(2) Connect cable No. 49 to right-hand battery positive (+) terminal (fig. 79). Connect cable No. 50 to ground on dash (behind generator-regulator) in conjunction with cable No. 7.

(3) Install clip on each cable and attach both clips to floor sill below right-hand battery.

(4) Install right-hand fender (par. 277).

143. Service Head Lights

a. HEAD LIGHT BEAM ADJUSTMENT.

(1) Head light beams must be accurately aimed. When aiming head lights, replace sealed-beam lamp unit (*b* below) if beam pattern is distorted. Beam distortion is usually due to a sprung or dented reflecter, a condition sometimes caused by careless handling.

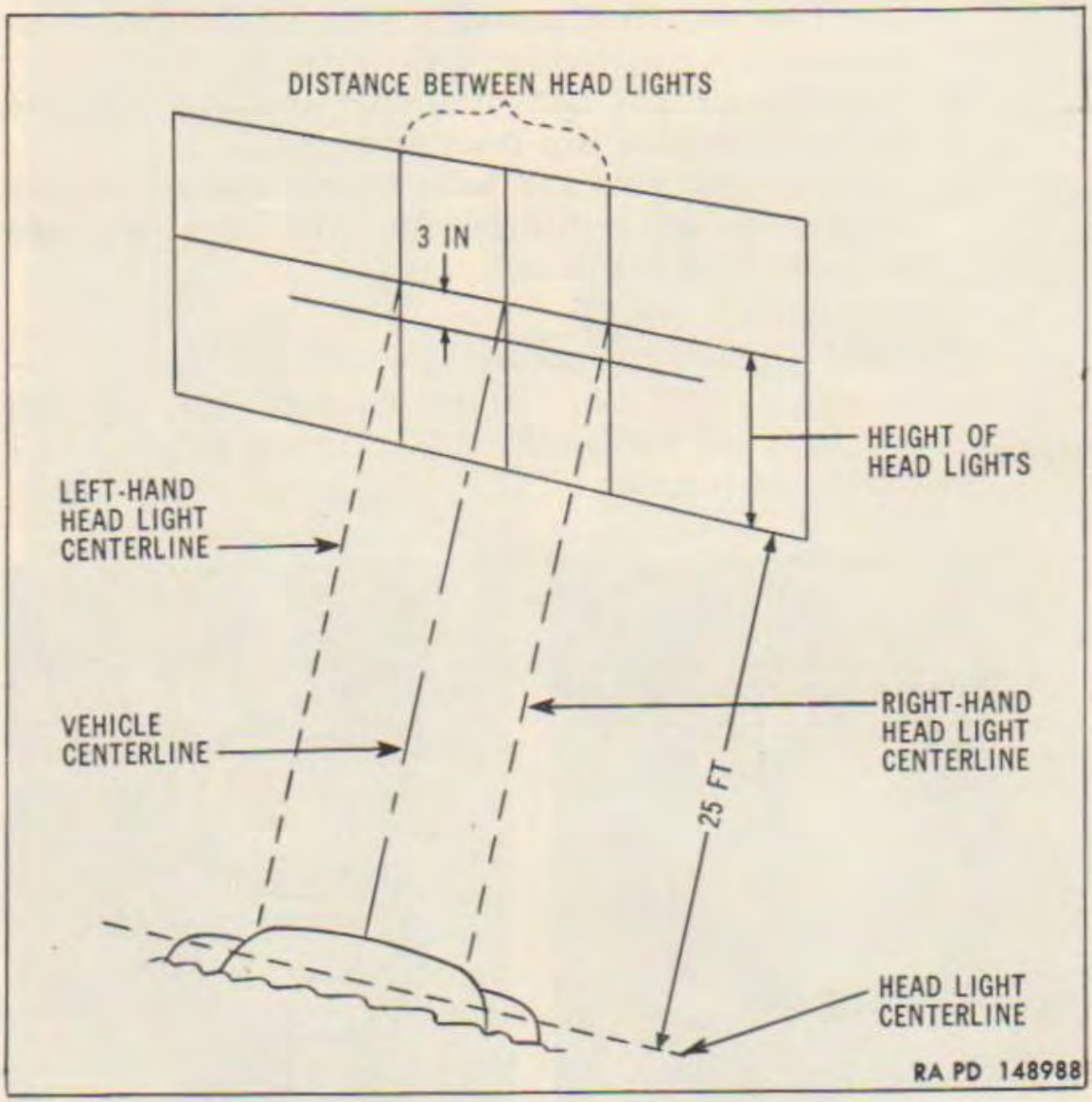


Figure 81. Head light aiming chart.

(2) Conventional aiming equipment should be used when aiming head lights; however, head light beam can be accurately adjusted as follows:

(*a*) Position unloaded vehicle on level floor with head lights 25 feet from a smooth vertical surface such as a wall or door, preferably of light color. Centerline of vehicle must be perpendicular to the vertical surface (fig. 81).

(*b*) Measure height of head light center from floor; then draw a horizontal line on vertical surface at this height. Draw a second line parallel with and three inches below the first line.

(*c*) Locate point at which projected centerline of vehicle intersects these lines. Measure distance between head light centers; then divide this distance equally on both sides of center mark. Draw a verical line through each of these ponts (fig. 81).

(*d*) Unlatch head light grille door at top and swing door down. Remove three screws attaching head light door (rim) to head light body and remove door.

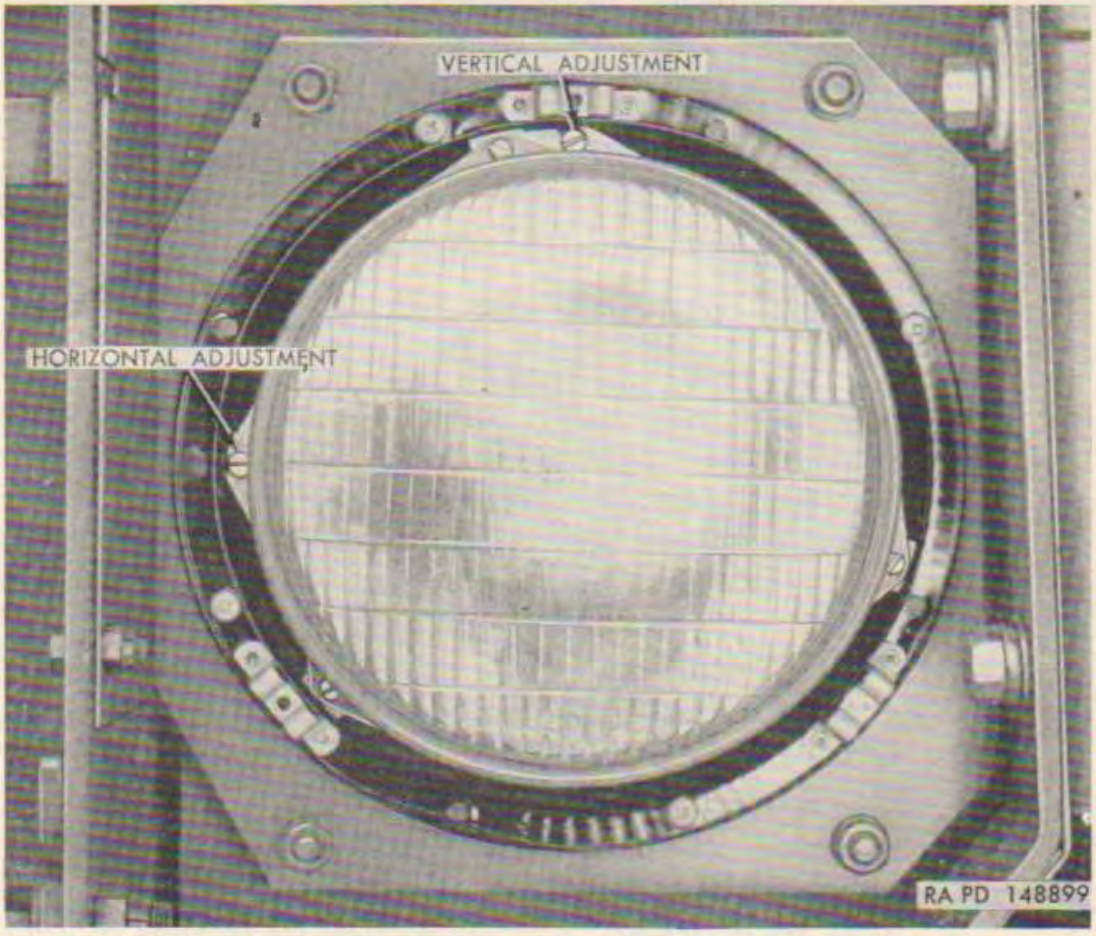


Figure 82. Head light beam adjusting screws.

Turn head lights on (par. 42) and select high beam with dimmer switch.

(*e*) Cover one head light while adjusting the other. Aim light beam with two adjusting screws (fig. 82). Top screw provides vertical adjustment and side screw provides horizontal adjustment. Turn adjusting screws as necessary to obtain a beam pattern as near as possible to that shown in figure 83.

(*f*) Install head light door (rim) and attach to body with three screws. Close head light grille door. Cover head light on which adjustment is completed while adjusting the other head light.

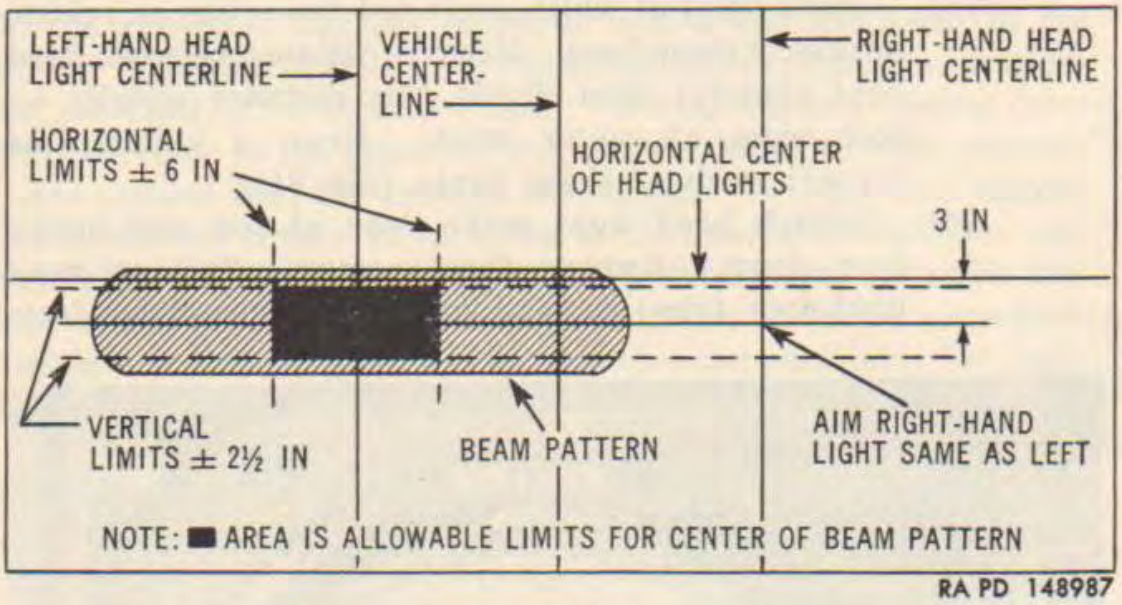


Figure 83. Head light beam pattern.

b. Sealed-beam Lamp Unit Replacement.

(1) *Removal* (fig. 84).

(*a*) Unlatch head light grille door at top and swing door down. Remove three screws attaching head light door (rim) to head light body and remove door.

(*b*) Remove three screws attaching sealed-beam lamp unit retaining ring to head light body and remove ring.

(*c*) Pull sealed-beam lamp unit from body, disengage connectors from clips in body, and disconnect cables at bayonet type connectors.

(2) *Installation* (fig. 84).

(*a*) Connect cables on new sealed-beam lamp unit to cables in light body, making sure numbers on cable tags are matched. Engage connectors in clips in light body.

(*b*) Position sealed-beam lamp unit in light body, install retaining ring, and attach with three screws.

(*c*) Adjust head light beam (*a* above); then install head light door (rim) and attach with three screws. Close head light grille door.

c. HEAD LIGHT ASSEMBLY REPLACEMENT.

(1) *Removal.*

(*a*) Disconnect two head light cables (Nos. 17 and 18) at bayonet type connectors (fig. 85). Remove front

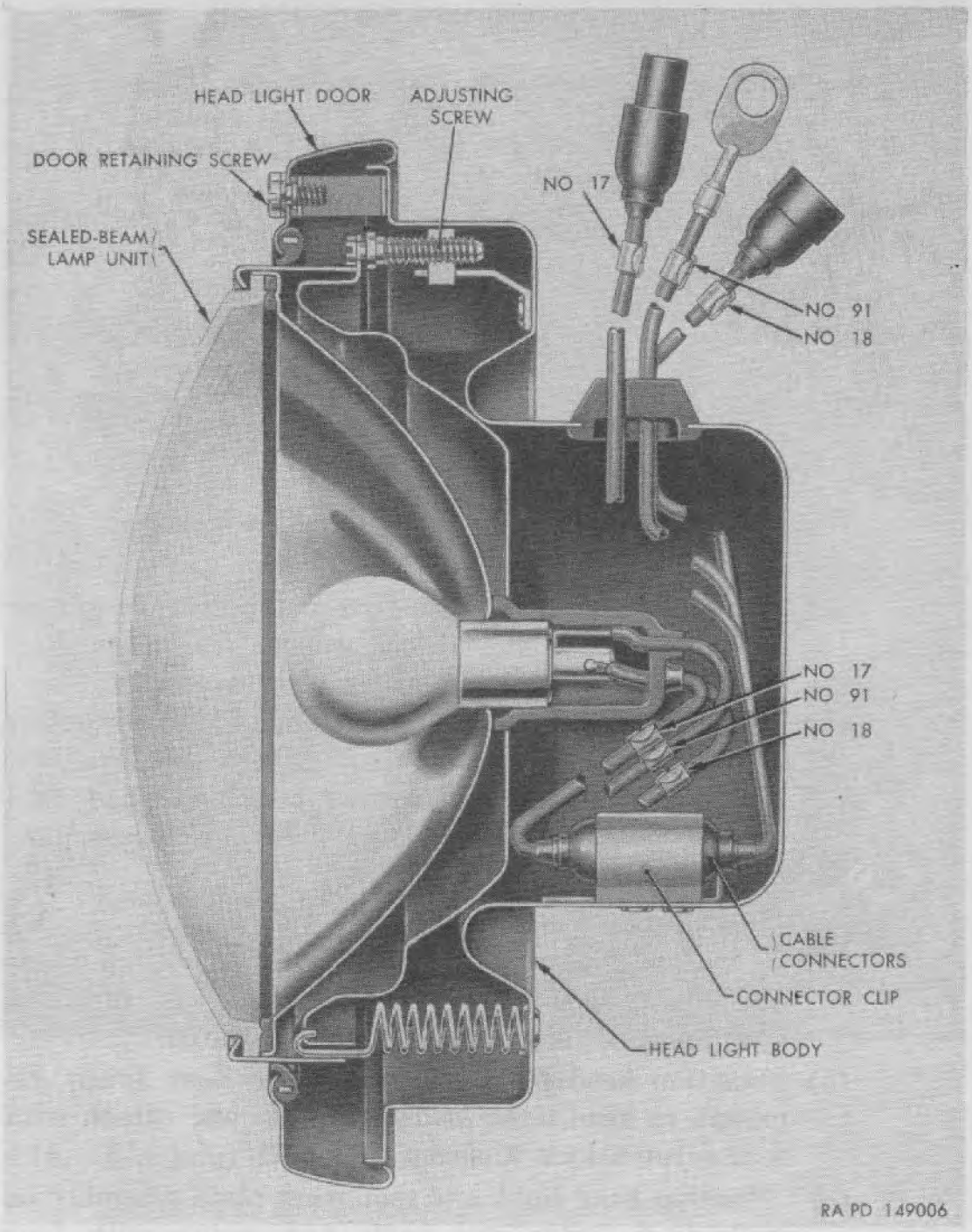


Figure 84. Sectional view of head light.

marker light mounting cap screw and lock washer attaching head light ground cable (No. 91) to radiator side baffle. Disengage ground cable from clip on radiator side baffle.

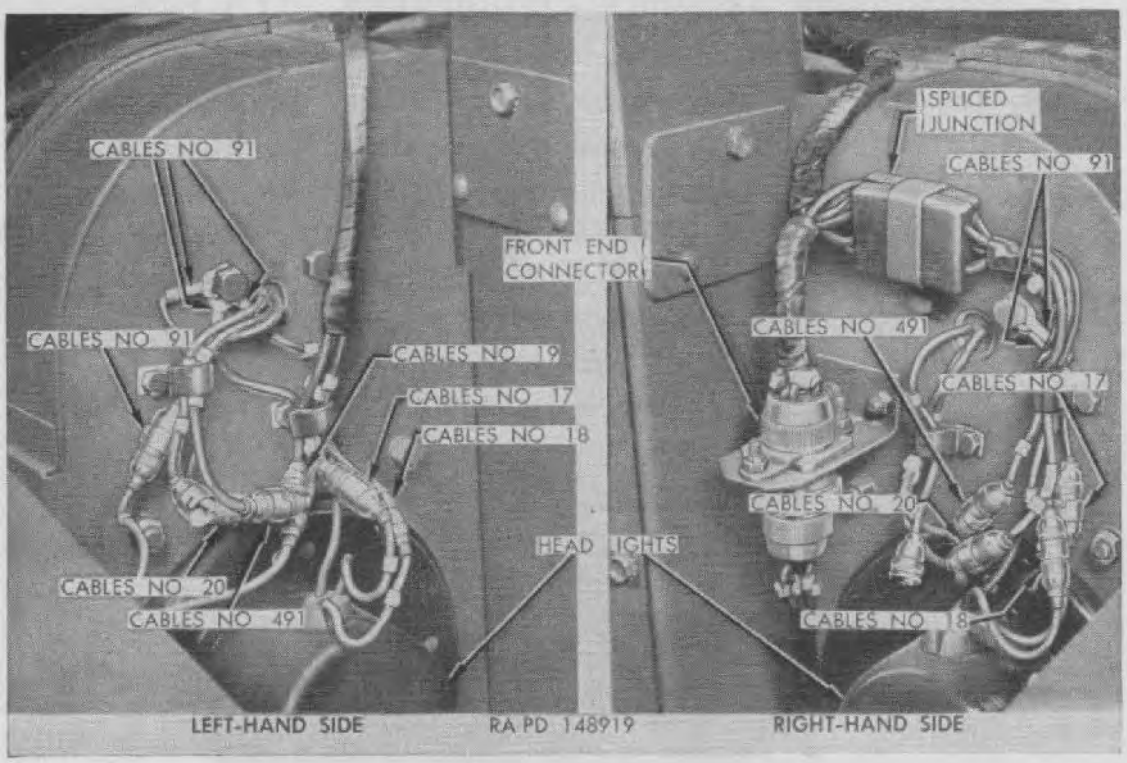


Figure 85. Head light and marker light wiring connections.

(*b*) Unlatch head light grille door at top and swing door down. Remove nut and lock washer from four studs securing head light mounting plate assembly.

(*c*) Remove three screws attaching head light door (rim) to head light body and remove door. Remove four nuts, lock washers, and screws attaching head light body to mounting plate. Remove head light assembly from mounting plate.

(2) *Installation.*

(*a*) Examine insulators on head light mounting studs in radiator side baffle. Replace stud and insulator assemblies if insulators are deteriorated.

(*b*) Position head light assembly, with door (rim) removed, in head light mounting plate and attach with four screws, lock washers, and nuts.

(*c*) Position head light and mounting plate assembly on studs in radiator side baffle and secure with four nuts and lock washers (fig. 86).

(*d*) Attach head light ground cable (No. 91) under head of front marker light mounting cap screw, using toothed lock washer under cap screw head (fig. 85). Connect the other two headlight cables (Nos. 17 and 18) to harness cables having same numbers. Secure cables in clip on radiator side baffle.

(*e*) Adjust head light beam (*a* above); then install head light door (rim) and attach with three screws. Close head light grille door.

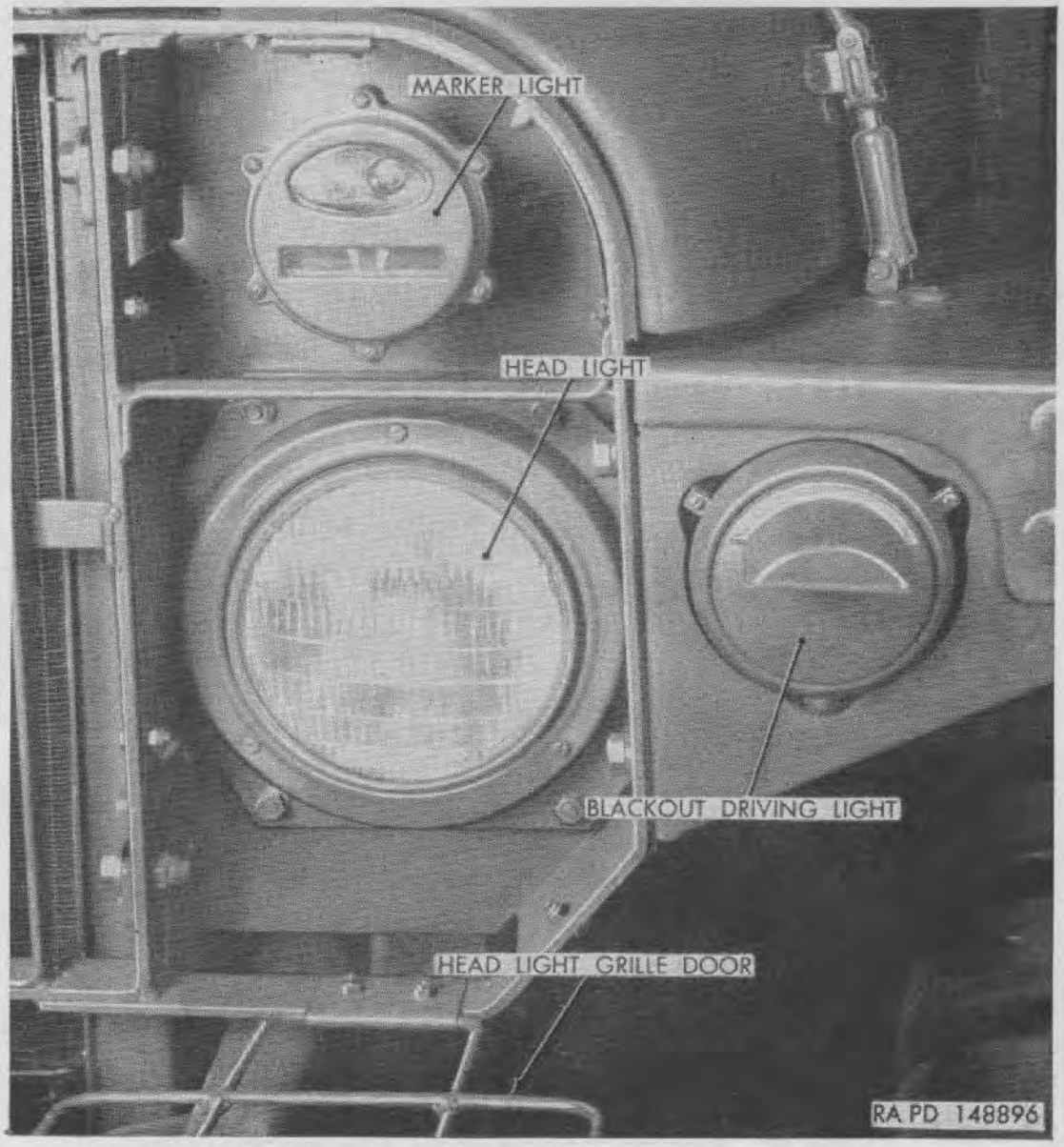


Figure 86. Front lights installed (left side shown).

144. Blackout Driving Light

a. SEALED-BEAM LAMP UNIT REPLACEMENT.

(1) *Removal* (fig. 87). Unscrew three screws attaching door to light body and remove door. Pull sealed-beam

unit out of body, disengage connectors from clips in body, and disconnect cables at connectors.

(2) *Installation* (fig. 87). Connect cables on new sealed-beam unit to cables in body, making sure numbers on cables are matched. Engage connectors in clips in body. Position sealed-beam unit in body, install door, and attach with three screws.

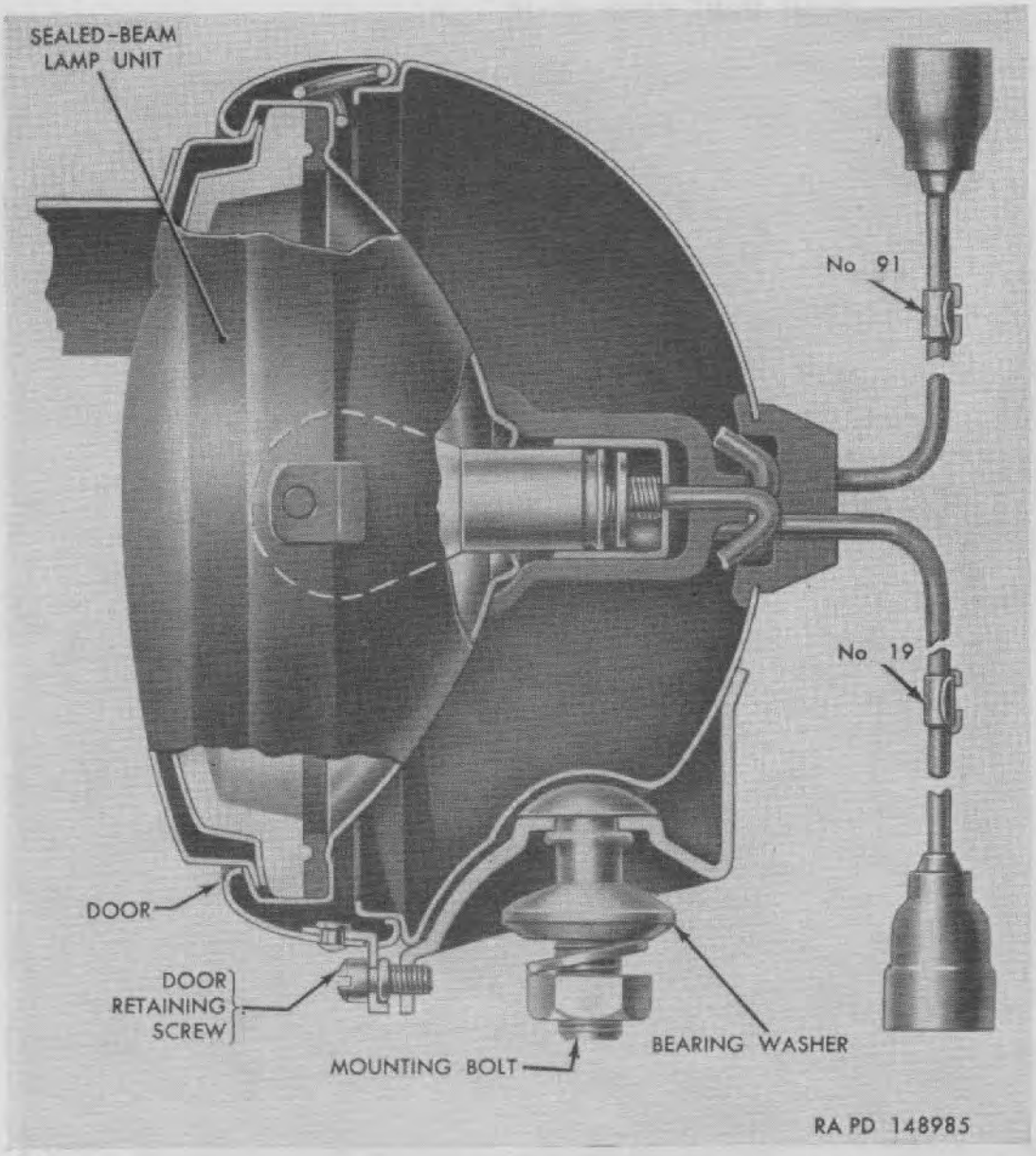


Figure 87. Sectional view of blackout driving light.

b. LIGHT ASSEMBLY REPLACEMENT.

(1) *Removal.*

(*a*) Disconnect light cables from harness cables at rear of left-hand radiator side baffle (cable Nos. 91 and 19, fig. 85). Remove grommet from fender skirt,

pull cables through hole in skirt, and disengage cables from clip on skirt.

(*b*) Remove nut, lock washer, and bearing washer from light mounting bolt under fender. Remove light assembly from fender socket.

(2) *Installation.*

(*a*) Insert light cables through hole in light socket and position light assembly in socket with mounting bolt through bottom hole in socket. Install bearing washer, lock washer, and nut on bolt. Hold light with beam visor horizontal and pointing straight ahead while tightening nut.

(*b*) Insert cables through hole in fender skirt, place grommet around cables, and install in hole in skirt. Engage cables in clip on fender skirt.

(*c*) Connect light cables to harness cables at rear of radiator side baffle (fig. 85), making sure numbers on cables are matched.

145. Front Marker Lights

a. Door and lamp replacement (fig. 88).

(1) Removal. Unscrew six door retaining screws; then remove door and lens assembly and door sealing gasket. Press lamp in and turn counterclockwise to remove from socket.

(2) *Installation.* Press new lamp into socket and turn clockwise to lock in place. Examine door sealing gasket. If not in good condition, place new gasket in groove in door. Install door and lens assembly and attach with six screws.

b. Marker Light Assembly Replacement.

(1) *Removal.*

(*a*) Disengage marker light cables from clip on back of radiator side baffle; then disconnect cables from harness at bayonet connectors (fig. 85).

(*b*) Remove two cap screws and lock washers attaching light assembly to radiator side baffle. Note that ground cables (both sides) and harness junction clip (right side) are secured under cap screw heads.

(2) *Installation.*

(*a*) Insert light cables through hole in radiator side baffle and position light assembly against baffle. At-

tach light assembly to baffle with two cap screws and toothed lock washers, making sure ground cables (both sides) and harness junction clip (right side) are secured under cap screw heads.

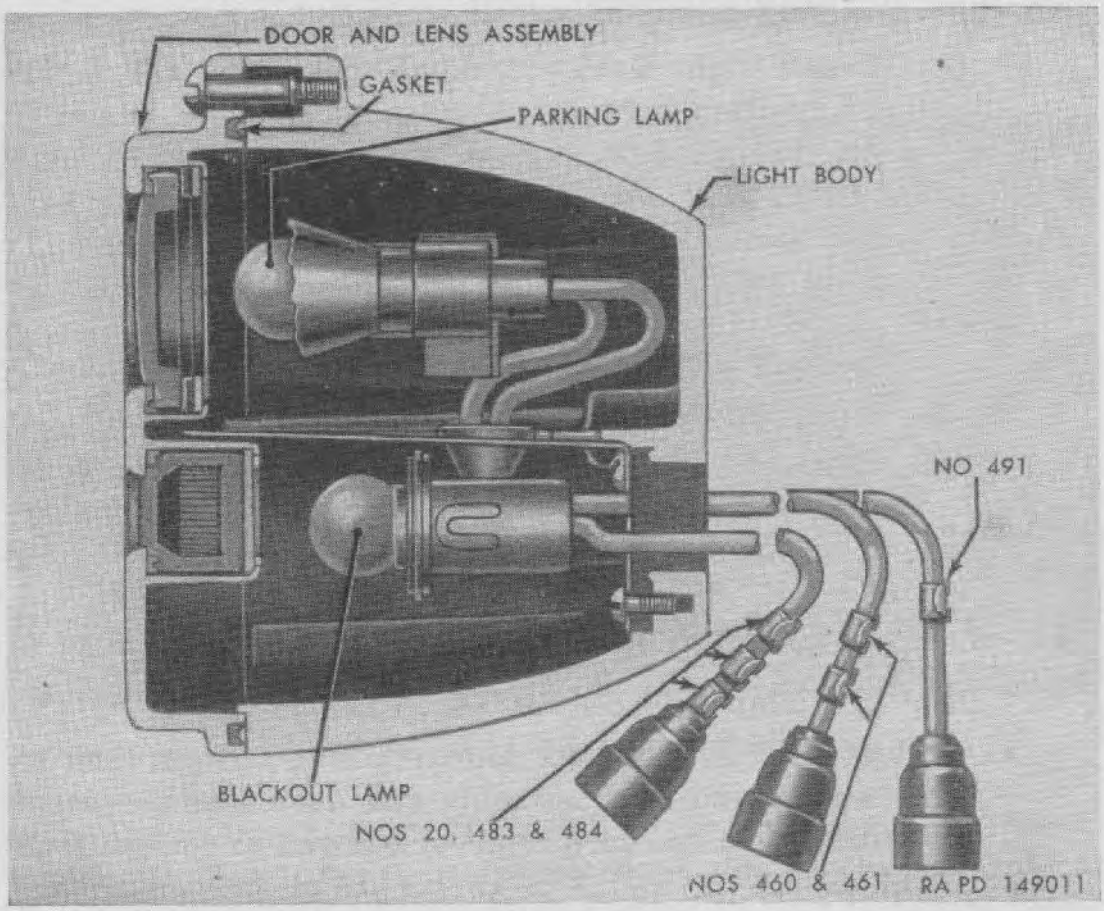


Figure 88. Sectional view of front marker light.

(*b*) Connect cable having three tags (Nos. 20, 483, and 484) (fig. 88) to harness cable No. 20 (fig. 85). Connect cable having one tag (No. 491) to harness cable No. 491. Other cable (Nos. 460 and 461) is not used. Secure cables in clip on back of radiator side baffle.

146. Stop and Tail Light

a. Door and Lamp Replacement (fig. 89). Door and lamp replacement is same as described for front marker lights (par. 145*a*).

b. Stop and Tail Light Assembly Replacement.

(1) *Removal.* Disengage light cables from clip. Disconnect light cables from harness at bayonet type connectors. Remove two cap screws and lock washers attach-

ing light assembly to bracket. Note that cable and harness clips are secured under cap screw heads.

(2) *Installation.* Insert cables through hole in bracket, position light assembly against bracket, and attach with two cap screws and toothed lock washers. Make sure cable and harness clips are installed under each cap screw head. Connect light cables to harness, making sure cable numbers are matched. There are three light cables on left-hand light and two on right-hand lamp.

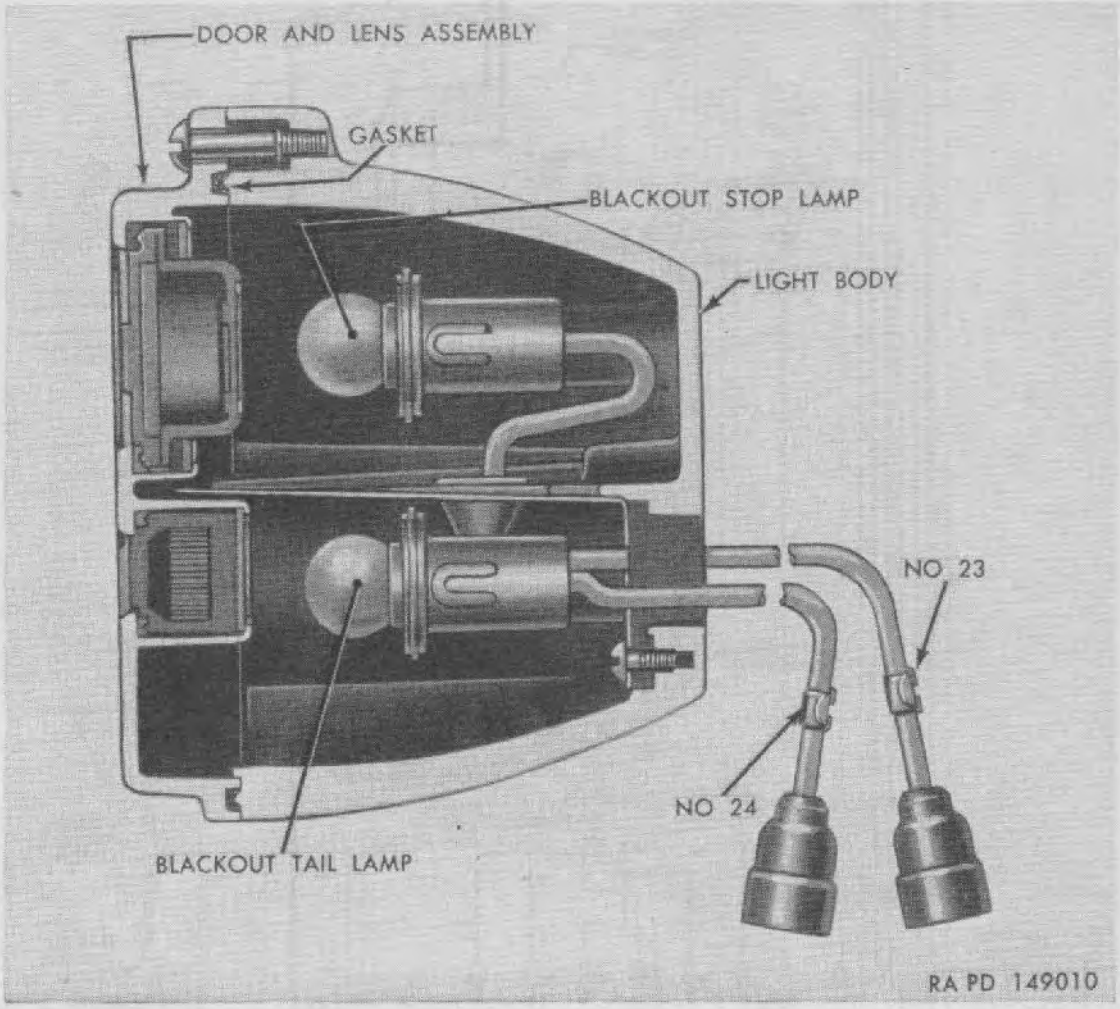


Figure 89. Sectional view of blackout stop and tail light.

147. Instrument Panel Lamps

a. REMOVAL. Remove four bolts attaching instrument cluster (fig. 91) to instrument panel and tip cluster down. To remove either of the three lamps, press back shell in and turn counterclockwise to release from body. With backshell removed, lamp is exposed. Press lamp in and turn counterclockwise to release from socket.

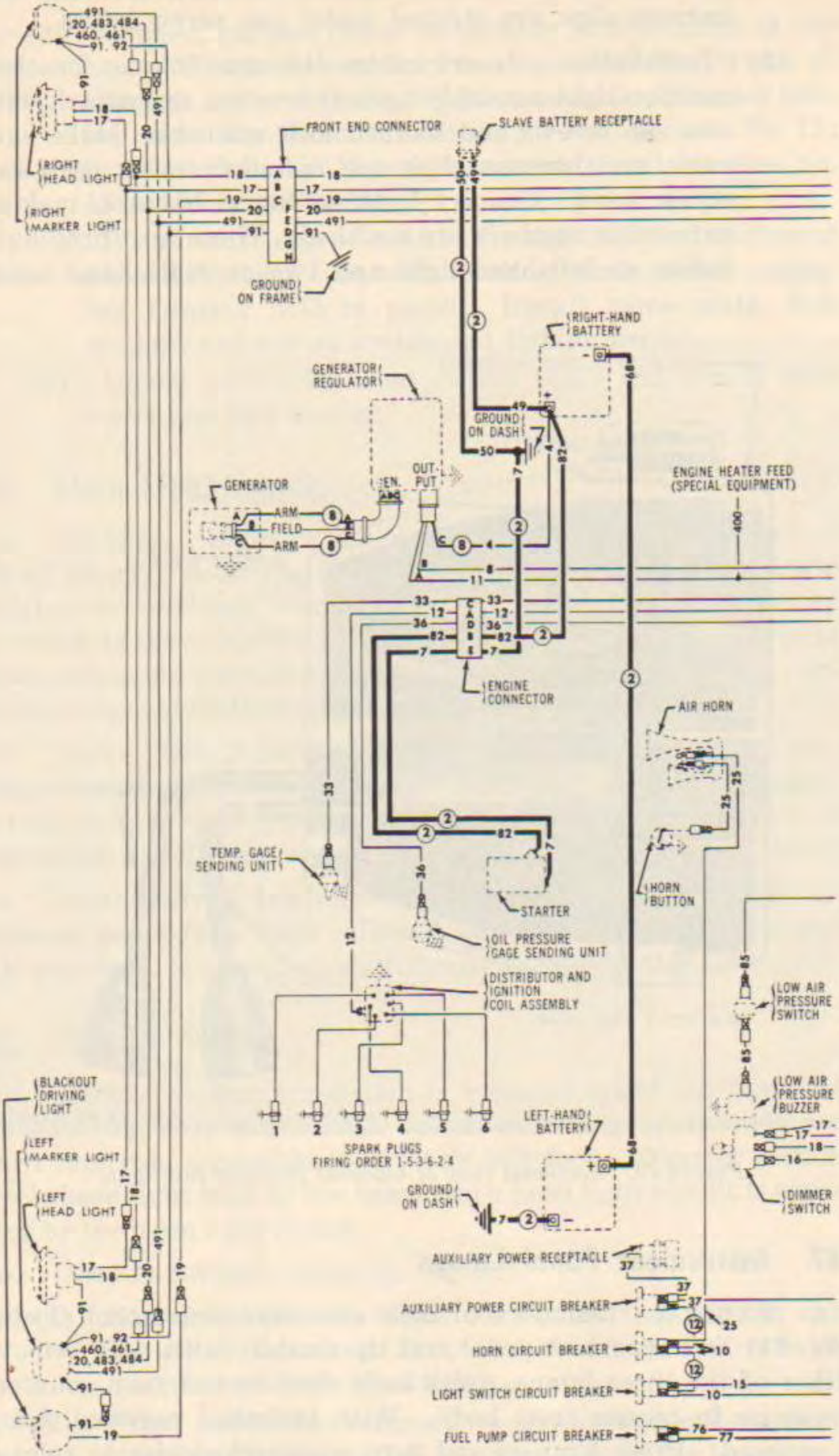


Figure 90. Wiring circuit diagram.

