H. M. P. MURPHY.

AIR BRAKE APPARATUS.

APPLICATION FILED APR. 4, 1908.

912,317. Patented Feb. 16, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

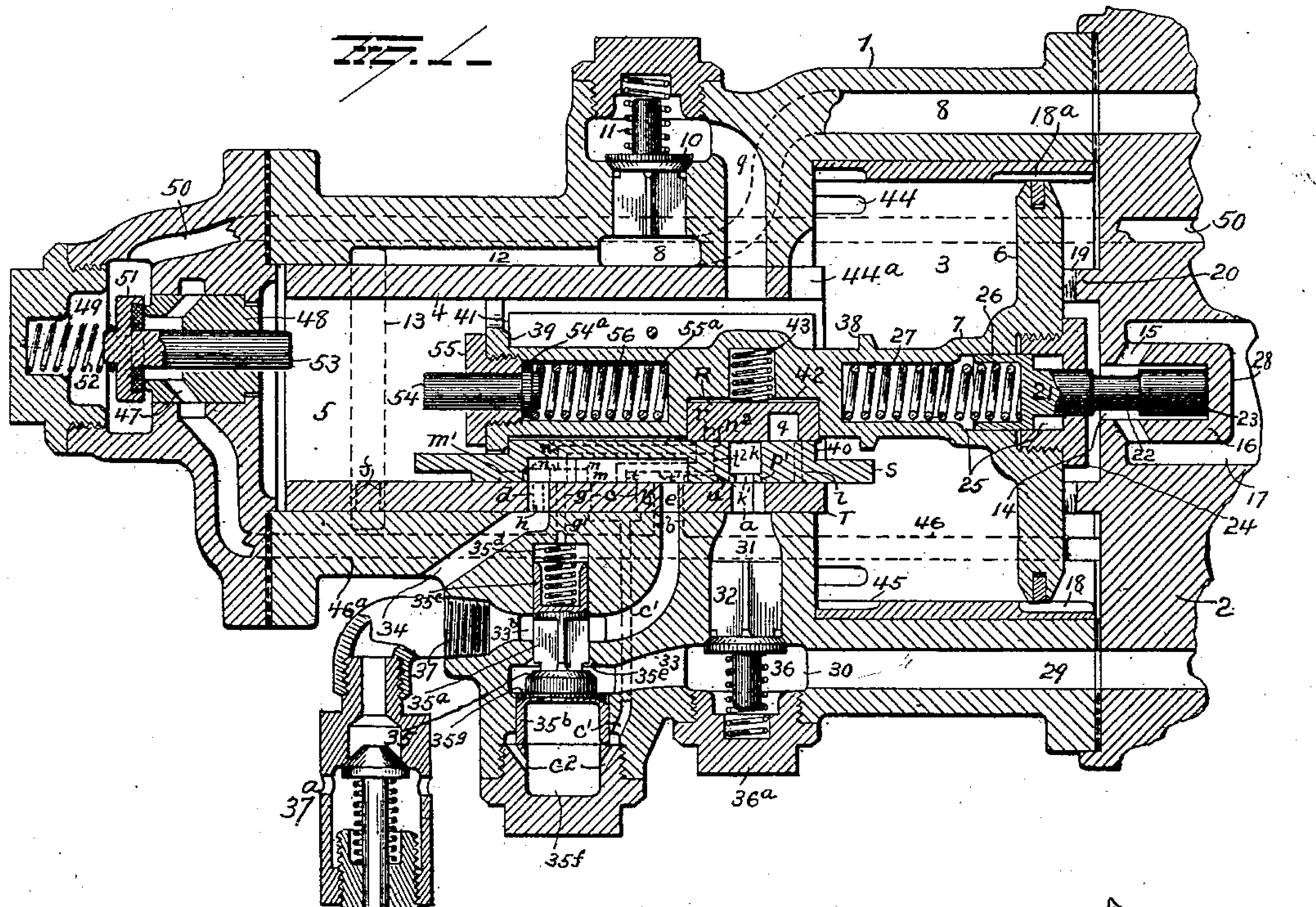
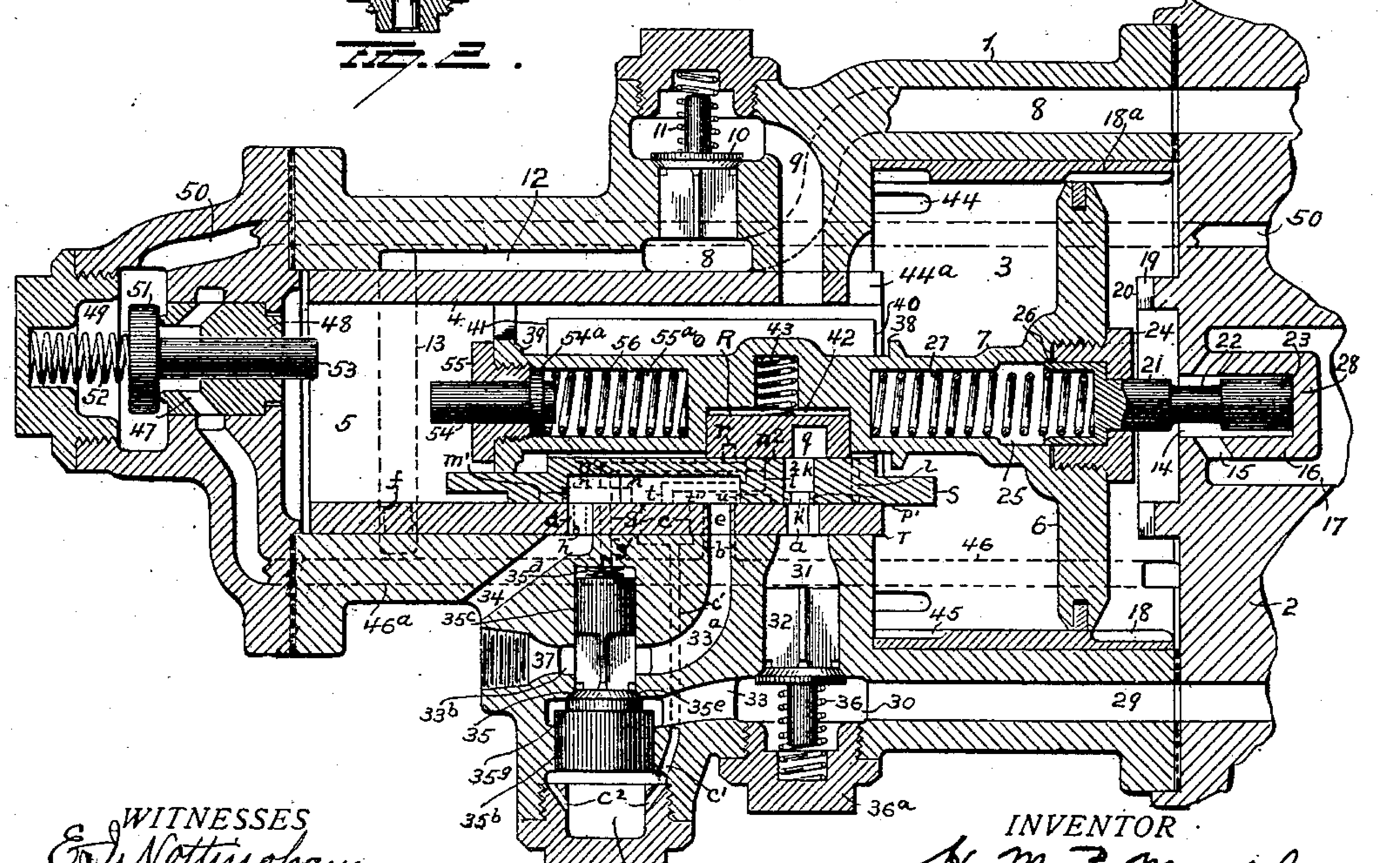


