665) are connected to receptacle terminals N and M, respectively (fig. 665).

- c. Remove trailer receptacle terminal pin (L, fig. 665) and solder to required length of lead cut from cable (G). Install lead in receptacle and connect free end to ground location of trailer receptacle terminal D, using transparent tubs 7056633 and terminal 7056706 (fig. 665).
- d. Assemble and install receptacle on vehicle.

- e. Run long lead of cable (E) along inside of frame member, follow path of existing harness and attach to harness with existing clips or tape. Pass cable through existing harness grommet in firewall and connect to rheostat.
- f. Connect rheostat harness (D) to rheostat. Pass free end through existing harness grommet in firewall, follow path of existing harness, attach to harness with existing clips or bind with tape, and connect to positive battery terminal.

Note. On all 5-ton trucks except M62, connect rheostat harness to positive battery terminal of magnetic starter switch.

- g. Loop and tape any excess cable to existing harness. Do not cut excess cable as it may



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Figure 663. Flange drilling details

be required for future installation on another vehicle. If any leads are too short, increase to desired length by using cable (G, fig. 660) and cable splicer (J, fig. 660). Cut off tightening tab flush with splicer, and tape splice to make waterproof.

513. Wiring Procedure for Truck Tractors M52, MS2A1 and Tractor Wrecker M246

a. Do not cut off the two shortest leads marked "53" from rheostat-to-controller cable (E, fig. 660). Disassemble two trailer receptacles, located at rear of cab and at rear of truck. Remove terminal pins M and N and solder to four short leads of cable (E). Install leads in receptacles, making sure the two controller terminals (B and C, fig. 666) are connected to the two receptacle terminals N and M, respectively (fig. 666).

b. Remove two trailer receptacle terminal pins (L, fig. 666) and solder to required length of leads cut from cable (G). Install leads in receptacles and connect free ends to ground location of trailer receptacle terminals (D, fig. 666) using two transparent tubes and terminals.

c. Assemble and install receptacles on vehicle.

d. Run lead along inside of frame member, follow path of existing harness, and attach to harness with existing clips or bind with tape. Pass cable through existing harness grommet in firewall end connect to rheostat.

e. Connect rheostat harness (D) to rheostat. Pass free end through existing harness grom-

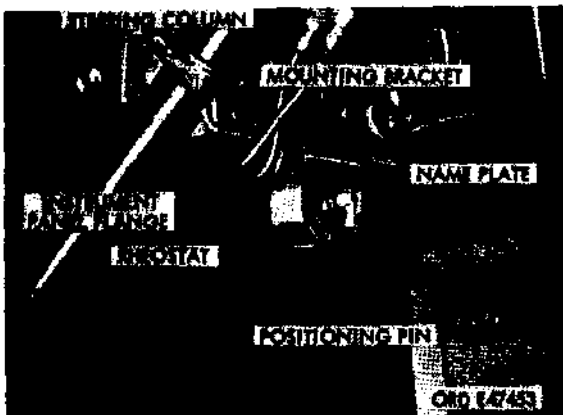


Figure 664. Rheostat installed on instrument panel flange

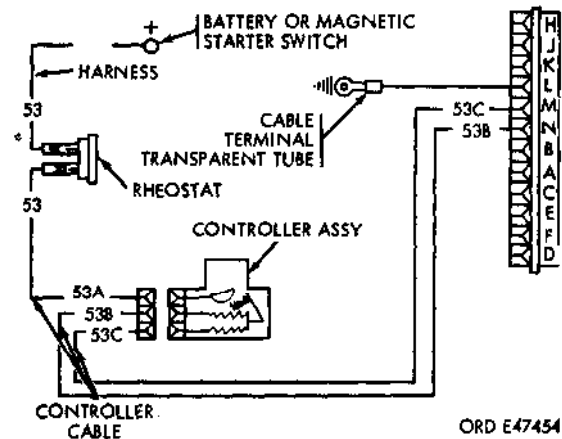


Figure 665. Wiring diagram for one-receptacle trucks

met in firewall, follow path of starter switch cable, and connect to positive battery terminal.

f. Connect rheostat harness (D, fig. 660) to the positive terminal of the magnetic starter switch.

g. Loop and tape any excess cable to existing harness. Do not cut excess cable as it may be required for future installation on another vehicle. If any leads are too short, increase to desired length by using cable (G, fig. 660) and cable splicer (J, fig. 660). Cut off tightening tab flush with splicer and tape splice to make waterproof.

514. Tests and Adjustments

Note. The manipulation of the rheostat on the instrument panel is not intended to operate the electric brakes on the towed load. The purpose of the rheostat is to regulate the amount of current going into the controller assembly (mounted on the frame) and, in turn, to the electric brakes on the towed load through the trailer receptacle when the brake pedal is depressed. The rheostat setting is directly dependent on the towed load. The lighter the towed load, the smaller the numerical rheostat setting. The heavier the towed load, the greater the numerical rheostat setting. The precise setting of the rheostat for a given load would be determined through operation experience. It should be noted that maximum braking effort is obtained with the highest rheostat setting and with 61 psi, plus or minus 5, in the compressed air system. The electric brake

control kit is so designed that the electric brakes on the towed load should operate ONLY when the brake pedal is depressed, as the electric circuit is closed only then and not when the rheostat on the instrument panel is manipulated.

a. General. Field reports and investigations identify loose contact screws, nuts, washers, and presence of dried varnish or lacquer flakes in the electrical mechanism as the most common causes of malfunction of the controller. These conditions impair the operating efficiency of the controller and result in reduced braking control of the towed vehicle.

b. Field Maintenance Instructions. The procedures contained in paragraphs 615 through 617 below will be applied by field maintenance personnel (3d echelon) or higher.

- (1) Before installation of new or used controllers.
- (2) Every six months or 6000 miles, whichever occurs first.

515. Disassembly of Controller

- a.** Open air reservoir drain cocks.
- b.** Remove controller assembly from vehicle.

c. Thoroughly clean exterior of controller to remove grease and dirt.

d. Remove diaphragm cover and diaphragm (fig. 667) from controller.

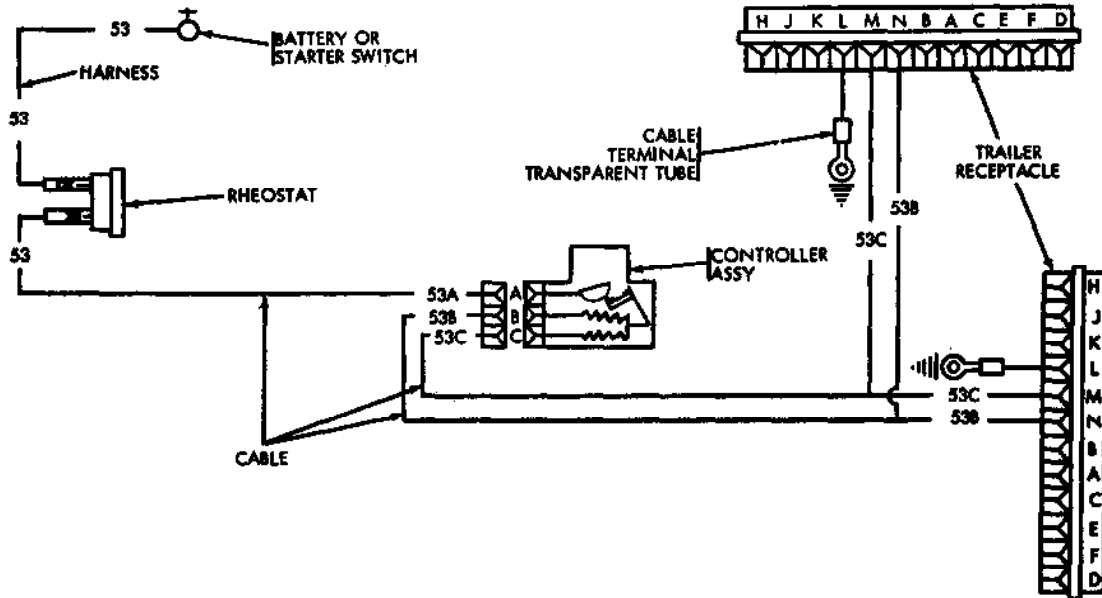
e. Remove cover from body. Remove and discard packing (fig. 668).

f. Before proceeding further with disassembly, push shaft head (fig. 667) into body several times to test compression of diaphragm return spring. Replace controller if spring fails to return the shaft head forcibly to its fully extended position.

g. Again push shaft head into body and observe contact between contact arm assembly and contact leaves of stack and brush resistor assembly (fig. 668). If failure to contact is obviously due to looseness of leaves, continue with disassembly, but if failure to contact is due to damage to leaves, replace stack and brush resistor assembly (fig. 668).

Note. It is not necessary to replace resistor if damaged intermediate leaves fail to make contact with contact arm. Adjust leaves to make full contact with arm.

h. Remove connecting cable (fig. 668) from stack and brush resistor.



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Figure 666. Wiring diagram for two-receptacle trucks

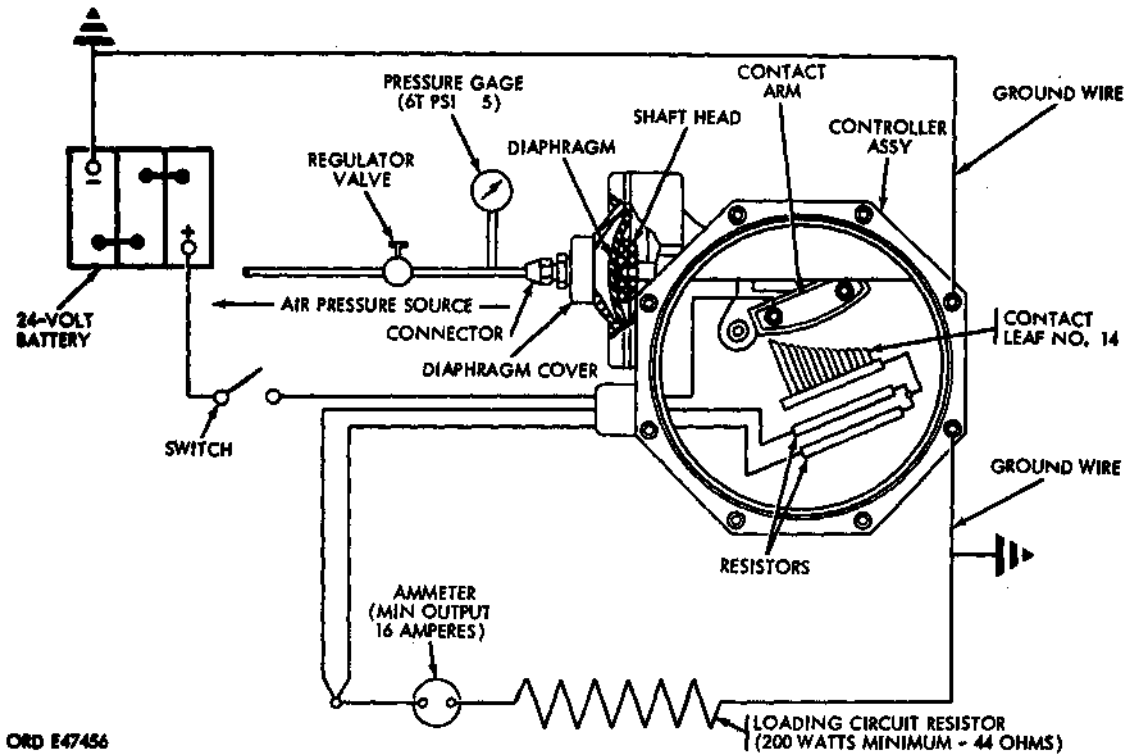


Figure 667. Wiring diagram for tests

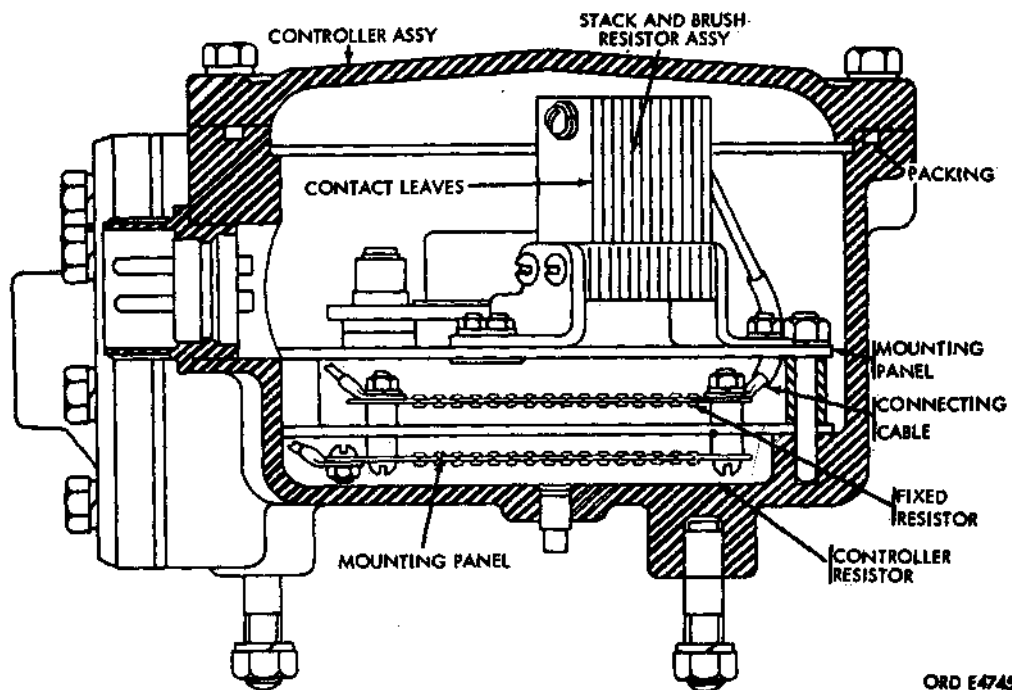


Figure 668. Resistor mounting details

TM 9-2320-211-35

i. Loosen and lift two panels, mounting contact arm and stack and brush resistor assemblies.

Note. It is not necessary to disconnect the connecting cable from contact arm to lift panel.

j. Remove spacers and remove panel mounting the fixed end controller resistors (fig. 668).

k. Using compressed air, remove varnish or lacquer flakes and dust from contact arm, resistors, and body.

516. Inspection and Repair

a. Inspect all screw hole threads, tap if necessary.

b. Check for loose or missing studs, screws, washers, and plugs.

c. Inspect the controller body and covers for cracks. Replace controller assembly if necessary.

d. Inspect diaphragm for brittleness and cracked fabric, especially at flexing points. Replace diaphragm if unserviceable.

e. Inspect fixed and controller resistors for broken or cracked fiber and broken windings. Replace fixed resistor or controller resistor if necessary.

f. Inspect cable-attaching rivet on contact arm for looseness. Re-rivet if necessary.

517. Assembly of Controller

a. Wipe diaphragm and shaft head and apply thin coating of insulating compound to shaft head contacting area of diaphragm.

Note. Insulating compound used on diaphragm was not included in early production kits and must be requisitioned through normal supply channels. Install diaphragm and diaphragm cover; do not tighten cover screws.

b. Install fixed and controller resistors, making sure upper end of contact arm engages collars on shaft. Position insulating sleeve on connecting cable to prevent chafing of cable against panel.

c. Install stack and brush resistor.

d. Connect controller to an air pressure source as shown in (fig. 667). Do not close electrical circuit switch. Coat joint between diaphragm cover and body with liquid soap. Open air regulator valve until diaphragm is exposed to a pressure of 100 psi, as shown on pressure gage and observe joint for air bubbles. If cover leaks, tighten attaching screws a partial turn at a time in opposed screw sequence to avoid stripping threads. If leaks cannot be stopped, replace controller. If cover does not leak, shut off regulator valve and release pressure by loosening connector (fig. 667) on controller.

e. Close electrical circuit switch. Open air regulator valve until diaphragm is exposed to a pressure of 61 psi, plus or minus 5. Observe action of contact arm to be sure that it is in full contact with contact leaf No. 14 (fig. 667). With a power output of 24 volts and a test loading resistance of 0.44 ohms, controller output must be at a minimum of 16 amperes as indicated on ammeter. If output is below 16 amperes, replace controller. If output is satisfactory, shut off air regulator valve, open switch, and disconnect controller from test facilities.

f. Install new packing and secure cover on body.

g. Install controller on vehicle and restore air pressure.

Section XI. ENGINE PRIMER PUMP

518. Description

A plunger on the engine primer pump is manually operated by means of a knob located on the dash panel. When the knob is pulled out, pressure is built up inside the pump to unseat a steel ball to permit fuel to flow from the engine fuel pump to the inlet manifold thereby providing additional fuel to the engine during

cold weather operations for easier starting (fig. 669).

519. Installation and Removal

a. Installation.

- (1) Install primer pump fuel line into vehicle fuel filter located on left side of frame.

- (2) Connect manifold fuel line to priming tee on manifold.
- (3) Connect primer pump to fuel lines, and secure pump to dash panel using outer locknut (fig. 670).

b. Removal. Disconnect fuel lines from primer pump, unscrew outer locknut, and remove primer pump from dash panel (fig. 670).

520. Disassembly of Engine Primer Pump

Note. The key letters noted in parentheses are in figure 670.

a. Separate body from plunger.

- (1) Mark edges of body (L) and plunger (F) with a file to facilitate assembly of parts in the same relative position.
- (2) Remove knob (A), nut (B), ring (C), packing (D), and cap (E) from plunger (F). Remove plunger from body (L) and remove nut (J), washer (H), and cup (G) from plunger.

b. Disassemble body. Remove nut (K) from body (L). Remove nut (Y) and connector (X). Remove plug (U) and lift out spring (V) and ball (W). Loosen and remove cap (S) and lift out spring (R), guide (Q) and diaphragm (P). Remove screen (T).

c. Remove nut (N) and connector (M) from engine primer pump body (L).

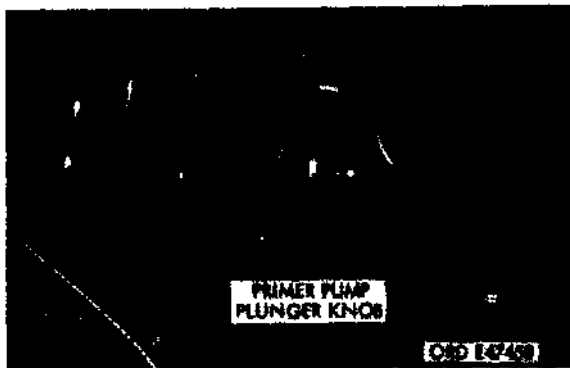


Figure 669. Primer pump installed

521. Cleaning, Inspection and Repair

a. Clean All Parts. Clean all metal parts in dry-cleaning solvent or mineral spirits paint thinner. Blow out all passages with compressed air.

b. Inspection and Repair.

- (1) **Plunger.** Discard the plunger if cracked, broken, or warped. Inspect for stripped or cross threads and correct with thread chaser, if practical.
- (2) **Body.** Discard body if flange is warped more than 0.010 inch. If warped less than 0.010 inch, refinish with disk grinder. Discard cap if threaded holes in flange are stripped or crossed.
- (3) **Screen.** Replace, if distorted or otherwise damaged.
- (4) **Diaphragm and spring.** Whenever pump is disassembled, diaphragm should be replaced. Examine diaphragm spring for resiliency of performance and replace if weak or otherwise defective.

522. Assembly of Engine Primer Pump

a. Assemble Body (Fig. 670).

- (1) Seat the ball (W) inside engine primer pump body (L) and install with spring (V) and plug (U) as shown (fig. 670).
- (2) Insert the screen (T), diaphragm (P), guide (Q) inside body. Compress the spring (R) on the guide and install the cap (S).
- (3) Insert the two connectors (M) and (X) and secure with nuts (N) and (Y). Attach nut (K) on the threaded end of body (L).

b. Assemble Plunger (Fig. 670). Install cap (E), packing (D), ring (C), nut (B), and knob (A) at one end of plunger. Install cup (S), washer (H), and nut (J) at the other end of the plunger.

c. Assemble Plunger to Body. Install plunger (F) (fig. 670), to body (L) (fig. 670), making sure that file marks on cover, line up with file marks on the body.

523. Test

Test operation of primer pump by attaching pressure gage to pump outlet. Operate pump plunger until gage shows 3 psi. Discontinue

building up pressure and observe time required for gage pointer to drop from 3 psi to 2 psi. A time lapse of five seconds or more indicates a satisfactory pump.

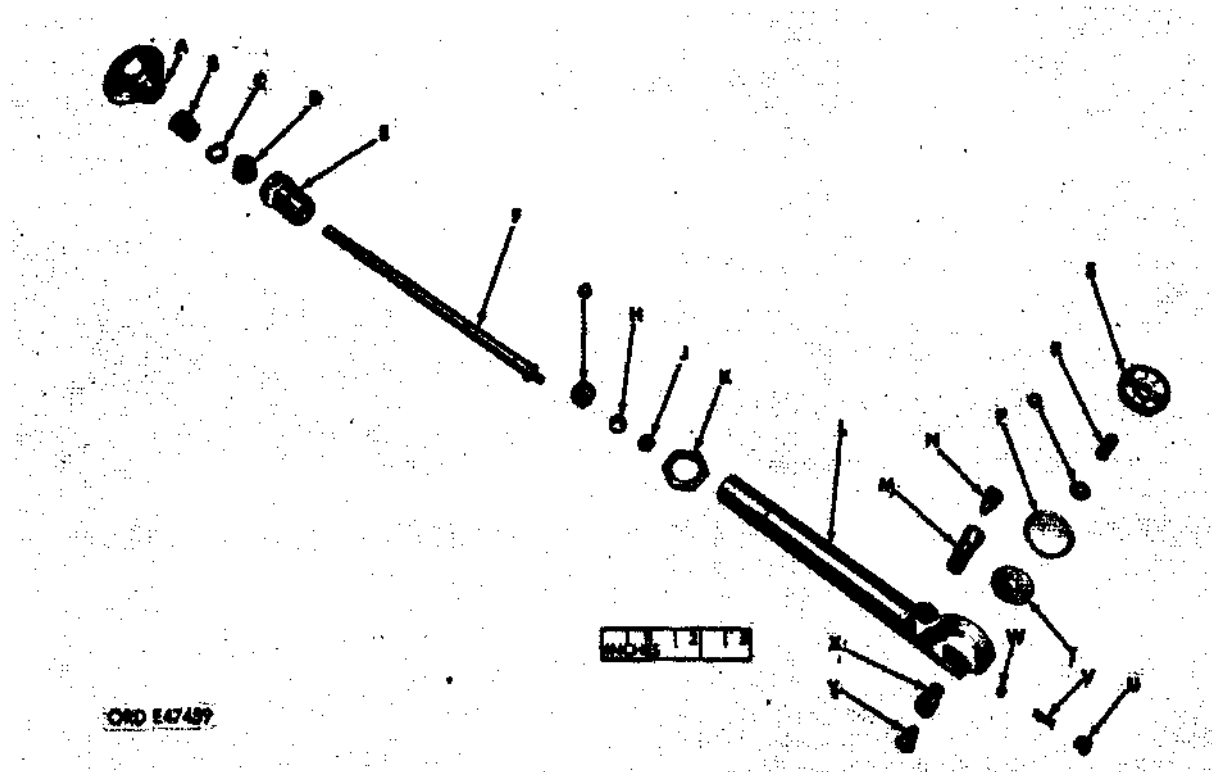


Figure 670. Engine primer pump - exploded view

| <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> | <u>Key</u> | <u>Item</u> |
|------------|-------------|------------|-------------|------------|-------------|
| A | Knob | J | Nut | S | Cap |
| B | Nut | K | Nut | T | Screen |
| C | Ring | L | Body | U | Plug |
| D | Packing | M | Connector | V | Spring |
| E | Cap | N | Nut | W | Ball |
| F | Plunger | P | Diaphragm | X | Connector |
| G | Cup | Q | Guide | Y | Nut |
| H | Washer | R | Spring | | |

Figure 670. Engine primer pump - exploded view - legend

Section XII (Added)

THERMAL BARRIER KIT (ALL MODELS)

524. Description

The thermal barrier kit consists of eighteen vinyl resin base pads with a vinyl film cemented to one side. The other side is cemented to the cab inside surfaces to help insulate the cab and thus maintain heat for the crew.

525. Installation Instructions

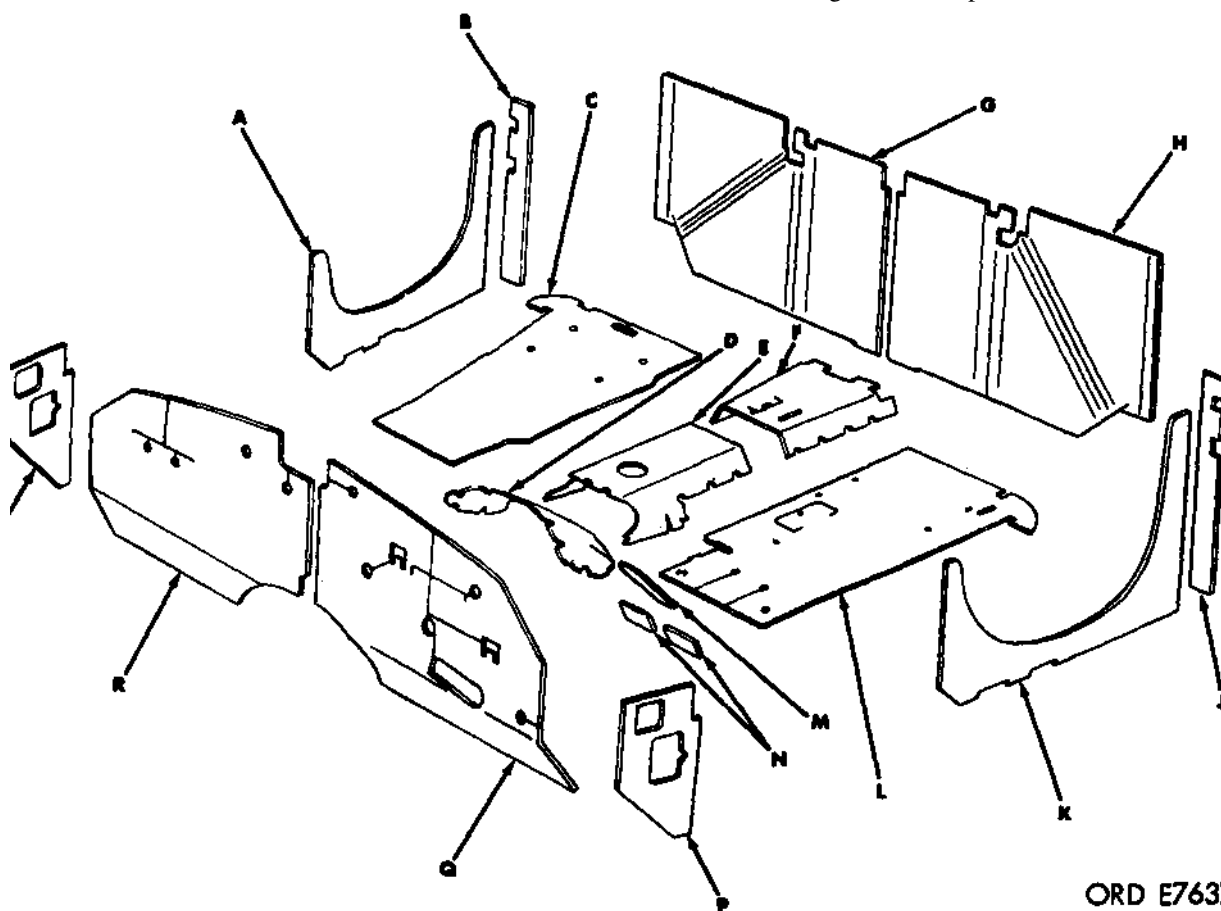
- a. Place vehicle in well lighted, well ventilated area.
- b. Remove seats (par. 132).
- c. Remove glove box.
- d. Remove dust and dirt from inside cab.
- e. Place supplementary fans and/or blowers in and around cab to provide adequate, positive ventilation.

Warning: The methyl-ethyl-ketone used to activate the thermal barrier cement creates toxic vapor, not to be inhaled. Provide rubber gloves for personnel handling methyl-ethyl-ketone soaked rags or brushes.

f. Install thermal barrier.

Note. The general procedure outlined below will be used in conjunction with individual heater installations, both hot water and fuel burning. Thus, where necessary, additional slits or cutouts will be made in barrier, using a sharp knife or scissors.

- (1) Select barrier part for individual placement as indicated in figure 671.
- (2) Make a trial placement temporarily positioning barrier in place, and make slits and



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Figure 671. Thermal barrier kit

| Key | Item |
|-----|--------------------------------|
| A | Right door support hinge cover |
| B | Right lock pillar cover |
| C | Right floormat |
| D | Front tunnel cover floormat |
| E | Center tunnel cover floormat |
| F | Rear tunnel cover floormat |
| G | Right rear cab panel cover |
| H | Left rear cab panel cover |
| J | Left lock pillar cover |

| Key | Item |
|-----|-------------------------------|
| K | Left door support hinge cover |
| L | Left floormat |
| M | Gas pedal cover |
| N | Clutch and brake pedal covers |
| P | Left air duct panel cover |
| Q | Left firewall |
| R | Right firewall |
| S | Right air duct panel cover |

Figure 671. Thermal barrier kit (legend)

cutouts required for a particular location, if necessary.

Note. Locations definitely requiring barrier or vehicle modification before cementing barrier include diverter mounting holes (personnel heaters), firewall knockouts, transmission tunnel knockouts and lever boots, battery box knockouts and receptacle opening and cable clamp holes. Others may be expected.

Caution: All barrier parts are cemented to inside of cab, including lock pillar cover

10938245, which is placed behind lock pillar.

- (3) Brush methyl-ethyl-ketone on cab section to be covered and brush it also on the inner side of barrier part to be cemented.

Note. The dull side is the inside.

- (4) Press part firmly into place.

Caution: Part must be properly placed, as no movement is possible after placement.

Section XIII (Added) FUEL BURNING PERSONNEL HEATER KIT (MULTIFUEL)

526. Description and Data

a. Description. The personnel heater kits are supplied for use in areas where the normal temperatures during the coldest period of the year is 5°F. and lower. In addition to the heater, heat controls, and accessories covered in this section, these kits also contain all mounting parts, ducts, fuel lines, and other equipment required for individual installations. Personnel heaters provide uncontaminated, heated air and are used primarily to supply heat to the crew compartment.

b. Data.

Heater:

| | |
|-------------------|----------------------|
| Manufacturer | Stewart-Warner Corp. |
| Model no. | 8420-C24 |
| Ordnance part no. | 8364020 |
| Weight | 17 lb |

Dimensions:

| | |
|--------|-----------|
| Width | 7-1/2 in. |
| Length | 15 in. |
| Height | 9-3/4 in. |

Heat output:

| | |
|-----------|---------------|
| High heat | 20,000 Btu/hr |
| Low heat | 8000 Btu/hr |

Fuel consumption:

| | |
|------------------------|-------------|
| High heat | 0.272 gph |
| Low heat | 0.122 gph |
| Fuel pressure required | 3 to 15 psi |
| Operating voltage | 24 v |

Current consumption:

| | |
|-----------|------------------|
| Starting | 16.0 to 19.5 amp |
| Low heat | 3.0 to 7.5 amp |
| High heat | 3.0 to 7.5 amp |

Blower motor:

| | |
|-------------------------|----------------------|
| Manufacturer | Stewart-Warner Corp. |
| Model no. | 701646 |
| Manufacturer's part no. | G700139 |
| Operating voltage | 24 v |
| Current consumption | 2.7 amp |

Fuel filter:

| | |
|-------------------|--------------|
| Manufacturer | Bendix Corp. |
| Ordnance part no. | 7761059 |

c. Composition of Kit. The personnel heater kit is comprised of the following major groups of items:

- (1) Personnel heater including control box, mounting plate, exhaust tubing, wiring and ducting.
- (2) Defroster assembly including diverter box, control cables and ducting to existing windshield defrost nozzles. There are also deflectors for mounting on top of instrument panel.
- (3) Electric fuel pump, including fittings, tubing and electrical lines. The fuel pump installation provides an elbow for fuel tubing to the coolant (power plant) heater so only one fuel pump is used for both kits.
- (4) A canvas radiator cover attached to the radiator brush guard controls the flow of

air through the radiator and protects the engine from windblown snow. An adjustable flap in the cover can be opened or closed to control the amount of air flowing through the radiator for engine cooling, and to help maintain engine coolant temperatures at near normal operating temperature.

- (5) An alcohol evaporator, used to permit vaporized alcohol to be drawn into the

vehicles compressed air system. Drawing alcohol into the air system guards against the freezing of moisture in the system when the vehicle is operating in freezing temperatures. The alcohol evaporator is mounted to a bracket near the personnel heater and has tubing to connect it with the vehicle's air compressor. Figures 672 through 674 illustrate the major parts of the personnel heater kit.



