

April 23, 1929.

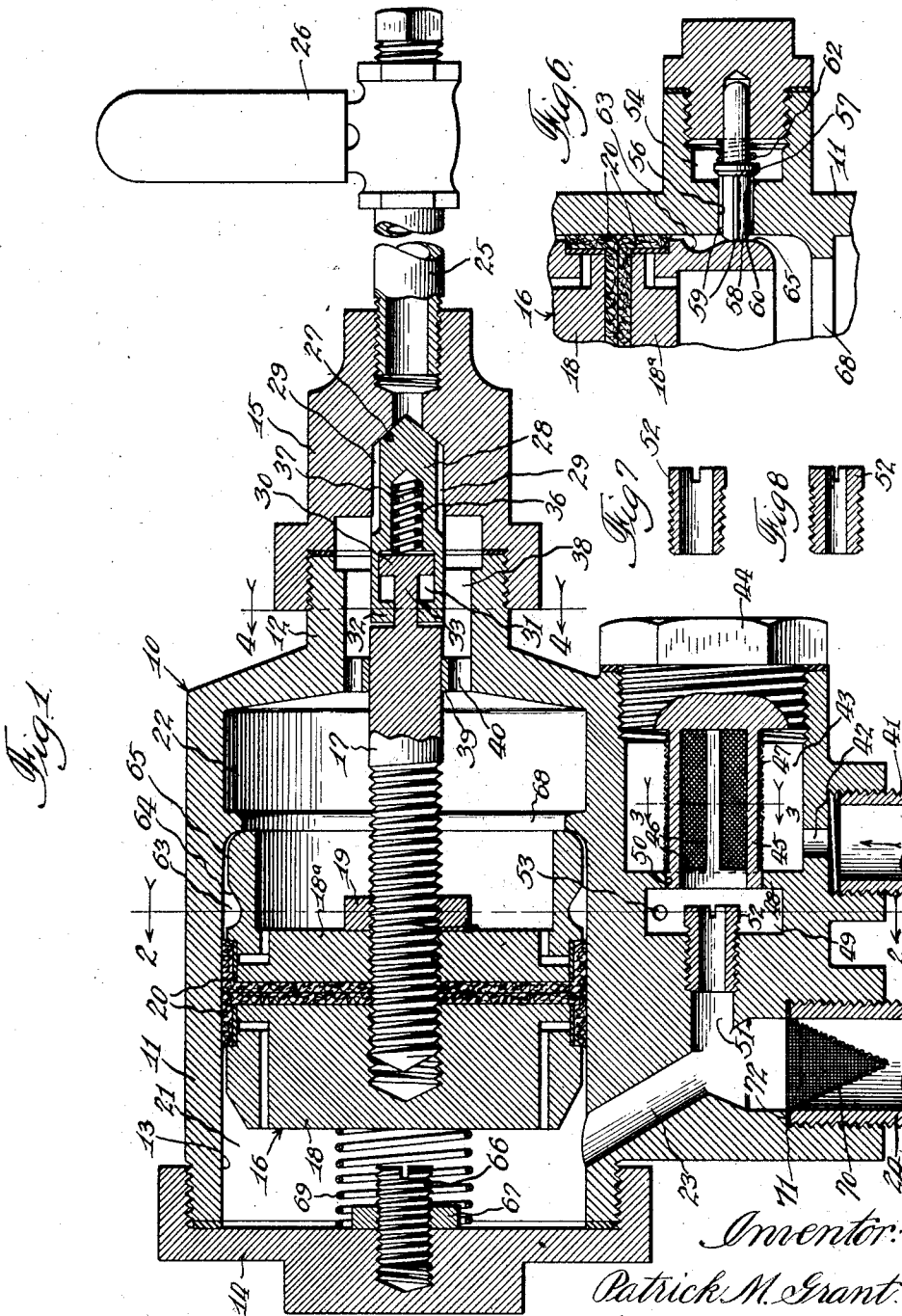
P. M. GRANT

1,710,055

FLUID PRESSURE OPERATED VALVE

Filed Feb. 13, 1928

2 Sheets-Sheet 1



Witness:
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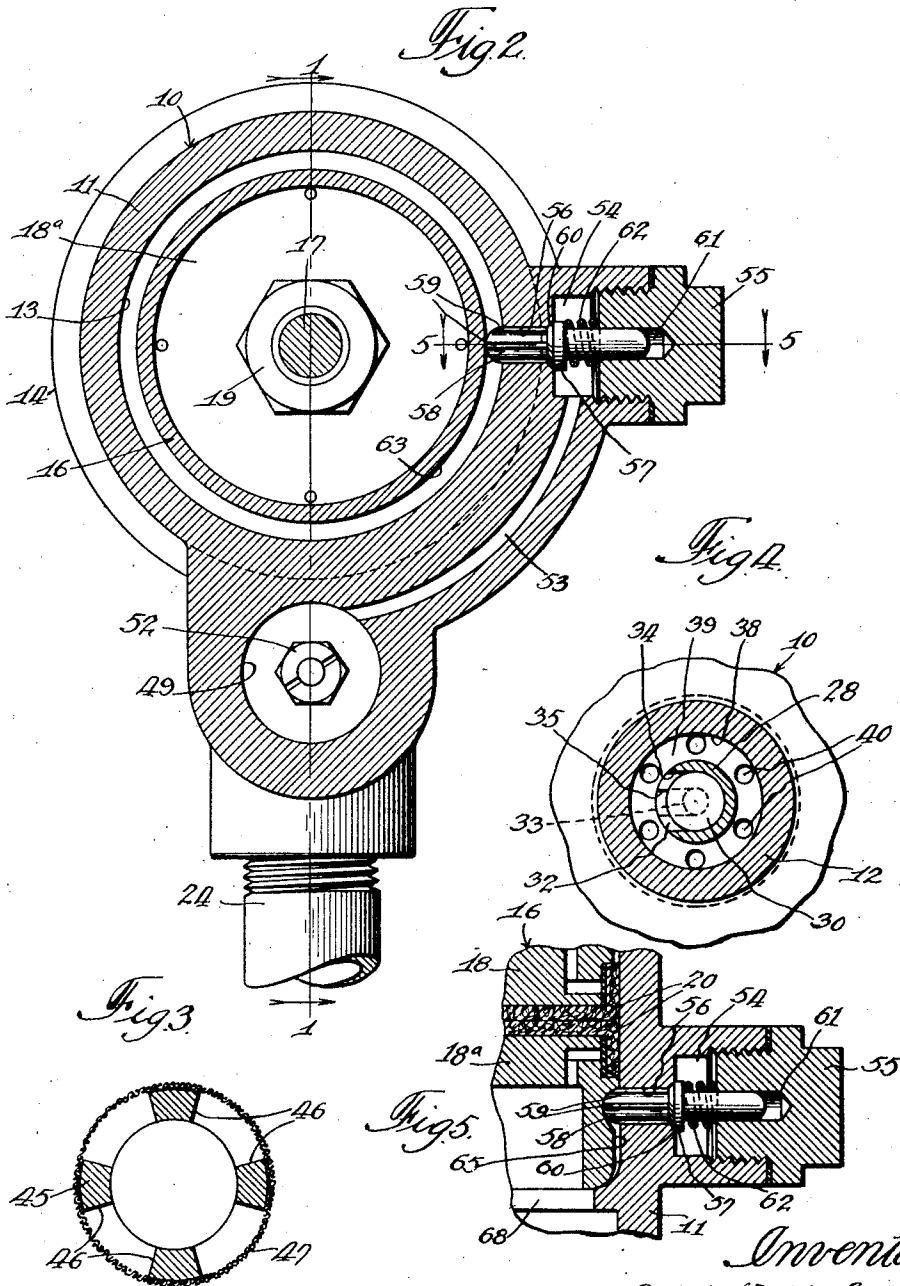
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UNITED STATES PATENT OFFICE.

PATRICK M. GRANT, OF CHICAGO, ILLINOIS.

FLUID-PRESSURE-OPERATED VALVE.

Application filed February 13, 1928. Serial No. 253,844.

This invention relates to fluid pressure operated valves and is particularly adaptable for use in connection with signalling devices, as, for example, in connection with air brake systems used on railroads, and will be described as employed in that connection.

One of the objects of the present invention is to provide a construction whereby an audible signal such as a whistle, or the like, will be automatically controlled, as in the present instance, by the fluid pressure maintained in the air brake system.

Another object of the invention is to provide means for adjusting the valve control elements to enable the proper positioning of various parts in a manner to facilitate the assembling of the device, and to obtain the maximum efficiency.

Another object of the invention is to provide, in combination with other features, an adjustable stop for limiting the movement of the valve controlling elements in order to maintain the proper relation of parts and insure the effectual operation of the device.

Another object of the invention is to provide a novel means whereby, the whistle or other signalling device may be actuated by pressure received directly from the source of fluid supply.

Another object of the invention is to provide a novel construction and arrangement wherein fluid under pressure is admitted to the whistle or other signalling device when the train line is "bled", and wherein, the supply of fluid to the whistle is shut off automatically, by the pressure itself when the "bleeding" vent in the train line is closed.

