

THE
WESTINGHOUSE
AUTOMATIC BRAKE

DESCRIPTION OF APPARATUS

AND

INSTRUCTIONS FOR WORKING

VICTORIAN RAILWAYS.

1888.

George E. Kilburn

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THE WESTINGHOUSE AUTOMATIC BRAKE.

GENERAL PRINCIPLE OF ITS ACTION.

Compressed air is the power employed to work the Brake.

The air, compressed by an Air Pump on the Engine into a main reservoir, flows through the Driver's Brake Valve into the main Brake Pipe, which extends the whole length of the train, and fills on each carriage a small reservoir by means of the Triple Valve attached to it. Each Triple Valve is also connected to a Brake Cylinder. As soon as the pressure in the Brake Pipe is lowered, the Triple Valve Piston on each vehicle is moved down by the greater pressure stored in the small reservoir, which is then allowed to pass instantly into the Cylinder, force out the Pistons and Rods, and thus cause the blocks to press against the wheels.

The Brakes are released by an increase of pressure in the main pipe, produced by allowing air to pass from the main Reservoir along the train. This moves up the Triple Valves, re-charges the small Reservoirs, and at the same time allows the air which had forced out the pistons to escape into the atmosphere.

GENERAL DESCRIPTION OF THE APPARATUS.

To make this description perfectly clear three plates are given.

Plate I. shows the Brake complete on an Engine and Tender.

Plate II. is a Diagram showing the operation of the Brake, from the Air Pump to the end of a vehicle. It is, of course, not exact, nor to scale, but is intended simply to show the relation which each part bears to the whole.

Plate III. shows the standard apparatus for one vehicle.

The Engine, Tender, and every vehicle of a train is fitted with the following parts, to be found on Plate I. and II.:—

A **Triple Valve**, F, by means of which the instantaneous automatic action is produced, in conjunction with

A small **Reservoir**, G, in which is stored the compressed air for applying the Brakes,

A **Brake Cylinder**, H, with pistons and rods connected to

The **Brake Levers** and **Blocks**.

Upon the Engine is also placed :—

The **Steam Engine** and **Pump** which produce the compressed air.

A **Main Reservoir**, C, for storing the air necessary for releasing the Brakes and re-charging the small Reservoirs.

A **Driver's Brake Valve**, D, which regulates the flow of air from the Main Reservoir into the Brake Pipe for charging the train and releasing the Brakes, and from the Brake Pipe to the atmosphere for applying the Brakes.

A single line of Pipe, E, called the **Brake Pipe**, extends the whole length of the train.

Each van has a valve connected to the Brake Pipe and a gauge to indicate the pressure of air. By opening his valve a Guard can stop the train, even against the will of the Driver, if necessary.

OPERATION OF BRAKE.—(See plates I. and II.)—The pump being started by admitting steam to the Cylinder A, air is forced from the Cylinder B into the Main Reservoir C, which is connected to the Driver's Brake Valve D.

When a train is to be charged—the hose couplings between the carriages having been united and the Engine connected to

the train—the compressed air stored in the Main Reservoir is turned into the Brake Pipe E, by putting the handle of the Driver's Brake Valve over to the left. It then fills the Brake Pipe and flows through the branch pipe on the Tender and each vehicle as shown by the arrows on Plate II. to the Triple Valve F, thence by the groove *a*, past the piston into small Reservoir G, where it remains until the Brake has to be applied. Uniform air pressure then exists throughout the train, **except in the Brake Cylinders**, the Brakes being off, and the pressure per square inch is shown on the gauge L, connected to the Brake Pipe.

So long as this pressure is maintained, the Brakes are kept **off**, as the passage from each small reservoir to its Cylinder remains closed; but letting the air escape from **the Brake Pipe** causes the Triple Valves to move down and uncover the passages to the Cylinders. The air stored in the small Reservoirs then flows into the cylinders, and forces out the pistons and rods, thus applying the Brakes. (See description of Triple Valves, p. 11.)

From the foregoing it will be seen, that the Driver can, by turning the handle of his Brake Valve, reduce the pressure in the Brake Pipe, and thus apply all the Brakes. If the Brakes are to be applied moderately, a small reduction of pressure in the Brake Pipe is made, as indicated in the description of the Driver's Brake Valve, p. 9.

The Brakes are taken off by re-opening the passage from the Main Reservoir, through the Driver's Valve, and thus restoring the pressure in the Brake Pipe; this lifts the Triple Valves, and places the Cylinders in communication with the atmosphere by means of the exhaust cavity, *c*, in each of the valves; the air used in the Cylinders is thus allowed to escape, and the Brake Pistons and rods are pushed back to their places by springs inside the Cylinders.