Figure 672. Component parts-winterization kit, personnel heater (1 of 3).

| Key | Item | Part Number | Quantity |
|-----|--------------------------------|---------------|----------|
| A | SHIELD, fuel pump | 10932116 | 1 |
| | SCREW, cap, hex-hd, 1/4-28x1/2 | MS 35207-279 | 4 |
| | NUT, self-locking, hex, 1/4-28 | 96906-51922-5 | 4 |

| Key | Item | Part Number | Quantity |
|-----|---|------------------------|----------|
| B | PUMP ASSY, fuel | 7748814 | 1 |
| | SCREW, cap, hex-hd, 1/4-28x1/2 | MS 35292-3 | 2 |
| | NUT, self-locking, hex, 1/4-28 | 96906-51922-5 | 2 |
| C | CONNECTOR ASSY, 5/16, pump inlet and outlet (Adapter) | MS 39206-4 | 2 |
| D | TEE int-ext, (at pump) | 444147 | 1 |
| E | COCK ASSY, fuel shutoff, 5/16 tube x 1/4 pipe | 543852 | 1 |
| F | FILTER ASSY, fuel | MS 51085-1 | 1 |
| | SCREW, mach, pan-hd, no. 10-32x1-3/4 | 96906-35207-270 | 2 |
| | NUT, safety no. 10-32 | 503209 | 2 |
| G | CONNECTOR ASSY, 5/16 tube x 1/4 pipe, filter outlet (Adapter) | MS 39206-4 | 1 |
| H | ELBOW, filter, inlet | MS 39202-4 | 1 |
| J | PLUG (pump tee) | 444571 | 1 |
| K | CLAMP, hose, 2-1/2-6-1/4 (for duct to wall) | 96906-35842-4 | 2 |
| L | TUBE, exhaust, 70 in. | 7986268 | 1 |
| M | CLAMP, 1-21/32 dia x 5/16 dia hole (for exhaust) | MS 21333-99 | 4 |
| | SCREW, cap, hex-hd, 1/4-28x1/2 | for 1st, 96906-35292-3 | 3 |
| | NUT, self-locking, hex, 1/4-28 | 2nd & 96906-51922-5 | 3 |
| | WASHER | 4th MS 35338-27 | 3 |
| | WASHER | MS 27183-14 | 3 |
| | SCREW, 1/4-28x1 | for MS 35292-8 | 1 |
| | NUT | third MS 51922-5 | 1 |
| | WASHER | clamp MS 27183-10 | 1 |
| N | ELBOW, heater exhaust | 7951084 | 1 |
| P | EXTENSION, heater exhaust | 7700245 | 1 |
| Q | PIN, cotter, 1/8 x 3 | MS 24665-363 | 2 |
| R | RING, rubber | 7700242 | 1 |
| S | WASHER, extension | 7700243 | 1 |
| T | ELBOW ASSY, 90°, 3/16 tube x 1/4 pipe, compressor | 444038 | 1 |
| U | EVAPORATOR ASSY | 7408773 | 1 |
| V | HEATER ASSY, personnel | 8364020 | 1 |
| W | CLAMP, heater mtg, 5-3/4 - 6-1/2 | 7951827 | 2 |
| X | ADAPTER, heater (air) | 7524078 | 1 |
| | SCREW, mach, pan-hd, no. 8-32x5/16 | 96906-35206-242 | 4 |
| | WASHER, lock int-ext tooth | 96906-35335-17 | 4 |
| Y | DUCT, flexible, 4 in. id, 14 in. lg | 8711056 | 1 |
| Z | BASE, heater mtg 1/4-28x3/4 | 10931988 | 1 |
| | SCREW, cap, hex-hd, 1/4-28x3/4 | 96906-35292-6 | 4 |
| | WASHER, ground | 96906-45904-68 | 2 |
| | NUT, self-locking, 1/4-28 | 96906-51922-5 | 4 |
| AA | ADAPTER (filter to heater tube) | MS 39203-4 | 1 |

Figure 672. Component parts-winterization kit, personnel heater (1 of 3) (Legend).

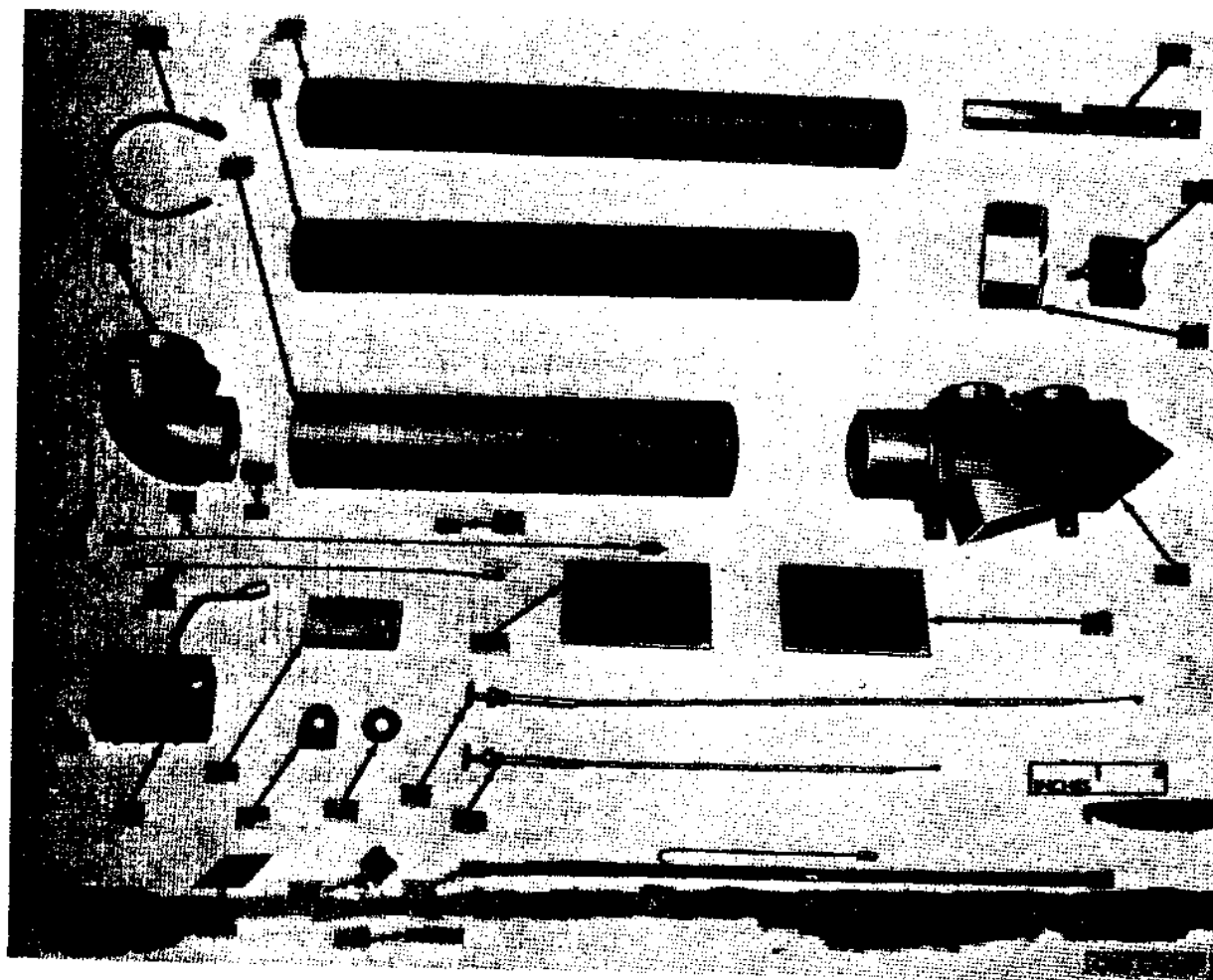


Figure 673. Component parts-winterization kit, personnel heater (2 of 3).

| Key | Item | Part Number | Quantity |
|-----|--|----------------|----------|
| AB | ELBOW, personnel heater | 7700374 | 1 |
| AC | CLAMP, hose, 2-½ - 6-½ | 96906-35842-4 | 6 |
| AD | DUCT, 4 in. id, 19-½ in. lg | 7951506 | 1 |
| AE | DUCT, 3 in. id, 26-½ in. lg | 7951086 | 1 |
| AF | DUCT, 3 in. id, 29-½ in. lg | 7401666 | 1 |
| AG | DEFLECTOR, defroster | 10896487 | 2 |
| | SCREW, tapping no. 4-24 x ½ | 96906-24641-14 | 10 |
| AH | SWITCH, emergency | MS 390C1-1 | 1 |
| | SCREW AND LOCKWASHER ASSY 8-32 x ½ | 425302 | 2 |
| AJ | GUARD, emergency sw | 10896521 | 1 |
| | 2 SCREW, ¼-28 x ¾ | MS 35292-3 | |
| | 2 NUT | MS 51922-5 | |
| AK | DIVERTER, defroster | 7700251 | 1 |
| AL | PLATE, wiring dia | 7951661 | 1 |
| | SCREW, tapping, pan-hd, no. 10-16 x ¾ | MS 24637-33 | 4 |
| AM | PLATE, operating instruction | 7951717 | 1 |
| | SCREW, tapping pan-hd, no. 10-16 x ¾ | MS 24637-33 | 4 |
| AN | CABLE ASSY, heater control, 19 in. lg | 7700353 | 1 |
| AP | CABLE ASSY, defroster control, 28 in. lg | 7700248 | 1 |
| AQ | NAMEPLATE, defroster control | 7700351 | 1 |
| AR | NAMEPLATE, heater control | 7951468 | 1 |

| Key | Item | Part Number | Quantity |
|-----|--------------------------------------|----------------|----------|
| AS | BRACKET, control cable mtg | 8359586 | 1 |
| | SCREW, mach, pan-hd, no. 10-32 x 5/8 | 96906-35226-64 | 2 |
| | NUT, no. 10-32 | 7951286 | 2 |
| AT | BOX ASSY, control | 10885798 | 1 |
| AU | HARNESS, box to heater | 8359927 | 1 |
| AV | DECAL | 10896515 | 1 |
| AW | PLATE | 10896371 | 1 |
| | SCREW, 1/4-28 x 3/4 | MS 35292-3 | 2 |
| | NUT, 1/4-28 | MS 51922-5 | 2 |
| AX | ADAPTER, Y | MS 27147-1 | 3 |
| AY | LEAD, ASSY | 10932060-1 | 1 |
| AZ | LEAD, ASSY | 10932060-2 | 1 |
| BA | LEAD, ASSY | 10932060-3 | 2 |
| BB | LEAD, ASSY | 10932060-4 | 1 |
| BC | SHELL | 8338561 | 2 |
| BD | PLUG | 7982907 | 2 |

Figure 673. Component parts-winterization kit, personnel heater (2 of 3) (Legend).

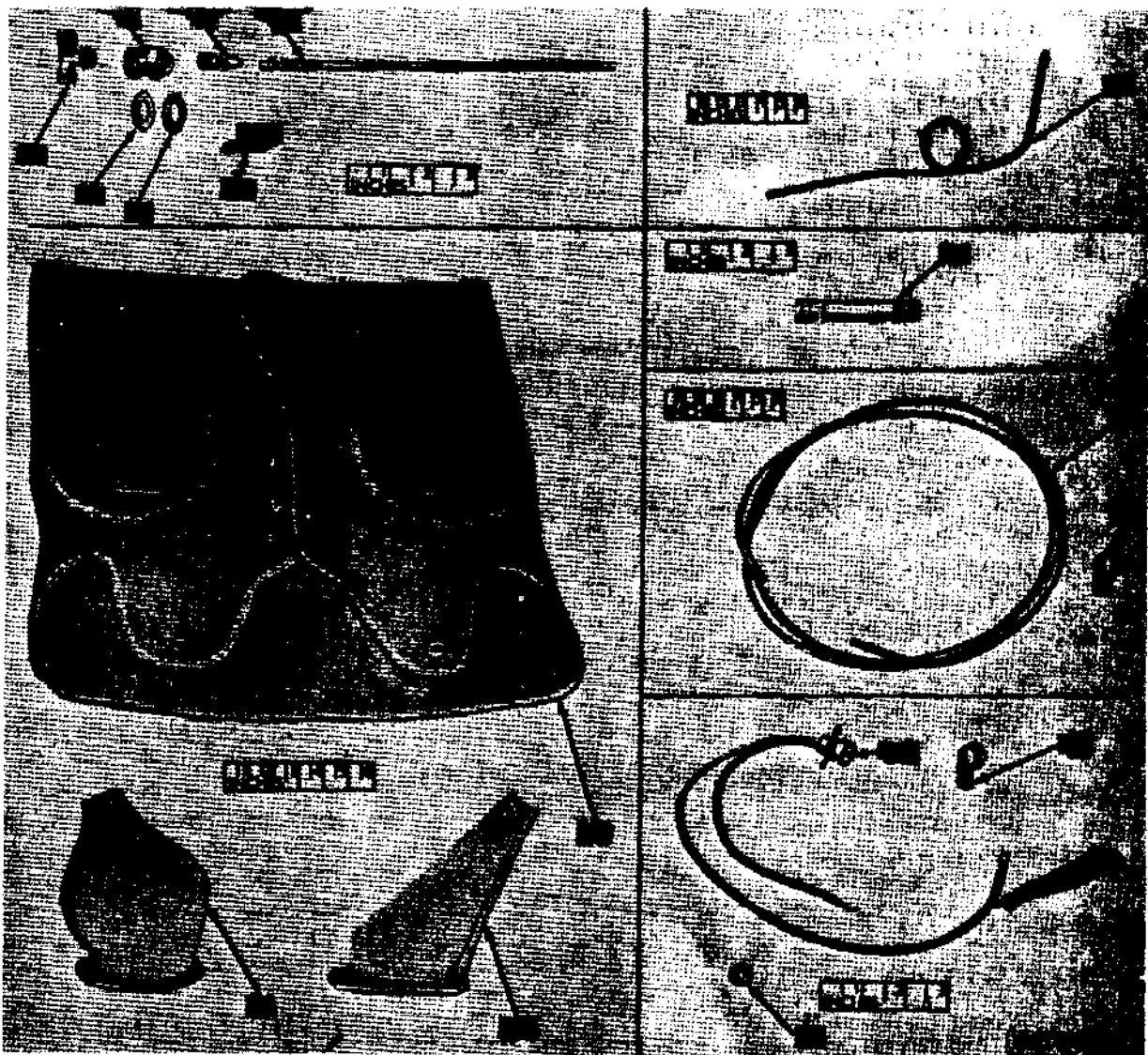


Figure 674. Component parts-winterization kit, personnel heater (3 of 3).

| Key | Item | Part Number | Quantity |
|-----|---|-----------------|----------|
| BE | COUPLING ASSY, adapter, veh filter | 444014 | 1 |
| BF | CONNECTOR ASSY, 3/8 tube x 1/4 pipe (adapter at vehicle filter) | MS 39206-6 | 1 |
| BG | TUBE, 18 in., heater to filter | 8689207 | 1 |
| BH | TUBE, pump to vehicle filter 68 in. lg | 8689207 | 1 |
| BJ | NIPPLE, pipe, 1/8 x 1-1/2, heater fuel inlet | 121830 | 1 |
| BK | TUBE, filter pump to heater, 88 in. | 8689207 | 1 |
| BL | CLAMP, tubing | MS 21333-99 | 4 |
| | SCREW, 1/4-28 x 1/2 | MS 35292-3 | 4 |
| | NUT, 1/4-28 | MS 51922-5 | 4 |
| BM | SLAVE RECEPTACLE ASSY | 7731421 | 1 |
| | SCREW, cap, hex-hd, 1/4-20 x 1 | 96906-35291-8 | 4 |
| | WASHER, lock, split, 1/4 in. | 96906-35337-25 | 4 |
| | NUT, plain hex, 1/4-20 | 96906-35690-405 | 4 |
| BP | GROMMET, receptacle cable | 7373246 | 2 |
| BN | CLAMP (for slave receptacle) | MS 21333-39 | 2 |
| | SCREW, tapping, 5/16 x 3/4 | No No. | 2 |
| BQ | COVER ASSY, transfer lever | 7389745 | 1 |
| | SCREW, tapping, fillister hd, 10-24 x 1/2 | MS 24629-46 | 4 |
| BR | COVER ASSY, radiator | 7978798 | 1 |
| | LOOP, radiator cover | 7716428 | 4 |
| | SCREW, tapping, pan-hd, no. 8-32 x 1/2 | MS 24649-35 | 30 |
| | SPRING ASSY, radiator cover | 7717706 | 7 |
| BS | BOOT ASSY, gear lever | 8370841 | 1 |
| | SCREW, tapping, pan-hd, no. 10-16 x 3/4 | MS 24617-30 | 4 |
| BT | TEE (2nd filter) | 444120 | 1 |
| BU | GROMMET (tool compartment) | MS 35489-75 | 1 |
| BV | GROMMET (firewall) | 7951712 | 1 |
| BW | BRACKET, filter mounting | 10931990 | 1 |
| | SCREW, 10-32 x 3/4 | MS 35207-265 | 2 |
| | NUT, 10-32 | 503209 | 2 |

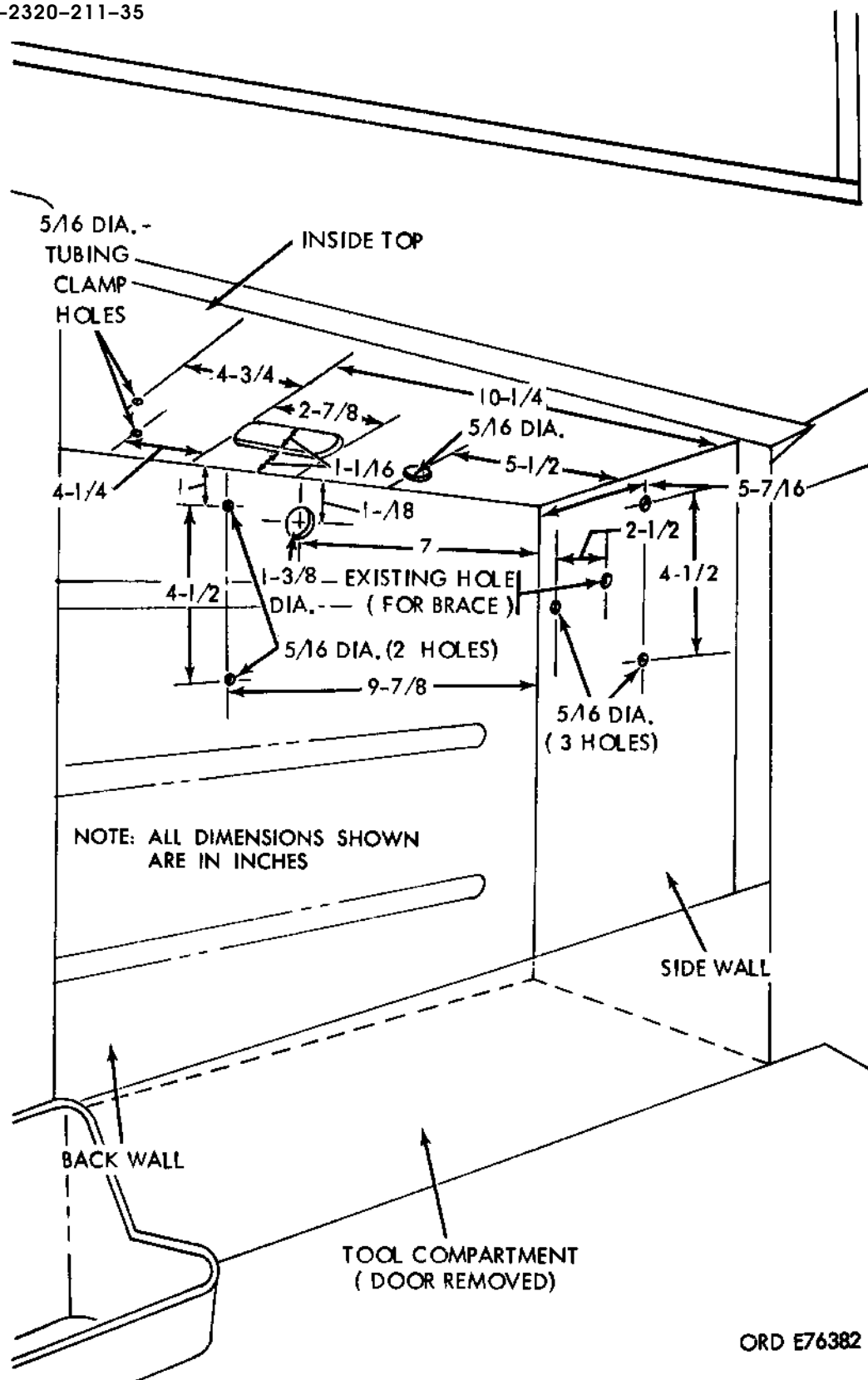
Figure 674. Component parts-winterization kit, personnel heater (3 of 3) (Legend)

527. Installation of Kit

a. Install Heater Fuel Pump.

Note. One fuel pump is used for both personnel heater and coolant heater.

- (1) Unscrew four hinge screws retaining tool compartment door (under the vehicle left door) and remove door.
- (2) Lay out location of two holes for pump shield, on back wall of compartment (Figure 675).
- (3) Punch and drill two 5/16 dia. holes located in (1) above. Prime and paint drilled holes.
- (4) Locate one 1-3/8 dia. tubing hole (for pump to coolant heater tube) in the same rear wall.
- (5) Using a Greenlee punch or hole saw, cut out 1-3/8 dia. hole located in (4) above. Prime and paint hole edge, and insert grommet MS 35489-75.
- (6) Locate three holes in tool compartment side wall as indicated in figure 675.
- (7) Center punch and drill three 5/16 dia. holes located in (6) above.
- (8) Locate one hole for pump electrical lead in top of tool box as indicated in figure 675.
- (9) Center punch and drill 5/8 dia. hole at location marked in (8) above. Prime and paint bare metal.
- (10) Lay out and scribe oblong hole in tool compartment top as indicated in figure 675.
- (11) Center punch and drill three pilot holes in oblong area so three cuts with 1-1/16 dia. hole saw (or greenlee punch) will fall within the indicated oblong.
- (12) Make three cuts as indicated in (11) above, then file off remaining metal within scribed oblong. Prime and paint bare metal.
- (13) Locate two tubing clamp holes in top of



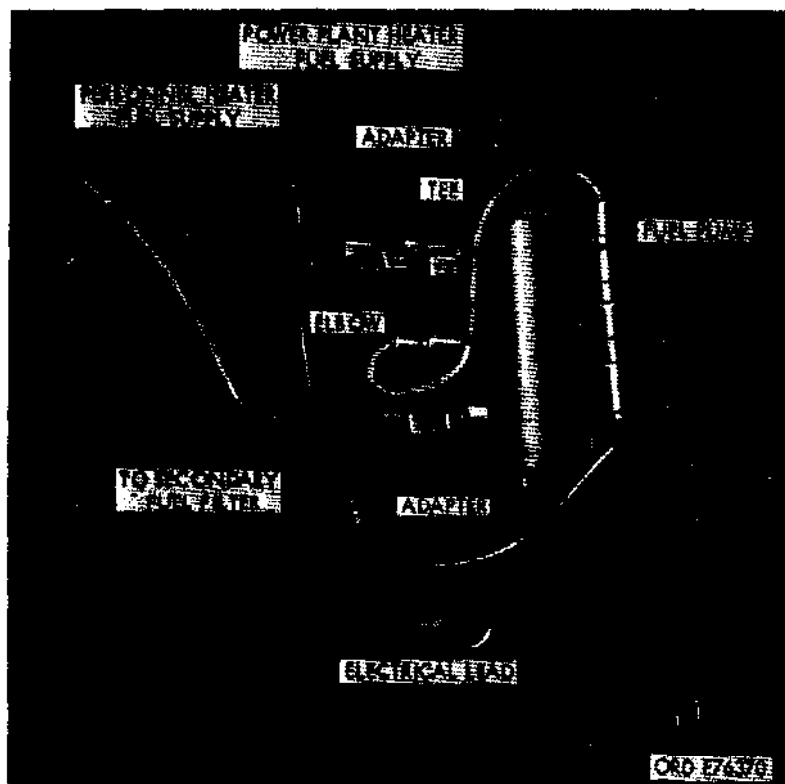


Figure 676. Electric fuel pump installed.

tool compartment as indicated in figure 675.

- (14) Center punch and drill two 5/16 dia. holes located in (13) above. Prime and paint bare metal.
- (15) Attach fuel pump 7748814 to side wall of tool compartment using one existing hole for bracket (fig. 675) and one 5/16 dia. hole drilled in (7) above. Use 1/4-28x1/2 screw (MS 96906-35292-3) and nut (MS 96906-51922-5).

Install Heater Mounting Base 10931988.

- (1) Drill one 9/32 locator hole in left vehicle fender inside engine compartment as indicated in Figure 677.
- (2) Place heater base on left front fender with the evaporator bracket facing front of vehicle.
- (3) Align locator hole drilled in (1) above with corresponding hole in base and temporarily drop in a 1/4-28 screw for a pivot.
- (4) With base pivoted as in (3) above, move forward end of base until left front base

hole is 3-1/2 inches from hinge line (fig. 677).

- (5) Using base holes as template, center punch and drill remaining base holes to 9/32 diameter. Prime and paint bare metal, except heater ground hole.
- (6) Secure heater base to fender using four 1/4-28 x 3/4 hex-head screws MS 96906-35292-6 and locknuts MS 96906-51922-5.

Note. Leave forward left mounting base screw loose for installation of heater ground wire.

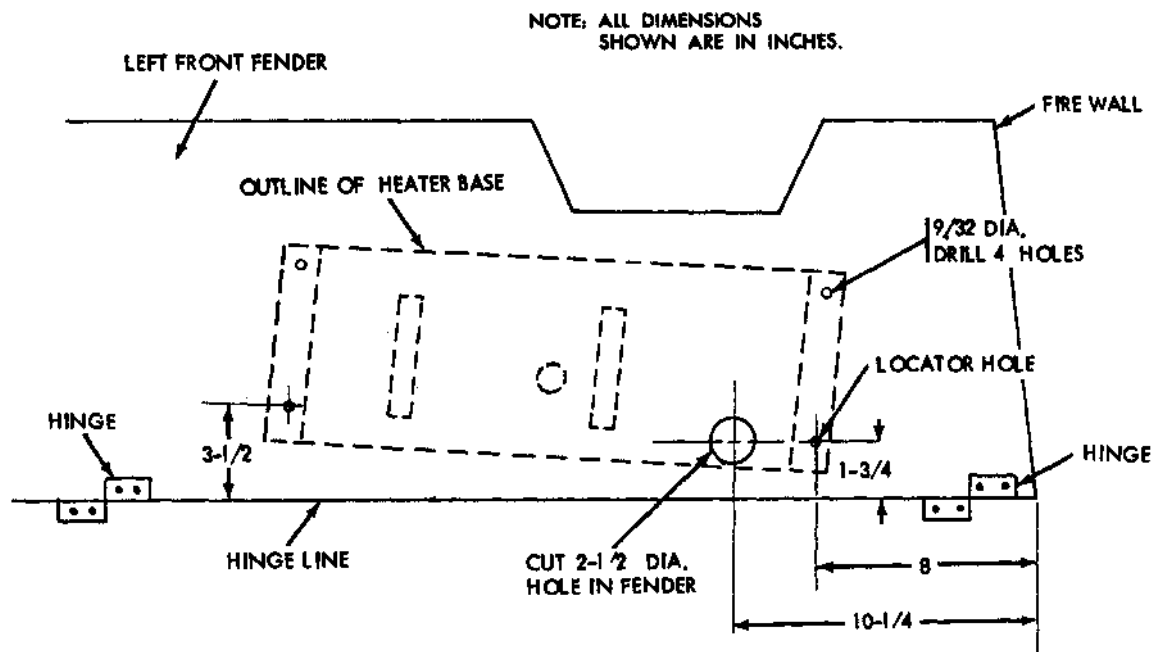
c. Install Diverter (Figure 678).

Note. Prior to beginning operations in vehicle cab, remove complete seat assembly. (TM 9-2320-211-35).

- (1) Locate, center punch and drill four 9/32 dia. holes as indicated in figure 678.

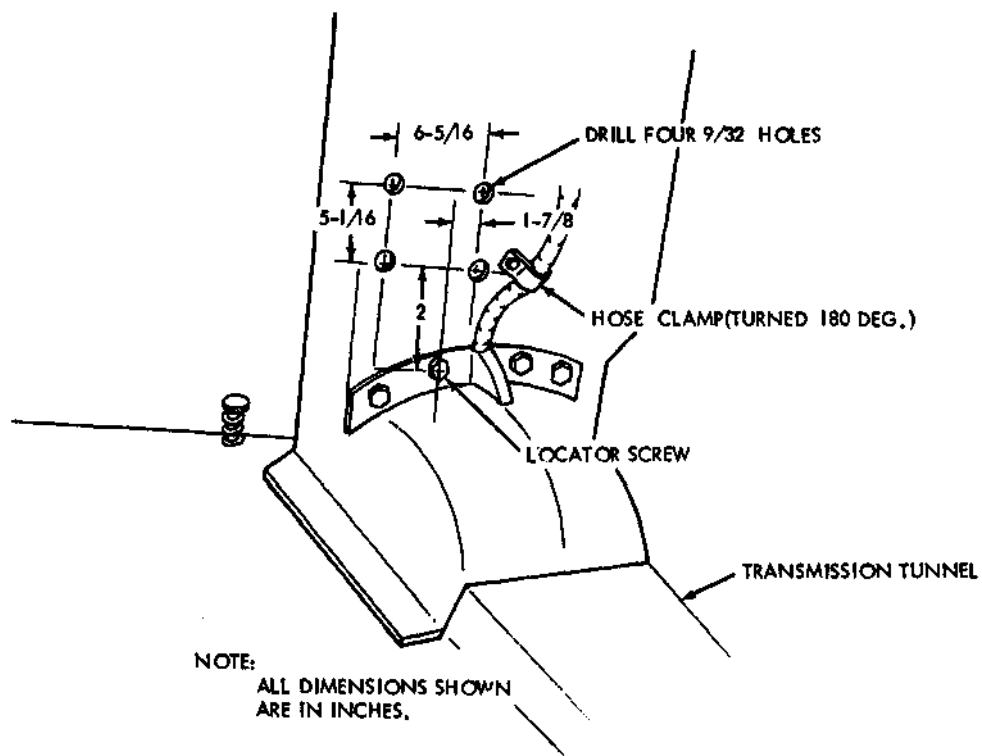
Note. It may be necessary to rotate hose clamp 180 degrees to the right as indicated in figure 678.

- (2) Align diverter with the drilled holes and fasten to firewall using four screws attached to diverter.



ORD E76374

Figure 677. Personnel heater mounting base installation diagram.



ORD E76372

Figure 678. Location of heat diverter mounting holes.

Note. Bend diverter mounting tabs to fit, if necessary.

d. Install heater Duct Elbow (Figure 679).

- (1) Remove the 4- $\frac{1}{8}$ inch knockout plug from the left side of firewall (Fig. 682).
- (2) Remove and retain the two screws and nuts and four lockwashers which came with the heater duct elbow.
- (3) Place elbow flanged end through knockout, with other end of elbow facing right toward diverter, as indicated in figure 679. Set angle of elbow about 20 degrees from horizontal.
- (4) Mark location of mounting holes to be drilled and remove elbow.
- (5) Center punch and drill two $\frac{3}{16}$ dia. holes

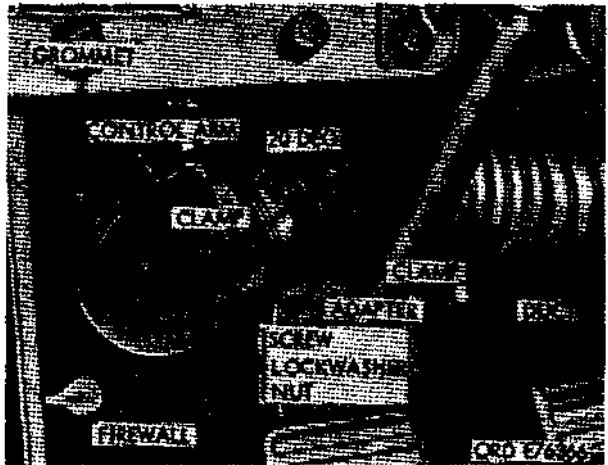


Figure 679. Heater duct elbow.

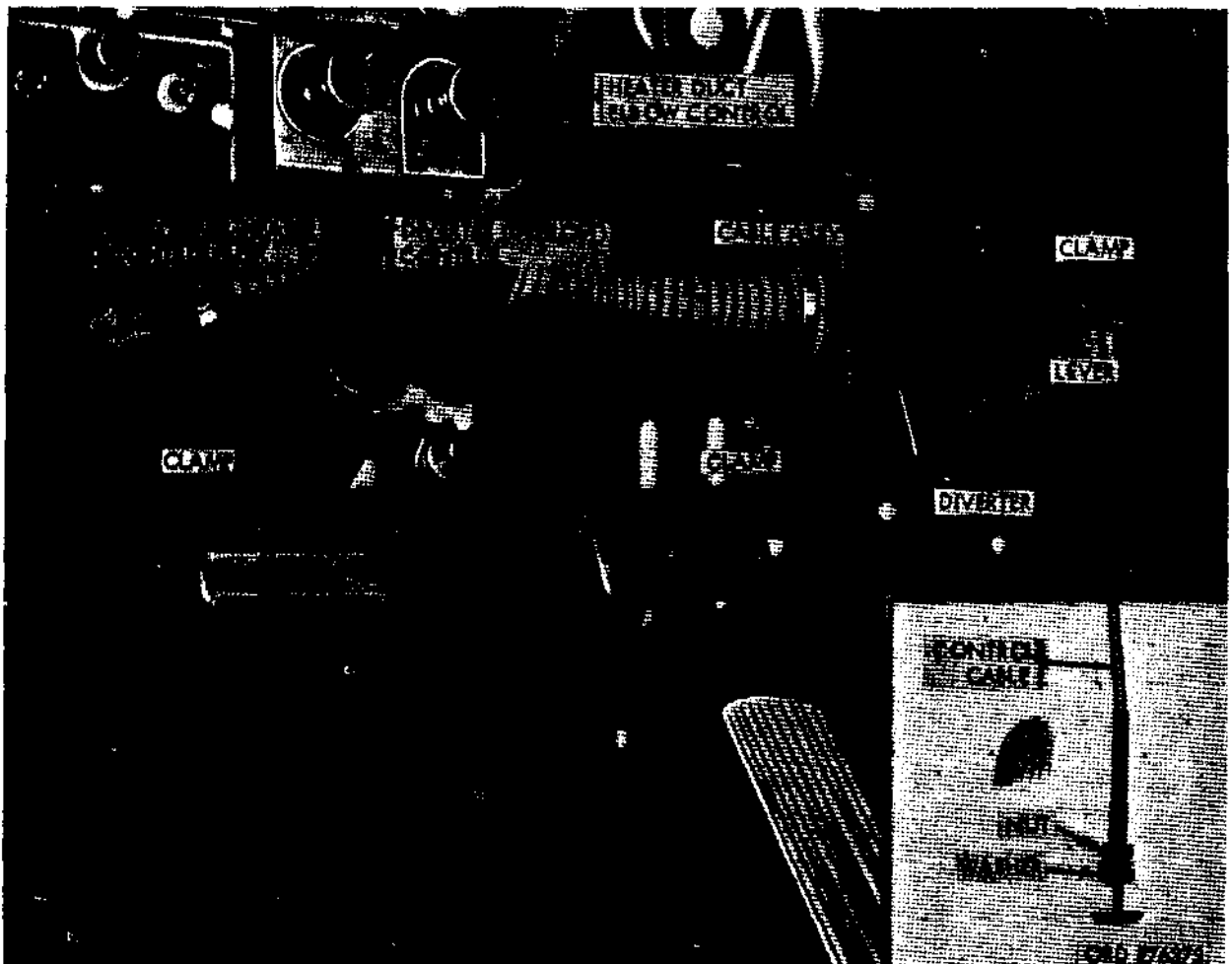


Figure 680. Control box and control cable installation.

in firewall. Attach elbow to firewall using hardware removed in (2) above.

e. Install Heater Control Box.

