

THE WESTINGHOUSE AIR BRAKE(1) INTRODUCTION:

Railway air brake history was made in 1872 by the invention of the automatic compressed air brake by Westinghouse, and this development proved the foundation upon which most subsequent compressed air brake development has been based. The most noteworthy feature of the automatic compressed air brake is simplicity, as evidenced by the fact that potential brake power on locomotives and vehicles can be established, and such power used at will, by means of controlled fluctuation of air pressure in one continuous pipe.

The safe working of trains is largely dependent upon the efficiency of the brake apparatus. The brake must exert sufficient force to prevent excessive speed on down grades, generally control speeds where required, and bring a train to a stop in a reasonable distance. The brake must also operate to stop a train in the event of a breakaway of one or more vehicles, or in any emergency.

Railway transportation safety and economy in the handling of goods, mixed and passenger traffic demands from the enginedriver two essentials: First, the ability to manipulate the air brake with skill and judgment, and secondly, he must have a thorough knowledge of the function and principle of operation of the various devices associated with the air brake, methods of testing for brake operating efficiency, and how to deal with any air brake breakdowns and running repairs that may be encountered in service. The first can only be obtained by practical experience, the second by study. This course therefore, has been prepared as a supplement to the Air Brake Handbook, which should be read in conjunction with the lessons.

The present lessons will only cover the Westinghouse Automatic Air Brake used in the steam service of the New Zealand Railways.

(2) HOW THE WESTINGHOUSE AUTOMATIC AIR BRAKE WORKS:

The general principle upon which the automatic air brake operates is shown by diagrams in Fig.1. The air compressor A, driven by steam from the boiler of the locomotive, compresses air to a pressure of 95 lbs per square inch in the main reservoir B.

When the locomotive is coupled to the train, the compressed air in the main reservoir B is fed via the driver's brake valve C into the brake pipe D, from which it passes to a device known as a triple valve E in each vehicle. Entering this valve E, it comes in contact with the piston (a) and pushes it to the extreme right of its stroke. When in this position the piston allows the air to flow through a groove (b) in the piston bush called the leakage groove, thence into the auxiliary reservoir F. When a sufficient quantity of air has passed this piston so that the pressure in the auxiliary reservoir F and brake pipe D are the same, the equipment is said to be charged. The pressure carried is 70 lbs per square inch and automatically maintained by means of a feed valve attached to the driver's brake valve C. The brakes may now be applied.

The brakes are "applied" to all vehicles on the train by a REDUCTION OF PRESSURE whether purposely, or accidentally, produced in the brake pipe D. In ordinary working, this is effected by allowing air to escape to the atmosphere by the driver's brake valve C, or in case of emergency, by the Guard or a passenger; but the same result follows if the train should part, a hose burst, or through any other accident causing an escape of air from the brake pipe; hence the term "automatic".

The reduction of pressure in the brake pipe D causes a lower pressure to be present on the left hand side of the triple valve piston (a). Then air pressure in the auxiliary reservoir F being greater, moves the triple valve piston (a) to the left.



Attached to the triple valve piston (a) is a slide valve (c) which moves with it and uncovers the port (d), making communication with the stored air in the auxiliary reservoir F and brake cylinder G. This forces the brake cylinder piston outward and by the aid of a system of levers causes the brake blocks to press against the wheels. The brakes when applied will remain in that position until released.

In order to "release" the brakes it is necessary to RESTORE the pressure in the brake pipe D by admitting air from the main reservoir B by means of the driver's brake valve C. Air again enters the triple valve E and the triple valve piston (a) is moved to the right. In this movement the slide valve (c) is again shifted so that the flow of air from the auxiliary reservoir F into the brake cylinder G is stopped, and communication is opened between the brake cylinder G and the atmosphere. This is accomplished by the passage way beneath the slide valve which establishes a communication between the port (d) and exhaust port (e), the latter being open to the atmosphere. When the air from the brake cylinder G escapes to the atmosphere, the brake levers etc. are relieved of pressure and the brake blocks released from pressing against the wheel. The auxiliary reservoir F again starts recharging from brake pipe D in readiness for the next brake application.

Such is the principle of operation of the air brake in a simple form. A more detailed description follows:

### (3) DESCRIPTION OF AIR BRAKE EQUIPMENT:

The simple automatic air brake applied to the engine, tender, and passenger and goods vehicles is diagrammatically illustrated in Fig. 1 to 3 (pages 3 and 4) Air Brake Handbook.

The following gives details of the apparatus:-

- (a) ENGINE (see fig. 1. Air Brake Handbook for diagrammatic arrangement of apparatus)

The Air Compressor or Pump provides the compressed air which is stored in the Main Reservoir for use in operating the brakes.

The Steam Stop Valve controls the steam supply from the locomotive boiler to operate the compressor; the steam passes through the Compressor Governor which is so adjusted as to automatically cut off the steam supply to the compressor when the required air pressure (95 lb. per sq in.) is obtained in the main reservoir, and to automatically allow the steam to flow to the compressor when the air pressure is reduced.

