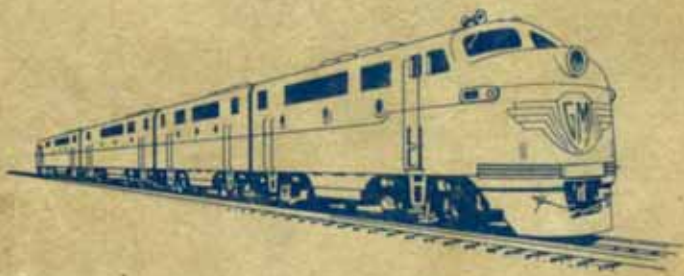


INSTRUCTOR'S GUIDE

ON THE OPERATION OF
MODEL F2
DIESEL LOCOMOTIVES



ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION • LA GRANGE, ILLINOIS, U. S. A.

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INTRODUCTION

The purpose of this Guide is to provide a program of instruction on the operation of the F2 locomotive. The Guide is divided into units of instruction which are to be taken up in sequence. Where practicable, a unit of instruction will be covered during each trip on the road or each day in helper service. If circumstances prevent full coverage of a unit during a single day or trip, instruction on that unit will be completed during following periods of duty of the trainee.

Each unit of instruction should be completely covered before the next is discussed. When this has been accomplished, the instructor will sign the trainee's copy of the Guide in the space corresponding to the unit number on the last page. A space is also provided for approval by a designated railroad official.

Throughout this Guide, reference is made to the Operating Instruction Manual covering the F2 locomotive. These references are to Section and Subject, rather than to page numbers, as these may vary with individual railroad manuals. In giving instructions, full use should be made of the Operating Instruction Manual.

Since some items of instruction are given in the CAB and others in the ENGINE ROOM, each unit is divided into "CAB INSTRUCTIONS" and "ENGINE ROOM INSTRUCTIONS." The twelfth unit is devoted to "DIESEL PIT INSTRUCTIONS" which can best be given when the locomotive is standing still. Such conditions also offer the best chance to actually do some trouble shooting (such as location of burned out fuses, etc.).

NOTE: The course covers instruction to be given on locomotives equipped with dynamic braking and

FIRST UNIT

No. 24 RL air brake equipment. For locomotives without dynamic braking or equipped with other types of air brake equipment, the instruction must be modified accordingly.

The instructions on the steam generator should also be adapted to cover the particular type of equipment furnished or omitted when no steam generator is used.

The object of the instruction, on the initial trip, will be to explain only such controls, gauges, and operating procedures as are necessary to handle the locomotive. All explanations should be BRIEF - cover what the controls do, the gauges indicate, or the operating procedures accomplish.

CAB INSTRUCTIONS - Before Moving Locomotive

- A - Control Push-Button Switch Box. Demonstrate locking and unlocking the buttons. Caution against leaving buttons unlocked in non-operating end. Indicate the buttons in sequence. (Section 1 - Engineer's Instruments)
- B - Reverse Lever. (Section 1 - Plate 1-1, Item 10.) Demonstrate application and removal, positions for forward and reverse operation, interlocks with transition lever and throttle. (Section 1 - Controller)
- C - Transition Lever. (Section 1 - Plate 1-1, Item 11.)
 - 1. Power Range. Demonstrate manipulation of transition lever from OFF to No. 4 positions. (Section 2 - Operation of Transition Lever.) Demonstrate interlocks with throttle. (Section 1 - Controller.)
 - 2. Dynamic Braking Range. Demonstrate manipulation of transition lever from OFF to "B" and through dynamic braking range. Demonstrate interlock with throttle. State that dynamic braking can be better demonstrated and explained when on the road and will be covered later.

- D - Load and Transition Indicating Meter. (Section 1). Point out and explain purpose during power operation. State that it is also used during dynamic braking to indicate the braking force and maximum allowable application. Demonstration will be made on the road.
- E - Throttle. Demonstrate manipulation from idle to various runs, explaining that speed and power of Diesel engines are so controlled. Explain button on throttle lever (Section 1 - Throttle Emergency Stop Button). Demonstrate action by moving throttle to "OFF" momentarily and have trainee observe effect on engine speed. Demonstrate throttle interlock with reverse and transition levers. (Section 1 - Controller.)
- F - Deadman Control Pedal (Section 1). Explain briefly. Explain similar effect obtained by holding down automatic brake valve handle, if locomotive is equipped with this feature. Bring out necessity of keeping pedal (or automatic brake valve handle) depressed, except when the locomotive is stopped and the independent brake is applied (25 lbs. or over).
- G - Instrument Panel. (Section 1)
- H - Wheel Slip Indicator. Purposes and action. Cover handling of throttle and use of sand. (Section 2 - Operation of Wheel Slip Indicator.)
- I - Pneumatic Control Switch or PC Switch. Demonstrate how to set for operation. State that it stops the engine fuel pumps and holds the speed of the engines to idle when tripped. (Section 1 and Section 2 - Pneumatic Control Switch.)

- J - Dynamic Brake Warning Light. (Section 1 - Dynamic Brake Warning Light and Section 2 - Operation of Dynamic Brake.)
- K - Locomotive Bell Valve (Section 1). Point out and demonstrate.
- L - Sanding Valve (Section 1). Point out and demonstrate.
- M - Horns. (Section 1). Point out and demonstrate, calling attention to use of rear-pointing horn for signals such as whistling off, calling in flagman, etc.
- N - Attendant Call. Use for signal communication between operating cabs and engine rooms.
- O - Headlight Switch. Demonstrate different positions.
- P - Speed Recorder (Section 1).
- Q - Cab Heaters. Show operating switches and water control valve in engine room. Demonstrate speed control of cab heater motors by use of switches. On locomotives equipped with steam generators, point out steam admission valves.
- R - Moving Locomotive. (Section 2 - To Move Locomotive.)

CAB INSTRUCTIONS - On Train Before Leaving

- A - Pumping Up Train Line. (Section 2 - If locomotive Has Been Coupled To Train and Train Line Must Be Pumped Up.) To determine whether

step "d" of reference is necessary, watch main reservoir pressure. If it drops appreciably, speed up the engines with the throttle. Emphasize necessity of opening generator field switch and opening throttle no further than the third notch.

B - Starting Train. Go over the procedure of starting a train with the trainee so he may have this information and know how to proceed when ready to leave. (Section 2 - Starting a Train.)

CAB INSTRUCTIONS - On Road

A - Starting a Train (Section 2).

1. Check throttle handling during start and repeat instructions if necessary.
2. Point out action of load and transition indicating meter while train is accelerating in transition lever position No. 1 through the throttle range. Make clear that it is permissible for the pointer to be to the right of the No. 1 green area temporarily while the train is accelerating but should not come to rest in this area.

B - Accelerating to Speed. (Section 2 - Increasing Speed.)

1. Point out action of pointer of load and transition indicating meter as speed increases after throttle is in Run 8. As the pointer moves to the left, call attention to the white area between No. 1 and No. 2 green areas. When the pointer crosses the white area instruct on change to No. 2 transition lever position.

2. As the acceleration continues and the pointer reaches the white area between No. 2 and No. 3 green areas, direct change of transition lever to No. 3 position cautioning that throttle must be reduced to Run 6 before movement of lever is made. Re-open throttle to No. 8 position after transition is completed.

3. When the pointer crosses the white area between No. 3 and No. 4 green areas, shift to transition lever position No. 4. No reduction of throttle is necessary.

NOTE: Emphasize that transition lever shifts are determined by the pointer only when the throttle is in Run 8, except under certain circumstances outlined in D-2 below. Hence train acceleration should be made with throttle in this position.

C - Operation When Speed Decreased Due To Grade. (Section 2 - Decreasing Speed.)

1. Entering grade. Explain necessity of opening throttle to Run 8 to check transition lever setting.
2. Demonstrate check of position of load and transition indicating meter pointer - it should be in numbered green area corresponding to transition lever position. Shift transition lever if necessary.
3. As speed decreases, pointer will move to the right. During deceleration, watch pointer and see that transition lever shifts are made when indicated by pointer crossing white area.

D - Operation - General

1. Handling of Locomotive (Section 2). Emphasize precautions given.
2. Reduced throttle. Point out action of the load and transition indicating meter pointer when the locomotive is being operated with the throttle in Run 7 or under. Emphasize that transition lever changes are usually based on the pointer readings in Run 8 only but shift must be made, in any throttle position, if the pointer moves to an area to the right of the one corresponding to the transition lever setting. Example: A locomotive is operating with the transition lever in No. 3 position and throttle in Run 5. The transition indicating meter pointer is in No. 3 green area. More power is necessary to maintain the desired speed. The throttle is opened to Run 6. The pointer moves to the right but remains in Area 3. No transition lever change is necessary in that case. The throttle is moved to Run 7. As a result, the pointer moves to the right into No. 2 area. As this area is to the right of the one corresponding to transition lever position (No. 3), the transition lever must be moved to No. 2 position immediately, temporarily reducing the throttle to Run 6 while making the transition lever change.
3. Load and transition indicating meter pointer remaining in white area. (Section 2 - Use of Load and Transition Indicating Meter). Explain reason for close watch of load and transition indicating meter if pointer comes to rest in white area. ^{off standing line} Emphasize necessity of prompt change of transition lever position when pointer

moves out of white area under conditions described in reference.