- (1) Attach plate 10896371 to control box 10885798 using existing nuts and washers on control box studs. Attach box to center plate holes with holes for mounting to dash at front of box.
- (2) Butt plate and box assembly against left side of cab, with plate mounting holes against lower lip of instrument panel (Fig. 680).
- (3) With plate as template, mark location of mounting holes.
- (4) Center punch and drill two 9/32 dia. holes located in (3) above.
- (5) Mount box with plate to dash panel lip using two 1/4-28x3/4 screws MS 96906-35292-3 and nuts MS 96906-51922-5.
- (6) Install decal 10896515 on front panel of control box, 1/4 in. above the phrase "HEATER CONTROL".

f. Install Diverter and Elbow Control Cables.

- (1) Place control cable bracket 8359586 against underside of instrument panel (figure 680) next to the control box.
- (2) Using any two of three holes in bracket, mark location of mounting holes in panel lip which will not interfere with windshield wiper switch or switch air tubes.
- (3) Center punch and drill two 3/16 dia. holes located in (2) above and attach with two 10-32x5/8 screws MS 96906-35226-64 and nuts 7951286.
- (4) Place nameplate 7951468 (marked De-froster) over left bracket hole, and insert the diverter heat control cable through the left hole in the bracket and connect it to the diverter control lever (Fig. 680). Push the control knob fully in and position the cable in the control cable clamp so that the control lever is on the extreme right and tighten the control cable clamp. Place nameplate 7700351 over right bracket hole and insert the heater elbow control cable in the right hole of the mounting bracket connecting the end of this cable to the elbow control arm. Push the control knob fully in and position the cable in the control cable clamp so that the butterfly in

the elbow is closed when the control knob is pushed all the way in and tighten the control clamp.

Note. Due to variation in length of the control cables, it may be necessary to lengthen the cable by unrolling the loop, which is formed at the end of the cable, or by rolling up additional wire to shorten the cable. This operation is done with long-nose pliers. If necessary, the end of the wire can be clipped off and a new loop formed when the cable cannot be shortened sufficiently by rolling up the existing loop. To unlock controls, turn knobs counterclockwise; to lock, turn knobs clockwise.

g. Install Elbow to Diverter Duct (Figure 680).

- (1) Slide one end of 4 in. x 19-1/2 in duct 7951506 onto end of elbow (*d* above) and secure with clamp MS 96906-35842-4.
- (2) Slide other end of ducting onto diverter opening (Fig. 680) and secure duct to diverter with another clamp MS 96906-35842-4.

h. Install Personnel Heater and Duct.

- (1) Assemble large flat washer 7700243 rubber ring 7700243 and metal exhaust ex-

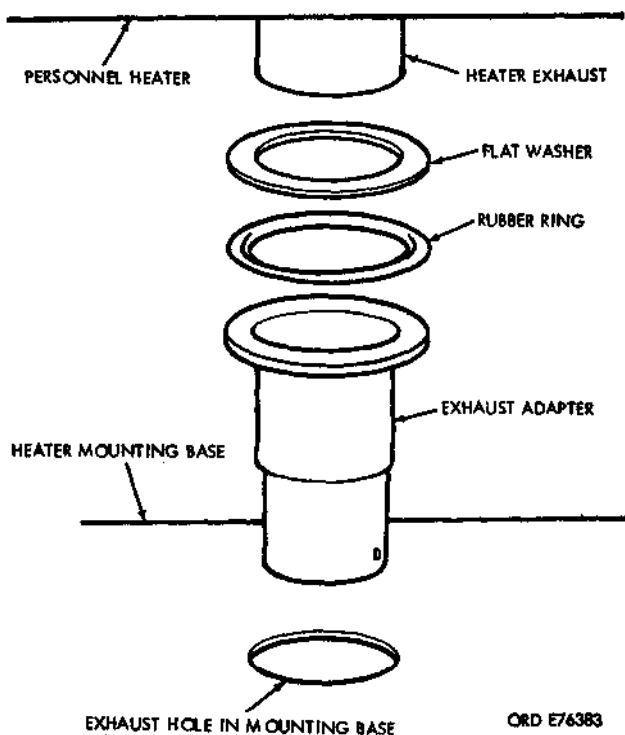


Figure 681. Heater exhaust adapter installation.

tension 7700245 to exhaust pipe on heater, and place heater on mounting base, passing extension through exhaust hole in base (Fig. 681).

- (2) Thread heater retaining clamps MS 96906-35842-4 through slots in bracket welded to base and under valve protective cover atop heater and tighten clamps to secure heater.

Note. Valve protective cover is retained with two fasteners.

- (3) Attach adapter 7524078 to heater as indicated in figure 681, using four screws MS 96906-35206-242 and washers MS 96906-35335-17.

- (4) Attach the 14 inch long duct 8711056 to the heater duct elbow (inside engine compartment) (fig. 682). Attach the other end to heater duct (fig. 682). Secure with clamp MS 96906-35842-4 at each end.

i. Install Heater Exhaust Tube.

- (1) Locate and cut out 2-½ inch hole in fender as indicated in figure 677. Use a hole saw or Greenlee punch for cut.
- (2) Secure heater exhaust elbow 7951084 to exhaust extension 7700245 using ¼ x 3 cotter pin MS 96906-24665-363.
- (3) Run the 70 in. long heater exhaust tube 7986268 up through hole cut in (1) above

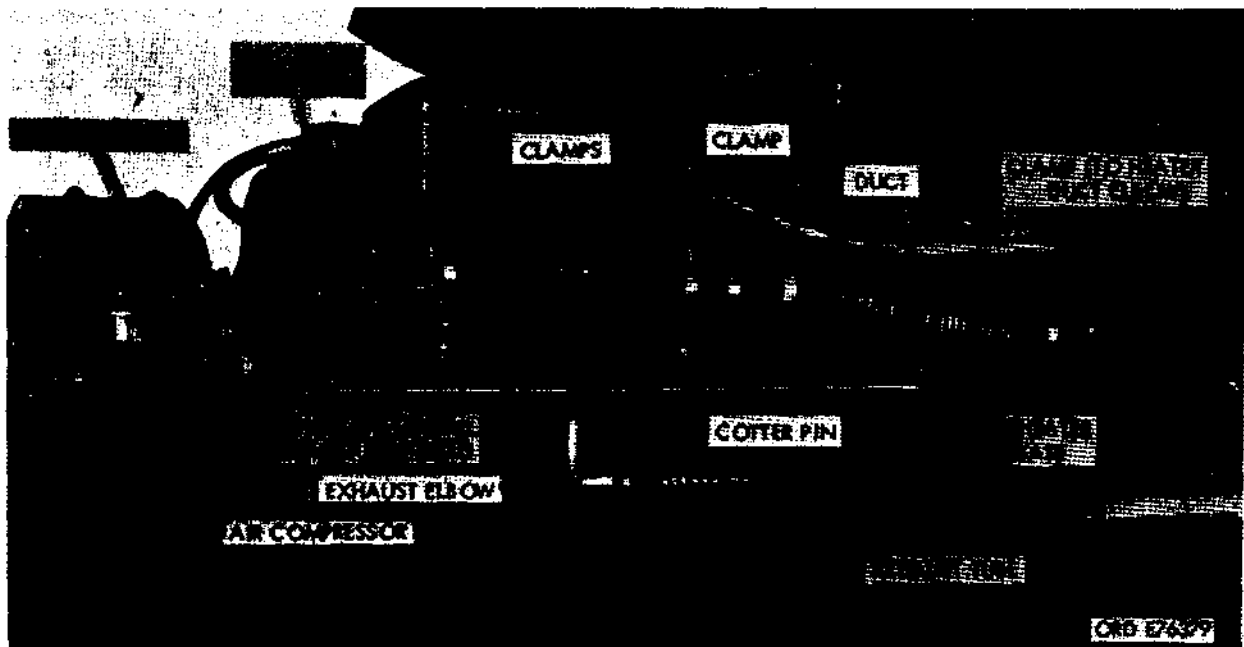


Figure 682. Installing personnel heater.

and place exhaust tube onto elbow so tube covers at least 1-¼ inch of elbow.

Note. It may be necessary to turn tube onto elbow to get it on.

- (4) Drill 5/32 dia. hole through tube and elbow about 1 inch from edge of tube and insert ¼ x 3 cotter pin MS 96906-24665-363.
- (5) Place four clamps MS 96906-21333-99 around exhaust tube 7986268 approximately as indicated in Figure 683. Attach

upper 2 clamps to existing holes in fender reinforcement (Fig. 683) using ¼-28x½ screw MS 96906-35292-3, large flat washer MS 96906-35333-27, lockwasher MS 96906-27183-14 and nut MS 96906-51922-5.

- (6) Drill a 5/32 dia. hole in other arm of same fender reinforcement approximately 3-¼ inches from bottom of reinforcement (Fig. 683) and attach clamp to fender reinforcement with ¼ -28x 1 screw MS 96906-

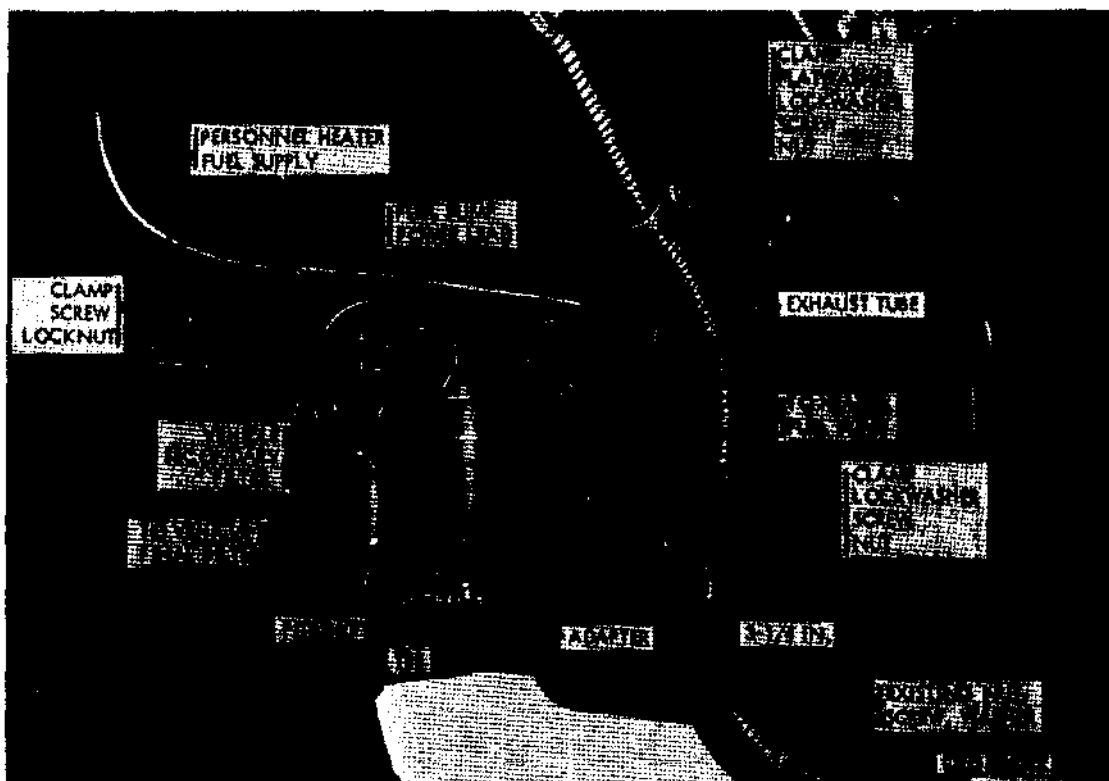


Figure 683. Attaching heater exhaust hose to fender.

35292-8, washer MS 96906-27183-10 and nut MS 96906-51922-5.

- (7) Remove and retain one nut and washer attaching fender bracket to running board hanger and attach final, lowest clamp to bracket using original, existing screw and nut retained above.

k. Install Defrost Reflectors (Fig. 684).

- (1) Lay right defrost deflector 10896407 along top of instrument panel so that window handle can be operated within deflector cut out.

Note. Top edge of deflector is $\frac{3}{8}$ inch from window.

- (2) Using deflector holes as a template, drill holes with No. 38 drill into top of instrument panel.

Note. Do not attempt to drill through second layer of metal; approximately $\frac{3}{8}$ inch below first.

- (3) Secure deflector with five 4-24x $\frac{1}{2}$ self-tapping screws MS 96906-24641-14.

- (4) Repeat operation on left side with other defrost deflector.

l. Install Defroster Ducts (Figure 685).

- (1) Secure 26- $\frac{1}{2}$ inch long x 3 inch diameter duct 7951086 to the right windshield de-



Figure 684. Defrost deflector installation details.

froster nozzle installed at factory using clamp MS 96906-35842-4.

- (2) Secure 29- $\frac{1}{2}$ inch long x 3 inch diameter duct 7401666 to the left windshield defrost nozzle with clamp MS 96906-35842-4.

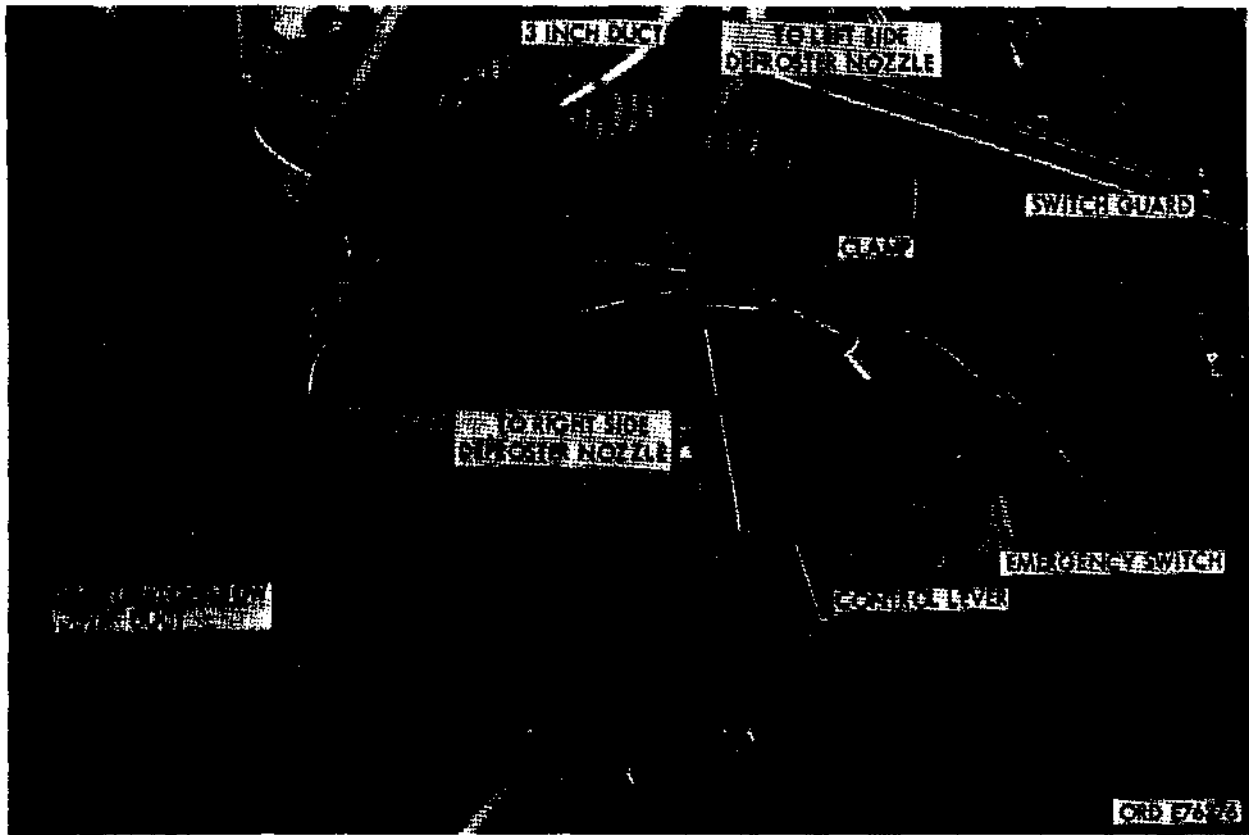


Figure 685. Defrost duct installation

- (3) Attach right side duct to left diverter opening and left side duct to right diverter opening. Clamp each duct to its diverter opening using clamp MS 96906-35842-4.

m. Install Emergency Switch (690).

- (1) Locate center of switch protective guard on under lip of instrument panel approximately 23 inches from right edge of panel.
- (2) Locate two holes for attaching screws using guard as a template.
- (3) Punch and drill two 9/32 dia. holes as located in (2) above and attach guard using two 1/4-28x3/4 screws MS 969015-35292-3 and nut MS 96906-51922-5.
- (4) Attach emergency switch MS 96906-39061-1 to guard with two 8-32x1/2 screw and lockwasher assembly 425302.

Note. Be sure switch "on" position is UP.

n. Install Fuel Lines.

- (1) Attach one arm of tee 444147 to upper opening of fuel pump (Fig. 676) with

opening facing out and downward some 10 degrees.

- (2) Attach elbow MS 39202-4 (for coolant heater line) to leg of tee installed in (1) above.

Caution: When installing tubing, check ends for burs in the I.D. and remove carefully. Burs cause a wax build up which will clog the tubing.

- (3) Attach one adapter MS 39206-4 to other arm of tee installed in (1) above and attach other adapter MS 39206-4 to lower opening of fuel pump.
- (4) Attach filter bracket 10931990 to forward, inner side of heater mounting base (Fig. 686) using two 10-32x3/4 screws (MS 35207-265) and nuts 503209.
- (5) Attach filter MS 51085-1 to bracket installed in (4) above using two 10-32x1-3/4 screws MS 35207-270 and nuts 503209.

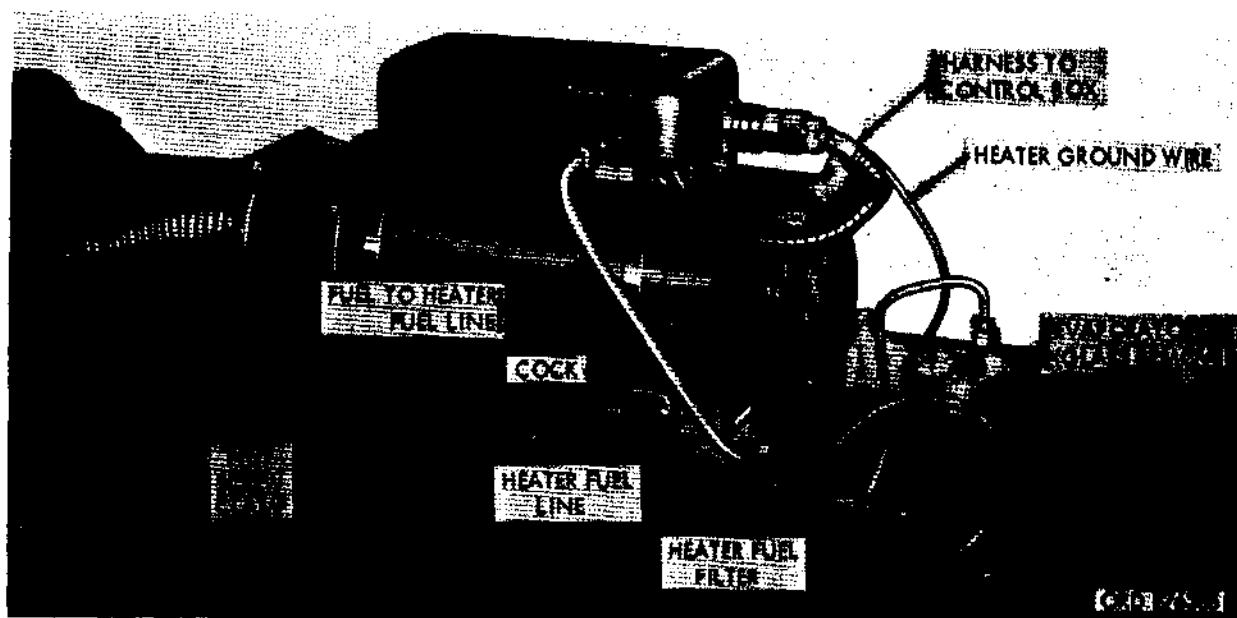


Figure 686. Heater fuel lines at heater.

Caution: Make certain arrow on filter points to front of truck.

- (6) Insert nipple 121830 into heater fuel inlet and screw adapter MS 39203-4 onto it (Fig. 686).
- (7) Attach elbow MS 39202-4 to forward opening of heater filter.
- (8) Attach cock 543852 to rear opening of heater filter and attach adapter MS 39206-4 to cock.
- (9) Loosen tube from bottom of vehicle secondary filter and remove existing elbow. Discard elbow (Fig. 683).
- (10) At the opening of filter (9) above, screw on tee 444120, with one arm pointing in direction of elbow removed in (9) above.
- (11) Insert adapter MS 39206-6 into rearward arm of tee,
- (12) Insert fitting 137409 into forward arm of tee, and reattach vehicle secondary filter to final filter tubing disconnected in (9) above.
- (13) Attach pump-to-secondary filter tube.

Note. Bottom all tubing in fittings before tightening to prevent leaks.

- (a) Take 68 in. long $\frac{1}{4}$ tubing 8689207 and lay it along top of tool compartment, inserting it through oval hole cut in

a(5) above (Fig. 675). Bend tubing to meet lower adapter on pump and attach thereto; bend the other end down to secondary filter and attach to adapter MS 96906-39206-6.

Caution: Remove all burs inside tube ends.

- (b) Fasten tubing to top of compartment and left running board brace as indicated in Figure 675 using clamps MS 96906-21333-99, $\frac{1}{4}$ -28x $\frac{1}{2}$ screws, MS 35292-3 and nut MS 51922-5.
- (14) Attach fuel pump-to-heater tubing.
 - (a) Place $\frac{1}{4}$ tubing 8689207 (88 in. long) along top of tool compartment and snap it into oblong hole in top cut in a(5) above.
 - (b) Attach tubing to arm of tee in upper part of pump (Fig. 676); run other end of tubing over vehicle filters and up through opening in inner fender (Fig. 683) and along side inner edge of heater mounting base and into cock inserted into heater filter in (8) above. Attach end of tubing to cock.
 - (c) Clamp tubing at heater base (Fig. 686), fender opening (Fig. 683) and atop tool compartment (Fig. 675), using clamps

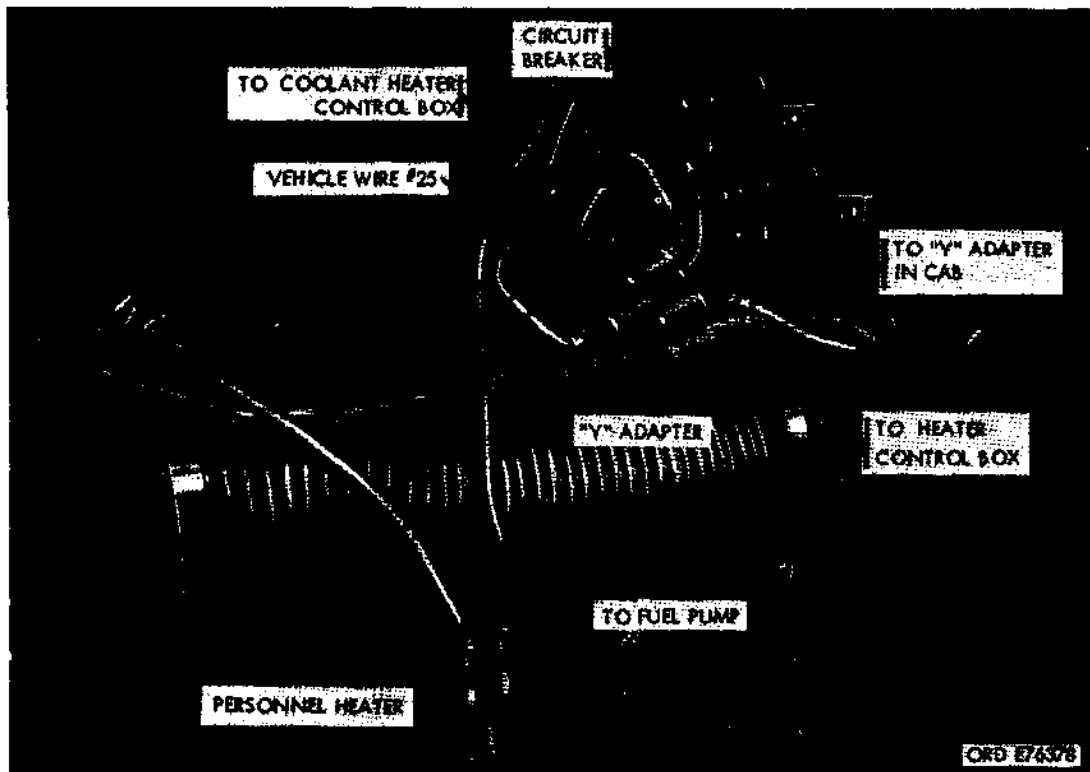


Figure 687. Vehicle to heater power connections.

MS 96906-21333-99, $\frac{1}{4}$ -28x $\frac{1}{2}$ screws
MS 96906-35292-3 and nuts MS
96906-51922-5.

Caution: Make certain tubing is not
being abraded by sharp edges or corners.

(15) Attach filter to heater tube.

(a) Bend 18 in. long $\frac{1}{4}$ tube 8689207 to
fit from exit of heater filter to heater fuel
inlet.

(b) Attach tube to elbow installed in filter
(7) above; attach other end to nipple
and adapter installed in (6) above.

*p. Installation of Alcohol Evaporator (Figure
686).*

(1) Attach alcohol evaporator to the bracket
welded to heater mounting base using 3
screws and locknuts provided with evapo-
rator.

(2) Remove pipe plug in top side of air com-
pressor intake body (Fig. 682) and re-
place with elbow 444038. Discard plug.

(3) Attach $\frac{1}{8}$ tubing to fitting on evaporator;

attach the other end to elbow installed in
(2) above. Tighten nuts securely.

*q. Installation of Harness and Wiring (Figure
689).*

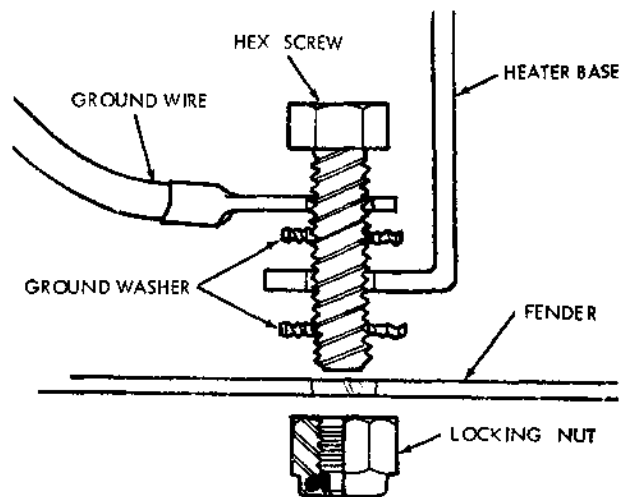
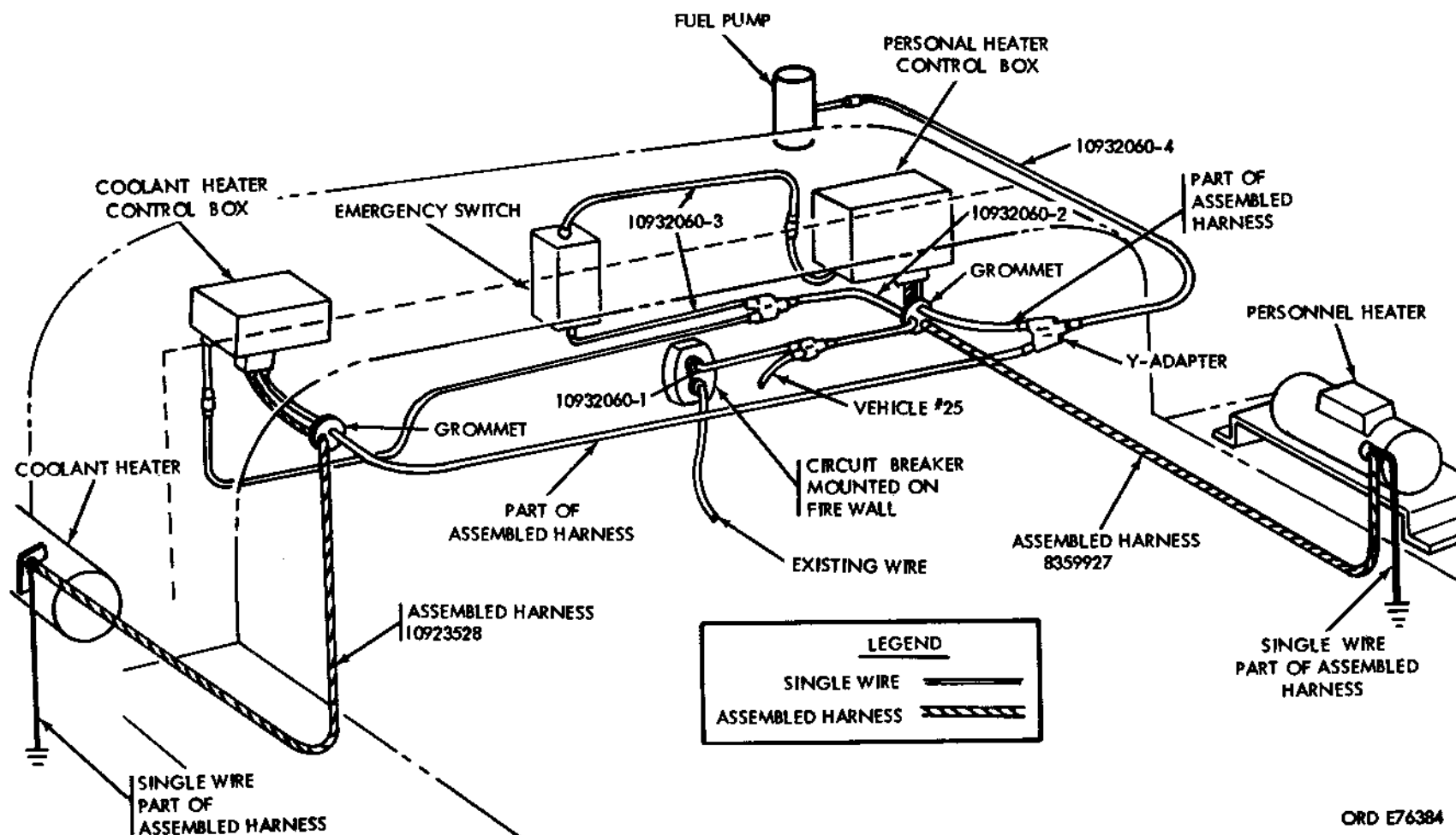


Figure 688. Heater ground wire installation.



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Figure 689. Personnel and coolant heater wiring perspective.

- (1) Remove 1- $\frac{3}{8}$ inch knockout on firewall above and near the heater duct (Figure 687).
- (2) Plug heater-to-control box harness 8359927 into heater receptacle.

Note. Each harness end is labeled.

- (3) Remove left front mounting base screw and nut (installed earlier) and attach heater ground line to base as indicated in Figure 688, using two grounding screws MS 96906-45904-68.

Caution: Make certain a good ground is obtained.

- (4) Lead heater to control box harness into cab through knockout hole obtained in (1) above, and plug it into control box receptacle.
- (5) Plug attached lead of harness into one arm of Y adapter MS 96906-27147-1 (Fig. 687).

Note. Use shell 8338561 and plug 7982907 as and where necessary in installing wiring.

- (6) Plug 72 inch lead assy 10932060-4 (Fig. 687) into other arm of Y adapter MS

96906-27147-1 (5) above, and lead it down inside fender and along side pump to heater tubing, on the top of tool compartment right side and into $\frac{5}{8}$ dia. hole drilled in *a.* above. Connect lead to fuel pump lead and install grommet 7951712 in hole.