Another object of the invention is to provide a device wherein direct communication is established between the whistle and the source of fluid pressure supply when the train line is "bled", and wherein, the fluid from said source of supply is utilized to break the communication to shut off the supply of fluid to the whistle when the vent in the train line is closed.

Another object of the invention is to provide means whereby the duration of time between the closing of the vent in the train line and the closing of the whistle valve may be varied as desired.

A further object of the invention is to provide means for assisting the fluid pressure in positively seating the whistle valve.

A still further object of the invention is to improve devices of this character in sundry

details hereinafter described and particularly pointed out in the appended claims.

One embodiment of the invention is shown, for illustrative purposes, in the accompanying drawing, in which

Fig. 1 is a central longitudinal sectional elevation through the device, taken substantially as indicated by the line 1—1 of Fig. 2.

Fig. 2 is a transverse sectional elevation taken on the line 2—2 of Fig. 1.

Fig. 3 is a sectional elevation through the fluid strainer, taken on the line 3—3 of Fig. 1.

Fig. 4 is a transverse sectional elevation taken on the line 4—4 of Fig. 1.

Fig. 5 is a fragmentary sectional plan view taken on the line 5—5 of Fig. 2.

Fig. 6 is a fragmentary sectional plan view similar to Fig. 5, showing the piston or movable abutment in a changed position for opening the inlet valve, and

Figs. 7 and 8 are views of the interchangeable tubes having openings of different sizes, adapted for use in varying the period of time between the closing of the train line vent and the closing of the whistle or outlet valve.

Referring to the drawing, the illustrative embodiment of the invention shown, comprises a housing or a casing 10 adapted to be positioned in the cab of a locomotive or the like, the said housing being provided with an enlarged rear end portion 11 and a reduced forward end portion 12, the portion 11 having a centrally disposed longitudinal bore 13 formed therein, and provided with screw threads adapted to receive a cap 14, while the reduced end portion 12 is provided with screw threads for receiving thereon an outlet valve fitting 15 having a centrally disposed longitudinal bore extending therethrough.

Mounted to slide longitudinally in the bore 13 is a piston or abutment 16 adapted to receive a rod 17 having one of its ends screw threaded to engage threaded openings in the plates 18 and 18^a of the piston, and jam nut 19 for holding the said plates together and securing the gaskets 20 in proper position between the said plates. The piston shown in the drawing is the type of piston covered by my Patent No. 1,414,463 issued May 2, 1922, the piston herein shown having gaskets adapted to effectually resist the passage of fluid pressure in either direction. The positioning of the piston 16 in the bore 13, forms, in effect, a movable partition wall or abutment extending transversely of the bore, and

provides or forms a valve closing pressure chamber 21 and a valve opening pressure chamber 22 within the housing or casing 10. The casing 10 is also provided with a port 23 communicating with the chamber 21 and with a pipe 24 typifying, in the present instance, an air brake system or the train line of an air brake system, in which a supply of fluid pressure is maintained for operating the brake mechanisms.

To the outer or forward end of the valve fitting 15 is connected, by means of a pipe 25, an audible signal device 26, shown in the present instance, as an air whistle adapted to be operated by the "bleeding" or venting of the train line, as may be done by a member of the train crew or by the parting of the train, and in either case the engineer or other person in the engine cab receives the signal caused by the venting of the train line, or is notified of any abnormal condition in the air brake system.

For operating the whistle, the fitting 15 is provided with a valve seat 27, and slidably mounted in the bore of the fitting 15 is a valve member 28 provided with a plurality of annularly spaced longitudinally disposed grooves or channels 29 on the periphery thereof for admitting fluid under pressure to the whistle when the valve member 28 is removed from its seat 27 by reason of a vent in the train line.

For actuating the whistle valve, the valve member 28 is connected to the rod 17 in a manner to be moved into and out of engagement with the valve seat 27 when the piston 16 is moved longitudinally of the bore 13 formed in the enlarged portion 11 of the casing 10, the connection being accomplished by means of a head portion 30 formed on the end of the rod 17 and positioned within an enlarged central chamber 31 formed in the valve member 28, the rear or open end of the chamber 31 being partially closed by a wall portion 32 through which extends a neck portion 33 formed centrally of the rod 17 and serving to connect the head 30 to the end of the rod.

The method of assembling the valve member 28 with the end of the rod 17 is clearly illustrated in Fig. 4, wherein the chamber 31 is shown as extending outwardly to the face of the valve member as indicated at 34 and the opening in the wall portion 32, in which the neck portion 33 is positioned, is shown as extending outwardly to the surface of the valve member as indicated at 35.

