



**MODEL 20 SCR
Serial No. 5500 and Up
Operation and
Maintenance Instructions**

REPLACES O. AND M. MANUAL FORM MM-33A
DATED MAY 1, 1972

FORM MM-33B
DATED JUNE 1, 1975

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THE RAYMOND CORPORATION

DESCRIPTION

MODEL 20 SCR

SECTION II

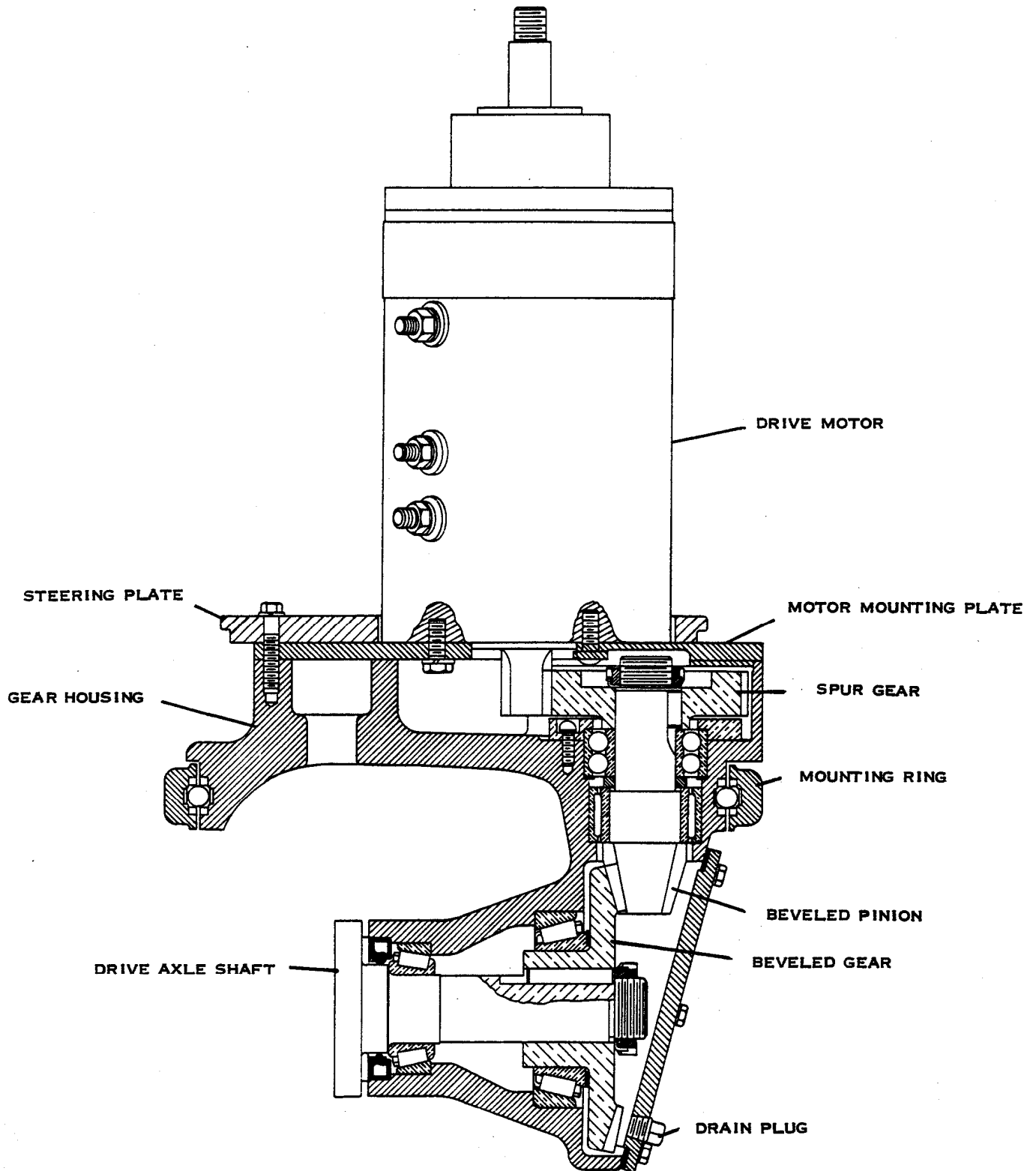


FIGURE 2-2 CROSS SECTION OF COMPLETE DRIVE UNIT

THE RAYMOND CORPORATION

MODEL 20 SCR

SECTION II DESCRIPTION

2-55 TRAVEL CIRCUIT

2-56 THE TRAVEL CIRCUIT FOR THE MODEL 20 SCR TRUCK IS COMPRISED OF A 2-3 HP DRIVE MOTOR, A DIRECTIONAL/SPEED CONTROL ASSEMBLY, AND AN ELECTRICAL PANEL CONTAINING THE FOLLOWING: A CONTROL UNIT, VARIOUS CONTACTORS, THE MAIN AND CHARGING SCR'S, A COMMUTATING SCR AND CAPACITORS, A RECTIFIER BLOCK ASSEMBLY, TRANSFORMER T1, THE PLUGGING RELAY K2, VARIOUS FUSES, AND VARIOUS DIODES AND TRANSIENT SUPPRESSORS. SEE FIGURE 2-6.

2-57 DIRECTIONAL/SPEED CONTROL ASSEMBLY

2-58 SELECTION OF TRAVEL DIRECTION AND SPEED ARE COMPLETELY REGULATED BY THE DIRECTIONAL/SPEED CONTROL ASSEMBLY (12, FIGURE 2-5). THE DIRECTIONAL/SPEED CONTROL ASSEMBLY HANDLE IS MOVED AHEAD FOR FORWARD TRAVEL OR PULLED BACK FOR REVERSE. THE DIRECTIONAL/SPEED CONTROL ASSEMBLY CONTAINS CAM ACTUATED SNAP SWITCHES WHICH COMPLETE CIRCUITS FOR FORWARD OR REVERSE, AND FOR M SPEED RANGE. TO OBTAIN THE VARIABLE SPEEDS IN SCR RANGE, THE DIRECTIONAL/SPEED CONTROL ASSEMBLY CONTAINS A POTENTIOMETER. THE POTENTIOMETER CONTROLS THE CURRENT TO THE WIDTH AND FREQUENCY CIRCUITS OF CONTROL UNIT, WHICH IN TURN, DETERMINES SPEED OF TRUCK.

2-59 CONTROL UNIT

2-60 THE CONTROL UNIT (6, FIGURE 2-17) CONTAINS THE ELECTRONIC CIRCUITRY WHICH CONTROLS OR REGULATES THE TRUCKS ENTIRE TRAVEL SYSTEM. THE CONTROL UNIT CONSISTS OF THREE PROGRAMABLE PRINTED CIRCUIT CARDS. THE AUXILIARY CIRCUIT CARD, THE VARIABLE PULSE GENERATOR CIRCUIT CARD AND THE POWER DRIVER CIRCUIT CARD. THE CARDS ARE EASILY REMOVED FROM CONTROL UNIT AND CAN BE REPLACED INDIVIDUALLY IF IT SHOULD BECOME NECESSARY. THE FOLLOWING DESCRIBES THE FUNCTION OF EACH PRINTED CARD:

A. AUXILIARY CIRCUIT CARD CONTAINS THE TIME DELAY FOR FORWARD AND REVERSE CONTACTORS, THE TIME DELAY FOR M CONTACTOR AND THE FAIL SAFE PROTECTIVE CIRCUITS. THE AUXILIARY CARD CAN BE IDENTIFIED AS ONE OF THE TWO LARGER CIRCUIT CARDS HAVING ONLY ONE ADJUSTMENT SCREW (No. 7). THE FOLLOWING DESCRIBES THE FUNCTION OF EACH CIRCUIT:

1. F (FORWARD) AND R (REVERSE) CONTACTOR DELAY - THIS CIRCUIT IS DESIGNED TO MAKE OPERATION OF TRUCK SMOOTHER AND TO PROLONG THE LIFE OF ELECTRICAL AND DRIVE COMPONENTS. THE DELAY CIRCUIT DE-ACTIVATES THE F OR R CONTACTOR WHEN THE FAIL SAFE CIRCUIT IS ACTIVATED. THE DELAY PROVIDES A SMOOTH "PLUGGING" OPERATION BY ALLOWING ONE DIRECTIONAL CONTACTOR TO DE-ENERGIZE BEFORE THE OTHER CAN ENERGIZE. THIS WOULD OCCUR DURING A PLUGGING OPERATION.

