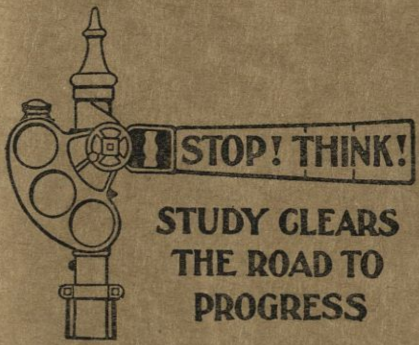
THE RAILWAY EDUCATIONAL BUREAU



INSTRUCTION PAPER

UNIT N. 23A

SUBJECT:

DIESEL LOCOMOTIVE OPERATION

RUNNING ALCO-G. E. SWITCHERS

OMAHA—POSTAL ZONE 2—NEBRASKA

This text does not discuss operating rules or requirements. It must be understood that a Diesel locomotive engineer is responsible for all ordinary operating requirements, the same as a steam locomotive engineer. He must know that he has a proper supply of Diesel fuel oil, lubricating oil, cooling water, sand, etc., also, that he has other necessary supplies, such as signal flags and lamps. He must know that the various auxiliaries of the power plant and the locomotive are working properly. He must make the required air brake tests. In addition, of course, he must obey all operating rules and safety precautions.

Transition is a name given to traction motor circuit changes which take place either automatically or by action of the engineer during the operation of a Diesel locomotive.

The transitions which take place in operating a switching locomotive are described in this text. Electrical facts about circuits and the circuit changes which are known as transition are explained in the section on Electrical Action in Unit N. 23. The electrical reasons why transition circuit changes must be made are explained in the Electrical Section of Unit N. 25.

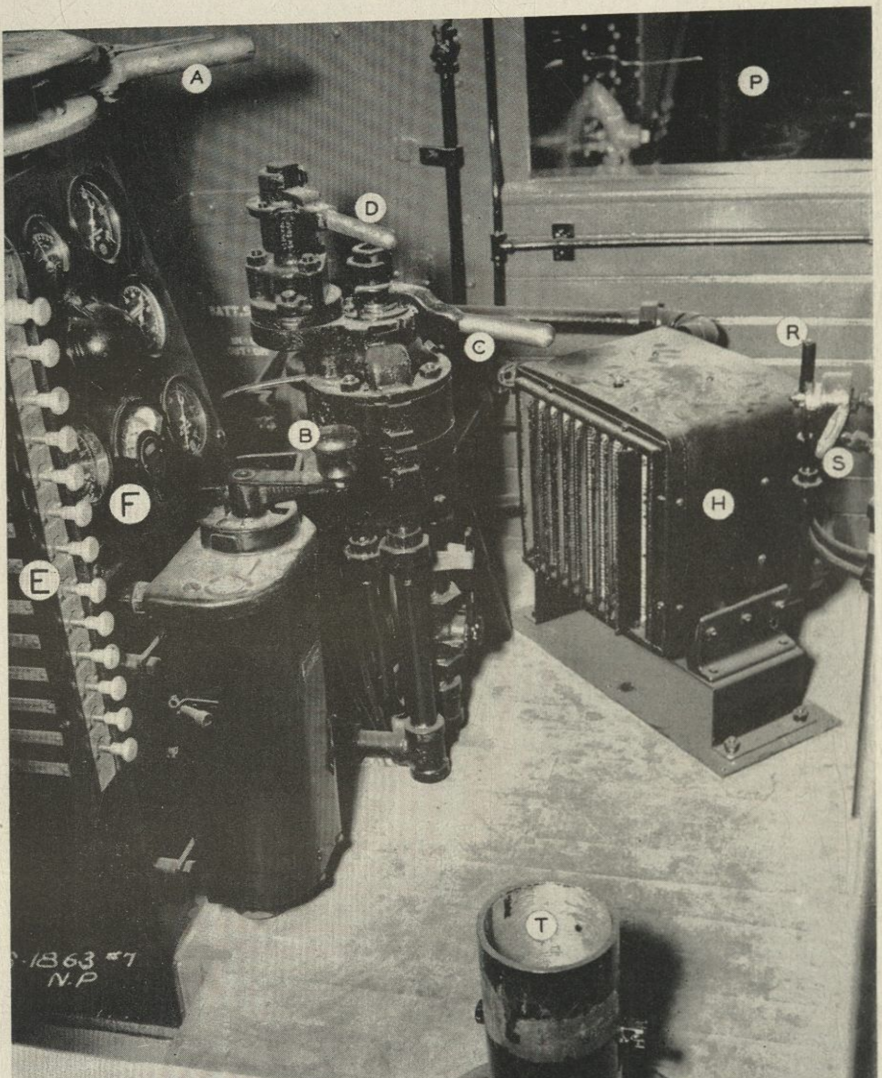


Fig. 1

A—Throttle
B—Reverser handle
C—Automatic brake valve
D—Independent brake valve
E—Switch panel
F—Instrument panel
H—Cab heater
P—Front cab window
R—Sander valve
S—Bellringer valve
T—Stand for engineer's seat

DIESEL LOCOMOTIVE OPERATION

RUNNING ALCO-G. E. SWITCHERS

1. The checking, starting, and stopping of the Diesel *engine* of the power plant of an Alco-G. E. Diesel switching locomotive have been discussed in a previous text. This text covers the running of Alco-G. E. switching locomotives.

