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TM 9-1727D

**RESTRICTED**

**WAR DEPARTMENT**

**TECHNICAL MANUAL**



**ORDNANCE MAINTENANCE**

**TRANSFER UNIT FOR LIGHT TANKS M5, M5A1,  
AND 75-MM HOWITZER MOTOR CARRIAGE M8**

**APRIL 28, 1943**

**FOR ORDNANCE PERSONNEL ONLY**

**RESTRICTED****TECHNICAL MANUAL }  
No. 9-1727D }****WAR DEPARTMENT  
Washington, April 28, 1943****ORDNANCE MAINTENANCE****TRANSFER UNIT FOR LIGHT TANKS M5, M5A1,  
AND 75-MM HOWITZER MOTOR CARRIAGE M8**

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**Prepared under the direction of the  
Chief of Ordnance****(with the cooperation of the Cadillac Motor Car Division,  
General Motors Corporation)**

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**CONTENTS**

|                               | Paragraphs | Pages   |
|-------------------------------|------------|---------|
| SECTION I. Introduction ..... | 1-3        | 1-6     |
| II. Transfer unit .....       | 4-23       | 7-195   |
| III. References .....         | 24-25      | 196     |
| INDEX .....                   |            | 197-201 |

**ORDNANCE MAINTENANCE—TRANSFER UNIT FOR LIGHT TANKS  
M5, M5A1, AND 75-MM HOWITZER MOTOR CARRIAGE M8**

**Section I**

**INTRODUCTION**

|                              | Paragraph |
|------------------------------|-----------|
| Purpose and scope .....      | 1         |
| Description of vehicles..... | 2         |
| References .....             | 3         |

**1. PURPOSE AND SCOPE.**

a. TM 9-1727D is published for the information and guidance of all ordnance personnel charged with the maintenance and overhauling of Light Tanks M5, M5A1, and 75-mm Howitzer Motor Carriage M8. It includes complete maintenance information on the transfer unit. The other technical manuals covering these vehicles are listed in section III.

**2. DESCRIPTION OF VEHICLES.**

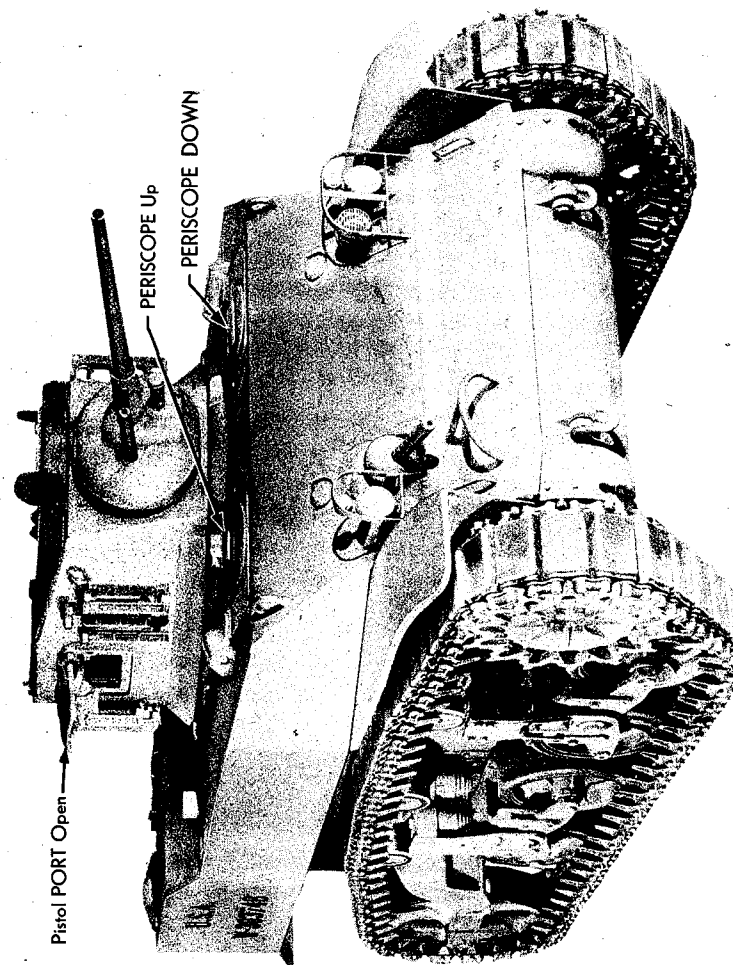
a. The Light Tanks M5 and M5A1 are armored, full-tracklaying combat vehicles, each carrying a crew of four men. They are each powered by two liquid-cooled, 90-degree, V-type, 8-cylinder engines, located in the engine compartment in the rear of the hull. Power is transmitted to the final drives and tracks through two Hydra-Matic transmissions, two propeller shafts, a two-speed, step-down transfer unit, and the controlled differential (fig. 4).

b. The Motor Carriage M8 (fig. 3) is an armored, full-tracklaying, self-propelled mount for a 75-mm howitzer. It carries a crew of four men. It is powered by the same engines, transmissions, and power train as the Light Tank M5.