Fig. 2.



WITNESSES

E. I. Nottingham

G. F. Downing

INVENTOR

H. M. P. Murphy

By H. A. Seymour

Attorney

H. M. P. MURPHY.

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2 SHEETS—SHEET 2.

Fig. 3.

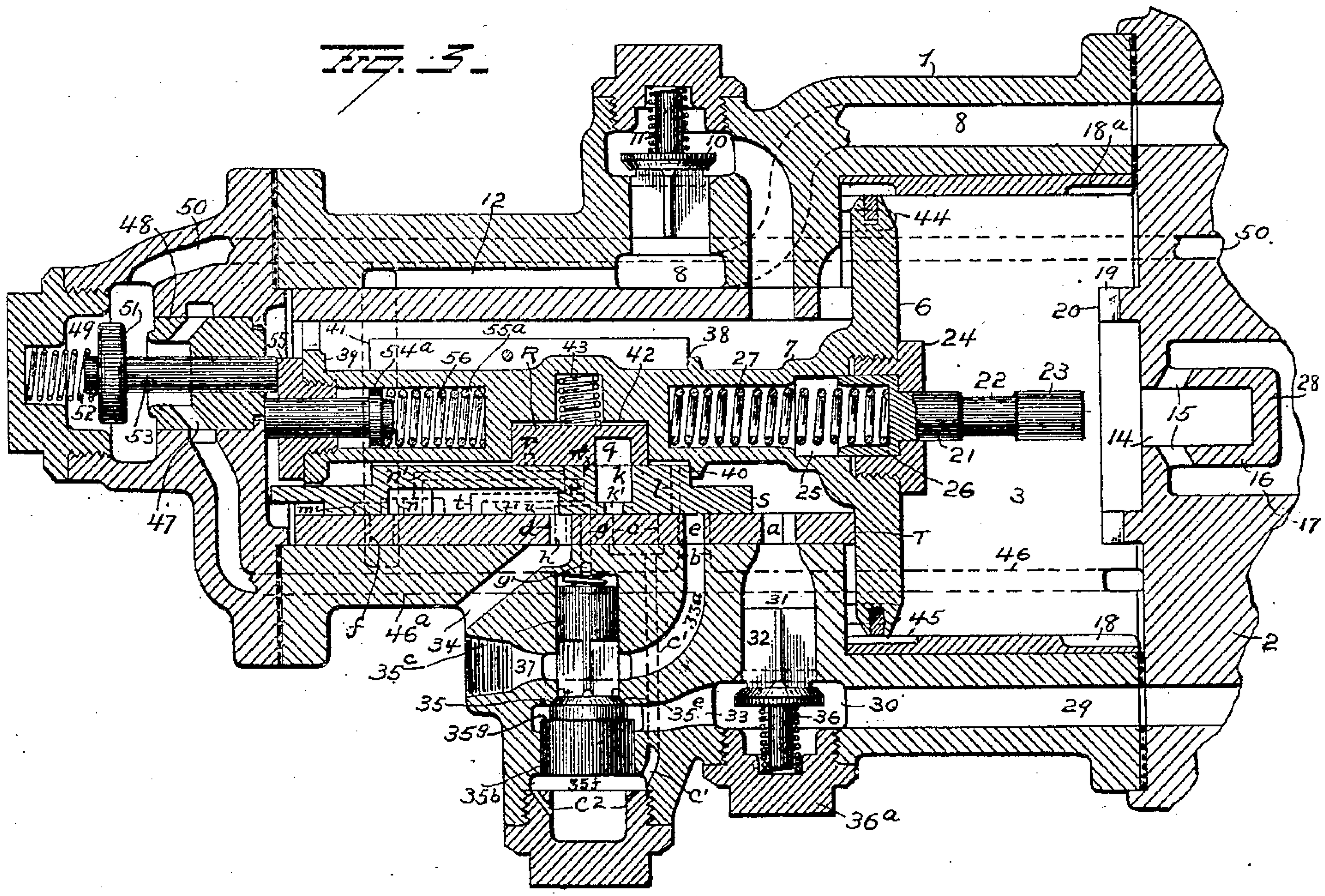


Fig. 4.