2. All operating rules and safety precautions must be observed always before a locomotive is moved.

3. Figure 1 illustrates the engineer's side of the cab of a 1000 horsepower Alco-G. E. switcher. The stand in the foreground is the support for the engineer's seat. The view through the front cab window in the illustration is forward along the length of the hood of the locomotive. The side cab windows are at the right of the picture. The windows at the rear of the cab are directly behind the engineer's seat. The names corresponding with the letters in Fig. 1 are listed below the illustration.

4. After the Diesel *engine* has been started and is running properly at idling speed and the air pressure for the brakes and controls has reached 70 pounds or more, the *locomotive* can be started as follows:

(a) Press in control switch, second switch from the top on switch panel *E,* Fig. 1.

(b) Move reverser handle *B* from its mid-position to the last notch in the direction in which the locomotive is to be moved.

(c) Be sure that the hand brake is released and that air brake valve handles *C* and *D* are in running position.

(d) Pull back on the throttle *A* about one-half inch. As soon as the locomotive starts to move and

Fig. 2

SWITCHES

1—Engine start
2—Control
3—Fuel pump
4—Front headlight, dim
5—Front headlight, bright
6—Rear headlight, dim
7—Rear headlight, bright
8—Gage light
9—Dome light
10—Engine compartment lights
11—Number lights
12—Marker lights
13—Heater fan

the slack is taken up, the throttle can be moved out another inch or more and then pulled back further, gradually, to accelerate the motion.

(e) If the acceleration is faster than necessary or if the speed increases beyond that required, the throttle should be eased off by returning it toward the idling position.

5. To stop the locomotive, return the throttle to the idling position and apply the brakes as necessary.

6. To reverse the locomotive, *first, bring the locomotive to a dead stop.* Then move the reverser handle to its extreme opposite position and pull back on the throttle as before.

7. Figure 2 is a close-up view of the control stand and instrument panel shown in Fig. 1. The names of the control and light switches, numbered from top to bottom, are shown under the illustration. A plate at each switch carries the name of the switch.

8. The various indicators on the gage panel shown in Fig. 2 are explained as follows:

THE UPPER LEFT-HAND GAGE. This is a duplex air brake gage. The red hand shows main reservoir pressure and the white hand shows equalizing reservoir pressure.

THE LOWER LEFT-HAND GAGE. This is another duplex air brake gage. The red hand of this gage shows brake cylinder pressure and the white hand shows brake pipe pressure.

THE AMMETER. This is the middle instrument at the top of the panel. It is similar to the little ammeter on the dashboard of an automobile. When the hand points to the right, it shows that the auxiliary generator is charging the battery and at what rate. When the hand points to the left, it shows that the battery is discharging and at what rate.

THE UPPER RIGHT-HAND GAGE. This gage shows the pressure in the fuel oil line to the Bosch injection assembly. It should read about 35 pounds when the fuel pump is running.

THE MIDDLE GAGE AT THE RIGHT. This is an air gage which shows the control pressure for operating the air pistons which move the reverser drum and the traction motor contactors. This gage should show 70 pounds pressure. The reverser will not operate and the locomotive cannot be started until there is sufficient air pressure to operate these switches.

THE LOWER GAGE AT THE RIGHT. This gage shows the pressure of the lubricating oil which is being delivered to the bearings of the engine. This gage should read from 35 to 45 pounds at all times while the engine is running. It may show a higher pressure when the engine is first started, especially if the oil is cold.

THE THERMOMETER. This is the middle gage at the bottom of the panel. It shows the temperature of the engine cooling water and should read between 150 and 170 degrees while the engine is running. After the engine has been started, the locomotive should not be used to handle a load until the thermometer shows at least 125 degrees.

THE HINGED CAP. The cap at the center of the panel covers the electric light bulb that illuminates the different dials. This light is turned off and on by operating the gage light switch, which is the eighth from the top of the bank of switches at the side of the panel. The hinge allows the cap to be raised if necessary to replace a burned-out bulb. There is an overload light which does not show in either Fig. 1 or Fig. 2. It is below the instrument panel in line with the lubricating oil pressure gage. (It can be seen in Fig. 11 of Unit N. 22A, at *G*.)

9. The throttle (*A*) at the top of the instrument panel is latched in idling position at the forward stop.

No current is produced by the main generator while the throttle is in idling position.* When the latch is released and the throttle moved *the first half inch* from its idling position, it gives what is called a "soft" start. This first half inch of movement makes electrical contacts which set up circuits so that a *limited* supply of electricity is furnished to the traction motors—an amount which is sufficient to move the locomotive or to start a few cars.