**3. REFERENCES.**

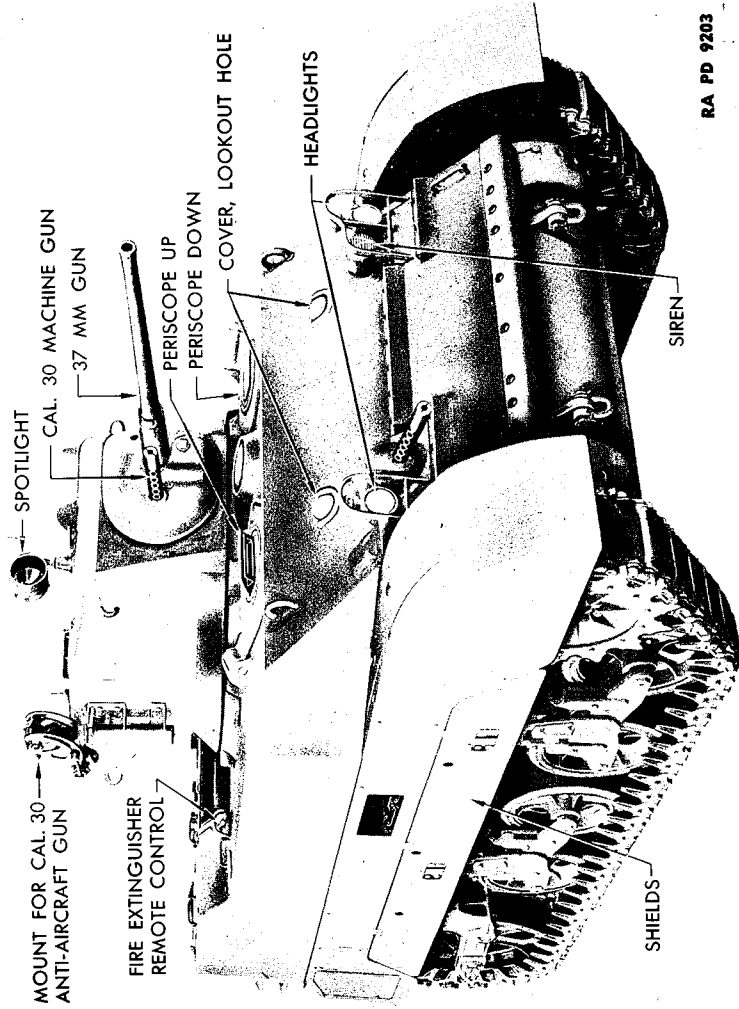
a. Section III of this volume lists all technical manuals, standard nomenclature lists, and other publications relative to the materiel described herein.

**INTRODUCTION**



**Figure 1 — Light Tank M5 — Right Front View**

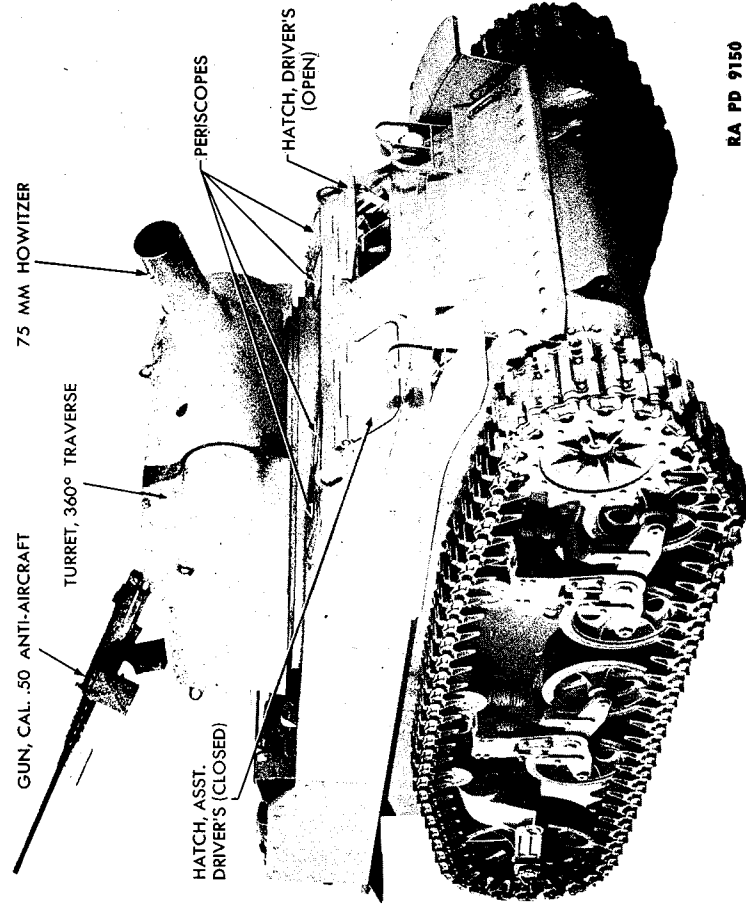
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M5, M5A1, AND 75-MM HOWITZER MOTOR CARRIAGE M8**



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**Figure 2 — Light Tank M5A1 — Right Front View**