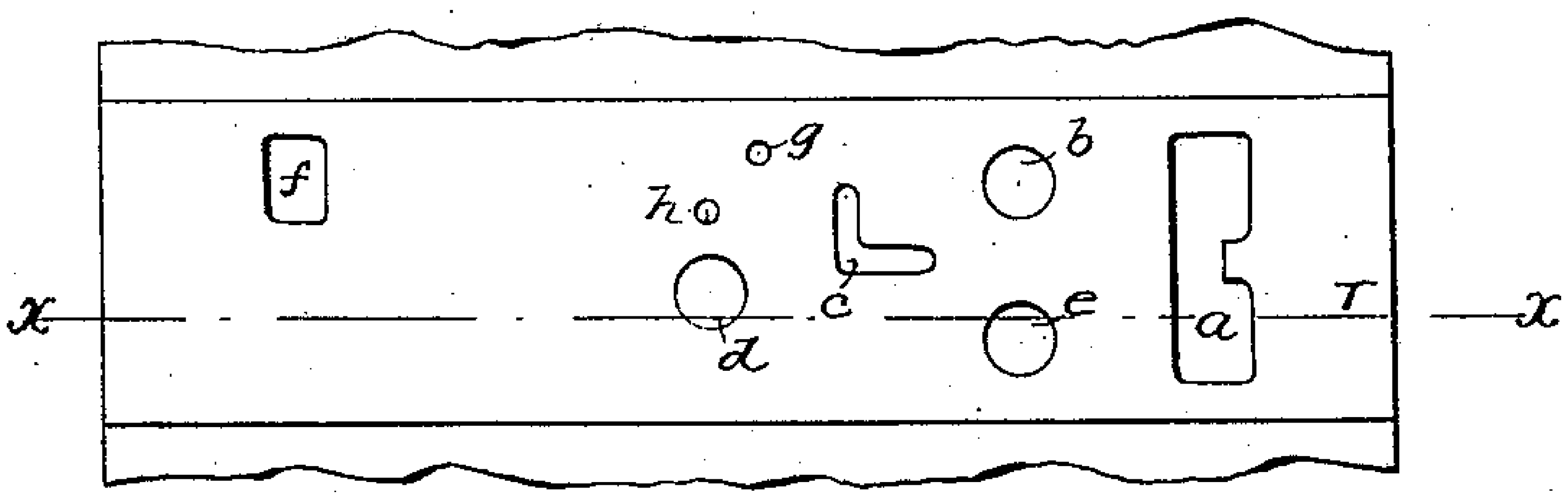


Fig. 5.

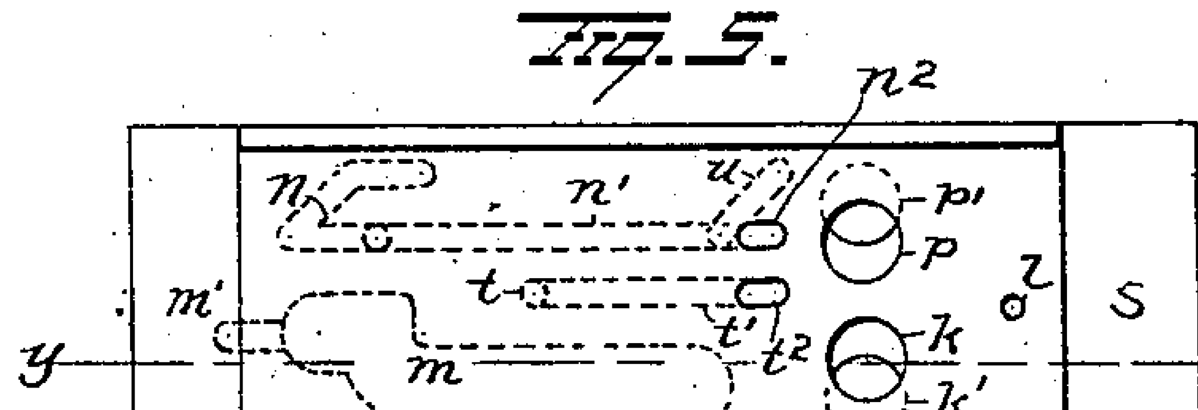
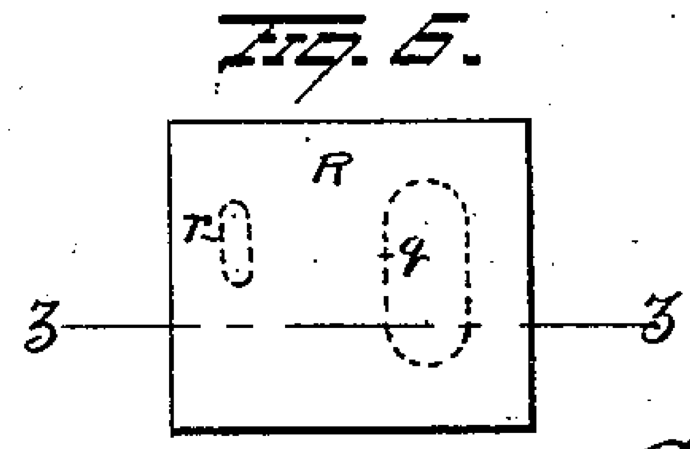


Fig. 6.



WITNESSES

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G. F. Downing

INVENTOR

H. M. P. Murphy

By H. A. Seymour

Attorney

UNITED STATES PATENT OFFICE.

HOWARD M. P. MURPHY, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR OF ONE-FOURTH TO L. H. BOWMAN, OF MUNHALL, PENNSYLVANIA, AND ONE-EIGHTH TO JOSEPH M. FLANNERY, OF PITTSBURG, PENNSYLVANIA.

