VICTORIAN RAILWAYS.

PRACTICAL QUESTIONS AND ANSWERS

CONCERNING THE

LOCOMOTIVE

FOR ENGINE CLEANERS.

MELBOURNE, JULY, 1906.

Supplement to Practical Questions and Answers concerning the Locomotive for Engine Gleaners.

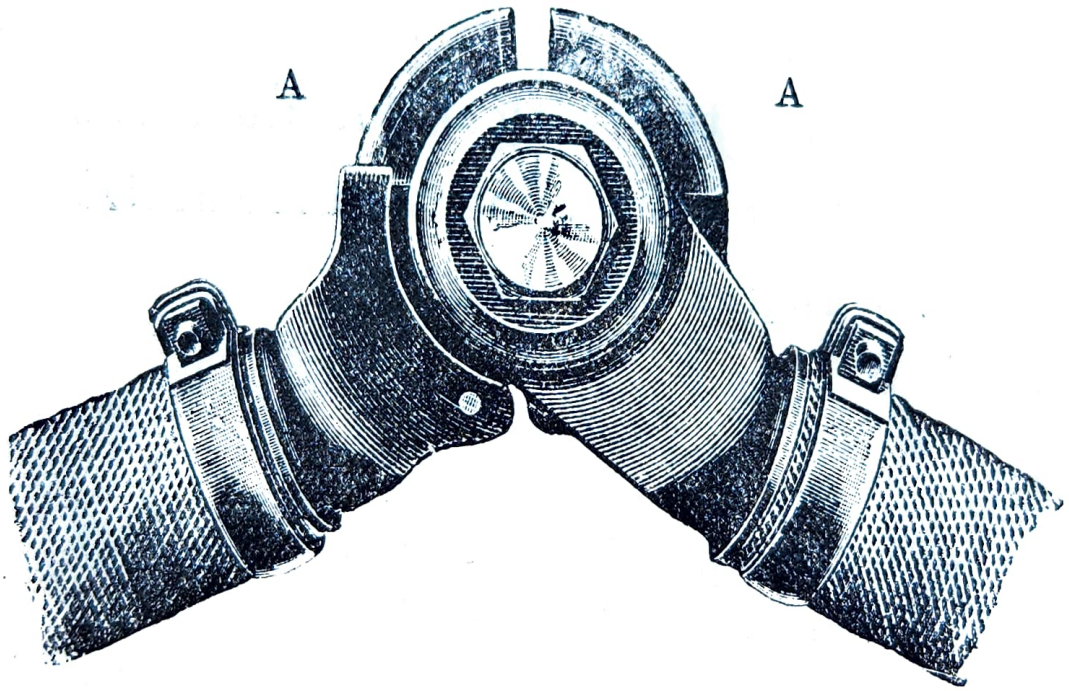
1. Q.—Describe briefly the position of the Train Pipe on a train?

A.—The Train Pipe extends from the Driver's Brake Valve to both ends of the train, communicating by "branch pipes" with the brake apparatus on the engine, tender and each vehicle.

2. Q.—How are the air-tight connections of the Train pipe made?

A.—Air-tight connections of the Train pipe are made between the vehicles by flexible rubber hoses, attached to the iron pipes, and fitted with metallic Coup-

ling Heads suitably arranged, to be readily coupled or uncoupled.



POSITION OF COUPLING HEADS BEFORE THEY CAN BE UNITED.

3. Q.—How are the Hose couplings between two vehicles united?

A.—The couplings between two vehicles are united by placing their heads face to face nearly at right angles, and then turning the projecting piece of the one into the corresponding groove of the other.

4. Q.—Describe briefly the Hose Coupling heads?

A.—The two Coupling Heads are exactly alike, each being provided with a rubber packing ring, so arranged that whenever two Couplings are united these rings face against each other. The air pressure in the Train Pipe tends to force the rings together, thus forming an air-tight joint, which becomes tighter with increase of pressure.

5. Q.—What happens should the Hose couplings be forcibly drawn apart by a separation of the train?

A.—The Brakes are applied with full force.

6. Q.—In what position are the stop cocks on a vehicle? For what purpose are they placed thereon?

A.—Stop cocks are fixed at each end of the train pipe of every vehicle, and are located near the connection with the Hose Coupling. These Coupling Cocks are for the purpose of retaining the air pressure stored in the brake apparatus of vehicles temporarily detached from a train.