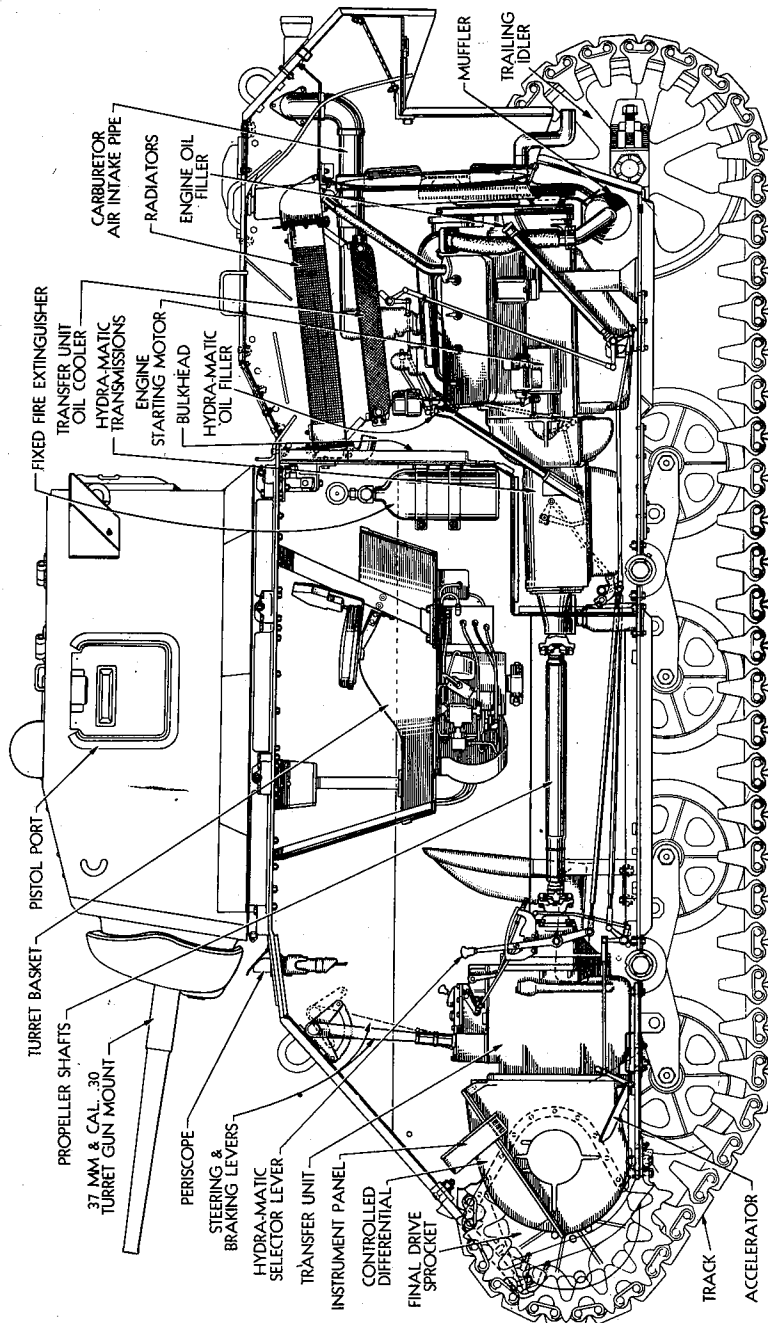
**INTRODUCTION**



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**Figure 3 — Motor Carriage M8 — Right Front View**

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**Figure 4 — Light Tank M5 — Longitudinal Cross Section**

**Section II**

**TRANSFER UNIT**

|  | Paragraph |
|--|-----------|
| Description .....  | 4         |
| Operation .....  | 5         |
| Tabulated data and specifications .....                    | 6         |
| Allocation of maintenance duties by echelons.....          | 7         |
| Inspection in vehicle .....                                | 8         |
| Trouble shooting .....                                     | 9         |
| Service in vehicle.....                                    | 10        |
| Replacement of components in vehicle.....                  | 11        |
| Removal of transfer unit from vehicle.....                 | 12        |
| Disassembly of transfer unit .....                         | 13        |
| Disassembly of transfer unit components.....               | 14        |
| Inspection and repair of transfer unit and components..... | 15        |
| Assembly of transfer unit components.....                  | 16        |
| Assembly of transfer unit .....                            | 17        |
| Installation of transfer unit.....                         | 18        |
| Limits and tolerances .....                                | 19        |
| Torque tightnesses .....                                   | 20        |
| Special tools .....  | 21        |
| Preparation for extreme conditions.....                    | 22        |
| Packing and shipping .....                                 | 23        |

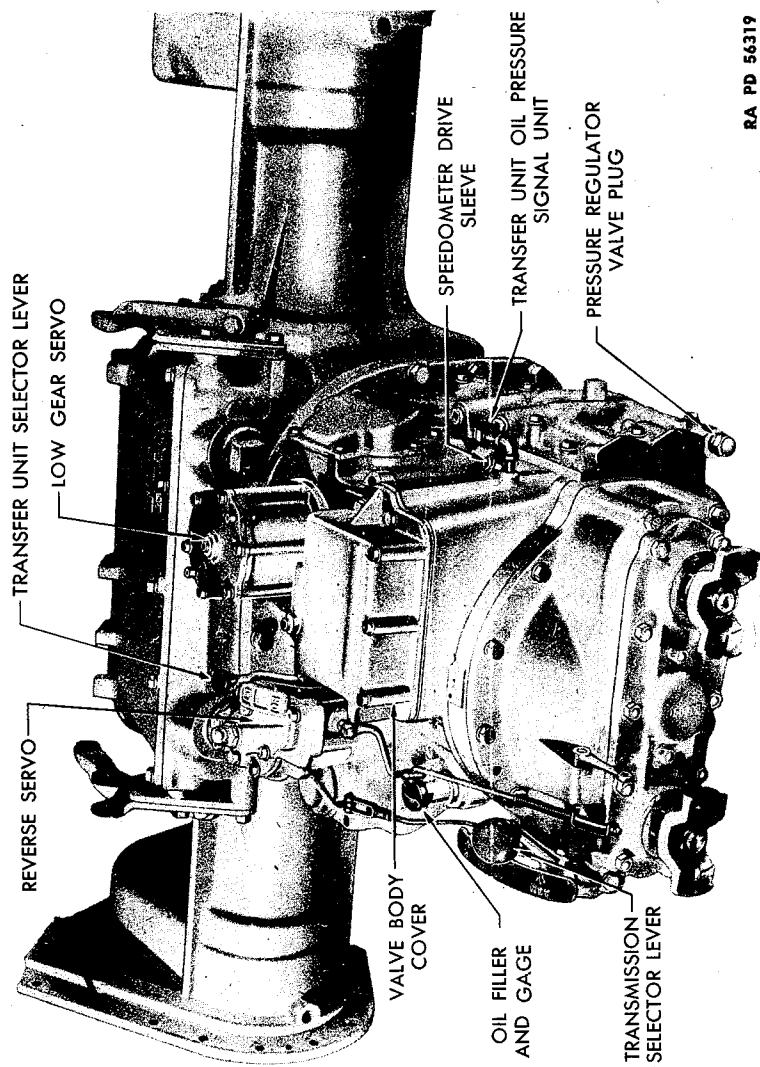
**4. DESCRIPTION.**

a. The transfer unit performs two distinct functions. It takes the power of the two engines, delivered to the transfer unit by the propeller shafts, and combines these two power flows into one. It also provides a two-speed, hydraulic-controlled gear reduction which, combined with the reductions in the transmissions, permits a total of six forward speeds and one reverse speed.

b. The transfer unit is located in the front end of the vehicle, mounted on a flange on the rear of the controlled differential housing (fig. 5).

c. The transfer unit case is composed of two sections, a large main case at the front which contains the mechanism for the gear reduction unit and the hydraulic control parts, and a smaller case at the rear which contains the connector unit by means of which the torque from the two propeller shafts is combined into the one transfer unit main shaft.