AIR-BRAKE APPARATUS.

No. 912,317. Specification of Letters Patent. Patented Feb. 16, 1909.

Application filed April 4, 1908. Serial No. 425,196.

To all whom it may concern:

Be it known that I, Howard M. P. Murphy, a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Air-Brake Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in air brake apparatus and more particularly to a triple valve mechanism.

One object of my present invention is to so construct a triple valve mechanism as to enhance the efficiency of the same and insure the accurate operation in effecting the application and release of the brakes under all conditions and also to cause the proper recharging of the auxiliary reservoirs.

A further object is to provide improved means for insuring efficiency and accuracy in both service and emergency applications of the brakes and to provide improved means for effecting a graduated release of the brakes.

A further object is to so construct a triple valve mechanism that it shall be very sensitive to variations of train pipe pressure, regardless of the position on a long or a short train, at which said mechanism may be located.

A further object is to improve in other respects, the construction of triple valve mechanism so as to avoid possibility of imperfect or faulty operation of the brakes and also to provide means for the maintenance of brake cylinder pressure in spite of leakage.

With these objects in view, the invention consists in certain novel features of construction and combinations and arrangements of parts as hereinafter set forth and pointed out in the claims.

In the accompanying drawings Figure 1 is a sectional view of a triple valve mechanism embodying my improvements, the parts being shown in "release" position; Fig. 2 is a similar view with the parts in "release lap" position. Fig. 3 is a view showing the parts in the "emergency" position; Fig. 4 is a plan view of the main slide valve seat: Fig. 5 is a top plan view of the main slide valve, and Fig. 6 is a top plan view of the graduating valve. In the sectional views, the sections of the slide valves and the valve seat are taken on the lines *x—x*, *y—y*, and *z—z* respectively of Figs. 4, 5, and 6.

1 represents a casing, one head 2, of which constitutes one end of a chamber 3. A bushing 4 is located within the casing and affords a valve chamber 5 which communicates at one end with the chamber 3. A piston 6 is located within the chamber 3 and is provided with a rod 7 for operating slide valves R and S in the valve chamber 5, as hereinafter described. Ducts 8—9 are provided for conducting train pipe fluid to the chambers 3—5 and the chamber 5, together with that portion of the chamber 3 to the left of the piston will constitute what may be conveniently termed, "a controlling space". At the juncture of the ducts 8 and 9 a check valve 10 is located, and is pressed upon its seat by means of a light spring 11, said valve being adapted to prevent a backward passage of fluid from the controlling space, through the duct 9 to the train pipe. A duct 12 constitutes a continuation of the train pipe duct 8 and is in free communication at one end with a duct 13 which terminates in a port *f* in a seat T for the main slide valve S. The port *f* and ducts 13, 12 and 8 thus constitute a free path for fluid from the valve chamber 5 (which constitutes a portion of the controlling space) to the train pipe under certain conditions, but such path is closed under other conditions (as in "emergency" position of the mechanism) by the covering of the port *f* by the main slide valve S.

Auxiliary reservoir fluid is admitted to the chamber 5 (at the right hand side of the piston 6 therein) through a port 14 which receives such fluid through ports 15 in a hollow enlargement 16, from an auxiliary reservoir duct 17. When the parts are in position to effect a recharge of the auxiliary reservoir, the piston 6 will uncover a duct 18 in the wall of chamber 3, so that train pipe fluid can flow from the controlling space at the left of the piston through said duct 18 and thence through ports 19 in abutments 20 and finally through port 14 and the ducts 15 to the auxiliary reservoir.

For reasons which will hereinafter appear, it is desirable at certain times to restrict the flow of auxiliary reservoir fluid from the auxiliary reservoir to the chamber 3 at the right of the piston 6 and at other times to permit free communication between the chamber 3 and the auxiliary duct. To accomplish this, a rod 21 is employed, said rod being provided with a contracted portion 22 which, when in the position shown in Fig. 1, will permit a free communication between the chamber 3 and the auxiliary reservoir duct. It is apparent however, that when the larger portion 23 of the rod is disposed in the port 14 and between the ports 15, the passage for auxiliary fluid to the chamber 3 at the right of the piston will be restricted. The rod 21 passes through a gland 24 secured to the piston 6 and enters a socket 25 in the piston rod 7, the movement of said rod 21 in one direction being limited by the engagement of a head 26 thereon with the gland 24. The rod 21 is normally pressed in this direction by a spring 27 located in the socket 25, and said rod 21 is movable in the other direction for effecting a slight movement of the piston by the action of the spring, by engagement with an abutment 28 afforded by the enlargement 16.

A duct 29 leads to the brake cylinders and communicates with a chamber 30. From this chamber, a duct 31 extends to the valve seat T, so as to communicate at one end with a port *a* therein. A check valve 32 closes the other end of the duct 31 so as to prevent a back flow of brake cylinder fluid through the duct 31 under certain conditions. A duct 33 also communicates with the chamber 30 so as to, in effect, constitute an extension of the brake cylinder duct 29. The duct 33 is adapted to communicate, through a valve chamber 33^b, with a duct 33^a, and the upper end of the latter terminates in a port *e* in the valve seat T. With the parts in the positions shown in Fig. 1, the brake cylinder ducts 29, 33 33^a are open to an exhaust duct 34 through the medium of port *e*, a cavity or passage *m* in the main valve S, and an exhaust port *d* in the valve seat T.