4. Overload Operation. (Section 2 - Use of Load and Transition Indicating Meter.) Point out overload area and explain briefly - subject will be covered in detail in later instruction. Should overload conditions be encountered on the initial trip, explain use of overload area fully.

5. Operation over railroad crossings (Section 2).

E - Dynamic Braking (Section 2)

1. Explain operation briefly (Section 2 - Operation of the Dynamic Brake).
2. Point out maximum braking load triangle on load and transition indicating meter scale and explain purpose. Explain purpose and action of dynamic brake warning light (Section 2 - Operation of the Dynamic Brake).
3. Emphasize warning against application of dynamic brake and independent air brake simultaneously.

- F - Changing Ends (Section 2). If conditions of operation on the initial trip require changing operating ends, instruct on procedure as given in reference. If not necessary on first trip, the instruction may be delayed until conditions demand it or until scheduled in Sixth Unit.

CAB INSTRUCTIONS - On Arrival At Terminal

- A - Leaving Locomotive (Section 2 - Stopping Engines

in Preparation for Terminal Layover). Demonstrate individual items listed in reference and sequence of procedure.

ENGINE ROOM INSTRUCTIONS - Before Moving Locomotive

A - Make brief tour of engine room, pointing out:

1. Engine control panels.
2. Lube oil pressure and suction gauges.
3. Temperature gauges.
4. Water glasses.
5. Fuel sight glasses.
6. Electrical control cabinet.
7. Ground protective relay.
8. Alarm lights.

B - Explain engine control panel. Describe function of:

1. Isolation switch.
2. Fuel pump switch.
3. Engine "START" and "STOP" buttons.
4. Main bearing lube oil pressure gauge.
5. Lube oil pump suction vacuum gauge.

C - Demonstrate precautions before starting engine (Section 2).

D - Demonstrate procedure of starting and stopping an engine and use of isolation switch. (Section 2 - Starting Engines after Layover and Stopping Engine in Preparation for Terminal Layover, Paragraphs 2a, b and c.) Particularly point out location and demonstrate check of starting contactors and ground protective relay after starting an engine.

E - Check engine cooling water temperatures. Point out that the temperature gauge pointer at each engine should be in the green area before the locomotive is moved.

F - Show student the classification light boxes and demonstrate setting of red or green lenses.

G - Demonstrate application and release of engine room hand brakes. (Section 1 - Hand Brake.)

ENGINE ROOM INSTRUCTIONS - On Road

A - Periodical checks of oil pressure and suction gauges on engine control panels and at air compressors.

B - Observation of engine water levels. When checking engine temperatures and oil pressures, the water levels in the glasses should be checked. Explain that there is no danger of operating with insufficient water in the cooling system so long as the water is not allowed to go below the minimum levels, which are indicated by lines painted on the tank at the upper and lower level gauges.

The engine should never be started when the water level is below the line at the top gauge, nor operated when the level is below the line at the bottom gauge. Progressive lowering of the water in the gauges will indicate a leak in the cooling system. For action when engine is observed to be losing water, see instructions later in the schedule.

- C - Distribution Panels in Electrical Control Cabinets. (Section 2 - Fig. 6-8.) Indicate locations of the panels and battery ammeters in each. A heavy discharge on the ammeter is a signal of trouble and check should be made to determine the cause as outlined in later instructions.
- D - Check of traction motor blowers. Emphasize that engine must be isolated at once if either traction motor blower is not operating properly. (Section 2 - Precautions During Locomotive Operation.)
- E - Dynamic Braking. Demonstrate check of brake blower motors when engineer's transition lever is moved to "B" position. Report on check should be made to engineer either personally or by code rings on attendant bell.

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SECOND UNIT

CAB INSTRUCTIONS

- A - Load and Transition Indicating Meter. Review instructions on First Unit. Explain use of overload area indications in determining permissible overload operation. Emphasize caution, in reference, against use of consecutive overload ratings.
- B - Deadman Control. Review and amplify instructions of First Unit. Explain effect on train air brakes when both pedal and automatic brake valve handle are released. Explain action in tripping PC switch. Arrange demonstration when locomotive is moving light.

ENGINE ROOM INSTRUCTIONS

- A - Emphasis should be placed on engine room instructions. Student should be given detailed instructions on engine room subjects, listed in First Unit, which may not have been made clear.
- B - Blowing Air Drains (Section 8 - Draining of Air System). Point out drains listed in reference and demonstrate systematic procedure in blowing at definite intervals.
- C - Overspeed Trip on Engine. Point out lever and describe function. (Section 2 - Engine Overspeed Trip.) The causes of tripping are listed in the reference. Tripping may also occur when the layshaft lever is carelessly handled when putting an engine "back on the line," allowing the engine to come up to speed too fast. Another possible

cause is resetting a ground relay without first isolating the engine.

D - Engine Governor and Electro-Pneumatic Control.

- Electro-Hydraulic governor Control incorporated in the gov.*
1. Explain purpose of governor - to maintain a certain engine speed. The particular speed maintained depends on how it is "set" by the electro-pneumatic governor control which is operated, by remote control, from the engineer's throttle.
 2. Explain movement of the electro-pneumatic governor control by change of throttle position, using the following steps in the explanation:- The control housing contains four small magnet valves known as the A, B, C and D valves. Each of the magnet valves, when energized, admits air to an air cylinder containing a piston. At any position above No. 1, the throttle energizes one or more of these magnet valves through a control circuit. This admits air to the corresponding cylinders. The pistons are linked to an arm connected to the governor and their combined motion determines the position of the arm, depending on the valve or combination of valves energized. (Electro-Pneumatic Governor Control Magnet Valves - Section 6 - gives the table of magnet valves energized in the different throttle positions and the corresponding engine speeds which the governor will maintain.)

E - Master "E" Magnet Valve. (Section 6 - Master "E" Magnet Valve.)

1. Show location in engine control panel.

2. General purpose and effect covered in reference.
3. Explain items which will cause master "E" magnet valve to be de-energized.
 - a. Control switch out in distribution panel.
 - b. 60 amp. control fuse blown in distribution panel.
 - c. Fuel pump switch out in control push-button box.
 - d. Fuel pump fuse blown in control push-button box.
 - e. PC switch tripped.
 - f. Isolation switch not fully in RUN position.
 - g. Low oil pressure switch open.
 - h. Lube oil suction switch open.
 - i. Ground protective relay tripped.

F - Ground Protective Relay (Section 2 and Section 6).

1. Point out again, repeating instructions made in First Unit. Make sure trainee can identify it in the electrical cabinet. Explain purpose of ground protective relay and causes for tripping. Explain reason for checking ground protective relay after starting engine.
2. Explain effect when ground protective relay is tripped. Master "E" magnet valve de-energized, causing engine speed to drop to idle or engine to stop, depending on throttle position when tripping occurs. Thus a ground protective relay may trip in a unit and not be noticed in the operating cab (except for loss of

locomotive power) until the engineer moves his throttle to Run 5 or Run 6. The engine will then go from idle to stop and the low oil pressure alarm will come on. X

3. Resetting ground protective relay. When found tripped, the ground protective relay should be reset as follows:
 - a. Isolate the engine.
 - b. Reset ground protective relay by pushing reset lever to the left.
 - c. Start engine, if stopped. It is advisable to check the ground protective relay again after starting the engine for reasons covered in (1) above.
 - d. Put engine "on the line" in the usual manner.

CAUTION: Emphasize that the ground protective relay must not be reset without isolating the engine. If engineer's throttle is open, the engine would speed up suddenly and may kick out the overspeed trip.

G - Ground Protective Relay Switch. (Section 2 and Section 6 - Ground Protective Relay.) Explain purpose of switch as given in reference. Emphasize that serious consequences may result if it is opened on the road. Consult the District Engineer for any rule which the individual railroad may have regarding the handling of the ground protective relay switch.

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THIRD UNIT

CAB INSTRUCTIONS

A - Pneumatic Control Switch "PC Switch" (Section 1, Section 2 and Section 6).

1. Purpose - to protect equipment when undesired conditions, emergencies etc., arise.
2. Causes of tripping:
 - a. Air brake application due to removal of foot from deadman pedal and release of automatic brake valve lever, where this feature is included.
 - b. Emergency air brake application. Stress particularly that the locomotive brakes must be fully released, after an emergency application, before the PC switch can be reset. Caution to hold the independent brake valve in direct release position until it is certain that the locomotive brakes are completely released.
 - c. Air application due to action of speed governor or train control.
 - d. Pumping up air on locomotive which has been standing dead with no air in main reservoirs. To prevent tripping from this cause, the independent brake valve should be placed in application position before the engines are started.

NOTE: The causes of tripping may vary on different railroads due to differences in air brake equipment, etc.

3. Effect when tripped:

- a. Stops all fuel pumps throughout the locomotive.
- b. Brings all engines to idle speed by de-energizing master magnet valve "E" or stops all engines if throttle is in Run 5 or Run 6.
- c. Prevents speed-up of engines from idle for the same reason.
- d. Cuts out automatic temperature control of engines - closes automatic shutters and stops fan motors.

B - Emergency Fuel Cutoff. (Section 5 - Emergency Fuel Cutoff.)

