APPARATUS FOR OPERATING AIR BRAKES.

(No Model.)

3 Sheets—Sheet 2.

Witnesses

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To all whom it may concern:

Be it known that I, William B. Mann, a resident of the city of Baltimore, State of Maryland, have invented a new and useful

Improved Apparatus for Operating Air-Brakes, which invention is fully set forth in the following specification:

My invention relates to air-brakes for railroad-trains, and more particularly to the apparatus for controlling the operation of such brakes. In brakes of this class it is essential that the operations of the brake mechanism should be controlled by the engineer from his position on the engine for the purpose of securing graduated application of the brakes for service stops and a very rapid and powerful application thereof for emergency stops.

In addition to this it is essential that the brakes should be applied automatically when the train breaks in two and leaves the rear portion thereof beyond the control of the engineer. The application of the brakes for service stops and in case of breaking of the train has heretofore been secured by utilizing air stored in an auxiliary reservoir carried under each car, the necessary movement of the triple valves being due to a reduction of train-pipe pressure, brought about by the operations of the engineer’s valve in the former case and by the breaking of the train-pipe in the latter case. It has been proposed to utilize air conducted directly from the train-pipe to the brake-cylinder for graduating or service applications, a material increase in train-pipe pressure being resorted to to secure the necessary movements of the triple valve. This is extremely undesirable in practice, because it is an essential requirement in all triple valves that they be capable of being thrown to emergency position with equal facility from the release and from the graduating positions, and as the emergency throw is only accomplished by a very material reduction of train-pipe pressure below the normal or running pressure it is evident that any increase beyond normal in the pressure of the train-pipe for service applications would have to be dissipated before the reduction below normal necessary for emergency action could begin. A further practical difficulty involved in the increase of train-pipe pressure to secure service or graduating action is that it involves the nice adjustment of all the parts to a predetermined normal pressure and in cases where it is found necessary to run the train with pressure in the train-pipe much below normal, as where the air compressor operates defectively or the train-pipes leak, service or graduating action could not be had.

In all cases with which I am familiar the necessary reduction of train-pipe pressure to secure quick service action of all the triple valves on a train for emergency stops has been secured by serially venting the train-pipe at several points along the train, preferably at each car, the action being initiated by a very considerable reduction through the engineer’s valve. In some cases the air vented from the train-pipe at the triple valves has been allowed to escape to the atmosphere and in other cases it has been conducted to the brake-cylinder to augment the pressure therein, mainly derived from the auxiliary reservoir. One of the difficulties heretofore experienced in thus venting the train-pipe to the brake-cylinder has been that the auxiliary-reservoir air in the brake-cylinder acted in opposition to the air flowing in from the train-pipe, and hence retarded the serial venting and consequent reduction of pressure in the latter. While such retardation may amount to but a fraction of a second at each triple valve, the aggregate in a train of fifty cars becomes materially important when it is necessary that the serial action of all the triple valves should be so rapid as to be practically instantaneous. Various more or less successful efforts have been made to avoid this difficulty, generally by the use of means for conducting the train-pipe air to the brake-cylinder in advance of auxiliary-reservoir air. A further difficulty experienced with a certain class of triple-valve mechanism heretofore used has been due to the great liability of the train-pipe to leak. A slight leak in the train-pipe gradually lowers the pressure therein, thus causing the triple-valve piston to move toward train-pipe pressure, thereby admitting air to the brake-cylinder and applying the brakes. In a long train the liability to leakage in the train-pipe is greatly increased, and repeated undesired
applications of the brakes due to this cause are a source of great annoyance and result in frequent delays and much loss of time.

The present invention has for one of its objects to secure service application of the brakes by the use of train-pipe air upon a slight reduction of pressure in the train-pipe rather than by an increase of pressure therein. A further object of the invention is to secure an emergency application of the brakes upon a considerable reduction of train-pipe pressure by the use of train-pipe air.

An additional object of the invention is to avoid the involuntary or undesired application of the brakes due to leaks in the train-pipe, and, finally, the invention has for its further objects to simplify the construction of triple valves to the end that they may be more cheaply manufactured and less liable to get out of order and to increase the efficiency and accuracy of said valves when in operation.

With these objects in view the invention consists, generally speaking, in an apparatus for simultaneously conducting train-pipe air to the brake-cylinder and reinforcing the air-pressure in the train-pipe with auxiliary-reservoir air.

Furthermore, the invention consists in an apparatus for simultaneously conducting air from the train-pipe to the brake-cylinder, from the auxiliary reservoir to the train-pipe, and from the auxiliary reservoir to the atmosphere.

Furthermore, the invention consists in means for conducting air from the auxiliary reservoir to the train-pipe, whereby equilibrium of pressure in the auxiliary reservoir and the train-pipe is maintained equal and involuntary applications of the brakes due to leaks in the train-pipe are avoided.

