EMD MAINTENANCE INSTRUCTION

# LOAD TESTING OF 567C LOCOMOTIVE POWER PLANTS

## DESCRIPTION

This bulletin describes the precautions and procedures to be complied with when load testing 567 locomotive power plants.

Since generator characteristics or load setting values are not the same for all locomotives, we have prepared a separate generator loading curve sheet for each group of locomotives which have generators of similar characteristics; therefore, to determine what the loading values should be for any locomotive it will be necessary to refer to the loading curve sheet corresponding to the type or model of power plant being tested. These sheets will be found in the back of this bulletin, Figs. 18 through 23.

The generator characteristic curve sheets referred to are as follows:

| Horsepower | Type Of Generator | Curve Sheet |
|---|---|---|
| 900 | D15C | Fig. 18 |
| 875/950 | D15 | Fig. 19 |
| 1200 (Sw.) | D15C | Fig. 20 |
| 1200 (Pass.) | D15B | Fig. 21 |
| 1310 | D12 | Fig. 22 |
| 1750 | D12, D12B, D12C | Fig. 23 |

The curves, as shown on each curve sheet, extend beyond the continuous rating of the generator. However, values beyond the continuous rating line are not to be used for load testing.

On all models of EMD locomotives the battery charging voltage will not affect the load setting as the load regulator will automatically adjust the battery field excitation of the main generator to give a balance load setting for every position of throttle opening. Regardless of this, it is still good practice to have the battery charging voltage correctly set (74 $\pm$ 2 volts).

There are so many different wiring combinations of the many locomotives now in service, that it would not be practical to include in this Maintenance Instruction a schematic diagram for each model of locomotive. Typical schematic diagrams for load testing Model SW1200, GP9, F9, SD9, E9 and G12 locomotives are shown in this Maintenance Instruction. To load test locomotives using 567 power plants other than those mentioned, use the locomotive wiring diagram to determine the physical connection of meters and load cable connections, following the general scheme shown in the typical schematic diagrams.

Safety to personnel and equipment cannot be overemphasized. Caution should be exercised against accidental contact with "live" equipment during "loading" operation.

## PRELIMINARY PROCEDURE

### PRECAUTIONS

The following precautions should be complied with on all locomotives when preparing to operate the power plant:

1. Lock reverser drum in NEUTRAL position; use locking pin provided with the reverser.
2. Close angle cock in control air line at high voltage cabinet and bleed air from line on contactor side of shut-off valve. (On some locomotives air

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can be bled by opening cock in air line strainer.)

3. Brake transfer switch (where used) must be in MOTOR position.
4. For safety purposes the load box should be grounded with a ground wire to the frame of the locomotive.
5. Remove starting fuse, battery charging fuse and battery field fuse during preliminary inspection (for safety reasons).

## SERVICING AND INSPECTION OF ENGINE PREPARATORY TO STARTING

Before making any full load test, it should be definitely determined that the main power plant as well as the auxiliary equipment is in good running condition.

NOTE: In the event the engine to be load tested has just been rebuilt, refer to Maintenance Instruction 2170 for proper procedure to be followed before load testing.

Become familiar with all instructions in the Engine Maintenance Manual and Locomotive Operating Manual relative to checking, starting and operating the engine. This includes the following:

1. Special care should be taken to see that the engine cooling system is full of water and that the shutters and other cooling control apparatus is properly adjusted to prevent the engine from overheating while the load test is being conducted.
2. Check shutter operation. See that all shutters work freely and that they can be moved to their fully open and fully closed position. Automatic shutters (if used) should be set as per Maintenance Instruction 5511.
3. See that fuel tank contains enough fuel for the period of operation.
4. Check specific gravity of electrolyte in storage battery; be sure the battery is in a well charged condition.
5. Check all water and oil drain valves for proper position. See Locomotive Operating Manual.
6. Check engine, governor, and air compressor lubricating oil levels. Fill if necessary.
7. Bar the engine over by using engine turning bar with the cylinder test valves open. Check for leaks. See that main generator, auxiliary generator, air compressor and cooling fans are free to rotate and there is no mechanical interference in any of the rotating equipment. The generator armature should be rotated two revolutions.
8. The throttle, governor, injector linkage and pilot valve should be checked and properly set according to instructions given in the Engine Maintenance Manual.
9. Check governor and injector linkage for free action.
10. Check injector racks for free movement, see that the racks are properly set according to instructions given in the Engine Maintenance Manual.
11. Check operation of cooling fans by manually operating temperature control (thermostat) switch while engine is idling. See Maintenance Instruction 5501.
12. With engine running at idle speed:
    a. Observe rotation of cooling and ventilating fans (if used). Rotation should be clockwise looking down at fans.
    b. Check alternator terminal voltages. Should be approximately 55 volts.
    c. Check operation of no-voltage relay. (See Maintenance Instruction 5323 for settings.)
    d. Check rotation of traction motor blowers.
    e. Check traction motors and main generator for air discharge; i.e., for restrictions between blowers and main machine and for unrestricted discharge openings.

13. With engine running at full throttle:

    a. Check operation of cooling fan motor contactors as to sequence and operation by bringing engine up to temperature. Refer to Operating Manual of locomotive under test.

    b. Check operation of no voltage relay. (See Maintenance Instruction 5323 for settings.)

    c. Check alternator terminal voltage. (Refer to locomotive wiring diagram for settings.)

SETTING AND TESTING

1. Five meters are required for taking the readings needed during a load test. Three of them are ammeters which are connected in the battery field, shunt field and main generator power circuits. The other two are voltmeters which are connected across the main generator load and across the auxiliary generator circuit.

   To read the voltage across the auxiliary generator circuit, connect the voltmeter positive to the positive side of the auxiliary generator knife switch and the voltmeter negative to the negative side of the switch.

NOTE: To simplify taking the necessary readings during load test it is recommended that a meter test set be constructed as per Figs. 1 and 2. This device uses two meters to do the work of five separate meters normally required.

The ammeter shunts as shown in the generator shunt and battery field circuits are permanently contained in the test set and wired to test set plugs. By means of test jacks (containing test leads with battery clips, spade clips or bolt on lugs) plugged into the test set plugs, circuit connection (to indicate shunt and battery field amperage) can be made by connecting the test leads into the shunt and battery field circuits, instead of installing individual meter shunts as shown in the schematic wiring diagrams.

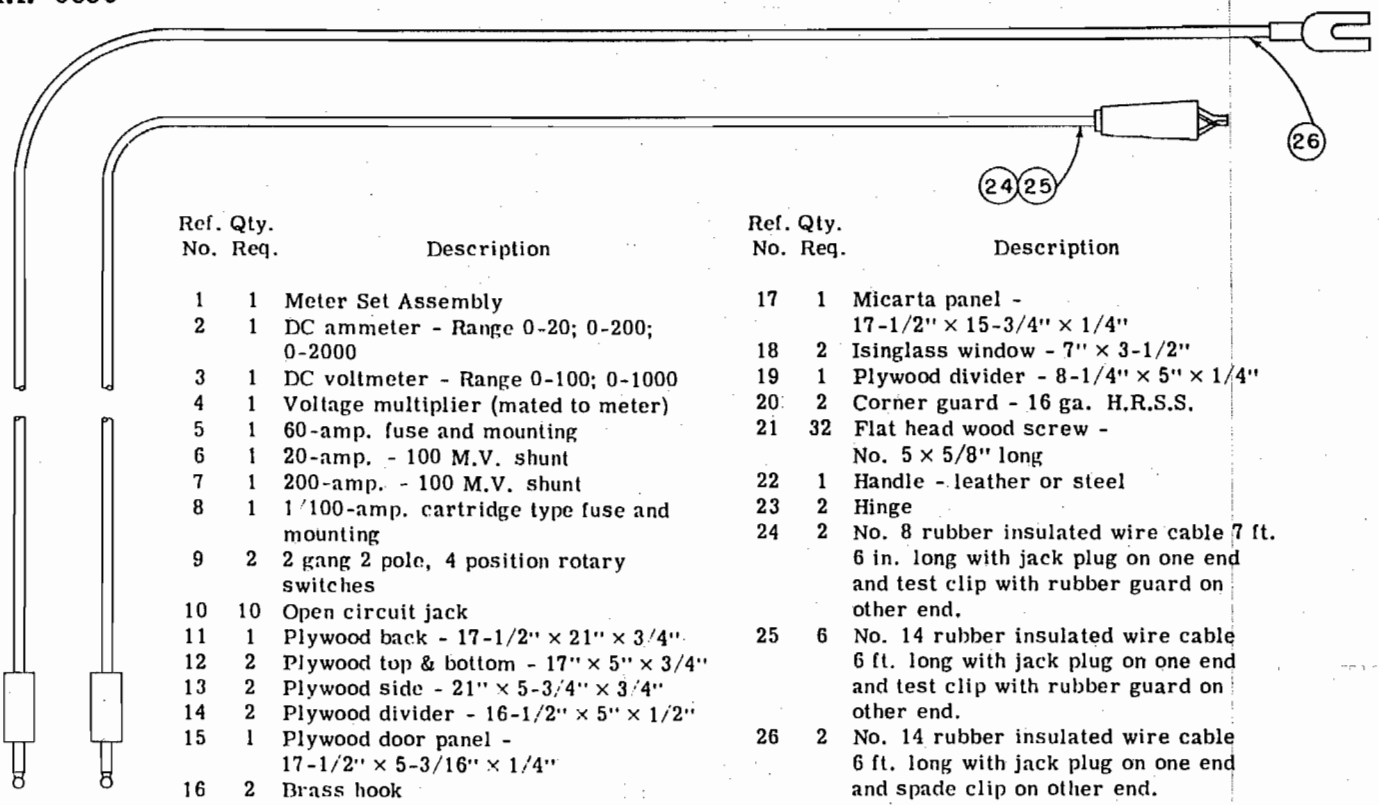
Load current indication can be made by connecting test leads with spade clips to the external main generator meter shunt plugged into the test set millivoltmeter. A selector switch (must be of low loss type) mounted on the test set can be operated to cut-in in the desired meter reading.

The voltmeter connections to the main generator and auxiliary generator circuits are made from the test set through plugs and jacks with leads containing clips. A selector switch mounted on the test set can be operated to cut in the desired voltmeter reading.

2. Insulated copper wire cables of sufficient current and voltage carrying capacity should be used to connect the power circuit of the generator to grid resistors or whatever type of power absorbing apparatus is used. Two (2) 500,000 circular mil cables bolted to the positive side and two (2) 500,000 circular mil cables bolted to negative side of the generator as shown in the schematic wiring diagrams may be used for each grid hatch assembly.

3. Locomotives equipped with dynamic brakes may have the engines load tested by connecting the output of the generator to the dynamic braking grids. Locomotives without dynamic brakes may have the engine load tested by connecting the generator to an external resistor bank.

4. For load testing locomotives equipped with dynamic brakes, the grid banks are connected in series-parallel and are capable of handling the generator current up to 650 amperes per bank for 600 ampere reading dynamic brakes or a total generator output of 1300 amperes, and 750 amperes per bank for 700 ampere reading dynamic brakes or a total generator output of 1500 amperes. This will permit taking full horsepower out of the power plant. Overheating of the grid resistors may result if operated beyond current limit amperage.




| Ref. No. | Qty. Req. | Description |
|---|---|---|
| 1 | 1 | Meter Set Assembly |
| 2 | 1 | DC ammeter - Range 0-20; 0-200; 0-2000 |
| 3 | 1 | DC voltmeter - Range 0-100; 0-1000 |
| 4 | 1 | Voltage multiplier (mated to meter) |
| 5 | 1 | 60-amp. fuse and mounting |
| 6 | 1 | 20-amp. - 100 M.V. shunt |
| 7 | 1 | 200-amp. - 100 M.V. shunt |
| 8 | 1 | 1/100-amp. cartridge type fuse and mounting |
| 9 | 2 | 2 gang 2 pole, 4 position rotary switches |
| 10 | 10 | Open circuit jack |
| 11 | 1 | Plywood back - 17-1/2" × 21" × 3/4" |
| 12 | 2 | Plywood top & bottom - 17" × 5" × 3/4" |
| 13 | 2 | Plywood side - 21" × 5-3/4" × 3/4" |
| 14 | 2 | Plywood divider - 16-1/2" × 5" × 1/2" |
| 15 | 1 | Plywood door panel - 17-1/2" × 5-3/16" × 1/4" |
| 16 | 2 | Brass hook |
| 17 | 1 | Micarta panel - 17-1/2" × 15-3/4" × 1/4" |
| 18 | 2 | Isinglass window - 7" × 3-1/2" |
| 19 | 1 | Plywood divider - 8-1/4" × 5" × 1/4" |
| 20 | 2 | Corner guard - 16 ga. H.R.S.S. |
| 21 | 32 | Flat head wood screw - No. 5 × 5/8" long |
| 22 | 1 | Handle - leather or steel |
| 23 | 2 | Hinge |
| 24 | 2 | No. 8 rubber insulated wire cable 7 ft. 6 in. long with jack plug on one end and test clip with rubber guard on other end. |
| 25 | 6 | No. 14 rubber insulated wire cable 6 ft. long with jack plug on one end and test clip with rubber guard on other end. |
| 26 | 2 | No. 14 rubber insulated wire cable 6 ft. long with jack plug on one end and spade clip on other end. |