1. Purpose and action. Note that fuel will continue to flow to the fuel pump until sump is pumped dry. (Section 5 - Fig. 5-1, Schematic Diagram, Fuel System.)
2. Location of cutoff valve under fuel tank.
3. Location of "pull-rings."
4. Method of resetting if tripped.

ENGINE ROOM INSTRUCTIONS

A - Oil Levels

1. Engine. (Section 4 - Operation and Adding Oil to System.) Review instruction of First Unit. Point out bayonet gauge location and explain marking of gauge. Show range of engine oil levels to be expected with engine running and

engine stopped. Explain procedure for adding oil. Caution particularly that oil must be added only through the opening on the lube oil strainer screen housing having square cap.

2. Air Compressor. Point out bayonet gauge and demonstrate check of oil level with engine stopped.
3. Engine Governors. The level should show at the mark on the sight glass.

B - Fuel Levels

1. Explain reading of fuel gauge in unit. (Section 5 - Fuel Level Gauge.) Demonstrate handling of air valve at gauge.

C - Water Levels. Review instructions for checking of water levels and allowable lower limits as given in First Unit.

D - Taking an Engine "Off the Line."

1. When under power. (Section 2 - Isolating and Stopping an Engine While Under Power, Steps 1 and 2.)
2. When idling. (Same - Step 2 only.)

E - Placing Engine Back "On the Line." (Section 2 - Starting and Placing Engine Back On Line When the Locomotive Is Under Power, Step 2 only.)

F - Alarm Circuits. In the explanation of the alarm circuits, emphasize that hot engine, low oil, or boiler stopped alarms will cause the corresponding lights to show on all units, not alone on the

one causing the alarm. On No AC Voltage alarm, the light will show only on the unit causing the alarm although the bells will sound throughout the locomotive.

1. Hot Engine Alarm (Red Light).
 - a. Shows on all units if one engine on the locomotive has high cooling water temperature.
 - b. Point out engine high temperature alarm switch. Explain action. (Section 2 - Engine High Temperature Alarm Switch.)
 - c. Explain that isolating a hot engine will not stop alarm bell.
2. Action to be taken on hot engine alarm. (Section 9 - If Hot Engine Alarm Sounds.) Check all engines to determine if one shows temperature considerably higher than others. Follow procedure outlined in reference. Caution against attempt to manipulate relays and contactors by hand. The voltages involved are sufficient to cause personal injury under some circumstances.
3. Low Oil Pressure Alarm (Yellow Light). (Section 2 and Section 4 - Low Oil Pressure Alarm Switch and Lube Oil Suction Alarm Switch.)
 - a. Shows on all units of the locomotive if one engine has low lubricating oil pressure, high oil pump suction vacuum, or if one engine stops. The alarm is caused by the operation of either of the two switches. Explain purpose and action of each.
 - b. Both alarms above are rendered inoperative if the isolation switch is placed in START position. Therefore, warn against leaving

engines idling with isolation switches so set.

4. Action to be taken when low oil pressure alarm occurs. (Section 9 - Low Oil Pressure Alarm or Lube Oil Suction Alarm.) Determine from character of alarm (steady or intermittent) whether the low oil pressure or the lube oil suction alarm switch is causing the alarm. Explain procedure listed in reference. Demonstrate checks to be made of oil pressure. Also explain procedure when cause of alarm is stoppage of an engine. (Section 9 - Engine Stopped.)
5. Boiler Stopped (Green Light). This alarm will sound in case of failure of the steam generator while it is in use. See later instructions on steam generator.
6. No AC Voltage Alarm. (Blue Light.) (Section 2 and Section 6.) The light will show only in the unit concerned. Explain causes of alarm and effect on engine speed and power when actuated. Point out 60-ampere fuse in alternator field excitation circuit.
7. Action to be taken when No AC voltage alarm occurs: -
 - a. Locate unit causing alarm and isolate engine.
 - b. Check operation of auxiliary generator.
 - c. Check auxiliary generator field fuse (30 ampere).
 - d. Check alternator field fuse (35 ampere).

NOTE: Stop engine before removing fuses in (c) or (d) above.

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FOURTH UNIT

CAB INSTRUCTIONS

- A - Review any points of previous Cab Instruction about which question may be raised.
- B - Wheel Slip Indicator. (Section 2 - Operation of Wheel Slip Indicator and Section 6 - Wheel Slip Relay.) Cover the following points:
1. Cause of operation - pickup of either wheel slip relay in any electrical control cabinet.
 2. Causes for pickup of wheel slip relay.
 - a. Slipping of any pair of wheels throughout the locomotive.
 - b. Trouble in traction motor.
 3. Result of pickup of wheel slip relay - loss of power in the unit affected due to dropping out of battery and shunt field contactors.
 4. Action of light indicator - intermittent in 2 (a) above.
 5. Explain use of sand when wheels slip. (Section 2 - Operation of Wheel Slip Indicator - 4th paragraph.) Emphasize that throttle must be reduced until slipping stops before sand is applied.
- C - Reverser Drum Operation (Section 2 - Operating Reverse Lever). Cover precautions necessary to insure that reverser drums are in correct position when starting train under conditions

described in reference.

D - Operating Through Water. (Section 2 - Operating Through Water.)

E - Use of Train Brakes When Using Power. (Section 2 - Air Braking With Power.)

F - Dynamic Braking. (Section 2 - Dynamic Brake)

1. Describe general scheme of operation.
2. Explain effectiveness with relation to speed. When the dynamic brake is applied at speeds above 15 to 25 MPH (depending on locomotive gear ratio) and the lever is manipulated to keep the pointer at the triangle on the transition meter, the dynamic braking effect increases as the speed decreases. As the speed drops, it will be necessary to move the lever further to the right to keep the meter pointer at the triangle. When the lever reaches full travel, at 15 to 25 MPH approximately, the maximum dynamic braking effect has been reached. As the speed continues to decrease, the pointer will move to the left. The dynamic braking effect will fall off rapidly, becoming negligible at low speeds.
3. Stopping a Train With Dynamic Brake. (Section 2 - Operation of Dynamic Brake.)
4. Unit Selector Switch. (Section 2 - Operation of Dynamic Brake; Section 6 - Unit Selector Switch.) Emphasize caution against changing setting if unit is isolated.

5. Repeat caution against having both air and dynamic braking applied on locomotive at the same time. (Section 2 - Operation of Dynamic Brake.)

6. Dynamic Brake Warning Light. (Section 2 - Operation of Dynamic Brake.) Operation of light shows maximum allowable application regardless of position of transition indicator pointer in operating unit.

G - Speed Indicator and Recorder. (Section 1 - Speed Recorder and Section 2 - Locomotive Overspeed.)

1. Drive cable - do not recommend lubrication of cable on the road.
2. False readings on the dial due to tape interference in the recorder.
3. Speed Governor. Describe action of the speed governor when the locomotive speed exceeds the setting for the particular locomotives involved in the instruction program.
4. Cutout cock for speed governor in case of trouble. Point out location in air brake equipment rack. Emphasize that cutout cock should be sealed in open position. If seal is broken, report to maintenance point.

ENGINE ROOM INSTRUCTIONS

A - Low Voltage System Supply. Explain that each unit of the locomotive requires a supply of low voltage electricity for starting engines, lighting control circuits, excitation of the main generator

battery field and other uses. Point out analogy to automobile which also has a low voltage system supply for starting, lighting, ignition, etc. Explain that the locomotive has two sources of low voltage electricity - the storage battery and the auxiliary generator - as does the automobile for the same reasons. Discuss briefly the two sources and how they are interconnected. Bring out that proper operation of the auxiliary generator is necessary to provide excitation of the alternator portion of the main generator. Point out main battery switch and auxiliary generator switch.

In connection with the auxiliary generator, explain that certain equipment is used in conjunction with it. Discuss briefly each of the items below, giving its purpose and identifying in the electrical control cabinet.

1. Voltage Regulator (Section 6).
2. Reverse Current Relay (Section 6).
3. Battery Charging Contactor (Section 6).
4. Charging Fuse - 150 ampere. Protects auxiliary generator and battery charging circuits against excessive current.
5. Auxiliary Generator Field Fuse. Protects auxiliary generator field windings against excessive current. Blown fuse will result in zero output reading on the ammeter, prevent excitation of the alternator and hence cause "No AC Voltage" alarm.

Explain the functions of the two ammeters in the electrical control cabinet.

1. Battery Ammeter (Section 6 - Ammeters). Explain that this instrument shows the current going into or being drawn from the battery. In this, it is similar in purpose to the ammeter on the dash of an automobile. After engines are started, the ammeter may show a "charge" for some time to replenish the battery. Normally, the ammeter will show zero or a slight charge (10 to 15 amperes). A heavy discharge indicates that the battery instead of the auxiliary generator is supplying low voltage circuit demands.
2. Auxiliary Generator Ammeter. (Section 6 - Ammeters). Emphasize that the auxiliary generator ammeter indicates the output of the auxiliary generator, not the current to the battery.

B - Low Voltage Current - Distribution and Use. Cover the various items on the distribution panel. Use the order given which corresponds to the layout of the distribution panel. Explain purpose of the circuit containing each switch or fuse to give general idea of the uses of low voltage current on the locomotive. Describe effect when blown fuse occurs, as noted below:

1. Lighting Switch (Section 6). Explain purpose and handling.
2. Train control and Speed Governor Switch. Supplies current for the purpose named. The switch must be kept closed in operating A units while the locomotive is in operation. Opening the switch will cause an air brake application similar to that resulting from overspeed operation.