10. The soft start position should be used when spotting cars or coupling to a passenger train which is to be switched. (There was no soft start position of the throttle on the older 660 horsepower switchers.) If a heavy load is to be switched, the throttle should be moved out about *an inch and a half* after the slack has been taken up. This increased movement closes additional electrical contacts which set up other circuits. These circuits supply increased power to the motors for starting heavier loads.

11. There are no notches on the throttle of the 660 horsepower or 1000 horsepower switcher except where the throttle is latched in idling position. Throttle movement away from the idling position is transmitted to two electrical contacts which are shown in Fig. 3 and to a system of levers known as the throttle linkage which is shown at *A, A, A,* in Fig. 4. The first half-inch movement completes a circuit at the lower of the two contact blocks shown in Fig. 3. The second movement completes a circuit at the upper contact block. Additional movement of the throttle affects only the mechanical throttle linkage.

12. The following electrical actions take place when the throttle is moved away from the idling position:

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*In explaining Diesel locomotive operation, it will be necessary throughout the texts to make statements such as this. *The reason why* the action or condition which is stated takes place requires an explanation of the electrical principle involved. These electrical principles are explained in the Electrical Action sections which appear in various texts of this series. Explanation of this particular electrical action will be found in Unit N. 24 where the electrical principle of the generator is covered.

First, a circuit is completed that operates an electro-pneumatic valve so that the reverser drum is turned to the proper position for forward or backward movement of the locomotive (in accordance with the position of the reverser handle). Second, this movement of the reverser drum sets up the required circuits from the generator to the traction motors; also, the exciter field contactor closes. Third, the generator field contactors close. This last circuit supplies current from the exciter to the coils of the field magnets of the generator. The generator then begins to deliver current to the traction motors. Further movement of the throttle does not have any additional *electrical* effect on the circuits. However, movement of the mechanical throttle linkage causes the governor to operate so that increased amounts of fuel oil are delivered to the cylinders of the engine.

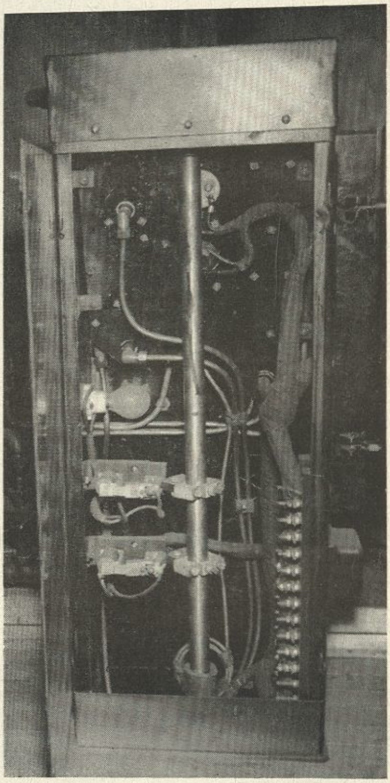

Fig. 3

13. The Diesel engine runs at about 275 revolutions per minute with the throttle in the idling position. Movement of the throttle away from the idling position causes the engine speed to increase up to 740 revolutions per minute at full throttle. If the throttle is moved clear out from idling position quickly, instead of gradually, the engine may speed up faster than the governor can react. If the engine speeds up much above 740 revolutions per minute, the overspeed lever will trip and shut off the fuel supply to the engine and the engine will stop. The overspeed trip will have to be reset by hand before the engine can be started again.*

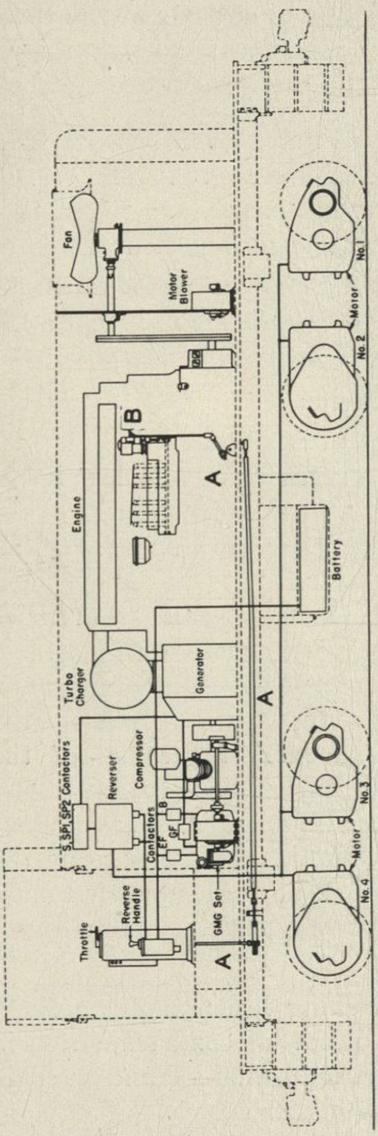

Fig. 4

14. The throttle never should be pumped back and forth. If it is pumped from idling position and back to idling, it will make and break electric circuits rapidly and unnecessarily. This is likely to cause electrical contacts to arc and burn and so may result in a locomotive failure.