THE RAYMOND CORPORATION
MODEL 20 SCR
SECTION III
OPERATING INSTRUCTIONS

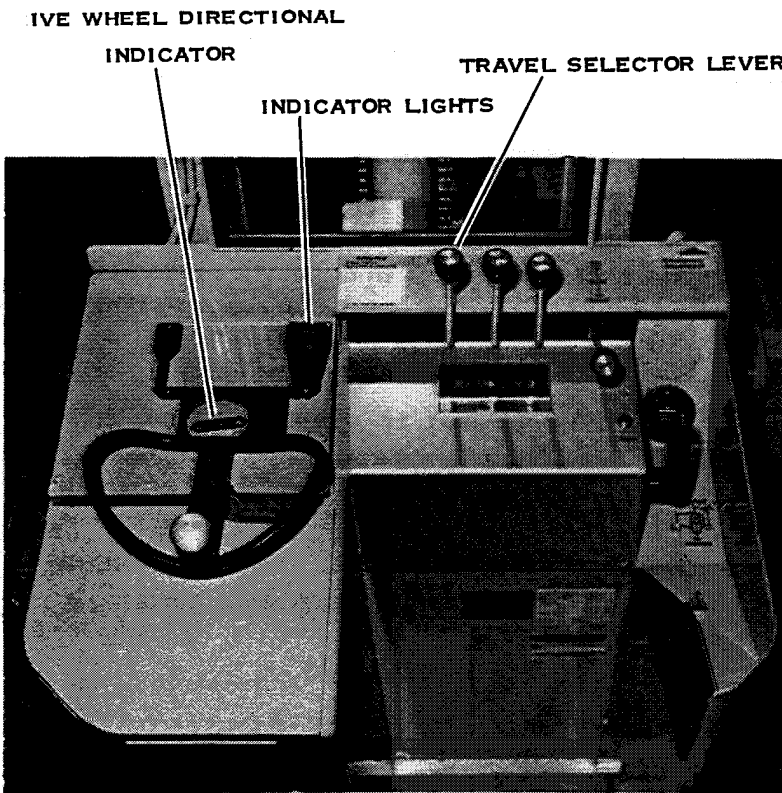


FIGURE 3-3 "4D" CASTER CONTROLS
AND DIRECTION INDICATORS

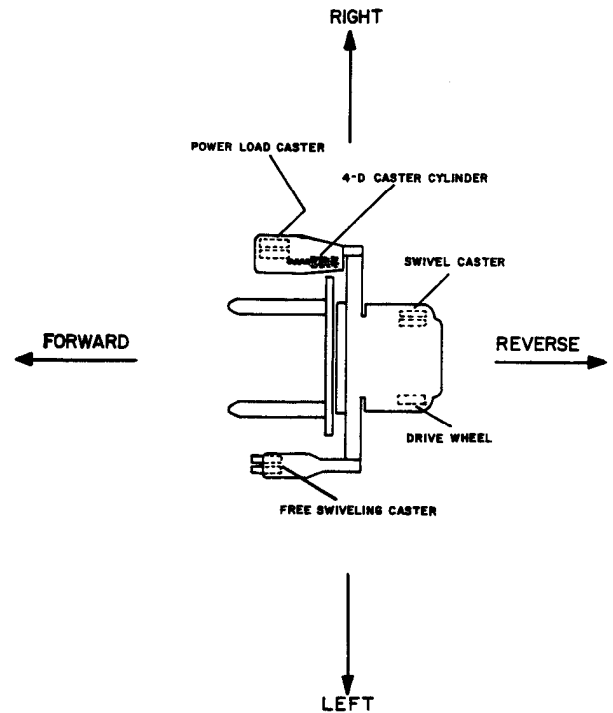


FIGURE 3-4 DEFINING TRAVEL DIRECTIONS
AND TRUCK WHEELS

3-46 TO TRAVEL SIDeways (4D)

3-47 PULL THE TRAVEL SELECTOR LEVER BACK TO SIDE DIRECTION. TURN THE STEERING WHEEL UNTIL THE DRIVE WHEEL DIRECTION INDICATOR SHOWS THE DESIRED DRIVE WHEEL POSITION. NOTE DIRECTION DRIVE WHEEL DIRECTION ARROW IS POINTING. MOVE DIRECTIONAL/SPEED CONTROL HANDLE FORWARDS (TOWARDS FORKS) TO TRAVEL IN THE DIRECTION THE ARROW IS POINTING OR PULL HANDLE BACK FOR THE OPPOSITE DIRECTION TRAVEL.

3-48 TO BRAKE

3-49 THE BRAKING SYSTEM OF THE MODEL 20 TRUCK MEETS ALL THE BRAKING REQUIREMENTS OF ANSI B56.1 AND IS TO BE CONSIDERED THE RECOMMENDED SYSTEM FOR STOPPING THE TRUCK.

3-50 TO BRAKE OR STOP, RETURN DIRECTIONAL/SPEED CONTROL HANDLE TO NEUTRAL POSITION AND GRADUALLY LET UP ON DEADMAN PEDAL AS NECESSARY.

WARNING

EXCEPT IN CASES OF EMERGENCY, AVOID ABRUPT STOPS OR CHANGES IN DIRECTION WHICH COULD CAUSE THE TRUCK TO TIP OR THE LOAD TO SHIFT.

THE RAYMOND CORPORATION

MODEL 20 SCR

SECTION V THEORY OF OPERATION

5-5 LOWERING

5-6 TO LOWER CARRIAGE, THE LIFT/LOWER CONTROL VALVE HANDLE IS PUSHED DOWNWARDS. THIS ALLOWS OIL TO FLOW FROM CYLINDER (10, FIGURE 5-1), BACK THRU FLOW CONTROL (9), THE PRESSURE LINE, THRU LIFT/LOWER CONTROL VALVE, THRU RETURN LINE BACK TO RESERVOIR. THE FURTHER DOWN THE CONTROL HANDLE IS PUSHED, THE WIDER THE VALVE IS OPENED AND THE FASTER CARRIAGE IS LOWERED. FLOW CONTROL (9) LIMITS MAXIMUM LOWERING SPEED TO APPROXIMATELY 70 FEET PER MINUTE.