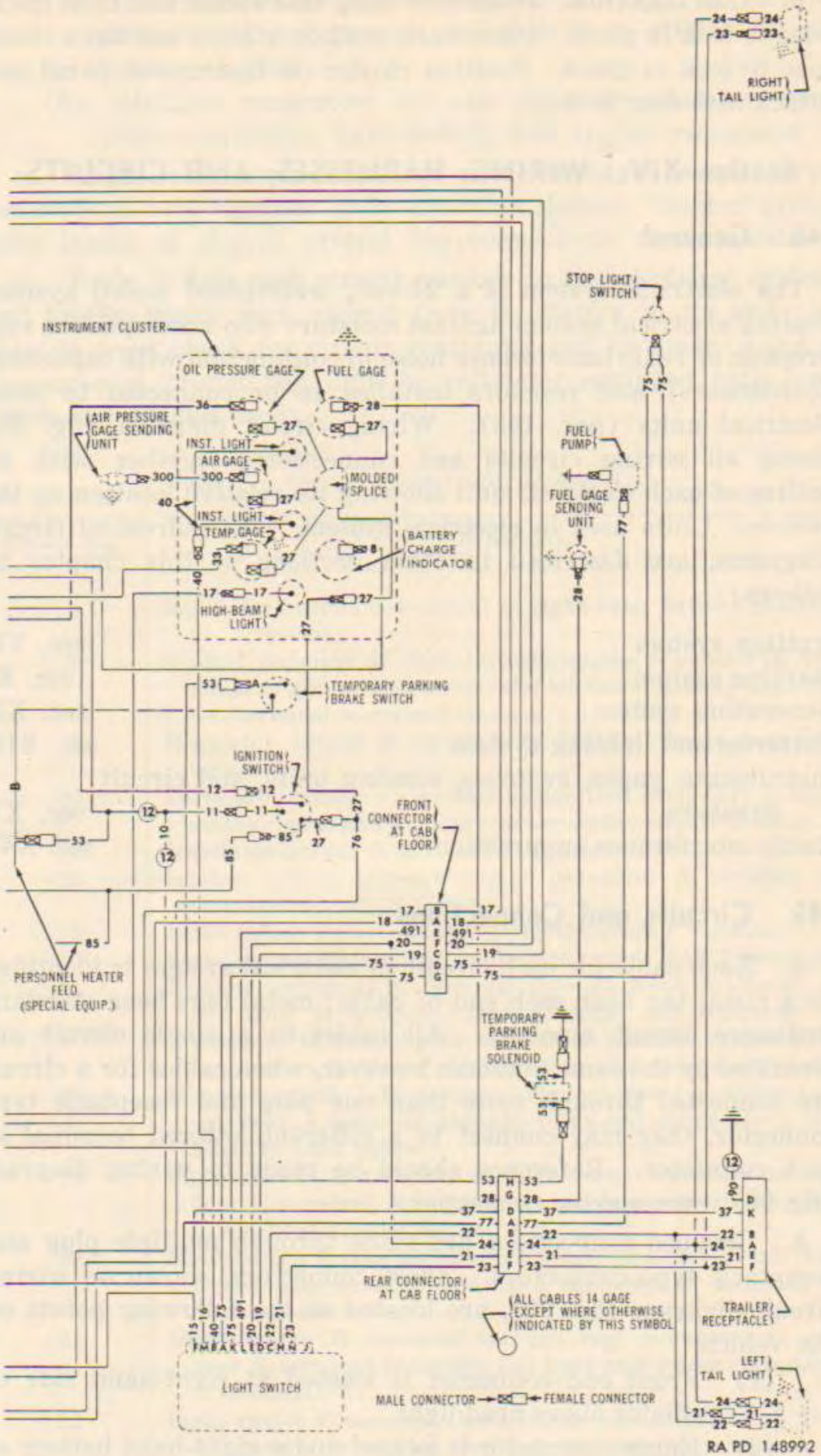


Figure 90—Continued.

b. INSTALLATION. Press new lamp into socket and turn clockwise to lock in place. Place back shell over body and turn clockwise to lock in place. Position cluster on instrument panel and attach with four bolts.

Section XIV. WIRING, HARNESSES, AND CIRCUITS

148. General

The electrical system is a 24-volt, waterproof sealed system. Sealing electrical system against moisture also accomplishes suppression of radio interference noise in conjunction with capacitors (condensers) and resistors installed in or connected to some electrical units (par. 168). Wiring circuit diagram (fig. 90) shows all wiring circuits and connections, together with an outline of each electrical unit showing its relative location on the vehicle. Units used in electrical system, with individual circuit diagrams, are described in other sections of this chapter as follows:

149. Circuits and Connections

a. Each cable for each circuit in electrical system is identified by a metal tag near each end of cable; metal tags bear standard Ordnance circuit numbers. All cables in a single circuit are identified by the same number; however, when cables for a circuit are connected through more than one plug and receptacle type connector, they may connect to a different lettered terminal at each connector. Reference should be made to wiring diagram (fig. 90) when making connections.

b. Grouped connections are made through multiple plug and receptacle type connectors. These connectors, shown on wiring circuit diagram (fig. 90), are located at the following points on the vehicle:

(1) Front end connector is located at right-hand side of radiator above head light.

(2) Engine connector is located under right-hand battery at side of generator-regulator.

(3) Two connectors are located in cab floor at left of driver's seat; disconnect is made from outside of cab below cab floor.

(4) Multiple connectors are also used at generator, generator-regulator, light switch, and trailer receptacle.

c. Single cable connections are made through bayonet type connections, held together by interlocking sleeves. Rubber grommets inside of sleeves protect the connections from moisture.

d. Table V lists each circuit number in the electrical system and briefly traces each circuit from its source to its end. A point-to-point check for circuit continuity can be made, using a conventional 24-volt test light or voltmeter equipped with long cables and suitable prods.

Table V. Circuit Numbers and Descriptions

Circuit No.	Circuit description
4	Regulator output C terminal to right-hand battery positive (+) terminal.
7	Ground terminal at dash through engine connector E terminal to ground on starter; also left-hand battery negative (−) terminal to ground on dash.
8	Regulator output B terminal to battery charge indicator terminal.
10	From tap junction on ignition switch feed cable (11) to light switch, horn, and auxiliary power outlet circuit breaker.
11	Regulator output A terminal to ignition switch.
12	Ignition switch through engine connector A terminal to distributor.
15	Light switch circuit breaker to light switch F terminal.
16	Light switch M terminal to dimmer switch BATT terminal.
17	Dimmer switch H.B. terminal through front connector at cab floor B terminal, through front end connector B terminal to head lights; also from dimmer switch H.B. terminal to Hi-Beam indicator lamp on instrument panel.
18	Dimmer switch L.B. terminal through front connector at cab floor A terminal, through front end connector A terminal to head lights.
19	Light switch D terminal through front connector at cab floor C terminal, through front end connector C terminal to blackout driving light.
20	Light switch E terminal through front connector at cab floor F terminal, through front end connector F terminal to front marker lights.
21	Light switch H terminal through rear connector at cab floor E terminal to service tail light and trailer receptacle E terminal.
22	Light switch C terminal through rear connector at cab floor B terminal to service stop light and trailer receptacle B terminal.

Table V—Continued

Circuit No.	Circuit description
23	Light switch N terminal through rear connector at cab floor F terminal to right blackout tail light and trailer receptacle F terminal.
24	From tap junction in front marker light feed cable (20) near front connector at cab floor through rear connector at cab floor C terminal to blackout tail lights and trailer receptacle A terminal.
25	Horn circuit breaker through horn solenoid valve to horn button.
27	Ignition switch through molded splice to all gages.
28	Fuel gage through rear connector at cab floor G terminal to fuel gage sending unit.
33	Temperature gage through engine connector C terminal to temperature gage sending unit.
36	Oil pressure gage through engine connector D terminal to oil pressure gage sending unit.
37	Auxiliary power circuit breaker to auxiliary power outlet and auxiliary power circuit breaker through rear connector at cab floor D terminal to trailer receptacle K terminal.
40	Light switch B terminal to instrument panel lights.
49	Right battery positive (+) terminal to slave battery receptacle positive (+) terminal.
50	Slave battery receptacle negative (−) terminal to ground on dash.
53	From junction in ignition switch feed (No. 11) to temporary parking brake switch; from temporary parking brake switch through rear connector at cab floor H terminal to temporary parking brake solenoid.
68	Right-hand battery negative (−) terminal to left-hand battery positive (+) terminal.
75	Light switch A terminal through front connector at cab floor D terminal to stop light switch, then back through front connector at cab floor G terminal to light switch K terminal.
76	From tap junction on cable No. 27 near ignition switch to fuel pump circuit breaker.
77	Fuel pump circuit breaker through rear connector at cab floor A terminal to fuel pump in fuel tank.
82	Right-hand battery positive (+) terminal through engine connector B terminal to starter switch.
85	Ignition switch through low air pressure switch to low air pressure buzzer.
90	Trailer receptacle D terminal to ground.
91	From all front end lights through front end connector D terminal to ground on frame.
300	Air pressure gage to air gage sending unit.
460 and 461	Front marker light signal lamps—Not used on these vehicles.
491	Light switch L terminal through front connector at cab floor E terminal, through front end connector E terminal to front marker lights.

e. Terminals at plug and receptacle type connectors are identified by letters which appear on both halves of the connector. Table VI which follows lists the lettered terminals at each connector, the circuit number of the cable connected at each terminal, and the name of the circuit carried through each terminal.

Table VI. Connector Tabulation

Plug and receptacle letter	Cable number	Circuit
(1) *Front end connector.*		
A	18	Head light low beam
B	17	Head light high beam
C	19	Blackout driving light
D	91	Ground on frame for all front end lights
E	491	Front parking lights
F	20	Front blackout marker lights
G and H	. . .	Open
(2) *Engine connector.*		
A	12	Distributor feed
B	82	Starter
C	33	Engine temperature gage
D	36	Oil pressure gage
E	7	Dash to starter ground
(3) *Front connector at cab floor.*		
A	18	Head light low beam
B	17	Head light high beam
C	19	Blackout driving light
D	75	Stop light switch feed
E	491	Front parking lights
F	20	Front blackout marker lights
G	75	Stop light switch return
H	. . .	Open
(4) *Rear connector at cab floor.*		
A	77	Fuel pump
B	22	Service stop light
C	24	Blackout tail light
D	37	Auxiliary power
E	21	Service tail light
F	23	Blackout stop light
G	28	Fuel gage
H	12	Temporary parking brake

Table VI—Continued

Connector Tabulation

Plug and receptacle letter	Cable number	Circuit
(5) *Light switch.*		
A	75	Stop light switch feed
B	40	Instrument lights
C	22	Service stop light
D	19	Blackout driving light
E	20	Front blackout marker lights
F	15	Light switch feed
H	21	Service tail light
J	. . .	Open
K	75	Stop light switch return
L	491	Front parking lights
M	16	Dimmer switch
N	23	Blackout stop light
(6) *Regulator output.*		
A	11	Ignition switch feed
B	8	Battery charge indicator
C	4	Regulator to battery

150. Wiring and Harnesses

a. WIRING. All cables are covered with rubber insulation and cable ends are soldered to their connecting plug or receptacle. All cables are 14 gage unless otherwise noted on wiring circuit diagram (fig. 90). Numeral within circle indicates gage size of cable. When replacing any cable, always use 14 gage unless otherwise indicated on wiring circuit diagram. Never replace a cable with one of a smaller size. Cable ends must be soldered to their connecting plug or receptacle, using rosin flux solder. Never use acid flux solder on electrical connections.

b. HARNESS.

(1) When a group of cables lead from one general location on the vehicle to another, these cables are grouped together to form a harness. Harnesses are wound with waterproof electrical tape. Ends of harnesses usually terminate at multiple plug and receptacle type connectors; however, one or more cables may branch out from various points on a harness.

(2) Any harness is readily replaceable by disconnecting each end and single cables leading from the harness, and disengaging harness from clips securing the harness at

various points on the vehicle. On multiple connectors, make sure locating key and keyway are alined before attempting to insert plug. Do not force plug into receptacle. If properly alined, plug will enter receptacle under light pressure. Make sure rubber sealing gasket or ring is in place before tightening connector nuts.

(3) Following is a list of harnesses used on these vehicles, together with a brief description of their location on the vehicle.

(*a*) *Head light wiring harness.* This harness leads from front end connector at right side of radiator through a spliced junction, with cables leading to right front lights and across top of radiator to left front lights.

(*b*) *Engine wiring harness.* Engine harness carries cables from engine connector (at side of generator-regulator) to starter, distributor, and temperature and oil pressure gage sending units.

(*c*) *Instrument panel-to-regulator-and-engine-connector wiring harness.* This harness, having single cable bayonet type connectors connected to various units under instrument panel, terminates at two multiple plug and receptacle type connectors, one connecting to generator-regulator output connector, the other connecting to engine connector at side of regulator.

(*d*) *Instrument panel-to-cab-floor wiring harness.* This harness leads from light switch to two connectors at cab floor at left of driver's seat.

(*e*) *Cab-to-head-light wiring harness.* This harness carries cables from front connector at cab floor, under back of cab to right-hand frame side rail, then forward inside of frame side rail to front end connector at right side of radiator.

(*f*) *Chassis wiring harness.* This harness leads from rear connector at cab floor rearward inside of frame left side rail. Near rear end of vehicle, it is divided at a spliced junction, with one group of cables leading to right stop and tail light, and one group leading to left stop and tail light and to trailer receptacle.

151. Auxiliary Power Outlet

Auxiliary power outlet (fig. 95) is an electrical receptacle mounted on steering column brace in cab. Circuit to auxiliary power receptacle in cab and to auxiliary power terminal (K) at trailer receptacle is fed from hot terminal on ignition switch

through a 15 amp circuit breaker which is also mounted on steering column brace in cab. When not in use, a sealing cap is screwed onto receptacle. Cap is secured to dash by a ball-type chain.

Section XV. INSTRUMENTS, GAGES, SWITCHES, SENDING UNITS, AND CIRCUIT BREAKERS

152. General

a. INSTRUMENT CLUSTER. The instrument cluster, located in center of instrument panel, contains the voltmeter, engine temperature gage, oil pressure gage, fuel gage, air pressure gage, and speedometer. Instrument lights and high-beam indicator light are mounted on back of instrument cluster (fig. 91). Instrument cluster may be replaced as a complete unit (par. 153), or each unit may be replaced separately as described in individual paragraphs.

b. GAGES AND SENDING UNITS. All gages except the speedometer are electrically operated, and are activated only when the ignition switch is turned on. Circuits to all gages are fed through the ignition switch; circuits are grounded at the sending units which control the gage actions. Sending units are actually rheostat type resistance units which automatically increase or decrease resistance in gage circuits according to the condition existing in the system controlling each circuit. Gage and sending unit replacement procedures are described in individual paragraphs.

c. SWITCHES. Ignition switch, light switch, dimmer switch, and horn switch (button) are manually operated. Stop light switch is automatically controlled by the hydraulic brake system, and low air pressure switch is automatically controlled by air pressure in the air system.

d. CIRCUIT BREAKERS. Four automatic reset type circuit breakers are used in the electrical system, protecting the fuel pump, light, horn, and auxiliary power circuits. Circuit breakers are mounted on under side of steering column brace (fig. 95). Connections at all circuit breakers are made through bayonet type connectors.

153. Instrument Cluster

a. INSTRUMENT CLUSTER REMOVAL (fig. 91).

(1) Disconnect speedometer flexible shaft from speedometer at rear of instrument cluster.

(2) Remove four bolts attaching instrument cluster to instrument panel. Tip cluster out from instrument panel, disengaging harness from clip at right side of cluster.

(3) Replacement of individual units in instrument cluster can be made with cluster in this position. To remove complete cluster assembly, disconnect all harness cables from units on cluster.

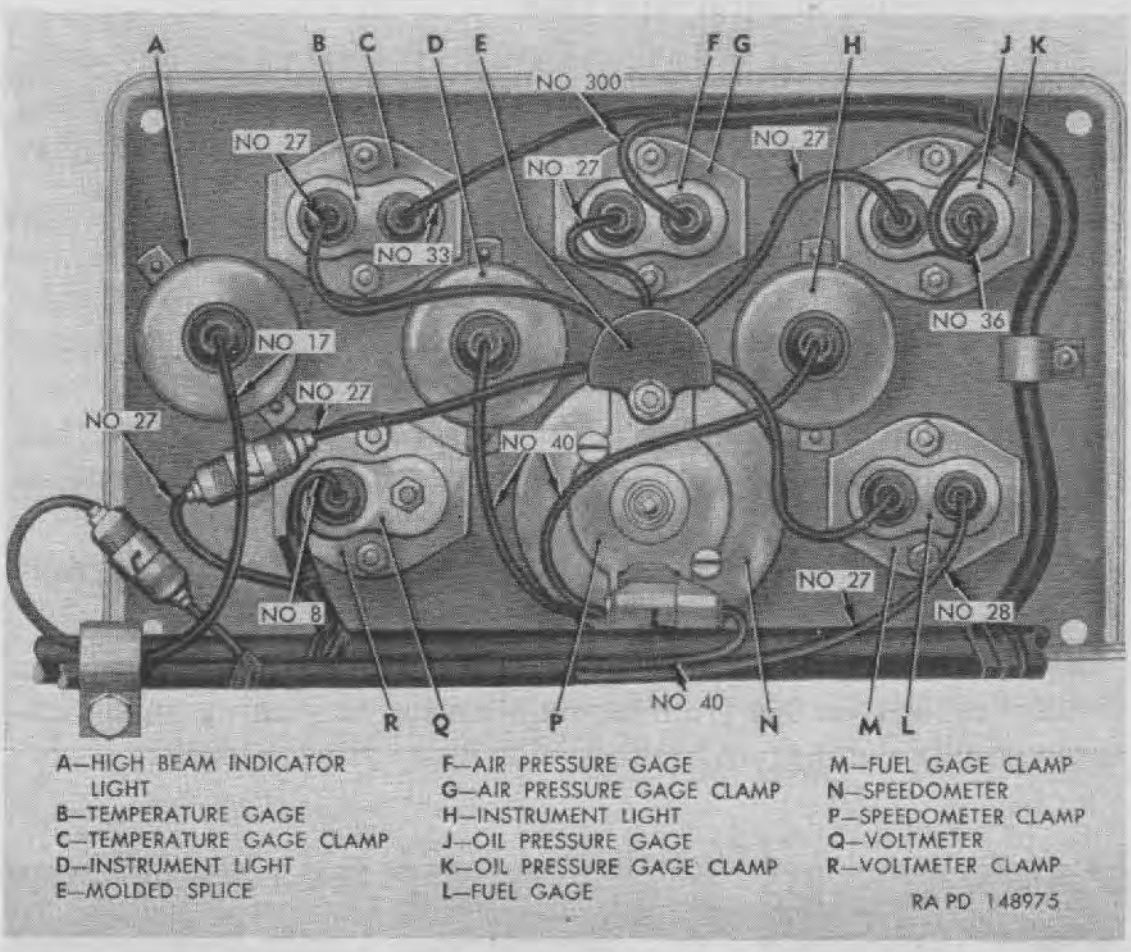


Figure 91. Instrument cluster—rear view.

b. INSTRUMENT CLUSTER INSTALLATION (fig. 91).

(1) If instrument cluster assembly was completely removed, position cluster at instrument panel and connect harness cables to instrument cluster units. Refer to figure 91 or to wiring diagram (fig. 90) to identify number on each cable and unit to which it connects.

(2) Engage harness in clip at right-hand end of instrument cluster, position cluster against instrument panel, and attach with four bolts.

(3) Connect speedometer flexible shaft to speedometer at rear of cluster.

154. Oil Pressure Gage and Sending Unit

e. GENERAL. Oil pressure gage registers oil pressure in engine main oil gallery. Gage circuit is controlled by a sending-unit

mounted on right-hand side of engine above starter and connected to oil line leading from engine oil gallery to oil filter (fig. 92).

b. OIL PRESSURE GAGE REMOVAL (fig. 91).

(1) Remove instrument cluster from instrument panel as directed in paragraph 153*a*.

(2) Disconnect two cables from oil pressure gage terminals.

(3) Remove nut and lock washer from two studs attaching clamp to back of gage. Remove clamp; then pull gage out front of cluster.

c. OIL PRESSURE GAGE INSTALLATION (fig. 91).

(1) Position gage in instrument cluster from front side. Place clamp over two studs on back of gage, install lock washer and nut on each stud, and tighten nuts.

(2) Connect cable No. 36 to female terminal on gage, and connect cable No. 27 from molded splice to male terminal on gage.

(3) Install instrument cluster as directed in paragraph 153*b*.

d. OIL PRESSURE GAGE SENDING UNIT REMOVAL (fig. 92). Disconnect cable (No. 36) from terminal on top of sending unit. Unscrew sending unit from bracket on engine cylinder block.

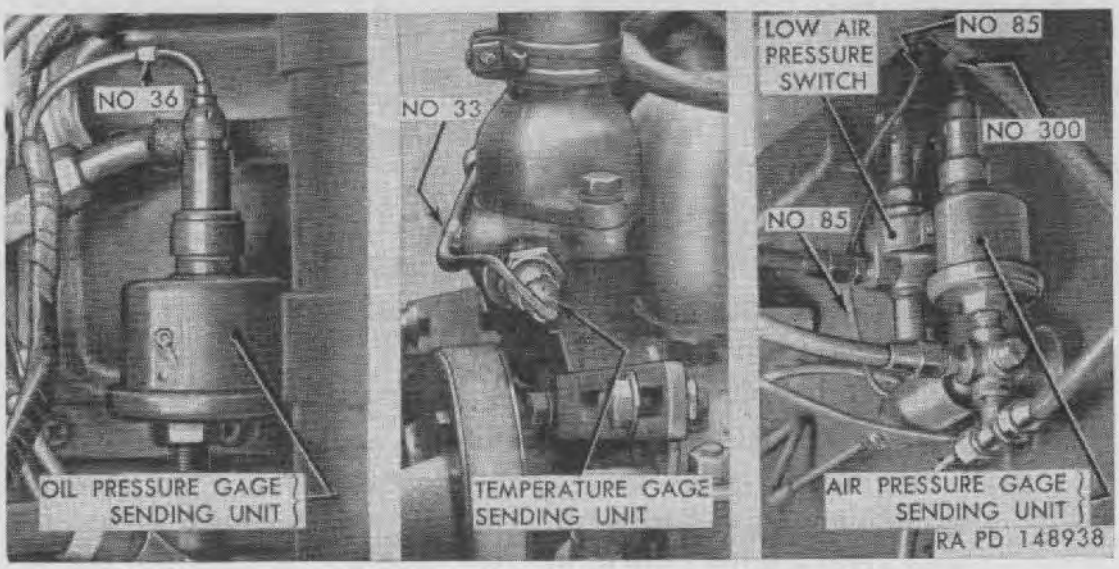


Figure 92. Sending units and low air pressure switch installed.

e. OIL PRESSURE GAGE SENDING UNIT INSTALLATION (fig. 92). Coat threads of sending unit with plastic type gasket cement and thread unit into bracket on engine cylinder block. Connect cable No. 36 to terminal on top of sending unit.

155. Fuel Gage and Sending Unit

a. GENERAL. Fuel gage in instrument cluster registers level of fuel in fuel tank. Fuel gage circuit is controlled by a sending unit installed in fuel tank. Sending unit action is controlled by a float and linkage mechanism which extends down into tank.

b. FUEL GAGE REPLACEMENT (fig. 91). Fuel gage replacement procedure is same as previously described for oil pressure gage (par. 154). Cable No. 27 from molded splice connects to gage male terminal, and cable No. 28 connects to gage female terminal.

c. FUEL GAGE SENDING UNIT REMOVAL. Disconnect cable from sending unit terminal on top of fuel tank. Remove five screws and gaskets attaching sending unit to tank. Lift complete sending unit and float mechanism out of tank.

d. FUEL GAGE SENDING UNIT INSTALLATION. Coat new gasket with liquid type gasket cement and place gasket on tank. Insert float mechanism into tank and position with sending unit terminal pointing toward frame side rail. Install five screws, with new gaskets, and tighten securely. Connect cable No. 28 to sending unit terminal.

156. Temperature Gage and Sending Unit

a. GENERAL. Temperature gage in instrument cluster registers temperature of engine coolant in degrees Fahrenheit. Temperature gage circuit is controlled by a temperature-gage sending-unit installed in engine thermostat housing (fig. 92).

b. TEMPERATURE GAGE REPLACEMENT (fig. 91). Temperature gage replacement procedure is same as previously described for oil pressure gage (par. 154). Cable No. 27 from molded splice connects to gage male terminal, and cable No. 33 connects to gage female terminal.

c. TEMPERATURE GAGE SENDING UNIT REMOVAL (fig. 92). Disconnect cable from sending unit terminal. Unscrew sending unit from engine thermostat housing.

d. TEMPERATURE GAGE SENDING UNIT INSTALLATION (fig. 92). Coat threads on sending unit with plastic type gasket cement and thread sending unit into engine thermostat housing. Connect cable No. 33 to sending unit terminal.

157. Air Pressure Gage and Sending Unit

a. GENERAL. Air pressure gage in instrument cluster registers air pressure in air system. Air pressure gage circuit is con-

trolled by a sending unit. Sending unit is mounted on dash inside cab and is connected to air system at air line junction fitting on dash (fig. 92).

b. AIR PRESSURE GAGE REPLACEMENT (fig. 91). Air pressure gage replacement procedure is same as previously described for oil pressure gage (par. 154). Cable No. 27 from molded splice connects to gage male terminal, and cable No. 300 connects to gage female terminal.

c. AIR PRESSURE GAGE SENDING UNIT REMOVAL (fig. 92). Exhaust air pressure from air system. Disconnect cable from sending unit terminal. Unscrew sending unit from air line junction fitting on dash.

d. AIR PRESSURE GAGE SENDING UNIT INSTALLATION (fig. 92). Coat threads of sending unit with plastic type gasket cement and thread unit into top of air line junction fitting on dash. Connect cable No. 300 to sending unit terminal.

158. Battery Charge Indicator

The battery charge indicator installed in instrument cluster, indicates charging activity of generating circuit. Replacement procedure is same as previously described for oil pressure gage (par. 154). Cable No. 8 connects to indicator terminal.

159. Speedometer and Flexible Shaft

a. GENERAL. Speedometer, in top center of instrument cluster, indicates truck speed in miles-per-hour, and records accumulated mileage. The LOW and HIGH RANGE markings around speedometer face are important with regard to driving the vehicle (ch. 2, sec. III). Speedometer is driven by a flexible shaft which is connected to an adapter at the transfer.

b. SPEEDOMETER REMOVAL (fig. 91).

(1) Remove instrument cluster from instrument panel as directed in paragraph 153*a*.

(2) Disengage cable connector from clip on speedometer clamp.

(3) Remove nut and lock washer from two speedometer clamp studs. Remove cable connector clip from one stud and remove molded splice from other stud.

(4) Remove long stud and lock washer securing clamp to speedometer. Remove clamp, then remove speedometer from front of panel.

c. SPEEDOMETER INSTALLATION (fig. 91).

(1) Position speedometer in instrument cluster from front side. Position clamp over speedometer at back of cluster; install long stud and lock washer, and nut and lock washer attaching clamp to speedometer.

(2) Place molded splice on long stud and secure with lock washer and nut. Place cable connector clip on short stud and secure with lock washer and nut. Engage cable connector in clip.

(3) Install instrument cluster in instrument panel as directed in paragraph 153*b*.

d. SPEEDOMETER FLEXIBLE SHAFT REMOVAL.

(1) Disconnect speedometer flexible shaft from speedometer and from speedometer adapter at transfer.

(2) Remove three flexible shaft clips, one at front of dash above engine and two at floor sills under cab. Withdraw shaft through hole in dash and remove from under cab.

e. SPEEDOMETER FLEXIBLE SHAFT INSTALLATION.

(1) The square end of the flexible shaft connects to the speedometer, and tongued end connects to adapter at transfer. Insert square end of flexible shaft through hole in dash and position grommet around shaft in dash.

(2) Connect flexible shaft at speedometer and at adapter on transfer.

(3) Install three flexible shaft clips, one on dash above engine and two on floor sills under cab.

160. Ignition Switch

a. GENERAL. Lever type ignition switch is mounted at extreme left side of instrument panel. With ignition switch turned on, ignition circuit, gage circuits, and fuel pump circuit are energized.

b. IGNITION SWITCH REMOVAL.

(1) Remove screw and lock washer attaching switch lever to switch shaft. Pull lever off shaft.

(2) Remove nut and lock washer from ignition switch; then remove switch from under instrument panel. Ignition switch name plate will come off instrument panel.

(3) Disconnect harness cables No. 10 and 11 from switch cable No. 11; then disconnect other harness cables from switch cables.

c. IGNITION SWITCH INSTALLATION.

(1) Connect harness cables to ignition switch cables as follows: Two-cable connector having cables No. 76 and 27 connects to switch cable No. 27; two-cable connector having cables No. 10 and 11 connects to switch cable No. 11; harness cables No. 12 and 85 connect to switch cables No. 12 and 85 respectively.

(2) Insert shaft end of switch through hole in instrument panel from back side, with locating pin in switch engaging locating hole in panel. Install name plate, lock washer, and nut on switch and tighten firmly.

(3) Install switch lever on switch shaft and attach with screw and lock washer.

161. Main Light Switch

a. GENERAL. Light switch is mounted on instrument panel at left of steering column. Switch is three lever type, with main switch lever, auxiliary lever, and switch locking lever. Operation of switch is described in paragraph 42. Wiring connections at switch are made through a multiple plug and receptacle type connector at back of instrument panel.

b. LIGHT SWITCH REMOVAL. Disconnect wiring harness connector from light switch connector at back of instrument panel. Remove four screws and lock washers attaching light switch to instrument panel, then remove light switch from back of panel.

c. LIGHT SWITCH INSTALLATION. Position light switch in instrument panel from back side and attach with four screws and lock washers. Connect wiring harness to light switch connector.

162. Dimmer Switch

a. GENERAL. Dimmer switch is mounted under toe board at left side (fig. 93), with switch button extending up through toe board into cab, accessible to driver's left foot. Dimmer switch selects head light high or low beam when head light circuit is energized by the main light switch.

b. DIMMER SWITCH REMOVAL (fig. 93).

(1) Disengage the two cable connector from clip on cab floor sill. Disconnect harness cables from switch cable and from terminals at switch.

(2) From inside cab, remove two screws and lock washers attaching dimmer switch to under side of toe board and remove switch.

c. DIMMER SWITCH INSTALLATION (fig. 93).

(1) Position switch under toe board, with switch plunger extending up through toe board. Attach switch to toe board with two screws and lock washers, installed from inside cab.

(2) Connect the two-cable harness connector (cables No. 17) to switch cable connector; engage connector in clip on floor sill. Connect harness cable No. 16 to switch BATT terminal, and connect cable No. 18 to switch low-beam (L) terminal.

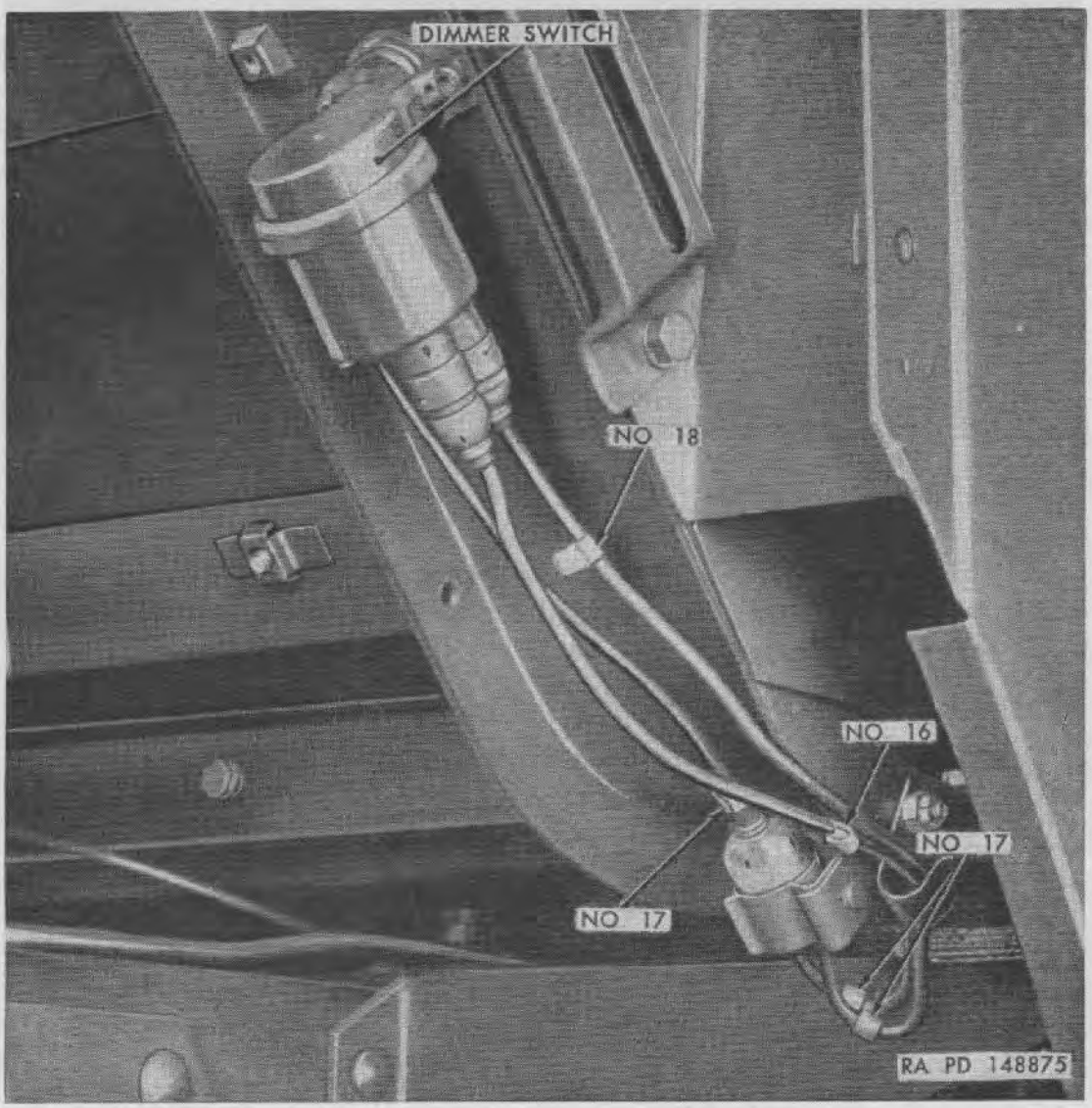


Figure 93. Dimmer switch installed.

163. Stop Light Switch

a. GENERAL. Hydraulically-operated stop light switch is connected into hydraulic brake line at frame right side rail ahead of right air tank (fig. 94). When brakes are applied, hydraulic pres-

sure closes switch contacts, completing circuit to blackout or service stop light, depending upon which circuit is energized through the main light switch (par. 42).

b. STOP LIGHT SWITCH REMOVAL (fig. 94). Disconnect wiring harness connector from stop light switch terminals. Unscrew switch from tee fitting in hydraulic brake line. *Do not apply brakes with stop light switch removed.*

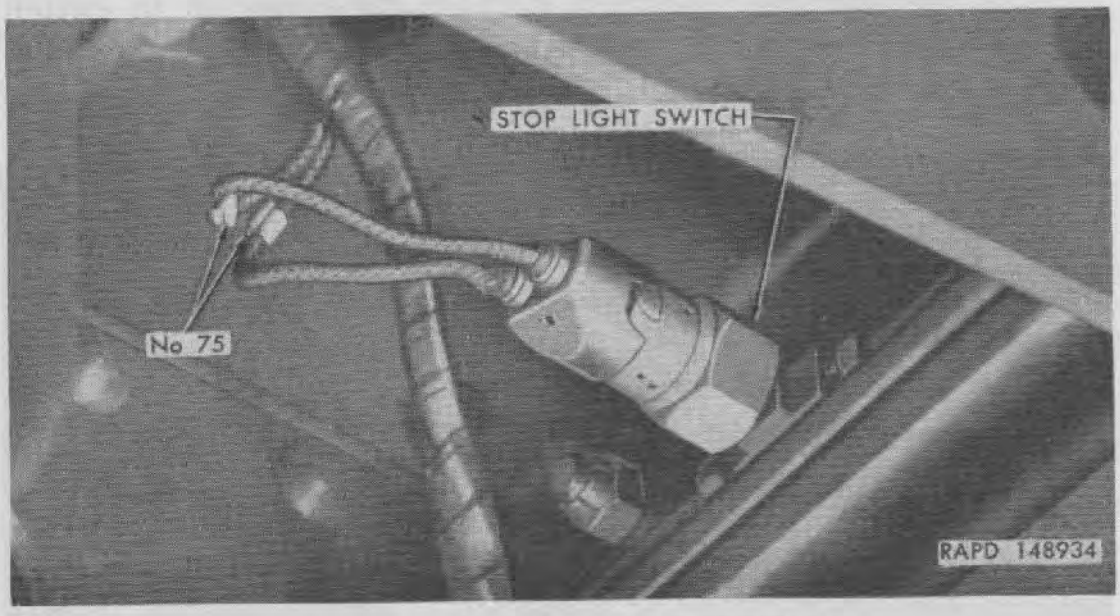


Figure 94. Stop light switch installed.

c. STOP LIGHT SWITCH INSTALLATION (fig. 94). Thread switch into tee fitting in hydraulic brake line and tighten firmly. Connect wiring harness connector (cables No. 75) to switch terminals. Bleed brakes (par. 219).

164. Circuit Breakers

a. GENERAL. Four automatic reset type circuit breakers are used in electrical system; protecting the fuel pump, light, horn, and auxiliary power circuits. Circuit breakers are mounted on under side of steering column brace (fig. 95). All connections at circuit breakers are made through bayonet type connectors.

b. CIRCUIT BREAKER REMOVAL (fig. 95). Disconnect wiring harness cable connectors from circuit breaker terminals. Remove two screws, nuts, and lock washers attaching circuit breaker to steering column brace and remove circuit breaker.

c. CIRCUIT BREAKER INSTALLATION (fig. 95). Position circuit breaker on steering column brace and attach with two screws, lock washers, and nuts. Connect wiring harness cables to circuit breaker terminals, referring to figure 95 for identification of cables connecting to each circuit breaker.

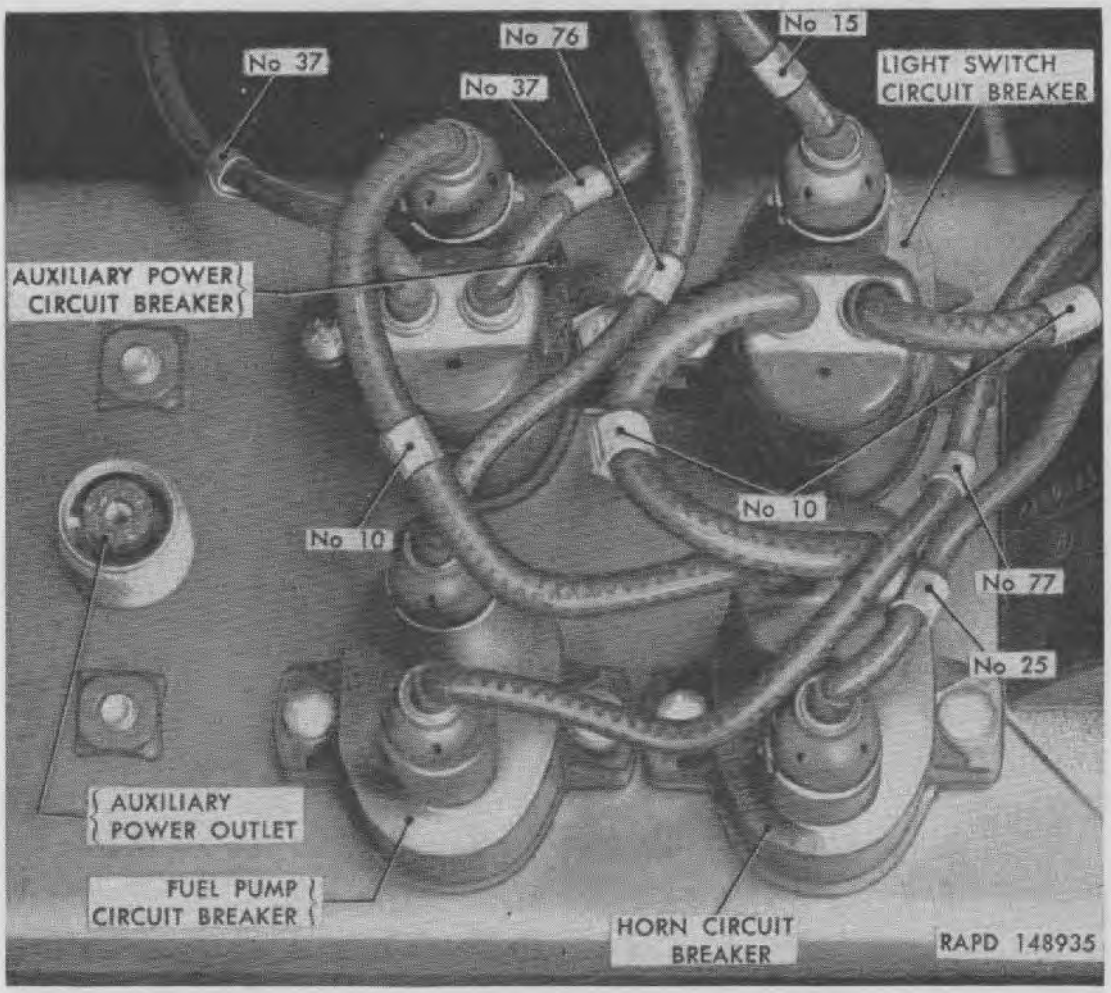


Figure 95. Circuit breakers and auxiliary power outlet installed.