N.B.—As mentioned in the description of the Driver's Brake Valve on page 9, it is important to run with the handle of that Valve in the **2nd, or feed position**. This is to ensure the prompt release of all the Brakes by means of the 10lb. extra pressure, which is thereby kept in the Main Reservoir.

SHUNTING.—An Engine or Carriage may be detached from a train without setting the Brakes by first closing the cocks in the Main Pipe, and then separating the Hose Couplings in the ordinary way.

If it were not for the cocks in the Main Pipe the Brakes would in all cases be applied when the Hose Pipes are separated by hand for the purpose of shunting.

The Cocks are **open** when the handle stands across or away from the pipe, and shut when the handle is up or alongside the pipe.

The application of the Brake on detached portions of a train through ordinary leakage is provided for, as fully explained on page 13.

It is of the utmost importance to see that the Brake Couplings are properly united and that the cocks in the Main Pipe are opened so as to make sure that pressure exists throughout the whole train. This is only ensured by opening the Valve in the last van for a second or two. If there is pressure, the air will escape, and the Brakes will be applied. If the connexion is complete, the Brakes will almost immediately be released by the air from the Main Reservoir.

If the Couplings are not united, or one or more cocks not opened, the Brakes will remain on those carriages which are in the rear of the point where the couplings have not been put together, or cocks are left closed.

The Pressure Gauge in the van should also be observed.

When carriages are disconnected from a train, the air pressure is retained, as above explained; hence the indication of the air gauge is never to be relied upon to establish the fact that the Couplings have been properly united, or the cocks opened. The gauge is intended to indicate the pressure which is being maintained by the Driver after the Couplings throughout the train have been connected.

In case of the Brake work being damaged on any vehicle, a $\frac{1}{2}$ -inch Stop-Cock, I, is placed on the branch pipe leading to

the Triple Valve, by means of which that particular vehicle may be shut off without affecting the Brakes on the rest of the train. When this Cock is open, the handle lies straight along the branch pipe. As shown in the drawing, the cock is shut.

A Release Valve, J, is fitted on each Cylinder for the purpose of releasing the Brake direct, if applied, when an Engine is not attached. Wires should be connected to the handle so that the Brake may be easily released from either side of the carriage. These valves must be **held open** until the air has escaped.

It should be clearly understood:—

1st. That it is the air stored in the small Reservoirs which applies the Brakes, while the air in the Main Reservoir Releases them; and

2nd. That the Brakes are applied by a decrease of pressure in the Brake Pipe, and taken off by restoring that pressure.

So that, whether by the Driver or Guard operating his Brake Valve, the accidental separation of the train, the breaking of a pipe, or any other means by which the pressure in the Brake Pipe is suddenly reduced below that in the small Reservoirs, the Brake will be put on, and will remain on. It is, therefore, **automatic** in its action, and is a "tell-tale" as to its own condition.

When coupling up to a train not charged with air, or to one having a less pressure than that on the engine, the Brakes on the latter will fly on, the higher pressure flowing into the lower, having of course reduced the pressure in the Tender Brake Pipe. No inconvenience will result from this if the Driver has been careful to come up to the train with a high enough pressure in his **Main Reservoir**, and he will at once take off the Brake when he turns the handle of the Brake Valve into the charging or "release" position. In any case, the Release Valves from the Brake Cylinders may be opened, and these should be so arranged as to be worked from the foot plate.

Delays have sometimes arisen from connecting portions of trains carrying different pressures; and, to avoid detentions from this cause, Drivers should be careful not to leave more than **50lbs. pressure** in a train, when detaching at **junctions or termini**. The Driver who intends to couple up at such places should, as already advised, carry a high pressure, say 80lbs., in the Main Reservoir, for the purpose of releasing any Brakes which may happen to go on.

A high pressure, in the Main Reservoir only, may soon be obtained by placing the handle of the Driver's Valve in the neutral position; the train pipe then being shut off, the pressure is increased only in the Main Reservoir.

If a Driver finds the air pressure in his train too high, he can readily reduce it by applying the Brake with full power, and then releasing it.

It should be understood that as the Gauge L is connected to the Brake Pipe, it can never show the pressure in the Brake Cylinders. When the Brake is on, the Brake Pipe is shut off from both the Reservoirs and Cylinders, and the pressure then indicated on the gauge is that left on the Brake Pipe only. The force, however, with which the Brakes are applied is in proportion to the reduction made on the gauge—that is, in the Brake Pipe—to the extent of 25lbs. The Brakes are then “full on,” and letting out more air than this would only be waste.