A safety or reducing valve 37^a is adapted to communicate through a duct 37 with the valve chamber 33^b; and mounted to move longitudinally in said valve chamber is a valve 35 which, under certain conditions, will be caused to engage a seat 35^e and thus close communication between the brake cylinder ducts 33—29 and the ducts 37 and 33^a. The valve 35 is provided with grooves 35^a in its intermediate portion to permit communication between the ducts 33 and 33^a and to permit communication of these ducts with the reducing valve duct 37. The lower portion 35^b, of the valve 35 operates as a piston in the lower portion of the valve chamber 33^b, while the upper portion 35^c of said valve, operates as a piston in the upper portion of the valve chamber 33^b. The diameter of the piston portion 35^b of the valve 35 is appreciably greater than the diameter of the piston portion 35^c of said valve, and also the greatest diameter of the seat 35^e is appreciably smaller than the diameter of the piston portion 35^b, for reasons which will be fully explained hereinafter. A spring 35^d normally tends to press the valve 35 in a direction to hold it from its seat and thus maintain (under certain conditions) communication between the duct 33 and the ducts 37 and 33^a.

Below the enlarged piston 35^b of the valve 35, a chamber 35^f is located, and with this chamber, ducts c^2 communicate. The short ducts c^2 communicate with each other and with a duct c^1, the latter terminating at its upper end in an L-shaped port *c* in the valve seat T. A short duct g^1 communicates at one end with the upper end of the valve chamber 33^b above the smaller piston portion 35^c of the valve 35, and at its upper end, the duct g^1 communicates with a port *g* in the valve seat T of the main slide valve. The seat T also contains a small port *h* which is connected directly to the atmosphere by the duct 34. The ports *g*, *h* and *c* in the main valve seat are controlled by the operation of the valves R and S, for controlling the movements of the valve 35 to effect the graduated release of the brakes and to cut off the pressure reducing valve from the brake cylinders in the emergency application of the brakes as more fully hereinafter described.

The main slide valve S is made with an approximately U-shaped cavity or passage *n* for the purpose of connecting the ports *g* and *h* in the "release" position of the mechanism and a port *t* in the main valve is adapted to register with the port *c* in the "release" position of the parts, and the cavity or passage *m* (in this position) connects the ports *d* and *e*. The cavity *m* is made with a small extension m^1 for establishing a connection between the ports *d* and *e* in case the main valve S should travel to the right of its "release" position. A port k^1 in the main valve, is adapted to register with the port *e* in the seat T, and a port p^1 in the main valve registers with a port *b* in the seat T when the mechanism is in "service" position, the port *b* being connected by a duct 46 with the auxiliary reservoir space at the right of piston 6. A port *l* in the main valve registers with the port *a* when the mechanism is in "quick service" position. A cavity or passage *u* in the valve S serves to connect ports *g* and *h* when the parts are in position to effect an "emergency" application of the brakes.

The graduating valve is made with a cavity or passage *q* adapted to fully connect ports *k* and *p* of the main valve when the graduating valve is in its extreme left hand position with reference to the main valve S, the port *k* communicating with the port k^1

and the port p with the port p^1 for the purpose of conveying auxiliary reservoir fluid to the brake cylinder in the "service" application of the brakes. A cavity r in the graduating valve is adapted to fully connect ports t^2 and n^2 of the main valve when the graduating valve is in its extreme right hand position with reference to the main valve (the port t^2 being connected by a duct t^1 with the port t and the port n^2 being connected by a duct n^1 with the cavity n, for the purpose of controlling the valve 35 to effect the graduated release of the brakes).

The valves R and S are, as before intimated, adapted to be controlled by the movements of the piston 6, but the latter can have a movement independently of the valve S throughout a portion of its throw, while the graduating valve R is always movable with the piston. To provide a lost-motion connection between the main slide valve S and the piston 6, the rod 7 is provided with shoulders 38 and 39 to engage shoulders 40 and 41 respectively on the valve S, said shoulders 40—41 being located a distance apart which is less than the distance between the shoulders 38—39 on the piston rod 7. The graduating valve R fits neatly in a recess 42 in rod 7 and is pressed to its seat on the main valve S by means of a spring 43, which latter also serves to hold the main valve S on its seat T.

At the left hand end of the chamber 3, the wall of said chamber is provided with a series of grooves or ducts 44 and with a groove or duct 45, the latter being somewhat longer than the ducts 44 for a purpose which will hereinafter appear. It will be seen that when the piston is in a position at or near the left hand end of the chamber 3, the grooves or ducts 44—45 will be uncovered so as to form by-passes for auxiliary reservoir fluid from the space at the right of the piston to the space at the left thereof and thence through ducts 44ª to the valve chamber 5. When the piston reaches a position to uncover the ducts 44—45, the valve S will have been so moved as to uncover the port a in the seat T, and the auxiliary reservoir air can therefore pass through the ducts 31—29 (past check valve 32) to the brake cylinders.

The duct 46, which communicates with the right hand end of the chamber 3, is extended past the port b of valve seat T, as shown at 46ª, and at its left hand end, the duct 46ª is connected, through ducts 47 in a valve seat 48, with a chamber 49 at the left hand end of the casing. A duct 50 leading from an emergency reservoir (not shown) also communicates with the chamber 49 and communication between the ducts 46ª and 50 is normally closed by a valve 51 which is pressed to its seat by a light spring 52. The valve 51 is provided with a rod 53 which is movable longitudinally through the seat or bushing 48 in which said rod has a snug fit and the rod 53 is adapted under certain conditions, to be engaged by a nipple 55 at the left end of the piston rod 7 for the purpose of opening the valve 51. The nipple is secured in the end of a socket 55ª in the piston rod and through said nipple, a rod 54 is longitudinally movable. The rod 54 is provided (within the socket 56) with a head 54ª against which one end of a spring 56 bears, the other end of said spring bearing against the end of the socket 55ª. The rods 53 and 54 are so disposed and are of such lengths relatively to each other that the rod 54 can engage the end wall of the valve chamber 5 and compress the spring 56 a slight amount, before the nipple 55, at the end of the piston rod 7, engages the rod 53 and opens the valve 51, so that a movement of the piston, 6, through a limited distance will be effected by the action of the spring 56 while the valve 51 remains seated, for a purpose hereinafter described.