165. Horn and Horn Button

a. GENERAL. Electrically - controlled, air - operated horn is mounted on under side of hood brace above engine (fig. 96). Horn is accessible with hood in raised position (par. 36). Flexible air line from junction fitting at engine side of dash connects to air inlet at horn operating solenoid. When circuit through solenoid is completed by the horn button in center of steering wheel (fig. 97), solenoid admits air pressure into the vibrating diaphragm type horn, causing horn to sound. Wiring connections at horn are made through bayonet type connectors; connectors are secured in clips attached to horn solenoid clamp. Horn circuit is protected by a 15 amp circuit breaker mounted on steering column brace (fig. 95).

b. HORN REMOVAL (fig. 96).

(1) Disengage wiring harness from clip on horn mounting bracket. Disengage cable connectors from clips on horn solenoid bracket and disconnect cables.

(2) Remove two nuts and bolts attaching horn to mounting bracket then disconnect air line from horn solenoid.

c. HORN INSTALLATION (fig. 96).

(1) Coat threads of air line fitting with plastic type gasket cement and connect air line to horn solenoid. Install horn on mounting bracket and attach with two bolts and nuts. Install harness clip under one bolt head.

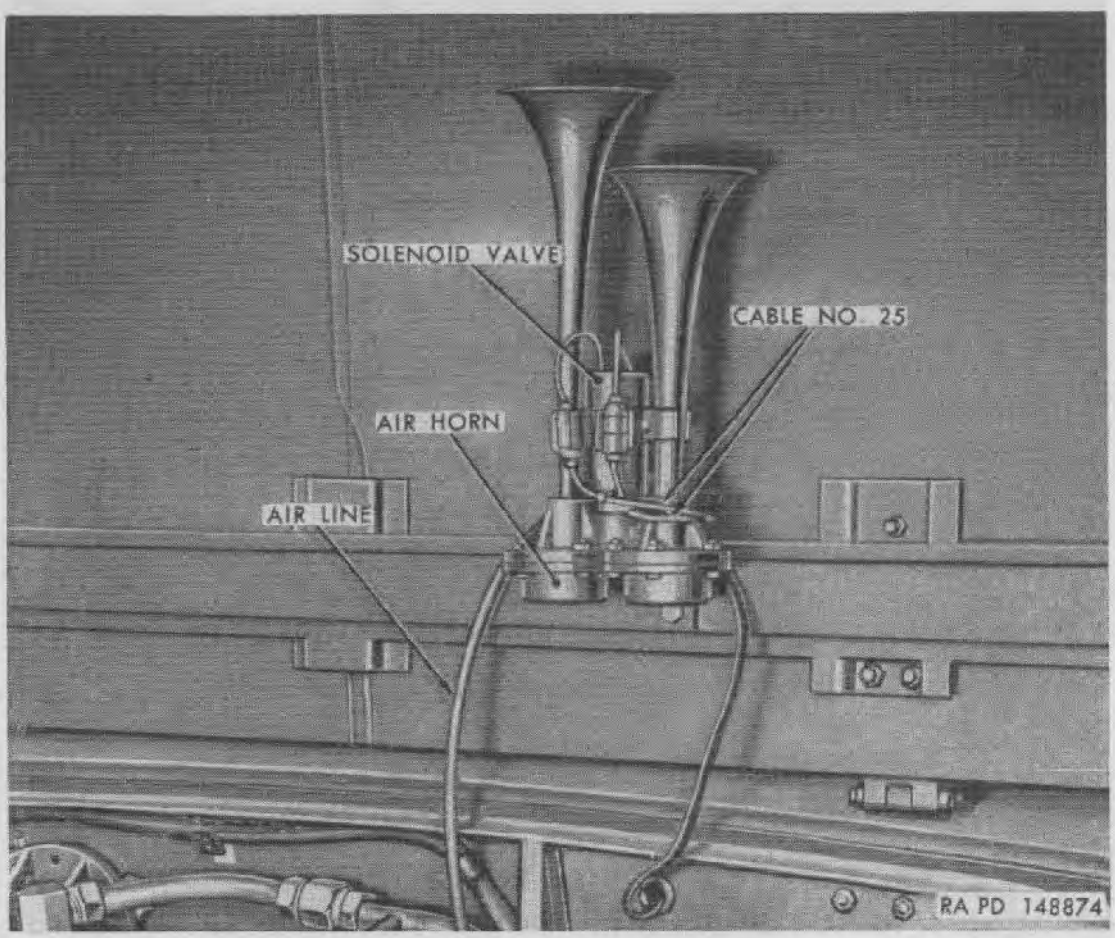


Figure 96. Horn installed.

(2) Connect harness cables (No. 25) to horn solenoid cables, then engage connectors in clips on horn solenoid clamp. Secure wiring harness in clip on horn bracket.

d. HORN BUTTON REMOVAL (fig. 97). Remove four screws attaching horn button retaining ring to steering wheel. Remove retaining ring, horn button, and contact and spring assembly.

e. HORN BUTTON INSTALLATION (fig. 97). Make sure end of contact and terminal on end of steering shaft are clean. Position contact and spring assembly on steering shaft nut, install horn button and retaining ring, and attach retaining ring to steering wheel with four screws.

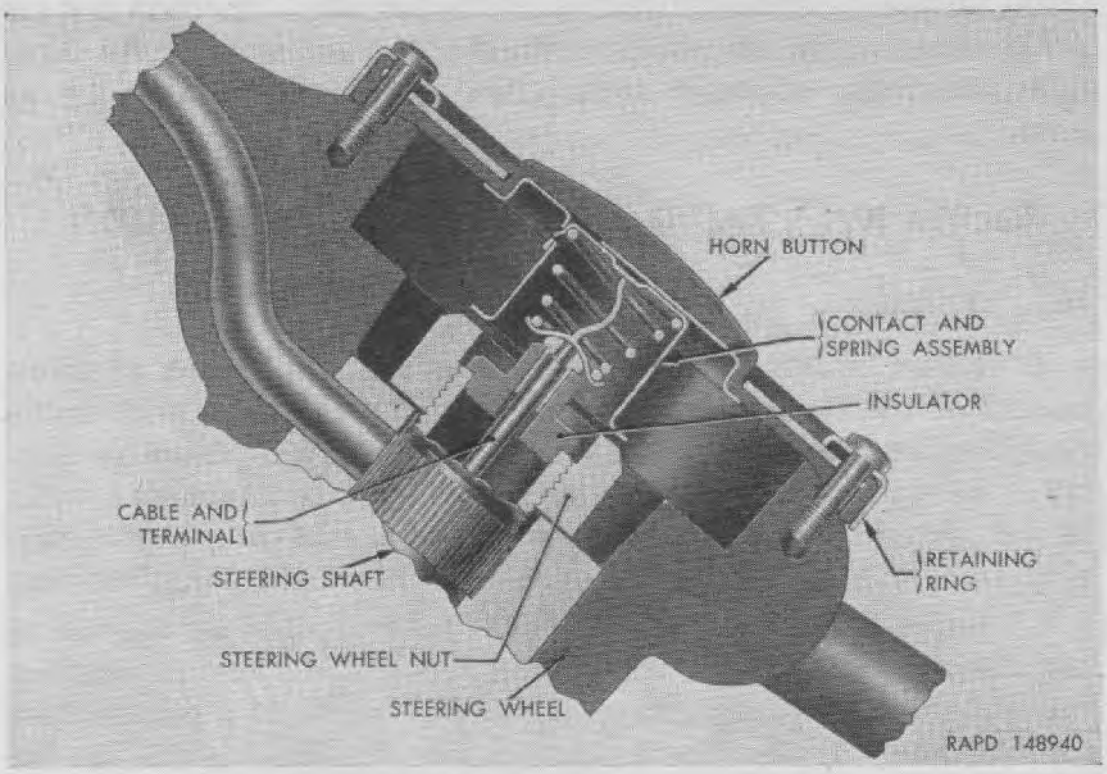


Figure 97. Horn button and contact installed.

166. Low Air Pressure Switch and Buzzer

a. GENERAL. Low air pressure switch is a safety device designed to automatically give a warning when pressure in air system falls below a safe limit (60 psi) for brake operation. Low air pressure switch is actually an air-controlled switch in an electrical circuit, automatically controlling the circuit to an alarm buzzer in cab. Low air pressure switch is mounted on dash inside cab, and is connected to air system at air line junction fitting on dash (fig. 92). Alarm buzzer is mounted on left side of dash inside cab. Switch and buzzer circuit is fed through ignition switch and grounded through the alarm buzzer mounting.

b. LOW AIR PRESSURE SWITCH REMOVAL (fig. 92). Disconnect cables from terminals at top and bottom of low air pressure switch. Disconnect air line from fitting on switch body. Remove two bolts and nuts attaching switch to dash; then remove switch.

c. LOW AIR PRESSURE SWITCH INSTALLATION (fig. 92). Position low air pressure switch on dash and attach with two bolts and nuts. Coat air line fitting threads with plastic type gasket cement; then connect air line to switch. Connect cables (No. 85) to terminals at top and bottom of switch.

d. LOW AIR PRESSURE BUZZER REMOVAL. Disconnect cable from terminal at top of buzzer. Remove three bolts and nuts attaching buzzer to dash, then remove buzzer.

e. LOW AIR PRESSURE BUZZER INSTALLATION. Position low air pressure buzzer on dash with terminal at top and attach with three bolts and nuts. Connect cable (No. 85) to terminal at top of buzzer.

Section XVI. RADIO INTERFERENCE SUPPRESSION

167. Purpose

a. Radio interference suppression is the elimination or minimizing of the electrical disturbances which interfere with radio reception, or disclose the location of the vehicle to sensitive electrical detectors. It is important, therefore, that vehicles with, as well as vehicles without, radios be suppressed properly to prevent interference with radio reception of neighboring vehicles.

b. Suppression of these vehicles is accomplished by the use of metalic shielding, capacitors (condensers), and resistor suppressors. Wiring that may carry interfering surges to a point where interference will affect radio reception is shielded.

168. Description

a. IGNITION SYSTEM. Radio interference suppression in the ignition system (fig. 44) is accomplished by a coaxial capacitor, a bypass capacitor, and a resistor-choke connected into the primary circuit; resistors in distributor rotor, distributor cap, and spark plugs; and shielded spark plug cables.

b. GENERATING SYSTEM. The generating system is suppressed by static collector brushes at each end of generator armature shaft; a coaxial capacitor in generator output cable; two coaxial capacitors connected in series in the regulator output cable; a radio frequency choke coil in field circuit in regulator; and a shielded generator-to-regulator wiring harness.

c. STARTER. The starter is suppressed by a capacitor connected into the field circuit.

d. FUEL PUMP. The electric fuel pump is suppressed by a coaxial capacitor in input cable and a shielded capacitor-to-motor cable.

169. Ignition System Radio Suppression

a. DESCRIPTION AND DATA (fig. 44). The primary connection at the distributor terminal is equipped with a 0.25 mfd coaxial capacitor which is grounded to the distributor housing. A 1.5 ohm resistor-choke is connected into the primary circuit ahead of the ignition coil. A 0.75 mfd bypass capacitor is connected to

ignition coil negative (−) terminal and grounded to the distributor housing. A 10,000 ohm resistor is built into the distributor rotor, and each output tower in the distributor cover is equipped with a 5,000 ohm resistor. Spark plug cables are shielded with a metallic braid molded into the cable insulator. A 10,000 ohm resistor is built into each spark plug. Spark plugs are shielded by the metal shells to which the cables connect. Defective capacitors and resistor-choke can be replaced; rotor, distributor cover, and spark plugs, must be replaced if resistors are defective.

b. DISTRIBUTOR IGNITION COIL CAPACITOR REPLACEMENT (fig. 50).

(1) *Removal.* Remove distributor cover. Disconnect capacitor cable terminal from ignition coil negative (−) terminal. Remove screw and clamp securing capacitor in distributor housing. Lift capacitor out of distributor housing.

(2) *Installation.* Make sure curved spring is clean and in place in bottom of capacitor opening in distributor housing, with convex side up. Insert capacitor into housing and secure in place with clamp and screw and lock washer assembly. Connect capacitor cable to ignition coil negative (−) terminal. Install distributor cover.

c. DISTRIBUTOR COAXIAL CAPACITOR REPLACEMENT (fig. 44).

(1) *Removal.* Remove distributor cover. Disconnect primary cable from connector at distributor. Remove four screw and lock washer assemblies attaching connector to distributor housing. Remove connector and gasket. Disconnect capacitor cable from resistor terminal.

(2) *Installation.* Place spring over capacitor cable with convex side next to capacitor. Thread capacitor cable through opening in distributor housing and insert capacitor into housing. Install connector and gasket on distributor housing and attach with four screw and lock washer assemblies. Connect capacitor cable to resistor terminal, and connect primary circuit cable to primary connector. Install distributor cover.

d. DISTRIBUTOR PRIMARY CIRCUIT RESISTOR REPLACEMENT (fig. 50).

(1) *Removal.* Remove distributor cover. Disconnect cable from resistor terminal, and disconnect resistor cable from ignition coil negative (−) terminal. Remove two screw and lock washer assemblies attaching resistor clamp to distributor housing. Remove clamp, then lift resistor and insulator out of distributor housing.

(2) *Installation.* Make sure curved spring is in place in resistor opening in distributor housing with convex side up. Position resistor and insulator in distributor housing and secure with clamp and two screw and lock washer assemblies. Connect resistor cable to ignition coil negative (−) terminal, and connect primary circuit coaxial capacitor cable to resistor terminal. Install distributor cover.

170. Generating System Radio Suppression

a. DESCRIPTION AND DATA. A 0.1 mfd coaxial capacitor is connected into the generator output cable; capacitor is installed in the generator harness connector elbow and grounded to the elbow. Conductive brushes are installed in the generator, grounding each end of the armature shaft. Wiring harness leading from the generator to the generator-regulator is shielded with metallic braid molded into the harness insulation. Two 0.1 mfd coaxial capacitors are connected in series in the generator-regulator output cable and are grounded to the regulator base. A radio frequency choke coil is connected into field circuit in the generator-regulator. Regulator base is divided into compartments for isolation of the leads.

b. REPLACEMENT. Since replacement of the suppression units in the generator and regulator requires disassembly of the generator and regulator, they cannot be replaced by the using troop organization. If radio interference is originating in the generator or regulator, the complete generator or regulator must be replaced (par. 137 or 138).

171. Starter Radio Suppression

a. DESCRIPTION AND DATA. Starter series field windings and insulated brushes are grounded to commutator end head through a 0.5 mfd capacitor. Capacitor (fig. 74) is mounted on commutator end head and is grounded through its mounting.

b. STARTER CAPACITOR REPLACEMENT (fig. 74).

(1) *Removal* Remove starter (par. 135*a*). Disengage two cover retaining clips from pins in starter field frame and pull end cover off starter. Disconnect capacitor cable from field and brush terminals. Remove through-bolt attaching capacitor to end head and remove capacitor.

(2) *Installation.* Insert through-bolt through capacitor clamp and commutator end head and thread bolt into drive

end head. Connect capacitor cable to starter field and brush terminals. Install starter end cover as directed in paragraph 135*b*. Install starter (par. 135*c*).

172. Fuel Pump Radio Suppression

a. DESCRIPTION AND DATA. A 1.5 mfd capacitor is installed in fuel pump terminal housing and connected to the fuel pump input cable. Cable from capacitor to fuel pump motor is shielded with metallic braid molded into the cable insulation.

b. FUEL PUMP CAPACITOR REPLACEMENT.

(1) *Removal.* Disconnect feed and ground cables from terminals on fuel pump motor terminal cover. Remove four bolts and lock washers attaching terminal cover to fuel pump hanger. Remove cover, then disconnect capacitor cable from fuel pump motor cable terminal. Remove four screws and lock washers attaching capacitor to terminal cover and remove capacitor.

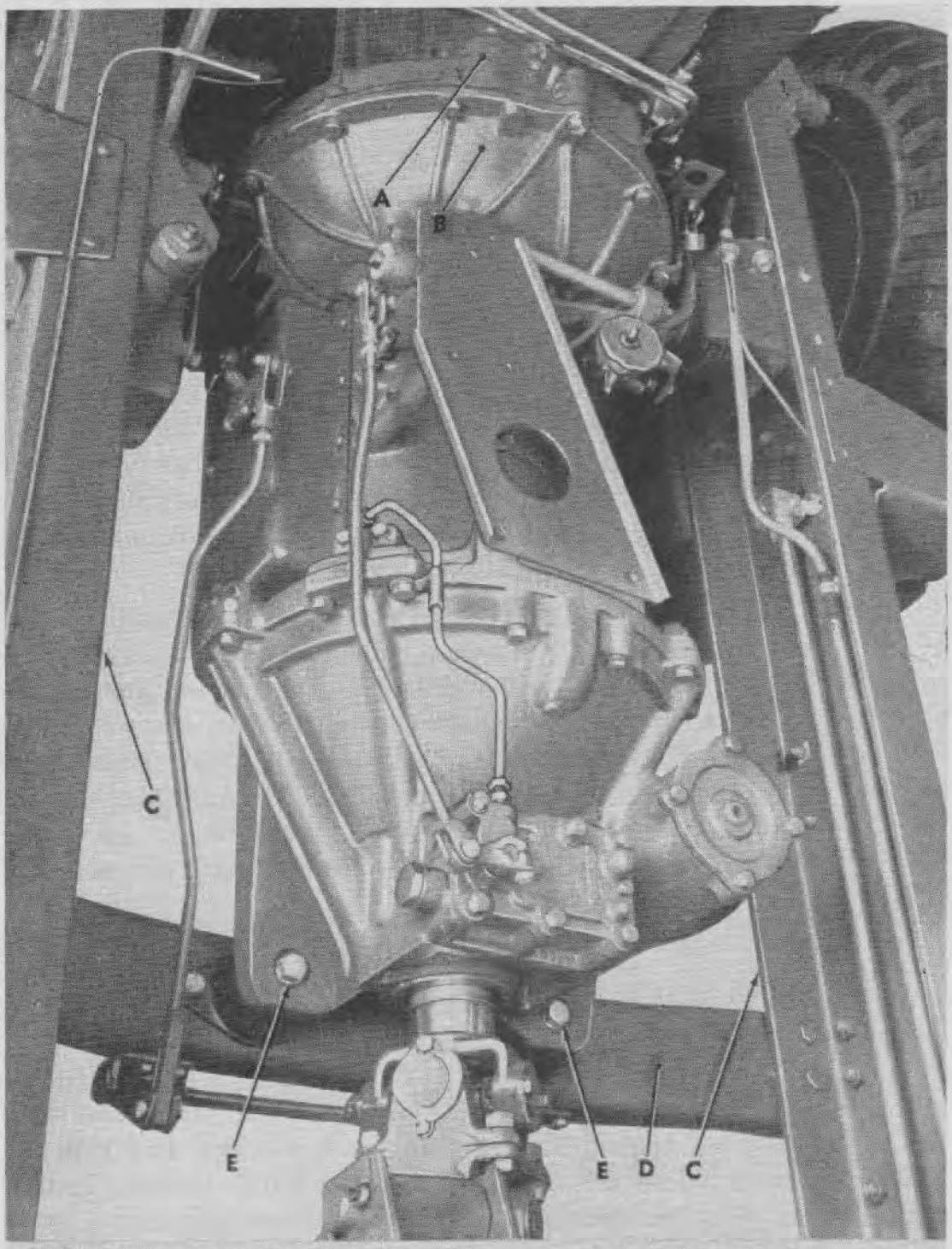
(2) *Installation.* Install new capacitor in terminal cover, using new gasket between capacitor flange and cover. Attach capacitor to cover with four screws and lock washers. Connect capacitor cable to fuel pump motor terminal with screw and lock washer. Install terminal cover and gasket on fuel pump hanger and attach with four bolts and lock washers. Connect feed cable (No. 77) to capacitor terminal and connect ground cable to other terminal on cover.

Section XVII. TRANSMISSION AND CONTROLS

173. Description

a. Hydra-Matic transmission is coupled directly to engine (fig. 98). The 8-speed transmission combines a 4-speed and reverse unit in the forward portion and high and low range gearing in the rear section. The entire transmission, therefore, provides a total of eight forward ratios and two reverse. Rear of transmission is supported by frame cross member through two flexible mountings. Transmission mountings serve also as power plant rear mountings.

b. When operating with transmission control lever in F–1 position (either range), automatic shift is said to be "throttle-conscious" as well as "speed conscious." By that is meant that transmission shifts occur at varying speeds, depending on amount of throttle opening. This is accomplished by connecting throttle



A—FLYWHEEL HOUSING—FORWARD HALF
B—FLYWHEEL HOUSING—REAR HALF
C—FRAME SIDE RAIL
D—FRAME CROSSMEMBER
E—TRANSMISSION MOUNTING BOLT
RA PD 148924

Figure 98. Transmission installed.

linkage to T-V (throttle valve) lever on transmission (fig. 102). Hydra-Matic transmission requires a minimum of attention, if lubricant level is maintained and linkage and front band are kept in adjustment.

c. Coolant from engine is circulated through cooler located in bottom of oil pan. Purpose of cooler is to maintain viscosity of transmission oil for proper functioning.

174. Data

a. RATIOS.

Gear	*High Range*	*Low Range*
1st	4.07:1	15.55:1
2d	2.63:1	10.05:1
3d	1.55:1	5.92:1
4th	1:1	3.82:1
Reverse	4.52:1	17.3:1

b. LUBRICANT CAPACITY. Refer to paragraph 57.

175. Leakage Tests

a. GENERAL. The Hydra-Matic transmission does not "use" or "burn" oil, as an engine does. Consequently, any appreciable loss of oil from transmission is due to leakage and cause must be determined and condition corrected to avoid damage to transmission. Conversely, if transmission fluid level raises, cause is due leakage into transmission of engine coolant.

b. OIL LEAKAGE.

(1) From underneath truck, carefully examine rear end of transmission case, at propeller shaft flange, for evidence of leakage.

(2) Remove flywheel housing cover (underpan). Wash flywheel and torus cover with dry-cleaning solvent or volatile-mineral-spirits paint thinner and dry completely.

(3) Spread a clean piece of white or brown paper under flywheel and cover.

(4) Run engine at speed of 700 rpm for several minutes, or until spray appears on paper; then stop engine.

(5) Check for leaks in line with spray marks on paper; also examine flywheel and torus cover carefully (fig. 99). Report condition to ordnance maintenance personnel.

c. COOLANT LEAKAGE.

(1) If oil level is found to be high at inspection periods, cause may be leakage from cooler core.

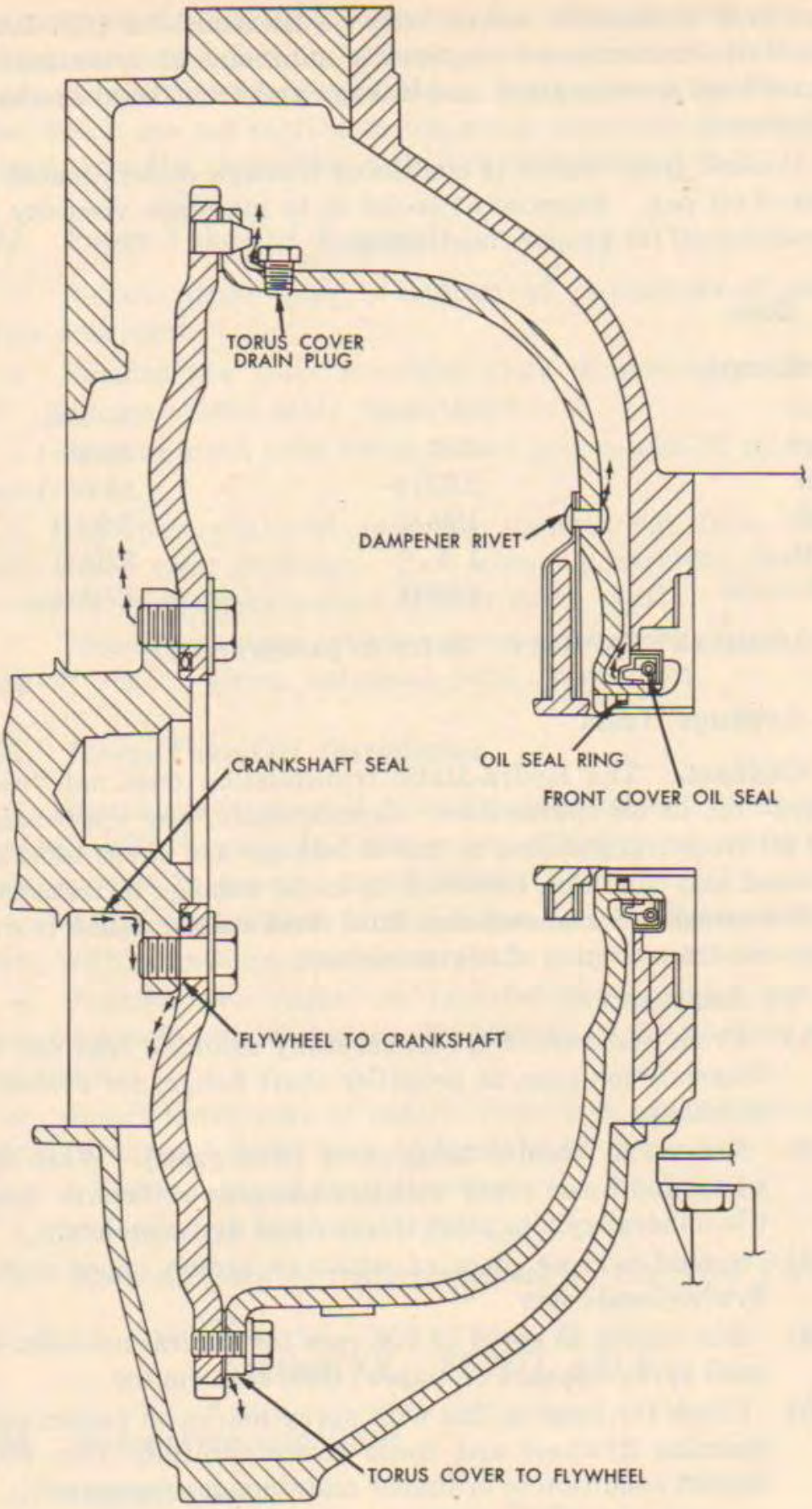


Figure 99. Location of possible leaks.

(2) If leakage from cooler core is indicated, drain oil from transmission into a clean container. Examine drainage for presence of water; if evidence of leakage is found, report to ordnance maintenance personnel. If leakage does not exist, fill transmission as directed in paragraph 59*f*.

176. Operation Tests

a. GENERAL. A systematic method of checking external adjustments is included in this paragraph. While many of the corrections are beyond the scope of the using organization, tests should be made to determine necessity for replacement of the transmission. It should be kept in mind that directions should be followed carefully and that a complete diagnosis be made. Perform all tests; if any are omitted, an incorrect diagnosis will probably result.

b. PURPOSE. Two types of tests are described—stall speed test and road test. Stall speed test is designed to provide an overall performance check of engine and transmission efficiency. Road test provides an accurate check of transmission operation under actual service conditions.

c. PRELIMINARY OPERATIONS. Before performing either stall speed test or road test, the following operations *must* be accomplished:

(1) Warm engine and transmission to normal operating temperatures.

(2) Check transmission oil level (par. 59*f*) and replenish if necessary.

(3) Check engine idling speed and adjust (par. 112*b*), if necessary. If stall speed test is to be performed, leave tachometer connected to engine, since this instrument is used in test.

(4) Remove pipe plug, located immediately rearward of front band adjusting screw, and install a fluid pressure gage (capable of registering 250 psi pressure). Start engine and, while holding brakes applied, note pressure readings in all four "HIGH RANGE" positions, with engine running at 1,000 rpm.

(5) With transmission oil warm, pressures should be 170–200 psi in reverse, and 95–110 psi in each of the other positions.

(6) If pressures are appreciably less than shown, notify ordnance maintenance personnel. Disconnect pressure gage and install pipe plug.

d. STALL SPEED TEST. Stall speed is the greatest engine revolutions per minute, with transmission in gear and truck stationary. Test should be made at intervals, after repair or replacement of engine or transmission, and whenever power plant appears to be operating at less than peak efficiency.

(1) Perform preliminary operations described in *c* above.

(2) Block wheels, or position truck with front bumper against a solid object, to prevent injury to personnel if brakes are accidentally released.

(3) Station an assistant inside truck to apply and hold brakes during test.

(4) Move transmission lever into F–1 HIGH RANGE position; then open throttle completely. Tachometer should show engine speed within ranges shown in table VII. Reduce engine speed to normal idle, move control lever to N (neutral) position, and shut off engine.

Caution: Do not hold throttle open for longer than 15 seconds. Immediately close throttle if engine speeds up to 2,000 rpm, to avoid damaging transmission.

(5) Block wheels to prevent reverse movement of truck. Repeat stall-speed test, but with transmission control lever in R HIGH RANGE position. If slipping does not now occur (engine speed in normal range) rear band is not holding properly. Report condition to ordnance maintenance personnel. If slipping still occurs (engine rpm above maximum) adjust front band (par. 179); then repeat stall-speed test in R HIGH RANGE and R LOW RANGE. If slipping still occurs, report condition to ordnance maintenance personnel.

Table VII. Stall-Speed Test Data

Engine RPM	
Minimum	Maximum
1,550	1,750

(6) If engine speed is within range given, engine and transmission are operating within normal efficient limits. Remove tachometer as described in paragraph 112.

(7) If engine speed is appreciably *below minimum* shown, engine is probably not developing full power. Tune engine (par. 93); then repeat stall speed test. If engine rpm is still below minimum, transmission malfunction is indicated. Report condition to ordnance maintenance personnel.

(8) If engine stall speed is appreciably *above maximum* rpm shown, excessive slippage in torus or in transmission is probable cause.

(9) Recheck transmission oil level (par. 59*f*) and replenish, if necessary; then shut off engine. After 10 minutes, and with engine not running, recheck oil level. If level has risen more than one-half inch in 10 minutes, driven torus check valve or front pump relief valve are at fault. Report condition to ordnance maintenance personnel.

e. ROAD TEST.

(1) Before making road-test on transmission, perform preliminary operations described in *c* above.

(2) When making road-test on transmission, perform tests in sequence listed in table VIII. Check minimum throttle upshifts first, and make each test several times to be sure shift events consistently occur at same speeds.

Note. When testing, be on the alert for any indications of irregular or improper performance. Note these; then, when test is completed, refer to *f* below.

Table VIII. Transmission Automatic Shift Pattern

Upshifts

Shift	Minimum Throttle (F–1 LEVEL HIGH RANGE) mph	Full Throttle (F–1 LEVEL HIGH RANGE) mph	Full Throttle (F–2 HILLY HIGH RANGE) mph
1st to 2d	8–9	13–15	13–15
2d to 3d	13–15	21–24	
3d to 4th	18–20	35–38	35–38

Downshifts

Shift	Full Throttle (F–1 LEVEL HIGH RANGE) mph	Closed Throttle (F–1 LEVEL HIGH RANGE) mph	Closed Throttle (F–2 HILLY HIGH RANGE) mph
4th to 3d	20–18 (to detent)	15–13	35–33
3d to 2d	18–16 (past detent)	14–12	
2d to 1st	11–9 (past detent)	10–7	11–9
4th to 3rd	Full throttle (past detent) (F–1 HIGH RANGE) 34 MPH		

(3) Tests for full-throttle downshifts can be made on a steep hill. If steep hill is not available, condition can be simulated on level road by light, continuous brake application.

f. DIAGNOSIS. When road test is completed and all irregular or improper operation noted, refer to table IX. Various improper operating conditions which may be found, their possible causes, and suggested remedies, together with paragraph references are included in table. However, possible causes and remedies beyond scope of the using organization are not specifically identified.

Note. Conditions and causes are listed in order of probability; therefore always check causes in sequence given.

Table IX. Improper Operation, Possible Causes, and Suggested Remedies

Oil level should be correct (par. 59 *f*) before making these tests

Condition	*Possible Causes*
All shifts occur too high	C*
All shifts occur too low	C*
Shifts vary (inconsistent)	C*
Transmission hunts between two ratios	C*
Misses one or more shifts	C*
Throttle downshift improper	C–D*
Engine speeds up; band apply rough	C–E*
Violent shifting	C–D–E*
Shifts above 2d in F–2 position	C*
No shifts—stays in same gear	C–D*
Excessive creeping	B*
Slipping	A–C–D–E*
No drive forward	A–C–D*
Locks up on reverse coast	D*
Moves forward when in reverse	(*)
No drive in reverse	A–C–D–E*
Drives in reverse only	A–C–D–E*

Key	*Possible Cause*	*Suggested Remedy*
A	Improper oil level.	Correct oil level as described in paragraph 59 *f*.
B	Improper engine idle speed.	Check and adjust engine idling speed (par. 112 *b*).
C	Linkage out of adjustment.	Check and adjust control linkage (pars. 177 and 178).
D	Improper oil pressure.	Check as described in *C* above. If not within limits, notify ordnance maintenance personnel.
E	Servo bands not adjusted.	Check and adjust front band (par. 179).
	*Other causes, beyond scope of using organization.	Notify ordnance maintenance personnel.

177. Manual-Shift Control Linkage

a. GENERAL. Manual-shift linkage is shown in figure 100; however (TV) lever and linkage is omitted for purposes of clarity. Shift linkage performs two functions—to select Hydra-Matic range positions and to shift transfer front axle clutches for forward and reverse operation.

Note. Key letters in text refer to figure 100. Also see figure 101 for view of linkage installed. On both illustrations, note that throttle linkage is omitted to clarify illustrations.

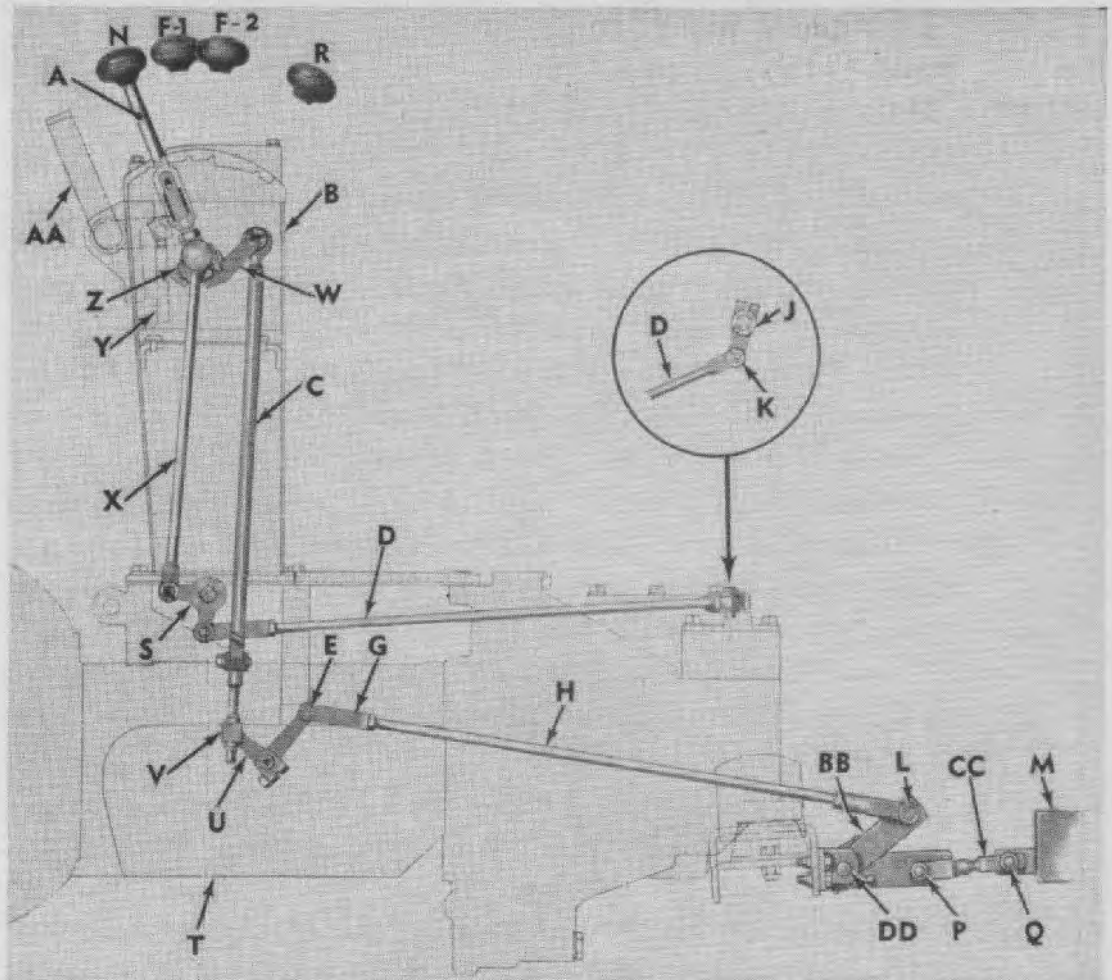


Figure 100. Transmission and transfer linkage arrangement.

b. ADJUSTMENT. Adjust linkage in sequence described. Both transmission and transfer incorporate internal detents to locate control positions. In addition, control also has detents for control lever; however, detents in transmission govern adjustment of linkage.

(1) Remove front floor pan assembly. Press down on control lever (A) and move into F–2 LOW RANGE position. Unscrew nut from trunnion (V) and disconnect trunnion from transmission shift lever (U).

(2) Disconnect transfer reverse rod (H) from transmission shift lever (U) by removing clevis pin (E).

(3) Disconnect reduction unit rod (D) from reduction unit lever (J) by removing clevis pin (K).

(4) Make sure control lever (A) is in F–2 position. Position transmission shift lever (U) by rotating all the way counterclockwise; then move back one detent position.

(5) Insert trunnion in transmission shift lever (U), adjusting trunnion nuts, as necessary, to provide free pin. Make sure pin does not bind in other positions of control lever; then return control lever to F–2 LOW RANGE position, and install trunnion stud nut.

(6) Make sure lever (A) is in N LOW RANGE position reduction unit (lever (J) in forward position). Connect reduction unit rod (D) to reduction unit lever (J) with clevis pin (K), adjusting yoke as necessary to provide free pin. Pin should also be free with control lever (A) in N HIGH RANGE position; however, if impossible to obtain free pin in both ranges, adjust to obtain free pin N LOW RANGE position.

(7) Move control lever (A) into F–1 HIGH RANGE position. With transfer reverse rod pushed in (rearward), adjust transfer reverse rod (H) so that cross shaft lever stop is against clevis with rod connected to transmission shift lever (U). Make sure all pins are secured with cotter pins.

c. REPLACEMENT. Each linkage rod is connected with a pin at each end, as shown in figures 100 and 101. Linkage rods are easily replaced by removing connecting pins; levers are removed after loosening clamping bolts.

d. TOWER REMOVAL. Remove front floor pan assembly. Unscrew nut from shift-lever trunnion (V) and disconnect from transmission shift lever (U). Remove clevis pin to disconnect reduction unit rod (D) from idler lever (S). Remove four cap screws which attach tower to transmission; then remove tower.