5-7 TRAVEL LIFT/LOWER

5-8 KEY SWITCH S1 MUST BE TURNED ON BEFORE TRAVEL LIFT OR LOWER CAN BE OPERATED. THE OPERATION OF THE TRAVEL LIFT/LOWER SYSTEM IS DESCRIBED IN THE FOLLOWING SEQUENCES:

- A. MOVING BACK ON TRAVEL LIFT/LOWER BUTTON CLOSES SWITCH S5 TO THE LIFT POSITION. PUMP CONTACTOR P IS ENERGIZED COMPLETING POWER CIRCUIT TO LIFT MOTOR. ALSO ENERGIZED IS SOLENOID SOL 1. THE NORMALLY OPEN SOLENOID IS NOW CLOSED.
- B. THE CLOSING OF SOLENOID SOL 1 DIVERTS OIL FLOW FROM LIFT CONTROL VALVE. HYDRAULIC OIL FLOWS FROM LIFT PUMP (1, FIGURE 5-1) TO MANIFOLD ASSEMBLY (2), CHECK VALVE (5), FLOW CONTROL (19), CHECK VALVE (6) AND FROM MANIFOLD THRU FLOW CONTROL (9) AND TO LIFT CYLINDER (10). TRAVEL LIFT SPEED IS LIMITED TO 40 FEET PER MINUTE.
- C. WHEN THE TRAVEL LIFT/LOWER BUTTON IS RELEASED, SWITCH S5 OPENS, DE-ENERGIZING LIFT MOTOR (1) AND SOLENOID SOL 1 (7). THE CARRIAGE STOPS ELEVATING AND IS HELD IN PLACE BY CHECK VALVE (6) CONTAINED IN THE MANIFOLD ASSEMBLY (2). THE CHECK VALVE ALLOWS OIL TO FLOW THRU MANIFOLD TO LIFT CYLINDER BUT BLOCKS OIL FLOW IN OPPOSITE DIRECTION.
- D. MOVING TRAVEL LIFT/LOWER BUTTON FORWARD CLOSES SWITCH S5 TO THE LOWER POSITION. SOLENOID SOL 2, CONTAINED IN THE MANIFOLD ASSEMBLY, IS ENERGIZED. THE NORMALLY CLOSED SOLENOID IS NOW OPENED.
- E. OIL FLOWS FROM LIFT CYLINDER (10), THRU FLOW CONTROL (9) TO MANIFOLD ASSEMBLY AND SOLENOID SOL 2 (4), FLOW CONTROL (20), RELIEF VALVE (18) AND BACK TO RESERVOIR. TRAVEL LOWER SPEED IS LIMITED TO 40 FEET PER MINUTE.

NOTE

CONTACTOR COILS X AND P ALONG WITH SOLENOID COILS SOL 1 AND SOL 2 HAVE TRANSIENT SUPPRESSOR CONNECTED IN PARALLEL WITH COIL. THE TRANSIENT SUPPRESSOR FOR THE X AND P COILS IS SUP-1. THE TRANSIENT SUPPRESSOR FOR THE SOL 1 AND SOL 2 COILS IS SUP-2. WHEN A COIL IS DE-ENERGIZED, A TRANSIENT VOLTAGE IS BUILT UP BY THE COIL. THE TRANSIENT SUPPRESSOR REDUCES THE VOLTAGE, PRODUCED BY THE COIL WHEN DE-ENERGIZED, TO A SAFE LEVEL.

THE RAYMOND CORPORATION

MODEL 20 SCR

SECTION V THEORY OF OPERATION

5-40 (CONT'D.)

- A. MS5A (FORWARD) OR MS5B (REVERSE) IS CLOSED. THE CLOSING OF EITHER SWITCH MS5 COMPLETES A SMALL CURRENT FLOW FROM SWITCH MS5, THRU M CONTACTOR COIL, TO TERMINAL K OF CONTROL UNIT AND ALSO TO THE HIGH SPEED LIMIT SWITCH SII (IF USED), THRU M TIME DELAY CIRCUIT OF CONTROL UNIT, TO TERMINAL L OF CONTROL UNIT AND BACK TO BATTERY. APPROXIMATELY 2.5 SECONDS AFTER MS5 CLOSSES, THE M TIME DELAY CIRCUIT COMPLETES A LOW RESISTANCE PATH BETWEEN TERMINALS K AND L OF CONTROL UNIT. THE M CONTACTOR IS NOW ENERGIZED, CLOSING ITS CONTACTS, AND PLACING THE DRIVE MOTOR DIRECTLY ACROSS THE BATTERY.

NOTE

HIGH SPEED LIMIT SWITCH SII IS OPTIONAL. THE SWITCH IS USED TO ELIMINATE M SPEED AND CUT BACK ON HIGH SCR RANGE WHEN TRUCK IS PERFORMING CERTAIN FUNCTIONS. THE LIMIT SWITCH NORMALLY IS USED TO ELIMINATE HIGH SPEEDS WHEN CARRIAGE IS ELEVATED ABOVE A CERTAIN HEIGHT (USUALLY 24").

- B. TO THE FAIL SAFE PROTECTIVE CIRCUIT, THE CLOSING OF THE M CONTACT TIPS APPEAR THE SAME AS A SHORTED MAIN SCR. THIS WOULD NORMALLY CAUSE THE FAIL SAFE CIRCUIT TO BE ACTIVATED AND INTERRUPT POWER TO TRAVEL CIRCUIT. HOWEVER, THE CLOSING OF EITHER M SPEED SWITCH DE-ACTIVATES THE M BLANK OVERLOAD CIRCUIT. THIS CIRCUIT, WHEN DE-ACTIVATED, IN TURN DE-ACTIVATES THE FAIL SAFE MONITORING CIRCUIT FROM THE SCR'S AND PREVENTS THE FAIL SAFE CIRCUIT FROM DE-ACTIVATING F AND R TIME DELAY CIRCUIT.

5-41 WHEN THE TRUCK IS "PLUGGED" THE FOLLOWING ELECTRICAL SEQUENCES OCCUR:
REFER TO FIGURE 5-14.

- A. THE DIRECTIONAL SPEED CONTROL HANDLE IS MOVED FROM ORIGINAL POSITION BACK THRU NEUTRAL TO A SPEED IN OPPOSITE DIRECTION.
- B. IF TRUCK WAS TRAVELING IN HIGH SPEED, MS5 OPENS AND THE M CONTACTOR IS DE-ENERGIZED. THE FAIL SAFE CIRCUIT IS RE-ACTIVATED AND IS READY TO MONITOR THE SCR'S, WHEN MS5A AND MS5B ARE OPENED.
- C. DIRECTIONAL SWITCHES MS1 AND MS2 ARE REVERSELY ACTUATED.
- D. THE DIRECTIONAL CONTACTOR (F OR R) WHICH WAS ORIGINALLY CLOSED, NOW OPENS, AND THE CONTACTOR ORIGINALLY OPEN, NOW CLOSSES.