3. Control Knife Switch. The control switch in the operating A unit supplies current to the control circuits of the locomotive.
4. Starting Fuse - 400 ampere. With the fuse blown, the engine cannot be started in that unit.
5. Main Battery Switch (Section 6). Previously described as an element of the low voltage system supply.
6. Train Control and Speed Governor Fuse - 60 ampere. Blown train control fuse has same effect as opening of Train Control and Speed Governor Switch in 2 above.
7. Main Control Fuse - 80 ampere. Blown fuse in distribution panel of operating A unit will stop operation of:
 - a. Engine speed control
 - b. Transition control
 - c. Reverser drums
 - d. Cam switches
 - e. Dynamic braking
 - Fuel pumps
 - g. Compressor control (compressors will not unload).
 - h. Engine "start" and "stop" buttons.
 - i. Engine temperature control (shutters will close and fan motors stop).
 - j. Emergency stop of engines by throttle in OFF.
 - k. All alarms

1. Cab heaters and defrosters (in operating unit only).
- m. Attendant call when sounded from operating unit.

Blowing of main control fuse on the distribution panel of the B unit will cause stoppage of fuel pump and engine temperature control in that unit only.

When the locomotive contains two A units, a main control fuse blown in the distribution panel of the non-operating A unit will stop the fuel pump, engine temperature control, cab heater motors, and defroster motor in that unit and prevent operation of the attendant call bell from that cab.

8. External Charging Fuse - 100 ampere. Blown fuse will have no effect on locomotive operation as it is used only when the storage batteries are being charged from an outside source at a maintenance point.
9. Steam Generator Fuses - 100 ampere (2). A fuse blown in the distribution panel of any unit will prevent operation of the steam generator in that unit.
10. Headlight, Engine Room Lights and Miscellaneous Light Fuses - 30 ampere. Fuses blown on the distribution panel of any unit will affect the corresponding circuits in the unit concerned.
11. Control Fuse - 30 ampere. Blown fuse in the distribution panel of the operating unit will have the following effects:
 - a. Engines will not turn over when START

- buttons on engine control panels are pressed.
- b. Engines will not stop when STOP buttons on engine control panels are pressed.
 - c. Throttle control of engines will not operate — engines will drop to idling speed and remain so — moving throttle to OFF will not stop engines.
 - d. Reverser drums will not operate.
 - e. Transition will not take place - power contactors will open in all electrical control cabinets.
 - f. Cam switches will not operate.
 - g. Dynamic brake will not apply.
 - h. Alarm bells will not operate.
 - i. Air compressor control will not operate.
12. Fuel Pump Fuse - 15 ampere. Blown fuel pump fuse on distribution panel of operating A units has the following effect in all units:
- a. Fuel pumps will not run.
 - b. Engine temperature control will not operate - fan motors will stop and shutters close.
 - c. Low oil pressure, lube oil suction and No AC Voltage alarms will not operate.
 - d. Engines will not speed up under throttle control.
 - e. Engines will stop if throttle is in OFF, Run 5 or Run 6.
13. Attendant Call Fuse - 15 ampere. When fuse is blown in A unit, call bell will not ring by use of the button. Ringing of the bells by the

- alarm circuits is not affected.
14. Defroster Fuse - 10 ampere. Effects of blown fuse:
 - a. Cab heater motors will not operate.
 - b. Defroster motors will not operate.
 15. Fuel Pump Motor Fuse - 10 ampere. Fuse blown on distribution panel of A or B unit will affect that unit only as follows:
 - a. Fuel pump motor will not run.
 - b. Engine temperature control will not operate - fan motors will stop and shutters close.
 16. Fuse Test Blocks, Lamp and Switch. Explain use for testing fuses and lamps. Demonstrate procedures.
- C - Use of low voltage current to start engines. Describe general scheme of circuit for starting engines. Point out equipment in circuit listed below, reviewing instruction where necessary.
1. Main battery switch.
 2. Starting fuse (400 ampere).
 3. Engine starting contactors (Section 6). If the starting contactors fail to close when the "START" button is pressed, the probable causes are listed under "Correction of Difficulties," Twelfth Unit, and will be covered in detail under that heading.
- D - Use of low voltage current for battery field of main generator. Explain briefly that the main

generator contains stationary coils or windings called field coils. One set of coils is supplied with electricity from the low voltage system and called the "battery field." Point out and describe action of the equipment in this circuit.

1. Interlocks on cam switch.
2. Battery field contactor (Section 6).
3. Battery field fuse (80 ampere).

Explain that the main generator battery field windings are also energized during dynamic braking application by the field loop circuit. The circuits involved will be discussed under later instruction.

E - Use of low voltage current for alternator field. Explain that the alternating current section of the main generator requires low voltage current for excitation. This is supplied by the auxiliary generator. Point out the fuse (35 ampere) in this circuit (located beside the battery field fuse) which, if blown, will cause failure of the alternator output and consequently actuate the No AC Voltage alarm.

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NOTES

FIFTH UNIT

CAB INSTRUCTIONS

- A - Preparation for double-heading with other locomotive. Refer to railroad's particular equipment and air brake instructions.
- B - Transition and Traction Motor Circuits (Section 2). Explain traction motor circuits by use of the diagrams on pages 5-2 and 5-3. Trace flow of current through the circuit established by each transition lever position. If practical, give instruction in conjunction with Engine Room Instructions, Paragraph D, by describing a circuit and then pointing out the actual contactors and their positions in the electrical control cabinet. This may be done either while under power or by demonstration in engine room, during a stop. Point out contactors. If time permits, have all engines shut down. Open fuel pump switch in control push-button switch box and place isolation switch of one unit in RUN position. Move transition lever to various positions to demonstrate action of the contactors.

ENGINE ROOM INSTRUCTIONS

- A - Load Indicator and Throttle Indicator. (Section 9 - Loss of Load on Engine.) Point out the two indicators and explain use to detect loss of load or improper loading of engine.
- B - Electrical Control Air System. (Section 7 - Electrical Control Air Pressure.)