15. There are definite notches on the throttle quadrants of some road locomotives. Movement of the throttle from notch to notch produces the desired increase of engine speed by means of electrical controls instead of mechanical connections. The throttle should be moved from notch to notch gradually with this arrangement. Time should be allowed for the governor to adjust the engine speed to each change of the throttle position.

16. The locomotive is reversed by means of the reverser handle at the top of the controller case in front of the instrument panel. Fig. 2 shows this handle in its

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*Paragraph 52 tells how the overspeed trip is reset.

mid or neutral position. It has three notches forward and three in reverse. The locomotive can be moved forward with the reverser handle in any one of the three forward notches and can be moved backward with the reverser handle in any one of the three backward notches.

17. The second and third notch positions are indicated by lines on the quadrant, see Fig. 2. The *feel* of the reverser handle will tell when each notch is reached. Ordinarily the reverser handle is moved clear forward or clear back in accordance with the direction in which it is desired to have the locomotive move. The different notches control the "transition" circuits.

TRANSITION

18. The traction motors of most Diesel locomotives are connected in series for starting and for low speed operation. This method of electrical connection gives the maximum tractive effort or torque at low speed. On all Alco-G. E. switching locomotives there is an arrangement for changing the traction motor circuits from series to series-parallel as soon as the locomotive or the train speed reaches six miles per hour. This change of circuits is known as TRANSITION. As the speed increases, the traction motors consume less current because of the counter-electromotive force generated. However, the voltage at the generator increases and additional current is supplied to the traction motors. The change of the traction motor circuits from series to series-parallel must be made before the voltage at the generator rises above a practical limit.*

19. On Alco-G. E. switching locomotives there is provision for a second transition. Second transition is from series-parallel to series-parallel—shunt.† This second transition is useful at higher speeds.

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*This is explained in the Electrical Section of Unit N. 25.

†Unfortunately there is a lack of uniformity of names used in describing Diesel locomotives and their operation. Alco-G. E. instruction books refer to this second transition as "reduced field" rather than series-parallel—shunt, or just shunt. Both names mean the same thing in this case.

20. On some locomotives transition takes place automatically. On the Alco-G. E. switching locomotives, transition may take place automatically or the engineer can control transition by placing the reverser handle in the first or second of the three notches in the direction in which the engine is to move. Thus, the reverser handle serves, also, as a selective transition control handle.

21. IN THE FIRST NOTCH away from the mid or neutral position (in either direction), the circuits will remain in series irrespective of the speed. IN THE SECOND NOTCH, the circuits will change from series to series-parallel automatically at about six miles per hour and then will remain in series-parallel. IN THE THIRD NOTCH, the circuits will be in series at starting, will shift automatically from series to series-parallel at about six miles per hour, and will shift again automatically from series-parallel to series-parallel—shunt, or reduced field, at about twenty-three miles per hour.

22. Speeds usually are low in yard switching and loads may be fairly heavy. Under these conditions, selective transition is desirable. The engineer can place the reverser handle in the first notch and hold the traction motor circuits in series as long as desired.

23. When the locomotive is being used for light, fast switching, the reverser handle can be left in the second notch. This will allow an automatic change of the circuits from series to series-parallel as the speed picks up during the short moves.

24. On light, long runs, such as in transfer service, the reverser handle should be moved to the third notch so that the circuits will change automatically from series to series-parallel and then to series-parallel—shunt at the higher speeds.

25. When automatic transition takes place, the circuit changes are accomplished by the automatic closing of a transition relay. The closing of the transition relay is brought about by an increase of the generator voltage as compared with the amount of current flowing to the traction motors. Generator voltage increases as the traction motor speeds increase. It decreases again when transition from series to series-parallel takes place.

26. On switchers, the transition relay is designed to pick up when the locomotive speed has risen to about six miles per hour. When the transition relay picks up, a succession of electrical changes occur; as a result, the traction motor contactors are operated by air pressure. The air valves are operated electrically. The movement of the traction motor contactors changes the circuit of the traction motors from series to series-parallel. The overload light may flash for an instant as this transition takes place.

27. When the circuits change from series to series-parallel, more current flows to the traction motors and the voltage at the generator drops accordingly. This drop in voltage allows the transition relay to drop out or open again. However, the dropping out of the relay at this time does not have any effect on the traction motor circuits which have been set up. The increased current flowing to the traction motors results in a further increase in the speed of the locomotive.

28. When the speed has increased to about twenty-three miles per hour, the voltage at the generator will have increased again sufficiently, in proportion to the current flowing to the traction motors, to cause the transition relay to pick up a second time. This second pickup of the transition relay causes a change in the field circuits of the traction motors. This second circuit change is known as series-parallel—shunt or reduced field. It results in a further increase of locomotive speed.