- (7) Locate vehicle No. 25 lead (hanging loose on inner firewall) and plug it into leg of a Y adapter (Fig. 687).
- (8) Plug 6 inch lead assy 10932060-1 into one arm of adapter installed in (7) above (Fig. 687).
- (9) Plug other end of 6 inch lead assy 10932060-1 into vacant orifice of circuit breaker (Fig. 687).
- (10) Plug 13 inch lead assy 10932060-2 into the other arm of Y adapter MS 96906-27147-1 and insert other end of lead assy through 1- $\frac{3}{8}$ knockout hole in firewall (knocked out in (1) above) into cab. Attach to leg of another Y adapter MS 96906-27147-1. Install grommet around control box to heater harness and 13 inch lead and insert in 1- $\frac{3}{8}$ inch hole knocked out in (1) above.

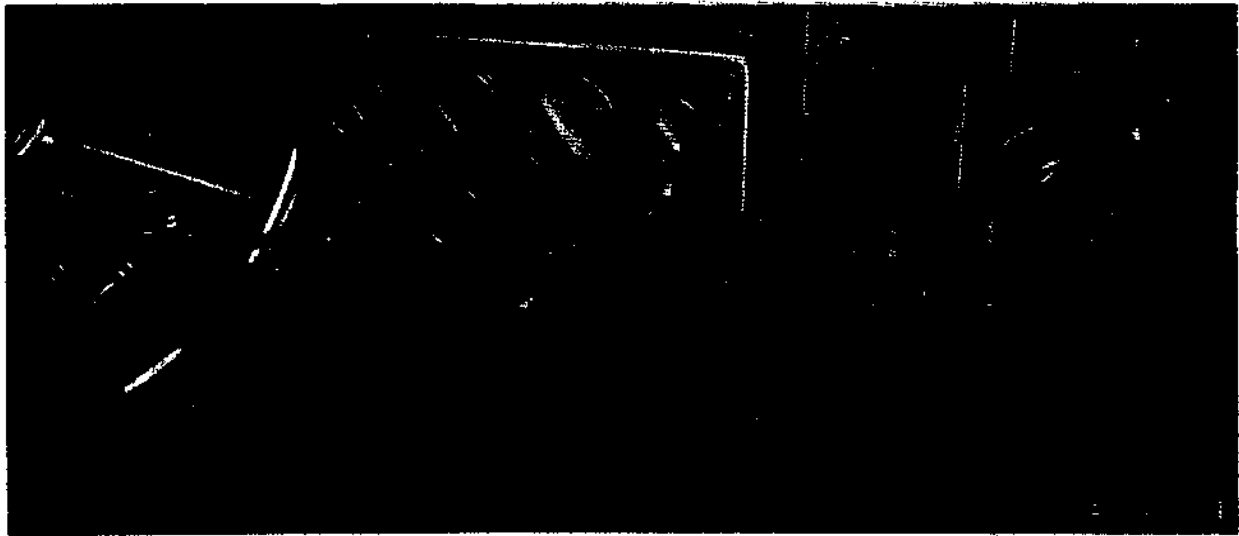


Figure 690. Wiring hook-up in cab.

- (11) Plug 38 inch lead assy 10932060-3 into one arm of Y adapter installed in (10) above. Plug the other end of 38 inch lead

assy into bottom terminal of emergency switch (Fig. 690).

- (12) Plug another 38 inch lead assy 10932060-

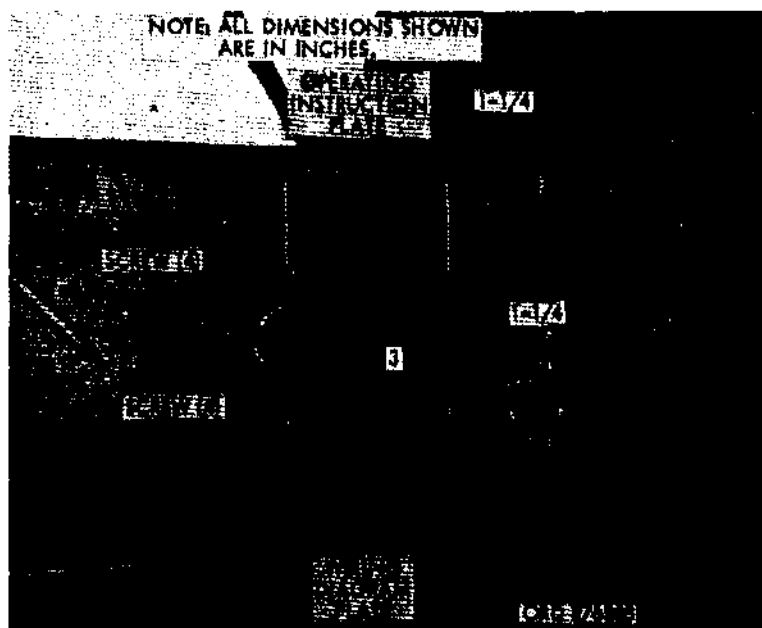


Figure 691. Installation of data and instruction plates.

3 into top terminal of emergency switch (Fig. 690) and plug the other end into the personnel heater control box lead.

r. Installation of Data and Instruction Plates (Figure 691).

- (1) Attach operating instruction plate 7951717 to inside of left door, using four No. 10-16 x $\frac{3}{8}$ sheet metal screws MS 96906-24637-33.
- (2) Attach wiring diagram plate 7951661 to inside of left door, using four 10-16 x $\frac{3}{8}$ sheet metal screws MS 96906-24637-33.

s. Installation of Slave Receptacle. Refer to paragraph 528.

Note. Although slave receptacle is part of personnel heater kit, it cannot be installed until battery box is installed, part of coolant heater installation (par. 528).

t. Installation of Shield.

Note. Do not install shield until after trial operation to detect leaks.

- (1) Place shield 10932116 over the fuel pump, aligning shield holes with holes drilled in tool compartment side and back.
- (2) Fasten shield in place using four $\frac{1}{4}$ -28 x $\frac{1}{2}$ screws MS 96906-35207-279 and locking nuts MS 96906-51922-5 (Fig. 692).

u. Installation of Gear Shift Lever Boot and Transfer Lever Cover.

Note. Thermal barrier (par. 525) is installed first.

- (1) Position gear shift lever in neutral and position boot 8370841 over lever, with curved seam toward instrument panel.
- (2) Hold boot in place and shift gears to determine lever can be shifted without stress.
- (3) Using boot base as template, center punch and drill 7/64 dia. mounting screw holes through thermal barrier and transmission tunnel.
- (4) Secure boot to transmission tunnel with four No. 10-12 x $\frac{3}{4}$ self-tapping screws 5305-012-8151.
- (5) Position transfer lever in high range and place cover 7389745 over lever with seam toward instrument panel.
- (6) Shift lever to determine whether lever can be shifted without stress.
- (7) Using cover base as template, center punch and drill four 7/64 dia. holes through thermal barrier and transmission tunnel.
- (8) Secure cover to tunnel with four No. 10-12 x $\frac{3}{4}$ self-tapping screws 5305-012-8151.

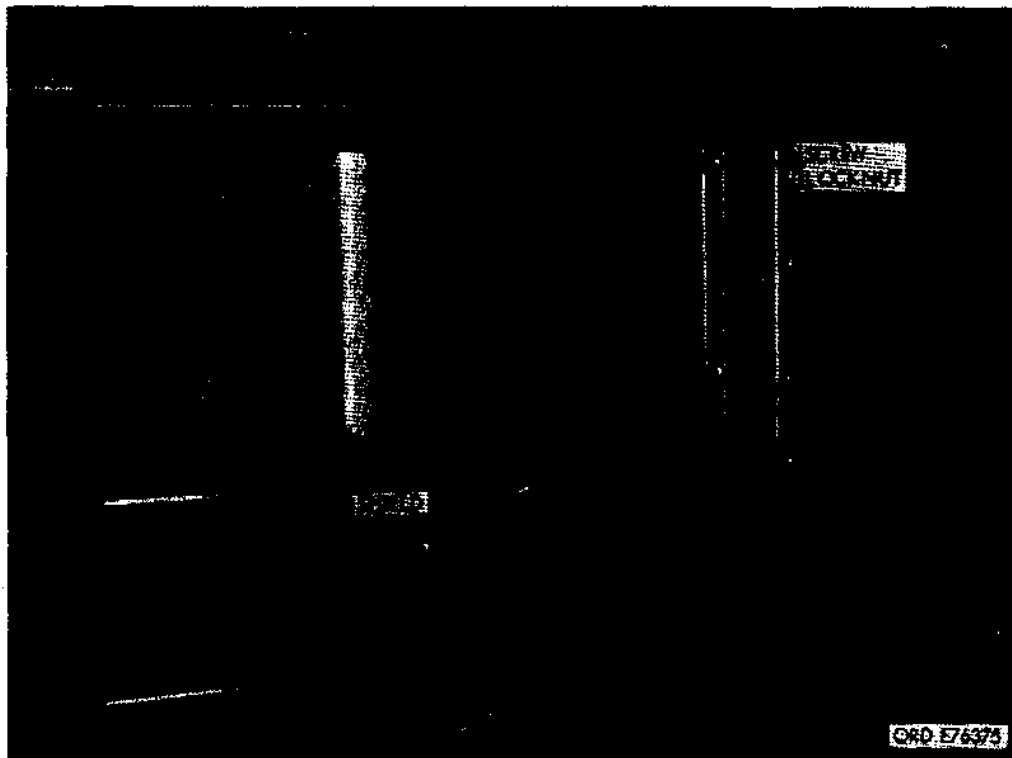


Figure 692. Installation of pump shield.

v. *Installation of Radiator Cover.* The cover assembly is installed by using the procedures given in paragraph 481d of this manual.

w. *Operating Test After Personnel Heater Kit Installation.*

- (1) Preliminary checks before starting heater.
 - (a) Open the personnel heater fuel shutoff cock, located at the fuel pump tee in the vehicle battery compartment to the fully counterclockwise position.
 - (b) Be sure the personnel heater emergency switch is in the "ON" position.
 - (c) Use the "push-to-test" feature of the

personnel heater control box indicator lamp. The lamp should light; if the lamp does not light, troubleshoot the heater circuit. Refer to paragraph 530 for troubleshooting.

- (2) Checking personnel heater operation
 - (a) Start to operate the personnel heater according to procedures given in TM 9-2320-211-10.
 - (b) Operate all personnel heater controls as directed in TM 9-2320-211-10. If the heater fails to operate properly, refer to troubleshooting, this manual to correct the defect.

Section XIV. (Added) POWER PLANT (COOLANT) HEATER KIT (MULTIFUEL MODELS)

528. Description, Data and Installation Instructions

a. Description.

- (1) *Coolant heater.* An electrically operated heater using fuel from the vehicle fuel system is mounted on the frame in the battery compartment of the vehicle. This heats the coolant to facilitate starting and to maintain near-normal engine operating temperature during standby periods. Exhaust gases from the heater pass through tubing to the oil pan shroud for warming the crankcase lubricant. The heaters are not designed for use while the vehicle is in motion, but for overnight or standby heating of the coolant and the crankcase lubricant when the engine is stopped.

Warning: This type of heater must not be used in closed areas occupied by personnel.

- (2) *Battery box and accessories.* The battery box and cover are provided with complete interior insulation and heating pad to maintain batteries at temperatures necessary for normal input and output voltages of the battery. Separate lines attached to the battery box heating pad and engine block permit heated coolant to circulate through the heating pad in the bottom of the battery box.
- (3) *Covers.* Covers are attached to the engine hood, brush guard, and the hood right-and-left-side panels to help retain heat in the engine compartment. These covers do not interfere with the opening of the hood.

b. Data.

Heater:

Manufacturer Stewart-Warner Corp.
Model no. 939-F24
Ordnance part no. 10914540
Weight 15 lb

Dimensions:

Width 6-3/4 in.
Length 15.5/16 in.
Height 9-1/2 in.

Heat output (coolant):

High heat 16,000 Btu/hr
Low heat 5500 Btu/hr

Heat output (exhaust):

High heat 8000 Btu/hr
Low heat 4500 Btu/hr

Fuel consumption:

High heat 0.260 gph
Low heat 0.110 gph
Fuel pressure required 3 to 15 psi
Operating voltage 24 v

Current consumption:

Starting 11 amp
Low heat 1.0 amp
High heat 1.0 amp

Blower motor:

Manufacturer Stewart-Warner Corp.
Model no. G 700139
Ordnance part no. 8359780
Operating voltage 24 v
Current consumption 0.7 amp

Fuel filter:

Manufacturer Bendix Corp.
Ordnance part no. 7761059

c. Composition of Kit. The kit is comprised of a coolant heater, battery box and covers, with necessary wiring controls and piping. Figures 693 through 696 indicate kit contents.

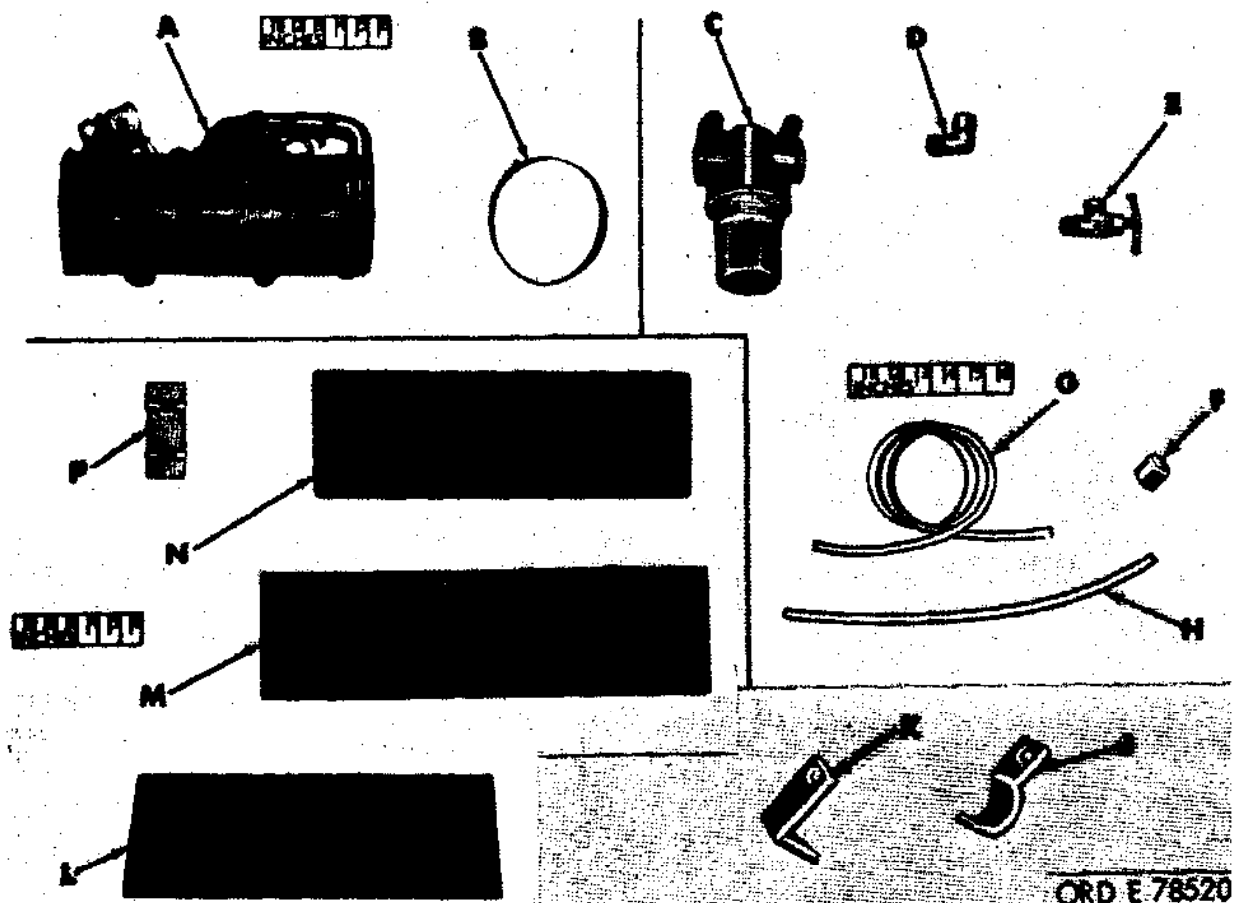


Figure 693. Major parts-winterization kit, power plant heater (1 of 4).

| Key | Item | Part Number | Quantity |
|-----|---|-----------------|----------|
| A | HEATER ASSY, power plant | 10914540 | 1 |
| B | CLAMP, 5- $\frac{3}{4}$ - 6- $\frac{1}{2}$ heater mounting | 7951827 | 2 |
| C | FILTER ASSY, fuel | MS 51085-1 | 1 |
| | SCREW, mach, pan-hd, no. 10-32x1- $\frac{1}{2}$ | 96906-35207-269 | 2 |
| | WASHER, lock, flat, ext tooth | 96906-35335-18 | 2 |
| D | ELBOW ASSY, 5/16 tube x $\frac{1}{8}$ pipe, filter outlet and inlet | MS 39202-4 | 2 |
| E | COCK ASSY, shutoff, 5/16 tube x $\frac{1}{8}$ pipe | 543852 | 1 |
| F | ADAPTER | MS 39206-4 | 1 |
| G | TUBE, 64 in. pump to filter | 8689207 | 1 |
| H | TUBE, 20 in. filter to heater | 8689207 | 1 |
| J | CLAMP, tube | MS 21333-99 | |
| | SCREW | MS 35292-4 | |
| | NUT | MS 51922-5 | |
| K | BRACKET, tube clamp mounting | 10931984 | 1 |
| L | BAFFLE, bottom | 7700424 | 1 |
| | SCREW, cap, hex-hd, $\frac{1}{4}$ -28x $\frac{3}{8}$ | 96906-35292-5 | 4 |
| | NUT, self-locking, $\frac{1}{4}$ -28 | 96906-51922-5 | 4 |
| M | SHIELD | 10931983 | 1 |
| | SCREW, cap, hex-hd, $\frac{1}{4}$ -28x $\frac{3}{8}$ | 96906-35292-5 | 4 |
| | NUT, self-locking $\frac{1}{4}$ -28 | 96906-51922-5 | 4 |
| N | PLATE, heater mtg | 10896366 | 1 |
| P | SADDLE, heater mtg | 10896477 | 2 |
| | SCREW, cap, hex-hd, $\frac{3}{8}$ -24x $\frac{5}{8}$ | 96906-35292-57 | 4 |
| | WASHER, int - ext tooth, $\frac{3}{8}$ in. | 96906-35335-21 | 4 |

Figure 693. Component parts-winterization kit, power plant heater (1 of 4) (Legend).

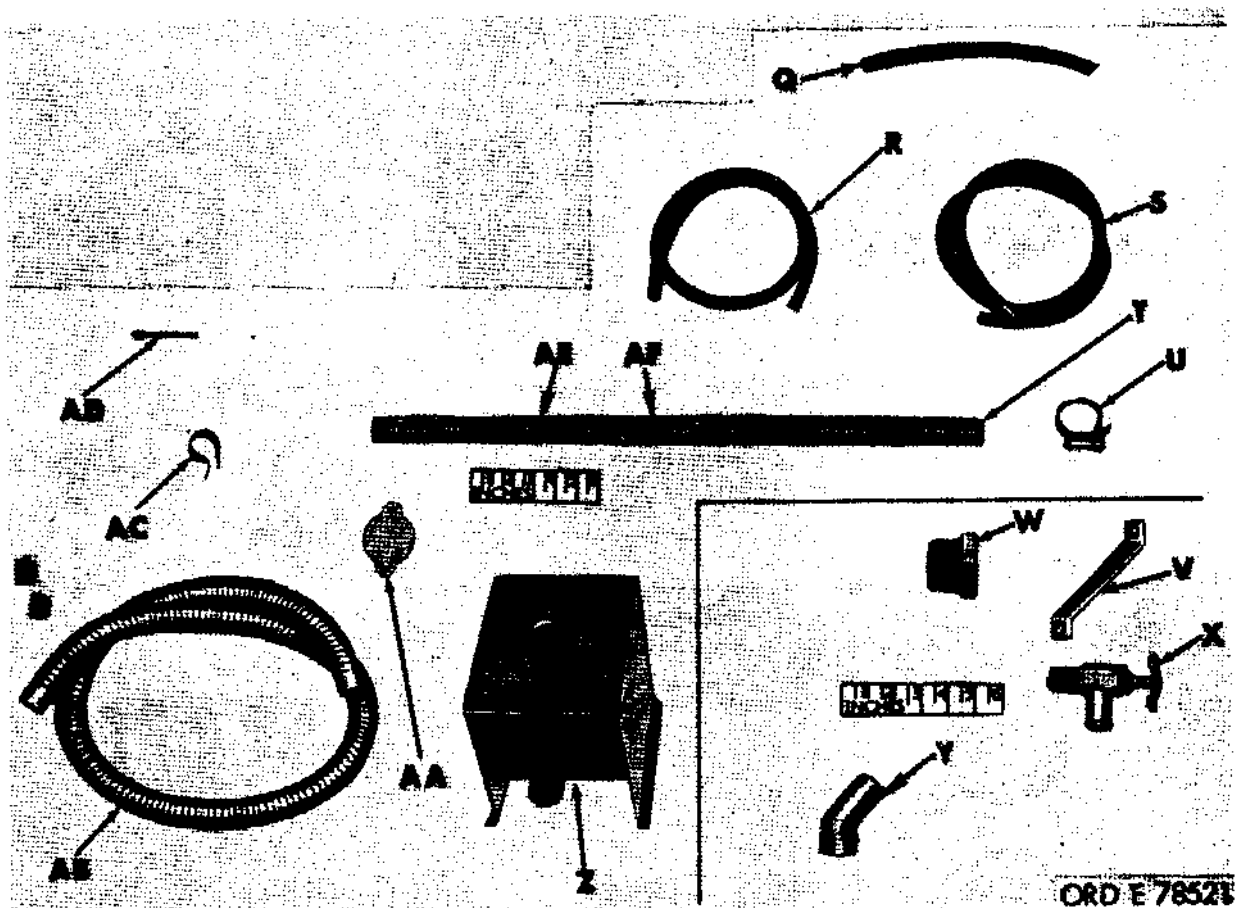
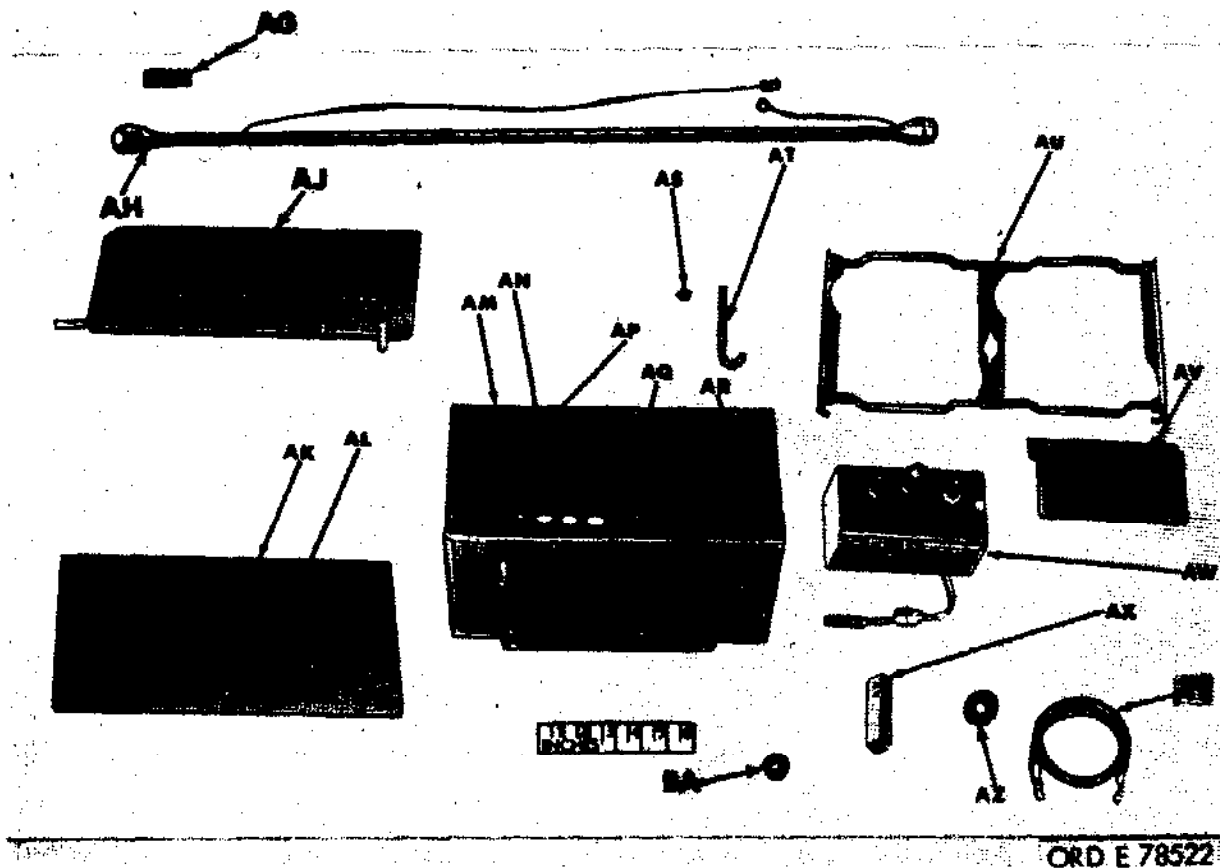


Figure 694. Component parts-winterization kit, power plant heater (2 of 4)

| Key | Item | Part Number | Quantity |
|-----|---|----------------|----------|
| Q | HOSE, 24 in. lg. coolant return | 8376141 | 1 |
| R | HOSE, 54 in. lg. coolant outlet | 8376141 | 1 |
| S | HOSE, 78 in. lg. coolant inlet | 8376141 | 1 |
| T | TUBE, hose, shield 52 in. lg. | 7986268 | 1 |
| U | CLAMP, hose $\frac{3}{4}$ - 1- $\frac{1}{2}$ | 96906-35842-2 | 6 |
| V | BRACKET, heater exhaust | 10931985 | 1 |
| | CLAMP (See AE) | | |
| | SCREW | MS 35291-60 | 1 |
| | NUT | MS 51922-17 | 1 |
| W | BUSHING, coolant outlet | 120322 | 3 |
| X | COCK, shutoff, $\frac{3}{8}$ pipe, $\frac{3}{8}$ hose | 596800 | 2 |
| Y | ELBOW, 45°, coolant outlet | MS 24518-7 | 1 |
| Z | SHROUD, oil pan | 10896359 | 1 |
| | SCREW, cap, hex-hd, $\frac{3}{8}$ -16x1 $\frac{1}{4}$ | 96906-35291-65 | 4 |
| | WASHER, lock, split, $\frac{3}{8}$ in. | 96906-35335-21 | 4 |
| AA | PLATE, shroud access | 10896364 | 1 |
| | SCREW, cap, hex-hd, $\frac{1}{4}$ -28x7/16 | 96906-35292-2 | 2 |
| | WASHER, lock, split, $\frac{1}{4}$ in. | 96906-35335-19 | 2 |
| AB | TUBE ASSY, exhaust, 56 in. lg. | 7986268 | 1 |
| AC | CLAMP, 2- $\frac{3}{8}$ in. (exhaust tube) | 8707524 | 5 |
| | SCREW, cap, hex-hd, $\frac{1}{4}$ x28x $\frac{3}{4}$ | 96906-35292-8 | 5 |
| | NUT, self-locking, hex, $\frac{1}{4}$ -28 | 96906-51922-5 | 5 |
| | WASHER | 96906-27183-10 | 5 |
| AD | PIN, cotter, 5/32x2- $\frac{3}{4}$ | MS 24665-363 | 2 |
| AE | TUBE, hose shield, 76 in. lg. | 7986268 | 1 |
| AF | TUBE, hose shield, 22 in. lg. | 7986268 | 1 |

Figure 694. Component parts-winterization kit, power plant heater (2 of 4) (Legend)



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Figure 695. Component parts, winterization kit, power plant heater (3 of 4)

| Key | Item | Part Number | Quantity |
|-----|--------------------------------|-----------------|----------|
| AG | DECAL | 10896514 | 1 |
| AH | HARNESS (box to heater) | 10923528 | 1 |
| AJ | HEAT PAD ASSY, battery box | 7700422 | 1 |
| AK | COVER, battery box | 7700387 | 1 |
| AL | INSULATION, cover | 7700413 | 1 |
| AM | BOX, battery-assy | 7700422 | 1 |
| AN | INSULATION, front and rear | 7700412 | 2 |
| AP | INSULATION, left end | 7700448 | 1 |
| AQ | INSULATION, bottom | 7700410 | 1 |
| AR | INSULATION, right end | 7700411 | 1 |
| | CLIP, insulation | 7954865 | 8 |
| | RETAINER, clip | 8366948 | 8 |
| AS | SPACER, battery box | 7700455 | 2 |
| | SCREW, cap, hex-hd, 3/8-24x1 | 96906-35292-60 | 4 |
| | WASHER, lock, split, 3/8 in. | 96906-35337-27 | 4 |
| AT | J BOLT, battery, 3/8-16x10-1/4 | 7700409 | 4 |
| AU | FRAME, battery | 7700398 | 1 |
| | WASHER, flat, round, 3/8 in. | 96906-27183-15 | 4 |
| | WASHER, lock, split, 3/8 in. | 96906-35337-027 | 4 |
| | NUT, plain, hex, 3/8-16 | 96906-35690-605 | 4 |
| AV | PLATE, control box mtg | 10931992 | 1 |
| | SCREW, cap, hex-hd, 1/4-28x1/2 | 96906-35292-3 | 2 |
| | NUT, self-locking, hex, 1/4-28 | 96906-51922-5 | 2 |
| AW | BOX ASSY, control | 10885798 | 1 |
| AX | EXTENSION, companion seat | 7700444 | 2 |
| | SCREW, cap, hex-hd, 1/4-20x3/4 | 96906-35291-6 | 4 |
| | WASHER, lock, split, 1/4 in. | 96906-35337-25 | 4 |
| | NUT, plain, hex, 1/4-20 | 96906-35690-405 | 4 |
| AY | CABLE ASSY, battery jumper | 10938140-1 | 1 |
| AZ | GROMMET (thru firewall) | 795-1712 | 1 |
| BA | GROMMET (battery box) (3) | 96906-35489-23 | 5 |
| | (tunnel) (1) | | |
| | (tool comp) (1) | | |

Figure 695. Component parts, winterization kit, power plant heater (3 of 4) (Legend)

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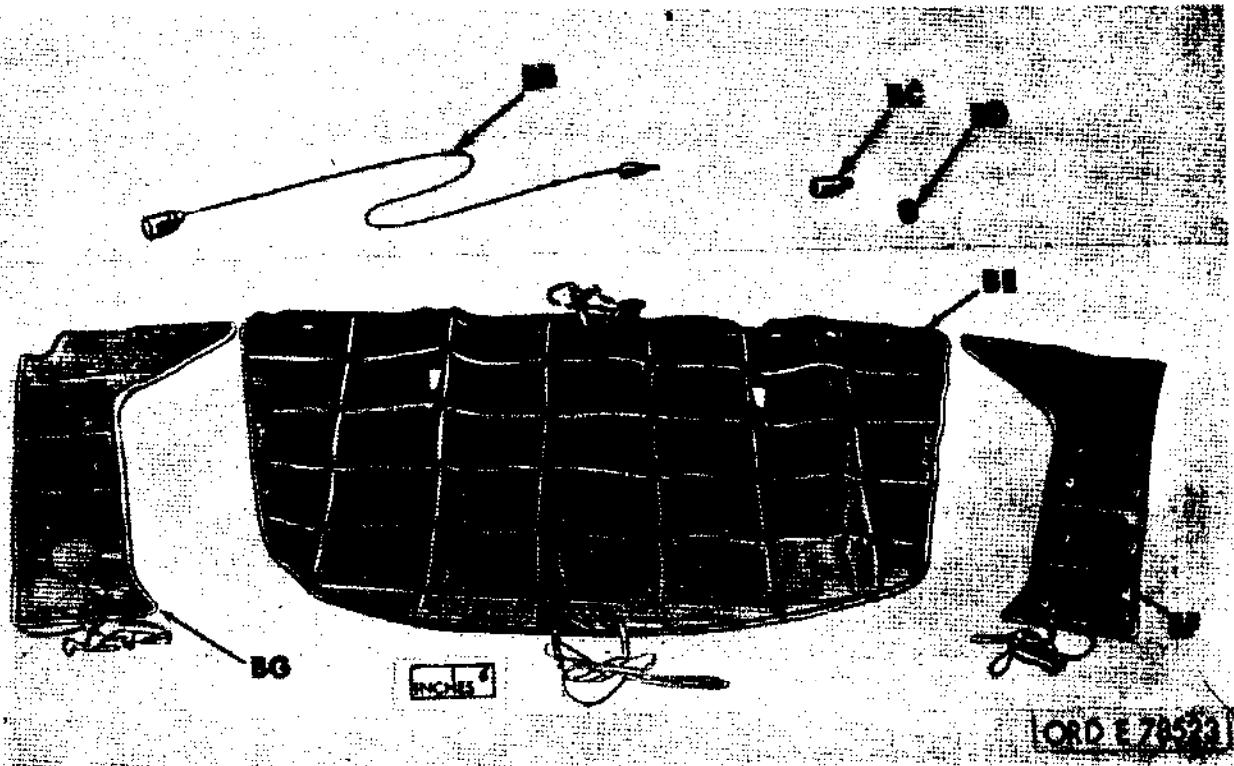


Figure 696. Component parts, winterization kit, power plant heater (4 of 4)

| Key | Item | Part Number | Quantity |
|-----|-------------------|-------------|----------|
| BB | LEAD | 10932060-3 | 1 |
| BC | PLUG | 7982907 | 1 |
| BD | SHELL | 8338566 | 1 |
| BE | COVER, hood | 7978825 | 1 |
| BF | COVER, left side | 10938119 | 1 |
| BG | COVER, right side | 10938122 | 1 |
| | LOOP, cover | 7716428 | 55 |
| | SCREW, no. 8-32x½ | 145327 | 110 |

Figure 696. Component parts, winterization kit, power plant heater (4 of 4) (Legend)

529. Power Plant Heater Installation

Instructions.

