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Locomotive Engineers' and Firemen's

Book of Instructions

and

Time Record

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MECHANICAL EXAMINATION

1. Q. **What are the duties of an engineman before attaching a locomotive to a train?**

A. He should make a complete inspection of the locomotive, observing all important nuts and bolts, look for any signs of hot bearings on previous trips, see that the engine is equipped with necessary tools and supplies, test both of the injectors and the air brake equipment to be sure they are in good working order, see that headlight and signal lamps are in place and ready for service, observe water conditions in boiler, inspect the interior of the fire-box and see that the locomotive is properly lubricated.

2. Q. **What tools should there be on the locomotive?**

A. Such as are necessary to properly operate the locomotive, care for the machinery, disconnect and block up in case of breakdown and the necessary firing tools.

3. Q. **What examination should be made after any repair work has been done on valve, brasses, etc.?**

A. See that brasses are properly fitted, keys fastened and nuts made tight. If any repairs have been made on valves or valve gear, would see that the reverse lever could be moved freely and that all movable parts had been properly replaced; would also give special attention with reference to lubrication of these parts.

4. Q. **What attention should be given to boiler attachments, such as gauge cocks, water glasses, etc.?**

A. Would see that the gauge cocks can be opened to try the water and closed, so steam and water would not come out into the cab. Observe the water glass and note if water is moving up and down in the glass, see that the steam valve at the top and water valve at bottom of glass could be opened and closed, and allow water and steam to circulate freely through the glass.

5. Q. **What do you consider necessary to report on locomotive boilers?**

A. Should report all defects on boiler and its attachments while engine is in engineer's charge.

6. Q. **Trace the steam from boiler through the cylinders to the atmosphere and explain how it transmits power?**

A. Steam enters the throttle valve located in the highest part of the dome in order to get the driest steam, then passes through the standpipe and dry pipe out of the boiler to the steam pipe tee or niggerhead located in the front end, then through steam pipes to the steam chest. A steam valve in each steam chest distributes the steam so that it enters the cylinders at or just before the beginning of the stroke; pushing the piston to the end of its stroke; just before the piston reaches the end of the cylinder, the steam valve opens communication to the exhaust port through a cavity in its exhaust side, then

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through the exhaust pipes and tips up through the draft or petticoat pipe and stack to the atmosphere. When steam pushes the piston through the cylinder, its power is transmitted by the main rod to the main crank pin which causes the wheels to revolve, thus moving the engine and its train.

7. Q. **Why is it important that there be no holes through the smoke-box door or front end and none in smoke-box seams or joints?**

A. So as to maintain as good a vacuum as possible in the smoke-box and prevent small amounts of air coming through leaks which tend to heat and warp the smoke-box and its door.

8. Q. **How should the locomotive be started to avoid jerks, and what train and other signals should be looked out for at the time of starting?**

A. Place the reverse lever in full gear, open the throttle valve gradually so as to start the train one car at a time and easily. Look for signals ahead to show that the track is clear and switch is in correct position, then look for signals from rear end that the train is all coming.

9. Q. **Will an engine equipped with superheat units move as quickly as a saturated steam locomotive when throttle valve is first opened?**

A. No.

10. Q. **Why?**

A. Because steam must first pass through superheat units before it enters the steam pipes leading to steam chest.

11. Q. **In placing engine on the turntable, at water or stand pipes, or at other similar places, what must be done?**

A. Close throttle valve sooner so that the steam confined in superheat units, pipes and steam chests, will have passed out to the atmosphere.

12. Q. **After a locomotive has been started, how can it be run most economically?**

A. By regulating the supply of steam to the steam chest with the throttle and the point of cut-off with the reverse lever; so that no more steam be used than necessary to maintain the proper speed, whenever possible working the engine at short cut-off so as to use steam expansively.

13. Q. **What is meant by working steam expansively?**

A. Hooking the reverse lever up toward the center gives the valve a shorter travel and closes the live steam port when the piston has made only a part of its stroke. This cuts off the supply of live steam coming from the steam chest. The expansion of the steam already in the cylinder pushes the piston to the end of its stroke without the use of a full cylinder of live steam.

14. Q. **How rapidly should water be supplied to the boiler?**

A. No faster than it is evaporated into steam, unless just before a hard pull; or when shutting off with a heavy bright fire in the fire-box to prevent waste of steam at the pops.

15. Q. **What is the difference between priming and foaming of locomotive boiler?**

A. Priming is caused by carrying the water too high in the boiler so that when the throttle valve is opened some of it passes over with the steam in form of a spray. Foaming is caused by the water becoming dirty from animal or alkaline matter, so that heat makes it foam like soap suds. Muddy water or certain vegetable matters will also make a boiler foam.

16. Q. **What should you do in a case of foaming? What in a case of priming?**

A. In a case of foaming, if possible, allow the boiler to cool off a little, increase the supply of feed water to prevent water getting too low, and whenever possible blow some of the dirty water out of the boiler, replacing it with clean water. In case of priming, shut off the supply of feed water until the water level drops to the proper height in the boiler.

17. Q. **What danger is there when the water foams badly? When it primes badly?**

A. There is danger of knocking out cylinder heads, cutting the valves, stalling on some grade, or getting on some train's time because the engine cannot be worked to its proper power. When shutting off steam, the water is liable to drop below the crown sheet and thus risk burning the fire-box. when water primes badly, it is liable to break cylinder packing rings, knock out cylinder heads, break bolts in the steam chest and cut the valves. In such a case additional oil should be fed to the steam chest until the valves are properly lubricated.

18. Q. **Suppose that with the water glass in good working order, immediately after closing the throttle the water disappeared from the water glass, what should be done?**

A. Would open the throttle and endeavor to raise water until both injectors would put enough water into the boiler to make it entirely safe to close the throttle. If unable to raise the water level to the lower gauge cock would smother the fire or put it out entirely, if necessary, keeping both injectors working.

19. Q. **What work about a locomotive should be done by the engineman?**

A. Inspection of the engine both before and after the trip. The engineer should do any necessary work on downs and insure getting over the road promptly. This the engine after starting out on the trip to avoid breakmeans tightening up any important bolts that work loose on the trip and keeping parts from working out of position, adjusting wedges and rod keys.

20. Q. **How should the work of setting up the wedges be done?**

A. Place the engine on the upper quarter on the side with the loose wedge. Do not set the brake if brake shoe will push the driving box against the defective wedge, but block engine truck wheels so the engine cannot move, push the boxes against the shoe or dead wedge with a little steam, set the wedge up until it is a snug fit, then pull it down about one-sixteenth of an inch and fasten. Provision should be made for expansion of the box when it gets warm.

21. Q. **How should rod brasses be keyed?**

A. If properly fitted they should be keyed brass to brass; if not so fitted, they should be keyed on the large part of the pin so they will be free enough to run without heating and snug enough to run without pounding. Do not key them so tight at either end as to prevent the lateral motion of the brass on the pins.

22. Q. **How should an engine be placed for the purpose of keying the rod brasses?**

A. For the main rod, place the engine on the quarter or the top forward eighth, whichever place gives the largest diameter of the pin to key the brass against. After keying up, test by moving the wheel to another position and see if brasses the free on the pin. For the side or parallel rods, always place the engine on the center for the side that is to be keyed.

23. Q. **How should the side rods on a mogul or consolidation locomotive be keyed?**

A. Place the engine on the center on that side, key up the brass on the main pin first, work each way toward the ends of the rods, being careful to keep them the proper length, so they do not bind when passing either center. Be sure that wedges are properly set up before keying the side rods.

24. Q. **What is the necessity for keeping the brasses keyed up properly?**

A. If too tight, they will surely run hot; if too loose, they will pound and injure the brasses as well as endanger the safety of the straps and rod bolts. Very loose brasses can pound enough to get hot.

25. Q. **What is meant by an engine out of tram? Out of quarter?**

A. When corresponding wheels on opposite sides of the engine on different axles are not spaced equally apart; where the axle of any wheel is not at a right angle to the center line from front to rear of engin, so they do not run square on the rails, or where the space between the axle centers on opposite sides is not equal. This is sometimes indicated by unequal flange wear and should be reported at once. Wheels are out of quarter when the crank pin in one wheel is not exactly 90 degrees or one quarter of a turn from the pin in the wheels on the other end of the same axle. This is usually caused by slipping the engine with sand on one rail only and the condition of engine should be reported at once.

26. Q. **Describe a piston valve.**

A. A piston valve is a cylindrical spool-shaped valve constructed with packing rings much the same as the steam piston that moves through the cylinder, except that a piston valve is double or composed of two pistons connected by center rod or spool working in a bushing of equal diameter. Steam and exhaust ports are cut through the bushing; steam ports to the cylinder and exhaust port to the exhaust pipe. There is also a steam port for live steam from the boiler. As the pressure on this valve is equal in both directions it is practically balanced.

27. Q. **What is a balanced slide valve? How is it balanced, and why? For what purpose is the hole drilled through the top of the valve?**

A. One in which the steam pressure on the top and bottom of the valve is nearly equalized. This is done by protecting a portion of the top of the valve from the steam pressure. It is usually balanced by strips held against the pressure or balance plate by one or more springs. This is done to prevent live steam from getting on top of valve and thus relieve the valve from the top pressure which would cause excessive friction between the bottom of the valve and its seat. The hole through the top is to allow any steam which might leak by the strips to pass into the exhaust, so pressure could not accumulate on the top of the valve, alto equalize the exhaust pressure between the top of the valve and exhaust cavity as well as to assist in lubricating the balance plate.

28. Q. **What is meant by inside and outside admission valves?**

A. With an inside admission valve (usually a piston valve), the live steam comes between the piston valve heads, the outside end of the heads being connected with and exposed to exhaust pressure, it admits steam past the inside edges of the valves. An outside admission valve has the space between the ends connected to the exhaust and a space at the ends connected with the live steam. It admits steam past its outside edges. A piston valve can be either inside or outside admission, while a slide valve is always outside admission.

29. Q. **What is the relative motion of the main piston and the steam valves for inside admission, and, on the other hand, for outside admission?**

A. If the piston is in the front end of the cylinder, an inside admission valve must move forward in order to connect the inside of the valve with the front live steam port to admit steam against the piston. The outside end of the valve opens the exhaust port for the back end of the cylinder. In the same position of the piston an outside admission valve must move backwards to open the steam port or in the same direction as the steam piston when commencing its stroke.