Having described the mechanical construction of my improvements, I will proceed to explain the operation of the mechanism under various conditions, in controlling the operation of the brakes. It may be assumed that the brakes have been applied, and that it is desired to effect a graduated release. In accomplishing this, the engineer will cause a temporary rise of train pipe pressure by a manipulation of a brake valve of any ordinary form of construction. The train pipe pressure having been raised above that in the auxiliary reservoir a sufficient amount to cause the piston to move to the right from its "service" or "emergency" position, said piston will operate to move the graduating and main slide valves R and S in the same direction. During this movement of the valves R and S to the right, the ports k^1 and e and p^1 and b will be first disconnected and then the cavity m will communicate with the port e, and port t will connect with port c and cavity n with port h. At the same time, the piston 6 will open or uncover the long groove 18ª at the right hand end of the chamber 3. The further movement of the piston 6 and valves R and S to the right will cause the port g to register with the cavity n and the rod 21 will be caused to compress the spring 27,—the contracted portion 22 of said rod, establishing free communication between the right hand side of the piston and the auxiliary reservoir. The movement of the parts will continue until they will assume the positions shown in Fig. 1, when the cavity m will freely connect ports d and e and the cavity n will be in full register with the ports g and h,—the port t being in full register with the port c. It will also be observed that at this time, the cavity r of the graduating valve will fully connect the ports t^2 and n^2. From the foregoing description, it will be seen that the valve 35 will be pressed to the position shown in Fig. 1, by the action of the spring 35^d and by the pressure of the brake cylinder fluid, as the space below the large piston portion 35^b of the valve 35 is freely and directly open to the atmosphere (through the ports and passages c^2, c^1, c, t, t^1, t^2, r, n^2, n^1, n, h and 34) and although the space above the smaller piston portion 35^c of valve 35 is also directly open to the atmosphere (through the duct g^1, port g, cavity n port h and duct 34), the cylinder pressure acting between these differential pistons (35^b and 35^c) will of course exert a net force in the direction of the large piston. In consequence of these conditions, fluid from the brake cylinder will be free to pass from the ducts 33 and 33^a (and thence, by ports e and d and cavity m) to the atmosphere through duct 34, as long as the space below the piston 35^b is open to the atmosphere. This will be the case as long as the graduating valve remains in the position shown in Fig. 1. If the rise of train pipe pressure which caused the piston 6 to move to its release position was only temporary (that is to say,—if after moving the "brake valve" to its "release" or "running" position for only a few seconds, the engineer returned it to its "lap" position), the pressures acting on the two sides of the piston, 6, will quickly become approximately equal, as the train pipe fluid will flow rapidly into the auxiliary reservoir through the ducts 18^a and 18, the latter having been opened by the piston just before reaching the end of its travel to the right. As soon as the pressures acting on the two sides of the piston 6, thus become approximately equal, the spring 27 will move the piston (through the medium of the rod 21) to the position shown in Fig. 2, thus closing or covering the duct 18 and also causing the graduating valve R to disconnect and close ports n^2 and t^2 of the main valve and therefore shut off the space below the piston portion 35^b of valve 35 from the atmosphere. The piston portion 35^b of valve 35 has a free fit in its cylinder (the lower portion of the valve chamber 33^b) and therefore brake cylinder fluid will quickly leak to the space 35^f below said piston portion 35^b. Because the upper piston portion 35^c of valve 35 is still exposed on its upper side to the atmosphere, the accumulation of pressure below the entire area of the piston portion 35^b will quickly cause the valve 35 to move upwardly; compress the spring 35^d and cause the valve 35 to become seated, as shown in Fig. 2, thus preventing the further flow of brake cylinder fluid to the atmosphere. Consequently, this position of the mechanism may be termed, its "release lap" position. If the train pipe pressure be again raised sufficiently above the auxiliary reservoir pressure to cause the piston 6 to again assume the position shown in Fig. 1, the space below the piston 35^b will be again opened to the atmosphere and the valve 35 will be forced open by the spring 35^d and by the brake cylinder pressure acting on the upper annular portion 35^g of the piston portion 35^b of valve 35, (said annular portion 35^g being formed between the piston portion 35^b and that portion of the valve 35 which engages the seat 35^e). The valve 35 having been reopened as above explained, a further flow of brake cylinder fluid to the atmosphere, will be permitted. It is evident therefore, that by making temporary increments of the train pipe pressure, the engineer can easily effect the graduated release of the brakes on all cars of the train having this improved equipment. Furthermore, when the brake cylinder pressure becomes reduced to a very low degree, the spring 35^d will maintain the valve 35 open, regardless of the position of the graduating valve as it is only the action of the brake cylinder pressure in conjunction with that of the atmosphere which causes the closing of the valve 35; consequently, any fluid leaking into the brake cylinder or its connecting ducts will be free to pass to the atmosphere, when, and after the brakes have been released in spite of the fact that the piston and graduating valve will be removed by the spring 27 to their "release lap" positions as soon as the auxiliary reservoir becomes approximately recharged to the normal point.

When it is desired to make a full release (not graduated) of the brakes, it is simply necessary to restore the train pipe pressure without interruption. This will, of course, hold the piston, 6, in its "release" position; the recharging ducts (18 and 18^a) being so proportioned to the exhaust ducts and ports (33, 33^a, r, m, d and 34) that the complete release of the brakes will be insured before the auxiliary reservoir can become recharged to its normal point.