THE RAYMOND CORPORATION

MODEL 20 SCR

EM No.	LUBRICANT	INSTRUCTION
1	TEXACO - REGAL AFB-2 GREASE MIL -G- 18709A OR EQUIV.	HAND PACK OR GREASE GUN - 175 HRS. OR MONTHLY WHICH EVER OCCURS FIRST.
2	TEXACO 10W-30W URSATEX MIL -L- 46152 OR EQUIV.	CLEAN AND SWAB 175 HRS. OR MONTHLY WHICH EVER OCCURS FIRST.
3	TEXACO - REGAL AFB-2 GREASE MIL -G- 18709A OR EQUIV.	CLEAN AND SWAB 175 HRS. OR MONTHLY WHICH EVER OCCURS FIRST.
4	TEXACO - REGAL AFB-2 GREASE MIL -G- 18709A OR EQUIV.	CLEAN AND SWAB EVERY 175 HRS. OR MONTHLY WHICH EVER OCCURS FIRST.
5	NONE - LUBED FOR LIFE OR BEARING	INSPECT EVERY 175 HRS. OR MONTHLY WHICH EVER OCCURS FIRST. REPLACE IF BEARING SHOWS BIND- ING CONDITION.
6	TEXACO - REGAL AFB-2 GREASE MIL -G- 18709A OR EQUIV.	CLEAN AND SWAB 175 HRS. OR MONTHLY WHICH EVER OCCURS FIRST.

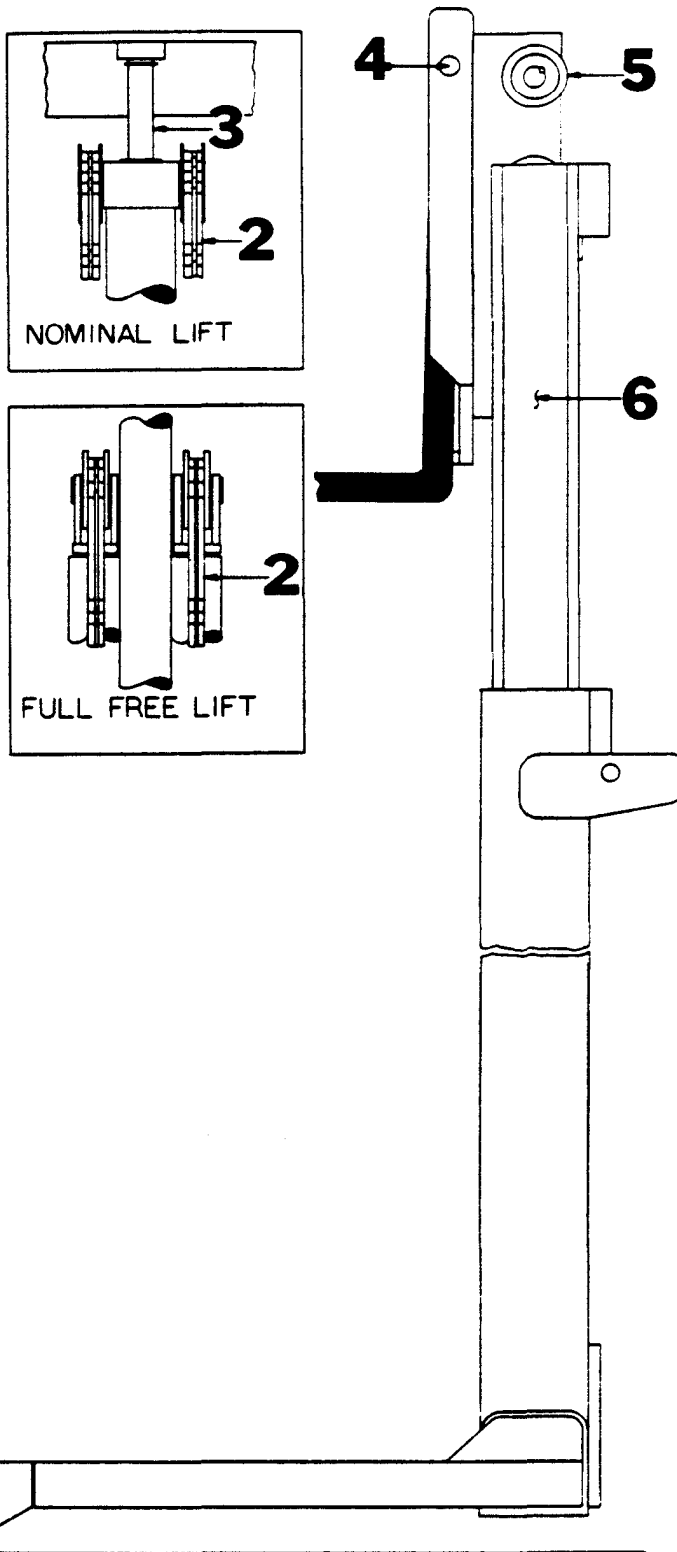


FIGURE 6-3 STRADDLE ATTACHMENT LUBRICATION

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THE RAYMOND CORPORATION

MAINTENANCE

MODEL 20 SCR

SECTION VI

6-9 (CONT'D.)

- C. REMOVE TWO CAP SCREWS SECURING TOP OF RESERVOIR. LIFT RESERVOIR FROM TRUCK.
- D. CLAMP DEADMAN PEDAL IN DOWN POSITION. REMOVE LOCK NUT (1, FIGURE 6-II) FROM DRIVE MOTOR SHAFT. LIFT OFF BRAKE DRUM (2), WOODRUFF KEY AND BRAKE DRUM SPACER (3).
- E. INSPECT ELECTRICAL CABLES CONNECTED TO DRIVE MOTOR FOR PROPER IDENTITY. REMOVE NUTS AND WASHERS FROM MOTOR TERMINALS.
- F. DISASSEMBLE FOUR SCREWS (14, FIGURE 6-II) AND WASHERS (15) HOLDING THE BRAKE MOUNTING PLATE (18) AND BRAKE ASSEMBLY TO DRIVE MOTOR.
- G. SWING HARNESS AND BRAKE SUB-ASSEMBLY UP OUT OF WAY.
- H. DISCONNECT STEERING CHAIN FROM STEERING PLATE.
- I. JACK UP TRUCK AND REMOVE DRIVE WHEEL IN ACCORDANCE WITH PARAGRAPH 6-8.
- J. REMOVE SHIELD (15, FIGURE 6-6) LOCATED ABOVE DRIVE WHEEL BY DISASSEMBLING TWO SCREWS (16) AND WASHERS (17).
- K. REMOVE FOUR SOCKET HEAD SCREWS SECURING DRIVE UNIT'S PIVOT RING TO TRUCK FRAME.
- L. ATTACH THE HOIST OR LIFTING DEVICE TO DRIVE UNIT. ONE METHOD OF ATTACHING HOIST TO DRIVE UNIT IS BY FABRICATING THE TOOL SHOWN IN FIGURE 6-9. THE TOOL CONSISTS OF A 3/4-16 HEX NUT TO WHICH A RING HAS BEEN WELDED. SCREW THE FABRICATED RING ON DRIVE MOTOR SHAFT TO PROVIDE A LIFTING EYE.
- M. SLOWLY LIFT DRIVE UNIT FROM TRUCK. IT MAY BE NECESSARY TO ROTATE DRIVE UNIT TO PREVENT INTERFERENCE
- N. REMOVE FIVE HEX SCREWS AND TWO BUTTON HEAD SCREWS SECURING STEERING PLATE AND MOTOR TO DRIVE UNIT.
- O. TO DISASSEMBLE PIVOT RING (25, FIGURE 6-6) REMOVE TWO SCREWS (20) AND WASHERS (21) SECURING FILLER PLUG (19). LIFT OUT FILLER PLUG. NOW REMOVE 75 BALL BEARINGS (24). TO REMOVE BEARINGS, TURN DRIVE UNIT SO HOLE IN PIVOT RING (25) FACES DOWN. THEN ROCK PIVOT RING BACK AND FORTH. A THIN BLADE INSERTED BETWEEN PIVOT RING AND GEAR HOUSING WILL ALSO AID BEARING REMOVAL.