30. Q. **What is an Allen ported valve, and what is its object?**

A. An Allen ported valve is an outside admission slide valve having an extra port from one end of the

valve to the other, above the exhaust cavity and through the body of the valve. This extra port is calculated to admit steam through the valve at the same time that steam passes by the end of the valve into the same steam port, thus doubling the area of opening for live steam when the port is first opened.

31 Q. **What is the difference in the valve motion for outside admission valves and for inside admission valves?**

A. An outside admission valve must be moved in the opposite direction to an inside admission valve in relation to the movement of the steam piston when beginning its stroke; therefore either the position of the eccentric or the position of the rocker arms in relation to the rocker shaft must be opposite for a change in these valves.

32. Q. **What is a direct motion valve gear? What is an indirect motion valve gear?**

A. A direct motion valve gear is one in which the valve moves in the same direction as the eccentric rod, that is doing the work, in many cases no rocker arm is used. In case a rocker arm is used, both arms point in the same direction like the letter U. An indirect motion valve gear is one in which the valve moves in an opposite direction to the eccentric rod doing the work. A rocker is used in whic hthe arms point in opposite directions from the shaft connecting them. Owing to the design and construction of the Walschaert valve gear, it is a direct motion gear when the engine is running in one direction with the link block in the bottom of the link, an indirect motion when the engine is running in an opposite direction with the link block in the top of the link; usually direct motion when running forward.

33. Q. **How can you detect the difference between a blow in valve or piston packing?**

A. A blow from the valve is more constant and has a somewhat different sound, while a blow from cylinder or piston packing will blow stronger at the beginning of the stroke and gradually decrease as the stroke is completed.

34. Q. **How would you place engine to locate broken admission steam ring in piston valve?**

A. Would place engine on quarter, reverse lever in center so as to cover ports, then open throttle; and the steam will blow out of cylinder cock at the end of cylinder where broken valve ring is located.

35. Q. **How would you locate broken exhaust ring in piston valve?**

A. Watch the crosshead when engine is working steam. As there will be three normal and one light exhausts, you can determine on which side of the engine the light exhaust takes place.

36. Q. **What is meant by lead? What by line and line?**

A. Lead is the amount of port opening for live

steam to cylinder ahead or back of piston when the piston is on dead center. If the steam edge of the valve is in line with the edge of the steam port when the piston is on the center, it is said to be line and line.

37. Q. **What is meant by steam lap?**

A. The distance that the valve overlaps the live steam edges of the steam ports when it is in the center of its travel over the seat. The distance is measured at one end only, although the valve laps equally at both ends.

38. Q. **What is meant by exhaust lap? What by exhaust clearance?**

A. Exhaust lap is the distance that the exhaust edge of the valve overlaps the exhaust edge of the steam port when the valve is in central position. Exhaust clearance is the opening between the exhaust edge of the valve and the exhaust edge of the steam port with valve in central position. If the valve has neither exhaust lap or clearance it is said to be line and line.

39. Q. **What is meant by release? What by compression?**

A. Release is the point in the travel of the piston when the port is opened. Compression is the distance the piston travels after exhaust port closes before the live steam port opens. During this travel of the piston the exhaust port is closed so the moving piston compresses the steam left in the cylinder.

40. Q. **With an indirect valve motion and outside admission valve, what would be the position of the eccentric relative to the crank pin on that side? What with a direct valve gear? What difference between outside admission valve and inside admission valve as to this position?**

A. With an indirect valve motion and an outside admission valve, the go-ahead eccentric follows the crank pin with engine running ahead. Without any lap or lead it would be a quarter of a turn or 90 degrees behind the pin, but as all valves have lap and lead, the eccentric is advanced or placed toward the pin enough to move the valve the amount of the lap and lead. With a direct valve gear and an outside admission valve, the eccentric will be a quarter of a turn or 90 degrees ahead of the crank pin and advanced enough to move the valve the amount of the lap and lead. With an inside admission valve and an indirect valve motion, the eccentric will come the same as for an outside admission valve and direct motion, or more than a quarter of a turn ahead of the pin. With an inside admission valve and direct motion, as piston valves are usually put up, the eccentric will follow the pin less than a quarter of a turn.

41. Q. **What effect would be produced upon the lap and lead by changing the length of the eccentric rod?**

A. Lap depends on the construction of the valve. A change of the eccentric rod would not effect it, but would widen the port opening at one end of the travel and

reduce it at the other. It should be equal at both ends. Lead is controlled by the position of the eccentric on the axle and it must be equal at both ends. Changing the length of the eccentric rod from the proper one does not really affect the lead, because no proper measurement can be made until lead is equal at both ends. Therefore improper length of eccentric rods varies the port opening at the beginning of the stroke of the piston at both ends.

42. Q. **Why are eccentric rods made adjustable?**

A. In order to change their length to make adjustment of the valve gear not as easily made in other ways.

43. Q. **Why is it necessary to keep the cylinders free from water?**

A. In order to avoid damaging valves and cylinders, to insure perfect lubrication and obtain the most efficient service from the locomotive.

44. Q. **Where is the piston rod packing located? Where cylinder packing?**

A. Piston rod packing is usually soft metallic rings located inside of a gland at the back end of cylinder and around the rod. Cylinder packing rings are usually cast iron, placed around the piston head and bearing against the walls of the cylinder.

45. Q. **How are metallic packing rings on piston rods and valve stems held in place? What provisions are made for the uneven movements of the rod?**

A. The packing rings fit into a vibration cup or cone located inside the gland, being held therein by means of a spring as well as by the steam pressure. Provision is made for uneven movement of the rod by making the inside of the gland larger than the vibrating cup and using a ball-joint ring between the vibrating cup and gland.

46. Q. **While running under steam and there is a failure of part of the locomotive which does not seem to prevent running at full speed, how would you proceed?**

A. Keep the locomotive running if in your judgment it is safe. Try to ascertain what the injury is and be prepared at the next stop to do such work as the case demands, being careful to make the stop at such a place that the work can be done without interfering with the movements of main line trains.

47. Q. **If one side of a locomotive is disabled, what would you do in a general way to make it possible to use steam on the other side?**

A. Disconnect enough parts to allow for the turning of the wheels and for reversing of the opposite side without moving the valve on the disabled side.

48. Q. **In case a locomotive in your care became disabled on the road, what would you do?**

A. First see that the train is protected. Next examine the locomotive and see what is necessary to do to move it and if possible the train. If unable to make repairs at once to bring the engine and train forward, would advise exact condition of engine and ask for help.

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In the meantime endeavor to move the train so as to give other trains the use of the main line.

49. Q. **Suppose a wash-out plug blew out or a blow-off cock broke off or would not close, what should be done?**

A. Kill the fire, get the train on a side track, if possible, and if unable to make repairs get the engine in condition to be towed in. In all cases with a disabled engine allow the train to drift to a siding, when possible, and stop between the switches so as to allow other trains to pass through siding.

50. Q. **Can a locomotive boiler without steam pressure be filled by being towed by another engine? If towed, how filled?**

A. Yes. Close all openings where air could enter the boiler. All relief valves, cylinder cocks, gauge cocks, the whistle valve and air pump steam valve should be closed. Place the reverse lever in full gear in the direction the engine is to be towed with water supply valve and injector throttle open. Use engine oil through auxiliary oil cups to oil valves and pistons. The movement of the pistons in the cylinders will pump the air out of the boiler and atmosphere pressure on water in the tank will force water into the boiler when engine is towed.

51. Q. **What should be done if grates should be burned out or broken while on the road?**

A. Pull the fire off the broken or burned grates, cover that section with any pieces of iron at hand (fish-plates or angle-bars are very good), then level up the fire, clean ash-pan and proceed with full train.

52. Q. **What precaution should be taken to prevent locomotive throwing fire?**

A. The netting and smoke-arch should be kept in good condition; cinder slide and hand hole plates securely fastened, ash-pan clean and slide dumpers for dumping ashes closed. Care should be exercised in working the engine, especially in the vicinity of stations or places where fire is liable to catch. Avoid working the engine hard so as to prevent throwing cinders.

53. Q. **What shall be done with a badly leaking or bursted flue?**

A. Plug it if possible with an iron or wooden plug. If in the fire-box end, a piece of scantling or post can be sharpened and driven into the flue from the fire-box door; it will then burn off up to where the water from the bursted flue keeps it wet. If a bottom flue, would cover it with ashes or green coal so that the leakage would not put out the balance of the fire. If able to maintain steam pressure, would then proceed with a full train.

54. Q. **What should be done in case the throttle valve stem became disconnected while the valve is closed? If it became disconnected, leaving valve open?**

A. Would notify the train crew and Dispatcher, and arrange to be towed in. With lubricator working, unless in very cold weather so there is danger of the water

freezing in the cylinders or steam chest passages, would not disconnect. By taking out lubricator chokes and steam chest valves from the oil pipe, a larger supply of steam could be got into the cylinders. If in to clear of other trains and practicable, would take up the dome cap and connect the throttle again. If disconnected and valve stuck open, would notify the train crew and Dispatcher, reduce steam pressure until the engine could be handled with reverse lever and brake, and proceed with such a train as the engine can handle.

55. Q. **In case a valve yoke or stem became broken inside of steam chest, how can the breakage be located?**

A. In this case the disabled valve is always pushed to the front end of the steam chest so that with a slide valve or outside admission piston valve the back port is open to live steam. When given steam, the engine will stop on the eighth, and when reversed will move over to the other eighth, being stopped there by the live steam in the back end of the cylinder having the disabled valve. Steam will blow from the back cylinder cock on the disabled side and cannot be changed by reversing the engine. If the valve is pushed far enough ahead to open the exhaust port, steam will blow through the exhaust so that the engine cannot be moved. With an inside admission valve the forward steam port will be opened and steam will come out of the forward cylinder cock on the disabled side.