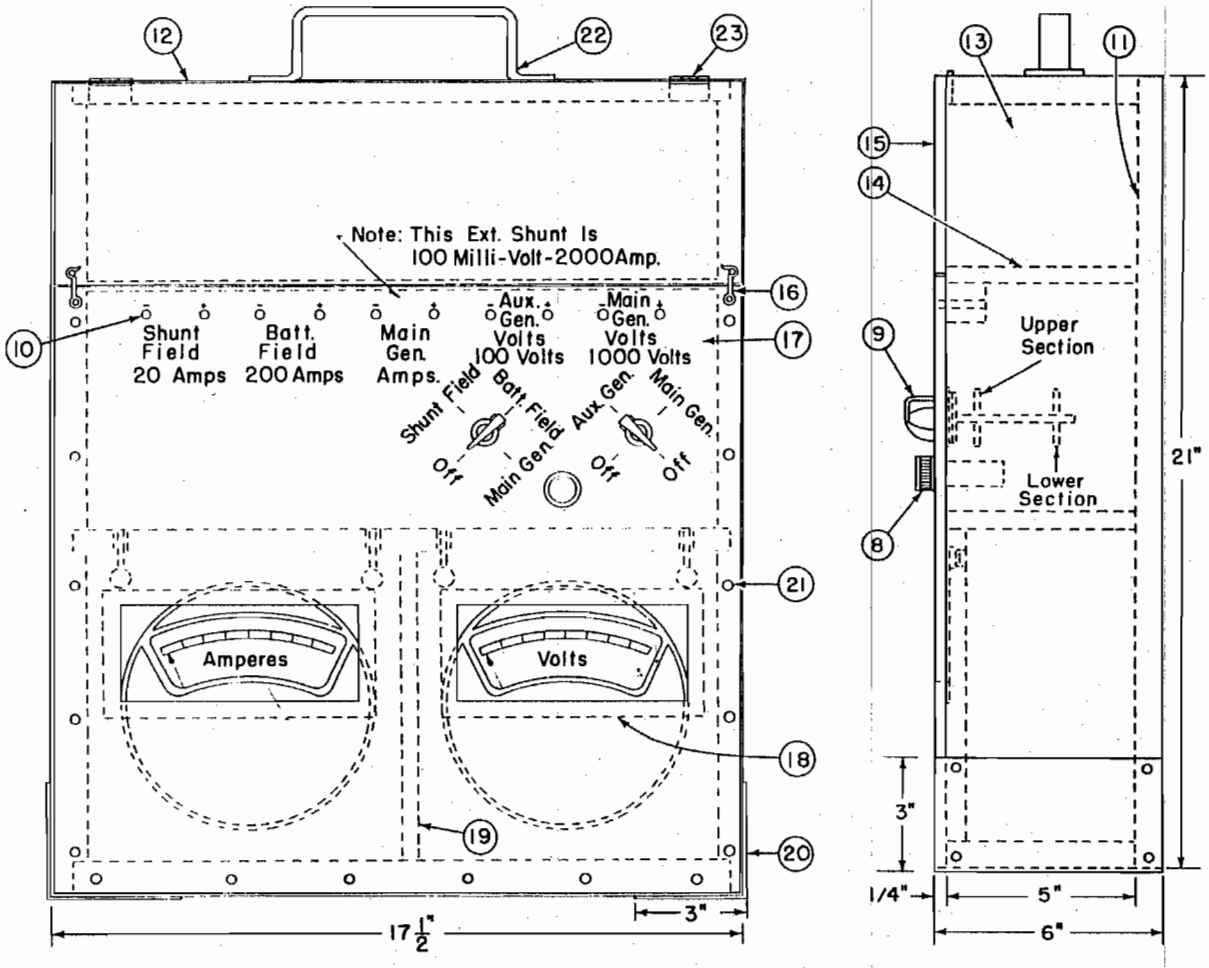



**Fig. 1 - Outline Of Meter Test Set**

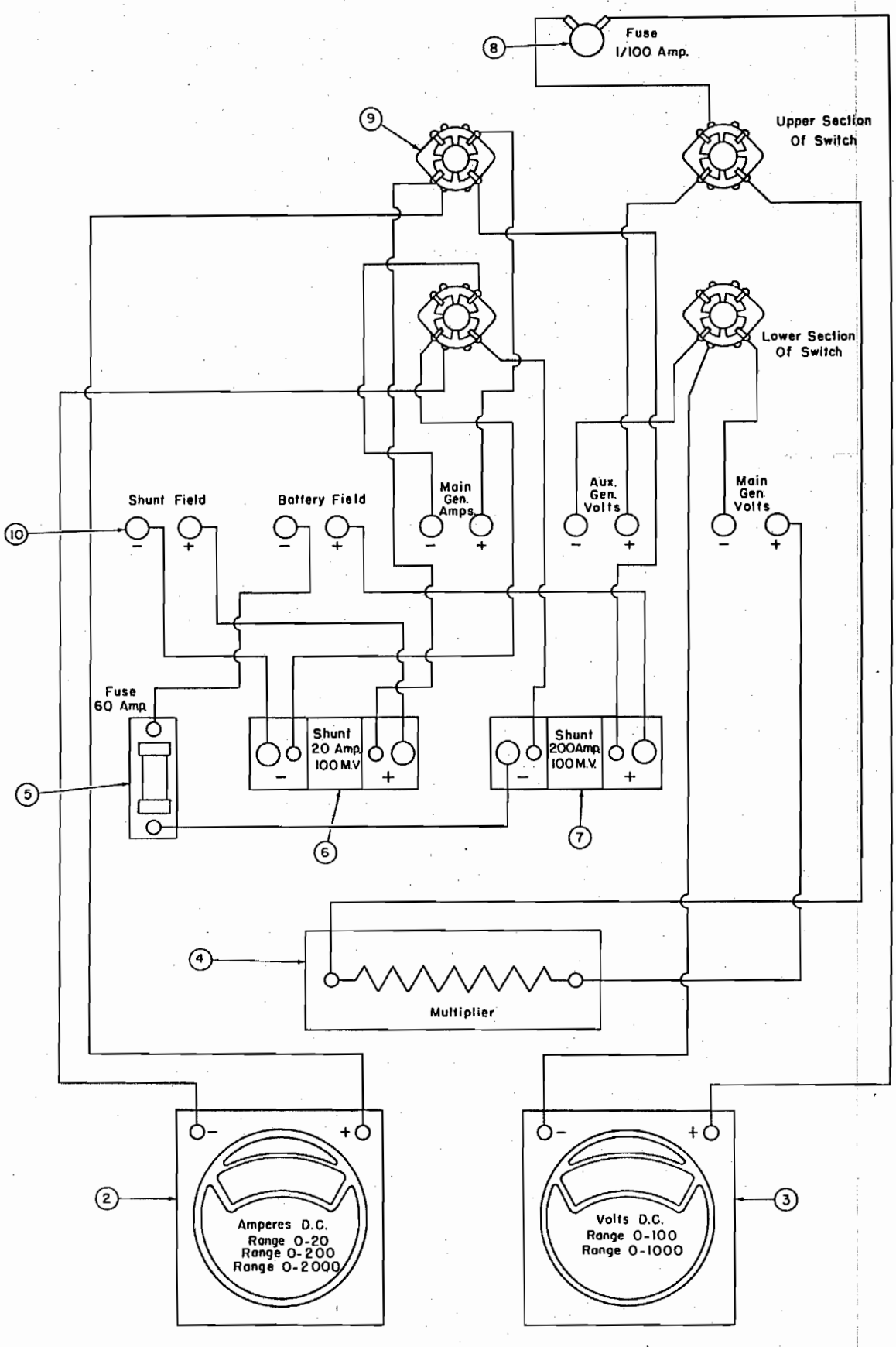



Fig. 2 - Wiring Diagram Of Meter Test Set Shown In Fig. 1

5. Replace all fuses removed during preliminary inspection.

6. Before starting the engine, open the cylinder relief valves and turn engine over a few revolutions to check for water in cylinders. Close relief valves and start engine; see that oil pressure is normal.

7. After starting the engine allow it to idle for a period of time until the water temperature is 140° F., before applying full load; be sure everything is functioning properly. Apply gauges if desired to check water pump pressure.

8. After operating engine at idle speed for a few minutes all pressures and temperatures should be within their normal range of operation. If not, the situation should be immediately investigated and the cause corrected.

9. Check voltage regulator setting as per Maintenance Instruction 570 and 4510, reverse current relay setting as per Maintenance Instruction 569 and operation of micropositioner as per Maintenance Instruction 5496. These checks should be made after starting engine and final settings when all equipment is hot.

10. A complete set of readings should be taken during load test including a set of readings at idle speed, these readings can be recorded on a form similar to Fig. 3. Water temperature, out of engine, should be held between 160° and 200° F., preferably 180° — 190° F. for full load run. The engine should not be run at speeds above the 3rd throttle position with water temperature below 120° F.

11. It is not necessary to vary the load current and voltage to check several points on the generator characteristic curve. Checking at one point on the curve is all that is necessary. The continuous current shown on the generator characteristic curve should not be exceeded when load testing.

12. The characteristic curves of two generators are seldom identical over the full range of power output, even for generators of the same type, due to the fact that the horsepower development of the prime mover varies somewhat. The characteristic curves in this maintenance instruction are for typical generators and rated horsepower development conditions.

13. The value of generator shunt field current can be found by consulting the generator characteristic curve sheet. For example, referring to the D12 generator characteristic curve sheet, Fig. 23, we find the shunt field current is .70 amperes per 100 volts when operating at a temperature of 75° C.

14. If it becomes necessary to check the load regulator resistors or battery field current values, see page 21 for such information.

15. On power plants suspected of not delivering rated load, the governor power piston measurement should be checked and compared with information in Section 12 of the Engine Maintenance Manual and Maintenance Instruction 2170.

## OPTIONAL CHECKS AND TESTS

Although not a part of the load test, the following checks and tests can be made:

1. On locomotives equipped with dynamic brakes, the grid banks can be checked by connecting a voltmeter across individual grid banks (make the voltmeter connections at the camswitch terminals) and read the voltage drop across each bank at a fixed current of approximately 500 amperes through the bank. From the voltmeter and ammeter readings determine the resistance of each bank by dividing the voltmeter reading by the ammeter reading. If there is more

# LOCOMOTIVE LOAD AND TRACK DATA

LOCO. MODEL GP9 LOCO. NO. _____

ENG. TYPE 16-567C ENG. SER. NO. 1 _____ NO. 2 _____ GEN. TYPE D12B GEN. SER. NO. 1 _____ NO. 2 _____

OPERATORS _____ DATE _____

| TIME K.H.K. P.M. | 12:15 | 1:00 | 1:20 | 1:40 | 2:00 | 2:20 | 2:40 | 3:00 | 3:05 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THROTTLE POS. | 4 | 6 | 8-f | 8-r | 8-f | 8-r | 8-f | 8 | 1 | | | | | |
| REV. PER MIN. | 515 | 675 | 835 | 835 | 835 | 835 | 835 | 835 | 275 | | | | | |
| SH. FIELD AMPS. | 3.4 | 4.9 | 6.2 | 5.9 | 5.9 | 5.9 | 5.9 | 5.3 | 0.8 | | | | | |
| BATT. FIELD AMPS. | 23 | 21 | 20 | 17 | 19 | 20 | 21 | 18 | 20 | | | | | |
| AUX. GEN. VOLTS | 74 | 74 | 74 | 74 | 74 | 74 | 74 | 74 | 76 | | | | | |
| BATT. CHGE. AMPS. | 25 | 15 | 10 | 10 | 5 | 5 | 5 | 0 | 0 | | | | | |
| MAIN GEN. VOLTS | 440 | 650 | 890 | 860 | 860 | 860 | 865 | 790 | 120 | | | | | |
| MAIN GEN. AMPS. | 1110 | 1330 | 1425 | 1450 | 1450 | 1450 | 1445 | 1575 | 550 | | | | | |
| GEN. OUTPUT K.W. | 488 | 864 | 1268 | 1247 | 1247 | 1247 | 1249 | 1244 | - | | | | | |
| GEN. INPUT H.P. | 689 | 1221 | 1791 | 1761 | 1761 | 1761 | 1765 | 1757 | - | | | | | |
| CORRECTED H.P. | - | - | - | - | 1977 | - | - | - | - | | | | | |
| COOLING FANS OPER. | 0 | 2 | 3 | 4 | 4 | 4 | 3 | 3 | 4 | | | | | |
| A.C. VOLTS | 110 | 139 | 165 | 162 | 162 | 165 | 166 | 166 | 57 | | | | | |
| GEN. COOLING AIR CIR. | OK | OK | OK | OK | OK | OK | OK | OK | OK | | | | | |
| AIR BOX TEMP. R.B. L.B. | | | | | | | | | | | | | | |
| WATER PRESS. R.B. L.B. | | | | | | | | | | | | | | |
| RACK INDICATOR | - | - | .96 | .96 | .96 | .96 | .96 | .96 | - | | | | | |
| LOAD REG. POSITION | 12:00 | 12:30 | 12:30 | 12:30 | 12:10 | 12:00 | 12:00 | 12:15 | 1:00 | | | | | |
| LOAD REG. POSITION AT TIME OF TRANSITION 1 - 2 _____ TRANSITION 2 - 3 _____ | | | | | | | | | | | | | | |
| COMP. OIL PRESS. | 25 | 29 | 30 | 30 | 28 | 27 | 27 | 26 | 20 | | | | | |
| ENG. BRG. PRESSURE | 53 | 55 | 53 | 52 | 53 | 53 | 53 | 51 | 20 | | | | | |
| OIL TEMP. - IN | 180 | 194 | 212 | 202 | 204 | 205 | 206 | 206 | 200 | | | | | |
| WATER TEMP.-IN/OUT | 162 | 175 | 179 | 176 | 172 | 175 | 176 | 179 | 173 | | | | | |
| FUEL INLET TEMP. | 68 | 70 | 72 | 74 | 75 | 77 | 78 | 80 | 82 | | | | | |
| FUEL RETURN GLASS | C | C | C | C | C | C | C | C | C | (C - Clear) | | | | |
| OVERSPEED TRIP | FIRST CHECK 910 RESET TO _____ | | | | | | | | | | | | | |
| LOAD REG. TIMING | MAX. TO MIN. 6 SEC. MIN. TO MAX. 27 SEC. | | | | | | | | | | | | | |
| T.M. COOLING AIR CIR. | OK | OK | OK | OK | OK | OK | OK | OK | OK | | | | | |
| *Remarks:* | | | | | | | | | | | | | | |

Fig. 3 - Typical Log Sheet

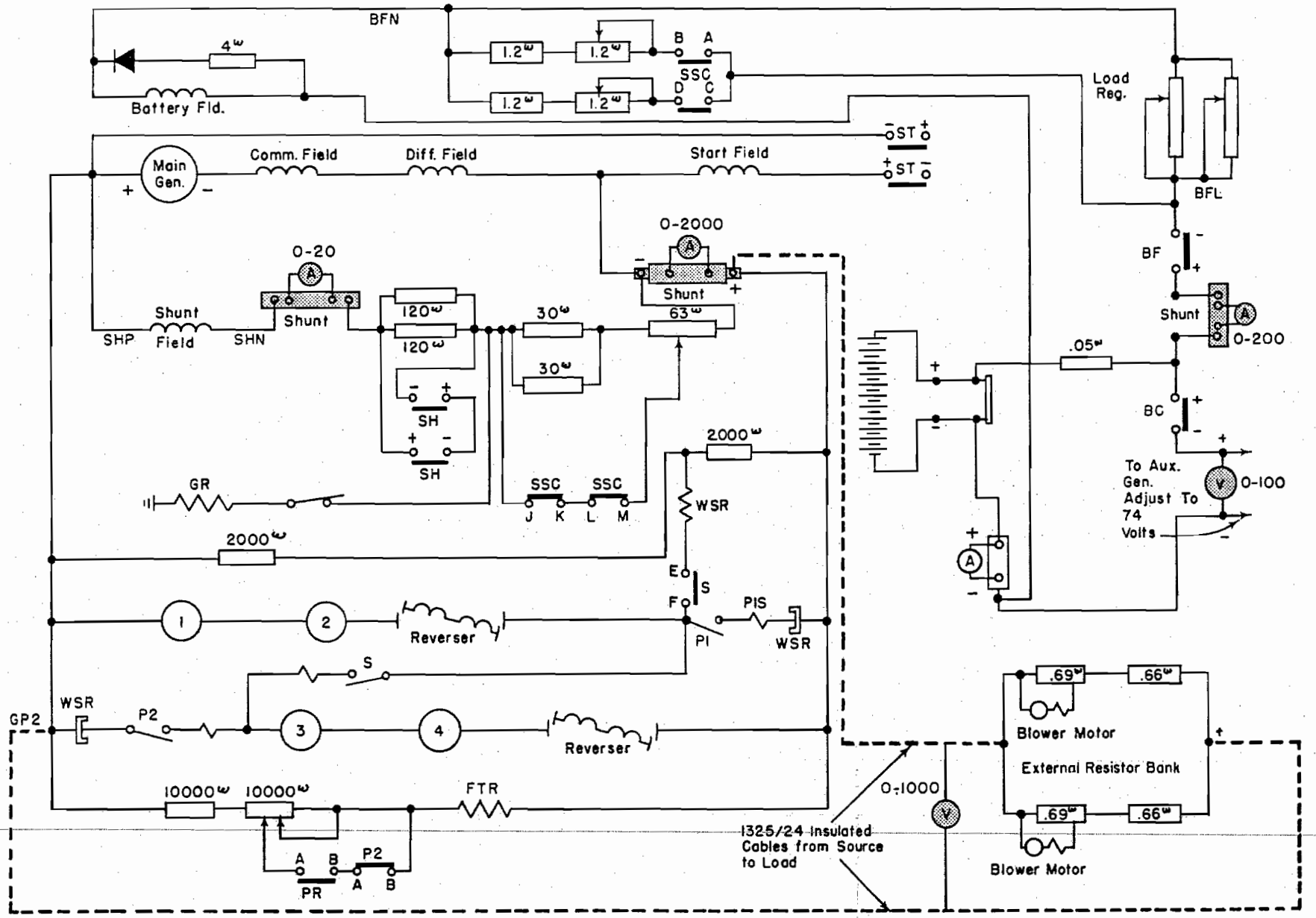



Fig. 4 - Schematic Wiring Diagram For Load Testing SW1200 Locomotive

than 10% resistance difference between any of the four (4) individual grid banks on the same locomotive unit, the cause for the resistance difference should be investigated.