8. Q.—Describe the position of the

handle of a straight stop cock (a) When open ? and (b) When closed ?

A.—When a straight stop cock is open the handle is in a horizonal position ; when closed, it is in a vertical position.

The handles of such cocks for open and closed positions are as shown below :—

Straight Coupling Cock.

B

Cock open.

C

Cock closed.

9. Q.—Describe the position of the handles of a Stop Cock on a bent Coupling cock :—

(a) When open ?

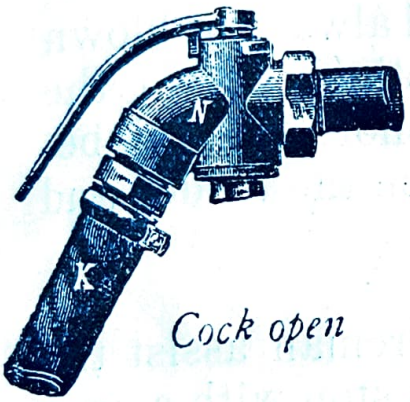
(b) When closed ?

A.—When stop cock is open the handle stands parallel with the pipe, and

when closed the handle stands across the pipe.

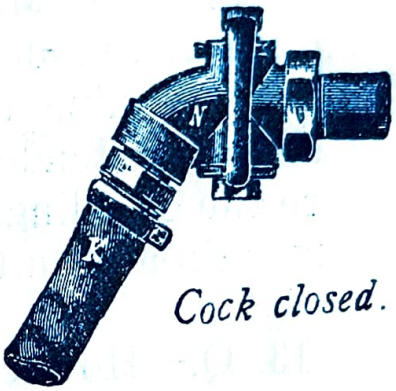
Bent Coupling Cock.

D



Cock open

E



Cock closed.

7. Q.—How many kinds of Stop Cocks are there?

A.—Two. One bent and one straight.

10. Q.—What should be done after the couplings between two vehicles have been connected?

A.—The corresponding cocks must at once be opened to allow a free communication of air through the Train Pipe.

11. Q.—Before separating the hose pipes, what must be first done?

A.—Before the Couplings are separated the corresponding cocks must always be closed.

12. Q.—Describe what should be done before coupling an engine on to a train?

A.—The Main Pipe under the locomotive and tender should always be blown out by opening the coupling cock at the back of the tender for a short interval, before the couplings between the tender and the train are united.

13. Q.—How can a Fireman assist the Driver to make a smooth stop with a passenger train?

A.—By carefully watching when the train is about to be stopped, and easing or tightening the brake, to prevent rebound between the engine and train.

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PREFACE.

This Book is printed for the purpose of assisting Engine Cleaners to gain a knowledge of certain of the duties required of Firemen.

Cleaners before being allowed out as Firemen will be subjected to an examination on the Rules and Signals, and on Questions 1 to 47 herein, and, after completing 313 days' firing, will, in addition to re-examination in the above, require to pass an examination in Questions 48 to 81 before their appointment as Firemen will be confirmed.

All Firemen at present unclassified will be subjected to an examination on the whole of the Questions contained herein, and must be certified by the Examiner as competent before their appointment will be confirmed.

W. M. SHANNON,

CHIEF MECHANICAL ENGINEER.

Practical Questions on the Locomotive and Brake that Cleaners will be required to know before being allowed to act as Firemen.

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1. Q.—What is the general form of a Locomotive Boiler?

A.—A Locomotive Boiler is generally cylindrical, having a fire-box of rectangular section, with tubes from it through the cylindrical part to a smoke box on the front end.

2. Q.—What is the form of a Fire-box?

A.—The fire-box is a rectangular box, having an inner shell made of copper. The spaces between the sides of the fire-box and the outside shell are securely fastened together by stay-bolts, which are placed about 4 inches apart. As the top of the fire-box is flat, it needs to be supported, or the pressure of steam would bend it down and tear the sheets. These crown sheets are supported by crown bars and sling stays which, when the pressure acts on the crown sheets, prevent them from being bent down.

3. Q.—What are the uses of Tubes?

A.—The tubes connect the fire-box with the smoke-box, and carry away the hot gases from the fire. Having a large heating surface, and being surrounded by the water inside the boiler, the heat is quickly given up to the water, and thus helps to generate steam.