56. Q. **After locating a breakage of this kind, how would wou proceed to put the engine in safe running order?**

A. Would move the valve to central position so as to cover both steam ports, if possible. This may be done by taking out the relief valve if on front side of the steam chest and pushing valve back, or taking up the cover for a slide valve; or taking off front head for a piston valve. Disconnect the valve rod from rocker arm and block valve stem so it cannot blow out of the gland or let valve work back. Loosen cylinder head in order to provide for lubricating cylinder so as to leave the main rod up on the disabled side and proceed on one side. If unable to cover the open steam port it would be necessary to disconnect the main rod on the disabled side, blocking the piston at the proper end of the guides so live steam coming into the cylinder would not move it.

57. Q. **If a slide valve is broken, what can be done to run the engine on one side?**

A. Remove the steam chest cover, place a thin board between the valve and the steam passages in the seat, replace steam chest cover, disconnect valve rod, and if able to lubricate the cylinders leave up the main rod and proceed on one side.

58. Q. **If one of the bolts connecting the two parts of a built-up link on the Stephenson gear breaks or is lost, how would you proceed?**

A. If temporary bolt cannot be supplied, take down

the forward part of the link, disconnect and remove link block, fasten valve to cover ports, and proceed. If moving link will clear rocker arm or other parts of the machinery after link block is taken out, it will not be necessary to disconnect eccentrics.

59. Q. **What should be done in case of link saddle pin breaking?**

A. Remove the broken parts and block the disabled link in such a position that the entire train could be started, using a very short block above the link block in the link slot and a longer one below it.

60. Q. **With one link blocked up, what should be guarded against?**

A. Reversing the engine or moving the tumbling shaft arm down so the link on the disabled side can strike it.

61. Q. **How can it be known if an eccentric has slipped on the axle?**

A. By the uneven exhaust of the engine and a thorough inspection to determine the cause.

62. Q. **Having determined which eccentric has slipped, how should it be reset?**

A. Place the engine on the center on disabled side and if a back-up eccentric has slipped, would place the reverse lever in full forward gear and mark the valve stem flush with the gland; then place the reverse lever in full back gear and move slipped eccentric until the mark on the stem returns to its original position, taking notice that the throw of the eccentric is on the other side of the axle from the go-ahead eccentric used as a marker, and tighten up set-screws. To set a go-ahead eccentric, use the back-up one on that side for that marker. If the eccentric had been keyed on, would move the cam until the keyway in the axle came in line with the slot in cam. Knowing the position of the eccentric in relation to the crank pin, an inspection would show where it belongs. The eccentrics are usually opposite the third spoke in the driving wheel from the pin, sometimes ahead of the pin, in other cases back of the pin, depending on whether it is an inside or outside admission valve, a go-ahead or back-up eccentric.

63. Q. **What should be done in case of a broken eccentric strap or rod?**

A. For a go-ahead strap or rod take down all broken parts, disconnect valve rod, cover parts, and come in on one side. It is safer to take down also the back-up strap and rod on that side. If the back-up strap and rod is broken, it is possible to secure the bottom end of the link so it will not turn over, work the engine full stroke ahead, proceeding with full train until the main line is clear.

64. Q. **How should the engine be disconnected if lower rocker arm became broken? If link block pin?**

A. Would remove broken parts; if moving link would strike anything connected with the rocker box or

broken arm it would be necessary to take down both eccentric straps and rods. Block valve central over ports and come ahead on one side. If a link block pin was broken, it might be possible to put a bolt in there to do the work, otherwise block the valve on the center of its seat and if the link will not clear the lower end of the rocker arm take down the eccentric straps and rod. In any case where necessary to take off the eccentric rod always take off the strap also.

65. Q. **For what break-down is it necessary to take down the main rod? The side rod?**

A. A broken main crank pin, broken main rod or strap, broken piston rod when near the middle of the rod, broken cross-head or guide, broken valve or seat when steam cannot be kept out of the cylinder. Side rods must come down for broken main pin, or broken side rod pin affecting that rod.

66. Q. **If it is not necessary to take down main rod of disabled side of the engine, how would you arrange to lubricate the cylinders?**

A. If cylinder and piston are in good shape and it is possible to block the valve to admit a small quantity of steam into the back end of the cylinder, oil from the lubricator will go through this opening and oil the piston rod and cylinder packing. If not possible to block the valve properly, cover the ports and oil the cylinder through the indicator plug openings or relief plug holes. If not possible to do this, slack off the bolts on the front cylinder head, wedge the head open so oil can be introduced. In some cases it may be necessary to take the head off; that however, allows dust and grit to enter the cylinder.

67. Q. **What is the by-pass valve, and what is its duty?**

A. By-pass valves are connected to the steam port leading to the cylinder. It's duty is to open when the engine is drifting with steam shut off, and close when working steam, to allow air to pass back and forth from opposite sides of the moving piston.

68. Q. **What is a vacuum relief valve? What a cylinder relief valve?**

A. A vacuum relief valve is usually located on the steam chest or the live steam passage to the chest and opens when steam is shut off and engine drifting, allowing atmospheric pressure to pass into the steam chest, closing when working steam. A cylinder relief valve is a pop valve screwed into the cylinder head and set at high enough pressure so it does not open in ordinary service, but will open to allow water to pass out when the exhaust port is closed by valves; or on compound engines when the pressure in the low-pressure cylinder gets too high.

69. Q. **What would be considered a bad engine or tender truck wheel?**

A. One loose on axle: having bad flat spots; very

sharp flanges; bad sand spots; cracks shelled out; or other defects that would make the wheel unsafe.

70. Q. **What should be done if a tender truck wheel or axle should break?**

A. Would place a piece of timber or rail across the tender, jack up the corner of the truck that is disabled, chain it to the timber and fasten the timber at the other end to hold it so it would carry the disabled truck. If it is possible to slide the wheel or truck, place a tie across the rail and keep the wheel from turning, then slide it to a siding.

71. Q. **What should be done if an engine truck wheel or axle should break?**

A. Would block between the engine frame and truck frame over the good wheel on disabled side, swing the disabled corner of truck to the engine frame with a chain. Look out when crossing frogs that disabled truck does not leave the track. With a broken flange, would block the wheel to prevent its turning and skid it to a siding.

72. Q. **What should be done for a broken tender truck spring?**

A. Jack the tender up to where it belongs and put a block in place of the broken spring.

73. Q. **What should be done with a broken engine truck spring or equalizer?**

A. For a broken spring, raise the front end of the engine and place blocks across the equalizers under the truck spring band. For a broken equalizer, block on top of engine truck boxes and under truck frame.

74. Q. **What should be done if a driving spring hanger or equalizer should break?**

A. Would block between the driving box affected and under the frame over it, using hardwood block or piece of iron. Would also block the equalizer up to its proper position between the disabled end and the frame, or over the other end, as the type of spring rigging requires, to hold the equalizer level. For a broken equalizer, would block on top of all boxes affected, would raise the engine by running the proper driving wheels upon an encline or wedge to lift the engine while other boxes were blocked; a re-railing frog comes handy for this work.

75. Q. **How can an engine be moved if the reverse lever or reach rod were caught at short cut-off by a broken spring or hanger?**

A. By removing the pin at the forward end of reach rod, to free the tumbling shaft and allow it to be moved either forward or back to move the engine. A block should be placed over the link block to avoid damaging it when uncoupled, as well as to hold link in proper position to move engine. This would allow the engine to be moved and clear the main line.

76. Q. **How can the blowing of steam past cylinder packing, a valve or valve strip be distinguished or located?**

A. Test for a leaky slide valve, place the engine on

the quarter on the suspected side with the reverse lever in center notch; the valve should be in the middle of its travel and cover both ports. If steam blows through the open cylinder cocks on that side, the valve or seat are defective. A leaky balanced valve strip will allow steam to blow through the hole on top of the valve into the exhaust port in the seat and very little steam will come out of the cylinder cock; in some cases with the valve barely opening a steam port to the exhaust, air will draw in at the cylinder cock. If there is a drip cock in the exhaust pipe under the saddle, the steam will blow out there. After testing for leaky valve, place the engine on about the forward bottom or top back eighth, block the wheels or set the brakes solid, put reverse lever in corner, open the cylinder cocks and give the engine steam. If steam comes out of both cylinder cocks, and testing valve shows it is tight, then the packing is blowing. Cylinder packing should be tested with steam first on one side of the piston and then on the other.

77. Q. **If engine should blow badly and be unable to start the train when on the right dead center, on which side would be the blow generally?**

A. On the left side. If the side standing on the quarter cannot start the train, the trouble is usually there.

78. Q. **If throttle were closed and steam came out of cylinder cocks, what might be the cause?**

A. To test for this, first shut off steam connection to the lubricator; steam leaking into the cylinders can come from a leaky throttle or leaky dry pipe.

79. Q. **Is it possible to distinguish between a leaky throttle and a leaky dry pipe?**

A. Yes; a leaky throttle usually leaks steam at all times. A leaky dry pipe will leak both steam and water. It will show a stream of water at the cylinder cocks when the water level in the boiler is raised above the leak in the dry pipe.

80. Q. **What effect have leaky steam pipes in the smoke-arch, and how should they be tested?**

A. Leaky steam pipes waste steam and very seriously affect the draft in the front end. A bad leak in the back part of the joint at the bottom will blow into the tubes and make the engine smoke at the door with the throttle wide open while standing still. To test them, open the front door and cover the joint with fine cinders. When the engine is given steam, the cinders will blow away from the leak; to properly test them in the shop, water under heavy pressure should be used.

81. Q. **How should the test for a leaky exhaust pipe joint, or a leaky nozzle joint be made?**

A. About the only test that can be made on the road is to open the front end and reverse the engine with throttle partly opened watching the suspected joint at the same time. For the bottom one with cinders around the joint, for the top one it can sometimes be detected by holding a torch near the joint.

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82. Q. **What should be done if a steam chest cracks?**

A. Would loosen up the steam chest cover to free the sides and wedge between the studs and walls of chest, crowding the broken parts together. A brake shoe key does this nicely. Would then tighten down on steam chest cover and proceed.

83. Q. **What should be done if a steam chest breaks?**

A. Would take off steam chest cover, place strips of boards over the steam inlets and black on top of them so that the steam chest cover would hold them in place and prevent live steam coming out of inlet. Would then make the necessary disconnection and proceed on one side.