## ORDNANCE MAINTENANCE—TRANSFER UNIT FOR LIGHT TANKS M5, M5A1, AND 75-MM HOWITZER MOTOR CARRIAGE M8



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TRANSFER UNIT AND CONTROLLED DIFFERENTIAL

**Figure 5 — Transfer Unit and Controlled Differential**

## TRANSFER UNIT

d. The connector gears which combine the torque are all of the same diameter and thus do not provide any reduction. The connector gear shafts are mounted in the case in single row ball bearings. The main shaft or input shaft into the transfer unit proper is mounted at its rearward end on a double row ball bearing and on its forward or inner end on a roller pilot bearing (L, fig. 6) in the counterbore of the transfer unit output shaft.

e. The spiral drive pinion for the controlled differential is splined to the transfer unit output shaft and held securely in place by a cottered castle nut. The forward or pinion end of the output shaft is mounted in the transfer case on a large, double-row ball bearing, and the rearward or inner end on a single-row ball bearing.

f. The gear reduction unit is a compound planetary system with the two center gears integral with the main shaft, and the second planet carrier attached to the output shaft. Two bands are used to lock the brake drum and thus provide reduction. The low gear band is self-energizing in forward speeds and the reverse band, in reverse speeds. A multiple disk clutch, engaged by oil pressure, is contained in the clutch drum assembly, and locks the planetary gear train as a unit to provide direct drive.

g. The servos which apply and release the two bands are mounted on the top of the main transfer unit case (figs. 7 and 8). The oil pumps and governor are mounted on a carrier located on the right-hand side of the unit, and the valves which control the shifting are mounted in a valve body on top of the unit.

## 5. OPERATION.

a. **Reduction.** When the vehicle is started or operated at low speeds, the transfer unit is in reduction (fig. 10). The low gear band is applied to the drum by spring pressure in the low gear servo, and the clutch is released because there is no oil pressure to the clutch apply pistons. The reverse servo is released by oil pressure applied to the release piston and is held in the released position by a mechanically-operated latch and a ball check valve which prevents air from being drawn into the system. As the main shaft is rotated, the two center gears, being integral with the shaft, also rotate. The internal gear for the first planetary gear train is held from rotating by the low gear band; consequently, the planet gears in this train "walk around" inside the internal gear and carry the planet carrier at a speed less than that of the first center gear. The planet carrier for the first planetary gear train is integral with the internal gear for the second planetary train; consequently, this internal gear rotates

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M5, M5A1, AND 75-MM HOWITZER MOTOR CARRIAGE M8

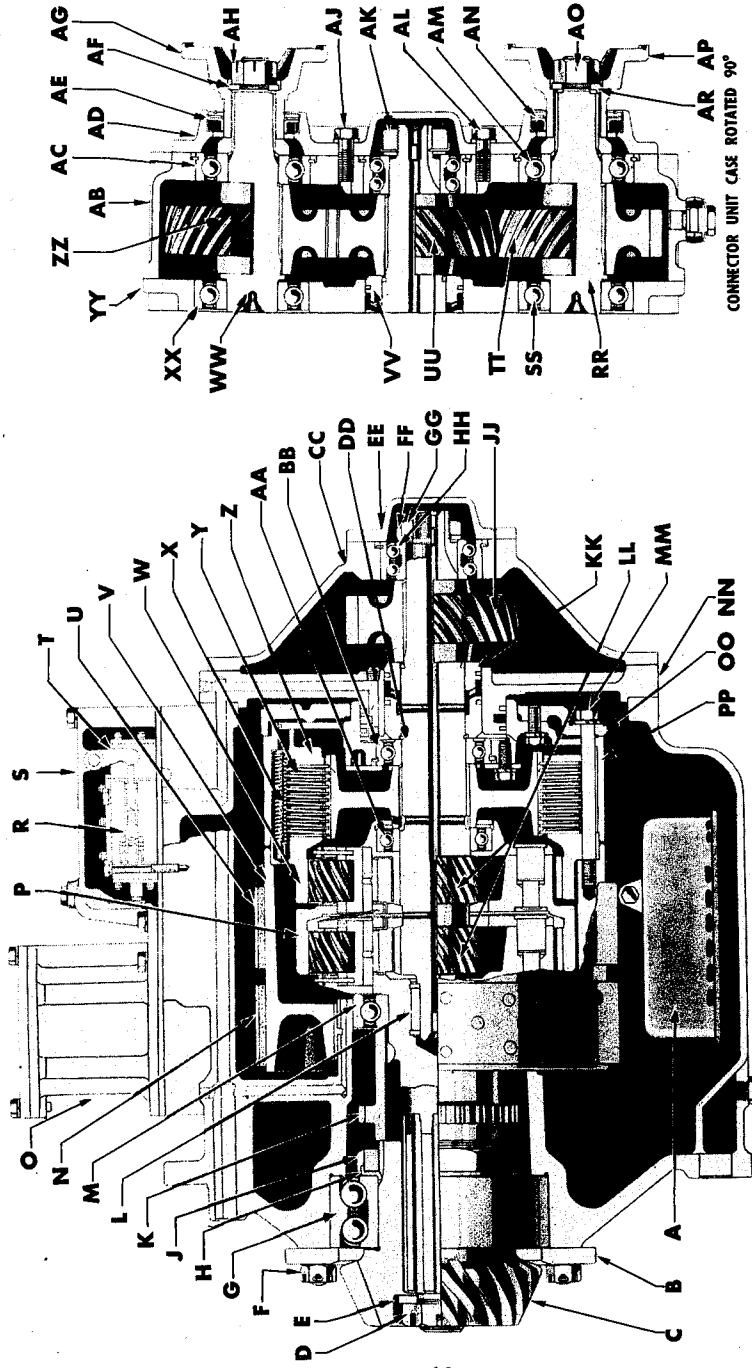


Figure 6 — Transfer Unit — Longitudinal Section

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CONNECTOR UNIT CASE ROTATED 90°