DIAGRAMS

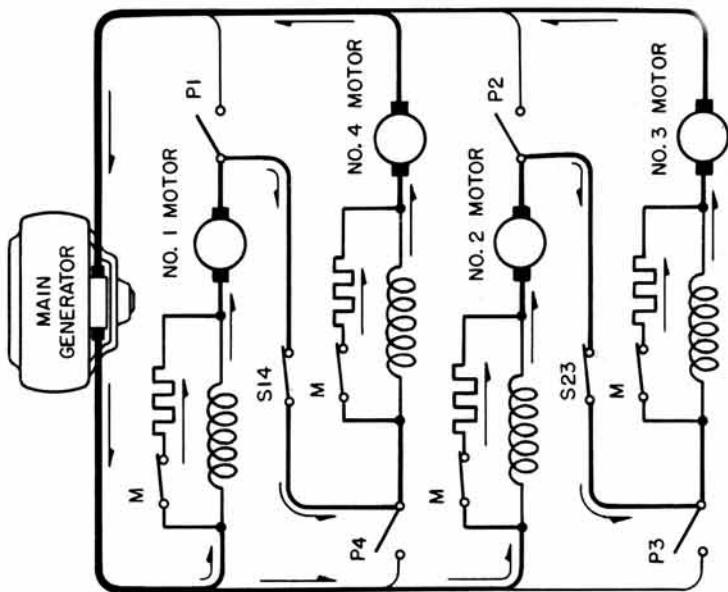


Fig. 1 - Series-Parallel

Fig. 2 - Series-Parallel Shunt

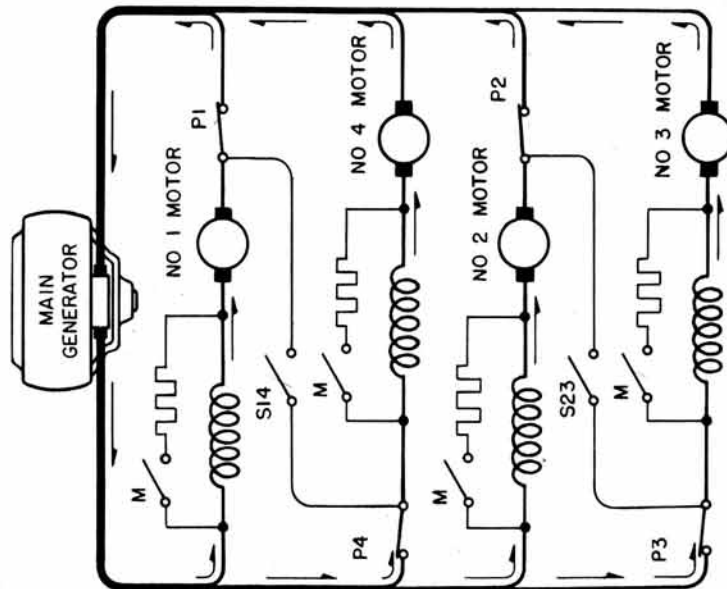


Fig. 3 - Parallel

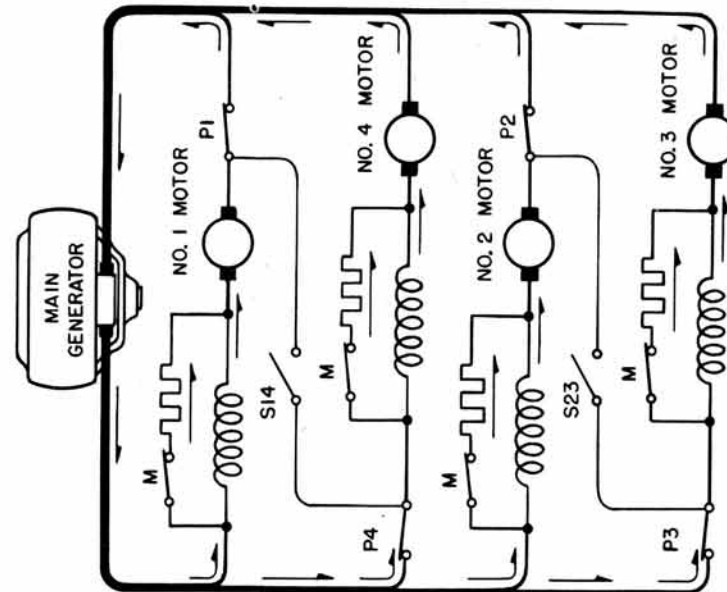


Fig. 4 - Parallel Shunt

1. Purpose - air supply for operation of electro-pneumatic controls in electro-pneumatic governor control, engine control panels, electrical control cabinets.

2. Pressure regulation

a. Location of gauges.

b. Gauge readings. (Section 7 - Electrical Control Air Pressures.)

c. Adjustment of pressure.

d. Effect of incorrect pressures - sluggish or non-operative control with low pressures, slamming action of contactors with high pressures.

3. Filters and Filter Drains.

C - Reverser Drum Operation. (Section 2 - Operating Reverse Lever and Section 6 - Reverser.) Explain procedure of operating a reverser drum manually, stating that this may be done in case of a stuck reverser. CAUTION - UNIT MUST BE ISOLATED. To recognize whether any particular reverser is correct or incorrect in its position for the direction of motion desired for the locomotive, check the number of segments presented to view. A reverser with four segments showing is set to move the unit toward the cab end or forward. A handy rule may be stated "four for forward." A reverser with eight segments showing is set to move the unit away from the cab end or backwards. A B unit is considered to be running forward when it is moving toward its accessory (engine control panel - temperature gauge - governor) end and the reverser should be so set when it is desired that the B unit move in this direction.

D - Power contactors (Section 6 - Traction Motor Pneumatic Contactors, and Traction Motor Field Shunting Contactors). Point out power contactors discussed during cab instruction. Instruct on identification of contactors and the positions they should assume for the different transition settings. The object should be to enable the trainee to recognize contactor positions proper for the various transition lever settings and thus detect any deviations from correct positions. Point out and name the S14 and S23 (series) and P1, P2, P3 and P4 (parallel) contactors in the electrical control cabinet. A convenient method suggested for this instruction is to have the trainee observe the contactor positions and determine what transition lever position they represent. This will promote thorough understanding of the relation between the two. The analysis is made as follows:

1. A check of the rear section of the electrical control cabinet shows S contactors closed and P contactors open. This setup indicates that the transition lever is either No. 1 or No. 2 position since both have the same P and S contactor positions. Next check the position of the M contactors. If M contactors are OUT, the unit is in series-parallel (No. 1). If M contactors are IN, unit is in series-parallel shunt (No. 2).
2. A similar check shows S contactors open, P contactors closed. The setup indicates that the transition lever is in either position 3 or position 4 since both have the same S and P contactor positions. Again check the position of the M contactors. If M contactors are OUT, the unit is in parallel (No. 3). If the M contactors are IN, the unit is in parallel shunt (No. 4).

E - Braking Contactors (Section 6). Point out and identify the braking contactors. State only that they concern the dynamic brake setup and should be open when the transition lever is in positions 1, 2, 3 or 4, closed when the lever is in OFF or dynamic braking positions.

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CAB INSTRUCTIONS

- A - Review of Cab Instruction with emphasis on any points not clearly understood.
- B - Changing Ends (Section 2). Explain and demonstrate procedure given in the reference.

ENGINE ROOM INSTRUCTIONS

- A - Lubricating Oil System. (Section 4). Explain in detail by tracing circulation as shown on Fig. 3-3. Cover component parts as listed below.
1. Scavenging pump suction strainers.
 2. Scavenging pump.
 3. Filter.
 4. Lubricating oil tank and cooler.
 5. Pressure pump suction strainers.
 6. Pressure pump for lubricating and piston cooling oil.
 7. Main bearing lubricating oil pressure gauge.
 8. Lube oil suction gauge.
 9. Low oil pressure alarm switch. Point out location. Review operation and purpose.

10. Lube Oil Suction Alarm Switch. Point out location. Review operation and purpose.
11. Bayonet Gauge - review oil level markings.
12. Oil Filler Openings. Point out and repeat instructions of Third Unit. Emphasize that oil must be added only through openings having square caps. Caution particularly against attempting to add oil through openings having round caps.

B - Cooling System (Section 3). Explain in detail by tracing circulation as shown in Fig. 3-3. Also cover the following points in discussion of the cooling system:

1. Engine Temperature Control. (Section 2 - Operation of the Cooling System and Section 6 - Thermostatic Switch). Explain briefly the purpose of the thermostatic switch and its progressive action as engine temperature rises. Also explain action of temperature control when the engine temperature falls. Explain purpose of starting fans in different order each time the thermostatic switch operates. Point out and identify the various relays and contactors of the engine temperature control, explaining purpose briefly. Do not attempt to give full analysis - endeavor to acquaint trainee with action of the system sufficiently to make intelligent reports of any difficulties to maintenance point.

Point out the importance of the engine temperature control in maintaining even cooling water temperatures and thus avoiding expansion and contraction of engine parts.

2. Hot Engine Alarm Switch. (Section 3 - Engine High Temperature Alarm Switch.) Explain action of switch. Bring out that the switch is operated by a thermal element located in the hottest section of the cooling system and is set to limit temperatures at that point.
3. Pressure gauges on discharge side of water pumps and normal readings.
4. Loss of Water. Point out drain valves (Section 3 - Fig. 3-3.) Also point out steam admission valves, since water may escape through these valves if they are open, and the check valves in line are defective. If valves are all closed and not leaking, loss of water is in seals, etc., inside the engine and no action can be taken on the road. Shut down the engine if the level falls to the line opposite water glass for minimum water level.
5. Freezing Weather Precautions - to be covered in later instructions.

C - Fuel System. (Section 5 - Fig. 5-1.) Explain in detail by tracing circulation as shown in plate. Cover the points listed below.

1. Fuel tanks - capacity.
2. Fuel tank vents. (Section 5 - Fuel Tank Vents.)
3. Fuel sumps and connection with Emergency Fuel Cutoff Valve. (Section 5 - Emergency Fuel Cutoff.)
4. Fuel Gauges. (Section 5 - Fuel Gauge and Fuel Level Gauge.)

5. Suction line to fuel pump.
6. Suction filter. (Section 5 - Pump Suction Filter.)
7. Fuel pump. (Section 5 - Fuel Pump.) Also open engine control panel and indicate:
 - a. Fuel pump switch.
 - b. Fuel pump contactor.
8. Sintered bronze filter. (Section 5 - Sintered Bronze Fuel Filter Assembly.)
9. Injector filters. (Section 5 - Sintered Bronze Fuel Filter Assembly.)
10. 5 lb. sight glass.
11. 60 lb. sight glass. Explain purpose and action.

D - Isolating and Stopping Engine While Under Power. (Section 2.) Review instruction on taking an engine off the line and stopping engine. Have trainee repeat this operation several times. Also cover taking an engine off the line while Dynamic Brake is in operation. (Isolating an Engine While Using Dynamic Brake. Section 2.)

Give reasons for taking an engine off the line and shutting down as follows:

1. Engine pounding.
2. Low oil pressure or lube oil suction alarm.
3. Overheating with all cooling cut in, or temperature control inoperative.

4. Failing to load properly.
 5. Defective injector.
 6. Lack of fuel (note sight glasses).
 7. Repeatedly tripping engine overspeed.
 8. Repeatedly tripping ground protective relay.
 9. No AC voltage.
 10. Air compressor having major defect. Should the compressor fail to unload and the heating become so excessive as to threaten compressor failure or damage, shut down engine.
 11. Low water level.
 12. Traction motor trouble.
 13. Either traction motor blower not working.
 14. Dynamic brake blower motors not working (engine should be taken off line only while dynamic braking is in use).
- E - Starting Engine and Putting Back On the Line. (Section 2 - Placing Engine Back "On the Line.") Review instruction previously given. When starting engine, direct trainee to hold "START" button in until engine fires steadily. Repeat instruction on First Unit regarding check of ground protective relay, starting contactors and interlocks after starting engine. When putting engine on the line, caution trainee to obtain firm hold on layshaft manual control lever before placing isolation switch in "RUN." Have trainee repeat operation several times.

NOTES

SEVENTH UNIT

CAB INSTRUCTIONS

A - Cutout Cocks In Nose And Cab.