The Brakes should not be applied with full power except in an emergency, and in that case all the air should be discharged from the Brake Pipe.

Drivers must exercise care and moderation in applying the Brakes for ordinary stops, so as to bring their trains to rest without inconvenience to the passengers.

To ensure this, it is necessary that the Brakes should be applied moderately in the first instance at a distance of several hundred yards from the station. Just before coming to a stand the Brakes should be released so as to avoid any jerk.

To apply the Brakes lightly not less than 5lbs. of air should be let out in the first instance. This is necessary to ensure the closing of all the leakage grooves, after which the Brake power can be increased by letting out $\frac{1}{2}$ lb. or more a time. The first reduction should be made more rapidly than results from ordinary leakage, and it is important **to close the Driver's Valve gradually**, so that the pressure does not begin to run up on the gauge again.

The same reduction of pressure per square inch is required for setting the Brakes with equal force on long or short trains, but the quantity of air to be discharged from the Brake Pipe to make this reduction will vary according to the length of the train. With long trains the Driver's Valve must be left open for a greater length of time, and must also be closed with greater care.

By violent use of the very great power now placed in their hands, it is possible for Driver's to cause very unpleasant shocks, especially if the screw couplings between the carriages are not tightly screwed.

Drivers should always bear in mind that much less force is required for a low than for a high speed; and that it is a bad practice to put the Brakes on so hard that the wheels slide over the rails. Such sliding spoils the wheels by producing flat places, is less effective in stopping, and gives a most disagreeable sensation to the passengers.

Guards can apply the Brakes by opening a valve in the van for that purpose, but they cannot release them.

Where "slip" vans are provided, however, there is a cock in the main pipe of each van which the Guards must shut before "slipping," to prevent the Brakes going on. These vans are provided with the Main Reservoir and a Valve similar to the Driver's Brake Valve, so that the Guard of the slipped portion may apply and release his Brakes just as the Driver does, for the purpose of stopping the carriages at the station platforms.

In case it should be necessary to empty the Reservoirs on a detached portion of a train, this may be done by first letting all the air out of the Brake Pipe, either through the Guard's Valve, or by opening the cock in the Main Pipe, and then opening the Release Valve J on each cylinder. The air in the Reservoirs will then escape through the cylinders to the atmosphere.

Brake Inspectors should pay special attention to the "taking-up" of the Brake blocks **uniformly** throughout a train; that is, the Brake Pistons, on each carriage, should travel equal distances so far as practicable (see Instructions, p. 18). Much better stops can be made when this point is properly attended to, and Drivers should always report when it requires to be done.

DESCRIPTION OF THE PRINCIPAL PARTS, PLATE II.

AIR PUMP.

On Plate II. is shown a section of the double acting Air Pump, composed of the steam cylinder and valves, A, and the air cylinder and valves, B—the piston of each working together on one rod.

Steam from the boiler enters the chamber, **c**, and also chamber, **d**, in connection with it. The ports from **c**, to each end of the cylinder are opened for supply and exhaust by the movement of the main valve, **1**. This valve consists of two pistons, **1¹**, **1¹**, on the same stem; and as the upper piston is of greater diameter than the lower, the tendency of the pressure in the chamber, **c**, is always to raise the valve, unless held down by the greater pressure of the larger piston, **2**, which is supplied with steam from the chamber, **d**. In the position shown on the plate, steam is passing into the bottom of cylinder **A** and forcing the main piston, **3**, upwards. As the main piston completes its upward stroke, the plate, **4**, pushes up the rod, **5**, working in the hollow piston rod, and with it the slide valve **6**. This closes the side valve **e**, from chamber, **d**, to the piston, **2**, and at the same time opens the exhaust passage, **f**, to the atmosphere through **g**, which relieves the pressure on the top

of piston 2. The steam in the chamber, **C**, then raises the main valve, 1, and enters the top of the cylinder above the main piston, 3, and at the same time the steam on the lower side is exhausted. On completing its downward stroke, the main piston again draws the rod, 5, and slide valve, 6, to the position shown, thus reversing the position of the main valve, 1, and consequently the stroke of the main piston, 3.

No particular description of the bottom cylinder and valves, **B**, is required. Each upward stroke admits air below the piston, and discharges air from above the piston, into the main reservoir, **C**; and each downward stroke does the reverse.