84. Q. **If a link lifter or arm were broken, what should be done?**

A. Take off the disabled parts, block between the top of the link and link block, having the disabled link blocked down very nearly in full strokes. For safety, both the top and bottom of the disabled link should have blocks in its slot; the good link would be held in place by the reverse lever and should under no consideration be dropped down any farther than the disabled link was.

85. Q. **If the reverse lever or reach rod should break, what should be done?**

A. If either breaks, place an iron bar or suitable piece of material across the top of both frames, securely fastening it in position, then fasten the arm of the humbling shaft to the bar. This will require the engine to be worked at about half cut-off; handle such part of the train as road conditions would permit.

86. Q. **What should be done if the piston, piston rod, cross-head, main rod or crank pin are broken or bent?**

A. If a piston should break, would remove broken parts, disconnect valve stem, clamp valve in central position, and if moving piston would not damage cylinder, leave main rod up and proceed. If a piston rod, cross-head, main rod or crank pin are broken or bent, would take down the main rod, block the valve and cross-head; if piston rod is broken off at the cross-head, leave main rod up.

87. Q. **What should be done when there is a loose or lost cylinder key?**

A. If the cylinder key is loose, it should be tightened up; if lost, something should be substituted. In case nothing solid can be found to take the place of the key, the engine should be run in light to avoid further damage.

88. Q. **What should be done if a safety valve spring or stud breaks?**

A. The steam pressure should be reduced. With broken spring, screw the parts down solid or clamp the stem down. This can be done by laying a piece of scantling across the top of the valve, fastening each end to the hand rail on opposite sides of the engine in case of broken stud. Would then raise steam pressure and pro-

TABLE SHOWING TIME

After Which Overtime Accrues on Runs 100 Miles to 199 Miles in Length on a Speed Basis of 12½ Miles per Hour

Distance Miles	Overtime Accrues after Hours	Distance Miles	Overtime Accrues after Hours
100	8.00	150	12.00
101	8.05	151	12.05
102	8 10	152	12.10
103	8.14	153	12.14
104	8.19	154	12.19
105	8.24	155	12.24
106	8.29	156	12.29
107	8.34	157	12.34
108	8.38	158	12.38
109	8.43	159	12.43
110	8.48	160	12.48
111	8.53	161	12 53
112	8.58	162	12.58
113	9.02	163	13.02
114	9.07	164	13.07
115	9.12	165	13.12
116	9.17	166	13.17
117	9.22	167	13.22
118	9.26	168	13.26
119	9.31	169	13.31
120	9.36	170	13 36
121	9.41	171	13 41
122	9.46	172	13.46
123	9.50	173	13.50
124	9.55	174	13.55
125	10.00	175	14.00
126	10.05	176	14.05
127	10.10	177	14.10
128	10.14	178	14.14
129	10.19	179	14.19
130	10.24	180	14 24
131	10.29	181	14.29
132	10.34	182	14.34
133	10.38	183	14.38
134	10.43	184	14.43
135	10.48	185	14.48
136	10.53	186	14.53
137	10.58	187	14.58
138	11.02	188	15.02
139	11.07	189	15.07
140	11.12	190	15.12
141	11.17	191	15.17
142	11.22	192	15.22
143	11.26	193	15.26
144	11.31	194	15.31
145	11.36	195	15.36
146	11.41	196	15.41
147	11.46	197	15.46
148	11.50	198	15.50
149	11.55	199	15.55

To B-23-34 192

OVERTIME HRS. MIN.	WORKING TIME FROM - TO	ENG. CODUCTOR FIREMAN-BREAKMAN	TOTAL MILES MADE	RATE PER 100	TOTAL AMT. $ & CTS.
	Bunk Dixon.			1.00	
	Dunn.			5.55	
	Sardine			1.00	
	Grove. march 3.			2.00	
B	1.35 for 2 quarts cum's				
	90¢ " 1 " "				
	35¢ " meat Bread.				
	20¢ " Key.				
	1.10 " Gas				
	52¢ " suppers 4				
	52¢ " for Lunch.				
	25¢ " meat bread.				
	1.10 " gas.				
	200 " gas.				
	73¢ " Rues cut fruits.				
	40¢ " Shoe Shine.				
	10¢ " Candy.				
	Pay check 81.94 10 of March				
	57 Supper	11			
	57 dinner				
	40¢ Lunch.	13			
	37¢ dinner				
	40¢ Supper.				
	1.80 to shave and Supper with Gladys - 14				
	11.07 Coffee				
	2.09 drugs. 3 - 13	$5.00 to Gladys			
	10				
	25				
	20 key				
	25¢ to arthur				
	25 Breakfast				
	57 dinner 16				
	25 Lunch.				
	72¢ close line	17			
	40¢ shoe Gladys	$5.00 to Gladys			
	20 Key	me.			
	50¢ dinner 18.				
	46¢ subsist 19		51		march 22
	25 to Gladys.		51	Dinner Supper	
	55¢ Supper				
	$20.00 Gladys. Cook		25	dinner	march 23

Time from March 1 192 33 To 192

ENG. No.	TRAIN No.	CALLED FOR	TIME LEFT	STATION	TIME ARRIVED	STATION	OVERTIME HRS. MIN.	WORKING TIME FROM - TO	ENG. CODUCTOR FIREMAN-BREAKMAN	TOTAL MILES MADE	RATE PER 100	TOTAL AMT. $ & CTS.
2396	X	3 15 p	1	Gib X	7 35	100						
" "	CD4	3 30 a	2	ns yds Gib X	11 35	130						
2342	2/2057	1 45 a	3	Gal.	750	106						
2342	CD4	3 30 a	4	ns yds. Gib X	11 50 a	121						
3338	10C7	12 15 p	5	to Dist and return	8 20	150						
2078	Wyeast	9 45 p	8	to Kaddle Gib X-ing	8 a	166						
2338	mc1	9 45	10	chi	11 10 a	106						
2342	JS2	10 30	11	Gib X mils	5 00 a	110						
2384	2/mc1	9 45 p	12	chi	5 00 a	100						
2083	2/JS2	1 45 p	13	mils	9 15	121-1192	Time left = 1992 mils check				$2.89	
2339	mc5	8 15	15	chi	2 00 a	100 221						
1085	2/JS2	1 30 p	16	ns yds Gib X mils	8 25	121 1492						
2084	2/JS2	2 15	18	Belt ex return	7 05	171 1664						
2085	mc5	8 15	19	Gib return	7 10	150	Palowski Eng.					
2346	2nd Local	5 45 p	22	to Gib	12 15	106						
2346	2/mc1	7 30	22	2nd Gib - chi	3 30	100	30 min overtime					
2346	2/JS2	1 30	23	ns yds Gib X mils	8 40	121						
2081	mc5	10 15	26	to Gib return	11 10	150	2 hr overtime					
2037	2/mc1	6 45 p	29	chi	11 a	100	2211					
2337	CD4	3 a	30	ns yds Gib X mils	15 55	121	2332					
2342	2/mc1	9 15 p	31	to Gib return	7 05 a	150	mc4 2482					

Time from April 1 192 33 To 192

ENG. No.	TRAIN No.	CALLED FOR	TIME LEFT	STATION	TIME ARRIVED	STATION	OVERTIME HRS.	MIN.	WORKING TIME FROM - TO	ENG. CODUCTOR FIREMAN-BREAKMAN	TOTAL MILES MADE	RATE PER 100	TOTAL AMT. $ & CTS.
2391	BC7	12 45	2	Weighart	5 25	100							
2392	BA2	9 05	2	" "	5 00	121	2	21					
2375	NG1	12 45	4	Glossenger	6 05	106	3	27	[local]				
2375	GN4	1 30	5	" "	6 45	110	4	37					
2394	NSgdo	2 40	7	" "	9 00	114	5	51	chick 84.78				
2083	BA2	8 00	7	" "	4 15	121	6	72					
2083	X	1 45	9	" "	7 20	106	7	78	local				
2083	CO4	4 00	10	" "	11 50	121	8	99					
2330	MC1	7 45	11	" "	11 30	100	9	99					
2084	2/GS2	1 30	12	" "	9 15	121	11	30					
2083	NG3	10 15	13	" "	5 50	106	12	26	local				
2083	GN6	7 30	14	" "	7 45	114	13	50	local. to Gib. 3.38 hrs over time or 67 mile				
2085	adv DC7	4 30	16	" "	4 10	175	15	25	Blx Turnin				
2343	DC7	12 15	17	" "	10 05	150	16	75	Gibs turn				
2373	NG3	10 15	18	weighart	6 30	107	17	82					
2365	GN6	7 30	19	" "	8 05	116	18	98	local. 3 48 over time				
2088	2/DC7	12 15	21	Glossenger	11 50	150	20	48	local.		$92,47		
2360	GC1	2 15	23	" "	6 25	105	21	52					
2360	CS2	4 00	23	" "	9 25	111	22	63	NS gdo and return to Kens on CS2				
2085	NG3	9 15	24	" "	6 30	107	23	70	local.				
2085	GN6	7 30	25	" "	7 40	169	25	39	local. Job to Cart lay to Gib to miles				
2342	MC1	7 45	27	" "	12 00	106	26	45					
2398	GS2	10 20	28	" "	4 45	110	27	45	GS2 chi to Blx via cal park				
2363	2/NG1	3 15	29	" "	9 00	106	28	51					
2363	GN4	1 30	30	" "	5 30	110	29	61					