4. Q.—What should a Fireman do when he comes on duty?

A.—Test water gauges to see that there is a proper quantity of water in the boiler and make sure that the gauge does not show false water; examine the fire, fill sand boxes, and see that sand valves work properly and that the sand is not damp, examine ash pan and see that it is clear of ashes, see that dampers and ash arresters all work properly, clean lamps and front of engine generally (which must be kept clean and tidy and all bright parts polished); see that the tubes are clean, and that the brick arch and baffle plate is in good order; examine smoke-box, clean spark arrester, and do such oiling as the Driver may entrust him with.

5. Q.—If a Fireman finds anything wrong with the water, or that the engine is likely to be late in steam, what should he do?

A.—After taking the necessary steps to ensure the safety of the boiler, he should call the attention of the Driver or Foreman to the matter at once, as the responsibility of the Shed Staff ceases from the time the Driver takes charge of the engine.

6. Q.—Do you understand that you are entirely subordinate to the Driver, and must carry out whatever instructions he gives you, cheerfully and respectfully?

A.—Yes.

7. Q.—Do you also understand that you are not relieved of any responsibility in regard to signals, and that you must always be on the alert to act on your own responsibility?

A.—Yes.

8. Q.—What is the object in making the exhaust steam pass through the funnel?

A.—To increase the draught on the fire.

9. Q.—Explain how the exhaust increases the draught?

A.—The steam exhausting up the chimney draws the gases from the smoke-box, creating a partial vacuum in the smoke-box. When this takes place the atmospheric pressure forces the air through the fire bars, thus creating the draught.

10. Q.—What is it that, in conjunction with the fuel, makes the fire burn?

A.—Oxygen.

11. Q.—Where does oxygen come from?

A.—The atmosphere.

12. Q.—Is it necessary for a great quantity of air to go through the bars to make the fire burn properly?

A.—Yes.

13. Q.—Why?

A.—Because oxygen forms only one-fifth of the total volume of the atmosphere, consequently a great deal of air has to go through in order to get enough oxygen to make the fire burn properly.

14. Q.—How do you make up a fire?

A.—To make up a good fire, coal should be put on sufficiently long before train time to allow the fire to burn through. It should be thickest under the door and in the back corners, and thinnest in the middle of the box.

15. Q.—Explain how you would prepare and how you would work fire on the road?

A.—The fire should be built according to the load and the contour of the road. A good body of fire should be built well back and along the sides, depressed in the centre, and tapering towards the tube plate, where it should be fairly thin. In fact, the fire should be built just like a

big concave wedge. It should be kept as bright and clear as possible, and the coal put on often, and in small quantities, in order that the gases may be burned. Two or three shovelfuls should not be exceeded at a time, and in many cases one shovelful should be sufficient. The coal should be broken into pieces about the size of the fist, as coal broken up like this lies more closely together, and burns more easily and more quickly than larger lumps. There should be about one cwt. of coal on the footplate at one time, and by this means the Fireman could test how far that would take him. When this was used, another cwt. should be shovelled from the bunker, and thus the quantity used on different sections could be intelligently gauged.

16. Q.—Why is it, if you have a thin fire, and a hole is made in it, steam will fall at once?

A.—The air is cold and goes direct through the tubes, cooling them. In order to have the air do any good, it must be thoroughly mixed with the gases given off by the incandescent fuel.

17. Q.—What is black smoke?

A.—A mixture of various gases, watery vapour, and carbon. The carbon is the black part.

18. Q.—Will it burn?

A.—Not after it is formed. It can be partly prevented by intelligent firing.

19. Q.—How can it be prevented?

A.—The carbon of the coal is released when a fresh fire is put in, and if, at the moment of release, it can be mixed with the proper quantity of air and kept at a sufficiently high temperature it will ignite and burn. The fuel is cold when first supplied to the fire, and keeps the temperature below the igniting point. The best preventative is to fire "light," that is, to supply a small quantity of fuel at a time.

20. Q.—What effect would a very small nozzle in blast pipe have on your fire?

A.—It would cause a very fierce draught and tear holes in a thin fire.

21. Q.—What would you do then?

A.—Carry a heavier fire.

22. Q.—What would you do to prevent black smoke when engine is rolling with steam shut off?

A.—Put on a slightly heavier fire in sufficient time before shutting off so that the fuel will have begun to burn and thus not give off black smoke when the supply of air is checked. If the engine is shut off unexpectedly at any place where it is desired to prevent smoke, open the

fire door, or slightly starting the blower, which will generally prevent it.