From the main reservoir, the air has a free passage to the Drivers' Brake Valve Isolating Cock, and if that cock is open, thence to the Drivers' Brake Valve. This valve controls the passage of air to the other parts of the apparatus, such as the Feed Valve, and allows compressed air to enter the Brake Pipe.

From the Brake pipe, the air flows into a branch pipe, first past an Isolating Cock; and then to the Triple Valve. The isolating cock, or cut out enables the brake to be cut out in the event of defects occurring, without interference with the brakes on the remainder of the train.

The air passes through the triple valve mechanism and then flows to the Auxiliary Reservoir where it is stored for applying the brakes. When an application of the brake is made the compressed air from the auxiliary reservoir enters the Brake Cylinder, forcing its piston outwards, and by the aid of a system of levers, causes the Brake Blocks to press against the tread of the wheels.

The system of levers and rods, by means of which the force developed in the brake cylinder is transmitted from the piston of the brake cylinder to the brake blocks to bring them against the wheels



with the desired pressure, is called the Brake Rigging.

The engine brake pipe is connected to the tender by a Hose Coupling, while at the front end of the engine, in addition to the hose connection, there is a Coupling Cock, to isolate the brake pipe when not connected to an adjacent vehicle.

A Hand Release Valve is fitted to a pipe which has direct communication with the brake cylinder thus enabling the air to be discharged from the brake cylinder and release the brake if required.

A Retaining Valve is fitted to the exhaust of the triple valve so that a pressure of approximately 15 lbs per square inch is maintained in the engine brake cylinder during the descent of long gradient, when it is desired to release the train brakes to recharge the auxiliary reservoirs.

NOTE: This device is not shown in Fig.1 and is only fitted to locomotives not fitted with straight air brake equipment.

A Release Spring, incorporated in the Brake Rigging, assists in withdrawing the brake blocks from the wheels when the brakes are released.

A Duplex Air Gauge on the engine has two hands or pointers. The Red Hand indicates the Main Reservoir pressure, and the Black indicates the Train Pipe Pressure.

(b) TENDER: (see Fig.2 Air Brake Handbook for diagrammatic arrangement of apparatus.)

Excepting for the compressor, Drivers' brake valve, and accessories for these units, the brake apparatus is similar to that on the engine.

Compressed air from the main reservoir flows through the Brake Pipe and Drip Cup past the Isolating Cock in the branch pipe, and then through the Triple Valve into the Auxiliary Reservoir.

To apply the brakes, the compressed air from this reservoir is caused to pass into the Brake Cylinder, forcing the piston outwards thus causing forces to be transmitted through the Brake Rigging, to the Brake Blocks or Shoes which are forced against the wheels.

A Hose Coupling connects the tender train pipe to the first vehicle, and the Coupling Cock controls communication between tender and vehicle. As the tender is always connected to the engine, a train pipe cock at the front end is not necessary.

A Release Spring assists in withdrawing the brake blocks from the wheels when the brakes are released.

NOTE: The Release Valve shown in Fig. 2 should be connected to the auxiliary reservoir and not the brake cylinder as shown. By discharge, the air from the auxiliary reservoir causes the triple valve to release and discharge air from the brake cylinder.

Retaining Valves for the same purpose as explained for the engine are fitted.

NOTE: This device is not shown in Fig.2.

(c) VEHICLES: (See Fig.3 Air Brake Handbook for diagrammatic arrangement of the apparatus.)

Compressed air from the locomotive flows through the same series of fittings as on the tender, except that on modern vehicles a CENTRIFUGAL DIRT COLLECTOR is fitted between the isolating cock and the triple valve. Some wagons have brake cylinders and the auxiliary reservoir connected together to form a Combined Apparatus as shown in Fig.33,



page 30 of the Air Brake Handbook.

Guards vans are fitted with a single hand gauge pressure of air in the brake pipe, and an EMERGENCY COCK which enables the brakes to be applied in case of an emergency. These are shown by the long dash lines Fig.3.

NOTE: An EMERGENCY COCK is also fitted to passenger cars so that the brake may be applied in case of an emergency.

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The students should make themselves familiar with the brake apparatus on locomotives and vehicles and know where to find each device when called upon to do so.

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#### (4) TYPES OF WESTINGHOUSE AIR BRAKES:

Besides the automatic air brake used in steam service there are others, and they are listed here as a matter of general interest:-

- (a) Automatic Air Brake.
- (b) A.6 E.T. Air Brake on Steam Locomotives Class Ka, Kb, J and Ja.
- (c) A 7-EL Air Brake for Electric Locomotives.
- (d) Electro-Pneumatic Brake for Electric service.
- (e) Straight Air Brake for Rail Cars.