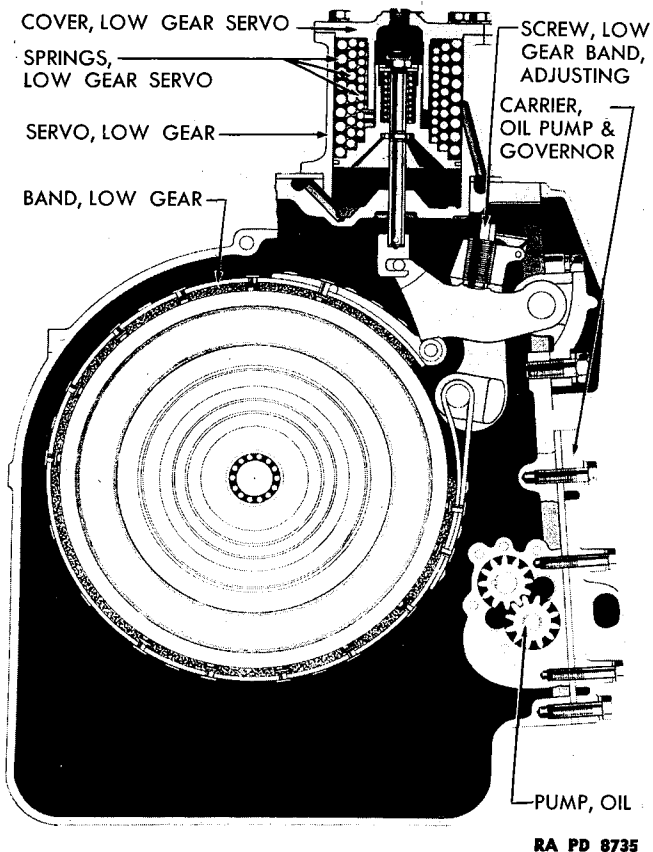
TRANSFER UNIT

- A—STRAINER, OIL
- B—RETAINER, DRIVE PINION BEARING
- C—PINION, SPIRAL DRIVE
- D—NUT, SPIRAL DRIVE PINION
- E—WASHER, SPIRAL DRIVE PINION NUT
- F—NUT, BEARING RETAINER
- G—BEARING, OUTPUT SHAFT, FRONT
- H—WASHER, LOCK, BEARING, RETAINER NUT
- J—NUT, BEARING RETAINER
- K—GEAR, DRIVE, OIL PUMP AND GOVERNOR
- L—BEARING, MAIN SHAFT PILOT
- M—BEARING, OUTPUT SHAFT, REAR
- N—BAND, LOW GEAR
- O—SERVO, LOW GEAR
- P—CARRIER, DIRECT DRIVE
- R—BODY, VALVE AND ACCUMULATOR
- S—COVER, VALVE, BODY
- T—LEVER, THROTTLE VALVE CONTROL, INNER
- U—BAND, REVERSE
- V—DRUM, BRAKE
- W—GEAR, INTERNAL, LOW GEAR CLUTCH DRUM
- X—SPRING, CLUTCH RELEASE
- Y—PLATE, CLUTCH, DRIVE
- Z—PLATE, CLUTCH, PRESSURE
- AA—BEARING, MAIN SHAFT
- BB—BEARING, CLUTCH DRUM
- CC—CASE, CONNECTOR UNIT
- DD—SHAFT, MAIN
- EE—COVER, CONNECTOR UNIT CASE
- FF—WASHER, LOCK, MAIN SHAFT NUT
- GG—NUT, MAIN SHAFT
- HH—BEARING, MAIN SHAFT, REAR
- JJ—GEAR, DRIVEN, CONNECTOR UNIT
- KK—SPACER, MAIN SHAFT
- LL—PINION, PLANETARY, DIRECT DRIVE CARRIER AND OUTPUT SHAFT
- MM—BOLT, CLUTCH DRUM TO BRAKE DRUM
- NN—COVER, TRANSFER UNIT CASE, REAR
- OO—COVER, CLUTCH DRUM
- PP—DRUM, CLUTCH
- RR—SHAFT, CONNECTOR UNIT DRIVE GEAR
- SS—BEARING, CONNECTOR DRIVE GEAR
- TT—GEAR, DRIVE, CONNECTOR
- UU—GEAR, DRIVEN, CONNECTOR UNIT
- VV—SPACER, MAIN SHAFT
- WW—SHAFT, CONNECTOR UNIT DRIVE GEAR
- XX—BEARING, CONNECTOR DRIVE GEAR, FRONT
- YY—COVER, TRANSFER UNIT CASE, REAR
- ZZ—GEAR, DRIVE, CONNECTOR
- AB—CASE, ASSEMBLY, CONNECTOR UNIT
- AC—BEARING, CONNECTOR DRIVE GEAR, REAR
- AD—COVER, CONNECTOR UNIT CASE
- AE—OIL SEAL, CONNECTOR UNIT UNIVERSAL JOINT YOKE
- AF—WASHER, YOKE
- AG—YOKE, UNIVERSAL JOINT
- AH—NUT, UNIVERSAL JOINT
- AJ—SCREW, CONNECTOR COVER TO CASE
- AK—NUT, MAIN SHAFT
- AL—SCREW, CONNECTOR COVER TO CASE
- AM—BEARING, CONNECTOR DRIVE GEAR, REAR
- AN—OIL SEAL, CONNECTOR UNIT UNIVERSAL JOINT YOKE
- AO—NUT, UNIVERSAL JOINT YOKE
- AP—YOKE, UNIVERSAL JOINT
- AR—WASHER, UNIVERSAL JOINT
- AS—SPRING, CLUTCH RELEASE

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Legend for Figure 6 — Transfer Unit — Longitudinal Section

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M5, M5A1, AND 75-MM HOWITZER MOTOR CARRIAGE M8**



