THE VACUUM AUTOMATIC BRAKE.

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GRESHAM AND CRAVEN,
ORDSAL LANE,

Where Full-size Models can be seen at work, representing an Engine and twelve Carriages.

THE

VACUUM AUTOMATIC BRAKE.

GENERAL DESCRIPTION.

This brake stops the train by the application of brake blocks to the tyres, in the same way as the ordinary hand brake. The levers, however, which apply the blocks, are moved by a piston, working in a cylinder, this piston deriving its power from the **pressure of the atmosphere.**

It is continuous, **each vehicle** carrying its **own brake cylinder,** all of which cylinders are connected to one pipe, running from end to end of the train, and it is through this pipe that the action of the brake cylinders is controlled.

An ejector placed upon the engine, exhausts the air out of the continuous pipe and each cylinder. The brake is **applied** by the **admission** of air into the train pipe, and **released** by the **withdrawal** of the same through the ejector.

The brake can be applied by the guard, and is **self-acting** in the case of an **accidental parting** of the train, or any damage happening to the brake itself.

It is **instantaneous** in its action, and can be **regulated** to a nicety for easy stops, or to control the train on an incline.

THE ACTION OF THE BRAKE.

Creating Vacuum.

The engine having been coupled to the train, and the hose couplings between the tender and train, also those between the coaches connected, and the one at the end of the train placed upon the plug, the driver admits steam to the small ejector, which will soon exhaust the train pipe and cylinders, to a vacuum of 20 to 24 inches, or the large ejector may be used if the vacuum is required to be obtained more rapidly. The small ejector must be kept at work continuously, to maintain the vacuum.

Applying Brake.

To apply the brake, the driver moves the handle of the combination ejector in the direction marked **"ON"** admitting air to the train pipe and to the **bottom of each cylinder,** which lifts the pistons and pulls the blocks to the wheels. The air cannot pass to the **top of the piston,** as it is prevented by the ball in the ball valve. **The power** of the application is controlled by the **amount of air** let into the continuous pipe.

Releasing Brake.

To **release** the brake, the handle must be returned to **"Running Position"** when the air let in to **apply** the brake will be removed through the small ejector, or it may be released more quickly by pushing the handle in the direction marked **"OFF"** and so admitting steam to the large ejector.

Graduating Brake.

The brake having been applied, the pressure of the blocks on the wheels may be **increased or diminished at pleasure** without removing them, and also **without reducing the full reserve power** of the brake, which is always at command for an emergency stop.

Station Stop.

Station stops should not be made by a violent application of the brake, but by a destruction of vacuum of say from 5 to 10 inches, which should be re-created slowly, as the train comes to rest, by placing the handle in **"Running Position,"**

By having the vacuum nearly restored at the end of the stop, "jerking" is prevented, and the brake is released without the use of the large ejector.

Quick Stop.

To apply the brake quickly, the handle must be moved to the position marked **"ON"** thus fully opening the air valve.

Van Stop.

The guard can apply the brake by pressing down the handle of his valve, admitting air, and applying the brake throughout the train which it will stop even if the engine remain under full steam. When a rapid application is made by the driver, the guard's valve opens automatically, letting in air from the van, thus increasing the rapidity of application, and closing again after the brake has been fully applied.

Releasing by Hand.

When it is desired to release the brake on coaches, not attached to an engine, the wire (at either side) must be pulled. This wire is attached to the release lever of the ball valve, and, pulling the ball off its seat, allows the air to pass to the top of the piston, destroying the vacuum, and so releasing the brake. While this is being done **a coupling must be left off the plug** at the end of the train to allow the air to enter and destroy the vacuum.

DETAILED DESCRIPTION.

STEAM STOP VALVE.

This valve (fig. 1), has two positions, "open" and "closed," and must always be full open when running and closed when the engine is in the shed, to avoid condensation in the steam pipe. By its use, the ejector may be examined whilst the boiler is under steam.

COMBINATION EJECTOR.