Note. Power plant heater uses fuel pump used for the personnel heater. See personnel heater installation instructions for pump installation details.

a. Prepare Vehicle.

- (1) Disconnect batteries (TM 9-2320-211-20).
- (2) Loosen thumb screws on battery box, turn thumb screw retainers down and slide out entire battery box with batteries. Remove battery jumper cable and discard. Tighten retainers in the lowered position.
- (3) Remove batteries from box, discard box.
- (4) Remove 8 capscrews, lockwashers and nuts

securing driver and companion seat to cab floor and remove both seats as one unit (paragraph 132).

- (5) Knock out three oblong holes in vehicle floor (Fig. 708) and one 1-½ dia. circular knockout in rear transmission tunnel.
- (6) Remove tape covering welded nut holes (Fig. 708) for attaching battery box.

b. Prepare Battery Compartment.

- (1) Place baffle 7700424 on battery box support as indicated in figure 697.
- (2) Using baffle as a template, locate four baffle mounting holes.

Note. Aline outer baffle edge w/inner edge of outer channel bar which supports slide bar.

- (3) Center punch and drill four 9/32 dia. holes located in (2) above. Prime and paint bare metal.

- (4) Fasten baffle to slide bar using four 1/4-28x5/8 screws, MS 96906-35292-5 and four self-locking nuts, MS 96906-51922-5.

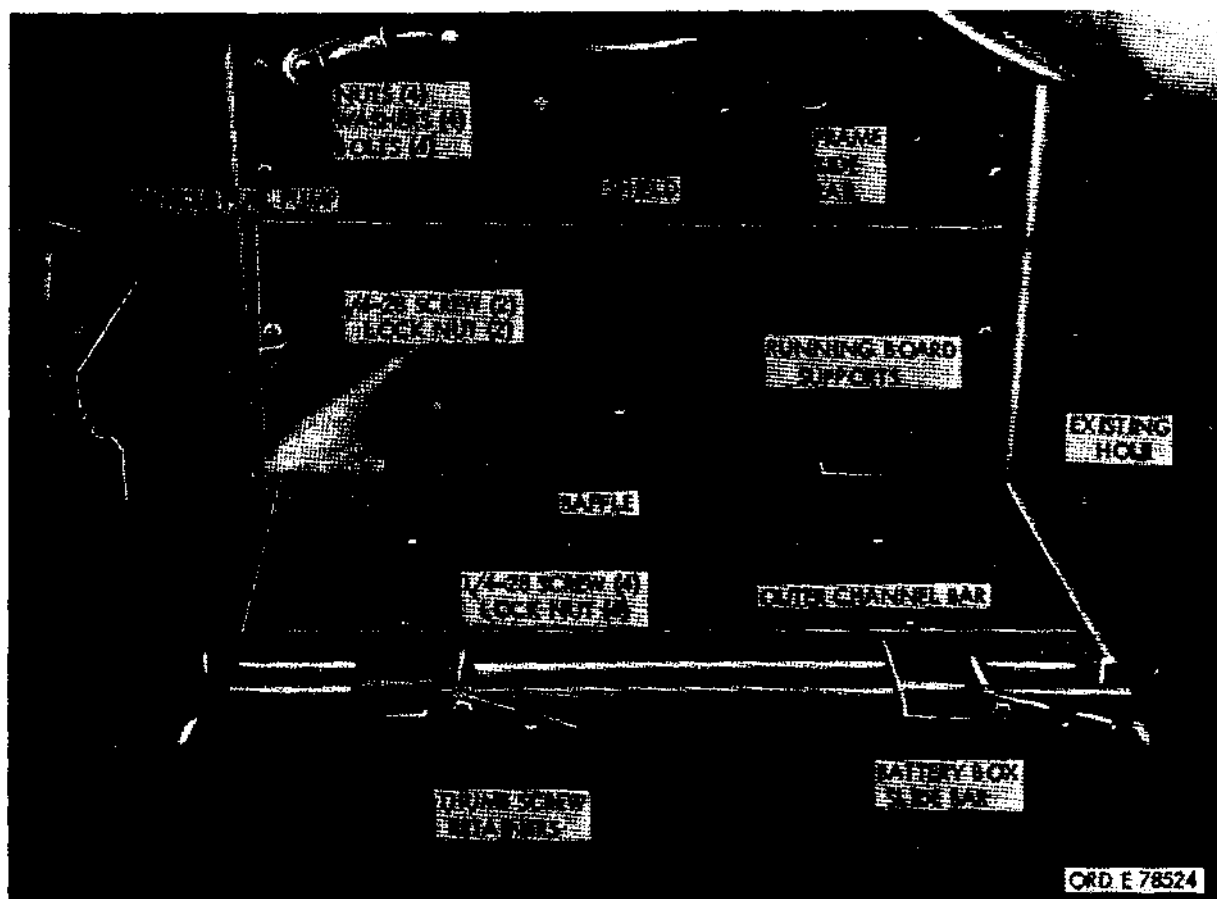


Figure 697. Installation of baffle and shield.

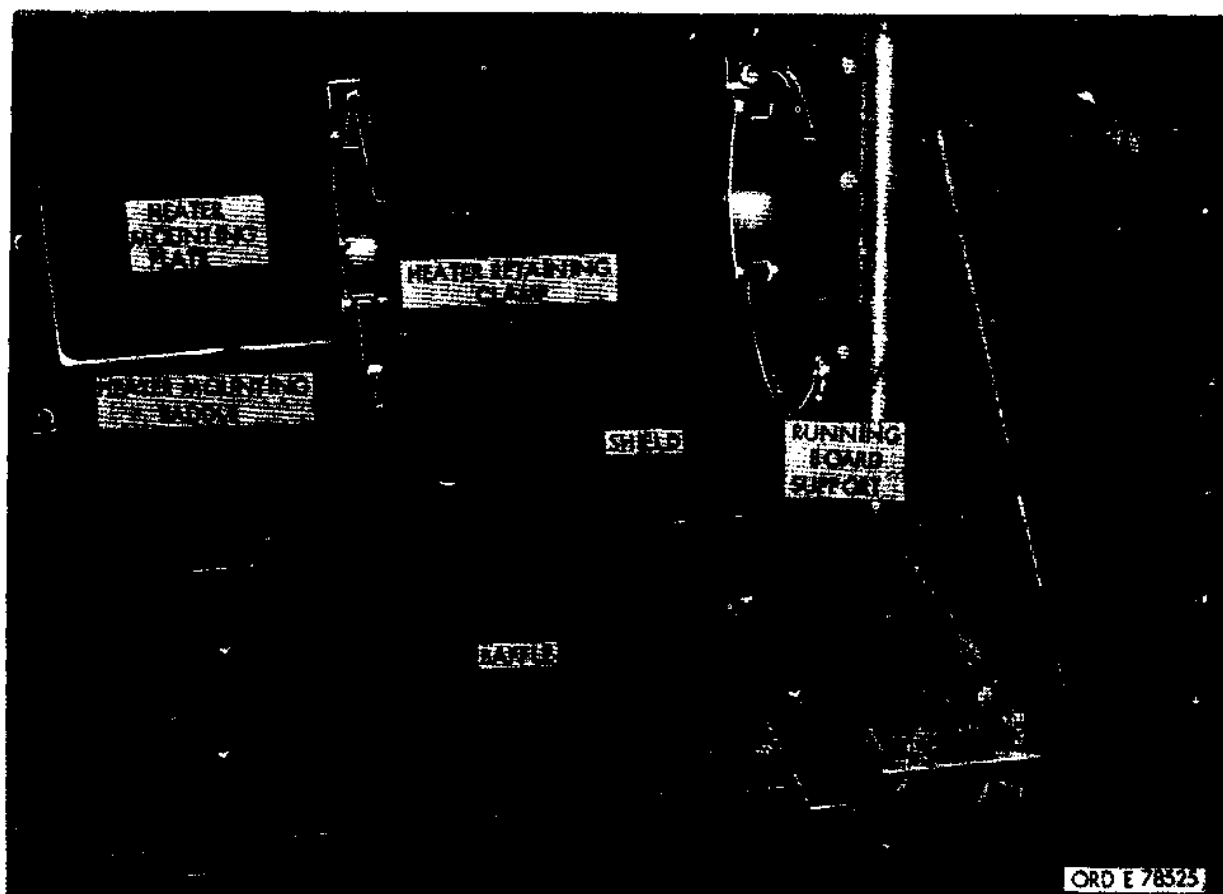


Figure 698. Installation of heater mounting plate and clamps.

- (5) Place shield 10931883 against and between the running board supports as indicated in figure 697.

Note. Semi-circular cut-out is positioned around existing bolt and nut which secures vehicle exhaust pipe bracket (fig. 697).

- (6) Using shield placed above as a template, locate two shield mounting holes on running board supports. Remove shield.
- (7) Center punch and drill two 9/32 dia. holes located in (6) above. Prime and paint bare metal.
- (8) Fasten shield to supports using two 1/4-28x5/8 screws, MS 96906-35292-5 and two locking nuts, MS 96906-51922-5.
- (9) Attach heater mounting saddles 10896477 to heater mounting plate, using 3/8-24x5/8 screws, MS 96906-35292-57 and internal-external tooth washers, MS 96906-35335-21 (fig. 698).
- (10) Remove the four nuts, washers and bolts from the top inner sides of running board hangers (fig. 697).
- (11) Secure heater mounting plate 10896366 to running board supports using nuts, washers, and bolts removed in (10) above.

c. Install Oil Pan Shroud (Figure 699).

- (1) Temporarily place shroud against oil pan well to determine which oil pan bolts need removal.

Note. It may be necessary to drop the front winch prop shaft (see TM 9-2320-211-20) to get shroud on oil pan.

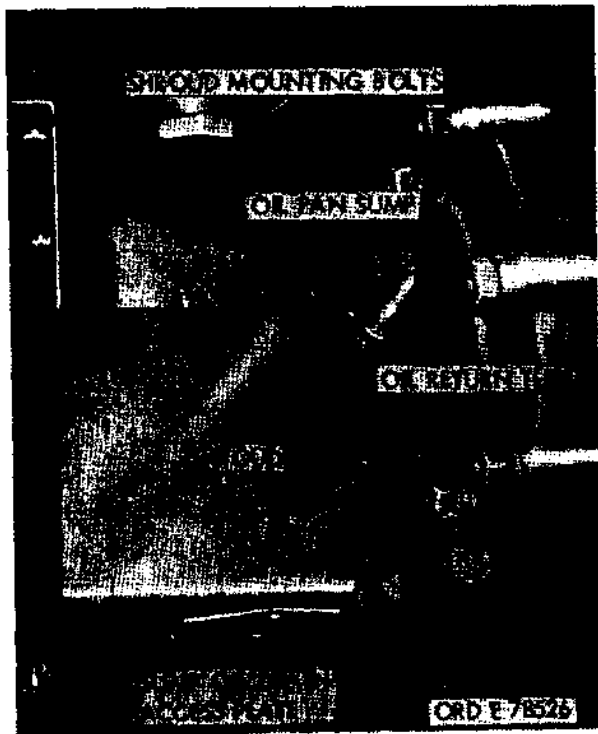


Figure 699. Shroud showing cut-out around oil return tube.



Figure 700. Exhaust tube to shroud installation.

- (2) Place shroud 10938376 against oil pan sump, aligning holes in shroud with pan holes and attach shroud to block using four screws MS 96906-35291-65 and washers MS 96906-35335-21.
- (3) Attach oil drain access plate 10896364 to bottom of shroud with two screws MS

96906-35292-65 and washers MS 96906-35291-65.

d. Install Power Plant Heater and Exhaust Tube.

- (1) Before attaching heater to mounting plate, slide one end of (56 in. long) heater-to-shroud exhaust tube (7986268) onto exhaust pipe of heater. Drill a 5/32 dia. hole, 3/8 in. from end, through tube and heater pipe (fig. 701) and insert cotter pin MS 96906-24665-363.
- (2) Run exhaust tube through hole in curved shield until heater abuts on plate. Attach heater to plate with round clamps through saddles (fig. 701).
- (3) Attach exhaust tube 7986268 to shroud tube attachment and drill through tube and shroud tube with 5/32 dia. drill, 3/8 in. from end. Fasten with cotter pin, MS 96906-24665-363.
- (4) Fasten bracket 10931985 to existing forward bottom screw hole in forward right running board support (fig. 697), using screw MS 96906-35291-60 and nut MS 96906-51922-17 (figs. 699 and 700). Secure tubing to bracket with clamp 8707524 1/4-28x3/8, screw MS 96906-35292-8, nut MS 96906-51922-5 and washer MS 96906-27183-10.

Note. At lowest point of exhaust tubing, drill 1/8 in. dia. hole to drain water condensation.

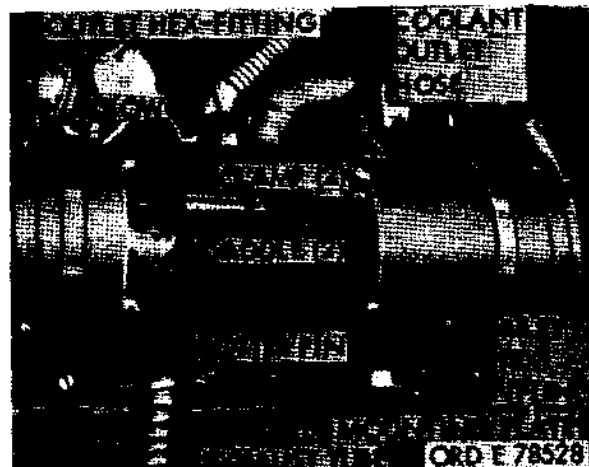


Figure 701. Mounting power plant heater.

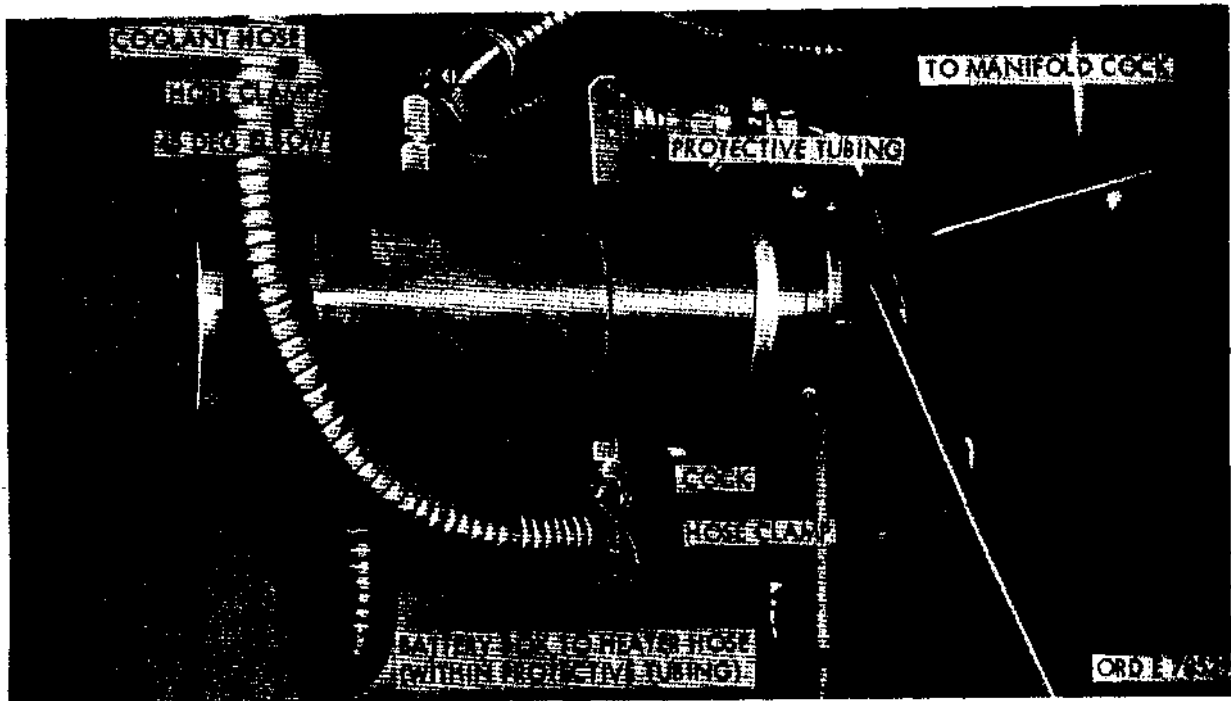


Figure 702. Completing installation in battery compartment.

e. Install Coolant Hoses.

- (1) Drain radiator coolant (TM 9-2320-211-20).
- (2) Remove sending unit and forward lower plug in water manifold. Install cock 543352 (fig. 703) and replace sending unit.
- (3) Remove block plug at turbocharger (fig. 704) and install cock 543852.
- (4) Screw 45 degree elbow MS 96906-24518-7 into outlet hex-fitting on top of heater (fig. 701).

Caution: Hold hex-fitting with wrench to prevent breakage when installing elbow.

- (5) Screw cock 596800 and bushing 120322 into bottom of coolant heater (fig. 702).

Note. See Caution above.

- (6) Place 76 in. long protective tubing 7986268 around 78 in. long hose 8376141 and thread hose and tube from battery compartment, along lower part of engine block and up to water manifold cock installed in (2) above (figs. 703, 704, 705, 706). Attach hose to 450 elbow atop

heater and to cock installed in water manifold using clamp MS 96906-35842-2.

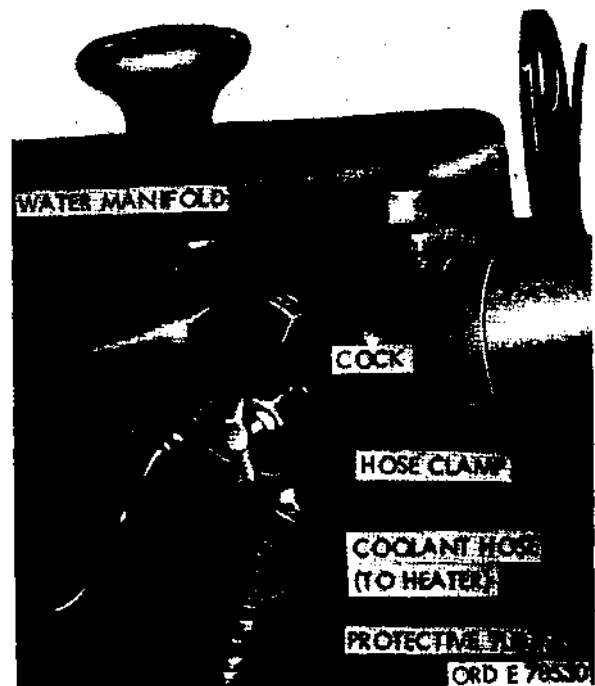


Figure 703. Inlet for heated coolant.

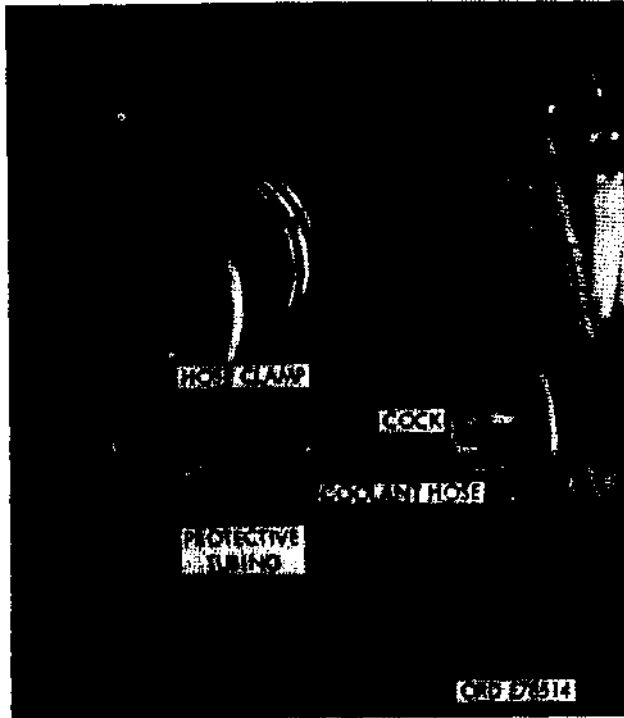


Figure 704. Outlet for heated coolant.

- (7) Remove thirteen screws securing mid-portion of transmission tunnel (fig. 707).
- (8) Place 52 in. long protective tubing 7986768 around 54 in. long hose 8376141 and thread hose and tube from cock under turbocharger (installed in (3) above) and up into transmission tunnel along right side of transfer lever. Run hose through knock-out.

Note If vehicle has power-take-off lever tubing will run between levers (fig. 707).

- (9) Attach hose to cock at turbocharger using clamp MS 96906-35842-2.
- (10) Attach hose to battery heating pad using the following procedure:
 - (a) Clean flooring on right side of cab.
 - (a) Reactivate "dry back" cement area of thermal barrier 8737708 by moistening surface with Methyl-ethyl-ketone.

Warning: Perform this operation in a well ventilated area; observe no smoking regulations.

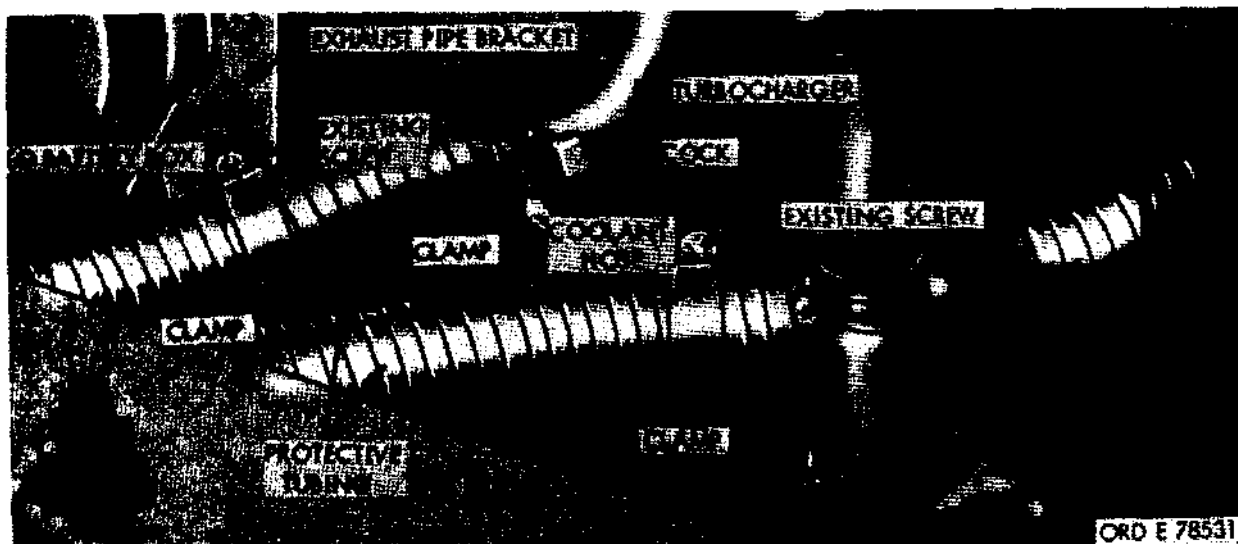


Figure 705. Coolant hoses installed.

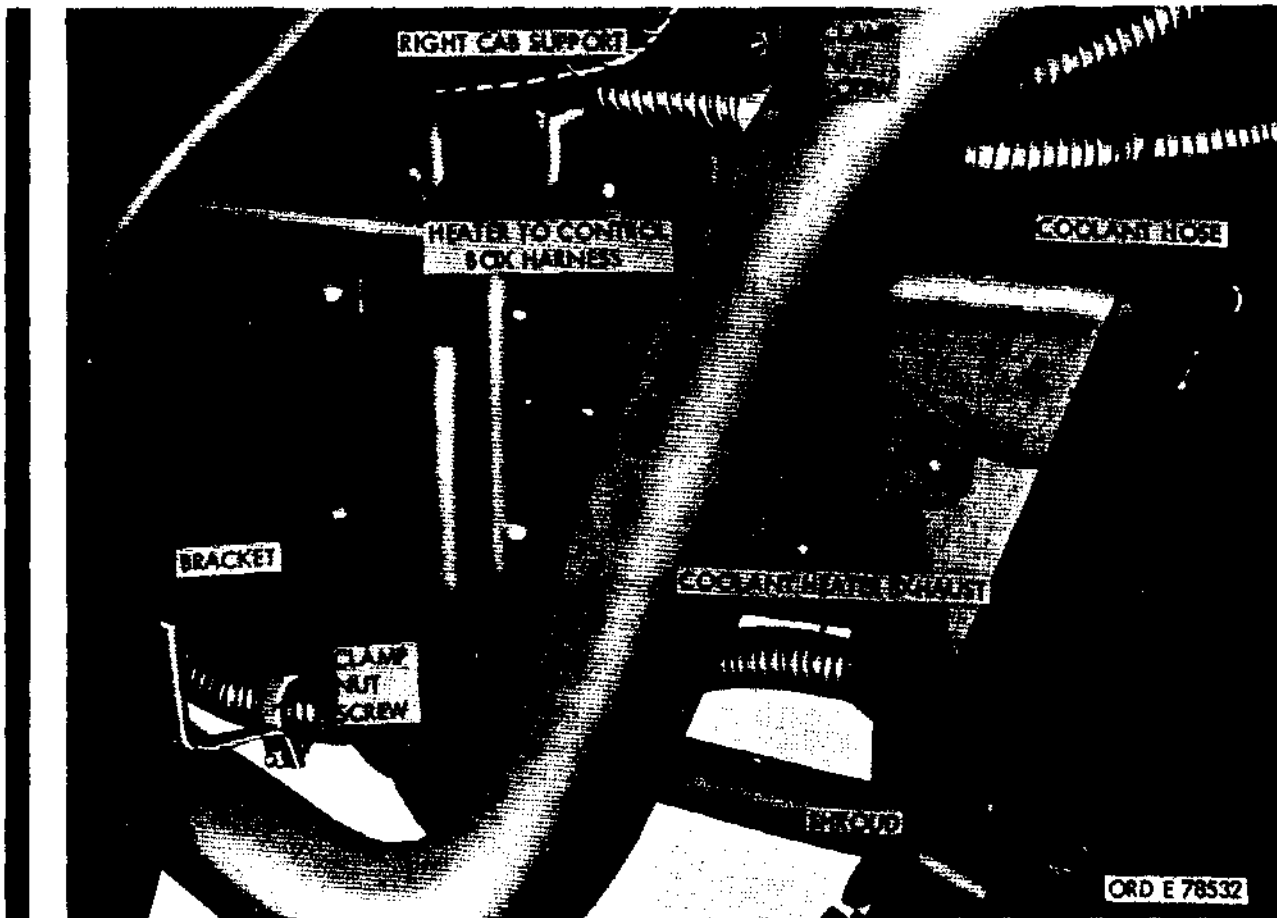


Figure 706. Clamping hose and tube.

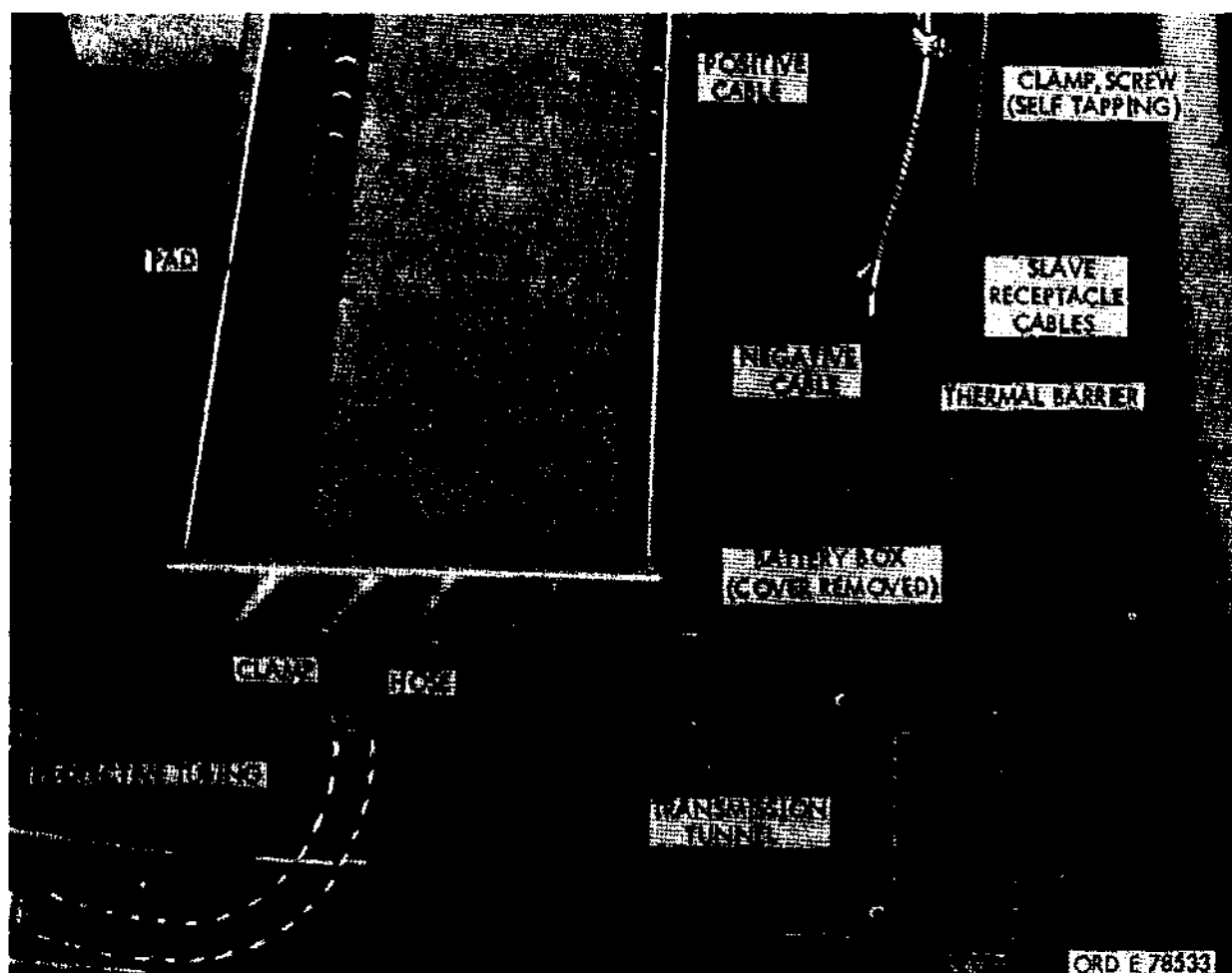


Figure 707. Location of hose and tubing in transmission tunnel.

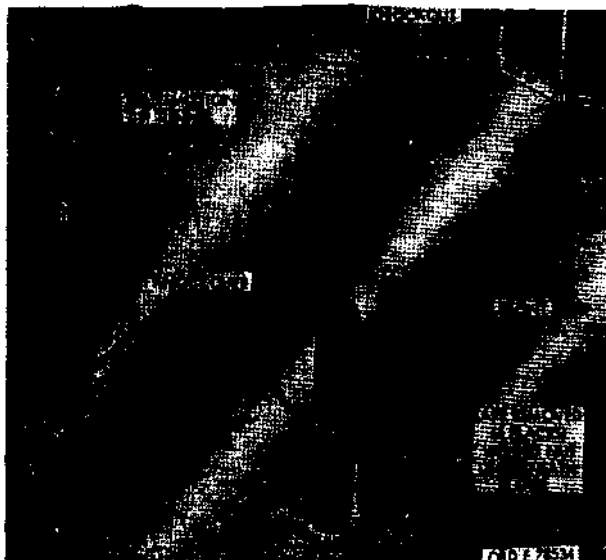


Figure 708. Diagram of cab interior knockouts and taped holes.

- (c) Paint floor area to be covered also, and lay barrier in place on vehicle floor, alining holes in barrier with holes in floor (fig. 709).

Note. Leave access to floor pan bolts by careful alinement of barrier cut-outs.

- (d) Install grommet MS 96906-35489-23, in hole in transmission tunnel.
- (e) Clean transmission tunnel flooring and install barrier 8737707 as directed in (b) and (c) above.
- (f) Place battery box assembly in place in cab and install three grommets in bottom of battery box (one in left rear hole, two in left and center front hole) (fig. 709) and place five pieces of insulation along bottom of box, trimming as necessary to provide free cable access to grommets holes.

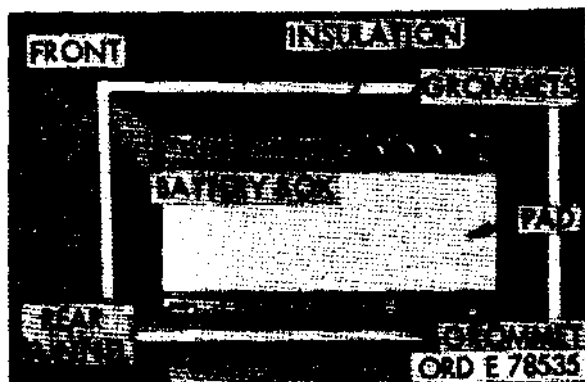


Figure 709. Battery box installation.