23. Q.—What good effect does it have to open the fire door when the engine is at work?

A.—When the fire is heavy it sometimes aids combustion by furnishing needed air, and it generally prevents waste of steam at the safety valve; **but great care must be taken in doing this, as it has a tendency to cool the tubes and cause them to leak.**

24. Q.—What should be the condition of the fire on arriving at a station where a stop is made?

A.—Bright and clear, so that little smoke will flow from the stack. There may be sufficient fire on the grates to build on when the engine is started.

25. Q.—What should be avoided before arriving at a station where a stop is to be made?

A.—(1) Avoid putting in a green fire just before a stop.

(2) As far as possible avoid all duties that will distract my attention from the signals.

26. Q.—What should be the condition of your fire when you pitch over the summit of a long grade?

A.—The same as for a station stop.

27. Q.—What is the use of the dampers?

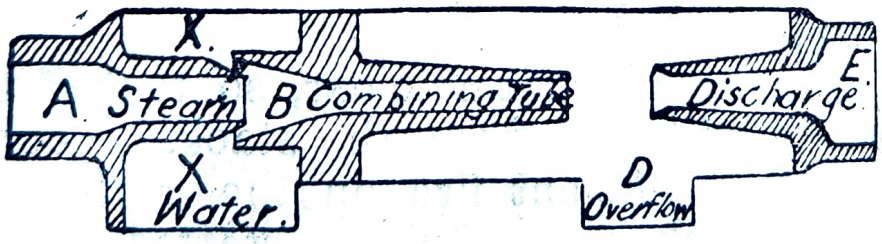
A.—To regulate the draught, and by that means control the steam pressure.

28. Q.—What is an injector?

A.—An instrument for feeding the boiler with water.

29. Q.—Explain the principle of the injector.

A.—There are numerous forms of injectors in use, but they are all developments of the arrangement of parts shown in illustration. Steam at a high velocity passes from the boiler into the tube A, and



striking the feed water at B is itself condensed. It, however, imparts a momentum to the water and sends it rushing along the delivery pipe E with sufficient force to raise the check valve against the pressure inside and pass into the boiler. As the current of water could not at once be started into rapid motion against the constant pressure of the check valve, an overflow opening is provided in the injector through which the water can flow unchecked till the necessary momentum is

obtained, when the overflow is closed. In a lifting injector the parts are so designed that, in starting, a jet of steam passes through the combining tube B at sufficient velocity to create a vacuum in the water chamber X, and the water is drawn into this place from the feed pipe as if by the suction of a pump; the steam jet then striking the water starts it into motion. If too much steam is admitted for the quantity of water passing, air will be drawn in through the overflow opening, mixing with the water and reducing its compactness, while some uncondensed steam will pass through with the water. This will reduce the force of impact of the feed water upon the boiler check, and when it becomes so light that the momentum of the feed water is no greater than the resistance inside the boiler, the water will break. On the other hand, when the quantity of water supplied is too great for the steam to put into high motion, part will escape through the overflow valve.

30. Q.—Explain how water should be carried in a boiler?

A.—Sufficient water should be carried to cover crown of fire-box and tubes in the front on up grades, and to cover the crown of fire-box on down

grades, or as nearly as possible, say half-a-glass should be shown on down grades and three-fourths on up grades. The water should never be out of sight in the bottom of the gauge-glass, under any circumstances.

31. Q.—Can too much water be carried?

A.—Yes. A boiler should not be forced to carry more water on grades than is required, and advantage should be taken of down grades and running into station to moderately fill boiler. Carrying too much water is bad, as it causes priming and gets into the cylinders, licks up the lubrication, and is liable under circumstances to break or split the cylinder covers or pistons.

32. Q.—What is a fusible plug and what are its uses?

A.—A fusible plug is a brass plug with a hole in the centre filled with lead. So long as there is water over it, it is kept at a low temperature, but if the water does not cover the crown of the fire-box, the heat in the fire-box will melt the lead and the steam will put out the fire. These plugs are therefore supplied as safeguards against burning of crown sheets on account of shortness of water. The lead in these plugs should be renewed every month.