29. BACKWARD TRANSITION is the name used to describe the change of the traction motor circuits from series-parallel—shunt back to series-parallel or from series-parallel back to series. Backward transition from series-parallel—shunt to series-parallel is desirable and necessary when the *engine* is working at full power and the locomotive speed drops back to about sixteen miles per hour. It occurs automatically under these conditions.

30. Similarly, the traction motor circuits should be changed from series-parallel to series when the locomotive speed drops back to eight miles per hour or less. Otherwise, it is quite likely that the locomotive will be overloaded and that damage may be done to the traction motors. *Backward transition from series-parallel to series must be made manually by the engineer.*

31. Manual transition, that is, the change of the traction motor circuits from series-parallel to series, is made properly by easing off on the throttle and then moving the reverser handle from the third or second notch back to the first notch. This movement of the reverser handle will cause the traction motor contactors to restore the traction motor circuits to series, after which the throttle can be moved out again as desired.

32. After first and second transition have taken place, manual backward transition always will occur if the reverser handle is moved from the third notch to the second or from the second notch to the first. The change will take place irrespective of the speed or other conditions. The throttle always should be eased off before making backward transition for any reason.

33. The overload warning signal is cut into the traction motor circuits only when these circuits are in series-parallel or in series-parallel—shunt. It is connected in the circuit so that it will light up if the load on the traction motors increases beyond the safe operating limit. When this warning signal lights up, the throttle should be eased off and the reverser handle moved to the next lower notch. If this overload warning light is not heeded, it is probable that the traction motors will become overheated sufficiently to cause considerable damage. The locomotive also is overloaded if it cannot handle its cars at more than six or seven miles an hour when the traction motor circuits are in *series*. There is no signal to show this. However, the motors will overheat if the train load is not reduced promptly.

34. When the traction motor circuits are in series-parallel and the locomotive is about to ascend a grade that will require a change of the circuits back to series, it is the best practice to move the reverser handle back to the first or series notch while the locomotive still is approaching the grade at a fair rate of speed. Only a little speed will be lost by easing off on the throttle and moving the reverser handle to the first notch at this time as compared with making the same move when the speed has dropped down to eight miles an hour on the grade. If there is no opportunity to get a run for a hard pull, it is best to approach the grade with the reverser handle in the first or series notch.

35. On some *road* switchers the reverser handle is alongside the throttle at the top of the instrument panel. This is where multiple unit control is installed. Then there is an ordinary throw switch directly below the instrument panel which is known as a series holding switch. When this switch is in one position (*S.* position), the traction motor circuits are *held* in series at all speeds; in the opposite position (*S. P.* position), transition to series-parallel and to series-parallel—shunt occurs automatically. This switch *must be thrown to the S. position* to make backward transition from series-parallel to series.

36. On those road switchers which have multiple unit control, the throttle has eight *notches* in addition to its idling position. Movement of the throttle from one notch to another sets up electrical circuits that operate electro-pneumatic valves at the engine governor. These valves act to increase or decrease the engine speed.

STOPPING THE LOCOMOTIVE

37. Alco-G. E. switching locomotives are equipped with ordinary Westinghouse or New York automatic air brake equipment. The equipment shown in Fig. 1 is Westinghouse No. 14 EL. (This is quite similar to the No. 6 ET equipment.) There is no practical difference between the installation of this equipment on a Diesel locomotive and on an ordinary steam switcher except for the necessary difference in the design and application of the brake rigging. Both brake valve handles can be removed from the brake valves.

38. To stop the locomotive or train, the throttle should be shut off and the brakes applied as on any other switching locomotive. If necessary to operate the sanders in stopping, they should be operated the same as they would be with a steam switching locomotive.

REVERSING THE LOCOMOTIVE

39. The locomotive is reversed by changing the direction of flow of electricity through the fields of the traction motors.* This electrical change is produced after the reverser handle has been moved to its reverse position. Then, when the throttle is opened, a circuit is closed that controls air valves which turn the reverser drum in the electrical apparatus cabinet. The turning of this drum sets up the desired circuits.

40. *The reverser handle should not be thrown from forward to reverse or from reverse to forward while the locomotive is in motion.* When the locomotive has *stopped* and the throttle is in idling position, the reverser handle can be moved to its opposite position. Then the throttle can be moved away from the idling position to cause the locomotive to move again.

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*The electrical principles involved are explained in the section on Electrical Action in Unit N. 25.

41. When the throttle is moved away from the idling position, a LOCKING COIL which regulates the movement of the reverser is energized electrically. With the throttle open, the reverser can be turned from any position to its mid-position, but it cannot be moved into reverse. If it is moved to mid-position, then it cannot be moved out of mid-position again until the throttle is returned to idling position. This interlock is not operative when the throttle is in the idling position. Therefore, if the locomotive is drifting, it is possible to move the reverser handle to its opposite position. *This must not be done.* If it is, and the throttle is moved from the idling position before the locomotive stops, electrical circuits will be completed which will cause the contacts to arc and may cause a flash-over at the traction motors that will cause serious damage.