THE RAYMOND CORPORATION

MAINTENANCE

MODEL 20 SCR

SECTION VI

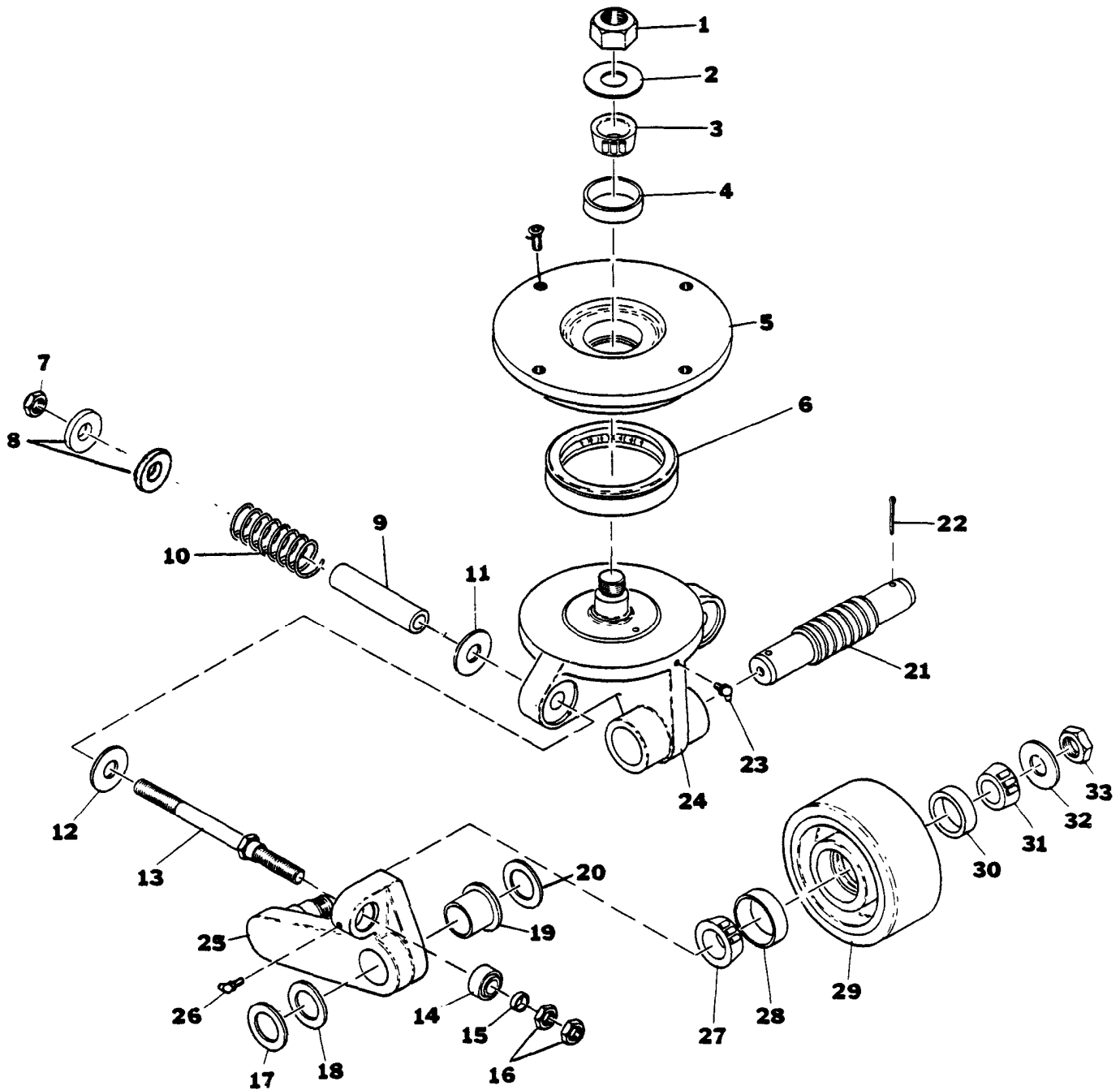


FIGURE 6-15 EXPLODED VIEW OF CASTER
6-25

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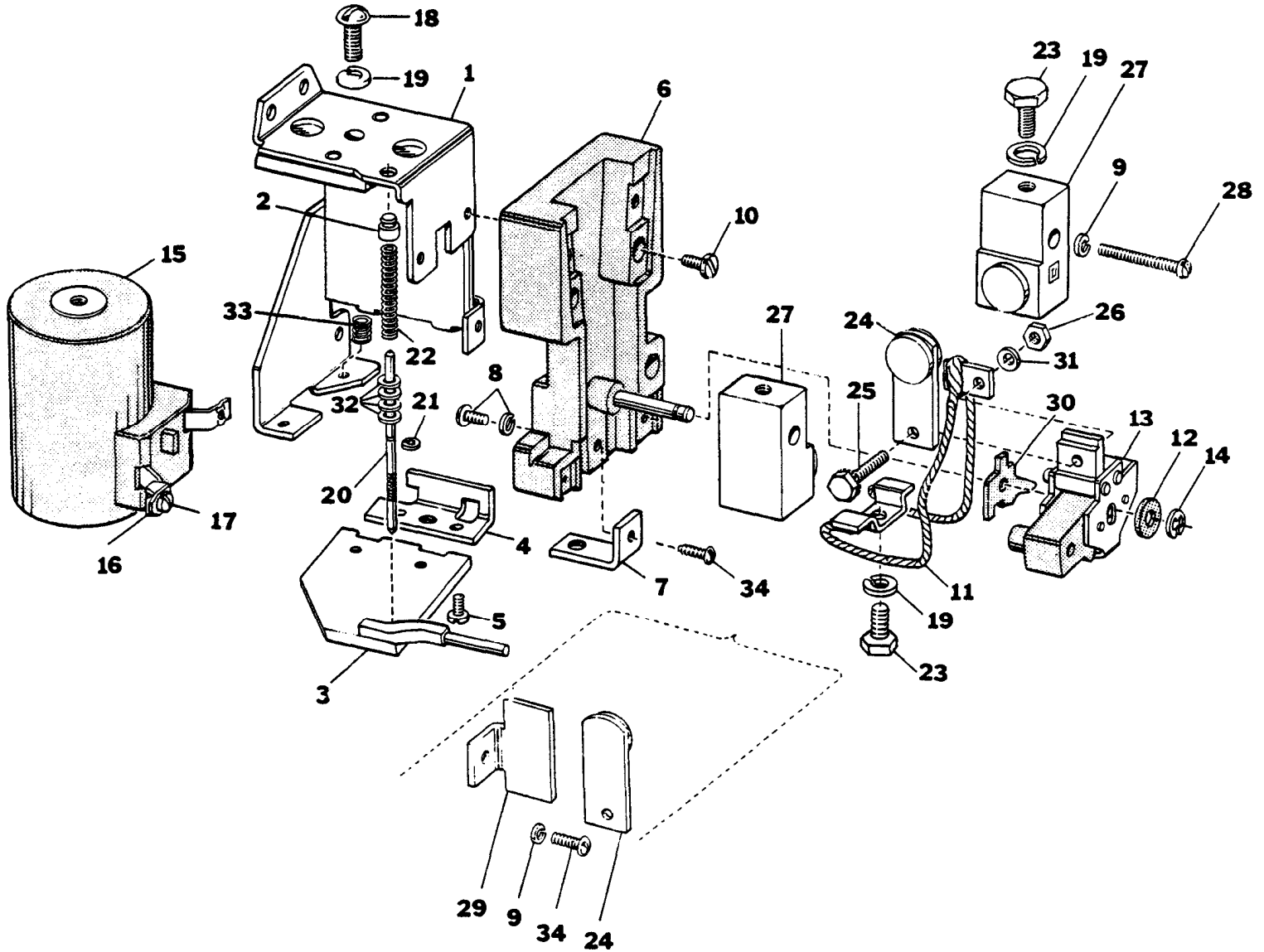
MODEL 20 SCR