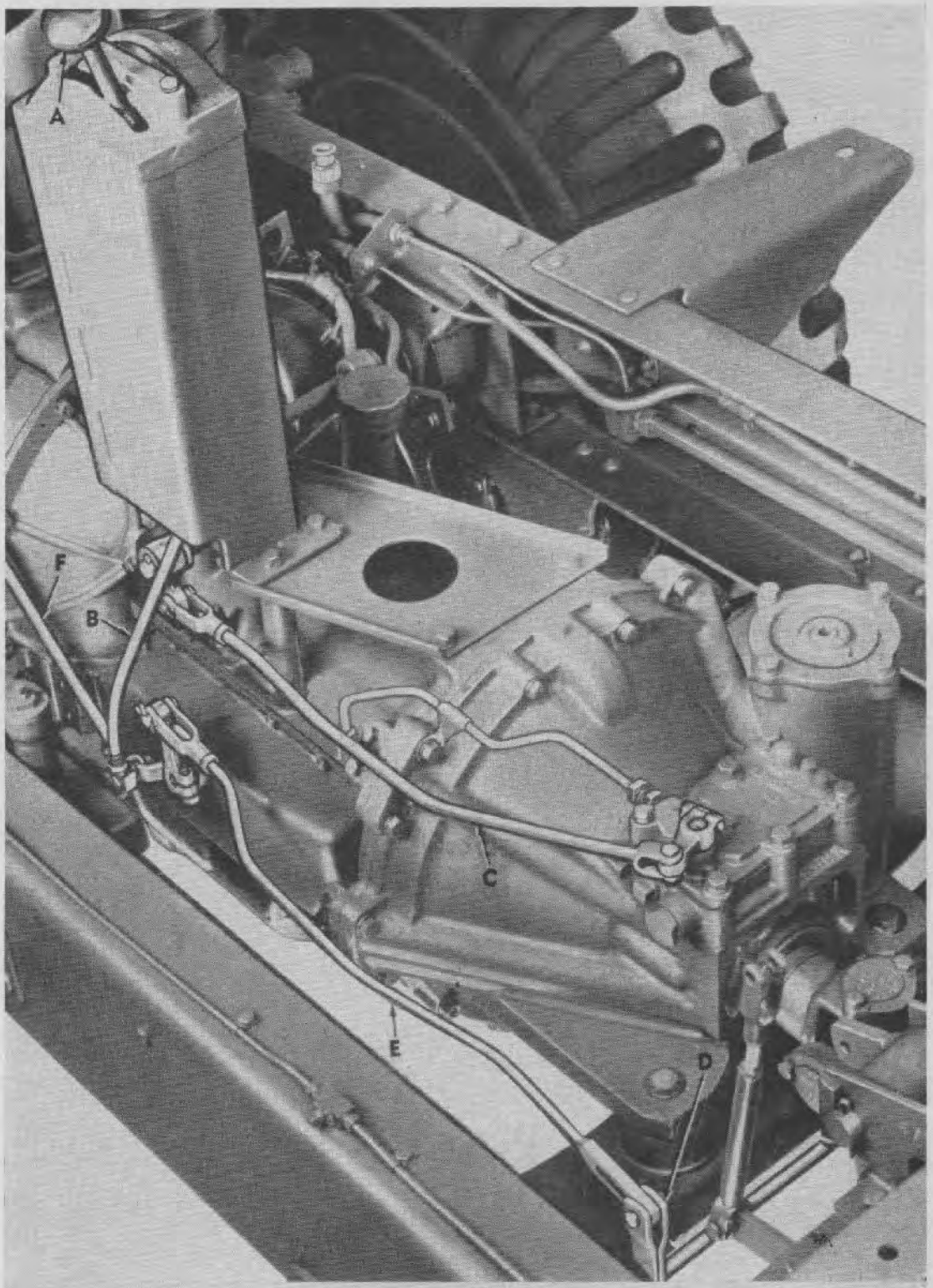


Figure 101. Shift linkage installed.

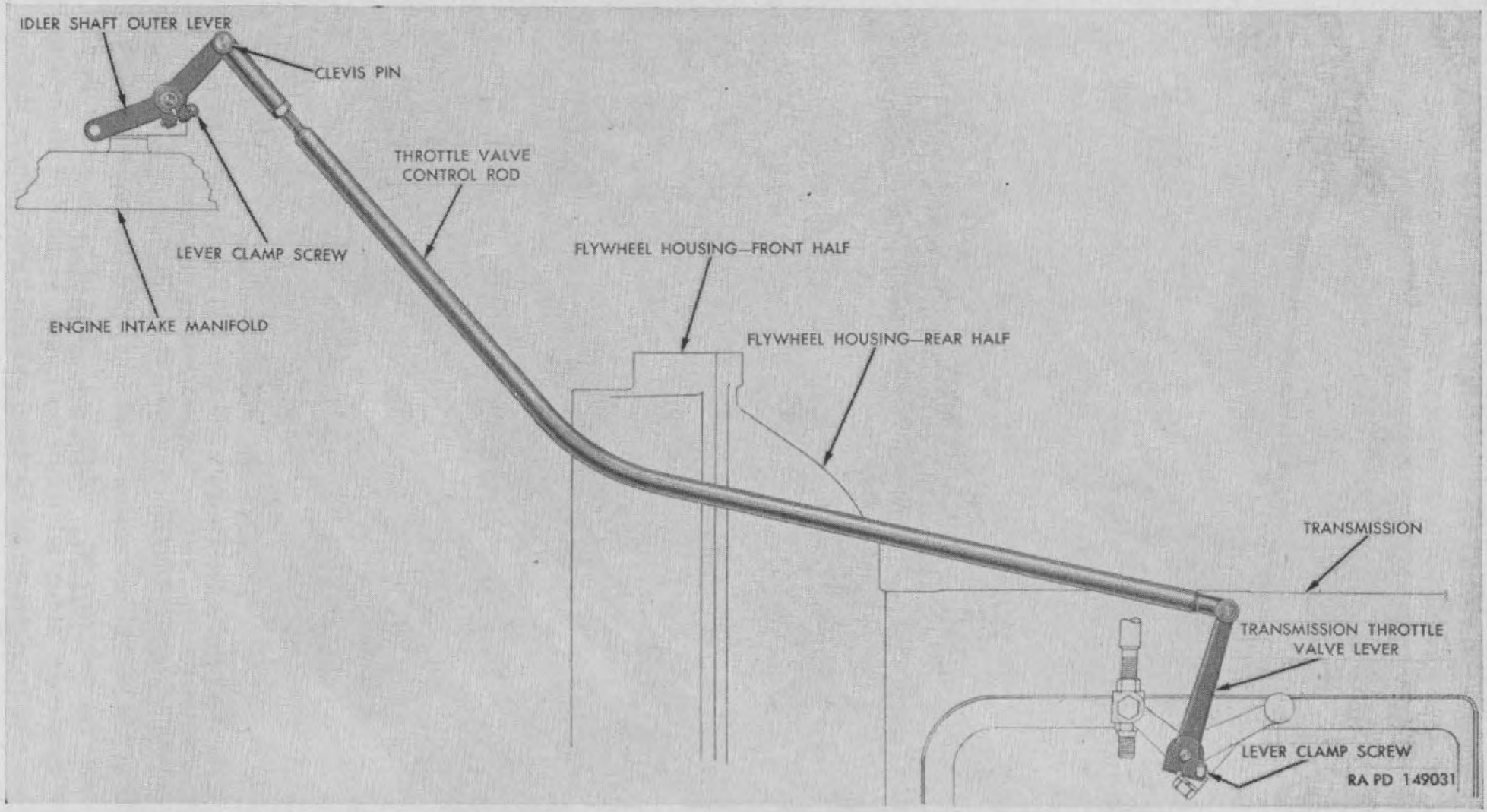


Figure 102. Throttle linkage arrangement.

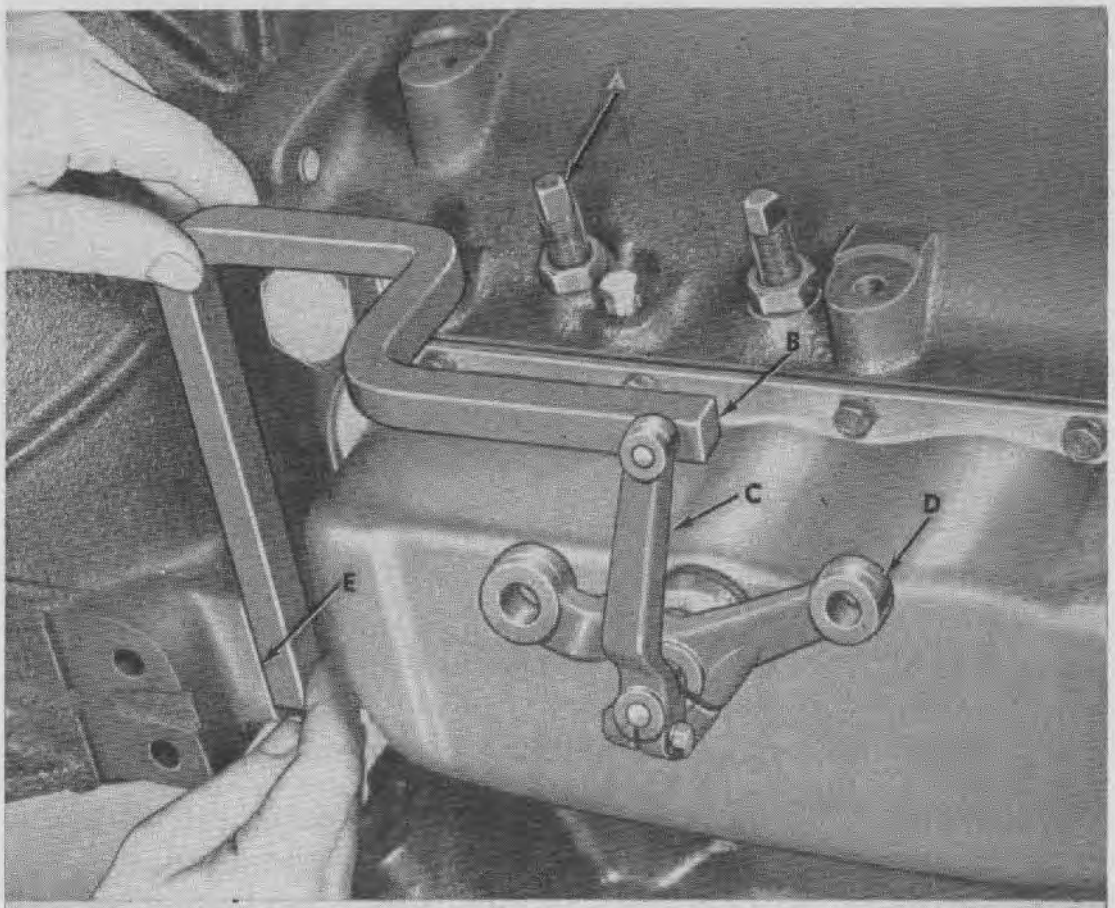
e. TOWER INSTALLATION. Position control tower to transmission and install attaching bolts. Position shift lever trunnion (V) to transmission shift lever (U) and install nut. Adjust trunnion nuts as described in *b* above. Connect reduction unit rod (D) to idler lever (S) with clevis pin. Adjust yoke, if required, as described in *b* above.

178. Throttle Linkage

a. ADJUSTMENT. Throttle lever and linkage must be carefully adjusted in order that shift pattern will be correct. Throttle valve lever is connected to accelerator linkage as shown in figure 102.

Caution: Do not pry against, or twist lever, since lever is supported only by die-cast control valve body.

(1) Hold transmission throttle valve gaging fixture 7950168 against machined surface of flywheel housing rear half, as shown in figure 103. Using clevis pin, check for free



A—FRONT BAND ADJUSTING SCREW
B—GAGING FIXTURE
C—THROTTLE VALVE LEVER
D—TRANSMISSION SHIFT LEVER
E—GAGING SURFACE
RA PD 149047

Figure 103. Adjusting throttle linkage using fixture 7950168.

pin in closed position of throttle valve lever. Bend throttle valve lever with bending tool 7950171, as required to obtain free pin.

(2) Holding lever against stop, loosen yoke lock nut on rod and adjust yoke on rod as necessary to obtain free installation of clevis pin through yoke and idler lever. Connect yoke with clevis pin and secure with cotter pin. Tighten lock nut against yoke.

b. REPLACEMENT. Remove clevis pins which attach rod to levers (fig. 102) to remove rod. Make sure yokes and pin are not unduly worn, when installing, since worn parts will not permit accurate adjustment. Throttle valve lever is attached to throttle valve shaft by means of a clamp screw. Serrations position the lever in relation to the shaft. Do not force lever onto shaft in wrong position.

179. Front Band Adjustment

a. INSPECTION.

Note. Do not attempt adjustment of rear band, since this band adjusts automatically. Rear band adjuster screw is used only for initial adjustment at assembly.

(1) Clean indicator pin plug (B, fig. 104) and adjacent surface of transmission; then run engine at idling speed, with control lever in F–1 HIGH RANGE position.

(2) Unscrew indicator pin plug (B, fig. 104). Indicator pin should be flush with machined surface of case. Use straightedge to check pin position.

b. ADJUSTMENT (fig. 104).

(1) Loosen adjusting screw lock nut (A).

(2) Turn adjusting screw (C) until indicator pin is exactly flush with machined surface of case.

(3) While holding adjusting screw stationary, tighten lock nut firmly; then install indicator pin plug (B).

180. Coordination with Ordnance Maintenance Unit

Replacement of the transmission with a new or rebuilt transmission is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, providing authority for performing this replacement is obtained from the appropriate commander. Tools needed for the operation, which are not carried in the using organization, may be obtained from the supporting ordnance maintenance unit.

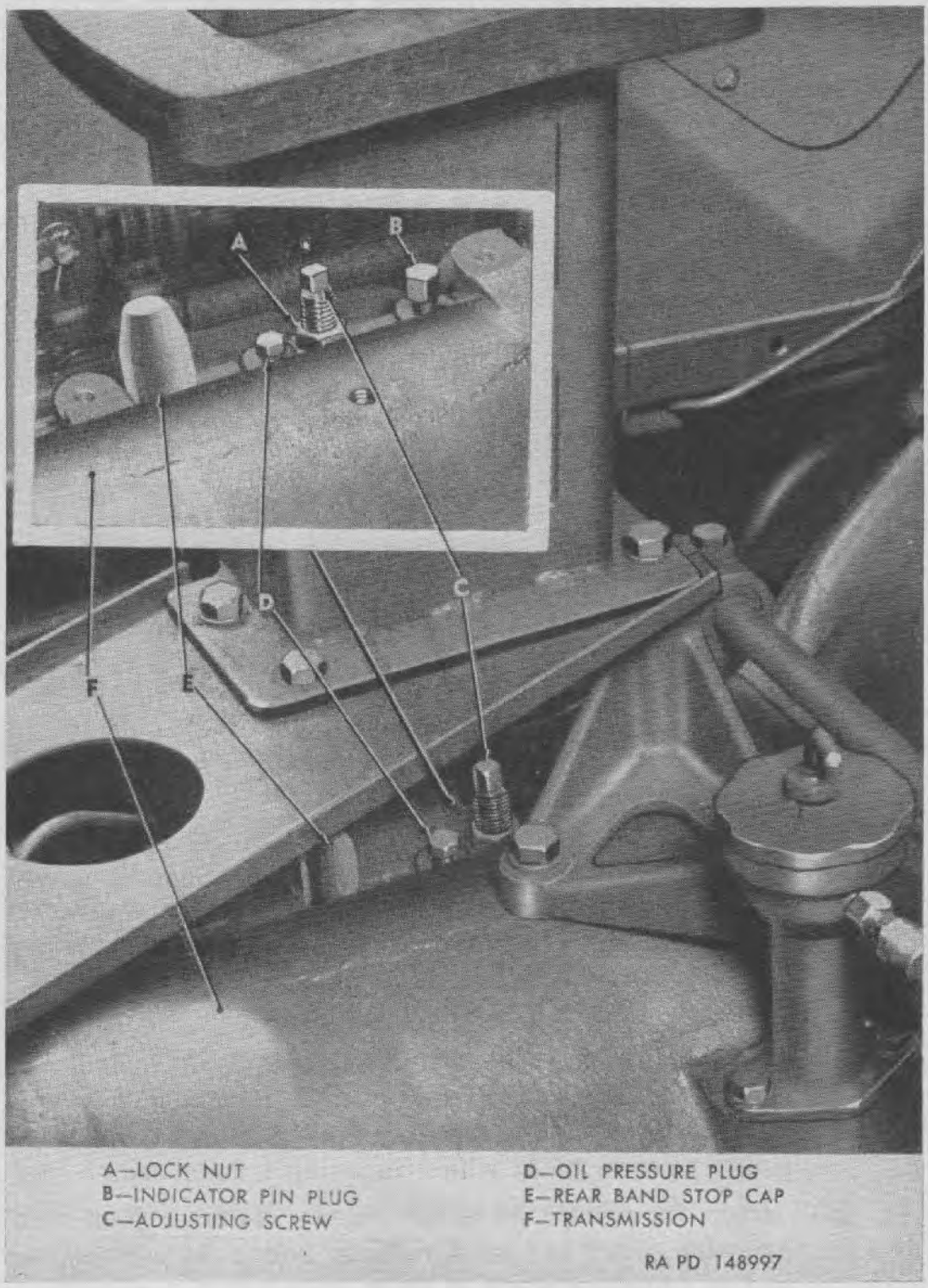


Figure 104. Front band adjustment.

181. Transmission Removal

a. GENERAL. Operations necessary to remove transmission from engine with power plant installed and with power plant removed are covered in this paragraph. After the operations given in *b* below have been accomplished, remaining operations are same regardless of whether power plant is installed or removed. Before deciding to replace transmission, perform all tests suggested in paragraph 176 to locate cause of trouble.

b. INITIAL OPERATIONS (REQUIRED WITH POWER PLANT INSTALLED).

(1) *Disconnect linkage and remove control tower.* Disconnect control linkage and remove control tower (pars. 177 and 178). Disconnect transfer control linkage at transmission support cross member and remove TV control rod (fig. 102). Remove transfer reverse control lever cross shaft from transmission rear support cross member.

(2) *Remove exhaust pipe rear section.* Remove exhaust pipe support bracket to transmission cross member bolt. Loosen exhaust pipe clamp nuts at each end of exhaust pipe rear section; then remove clamps and rear section of exhaust pipe.

(3) *Remove propeller shaft.* Remove four bolts, nuts, and lock washers used to connect yoke to flange on transmission and on transfer; then remove transmission-to-transfer propeller shaft assembly.

(4) *Detach power plant from rear mountings.* Remove two cap screws and lock washers which hold transmission to rear mountings (fig. 39).

(5) *Raise power plant.* Using engine sling and overhead hoist or suitable jack, raise rear end of power plant just enough to relieve load from cross member under rear of transmission. Place blocking securely under engine to support power plant while removing transmission.

(6) *Drop front axle propeller shaft.* Remove four front propeller shaft to transfer flange bolts; then lower rear end of propeller shaft to floor.

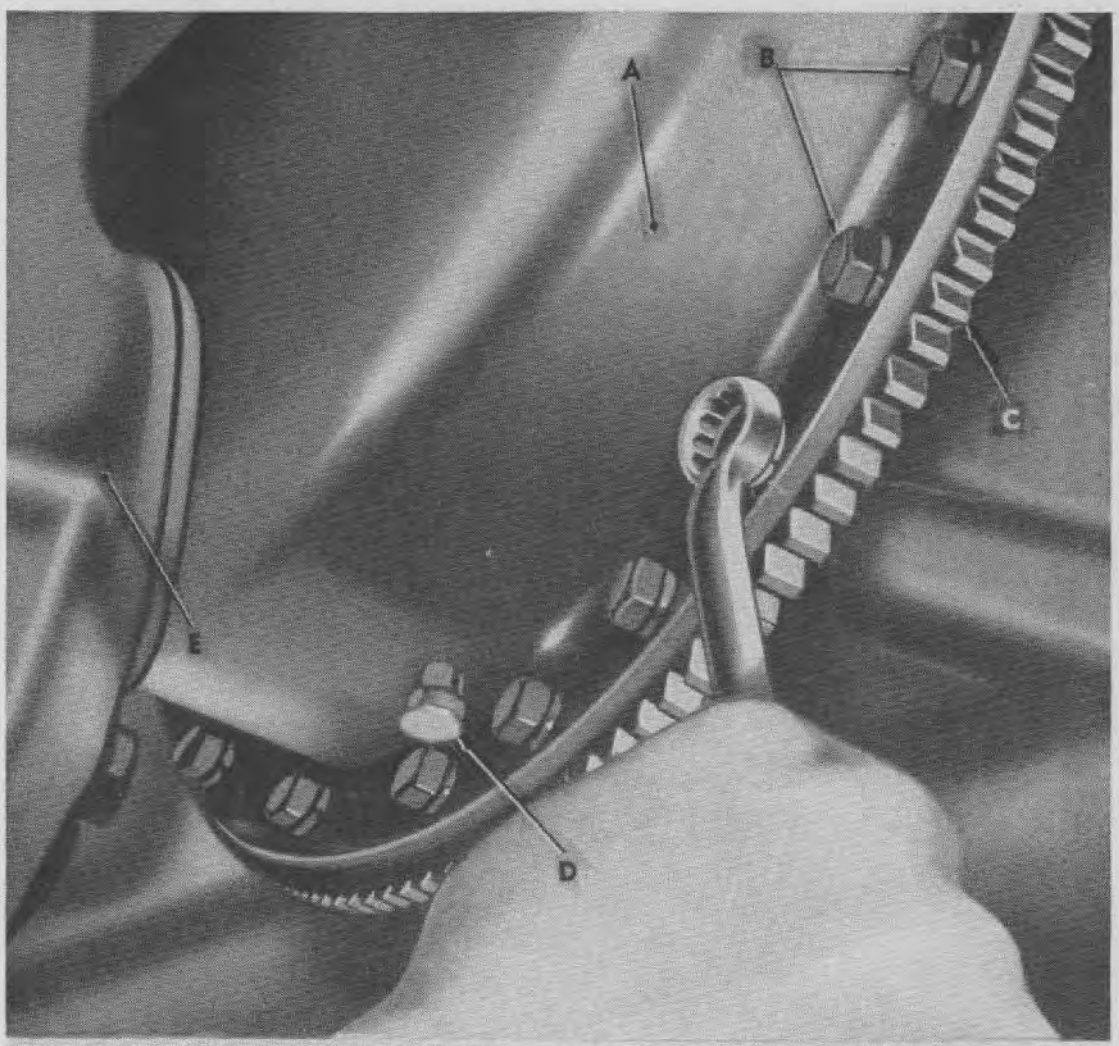
(7) *Remove transmission support cross member.* Remove bolts at each frame side rail and remove cross member at rear of transmission.

(8) *Disconnect starter control.* Disconnect starter shift lever rod at cross shaft lever (fig. 75).

c. REMOVE TRANSMISSION FROM ENGINE.

Caution: Make sure transmission is securely supported, with no danger of dropping on a workman underneath.

(1) *Drain coolant and disconnect cooling lines.* Drain engine cooling system (par. 126*b*). Unscrew cooling line nuts at transmission and pull lines free from fittings at transmission.



A—TRANSMISSION-TORUS COVER
B—TORUS COVER TO FLYWHEEL BOLTS
C—ENGINE FLYWHEEL
D—TORUS DRAIN PLUG
E—TRANSMISSION
RA PD 148929

Figure 105. Removing torus cover bolts.

(2) *Drain transmission oil.* Drain oil from transmission as instructed in paragraph 59*f*, using suitable receptacle to catch oil at each drain point.

(3) *Remove torus cover bolts.* Using wrench as shown in figure 105, remove torus-cover-to-flywheel bolts.

(4) *Remove flywheel housing bolts.* Use either a suitable transmission jack with saddle or an overhead support to

carry weight of transmission, and remove bolts attaching flywheel housing rear half to front half which is bolted to engine.

(5) *Remove transmission.* Move transmission assembly away from engine (fig. 106) and mount in repair stand. Remove spacer from front end of transmission mainshaft.

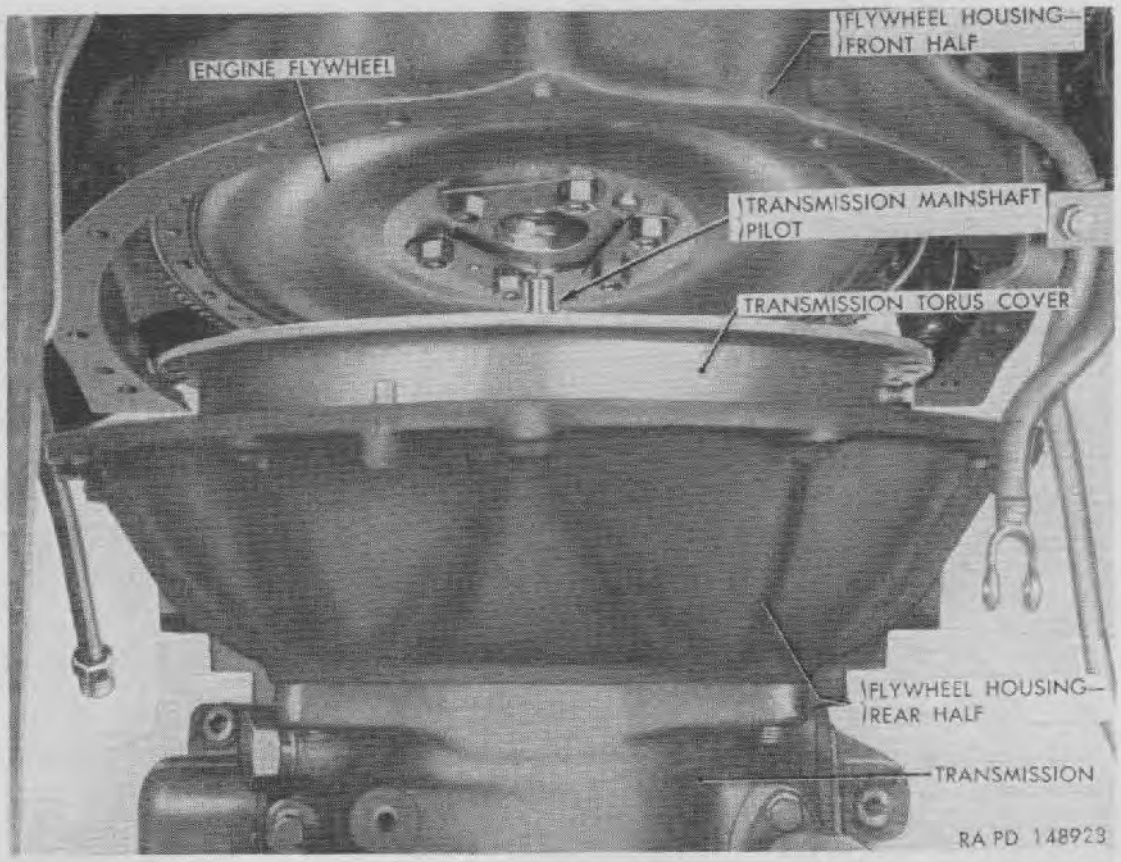


Figure 106. Removing transmission.

d. FLYWHEEL HOUSING REAR HALF REMOVAL. Flywheel housing rear half, installed on transmission case, is matched with front half installed on engine.

Note. Flywheel housing front and rear halves must remain with engine on which they were originally installed. A plate attached to each half of flywheel housing bears engine serial number. The operation described in (1) and (2) below must be performed if transmission is not to be installed on engine from which it was removed, or if it is necessary to remove flywheel housing from transmission.

(1) Bend lock plate away from mainshaft nut. Use 1-7/16-inch deep socket to remove nut from mainshaft. Use suitable tool to hold torus.

(2) Grasp hub and pull driven torus off mainshaft. If torus sticks, strike end of mainshaft lightly with rawhide or plastic hammer.

(3) Using snap ring pliers, remove driving torus snap ring; then remove driving torus and torus cover together by sharp straight pull on cover.

Caution: Do not rock cover from side to side to remove, as damage to oil seal or seal ring may result.

(4) Remove four cap screws and lock washers which attach flywheel housing rear half to transmission; then remove flywheel housing.

182. Transmission Installation

a. GENERAL. Operations for installing flywheel housing rear half on transmission (*b* below) are accomplished with transmission in suitable repair stand. Procedure for installing transmission on engine (*c* below) is same regardless of whether power plant is in vehicle or removed. If transmission is to be installed with power plant in vehicle, perform operations given under *d* below in addition to operations under *b* and *c*. Before installing torus cover on transmission, bolt cover to flywheel and with dial indicator mounted at flywheel housing front half, check runout at torus cover hub sealing surface. Runout must not exceed 0.005 inch. If runout is excessive, remove torus cover from flywheel and check flywheel runout at rearward side. If flywheel runout does not exceed 0.005 inch, replace torus cover. If flywheel runout exceeds 0.005 inch, report to ordnance maintenance personnel. A final check for runout at torus cover hub should be made if new cover is used.

b. FLYWHEEL HOUSING REAR HALF INSTALLATION. Front and rear halves of flywheel housing each have a metal plate attached, on which the engine serial number is imprinted.

Note. Number on flywheel housing rear half must correspond with number on front half, and with engine serial number plate on engine cylinder block (fig. 7).

(1) Locate flywheel housing at transmission and install four cap screws and lock washers, and tighten firmly to mount housing on transmission.

(2) Push torus cover into place on splines at transmission front drive gear, using care to avoid damaging oil seal and seal rings as cover is pushed into place.

(3) Install driving torus on intermediate shaft splines. Using snap ring pliers, install new snap ring to retain driving torus.

(4) Install driven torus on mainshaft splines. Place new mainshaft nut lock plate on mainshaft, then install nut on threads. Tighten nut to 50–60 pound-feet, using torque wrench and 1 7/16-inch deep socket and using suitable tool to hold torus. Bend lock plate against nut to hold nut tight. Install spacer on front end of transmission mainshaft.

c. INSTALL TRANSMISSION ON ENGINE.

(1) Clean torus cover gasket surface at flywheel thoroughly, coat torus cover gasket lightly with general purpose grease, and place gasket at flywheel with all holes in gasket alined with holes in flywheel.

Note. Gasket must be free from creases and wrinkles, and there must be no nicks or burrs at gasket surface on torus cover.

(2) Use transmission jack and saddle or overhead hoist and raise transmission into position at engine, with pilot on mainshaft alined with pilot bearing (fig. 106); then turn torus cover or flywheel until large dowel in flywheel is alined with large dowel hole in torus cover.

(3) Move transmission toward engine so mainshaft pilot enters pilot bearing and dowel holes in flywheel housing rear half fit over dowels in housing front half. Install bolts and cap screws which hold halves of flywheel housing together.

(4) Install torus cover to flywheel cap screws with new lock washers. Tighten all cap screws finger-tight at first. Tighten cap screws at each dowel pin with wrench, tighten screws alternately to avoid distorting torus cover. Finally tighten all screws with torque wrench to 20–25 pound-feet torque.

(5) Check to see that drain plug in torus cover is tight; then install flywheel housing underpan.

(6) Connect transmission cooler line at each side of transmission.

d. FINAL OPERATIONS (REQUIRED WHEN POWER PLANT IS INSTALLED).

(1) *Connect starter control.* Connect cross-shaft-lever-to-starter shift lever rod at cross shaft lever (fig. 75).

(2) *Install transmission control cross member.* Locate transmission support cross member at frame and install bolts at each end of cross member. Install transfer reverse cross shaft and bracket on cross member.

(3) *Lower power plant and install rear mounting bolts.* While supporting power plant, remove blocking from under engine; then lower power plant so weight rests on mountings on transmission support cross member. Install two bolts with lock washers which hold power plant on rear mountings.

(4) *Install propeller shaft.* Install propeller shaft at rear end of transmission, using new lock washers on the eight bolts used to connect flanges at transmission and transfer.

(5) *Connect front axle propeller shaft.* Lift front axle propeller shaft into place at flange on transfer; then install universal joint flange bolts.

(6) *Install exhaust pipe rear section.* Using new exhaust pipe joint seal (fig. 64), assemble exhaust pipe rear section and clamps. Install bolt to attach exhaust pipe support bracket to transmission support cross member. Tighten nuts on clamp bolts firmly.

(7) *Install transmission control tower and connect linkage.* If control levers have been removed from transmission, install levers and connect transfer reverse rod. Check throttle valve lever position with gage, and install and adjust throttle valve rod (par. 178). Mount transmission control tower on transmission and connect manual-shift control linkage (par. 177).

(8) *Fill cooling system.* Fill cooling system as directed in paragraph 126 *a*.

(9) *Fill transmission with oil.* Fill transmission with oil, following directions given in paragraph 59 *f* (4).

(10) *Record of replacement.* Make a record of replacement on DA AGO Form 478.

Section XVIII. TRANSFER AND CONTROLS

183. Description and Data

a. DESCRIPTION. Transfer is essentially a single-speed auxiliary unit, consisting of a case, gears, and output shafts for transferring power to each of the three driving axles (fig. 107). Mounted on frame cross member directly rearward of transmission, transfer is driven from transmission by a short-coupled propeller shaft. Transfer includes a neutral position for disconnecting axles from power plant when winching (when vehicle is so equipped), and for towing when truck is disabled. Transfer in-

corporates a double jaw-type clutch in front axle drive gearing, to provide automatic engagement and disengagement of front driving axle. Except when required for tractive effort, front axle runs free, reducing tire wear and steering effort.

b. DATA.

Type ..... single-speed with automatic front axle declutching.
Make ..... GMC Truck and Coach.
Number 2278438
Ratio ..... 1.16 to 1

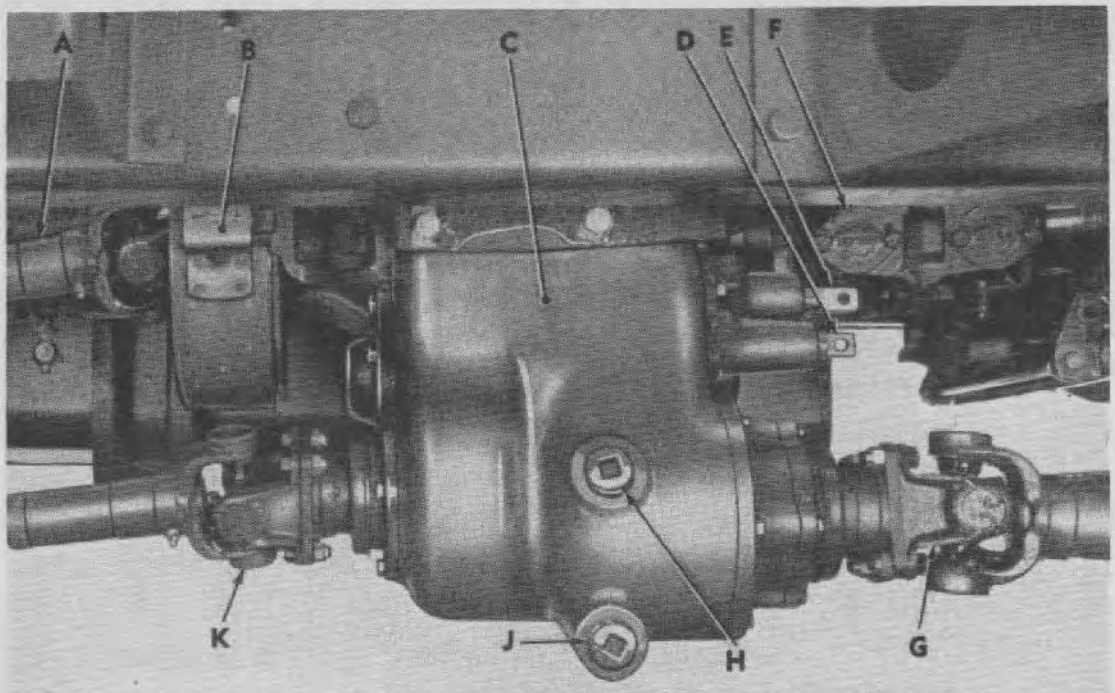


Figure 107. Transfer installed.

184. Front-Axle Drive Shift Linkage

a. GENERAL. Mechanism for positioning front axle drive jaw clutch for forward or reverse operation is interconnected to transmission shift linkage (fig. 100). Consequently, from driver's view point, operation of transfer is automatic except when winching or when being towed. Adjustment of transfer forward and reverse shift linkage (fig. 100) must be made whenever transmission manual-shift linkage is adjusted or replaced.

b. LINKAGE ADJUSTMENT. Since transfer forward and reverse linkage is interconnected with transmission manual-shift linkage, refer to paragraph 177 for adjustment information.

c. LINKAGE REPLACEMENT.

(1) *Removal.* Remove clevis pin at each end of rod; then remove transfer reverse rod (H, fig. 100). Remove clevis pin at each clevis; then remove cross shaft lever to transfer rod. Remove two bolts and nuts which attach cross shaft bracket to transmission rear support; then remove cross shaft as a unit with lever and bracket.

(2) *Installation.* Position cross shaft, as a unit with lever and bracket, at transmission rear support. Install two bolts and nuts attaching cross shaft bracket to support, and tighten firmly. Position cross shaft lever to transfer rod in vehicle and connect with clevis pin at each end (fig 100). Do not install cotter pins. Position transfer reverse rod in vehicle and connect with clevis pin at each end, but do not install cotter pins. Adjust forward and reverse shift linkage as described in *b* above; then secure each of the four clevis pins with a cotter pin.

185. Manual-Shift Linkage

a. GENERAL. Transfer is placed into neutral and driving operation with manually-operated transfer lever, located above floor slightly to right of driver's seat (H, fig. 108). Through linkage, manually-operated lever actuates power-take-off shifter shaft in transfer. With transfer lever raised to "UP-ENGAGED" position, transfer is in driving position. When transfer lever is lowered to DOWN-NEUTRAL position, transfer is in neutral.

b. LINKAGE ADJUSTMENT. With hand-operated transfer lever in UP-ENGAGED position, and with lever resting on lower edge of guide slot, make sure shifter shaft in transfer is pulled out (forward) to detent stop. Adjust clevis (E, fig. 108) to center clevis pin vertically in elongated holes in clevis. Tighten lock nut firmly and secure all clevis pins with cotter pins.

c. LINKAGE REPLACEMENT.

(1) *Removal.* Remove cotter pin and clevis pin which connect transfer-lever-to-cross-shaft rod (F, fig. 108) to transfer lever (H, fig. 108). Remove cotter pins, retaining washer, and shaft which connect transfer lever to bracket; then remove transfer lever. Remove cotter pin, two washers, and clevis pin from lower end of

transfer lever-to-cross-shaft rod (F, fig. 108); then remove rod. Remove cotter pin, two washers, and clevis pin which connect cross shaft lever to transfer shifter shaft. Remove two nuts and bolts which attach each cross shaft bracket to frame crossmember; then remove cross shaft and brackets from vehicle.

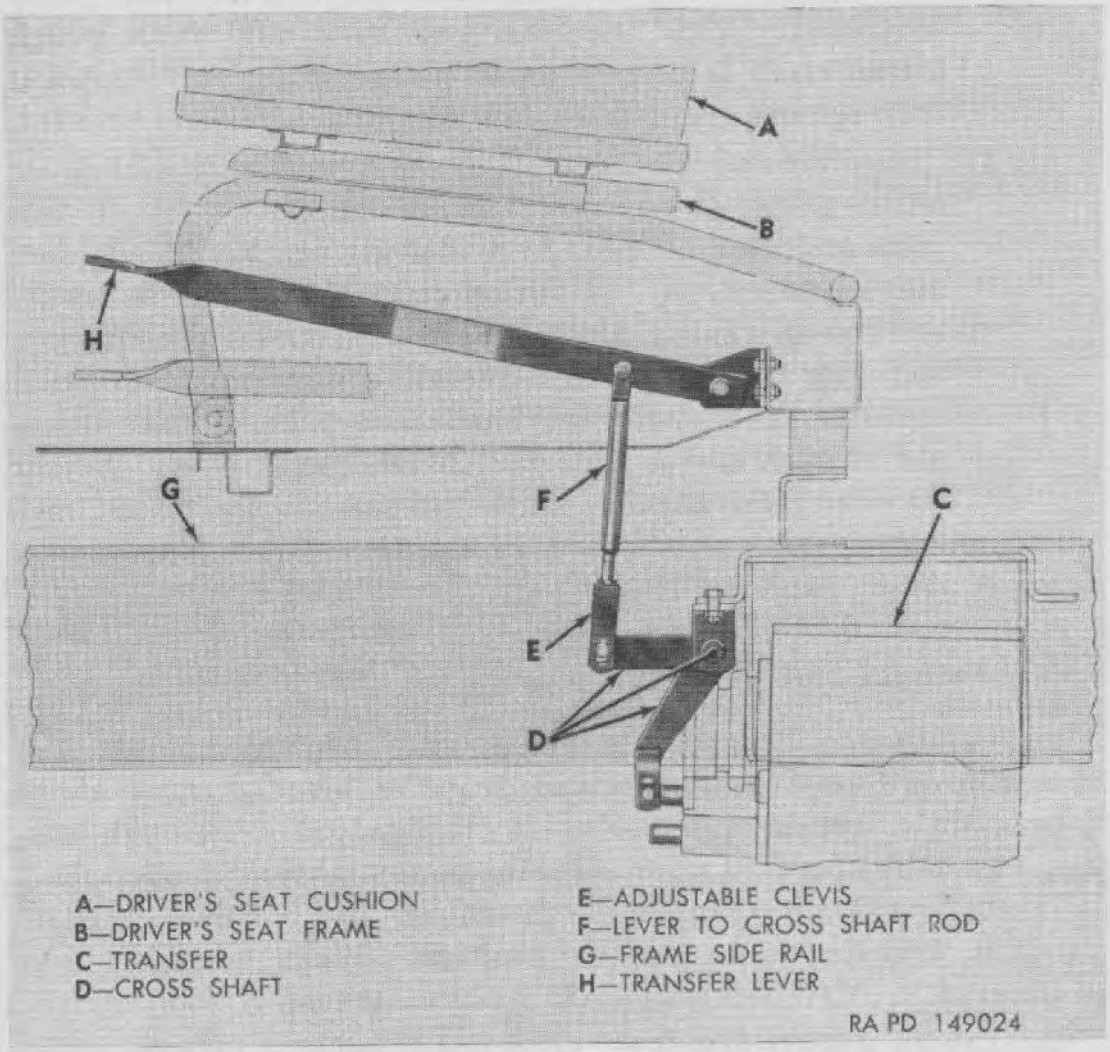


Figure 108. Transfer lever linkage.