This "ejector" (fig. 2), consists of two ejectors known as the "large and small," the latter being placed inside the former. The small one is worked continuously, and is controlled by the small screw steam valve shown just above the nozzles, this valve being adjusted to give the required vacuum. The large ejector is worked by the admission of steam

through a disc valve, placed underneath the air valve, and upon the same spindle, and is opened by the driver's handle being placed in the position marked **"OFF"** The action of both ejectors is the same, steam is admitted around the cones and passes through the ejector barrel at a great velocity, withdrawing the air from the train pipe and cylinders, carrying it along the exhaust pipe, into the chimney of the locomotive.

Driver's Handle.

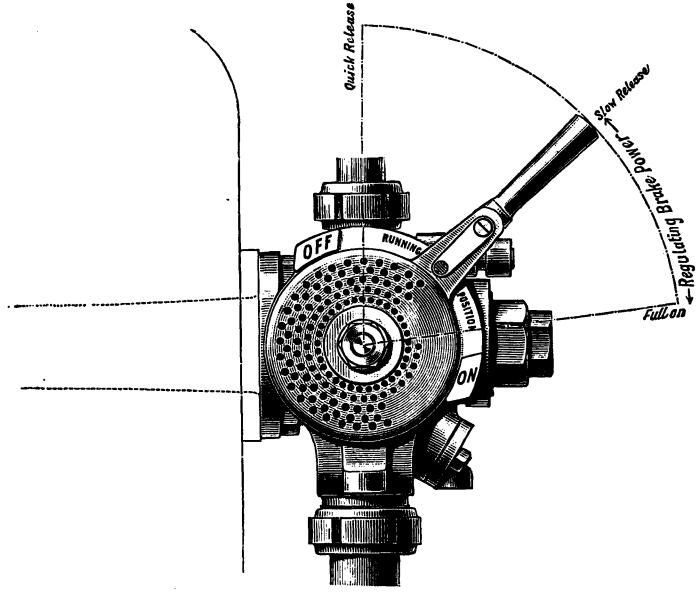
The driver's handle on the application valve is shown more clearly in the drawing on next page. The handle has three positions, **"OFF"** being the position when it is required to release the brake quickly, and in which position (as before described) steam is admitted to the large ejector. In **"Running Position"** the large ejector steam valve and the air valves are both closed, and the brake is released slowly by the small ejector only, and the vacuum also maintained after the brake is released. **"ON"** is the position for applying the brake fully, and opens the air valve, when the air passes through the holes in the disc, and applies the brake. The movement between **"Running Position"** and **"ON"** is for regulating the brake by letting in more or less air to apply or increase the power after application, or to withdraw the air to release or diminish the power on the blocks.

A small auxiliary pipe is carried from the ejector by the side of the train pipe, and runs only to the engine and tender vacuum chamber fig. 10.

At the top of this pipe, in some cases, is fixed a small valve, by opening which the brake can be released on the engine and tender when the ejector is closed.

The "driver's handle" should be kept free, and the air holes clean. The steam disc may be lubricated, when necessary, by unscrewing the small oil screw on the top of the ejector after first closing the steam stop valve.

The clappet valve in the train pipe branch should be kept air-tight; it may be easily taken out for examination by removing the flange that carries the drip pipe. This drip pipe should be kept clear to allow any condensation of steam to run out.



DRIVER'S HANDLE.

BRAKE CYLINDER.

This cylinder (fig. 3), is shown in section, self-contained in the vacuum chamber as applied to carriages, and is the only fitting required. The piston fits freely in the cylinder, and is packed with a rolling rubber ring, which, when the piston moves, rolls between it and the cylinder, making a perfect packing without friction. The piston rod is coated with brass and works through a brass bush and a packing rubber which prevents air passing the rod. This rod should be kept clean by wiping with a dry cloth, but **no oil or grease must ever be used.** At the bottom of the cylinder is attached the **ball valve,** the branch of which is connected by a small hose pipe to the train pipe. This valve is of the most simple construction, as there is only one moving piece, and that being a small $\frac{1}{2}$-inch brass ball, having a rolling action in a horizontal position, has consequently no friction. The spindle with release lever is added for the purpose of withdrawing the ball from its seat, when it is required to release the brake by hand. This spindle is made air-tight by a small diaphragm, the pressure on which, when a vacuum is created, pulls in the spindle and allows the ball to go freely to its seat.