AUTOMATIC ALARMS AND SAFEGUARDS

42. The locomotive is equipped with two automatic alarms and three automatic safety devices. The two automatic alarms are:

(1) A GENERATOR OVERLOAD RELAY. This causes a signal lamp to glow when the load on the main generator reaches the safety limit. This signal operates only when the traction motor circuits are in series-parallel or in series-parallel—shunt.

(2) A WHEEL-SLIP BUZZER. This will sound when the driving wheels are slipping. Some locomotives are equipped so that the operation of the wheel-slip relay automatically stops the slipping.

43. The operation of the overload signal has been discussed in paragraph 33.

44. Wheel slippage is indicated by an intermittent buzzing of the wheel-slip indicator which is located at the bottom of the switch panel in the cab. When wheel slippage is indicated, the throttle should be eased off immediately. *When the wheels have stopped spinning,* the sander can be opened, after which the throttle can be returned gradually to its former position. The sanders must not be opened while the buzzer indicates that the wheels are slipping. If sand is used improperly, it is quite likely that the slipping may be stopped so suddenly that the teeth of a traction motor pinion will shear off or other similar damage will occur.

45. If a brake sticks and *one pair* of wheels on a truck *slides* when the locomotive pulls away from a stop, the buzzer will sound continuously. This warning must be heeded immediately! The independent brake valve handle should be moved to release position and back in an effort to kick off the brake. If the buzzer still sounds, the locomotive must be stopped and the cause of the wheel sliding corrected.

46. The wheel-slip buzzer is not designed to indicate whether a pair of locomotive wheels is *sliding*. There will be no indication if the sliding occurs while the throttle is in the idling position. There will be no indication if *both* pairs of wheels on one truck are sliding. However, if the buzzer does sound steadily, the locomotive should be stopped.

47. It is possible for the wheel-slip relay to stick and cause the buzzer to sound continuously. This should be checked if there is no indication of wheel sliding.

48. The three automatic safety devices are:

(1) THE LOW OIL PRESSURE SWITCH. If the lubricating oil pressure drops below 20 pounds, the low oil pressure switch breaks the circuit to the governor solenoid. When this occurs, a valve is opened in the governor that operates to shut off the supply of fuel oil to the cylinders of the engine.

(2) THE GROUND RELAY. This is an electrical device which operates to "unload the generator" if

there is a ground in the high voltage system. When this relay operates, its armature is pulled in and latched automatically. The resulting circuit changes cut down the current output of the generator to nothing. This will cause the engine to speed up. When this occurs, the throttle should be moved to idling position at once, otherwise the overspeed trip may operate to shut down the engine.

(3) THE OVERSPEED TRIP. This is a lever on the Bosch injection plunger pump assembly which throws out and trips the shutdown pins if the engine exceeds the normal speed of 740 revolutions per minute by about 100 revolutions per minute or more. When this overspeed lever trips, the injector pump plungers are made inoperative and the engine shuts down for lack of fuel.

49. If the engine is shut down automatically because of low lubricating oil pressure, there is nothing that can be done until the oil pressure will build up properly. The lubricating oil level may be too low, or the oil may be too hot, or it may have become diluted. In the latter event, the crankcase can be drained and refilled with fresh oil. After the engine fires on cranking, it will shut down again if the engine start switch is released before the oil pressure has built up to at least 20 pounds.

50. The ground relay is inside the electrical cabinet. It should not be reset unless the throttle is in idling position. It is reset by lifting its red handle. If the relay armature closes and latches again as soon as the throttle is moved away from the idling position and if the ground cannot be located, the relay can be made inoperative in an emergency by opening its switch.

51. The ground relay switch is of the knife-blade type. It is located close to the relay on most locomotives, but on others it is on the wall of the electrical cabinet, behind the door—not in plain sight. When this switch is opened, the ground relay is cut out and its safety protection against grounded circuits is eliminated. This switch never should be opened to permit movement of the locomotive except in an emergency or when it is possible to clear the main line by moving the locomotive just a short distance.

52. The overspeed trip lever is alongside the Bosch injection plunger pump assembly. This lever trips and releases the six cutout pins of the six plunger pumps so that all pump plungers become inoperative. To reset the trip lever, each of the six cutout pins must be pulled out by hand and turned so that the finger on the shaft of each pin rests on the cutoff shaft but is clear of the notches in the rack. Then the trip lever can be pulled out to reset position. When this has been done, each pin will have to be turned *again* if its finger has not entered the notch on the rack at its position. All of the pin handles will stand nearly vertical when reset properly. Failure to reset the pins properly may prevent the trip lever from functioning to shut down the engine should overspeed occur again.

Miscellaneous Operation

53. Running through water—floods. If the track is flooded with water deep enough to reach the traction motors, the motors will be ruined if allowed to become water soaked. The traction motors have a clearance of only 4 or 5 inches above the top of the rail. If the water is this high, the locomotive must not be moved into it under any circumstances. If the water is less than 4 inches above the rail, the traction motors will not be harmed if the locomotive is run through the water slowly enough to prevent splashing. Two or three miles per hour should be the limit of the speed.