- (g) Install battery heating pad in bottom of battery box with inlet tube sticking through box at transmission tunnel.
- (h) Pass end of 54 in. long hose 8376141 through grommets in transmission tunnel and attach to battery pad inlet tube with clamp MS 96906-35842-2 (fig. 707).
- (j) Remove screw from right rear corner of transmission shift lever cover. Secure hose and tube assembly to shift lever cover with clamp 8707524.
- (k) Remove bottom screw from exhaust pipe support bracket. Secure hose and tube

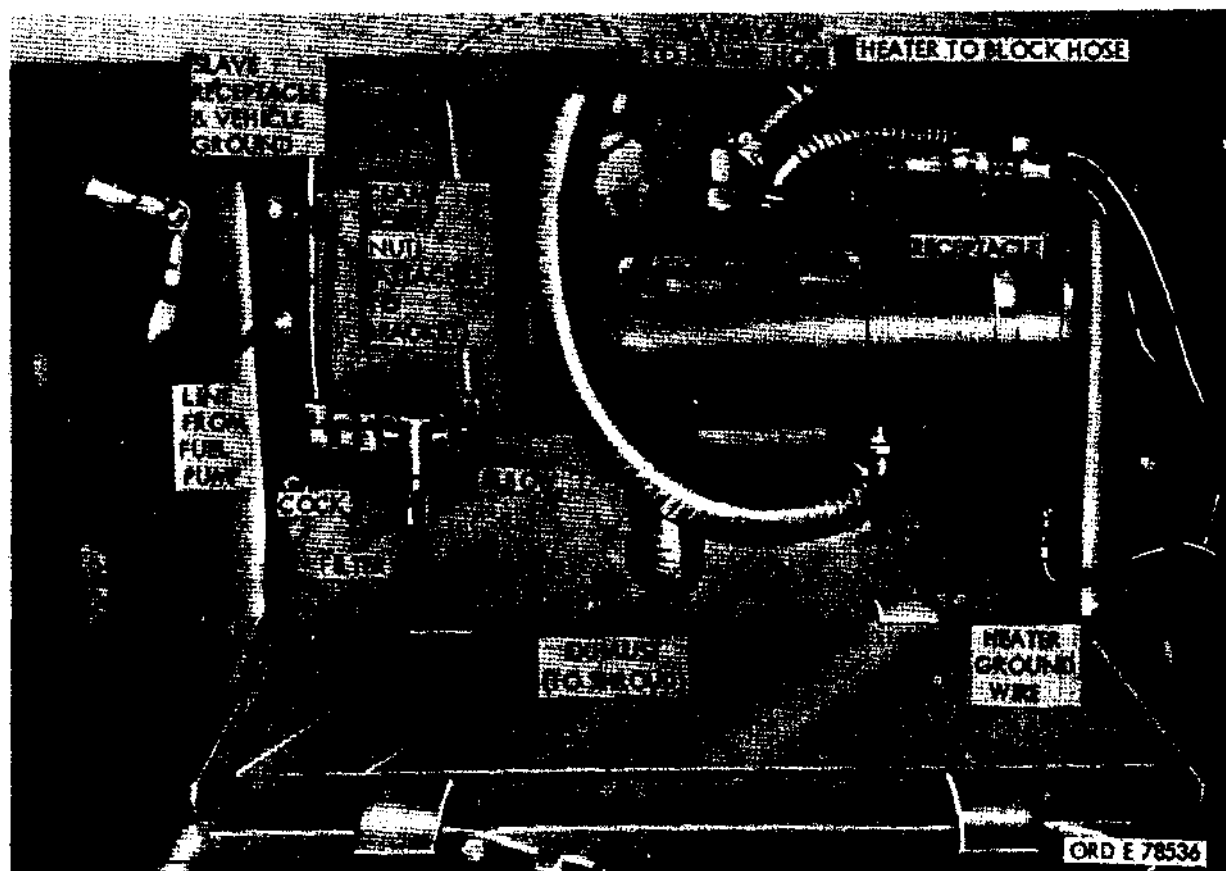


Figure 710. Power plant heater installed.

- assembly to exhaust pipe support bracket with clamp 8707524 (fig. 704).
- (11) Place one end of 24 in. long coolant return tube over battery outlet tube beneath vehicle floor (through oblong hole) and secure with clamp MS 96906-35842-2.
- (12) Place 22 in. long protective tube 7986268 over hose attached in (j) above, and attach other end of hose to cock 596800 in heater previously installed. Secure with clamp 96906-35842-2.
- (13) Insert hose 8376141 (78 in. lg) inside of

- tube 7986268 (76 in. lg). Install hose and tube assy by connecting one end of hose to cock on engine manifold. Secure with clamp MS 35842-2.
- (14) Route assy under supercharger to right side of flywheel housing and into battery compartment. Connect end of hose to elbow on top of heater and secure with clamp MS 35842-2.
 - (15) Remove bottom left screw from oil pressure regulator. Secure hose and tube assy to oil regulator assy with clamp 8707524.
 - (16) Drill a 5/16 in. dia. hole through both sides of lower right cab support, $\frac{7}{8}$ in. from bottom and $\frac{3}{4}$ in. from edge (fig. 705). Secure hose and tube assy to inside surface of cab support with clamp 8707524, screw MS 35292-8, washer, MS 27183-10 and nut MS 51922-5.
 - (17) Replace coolant in radiator.

f. Affix Battery Box.

- (1) Remove tape on cab floor covering hole and welded nut (fig. 708). Place battery box flange over holes with welded nuts.
- (2) Place spacers 7700455 under battery box toward outside of vehicle (to level box) and attach box to floor and welded nuts using four $\frac{3}{8}$ -24x1 screws MS 96906-35292-60 and washers MS 96906-35337-27.

g. Install Slave Receptacle.

Note. Slave receptacle is part of personnel kit, but must be installed after battery box.

- (1) Remove four screws and nuts securing slave receptacle opening cover to the right rear corner post of cab.
- (2) Insert cables of slave receptacle assembly through hole in cab floor adjacent to right hand door (fig. 707), and secure receptacle to cab, using four $\frac{1}{4}$ -20x1 screws MS 96906-35291-8, washers 96906-35337-25 and nuts MS 96906-35690-405.
- (3) Route positive (long) receptacle cable through hole in floor (fig. 707) nearest the door, under the cab floor and up through center hole in forward edge of battery box, making certain grommet MS 35489-23 is first installed.
- (4) Route negative (short) receptacle cable through other hole in floor and attach to new ground post (fig. 710) located on running board bracket support,

h. Install Heater Control Box.

- (1) Butt heater control box mounting plate 10931992 against instrument panel lip (fig. 711) on reinforcing bracket center plate on bracket.
- (2) Using plate 10931992 as template, locate mounting holes.
- (3) Center punch and drill two 5/16 dia. holes located in (2) above.
- (4) Attach plate 10931992 to control box 10885798 using existing screws and nuts on control box,
- (5) Attach plate and box assembly to bracket using two $\frac{1}{4}$ -28x $\frac{1}{2}$ screws MS 96906-

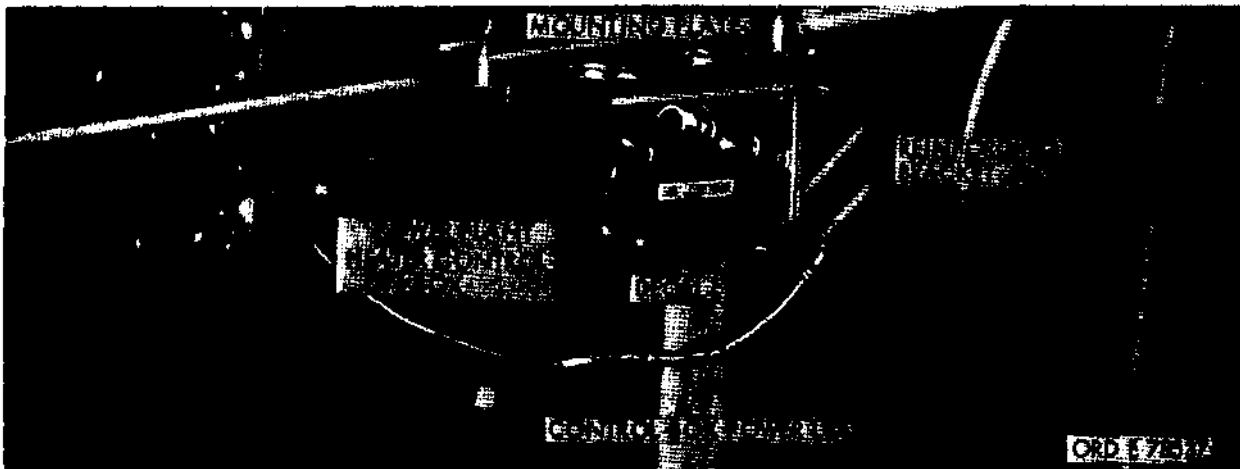


Figure 711. Installation of power plant heater control box.

35292-3 and self-locking nuts MS 96906-51922-5.

- (6) Place decal 10896514 on front of heater control box panel, approximately as indicated in figure 711.

j. Install Fuel Filter and Fuel Lines.

- (1) Install elbow MS 96906-39202-04 in outlet side of filter MS 96906-51085-1 with opening directed up.
- (2) Install cock 543852 in inlet side of filter with control handle located on top.
- (3) Install elbow MS 96906-39202-4 in cock (2) above, with outlet directed up.
- (4) Install filter with attached cocks and elbows on lower left side of plate 10896366 (fig. 710) using two 10-32X1-½ screws MS 96906-35207-269, and washers MS 96906-35335-18.
- (5) Install tube 8689207 (20 in. long) from filter outlet to heater control valve (fig. 710).

Caution: Tubing ends must be smooth and free of any ridge or obstruction before being installed.

- (6) Install tube 8689207 (64 in. long) to fuel pump.
- (7) Cover both ends of tubing to prevent entrance of foreign matter.
- (8) Snake tube under cab from battery compartment through grommets hole in tool box on left side of vehicle (where fuel pump is installed).
- (9) Attach one end of tube to elbow MS 96906-39202-4 in battery compartment. Attach other end to adapter tee 44417 attached to fuel pump.

Caution: Make sure all tubing is bottomed in fittings and tighten all connections securely to prevent leakage.

- (10) Fasten tubing to bracket 10931984 (fig. 710) with clamp MS 96906-213333-99, ¼-28x9/16 screw MS 96906-35292-4 and nut MS 96906-51922-5.
- (11) Install shield 10932116 (part of personnel heater kit) over fuel pump and secure to tool box with four ¼-28x½ screws MS 96906-35-207-279 and locking nuts MS 96906-51922-5.

k. Install Electrical Connections.

- (1) Cut a 1-¾ in. dia. hole in bottom right corner of firewall 5 in. from cab sidewall and 3-½ inches above junction of floor panel and firewall.
- (2) Install heater end of harness 10923528 in heater receptacle. Attach ground lead as indicated in figure 710.

Note. Harness is marked.

- (3) Route control box end of harness to right rear side of battery compartment, over top of frame side rail into engine compartment and through 1 made firewall (end of single very long lead is to remain in engine compartment).
- (4) Install grommet 7951712 around harness and lead in firewall.
- (5) Install shell 8338566 on very long lead from control box end of harness and attach to Y-connector (adapter) at personnel heater duct (See schematic, par. 527).
- (6) Connect coolant heater control box lead (from box, not harness) to one arm of Y-connector (adapter) under steering column within cab (fig. 712).
- (7) Secure loose wires to existing harnesses where possible using suitable tape (fig. 710).

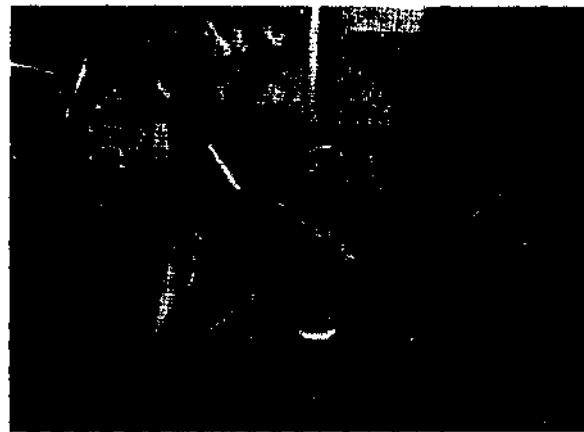


Figure 712. Connecting coolant heater control box.

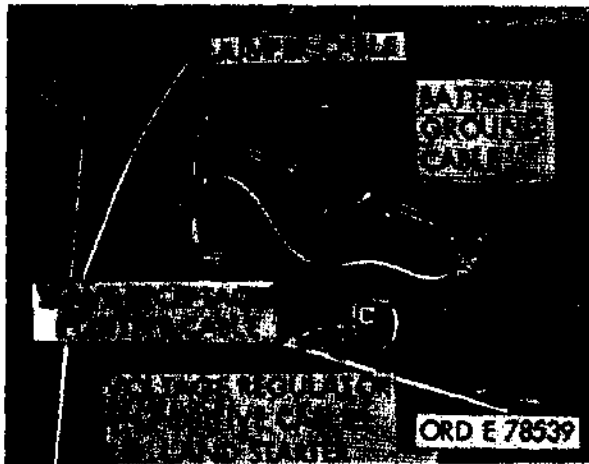


Figure 713. Battery box connections.

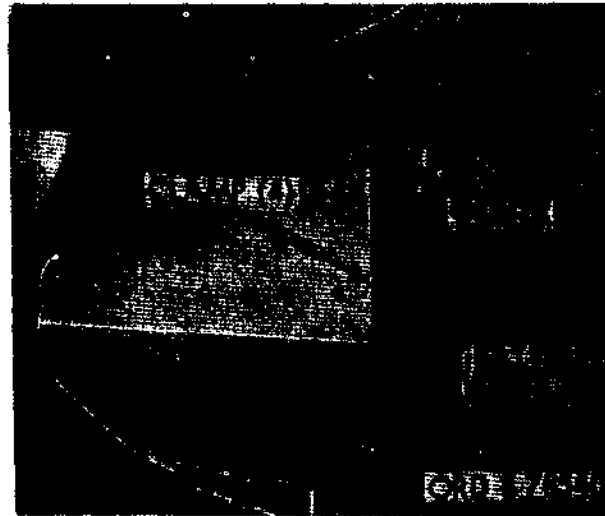


Figure 714. Installing battery box cover.

l. Install Batteries.

- (1) Remove battery ground cable terminal clamp and pass cable up through rear left hole into battery box (fig. 709). Install terminal clamp.
- (2) Remove battery positive cable terminal clamp and pass positive cable up through front right hole; voltage regulator cable through center hole; and slave receptacle positive cable through front left hole (fig. 709). Connect regulator and battery positive cables to one side of clamp and slave receptacle cable to other side (fig. 713).
- (3) Hook four "J" bolts into the straps in bottom corners of battery box.
- (4) Place the four cables out of the way and install the vehicle batteries with positive terminals toward the front.
- (5) Position battery holddown frame over the batteries and "J" bolts and secure frame, using four flat washers MS 96906-27183-15, four split washers MS 96906-35337-027, and four nuts MS 96906-35690-605.
- (6) Connect jumper cable between the two outer terminal clamps and connect positive cable terminal clamp to the positive terminal post of the battery (fig. 713).

Caution: Battery ground cable should be left disconnected until the winterization kit is completely installed,

- (7) Install battery box cover on battery box by latching the four clamps (fig. 714).

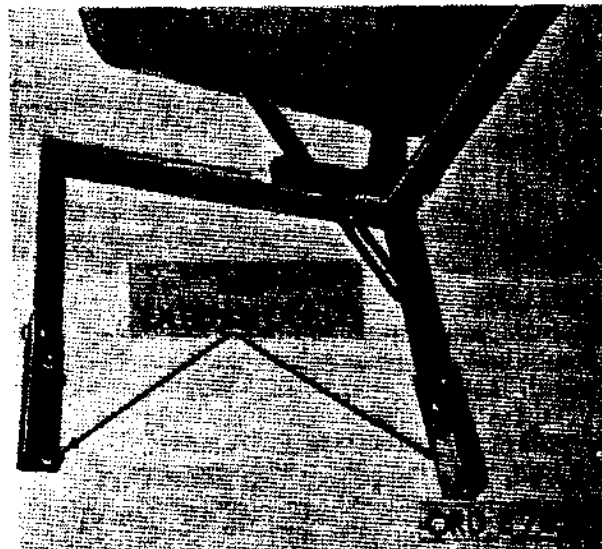


Figure 715. Installing companion seat leg extension.

m. Modification of Companion Seat.

- (1) Secure a leg extension to both right hand legs of the companion seat, using two 1/4-20x3/4 screws MS 96906-35291-6, lockwashers MS 96906-35337-25, and nuts MS 96906-35690-405 (fig. 715).
- (2) Place the seat frame in position and secure the leg extensions to the floor panel, using two original 3/8 - 16x1 screws and internal-tooth lockwashers.

- (3) Secure companion seat support to driver seat support, using four original 5/16-18x3/4 screws, washers, and locknuts through the lower four holes in the seat support (fig. 716).
- (4) Remove slotted link (fig. 716).

Note. Install companion seat cushion; intermediate tunnel.

n. *Installation Hood and Side Covers.* Install hood and side covers as indicated in paragraph 498, (one side) except that air intake duct (one side) must be freed to fit right side cover on. Duct is freed by loosening clamp.

p. *Operating Test After Power Plant Heater Installation.*

Note. Prior to performing the operating test for the winterization kit, lubricate and service the vehicle as outlined in LO 9 2320 211 12 and TM 9-2320-211-10 and changes hereto.

- (1) *Preliminary checks before starting the heater.*
 - (a) Open the power plant heater fuel shutoff cock, located at the heater in the vehicle battery compartment, to the fully counterclockwise position.
 - (b) Open the coolant inlet shutoff cock located on the vehicle water manifold by turning it counterclockwise.
 - (c) Open the coolant outlet shutoff cock located on the left side of the oil pressure regulator valve by turning it counterclockwise.
 - (d) Use the "push-to-test" feature of the heater control box indicator lamp. The lamp should light; if the lamp does not light, troubleshoot the heater circuit.

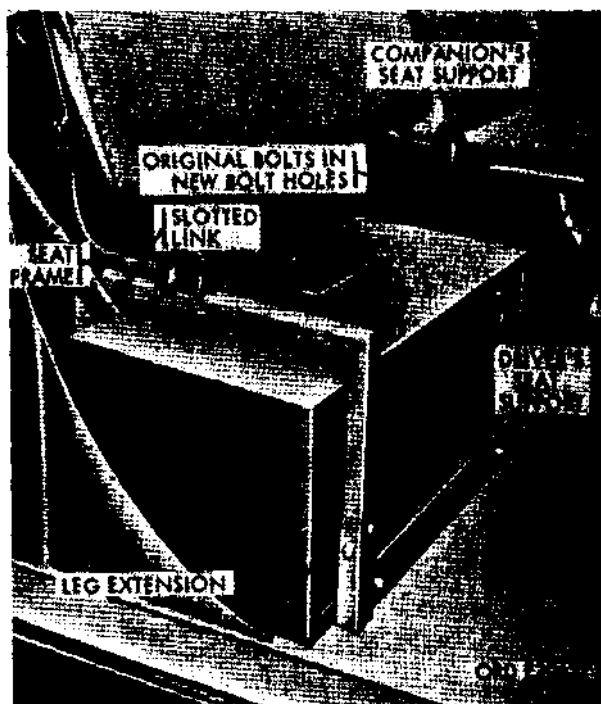


Figure 716. Companion seat installed.

Refer to Table XVIII for troubleshooting.

- (2) *Checking power plant heater operation.*
 - (a) Start and operate the heater according to the procedures given in TM 9-2320-211-10.
 - (b) Operate all heater controls as directed in TM 9-2320-211-10. If the heater fails to operate properly, refer to Troubleshooting, Table XVIII, and Maintenance Section XVI of this manual to correct the defect.

Section XV. (ADDED) TROUBLESHOOTING THE WINTERIZATION KIT (MULTIFUEL MODEL VEHICLES)

530. General

This section contains troubleshooting procedures for the winterization kit installed in multifuel model vehicles only. The troubleshooting procedures given in Table XVIII are arranged to assist repair personnel in locating malfunctions and directing them to the proper procedure for corrective action.

531. Precautions to Prevent Fire or Explosion

Before operating the winterization heater, determine from the using organization or the vehicle equipment log the exact nature of the trouble. If the malfunction involves excess or leaking fuel, make a thorough visual inspection to make sure explosive

vapors have not accumulated in or near the vehicle. Raise the hood and open the doors of the cab; ventilate the area thoroughly, with forced air (if avail-

able). Have a fire extinguisher of the type approved for volatile fuels at hand when troubleshooting fuel problems in heating units.

Table XVIII. (Added) Troubleshooting- Winterization Kit

| Malfunction | Probable Cause.! | Corrective Action |
|--|---|---|
| PERSONNEL HEATER | | |
| 1. Heater fails to start when control switch is turned on. | a. Emergency switch off. b. No fuel pressure. c. Defective electrical circuit. d. Defective heater component. | a. Snap switch to ON position. b. Open fuel shutoff cock. c. Repair defective wiring harness. d. Repair or replace defective component or replace heater (Par 532). |
| 2. No heat output, or low heat output. | a. No fuel pressure. b. Ice in fuel system. c. Defective component. d. HI-LO switch in LO position. | a. Open fuel shutoff cock. b. Remove ice from fuel line. Clean fuel filter element, and replace if damaged (TM 9-2320-211-20 and changes thereto). c. Repair or replace defective component or replace heater (Par 532) d. Switch to HI position. |
| 3. Indicator light inoperative, | a. Defective lamp. | a. Use press-to-test feature. Replace lamp if defective TM 9-2320-211-20, and changes thereto). |
| 4. Indicator light always on. | b. Defective wiring or lamp holder. Defective component, | b. Repair defective wiring harness or replace lamp (TM 9-2320-211-20, and changes thereto). Repair defective component or replace heater (Par 533). |
| 5. Heater operates several minutes then stops | a. Restriction in fuel line. b. Defective fuel control valve. c. Defective flame detector switch. | a. Clean fuel filter element, and replace if damaged (TM 9-2320-211-20, and changes thereto). b. Replace fuel control valve (Par 533). c. Replace flame detector switch. |
| 6. Blower will not stop when heater is turned off. | a. Defective flame detector switch. b. Defective blower motor wiring. | a. Replace flame detector switch (Par 533). b. Repair defective wiring harness (Par 533). |
| 7. Heater smokes excessively or "bangs" upon starting. | a. Starting with HI-LO switch in HI position. b. Defective fuel control valve. | a. Refer to operating instructions (TM 9-2320-211-10, and changes thereto). b. Replace fuel control valve (fig. 718). |
| 8. Blower runs, but heater fails to ignite. | a. No or low fuel pressure. b. Restriction in fuel line. c. Defective electrical wiring. d. Defective preheat resistor. e. Defective igniter. f. Defective fuel. | a. Check fuel shutoff cock position. b. Clean fuel filter element and replace if damaged (TM 9-2320-211-20, and changes thereto). c. Repair defective wiring harness (Par 533). d. Replace preheat resistor (Par 533). e. Replace igniter assembly (Par 533). f. Replace fuel control valve (Par 533). |
| 9. Inadequate heat output. | a. Fuel pump filter element restricted. | a. Clean fuel pump filter element and replace if damaged (TM 9-2320-211-20, and changes thereto). |

Table XVIII. (Added) Troubleshooting-Winterization Kit - Continued

| Malfunction | Probable Causes | Corrective Action |
|---|---|--|
| PERSONNEL HEATER Continued | | |
| 10. Inadequate windshield defrosting. | b. Ice crystals in fuel. | b. Remove ice from fuel system. Clean fuel filter element and replace <i>if</i> damaged (TM 9-2320-211-20, and changes thereto). |
| | c. Extreme cold weather. | c. Adjust radiator cover (TM 9-2320-211-10, and changes thereto). |
| | d. Defective component. | d. Repair defective component or replace heater (fig. 718). |
| | a. Improperly adjusted heater control cable. | a. Adjust cable (Par 527). |
| 11. Heater overheats but continues to run. | b. Improperly adjusted defroster control cable. | b. Adjust cable (Par 527). |
| | c. Defroster ducting loose or damaged. | c. Tighten clamps or repair ducting (TM 9-2320-211-20, and changes thereto). |
| 12. Fuel odor. | a. Defective overheat switch. | a. Replace overheat switch (Par 533). |
| | b. Defective fuel control valve. | b. Replace fuel control valve (Par 533). |
| 13. Burned fuel odor. | a. Fuel leak. | a. Tighten fuel lines or replace defective component. |
| | b. Defective component. | b. Replace defective component. |
| | a. Restriction in exhaust. | a. Remove restriction. Replace exhaust tube if damaged (Par 527). |
| | b. Too heavy grade of fuel. | b. Change to suitable grade of fuel (TM 9-2320-211-10, and changes thereto). |
| | c. Defective heat exchanger. | c. Replace heat exchanger (Par 533). |
| POWER PLANT HEATER | | |
| 14. Heater fails to start when control switch is turned on. | a. No fuel pressure. | a. Open fuel shutoff cock (Par 537). |
| | b. Defective electrical circuit. | b. Repair defective electrical harness. |
| | c. Defective heater component. | c. Repair or replace defective component or replace heater (Par 538). |
| 15. No heat output, or low heat output. | a. No fuel pressure. | a. Open fuel shutoff cock (Par 537). |
| | b. Ice in fuel system. | b. Remove ice from fuel line. Clean fuel filter element and replace if damaged (TM 9-2320-211-20, and changes thereto). |
| | c. HI-LO switch in LO' position. | c. Switch to HI position. (Par 537). |
| | d. Defective heater component. | d. Repair or replace defective component or replace heater (Par 538). |
| 16. Indicator light inoperative. | a. Defective lamp. | a. Use press-to-test feature. Replace lamp if defective (TM 9-2320-211-20, and changes thereto). |
| 17. Heater operates several minutes, then stops. | a. Restriction in fuel line. | a. Clean fuel filter element and replace if damaged TM 9-2320-211-20, and changes thereto). |
| | b. Defective fuel control valve. | b. Replace fuel control valve (Par 538). |

Table XVIII. (Added) Troubleshooting- Winterization Kit — Continued

| Malfunction | Probable Causes | Corrective Action |
|---|---|--|
| | POWER PLANT HEATER Continued | |
| | c. Defective flame detector switch. | c. Replace flame detector switch (Par 538). |
| 18. Blower will not stop when heater is turned off. | a. Defective flame detector switch. b. Defective wiring. | a. Replace flame detector switch (Par 538). b. Repair defective wiring harness.. |
| 19. Heater smokes excessively or "bangs" upon starting. | a. Defective flame detector switch. b. Defective fuel control valve. | a. Replace flame detector switch (Par 538). b. Replace fuel control valve (Par 538). |
| 20. Blower runs, but heater fails to ignite. | a. No fuel pressure or low fuel pressure. b. Restriction in fuel line. c. Defective electrical wiring. d. Defective preheat resistor. e. Defective igniter. f. Defective fuel control valve. | a. Check fuel shutoff cock position (Par 529). b. Clean fuel filter element and replace if damaged (TM 9-2320-211-20, and changes thereto). c. Repair defective wiring harness d. Replace preheat resistor (Par 538). e. Replace igniter assembly (Par 538). f. Replace fuel control valve (Par 538). |
| 21. Inadequate heat output, | a. Coolant shutoff cocks partially or fully closed. b. Ice crystals in fuel. c. Extreme cold weather. d. Defective heater component. | a. Open shutoff cocks fully (Par 527). b. Remove ice from fuel system. Clean fuel filter element and replace if damaged (TM 9-2320-211-20, and changes thereto) c. Adjust radiator cover. d. Repair defective component or replace heater (Par 538). |
| 22. Heater overheats but continues to rust. | a. Defective overheat switch. b. Defective filter control valve. | a. Replace heater assembly (Par 538). b. Replace fuel control valve (Par 538). |
| 23. Fuel odor. | a. Fuel leak. b. Defective component. | a. Tighten fuel lines or replace defective component. b. Replace defective component. |
| | HARDTOP CLOSURE | |
| 24. Excessive rattles. | a. Loose parts or joints. b. Worn or damaged glass channel. | a. Tighten all nuts and screws (Par 492). b. Repair or replace glass channel. |
| 25. Excessive air leaks | a. Loose parts or joints. b. Worn or damaged weatherseals. c. Broken glass or damaged glass channel. | a. Tighten all <i>nuts</i> and screws (Par 492). b. Reseal weatherseals. c. Replace glass or channel. |
| 26. Water leaks. | a. Loose parts or joints. b. Worn or damaged glass channels. | a. Tighten all nuts and screws (Par 492). b. Repair or replace glass channel. |
| 27. Cracked glass. | Worn or damaged glass channels. | Repair or replace glass channel. |

Section XVI. (ADDED) MAINTENANCE INSTRUCTIONS FOR PERSONNEL HEATER KIT COMPONENTS (MULTIFUEL MODEL VEHICLES)

532. Disassembly of Personnel Heater Kit Into Subassemblies

a. Removal of Personnel Heater Assembly.

- (1) Turn off the personnel heater fuel shutoff cock by turning it clockwise.
- (2) Disconnect the electrical harness connector from the personnel heater by turning it counterclockwise.
- (3) Disconnect the fuel line from the elbow extending from the heater assembly. Remove the elbow and the nipple from the heater assembly.
- (4) Loosen the clamp securing the air duct to the heater adapter and slide duct from the adapter flange.
- (5) Disconnect the mounting clamps securing the heater assembly to the mounting saddles and remove heater.
- (6) Remove the "O" ring packing and flat steel washer from the heater exhaust flange, figure 717.

b. Removal of Personnel Heater Blower Assembly.

Note. The key letters noted in parentheses refer to figure 718, except where otherwise indicated,

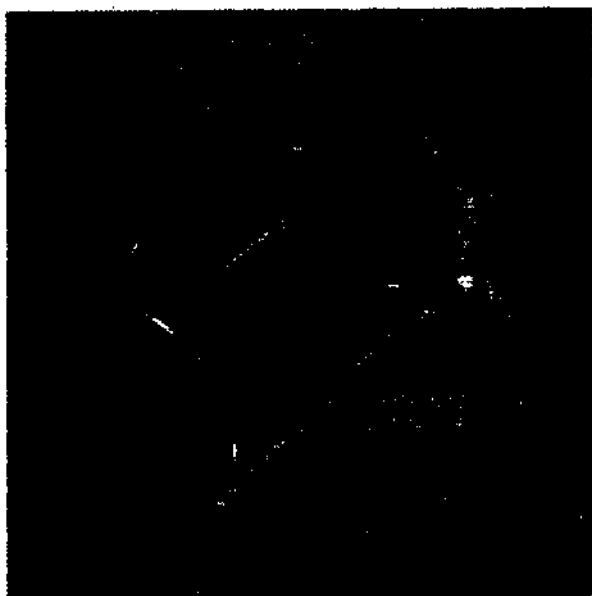


Figure 717. Removal of "O" ring packing and flat washer.

- (1) Remove the guard assembly (DD) by loosening the two Dzus fasteners and lifting it off the personnel heater,
- (2) Disconnect the blower electrical lead from the terminal labeled "COMM" of the flame detector switch.
- (3) Remove the four screws (NN) from the heater housing at the end of the blower (LL), then carefully pull the blower straight off the heater.
- (4) Remove the screw (A) from the bracket of the combustion air tube (C). The tube (C), elbow (D) and sealing washer (E) can then be lifted from the heater.

Caution: Do not bend or twist the air tube or blower from side to side, since this may damage the ventilating air blower wheel on the end of the motor shaft

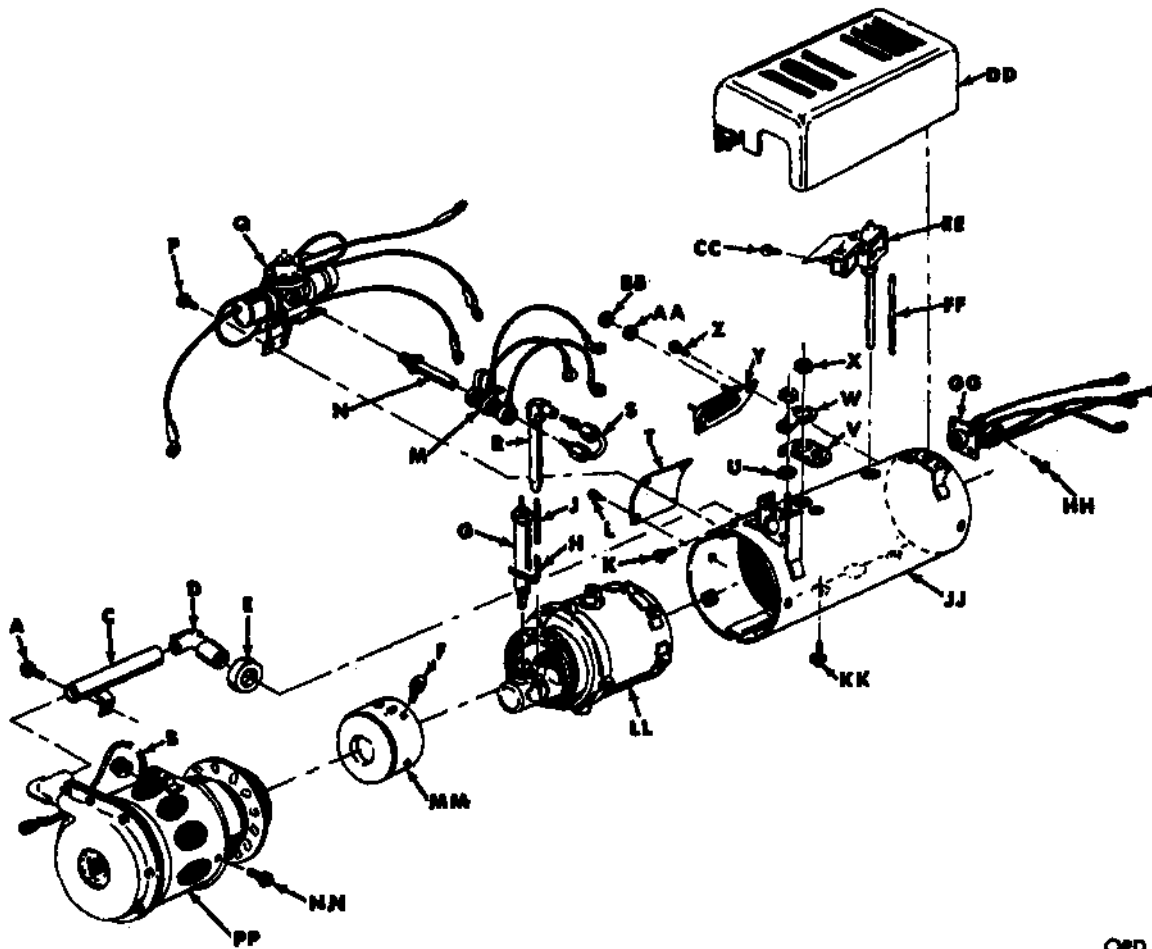
- (5) To further disassemble and repair blower motor assembly, refer to j below.

c. Removal of Personnel Heater Preheat Resistor and Fuel Control Valve (Fig. 718)

Warning: Do not permit smoking, sparks or open flame within 50 feet of the work area during any operation involving fuel line removal.