33. Q.—How would you cool down and wash out a boiler?

A.—Reduce the pressure of steam by means of the continuous use of the injectors, which, in the case of washing out with cold water, may take from three to four hours. Place the hose in the front of the boiler which is to be filled right up to the top of the dome. Then allow the water to run out through the injector steam cocks, keeping the hose still running, until the water is quite cold. The corner plugs and blow-down cock should then be opened out, care being exercised to see that this is not done until the water is down to normal temperature, and the whole weight of the water in the boiler is allowed to rush through and carry out scale and any debris that may have accumulated. The wash-out rake to be used freely during these operations.

threaded. Then fill the boiler till the glass shows two-thirds full, and shut off all valves that have been previously opened, replace the front plug, see that the Regulator is closed, and roll up and put the wash-out hose in its proper place.

34. Q.—What is the use of the Brick Arch?

A.—To steady the temperature of the fire-box and ensure more complete combustion.

35. Q.—What is the use of the Baffle Plate?

A.—To prevent the cold air impinging on the tube plate when the fire door is open, and to assist combustion by directing the air to the top of the fire.

Westinghouse Air Brake and Hand Brake.

36. Q.—What are the means provided for stopping the engine and train?

A.—The hand brakes and the air brakes.

37. Q.—What is the duty of the Fireman when the train has to be stopped?

A.—To apply his hand brake.

38. Q.—How can the Fireman assist the Driver to make a smooth stop with passenger trains?

A.—By carefully watching when the train is just about to be stopped, and easing or tightening his brake to prevent rebound between engine and train.

39. Q.—Name the principle parts of the air brake on the engine?

A.—Air pump, main reservoir, small reservoir, driver's valve, triple valve and brake cylinders.

40. Q.—Name the parts attached to the tender and other vehicles in the train?

A.—Small reservoir, triple valve and brake cylinder.

41. Q.—How is the compressed air that operates the brake obtained?

A.—The air is compressed by the pump fixed on the engine and which is driven by steam drawn from the boiler. The air is compressed in the air cylinder and forced into the main reservoir?

42. Q.—Explain how the air is supplied to the small reservoir from the main reservoir?

A.—By the train pipe which extends from the main reservoir to the back end of the engine, and is connected by the rubber hose pipe and couplings to the tender and other vehicles, which are also fitted with a continuous pipe, and by the branch pipes which connect it to the triple valve and small reservoir.

43. Q.—How is the air stored in the small reservoir used to apply the brake-blocks to the wheels?

A.—The small reservoir is connected through the triple valve with the brake cylinders, the pistons of which are connected with the brake levers and rods, and when pushed out they force the brake blocks on the wheels.

44. Q.—How is the pressure in the brake cylinder controlled?

A.—By increasing or decreasing the pressure in the train pipe which permits the air to flow into, or releases it from the cylinder by moving the triple valve down or up.

45. Q.—Explain how the brake is applied from the engine?

A.—By turning the handle of the driver's valve to the right, the main reservoir is cut off from the train pipe, and the air from the train pipe escapes to the atmosphere. The pressure in the small reservoir forces down the triple valve, and air flows into the brake cylinder, forcing out the pistons and putting the brake blocks on the wheels.

46. Q.—How is the brake released?

A.—By turning the handle of the driver's valve hard over to the left or "charging position." This closes the

discharge valve from the train pipe and opens the connection between the train pipe and main reservoir, the pressure from which flows into the train pipe, forcing up the triple valve. This opens the release port, and the air from the brake cylinder escapes to the atmosphere; the pistons return to their normal position, and the blocks fall away from wheels.

47. Q.—How are the brakes released by hand?

A.—By pulling the release wires at the sides of the cars or opening the release cocks on the footplate.

Note.—In addition to the for going, Cleaners must have a knowledge of the uses of Fixed, Hand, and Lamp Signals as laid down in Regulations, and a general knowledge of the Regulations laid down for the guidance of Enginemen.

Practical Questions for Acting Firemen before being Classified as Firemen.

48. Q.—Trace the passage of the steam from the time it leaves the boiler till it reaches the atmosphere.

A.—The regulator valve being opened, the steam flows from the dome into the internal steam pipe in the boiler, then into the steam chest, and is admitted to the cylinder by the slide valve opening the steam port. After doing its work in the cylinder it returns through the same port into the cavity of the slide valve to the exhaust pipe and up the funnel to the atmosphere.