2. During load testing it is possible to check the setting of the overcurrent limit relay (CLR) as per Maintenance Instruction 2040 by increasing the load current on locomotives having this feature. To do this, the grid banks will have to be connected in parallel instead of series-parallel as for load testing, or one-half of a second grid hatch may be connected in parallel with the first grid hatch. After making the necessary connections run the engine just long enough to obtain a current reading.

## SPECIFIC PROCEDURES

### SW1200 SWITCHING LOCOMOTIVES

Fig. 4 shows a typical schematic wiring diagram for load testing SW1200 (1200 HP) switching locomotives. All 1200 HP switching locomotives using 567 power plants may not fall into this category; however, this typical schematic wiring diagram shows where and how meters may be connected in the generator circuit.

Ordinarily five meters are required for load testing locomotive power plants. Figs. 1 and 2 show details for the construction of a meter test set whereby two meters will do the work of five meters. Connections should be made as outlined under NOTE of SETTING AND TESTING on page 3.

Bolt one end of a 1325/24 insulated cable to the GP2 stud on the relay panel. Bolt the other end of the cable to positive side of the load (grid banks, etc.). This is generator positive.

Install the main generator shunt, connect negative grid cables to the positive side of shunt.

The load resistors (grid banks) as shown in Fig. 5, consist of dynamic grid hatch with equipment.

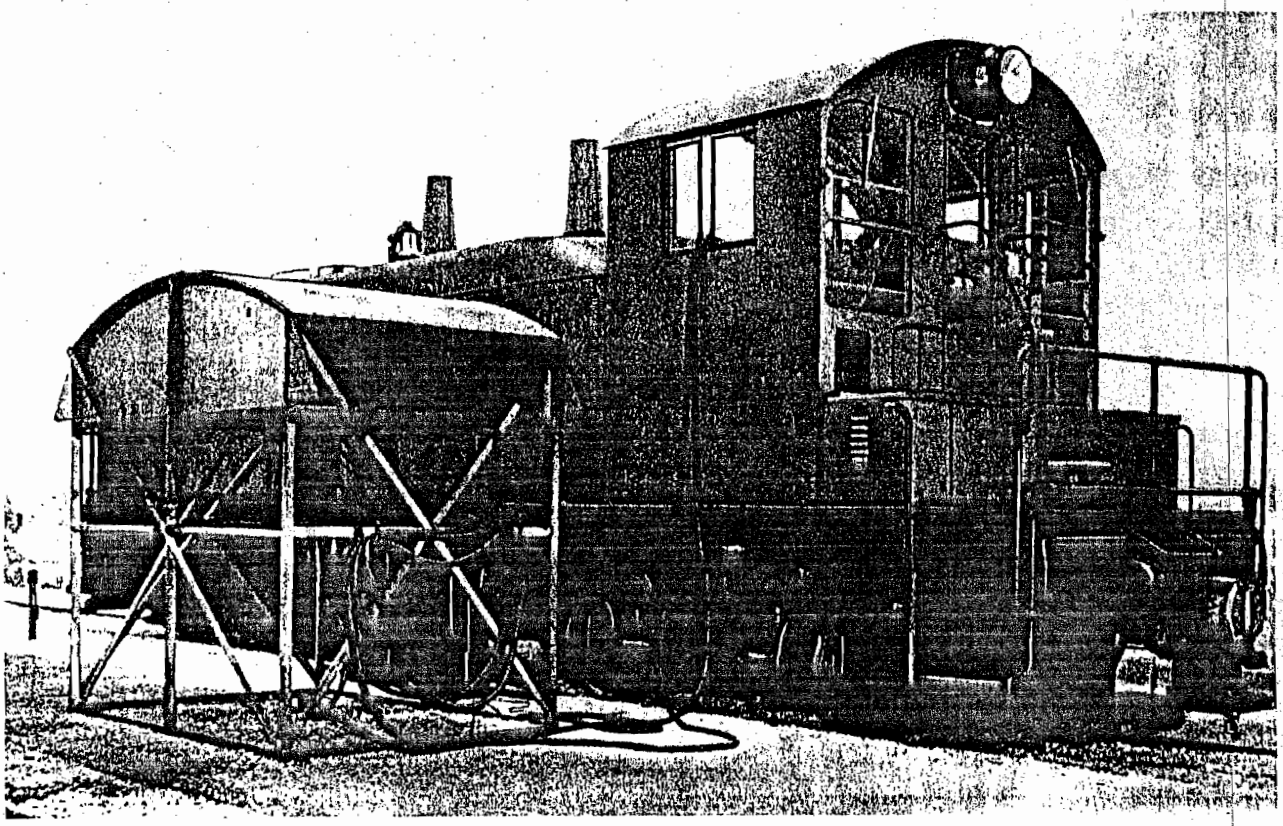


Fig. 5 - Engine Loading Grid Banks

Since the reverser is in neutral position, the control circuit to the shunt field contactor is open, therefore, it will be necessary to use a jumper from b of GR to the + coil terminal of SF contactor or by "cutting out" either #1 or #2 traction motor by use of the motor cut-out switch.

Center and pin reverser.

The selector lever must be in AUTOMATIC or SERIES position.

With the control circuits energized to get generator field excitation, open the throttle to Run 1. Run a load test on the power plant as follows:

Run in #4 throttle position for 1/2 hour.

Run in #6 throttle position for 3/4 hour.

Run in #8 throttle position for 2 hours.

In #8 throttle position compare the generator voltage and current readings obtained with the values shown on the characteristic curve sheet, Fig. 20. This will show how nearly the engine is delivering its rated output. Do not exceed the continuous current shown on the characteristic curve.

## GP9 AND F9 LOCOMOTIVES - WITH DYNAMIC BRAKES

Fig. 6 shows a typical schematic wiring diagram for load testing of Model GP9 and F9 locomotives equipped with dynamic brakes.

The meter connections can be made as shown in Fig. 6, however, a meter test set can be constructed as per Figs. 1 and 2, with connections made in the manner as described under NOTE of SETTING AND TESTING on page 3.

The cable or copper bus bar connections, Fig. 7, are made by fastening the jumpers to the bus bar supports of the brake transfer switch. Use bus bars or cable of 500,000 circular mils (1325/24 equivalent) for jumpers.

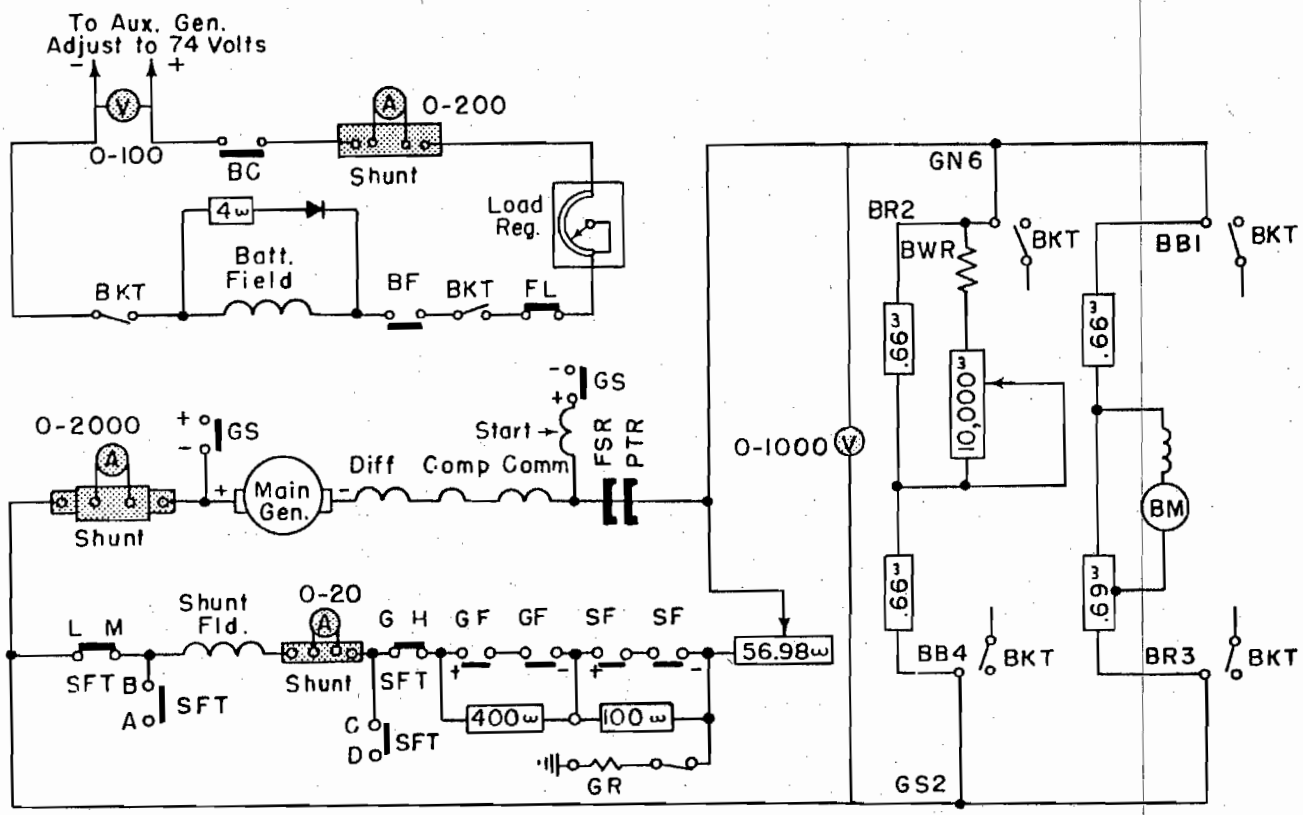



Fig. 6 - Schematic Wiring Diagram For Load Testing GP9 And F9 Locomotives With Dynamic Brakes

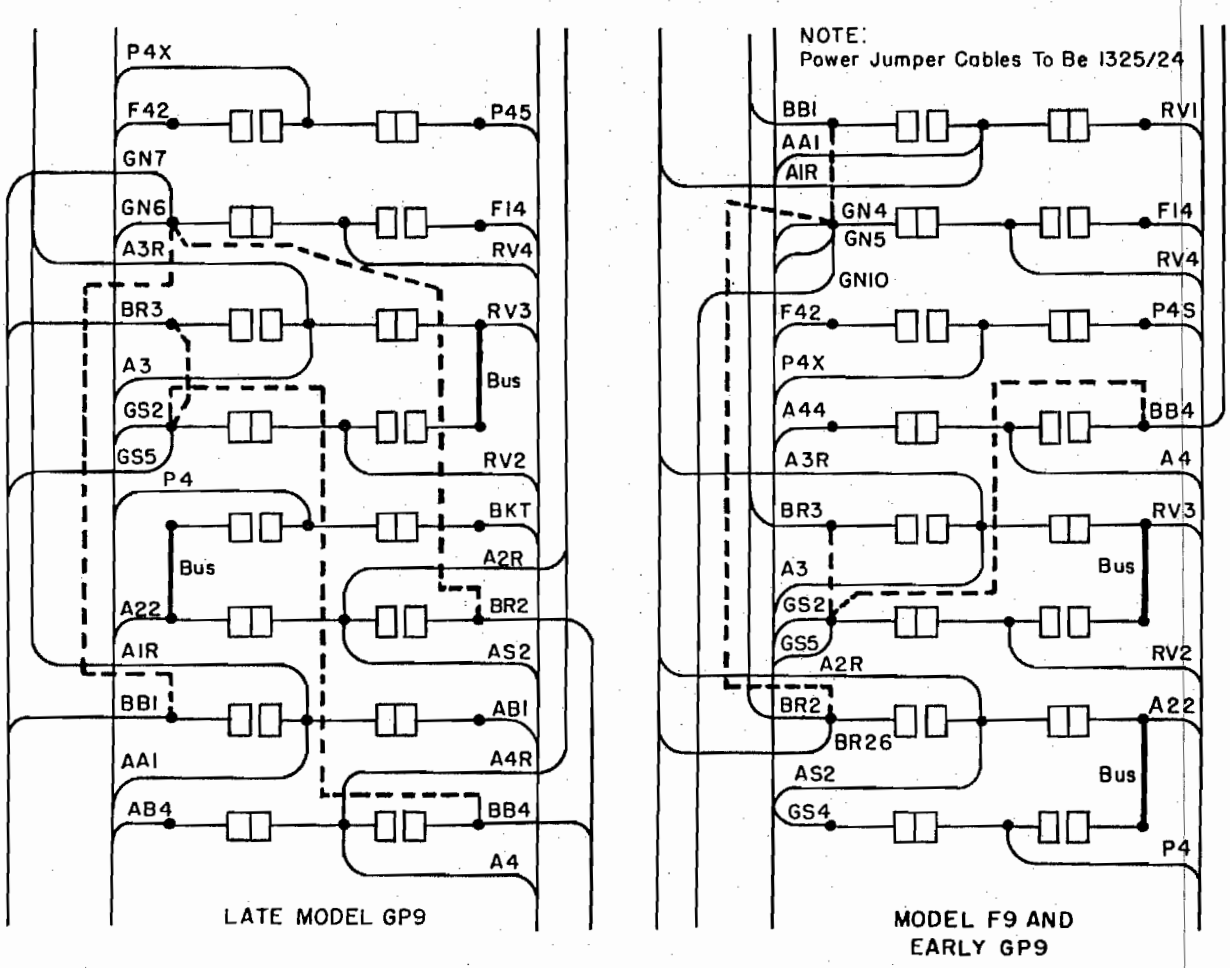



Fig. 7 - Brake Transfer Switch Connections (GP9 - F9)

Make jumper connections between terminal points of brake transfer switch as follows:

1. Connect GS2 to BB4.
2. Connect GS2 to BR3 with a short bus.
3. Connect GN4 or GN6 to BR2.
4. Connect GN4 or GN6 to BB1.