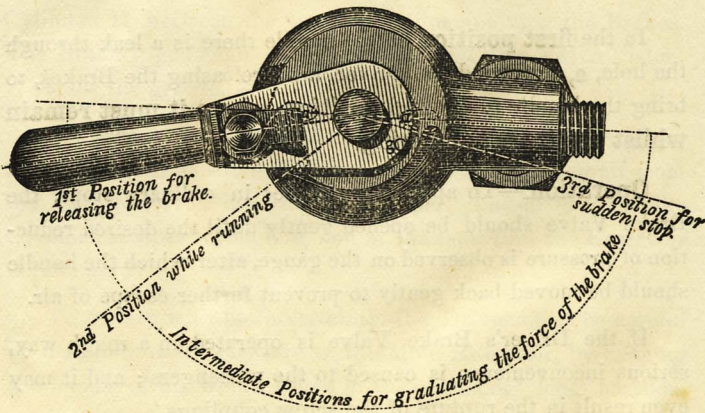
DRIVER'S BRAKE VALVE.

As shown on Plate II., the Driver's Brake Valve, **D**, forms the connexion between the Main Reservoir and the Brake Pipe. A communication between them is made through the main valve, 1, and there is also communication between the Brake Pipe and the atmosphere at **M**, through the discharge valve, 2.

There are three principal positions of the handle for working the Brake. (See plan and diagram blow):—

- 1st. For charging the train and releasing the Brakes.
- 2nd. For "feeding" while the train is running.
- 3rd. For applying the Brakes.

Plan of Main Valve 1 and positions of Handle.



In the first position, a free communication is formed through the large ports, **a, a**, in the valve 1, from the Main Reservoir to the Brake Pipe; but

In the 2nd position, the air must pass through the small valve, 3, and the hole, **g**, before it reaches the Brake Pipe.

This valve, 3, is held on its seat by a spiral spring of a strength corresponding to 10lbs. per square inch, so that when feeding in this **2nd position**, the pressure in the Brake Pipe is 10lbs. less than that in the Main Reservoir. This extra pressure is utilized when releasing the Brakes.

A little farther to the right the position is **neutral**. There is then no communication between the Main Reservoir and the Brake Pipe; neither can air flow from the Brake Pipe to the atmosphere; turning the handle, however, further to the right, has the effect of taking weight off the valve, 2, which is then lifted by the pressure in the Brake Pipe, and some of the air escapes from it into the atmosphere at **M**.

This escape of air applies the Brakes with a force corresponding to the reduction of pressure shown by the Brake Pipe Gauge **L**, connected to the branch **h**.

In the 3rd position, all the weight is taken off the Discharge Valve 2, thus allowing air to escape rapidly, which applies the Brakes with full force.

In the **first position** of the handle there is a leak through the hole, **c**, to remind the Driver, after releasing the Brakes, to bring the handle to the **2nd position, where it must remain whilst the train is running.**

Operation.—To apply the Brakes in ordinary stops, the Brake Valve should be opened gently until the desired reduction of pressure is observed on the gauge, after which the handle should be moved back gently to prevent further escape of air.

If the Driver's Brake Valve is operated in a rough way, serious inconvenience is caused to the passengers; and it may even result in the rupture of the screw couplings.

To prevent the jerk which is often experienced with all kinds of Brakes at the moment when the train comes to rest, it is sufficient for the driver to release the Brakes at the last revolution of the wheels in order to give the carriages time to assume their normal position. When doing so the Hand Brake on the Tender may be put on to advantage, so as to hold the train at the platform.

TRIPLE VALVE.

The Triple Valve F, Plate II., is simply a small piston, 1, carrying with it a slide valve, 2, which can be moved up or down by **increasing or decreasing the pressure in the Brake Pipe.**

As soon as the air from the Main Reservoir is turned into the Brake Pipe (by means of the Driver's Valve), the piston, 1, is pushed up into the position shown, and air is allowed to feed past it through a small groove, **a**, into the Reservoir, G. At the same time the slide valve, 2, covers the port, **b**, to the Brake Cylinder, and is in such a position that the air from the latter may exhaust into the atmosphere through **c**.

The piston, 1, has now the same air pressure on both sides, but if the pressure in the Brake Pipe is **decreased**, the piston and slide valve are forced down, thereby uncovering the passage **b**, through which air from the reservoir, G, flows into the Brake Cylinder, H, between the pistons, P, thus applying the Brakes. The Brake Pipe is shut off as soon as the Triple Valve Piston, 1, passes the groove, **a**.

To release the Brakes, the piston and slide valve are again moved into the position shown, by the Driver turning air from the Main Reservoir into the Brake Pipe. The air in the Brake Cylinder escapes through **c**, and at the same time the Reservoir is re-charged.