The action of the cylinder is as follows: The air is drawn out through the train pipe from the bottom of the piston **direct** and from the top

by passing the ball, which it forces up the incline of the spindle; when all the air is withdrawn the ball rolls down the incline and on to its seating. To apply the brake, the air is let into the train pipe, and it then passes to the **under** side of the piston and being prevented from entering to the **top** by the ball, lifts the piston and so applies the brakes with any amount of force according to the quantity of air let in.

DRIVER'S VACUUM GAUGE.

The driver's vacuum gauge (fig. 7), has two pointers, the one on the left marked "train pipe," and the one on the right "vacuum chamber," both indicating the vacuum carried.

When the brake is applied the pointer on the left indicates the amount of vacuum remaining in the train pipe and below the pistons: the **difference** between it and the pointer on the right, which indicates the vacuum in the vacuum chamber and above the pistons, is the amount of power applied on the underside of the brake pistons. For instance, if 10 inches is indicated in the train pipe, and 20 inches in the vacuum chamber, the brake is applied with a power of 10 inches, or about half its full power.

DRIP TRAP.

This trap (fig. 5) is placed on the train pipe at the lowest point, so that any moisture in the pipe will drain into it. It is fitted at the bottom with

a self-acting ball valve, which opens when all the vacuum in the train pipe is destroyed, and allows the water which may have collected to run out. This valve should be occasionally examined and cleaned.

UNIVERSAL HOSE COUPLINGS.

This coupling will be readily understood by reference to the drawing. It consists of a pair of castings exactly alike with horns top and bottom; it is impossible to couple them wrongly. To couple they should be lifted up sufficiently high to enable the bottom horn to be placed together, and then lowered, the top lug of one being placed in the slot of the other. To uncouple it is simply necessary to raise the couplings, when they will separate.

GUARD'S VAN VALVE AND VACUUM GAUGE.

This valve (fig. 11) is fixed on the main train pipe, and enables the guard, by pressing down the handle, to apply the brake.

It also opens automatically when the driver applies the brake suddenly admitting air until the brake is fully applied.

The valve has a small hole through its stem, and is secured at top by a diaphragm to a small dome-like chamber, which chamber is exhausted

when a vacuum is created in the train pipe. If a gradual application is made the vacuum in this chamber is destroyed as quickly as in the pipe, but when the brake is applied suddenly, the vacuum beneath the valve is destroyed much quicker, and then the pressure of the atmosphere on the diaphragm lifts the valve, which remains open until the vacuum is destroyed in the dome-like chamber through the small hole, when it closes by gravity.

The guards vacuum gauge (fig. 7) has one pointer indicating the amount of vacuum throughout the train.

INSTRUCTIONS FOR WORKING THE BRAKE.

The Brake can be applied throughout the Train by the Driver from the Engine, or by the Guard from the Van.

ENGINE DRIVER'S INSTRUCTIONS.

Before starting the Driver must see that the gauge indicates at least 18 inches of vacuum, and that not less than this amount is maintained during the journey and while standing at stations. The vacuum is created by admitting steam to the small ejector, by means of the steam cock on combination ejector.

To apply the Brake, move the handle on combination ejector in the direction marked **"BRAKE ON."**

To release the Brake, move the handle on combination ejector in the direction marked **"BRAKE OFF."**

In ordinary running this handle must stand at **"Running Position."**

GUARD'S INSTRUCTIONS.