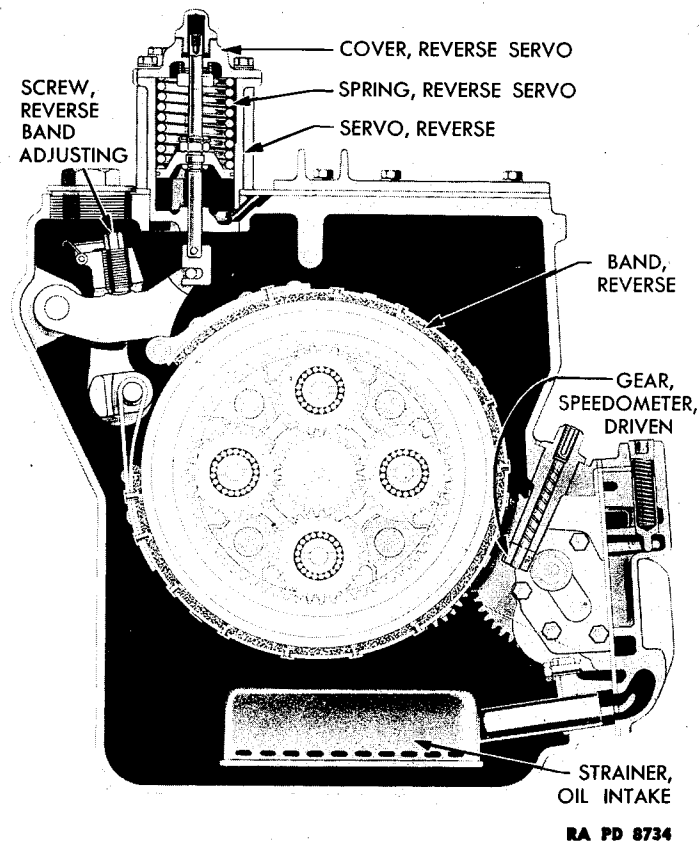
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**Figure 7 — Transfer Unit — Cross Section at Low Gear Servo**

at a speed less than that of the second center gear. The planet gears of the second planetary train accordingly rotate with these gears and at the same time "walk around" the second center gear at an over-all gear reduction of 2.37 to 1. Since the output shaft is attached to the planet carrier of the second planetary gear train, this is the gear reduction of the transfer unit.

**b. Upshift.** When the vehicle speed is such that the transfer unit upshifts, oil pressure is applied to the release side of the low gear servo. This oil pressure overcomes the apply pressure of the springs and assures the gradual release of the low gear band from the brake drum. At the same time that this occurs, oil pressure is also delivered to the clutch apply pistons and the clutch is applied (fig. 11). Details of the hydraulic mechanism whereby this is accomplished are given in paragraph 5 j.

**TRANSFER UNIT**



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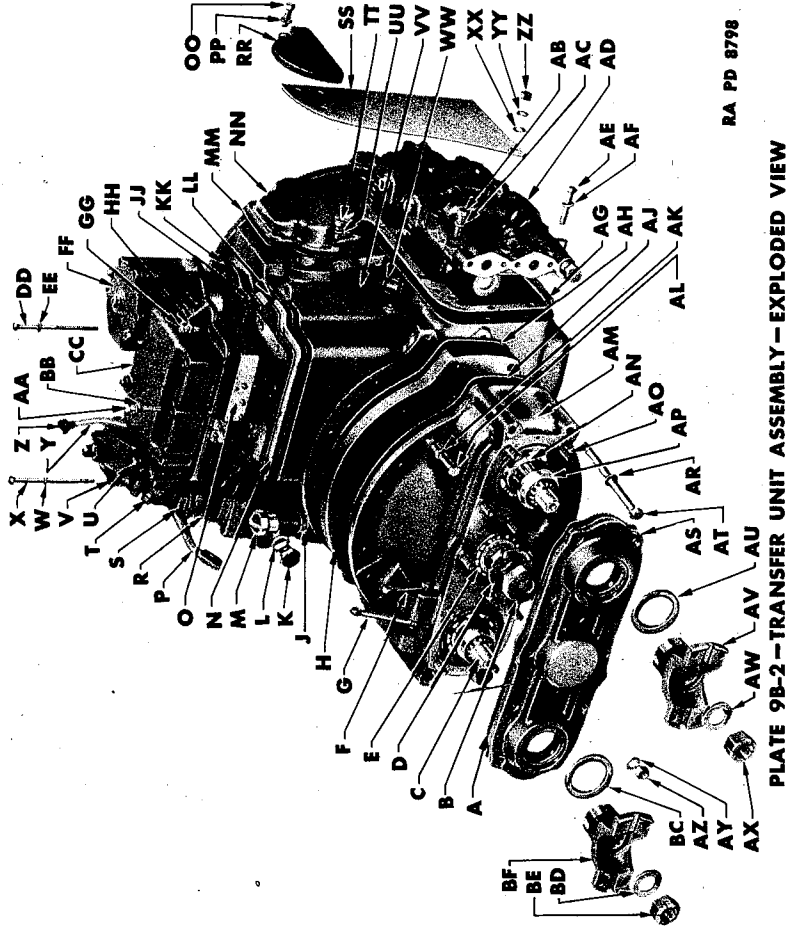
**Figure 8 — Transfer Unit — Cross Section at Reverse Servo**

**c. Direct Drive.** When the above action has taken place, the entire planetary gear train revolves as a unit and the rotation of the propeller shafts is transmitted without reduction to the pinion on the output shaft.

**d. Reverse.** When the selector lever for the Hydra-Matic transmissions is moved into the reverse position, a connection from this lever to the transfer unit releases a mechanical latch holding the reverse servo apply spring in the released position. This spring, being freed, applies the reverse servo. At the same time, a valve is repositioned to relieve the oil pressure that also holds the reverse servo in the released position. The flow of power to the transfer unit is exactly the same as previously described except that the direction of rotation is reversed. The reverse band application is necessary to provide self-energizing action with this direction of rotation, and both bands act to hold the drum from slipping (fig. 12).