(2) *Installation.* Position cross shaft and brackets to frame cross member. Attach each bracket with two bolts and nuts, tightening nuts firmly. Install clevis pin and two washers connecting cross shaft lever to transfer shifter shaft. Position transfer lever (H, fig. 108) to bracket and attach with shaft and retaining washer; then secure with cotter pins. Position transfer-lever-to-cross-shaft rod (F, fig. 108) and attach to transfer lever with clevis pin; then secure with cotter pin. Adjust linkage, as described in *b* above; then connect rod

(F, fig. 108) to cross shaft lever with clevis pin, two washers, and cotter pin.

186. Coordination with Ordnance Maintenance Unit

Replacement of the transfer with a new or rebuilt transfer is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, providing authority for performing this replacement is obtained from the appropriate commander. Tools needed for the operation, which are not carried in the using organization, may be obtained from the supporting ordnance maintenance unit.

187. Transfer Removal

a. DRAIN LUBRICANT. Remove drain and filler plugs (fig. 109), and allow lubricant to drain. Install and tighten plugs when drainage is complete.

b. DISCONNECT CONTROL LINKAGE. Disconnect control linkage by removing cotter pins and clevis pins from front axle shifter shaft and power-take-off shifter shaft (figs. 107 and 109). If winch is used, disconnect control at power-take-off (par. 190).

c. DISCONNECT VENT LINE. At top of transfer, unscrew tubing nut to disconnect vent line. Cover opening with tape.

d. DISCONNECT SPEEDOMETER FLEXIBLE SHAFT. Unscrew knurled nut with pliers and pull flexible shaft out of speedometer driven gear shaft.

e. DISCONNECT PARKING BRAKE CONTROL. Remove cotter pin and clevis pin which attach parking brake rod to brake cam levers.

f. DISCONNECT PROPELLER SHAFTS. Disconnect propeller shafts at transfer, two at front and two at rear, by removing bolts and nuts attaching propeller shaft flanges to transfer companion flanges. If equipped with winch, disconnect drive shaft at power-take-off (par. 288).

g. REMOVE TRANSFER. Roll dolly jack under vehicle and raise into position to support transfer. Bend cap screw lock plates away from screw heads and remove four mounting screws from each side. Lower transfer on jack and withdraw from under vehicle.

h. REMOVE ACCESSORIES. Remove parking brake assembly from rear of transfer (pars. 235*a* and 236*a*). Remove power-take-off (when used) as described in paragraph 192.

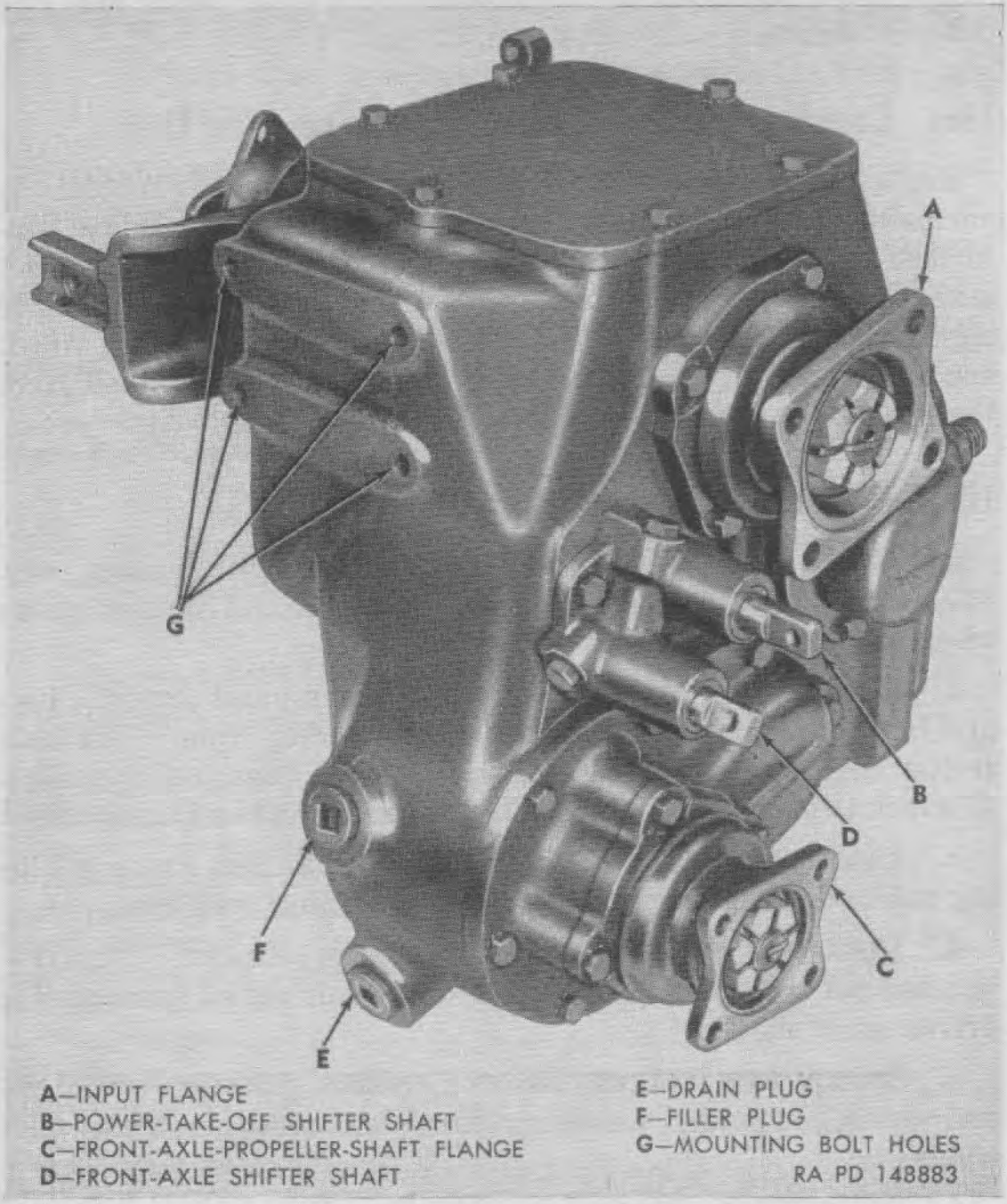


Figure 109. Transfer removed.

188. Transfer Installation

a. INSTALL ACCESSORIES. If vehicle is equipped with winch, install power-take-off as described in paragraph 193. Install parking brake assembly on rear of transfer (pars. 235*b* and 236*b*).

b. INSTALL TRANSFER. Place transfer on dolly jack and roll into position under vehicle. Raise transfer into position between supports and aline holes in supports with threaded holes in case. With lock plates under cap screw heads, install eight cap screws, four on each side. Tighten cap screws to 60 to 85 pound-feet torque and bend lock plates against cap screw heads. Lower dolly jack and remove from under vehicle.

c. CONNECT PROPELLER SHAFTS. Connect propeller shafts to transfer, two at front and two at rear. If equipped with winch, connect drive shaft to power-take-off (par. 288).

d. CONNECT PARKING BRAKE CONTROL. Install clevis pin connecting parking brake rod to brake cam levers. Secure clevis pin with new cotter pin. Adjust parking brake (par. 234).

e. CONNECT SPEEDOMETER FLEXIBLE SHAFT. Connect speedometer flexible shaft to transfer. Make sure that tongue on cable meshes with speedometer gear shaft. Tighten knurled nut with pliers.

f. CONNECT VENT LINE. Connect vent line at top of transfer. Tighten tubing nut firmly.

g. CONNECT CONTROL LINKAGE. Install clevis pins connecting linkage to shifter shafts. Secure clevis pins with new cotter pins. If winch is used, connect control to power-take-off (par. 190).

h. LUBRICATE. Examine condition of drain plug and replace if necessary. Install lubricant as described in paragraph 59*j*. Make sure drain and filler plugs are tight.

i. RECORD REPLACEMENT. Make a record of the replacement on DA AGO Form 478.

Section XIX. POWER-TAKE-OFF AND CONTROLS

189. Description

Single-speed power-take-off assembly is mounted to left side of transfer (fig. 110). Output shaft of power-take-off drives winch

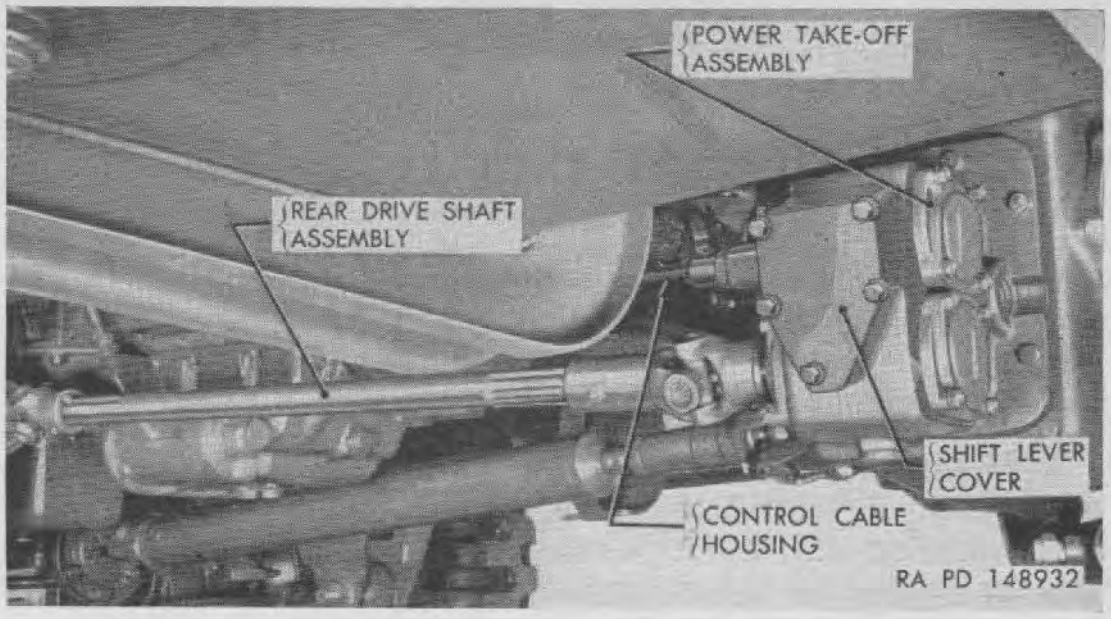


Figure 110. Power-take-off installed.

through drive shafts and universal joints. Power-take-off mechanism is placed into neutral, forward, and reverse driving positions by means of a manually-operated control lever, mounted under driver's seat. Lever is connected by cable linkage to shift lever on power-take-off (fig. 111). Operation of the power-take-off in conjunction with the winch is explained in paragraph 46.

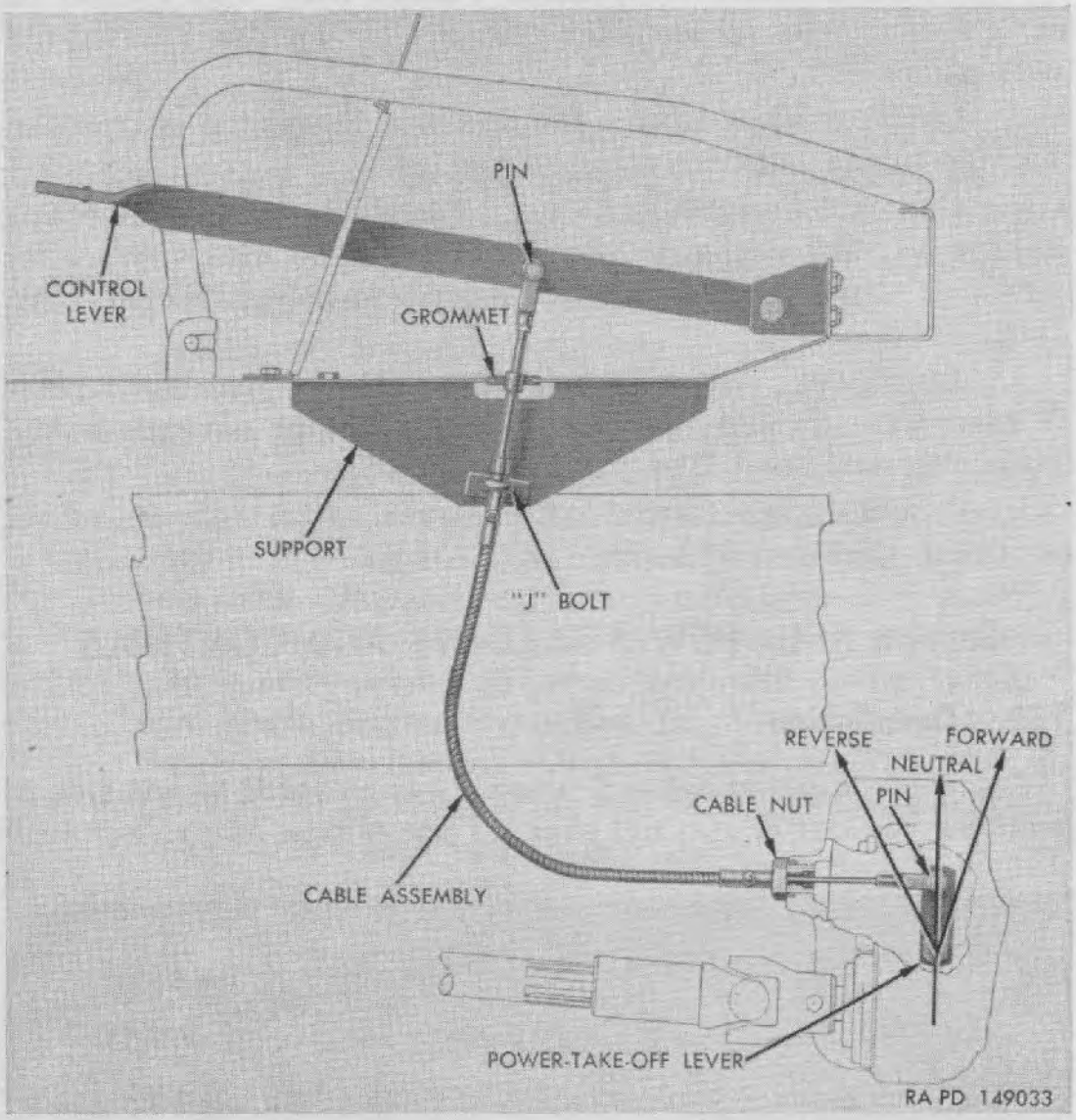


Figure 111. Power-take-off control linkage.

190. Controls and Linkage

a. GENERAL. The control cable assembly is connected to power-take-off control lever (in cab) and to shifting lever in power-take-off (fig. 111). Cable assembly is attached with a J bolt to a support bolted under floor pan. Cable assembly is equipped with an adjustable yoke at control lever (fig. 111).

b. LINKAGE REMOVAL (fig. 111).

(1) Remove J bolt and nut attaching cable assembly to support under floor pan.

(2) Remove pin from yoke at control lever.

(3) Pull cable assembly down through rubber grommet in floor pan (under driver's seat).

(4) Remove five bolts attaching cover plate to power-take-off. Reach in and remove clevis pin from yoke at take-off lever.

(5) Loosen cable nut at power-take-off. Turn cable housing to remove cable assembly from power-take-off.

c. LINKAGE INSTALLATION (fig. 111).

(1) Place nut and lock washer on lower end of housing; then insert lower end of cable into power-take-off. Install pin through yoke and take-off lever. Turn cable housing to thread housing into power-take-off case; then tighten cable nut securely.

(2) Push cable assembly up through grommet in floor pan.

(3) Attach cable assembly to support (under floor pan) with J bolt and nut. Make certain that J bolt engages groove in cable assembly.

(4) With control lever in center slot of lock plate in cab (NEUTRAL) and shifting lever on power-take-off in vertical position (NEUTRAL), adjust yoke at control lever and at power-take-off lever for free entry of clevis pins without bind. Tighten jam nut at yoke.

(5) Check action of linkage by placing control in lower slot in lock plate (FORWARD). Lever at power-take-off should move toward rear to engage power-take-off for pulling or winding in cable on winch (par. 46*b*). Place control lever in upper slot of lock plate (REVERSE). Lever at power-take-off should move forward to engage power-take-off for paying-out or unwinding cable on winch (par. 46*c*).

(6) Install plate on side of power-take-off with five attaching bolts.

(7) Lubricate cable through lubrication fittings in cable assembly (par. 57).

191. Coordination with Ordnance Maintenance Unit

Replacement of the power-take-off with a new or rebuilt power-take-off is normally an ordnance maintenance operation, but may

be performed in an emergency by the using organization, providing authority for performing this replacement is obtained from the appropriate commander. Tools needed for the operation which are not carried in the using organization may be obtained from the supporting ordnance maintenance unit.

192. Power-Take-Off Removal

a. Remove drain plug at bottom of power-take-off case to drain lubricant.

b. Remove five bolts attaching plate to side of power-take-off. Remove control cable (par. 190*b*).

c. Remove eight bolts which attach power-take-off to transfer case.

d. Pull power-take-off assembly straight out from transfer until gears clear transfer. Pull assembly straight back until universal joint clears splines of rear drive shaft.

e. Loosen set screw which secures universal joint to power-take-off shaft. Drive universal joint from shaft.

193. Power-Take-Off Installation

a. Install rear universal joint to power-take-off shaft, engaging key with keyway in joint yoke. Tighten set screw which secures joint to power-take-off shaft.

b. As power-take-off is raised into place, engage universal joint with splines on rear drive shaft.

c. Position new gasket on transfer case opening. Position power-take-off into transfer. Install and tighten eight attaching bolts.

d. Insert lower yoke of control cable into power-take-off. Insert pin through yoke and power-take-off lever.

e. Install control cable (par. 190*c*).

f. Fill transfer with lubricant (par. 57).

g. Make a record of the replacement on DA AGO Form 478.

Section XX. FRONT AXLE

194. Description and Data

a. DESCRIPTION.

(1) *General.* Front axle is hypoid, single-reduction type, using conventional differential and carrier assembly to transmit drive to front wheels through constant-velocity

Bendix-Weiss universal joints. Power to differential is transmitted from transfer through conventional propeller shaft.

(2) *Mounting.* Axle is attached to front springs in the usual manner using U bolts. Axle position is also held in exact location by the use of three torque rods between axle housing and frame brackets, which absorb all drive and braking torque and allow much easier riding of front springs.

b. DATA.

Type	hypoid, single-reduction.
Ratio	6.17 to 1.
Type of constant-velocity joints	Bendix-Weiss.

195. Front-Wheel Alinement

a. ALINEMENT FACTORS. Front-wheel alinement factors, such as camber, caster, turning angle, and toe-in, have a major effect on steering from a standpoint of control, ease of steering, and safety. Front wheel misalinement is a major cause of premature and uneven tire wear.

b. CASTER. Front-axle caster is the inclination of the center line through the upper and lower steering knuckle trunnions toward the rear of the vehicle (L, fig. 112). Caster is established by design, therefore no adjustment can be made.

c. CAMBER. Front wheel camber is the outward inclination of the wheels as viewed from the front of the vehicle; that is, the wheels are farther apart at the top than at the bottom (J, fig. 112). There is no adjustment for camber; however, loose wheel bearings, loose steering knuckle trunnion bearings, bent steering knuckle, or bent axle housing will affect camber.

d. TURNING ANGLE. Front wheel turning angle is the maximum angle through which the wheels may be turned from the straight-ahead position. This angle is greater for the inside wheel (C, fig. 112) than for the outside wheel (D, fig. 112).

e. TOE-IN. Front wheel toe-in is the amount by which the wheels are closer together at the front than at the rear, with the wheels in a straight-ahead position (A minus B, fig. 112). Camber causes both wheels to have a tendency to turn outward from the vehicle. Toe-in counteracts this tendency and causes the wheels to roll straight ahead with no scuffing action.

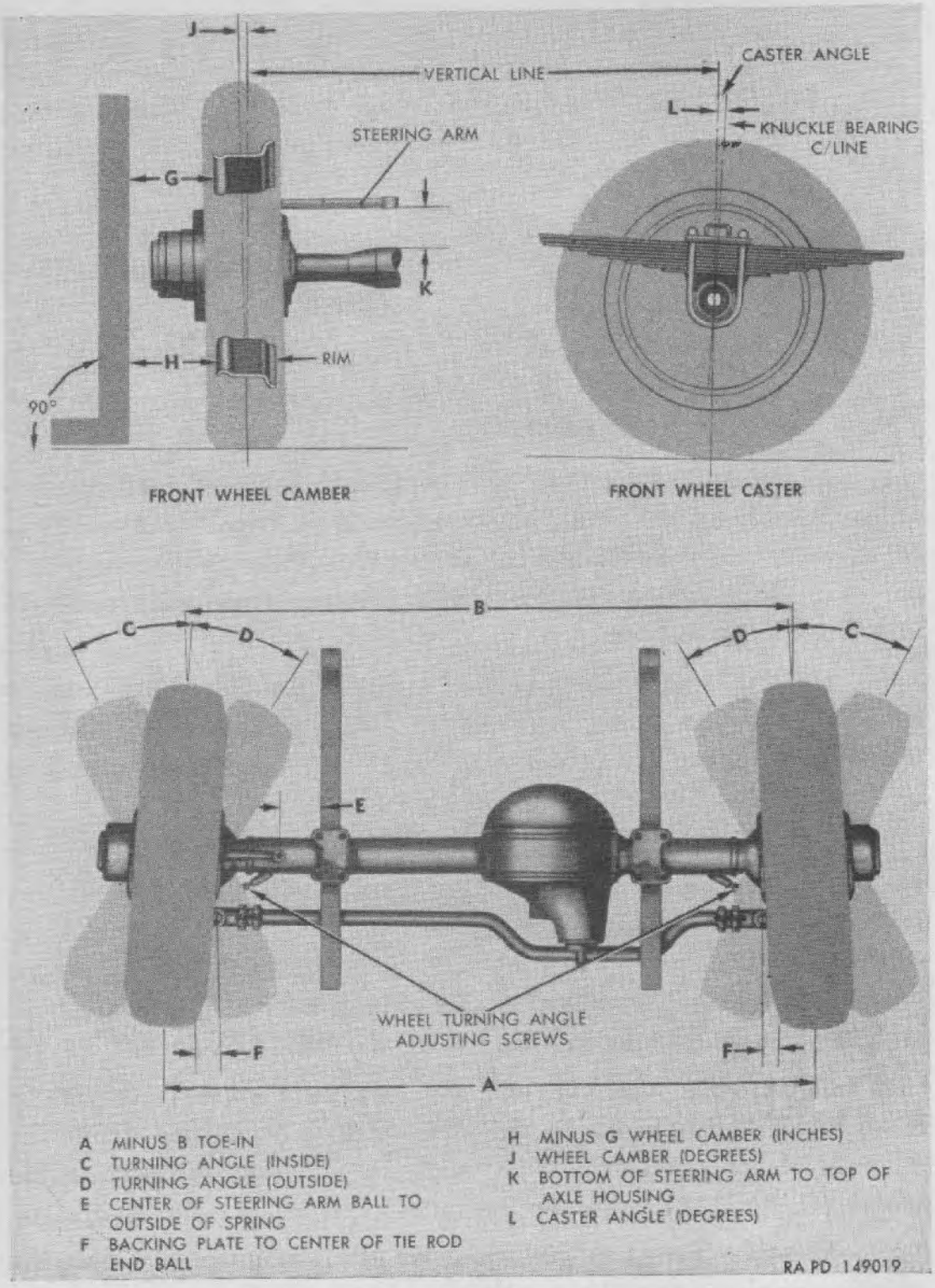


Figure 112. Front-wheel-and-axle-alinement chart.

f. ALINEMENT DATA.

A minus B	Toe-in (at hub C/L)	5/32 in to 7/32 in.
C	Turning angle—inside	28 deg + 1 deg − 0 deg.
D	Turning angle—outside	26 deg.
E	Center line of steering arm ball to outside of spring	3¼ in.
F	Backing plate to center of tie rod end pin	2⅞ in.
H minus G	Wheel camber	27/64 in to 0 in.
J	Wheel camber	¾ deg to 0 deg.
K	Bottom of steering arm to top of axle housing	3⅜ in.
L	Caster angle	1 deg 45 min.

196. Toe-In Adjustment

a. TOE-IN CHECK (fig. 113). Inflate tires to correct pressure (par. 240*a*), check for proper wheel bearing adjustment (par. 244); then place vehicle on a smooth, level surface with the wheels in straight-ahead position. Place a toe-in wheel alinement gage between the wheels ahead of the axle at hub height with the ends of the gage bearing against the tire side walls and with ends of both pendant chains an equal distance from ground. Set gage so pointer registers zero. Remove gage and place at same relative position at rear of tire and with ends of pendant chains same distance from ground as at front. The pointer will indicate the amount of toe-in or toe-out. Correct toe-in is 5/32 inch to 7/32 inch.

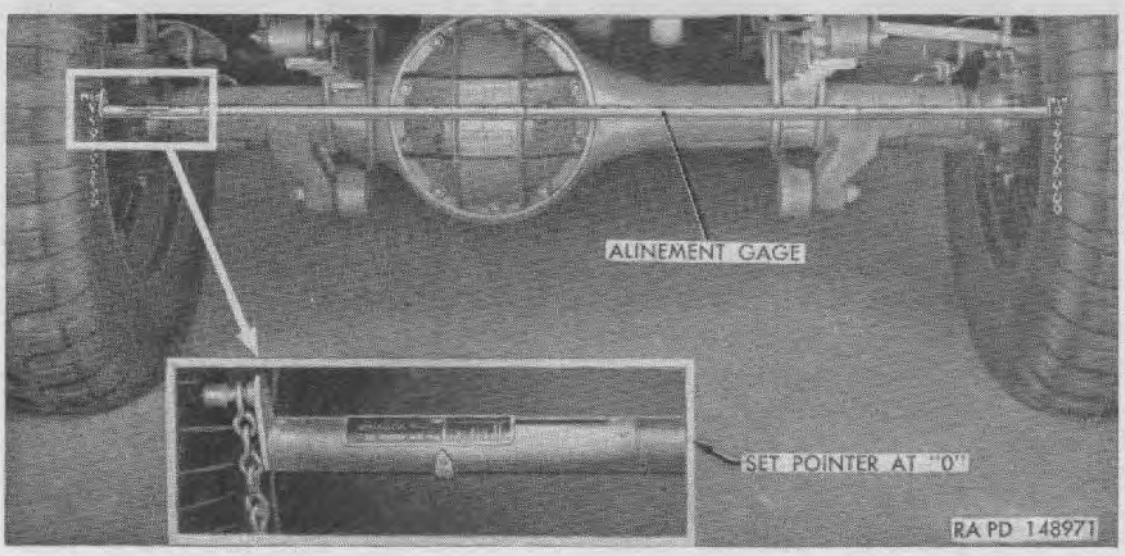


Figure 113. Checking toe-in (Gage 41–G–510).

b. TOE-IN ADJUSTMENT. Loose wheel bearings, worn steering knuckle bushings, loose steering knuckle support trunnion bearings, damaged wheels, and bent steering knuckle, housing, and tie-rod will affect toe-in. Replace damaged parts, and adjust wheel bearings (par. 244), before adjusting the tie rod to correct toe-in.

(1) *Remove tie rod* (fig. 114). Position vehicle with wheels in straight-ahead position and remove tie rod (par. 197*b*).

(2) *Adjust tie rod.* Loosen tie rod end clamp bolt nuts at each end of tie rod. Remove inner clamp bolt and tie-rod-in lock (fig. 115) at tie rod left end. Screw tie rod ends onto or off of tie rod as required to obtain correct toe-in.

Note. Tie rod right end has coarse threads, while tie rod left end has fine threads. This construction permits a finer adjustment than would be possible if both threads were same size. Toe-in will be changed about one-eighth inch by each revolution of right (coarse thread) end, and slightly less by turning left (fine thread) end. In some instances it may be necessary to adjust both ends to obtain correct toe-in.

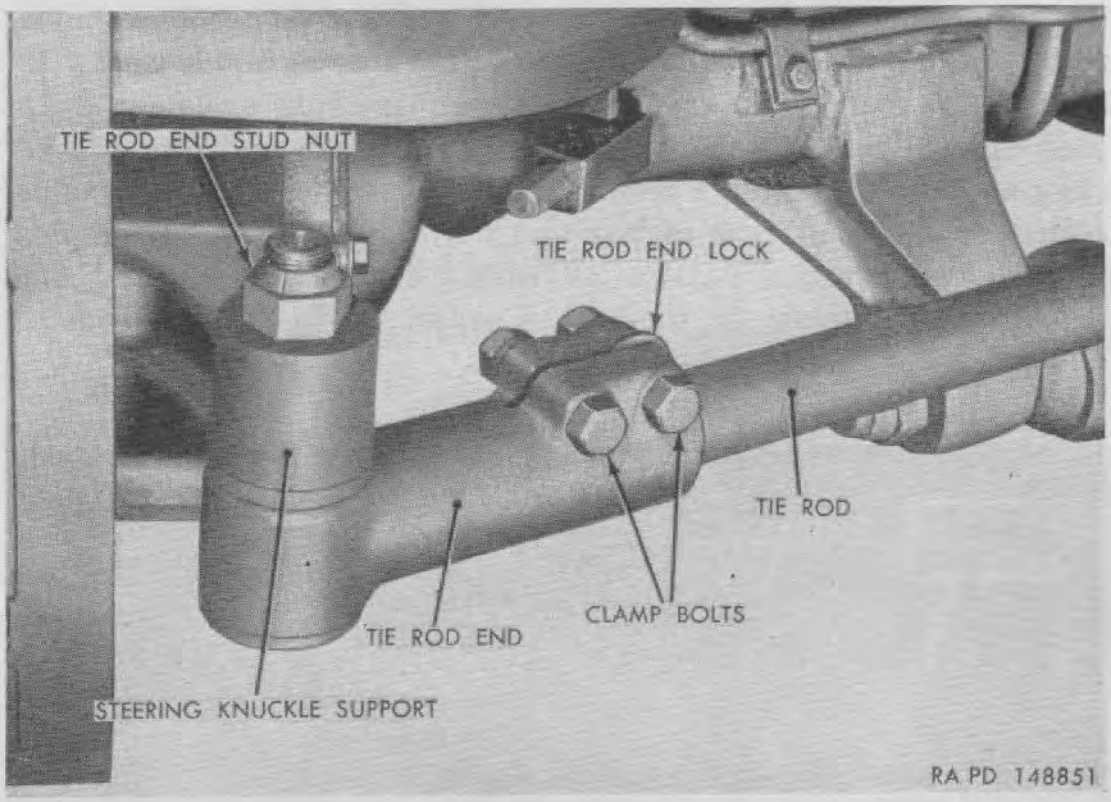


Figure 114. Tie rod installed.

(3) *Check adjustment.* After adjusting tie rod ends, temporarily install ends on steering knuckle supports. Measure toe-in as instructed in *a* above, and readjust if necessary until measurement is correct.

(4) *Install tie rod.* When adjustment is correct reinstall tie rod ends permanently to steering knuckle support. Install lock in tie rod left end (fig. 115), making certain that lock is seated in keyway in tie rod. Aline lock with bolt hole in tie rod end; then install clamp bolt and nut. Tighten two clamp bolt nuts at each tie rod end.

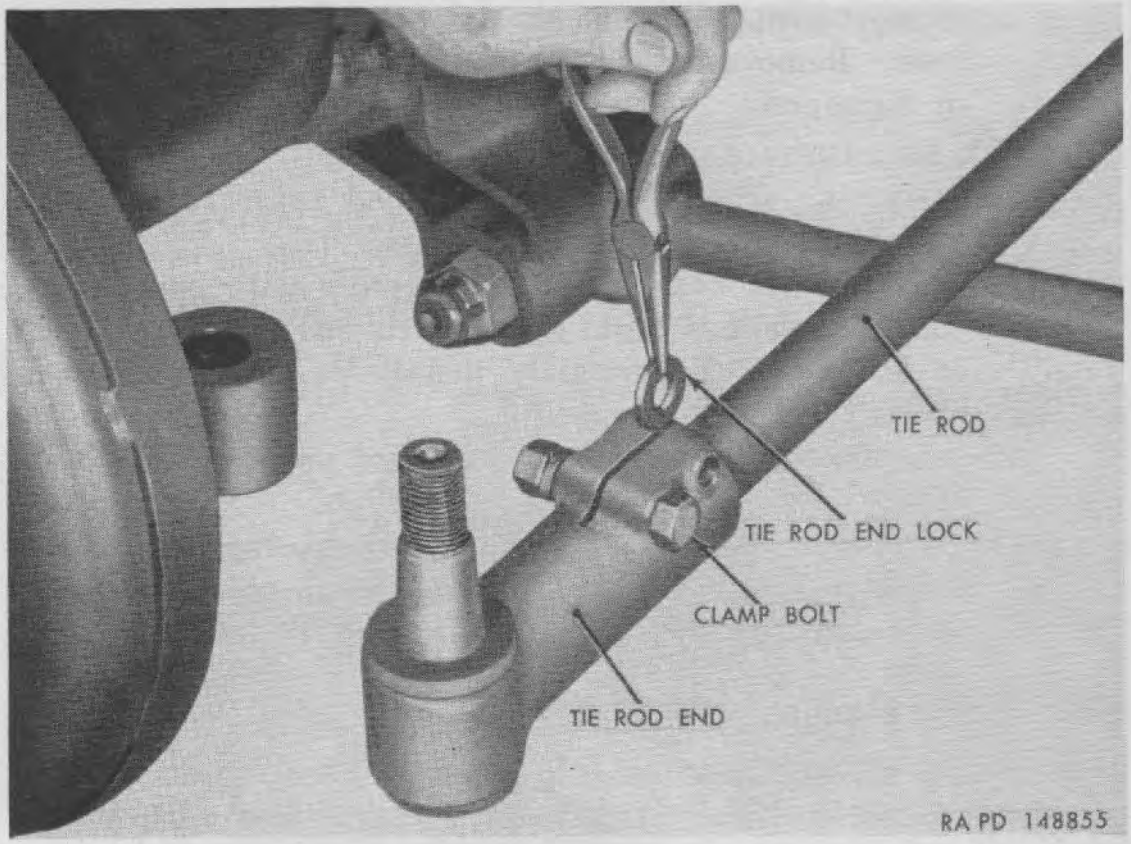


Figure 115. Installing tie rod end lock.

197. Tie Rod

a. GENERAL. Tie rod is solid type with double offset to clear differential carrier and is connected to steering knuckle supports by tie rod ends which are threaded onto tie rod and held by two clamps bolts at each end. Left end of tie rod has fine threads while right end has coarse threads, which permits a fine degree of toe-in adjustment. Tie rod ends incorporate a tapered pin mounted in material requiring no lubrication. Tapered pin is held in steering knuckle support by a nut.

b. TIE ROD REMOVAL.

(1) *Position vehicle.* Place vehicle on a level surface and apply parking brake. Place a jack under front axle and raise enough to take weight of vehicle off front wheels.

(2) *Remove tie rod.* Loosen two tie rod end clamp bolt nuts at each end of tie rod, also remove inner clamp bolt and lock (fig. 115) at tie rod left end. Remove tie-rod-end-tapered-pin nut at each end of tie rod. Tap steering-knuckle-support arm a sharp blow with hammer as downward pressure is applied to tie rod end with a pinch bar. Move each tie rod end down an at same time twist forward until free from steering-knuckle-support arm. Remove tie rod end when both ends are free. Remove and discard rubber seals if deteriorated or damaged.

c. TIE ROD INSTALLATION.

(1) *General.* Toe-in must be adjusted (par. 196*b*) when installing new or reconditioned tie rod.

(2) *Position tie rod.* Position assembly with end having coarse threads at right side and tie rod end having lock at left side. Temporarily install tie rod until toe-in check (par. 196*a*) is made.

(3) *Adjust tie rod.* Adjust tie rod for proper toe-in (par. 196*b*).

(4) *Install tie rod.* Install tie rod ends to steering knuckle supports (par. 196*b* (4)), using new seals if old parts were discarded.

198. Drive Flange

a. DRIVE FLANGE REMOVAL. Remove eight stud nuts attaching drive flange to hub. Strike hub a sharp blow with a soft hammer to loosen tapered split dowels; then remove dowels from studs. Install two cap screws (½-20 NF) in the tapped holes in drive flange. Turn screws evenly and alternately until flange is removed. Remove and discard flange to hub gasket.

b. DRIVE FLANGE INSTALLATION. Install drive flange over splined outer end of axle shaft, using a new gasket between flange and hub. Aline holes in flange with hub studs; then push flange in against hub. Install eight split tapered dowels and nuts on studs and tighten nuts to 55–65 pound-feet torque. When nuts have been tightened, inspect for slight clearance (aprx. 1/16 in) between nut and flange. If no clearance exists, it indicates that dowels, tapered holes in flange, or studs are worn excessively and must be replaced with new parts.

199. Axle Shaft and Universal Joints

a. GENERAL. Axle shafts are full-floating type with a Bendix-Weiss constant-velocity universal joint at each steering

knuckle. Each axle shaft is splined at inner end in differential side gear, and at outer end in drive flange which is attached to wheel hub.

b. AXLE SHAFT AND UNIVERSAL JOINT REMOVAL.

(1) *Remove wheel.* Jack up axle; then remove wheel stud nuts and remove tire and wheel assembly.

(2) *Remove drive flange, hub, and drum.* Remove drive flange (par. 198*a*). Remove wheel hub and brake drum assembly (par. 245*a*).

(3) *Loosen brake hose shield.* Remove three cap screws and lock washers attaching brake hose shield to top of steering knuckle support, to permit utilizing full length of brake flexible hose when brake backing plate and shoe assembly is removed.

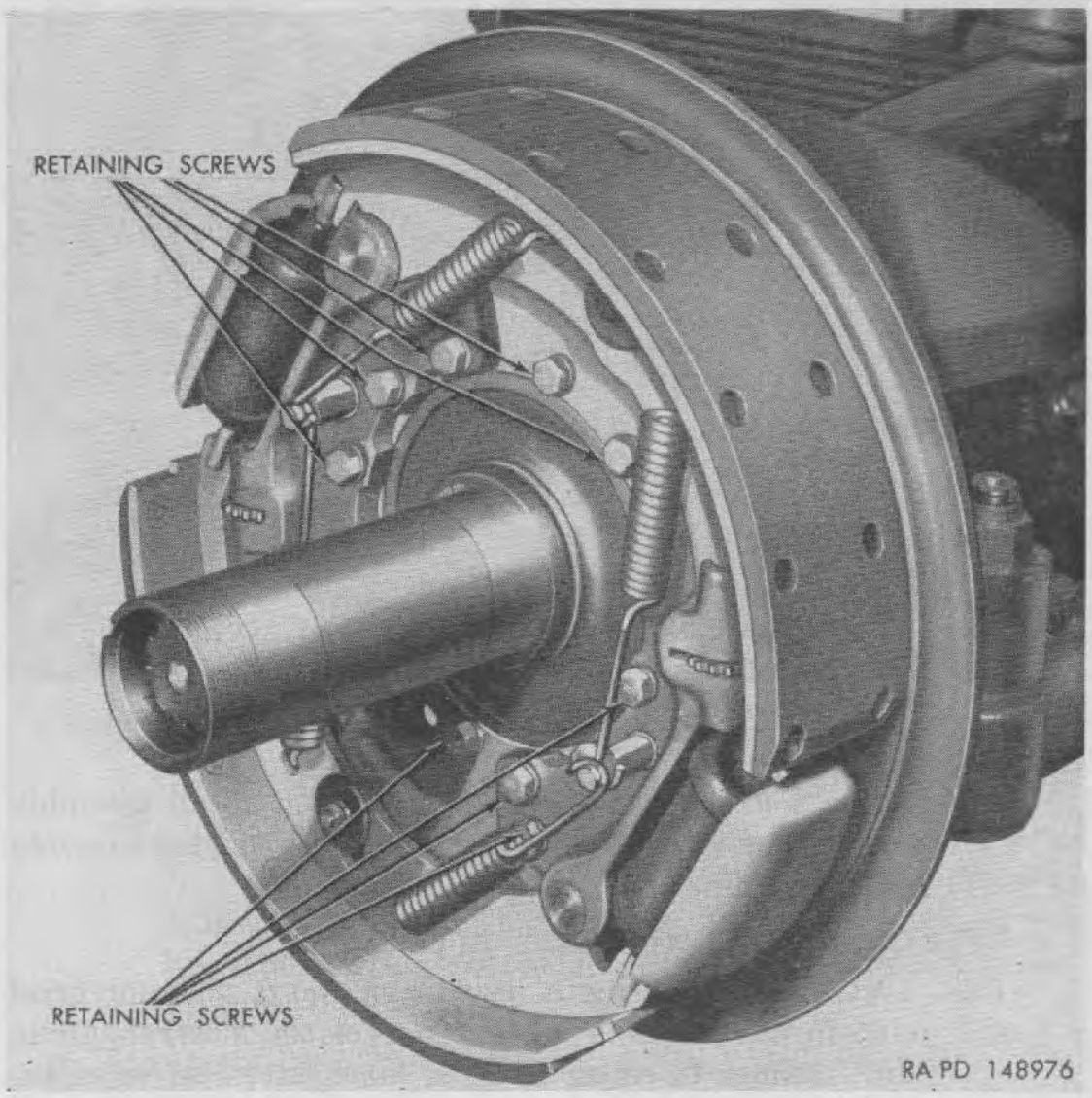


Figure 116. Brake backing plate and shoe assembly installed.