Time from May – 1 1927 To 192

ENG. No.	TRAIN No.	CALLED FOR	TIME LEFT date	STATION	TIME ARRIVED	STATION	OVERTIME HRS. MIN.	WORKING TIME FROM - TO	ENG. CODUCTOR FIREMAN-BREAKMAN	TOTAL MILES MADE	RATE PER 100	TOTAL AMT. $ & CTS.
2380	2/mj1	1 45	1	Glossenger	2 15 am	173		Matteson Turn				
2387	mc5	8 15	5	" "	1 30 am	100						
2387	2/gS2	3 30	6	" "	9 05	121	396					
2338	bc3	1 45	8	" "	6 40	100	496	$107.06	" "			
2338	cS2	5 00	8	" "	10 55	110	606					
2360	Jolx	6 45	10	" "	12 15	106	712	local				
2360	Jol local	9 30	11	" "	6 00	110	822					
2367	Bvzin	9 45	12	" "	8 00	150	972	Gibson turn	2090			
2399	bc7	12 15	14	" "	4 55	100	1072		219			
2399	BA2	8 55	14	" "	3 20 am	121	1193		2309			
2338	bc7	12 30	18	" "	5 30 am	100						
" "	BA2	7 30	18	" "	3 10 am	121	1414					
2372	bc7	12 30	20	" "	5 20	100	1514		" "			
" "	BA2	9 00	20	" "	4 55 am	121	1635	$82.60				
2364	gc1	2 15	25	" "	8 15 am	100	1735					
" "	cS2	4 00	25	" "	9 30	111	1846					
2325	gc1	2 15	27	" "	5 25	15 hrs 40 min	1946	hit truck at mc at 4 45 back 6 miles				
2365	2/mj1	7 00	28	" "	9 30	109 miles	144	local				
2365	gn4	1	29	" "	6 55	110	2090	"				
2380	mc1	7 00	31	" "	10 55	100	2190					

Time from June 1 1927 To 192

ENG. No.	TRAIN No.	CALLED FOR	TIME LEFT	STATION	TIME ARRIVED	STATION	OVERTIME HRS.	MIN.	WORKING TIME FROM - TO	ENG. CODUCTOR FIREMAN-BREAKMAN	TOTAL MILES MADE	RATE PER 100	TOTAL AMT. $ & CTS.
2380	CD4	3 30 am	June 1	Glossinger	9 30 am		121						
2338	JC1	2 15 am	3	" "	8 15 am		100	2	21				
2338	CS2	4 00 pm	3	" "	9 30		111	3	32				
2363	DC3	1 45 am	5	" "	7 05 am		100	4	32				
2351	2/JS2	3 30	5	" "	11 20		121	5	53				
2348	Gib 7	1 15 pm	7	Sheeler	8 15		150	7	13	$76.35			
2373	DC3	1 45	9	Glossinger	6 20 am		100	8	13				
2373	CS2	3 30	9	" "	9 35		111	9	24				
2367	DC3	1 45	11	" "	7 00 am		106	10	30				
2387	CS2	4 00	11	" "	9 55		111	11	41				
MC1	2363	9 45	12	Weighart	7 45 am		150	12	91	Gib turn ND4-6			total for 1565 a
2399	NJ3	9 15	14	Glossinger	5 00 am		107	13	98	Local.			
2399	JM6	7 30	15	" "	7 00 am		114	15	12	Local 53 miles overtime			
2343	DC7	1 15	17	Glossinger	5 40		100	16	12				
2343	BA2	8 15	17	" "	5 15 am		121	17	33	2 hrs 44 mins over time = 52 miles or			
2027	JC1	2 15 am	19	" "	10 30 am		106	18	39	15 mins overtime			
2027	CS2	4 00	19	" "	9 50		121	19	60				
2345	RT.	6 15	21	" "	8 35		106	20	66	RT. to Job. 14 hr 50 mins 6 20 over T. or 119 miles			
2345	JN4	1 30	22	" "	5 00		110	21	70	$100.78			
2375	NJ3	9 45	23	Weighart	8 00 am		107	22	77	Local. 2 11 over time or 41 miles			
2375	JM6	7 30	24	" "	6 45 am		114	23	91	2 hr 38 mins over T. or 49 miles Local			
2345	BD4	3 15	26	Glossinger	1 35 pm		116	24	07	or 29 miles over time			
2351	CD4	3 30 am	27	" "	10 20 am		121	25	28				
2367	DC3	1 45	29	" "	6 55 am		106	26	34				
2367	2/JS2	3 25	29	" "	9 15		121	27	55				

Time from July - 1-37 192 To 192

ENG. No.	TRAIN No.	CALLED FOR	TIME LEFT	STATION	TIME ARRIVED	STATION	OVERTIME HRS. MIN.	WORKING TIME FROM - TO	ENG. CODUCTOR FIREMAN-BREAKMAN	TOTAL MILES MADE	RATE PER 100	TOTAL AMT. $ & CTS.
2338	Jal local	7 15 am	1	Ritam	4 45 pm	107						
2338	"	2 00 am	2	" "	11 55 am	122		39 min overtime or 12 mile				
2088	ng1	1 45 pm	3	Burgensen	7 00	107						
2088	jn4	1 30 pm	4	" "	5 55	110						4 46
2387	ng3	8 15 pm	6	Glossenger	3 10 am	106		local $100.58				5 52
2387	jn6	7 00	7	" "	6 55 am	114		local 52 miles overtime				6 76
2391	ng1	1 45 pm	9	" "	7 00 pm	107		~~local 52 miles overtime~~				7 83
2391	jn4	1 30 pm	10	" "	6 10	110						8 93
2375	ng3	9 45 pm	14	" "	3 30 am	107						10 00
2343	jn4	1 30 pm	15	" "	6 55 pm	110						11 10
					July 16							12 16
2381	Jal local	7 45 am	19	Redding	1 20 pm	106		3 hrs to meal				13 26
2381	local	9 00 am	20	" "	5 35	110						
2391	ng3	1 45 am	22	Glossenger	6 45 am	100		$79.50				14 26
2391	2/2S2	3 30 pm	22	" "	9 35 pm	121						15 47
2380	ng3	9 45 pm	23	" "	6 55	107		local				16 54
2380	jn6	7 00	24	" "	2 35 am	110		local.				17 64
2380	ng3	9 15 pm	26	Fisher	3 10 am	107		local.				18 71
2380	jn4	1 30 pm	27	" "	5 50	110						19 81

on Pass 28

Time from aug -1 1927 To 192

ENG. No.	TRAIN No.	CALLED FOR	TIME LEFT	STATION	TIME ARRIVED	STATION	OVERTIME HRS. MIN.	WORKING TIME FROM - TO	ENG. CODUCTOR FIREMAN-BREAKMAN	TOTAL MILES MADE	RATE PER 100	TOTAL AMT. $ & CTS.
1 trip on pass.												
4	mc	7 15	2391	Sheeler	12 00 am	105						
5	cD4	5 30 am	2391	" "	10 45 a	111						2 26
2342	mc5	8 15	6	" "		100						
2342	2/gs2	3 30	6	" "	9 50	121			85.79			4 37
2087	mc5	8 45	9	" "	3 05	100						5 37
2387	2/gs2	3 30	10	" "	10 05	121						6 59
2380	LDC1	1 15	12	" "	5 45	100						7 59
2380	cD4	3 30 am	13	" "	11 00 am	121						9 70
2339	ng3	10 15	14	" "	5 50 am	107						11 87
2339	gn4	1 45	15	" "	6 40 am	110		Tax check 76.71				
2088	gc1	3 15	18	cooper	12 20	111	13 miles over time					12 98
2088	cD2	5 45	18	" "	10 00	100						13 98
2342	gc1	3 45	20	" "	11 30	111						15 00
2399	CD2	5 30	20	" "	10 05	100						16 00
2399	nsyd	5 45 am	22	" "	11 30 am	114			$82.01			17 14
2399	BA2	8 30	22	" "	4 00 am	110						18 24
2387	ng1	1 45	24	sheeler	6 45	106						19 30
2387	gn4	1 30	25	" "	5 30	110						20 40
2351	gc1	3 00 am	29	cooper	3 25	119	3 miles porter 62 miles over time					21 60
2338	cD4	3 30 am	30	" "	10 55	121						22 81
2088	ng3	9 45	31	" "	6 50 am	107	Local					23 90
2087	gn4											

Time from Sept 1 1932 To 192

ENG. No.	TRAIN No.	CALLED FOR	TIME LEFT	STATION	TIME ARRIVED	STATION	OVERTIME HRS. MIN.	WORKING TIME FROM - TO	ENG. CODUCTOR FIREMAN-BREAKMAN	TOTAL MILES MADE	RATE PER 100	TOTAL AMT. $ & CTS.
2187	9 m4	2 pm	1	coupler	6 50 a	110						
2392	9 S yd	4 pm	3	" "	12 10	119		Local.				3 29
2392	C D2	5 30	3	" "	10 pm	100						
2084	Bit	6 15	6	" "	10 20	119		Local	D			4 48
2084	BA2	7 30	6	" "	4 35	110	15 mins overtime		84.16			5 58
Dead Head							on the 8					6 63
2068	9 m4	2 pm	9	" "	6 30	110						7 73
2367	9 Local	9 30	11	" "	6 50	110	2 16 mins overtime					8 86
2367	9 Local	9 30	12	" "	6 pm	110	12 mins overtime					9 90
2351	9 S yd	3 15 pm	14	" " Back on BA2	arrived at		mins 4 10 pm 205 miles					11 95
2083	9 Local	11 30	16	" "	6 25	106						13 50
2083	Local	9 30	17	" "	10 50	110	5 hr 2 mins overtime		local			14 40
2373	2343	12 15	19	" "	8 50	109						15 40
2373	2343	7 30	19	" "	4 05 pm	100 1 hr 5	1 hr mins overtime to Cary Gap work & Joliet					16 40
2084	2083	1 30 pm	20	" "	7 05	110	1 hr 2 mins overtime		28254			17 50
2324	Spec.	11 30 a	Dead Head to	Chi. for	9		6 20	165 miles				18 75
2377	9 J1	3 15	22	" "	10 50	116 local	mile to Bit - work - yd					19 91
2377	9 m4	7 30	23	" "	6 30	110						20 00
2345	9 C1	9 15	24	" "	1 pm	100						
2342	9 S2	7 05	25	" "	11 05	111						23 11
2372	9 S yd	12 45	27	" "	9 45	110	42 mins overtime					24 21
2372	C D2	6 25	27	" "	9 55	100						25 21
2339	9 J3	11 15	28	" "	8 40	107	1 15 mins overtime					26 27
2337	9 m6	9 30	29	" Local	10 a	116 Jol.	To Bit to mile 5 hrs 43 mins overtime					27 43