SECTION VI MAINTENANCE

- 6-69 THE REACH AND/OR TILT VALVE IS ADJUSTED BY REMOVING THE SLOTTED PLUG LOCATED ON THE VALVE AND REMOVING SHIMS TO DECREASE OPERATING PRESSURE.
- 6-70 THE FOLLOWING MATERIALS ARE RECOMMENDED FOR USE IN TESTING PRESSURES.
- A. 1 HYDRAULIC PRESSURE GAUGE 0-3000 PSI
(U.S. GAUGE #P-500, 1/2", L.M. 0-3000 PSI)
 - B. 1 782-504 (RAYMOND PART NO.) COUPLING 1/4"
 - C. 1 782-301 (RAYMOND PART NO.) REDUCING BUSHING
1/4" TO 1/8"
 - D. 1 790-404 (RAYMOND PART NO.) ELBOW, MALE -
1/8" NPT TO 3/16" TUBE
 - E. 2 800-404 (RAYMOND PART NO.) SWIVEL 3/16" HOSE FITTING
 - F. 1 820-507 (RAYMOND PART NO.) HOSE, APPROX. 2'
- 6-71 POWER STEERING TORQUE GENERATOR (IF USED).
- 6-72 IF TORQUE GENERATOR LEAKS OR FAILS TO PERFORM PROPERLY, IT IS RECOMMENDED A NEW OR REBUILT TORQUE GENERATOR BE INSTALLED. THE OLD GENERATOR CAN BE RETURNED TO FACTORY FOR REBUILDING.
- 6-73 POWER STEERING PRESSURE RELIEF
- 6-74 THE PRESSURE RELIEF FOR POWER STEERING IS LOCATED IN A MANIFOLD ATTACHED TO THE TORQUE GENERATOR. THE RELIEF CARTRIDGE IS PRE-SET AT THE FACTORY TO RELIEVE WHEN PRESSURE IN STEERING SYSTEM EXCEEDS 500 PSI. THE CARTRIDGE SHOULD REQUIRE NO ADDITIONAL ADJUSTMENTS.
- 6-75 POWER STEERING PRESSURE CAN BE CHECKED BY CONNECTING THE PRESSURE GAUGE TO THE AUXILIARY PRESSURE TEST PORT. TURN STEERING WHEEL ALL THE WAY IN EITHER DIRECTION UNTIL IT CONTACTS STOPS. MAXIMUM PRESSURE SHOULD BE OBSERVED AT THIS POINT. RE-ADJUST RELIEF VALVE TO RELIEVE AT 500 PSI IF PRESSURE IS OVER 500 PSI.
- 6-76 POWER STEERING PRESSURE IS ADJUSTED BY REMOVING CAP NUT SECURING ADJUSTING SCREW TO THE PRESSURE RELIEF VALVE. TURNING THE ADJUSTING SCREW IN (CLOCKWISE) INCREASES PRESSURE. TURNING SCREW OUT DECREASES PRESSURE.

THE RAYMOND CORPORATION

MODEL 20 SCR



- | | |
|----------------------------|------------------------|
| 1. MAGNET FRAME ASSY. | 18. SCREW |
| 2. BUSHING | 19. WASHER |
| 3. ARM AND CRANK ASSY. | 20. PUSH ROD |
| 4. MOVABLE HINGE | 21. RETAINING RING |
| 5. SCREW | 22. SPRING |
| 6. BASE ASSY. | 23. SCREW |
| 7. FLEX. CONNECTOR SUPPORT | 24. MOVABLE CONTACT |
| 8. SCREW ASSY. | 25. SCREW |
| 9. WASHER | 26. NUT |
| 10. SCREW | 27. STATIONARY CONTACT |
| 11. FLEX. CONNECTOR | 28. SCREW |
| 12. SPECIAL WASHER | 29. STOP |
| 13. ROCKER ARM ASSY. | 30. INTERLOCK ACTUATOR |
| 14. RETAINING RING | 31. CONICAL WASHER |
| 15. MAGNET COIL | 32. SHIM WASHER |
| 16. WIRE CLAMP | 33. HINGE SPRING |
| 17. SCREW ASSY. | 34. SCREW |

FIGURE 6-23 TYPE B CONTACTOR (F, R AND M), SQUARE D

THE RAYMOND CORPORATION
MODEL 20 SCR
SECTION VI
MAINTENANCE

6-124D (CONT'D.)

- A. AFTER HAVING ASSEMBLED POTENTIOMETER OR OTHER PARTS AND BINDING OF GEARS OCCURS, THE MASTER SWITCH ASSEMBLY SHOULD BE REMOVED FROM TRUCK TO CHECK ADJUSTMENT.
- B. REFER TO PARA. 6-124C FOR INSTALLATION AND ADJUSTMENT OF POTENTIOMETER.
- C. WITH DIRECTIONAL SPEED CONTROL ASSEMBLY REMOVED, CHECK FOR PROPER MESHING OF GEARS AS SHOWN IN VIEWS III AND IV OF FIGURE 6-25A AND AS DIRECTED IN THE FOLLOWING STEPS:
1. ROTATE DIRECTIONAL SPEED CONTROL HANDLE IN DIRECTION INDICATED IN VIEW III TO POINT WHERE THE FIRST TOOTH OF DUAL GEAR (3) CATCHES A TOOTH ON POTENTIOMETER GEAR (4). THE CIRCLED AREA POINTED OUT IN VIEW III SHOWS CORRECT MESHING OF THE POTENTIOMETER GEAR (4) AND DUAL GEAR (3). AT NO TIME SHOULD TIPS OF GEARS MEET.
 2. IF GEARS DO NOT MESH PROPERLY, LOOSEN SET SCREW (9) AND ADJUST SET SCREW (5) BY LOOSENING NUT (15). TURNING SET SCREW IN WILL MOVE POTENTIOMETER GEAR (4) FURTHER AHEAD WHILE TURNING SET SCREW OUT WILL ALLOW GEAR (4) TO BE MOVED BACK. THE POTENTIOMETER GEAR (4) SHOULD, AT ALL TIMES WHEN MAKING ADJUSTMENT, REST AGAINST SET SCREW (5) AND BE HELD IN POSITION BY SPRING (12).
 3. IF SPRING (12) DOES NOT HOLD POTENTIOMETER IN PLACE, THE SPRING CAN BE BENT SLIGHTLY.
 4. ROTATE HANDLE IN DIRECTION INDICATED IN VIEW IV TO POINT WHERE THE FIRST TOOTH OF DUAL GEAR (3) CATCHES A TOOTH ON IDLER GEAR (6). THE CIRCLED AREA POINTED OUT IN VIEW IV SHOWS CORRECT MESHING OF IDLER GEAR (6) AND DUAL GEAR (3). AT NO TIME SHOULD TIPS OF GEARS MEET. IF POTENTIOMETER GEAR (4) AND DUAL GEAR (3) MESH PROPERLY, THE IDLER GEAR (6) AND DUAL GEAR (3) SHOULD ALSO MESH PROPERLY.
 5. RE-ADJUST POTENTIOMETER PER PARAGRAPH 6-124C, STEP F. ROTATE HANDLE BACKWARDS AND FORWARDS SEVERAL TIMES AND RECHECK MESHING OF GEARS. RE-ADJUST AS NECESSARY.
- D. OBSERVE LOCATION OF CERTAIN PARTS WHEN DISASSEMBLING DIRECTIONAL SPEED CONTROL ASSEMBLY. THE TWO BINDING HEAD SCREWS (11) SECURING BRACKET (10) TO SWITCH BRACKET (8) SHOULD NOT BE TIGHT. THERE SHOULD BE A SLIGHT GAP BETWEEN HEAD OF SCREW AND BRACKET (10), AS THE BRACKET SHOULD RIDE FREELY ON THE BINDING HEAD SCREWS. ALSO THE TWO GEAR SHAFTS (2) HOLDING THE SUPPORT BEARING (1) AND GEARS IN PLACE SHOULD NOT BE TIGHT. THERE SHOULD BE SOME MOVEMENT OF THE SUPPORT BEARING. A GOOD GUIDE FOR CORRECT ADJUSTMENT OF THE TWO GEAR SHAFTS (2) IS TO HAVE THE TAPERED SEGMENT OF SHAFT TIGHTENED SNUGLY TO TAPERED HOLE IN SWITCH BRACKET (8) AS SHOWN IN FIGURE 6-25A, VIEW I.