(4) *Remove brake backing plate and shoe assembly.* Remove 12 retaining screws and lock washers (fig. 116) attaching brake backing plate to steering knuckle.

Note. Observe installed position of backing plate so that it can be reinstalled in its original location.

Remove backing plate and shoe assembly from steering knuckle and swing over end of steering knuckle (fig. 117). Remove old gasket from backing plate and steering knuckle.

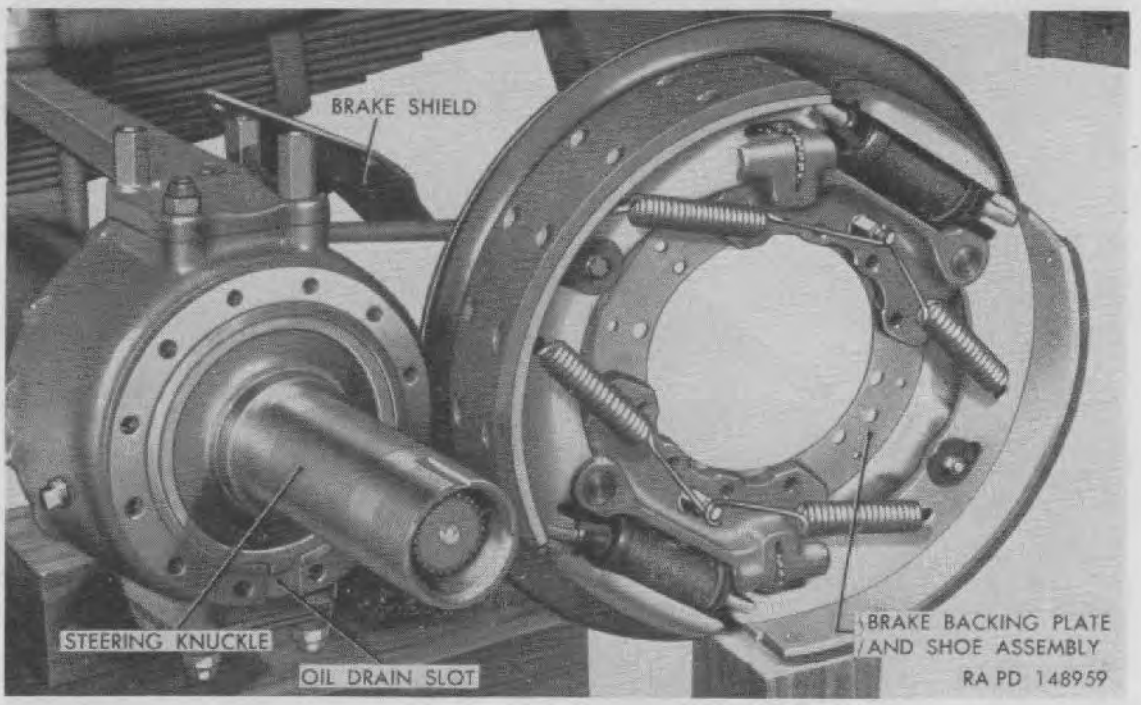


Figure 117. Brake backing plate and shoe assembly removed showing steering knuckle.

(5) *Remove steering knuckle.* Tap steering knuckle with soft hammer to loosen from steering knuckle support; then remove steering knuckle. Remove old gasket from steering knuckle and knuckle support.

(6) *Remove axle shaft and universal point.* Pull assembly straight out (fig. 118) as assembly is supported to avoid damage to axle shaft oil seal in housing.

c. CLEANING, INSPECTION, AND LUBRICATION.

(1) *Cleaning.* Thoroughly wash axle shaft and universal joint in dry-cleaning solvent or volatile-mineral-spirits paint thinner to remove all old lubricant; also wash inside of steering knuckle support, steering knuckle, and housing outer end.

(2) *Inspection.* Inspect balls and ball races for grooved, scratched, or pitted condition. To determine if excessive play or backlash exist in the universal joint, place the assembly in a vise, having soft jaws, in a vertical position with the outer (short) shaft up, and with vise jaws gripping the inner shaft below the universal joint. Firmly push down on outer shaft so that it rests on center ball, and at the same time attempt to twist the joint in both directions. If any play or backlash is evident, report to ordnance maintenance personnel. Inspect axle shaft thrust washers in steering knuckle and axle housing for excessive wear or damage. Examine axle shaft splines for nicks, cracks, or other damage. Inspect oil seal in axle housing for wear or cuts in lip of seal. Report all worn or damaged conditions to ordnance maintenance personnel.

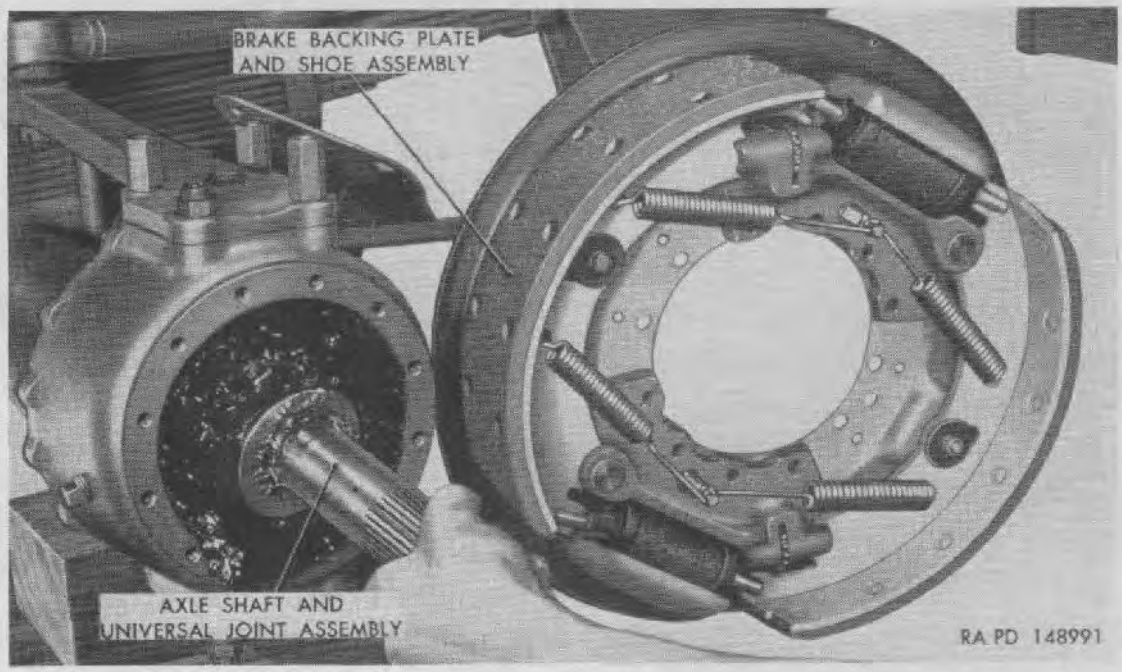


Figure 118. Removing axle shaft and universal joint assembly.

(3) *Lubrication.* Pack new lubricant well into universal joint and around balls until if fills all space between balls and universal joint yokes (par. 57). Also spread lubricant on surfaces which contact thrust washers and bushing in steering knuckle.

d. AXLE SHAFT AND UNIVERSAL JOINT INSTALLATION.

(1) *Install axle shaft and universal joint.* Use care not to damage axle shaft seal in housing, and insert axle shaft

and universal joint assembly into axle housing, guiding splined end of inner shaft into splined differential side gear.

(2) *Install steering knuckle.* Carefully install new gasket to steering knuckle support. Place steering knuckle over outer end of axle shaft and position against steering knuckle support with bolt holes in alinement.

Note. Milled oil drain slot in steering knuckle flange must be at bottom (fig. 117).

(3) *Install backing plate and shoe assembly.* Carefully install new gasket to steering knuckle. Swing backing plate and shoe assembly over end of steering knuckle and into place against steering knuckle, being sure plate is properly located at noted at time of removal (fig. 116). Aline bolt holes in plate with those in steering knuckle and install 12 retaining screws and lock washers. Tighten screws. Install brake flexible hose shield at top of steering-knuckle-arm studs, using three cap screws and lock washers.

(4) *Install hub and drum.* Install wheel hub and brake drum assembly (par. 245) and adjust hub bearings (par. 244).

(5) *Install drive flange.* Install axle drive flange (par. 198*b*).

(6) *Install wheel.* Install wheel and tire on hub, install wheel stud nuts, and tighten. Lower jacks and remove from under vehicle.

200. Housing Outer Seal

a. GENERAL. Axle housing outer end seals are installed on inner side of each steering knuckle support around spherical surface of axle housing outer end. Each assembly consists of a gasket, outer retainer, oil seal (felt), spring seal retainer, dust seal, seal retainer, and inner retainers (fig. 119). The oil seal is composition of felt and neoprene to prevent leakage of lubricant. The dust seal is spring loaded and bears tightly against spherical surface. When seals are in good condition and properly installed, lubricant leakage is prevented and entrance of dirt, water, or other contaminants is prevented.

b. REMOVAL.

(1) *Remove inner retainers.* Remove 12 caps and screws and lock washers attaching two inner retainers, seal retainer, and outer retainer to steering knuckle support (fig. 119).

(2) *Remove oil seals* (fig. 119). Oil seal (felt) is split and can be replaced with new part. Dust seal (neoprene) and spring seal retainer are not split and cannot be replaced at this time. Report worn or damaged conditions to ordnance maintenance personnel.

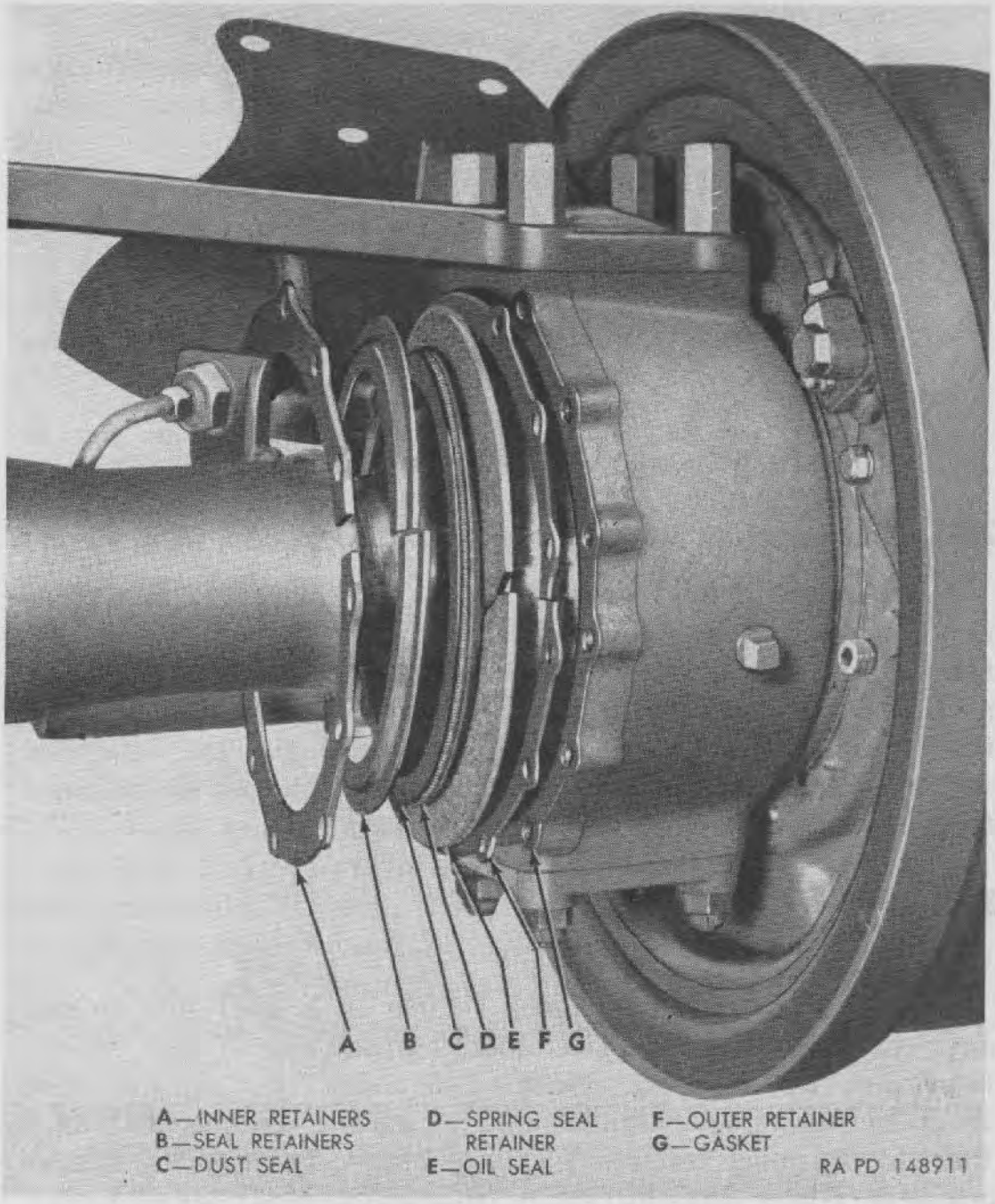


Figure 119. Housing outer seal components.

c. CLEANING AND INSPECTION.

(1) *Cleaning.* Clean steering knuckle support and outer retainer to remove all gasket material. Clean axle housing spherical surface and retainers, using dry-cleaning

solvent or volatile-mineral-spirits paint thinner. Clean spherical surface with fine flint paper if surface is pitted or rusty.

(2) *Inspection.* Inspect oil seal to determine if continued use is advisable. Report all worn or damaged conditions to ordnance maintenance personnel.

d. INSTALLATION.

(1) *Install gasket.* Install new gasket to steering knuckle support, using small quantity of gasket cement to hold gasket in place.

(2) *Install seal and retainers.* Install remaining parts in order illustrated in figure 119 as follows: Outer retainer, oil seal (felt), dust seal and spring, seal retainer, and two inner retainers. When the above parts are properly positioned, secure with 12 cap screws and lock washers.

Note. Felt side of oil seal must be toward outside and joint at top; also, install outer seal joint toward front.

201. Coordination with Ordnance Maintenance Unit

Replacement of the front axle with a new or rebuilt front axle is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, providing authority for performing this replacement is obtained from the appropriate commander. Tools needed for the operation which are not carried in the using organization may be obtained from the supporting ordnance maintenance unit.

202. Front Axle Removal

(fig. 120)

a. POSITION VEHICLE. Place vehicle on a level surface and apply parking brake, or place blocks on each side of rear wheels, to prevent vehicle rolling. Place a jack under front axle and raise front end of vehicle high enough to permit withdrawing axle. Place blocks under frame side rails at rear of front spring hanger brackets. Lower jack until entire front end weight rests on blocks.

b. REMOVE WHEELS. Remove wheel stud nuts and remove wheel and tire from each side.

c. DISCONNECT PROPELLER SHAFT. Remove four bolts and nuts attaching propeller shaft universal joint flange to differential pinion flange. Tie propeller shaft up to prevent universal joint becoming damaged or filled with dirt.

b. CONNECT UPPER TORQUE ROD. Insert upper torque rod tapered pin into axle bracket and install nut and washer. Tighten nut to 350–400 pound-feet torque.

c. CONNECT FLEXIBLE HOSE. Connect hydraulic brake and axle vent flexible hose at junction on top of axle housing.

d. CONNECT AXLE TO SPRINGS. Lift axle until spring center bolt is located in hole of spring seat on top of axle. Install "U" bolts and spring bumper block with shock absorber link eye at front. Install "U" bolt nuts and tighten nuts to 170–200 pound-feet torque.

e. CONNECT SHOCK ABSORBER LINKS. Install shock absorber link stud in spring bumper block and install nut. Tighten nut to 48–64 pound-feet torque.

f. CONNECT LOWER TORQUE RODS. Insert lower torque rod tapered pins into axle brackets and install washers and nuts. Tighten nuts to 350-400 pound-feet torque.

g. CONNECT DRAG LINK. Install drag link tapered stud in steering arm and install nut. Tighten nut securely.

h. CONNECT PROPELLER SHAFT. Position propeller shaft joint flange to differential pinion flange and install four bolts and nuts attaching these two flanges. Tighten four nuts to 33–43 pound-feet torque.

i. INSTALL WHEELS. Install wheels on hub and install stud nuts. Tighten nuts to 300–350 pound-feet torque.

j. BLEED BRAKES. Perform brake bleeding operation (par. 219).

k. LUBRICATE. Check lubricant level in axle differential and universal joints at outer end of housing (par. 57).

l. REMOVE BLOCKS AND JACK. Raise front of vehicle with jack sufficiently to permit removal of blocks from under frame side rails. Lower jack and withdraw from under vehicle. Recheck spring U bolts nuts for 170–200 pound-feet torque with full weight of vehicle resting on springs.

m. RECORD REPLACEMENT. Make a record of the replacement on DA AGO Form 478.

Section XXI. REAR AXLES

204. Description and Data

a. DESCRIPTION.

(1) *General.* Rear axles are hypoid, single-reduction type, using conventional differential and carrier assembly to

transmit drive to rear wheels through full-floating axle shafts. Housing is forged banjo type with cast cover which provides maximum strength and accessibility to differential.

(2) *Mounting.* Each axle is positioned and attached to frame by three torque rods, which transmit all of the drive and braking torque to the frame. Vehicle load is transmitted to axle through main and secondary springs which contact axle housings through brackets welded to axle housing. Springs contact at housing is slipper action on brackets welded to axle housings.

b. DATA.

Type	hypoid, single-reduction.
Type axle shafts	Full-floating.
Ratio	6.17 to 1.

205. Axle Shafts

a. GENERAL. Axle shafts are full-floating type with forged flange having integral lifting and hold-down eye at outer end and splines at differential end. Flanged end of shaft is attached to hub by studs, tapered dowels, and nuts. Inner end of shaft is splined to differential side gear.

b. AXLE SHAFT REMOVAL. Remove eight stud nuts at hub. Strike end of axle shaft (fig. 121) with hammer to loosen tapered

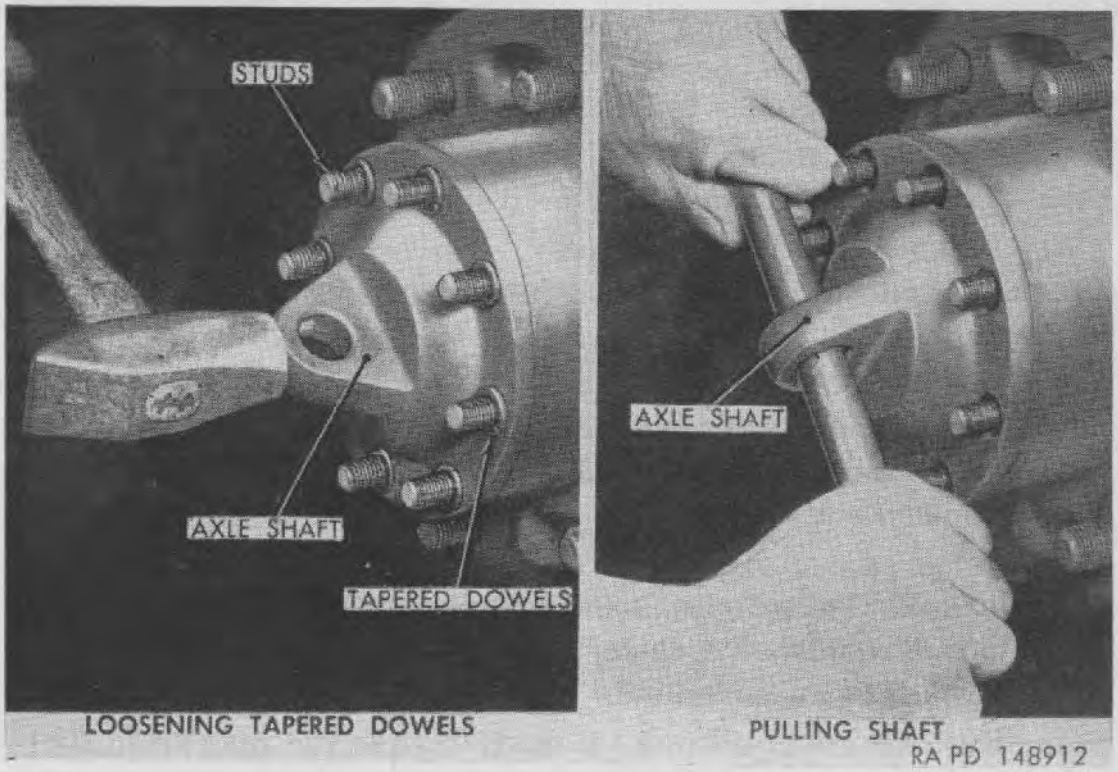


Figure 121. Removing axle shaft.

dowels; then remove dowels. Insert small steel bar through eye in end of axle shaft (fig. 121) and pull shaft out of axle.

c. AXLE SHAFT INSTALLATION. Clean shaft to remove any dirt; then dip splined end in axle lubricant. Insert splined end into hub, guiding splines into differential side gear. Rotate shaft or wheel hub as necessary to aline hub studs with holes in shaft flange; then press shaft into place. Install split tapered dowels and nuts on each stud and tighten nuts to 55–65 pound-feet torque. There should be slight clearance (apprx. 1/16 in.) between nut and shaft flange. If no clearance exists, studs, dowels, or holes in flange are worn excessively, and new parts must be installed.

206. Coordination with Ordnance Maintenance Unit

Replacement of the real axles with new or rebuilt rear axles is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, providing authority for performing this replacement is obtained from the appropriate commander. Tools needed for the operation which are not carried in the using organization may be obtained from the supporting ordnance maintenance unit.

207. Forward Rear Axle Removal

a. POSITION VEHICLE. Place vehicle on a level surface and block front wheels to prevent vehicle rolling. Place a jack under axle and raise vehicle until tires are off the ground.

b. REMOVE WHEELS. Remove wheel stud nuts and remove wheel and tire from each side.

c. BLOCK VEHICLE. Place blocks under torque rod support bracket at spring seat on each side to support vehicle.

d. DISCONNECT FLEXIBLE HOSE. Disconnect hydraulic brake and axle vent flexible hose at junction block on top of axle housing.

e. DISCONNECT PROPELLER SHAFTS. Remove four bolts and nuts attaching propeller-shaft-universal-joint flange to differential pinion flange. Remove bolts and nuts attaching propeller shafts to each end of propeller shaft pillow block on top of axle housing.

f. LOOSEN TORQUE RODS. Remove nuts and washers from three torque rods; then use soft metal hammer to loosen torque-rod taper pins in axle brackets.

g. REMOVE TORQUE RODS. Remove torque rod pins from each axle bracket.

Caution: Be sure axle is safely supported to prevent rolling off jack and resulting in injury to personnel.

h. REMOVE AXLE. Lower axle with jack and pull forward as necessary to disengage main spring ends from axle brackets; then completely remove assembly.

i. REMOVE PILLOW BLOCK. Remove four stud nuts and tapered dowels attaching pillow block to bracket on axle housing; then remove pillow block assembly.

Note. If same axle assembly is to be reinstalled, it is not necessary to remove pillow block assembly.

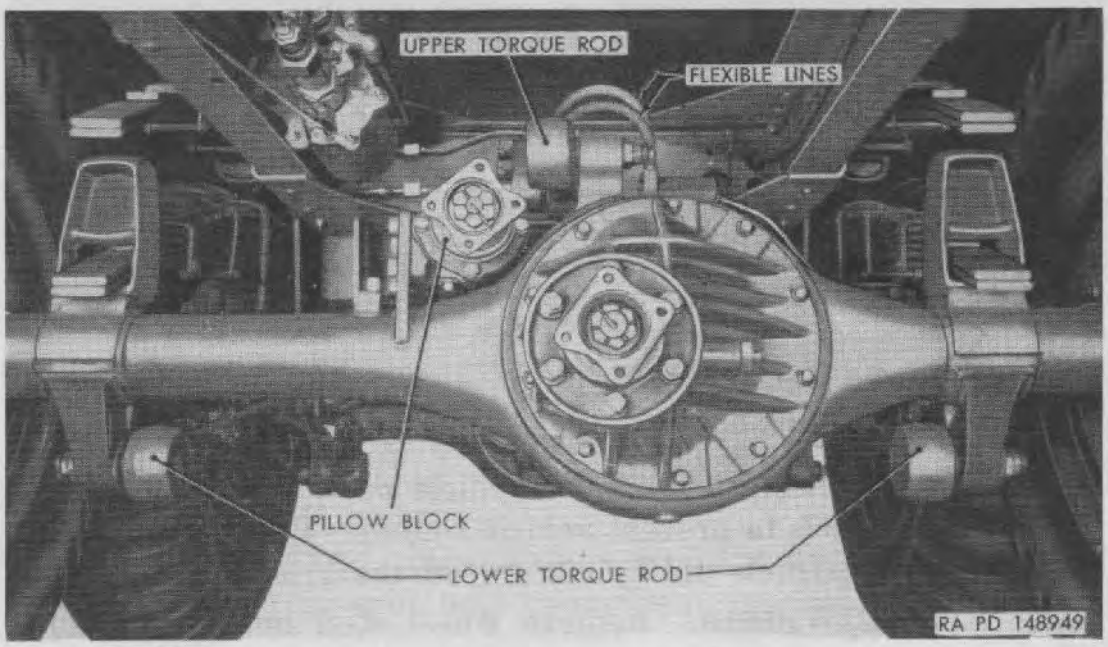


Figure 122. Forward rear axle installed.

208. Forward Rear Axle Installation

(fig. 122)

a. INSTALL PILLOW BLOCK. Position pillow block to axle bracket; then install four tapered dowels and stud nuts. Tighten nuts to 48–64 pound-feet torque.

b. POSITION AXLE. Move axle into position under vehicle and engage main spring ends with openings in brackets at each end of axle housing.

c. CONNECT TORQUE RODS. Attach three torque rods to axle brackets by installing tapered pins in axle brackets. Install washer and nut on each pin and tighten to 350–400 pound-feet torque.

d. CONNECT FLEXIBLE HOSE. Connect hydraulic brake and axle vent flexible hose at junction on top of axle housing.

e. CONNECT PROPELLER SHAFTS. Position respective propeller shafts to differential pinion flange and to each end of pillow block assembly, with lubrication fittings in same plane as other shafts; then install four bolts and nuts at each location. Tighten nuts to 33–43 pound-feet torque.

f. INSTALL WHEELS. Install wheels on hubs; then install wheel stud nuts. Tighten nuts to 300–350 pound-feet torque.

g. REMOVE BLOCKS AND JACK. Raise vehicle with jack as necessary in order that blocks under each torque rod support bracket at spring seat can be removed; then lower jack and withdraw from under vehicle.

h. BLEED BRAKES. Perform brake bleeding operation (par. 219).

i. LUBRICATE. Check lubricant level in axle differential (par. 59*i*). Lubricate propeller shaft universal joints and pillow block (par. 57).

j. RECORD REPLACEMENT. Make a record of the replacement on DA AGO Form 478.

209. Rear Rear Axle Removal

(fig. 123)

a. POSITION VEHICLE. Place vehicle on a level surface and block front wheels to prevent vehicle rolling. Place a jack under axle and raise vehicle until tires are off the ground.

b. REMOVE WHEELS. Remove wheel stud nuts and remove wheel and tire assembly from each side.

c. BLOCK VEHICLE. Place blocks under torque rod support bracket at spring seat at each side to support vehicle after axle is removed.

d. DISCONNECT FLEXIBLE HOSE. Disconnect hydraulic brake and axle vent flexible hose at junction block on top of axle housing.

e. DISCONNECT PROPELLER SHAFTS. Remove four bolts and nuts attaching propeller shaft universal joint flange to differential pinion flange.

f. LOOSEN TORQUE RODS. Remove nuts and washers from three torque rods; use soft metal hammer to loosen torque rod pins in axle brackets.

g. REMOVE TORQUE RODS. Remove torque rod pins from each axle bracket.

Caution: Be sure axle is safely supported to prevent rolling off jack and resulting in injury to personnel.

h. REMOVE AXLE. Lower axle with jack and pull assembly rearward as necessary to disengage main spring ends from axle brackets; then completely remove assembly.

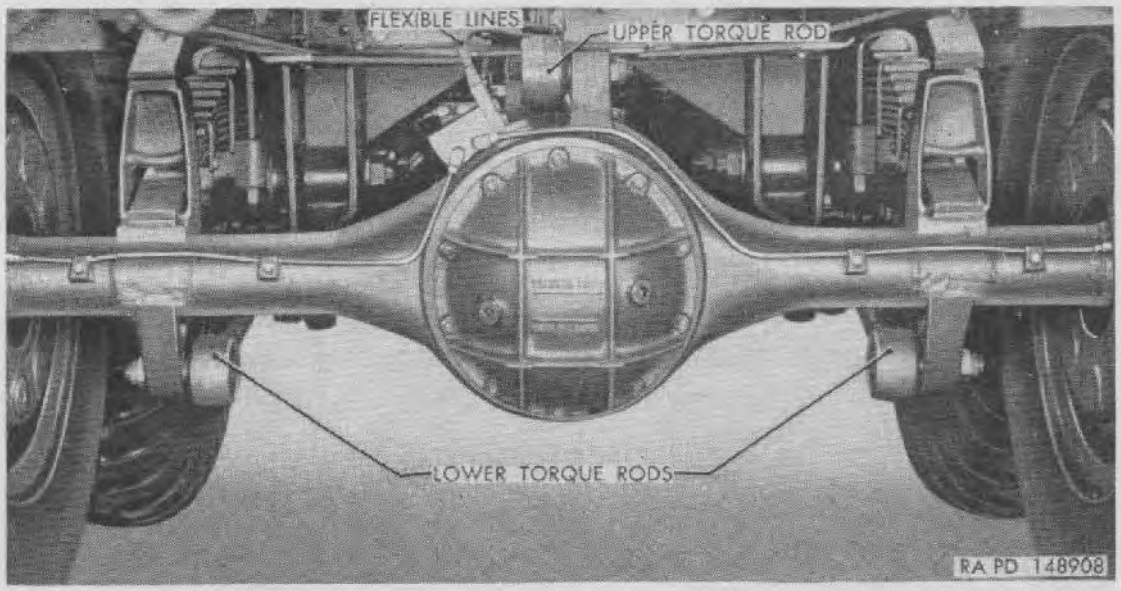


Figure 123. Rear Rear axle installed.

210. Rear Rear Axle Installation

(fig. 123)

a. POSITION AXLE. Move axle into position under vehicle and engage main spring ends with openings in bracket at each end of axle housing.

b. CONNECT TORQUE RODS. Attach three torque rods to axle brackets by installing tapered pins in axle brackets. Install nut and washer on each pin and tighten to 350–400 pound-feet torque.

c. CONNECT FLEXIBLE HOSE. Connect hydraulic brake and axle vent flexible hose at junction on top of axle housing.

d. CONNECT PROPELLER SHAFT. Position propeller shaft joint flange to differential pinion flange, with lubrication fittings in same place as other shafts; then install four bolts and nuts. Tighten nuts to 33–43 pound-feet torque.

e. INSTALL WHEELS. Install wheels on hub, then install wheel stud nuts. Tighten nuts to 300–350 pound-feet torque.

f. REMOVE BLOCKS AND JACK. Raise vehicle with jack as necessary in order that block under each torque rod bracket can be removed; then lower jack and withdraw from under vehicle.

g. BLEED BRAKES. Perform brake bleeding operation (par. 219).

h. LUBRICATE. Check lubricant level in axle differential (par. 59*i*). Lubricate propeller shaft universal joint (par. 57).

i. RECORD REPLACEMENT. Make a record of the replacement on DA AGO Form 478.

Section XXII. PROPELLER SHAFTS AND UNIVERSAL JOINTS

211. Description

a. GENERAL. Propeller shafts, pillow block, and drive and driven units arrangement is illustrated in figure 124. Drive between transmission and transfer is transmitted through two universal joint assemblies. Drive from transfer to axles is through conventional tubular type propeller shafts.

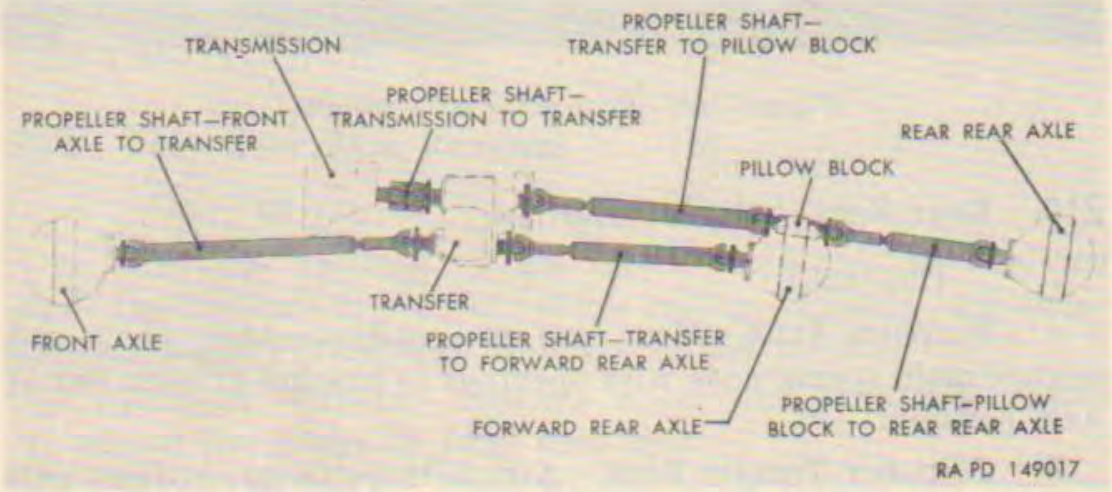


Figure 124. Propeller shafts and universal joint arrangement.

b. AXLE PROPELLER SHAFTS. Each of the four tubular propeller shafts has a universal joint at each end of shaft. In addition, each shaft has a slip joint at one end to permit telescopic action of shaft during operation. One half of slip joint is a splined solid stub shaft, having one blank spline for alinement, and is welded to tubular shaft, while opposite half is incorporated in universal joint yoke.

c. TRANSMISSION-TO-TRANSFER PROPELLER SHAFT (fig. 125). Power from transmission to transfer is through two universal joint assemblies which are bolted together thus eliminating shaft usually used. Slip joint between transmission and transfer is through splined yoke which engages transmission output shaft.

d. UNIVERSAL JOINTS. Universal joints permit angular movement of shaft during rotation. Movement between the shaft

yoke and flange yoke is through bearings over each arm of journal or cross. Seal at each journal arm prevents loss of lubricant or entry of dirt, water, or other foreign matter.

e. PILLOW BLOCK. Pillow block assembly, mounted on top of forward rear axle, connects and supports the two propeller shafts required to transmit power from transfer to rear rear axle (fig. 124).

212. Propeller Shaft and Universal Joint Removal

a. GENERAL. Propeller shafts used between transfer and respective drive units can be completely removed by disconnecting both ends; also, when service requirments permit, only one end can be disconnected from its respective unit.

b. AXLE PROPELLER SHAFT REMOVAL. Remove four bolts and nuts at each end of shaft, attaching joint flange to drive or driven unit flange; then remove complete shaft.

c. TRANSMISSION-TO-TRANSFER SHAFT REMOVAL. Remove four bolts and nuts attaching two universal joints together; also remove four nuts and bolts attaching rear joint flange to transfer flange (fig. 125). Remove rear universal joint. Slide front universal joint toward rear and off transmission output shaft.

d. SLIP JOINT REMOVAL. Slip joint removal can be accomplished while complete shaft is removed; also when only slip joint end of shaft is disconnected from its respective unit flange. Loosen knurled cap, threaded to slip joint; then slide slip joint and universal joint from splined stud shaft.

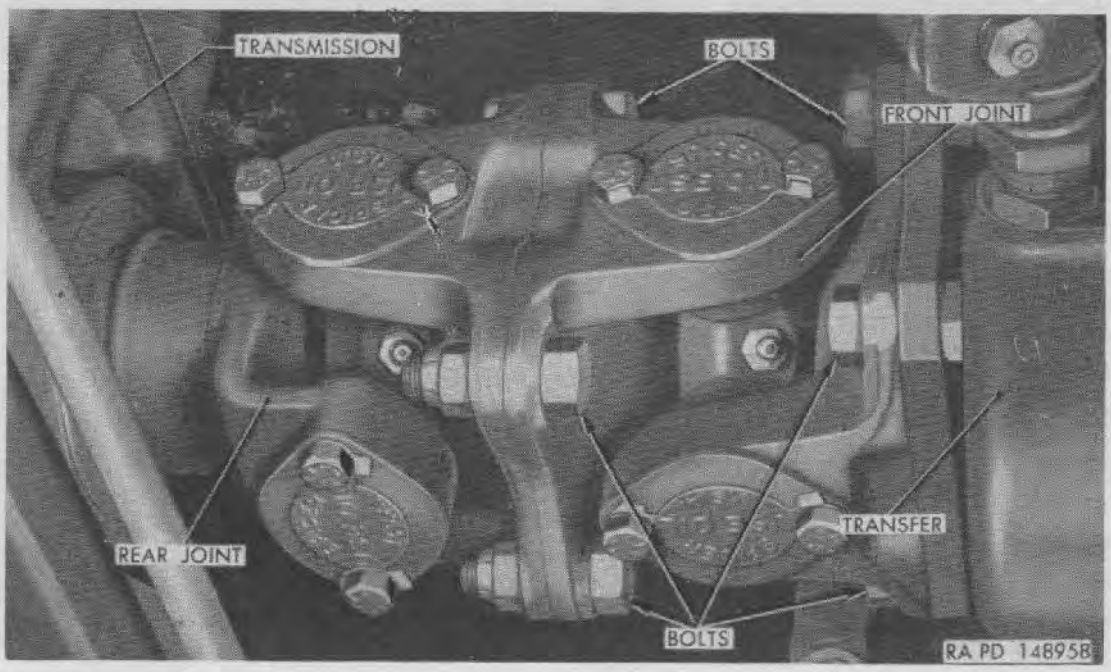


Figure 125. Transmission-to-transfer propeller shaft installed.

213. Propeller Shaft and Universal Joint Installation

a. SLIP JOINT INSTALLATION. If slip joint has been removed, clean splines and apply lubricant; then slide slip joint over stub shaft.

Note. One splined tooth in slip joint yoke and stub shaft is blank, which assures proper universal joint alinement. Thread knurled cap tightly to slip joint yoke.

b. AXLE PROPELLER SHAFT INSTALLATION. Position shaft between flanges of connecting units with lubrication fittings in same plane as other shafts; then install four bolts and nuts at each end. Tighten nuts to 33–43 pound-feet torque.

Note. Propeller shafts are installed with slip joint toward front of vehicle except shaft used between front axle and transfer, which is installed with slip joint toward rear of vehicles (fig. 124).

c. TRANSMISSION-TO-TRANSFER SHAFT INSTALLATION. Apply lubricant (par. 57) to slip joint wear sleeve; then slide joint over transmission output shaft, being careful that transmission rear seal is not damaged during installation. Move joint toward transmission to provide sufficient space to install rear universal joint. Locate rear joint between front joint and transfer flange with lubrication fittings in alinement; then install four bolts and nuts attaching two universal joint together; also install four bolts and nuts attaching rear joint to transfer flange. Tighten eight nuts to 48–64 pound-feet torque.

214. Universal Joint Repair

a. GENERAL. Universal joints should be repaired whenever excessive wear is indicated by looseness in bearings between journal and yoke flanges. Universal joint repair kits are available and consist of one journal w/seals, four needle bearings, and retaining parts.

b. UNIVERSAL JOINT DISASSEMBLY. On axle propeller shaft universal joints, pinch ends of four snap rings together and remove rings. On transmission-to-transfer universal joints, bend ears of cap screw lock away from cap screw; then remove eight cap screws, four locks, and four bearing caps. Strike journal sharply to force each bearing far enough out of flange yoke to permit removal of bearings. Remove journal by moving it sideways as far as possible; then tilt to clear side of yoke.

c. UNIVERSAL JOINT ASSEMBLY. Insert one arm of journal into yoke, tilt journal until opposite arm clears yoke and journal is

in position. Work lubricant (par. 57) into bearings until they are thoroughly lubricated. Position bearings in yoke; then press or squeeze into place with vise. On axle propeller shafts joints, install snap rings, being sure they are seated in groove, or on transmission-to-transfer joints, install bearing caps, locks, and cap screws. Install yoke flange to journal; then install bearings as instructed previously in this paragraph. Install snap rings or bearing caps, locks, and cap screws as also previously instructed in this paragraph. Lubricate universal and slip joints (par. 57).