When it is desired to make a "service" application of the brakes, the train pipe pressure will be reduced in the usual way and a simultaneous reduction of pressure will occur in the controlling space through the medium of the port f. In the "quick service" position of the valves, the port p^1 will partly register with the port b and the port k^1 with the port e and port l will register with the port a. The graduating valve will connect ports p and k by means of the cavity q and uncover the upper end of port l. The larger portion 23 of the rod 21 will restrict the port 14. Thus it will be seen that means are provided for permitting of a flow of fluid to the brake cylinders from the auxiliary reservoir and from the train pipe, and also that because of the restriction of port 14 by the rod 21 and because of the fact that the fluid conveyed to the brake cylinder from the auxiliary reservoir must be taken from the piston chamber 3 at the right hand side of the piston 6, through duct 46,—the piston will be caused to stop in its "quick service" position when the rate of reduction of train pipe pressure is moderate. When the desired amount of pressure is thus obtained in the brake cylinders, the piston will move to the right until the shoulder 39 of the rod 7 engages the main valve and is thus stopped. This movement of the piston will cause the graduating valve to disconnect and close ports *p* and *k* and to close port *l*, thus preventing a further flow of fluid to the brake cylinder. If the rate of reduction of train pipe pressure is slightly more rapid (than in the case just assumed), the valves will be moved to the "full service" position, when the ports p^1 and *b* and k^1 and *e* will be fully connected and port *l* will have passed over port *a*. Thus a rapid flow of fluid from the auxiliary reservoir to the brake cylinder will result, but no fluid can flow from the train pipe to the brake cylinder. When the desired degree of brake cylinder pressure has been obtained, the graduating valve R will (as in the "quick service" position) disconnect and close ports *p* and *k* and thus prevent a further flow of auxiliary reservoir fluid to the brake cylinder.

When the pressures in the auxiliary reservoir and brake cylinder become equal after a "service" application of the brakes, a reduction of train pipe pressure below the point necessary to produce this equalization of pressures, will cause the piston 6 to move to the left beyond its "service" positions, thus causing ports p^1 and k^1 to be disconnected from the ports *b* and *e* and subsequently opening port *a* slightly and then closing port *f*. The spring-pressed rod 54 then engages the end wall of the chamber 5 and thus tends to prevent the further motion of the moving parts to the left. During this motion the check valve 32 prevents a flow of fluid from the brake cylinder, through port *a*, to the controlling space. If the brake cylinder pressure now tends to become depleted by leakage, fluid will flow through port *a* to the brake cylinder from the controlling space, in which latter the pressure may be maintained through the medium of the train pipe if it be desired to provide for the maintenance of the brake cylinder pressure through that medium, or if the train pipe pressure is lower than that in the controlling space, the flow of fluid from the controlling space to the brake cylinder will cause the auxiliary reservoir pressure acting on the right hand side of the piston 6 to force the latter to the left (against the resistance of the spring 56) far enough to uncover the long groove or duct 45 and thus permit a flow of auxiliary reservoir fluid around the piston to supply leakage. The approximate equalization of the pressure on the two sides of the piston 6 (after the groove 45 is uncovered) together with the resistance to the further movement of the piston caused by the nut 55 meeting the end of rod 53 (the latter being pressed to the right by the high pressure of the emergency reservoir fluid acting on the left hand side of the valve 51), will prevent the further movement of the piston 6 to the left and after the brake cylinder has been supplied in the manner just described, the spring 56 will return the piston 6 so as to close the groove 45.

In the "emergency" application of the brakes, the parts will be made to assume the positions shown in Fig. 3. In making an emergency application of the brakes, such a reduction of train pipe pressure will be caused (by manipulation of a "brake valve" in the usual way) as to cause the slide valves to be moved at once to the left, past their "service" positions, and thus opening port *a* (and consequently permitting a rapid flow of fluid from the controlling space to the brake cylinder and thus insuring the full travel of the piston 6) and subsequently closing port *f*. The piston 6 will thus be forced to its extreme left hand position against the bushing 4, and thus causing the valve 51 to be unseated through the medium of the rod 53 and nut 55 carried by the piston rod, and consequently permitting fluid from the emergency reservoir to flow to the chamber 3 at the right of the piston 6. The movement of the piston 6 to its "emergency" position also causes the rod 21 to be withdrawn from the port 14 and thus permits, at this time, a free flow of auxiliary reservoir fluid to the chamber 3 at the right of the piston, and the fluid from both the emergency and auxiliary reservoirs, will flow from this space at a rapid rate to the controlling space through the grooves 44—45 and duct 44^a, and thence to the brake cylinder through the port *a*. The full opening of the port *a* by the main valve will permit of a free flow of train pipe fluid to the brake cylinder at this time in order to thus transmit the rapid reduction of train pipe pressure throughout the train. When the pressure in the controlling space tends to become higher than that in the train pipe, the check valve 10 is seated by its spring and thus a back flow of fluid to the train pipe is prevented. When the pressure in the emergency reservoir, auxiliary reservoir and brake cylinder become approximately equalized, the spring 56, through the medium of the rod 54, will cause the piston to move to the right far enough to close the ducts 44 and 45, in order to prevent a flow of fluid from the train pipe to the auxiliary reservoir when it is subsequently desired to release the brakes.

During the service application of the brakes (and in all positions of the main slide valve between its "release" and "emergency" positions) the ports *e* and *g* were closed completely, consequently the spring 35^d held the valve 35 in its lower position (as shown in Fig. 1), as there were no connections formed to cause fluid pressure to move said valve. For this reason, during the service application of the brakes, the pressure reducing valve, connected to the duct 37 is obviously in free communication with the brake cylinders, thus providing means for limiting the brake cylinder pressure in service applications to a predetermined degree, *i. e.*, the pressure for which the reducing valve is adjusted. In the "emergency" position of the main slide valve, as shown in Fig. 3, the main valve connects ports *g* and *h* by means of cavity *u*, and consequently the space above the piston portion 35^c of the valve 35 is thus exposed to the atmosphere. As soon, therefore, as the brake cylinder pressure rises slightly, the action of this pressure on the valve 35 will cause said valve to become seated (in spite of the light tension of the spring 35^d), and thus the pressure reducing valve connected with the duct 37, will be cut off from the brake cylinder completely, as the port *e* is closed in the emergency position of the main valve. Thus it will be seen that the pressure in the brake cylinder is not limited in case of emergency but will rise to a high degree, depending on the sizes of the auxiliary and emergency reservoirs relative to the brake cylinder and on the normal pressure carried in the system.