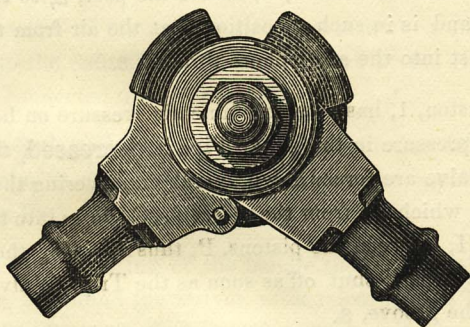
To release with more certainty the Driver must be careful to maintain extra pressure in the Main Reservoir, by keeping the handle of his Brake Valve in the second or "feed" position, while the train is running.

COUPLING.

The couplings K, Plate II., are exactly alike, and air tight joint is formed between them by means of the rubber packing ring in each, which being forced together by the air pressure behind them, the joint thus becomes tighter by increase of pressure.

These couplings are united by simply placing them face to face nearly at right angles, the stop pins being on the underside, as represented below, so that the projection of the one fits the corresponding groove of the other, and then turning the coupling straight into the position shown on Plate II.

No damage is done to the couplings if drawn apart forcibly by the separation of the train, as the rubber rings are forced into their respective couplings far enough to permit the projections to disengage from their grooves, and the Brakes will then go full on.



BRAKE CYLINDER.

The figure H, Plate II, represents the standard form of Brake Cylinder for a carriage. It contains two pistons, which are held in the position shown by the spiral springs within. When air is admitted, the two pistons are thrust outwards with equal force, and the Brakes go on. When the air is allowed to exhaust, the springs expanding, push back the pistons, and release the Brakes.

A leakage groove is provided to prevent the Brakes from being applied when the air flows slowly from the Triple Valve to the Cylinder as a result of a leak in the Brake Pipe. This groove permits air to pass the piston, P, unless it is admitted suddenly, in which case the piston moves past the groove. For this reason Drivers should never discharge less than 5lbs. air pressure to apply the Brake.

INSTRUCTIONS FOR WORKING THE WESTINGHOUSE BRAKE.

TO DRIVERS.

1. Drivers must see:—(a) that the top or steam cylinder is well lubricated with oil; (b) that the air cylinder is sparingly lubricated with a small quantity of kerosene (tallow or oil must not be used in the air cylinder, as they destroy the hose pipe); (c) that the air pump is constantly run, but never faster than is necessary to maintain the required pressure in train pipe, say, for suburban trains, 55lbs.; and for express or long journey trains, 65lbs. to 70lbs.

2. If a Driver finds the air pressure in his train too high, he can easily reduce it by applying the Brake with full power, then releasing it.

3. Drivers when coming on to a train, or when carriages are being attached, must have the air-pump working and the Brake regulator in the neutral position; this will enable them to accumulate a high pressure of air in the main reservoir, and so obtain an excess of air without increasing the pressure in the working reservoirs of the engine and tender. When the coupling-up is completed, the Driver must let the accumulated air pass into the train, and immediately replace the handle in the neutral position; the Driver will then see by the reduction of air in the gauge if the Guard has tested the Brake.

4. Drivers must always satisfy themselves that the Brake coupling on their engine is properly connected to that on the train, and that the **cocks in the Brake Pipe are open.**

5. Drivers, upon feeling that the Brakes have been applied by the Guard, or automatically, must at once aid in stopping the train by turning the handle of the Brake Valve towards the right, thus preventing escape of air from the main reservoir.

6. The blocks of the driving wheel Brake should be so adjusted by turning the screw that the pistons travel from 3 to 4 inches.

7. The Driver must, before starting, ascertain from the Head Guard how many vehicles are fitted, and that the pipe of the Westinghouse Brake is connected ready for working.

8. Engine-drivers are to report in writing to their Foreman (addressed to the Locomotive Superintendent), whether the Brake has failed to act when required, under the following heads:—

- 1st. Failure or partial failure to act when required in case of an accident to a train or collision between trains.
- 2nd. Failure or partial failure to act under ordinary circumstances to stop a train when required.
- 3rd. Delay in the working of trains, in consequence of defects in or improper action of the Brakes, distinguishing whether they arose from neglect, or inexperience of servants or failure of machinery or material, giving the name of trains and particulars of circumstances relating to the cause of failure under the above three headings.

In addition to the foregoing, Drivers must state whether the Brakes on their trains are air or vacuum.

9. While an engine is attached to a train the donkey pump must never be stopped, but must be kept working at a speed sufficient to maintain the required pressure. The Brake is applied by a decrease of air in the main Pipe, and if the decrease is made by leakage, it acts the same as if the decrease had been made by allowing air to escape by way of the Driver's valve.

10. To apply the Brakes lightly, the Driver's valve on the engine must be partially opened, and as soon as the gauge shows a reduction of from 5 to 8lbs. this valve must be gently closed. If the pressure runs up on the gauge when the handle is brought back, it shows that the handle has been placed in the "feeding" instead of the "neutral" position.