Remove generator shunt panel and apply 2000 amperes, 50 or 100 M.V. shunt.

Connect a jumper between GRH and the positive coil terminal of the SF contactor to pick up SF contactor.

Connect a voltmeter across the main generator at a convenient point to obtain main generator voltage reading.

Prepare engines as outlined under PRELIMINARY PROCEDURE section (1 through 3). Start engines and complete circuits for road operation.

1. Close Fuel Pump and Control and Engine Run switches. Start the engine.
2. Close Generator Field switch.
3. Put isolation switch in RUN position.
4. Put selector lever in #1 position.
5. Put throttle in Run #1.

Check to see that the dynamic brake grid blower motor is turning in the right direction. With the control circuits energized to get generator field excitation, open the throttle gradually and run a load test on the power plant as follows:

Run in #4 throttle position for 1/2 hour.

Run in #6 throttle position for 3/4 hour.

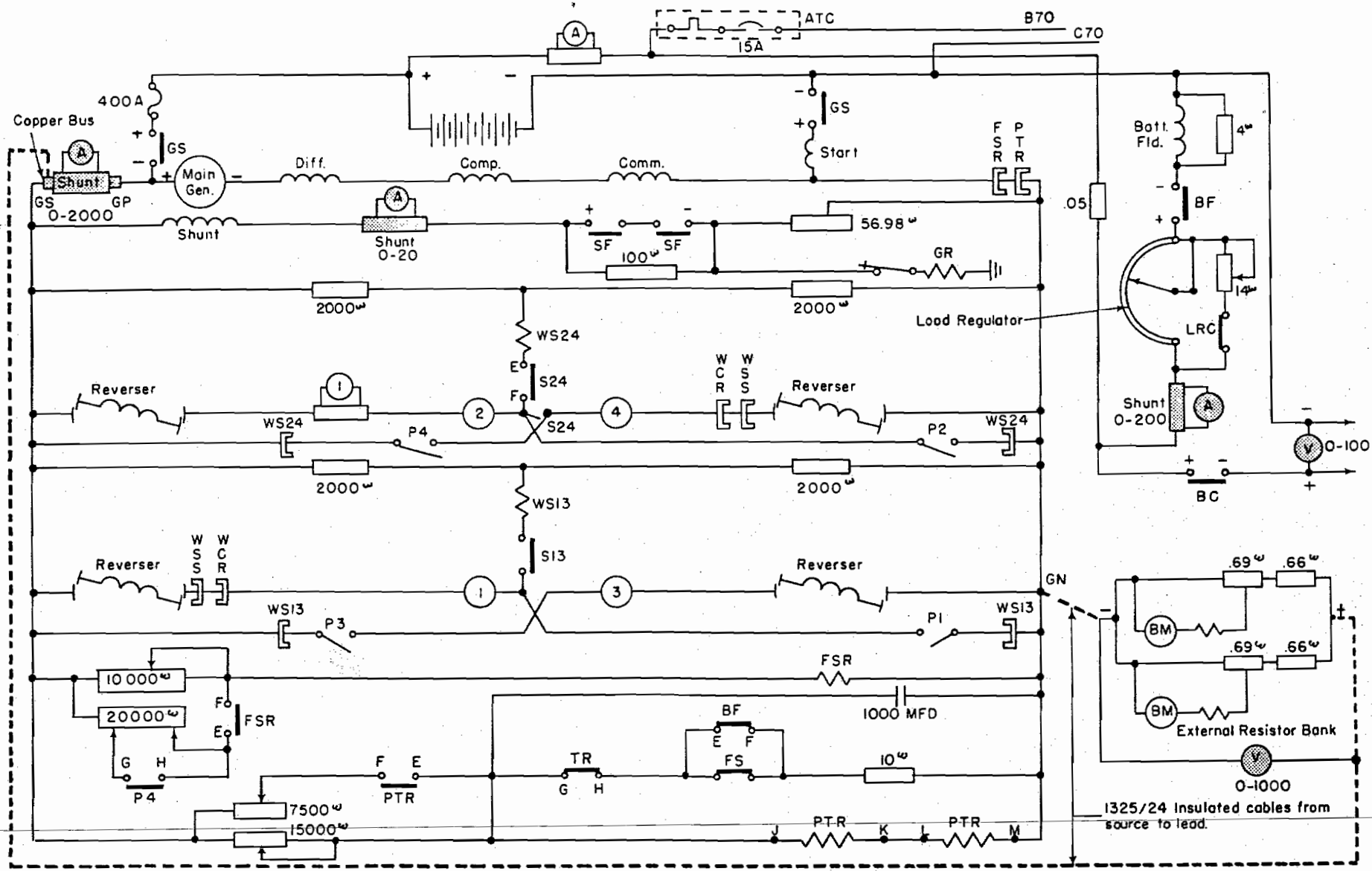



Fig. 8 - Schematic Wiring Diagram For Load Testing GP9 And F9 Locomotives (Without Dynamic Brakes)

Run in #8 throttle position for 2 hours.

In #8 throttle position compare the generator voltage and current readings obtained with the values shown on the generator characteristic curve sheet, Fig. 23. This will show how nearly the engine is delivering its rated output. Do not exceed the continuous current shown on the curve sheet.

Return locomotive to normal operating condition on completion of test.

## GP9 AND F9 LOCOMOTIVES - WITHOUT DYNAMIC BRAKES

To load test Model GP9 and F9 locomotives without dynamic brakes, external grid load is necessary to absorb the generator output as shown in Fig. 8.

After making meter and load cable connections to the locomotive power plant, Fig. 8, load testing of Model GP9 and F9 locomotives without dynamic brakes can be made in manner as described for load testing Model GP9 and F9 locomotives with dynamic brakes.

## SD9 LOCOMOTIVES - WITH DYNAMIC BRAKES

Fig. 9 shows a typical schematic wiring diagram for load testing of Model SD9 locomotives equipped with dynamic brakes.

The meter connections can be made as shown in Fig. 9, however, a meter test set can be constructed as per Figs. 1 and 2, with connections made in the manner as described under NOTE of SETTING AND TESTING on page 3.

Power Circuit Connections:

1. Brake transfer switch must be in MOTOR position.
2. Lock the reverser in CENTERED position.
3. Close the angle cock in the control air line at the electrical control cabinet

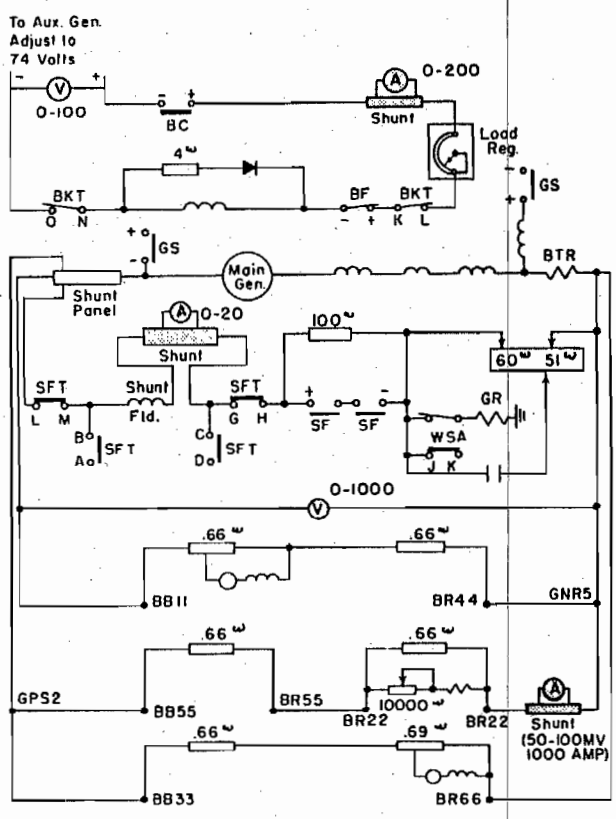



Fig. 9 - Schematic Wiring Diagram For Load Testing SD9 Locomotives With Dynamic Brakes

and bleed air from the line on the contactor side of the angle cock.

4. Connections at the brake transfer switch.

   a. Use bus bars or cable having 500,000 circular mils (1325/24 equivalent) for jumpers. Connect as follows: (See Fig. 10.)

   Connect GPS2 to BB33.

   Connect GPS2 to BB55.

   Connect BR66 to BTR relay.

   Connect BB22 to BR55.

   Connect BR22 to GNR5 with a 50 M.V. 1000 ampere meter shunt between the two points.

   Connect BR44 to GNR5.

   Connect BB11 to the Generator Shunt Panel.

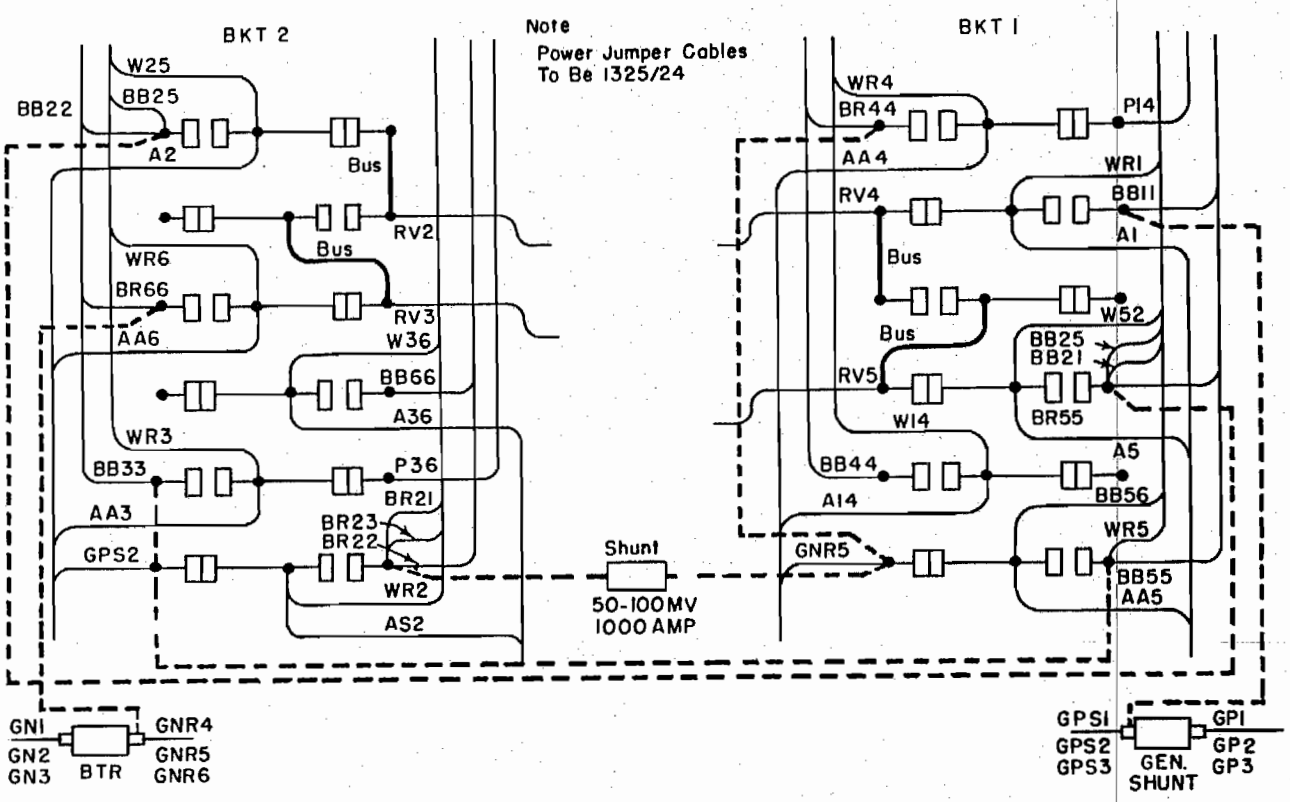



Fig. 10 - Brake Transfer Switch Connections (SD9)

Control Circuit Connections:

Jumper S45-E to S45-F.

Start the engine and complete the control circuits for road operation.

1. Close Fuel Pump and Control switches. Start engine.
2. Close Generator Field switch.
3. Put isolation switch in RUN position.
4. Put selector lever in #1 position.
5. Put throttle in Run #1.

Check to see that the grid blower motors are turning. If all conditions are normal and the engine is at normal operating temperatures and pressures, begin the test by operating as follows:

Run in #4 throttle position for 1/2 hour.

Run in #6 throttle position for 3/4 hour.

Run in #8 throttle position for 2 hours.

In #8 throttle position compare the generator voltage and current readings obtained with the values shown on the generator characteristic curve sheet, Fig. 23. This will show how nearly the engine is delivering its rated output. Do not exceed the continuous current shown on the curve sheet.

Return the locomotive to normal operating condition on completion of test.

## SD9 LOCOMOTIVES - WITHOUT DYNAMIC BRAKES

To load test Model SD9 locomotives without dynamic brakes, external grid banks should be used to absorb the generator output as shown in Fig. 11.