215. Pillow Block

a. GENERAL. Pillow block consists of a shaft supported by two ball bearings mounted in a housing. Double lip oil seals, supported in retainers, are used at each end to prevent loss of lubricant and entry of dirt, water, and other foreign matter. All detail parts, except housing and shaft, are identical with those used in transfer.

b. PILLOW BLOCK REMOVAL. Remove propeller shafts at front and rear of pillow block by removing four bolts and nuts at each

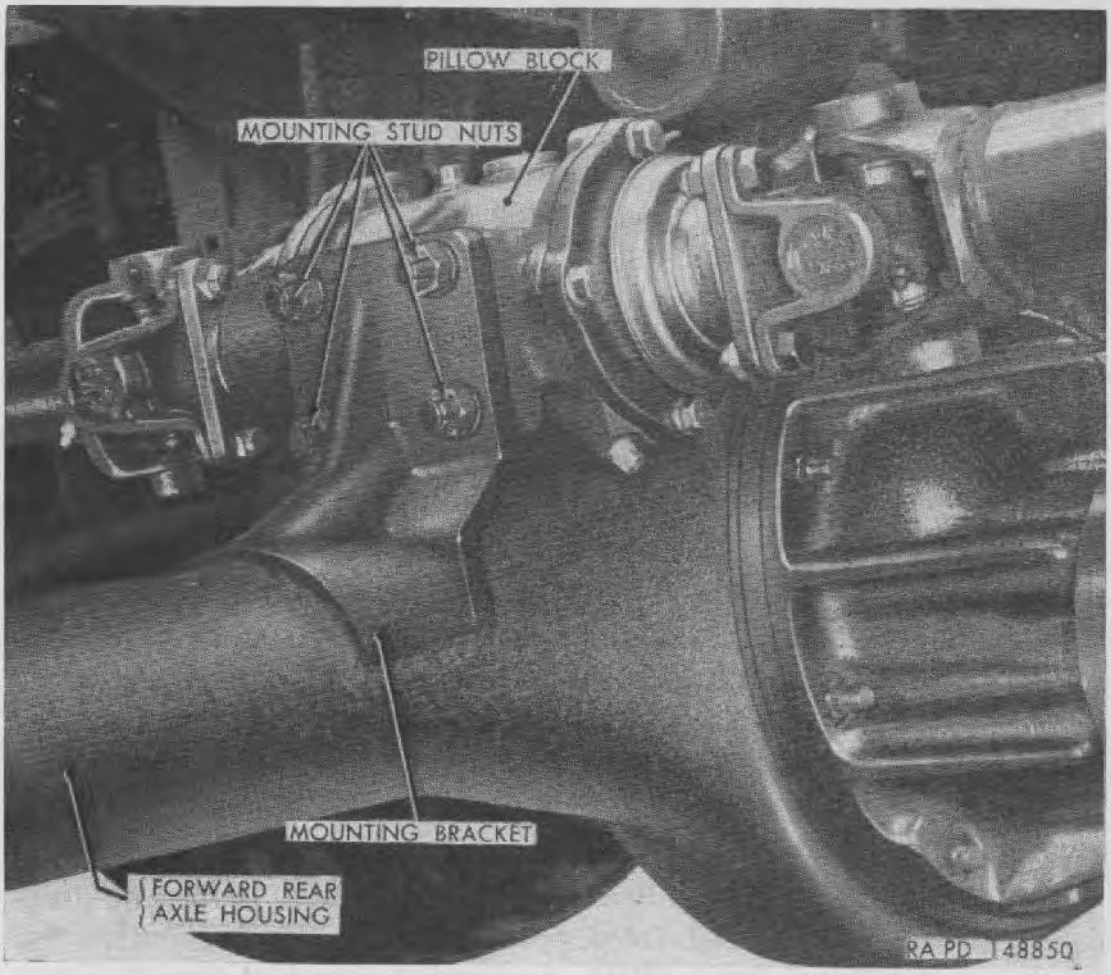


Figure 126. Pillow block installed.

end. Remove four mounting stud nuts and split tapered dowels (fig. 126) attaching pillow block to mounting bracket; then remove pillow block.

c. PILLOW BLOCK INSTALLATION. Position pillow block assembly on inside (differential side) of mounting bracket (fig. 126) with drain plug toward front. Install four tapered split dowels and four mounting stud nuts. Tighten nuts to 48–64 pound-feet torque. Install propeller shafts (par. 213). Lubricate pillow block and propeller shaft universal joints (par. 57).

Section XXIII. SERVICE BRAKE SYSTEM

216. Description and Operation

a. DESCRIPTION. The combined air-hydraulic service brake system consists primarily of a pedal, interconnected to a hydraulic master cylinder to build up the initial hydraulic pressure; an air power cylinder to increase the hydraulic pressure; hydraulic wheel cylinders to transmit the hydraulic pressure to the brake assemblies at each wheel; compressed air system which maintains a supply of compressed air for operation of the air power cylinder; and interconnecting lines, fittings, and linkage.

b. OPERATION.

(1) *Application.* When brake pedal is depressed, hydraulic brake fluid is displaced from the master cylinder into the power cylinder, and through the power cylinder slave cylinder into the lines leading to the wheel cylinders. When hydraulic pressure against the power cylinder control valve hydraulic piston reaches a certain point, control valve functions to admit compressed air into the power cylinder behind the air piston, causing piston to move forward in the cylinder. Forward movement of air piston forces slave cylinder piston forward in slave cylinder, displacing hydraulic brake fluid under high pressure in to the lines leading to the wheel cylinders. Hydraulic brake fluid entering wheel cylinders forces wheel cylinder pistons apart; outward movement of wheel cylinder pistons is transmitted to the brake shoes through push rods, forcing brake shoes into contact with brake drums.

(2) *Release.* When brake pedal is released, hydraulic pressure is removed from power cylinder control valve hydraulic piston. With pressure removed from control valve hydraulic piston, control valve functions to exhaust

air pressure from power cylinder into the air vent system. With air pressure removed from behind power cylinder air piston, piston return spring forces air piston to rear of cylinder, at the same time pulling slave cylinder piston to rear of slave cylinder, removing pressure from hydraulic brake fluid in wheel cylinders. With hydraulic pressure removed from wheel cylinder pistons, brake shoe return springs pull brake shoes away from brake drums, forcing wheel cylinder pistons together. Hydraulic brake fluid is displaced from wheel cylinders and returns to the master cylinder via the power cylinder slave cylinder.

217. Service Brake Data

Air compressor:	
Make	Midland Steel Products.
Capacity	7¼ cu ft per min @ 1,250 rpm
Master cylinder:	
Cylinder bore	1¾ in.
Piston stroke	1 7/16 in.
Air power cylinder:	
Make	Bendix Products Division.
Model	A35-15-154.
Cylinder shell diameter	4¼ in.
Slave cylinder bore	1⅛ in.
Air piston stroke	3⅞ in.
Slave cylinder piston stroke	3¾ in.
Wheel cylinders:	
Bore diameter	1¼ in.
Brake drums:	
Diameter	15 in.
Brake lining:	
Width	3 in.
Thickness	⅜ in.

218. Brake System Tests

a. PERFORMANCE TESTS.

(1) *Road test.* Road-test brakes by making a brake application at about 20 mph to determine if vehicle stops evenly and quickly. If pedal has a spongy feel when applying brakes, air is present in hydraulic system. Brake system must be bled to remove air (par. 219).

(2) *Check pedal free-travel.* Press brake pedal down with hand until resistance other than that of the pedal return

spring is felt. Pedal movement should not be less than one-fourth inch or more than one-half inch before master cylinder push rod contacts piston and manual stroke commences. If free-travel is not within one-fourth inch to one-half inch, adjust push rod (par. 223*b*).

(3) *Operating test.*

(*a*) Build up air pressure in system to normal operating pressure (100 psi).

(*b*) Apply brakes; then listen for sound of exhausting air pressure as brakes are released. Rapid release of air pressure indicates that power cylinder control valve is operating.

(*c*) Depress brake pedal and hold pressure on pedal. If pedal gradually falls away under pressure, leakage in hydraulic system is indicated. Make hydraulic pressure test (*c* below).

(*d*) If stop washer on pedal shaft goes to within two inches of the toe pan when brakes are applied, brake shoes require adjustment (par. 220) or replacing (par. 221).

b. AIR PRESSURE TESTS. An air pressure test gage is required when making the following tests.

(1) Remove lubrication pipe plug from rear end of air power cylinder and connect air pressure test gage at this point. Build up air pressure in system to normal operating pressure (100 psi).

(2) Coat all air line connections with solution of soap and water to check for leakage. Leakage can sometimes be corrected by tightening the connection. If this fails to correct leakage, air line or fittings must be replaced (par. 227*b*).

(3) Connect a flexible hose or a bent tube to power cylinder exhaust port; hose or tube must be long enough to hang down over side of power cylinder. Hold a jar of water up under exhaust tube so that end of tube is immersed in water. Watch for bubbles to appear in water. The appearance of bubbles indicates a leaking control valve poppet air inlet seal, requiring replacement of air power cylinder (par. 225).

(4) Make a brake application and hold pressure on pedal, and observe action of air pressure test gage at rear of power cylinder. Power cylinder should hold maximum pressure registered on gage without noticeable loss until the brake pedal is released. Loss of air pressure indi-

cates a leaking control valve poppet exhaust seal, or leakage past the power cylinder piston. Replace power cylinder (par. 225).

(5) Depress and momentarily hold brake pedal to several positions between fully released and fully applied positions. Pressure registered on test gage should increase gradually according to brake pedal depression. Failure to graduate the pressure evenly indicates a sticking control valve hydraulic piston. Replace power cylinder (par. 225).

(6) Make a full brake application; then observe action of air pressure test gage when brakes are released. If gage does not return to zero or is slow in returning, a sticking control valve hydraulic piston is indicated. Replace power cylinder (par. 225).

c. HYDRAULIC PRESSURE TEST. A hydraulic pressure test gage capable of registering at least 1,200 psi and an air pressure test gage are required for making this test.

(1) Connect hydraulic pressure gage to one of the wheel cylinder bleeder valve openings or at top of slave cylinder. Connect air pressure test gage to lubrication pipe plug opening at rear of power cylinder.

(2) Apply brakes until approximately 60 psi is registered on air pressure test gage. Observe reading on hydraulic pressure gage. Pressure should be 950 to 1,100 psi with 60 psi air pressure applied to power cylinder. If air pressure applied is higher or lower than 60 psi, hydraulic pressure will be proportionately higher or lower.

(3) Apply brakes and hold applied for at least one minute, observing action of hydraulic pressure gage. A low-pressure reading or a drop in hydraulic pressure indicates leakage in hydraulic lines, wheel cylinders, or air power cylinder. Replace hydraulic lines (par. 227*a*), wheel cylinders (par. 226), or air power cylinder (par. 225) as necessary.

219. Bleeding Brake System

a. GENERAL. Master cylinder filler cap is accessible through hole in left side of floor pan after removing pry-out hole cover. Air power cylinder bleeder valves are accessible from under vehicle (fig. 127); wheel cylinder bleeder valves are accessible at inner side of backing plates (fig. 128). Bleeding brake system may be accomplished by one of two methods, *pressure* or *manual*.

Caution: Engine must not be running and all air pressure must be exhausted from the air system before bleeding brakes.

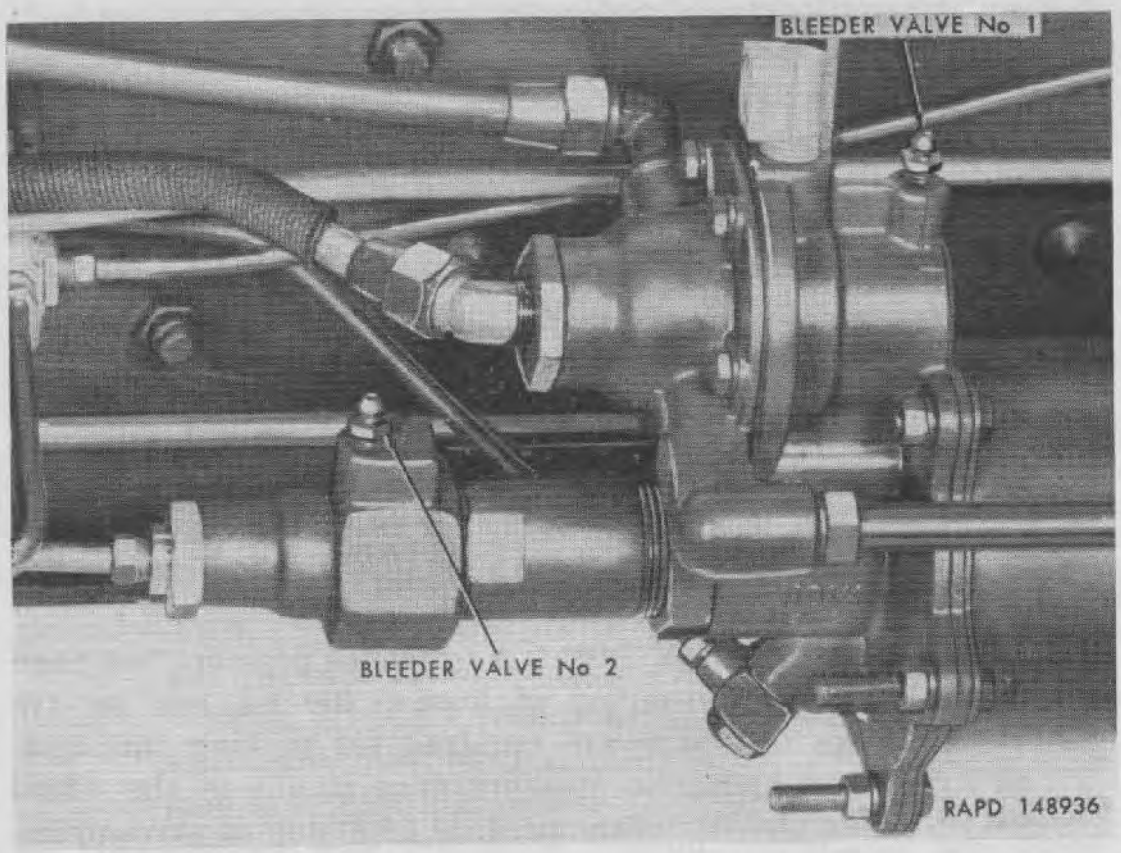


Figure 127. Air power cylinder bleeder valves.

b. PRESSURE BLEEDING.

(1) Clean dirt from around master cylinder filler cap; then remove cap from filler extension.

(2) Make sure fluid level in pressure bleeding tank is up to petcock above outlet, and that tank is charged with 10 to 20 psi air pressure. Connect pressure tank hose to master cylinder filler extension, open valves at both ends of hose to bleed air from hose; then tighten connection.

(3) Bleed air power cylinder first. Slip end of bleeder hose over bleeder valve at top of power cylinder control valve and place other end in a glass jar containing enough hydraulic brake fluid to cover end of hose. Open bleeder valve with wrench and observe flow of fluid from hose. Close bleeder valve as soon as bubbles stop and fluid flows in a solid stream. Repeat this procedure at bleeder valve on top of slave cylinder end fitting.

(4) Bleed both bleeder valves at each wheel, following same procedure used at power cylinder, (3) above. Make sure each bleeder valve is closed tightly after bleeding.

(5) Disconnect bleeder tank hose from master cylinder filler extension. Install filler cap, with new gasket. Install access plug in floor pan.

c. MANUAL BLEEDING. Manual bleeding is the same as pressure bleeding except that the hydraulic brake fluid is forced through the lines by pumping the brake pedal instead of by air pressure. Two persons are required, one to pump brake pedal and replenish fluid in master cylinder, the other to accomplish the bleeding operations at the power cylinder and wheel cylinders. Fluid in master cylinder should be replenished after bleeding at each bleeder valve. When pumping pedal, push it down slowly, let it snap back, and immediately start the downward stroke. After all air is expelled at each bleeder valve, close valve during downstroke of brake pedal.

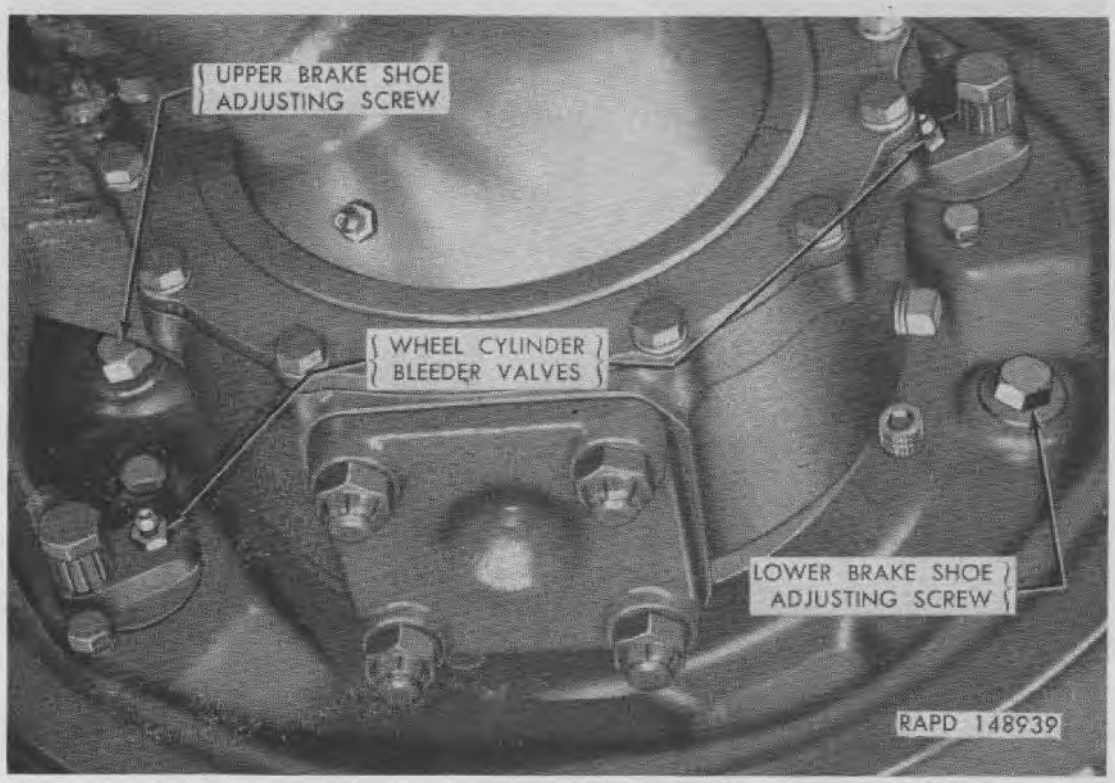


Figure 128. Brake bleeder valves and adjusting studs (left front wheel).

220. Brake Adjustment for Normal Wear

a. GENERAL. Brake adjustments to compensate for normal lining wear are made at the brake shoes. These adjustments should be made before the brake pedal reserve travel becomes less than two inches. Adjustments are made by turning adjusting pinion studs at inner side of backing plates (fig. 128). Always check wheel bearing adjustment (par. 244) before adjusting brake shoes. Do not adjust brake shoes while brake drums are hot.

b. ADJUSTMENT.

(1) Jack up axle; then make a brake application and release to center brake shoes with brake drums.

(2) Using a torque wrench on adjusting pinion studs (fig. 129), turn studs in direction of forward rotation of wheel until a torque wrench reading of 13 to 16 pound-feet torque is obtained; then turn studs in opposite direction one-third turn (120 deg.) to provide running clearance between lining and drum.

(3) After completing adjustment at each wheel, make sure wheel turns freely; then remove jacks from under vehicle.

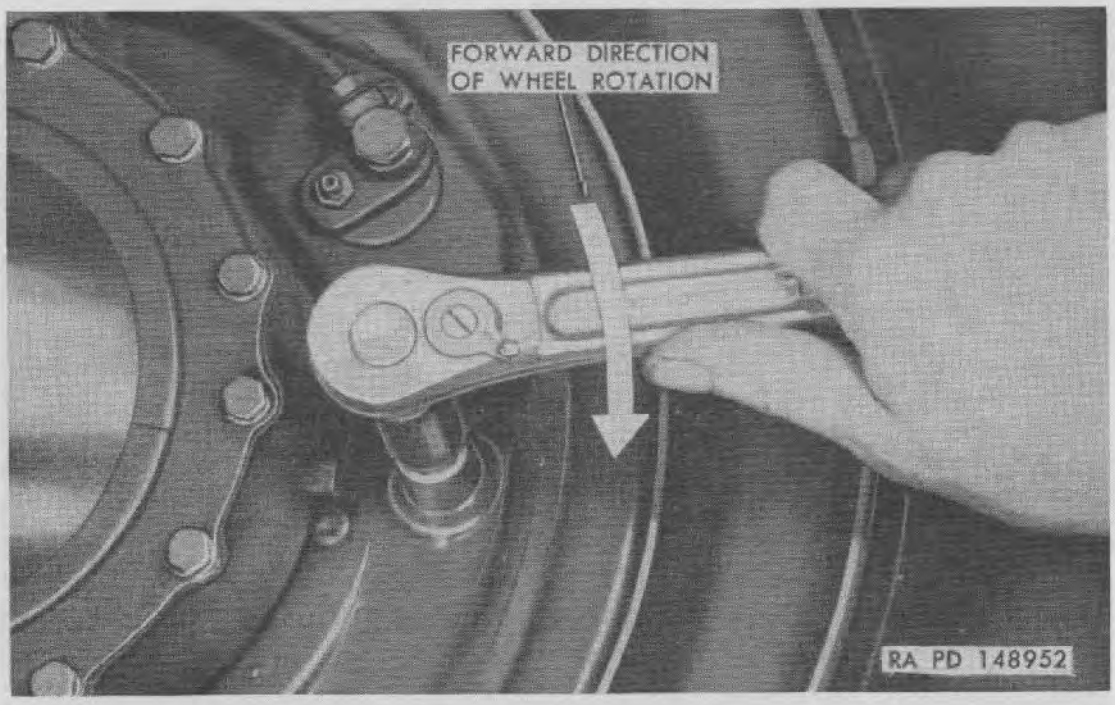


Figure 129. Adjusting brake shoes.

221. Brake Shoes—Front and Rear

a. DESCRIPTION. All brake shoes on vehicle are identical. Two brake shoes are mounted on each backing plate in conjunction with two anchor blocks and two wheel cylinders (fig. 130). Anchor blocks serve as shoe stops and shoe centering points, and provide the fulcrums around which the shoes pivot when brakes are applied. Four brake shoe return springs hold shoe ends firmly against anchors when brakes are released. Heel of each shoe anchors against steel pins installed in anchor blocks. Toe of each shoe anchors against adjusting screws which are threaded into the anchor blocks. Both shoes are always primary shoes, independently self-energized in either direction of brake drum rotation. Shoes anchor either at toe or at heel, depending upon direction of drum rotation when brakes are applied.

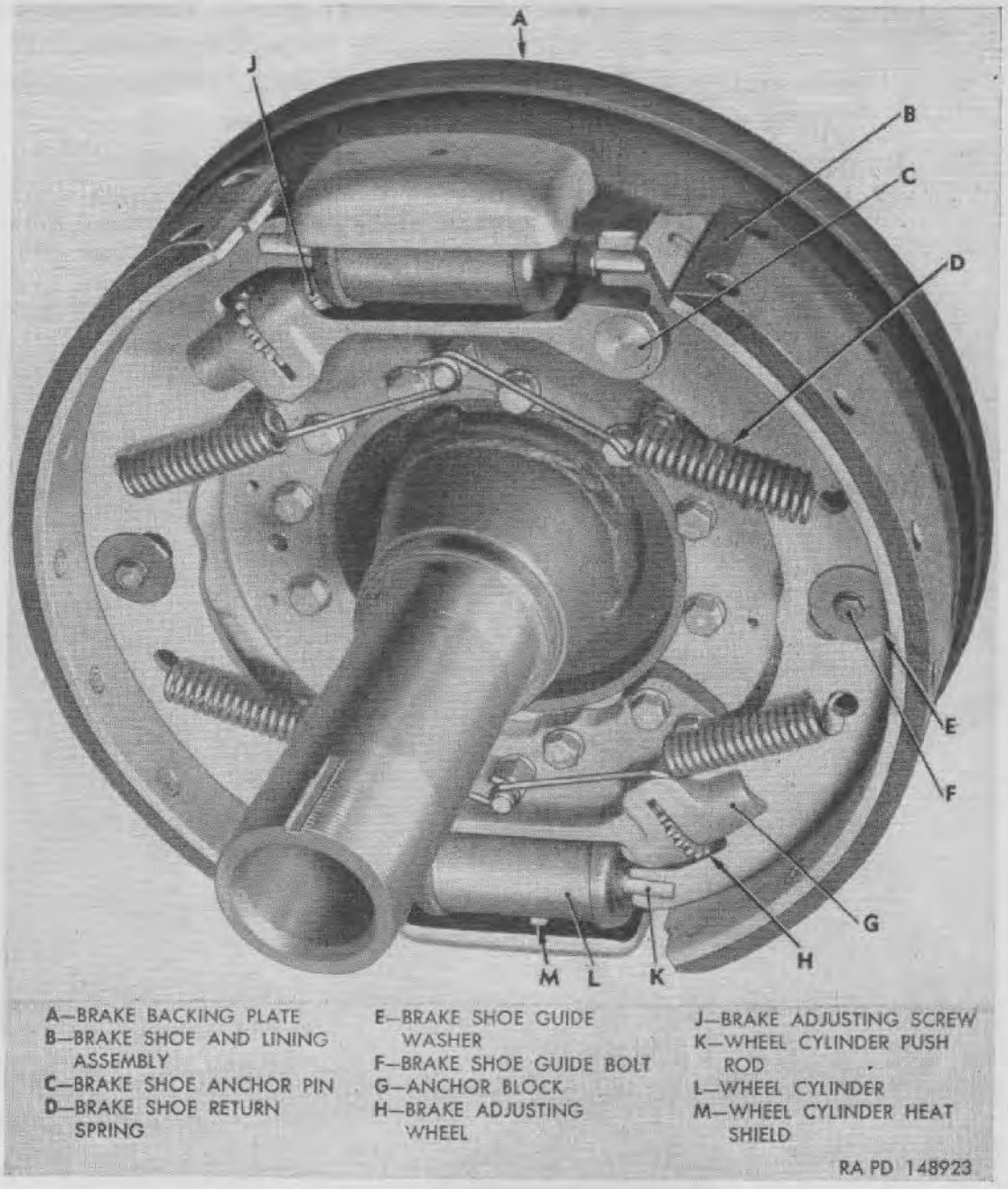


Figure 130. Brake shoes and wheel cylinders installed (rear wheel).

b. BRAKE SHOE REMOVAL (fig. 130).

(1) Jack up axle and remove wheel (par. 239*a*).

(2) At front axle, remove axle shaft drive flange (par. 198*a*); at rear axle, remove axle shaft (par. 205*b*).

(3) Remove hub and brake drum (par. 245 or 246).

(4) Using brake spring tool 7950060, unhook brake shoe return springs from spring anchor studs (fig. 131); then remove springs from brake shoes.

(5) Remove nut, lock washer, guide washer, and spacer from front brake shoe guide bolt; then lift shoe ends out of anchor blocks and wheel cylinder push rods.

(6) Remove guide bolt, lock washer, guide washer, and spacer attaching rear brake shoe to backing plate; lift shoe ends out of anchor blocks and wheel cylinder push rods to remove shoe.

c. BRAKE SHOE INSTALLATION (fig. 130).

Note. Large portion of brake shoe web which engages slots in anchor blocks is curved at one end and flat at the other end. Shoes must be installed with curved end at adjusting screw and flat end engaging groove in anchor pin in anchor block.

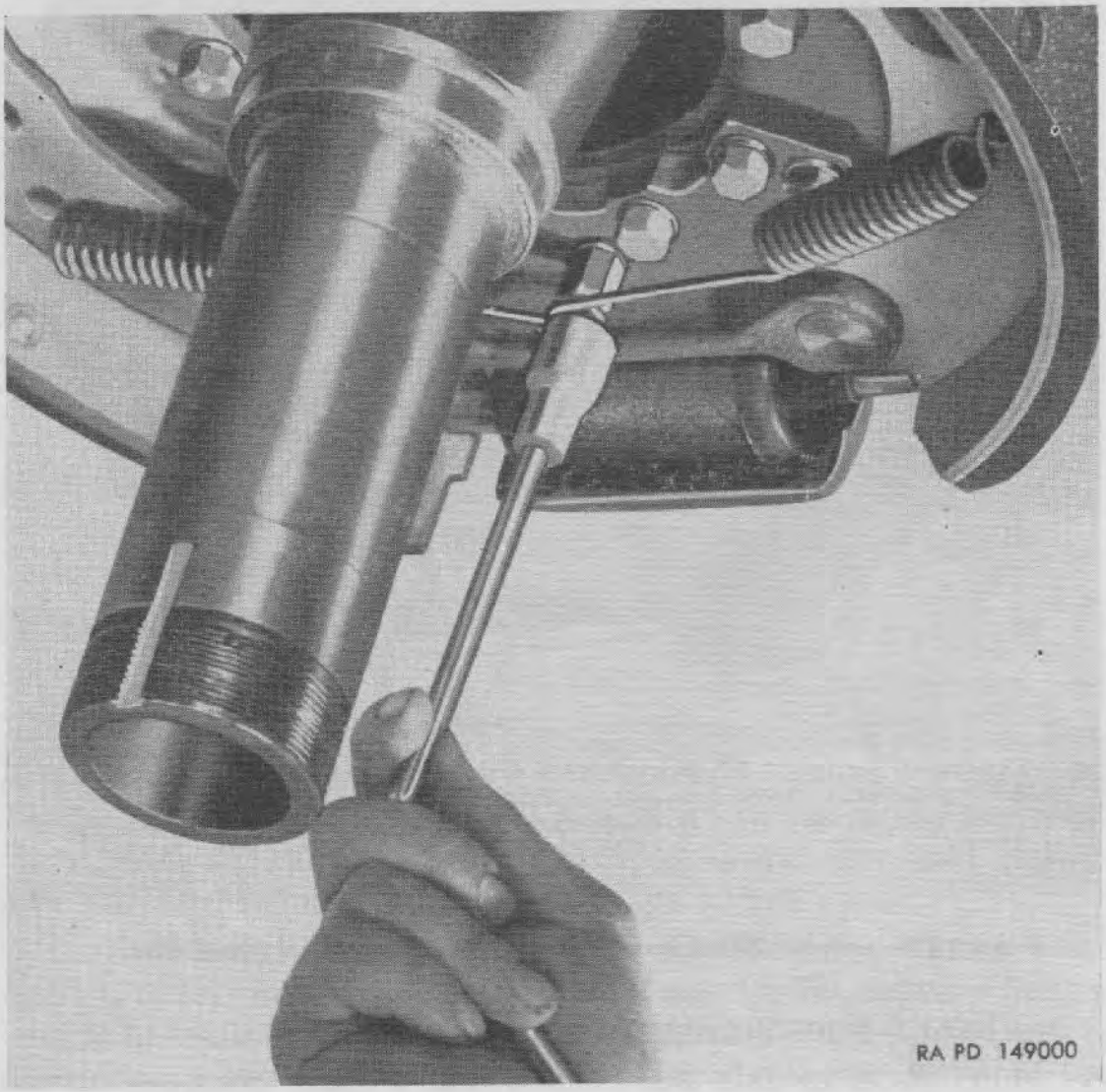


Figure 131. Removing brake shoe return springs using tool 7950060.

(1) Position front brake shoe on backing plate, with shoe web engaging slots in wheel cylinder push rods and anchor blocks, and with elongated hole in center of shoe web over guide bolt. Install spacer, guide washer, lock washer, and nut on guide bolt and tighten firmly.

(2) Position rear brake shoe at backing plate, with shoe web engaging slots in wheel cylinder push rods and

anchor blocks. Install lock washer, guide washer, and spacer on guide bolt, insert bolt through shoe web and backing plate, and thread bolt into hydraulic brake line tee fitting at inner side of backing plate. Tighten bolt firmly.

(3) Install brake shoe return springs, installing end of each spring in brake shoe web, then hooking springs onto anchor studs using brake spring tool 7950060 (fig. 132).

(4) Install hub and brake drum assembly (par. 245 or 246).

(5) At front axle, install axle shaft drive flange (par. 198*b*); at rear axle, install axle shaft (par. 205*c*).

(6) Install wheel (par. 239*b*). Adjust brake shoes (par. 220).

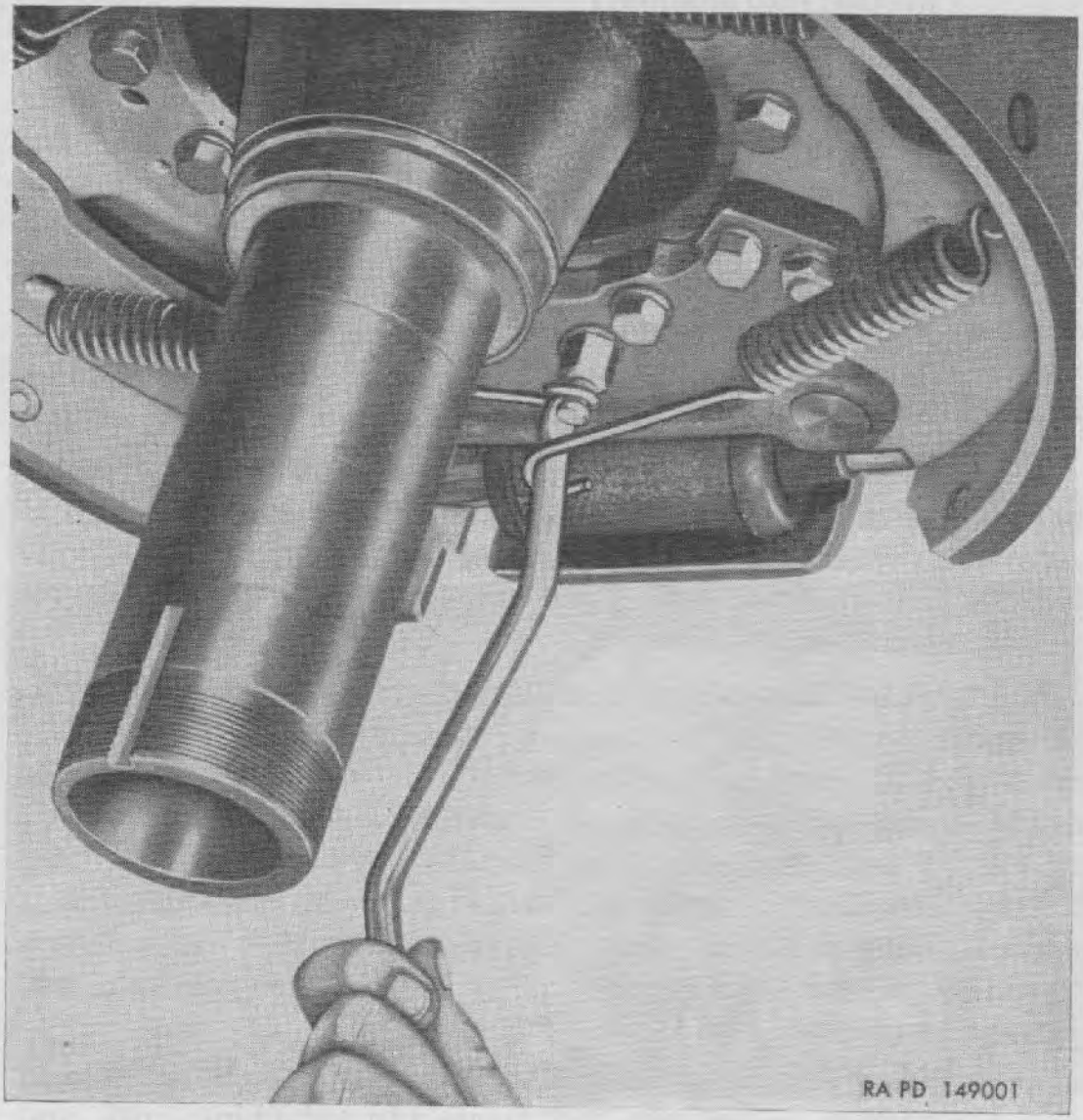


Figure 132. Installing brake shoe return springs using tool 7950060.

222. Brake Drums

a. GENERAL. Brake drums may be either cast iron, or cast iron with steel back. Brake drums are attached to hub flanges by brake drum adapters. Adapters are secured to inner side of hub flanges under heads of wheel studs which are pressed into hub flanges (figs. 144 and 145).

Note. Brake drum removal and installation procedures which follow apply with hub installed on axle; however, the same procedures will apply with hub removed from axle by omitting *b* (1) and *c* (2) below.

b. BRAKE DRUM REMOVAL.

(1) Jack up axle and remove wheel (par. 239*a*).

(2) Remove nuts and flat washers from 18 bolts securing brake drum to brake drum adapter. Tap drum to loosen from adapter; then lift drum off adapter. (Bolts are pressed into adapter.)

c. BRAKE DRUM INSTALLATION.

(1) Install brake drum on brake drum adapter, with bolts in adapter inserted through holes in drum flange. Install flat washer and nut on each bolt, and tighten nuts to 20–27 pound-feet torque.

(2) Install wheel (par. 239*b*). Adjust brake shoes (par. 220).

223. Brake Pedal and Linkage

a. GENERAL. Brake-pedal shaft is welded to master cylinder bracket which is riveted to frame side rail. Pedal lower half is secured on shaft by master cylinder-to-pedal-shaft brace and cotter pin (fig. 133). Pedal upper half is secured in pedal lower half by a clamp bolt and nut.

b. BRAKE-PEDAL-LINKAGE ADJUSTMENT. Master-cylinder piston must return to fully released position when brake pedal is released. If piston and cup do not return completely to end of cylinder, bypass port between cylinder and reservoir will be closed and fluid returning from the wheel cylinders cannot enter the master cylinder reservoir. Proper pedal linkage adjustment must be maintained to insure return of master cylinder piston to end of cylinder. Adjustment is made at master cylinder piston push rod as follows (fig. 133):

(1) Loosen lock nut on master-cylinder-push-rod yoke; then remove cotter pin and clevis pin attaching yoke and return spring clip to brake pedal.

(2) With brake-pedal bumper against pedal plates on toe board and master-cylinder piston at extreme front end of cylinder, adjust yoke in push rod as necessary to aline holes in yoke and pedal; then turn yoke into push rod an additional one-half turn to provide slight clearance between push rod and piston.

(3) Install clevis pin attaching push rod yoke to brake pedal, with return spring clip installed under head of clevis pin, and secure with cotter pin. Tighten lock nut against push rod.

c. BRAKE PEDAL UPPER HALF REPLACEMENT.

(1) *Removal.* Remove nut from clamp bolt securing pedal upper half in pedal lower half (fig. 133) and remove clamp bolt. Pull pedal upper half up out of pedal lower half and hole in pedal plate.

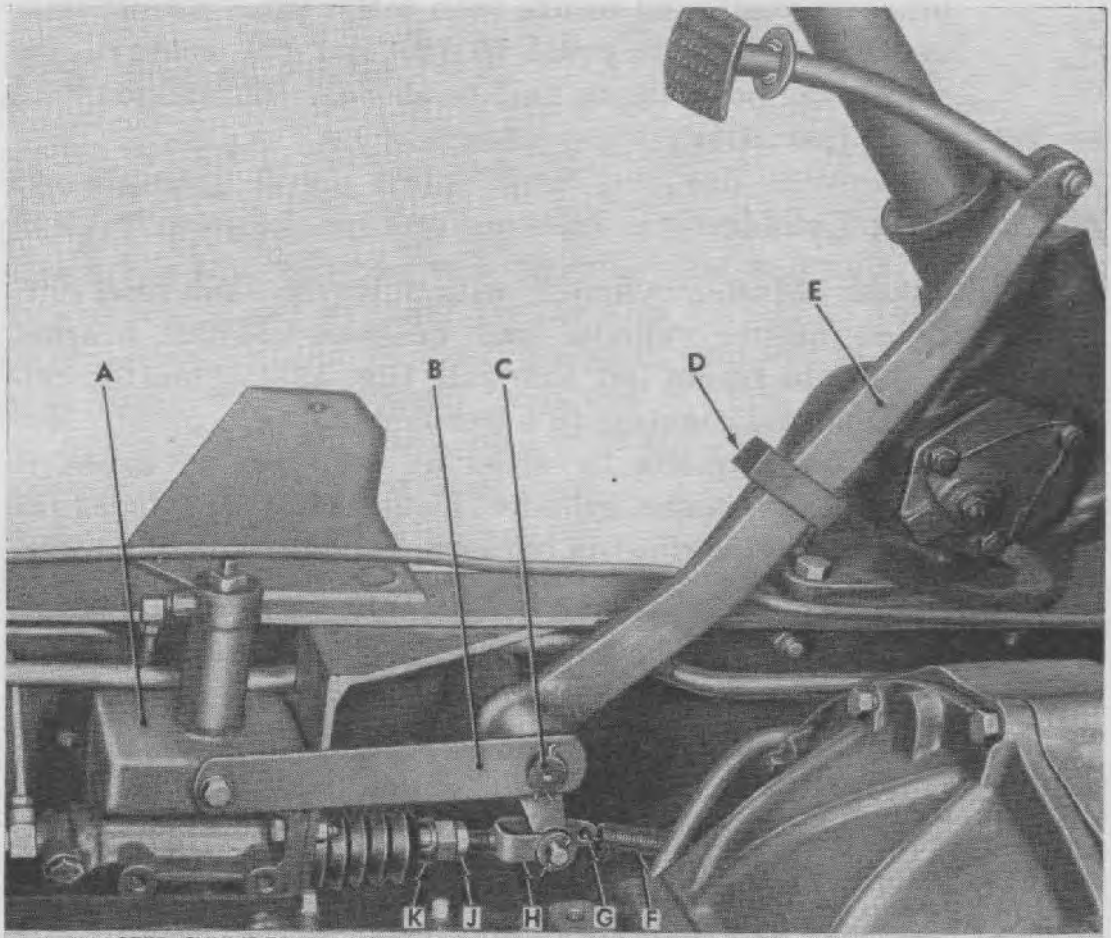


Figure 133. Brake pedal and master cylinder installed.