When the Guard has occasion to apply the Brake, he must press down the handle on the valve placed in his van. This admits air throughout the Train pipe, and is only to be employed in cases of emergency. The valve in the van opens automatically when the Brake is applied suddenly by the Driver, and ensures rapid action. The Guard must see by the gauge in his van that a vacuum of at least 18 inches is maintained, or report otherwise to the Driver. See that all the pipes between the carriages and engine are properly coupled together, and that the coupling on the last coach is placed upon the plug.

Whenever the pipes between the vehicles are disconnected, the coupling must be placed upon the stop plug at the end of the vehicle.

GENERAL INSTRUCTIONS.

To release the Brake for shunting purposes (the Engine having left the train), first see that the hose coupling at one end of the Train is off the plug, then pull the wire or cord fixed under the frame of each carriage. This admits air to the top side of the cylinder, and the Brakes fall off by gravity.

To couple the pipes the porter must take one in each hand and lift them sufficiently high to hook the bottom horns of the coupling together first, and then, by lowering them, place the top horns of the couplings in the slots.

To uncouple the pipes the porter must simply lift them straight up, when the horns at the top will come out of the slots, and the coupling will then separate.

ADVANTAGES OF THE VACUUM AUTOMATIC BRAKE.

1. It is instantaneous in its action, as air flows into the train pipe at the rate of 7 miles per minute. There is **less atmospheric air required** to be let into the cylinder than with the compressed air brake, and it is also **direct acting** the moment the application valve is opened.

2. It can be applied to a train of any number of carriages.

3. It can be applied any number of times in **rapid succession without diminishing its power,** which is always retained, the vacuum in the upper part of the cylinder never being destroyed. **(The compressed air brake loses its power completely after a few successive applications.)**

4. Simplicity. There is only one application valve on trains of any length, and this worked **positively** by the driver's handle, whereas the **compressed air brake** requires a complicated "triple" valve on engine, tender, and every carriage of the train, and **none of these are positive in their movement.**

5. The pressure on the blocks can be increased or **decreased** at pleasure, without removing the blocks from the wheels. It may thus be applied with any amount of power for controlling a train down an incline of any length, whilst its **full power** is at command for instantaneous application by driver, guard, or by an accidental parting of the train.

6. For controlling trains on an incline, the power can be **increased or reduced** at pleasure without releasing the Brake.

7. The pressure is in all cases external; the joints are thus easily kept tight, and there is no tendency to burst the connecting hose, as is the case with the **compressed air brake.**

8. Economy. The small ejector using less steam than a pump.

9. There are practically no frictional surfaces, the piston being packed with a rolling ring, and the valve is a rolling ball. No lubrication is required, and the working of the brake is not affected by dust or frost.

10. **No dangerous cocks** at the ends of the carriages are required—the vacuum being restored in the train pipe very rapidly by the ejector after coupling or uncoupling carriages. Where carriages have to be slipped whilst the train is in motion, cocks are applied between the couplings. (Cocks are a necessity on the **compressed air brake** owing to the length of time taken by the pump to get up the necessary pressure in the train pipe.)

11. It is automatic, or self-applying, in case of accidental separation of carriages or damage to **any** of its parts.

12. The brake can be released **slowly** to prevent skidding or "jerky" and unpleasant stopping.

13. When running with pilot engine no special instructions are required, and both drivers can use the brake. With the **compressed air brake** special instructions are neccessary.

The following are Stops made by the

VACUUM AUTOMATIC BRAKE

ON THE LEVEL & RAILS DRY.

With twelve 4 wheeled coaches

30 Miles per hour—Stop in 85 yards, 11 Seconds.

40 ,, ,, ,, 130 ,, 13½ ,,

50 ,, ,, ,, 200 ,, 17 ,,

60 ,, ,, ,, 360 ,, 23½ ,,

With twelve 6-wheeled coaches with blocks on 4 wheels of each coach.

30 Miles per hour—Stop in 100 yards, 11½ Seconds.

40 ,, ,, ,, 175 ,, 16 ,,

50 ,, ,, ,, 250 ,, 18 ,,

60 ,, ,, ,, 400 ,, 25 ,,