Time from Oct. 1 1937 To 192

ENG. No.	TRAIN No.	CALLED FOR	TIME LEFT	STATION	TIME ARRIVED	STATION	OVERTIME HRS. MIN.	WORKING TIME FROM - TO	ENG. CODUCTOR FIREMAN-BREAKMAN	TOTAL MILES MADE	RATE PER 100	TOTAL AMT. $ & CTS.
2034	gC1	3 30 am	1	cooper	10 05 am	105						1 05
2085	CD2	6 00	1	" "	10 10	100						2 05
2347	ng1	2 30	2	" "	7 50	107						3 12
2347	gal gal	6 30 am	3	" "	3 45	110						4 22
2376	DC3	2 15 am	5	" "	6 15 am	100						5 22
2087	CS2	3 30	5	" "	9 30	110						6 32
2388	Gil x	10 15	6	" "	10 20 am	150	35 mins overtime					7 82
2380	gC1	3 15 am	8	" "	10 45 am	105	$111.27					8 87
2347	CD2	6 00	8	" "	10 55	100						9 87
2396	ng1	2 45	9	Deutscher	8 15	107						10 94
2396	Local	8 30 am	10	" "	5 55	110						11 04
2349	mC5	8 45 pm	11	cooper	8 55 am	150	40 miles over time					12 54
2390	7 15 am	gol x	13	" "	1 50	107	Local					13 62
2390	12 15 am	x	13	" "	9 25 am	116	Gol. to Gil to mile					14 79
2337	gal Local	7 45 am	19	" "	3 35	105						15 81
2337	Local	8 30 am	20	" "	6 10	110		1 hrs 22 mins overtime				16 81
2367	gn4 ng1	2 45	21	" "	9 40	109						18 00
2367	gn4	1 30 pm	22	" "	6 30	110		$118.50				19 10
1218 997	DC7	1 30	23	" "	8 15	150 on	DC7 to lit and return					20 60
2087	ng3	10 45	24	" "	5 45	107						21 67
2087	gn6	7 30	25	" "	3 35 am	110						22 77
2343	DC3	2 15 am	27	" "	7 50 am	106						23 83
2343	g/gS2	3 30	27	" "	9 10	110						24 93
2387	ng1	2 00	28	" "	8 40	107						26 00
2387	gn4	1 30	29	" "	5 40	110						27 10
2376	ng1	1 45	30	" "	6 30	107						
2376	gn4	1 30	31	" "	6 15	110						

Time from Nov. 1 1937 To 192

ENG. No.	TRAIN No.	CALLED FOR	TIME LEFT	STATION	TIME ARRIVED	STATION	OVERTIME HRS. MIN.	WORKING TIME FROM - TO	ENG. CODUCTOR FIREMAN-BREAKMAN	TOTAL MILES MADE	RATE PER 100	TOTAL AMT. $ & CTS.
2341	gC1	3 30 am	2	cooper	10 15 am	105						
2341	3gS2	4 00 pm	2	" "	10 00 pm	110						2 15
2387	DC3	2 15 am	4	" "	7 25 am	105						3 20
2379	cD2	6 00 pm	4	" "	9 50 pm	100						4 20
2085	mC1	7 45 pm	5	" "	12 10 am	100						5 20
2085	gS2	10 30 am	6	" "	6 55 pm	110	7 mins over time		20 mis turning at 1 c.			6 30
2376	mC5	10 00 pm	7	" "	4 00 am	100	Double Head with		1258 $101.07			7 30
2376	2gS2	3 15 pm	8	" "	9 45 pm	121						8 51
2085	ng3	11 15 pm	9	" "	9 15 am	107	2 hrs over time		Local.			9 58
2085	gm6	7 30 pm	10	" "	5 45 am	110	1 hr. 57 min	Local				10 68
2379	gC1	3 00 am	12	" "	9 15 am	115						11 78
2363	BA2	7 30 pm	12	" "	3 45 am	121						13 99
2373	gC1	3 00 am	20	cooper	9 40 am	112						15 11
2340	BA2	7 30 pm	20	" "	3 35 am	121						16 32
2083	gol x	10 45 pm	22	" "	4 30 am	106	local		$96.33			17 38
2083	gn6	7 30 pm	23	" "	4 35 am	110	local.	47 mins over time.				18 48
2368	gol x	3 15 pm	25	" "	9 10 pm	107						19 55
2368	gol local	9 00 pm	26	" "	4 05 pm	110		Local.				20 62
2396	gol x	8 40 pm	28	" "	4 15 am	107	Local.					21 69
2396	gn6	7 30 pm	29	" "	8 15 am	134	Local.	Gol. East Gray to Gib - miles	2 hr 47 mins over time			23 03

Time from Dec. 1 1927 To 192

ENG. No.	TRAIN No.	CALLED FOR	TIME LEFT	STATION	TIME ARRIVED	STATION	OVERTIME HRS. MIN.	WORKING TIME FROM - TO	ENG. CODUCTOR FIREMAN-BREAKMAN	TOTAL MILES MADE	RATE PER 100	TOTAL AMT. $ & CTS.
2394	2C7 BR2	2 15 pm	day.	cowper	4 20 pm	Dc7-to	45 min to engr. Bk to mils					205
2384	2C6 952	5 45 pm	3	" "	5 15 pm	Local	mils to Bk to wilson 952					175
2086	3MC5	10 00 pm	8	" "	4 10 pm							100
2086	2 952	2 30 pm	8	" "	9 20 pm			$68.11				111
2367	9C1	3 45 pm	10	Redding	9 25 pm					105		
2347	4D2	6 00 pm	10	" "	10 00 pm					100		802
2347	3MC5	10 15 pm	11	cowper	9 00 am	Dc6 turn	9 PM - 6			150		952
2088	4C6	9 45 pm	13	" "	9 55 am	" "		Local		166		1118
2075	3J1	2 00 pm	15	" "	7 05					107		1236
20												
2085	3rd called	9 00 am	16	" "	3 50			Local		110		1335
2383	3MC5	10 15 pm	17	" "	5 30		turn for mB4-6			150		1485
2087	3J3	10 45 pm	19	" "	7 20	Local		35 min over time		106		1591
2087	3J4	4 30 pm	20	" "	6 35					110		1691
4350	2C7	1 45 pm	22	" "	4 25 pm			$85.11		205		1896
			Laid off for Xmas.									
2372	3rd Coach.	3 15 pm	28	" "	10 40 pm	Local.				106		2000
2392	3J4 952	1 30 pm	29	" "	8 15 pm	3rd to	1 hr 45 min to Bk to mils			136		2136
2363	MC5	6 45 pm	31	" "	2 45 am					100		2236

Time from ______________________ 192__   To ______________________ 192__

ENG. No.	TRAIN No.	CALLED FOR	TIME LEFT	STATION	TIME ARRIVED	STATION	OVERTIME HRS. MIN.		WORKING TIME FROM - TO		ENG. CODUCTOR FIREMAN-BREAKMAN	TOTAL MILES MADE	RATE PER 100	TOTAL AMT. $ & CTS.	

Time from ______________________________ 192___

ENG. No.	TRAIN No.	CALLED FOR	TIME LEFT	STATION	TIME ARRIVED	STATION

Time Computing Table

Table Showing Time and One-Half for Overtime (18¾ Miles per Hour) Expressed in Miles. Applicable to Road Freight, Transfer and Yard Switching Service from 3 Minutes to 8 Hours, Inclusive.

Over-time	Miles	Over-time	Miles	Over-time	Miles
3	1	2 43	51	5.23	101
6	2	2.46	52	5.26	102
10	3	2.50	53	5.30	103
13	4	2.53	54	5.33	104
16	5	2.56	55	5.36	105
19	6	2.59	56	5.39	106
22	7	3.02	57	5.42	107
26	8	3.06	58	5.46	108
29	9	3.09	59	5.49	109
32	10	3.12	60	5.52	110
35	11	3.15	61	5.55	111
38	12	3.18	62	5.58	112
42	13	3.22	63	6.02	113
45	14	3.25	64	6.05	114
48	15	3.28	65	6.08	115
51	16	3.31	66	6.11	116
54	17	3.34	67	6.14	117
58	18	3.38	68	6.18	118
1.01	19	3.41	69	6.21	119
1.04	20	3.44	70	6.24	120
1.07	21	3.47	71	6.27	121
1.10	22	3.50	72	6.30	122
1.14	23	3.54	73	6.34	123
1.17	24	3.57	74	6.37	124
1.20	25	4.00	75	6.40	125
1.23	26	4.03	76	6.43	126
1.26	27	4.06	77	6.46	127
1.30	28	4.10	78	6.50	128
1.33	29	4.13	89	6.53	129
1.36	30	4.16	80	6 56	130
1.39	31	4.19	81	6.59	131
1.42	32	4.22	82	7.02	132
1.46	33	4.26	83	7.06	133
1.49	34	4.29	84	7.09	134
1.52	35	4.32	85	7.12	135
1.55	36	4.35	86	7.15	136
1.58	37	4.38	87	7.18	137
2.02	38	4.42	88	7.22	138
2.05	39	4.45	89	7.25	139
2.08	40	4.48	90	7.28	140
2.11	41	4.51	91	7.31	141
2.14	42	4.54	92	7.34	142
2.18	43	4.58	93	7.38	143
2.21	44	5.01	94	7.41	144
2.24	45	5.04	95	7.44	145
2.27	46	5.07	96	7.47	146
2.30	47	5.10	97	7.50	147
2.34	48	5.14	98	7.54	148
2.37	49	5.17	99	7.57	149
2.40	50	5.20	100	8.00	150

ceed. Care should be taken to see that the other safety valves relieve the steam pressure properly.

89. Q. **How can an engine be brought in with a broken front end or stack?**

A. By boarding up the front end to make it as near air-tight as possible and using a barrel or a petticoat pipe in place of the stack, wiring it fast to the smoke-arch. Where a portion of the stack is inside the smoke-box, the engine might steam without the barrel or petticoat pipe.

90. Q. **What should be done if the frame is broken between the main driver and cylinder?**

A. Either give up the train and come in light, or disconnect the engine on that side and come in with reduced tonnage, depending on how badly engine pounds when working steam.