1. Cutout Cock for Deadman Control. Located in nose on the equipment rack. The cutout cock is normally open and sealed in that position. When closed, the cock cuts out the deadman control action. If seal is broken, report it to maintenance point.
2. Cutout Cock for Speed Governor. Located in the nose, on the equipment rack. The cutout cock is normally open and sealed in that position. When closed, the cock cuts out the speed governor action. If seal is broken, report it to maintenance point.
3. Cutout Cock for Safety and Control Features. Located on the side of the application portion of the brake valve, facing the engineer. The cutout cock is normally open and sealed in that position. When closed, the cock cuts out the speed governor and deadman pedal. If seal is broken, report it to maintenance point.

ENGINE ROOM INSTRUCTIONS

A - Review of Engine Room Instructions with emphasis on any points not clearly understood.

B - Accessory Devices.

1. Fuel Tank Vent. Point out and explain its

purpose as a breather or vent for the fuel tank. Note that vent terminates outside the locomotive.

2. **Flame Arrestor In Fuel Tank Vent.** Purpose is to prevent any "backup" of fire through the vent into the fuel tank.
3. **Toilet Tanks.** Point out filler pipes.

C - Sander Automatic "E" Valve. (Section 7 - Fig. 7-1.) Point out and explain that the automatic valves are operated by air when the hand sander valve is operated; or the automatic air brake handle is depressed to operate the sanding bail. Emergency air brake application also operates the sander automatic "E" valve.

NOTE: Sand application arrangements will vary on different locomotives. Check equipment to determine which of the above are used.

D - Transition. Forward and Backward (Section 6). Explain briefly the action which takes place in the electrical control cabinet when the transition lever is moved. The action of the power contactors has been covered in previous instruction but should be reviewed if necessary. Bring out that all power contactors are open when the throttle is in idle, and the throttle must be moved to Run 1 or further to set up traction motor circuits. For change from position 2 to 3 and vice versa, point out the parallel relay and time delay relay and explain their purposes and action.

For changes when transition lever is moved to OFF - see later instruction.

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NOTES

EIGHTH UNIT

CAB INSTRUCTIONS

A - Tying Up Locomotive For Layover. The following operations in the cab are necessary for the complete tie-up of the locomotive. See Engine Room Instructions for similar details requiring attention in the Engine Room.

1. Close throttle to idle position.
2. Put transition lever in "OFF" position.
3. Move reverse lever to neutral position and remove lever.
4. With deadman control pedal depressed, release independent air brake by placing the independent brake valve in release position.
5. Make full service application with automatic brake valve.
6. Close double-heading cock.
7. Release deadman control pedal.
8. Move K-2-A Rotair valve to proper lap position. ("FRGT. LAP" for freight service or "PASS. LAP" for passenger service.)
9. Move automatic brake valve to running position and remove handle.
10. Remove independent air brake handle with valve in release position.

11. Open generator field switch in control push-button box.
12. AFTER ENGINES ARE STOPPED, open Control switch in control push-button box.
13. Open remainder of switches in control push-button box and close switch lock.

B - Preparing Locomotive For Being Towed Dead In Train. (Section 2 - Towing Locomotive.)

ENGINE ROOM INSTRUCTIONS

A - Tying Up Locomotive For Layover. (See cab instructions above, for purpose of full instructions on this point.) In the engine room of each unit:

1. Place isolation switch in "START" position.
2. Stop engine.
3. Open fuel pump switch.
4. Open main battery switch in distribution panel.
5. Open Control Switch in distribution panel.
6. Set hand brakes.

B - Preparing Locomotive For Being Towed Dead In Train. (Section 2 - Towing Locomotives.) Demonstrate "TOW" position of cam switch and method of pinning reverser in neutral position. Reverse lever must be in neutral, or control switch open, for this operation.

C - Traction Motor Blowers. (Section 6 - Traction Motors.) Explain the necessity for cooling traction motors because of the heat generated by the heavy current involved. Emphasize the necessity for the proper operation of traction motor blowers and caution against operating a unit without all blowers working.

D - Winter Precautions. Explain that the steps listed below represent precautions against freezing and damage to the locomotive in case a unit is shut down or the locomotive tied up. Which steps will be required depend on conditions encountered and judgement must be exercised to take those necessary to protect the equipment.

1. Heating units with steam from steam generator or outside steam source (Section 3 - freezing weather precautions). Point out the steam admission valves in each unit for supplying steam to the engine cooling system. Also show location of valves for supplying steam to cab heaters in A units. The valve in line from the engine to the cab heaters (above the left-hand engine room steps) should be closed.
2. Drain the cooling system (Section 3). Indicate drain valves in each unit for draining engine cooling water system. Point out plug in right bank water pump which must be removed to provide complete drainage of the pump.
3. Drain cab heaters. Demonstrate procedure necessary for draining cab heaters in A units:
 - a. Check the valve in the cab heater circulating system (above left-hand engine room steps) to see that it is open.

NOTES

NINTH UNIT

CAB INSTRUCTIONS

- A - Review of previous instruction - further discussion of points requiring clarification.
- B - Transition By Speed Indicator Readings. (Section 2 - Operating Without Load and Transition Indicating Meter.) Emphasize strongly the last paragraph of the reference. Transition should never be made from the speed indicator reading if the load and transition indicating meter is functioning.

ENGINE ROOM INSTRUCTIONS

A - Air Compressors. (Section 7.)

1. Point out high and low pressure cylinders, lube oil pressure and bayonet gauges, intercooler and intercooler pressure gauge, intercooler safety valve, compressor control switch and magnet valve.
2. Describe principle and action of compressor control. If one compressor continues to operate without unloading (as shown by extremely hot discharge pipe) or runs unloaded at all times, report it to maintenance point for attention. If the compressor fails to unload and the heating becomes so excessive as to threaten compressor failure or damage, shut down engine.
3. Attention Required In Service
 - a. Check oil level

TENTH UNIT

CAB INSTRUCTIONS

- A - Review of previous instructions, stressing items not clearly understood.

ENGINE ROOM INSTRUCTIONS

A - Dynamic Braking. (Section 2.)

1. Explain changes which take place in electrical control cabinet when transition lever is moved to "OFF" position, preparatory to application of dynamic brake. For each item below, point out the electrical equipment involved. Make sure the proper position of each relay contactor, etc., is understood. See Section 6 for details of equipment.
 - a. All P, S and M contactors are open. Explain that these contactors opened when the throttle was closed to "IDLE" prior to moving the transition lever to "OFF." Thus any check of the electrical control cabinet should show all P, S and M contactors out when the transition lever is in "OFF" or dynamic braking positions.
 - b. Brake relay (BR) is energized, causing it to move to dynamic braking position. In doing so, it opens one set of contacts and closes another. Movement of the brake relay causes the cam switch to move to "TOW" position.
 - c. Cam switch (CS) moves from "MOTOR" position to "TOW." This movement places

the cam switch in position for dynamic braking operation.

- d. Braking contactors (B1, B2, B3) close. The circuit which operates the braking contactors contains interlocks on the brake relay, cam switch, P2 and P4 contactors. To close the interlocks and complete the circuit, it is necessary that the brake relay be in dynamic braking position, the cam switch in "TOW", P2 open, and P4 open. The isolation switch must be in "RUN" position.
 - e. Field loop contactor (FL) closes. Explain that field loop contactor is provided in the electrical control cabinet of A units only. Explain particularly the positions of the contactor when open and when closed. Should the locomotive have two A units, the field loop contactor will close in the cabinet of the operating A unit only while the one in the non-operating A unit will remain in open position.
2. Explain further action which occurs when transition lever is moved to "B" position - battery field contactors will close in all units, establishing field loop circuit.
 3. Unit selector switch. Should be in position corresponding to number of units comprising locomotive at all times. Emphasize that the unit selector switch setting is NOT changed when it is necessary to isolate an engine en-route. (Sections 1 and 6 - Unit Selector Switch.)

B - Steam Generator (on locomotives so equipped). Review instructions on starting and operation given in previous trip. Make sure all points are

fully understood before proceeding with following items:

1. Stopping steam generator. Demonstrate procedure when interruption in operation is to be of short duration. Show steps necessary to shut down steam generator for terminal stop or similar conditions.
2. Explain safety protective devices of steam generator.
 - a. Safety valves.
 - b. Stack switch
 - c. Control switch
 - d. Servo-fuel control (fuel control on CFK-4225).
 - e. Steam temperature limit control.
 - f. Water relief valve.
 - g. Overload switch.
 - h. Fuses.

NOTES

ELEVENTH UNIT

CAB INSTRUCTIONS

A - Operating with Helper Engine. (Section 2 - Steam Locomotive used as Helper Engine.)

1. Division of load and tendency to overload Diesel locomotive.
2. Operating at reduced throttle to apportion load.
3. Continuous speed ratings with reduced throttle.

B - Continuous Tonnage Ratings. (Section 2 - Table of Continuous Tonnage Ratings.)

1. Explain differences in pinion and axle gear combinations and various speed relations, with reference to continuous rating.
2. Explain that table in reference indicates the tonnage which a locomotive, having a given gear ratio and horsepower, should handle on a particular grade without causing the pointer on the load and transition indicating meter to go to the overload area (in Transition 1 and Throttle Run 8). Stress the first paragraph below the table in this explanation.
3. The approximate speed at the above ratings provides a check between the speed indicator and the transition indicating meter, when the locomotive is operating in Transition 1 and Throttle Run 8. Further checks may be made by use of the table in Manual Transition Speeds, Section 1. Emphasize strongly the last para-

graph, under the Table of the reference.