After making meter and load cable connections to the power plant, Fig. 11, load testing Model SD9 locomotives without dynamic brakes can be made in manner

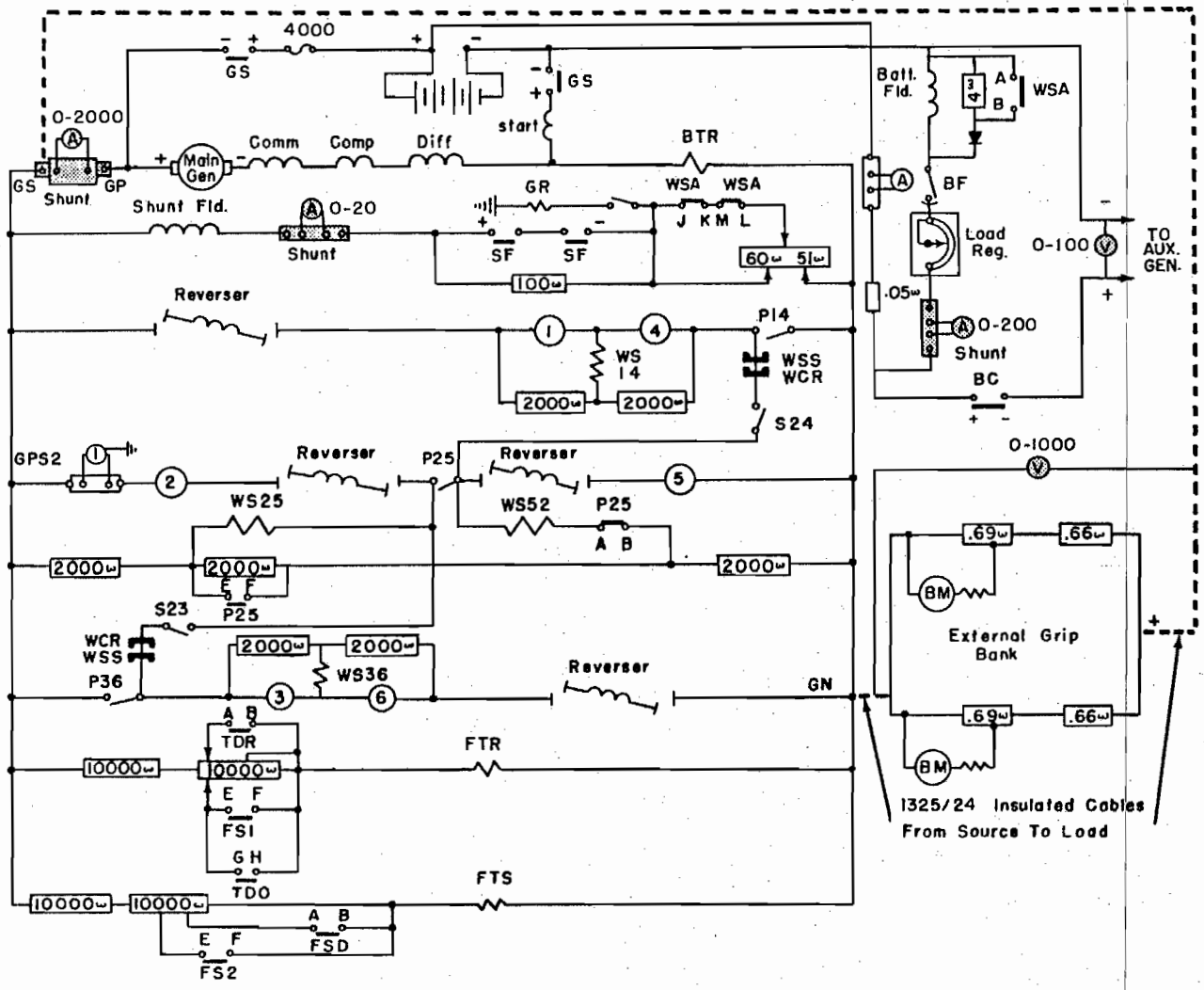



Fig. 11 - Schematic Wiring Diagram For Load Testing SD9 Locomotives (Without Dynamic Brakes)

as described for load testing Model SD9 locomotives with dynamic brakes.

## E9 LOCOMOTIVES - WITH DYNAMIC BRAKES

Figs. 12 and 13 show typical schematic wiring diagrams for load testing of Model E9 locomotives equipped with dynamic brakes.

The meter connections can be made as shown in Figs. 12 and 13, however, a meter test set can be constructed as per Figs. 1 and 2, with connections made in the manner as described under NOTE of SETTING AND TESTING on page 3.

When load testing the E9 locomotive, it must be remembered that only one power plant can be load tested at a time.

Power Circuit Connections:

1. Brake transfer switches must be in MOTOR position.
2. Lock the reversers in CENTERED position.
3. Close the angle cocks in the control air lines at the electrical control cabinets and bleed air from the line on the contactor side of the angle cock. This applies to both high voltage cabinets.

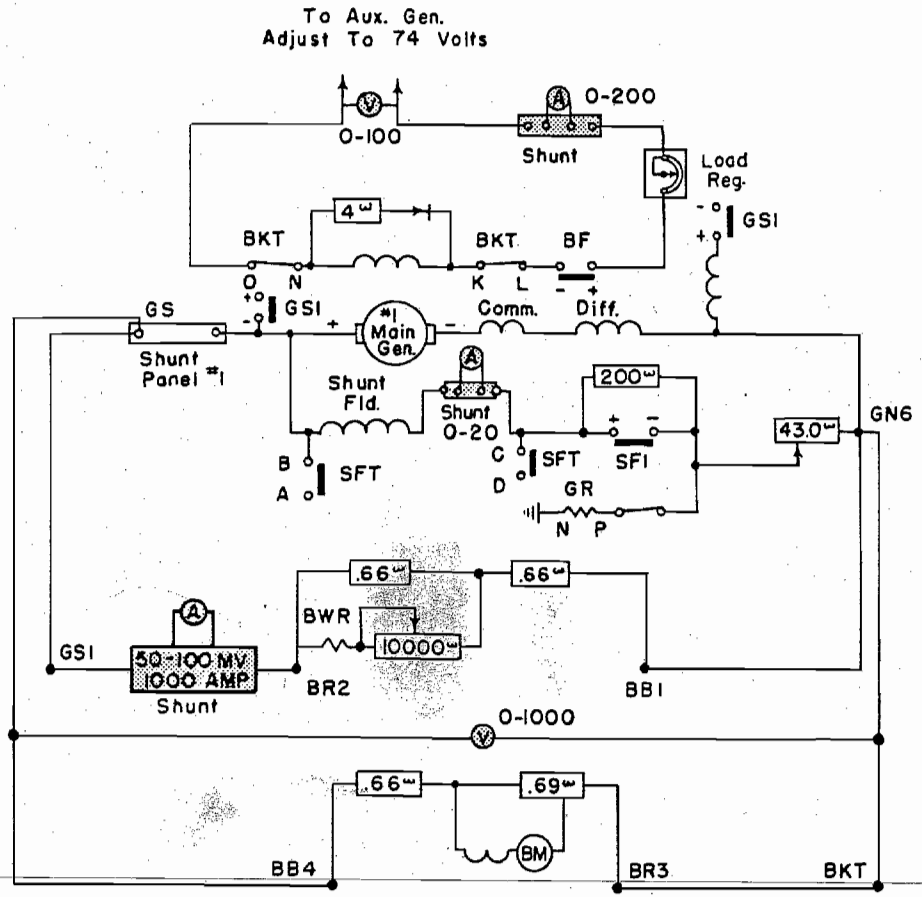



Fig. 12 - Schematic Wiring Diagram
For Load Testing #1 Power Plant - E9
(With Dynamic Brakes)

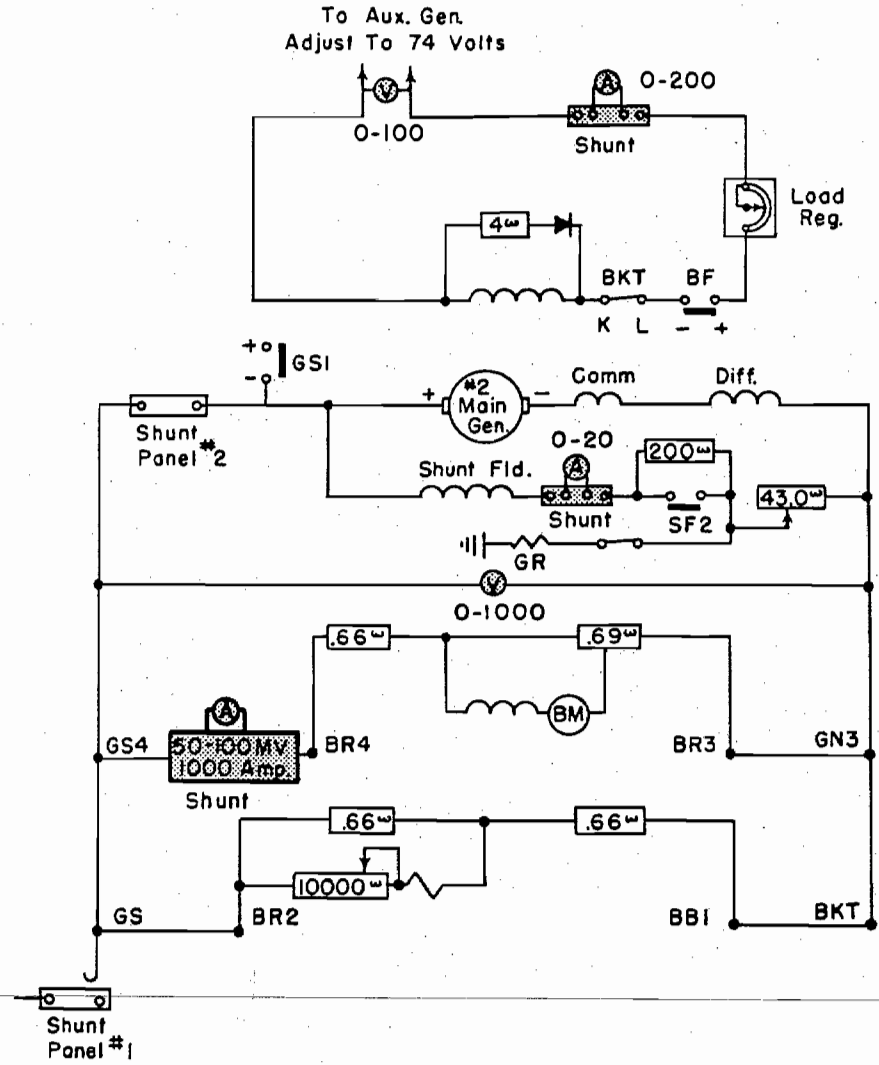



Fig. 13 - Schematic Wiring Diagram
For Load Testing #2 Power Plant - E9
(With Dynamic Brakes)

Circuit Connections For #1 Power Plant Load Test

Use cable having 500,000 circular mils (1325/24 or equivalent) for jumpers. Connect as follows: (See Fig. 14.).

Power Connections

1. At #1 Brake Transfer switch:

   Connect GS1 to BR2 with a 50 M.V. 1000 ampere meter shunt between the two points.

   Connect BB1 to GN6.

   Connect GN6 to BKT.

2. At #2 Brake Transfer switch:

   Connect BB4 to GS.

   Connect BR3 to BKT.

Control Circuit Connections

1. Jumper G interlock of S12 power contactor to H interlock of P2 power contactor.

Start the engine under test only and complete the circuits for road operation as follows:

1. Close Fuel Pump and Control switches. Start engine.
2. Close Generator Field switch.
3. Put isolation switch in RUN position.
4. Put selector lever in #1 position.
5. Put throttle in Run #1.

Check to see that the grid blower motor is turning. If all conditions are normal and the engine is at normal operating temperatures and pressure, begin the test by operating as follows:

Run in #4 throttle position for 1/2 hour.

Run in #6 throttle position for 3/4 hour.

Run in #8 throttle for 2 hours.

In #8 throttle position compare the generator voltage and current readings obtained with the values shown on the

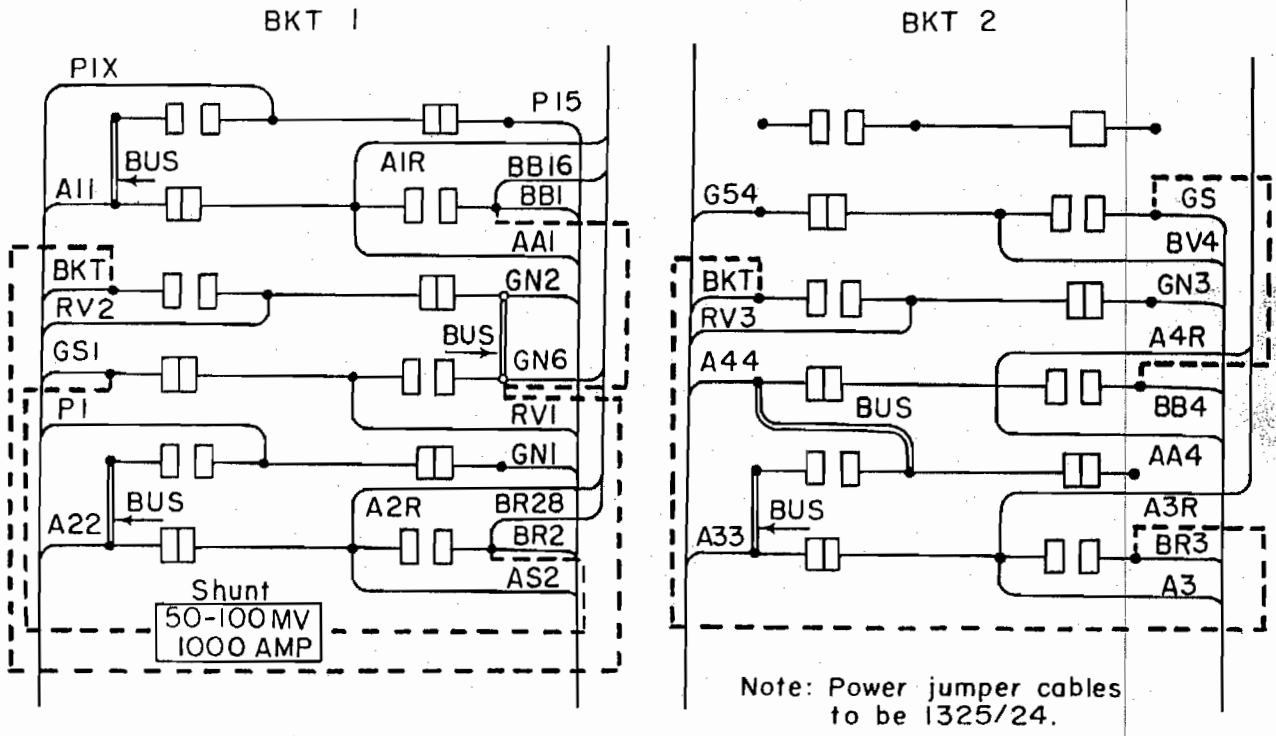



Fig. 14 - Brake Transfer Switch Connections (#1 Power Plant)

generator characteristic curve sheet, Fig. 21. This will show how nearly the engine is delivering its rated output. Do not exceed the continuous current shown on the curve sheet.

At the completion of the load test of the first power plant remove jumpers and return all wires to their normal connections before proceeding to load test second power plant.

Circuit Connections For #2 Power Plant Load Test. (See Fig. 15.).

Power Connections

1. At #1 Brake Transfer switch:

   Connect BKT to BB1.

   Disconnect GS lead from shunt panel and connect to BR2.

2. At #2 Brake Transfer switch:

   Connect BKT to GN3.

   Connect GN3 to BR3.

   Connect GS4 to BB4 with a 50 M 1000 ampere meter shunt betwe the two points.

   Connect GS4 to GS.

Control Circuit Connections

1. Jumper G interlock of S34 contact to H interlock of P3 contactor.

After the above connections ha been made, proceed with load test manner as described for load testi first power plant.

Return locomotive to normal ope ating condition at completion of test.

E9 LOCOMOTIVES - WITHOUT DYNAMIC BRAKES

To load test Model E9 locomotive without dynamic brakes, external gr banks should be used to absorb the ger erator output as shown in Fig. 16.