11. The Brakes are fully applied when the pressure shown in the gauge is reduced by 25lbs.; any further reduction would be waste of air. In cases of emergency, however, the Driver's valve must be fully opened to let all the air in the Brake Pipe escape.

12. Long trains require more careful handling than short ones, and a greater quantity of air must be discharged from the Brake Pipe.

13. **The Brake should be applied in good time, so that a moderate application may stop the train and avoid jerks and skidding of the wheels.**

14. In releasing the Brake, the regulator handle must be moved back against the stop **for about 10 seconds, and then placed in the second position, where it must remain while the train is running.** (This instruction must receive special attention.)

15. To prevent a rebound, the Driver should release the Brakes in proper time before coming to a dead stop.

16. Delays are caused by Drivers not releasing all the Brakes in the train, some of the blocks remaining on in consequence of not keeping the Brake regulator in the extreme back position long enough to release the Brakes properly. The regulator should be brought back smartly, so that the force of the extra pressure can instantly release the blocks from the wheels of the whole train. An extra pressure of ten pounds (10lbs.) in the main reservoir will give a great force upon the pistons of the triple valves, and is sufficient to drive them up. **Delays will occur if Drivers neglect to keep this amount of extra pressure in their main reservoirs.**

17. After a train has been reduced to a very slow rate of speed, it must be finally stopped by a Hand Brake on engine or tender (except in cases of emergency), **and the Westinghouse Brake must not be on when the train stops. This also applies to stopping trains at water cranes.**

18. Delays may arise from connecting portions of trains carrying different pressures; and, to avoid detention from this cause, Drivers must be careful not to leave more than **50lbs.** pressure in a train when detaching at a junction or terminus. The Driver who intends to couple-up at such places should, as already advised, carry a high pressure, say **70lbs.**, in the main reservoir, for the purpose of releasing any Brakes which may happen to be on.

19. If vehicles having different air pressures be coupled together, the Brakes will apply themselves on those which have the highest pressure. If the Brakes on the engine and tender thus apply themselves by being coupled to a train not charged, they should at once be taken off by opening the release valves from the Brake cylinders, which ought to be so arranged as to be worked from the foot-plate. After connecting the engine to the train, or after new vehicles have been added, the pipes and reservoirs are to be charged as quickly as possible. The Brakes should then be applied with full force by the Driver, who should not start away until the Inspector or Guard has signalled that the Brakes are acting on all the vehicles.

20. It is most important that Drivers should let the **water out of their main reservoirs**, drip cups, and triple valves at least once a week.

21. Firemen will be held responsible that they learn the use of the Westinghouse Brake, when employed on engines so fitted; and no Fireman will be promoted until he has proved that he is perfectly competent to work it properly.

22. When approaching terminal stations, and stations where obstructions exist on the same line of rails, Drivers are to work their trains with the Hand Brakes, excepting in cases of

emergency, when the Continuous Brake is to be brought into operation.

23. In all other cases, the continuous Brake is to be used, due regard being paid to the momentum of the train so as to avoid overshooting the platforms.

24. In the event of a connexion breaking or Brake not working properly on any carriage, the Driver must send his Fireman to shut off said connexion or release the Brake on such vehicle.

TO GUARDS.

1. Before leaving a terminus, after adding to a train on the journey or another engine being attached, the Rear Guard must ascertain whether the couplings are connected and the cocks in the Brake Pipe are all open throughout the train, by applying the Brakes from his van, by his reducing the pressure in the gauge 20lbs., and seeing that they are released from the engine.

2. If the Brake is not in use on the whole train, or if the van is not the last vehicle, the test must be made by opening the cock in the Brake Pipe of the last vehicle connected. Guards, when they have occasion to apply the Brake from their vans, must open the tap and allow the air to escape until the train is brought to a standstill; but they should only use the Brake in cases of emergency. Guards must in all cases **screw the Hand Brakes clear off** before starting.

3. **Guards must on no account start a train until they have tested the Brake;** and, in the event of the engine being changed, or vehicles attached or detached at any station during the journey, the Brake must be again tested before resuming the journey.

4. Guards working vans having a Pipe only "**must use the Hand Brake,**" whether the Westinghouse Brake is in use on the other portion of the train or not.

5. The Guard in charge of a train must inform the Driver how many vehicles are fitted, and whether the train is in working order. **Should it happen that the front part of a**

train is in use, the Rear Guard must use his Hand Brake with great care, to prevent jerking or rebound.