91. Q. **If the frame is broken back of the main driver?**

A. Do not disconnect and do not try to pull a heavy train; it is safer to come in with light tonnage.

92. Q. **In case of broken side rods, what should be done?**

A. Take down the broken rod and corresponding rod on the other side of the engine.

93. Q. **What can be done if the intermediate side sods were broken on a consolidation engine having the eccentric on the axle ahead of the main wheel?**

A. In this case the engine must be towed in. It is possible when the main pin is broken, so that all rods on one side are taken off, to leave the rods up on the other side and move the engine with her own steam, but very few roads will allow this, because engineers will be inclined to leave the main rod up on the disabled side to prevent engine catching on the center. If main rod is left up on the disabled side, the wheels will surely slip and wreck the rods on the other side.

94. Q. **Should one of the forward tires, main tire, intermediate tire, back tire, or a trailer tire break, what must be done to bring the engine up?**

A. Would run the wheel of the broken tire on a block in order to raise the wheel clear of the rail and the box up in the driving box jaws. Remove the oil cellar and place a block between the driving journal and pedestal brace to carry the disabled wheel center clear of the rail. Would also block up on top of the box of the wheel ahead or back as the case might be, in order to take the weight from the disabled wheel. It might not be necessary to take off any of the rods, but would run the engine light to the shop, giving special attention to lubrication of the disabled wheel and using extra precaution in entering side tracks and passing over frogs and switches. With the tire of a back driver or trailer wheel broken, it is usually necessary to swing the rear end of the engine from the tender to keep the rear end on the track. With an inside radial journal, box on the trailer axle; for a

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broken trailer tire, both trailer wheels must be blocked and swung clear of the rail.

95. Q. **What is a good method of raising a wheel when jacks are not available?**

A. By raising the wheel on a hardwood block or iron wedge; a re-railing frog comes very handy for this purpose.

96. Q. **How can it be known when the wedges are set up too tight and the driving box sticks, and in what manner can they be pulled down?**

A. If wedges are set up too tight, it causes the boxes to stick and the engine to ride rough. Inspection of the engine when moving will locate the disabled box; usually this gets hot at once and the wedges should be immediately pulled down. Loosen the jam nuts on the wedge bolts and back them down; if the wedge is stuck very tight it may be necessary to run one or more of the wheels over a block; or to loosen the pedestal brace bolt and allow the jaws to spread to release the box.

97. Q. **What are some of the various causes for pounds?**

A. Wedges not properly adjusted, loose or worn driving box brasses; rod brasses not keyed or in need of reducing, loose side rod bushings or side rod connections, worn cross-heads, wrist pins, broken frame, loose cylinder key, loose piston on rod, or rod loose in cross-head, loose follower bolts or obstruction in the cylinder.

98. Q. **How may a pound in driving boxes, wedges or rod brasses be located, and after locating what should be done?**

A. Place the engine at half stroke on side to be tested. Do not set brake when testing for loose wedges or defective boxes; set brake when testing for other pounds. Reverse engine from forward to back gear under steam, noting the movement of the axle in the boxes, the driving boxes between, the wedges, rod brasses on the pins and movement of cross-head between the guides. If possible would adjust wedges or rod brasses at once and report repairs needed at the terminal.

99. Q. **How locate loose follower bolts?**

A. Shut off steam and allow engine to drift; there will be a pound in the cylinder when the loose follower bolt strikes a forward cylinder-head as the engine passes the forward center on that side; give engine steam while still moving and if the pound stops it is likely to be a loose or broken follower bolt. When working steam, the compression or pre-admission takes up the lost motion in the rod and connections, so the loose bolt does not strike the head; when shut off the piston travels the extra amount of this lost motion and the bolt strikes the head.

100. Q. **When should cross-heads or guides be reported to be lined?**

A. When there is excessive lost motion between the cross-head and the top and bottom guides, or between the cross-head and the guide at the sides, or when the piston rod is not central between the guides.

101. Q. **When should driving box wedges be reported to be lined?**

A. When they have been set up as far as possible and the boxes are still loose between the wedge and shoe. At this time would also report any excessive flange wear on any one particular tire.

102. Q. **When should rod brasses be reported to be reduced? When to be lined?**

A. Rod brasses should be reported reduced when they are larger than the pins and are pounding and cannot be keyed up properly. They should be reported to be lined when the key has been drawn or driven to its full length and the brasses do not close together or are too loose in the strap lengthwise of the rod.

103. Q. **When should lost motion between engine and tender be taken up?**

A. When the lost motion becomes so great as to endanger the breaking of connections.

104. Q. **How do you proceed to pack a driving box equipped with a grease cellar?**

A. Remove the filling plate on the inside of the cellar. Pull down the indicators and follower plates, insert the grease between the follower plate and perforated plate; when full, replace the filling plate on the inside of the cellar and allow the spring and follower plate to force the grease through the perforated plate to journal.

105. Q. **Please explain the principle on which an injector work.**

A. With a lifting injector the steam valve is opened a small amount to furnish steam for the priming or strating jet. This forces the air in the body of the injector and top end of suction pipe out through the overflow valve, producing a partial vacuum in the body of the injector. Atmospheric pressure in the tank then forces the water into the injector body. When it begins to come out through the overflow, a further movement of the steam valve opens the forcing valve wide, so a full supply of steam strikes the water at a high velocity and at the same time condensing. This action of the steam gives the water sufficient velocity to overcome the boiler pressure and pass into the boiler.

106. Q. **Explain the passage of steam from the boiler to the steam heat pipe.**

A. Steam is admitted to the steam heat pipe, in which there is placed a reducing valve through which it passes at reduced pressure, into the steam heat pipe under the entire length of the train. The reducing valve is located in the cab close to the steam heat throttle.

107. Q. **If the steam heat gauge shows proper pressure but the steam heat pipe pressure appears to be low, what should be done?**

A. If the steam heat gauge is showing the correct pressure there is an obstruction in the pipe somewhere, most likely in the steam heat hose, and this should be looked for and remedied; if the gauge is correct, then

it is the reducing valve that is at fault and this should be readjusted, as well as the gauge.

108. Q. **What is the cause of failure with the second injector, and what should be done to obviate this failure?**

A. Lack of attention and failure to use every day will allow joints to work loose and boiler check to fill up with mud and scale. It should be tested every day and worked regularly so as to keep it in good working order.

109. Q. **If an injector stops working while on the road, what should you do?**

A. Would first ascertain if sufficient water was in the tender and tender valve open, and that water was cool enough in the tender so the injector would handle it. Would next see that no obstruction was in the feed pipe or strainer and that the feed pipe was free from leaks, and that the injector was getting a sufficient supply of steam. If the injector would not prime, would see whether overflow or heater valve could open wide, or if overflow pipe was obstructed. If suction pipe was very hot would blow water back into tank and let suction fill with cold water. If possible, examine for obstruction in the steam priming tube and water tubes. If it would prime and fail to deliver water to the boiler, would see that the delivery tube was not obstructed and then look for trouble at the boiler check. An obstruction in the tubes would stop the injector working at once, while wear of the tubes or filling up with scale would affect the injector gradually.

110. Q. **What are the advantages of the combination boiler check and stop valve?**

A. A combination boiler check is fitted with a valve similar to a globe valve and can be closed at will. Its advantage is that the boiler pressure can be shut off from the check and the valve repaired without cooling the boiler. This hand-operated valve can be closed to prevent the boiler water passing back in case the check valve sticks up and allows the boiler water to pass back to the

111. Q. **How can a disconnected tank valve be opened without stopping?**

A. Close the overflow or heater valve and turn steam back toward the tank; this will usually lift the valve from its seat or turn it around so it opens.

112. Q. **What comprises the steam heat equipment on a locomotive?**

A. A globe valve throttle at the boiler, a reducing valve. a steam gauge connected to the steam heat pipe and the proper piping hose connections.

113. Q. **What pressure is carried in the steam heat pipe and how is it controlled?**

A. From twenty to sixty pounds in the train pipe, depending on the length of the train, and is controlled by the regulating valve.

114. Q. **What would you do in case regulating valve failed to operate?**

A. In case the regulating valve would not admit sufficient steam to the train pipe, would take it apart and block the steam valve open. If the pressure ran up too high in the steam heat train pipe, would control it with the steam throttle at the boiler head.

115. Q. **How does the steam reducing valve control the pressure?**

A. The inlet valve for live steam is opened and closed by the movement of a metallic diaphragm in the valve which is opened by spring pressure on one side and closed by steam pressure on the other side. To regulate this pressure, stiffen the spring to carry more, weaken it to carry less by turning the handle connected to this spring either up or down.

116. Q. **If steam heat gauge showed the required pressure and cars were not being heated properly, how would you proceed to locate the trouble?**

A. First note where the hand on the steam heat gauge stands when steam is shut off; if it does not drop back to zero see how much it lacks of this and note the rise of pressure shown by the gauge when steam is turned on. This is to test the gauge. If gauge is not correct, pay no attention to it, but send back steam enough to heat the train. Over sixty pounds will usually make the hose couplings on the cars rise up and leak at the joints.

117. Q. **When engine is detached from the train, what precaution should you take to prevent freezing of the steam heat train pipe? What to prevent damage of steam heat hose?**

A. Open steam throttle to allow a very little steam to pass into steam heat train pipe to prevent its freezing. If end of hose is liable to strike frogs or crossings, hang it up where it will be safe.

118. Q. **What constitutes abuse of an engine?**

A. Improper use of injector by filling boiler at a rapid rate when drifting or standing in a siding, unless you have a heavy bright fire to heat the injected water to the boiler temperature as fast as it comes into the boiler. Excessive use of the blower, especially with a light fire, or when cleaning the fire. Improper attention to machinery, such as keeping parts not properly lubricated, rods not properly keyed, wedges not adjusted, carrying too much or too little water in the boiler, working water through the cylinders, allowing engine to slip unnecessarily, use of sand on one rail only or otherwise improperly; being careless in any way where care is required and not properly reporting the necessary work so it can be done promptly.

119. Q. **How are accidents and breakdowns best prevented?**

A. By inspection both at and after leaving terminals, frequently while on the road, keeping all parts properly adjusted, water in the boiler at the proper level and using good judgment in the handling of the engine and train. It is much better to use care and prevent accidents than to make repairs after they occur.