LESSON No. 7 - LIST OF QUESTIONS

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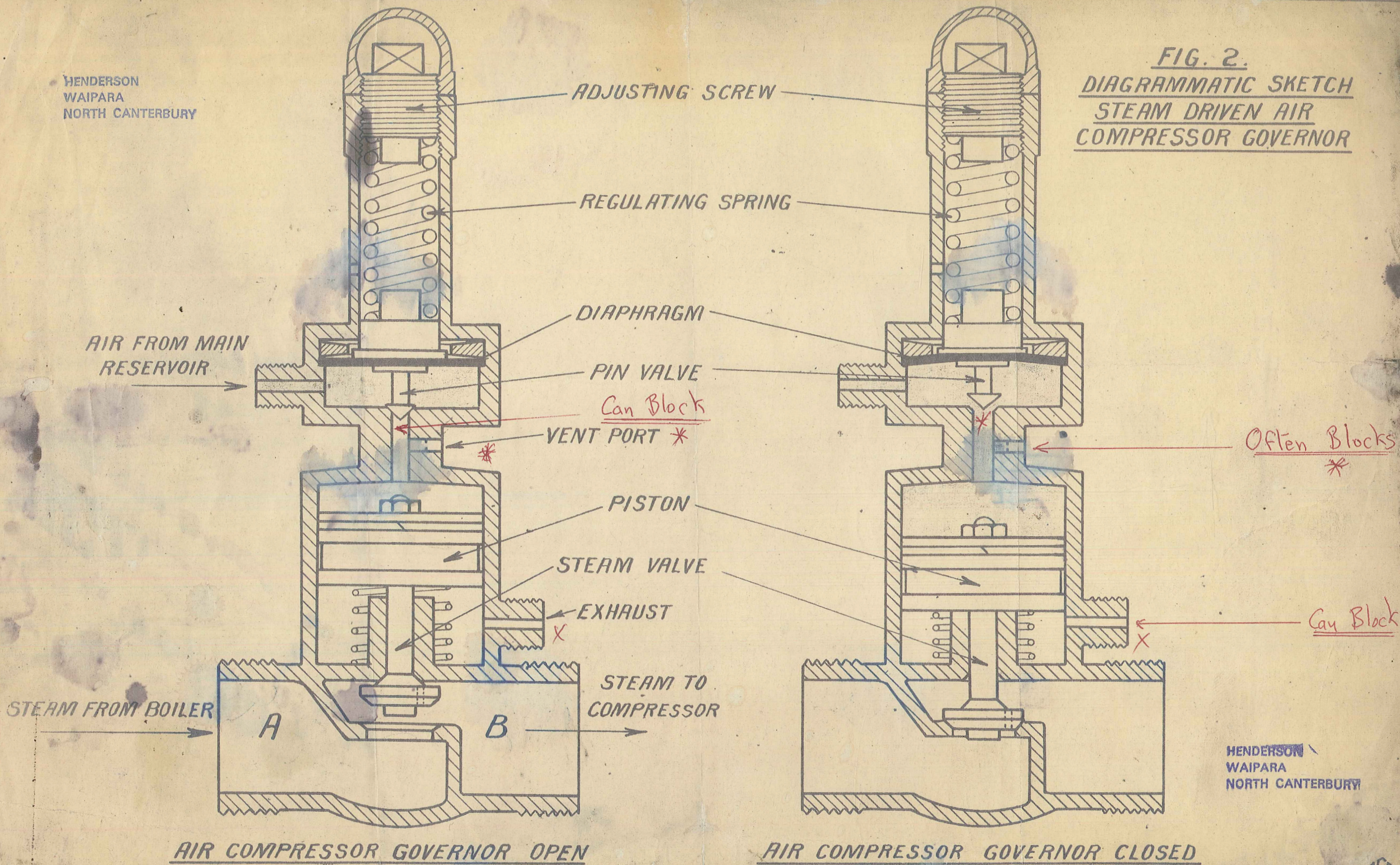
The student is to carefully study the contents of this lesson BEFORE attempting to answer the test questions.

- (1) State the various means which will cause the automatic air brake to be applied.
- (2) Give a brief description of the working of the automatic air brake.
- (3) Give a diagrammatic sketch of the layout of the automatic air brake on an engine and tender. Use rectangles or squares to represent the parts and name each part.
- (4) If a number of vehicles break away from a train, will the brake operate? Give detailed reasons for your answer.
- (5) Why is an isolating or cut-out cock fitted between the brake pipe and the triple valve?
- (6) When a passenger operates the emergency cock in the car, give a brief description of what happens, also what the Enginedriver should do in such event.
- (7) Where is the compressed air stored for the purpose of applying the brake?
- (8) Where is the compressed air stored for the purpose of releasing the brake?
- (9) What air pressure should be carried in the brake pipe and auxiliary reservoirs when the equipment is charged.
- (10) What air pressure is carried in the main reservoir of locomotives fitted with the automatic air brake? If the correct main reservoir pressure cannot be maintained on gradients, what action should the enginedriver take?



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FIG. 2.  
DIAGRAMMATIC SKETCH  
STEAM DRIVEN AIR  
COMPRESSOR GOVERNOR



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