THE RAYMOND CORPORATION

MAINTENANCE

MODEL 20 SCR

SECTION VI

6-166 (CONT'D)

- B. CONNECT POSITIVE LEAD TO THE OTHER WHITE WIRE, TERMINAL TS1-12. OHMMETER SHALL INDICATE AN OPEN CIRCUIT OR INFINITY.
- C. REPLACE SUPPRESSOR MODULE IF OHMMETER INDICATES CONTINUITY FOR EITHER TEST.
- D. CONNECT POSITIVE LEAD TO THE BLACK WIRE, TERMINAL TS1-15. CONNECT NEGATIVE LEAD TO WHITE WIRE, TERMINAL TS2-1, THEN TO THE OTHER WHITE WIRE, TERMINAL TS1-12. OBSERVE OHMMETER AFTER EACH CONNECTION. OHMMETER SHALL INDICATE APPROXIMATELY 20,000 TO 40,000 OHMS FOR BOTH TESTS.
- E. REPLACE SUPPRESSOR MODULE IF AN OPEN CIRCUIT EXISTS FOR EITHER TEST.

6-167 THE TRANSIENT SUPPRESSOR (SUP 2) FOR SOLENOID COILS SOL-1 AND SOL-2 IS LOCATED ON THE HYDRAULIC MANIFOLD ASSEMBLY. THE SUPPRESSOR CAN BE CHECKED AS FOLLOWS WITH AN OHMMETER:

- A. DISCONNECT BLACK SUPPRESSOR WIRE TS4-2 FROM TERMINAL STRIP TS4. CONNECT POSITIVE (RED) LEAD OF OHMMETER TO WHITE WIRE, TERMINAL TS4-1. CONNECT NEGATIVE (BLACK) LEAD TO BLACK WIRE, TERMINAL TS4-2. OHMMETER SHALL INDICATE AN OPEN CIRCUIT OR INFINITY.
- B. CONNECT POSITIVE LEAD TO THE OTHER WHITE WIRE, TERMINAL TS4-5. OHMMETER SHALL INDICATE AN OPEN CIRCUIT OR INFINITY.
- C. REPLACE SUPPRESSOR MODULE IF OHMMETER INDICATES CONTINUITY FOR EITHER TEST.
- D. CONNECT POSITIVE LEAD TO THE BLACK WIRE, TERMINAL TS4-2. CONNECT NEGATIVE LEAD TO WHITE WIRE, TERMINAL TS4-1, THEN TO THE OTHER WHITE WIRE, TERMINAL TS4-5. OBSERVE OHMMETER AFTER EACH CONNECTION. OHMMETER SHALL INDICATE APPROXIMATELY 20,000 TO 40,000 OHMS FOR BOTH TESTS.
- E. REPLACE SUPPRESSOR MODULE IF AN OPEN CIRCUIT EXISTS FOR EITHER TEST.

6-168 THE TRANSIENT SUPPRESSOR (SUP 3) FOR THE H COIL IS LOCATED ADJACENT TO THE HORN. THE SUPPRESSOR CAN BE CHECKED WITH AN OHMMETER AS FOLLOWS:

- A. DISCONNECT BLACK SUPPRESSOR WIRE H-2 FROM HORN H. CONNECT POSITIVE (RED) OHMMETER LEAD TO WHITE WIRE, TERMINAL H-1. CONNECT NEGATIVE (BLACK) LEAD TO BLACK WIRE, TERMINAL H-2. OHMMETER SHALL INDICATE 40,000 TO 60,000 OHMS.
- B. REVERSE OHMMETER CONNECTIONS. OHMMETER SHALL AGAIN INDICATE 40,000 TO 60,000 OHMS.
- C. REPLACE SUPPRESSOR MODULE IF AN OPEN CIRCUIT EXISTS FOR EITHER TEST.

THE RAYMOND CORPORATION

MODEL 20 SCR

SECTION VII TROUBLESHOOTING

7-7 INSULATION RESISTANCE BETWEEN HEAT SINKS AND TRUCK FRAME SHALL BE 1 MEGOHM MINIMUM. IF RESISTANCE IS LOW, CLEAN AROUND HEAT SINK. IF RESISTANCE IS STILL LOW, REPLACE CERAMIC INSULATORS BETWEEN HEAT SINKS AND TRUCK FRAME. RESISTANCE BETWEEN CABLES, BUSS BARS, AND TRUCK FRAME SHALL NOT BE LESS THAN 1 MEGOHM.

7-8 IF TRUCK PROBLEMS CANNOT BE LOCATED IN WIRING, TROUBLESHOOTING OF CIRCUIT IN ACCORDANCE WITH FOLLOWING PAGES IS RECOMMENDED. FIRST, HOWEVER, DETERMINE WHICH OPERATIONS THE TRUCK IS FAILING TO PERFORM. TO ACCOMPLISH THIS, JACK AND BLOCK UP TRUCK SO DRIVE WHEEL IS OFF FLOOR. THEN OPERATE TRUCK PROCEEDING VERY SLOWING THROUGH ALL OPERATIONS OBSERVING DURING WHICH SEQUENCE TRUCK FAILS. AFTER DETERMINING WHICH OPERATIONS THE TRUCK FAILS TO PERFORM, REFER TO LISTING OF TRUCK PROBLEMS, PARAGRAPH 7-9.

NOTE

REFER TO WIRING DIAGRAM, FIGURE 7-1 FOR LOCATION OF COMPONENTS AND TERMINALS REFERENCED IN FOLLOWING PAGES.