After making meter and load cabl connections to the #1 power plant, Fig 16, load test of #1 power plant can b

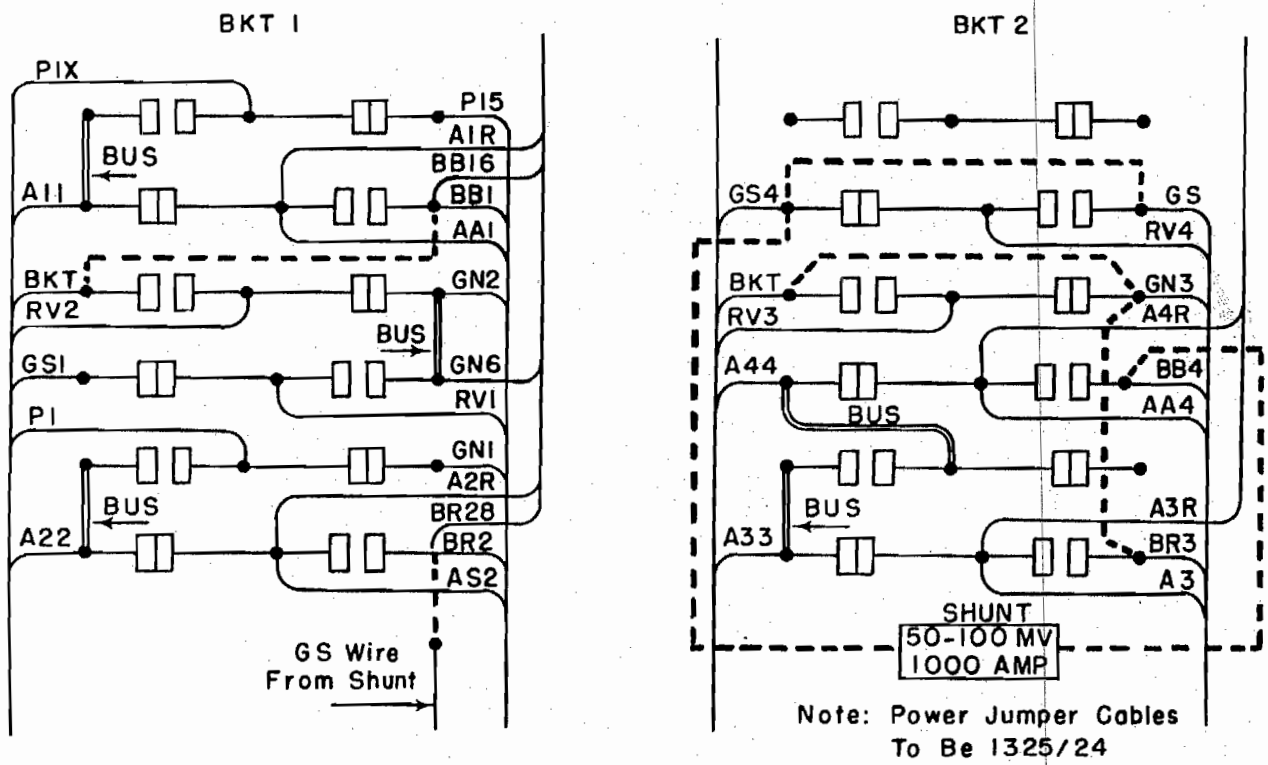



Fig. 15 - Brake Transfer Switch Connections (#2 Power Plant)

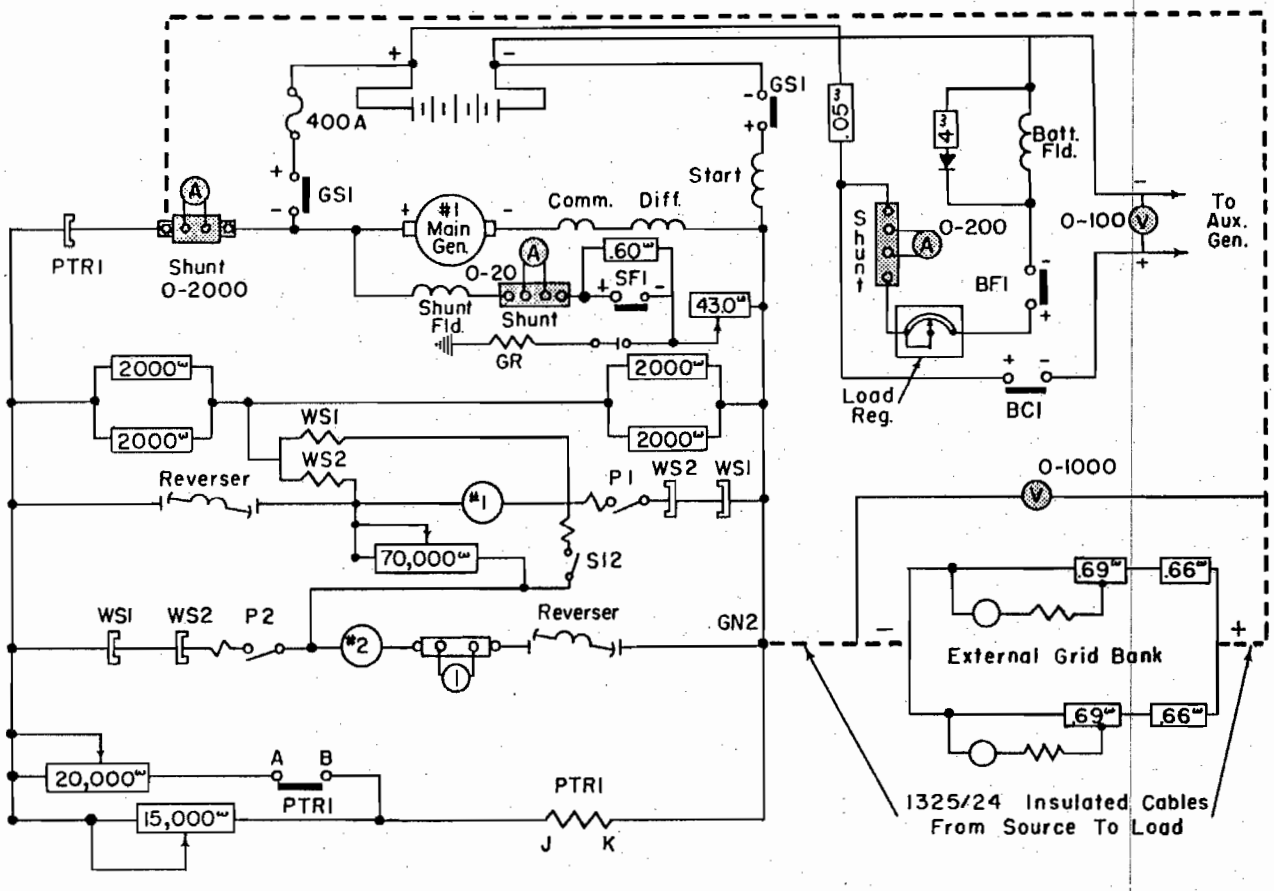



Fig. 16 - Schematic Wiring Diagram For Load Testing E9 Locomotives (Without Dynamic Brakes)

made in manner as described for load testing Model E9 locomotives with dynamic brakes.

At completion of load test of #1 power plant, return power plant to normal operating condition and proceed to load test the #2 power plant in same manner. Meter and load cable connections for #2 power plant are to follow same pattern as used on the #1 power plant.

Return locomotive to normal operating condition at termination of test.

## G12 EXPORT LOCOMOTIVES

Fig. 17 shows a typical wiring diagram for load testing of Model G12 locomotives with or without dynamic brakes.

The capacity of the 300 ampere grids is not sufficient to absorb the full 1310 HP (920 kw) of the engine on locomotives equipped with dynamic brakes, therefore, external grids should be used when making a full load test on all G12 locomotives.

The wiring diagram shown in Fig. 17 shows where meters may be connected in the generator circuit. Ordinarily five meters are required for load testing locomotive power plants. Figs. 1 and 2 show details for the construction of a meter test set whereby two meters will do the work of five meters, with connection made as outlined under NOTE of SETTING AND TESTING on page 3.

### Power Connections

1. Brake transfer switch must be in MOTOR position on locomotives with dynamic brakes.
2. Lock the reverser in CENTERED position.
3. Close the angle cock in the control air line at the electrical control

cabinet and bleed all the air from the line on the electrical equipment side.

Start engine and complete the control circuits for road operation as follows:

1. Close Control and Fuel Pump switches. Start engine.
2. Close Generator Field switch.
3. Put isolation switch in RUN position.
4. Put selector switch in RUN position.
5. Advance throttle to Run #1.

With the control circuits energized to get generator field excitation, open the throttle gradually and run a load test on the power plant as follows:

Run in #4 throttle position for 1/2 hour.

Run in #6 throttle position for 3/4 hour.

Run in #8 throttle position for 2 hours.

In #8 throttle position compare the generator voltage and current readings obtained with the values shown on the generator characteristic curve sheet, Fig. 22. This will show how nearly the engine is delivering its rated output. Do not exceed the continuous current shown on the curve sheet.

Return locomotive to normal condition on completion of test.