- (1) Disconnect valve wires from terminal 30 of the overheat switch, from the screw terminal at the connector assembly and the ground stud on the heater housing.
- (2) Remove the short fuel tube (S) by loosening the two compression fittings.
- (3) Disconnect leads of the preheat resistor (M) from the flame detector switch and overheat switch. Also free the strap from the igniter terminal. Slide the preheat resistor off the fuel tube (N).
- (4) Remove three mounting screws (P) from the fuel control valve mounting bracket and lift the valve (Q) with the fuel tube (N) in the outlet. Remove the tube from the valve.

Caution: Hold the valve by the body casting when removing the tube. Do not apply pressure to solenoid cups, since this may break the seal and cause fuel leakage.



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Figure 718. Disassembly of personnel heater-exploded view

| Key | Item | Key | Item |
|-----|---------------------|-----|-------------------------|
| A | screw | v | Hatch cover |
| B | Grommet | w | Ground strap |
| C | Combustion air tube | x | Nut (2 req'd) |
| D | Elbow | Y | Overheat switch |
| E | Sealing washer | z | Screw (2 req'd) |
| F | Screw (3 req'd) | AA | Lockwasher (2 req'd) |
| G | Igniter | BB | Nut (2 req'd) |
| H | Wick | CC | Screw (5 req'd) |
| J | Wick | DD | Guard assy |
| K | Screw (4 req'd) | EE | Flame detector switch |
| L | Rivet (4 req'd) | FF | Quartz rod |
| M | Preheat resistor | GG | Receptacle ussy |
| N | Fuel tube | HH | screw |
| P | Screw (3 req'd) | J J | Housing |
| Q | Fuel control valve | KK | Screw (3 req'd) |
| R | Standpipe | LL | Heat exchanger aasy |
| S | Fuel tube | MM | Combustion stir housing |
| T | Nameplate | NN | Screw (4 req'd) |
| U | Lockwasher | PP | Blower assy |

Figure 718. Disassembly of personnel heater-exploded view (Legend)

- (5) To further disassemble and repair fuel control valve, refer to k (below).

d. Removal of Personnel Heater Flame Detector Switch (Fig. 718).

- (1) Disconnect wires from the flame detector switch (EE), if not already removed.
- (2) Loosen the hexagonal nut underneath the microswitch and pull the switch (EE) straight out of the bushing of the heat exchanger.

Caution: Do not bend tube of flame detector during removal. It contains a quartz rod which may be broken by flexing of the tube.

- (3) To further disassemble and repair, refer to paragraph 386c of this chapter.

e. Removal of Personnel Heater Overheat Switch (Fig. 718).

- (1) Remove the nuts (BB) and lockwashers (AA) from the terminals of the overheat switch (Y). Disconnect any wires which may be connected to the terminals.
- (2) Remove the two mounting screws (Z) and lift off the switch (Y).
- (3) To further disassemble and repair, refer to paragraph 386d of this chapter.

f. Removal of Personnel Heater Igniter (Fig. 718).

- (1) Using a 13/16-inch deep socket, loosen the igniter (G) until it turns easily by hand, then work it through the hatch cover (V).

Note. Replace the igniter at each overhaul.

- (2) When reinstalling the igniter, start threads by hand, then tighten securely.

g. Removal of Personnel Heater Standpipe (Fig. 718).

- (1) Using a wrench on the flats at the top of the standpipe (R), free the threads from the heat exchanger and pull it through the hatch cover (V) which will also be freed. Remove the wick (J). Another wick (H) is shown above the heat exchanger. This wick extends into the heat exchanger as an extension of the standpipe wick and can be removed after the heat exchanger is removed from the housing.
- (2) When replacing the standpipe, place the hatch cover (V) in position first, then start threads by hand. Tighten with a wrench,

turning the inlet at a right angle to the housing, facing away from the fuel control valve,

Note. This is a fuel seal; tighten carefully.

h. Removal of Personnel Heater Receptacle and Nameplate (Fig. 718).

- (1) It is not necessary to remove the receptacle assembly (GG) for overhaul unless damage is apparent. If damaged, it can be removed by removing the four screws (K).
- (2) Never remove the nameplate (T), unless it becomes necessary to change information by steel stamping.

i. Removal of Personnel Heater Housing (Fig. 718). Remove housing (JJ) by removing the three screws (KK) from the seam and spreading the metal just enough to permit the heat exchanger (LL) to slide out. Do not spread the seam far enough to cause permanent distortion.

j. Disassembly of Blower Assembly.

Note. The key letters noted in parentheses refer to figure 719, except where otherwise indicated.

- (1) Remove the ventilating air blower wheel (H) by loosening the setscrew (J) in its hub.
- (2) Remove the combustion blower housing (B) by removing nine screws (A) and speed nut (L).
- (3) Remove the combustion air blower wheel (C) by loosening the setscrew (J) in its hub. This will uncover the motor mounting nuts (D).
- (4) Remove the two nuts (D) to free the motor (F) and slide out the motor with the housing (G) attached, then remove housing by removing four screws (K). Ordinarily there will be no need to remove the screen from the blower housing (E) unless damage is evident.

k. Disassembly of Fuel Control Valve.

Note. Normally, the fuel control valve should be tested in a fully assembled condition during overhaul and should be reinstalled without repair, except as noted under Cleaning, Inspection, and Repair (par. 533b). Disassembly should be attempted only after the valve is proved defective, and should progress only to the extent necessary to effect repairs. The key letters noted in parentheses refer to figure 720, unless otherwise indicated.

- (1) Disassemble pressure regulator side of the fuel control valve in order of item letters

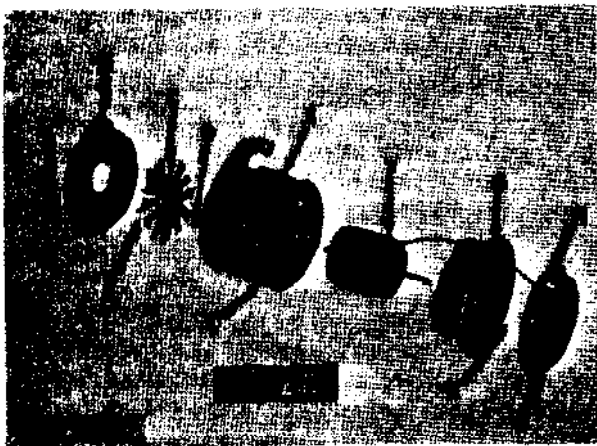


Figure 719. Disassembly of blower assembly-exploded view.

| Key | Item |
|-----|----------------------------|
| A | Screw (9 req'd) |
| B | Combustion blower housing |
| C | Combustion blower wheel |
| D | Nut (2 req'd) |
| E | Blower housing with screen |
| F | Motor |
| G | Ventilating blower housing |
| H | Ventilating blower wheel |
| J | Setscrew (2 req'd) |
| K | Screw (4 req'd) |
| L | Speed nut (9 req'd) |

Figure 719. Disassembly of blower assembly-exploded view (legend)

(A) through (L) if repairs to this section are required.

Caution: Use clean tools and work on a clean surface when making valve repairs. It is extremely important to prevent entry of even the smallest particles of foreign matter, since they may clog the needle valve or cause leakage at solenoid valve seating surfaces. Do not smoke while performing this operation; keep tobacco ashes away from the area.

- (2) If the diaphragm cap (F) is removed, always install new gaskets (K) to ensure a satisfactory seal.
- (3) Do not remove valve assembly (M) unless absolutely necessary. The screen (P) need not be replaced during overhaul unless the inlet screen (Q) shows evidence of clogging or gum formation. If it is necessary to remove the valve, use only a socket or box wrench. Install a new screen (P) and new

gaskets (N) if the valve is removed. Tighten the valve carefully, but do not use excessive torque which may distort the soft brass valve body.

Note. Disassembly of both solenoids is the same.

Caution: If disassembled, use a new gasket (S) and tighten screws (X) very carefully to apply an even pressure on the valve body. This is a fuel seal and leakage will result from careless reassembly.

1. Personnel Heater Emergency Switch Replacement.

- (1) Disconnect the personnel heater control box wiring harness, and circuit breaker harness from the rear of the emergency switch.

| Key | Item |
|-----|---------------------------|
| A | Nut |
| B | Cable asay |
| c | Screw (6 req'd) |
| D | Adjusting screw |
| E | Stud |
| F | Diaphragm cap |
| G | Adjusting cap |
| H | Spring |
| J | Diphragm assy |
| K | Gasket (2 req'd) |
| L | Heating element |
| M | Valve assy |
| N | Gasket (2 req'd) |
| P | Screen |
| Q | Screen |
| R | Valve body |
| s | Gasket (2 req'd) |
| T | Plunger assy (2 req'd) |
| u | Spring (2 req'd) |
| v | Sleeve and core (2 req'd) |
| w | Solenoid cup (2 req'd) |
| x | Screw (6 req'd) |
| Y | Washer (2 req'd) |
| z | Coil assy (2 req'd) |
| AA | Lockwasher (2 req'd) |
| BB | Screw (2 req'd) |
| CC | Gasket |
| DD | Screen |
| EE | Orifice plate |
| FF | Gasket |
| GG | Cover |
| HH | Adapter |
| JJ | Thermostat |
| KK | Clamp |
| LL | Screw (3 req'd) |
| MM | Cable aaay |

Figure 720. Disassembly of fuel control valve-exploded view (legend)

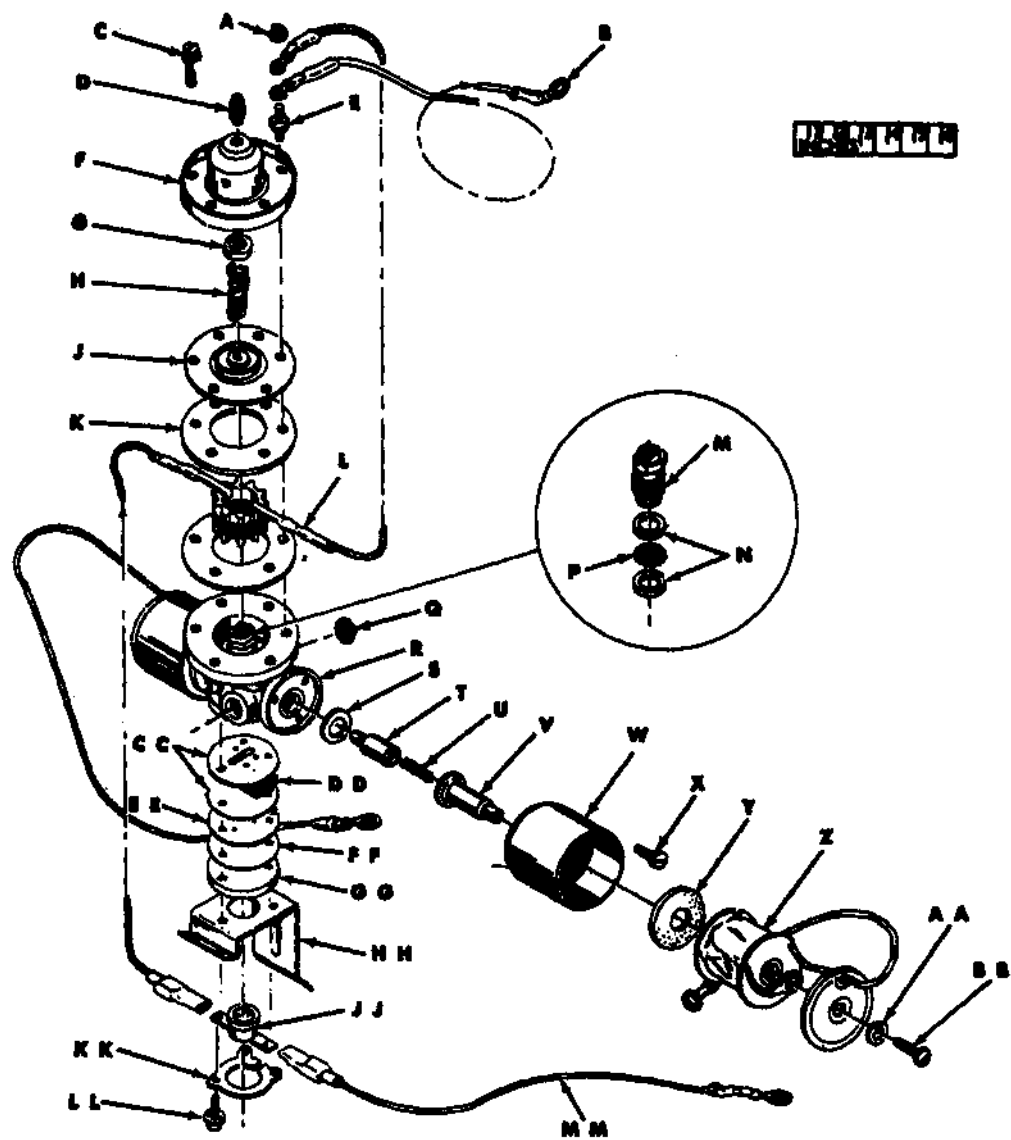


Figure 720. Disassembly of fuel control valve—exploded view.

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- (2) Remove the two screw and lockwasher assemblies securing the switch guard and emergency switch to the dash panel. Remove the switch and the guard.
- (3) Install the emergency switch in the reverse order of removal.

Note. When assembling, be sure "OFF" side of switch is facing downward.

m. Removal of Personnel Heater Control Box.

- (1) Disconnect the wiring harness from the rear of the control box and remove the two screws securing the control box panel to the case assembly.
- (2) Remove the control box panel and controls from the case.

n. Removal of Fuel Pump Assembly. Refer to paragraph 527a and reverse the installation procedures therein to remove the fuel pump from the battery compartment.

533. Cleaning, Inspection and Repair of Personnel Heater Components

a. Heat Exchanger.

- (1) Inspect the heat exchanger for possible damage or leaks. If the heat exchanger is burned through, or shows evidence of cracks, it must be replaced.
- (2) Scrape as much carbon out of the igniter pocket as possible, using a sharp tool, and blow out with compressed air.
- (3) Combustion residue in the heat exchanger caused by burning leaded gasoline is best removed by soaking in a 20% (by weight) solution of ammonium acetate at a temperature of 180°F. for a period of 5 to 10 hours. Drain and rinse thoroughly after cleaning. For other types of fuel, such as diesel fuel, JP4, CIE, etc., a commercial solvent such as "Oakite," or a similar product should be used according to the manufacturer's instructions. Regardless of the type of cleaning solution used, it is important to rinse the heat exchanger thoroughly to remove all traces of solvent and dry it carefully before the unit is reassembled.

b. Fuel Control Valve.

Note. The key letters noted in parentheses refer to figure 720, except where otherwise indicated.

- (1) Remove the three screws (LL), clamp

(KK) and thermostat (JJ) to free the adapter (HH) and orifice plate (EE) with gaskets (FF and CC). Also remove screen (BB) and the small screen (Q) from valve inlet. Disassembly should normally proceed no farther than this point for overhaul.

- (2) Clean the orifice plate with compressed air and inspect with a magnifier.

Caution: Do not force any tool, wire, or other object through the orifice plate openings. The slightest distortion of these calibrated holes, even removal of a bur, may cause serious overheating when the heater is reassembled.

- (3) Test continuity through heating element (L) with an ohmmeter and inspect condition of electric leads very carefully at the points where they emerge from gaskets. Replace heating element if it shows an open circuit, or if electric leads are badly bent or twisted.
- (4) Inspect all electric leads for condition of connectors and tightness of terminals. Resolder if loose.
- (5) The contacts of the thermostat (JJ) open at 70 plus or minus 5°F. and may be open at room temperature. Since the contacts will not close until the temperature is reduced to 30 plus or minus 10°F., it may be necessary to refrigerate this unit to determine if it is operating properly. This test should not be necessary if the thermostat is known to be operating properly, but can be conducted if the heater has poor starting characteristics at low temperatures. Test as follows if required:
- (6) Connect a test light or other indicating device to the thermostat contacts. If room temperature is 75°F., the thermostat contacts must be open. Closed contacts at this temperature indicate a defective thermostat. If the contacts are open at room temperature, place the thermostat in a refrigerator set for a temperature of 20°F. The contacts must close at this temperature. The exact closing temperature is unimportant so long as contacts are closed at not less than 20°F., and open at not

more than 750 F. Replace the thermostat if not within limits. It is not adjustable.

Caution: Do not immerse the thermostat in any liquid as a refrigerant. It is not waterproof and may be destroyed by such practice.

c. Flame Detector Switch.

- (1) Completely remove the adjusting screw of the flame detector switch and clean off cement used to seal the adjustment.
- (2) Turn the switch over and let the quartz rod slide out through the threaded opening from which the adjusting screw was removed.
- (3) Inspect the quartz rod and clean it. The rod must not be chipped or cracked. Discard the rod if defective. If quartz rod is broken, be sure all pieces are removed from the tube.
- (4) Clean the tube of the flame detector switch with a wire brush and inspect it for straightness and the presence of corrosion. Replace the entire switch if the tube is bent or badly corroded, or if the microswitch is defective.
- (5) Replace the rod in the tube and reinstall the adjusting screw, making sure the rod is centered in the depression in the end of the screw.
- (6) Adjust switch as follows:
 - (a) Turn the screw in until the switch just clicks.
 - (b) Turn in 1/2 turn past the click point.
 - (c) Cement the adjusting screw to the lever arm with G.E. No. 1201 Glyptol cement or Ambroid.

Caution: Do not allow cement to run over side of lever arm and touch pin or bracket.

d. Overheat Switch. Inspect the overheat switch for damage and clean contacts by sliding a clean strip of bond paper between points. Do not use an abrasive. Do not attempt to bend the blade or contact arm or change the setting of the adjusting screw. Replace the entire switch if defective.

e. Fuel Filter. Clean fuel filter at each overhaul according to the procedures contained in TM 9-2320-211-20.

f. Blower Assembly.

- (1) Immerse fans in dry-cleaning solvent and dry. Also clean housing and motor-mounting bracket in the same manner. Wipe off outside of motor but do not immerse in cleaning solvent since this may dissolve lubricant.
- (2) This motor is permanently lubricated with a low-temperature grease at the factory. No lubrication is required nor should be attempted.

g. Wiring.

- (1) Inspect all wiring for condition of insulation and tightness of electric connectors.
- (2) Inspect terminal strip for cracks and condition of threaded inserts.

h. Heater Case. Clean heater case inside and out and inspect for dents and roundness. Also inspect condition of threads of weld nuts.

i. Control Box. For cleaning, inspection, repair and test of the control box, refer to TM 9-8662.

j. Fuel Pump. For cleaning, inspection, repair and test of fuel pump, refer to TM 9-8662.

534. Reassembly of Personnel Heater Kit

Reassembly is the reverse of disassembly with the precautions and exceptions noted "throughout the disassembly procedure.

535. Personnel Heater Testing

a. Test Equipment. The following equipment will be required to properly test the heater:

- (1) A source of 24 volts dc.
- (2) A suitable rack or cradle to support the heater during test with provision to dispose of the exhaust gases.
- (3) A test wiring setup similar to the one illustrated in figure 721.
- (4) A fuel tank and electric fuel pump to supply fuel under pressure to the heater.
- (5) A flowmeter, which should be installed in the fuel system to measure fuel flow while the heater is burning. If a flowmeter is not available, it is possible to remove the fuel control valve from the heater and test fuel by means of a glass graduate.
- (6) A strobe-light type of tachometer, to determine speed of the blower motor.

b. Mounting Bracket.

- (1) Fuel flow of the heater is adjusted at the

factory for a specific mounting position and it is necessary to test heaters in the same position that they will have when installed in the vehicle. If several heaters are being used in different mounting positions, it will be necessary to identify each heater with respect to its position, since a heater which has been tested and adjusted for any position other than normal will not operate properly in the normal position and vice versa.

- (2) The heater test-mounting bracket, or cradle, should be permanently mounted, if possible, and should be designed so that the heater can be removed and replaced with a minimum of effort. The exhaust fitting should be a part of the mounting fixture, and the total length of exhaust tubing should not be more than ten feet. Keep bends and turns to a minimum.

c. Fuel System (Fig. 720).

- (1) The fuel flowmeter should be installed in the fuel line between the fuel pump and the heater assembly. A fuel shutoff valve must be included near the outlet end of the fuel line. A flexible section will be helpful in making connections to the heaters,
- (2) In the absence of a flowmeter, a glass graduate and watch may be used to determine fuel flow through the fuel control valve. It is necessary to remove the valve when testing in this manner but, when carefully timed, this test provides an accurate check on fuel flow and may be used to check a flowmeter of doubtful accuracy.

d. Electrical System.

- (1) The source of direct current must be capable of continuous operation without excessive change in voltage with variations in load. If a transformer and rectifier are used without storage batteries, it will usually be necessary to provide some means of regulating voltage at the heater test panel. A bank of storage batteries without regulation should be satisfactory, provided the charging rate is sufficient to keep batteries in a fully charged condition and wiring is of sufficient size to prevent an excessive voltage drop in the line. In any system, an ammeter and voltmeter must be

provided at the test panel to indicate total current draw and applied voltage during the test.

- (2) A suggested wiring diagram for the heater test panel is shown in figure 721. The control switches, meters, flowmeter, and voltage regulator should be mounted in a group on one panel so that all can be observed at one time. An electric timer is also useful, but a watch can be used instead.

e. Test Procedure. A complete test of the heater consists of the following:

- (1) A bum test of the general heater performance.
- (2) Measurement of fuel flow through the fuel control valve.

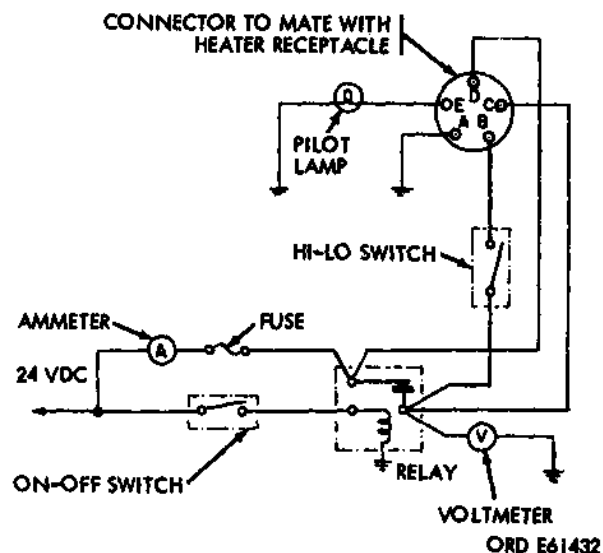


Figure 721. Test wiring set-up for 8420-C heater tests.

- (3) A check of the overheat switch action,
- (4) Timing of the blower fan to determine motor speed.

f. Burn Test.

- (1) Install the heater on the test bench mounting bracket (b (2) above).
- (2) Make fuel, electric and exhaust connections to the heater. The heater must be mounted in the same position it normally occupies in the vehicle, since the mounting position affects the fuel flow through the control valve.

- (3) If the power source is adjustable, preset the voltage control by trial and error so that voltage will be 24 volts with the full starting load of the heater. If a nonadjustable power supply is used, make sure the voltage is at least 22 volts under starting conditions. The test will not be valid unless starting voltage is within these limits, since ignition time is affected by voltage.
- (4) With the above conditions established, set the HI-LO switch to LO, and then turn heater control switch to ON. Start timing heater operation from the instant the switch is turned on.
- (5) Standards.
 - (a) Current draw must not exceed 16 amperes at 24 volts.
 - (b) Note fuel flow during the starting cycle. Flow must be more than 0.012, but less than 0.014 lb./min.
 - (c) The heater should ignite within 40 seconds.
 - (d) The flame detector switch must transfer within 2.5 minutes from the moment the heater control switch was turned on.

Note. Ignition may be inaudible. If so, transfer time of the flame detector switch will be used as the limiting factor for test.

- (e) Immediately after the flame detector switch transfers, turn the HI-LO switch to HI and note current draw. Draw must not exceed 3.25 amperes.

Note. The current draw will be 3 amperes more if test is conducted at a temperature that will maintain the fuel valve thermostat in a closed position.

- (f) Observe high heat fuel flow on the flowmeter. Flow must be more than 0.026, but less than 0.032 lb./rein.
- (g) If fuel rates for high heat are not within limits, turn adjusting screw of the fuel control valve clockwise to increase fuel flow, or counterclockwise to decrease flow and retest. If, after adjusting fuel flow for high heat, it is found that low heat flow is not within limits, it is an indication that one of the metering holes in the orifice plate is clogged. Remove plate, clean, and retest. Both high and low heat flow must be "within limits to

ensure proper starting and satisfactory heat output.

g. *Overheat Test.* While the heater is burning on high heat, block off all flow of ventilating air by covering the heater outlet with sheet metal. The overheat switch must open and shut off fuel flow in more than 15 seconds, but less than 30 seconds from the moment air flow was shut off. Replace the overheat switch if not within limits.

h. *Purge Test.* With the heater burning on high heat, turn the heater control switch off. Fuel flow must drop to zero immediately. The blower must continue to run for more than one minute, but less than 3-1/2 minutes, and must then automatically stop. Reset, or replace the flame detector switch if not within limits.

i. *Blower Test.* To time the blower, remove the guard and mark the combustion blower fan with chalk. Start the heater and time the fan with a tachometer. Blower speed must be 5600 rpm minimum with no restriction on the heater outlet, and with an applied voltage of 24 volts.

j. *Fuel Control Valve Tests (Fig. 722).*

- (1) If a flowmeter is not available to test fuel flow, the fuel control valve can be removed from the heater and tested separately by measuring the amount of fuel which passes through the valve in a specified time.
- (2) The fuel control valve must be tested in its actual operating position. The test setup illustrated in figure 722 is suitable for a valve which will operate in the normal position only. If the heater operates in any other position, it will be necessary to attach the fuel tube and standpipe to the valve, or to simulate these parts with tubing of not less than 3/16-inch diameter. This entire assembly must then be tested in its actual operating position.
- (3) In addition to the tubing, a 50- or 100-cc glass graduate with accurate calibrations will be required. A fixture to hold the valve should be provided and two test leads with alligator clips and a panel switch must be provided to energize the solenoids.

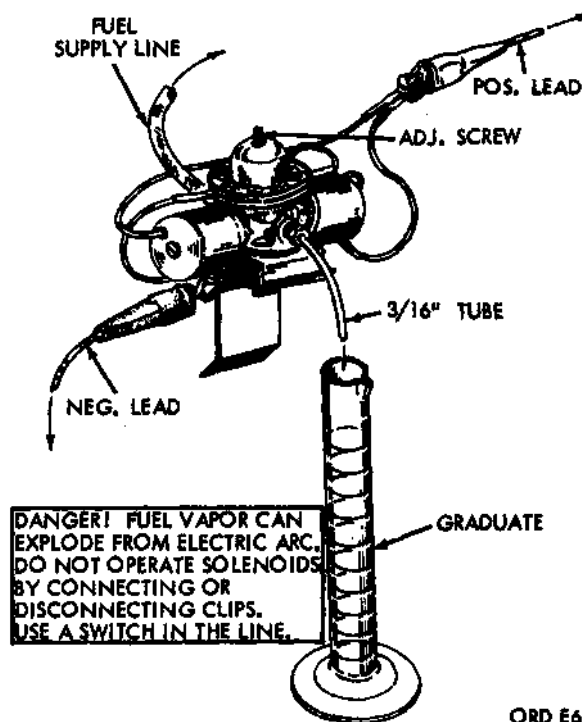
Warning: Dripping fuel is extremely explosive. Do not permit smoking, sparks or open flame within 50 feet of work area during this test. Be extremely careful that all electrical connections are tight. Use the approved switch for starting and stopping the

solenoids; DO NOT operate the solenoids by connecting and disconnecting the test clips.

(4) To test fuel flow proceed as follows:

- (a) Mount the valve in the holding fixture and connect the fuel line and test leads according to figure 722. Place a container under the valve and apply fuel pressure,
- (b) Turn on the switch to energize the solenoids and permit fuel to flow for a few seconds until conditions are stabilized, then place the graduate under the outlet tube and start timing flow. One minute can be used as a timing interval if the graduate has sufficient capacity,
- (c) Snap the solenoid switch off at the end of the timing interval and place the graduate on a flat surface to read the contents. The amount of fuel must be within the limits shown in Table XIX for high heat. If fuel flow is not within limits, turn the adjusting screw in to increase flow or out to reduce flow. Recheck flow after adjusting.
- (d) After high heat flow has been brought within limits, turn the switch to "FF" position and disconnect the lead to the restriction solenoid and repeat test to measure low heat flow. If the low heat

flow is not within limits, it will be necessary to clean or replace the orifice plate and then test and readjust the valve. Repair or replace the valve if this does not correct the condition.



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Figure 722. Fuel control valve test setup.

Table XIX. Fuel Flow

| Solenoid position | Fuel Rate lb/min | | Fuel Rate in cc/min | | | | |
|-------------------|---------------------|-------|---------------------|--------|------------------------|--------------------|---------|
| | | | DFA | DFT | Gasoline MIL-G-3056 | GIE MIL-P-45121 | DE 2 |
| High Heat | 0.029 | 0.003 | 16 ± 2 | 16 ± 2 | 17 ± 2 | 16 ± 2 | 16 ± 2 |
| Low Heat | 0.013 | 0.001 | 7 ± 1 | 7 ± 1 | 8 ± 1 | 7.5 ± 1 | 7.5 ± 1 |

k. Fuel Flow Rates.

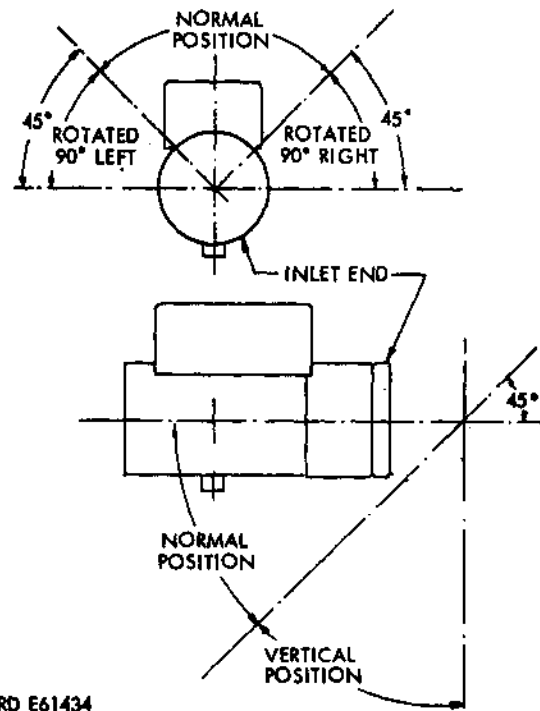
- (1) Two methods are used in this manual to show fuel flow rates. It will be noted that flow rates for use with a flowmeter are shown in pounds per minute and rates for separate testing of a detached valve are shown in cubic centimeters per minute. All fuels intended for use with this heater should flow at the same rate in pounds per minute, regardless of mounting position. Because of the variation in density, the flow, when measured in cubic centimeters

per minute, will vary from one fuel to another.

- (2) All fuel rates are specified for fuel at room temperature. Fuel valves should not be adjusted at extremely low or high temperatures.
- (3) When the heater is to operate in the "normal" operation position (that is with the exhaust tube pointed straight down), the high heat fuel rate is set at the factory according to the chart below. If a heater set for normal operation is subsequently

mounted in any other position, the fuel rate will be less than this amount as a result of back pressure caused by the weight of fuel in the standpipe. This is the reason the actual mounting position must be taken into consideration when adjusting the fuel rate. It should be noted that the converse of this condition (where a heater is set for an alternate position and then burned in the upright position) will cause the fuel rate to be too high and may cause a serious overheat condition.