**ORDNANCE MAINTENANCE — TRANSFER UNIT FOR LIGHT TANKS  
M5, M5A1, AND 75-MM HOWITZER MOTOR CARRIAGE M8**



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**PLATE 9B-2—TRANSFER UNIT ASSEMBLY—EXPLODED VIEW**

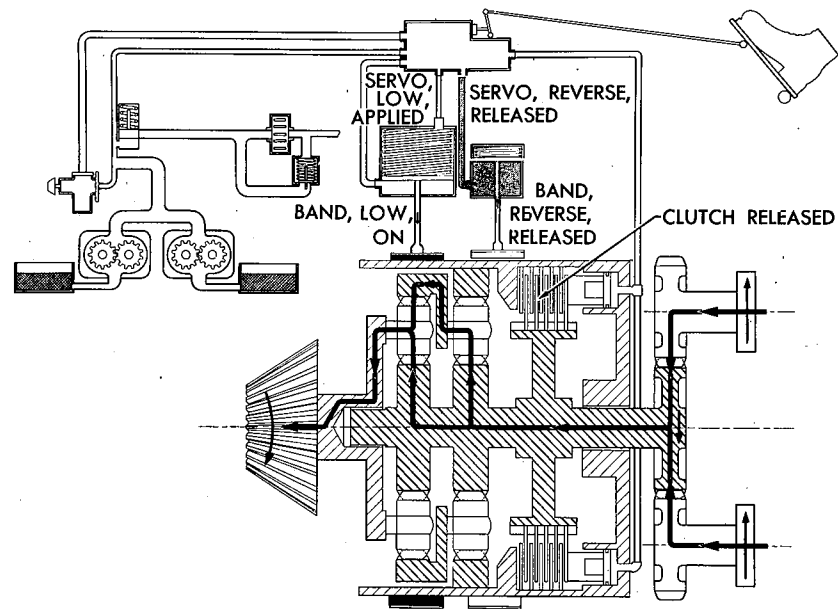
**Figure 9 — Transfer Unit Assembly — Disassembled**

- |   |  |   |                           |
|---|--|---|---------------------------|
| <p><b>A</b>—GASKET, CONNECTOR UNIT CASE COVER</p> <p><b>B</b>—NUT, MAIN SHAFT</p> <p><b>C</b>—SHAFT, CONNECTOR UNIT DRIVE GEAR</p> <p><b>D</b>—WASHER, LOCK, MAIN SHAFT NUT</p> <p><b>E</b>—BEARING, MAIN SHAFT, REAR</p> <p><b>F</b>—LEVER, THROTTLE VALVE RELAY SHAFT, SHORT</p> <p><b>G</b>—LEVER, THROTTLE VALVE RELAY SHAFT, LONG</p> <p><b>H</b>—COVER, TRANSFER UNIT CASE, REAR</p> <p><b>J</b>—SLEEVE, OIL FILLER</p> <p><b>K</b>—PLUG, REVERSE BAND LEVER SHAFT</p> <p><b>L</b>—GASKET, REVERSE BAND LEVER SHAFT PLUG</p> <p><b>M</b>—INDICATOR, OIL LEVEL</p> <p><b>N</b>—PLATE, SPACER, TRANSFER UNIT CASE, TOP</p> <p><b>O</b>—BODY, VALVE AND ACCUMULATOR</p> <p><b>P</b>—LEVER, REVERSE BRAKE SERVO EXHAUST VALVE, OUTER</p> <p><b>R</b>—GASKET, REVERSE BRAKE ADJUSTMENT HOLE PLUG</p> <p><b>S</b>—PLUG, REVERSE BRAKE ADJUSTMENT HOLE</p> <p><b>T</b>—SCREW, CAP, HEX. HEAD</p> <p><b>U</b>—SCREW, CAP, HEX. HEAD</p> <p><b>V</b>—SERVO, REVERSE</p> <p><b>W</b>—WASHER, LOCK</p> <p><b>X</b>—SCREW, CAP, SERVO BODY TO CASE</p> <p><b>Y</b>—LEVER, MANUAL VALVE CONTROL, OUTER</p> | <p><b>Z</b>—KNOB, MANUAL CONTROL VALVE OUTER LEVER</p> <p><b>AA</b>—SCREW, CAP, VALVE BODY COVER</p> <p><b>BB</b>—WASHER, LOCK</p> <p><b>CC</b>—COVER, VALVE BODY</p> <p><b>DD</b>—SCREW, SERVO BODY TO CASE</p> <p><b>EE</b>—WASHER, LOCK</p> <p><b>FF</b>—SERVO, LOW GEAR</p> <p><b>GG</b>—SCREW, VALVE BODY COVER</p> <p><b>HH</b>—WASHER, LOCK</p> <p><b>JJ</b>—GASKET, VALVE BODY COVER</p> <p><b>KK</b>—GASKET, LOW GEAR SERVO BODY</p> <p><b>LL</b>—GASKET, TRANSFER UNIT CASE, TOP</p> <p><b>MM</b>—GASKET, LOW GEAR BRAKE ADJUSTMENT HOLE COVER</p> <p><b>NN</b>—COVER, LOW GEAR BRAKE ADJUSTMENT HOLE</p> <p><b>OO</b>—SCREW, CAP</p> <p><b>PP</b>—WASHER, LOCK</p> <p><b>RR</b>—EXTENSION, LEG GUARD</p> <p><b>SS</b>—SHIELD, LEG GUARD</p> <p><b>TT</b>—SCREW, LOW GEAR, ADJUSTING COVER</p> <p><b>UU</b>—WASHER, LOCK</p> <p><b>VV</b>—CASE, TRANSFER UNIT</p> <p><b>WW</b>—SLEEVE, SPEEDOMETER DRIVE SHAFT</p> <p><b>XX</b>—WASHER, PLAIN, S., U.S. STD.</p> <p><b>YY</b>—WASHER, LOCK</p> <p><b>ZZ</b>—NUT, LEG GUARD, SHIELD</p> <p><b>AB</b>—SCREW, CARRIER</p> <p><b>AC</b>—WASHER, LOCK</p> | <p><b>AD</b>—CARRIER, OIL PUMP AND GOVERNOR</p> <p><b>AE</b>—SCREW, CARRIER</p> <p><b>AF</b>—WASHER, LOCK</p> <p><b>AG</b>—GASKET, OIL PUMP AND GOVERNOR CARRIER</p> <p><b>AH</b>—GASKET, CASE, COVER</p> <p><b>AJ</b>—GASKET, CONNECTOR UNIT CASE</p> <p><b>AK</b>—WASHER, LOCK</p> <p><b>AL</b>—SCREW, CAP, CONNECTOR UNIT CASE TO TRANSFER UNIT CASE</p> <p><b>AM</b>—CASE, CONNECTOR UNIT</p> <p><b>AN</b>—BEARING, CONNECTOR DRIVE GEAR, REAR</p> <p><b>AO</b>—STUD, CONNECTOR UNIT CASE COVER</p> <p><b>AP</b>—SPACER, CONNECTOR UNIT DRIVE GEAR SHAFT</p> <p><b>AR</b>—WASHER, LOCK</p> <p><b>AS</b>—COVER, CONNECTOR UNIT CASE TO TRANSFER UNIT CASE</p> <p><b>AT</b>—SCREW, CONNECTOR UNIT CASE TO TRANSFER UNIT CASE</p> <p><b>AU</b>—OIL SEAL, UNIVERSAL JOINT YOKE</p> <p><b>AV</b>—YOKE, UNIVERSAL JOINT</p> <p><b>AW</b>—WASHER, UNIVERSAL JOINT YOKE</p> <p><b>AX</b>—NUT, UNIVERSAL JOINT YOKE</p> <p><b>AY</b>—WASHER, LOCK</p> <p><b>AZ</b>—NUT</p> <p><b>BC</b>—OIL SEAL, UNIVERSAL JOINT YOKE</p> <p><b>BD</b>—WASHER, UNIVERSAL JOINT YOKE</p> <p><b>BE</b>—NUT, UNIVERSAL JOINT YOKE</p> <p><b>BF</b>—YOKE, UNIVERSAL JOINT</p> | <p><b>RA PD 8798B</b></p> |
|---|--|---|---------------------------|