120. Q. **What are the duties of an engineman when leaving his engine at the terminal?**

A. Place her on the proper track to be turned over to the hostler, leave throttle closed securely, reverse lever in center notch, cylinder cocks open, and lubricator feeds to steam chest and cylinders closed. The boiler should be full of water and sufficient fire to maintain steam pressure until fire is knocked out. Call fireman's attention to anything of special importance. Inspect the engine very thoroughly, ascertain whether any tools or signals have been lost on the trip and make a full report of the condition of the entire locomotive.

121. Q. **What is the most important bolt or nut on the locomotive?**

A. The loose one. It should be cared for immediately.

122. Q. **In reporting work on an engine, is it sufficient to do it in a general way, such as saying: "Injector won't work," "lubricator won't work," "engine won't steam," "engine blows," etc? Or would you report each special defect so it could be located after the engine was put in roundhouse or desginated track whether it had steam pressure in boiler or not?**

A. No. Report all defects noticed so plainly that they can be located by the repair man without unnecessary work and whether there is steam in the boiler or not at the time repairs are to be made. If the engine blows, make a test to locate the blow and report any unusual feature in the operation of the engine during the trip.

DISTRIBUTING VALVE DEFECTS

140. Q. **If the locomotive brake released with the automatic brake valve in lap position, where would you look for the trouble?**

A. Would look for a leak in the application cylinder pipe or in the application cylinder cap gasket.

141. Q. **If the brake remained applied in lap position, but releases in released or holding position, where would you look for the trouble?**

A. Would look for a leak in the distributing valve release pipe.

142. Q. **If the distributing valve release pipe and application cylinder pipe were crossed, what would be the effect?**

A. A break application made by the automatic brake valve cannot be released by the independent brake valve.

143. Q. **If the safety valve leaks, what will be the effect?**

A. This may prevent the brake applying, and in an independent application if the brake does apply, it will release when the brake valve is returned to lap position.

AIR BRAKE

1. Q. **Why is the present brake called the automatic brake?**
A. The present brake is called the automatic brake because when a hose bursts or train parts the triple valves will automatically apply the brakes on the whole train.

2. Q. **Where is the compressed air stored?**
A. Compressed air is stored in main reservoir train pipe and auxiliary reservoirs.

3. Q. **What are the several functions of the auxiliary reservoir, train pipe, triple valve and brake cylinder?**
A. The function of the auxiliary reservoir is to receive and store air for use in applying the brake on the car on which it is placed. Auxiliary pressure, when it is fully charged, is equal to train pipe pressure. The function of the train pipe is that of a conduit through which air passes to charge the triple valve and the auxiliary reservoirs. The triple valve has three functions to perform: 1st—To charge the auxiliary by connecting it with the train pipe. 2nd—To apply the brake by connecting the auxiliary with the brake cylinder. 3rd—To release the brake by connecting the brake cylinder with the atmosphere. 4th—The brake cylinder is a cylinder in which a piston operates, and brake levers are connected to the cross-head in such a way that when air is admitted to the brake cylinder it forces the piston out and the brake shoes are forced up to the wheels.

4. Q. **Where does the pump deliver the air?**
A. The pump delivers the air to the main reservoir.

5. Q. **Where does the main reservoir pressure begin and end?**
A. Main reservoir pressure begins at the pump and ends at the engineer's brake valve.

6. Q. **What is excess pressure?**
A. Excess pressure is the pressure maintained in the main reservoir and is so called because it exceeds the pressure maintained in the train pipe and auxiliary reservoirs.

7. Q. **Why is excess pressure necessary?**
A. Excess pressure is necessary to quickly recharge the train pipes and auxiliaries after brakes have been set by reducing train pipe pressure. Also to supply any leaks in train pipe.

8. Q. **How should a brake be cut off?**
A. When, on account of some defect in the apparatus, it becomes necessary to cut a brake out of service, proceed as follows: If a quick action brake, close the cut-out cock in the branch pipe of the triple valve. If a plain triple is used, first release the brake so that the brake piston moves back and uncovers the leakage groove; turn the handle to the position that is midway between the horizontal and verticle positions. The release valve of the auxiliary reservoir must then be opened and secured in that position.

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9. Q. **How should handle of cut-out cock stand when closed?**

A. Handle of cut-out cock should be parallel to train pipe below engineer's brake valve when closed. The handle of cut-out cock on a car branch pipe stands at right angles with branch pipe when open and parallel with branch pipe when closed.

10. Q. **How should handle of angle cock stand when closed?**

A. Handle of angle cock should stand at and parallel to branch pipe when closed.

11. Q. **What does line on end of plug indicate, regardless of position of handle?**

A. If there be doubt whether a cock be open or closed, glance at crease in top plug valve. This crease should be parallel with the pipe when the cock is open.

12. Q. **How should a brake be "bled" off?**

A. If a brake on any particular car should "stick" it can be released by opening the bleed cock on the auxiliary on that car until air begins to exhaust from the triple valve, when the bleed cock should be immediately closed.

13. Q. **When should the brake valve be used in the emergency position?**

A. In case of actual emergency the brake valve handle should be thrown to full emergency position and left there, and sand used.

14. Q. **What does the red hand on the air gauge register?**

A. Main reservoir or excess pressure.

15. Q. **What does the black hand register?**

A. The pressure in chamber D of engineer's brake valve, which is usually the same as train pipe pressure.

SPECIAL INSTRUCTIONS ON THE No. 6 E T BRAKE EQUIPMENT

If after making a service application and with automatic brake valve handle on lap, the brakes pipe exhaust continues to blow, look for a leak in the equalizing reservoir or its connections, including those to the air gauge.

If the equalizing reservoir pipe breaks, plug it at the brake valve union, then plug the brake pipe service exhaust. When the automatic brake valve is in this condition, to apply the brakes, move the handle gradually toward the emergency position, making the desired brake pipe service reduction gradual and direct, then return the handle gradually to lap position.

If the brake pipe connection to the distributing valve breaks, plug the pipe if it is not provided with a cut-off cock.

If the distributing valve release pipe leaks between the independent and automatic brake valve, the effect

will be to destroy the holding features of the automatic brake valve when releasing the train brakes.

If the release pipe leaks between the distributing valve and the independent brake valve, it will prevent an independent application of the brakes remaining applied.

If the brake leaks off with both the automatic brake valve and independent brake valve application, it is caused by a leakage in application cylinder pipe, in the application cylinder cap or in the safety valve.

Should the application cylinder pipe break, plug it up at the distributing valve; then the independent brake cannot be used, but the automatic brake will not be affected.

If the distributing valve release pipe breaks and the use of the independent valve and of the holding feature of the automatic brake valve are desired, plug the broken distributing valve release pipe at the distributing valve. The locomotive brake must then be released with the independent brake valve.

If the main reservoir pipe connection to the lower side of the diaphraghm in the governor breaks, plug it or crush the end and proceed. Throttle the air pump.

If the distributing valve supply pipe breaks, stop the flow of air and plug the opening from the distributing valve. The locomotive brakes are then inoperative except when a quick action cap is used on the distributing valve and then only in emergency. In the latter event, the pressure obtained in the locomotive brake cylinders is equal to that vented through the quick action cap from the brake pipe.

If the main reservoir pressure is materially reduced or the number of compressor strokes increase considerably when the brakes are applied, it indicates a very leaky condition of the brake cylinders and their connections.

If the engine brake creeps on with the automatic and independent brake valves in running position, move the automatic brake valve to release position and back to running position. When the brake acts in this manner it indicates a dirty feed valve, which should be reported to be cleaned.

If the locomotive breaks off from the train, immediately place the automatic brake valve in emergency position.

WALSCHAERT VALVE GEAR

1. Q. **Give a brief explanation of the Walschaert valve gear.**

A. The Walschaert gear has an eccentric crank attached to the end of the main pin on each side of the locomotive, with an eccentric rod from this pin to the connection at the bottom end of the forward and back motion. The link swings on a center trunnion and cannot be moved up and down as the Stephenson link, but link block can be moved from one end of the link to the other to reverse the engine, or part way toward the center of the link to change the cut-off. A radius rod connects the link block to the valve stem. There are two motions given to

the valve stem, one from the link block which regulates the travel of the valve for the cut-off and reversing; the other motion is from a connection with the cross-head, which gives the valve a positive motion to take care of the lap and lead. To give this motion there is used a combination lever or a lap and lead lever connected to a cross-head arm by the union link.

2. Q. **Is the Walschaert Gear direct or indirect?**

A. It is direct when the link block is below the center of the link; it is indirect when the link block is above center of the link.

3. Q. **What are the principal differences in the location of the Stephenson and Walschaert gears, and what advantages does this give the Walschaert?**

A. The Stephenson gear is placed between the main frames and employs two eccentrics their straps and rods on each side of the locomotive; one for forward and one for backward motion. The Walschaert gear is placed outside the driving wheels and frame, but has one eccentric, which is simple arm connected to the outside end of the crank pin for both forward and back motion. The links are set above the wheels on a level with the steam chest, the combination lever next to the crosshead. This gives it an advantage of a better chance to inspect all parts, the eccentric connections are much lighter and direct, which makes them less liable to wear or break down and the valve has a constant lead.

4. Q. **How is the lead effected by movement of the reverse lever with the two gears?**

A. With the Stephenson gear the lead increases as the reverse lever is hooked toward the center in both forward and back motion. With the Walschaert gear the lead is the same in all positions of the lever, so that the lever is used only to reverse the engine or adjust the cut-off.

5. Q. **In reversing, how do the two gears differ as to movement of the link and link block?**

A. With the Stephenson gear, when reversing, the link is raised and lowered, bringing the block which is not moved by the reverse lever under control of either the forward or back-up eccentric as it is desired to move the engine the proper way. With the Walschaert gear the link is not moved by the reverse lever, but the link block is raised and lowered in the link; the position of the block above or below the center of the link controlling the direction or motion.

6. Q. **What would you disconnect if the eccentric crank, eccentric rod, or the arm at the bottom of the link should break?**

A. Would remove the broken parts, disconnect the link lifter from the radius rod and block the link block in the center of the link; the combination lever would then move the valve twice the amount of its lap and lead, which would be sufficient to provide for lubricating the cylinder.