49. Q.—Describe gauge glass and mountings, and how to test the same.

A.—A gauge glass is a glass tube fitted into two mountings on the face of the boiler, and serves to indicate the level of water in the boiler. The cock on the top mounting is for steam. The cock on the bottom mounting is for water and waste water. (Some engines are fitted with independent cocks for water and waste water.)

To test the gauge glass open the waste water cock and give the glass a blow through, then close this cock and see that the water comes back smartly into glass.

To test the cocks separately, open the waste water cock and close the steam cock; this will give the water passage a blow through. Close the water way cock and open steam cock; this will give the steam passage a blow through, then open

water way cock and close waste water cock and see that the water comes back smartly in the glass. If it comes into the glass sluggishly, it will show that the water passage is partially choked; if the water rises high in the glass and then settles back slowly, it will show that the steam passage is partially choked.

50. Q.—What is the best position in which to set the engine before examining underneath?

A.—The best position is with both cranks down, regulator shut, and the engine placed in middle gear with the hand brakes hard on, and the cylinder cocks open.

51. Q.—What parts require special attention in examining an engine?

A.—The glands and their nuts, all set screws, big end and eccentric bolts, all cotters, split pins, springs, brake gear, etc.

52. Q.—Is it necessary to go underneath the tender, as part of the regular examination, before leaving the shed?

A.—Yes; the brake gear, the springs, pins and pillars, the couplings between engine and tender, etc., are liable to fail if neglected.

53. Q.—What is the effect of filling boiler too high at starting?

A.—When the regulator is opened, the engine works the first few strokes with very wet steam instead of dry steam, and this takes all the lubrication off the valve faces and from the cylinders, making the engine work stiffly, and preventing her from pulling what she would do if properly handled.

54. Q.—Is it good management to have the engine blowing off hard when waiting for a train?

A.—No; this can be altogether avoided if the fireman takes care in the matter, and uses his dampers and injectors with judgment. All steam blown off through the safety valves is so much fuel wasted for nothing, and should be avoided, whether standing or running.

55. Q.—What is the best way to work an injector?

A.—When adjustable it should be set to supply as much water as the engine is using, so as to be kept almost constantly at work; this is important on long runs. If an injector has been shut off, it should not be put on just before firing, but the engine should be fired first, and the injector put on afterwards. It is important also to keep the injector steam cock closed when the injectors are not in use, otherwise the steam remains in

contact with the injector, thus injuring the cones and increasing the risk of failure when required. The injectors should be worked alternately to ensure both being kept in working order.

56. Q.—Explain the action of the sight feed lubricator?

A.—The action of the sight feed lubricator is as follows:—When steam is admitted into the lubricator it is condensed in the globe, at the same time it is condensed in an internal pipe in the globe, and charges the sight feed glass with water. On opening the water valve the pressure is admitted to the bottom of the oil chamber, and forces the oil through an internal pipe to the sight feed valve. By then opening the retention valve a jet of dry steam is admitted to the cylinders, and by opening the sight feed valve the oil passes by its specific gravity through the water in the sight feed glass to the retention valve. Here it is met by the jet of dry steam which mingles with the oil and forces it away in the form of a spray to the steam chest and cylinders, where it lubricates the valves and cylinders.

57. Q.—What is the purpose of a safety valve on a locomotive boiler? Why are more than one used?

A.—To relieve the boiler from over-pressure of steam. Two safety valves are used because one is sometimes unequal to the task of preventing over-pressure.

58. Q.—What should be done to prevent waste of steam through safety valves?

A.—The firing should be so regulated when the engine is working that the steam will not rise to the blowing off point when steam has to be shut off unexpectedly. Blowing off may be prevented by closing the dampers, opening the fire-box door a little, and keeping the injector going. The surplus steam on "DD" class may be blown back into tender.

59. Q.—Describe a blower, and its use and abuse?

A.—A blower is a jet of steam passed up the smoke stack to induce an artificial current of air. Its proper use is to prevent smoke when an engine is not working, to draw the fire gases away so that they do not pass into the cab, and to stimulate the fire when necessary. The abuse of the blower is drawing cold air through the tubes, and by forcing the fire when it is not necessary, causing waste of steam through the safety valves.

60. Q.—What advantage is it for the fireman to know the grades of the roads and the location of the stations?

A.—This enables him to regulate the firing to suit the fluctuating work the engine is required to do.