**TRANSFER UNIT**

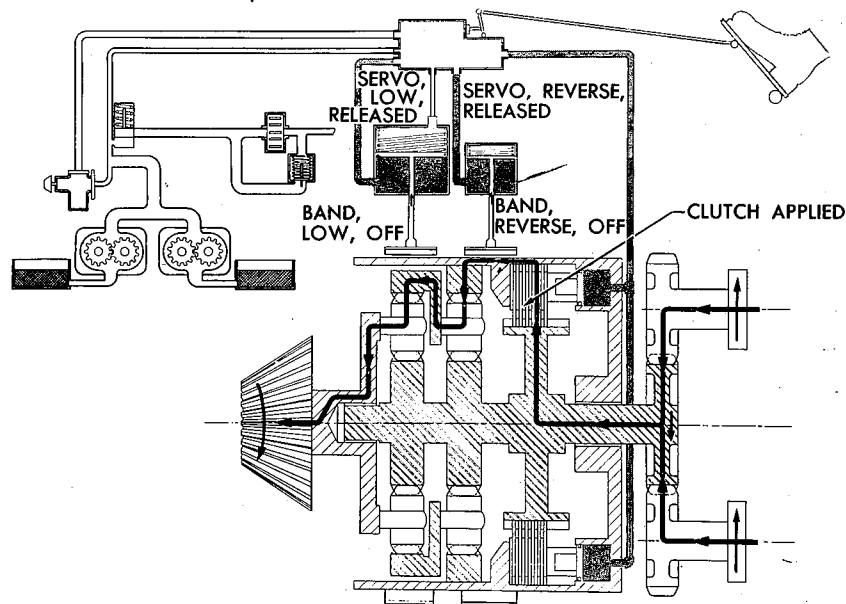
**Legend for Figure 9 — Transfer Unit Assembly — Disassembled**

**ORDNANCE MAINTENANCE—TRANSFER UNIT FOR LIGHT TANKS  
M5, M5A1, AND 75-MM HOWITZER MOTOR CARRIAGE M8**



RA PD 8736

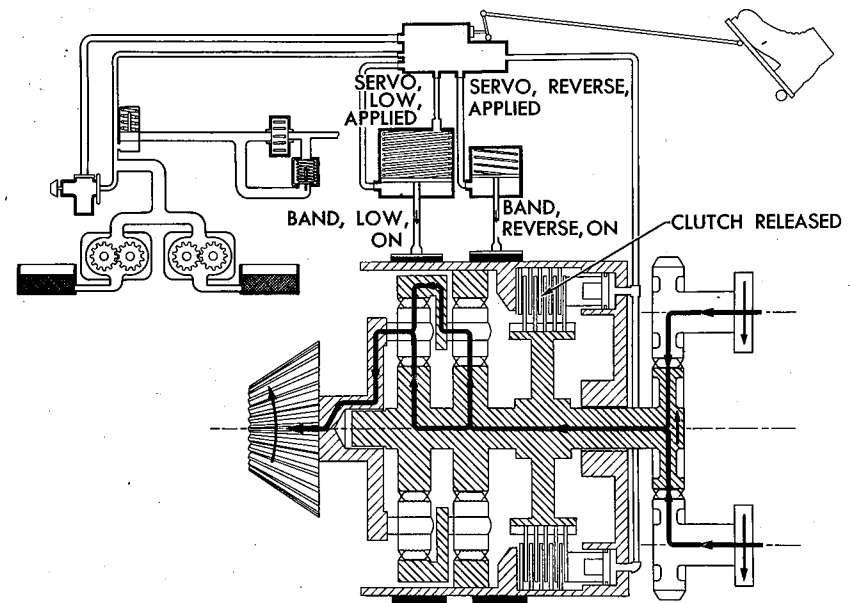
**Figure 10—Transfer Unit in Reduction**



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**Figure 11—Transfer Unit in Direct Drive**

**TRANSFER UNIT**



RA PD 8738

**Figure 12—Transfer Unit in Reverse**

e. **Hydraulic Control System.** The timing of the changes in gear ratios, either upshifting or downshifting, is the function of the hydraulic control system. This system is basically one of carefully balanced valves to provide a precise relationship between the velocity of the vehicle and the performance demands of the driver as expressed by the pressure on the accelerator. The hydraulic control units, illustrated in diagrammatic form in figure 13, consist of the following: a compound oil pump connected to an oil pressure regulator, a centrifugal-type governor, a control valve body containing the control valves and shift valves, and the necessary connecting passages.

f. The governor and oil pump are mounted on a carrier on the right-hand side of the transfer unit case and are driven by the same shaft, which in turn is geared to the output shaft. With this arrangement, the oil pump delivers oil only when the vehicle is in motion, at which time it provides both the oil pressure for operating the control mechanism and the oil for lubricating the gears and bearings of the transfer unit and the controlled differential.

g. The oil pressure supplied by the pump for the control mechanism is maintained between 85 and 90 pounds by means of the oil pressure regulator. This pressure is directed through control valves to apply or