ENGINE ROOM INSTRUCTIONS

A - Fuel System. Amplify instruction given in Sixth Unit, after review of same, by covering the parts listed below.

1. Fuel pump stopped. Explain that, when a fuel pump is found to be stopped or will not start when the fuel pump switch is closed at the engine control panel, the first step is to determine whether the pumps in the other units of the locomotive are also inoperative. If all pumps are stopped, check for following causes of difficulty.

- a. Main battery switch open (when engine in operating A unit is stopped).
- b. Control switch open in distribution panel of operating A unit.
- c. 80 ampere control fuse blown in distribution panel of operating A unit.
- d. PC switch tripped.
- e. Fuel pump switch out in control push-button box.
- f. Fuel pump fuse, 15 ampere, blown in distribution panel of operating A unit.

If the pumps in the other units are running, check the unit in which the fuel pump is stopped for:

- a. Fuel pump switch off at engine control panel.

- b. Defective fuel pump contactor.
 - c. Control switch open in distribution panel of unit concerned.
 - d. Control fuse (80 ampere) blown in distribution panel of unit concerned.
 - e. Fuel pump motor fuse (10 ampere) blown in distribution panel of unit concerned.
 - f. Loose connection of cable to fuel pump at engine control panel.
 - g. Defective fuel pump motor.
 - h. Motor running but fuel pump inoperative because of defective coupling.
2. Fuel level low in 5 lb. sight glass (no fuel showing in 60 lb. sight glass). If fuel is still spilling into center standpipe in glass, cause is partially clogged fuel pump suction line or suction filter, or air leak in suction line. Condition should be checked periodically during remainder of trip, particularly when throttle is in Run 8. So long as any fuel flows into the standpipe, no action is required but condition may get progressively worse until no fuel appears when engines are at 800 RPM. Report to maintenance point for correction.
3. No fuel in 5 lb. sight glass - none in 60 lb. sight glass (Section 5 - Sintered Bronze Fuel Filter Assembly). Causes are the same as in (2) above but clogging or air leak is more serious. The engine may "hunt" and run erratically when speeded up or, finally, stop. When such conditions are noted, take the engine "off the line" and stop it. Check emergency cutoff valve under fuel tank during a

stop. Report difficulty to maintenance point for correction.

4. Bubbles in 5 lb. sight glass (Section 5 - Sintered Bronze Fuel Filter Assembly). If condition becomes so pronounced as to interfere with proper operation or loading of the engine, take the engine off the line and shut it down. Otherwise, continue operation and report condition to Maintenance.
5. Fuel showing in 60 lb. sight glass (Section 5 - Sintered Bronze Fuel Filter Assembly). Explain action of by-pass valve and effect when it opens to allow fuel to by-pass out through the standpipe of the 60 lb. glass. Describe "preliminary dribble" which may give warning that a clogged filter condition exists. As the condition becomes worse, the dribble will increase until enough is by-passed to cause the engine to starve for fuel. Report condition to Maintenance.

B - Filling Engine With Water (Section 3 - Filling the Cooling System.)

C - Steam Generator (on locomotives so equipped).

1. Review instructions previously given on starting, stopping and operating the steam generator.
2. Explain action required when "Boiler Off" alarm sounds. Outline steps to be taken in determining cause of alarm.

NOTES

TWELFTH UNIT

DIESEL PIT INSTRUCTIONS

During Instruction, points will be taken up which have not been covered in the previous eleven units of the schedule. The instruction will also serve as a general review to disclose any points not previously made clear.

A - Correction of Difficulties. (Section 9.) Discuss topics contained in Section 9 briefly. Concentrate instruction on procedures to be followed in cases of alarm signal indications and effect of blown fuses on locomotive control and operation. Under "If Engine Does Not Rotate When Attempt Is Made To Start," give items which may cause starting contactors to remain open when "START" button is pressed:

1. Main battery switch open in operating A unit - if engine in that unit is stopped.
2. Main control knife switch open in distribution panel of operating A unit.
3. Main control fuse (80 ampere) blown - same location.
4. Control fuse (30 ampere) blown - same location.
5. Control switch open in control push-button switch box of operating A unit.
6. Isolation switch not fully in "START" in unit concerned.

B - Review of instruction. The trainee will explain his understanding of the following topics. Where demonstration is indicated, he will make same and explain reasons for each item demonstrated.

1. Starting an engine after a layover.
 - a. Explain checking of oil and water levels and possibility of water accumulation in cylinders.
 - b. Demonstrate starting of engine and check of starting contactors and their interlocks, ground protective relay and oil pressures before placing isolation switch in "RUN" position.
2. Lubricating oil pressures and levels.
 - a. Explain lube oil levels and pressures in engines, air compressors, and engine governors.
 - b. Demonstrate check of these items.
 - c. Demonstrate procedure for adding oil.
3. Engine cooling system.
 - a. Explain water levels, pump pressure gauges and readings.
 - b. Explain operation of automatic control of engine cooling water temperature. Point out contactors, relays and magnet valves.
4. Fuel System.
 - a. Explain passage of fuel through system from tank to engine to 5 lb. sight glass. Explain 5 and 60 lb. sight glasses and action to be taken in case of difficulties

indicated by observation of the different glasses.

- b. Demonstrate check of fuel levels.
- c. Point out emergency fuel cutoff valve and explain purpose. Describe procedure of tripping and resetting emergency fuel cutoff valve.
5. Throttle operation in cab.
 - a. Explain purpose and effect of emergency stop button. Explain interlocks with transition and reverse levers.
 - b. Demonstrate or describe throttle operation when starting a train, passing over railroad crossings, making transition, and when wheel slip indicator lights.
6. Sanders.
 - a. Explain action of ~~sander relay valves~~ and operation by handle of automatic brake valve or hand sander valve in cab.
 - b. Demonstrate operation of automatic brake valve and hand sander valve for sand application.
7. Dynamic Brake.
 - a. Explain use of dynamic brake in handling train and caution against having independent air and dynamic brake on locomotive at the same time. Explain circuit through locomotive and point out (in electrical control cabinet), cam switch, brake relay, field loop contactor, and braking contactors. Explain unit selector switch and proper

setting. Explain necessity for proper grid blower operation.

- b. Demonstrate handling of transition lever in dynamic braking. Demonstrate check of proper position of field loop contactor, brake relay, cam switch, and braking contactors for dynamic braking. Demonstrate check of grid blower operation.

8. Operation of engines by throttle control.

- a. Explain purpose and operation of electro-pneumatic governor control. Point out indicator on back of control housing. Explain relation between indicator reading and locomotive throttle position.
- b. Describe purpose and action of master "E" magnet valve and its effect on engine speed when de-energized.

9. Safety Control Features.

- a. Explain ~~deadman control~~, speed governor and PC switch, giving purpose and action of each.
- b. Demonstrate resetting of PC switch.
- c. Demonstrate method of cutting out deadman control and speed governor.

10. Fire Extinguishers. Point out location. Explain proper method of use.

11. Signal and alarm circuits.

- a. Explain the hot engine, low oil, No AC Voltage and boiler stopped alarms and action to be taken in case of each.

- b. Demonstrate check for causes of each alarm.

12. Overspeed Trip.

- a. Explain purpose and action of overspeed trip.
- b. Demonstrate resetting of overspeed trip.

13. Load on Engines.

- a. Point out load indicator on governor and explain its use, by comparison with the throttle position indicator, to determine whether engine is loading properly. Demonstrate check of the two indicators.
- b. Explain causes of partial or complete loss of load in a unit.
- c. Explain action of the load regulators.
- d. Explain effect of open battery field contactor or shunt field contactor on the loading of the engine.
- e. Explain effect of action of wheel slip relays on loading of the engine.

14. Fuses.

- a. Explain function of fuses in electrical control cabinet and steam generator (where used). For each fuse, describe effect when blown.
- b. Demonstrate removal and renewal of fuses.
- c. Explain method of testing fuses on test blocks in distribution panel.

15. Switches.

- a. Describe briefly the purpose of each switch in the control push-button switch box, electrical control cabinet and engine control panel.
- b. Explain the proper handling of each switch.

16. Control Air System.

- a. Explain purpose and details of control air system.
- b. Demonstrate adjustment of control air pressure, blowing of drains, and use of cutout cocks.

17. Electrical Control Cabinets - Power Circuits.

- a. Explain action and purposes of ground protective relay, reverser drum, parallel relay, time delay relay, P, S and M contactors, wheel slip relays.
- b. Demonstrate proper procedure of resetting ground protective relay.
- c. Explain check of reverser drum position to determine the direction of movement for which it is set.
- d. Explain check of power contactors to determine whether unit is making transition properly.

18. Low Voltage Circuits.

- a. Explain circuits to start engine, energize battery field, light locomotive headlight and engine room lights. Explain functions of storage battery and auxiliary generator

and their relation. Point out and identify in electrical control cabinet: voltage regulator, auxiliary generator switch, auxiliary generator output ammeter, reverse current relay, battery field fuse, auxiliary generator field fuse, auxiliary generator charging fuse, and battery charging contactor.