Furthermore, the invention consists of means which upon a slight reduction of train-pipe pressure first automatically open and then automatically close a restricted passage from the train-pipe to the brake-cylinder, whereby graduated and service application of the brakes is secured by air taken directly from the train-pipe.

Furthermore, the invention consists of means which upon a great reduction of pressure in the train-pipe automatically open free communication between the train-pipe and the brake-cylinder, whereby emergency application of the brakes is secured entirely by air taken directly from the train-pipe to the brake-cylinder.

Furthermore, the invention consists of means whereby a restricted passage between the train-pipe and the brake-cylinder is automatically opened upon a slight reduction of train-pipe pressure, an enlarged passage is opened from the train-pipe to the brake-cylinder upon a great reduction of said pressure, and means automatically opening communication from the auxiliary reservoir to the train-pipe upon either a slight or great reduction of train-pipe pressure, whereby the pressure in the train-pipe is reinforced by air drawn from the auxiliary reservoir when making either service or emergency applications of the brakes, and, finally, the invention consists in certain details of construction and combination of parts hereinbefore described and then defined in the claims.

In carrying out my invention various forms of apparatus may be employed, and I have illustrated in the accompanying drawings one form of apparatus invented by me which I have found to be highly efficient for the purpose, in which—

Figure 1 is a sectional view of a triple valve and its casing having suitable connections with an auxiliary reservoir, a brake-cylinder, and a train-pipe, parts being shown in elevation and the triple valve and its cooperating parts in the position they occupy when the brakes are released. Fig. 2 is a view similar to Fig. 1 with the parts in the position they occupy when admitting air to the brake-cylinder for service applications. Fig. 3 shows the parts in position for holding air in the brake-cylinder for service applications. Fig. 4 is a view of the parts in emergency position. Fig. 5 is an enlarged plan view of the bottom of the valve-casing, showing location and arrangement of the ports therein. Fig. 6 is a similar bottom plan view of the main valve, showing the ports therein and in dotted lines the passages therethrough. Figs. 7 and 8 are enlarged transverse vertical sections on the lines 77 and 88, respectively, of Fig. 1; and Fig. 9 is a view, similar to Fig. 1, of a modification, while Figs. 10 and 11 are plan views of the bottom of the valve and of the valve-seat, respectively.

Referring to the drawings, in which like letters represent like parts, H is a valve-casing having port A leading to the train-pipe, port B leading to the brake-cylinder, and ports C and D leading through port E to the atmosphere. Within the valve-casing H is a main valve G, having the usual operating-piston G, working in the cylinder H, formed as an extension of the valve-casing H. The ordinary feed-in passage h is provided around the piston G, whereby when the parts are in charging position air may pass from the train-pipe through the valve-casing H to the auxiliary reservoir I. In addition to this feed-in passage h is provided a somewhat restricted duct or passage-way from the auxiliary reservoir I to the train-pipe, which passage is controlled by a valve opening toward train-pipe pressure. Any suitable conduit for conducting the air from the auxiliary reservoir to the train-pipe side of the piston G' may be employed, and I have shown for this purpose a passage h' formed in the wall of the valve-casing and having a check-valve h' opening toward train-pipe pressure. The main valve G has formed therein a chamber G', communicating with a somewhat smaller chamber.
G^2 and having a valve-seat g^2 formed at their junction, while a passage F extends from the chamber G^2 to the ends of the valve G, as shown. The chamber G^2 has a port A' opening therefrom to the lower face of the valve, while the chamber G^2 has two ports B' and D likewise opening to the lower face of the main valve. The port D is located between and is much smaller than ports A' and B', which may be of about the same size. Two ducts e lead through the body of the valve from the passage F to ports E E in the bottom face of the valve, the transverse distance between ports E E being exactly equal to that distance between ports C C in casing H. On opposite sides of the chamber G^2, I form in the body of the valve H parallel ducts c c, each having ports C' at one end and C^2 at the other. The distance between ports C' and C^2 from center to center is substantially equal to the distance from the center of ports C to the longitudinal center of port B. A graduating-valve g^2 is attached to and moves with the piston G', said valve entering the chamber G^2 and seating on the seat g^3, as shown in Figs. 1 and 3. Projecting forward from the graduating-valve g^2 is a reduced stem g^2 which passes through chamber G^2 and enters passage F, fitting the same practically air-tight and closing communication between the ducts e e and passage F when the graduating-valve g^2 is on the seat g^3, as shown in Figs. 1 and 3, but uncovering said ducts when the graduating-valve is unseated, as shown in Figs. 2 and 4. The length of the stem g^2 is such that it is never entirely withdrawn from the passage F. The piston G', together with its stem and head G^1, has a slight movement relative to the main valve G.