(2) *Installation.* Insert pedal upper half down through felt seal in pedal plate and into end of pedal lower half. Aline notch in pedal upper half with clamp bolt hole in pedal lower half, install clamp bolt and nut, and tighten nut to 20–27 pound-feet torque.

d. BRAKE PEDAL LOWER HALF REPLACEMENT (fig. 133).

(1) *Removal.* Remove brake pedal upper half (*c* above). Remove cotter pin and clevis pin attaching master cylinder push rod yoke and return spring clip to pedal lower half. Remove cotter pin securing pedal shaft brace on pedal shaft. Loosen bolt attaching brace to master cylinder, remove brace from end of pedal shaft; then slide pedal lower half off shaft. Remove rubber bumper from pedal lower half.

(2) *Installation.* Install rubber bumper on pedal lower half. Place pedal lower half on pedal shaft, position brace on shaft, and secure with cotter pin. Adjust linkage and connect to pedal (*b* (2) and (3) above). Install brake pedal upper half (*c* above). Lubricate brake pedal (par. 57).

224. Master Cylinder

a. GENERAL. Master cylinder, with integral fluid reservoir, is mounted on master cylinder and brake-pedal-shaft bracket which is riveted to frame left side rail (fig. 133). Master cylinder piston push rod connects to lower end of brake pedal. Hydraulic brake line connects to outlet at rear end of cylinder. Linkage connecting master cylinder piston push rod to brake pedal is adjusted as described in paragraph 223*a*.

b. MASTER CYLINDER REMOVAL (fig. 133).

(1) Remove bolt and gaskets attaching hydraulic brake line connector to rear end of master cylinder.

(2) Remove cotter pin and clevis pin attaching master cylinder piston push rod to brake pedal.

(3) Disconnect air vent line from master cylinder filler extension.

(4) Remove bolt attaching brake pedal shaft brace to side of master cylinder.

(5) Remove four nuts and bolts attaching master cylinder to bracket; then remove master cylinder from bracket.

(6) Remove yoke and lock nut from master cylinder piston push rod.

c. MASTER CYLINDER INSTALLATION (fig. 133).

(1) With lock nut threaded onto push rod yoke, thread yoke into end of master cylinder piston push rod.

(2) Position master cylinder at bracket, with push rod and yoke inserted through hole in bracket. Attach master cylinder to bracket with four bolts and nuts. Tighten nuts to 20–27 pound-feet torque.

(3) Attach brake pedal shaft brace to side of master cylinder with bolt and lock washer.

(4) Insert hydraulic brake line connector bolt through connector, with gasket on both sides of connector, and thread bolt into rear end of cylinder. Tighten bolt firmly.

(5) Connect air vent line to master cylinder filler extension.

(6) Connect piston push rod yoke to brake pedal, making adjustment as described in paragraph 223*b*.

(7) Bleed brake system (par. 219).

225. Power Cylinder

a. GENERAL. Air-hydraulic power cylinder is mounted on two brackets inside frame right side rail above forward rear axle. Power cylinder front bracket is riveted to frame, and rear bracket is attached to frame by two bolts and nuts. Hydraulic line from master cylinder connects to bottom of control valve. Hydraulic outlet line to wheel cylinders connects to slave cylinder end fitting. Air line from front end of right air tank connects to power cylinder control valve inlet port, and air vent line connects to control valve exhaust port.

b. POWER CYLINDER REMOVAL.

(1) Exhaust air pressure from air system; then disconnect air line from control valve inlet port. Disconnect air vent line from control valve exhaust port.

(2) Disconnect hydraulic brake lines from slave cylinder end fitting and from bottom of control valve.

(3) Remove nuts from two bolts securing power cylinder to front mounting bracket.

(4) Remove two nuts and bolts attaching rear bracket to frame side rail. Remove power cylinder and rear bracket; then remove rear bracket from stud on back of cylinder.

c. POWER CYLINDER INSTALLATION.

(1) Install rear bracket on stud at rear of power cylinder and secure with flat washer and nut. Do not tighten nut.

(2) Position power cylinder at frame side rail, with two end plate bolts inserted through front mounting bracket. Install nut on each bolt and tighten to 9½–13 pound-feet torque.

(3) Position rear bracket at frame and secure with two bolts and nuts, attaching hydraulic brake line clip under nut on front bolt. Tighten nuts to 20–27 pound-feet torque; then tighten nut attaching bracket to rear end of cylinder to 9½–13 pound-feet torque.

(4) Connect hydraulic lines to slave cylinder end fitting and to bottom of control valve. Tighten connections firmly.

(5) Connect air line to control valve inlet port, and connect air vent line to exhaust port.

(6) Bleed brake system (par. 219). Build up air pressure in system and perform brake system tests (par. 218).

226. Wheel Cylinders

a. GENERAL. Two double-end wheel cylinders are mounted on each backing plate between ends of brake shoes (fig. 130). Bleeder valve and hydraulic inlet openings extend through backing plate. Each cylinder is attached to backing plate by two bolts and lock washers. Push rods transmit movement of wheel cylinder pistons to brake shoes. In each wheel cylinder, the piston which operates the toe end of brake shoe has a longer stroke than the piston in the other end to compensate for the increased piston travel made necessary when brakes are adjusted to compensate for normal lining wear. Rubber boot at each end of cylinder keeps out water and dirt, and a heat shield at each cylinder deflects heat, created during brake application, away from cylinder.

b. WHEEL CYLINDER REMOVAL.

(1) Remove brake shoes (par. 221*b*).

(2) At inner side of backing plate, remove bolt attaching hydraulic brake line connector to wheel cylinder.

(3) Remove two bolts and lock washers attaching wheel cylinder to backing plate; then remove wheel cylinder and heat shield from backing plate. Remove heat shield from wheel cylinder.

c. WHEEL CYLINDER INSTALLATION.

(1) Install heat shield on wheel cylinder; then place wheel cylinder and heat shield on backing plate with long end of cylinder adjacent to adjusting screw in anchor block.

Attach wheel cylinder to backing plate with two bolts and lock washers, threading bolts into wheel cylinder from inner side of backing plate.

(2) Insert hydraulic brake line connector bolt through connector, with new copper washers on bolt on both sides of connector, and thread bolt into wheel cylinder.

(3) Install brake shoes and complete the installation (par. 221*c*).

(4) Bleed brake system (par. 219).

227. Hydraulic and Air Lines and Connections

a. HYDRAULIC BRAKE LINES. Metal lines are used to carry hydraulic brake fluid from master cylinder to air power cylinder, from power cylinder outlet to tee fitting at frame side rail, and from frame tee fitting to front and rear axle flexible hose connections; also from flexible hose junctions at each axle to wheel cylinders at rear brakes and to flexible hose connections at front brakes. Flexible hose are used between frame connections and axles and from axle to wheel cylinders at front brakes due to constant flexing during vehicle operation. Brake lines are made of special metal tubing with flared type connections, designed to withstand high pressure and to resist corrosion; ordinary copper tubing is not satisfactory for use as hydraulic brake lines. When replacing brake lines, be sure replacement line is the same size as the one removed. Whenever a hydraulic brake line has been replaced or disconnected, make sure connections are tight, then bleed brake system (par. 219).

b. AIR-LINES. Air lines are of seamless copper tubing with three-piece compression-type fittings. Air lines may be tested for leakage by building up air pressure in system to normal operating pressure; then coating all air lines connections with a solution of soap and water. Leakage will be evidenced by the appearance of soap bubbles. Leakage can sometimes be corrected by tightening the connection. If tightening fails to correct leakage, new air line or connection must be installed. When replacing air lines, tubing must be free of burs, copper cuttings, and dirt. Blow line out with compressed air before installing. Any of the above mentioned particles will destroy sealing seats in power cylinder control valve. Replacement lines must be of the same size as the ones removed. Whenever air lines have been replaced or disconnected, tighten connections firmly; then check for leakage.

228. Air Compressor Governor

a. GENERAL. Air compressor governor controls pressure in air system by starting or stopping compression of air when system pressure reaches the desired minimum or maximum. Governor, mounted on compressor cylinder head, consists primarily of a diaphragm-operated plunger which actuates a trigger to hold the air inlet valves off their seats, stopping compression, when system pressure reaches maximum limit (100 psi). When pressure is reduced to minimum (75 psi), trigger releases inlet valves and compression of air is resumed. Governor diaphragm is connected to air system at air line junction fitting on engine side of dash.

b. AIR COMPRESSOR GOVERNOR ADJUSTMENT. Adjustment points and method of checking and making adjustments are shown in figure 134. Adjustments must be made in the sequence given. Make sure cylinder head bolts are firmly tightened before adjusting governor.

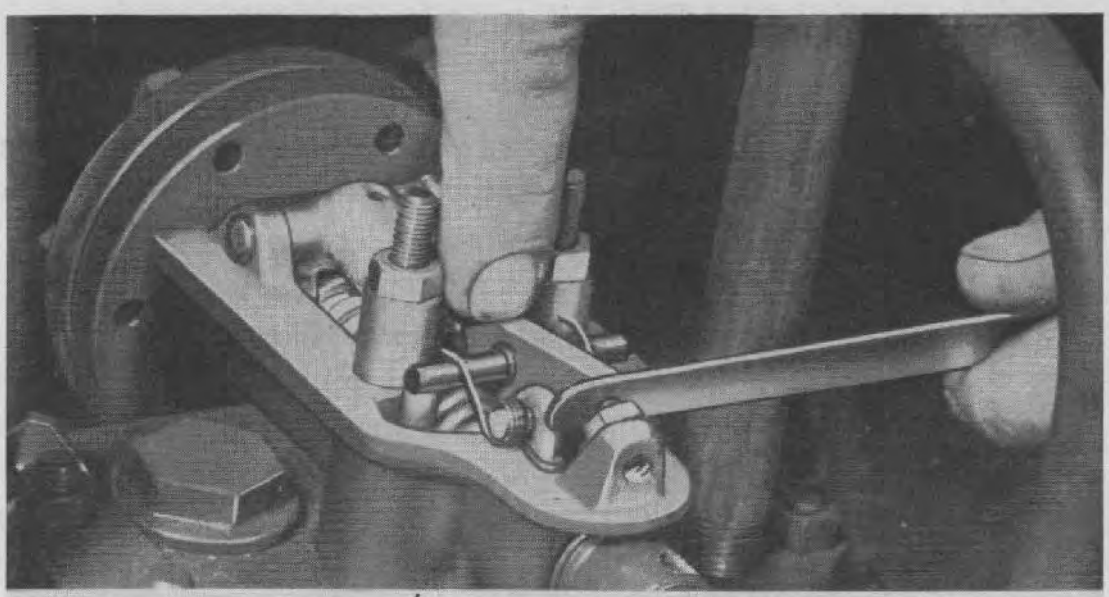
(1) With engine stopped and no air pressure in system, remove top cover from governor. Depress trigger by pressing with finger on end of trigger opposite adjusting screw (fig. 134). Adjust trigger stop screw to provide 0.044-inch clearance between trigger and adjusting screw with trigger depressed. Tighten adjusting screw lock nut.

(2) Insert a screw driver between plunger housing and governor body and pry up on plunger housing until the plunger slides over the nose of the trigger and depresses the trigger (fig. 134). Hold plunger in this position and bend the plunger housing stop to obtain 0.020-inch clearance between plunger housing and stop.

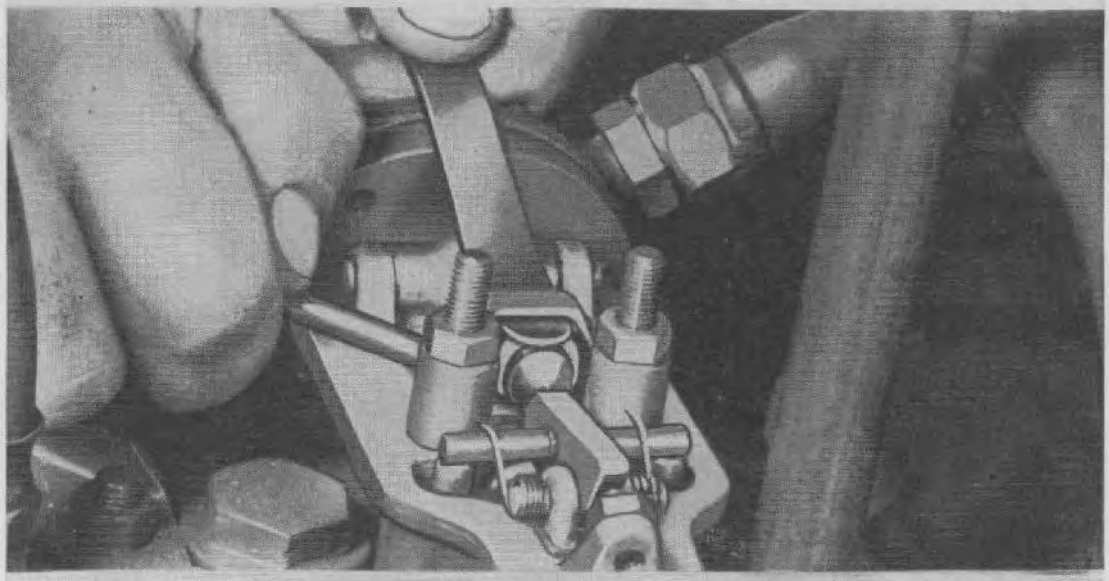
(3) Start engine and build up air pressure in system. Adjust cut-out pressure to 100 psi by turning the adjusting screw (fig. 134). Turn screw clockwise to increase cut-out pressure and counterclockwise to reduce cut-out pressure. One complete turn of adjusting screw will change pressure setting 14 psi. Correct cut-out pressure setting should provide a cut-in pressure of 75 psi.

(4) Reduce air pressure in system and check cut-in pressure. If not within 20–25 psi below cut-out pressure; recheck all adjustments.

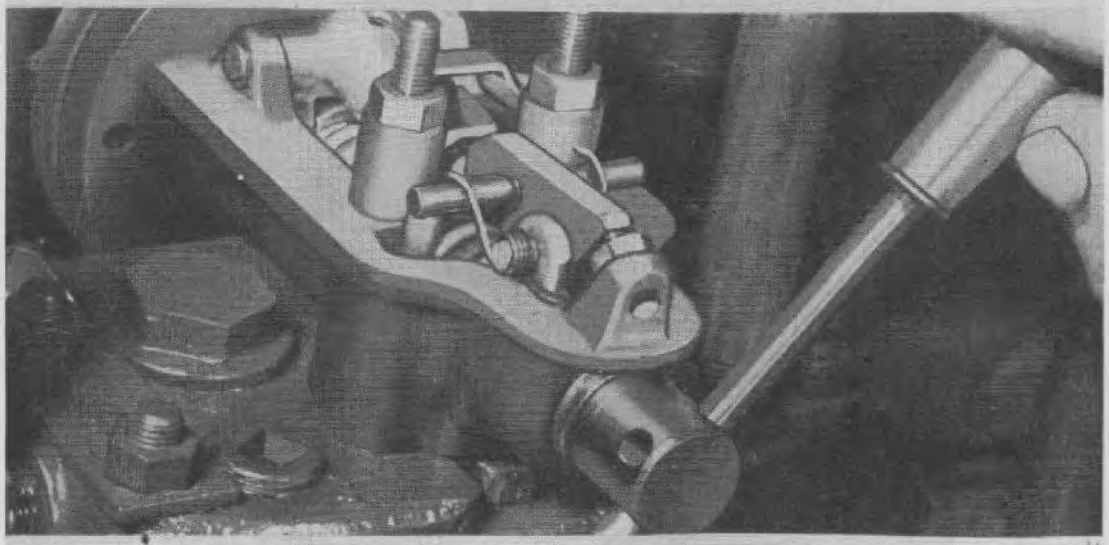
(5) Install cover on governor; then lubricate governor (par. 57).



CHECKING TRIGGER TO STOP CLEARANCE



CHECKING PLUNGER HOUSING TO STOP CLEARANCE



ADJUSTING CUT-OUT PRESSURE RA PD 148922

Figure 134. Air compressor governor adjustments.

229. Air Compressor Drive Belt

a. Air Compressor Drive Belt Adjustment (fig. 135).

(1) Loosen bolts attaching air compressor adjusting arm to engine thermostat housing and to bracket on compressor cylinder head.

(2) Loosen nut on air compressor pivot bolt.

(3) Move compressor toward or away from engine as necessary to provide correct belt tension; tension is correct when a light pressure on belt midway between pulleys will cause ½- to ¾-inch deflection of belt.

(4) When correct belt tension is obtained, hold compressor in position and tighten adjusting arm bolts and pivot bolt nut.

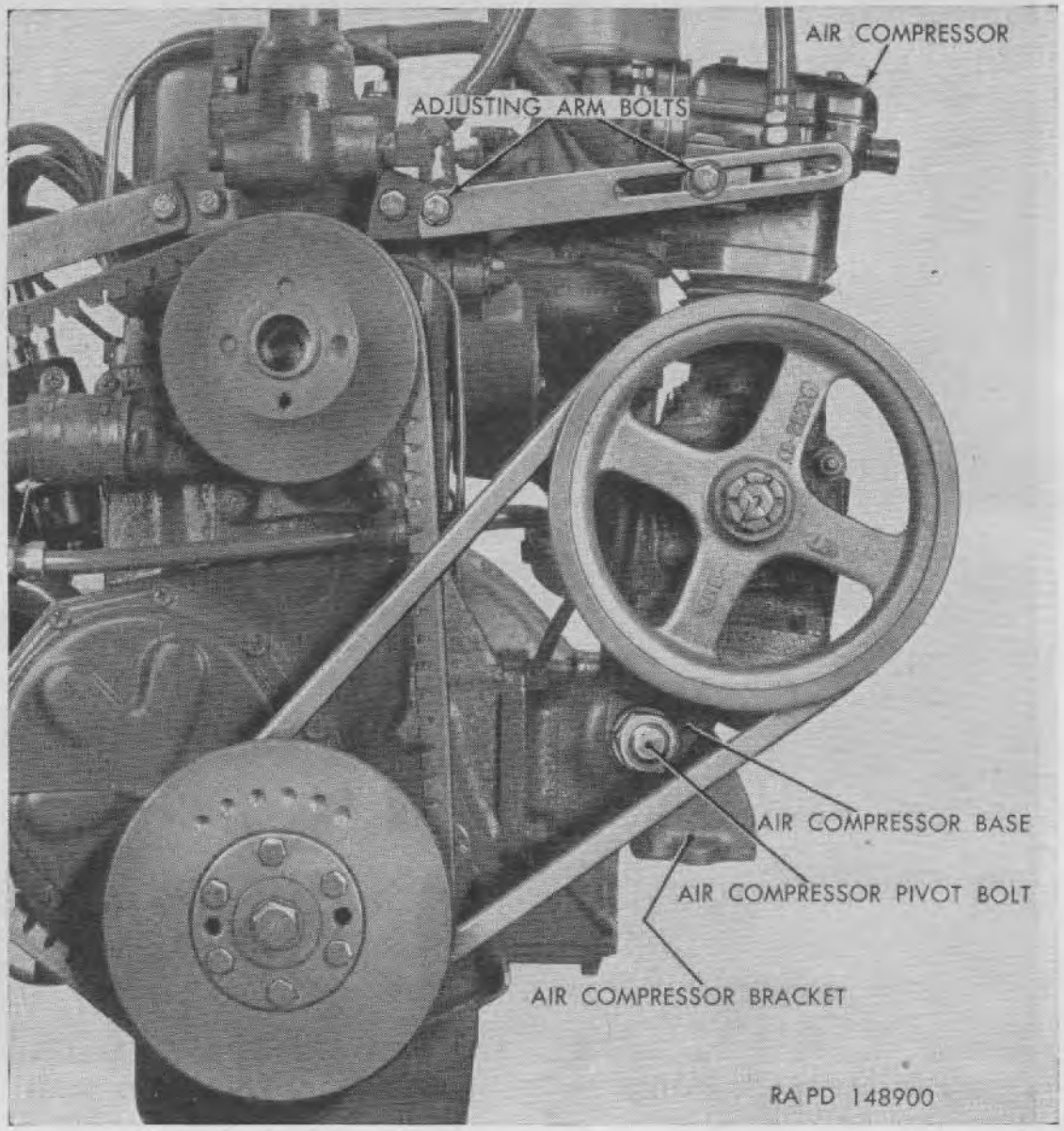


Figure 135. Air compressor drive belt adjustment points.

b. AIR COMPRESSOR DRIVE BELT REPLACEMENT (fig. 135).

(1) Loosen air compressor adjusting arm bolts and pivot bolt nut.

(2) Swing compressor toward engine; then remove belt from compressor pulley and from crankshaft pulley.

(3) Position new belt in groove in crankshaft pulley and in air compressor pulley.

(4) Adjust belt tension ((3) and (4) above).

230. Air Compressor

a. GENERAL. Air compressor, mounted on left front side of engine, is a two-cylinder reciprocating-type unit. Compressor is driven by belt from the engine crankshaft, lubricated by the engine lubricating system, and the compressor cylinder head is cooled by the engine cooling system. Air compressor crankshaft turns continuously while engine is running, but actual compression of air is controlled by the compressor governor which is mounted on the compressor cylinder head. Air compressor air intake port is connected to engine air intake system at the carburetor air inlet elbow. Oil is carried from the engine main oil gallery to the compressor crankshaft rear end cover by a flexible hose, and is forced through the drilled crankshaft, lubricating connecting rods, piston pins, and cylinder walls. Oil drains into compressor mounting and returns to the engine crankcase through the oil return hose.

b. AIR COMPRESSOR REMOVAL (fig. 135).

(1) Exhaust air pressure from air system.

(2) Disconnect oil inlet and oil return hose from compressor crankcase rear end cover and compressor base.

(3) Disconnect water inlet and outlet hose from compressor cylinder head.

(4) Disconnect air inlet hose and air discharge line from compressor cylinder head, and disconnect compressor governor air hose from governor end cover.

(5) Remove bolt and lock washer attaching compressor adjusting arm to bracket on compressor cylinder head. Move compressor toward engine and remove belt from compressor pulley.

(6) Remove nut, lock washer, and pivot bolt attaching compressor base to bracket. Lift compressor and base away from engine.

(7) Remove four bolts and lock washers attaching compressor to base and remove base.

(8) Remove cotter pin and nut securing pulley on compressor crankshaft; then remove pulley from crankshaft, using a suitable puller.

(9) Remove all air, oil, and water line connectors from compressor for installation on replacement unit.

(10) Remove compressor adjusting arm bracket from cylinder head studs for installation on replacement unit.

c. AIR COMPRESSOR INSTALLATION (fig. 135).

(1) Install air, oil, and water line connectors on compressor, coating threads of each connector with plastic-type gasket cement. Tighten connectors firmly, leaving elbows pointing in proper direction for connecting hose.

(2) Install pulley on compressor crankshaft, making sure key is in place in keyseat in crankshaft. Secure pulley on shaft with nut and cotter pin.

(3) Remove nuts from two cylinder head studs at front of compressor, install adjusting arm bracket on studs, and secure with lock washers and nuts.

(4) Install mounting base on bottom of compressor and attach with four bolts and lock washers. Tighten bolts firmly.

(5) Position compressor at engine with base over bracket, and install pivot bolt through base and bracket. Install lock washer and nut on bolt.

(6) Attach adjusting arm to bracket on compressor cylinder head with bolt and lock washer. Do not tighten bolt at this time.

(7) Connect oil inlet and oil return hose to compressor crankcase rear and cover and to compressor mounting base, using plastic-type gasket cement on hose connector threads.

(8) Connect air discharge line and air inlet hose to compressor cylinder head, and connect governor air hose to governor end cover, using plastic-type gasket cement on connector threads.

(9) Connect water inlet and outlet hose to compressor cylinder head, using plastic-type gasket cement on hose connectors.

(10) Adjust air compressor drive belt tension (par. 229*a*). Adjust air compressor governor if necessary (par. 228*b*).

231. Air Tanks and Safety Valve

a. GENERAL.

(1) *Air tanks.* Two air tanks are mounted inside of frame side rails ahead of forward rear axle (fig. 136). The

purpose of the air tanks is to provide a place to store compressed air so there will always be an ample supply available for immediate use for brake operation. They also provide storage for sufficient compressed air to permit several brake applications with engine stopped. Another purpose of the air tanks is to provide a place where the air, heated during compression, may cool and the oil and water vapors condense. Drain cocks are provided in bottom of air tanks for draining condensation from tanks.

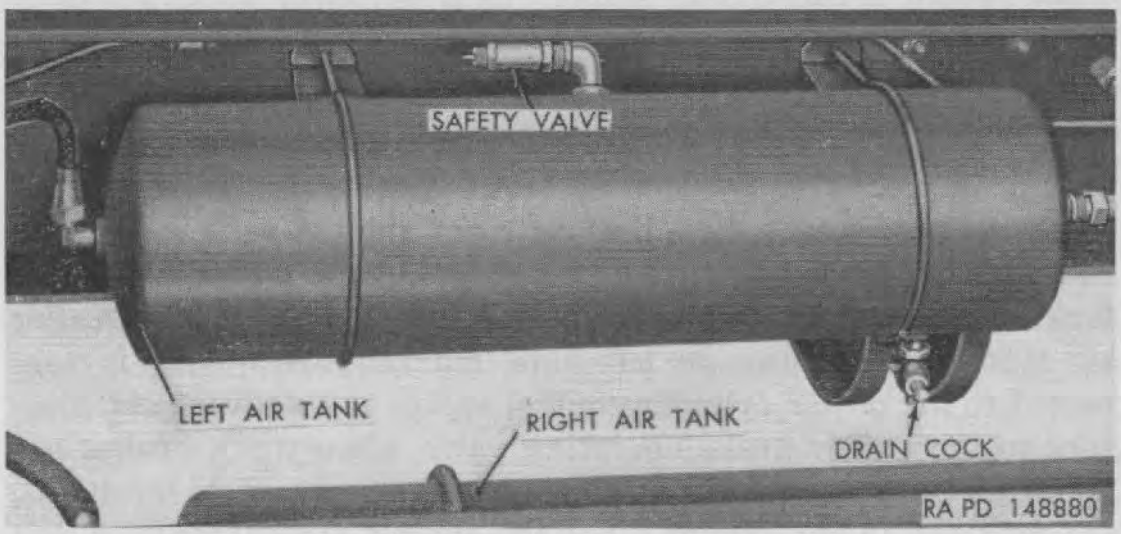


Figure 136. Air tanks, drain cock, and safety valve.

(2) *Safety valve.* Safety valve, installed on top of left air tank (fig. 136), is provided to eliminate the possibilty of air pressure building up in the system beyond a safe maximum in the event of failure of the compressor control valve. Safety valve permits air pressure in excess of 150 psi to escape.

b. AIR TANK REPLACEMENT. The following procedures cover replacement of either air tank.

(1) *Air tank removal.* Exhaust air pressure from air system. Disconnect air lines from air tank. Remove nuts from air tank "U" bolts and remove tank, U bolts, and tank supports. Remove U bolts and supports from tank. Remove drain cock and air line connectors from tank for installation on replacement tank.

Note. If left tank is removed, remove safety valve and elbow from top of tank.

(2) *Air tank installation.* Install air line connectors and drain cock on tank, using plastic-type gasket cement

on all threads. Install safety valve and elbow on left-hand tank. Position U bolts on tank, place tank supports on U bolts, and install on frame side rail. Install nuts on "U" bolts and tighten to 9½–13 pound-feet torque. Connect air lines to tank and tighten connections firmly. Build up air pressure in system; then test connections for leakage using soap and water solution.

c. SAFETY VALVE REPLACEMENT (fig. 136). Unscrew safety valve from elbow on top of left air tank. Coat threads of new or rebuilt safety valve with plastic-type gasket cement and thread into elbow on air tank. Tighten firmly.

232. Trailer Service Connections

a. GENERAL. Two air line couplings at rear end of vehicle provide a means of connecting brake system on trailer to the truck brake system. Coupling on right side of vehicle, marked EMERGENCY, is connected to tee fitting on top of right air tank, and delivers a constant supply of air pressure to the trailer air system. Coupling on left side, marked SERVICE, is connected to air power cylinder control valve, and delivers air pressure to the trailer brake operating valve when truck brakes are applied. Dummy couplings, attached to frame brackets by chains, are provided to seal trailer couplings against the entrance of dirt when not in use. A shut-off cock at each trailer coupling provides a means of shutting off the trailer brake air lines when not connected to trailer.

b. TRAILER COUPLING REPLACEMENT.

(1) *Removal.* Shut-off cock must be closed. Remove dummy coupling from trailer coupling; then unscrew trailer coupling from pipe nipple.

(2) *Installation.* Coat threads of pipe nipple with plastic-type gasket cement, thread trailer coupling onto pipe nipple, and tighten firmly. Assembly dummy coupling to trailer coupling.

c. TRAILER LINE SHUT-OFF COCK REPLACEMENT.

(1) *Removal.* Exhaust air pressure from air system. Disconnect air line from shut-off cock. Unscrew shut-off cock from pipe nipple.

(2) *Installation.* Coat threads of pipe nipple with plastic-type gasket cement. Thread shut-off cock onto pipe nipple and tighten firmly. Connect air line to shut-off cock, using plastic-type gasket cement on air line connector threads. Build up air pressure in air system;

then test connections for leakage, using soap and water solution. Truck brakes must be applied when testing left (SERVICE) connection.

Section XXIV. PARKING BRAKE SYSTEM

233. Description and Data

a. DESCRIPTION. Parking brake is an external-contracting one-piece band-type brake, located at rear of transfer assembly (fig. 137). Parking brake drum is installed between transfer-to-pillow-block propeller shaft flange and transfer output shaft flange. Brake band and lining assembly is supported by a support bracket and anchor support attached to the transfer housing. Parking brake hand lever, located at right of driver in cab, operates brake band through a relay lever and interconnecting rods (fig. 138).

b. DATA.

Type	external-contracting band.
Brake drum diameter	9½ in.
Brake lining width	3 in.
Brake lining thickness	5/16 in.

234. Parking-Brake Adjustment

a. GENERAL. Parking-brake adjustment is required when hand lever reserve travel is less than one-half the ratchet range. Adjustments are made at the brake band at rear of transfer, and at forward end of brake rod connecting brake cams to relay lever.

b. ADJUSTMENT PROCEDURE.

(1) Block wheel to prevent vehicle moving. Place hand lever in fully released position. Disconnect brake rod adjustable yoke from relay lever by removing cotter pin and clevis pin.

(2) Remove lock wire from anchor adjusting screw (C, fig. 137). Turn anchor adjusting screw as necessary to obtain a clearance of 0.015 inch between lining and drum. Install lock wire.

(3) Loosen lock nut on locating bolt (J, fig. 137). Draw up locating bolt until there is a clearance of 0.020 inch between lower end of lining and brake drum. Measure clearance about 1½ inches from end of lining. Tighten lock nut on locating bolt.

(4) Loosen lock nut on adjusting bolt (M, fig. 137). Draw up adjusting bolt to obtain a clearance of 0.020 inch between upper end of lining and brake drum. Measure clearance about 1½ inches from end of lining. Tighten lock nut on adjusting bolt.

(5) Adjust yoke on brake rod at relay lever (K, fig. 138) so that clevis pin may be freely inserted through yoke and lever. Install clevis pin and cotter pin; then tighten lock nut against yoke. Remove blocks from wheel.

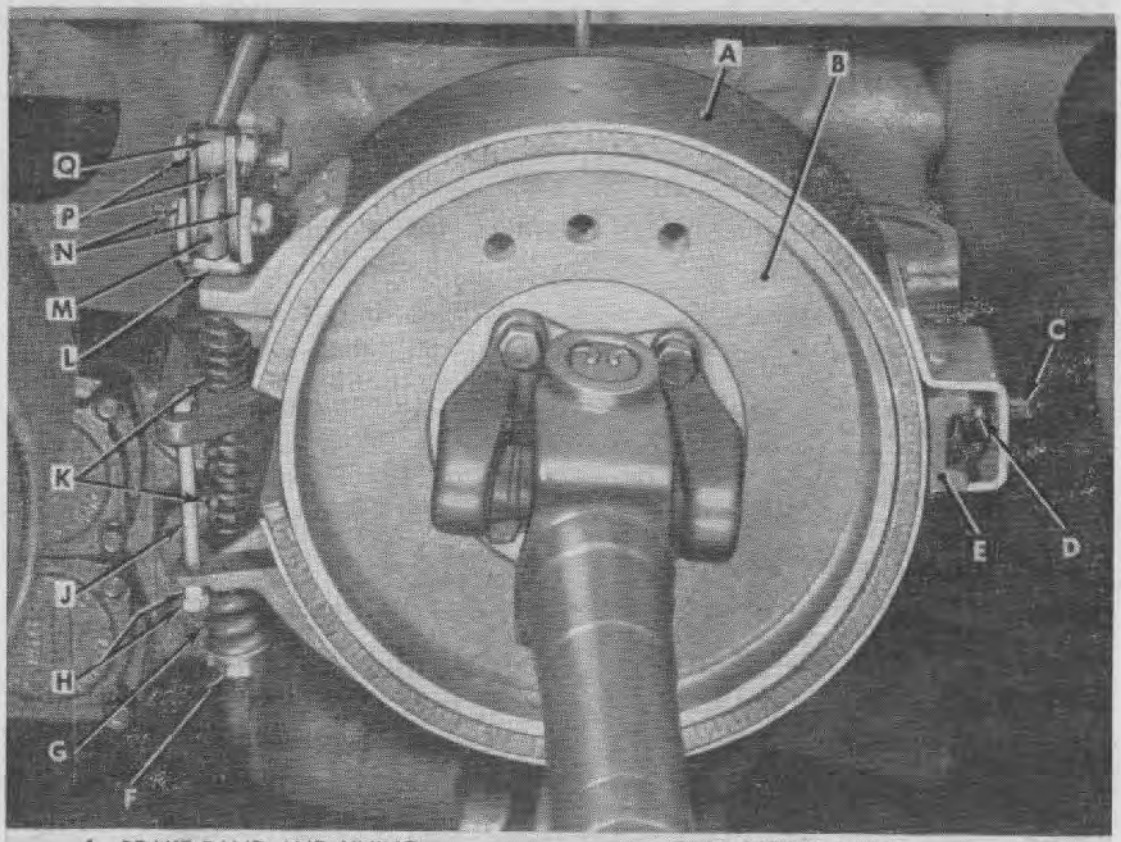


Figure 137. Parking brake drum and band installed on transfer.

235. Brake Band and Lining

a. Brake Band and Lining Removal (fig. 137).

(1) Block wheels to prevent vehicle moving. Disconnect brake rod from cams by removing cotter pin and clevis pin. Remove cotter pin, clevis pin, and cams from upper end of adjusting bolt.

(2) Remove nuts, washers, and spring from lower end of adjusting bolt. Lift adjusting bolt straight up out of brake band brackets and support bracket, stripping release springs and cam shoe off bolt as bolt is removed.

(3) Remove nuts from locating bolt and remove bolt. Remove lock wire from anchor screw; then back screw out of anchor support.

(4) Slide band and lining assembly rearward off brake drum and anchor support, removing anchor screw spring as band is removed. Pull band and lining assembly off over propeller shaft.

b. Brake Band and Lining Installation (fig. 137).

(1) Place brake band and lining over propeller shaft. Place anchor screw spring in depression in anchor support, and compress spring as brake band and lining assembly is placed over brake drum and anchor support.

(2) Thread anchor screw into anchor support until it contacts brake band. Insert locating bolt down through hole in support bracket and brake band lower bracket. Install two nuts on locating bolt.

(3) Install cams between links and install clevis pin and cotter pin.

(4) Insert threaded end of adjusting bolt down between cam levers with hook toward rear of vehicle; as bolt is lowered into place, it must pass through cam shoe, band upper bracket, upper release spring, support bracket, lower release spring, and band lower bracket. Install tension spring, flat washer, and two nuts on adjusting bolt.

(5) Connect brake rod to cam levers, using clevis pin and cotter pin. Adjust lining to drum clearance (par. 234*b*).

236. Parking Brake Drum

a. Parking Brake Drum Removal (fig. 137).

(1) Remove parking brake band and lining assembly (par. 235*a*).

(2) Remove four nuts and bolts attaching propeller shaft flange and brake drum to transfer shaft flange. Slide slip yoke back on propeller shaft and lower front end of propeller shaft to floor.

(3) Remove parking brake drum from transfer shaft flange. Do not drop locating ring out of inside of drum.

b. PARKING BRAKE DRUM INSTALLATION (fig. 137).

(1) Make sure shoulder on transfer shaft flange and mating surface on brake drum web are clean and smooth. Make sure locating ring is in place in center of drum. Position drum on flange with bolt holes alined.

(2) Raise propeller shaft, position propeller shaft flange against brake drum, and install four bolts. Install nuts on bolts and tighten to 33–43 pound-feet torque.

(3) Install parking brake band and lining (par. 235*b*).

237. Parking Brake Linkage

a. PARKING BRAKE HAND LEVER REPLACEMENT (fig. 138).

(1) *Removal.* Remove cotter pin, clevis pin, and two flat washers (spacers) attaching brake rod to hand lever adapters. Remove nut from clamp bolt securing hand lever on lever pin, remove clamp bolt, and then remove hand lever from pin.

(2) *Installation.* Install hand lever on lever pin, with clamp bolt hole alined with groove in pin. Install nut on clamp bolt and tighten to 20–27 pound-feet torque. Connect brake rod to hand lever adapters, using clevis pin, two flat washers, and cotter pin; one flat washer must be installed on each side of brake rod eye between adapters. Apply parking brake; if hand lever reserve

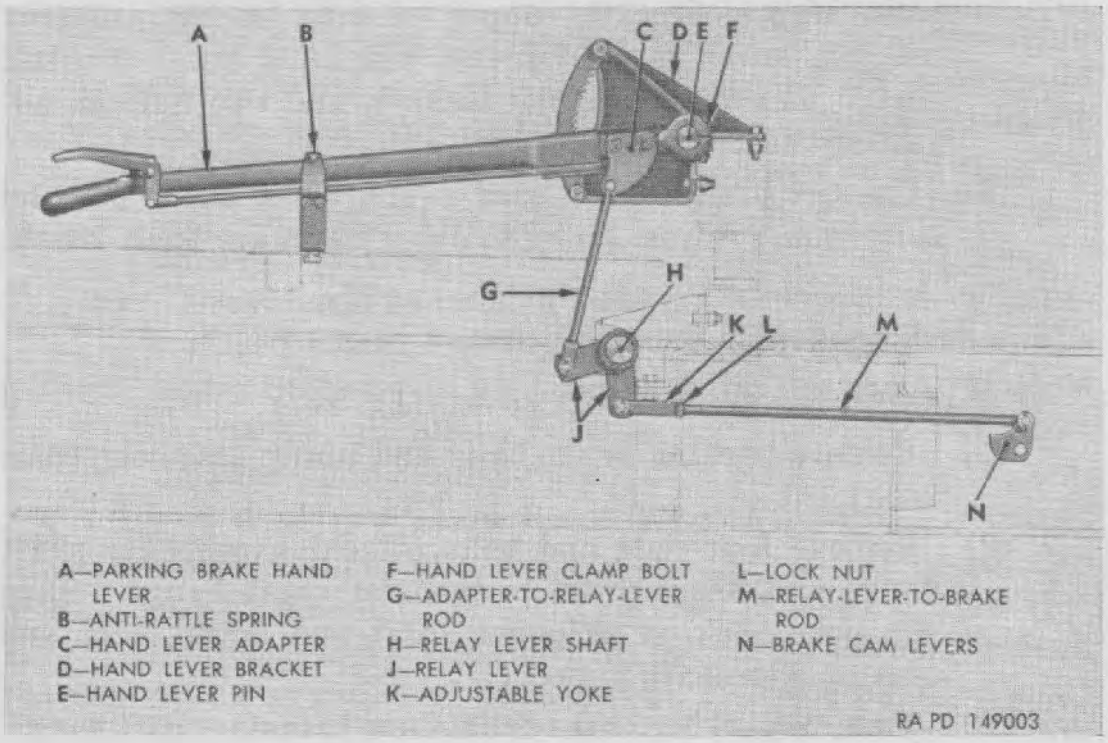


Figure 138. Parking brake linkage.