19. Ammeters.

- a. Explain purpose and interpretation of readings of ammeters in electrical control cabinet.

20. Alternating Current Circuits.

- a. Explain source of alternating current and use for traction motor blowers and engine cooling fan motors.
- b. Point out fuse in alternator excitation circuit and explain effect when blown.

21. Operation of Steam Generator - Where Used.

- a. Explain controls and gauges of steam generator.
- b. Demonstrate procedure of starting steam generator.
- c. Demonstrate method of handling to maintain train steam line pressure.
- d. Demonstrate procedure of shutting down steam generator.

NOTE: For purpose of demonstrating (c), open slightly the steam line valve at end of locomotive and allow some steam to blow out. If this method cannot be used, open steam admission valves at each engine

temporarily to simulate use of steam in heating a train.

22. Preparing a locomotive for layover. Demonstrate shutdown of engines, switch positions in cab and electrical control cabinets, handling of air brake valves and controls in cab.
23. Preparing a locomotive for double-heading. Demonstrate handling of air equipment when preparing for double-heading.
24. Preparing a locomotive for towing.
 - a. Explain necessity of having cam switches in "TOW" position.
 - b. Demonstrate handling of controls in cab and pinning reverser drums in neutral in engine room.

NOTES

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NOTES

THIS IS TO CERTIFY THAT THE FOLLOWING UNITS
OF INSTRUCTION ON THE OPERATION OF THE
FREIGHT LOCOMOTIVE HAS BEEN GIVEN THE
HOLDER OF THIS INSTRUCTOR'S GUIDE. 802 A-B

1. Train 97 - L.F. Williams 12-16-46
INSTRUCTOR DATE 802
2. #98 - L.F. Williams 12/18/46 802-1
INSTRUCTOR DATE 803-L
3. #99 Frank H. Green 12/19/46 803-A
INSTRUCTOR DATE 801-A
4. #97 R.E. Hill 12/21/46 801-B
INSTRUCTOR DATE 881-A
5. #98 C.B. Gooten 12/23/46 881-B
INSTRUCTOR DATE 802
6. #93 C.B. Gooten 12/24/46 802
INSTRUCTOR DATE 802
7. #92 L.E. Spatts 1-27-47 802
INSTRUCTOR DATE 802
8. #94 L.E. Spatts 1/13/47 802
INSTRUCTOR DATE 802
9. #94 L.E. Spatts 1/13/47
INSTRUCTOR DATE 802
10. #97 L.E. Spatts 1-15-47
INSTRUCTOR DATE 802
11. #90 L.E. Spatts 1-17-47 802
INSTRUCTOR DATE 802
12. D.A. Dickson January 24th 1947
INSTRUCTOR DATE 802

APPROVED

RAILROAD OFFICIAL

DATE

SUPPLEMENT TO F2 INSTRUCTOR'S GUIDE

INSTRUCTION ON OPERATION OF MODEL F3 DIESEL LOCOMOTIVE

Due to the similarity between the F2 and F3 model locomotives, the F2 Instructor's Guide can be used as the outline of instruction on the operation of F3 locomotives, with the minor changes noted below.

In using the Guide, the references listed should be checked back in the main section of the Operating Manual and in the Supplement covering the F3 model. Where differences between the two models exist, they are described in paragraphs of the supplement carrying the same title. If no listing is shown in the supplement for any particular topic, the instruction matter in the Operating Manual may be considered to cover both models.

CHANGES FOR MODEL F3 OPERATING INSTRUCTION

FIRST UNIT

Page 1-4

CAB INSTRUCTIONS - Par. B, Item 1. Change "white area" to "line."

Page 1-5

CAB INSTRUCTIONS - Par. B, Item 2. Change "white area" to "line." Omit caution to reduce throttle to Run 6 as this action is not required on F3 locomotives.

Page 1-5

CAB INSTRUCTIONS - Par. C, Item 3. Change "white area" to "lines between green areas 1 and 2 or 2 and 3 and white area between 3 and 4."

Page 1-6

CAB INSTRUCTIONS - Par. D, Item 2. Omit reference to necessity of reducing throttle to Run 6.

Page 1-6

CAB INSTRUCTIONS - Par. D, Item 3. Change "white area" (2nd & 6th lines) to "white area or on dividing line." Change "out of white area" (1st line, Page 1-7) to "out of white area or off dividing line."

SECOND UNIT

Page 2-2

ENGINE ROOM INSTRUCTIONS - Pars. D & E. Omit and substitute:

D - Engine Governor and Electro-Hydraulic Control

1. Explain purpose of governor to maintain a certain engine speed. The particular speed it will maintain depends on the electro-hydraulic governor control incorporated in the governor, which is operated by remote control from the engineer's throttle. (Section 1 of Supplement - Engine Governor).
2. Explain the operation of the electro-hydraulic governor control in regulating engine speed and function of solenoids A, B, C, and D. (Section 1 of Supplement - Engine Governor and Section 6 of Supplement - Electro-Hydraulic Governor Solenoids).
3. Explain the action of the electro-hydraulic governor control when lube oil pressure falls below safe limit or lube oil pump suction

vacuum becomes excessive. Point out push buttons and demonstrate tripped and reset positions. (Section 2 of Supplement - Governor Safety Control).

E - "ER" Relay Valve (Section 6 of Supplement - "ER" Relay).

1. Show location in engine control panel.
2. Explain general purpose and effect when de-energized.
3. Explain items which will cause "ER" relay valve to be de-energized as listed in reference.

Page 2-3 and 2-4

ENGINE ROOM INSTRUCTIONS - Par. F, Item 2. Change "Master 'E' magnet valve" to "ER relay." Change "the low oil pressure alarm will come on" to "the alternator failure alarm light will show in the unit concerned and the alarm bells will sound throughout the locomotive."

THIRD UNIT

Page 3-2

CAB INSTRUCTIONS - Par. A, Item 3b. Change "Master 'E' magnet valve" to "ER relay."

Page 3-3

ENGINE ROOM INSTRUCTIONS - Par. A, Item 3. Change "the mark on the sight glass" to "between the two marks on the sight glass."

Page 3-3 and 3-4

ENGINE ROOM INSTRUCTIONS - Par. F. Omit

first sentence - on F3 locomotives, alarm lights will show only in unit causing the alarm. Omit item 1a. Change "No AC voltage alarm" to "alternator failure alarm" wherever used in this paragraph, or later in the Guide. Explain that the Operating Manual refers to this as "No AC Voltage Alarm" while the lights on the electrical control cabinets are marked "Alternator Failure." The two terms are synonymous since any alternator or AC system failure will result in no voltage across at least one phase of the AC system.

Page 3-4 and 3-5

ENGINE ROOM INSTRUCTION - Par. F, Items 3 and 4. Omit and substitute:

3. Low Oil Pressure Alarm (yellow light) (Section 2 of Supplement - Governor Safety Control). Explain action of governor safety control in case of low lubricating oil pressure or high lube oil pump suction vacuum. Point out push-button on governor housing and demonstrate trip and reset positions.
4. Action to be taken when low oil pressure alarm occurs. (Section 2 of Supplement - Governor Safety Control.) Explain and demonstrate procedure given in reference.

Page 3-5

ENGINE ROOM INSTRUCTIONS - Par. F, Item 6. Change "60-ampere fuse" to "35-ampere fuse" for both F2 and F3 locomotives.

FOURTH UNIT

Page 4-9

ENGINE ROOM INSTRUCTION - Par. B, Item 12C.

Change to "low oil and alternator failure alarms will not operate." Under Item 13, add "Remote Control of steam generators will not operate."

FIFTH UNIT

Page 5-1

ENGINE ROOM INSTRUCTIONS - Par. A. Change to:

- A - Fuel and Speed Indicators on Governor (Section 9 of Supplement - Loss of Load on an Engine.) Explain purpose and reading of the "FUEL" and "SPEED" indicators and comparison of their readings to detect loss of load or improper loading of engine.

Page 5-4

ENGINE ROOM INSTRUCTIONS - Par. B, Item 1. Omit "electro-pneumatic governor control."

Page 5-4

ENGINE ROOM INSTRUCTIONS - Par. C. Change last sentence. A B-unit is considered to be running forward when it is moving toward its main generator end.

SIXTH UNIT

Page 6-1 and 6-2

ENGINE ROOM INSTRUCTIONS - Par. A, Items 9 and 10. Omit and substitute review of governor safety control instruction given in Second Unit.

Page 6-4

ENGINE ROOM INSTRUCTION - Par. D, Item 2. Omit and substitute:

SUPPLEMENT TO F2 INSTRUCTOR'S GUIDE

2. Tripping of governor safety control either when the engine is idling or when it is put on the line under power.

TWELFTH UNIT

Page 12-4

DIESEL PIT INSTRUCTIONS - Par. B, Item 8. Omit and substitute:

8. Operation of engines by throttle control.
 - a. Explaining purpose and operation of electro-hydraulic governor control. Point out indicators on governor housing. Explain relation between reading of pointers.
 - b. Describe purpose and action of ER relay and its effect on engine speed when de-energized.

Page 12-5

DIESEL PIT INSTRUCTIONS - Par. B, Item 13a. Change to:

- 13a. Explain use of "FUEL" and "SPEED" indicators to determine whether engine is loading properly.