54. Running through rain. The only difficulty in running through rain is that a certain amount of water is drawn through the radiators by the fan. On switchers, no particular difficulty is experienced. On road locomotives, a certain amount of water will come into the engine compartment. This cannot be helped, but ordinarily will do no harm.

55. RUNNING THROUGH SLUSH. There is not much that can be done about running through slush. If the traction motors are water proof, no harm will be done. However, traction motors seldom are completely water proof so there is a chance that some damage may result.

56. RUNNING THROUGH SNOW. No difficulty is experienced while running through ordinary snow. Diesel locomotives will buck drifts better than a steam locomotive. However, if a switcher is plowing through drifts at low speed, snow may cave in between the two trucks. Then, when it is necessary to back up, the snow may pack under the traction motors and lift a truck so that the locomotive will lose traction and will have to be shoveled out.

57. OPERATING OVER RAILROAD CROSSINGS. Whenever a locomotive approaches a railroad crossing at a speed of more than five or six miles an hour, the throttle should be eased off before passing over the crossing. It is not necessary to move the throttle clear to the idling position. The electrical controls do not return to their starting position when the throttle is just eased off, but they will if the throttle is returned to the idling position. Normal operation can be resumed immediately after the locomotive has passed over the crossing.

58. PUMPING UP AIR PRESSURE RAPIDLY. The speed of the air compressor is in proportion to the speed of the Diesel engine. Normally, the compressor supplies air as fast as it is needed. If it is necessary to pump up pressure rapidly when the engine is idling, the reverser handle should be placed in mid-position so that no power will flow to the motors. Then the throttle can be opened very gradually until the speed of the engine increases to 400 or 500 revolutions per minute. This will increase the speed of the air compressor accordingly. The same procedure can be followed on road locomotives when the train is drifting down a long grade.

59. Operating sanders. The wheels of a Diesel locomotive are less likely to slip than those of a steam locomotive when a train is being started carefully. This is because of the uniform turning action or torque of the traction motors. When needed, sanders are used in about the same manner as those on a steam locomotive. If sand is to be used when making a stop, the sanders should be operated before the brakes are applied, just as they would be on a steam locomotive.

60. Shutting down the engine when "on the spot." There is no reason why the Diesel engine of an Alco-G. E. switcher should not be shut off during warm weather if the locomotive is to stand still for a half hour or more. In cold weather all shutters should be closed and the engine should be left running at idling speed to prevent the possibility of the water in the radiators freezing.

61. Speed limits. The 1000 horsepower switcher has a maximum permissible speed of 40 miles per hour. The sharpest curve on which it is designed to operate without cars is one of 50-foot radius. These same limits apply to the 660 horsepower switcher. The road switcher can be run at speeds up to 60 miles per hour.

62. Train load. The weight of the 1000 horsepower switcher is 115 tons. The weight of the 660 horsepower switcher is 99 tons. The 1000 horsepower switcher has a starting tractive effort of about 69,000 pounds. The builders recommend that the train load should be limited, for pulls of any length, to a tonnage which the locomotive can pull at least eight miles per hour when the engine is working at full power. Similarly, the starting effort of the 660 horsepower switcher is about 49,700 pounds, and the minimum speed limit for pulls of any length at full power is six miles per hour. These slow speed limit figures refer to a continuous drag lasting for an hour or more. Continued overloading will cause excessive heating of the traction motors.

63. DEADHEADING. Before the locomotive is moved even for a short distance by another locomotive, the reverser drum in the electrical cabinet should be moved to its neutral position, by hand if necessary, and locked there. If there is air in the control reservoir, it should be bled out. The throttle should be in idling position. Both brake valve handles should be in the running position.

64. If the locomotive is to be hauled dead in a train, the same procedure should be followed; but, in addition, the cutout cock below the automatic brake valve should be closed and the dead engine valve should be opened. The dead engine valve will be found under the running board, back of the battery box on the engineer's side. The main battery switch should be open. There is no current in the reverser when the Diesel engine is not running. However, it would be dangerous to touch this reverser in the electrical cabinet if the engine is running and the throttle is open.

65. OILING AROUND. Steam locomotive men will note the absence of the usual oil cans and tallow pot in the cab. There is no regular oiling around to be done on a Diesel locomotive as is necessary on a steam locomotive. The only exception is that side bearings on the truck bolsters need oiling occasionally. About the only other servicing required during a trip is to give the handle of the fuel oil filter, near the fuel pump, and of the lubricating oil filter, at the right front corner of the engine, a turn or two every few hours.

66. The oil reservoir of the governor has to be kept about half full. The cutoff rack shaft of the Bosch injection assembly has to be kept cleaned and oiled. There are regular intervals at which other oiling must be done.