Thus when the parts are in the position shown in Fig. 1 there is a small amount of lost motion between the piston G' and main valve G before the head G^1 contacts with the valve, and since the graduating-valve g^2 together with the stem g^2 move with the piston this lost motion serves to unseat the graduating-valve g^2 and to draw the stem g^2 back, so as to uncover the ducts e e. On the reverse movement of the piston the main valve does not move until the graduating-valve is seated, after which the pressure of the piston is transmitted through the graduating-valve to move the main valve.

The operation of the apparatus above described is as follows: Compressed air from the main reservoir on the engine is admitted to the train-pipe and forces the piston to its extreme right-hand position, (shown in Fig. 1,) in which position the ports A', A', B', D, and E E are all closed, while the ports C^2 and C^2 register with the port B and the ports C' C register with the ports C C, thereby affording a free passage from the brake-cylinder to the atmosphere. The valve h^2 is also closed by the pressure in the train-pipe and air passes from the latter through the feed-in valve h and the main-valve chamber to the auxiliary reservoir. This leaves all the parts in release or running position, and it is desired to make a service application of the brakes the engineer slightly reduces the pressure in the train-pipe through the engineer's valve in the usual and well-known way, which reduction in pressure causes the piston G' to make a partial traverse of its cylinder from right to left (see Fig. 2) and also opens the valve h^2. In this position, Fig. 2, ports E E register with C C, port D is over port B, and port A' is partially over port A, so that train-pipe air is passing through ports A A', chambers G^2 G^2, and ports D and B to the brake-cylinder. This of course has a tendency to further reduce train-pipe pressure to the point where it would cause the piston to take quick action, as hereinafter described; but this tendency is counteracted by auxiliary-reservoir air, which passes through conduit h^2 and valve h^2 to the train-pipe, thus reinforcing the train-pipe pressure. At the same time that air is thus passing from the auxiliary reservoir to the train-pipe air is escaping from the former to the atmosphere through passage F, ducts e e, and ports E E C C. The result is that the pressure on the auxiliary-reservoir side of piston G' falls very slightly below that on the train-pipe side and the piston shifts from left to right—that is, from the position shown in Fig. 2 to that shown in Fig. 3—thereby seating the graduating-valve g^2 and closing the ducts e e by advancing the stem g^2 in the passage F. At the same instant the valve h^2 also closes. The escape of air from the train-pipe to the brake-cylinder and from the auxiliary reservoir to the atmosphere is thus cut off, but without releasing the pressure in the brake-cylinder. If desired, the operation may be repeated by again slightly reducing train-pipe pressure through the engineer's valve. By restoring the pressure in the train-pipe to normal the parts may be returned to the position shown in Fig. 1 and the air in the brake-cylinder vented through port B, ducts c c, and ports C C to the atmosphere, thereby releasing the brakes. If now it be desired to produce an emergency application of the brakes, the engineer reduces the pressure in the train-pipe some ten or twelve pounds, thereby causing the piston G' to quickly shift from its extreme right position, Fig. 1, to its extreme left position, Fig. 4.
This opens the graduating-valve \( g \), brings port A' fully over port A and port B' fully over port B, thus suddenly venting the train-pipe to the brake-cylinder, and thereby securing a quick release of all the triple valves of the series. In this position no air escapes from the auxiliary reservoir to the atmosphere, because the ports E and E no longer register with ports C and C', but the valve \( k' \) is open and auxiliary-reservoir air passes thereto through the train-pipe, and thereby reinforces the pressure in the latter, and consequently in the brake-cylinder.

Should the pressure in the train-pipe be suddenly lowered by the breaking of the train when the parts are in either of the positions shown in Figs. 1, 2, and 3, the check-valve \( h' \) would be instantly closed by the interior pressure, and the triple-valve mechanism would assume the position shown in Fig. 4, and auxiliary-reservoir air would pass through conduit \( h' \), thence through the main valve to the brake-cylinder.

It will be readily understood that the emergency throw of the piston \( G' \) and valve \( G \) may be secured with equal facility from the release position, Fig. 1, or graduating positions, Figs. 2 and 3.

In case the pressure in the train-pipe is gradually lowered by reason of one or more leaks along the pipe air from the auxiliary reservoir will pass to the train-pipe through conduit \( h' \), thereby maintaining the equality of pressure on the opposite sides of the piston \( G' \) notwithstanding the constant lowering of pressure in the train-pipe due to the leakage. The piston \( G' \) will therefore remain stationary and no pressure will be admitted to the brake-cylinder. This ability of the piston \( G' \) to move promptly upon a moderate or great reduction of train-pipe pressure through the engineer's valve and its immobility when pressure is slowly reduced by reason of leakage in the train-pipe is of great importance, as it enables a train with a leak to be operated without the annoyance and delay due to involuntary applications of the brakes.