61. Q.—What are the advantages of an arch in a locomotive fire-box?

A.—It tends to keep the temperature of the fire-box uniform, and prevents the cold air passing directly into the tubes. It lengthens the journey of the fire gases on their way to the tubes, and also acts to the same extent as a spark arrester.

Westinghouse Brake.

62. Q.—What kind of driver's valves are in use on locomotives on the Victorian Railways?

A.—The ordinary valve, such as that on the "E" class and others, and the equalising valve, such as that on the "DD" and other classes of engines.

63. Q.—Explain the difference between them?

A.—With the ordinary driver's valve, when the brake is applied for service stop, the air is discharged directly from the train pipe into the atmosphere; but with the equalising valve the air is in the first place allowed to escape from a small drum attached to the driver's valve. The reduction of the pressure there in

turn relieves the pressure on the top of a piston that closes the discharge port from the train pipe, and allows air to escape from the train pipe till the pressure falls to what is shown on the gauge by the black pointer, or equalises through the train to the pressure shown on the gauge by that pointer.

64. Q.—Where is the air stored that applies the brake?

A.—In the small reservoir.

65. Q.—Where is the air stored that releases the brakes?

A.—In the main reservoir.

66. Q.—When is the small reservoir recharged? When the brake is off, or when it is on?

A.—When it is off; as the cylinder release port, and the reservoir charging port in the triple valve are open at the same time.

67. Q.—What is meant by reserve pressure?

A.—Reserve pressure is the pressure that is carried in the main reservoir in excess of that carried in the train pipe when the driver's handle is in the running position.

68. Q.—How much reserve pressure should be carried?

A.—From 10 to 15 lbs. on Passenger trains, and from 20 to 30 lbs. on Goods trains.

69. Q.—What is the use of the pressure retaining valve?

A.—It is a valve loaded to a given amount, which is placed on the cylinder exhaust port to retain that given amount of pressure in the brake cylinder after the brake has been released by the driver's valve.

70. Q. — Where are they generally fitted?

A.—On the engine and tender foot-plate, where they can be opened or shut by the driver or fireman.

71. Q.—Why are they used?

A.—They are used to prevent the engine surging away from the train when the brakes are released, and for holding the train on a falling grade whilst the reservoirs are being re-charged.

72. Q.—What is the use of the reserve pressure?

A.—It is required to re-charge the train pipe after an application of the brake, to a sufficiently high pressure to overcome the pressure on top of the triple valve, and to force it up to the release position and allow the brakes to come off.

73. Q.—Is it more necessary on a long than on a short train?

A.—Yes; because the longer train pipe requires more air to fill it.

74. Q.—How many kinds of triple valves are there in use?

A.—Two; the ordinary and the quick acting.

75. Q.—What is the difference between them?

A.—With the ordinary triple valve, when the brake is applied all the air discharged from the train pipes goes through the driver's valve to the atmosphere; with the quick acting valve, in emergency action, a portion of the train pipe air is passed into the brake cylinder, where it increases the pressure, and quickly empties the train pipe.

76. Q.—Name the principal parts of an air pump?

A.—Steam cylinder, centre piece and air cylinder, main pistons (steam and air), main valve, reversing valve, reversing valve spindle and air valves.

77. Q.—What are the points in connection with the air pumps that mostly require the driver's and fireman's attention?

A.—Packing and lubrication.

78. Q.—What requires to be frequently

done to the main reservoir?

A.—It is necessary to frequently drain off the water that accumulates in it.

79. Q.—How does the pump work?

A.—When the main piston is at the bottom of the cylinder and the steam is turned on, it flows into the main valve chambers, the reversing valve chamber and to the top of the reversing piston, and also under the main piston, driving it up. When it reaches the top it moves the reversing valve up, cutting off the steam to, and opening exhaust from the top of the reversing piston. The main valve then rises and opens the steam port to the top of the main piston, which is forced down to the bottom, where it again pulls the reversing valve to the first position and repeats the same series of operations.

80. Q.—Is the air pump single or double acting?

A.—Double acting; as it compresses the air at each end of the cylinder at each alternate stroke.

81. Q—What is the proper air pressure to carry?

A.—On Suburban and Passenger trains 60 lbs., Express 70 to 80 lbs., on Goods trains 50 to 60 lbs.