6. When the Brake is in use, the Guard must enter in his journal "Westinghouse Brake in use," and if the Brake has acted properly, this is all that it is necessary to say in the journal; but, in the event of its not working properly, he must make a special report, giving full particulars, and add to his journal, "See Special Report."

7. Guards must **not use the Brake except in case** of emergency, such as violent oscillation, carriages on fire, or anything likely to cause danger to a train, when the Brake must be instantly applied, and the train brought to a standstill as quickly as possible.

8. Guards must note in their train books the pressure registered in their gauges at changing and terminal stations.

Inspectors should see:—

(1) That the Brake connexions are perfect and properly adjusted for the wear of the blocks and wheels by being uniformly taken up. The pistons of double-piston cylinders should each travel not less than two nor more than four inches. Those of single-piston cylinders should not travel less than four, nor more than eight inches.

(2) That the Brake cylinders are perfect, and lubricated at least every three months with mineral oil.

(3) That the hose-couplings are united, and the cocks in the pipes are open; that is, the handles must stand across or away from the pipe, except the one at the end of the train, which must lie along the pipe in the shut-off position.

(4.) That the joints are all air tight.

GENERAL.

1. Before detaching the engine or any carriages, the Brakes must be fully released on the whole train. Neglecting this precaution, or setting the Brakes when the engine is away, may cause serious inconvenience in shunting.

2. The pipes and joints must be kept tight, and when leaks are discovered they must be corrected, if serious, before the vehicle is again used.

3. If the Brakes are applied by the separation of the train, or by the breaking of a pipe, or should the Brakes of any vehicle stick on, they can be released by opening the release valve attached to the cylinder. **These valves must be held open until the air has escaped.**

4. Should it be desirable to throw the Brake of any vehicle out of operation without affecting the others, the small cock leading from the main pipe to the triple valve must be closed. When this cock is open, the handle stands straight along the branch pipe.

5. At each end of every vehicle a tap is fitted to the Brake Pipe, and, when the hose-couplings are connected, all the taps must be open with the exception of the one at the end of the train.

6. These taps must always be opened after connecting the hose-couplings, and closed before separating them. It is important to observe that these taps are open when the handles stand across or away from the line of pipe, and closed when parallel to or alongside the pipe.

7. Care must be taken:—(A) That the Brake connexions are perfect, and properly adjusted for the wear of the blocks and wheels; (b) that the Brake cylinders are perfect, and lubricated occasionally with mineral oil; and (c) that the couplings and other parts are tight.

8. **Carriage Examiners must see that the cocks under each carriage are in their proper position before the train starts, so as to prevent delay on the journey.**

9. Shunters, in all cases, after connecting the couplings, must open the cocks at the ends of the carriages except last, so as to complete the Brake throughout the train. Before uncoupling, the pipe taps must be shut, but before doing so Shunters must satisfy themselves that the Driver has taken the Brake off, and that the Hand Brake at the rear of the train has been applied.

10. It is the duty of each Station Master, Inspector, or person starting a train where it commences its journey, to see that the air-pipes are connected between each vehicle, and also to see that the train is properly coupled-up in every other respect.

11. The performance of this duty by the Station Master, Inspector, or other person will not in any way **relieve the Guard** of his responsibility for seeing that every coupling is properly made, and that the Brake is in working order.

12. Shunters, Couplers, &c., before uncoupling the engine from the train, must see that the tap on the end of the vehicle next to engine is closed, and a signal must then be given to the Driver to apply the Brake fully on engine. This exhausts the air from the hose-pipes. The tap on pipe leading from the engine must then be closed, and the couplings separated.

13. Porters and others crossing over the buffers between carriages must not step on the hook of the hose coupling, or on the air-pipe. Station Masters must caution their staff to strictly observe this instruction.

14. Engine-drivers and Guards must not depend entirely upon the action and power of the Brake; but when approaching terminal stations or junctions the speed must not be greater than that which is usual with trains worked by ordinary Hand Brakes. Drivers and Guards must also have their trains well under control, so that they can be brought to a standstill with the Hand Brake if necessary.

15. Shunters and others in running off carriages into sidings must not use the Westinghouse Brake, and must shunt the vehicles in such a manner as to be able to stop them by hand before reaching any carriages that may be standing on the sidings or before striking the buffer stops.

16. On any occasion when the Brake, from any cause, gets out of order and cannot be used, **the Guard will report the same to the Inspector**, and will be held responsible that the Brake pipe is not coupled on to the engine, and the Driver informed that the Brake on the carriages cannot be used.