Referring to the modified apparatus shown in Fig. 9, the valve-casing \( H \) has the same ports A and B that are found in the construction hereinafter described and a port \( C' \) corresponding to the ports \( C \). Between the ports \( B \) and \( C' \) is a second port \( B' \), leading from the valve-chamber to the brake-cylinder. The main valve has the ports A' and B', as in the other structure, but omits the port D, and in its stead a port \( B' \) leads from the chamber \( C' \), at the end thereof nearest the piston \( G' \).

The stem \( g' \) is omitted from the graduating-valve \( g' \), and the communication between the chamber \( G' \) and passage \( F \). A port \( E' \) leads from the chamber \( F \) to the lower face of the main valve, and the entrance of air from the auxiliary reservoir to said passage is controlled by a spring-pressed valve \( j' \), having a stem projecting out through the passage into contact with the piston-stem head \( G' \).

The operation is as follows: The parts being in release position (as shown in Fig. 5) the brake-cylinder \( F \) in communication with the atmosphere through the chamber \( G' \), as will be readily understood. When pressure is slightly reduced in the train-pipe for graduating action, the main valve is shifted to the left, bringing port A' over A, B' over B', and E' over C' and opening valves \( g' \) and \( j' \). The remaining part of the graduating action is as in the apparatus of Figs. 2 and 3. For an emergency application of the brakes a great reduction of train-pipe pressure causes the piston to take its extreme traverse, bringing port B' over A, B' over B', and E' over E'. Train-pipe air then passes directly through chamber \( G' \) to the brake-cylinder without entering chamber \( G' \), and some auxiliary-reservoir air also enters the brake-cylinder direct through port \( B' \), while a larger amount passes to the train-pipe through conduit \( h' \) to reinforce train-pipe pressure.

It will be readily understood that many other forms of apparatus may be devised involving the same inventive idea, and I do not therefore desire to be limited to any specific form of apparatus.

Having thus described my invention, what I claim is—

1. The combination of the train-pipe, the auxiliary reservoir and the brake-cylinder, with means simultaneously admitting train-pipe air at train-pipe pressure to the brake-cylinder and auxiliary-reservoir air to the train-pipe.

2. The combination of the train-pipe, the auxiliary reservoir and the brake-cylinder, with means simultaneously admitting train-pipe air at train-pipe pressure to the brake-cylinder and auxiliary-reservoir air to the train-pipe upon a lowering of train-pipe pressure.

3. In a compressed-air brake mechanism, the combination of means simultaneously admitting air from the train-pipe to the brake-cylinder, and from the auxiliary reservoir to the train-pipe, with additional means for lowering auxiliary-reservoir pressure.

4. The combination of the train-pipe, auxiliary reservoir and brake-cylinder, with means opening a passage from the auxiliary reservoir through the train-pipe to the brake-cylinder upon a lowering of train-pipe pressure, and additional means for lowering auxiliary-reservoir pressure.

5. The combination of the train-pipe, auxiliary reservoir, and brake-cylinder, and a conduit connecting the auxiliary reservoir with the train-pipe, having a valve therein opening to communication between the train-pipe and brake-cylinder, with a main valve having ports which connect the brake-cylinder to the atmosphere only when the parts are in release position, other ports which connect the train-pipe to the brake-cylinder upon a slight reduction of train-pipe pressure, and a port connecting the auxiliary reservoir to
the atmosphere upon a like reduction of train-pipe pressure, whereby service application of the brakes may be secured with pressure taken direct from the train-pipe.

6. The combination of the train-pipe, auxiliary reservoir, and valved conduit connecting them, the brake-cylinder, the main valve and its operating-piston, with ports controlled by said main valve and connecting the train-pipe to the brake-cylinder, and means controlled by said piston and opening the auxiliary reservoir to the atmosphere when the piston makes its partial traverse for service stops, whereby the valve is prevented from taking quick action.

7. In a triple-valve mechanism the combination of means simultaneously admitting air from the train-pipe to the brake-cylinder, from the auxiliary reservoir to the train-pipe and from the auxiliary reservoir to the atmosphere.

8. In a triple-valve mechanism the combination of means simultaneously admitting air from the train-pipe to the brake-cylinder, from the auxiliary reservoir to the train-pipe and from the auxiliary reservoir to the atmosphere upon a slight reduction of train-pipe pressure, but which upon a great reduction of train-pipe pressure, admits air from the auxiliary reservoir to the train-pipe only, and from the latter to the brake-cylinder.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

WILLIAM B. MANN.

Witnesses:

JOSEPH T. GOTT,

JAMES M. FAIRBANK.