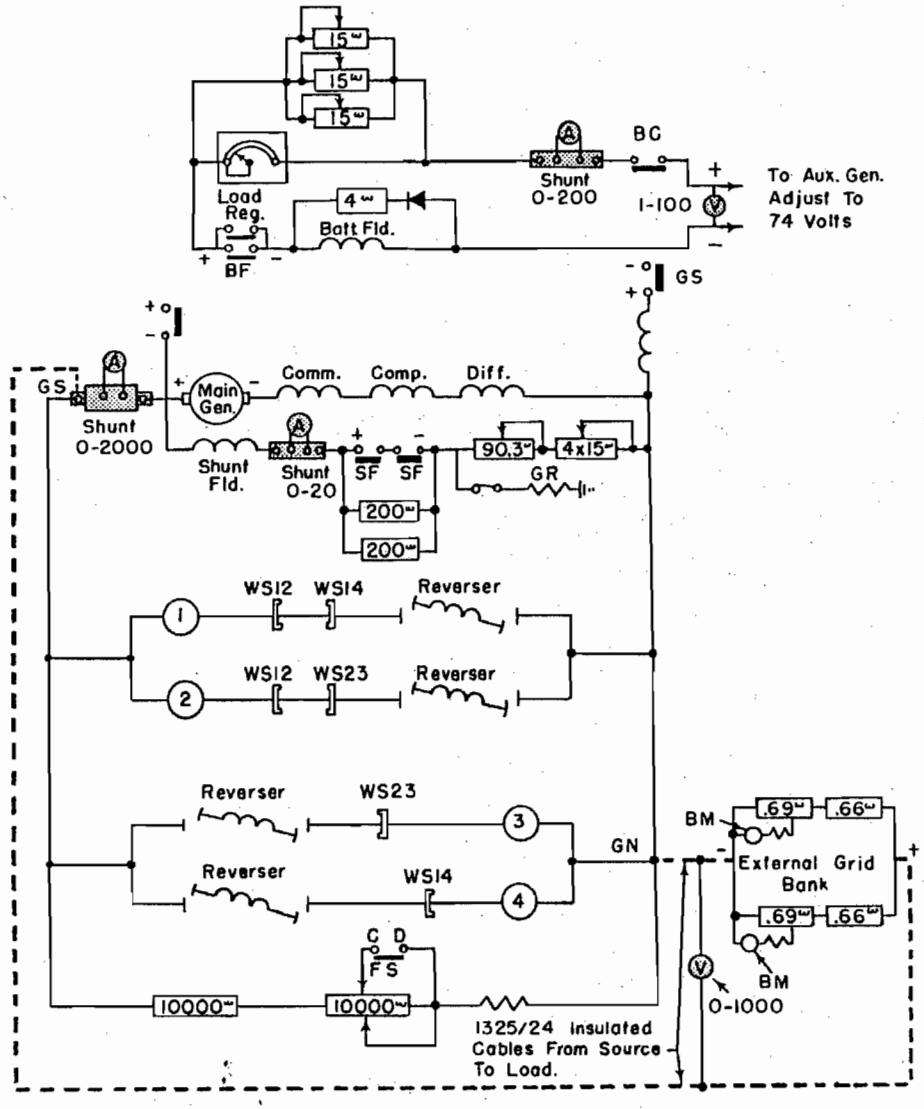



Fig. 17 - Schematic Wiring Diagram For Load Testing G12 Locomotives

# LOAD REGULATOR RESISTORS
## COMMUTATOR TYPE LOAD REGULATOR
## RESISTANCE AND AMPERE PER STEP

| | Load Regulator Resistors | | | 900 - 1200 HP Switchers | | 1500 - 1750 HP F7, FP7, GP7, GP9, F9, FP9 | | 1200 HP Passenger | |
|---|---|---|---|---|---|---|---|---|---|
| | Step No. | Ohms Step | Total Ohms | Total Ohms | Amps @74V | Total Ohms | Amps @74V | Total Ohms | Amps @74V |
| Gen. Batt. Fld. Res.* | | | | 1.212 | | 1.190 | | 1.212 | -- |
| Field Fixed Res.** | | | | 0.0 | | 0.0 | | 0.0 | -- |
| Total Ext. Res. | 0 | | | 1.212 | 61.1 | 1.190 | 62.2 | 1.212 | 61.1 |
| Grid Frame #A | 1 | .036 | .036 | 1.248 | 59.4 | 1.226 | 60.4 | 1.248 | 59.4 |
| 8058048 | 2 | .042 | .078 | 1.290 | 57.4 | 1.268 | 58.4 | 1.290 | 57.4 |
| " | 3 | .042 | .120 | 1.332 | 55.5 | 1.310 | 56.5 | 1.332 | 55.5 |
| " | 4 | .042 | .162 | 1.374 | 53.9 | 1.352 | 54.7 | 1.374 | 53.9 |
| " | 5 | .042 | .204 | 1.416 | 52.3 | 1.394 | 53.1 | 1.416 | 52.3 |
| " | 6 | .050 | .254 | 1.466 | 50.6 | 1.444 | 51.2 | 1.466 | 50.6 |
| " | 7 | .050 | .304 | 1.516 | 48.9 | 1.494 | 49.5 | 1.516 | 48.9 |
| " | 8 | .050 | .354 | 1.566 | 47.3 | 1.544 | 47.9 | 1.566 | 47.3 |
| " | 9 | .050 | .404 | 1.613 | 45.8 | 1.594 | 46.4 | 1.613 | 45.8 |
| " | 10 | .062 | .466 | 1.678 | 44.1 | 1.656 | 44.7 | 1.678 | 44.1 |
| " | 11 | .062 | .528 | 1.740 | 42.6 | 1.718 | 43.1 | 1.740 | 42.6 |
| " | 12 | .062 | .590 | 1.802 | 41.1 | 1.780 | 41.6 | 1.802 | 41.1 |
| " | 13 | .062 | .652 | 1.864 | 39.7 | 1.842 | 40.2 | 1.864 | 39.7 |
| " | 14 | .062 | .714 | 1.926 | 38.4 | 1.904 | 38.9 | 1.926 | 38.4 |
| " | 15 | .062 | .776 | 1.988 | 37.2 | 1.966 | 37.6 | 1.988 | 37.2 |
| " | 16 | .076 | .852 | 2.064 | 35.8 | 2.042 | 36.2 | 2.064 | 35.8 |
| " | 17 | .076 | .928 | 2.140 | 34.6 | 2.118 | 34.9 | 2.140 | 34.6 |
| " | 18 | .076 | 1.004 | 2.216 | 33.4 | 2.194 | 33.7 | 2.216 | 33.4 |
| " | 19 | .089 | 1.093 | 2.305 | 32.1 | 2.283 | 32.4 | 2.305 | 32.1 |
| Grid Frame #B | 20 | .089 | 1.182 | 2.394 | 30.9 | 2.372 | 31.2 | 2.394 | 30.9 |
| 8058049 | 21 | .102 | 1.284 | 2.496 | 29.7 | 2.474 | 29.9 | 2.496 | 29.7 |
| " | 22 | .102 | 1.386 | 2.598 | 28.7 | 2.576 | 28.7 | 2.598 | 28.7 |
| " | 23 | .113 | 1.499 | 2.711 | 27.3 | 2.689 | 27.5 | 2.711 | 27.3 |
| " | 24 | .113 | 1.612 | 2.824 | 26.2 | 2.802 | 26.4 | 2.824 | 26.2 |
| " | 25 | .113 | 1.725 | 2.937 | 25.2 | 2.915 | 25.4 | 2.937 | 25.2 |
| " | 26 | .128 | 1.853 | 3.065 | 24.1 | 3.043 | 24.3 | 3.065 | 24.1 |
| " | 27 | .128 | 1.981 | 3.193 | 23.2 | 3.171 | 23.3 | 3.193 | 23.2 |
| " | 28 | .154 | 2.135 | 3.347 | 22.1 | 3.325 | 22.3 | 3.347 | 22.1 |
| " | 29 | .154 | 2.289 | 3.501 | 21.1 | 3.479 | 21.3 | 3.501 | 21.1 |
| " | 30 | .154 | 2.443 | 3.655 | 20.3 | 3.633 | 20.4 | 3.655 | 20.3 |
| " | 31 | .192 | 2.635 | 3.847 | 19.2 | 3.825 | 19.3 | 3.847 | 19.2 |
| " | 32 | .192 | 2.827 | 4.039 | 18.3 | 4.017 | 18.4 | 4.039 | 18.3 |
| " | 33 | .192 | 3.019 | 4.231 | 17.5 | 4.209 | 17.6 | 4.231 | 17.5 |
| " | 34 | .231 | 3.250 | 4.462 | 16.6 | 4.440 | 16.7 | 4.462 | 16.6 |
| " | 35 | .231 | 3.481 | 4.693 | 15.8 | 4.671 | 15.8 | 4.693 | 15.8 |
| " | 36 | .231 | 3.712 | 4.924 | 15.0 | 4.902 | 15.1 | 4.924 | 15.0 |
| " | 37 | .293 | 4.005 | 5.217 | 14.2 | 5.195 | 14.2 | 5.217 | 14.2 |
| " | 38 | .293 | 4.292 | 5.510 | 13.4 | 5.488 | 13.5 | 5.510 | 13.4 |
| " | 39 | .308 | 4.606 | 5.818 | 12.7 | 5.796 | 12.8 | 5.818 | 12.7 |
| " | 40 | .308 | 4.914 | 6.126 | 12.1 | 6.104 | 12.1 | 6.126 | 12.1 |
| Res. Tube #8005141 | 41 | .400 | 5.314 | 6.526 | 11.3 | 6.504 | 11.4 | 6.526 | 11.3 |
| " | 42 | .400 | 5.714 | 6.926 | 10.7 | 6.904 | 10.7 | 6.926 | 10.7 |
| " | 43 | .400 | 6.114 | 7.326 | 10.1 | 7.304 | 10.1 | 7.326 | 10.1 |
| Res. Tube #8005142 | 44 | .540 | 6.654 | 7.866 | 9.4 | 7.844 | 9.4 | 7.866 | 9.4 |
| " | 45 | .540 | 7.194 | 8.406 | 8.8 | 8.384 | 8.8 | 8.406 | 8.8 |
| " | 46 | .540 | 7.734 | 8.946 | 8.3 | 8.924 | 8.3 | 8.946 | 8.3 |
| Res. Tube #8005143 | 47 | .730 | 8.464 | 9.676 | 7.7 | 9.654 | 7.7 | 9.676 | 7.7 |
| " | 48 | .730 | 9.194 | 10.406 | 7.1 | 10.384 | 7.1 | 10.406 | 7.1 |
| " | 49 | .730 | 9.924 | 11.136 | 6.6 | 11.114 | 6.7 | 11.136 | 6.6 |
| Res. Tube #8005144 | 50 | 1.020 | 10.944 | 12.156 | 6.1 | 12.134 | 6.1 | 12.156 | 6.1 |
| " | 51 | 1.020 | 11.964 | 13.176 | 5.6 | 13.154 | 5.6 | 13.176 | 5.6 |
| " | 52 | 1.020 | 12.984 | 14.196 | 5.2 | 14.174 | 5.2 | 14.196 | 5.2 |

**See "Notes" on the following page

NOTES:

* The generator battery field resistance values are average resistance values at 75° C.

** Fixed resistor in series with the battery field and load regulator resistors.

2000 HP passenger locomotives, having an emergency load regulator switch mounted on load regulator frame, start with a minimum field of 10.7 amperes. In normal operation, the emergency switch shorts out four resistance tubes. By changing this switch to "Emergency," the four tubes are cut into the circuit and a minimum field of 4.9 amperes is obtained for starting. On later built E7 locomotives this switch has been discontinued.

There are five (5) part numbers for the commutator type load regulator. The resistance per step is the same for all five regulators, but two of the regulators have an external oil line by-pass assembly while the others have a built-in check valve to provide the oil by-pass. There is also a right and left hand designation depending upon which side of the locomotive the load regulator is to be installed. The following list will correlate the above.

| Part Number | Description Of Load Regulator |
|---|---|
| 8055000 | Uses an external oil by-pass assembly on the vane motor. Vane motor is mounted on RH side of load regulator. Used on switcher, FT, and 2000 HP passenger locomotives. |
| 8091072 | Uses an external oil by-pass assembly on the vane motor. Vane motor is mounted on LH side of load regulator. Used on F2 and F3 locomotives. |
| 8121963 | Has a built-in check valve oil by-pass in vane motor. Vane motor is mounted on RH side of load regulator. Used on switcher, FT, and 2000 HP passenger locomotives. |
| 8117013 | Has a built-in check valve oil by-pass in vane motor. Vane motor is mounted on LH side of load regulator. Used on F3, F2, F7, F9, SD7, SD9, GP9, E8, E9. |
| 8155361 | Used on GP7 locomotives. Has FTS and LRS switches actuated by vane motor. Vane motor is mounted on LH side of load regulator. Has a built-in check valve oil by-pass in vane motor. |

D15C GENERATOR CHARACTERISTICS
900 Horsepower Switcher
AUTOMATIC TRANSITION

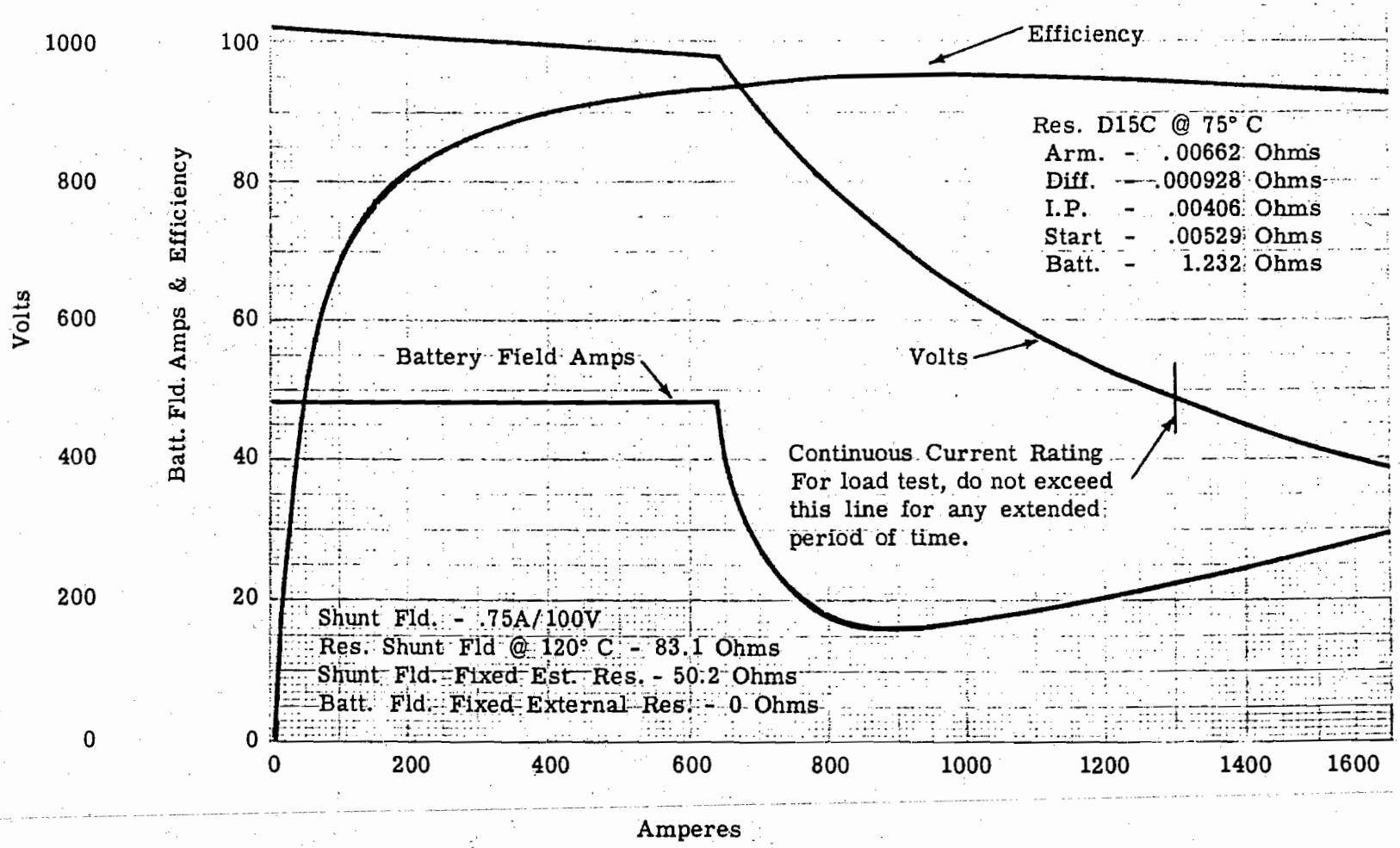



Fig. 18 - D15C Generator Characteristics

# D15 GENERATOR CHARACTERISTICS
## 950-875 HP Export Locomotive

Shunt Fld. - .75A/100V
Res. D15 Gen. @ 75° C
Arm. - .00662 Ohms
Diff. - .000928 Ohms
I.P. - .00406 Ohms
Start - .00529 Ohms
Batt. - 1.232 Ohms

Res. Shunt Fld. @ 120°C - 83.1 Ohms
Shunt Fld. Fixed Ext. Res. - 50.2 Ohms
Shunt Fld. Turns - 899
Batt. Fld. Turns - 76
Diff. Fld. Turns - 1