17. Delays and inconveniences may be caused by persons tampering with and altering the taps of the Brake. Station

Masters and Inspectors must give this matter particular attention, and see that each member of the staff properly understands when and how to turn off or put on these cocks ; and that no person except those properly authorized are allowed to interfere in any way with the cocks or fittings of the Brake.

THE FOLLOWING INSTRUCTIONS ARE TO
DRIVERS USING ANY CONTINUOUS BRAKE.

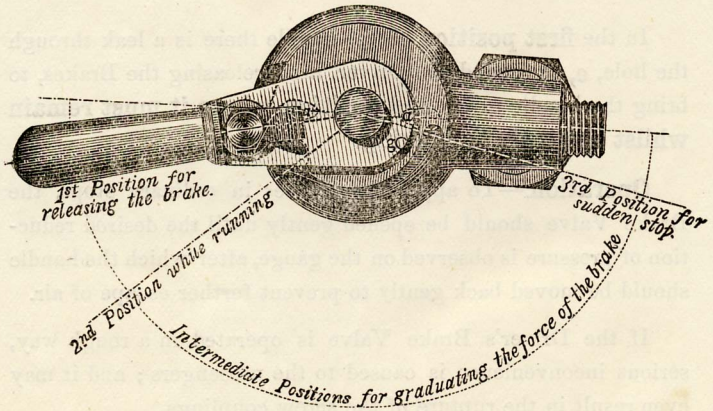
1. Drivers of trains or engines fitted with Automatic Continuous Brakes are cautioned against placing implicit reliance upon the Continuous Brake for the purpose of stopping at terminal stations, or roadside stations, when another train is standing on the same line of rails.

2. The time to be gained by coming into a terminal station at a high rate of speed is insignificant when the great risk attendant upon such a proceeding is taken into consideration.

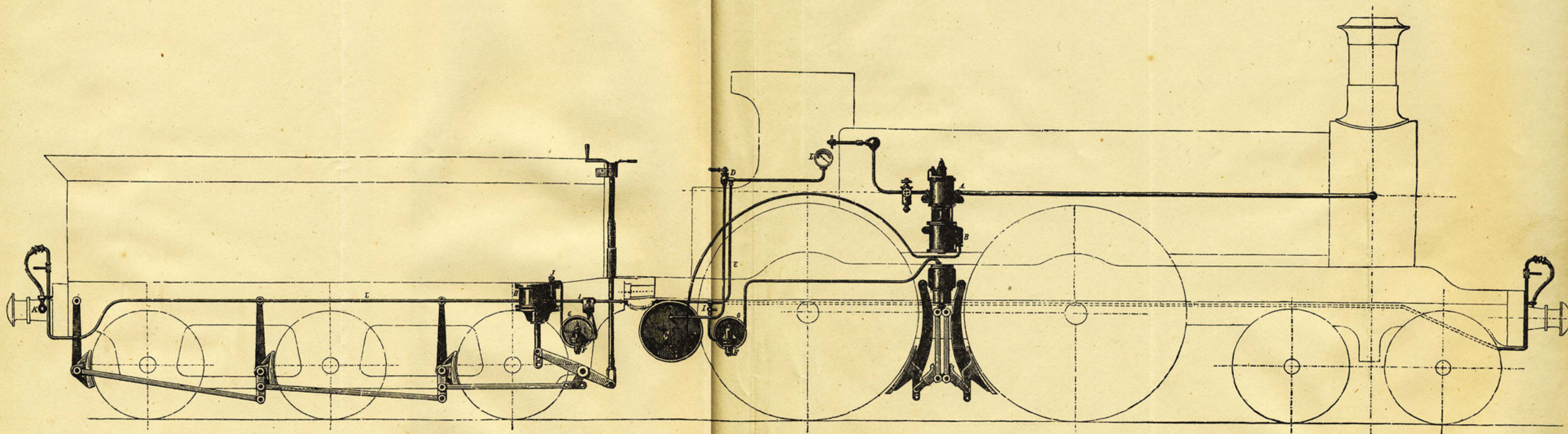
3. When approaching terminal stations, and stations where obstructions exist on the same line of rails, Drivers are to work their trains with the Hand Brakes, excepting in cases of emergency, when the continuous Brake is to be brought into operation.

4. In all other cases, the continuous Brake is to be used, due regard being paid to the momentum of the train so as to avoid overshooting the platforms.

5. In the event of a connexion breaking or Brake not working properly on any carriage, the Driver must send his Fireman to shut off said connexion or release the Brake on such vehicle.



THE WESTINGHOUSE AUTOMATIC BRAKE APPLIED TO LOCOMOTIVE AND TENDER.



Unfortunately **Plate II** is missing.

Plate III.

STANDARD APPARATUS FOR ONE VEHICLE.