- (4) Mounting positions of the heater are defined as falling within the areas indicated in figure 723. If the heater is both tilted and rotated, the rotation will define the mounting position unless the tilt exceeds 45°, in which case the mounting position is considered to be "vertical." Heater positions should be specified as "Normal," "Rotated 90°" or "Vertical," according to the areas illustrated in figure 723 if special adjustment is desired at the factory.
- (5) These heaters are not designed for use in any installation where the exhaust outlet is above the horizontal level and must never be installed in the vertical position with the blower at the bottom, since this may interfere with proper operation or cause leakage of fuel through the combustion air inlet.



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Figure 723. Heater mounting positions.

536. Installation of Personnel Heater

Install the heater assembly by following the procedures in paragraph 527 of this manual.

Section XVII. (ADDED) MAINTENANCE INSTRUCTIONS FOR POWER PLANT HEATER KIT COMPONENTS (MULTIFUEL MODEL VEHICLES)

537. Disassembly of Power Plant Heater Kit Into Subassemblies

a. Removal of Power Plant Heater Assembly

- (1) Turn the inlet and outlet shutoff cocks fully to the right.
- (2) Turn the power plant heater shutoff cock fully to the right.

Warning: Do not permit smoking, sparks or open flame within 50 feet of vehicle during any operation involving removal of fuel lines, fuel draining or fuel filtering.

- (3) Disconnect the fuel line from the fitting in the fuel control valve. Remove the fitting from the control valve.

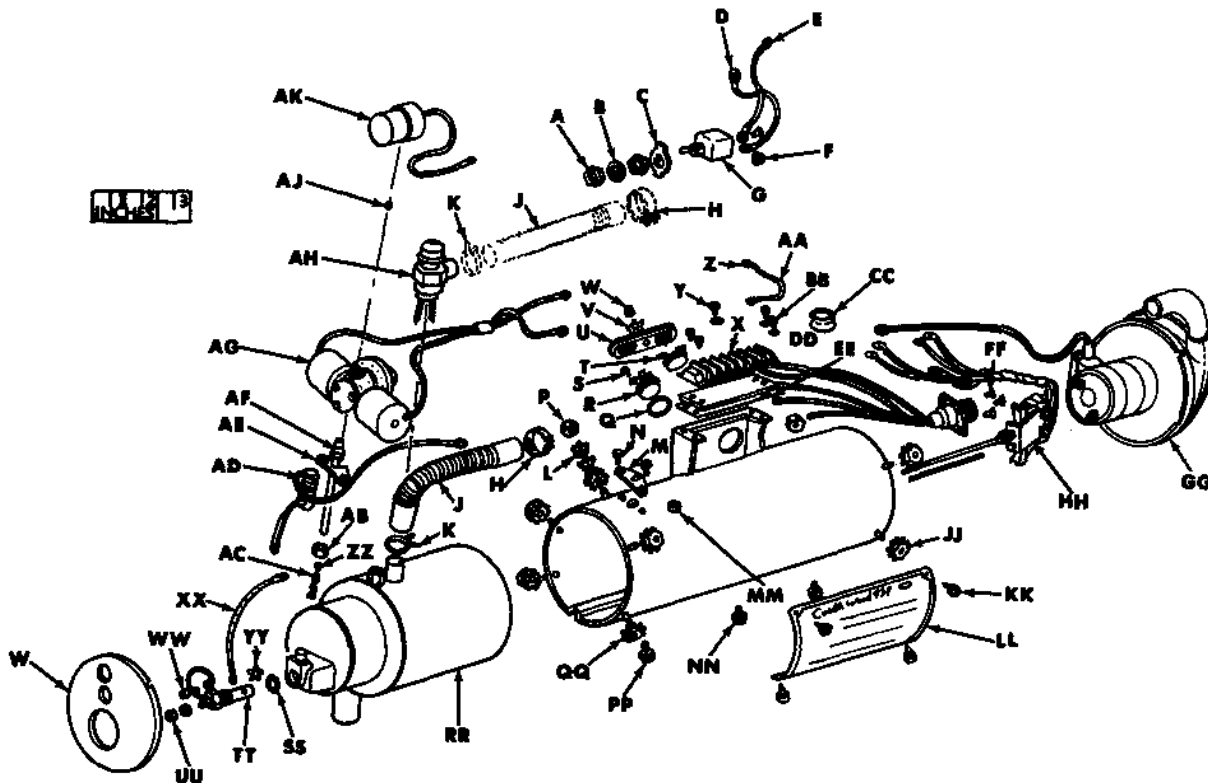
- (4) Disconnect the electrical harness connector from the heater by turning it counterclockwise.
- (5) Remove the cotter pin securing the exhaust tube extension elbow to the heater. Separate the elbow from the heater.
- (6) Remove the clamp securing the hose to the bottom of the heater and remove the hose from the heater, then remove the elbow.
- (7) Loosen the hose clamp securing the heater coolant inlet hose to the elbow on top of the heater assembly. Remove the heater inlet hose and, then remove the 45-degree elbow.
- (8) Hold the heater assembly to prevent it

from falling and disconnect the two heater mounting clamps. Remove the heater assembly from the mounting saddles.

Note. The key letters noted in parentheses refer to figure 724, except where otherwise indicated.

b. Removal of Blower Assembly.

- (1) Compress the clamp (K) of the combustion air hose (J) with hose clamp pliers and disconnect hose from the heat exchanger or ignition tee (AH) if used. Remove hose from the blower (GG) by loosening clamp (H).



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Figure 724. Power plant heater disassembly-exploded view.

| Key | Item | Key | Item |
|-----|--------------------|-----|-------------------------------|
| A | Nut (2 req'd) | v | Lockwasher |
| B | Lockwasher | W | Nut |
| C | Switch plate | X | Terminal strip and receptacle |
| D | Wire assembly | Y | Screw (11 req'd) |
| E | Wire assembly | Z | Wire assembly |
| F | Screw (2 req'd) | AA | Wire assembly |
| G | Switch | BB | Screw (4 req'd) |
| H | Clamp | CC | Grommet |
| J | Hose | DD | Marker strip |
| K | clamp | EE | Terminal marker support |
| L | Lockwasher | FF | Screw (4 req'd) |
| M | Plate | GG | Blower assembly |
| N | Screw (2 req'd) | HH | Flame detector switch |
| P | Nut | JJ | Nut (4 req'd) |
| Q | "O ring | KK | Rivet (4 req'd) |
| R | Restriction switch | LL | Name plate and wiring diagram |
| S | Screw (4 req'd) | MM | Grommet |
| T | Overheat switch | NN | Heater housing |
| U | Thermostat cover | | |

Figure 724. Power plant heater disassembly-exploded view (legend).

- (2) Disconnect the electrical lead of the blower (GG) from terminal No. 6 of the terminal strip.
- (3) Loosen, but do not remove, the four hex-nuts (JJ) on the studs at the end of the heater case. Turn the blower (GG) counterclockwise to disengage the bayonet slots and pull the entire assembly off the end of the heater. Do not twist or move the assembly from side-to-side.

c. Removal of Flame Detector Switch.

- (1) Disconnect flame detector switch electrical leads from terminals 2, 3, 4, 6 and 7 to the terminal strip.
- (2) Using a short 1/2-inch open end wrench, back off the hexagonal compression nut which attaches the flame detector switch (HH) to the bushing on the end of the heat exchanger (RR). Pull the flame detector switch wires through the grommet (CC) in the heater housing and then pull the switch straight out of the heat exchanger, being careful not to bend the steel tube. This tube contains a quartz rod which may be broken by excessive bending of the tube.

d. Removal of Igniter.

- (1) Remove the end plate (W) from the end of the heater by loosening the four hex-nuts (QQ) and turning the cover in a counterclockwise direction.
- (2) Disconnect the ground lead (XX) by removing nut (P) and lockwasher (L) from inside the heater housing and bend igniter ground wire so that it will fit inside a deep socket.
- (3) Disconnect the copper connecting strap of the preheat resistor (AD) and remove the igniter, using 13/16-inch deep socket.
- (4) When it is desired to change the igniter alone, without disassembly of the heater, this can be accomplished through the opening in the end of the heater case.

e. Removal of Fuel Control Valve.

- (1) Disconnect fuel control valve leads from the overheat switch and HI-LO switch.
- (2) Loosen the hexagonal compression fitting (AB) at the lower end of the standpipe (AF) until the standpipe will turn freely in the fitting.

- (3) Hold the fuel control valve (AG) firmly and unscrew the standpipe from the valve, using an open-end wrench on the hexagon at the upper end of the standpipe (AF). Lift off the valve when the threads are clear. Avoid unnecessary pressure on the solenoid cups of the fuel valves since fuel leakage may result if the cups are loosened from the surface of the valve body.

f. Removal of Standpipe and Fuel Preheater.

- (1) Remove the two screws (N) from the plate (M) which surrounds the standpipe (AF). Leave one plate loose on the standpipe and remove slotted tapping plate (AE) from inside the heater housing (NN).
- (2) Disconnect lead of the preheat resistor (AD) from terminal No. 7 of the terminal strip.
- (3) Remove the compression fitting (AB) at the lower end of the standpipe (AF) and lift out standpipe, preheat resistor (AD), plate (M) and compression fitting (AB) through the opening in the heater housing fitting.
- (4) It will usually be 'necessary to destroy the fitting (ZZ) on the standpipe to remove the resistor or compression fitting. Always use a new fitting if the old one was disturbed in its position on the standpipe, or if its condition is not satisfactory for use.

g. Removal of Temperature Switches.

- (1) Disconnect the wires from the two switches (T) and (R) underneath the terminal strip. Disconnect wire from the overheat switch (T) and note its position for re-assembly.
- (2) Remove the hex-nut (W) from the stud between the switches and lift off the thermostat cover (u). Remove switches and "O" rings (Q). These switches are identical except for temperature setting. They can be distinguished by the part number stamped on the switch, since the last three numbers indicate the temperature setting. Part No. 700220 is set for 220°F. Part No. 700245 is set for 245°F. and is the overheat switch. When replacing these switches, make sure they go into the proper socket on the heat exchanger. The overheat switch must be installed in the socket

toward the blower end of the heater to obtain proper temperature control.

Caution: When replacing switches (or switch), make sure the "O" ring is in place under the switch to seal out dirt and grease, and also make sure the heat exchanger is reasonably clean at the point of contact. An accumulation of foreign matter, or failure to reinstall "O" rings may result in switch failure or unsatisfactory operation.

h. Removal of Terminal Strip and Connector. If it becomes necessary to remove the terminal strip and connector, these parts can be removed by removing the two screws (BB) at each end of the terminal strip and the four screws (FF) which secure the connector. Parts can then be separated with a hot soldering iron.

i. Removal of Heater Housing.

- (1) To remove the heater housing (INN), remove the three screws (PP) from the seam and spread the housing so that it will clear the exhaust tube and coolant fittings. Avoid spreading the housing so far as to cause permanent distortion of its shape.
- (2) The heater is now completely disassembled for service purposes and no attempt should be made to remove other components from the housing or heat exchanger. However, the blower and fuel control valve may be disassembled as directed below if parts are available for repair.

i. Disassembly of Blower Assembly.

Note. The key letters noted in parentheses refer to figure 725, except where otherwise indicated.

- (1) Remove the nine screws (J) and speed nuts (E) from the flange of the blower.
- (2) Lift off the front of the blower housing (A) and loosen the setscrew (H) in the hub of the blower wheel (B). Lift the wheel off the motor shaft.
- (3) Remove three screws (G) which attach the combustion air elbow and plate assembly (C) to the bell end of the motor (D). Lift the motor off, being careful not to lose the screws (G) and spacers (F).
- (4) Do not attempt to disassemble or lubricate the motor since it is packed with a special low-temperature lubricant. Replace the entire motor if it is found to be defective.

k. Disassembly of Fuel Control Valve. The fuel

control valve is disassembled by following the procedures contained in paragraph 532k.

538. Cleaning, Inspection and Repair of Power Plant Heater Components

a. Heat Exchanger.

- (1) Inspect the heat exchanger for possible damage or leaks. If the heat exchanger is badly corroded, or shows evidence of leakage, it must be replaced.
- (2) Scrape as much carbon out of the igniter pocket as possible, using a sharp tool, and blow out with compressed air.
- (3) Remove combustion residue from the heat exchanger by soaking it in a 20% (by weight) solution of ammonium acetate at a temperature of 180°F. for a period of 5 to 10 hours. Drain and rinse the heat exchanger thoroughly after soaking, then dry with compressed air.



Figure 725. Disassembly of blower assembly—exploded view.

| Key | Item |
|-----|-------------------------------------|
| A | Blower housing |
| B | Blower wheel |
| C | Combustion air elbow and plate assy |
| D | Motor |
| E | Speed nut (9 req'd) |
| F | Spacer (3 req'd) |
| G | Screw (3 req'd) |
| H | Setscrew |
| J | Screw (9 req'd) |

Figure 725. Disassembly of blower assembly—exploded view (legend).

b. *Ignitor.* Replace the igniter at each overhaul.

c. *Fuel Control Valve.*

- (1) Replace the fuel inlet screen and install a new one.
- (2) Be very careful to note the positions of the orifice plate and gaskets so that they can be properly reassembled. Then remove the three screws from the side of the valve and separate the gaskets from the orifice plate. Clean the screen and orifice plate with compressed air.
- (3) Inspect the vaporizer wick in the standpipe. If the wick is clogged with lead from the gasoline, it must be replaced.
- (4) Do not disassemble the pressure regulator side of the valve or change adjustment of the diaphragm screw, since special equipment is required to calibrate the valve.

Caution: Do not force any tool or other object through the orifice plate openings. The slightest* torsion of these calibrated holes, even removal of burs, will destroy the plate and may cause serious overheating when the unit is reassembled.

d. *Standpipe and Wick Assembly.*

- (1) Do not attempt to disassemble the orifice from the end of the standpipe and wick assembly. Remove the screen and wick, but do not disturb the orifice, since special tools are required to install and calibrate this part.
- (2) Blow out the orifice with compressed air (applied at valve end of the standpipe) and inspect for corrosion using a magnifier. Replace the entire wick and standpipe assembly if evidence of corrosion or damage is found.

Caution: Do not insert any tool through the orifice opening. The slightest distortion of this calibrated hole will destroy the standpipe and wick assembly end may cause overheating when the heater is reassembled.

e. *Blower Assembly.*

- (1) Wash the two halves of the blower housing and the fan in dry-cleaning solvent or mineral spirits paint thinner and dry. Wipe off the motor but do not immerse in solvent. This motor is permanently lubricated with a special low-temperature lubricant and no attempt at lubrication should be made.

- (2) When reassembling the blower, mount the motor on the blower housing, using the screws and spacers, and then install the fan on the motor shaft. Adjust the fan so that the hub is flush with the end of the motor shaft and tighten the set-screw. Hold the other half of the housing in position and spin the fan with the end of the Allen wrench or a piece of wire to make sure the fan does not scrape before installing the screw in the housing flange.

f. *Flame Detector Switch.*

- (1) Completely remove the adjusting screw of the flame detector switch and loosen the two microswitch mounting nuts.
- (2) Turn the microswitch back and remove the bow spring. Turn the switch over and let the quartz rod slide out of the tube. Examine the quartz rod for chipped or broken condition. Replace the rod if it is defective. Clean the tube of the switch with a wire brush and check it for straightness. If the tube is warped, replace the flame detector switch.
- (3) Reinstall the quartz rod and turn the switch back into position, then install the bow spring and adjusting screw. Tighten the mounting nuts so that the switch is held in position but is not locked.
- (4) Press up on the bow spring to permit the quartz rod to center itself in the tube.
- (5) Adjust the switch as follows:
 - (a) Back off the adjusting screw until the switch clicks.
 - (b) Turn the adjusting screw in slowly until the switch just clicks, then turn the screw exactly three-fourths of a turn past the click point.
 - (c) Hold screws and tighten mounting nuts to lock the microswitch firmly in place.

g. *Temperature Control Switches.* Inspect the temperature control switches for corrosion. If the switches are damaged, or are known to be operating at a temperature which is not correct they must be replaced since they are not repairable. Excessive bending or rough handling of these switches may cause distortion and permanent loss of calibration, even in a new switch.

h. *Fuel Filter.* To clean fuel filter, remove bowl by unscrewing counter-clockwise, and clean inside

of bowl. Clean filter elements by washing thoroughly in dry-cleaning fluid or mineral spirits paint thinner. When reassembling, be sure gasket is in place between bowl and filter body.

i. Wiring

- (1) inspect for cracks and worn insulation. Repair defective wiring where possible; otherwise replace wiring. If wiring is permanently attached to a component and cannot be repaired satisfactorily, replace entire component.
- (2) Inspect terminal strip for possible damage. Replace where necessary.

539. Reassembly of Power Plant Heater Kit

For sequence of reassembly, reverse the procedure under disassembly unless otherwise noted in the disassembly procedure.

540. Power Plant Heater Testing

a. *Test Equipment.* The following equipment will be necessary to properly test the heater after overhaul:

- (1) A source of 24 volts dc.
- (2) A suitable rack, or cradle, to support the heater with provision to dispose of the exhaust.
- (3) A control box and wiring harness.
- (4) An electric fuel pump, or a fuel supply tank with a head of 15 inches. Tests with a greater or smaller head will not be a valid indication of proper heater operation.
- (5) A tank or container for coolant, and associated tubing and fittings to make connections to the heater.
- (6) A thermometer, or thermocouple and potentiometer indicator, to measure coolant temperature.
- (7) A water manometer to measure static pressure of the combustion air blower.

b. Coolant System.

- (1) To speed up testing of the temperature control switches, the coolant system should not contain more than about five gallons of coolant. The coolant should be the same as that used in the engines which are being heated. Water cannot be used to test action of the control switches, since

they are set at a temperature above the boiling point of water.

- (2) It will be necessary to allow the coolant to cool between heater tests. For this reason, a method of changing coolant quickly is advisable if it is anticipated that several heaters will require testing in rapid succession. The coolant system should have a drain valve at its lowest point.
- (3) The coolant container may be open or closed but must be vented to the air. A thermosyphon type of circulation is satisfactory and no pump will be required.

c. Electrical System.

- (1) The power plant heater should be wired as shown in figure 721, using the regular wiring harness, except that a voltmeter must be connected across the circuit and an ammeter should be included between the HOT lead of the control box and the source.
- (2) The source of electric power should preferably have a means of adjusting the voltage, especially if a transformer and rectifier are used, but a fully charged storage battery should be satisfactory without regulation.
- (3) Provision must be made for a thermometer or thermocouple pair in the outlet fitting of the heater so that the temperature can be read at this point. A thermocouple pair can be installed by running wires underneath the connecting hose at the heater outlet, being careful not to damage the insulation of the thermostat wires.

d. Exhaust Collector. Provision must be made to conduct the heater exhaust gases outside the building in which tests are being conducted. The exhaust extension may be made of a flexible exhaust tube and should not be more than ten feet long.

e. Scope of Tests.

- (1) A complete test of the power plant heater consists of the following:
 - (a) Fuel flow test.
 - (b) Bum test.
 - (c) Overheat switch test.
 - (d) HI-LO thermostat test.
 - (e) Combustion air blower test.
- (2) Since equipment for the combustion air blower test may be difficult to obtain in the

field, this test can be eliminated, provided the heater burns properly and the ignitor cavity does not show an excessive deposit of carbon. If the heater goes out during test, or if it smokes excessively and has heavy carbon deposits within the igniter cavity, it can be assumed that the blower is not delivering sufficient air and the blower motor should be changed. Moderate carbon deposits are normal and do not indicate a defective blower.

f. Fuel Flow Test. The fuel control valve of the power plant should always be tested after cleaning and fuel flow should be tested when the heater is put on the test block after repair. If the test setup includes a flowmeter, fuel flow can be checked during the burn test; otherwise, it must be removed from the heater and tested as follows:

- (1) Connect the fuel control valve to the fuel supply at a pressure of 1 to 15 psi. Fuel should be turned off at the shutoff valve.

Warning: Dripping fuel is extremely explosive. Do not permit smoking, sparks or open flame within 50 feet of work area during this test. Be extremely careful that all electrical connections are tight. Use the approved switch for darting and stopping the solenoids; DO NOT operate the solenoids by connecting and disconnecting the test clips.

- (2) Place the outlet of the control valve over a glass graduate calibrated in cubic centimeters. A suitable container to catch overflow must be provided.
- (3) Ground the body of the valve to a 24-volt source and energize both solenoids of 939-A valve, or the single solenoid of the 939-C, by placing lead wires in the clip of a positive wire connected to the electric power source controlled by an enclosed switch a few feet from the test area. This will open the solenoids and permit high heat fuel flow.
- (4) Switch on the solenoid and then turn the fuel supply on and permit fuel flow into the overflow container for a few seconds to bleed the line and stabilize fuel flow.
- (5) After flow is stabilized, place the graduate under the outlet of the valve for a period of exactly one minute, then shut off fuel first and switch off solenoid. Read the con-

tents of the graduate at eye level. The contents must be within the limits of 14 to 18.5 cc.

- (6) For 939-A only, repeat the above procedure by energizing the shutoff solenoid with the restriction solenoid disconnected. The quantity of fuel for low heat operation must be within the range of 5.5 to 8.5 cc. If a flowmeter is used during the burn test, flow rates can be determined by the following chart.

High Heat 0.023 to 0.029 lb./min. or 14 to 18.5 cc/min

Low Heat 0.009 to 0.013 lb./min. or 5.5 to 8.5 cc/min
939-A Only

- (7) If flow rates are not within limits, replace the fuel control valve. Do not attempt to adjust the pressure regulator.

g. Leak Test. Using the same setup described for the fuel flow test, energize solenoid valve, or valves, to obtain high heat fuel flow and permit fuel to flow for a few seconds. Switch off the solenoid and observe the fuel control valve outlet, or outlet of the standpipe, for evidence of leakage. One or two drops may form and fall after the switch is off, but flow should then stop entirely. Observe the valve for about one minute and then repeat the test. No leakage is permitted and the valve must be replaced if any occurs.

h. Burn Test.

- (1) Place the fully assembled heater on the test bench and make fuel, coolant, electrical and exhaust connections. Do not attempt to burn the heater unless there is an unrestricted supply of coolant.
- (2) Before starting the burn test, remove the cover from the end of the heater housing and look inside for evidence of heat exchanger leakage. Replace the heat exchanger if leakage is indicated.
- (3) Replace the cover on the heater housing and place the heater control switch in the ON position. Start timing heater from the moment the switch is placed in START position, or from the moment the switch is turned on. Note current draw on the ammeter.
- (4) Current draw should be approximately 11 amperes at 24 volts.

- (5) The heater should ignite within 20 seconds from the moment the switch was turned ON.
- (6) The flame detector switch must transfer in more than eight seconds, but less than 25 seconds from the instant of ignition. Transfer of the switch will be indicated by the pilot lamp and by a drop in current draw. Reset voltage to 24 volts after the flame detector switch transfers. Current draw should then be approximately one ampere at 24 volts.
- (7) If the heater fails to ignite, or is slow in establishing flame, clean the igniter cavity and install a new igniter. Insufficient fuel flow or a clogged vaporizer wick can also cause slow ignition.
- (8) If the flame detector switch does not transfer within limits (h(6) above), reset the switch, or the quartz rod if defective.
- (9) Allow the heater to burn one minute on high heat, then snap the control box switch to LO. Burning within the heater should be reduced in intensity, but the heater must continue to burn. If the heater goes out, replace the fuel control valve and repeat the test.
- (10) Turn the heater control switch to OFF position. Burning should stop immediately and fuel flow should also stop; but the blower should continue to run for more than one minute, but less than two minutes, and then automatically stop. If blower operation is not within limits, reset the flame detector switch and repeat the test. If the blower fails to stop, the quartz rod of the flame detector switch is broken and must be replaced.

Note. All the above specifications are based on a room temperature above 65°F. If the room temperature is very cold, the starting time and blower overrun time may not be as specified.

i. HI-LO Thermostat and Overheat Switch Test.

- (1) Turn the heater on and allow it to run until the coolant is heated sufficiently to cause the heater to cycle from high to low heat. Permit conditions to stabilize and observe the temperature at the coolant out-

let of the heat exchanger. This temperature must be between 200° and 225°F. If temperature is not within limits, replace the HI-LO thermostat.

- (2) After testing the HI-LO thermostat, connect a test wire across the terminals of the HI-LO switch so that the heater will remain on high heat. Allow the coolant to heat until the overheat switch cuts out (burning will stop). Observe the temperature immediately when the switch opens. This temperature must not be less than 230° or more than 260°F. Replace the overheat switch "if not within limits,

j. Blower Assembly Test.

- (1) Due to its concealed position, testing of the blower is difficult on the 939 Coolant Heater and this test is not required unless there is reason to believe that difficulty is being experienced as a result of insufficient combustion air.
- (2) If it becomes necessary to test the combustion air blower, its condition can be determined by measuring static pressure in the combustion air duct with a water manometer. To make this test, install a short section of tubing with a pressure tap on the combustion air inlet of the exchanger and attach a water manometer to the tap. The Part No. ST-890039 pressure test elbow is suitable for making this test, but any pressure tap is satisfactory, provided no sharp bends are introduced into the duct, and the pressure tap opening is smooth and flush inside the tube. Reconnect the blower hose to the pressure tap.
- (3) Disconnect the No. 6 blower lead from the terminal strip and energize the blower at 24 volts. Check carefully for air leaks and then read the static pressure as indicated on the manometer. This static pressure should be at least 1.8 inches of water. If static pressure is less, replace the blower motor.

541. Installation of Power Plant Heater

Install the heater assembly by following the procedures in paragraph 529 of this manual.

APPENDIX I

TORQUE CHART 5-TON, 6 X 6 TRUCKS

| Component(s) | Thread Size | Torque req'd ft-lb |
|---|-------------|-----------------------|
| AXLE AND DIFFERENTIAL | | |
| Carrier top cover to carrier | 3/8-16 | 25-35 |
| Drive flange to hub | 1/2-13 | 85-95 |
| Differential to axle housing stud | 5/8-18 | 140-155 |
| Carrier bearing cap to carrier | 3/4-16 | 280-325 |
| AXLE SUSPENSION | | |
| Front spring U-bolts | 7/8-14 | 300-400 |
| Rear spring U-bolts | 1-14 | 350-450 |
| Torque rod end ball nuts | 1-1/2-12 | 350-400 |
| TRANSFER | | |
| Sprag unit housing to case cover | 7/16-14 | 20-25 |
| Input shaft front bearing cover to case | 7/16-14 | 20-25 |
| Input shaft rear bearing cover to case | 7/16-14 | 20-25 |
| Rear output shaft rear bearing cover to case | 7/16-14 | 20-25 |
| Front cover to case | 7/16-20 | 20-25 |
| Intermediate shaft rear bearing cover to case | 1/2-13 | 20-25 |
| TRANSMISSION | | |
| Power-takeoff housing to transmission case | 3/8-16 | 30-40 |
| Input shaft bearing cover to case | 3/8-16 | 30-40 |
| Shifter housing to case | 3/8-16 | 30-40 |
| Shifter housing cover to shifter housing | 7/16-14 | 35-45 |
| Mainshaft rear bearing cover to case | 1/2-13 | 35-45 |
| Countershaft rear bearing cover to case | 1/2-13 | 35-45 |
| POWER TAKEOFF | | |
| Front bearing cap to case | 5/16-18 | 15-20 |
| Rear output shaft housing to case | 5/16-18 | 15-20 |
| Cover to case | 3/8-16 | 30-40 |
| PROPELLER SHAFT | | |
| Yoke to journal bearing | 7/16-20 | 45-55 |
| Journal adapter to journal bearing | 7/16-20 | 45-55 |
| STEERING GEAR | | |
| Steering arm ball stud retaining nut | 7/8-14 | 140 |
| Side cover to gear housing | 3/8-16 | 25-35 |
| Control housing to gear housing | 3/8-16 | 25-35 |
| Cylinder mounting flange to gear housing | 3/8-16 | 25-35 |
| End cover to gear housing | 3/8-16 | 25-35 |
| Piston to sliding bar | 3/4-16 | 90-100 |
| Pitman arm hex-nut to shaft | 1-1/4-12 | 175-200 |

TORQUE CHART - Continued

| Component(s) | Thread Size | Torque req'd ft-lb |
|---|-------------|--------------------------|
| WHEELS | | |
| Wheel hub stud nut | 3/4-16 | 400-450 |
| Front and rear wheel bearing locknut | 2-7/16-16 | 100-150 |
| Front wheel brakedrum to adapter bolt nut | 3/8-24 | 40-44 |
| Rear wheel brakedrum to adapter bolt nut | 3/8-24 | 40-44 |
| Rear wheel brakedrum adapter to hub screw | 1/2-13 | 52-58 |
| CAB | | |
| Seat supports | 5/16-18 | 10-13 |
| Seat supports | 3/8-24 | 25-29 |
| Floor pan screws | 1/4-20 | 5-8 |
| Cab doorscrews | 1/4-20 | 5-8 |
| Cab mounting bolts - front | 1/2-20 | 40-60 |
| Cab mounting bolts - rear | | 3/8" of bolt thru nut |
| Grab handle screw | 1/4-20 | 5-8 |
| W/S pivot bolts | 3/8-24 | 25-29 |
| W/S holddown latches | 1/4-28 | 6-10 |
| Side view mirror | 5/16-24 | 12-15 |
| Slave receptacle | 1/4-28 | 6-10 |
| Cab guard mounting bolt | 1/2-20 | 62-68 |
| Gun mount bolts | 1/2-20 | 15-20 |
| Panel instruments | 10-32 | |
| | Screws | Secure |
| Windshield safety arms | | Secure |
| CHASSIS | | |
| Clutch pedal lever clamp bolt | 7/16-20 | 42-47 |
| Tie-down handles | 1/2-20 | 5-8 |
| Trailer connector socket | 1/4-28 | 6-10 |
| Tool box mounting bolts | 3/8-24 | 25-29 |
| Liquid container carrier mounting | 3/8-24 | 25-29 |
| Lashing hooks | 5/16-18 | 10-13 |
| Running board mounting bolts | 5/16-24 | 12-15 |
| B.O. life guard mounting bolts | 5/16-24 | 12-15 |
| Bumper mounting bolts | 1/2-20 | 62-68 |
| Brush guard bracket mounting bolt | 9/16-18 | 82-90 |
| Hook hinges | 1/4-28 | 6-10 |
| Radiator braces | 3/8-24 | 25-29 |
| Battery comp. splash shield | 5/16-24 | 12-15 |
| Battery supports to rng. board supports | 3/8-24 | 25-29 |
| Air reservoirs mounting clamps | 5/16-24 | 12-15 |
| Spare tire carrier mounting bolts | 3/8-24 | 25-29 |
| Pioneer tool rack mounting bolts | 3/8-24 | 25-29 |
| Tow shackles | 1/2-20 | 62-68 |
| Taillights (service) | 3/8-16 | 23-26 |
| Fender to cab cap screws | 3/8-16 | 8 Min. - Washer not flat |
| Headlight bracket mounting bolt | 3/8-24 | 10-20 |

TORQUE CHART - Continued

| Component(s) | Thread Size | Torque req'd ft-lb |
|-----------------------------|-------------|-----------------------|
| CHASSIS - Continued | | |
| Headlight wiring clips | 3/8-24 | 10-20 |
| Brush guard hinge bolts | 1/2-20 | 40-60 |
| Tire carrier hinge | | Secure |
| Winch prop. shaft U-bolt | Setscrew | Secure |
| BODY | | |
| Body mounting bolts | 9/16-18 | 82-90 |
| Body mounting shear bolts | 3/4-16 | 5/8" bolt thru nut |
| Splash guard mounting bolts | 3/8-24 | 25-29 |
| Reflector screws | 5/16-24 | Secure |
| Body pivots | 3/4-16 | 150-170 |

GENERAL TORQUE CHART (LUG LOCKNUTS)

| Size | Thds/In. | Torque | Size | Thds/In. | Torque |
|------|----------|--------|------|----------|---------|
| 1/4 | 20 | 5-8 | 9/16 | 12 | 68-75 |
| | 28 | 6-10 | | 18 | 82-90 |
| 5/16 | 18 | 10-13 | 5/8 | 11 | 100-115 |
| | 24 | 12-15 | | 18 | 120-135 |
| 3/8 | 16 | 23-26 | 3/4 | 10 | 170-190 |
| | 24 | 25-29 | | 16 | 210-230 |
| 7/16 | 14 | 34-39 | 7/8 | 9 | 290-310 |
| | 20 | 42-47 | | 14 | 340-360 |
| 1/2 | 13 | 42-58 | 1 | 8 | 420-440 |
| | 20 | 62-68 | | 14 | 500-520 |

APPENDIX II REFERENCES

1. Indexes

The following indexes should be consulted frequently for latest changes to or revisions of references given in this appendix and for new publications or instructions relating to materiel covered in this manual.

Index of Army Motion Pictures, Film Strips, Slides, and
Phono Recordings DA Pam 108-1

Military Publications:

Index of Administrative Publications DA Pam 310-1
Index of Blank Forms DA Pam 310-2
Index of Graphic Training Aids and Devices DA Pam 310-5
Index of Supply Manuals - Ordnance Corps. DA Pam 310-29
Index of Technical Manuals, Technical Bulletins, Supply
Bulletins, Lubrication Orders, and Modification Work Orders DA Pam 310-4
Index of Training Publications DA Pam 310-3

2. Forms

DA Form 2028, Recommended Changes to DA Technical Manual Parts Lists or Supply Manual 7, 8, or 9, is used to report publication errors or omissions. For use of maintenance forms refer to TM 38-750, the Army Equipment Record Systems and Procedures. Forms pertaining to the Army Safety Program are prescribed in SR 385-10-40.

3. Other Publications

Deep-water Fording of Ordnance Materiel TM 9-238
Driver's Manual TM 21-305
Driver Selection and Training TM 21-300
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For explanation of abbreviations used, see AR 320-50.