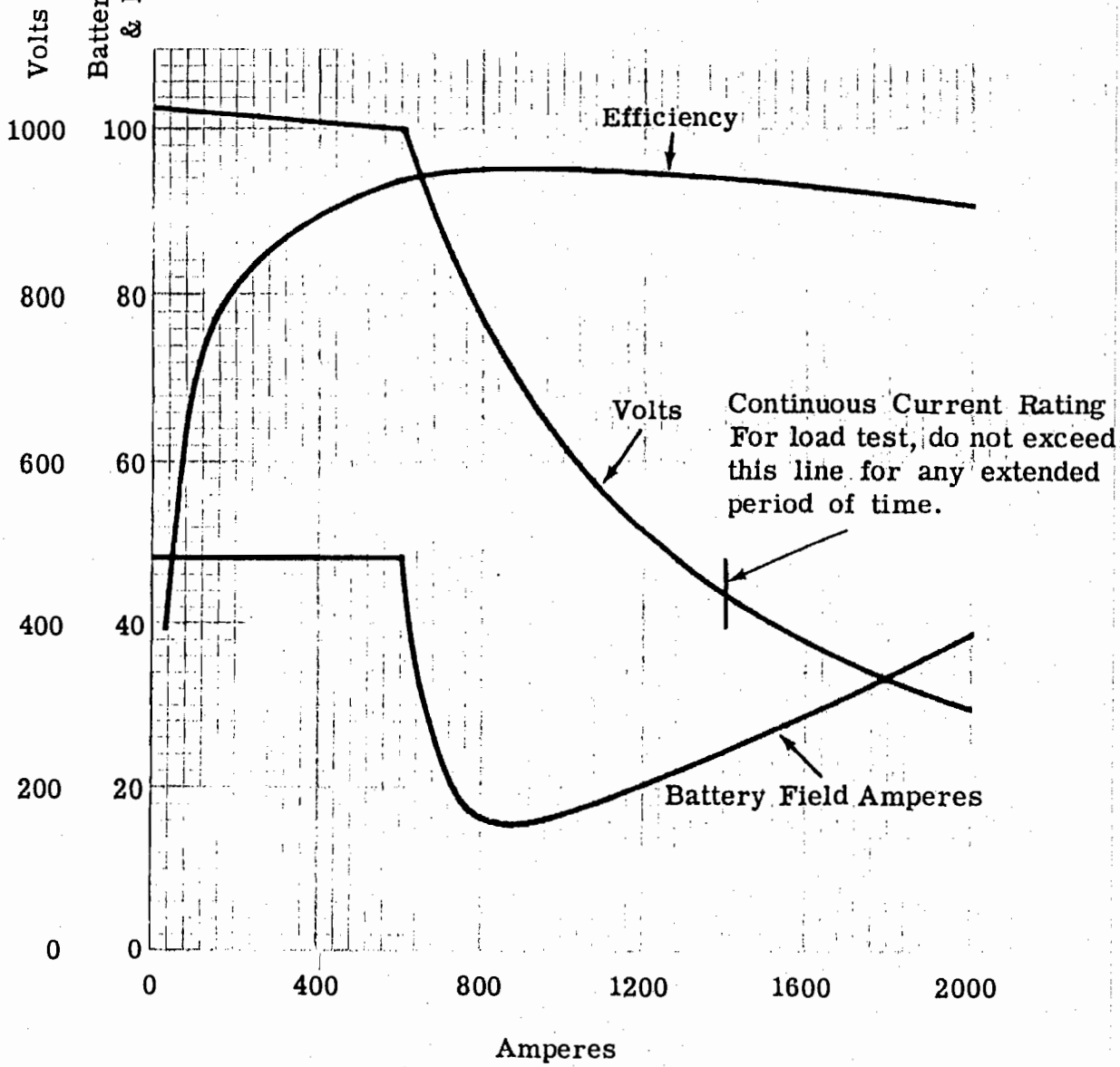



Fig. 19 - D15 Generator Characteristics

D15C GENERATOR CHARACTERISTICS
1200 Horsepower Switcher
AUTOMATIC TRANSITION

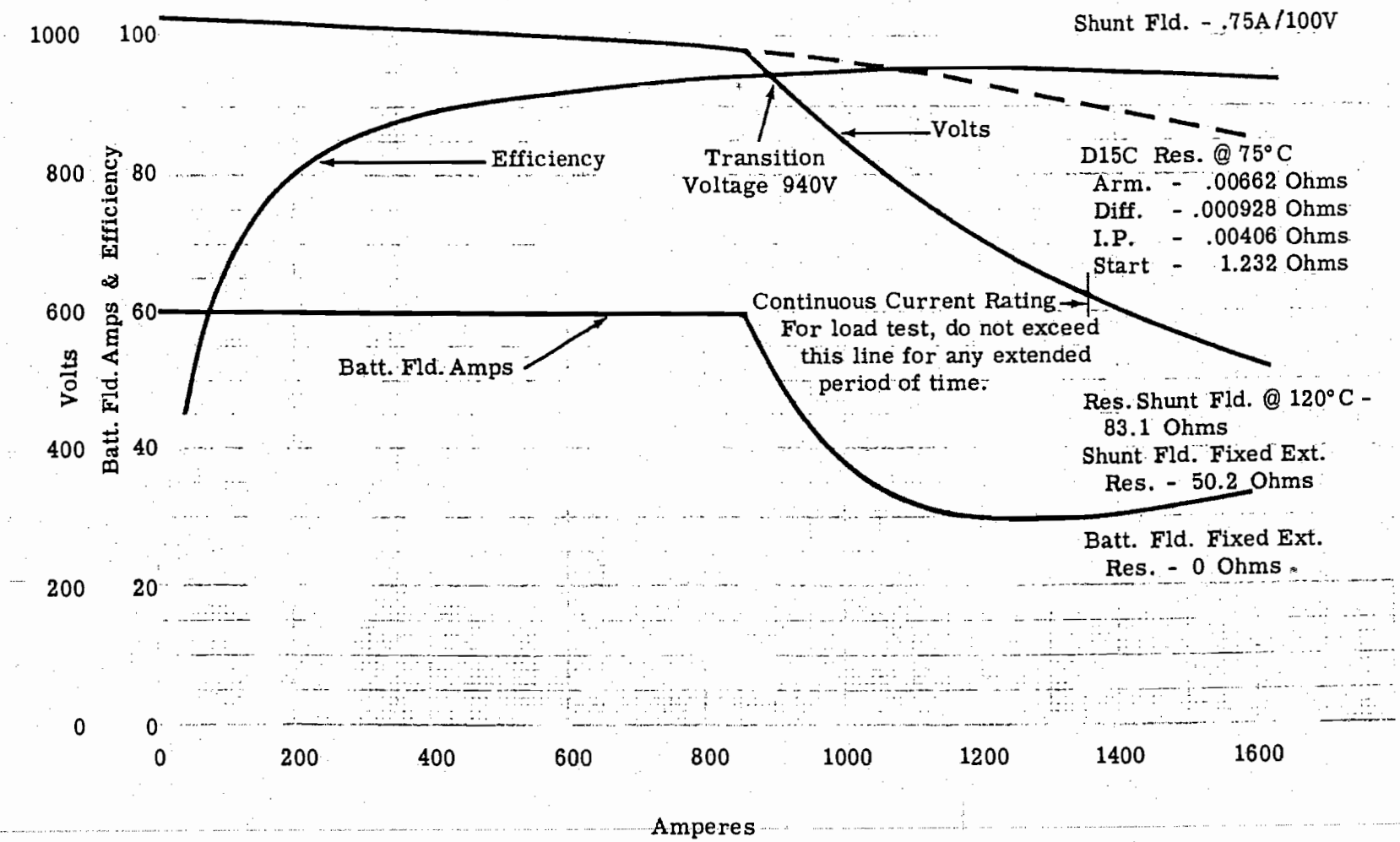



Fig. 20 - D15C Generator Characteristics

D15B GENERATOR CHARACTERISTICS
1200 Engine Horsepower
Model E9 Locomotive

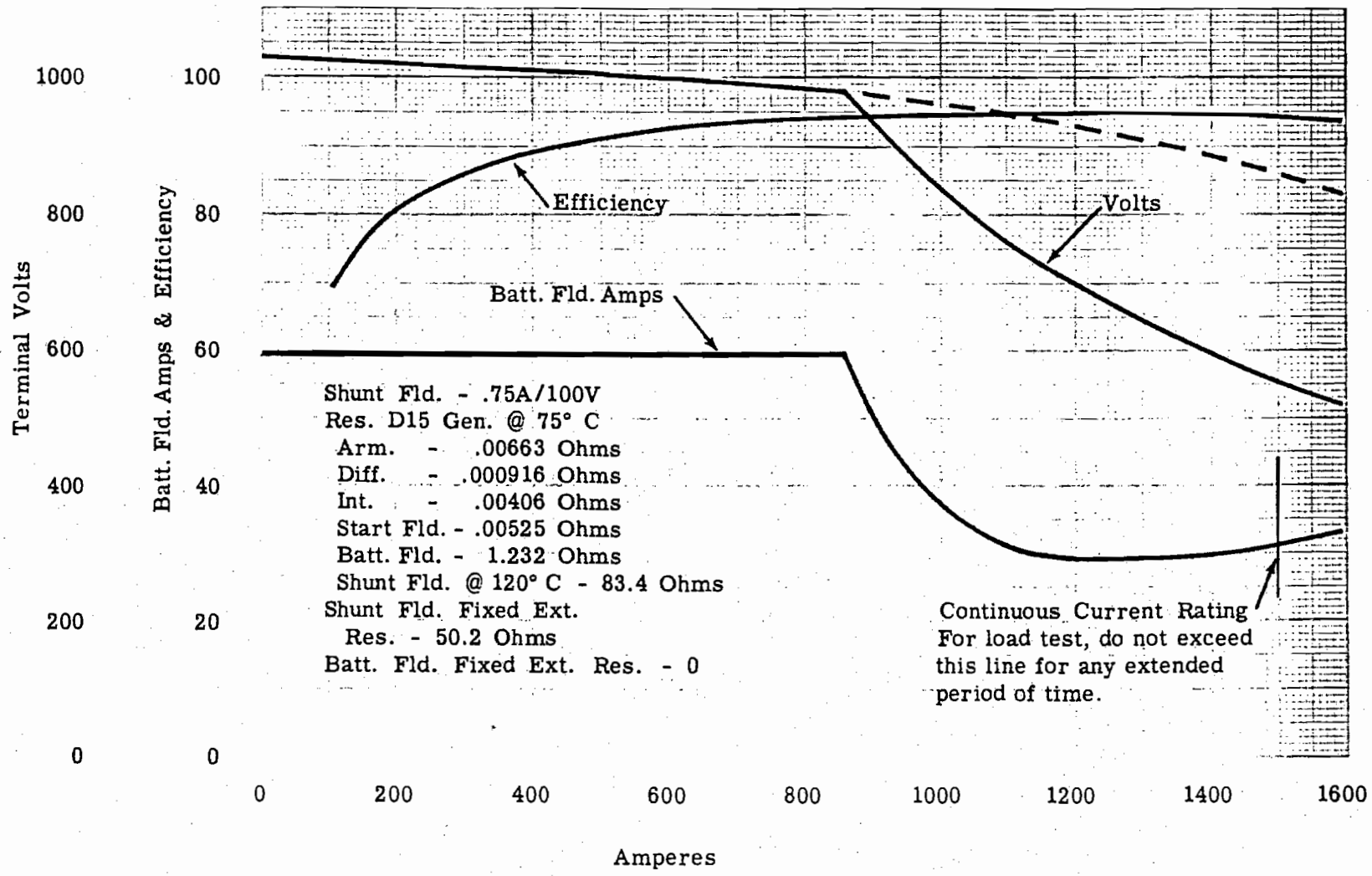



Fig. 21 - D15B Generator Characteristics

D12 GENERATOR CHARACTERISTICS
1310 Engine Horsepower

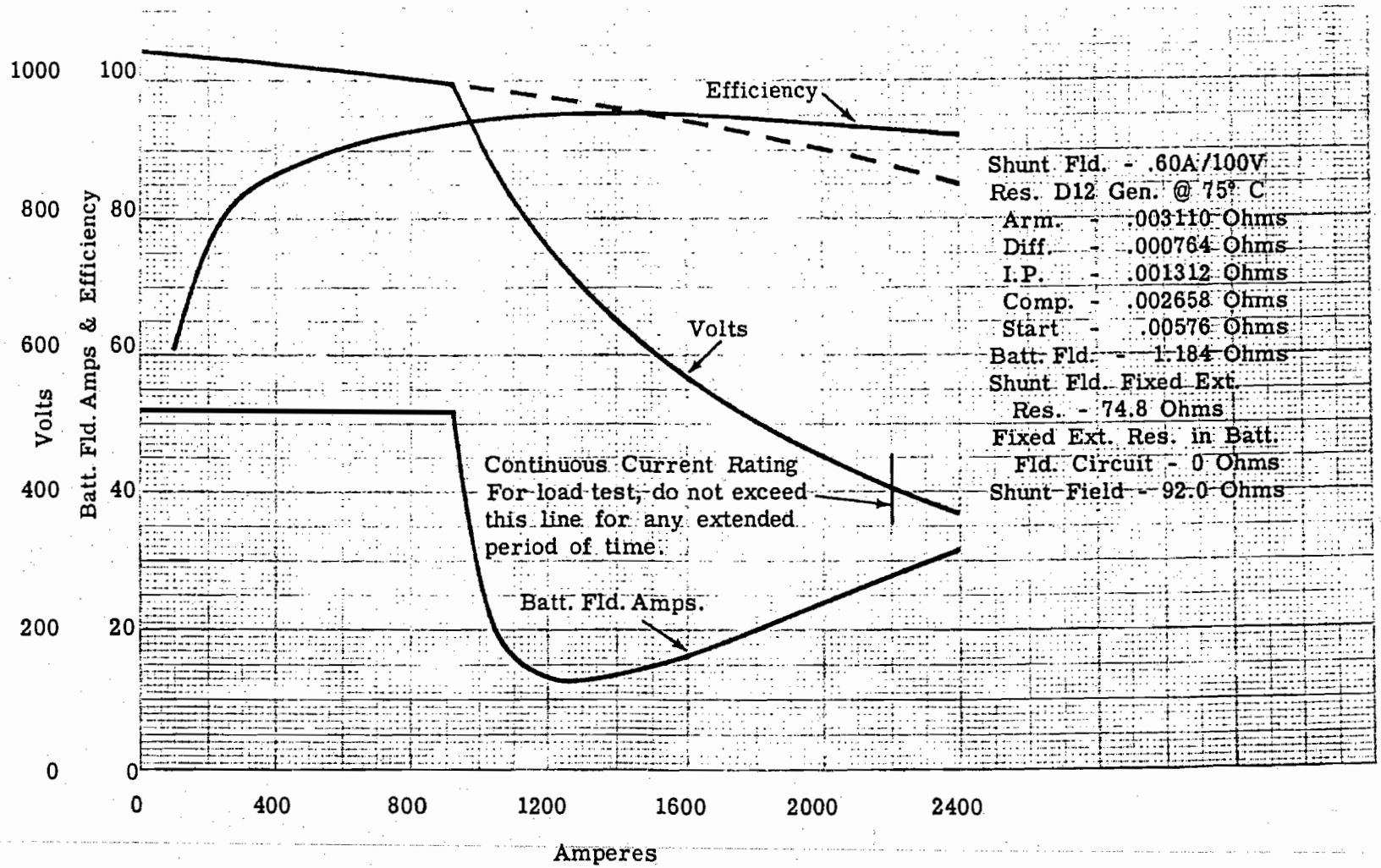



Fig. 22 - D12 Generator Characteristics — 1310 HP

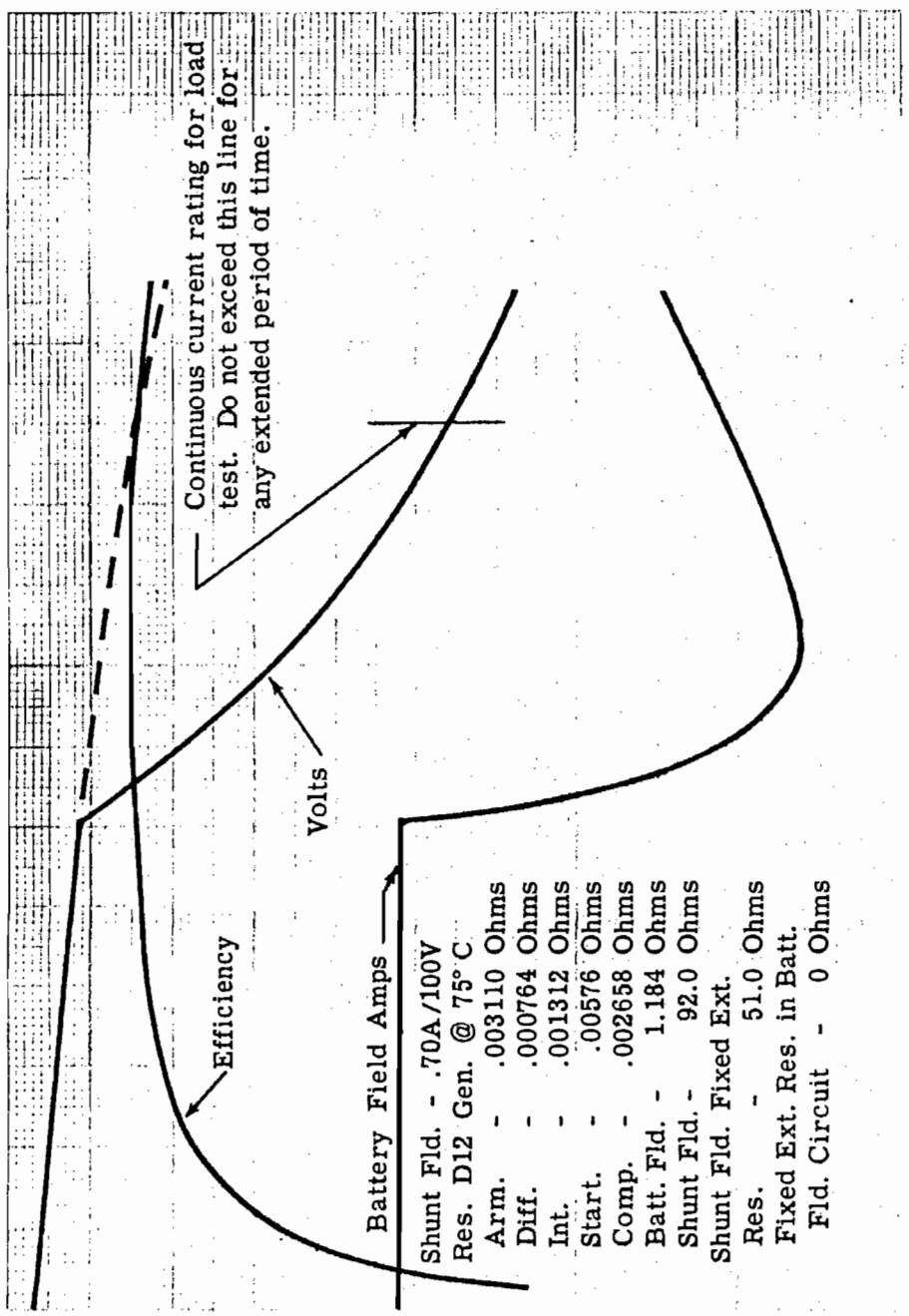



Fig. 23 - D12 Generator Characteristics — 1750 HP