67. Engineers operating Diesel locomotives must refer to the gages on the instrument panel from time to time in order to check engine cooling water temperature, fuel oil pressure, lubricating oil pressure, and air brake pressures. When the locomotive is operating, engine cooling water temperature should range between 150 and 170 degrees. The fuel oil pressure should be about 35 pounds. The lubricating oil pressure should be from 35 to 45 pounds. Control air pressure should be 70 pounds. Air brake pressures should be in accordance with the standard of each individual railroad.

68. If the engine cooling water temperature runs too high or too low, adjustment of the shutters should correct the condition. If the cooling water temperature rises rapidly and reaches 190 degrees, the engine should be idled or shut down until the trouble is located and corrected.

69. Speaking generally, cooling is controlled by operating the shutters above the fan first. If more cooling is required, the radiator shutters on the fireman's side should be opened next. The shutters at the radiator on the engineer's side should be opened last. The shutter at the oil sections of the radiator (the back sections on the engineer's side) should not be opened except in warm weather or when it is apparent that the oil is too hot or is getting thin.

70. It is well to check the ammeter occasionally while the Diesel engine is working under load to make sure that the auxiliary generator is charging the battery. If the hand of the ammeter points to the charge side of the scale, it shows that the battery is being charged. When the engine is being started or the battery is being drained faster than it is being supplied, the hand will swing over to the discharge side of the scale, the same as it does on an automobile.

GENERAL INFORMATION

71. CONTROL AIR PRESSURE. Air piped to the electro-pneumatic valves comes from the main reservoir through a reducing valve to a small storage reservoir. The reducing valve and reservoir are at the left side of the locomotive, under the cab. The reducing valve is set for 70 pounds. This is one reason why there should be at least 70 pounds of air pressure in the air system before attempting to operate the locomotive.

72. The cooling water system of the 1000 horse-power switcher holds 240 gallons. The cooling water system of the 660 horsepower switcher holds 220 gallons. The lubricating oil space in the crankcase of all Alco Diesel engines is designed to hold 85 gallons of oil. The fuel oil tank of each switcher holds 635 gallons.

73. Ordinarily, the engineer can hear the transition contactors when they pull in and change the circuits from series to series-parallel. This is not necessarily true of the other transition changes.

74. There is a drain valve in the engine cooling system for use in draining the engine block. This valve *must be kept closed* when the engine is running, other-wise, enough of the cooling water will flow back through this open valve to prevent proper cooling of the engine.

75. If the engine does not stop running when the fuel pump switch is pulled, it can be shut down by trip-ping the overspeed lever. The engine also can be stopped in an emergency by pulling the emergency fuel cutoff valve knob.

76. When the storage battery is fully charged, there is a tendency for the hand of the ammeter to flicker back and forth rapidly. No harm is done and no attention need be paid to this condition.

EXAMINATION QUESTIONS

NOTE: In answering these questions, it is understood that the Diesel engine has been started and that the engine and auxiliaries are running properly.

1. . . What general checking should be done preparatory to moving a switching locomotive?

2. . . Why should there be 70 pounds of control air pressure available before attempting to move the locomotive?

3. . . What switch at the control station must be closed before the locomotive will start?

4. . . How should the throttle be handled in coupling to a passenger train that is to be switched?

5. . . How should the throttle be handled to start a string of loaded cars?

6. . . Tell how to slow down and stop the locomotive when about to couple to cars.

7. . . Tell how the reverser handle and throttle should be moved when the locomotive is to be stopped and then is to be started moving in the opposite direction.

8. . . If the throttle is pulled way out quickly, what may happen?

9. . . If the throttle is pumped back and forth from its idling position, what may result?

10. . . At about what speed should automatic transition from series to series-parallel take place?

11. . . How can it be told when automatic transition from series to series-parallel takes place?

12. . . In starting a train, what must be done if the wheel-slip indicator buzzes intermittently?

(Questions continued on next page)

13....Tell how sanding should be done when the wheel-slip buzzer indicates that it may be desirable.

14....Is transition desirable when the locomotive is being used in heavy switching service and numerous stops and starts are being made at short intervals?

15....Is transition desirable in transfer service where three or four cars are to be hauled for a considerable distance?

16....Where should the reverser handle be placed if it is desired to hold the electric circuits of the traction motors in series?

17....Where should the reverser handle be placed if light fast switching is to be done?

18....Where should the reverser handle be placed if the engine is to be used to handle light loads in transfer service?

19....Explain what is meant by backward transition.

20....A switcher with the reverser handle in the third notch has made both first and second transition. A heavy grade has reduced the speed to eight miles per hour. Explain how backward transiton should be accomplished.

21....What care must be used in reversing the locomotive?

22....Explain how the cooling of the engine is controlled.

23....What should be done if the cooling water temperature increases rapidly to 190 degrees?

24....What should be done if the lubricating oil pressure gage shows less than 30 pounds pressure with the engine running at normal speed?

25....Explain how to reset the overspeed trip lever.

R.E.B.—2-45-15.