7-9 LISTING OF TRUCK PROBLEMS

<u>PARA. No.</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
7-10	GENERAL TRAVEL PROBLEMS	7-3
7-11	TRUCK COMPLETELY INOPERATIVE	7-3
7-12	TRUCK HAS NO TRAVEL OR LIFT	7-9
7-13	TRUCK HAS NO TRAVEL	7-10
7-14	TRUCK HAS NO FORWARD TRAVEL	7-12
7-15	TRUCK HAS NO REVERSE TRAVEL	7-13
7-16	TRUCK HAS NO M SPEED	7-13
7-17	TRUCK RUNS AT APPROX. HALF SPEED IN SCR RANGE	7-15
7-18	TRUCK DEVELOPS TOP SPEED THROUGHOUT SCR RANGE	7-16
7-19	TRUCK ACCELERATION IS JERKY IN SCR RANGE	7-17
7-20	TRUCK REACTS VIOLENTLY WHEN PLUGGED	7-17
7-21	JERKY ACCELERATION BETWEEN SCR AND M SPEED	7-17
7-22	F OR R CONTACTOR HEARD CYCLING	7-18
7-23	F OR R CONTACTOR OPENS DURING ROUTINE TRAVEL	7-19
7-24	TRAVEL IS HALTED DURING A PLUGGING SEQUENCE	7-19
7-25	TRUCK STALLS WHILE GOING UP A RAMP	7-20
7-26	AUXILIARY CIRCUIT	7-20
7-27	IMPROPER OPERATION OF AUX. SYSTEM	7-20
7-28	NO POWER STEERING WHEN DEADMAN IS DEPRESSED BUT OPERATIVE WHEN AUX. SWITCH IS CLOSED	7-22
7-29	POWER IS SUPPLIED TO TRAVEL CIRCUIT WHEN AN AUX. SWITCH IS CLOSED AND DEADMAN PEDAL IS UP	7-22
7-30	LIFT/LOWER CIRCUIT	7-22
7-31	IMPROPER OPERATION OF LIFT SYSTEM	7-23
7-32	REMOTE LIFT/LOWER INOPERATIVE	7-24
7-33	HORN INOPERATIVE	7-26

THE RAYMOND CORPORATION

MODEL 20 SCR

SECTION VII TROUBLESHOOTING

7-13 TRUCK HAS NO TRAVEL - LIFT AND HORN CIRCUITS FUNCTION (CONT'D.)

INSPECT	TEST PROCEDURE	SOLUTION
C. CONTACTORS AND COILS F, R AND M	TEST COILS PER FIGURE 6-31. CHECK CONTACTORS FOR PROPER OPERATION PER PARA. 6-106.	REPLACE COILS IF FAULTY. REPAIR CONTACTORS IF NECESSARY.
D. M CONTACTOR	INSPECT M CONTACTOR TO BE SURE CONTACTS ARE OPEN.	REPAIR OR REPLACE CONTACTOR IF NECESSARY.
E. CONTROL UNIT AND FUSE FU5	CHECK CONTROL UNIT OPERATION. REFER TO PARA. 6-125 THRU 6-160.	REPLACE CONTROL UNIT OR ITS RESPECTIVE CIRCUIT CARDS IF NECESSARY.
<p><u>NOTE</u></p> <p>REPEATED ACTIVATION OF FAIL SAFE CIRCUIT IS AN INDICATION OF A MAL-FUNCTION IN THE SCR CIRCUITRY OR THE FAIL SAFE CIRCUIT IS DEFECTIVE. REPLACE VARIABLE PULSE GENERATOR CIRCUIT CARD IF CURRENT LIMIT, PLUGGING RELAY, HIGH SPEED LIMIT OR OSCILLATOR CIRCUITS ARE DEFECTIVE. REPLACE POWER DRIVER CIRCUIT CARD IF POWER DRIVER CIRCUIT IS DEFECTIVE. REPLACE AUXILIARY CIRCUIT CARD IF F AND R TIME DELAY, M TIME DELAY, OVERLOAD, M BLANK OVERLOAD, WELD DETECTOR OR M LOCKOUT CIRCUITS ARE DEFECTIVE.</p>		
F. DRIVE MOTOR	CHECK MOTOR PER PARA. 6-94.	REPAIR OR REPLACE AS NECESSARY.
G. LOOSE CONNECTIONS OR BROKEN WIRES IN POWER CIRCUIT.	DISCONNECT BATTERY AND CHECK WIRING FOR CONTINUITY WITH OHM-METER.	REPAIR IF NECESSARY.
H. RECTIFIER REC 2	TEST FOR SHORTED RECTIFIER. A SHORTED REC 2 WOULD CAUSE THE FAIL SAFE CIRCUIT TO ACTIVATE.	REPLACE REC 2 IF DEFECTIVE.
I. PLUGGING RELAY K2	REMOVE WIRE K2-3 FROM RELAY. USING AN OHMMETER, CHECK BETWEEN TERMINALS K2-3 AND K2-4. OHMMETER SHOULD INDICATE AN OPEN CIRCUIT.	REPLACE PLUGGING RELAY IF OHMMETER SHOWS CONTINUITY.

THE RAYMOND CORPORATION

MODEL 20 SCR

SECTION VII TROUBLESHOOTING

7-27 IMPROPER OPERATION OF AUXILIARY SYSTEM (CONT'D.)

INSPECT	TEST PROCEDURE	SOLUTION
A. FUSE FU2	REMOVE FUSE AND CHECK FOR CONTINUITY WITH OHMMETER. CONTINUITY MUST EXIST.	REPLACE FUSE FU2 IF CONTINUITY DOES NOT EXIST.
B. AUXILIARY SWITCHES S6, S7 AND S8 (AS USED)	<p>1. CONNECT POSITIVE VOLTMETER TO TERMINAL S6-2 AND NEGATIVE LEAD TO TERMINAL TP-1 WITH KEY SWITCH S1 ON, APPROX. 24 VOLTS SHOULD BE READ.</p> <p>2. MOVE POSITIVE VOLTMETER LEAD FROM S6-2 TO S6-1. WITH KEY SWITCH ON AND DEADMAN PEDAL UP, NO VOLTAGE SHOULD BE READ. DEPRESS DEADMAN PEDAL AND OBSERVE VOLTMETER. APPROX. 24 VOLTS SHOULD BE READ.</p> <p>3. MOVE POSITIVE VOLTMETER LEAD FROM S6-1 TO TS1-12. TURN KEY SWITCH S1 ON. CLOSE SWITCH S6 BY ACTUATING AN AUXILIARY LEVER, OBSERVE VOLTMETER. APPROX. 24 VOLTS SHOULD BE READ. OPEN S6 AND CLOSE S7, AGAIN 24 VOLTS SHOULD BE READ. OPEN S7 AND CLOSE S8, AGAIN 24 VOLTS SHOULD BE READ.</p>	<p>IF NO READING, CHECK WIRING TO SWITCH S6 FROM KEY SWITCH S1.</p> <p>IF NO READING, CHECK WIRING FROM DEADMAN SWITCH S2 TO SWITCH S6.</p> <p>CHECK WIRING IF NO READING, ALSO CHECK RESPECTIVE SWITCHES AND REPLACE AS NECESSARY.</p>
C. COIL X	TEST COIL PER FIGURE 6-31.	REPLACE IF DEFECTIVE.
D. X CONTACTOR	INSPECT CONTACTOR PER PARA. 6-106. ALSO ENERGIZE X CONTACTOR AND OBSERVE CLOSING OF CONTACT TIPS.	REPAIR OR REPLACE AS NECESSARY.
E. DIODE CRI	TEST DIODES PER PARA. 6-169.	REPLACE FAULTY DIODE.
F. TRANSIENT SUPPRESSOR SUP 1	TEST SUPPRESSOR PER PARA. 6-166.	REPLACE FAULTY SUPPRESSOR.

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