It will be seen from an inspection of Fig. 1 that when an emergency reservoir is connected to the duct 50, said reservoir will be charged (when the pressure in it is below the normal value) with compressed air simultaneously with the recharge of the auxiliary reservoir; fluid from the chamber 3 (at the right of the piston 6) passing through ducts 46, 46^a and 47, and, unseating valve 51, the air will flow through the chamber 49 and duct 50 to the emergency reservoir.

Having fully described my invention what I claim as new and desire to secure by Letters-Patent, is:—

1. In a triple valve mechanism, the combination with a casing provided with a brake cylinder duct, valve devices for controlling the application and release of the brakes, and means for controlling the operation of said valve devices, of a pressure reducing valve connection communicating with said brake cylinder duct, a valve, and means controlled by brake cylinder pressure for closing said valve to close communication between the brake cylinder duct and the reducing valve connection.

2. In a triple valve mechanism, the combination with a casing provided with a brake cylinder duct, valve devices for controlling the application and release of the brakes, and means for controlling the operation of said valve devices, of a pressure reducing valve connection communicating with the brake cylinder duct, a valve interposed between the brake cylinder duct and the reducing valve connection, means for subjecting one side of said valve to atmospheric pressure, a spring normally tending to unseat said valve, and means controlled by pressure in the brake cylinder for closing said valve to close communication between said brake cylinder duct and the reducing valve connection.

3. In a triple valve mechanism, the combination with a casing and a brake cylinder duct, valve devices for controlling the application and release of the brakes, and means for controlling the operation of said valve devices, of a reducing valve connection communicating with the brake cylinder duct, a normally open valve interposed between said brake cylinder duct and reducing valve connection, means controlled by said valve devices for subjecting one side of the normally open valve to atmospheric pressure, and means controlled by brake cylinder pressure for closing said normally open valve to close communication between the brake cylinder duct and the reducing valve connection.

4. In a triple valve mechanism, the combination with a casing provided with a brake cylinder duct, valve devices for controlling the application and release of the brakes, means for controlling said valve devices, and a reducing valve connection communicating with the brake cylinder duct, of a normally open valve interposed between the brake cylinder duct and the reducing valve connection, means controlled by fluid pressure in the brake cylinder duct for closing said valve to close communication between the brake cylinder duct and reducing valve connection, and ducts and ports controlled by said valve devices for subjecting both sides of said normally open valve to atmospheric pressure.

5. In a triple valve mechanism, the combination with a casing provided with a brake cylinder duct, valve devices for controlling the application and release of the brakes, means for controlling the operation of said valve devices, of a reducing valve connection, a duct controlled by said valve devices and communicating with said reducing valve connection, a valve for controlling communication of the reducing valve connection and said last-mentioned duct, with the brake cylinder duct, said valve having a large piston portion at one end and a small piston portion at the other end, said large piston portion being exposed to brake cylinder pressure, and means controlled by said valve devices for subjecting the free ends of

said piston portions to atmospheric pressure.

6. In a triple valve mechanism, the combination with a casing provided with a brake cylinder duct, a main valve and a graduating valve, a piston for controlling said valves, means for subjecting one side of said piston to auxiliary reservoir pressure and means for subjecting the other side of said piston to train pipe pressure, of a duct controlled by said valve devices, a release valve for controlling communication of said last-mentioned duct with the brake cylinder duct, said valve having a large piston portion at one end and a small piston portion at the other end, said large piston being exposed on the side adjacent to the smaller piston portion to brake cylinder pressure, means controlled by the main slide valve for exposing the free end of the smaller piston portion of said release valve to the atmosphere, and means controlled by the main slide valve and the graduating valve for exposing the free end of the larger piston portion of the release valve to the atmosphere, and means for subjecting the free end of the larger piston portion of the release valve to brake cylinder pressure.

7. In a triple valve mechanism, the combination with a casing provided with a brake cylinder duct, a main valve and a graduating valve, a piston for controlling said valves, means for subjecting one side of said piston to auxiliary reservoir pressure and means for subjecting the other side of said piston to train pipe pressure, of a duct controlled by said valve devices, a release valve for controlling communication of said last-mentioned duct with the brake cylinder duct, said valve having a large piston portion at one end and a small piston portion at the other end, said large piston portion being exposed on the side adjacent to the smaller piston portion to brake cylinder pressure, means controlled by the main slide valve for exposing the free end of the smaller piston portion of said release valve to the atmosphere, and means controlled by the main slide valve and the graduating valve for exposing the free end of the larger piston portion of the release valve to the atmosphere, and means for subjecting the free end of the large piston portion of the release valve to brake cylinder pressure, and spring-actuated means for moving the graduating valve to close communication between the larger piston portion of the release valve and the atmosphere.

8. In a triple valve mechanism, the combination with a casing provided with a brake cylinder duct, a main valve and a graduating valve, a piston for controlling said valves, means for subjecting one side of said piston to auxiliary reservoir pressure and means for subjecting the other side of said piston to train pipe pressure, of a duct controlled by said valve devices, a release valve for controlling communication of said last-mentioned duct with the brake cylinder duct, said release valve having a large piston portion at one end and a small piston portion at the other end, said large piston being exposed on the side adjacent to the smaller piston portion to brake cylinder pressure, means controlled by the main slide valve for exposing the free end of the smaller piston portion of said release valve to the atmosphere, and means controlled by the main slide valve and the graduating valve for exposing the free end of the larger piston portion of the release valve to the atmosphere, and means for subjecting the free end of the large piston portion of the release valve to brake cylinder pressure, and spring-actuated means for moving the graduating valve to close communication between the larger piston portion of the release valve and the atmosphere, and means controlled by the first mentioned piston for simultaneously restricting the passage of train pipe fluid to the auxiliary reservoir.

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

HOWARD M. P. MURPHY.

Witnesses:

A. N. Mitchell,

R. S. Ferguson.