The valve member 28 is provided with a centrally disposed longitudinal chamber 36 communicating with the chamber 31 and in the chamber 36 is mounted a compression spring 37 adapted to bear against the head portion 30 of the rod 17 and the interior or bottom portion of the chamber 36. It will be observed from the foregoing description that when the piston 16 is moved to the left, as viewed in Fig. 1, the head portion 30 will

move a substantial distance within the chamber 31 before engaging the wall portion 32 of the valve member 28 and before withdrawing the valve from its seat 27, thus providing a degree of lost motion in the connection between the rod 17 and valve member 28, and that the head 30 after engaging the wall portion 32, will, by reason of any continued movement of the piston 16, open the whistle valve and permit the passage of air to the whistle or other signalling device. It will be observed further that upon the return movement of the piston 16 to the position shown in Fig. 1 the valve member 28 will first engage the seat 27 and thereafter the continued movement of the piston will, by reason of the elongation of the chamber 31, cause the head 30 to compress the spring in the chamber 36, thereby securely seating and holding the valve member 28 upon the seat 27.

The reduced end portion 12 of the casing 10 is provided on its interior with a central opening 38, and formed integrally with the casing between the said opening 38 and chamber 22 is a wall portion 39 serving as a guide and support for the forward or outer end of the rod 17, and in which are formed a plurality of annularly spaced ports or openings 40 through which fluid under pressure from the chamber 22 is admitted to the whistle valve.

For supplying fluid to the whistle and whistle valve actuating means, as well as to the train line of the air brake system, the casing 10 may be provided with suitable ports, chambers, controlling means and a supply pipe 41 adapted to communicate with an air compressor or other suitable source of fluid supply.

By reference to Fig. 1 of the drawing, it will be noted that the supply pipe 41 is screw threaded or otherwise suitably connected to a portion of the casing 10 and is adapted to communicate by means of a port 42 with a fluid cleaning chamber 43 formed in the lower portion of the casing and having its outer open end portion closed by means of a screw threaded plug 44. The plug 44 is provided, within the chamber 43, with a centrally disposed longitudinally extending reduced annular wall portion 45 having a plurality of longitudinally extending annularly spaced openings or slots 46 formed therein, and provided on its periphery with a fabric covering 47, such as a fine screen or the like, adapted to cover said openings in a manner to strain or clean the fluid admitted to the cleaning chamber 43 of any dust, cinders or other foreign matter before it passes to the whistle valve and valve actuating mechanism.

Formed in the lower portion of the casing 10 adjacent the chamber 43 and separated therefrom by a wall 48 is a distributor chamber 49 adapted to communicate with the interior of the screened wall portion 45 of the plug 44, the inner end of which is formed to

fit snugly in an opening 50 formed in the wall 48.

Communicating with the distributor chamber 49 is a port 51 in which is mounted a hollow tube 52 through which the fluid may pass from the chamber 49 into the port 23 and thence to the chamber 21, and through the pipe 24 to the train line of the air brake system.

Formed in the casing 10 and extending around a portion thereof is an arcuate shaped port 53 (see Fig. 2) communicating at one of its end portions with the chamber 49 and with its opposite end portion with an inlet valve chamber 54 formed in the casing 10, the said chamber 54 having its outer or open end portion closed by means of a screw threaded plug 55. Adjacent and communicating with the chamber 54 is a passage 56 formed in the side wall of the casing 10 in a manner to provide communication between the said chamber 54 and the chamber 22, for supplying fluid to the chamber 22 for actuating the outlet or whistle valve and whistle.

Mounted in the passage 56 is an inlet valve 57 having a stem 58 provided with grooves 59 formed therein for permitting the passage of fluid from the chamber 54 to the chamber 22, the said valve 57 being adapted to engage a valve seat 60 formed in the casing 10 adjacent and surrounding the passage 56. The valve stem 58 is extended outwardly beyond the valve 57 in a manner to enter a centrally disposed longitudinal bore 61 formed in the plug 55 in a manner to be guided thereby, while a compression spring 62 is positioned to surround the outwardly extending portion of the valve stem between the plug 55 and the valve 57 in a manner to resiliently hold the valve on the seat 60.

The plate 18^a of the piston 16 is provided on its periphery adjacent the wall of the casing 10 with an annular groove 63 positioned thereon in a manner to receive the inner end of the valve stem 58 when the piston occupies its rearmost position with the whistle valve closed as illustrated in Fig. 1 of the drawings, the groove 63, including a camming surface, as indicated by the reference character 64, to facilitate the removal of the valve stem outwardly from the groove when the piston is moved in a direction to open the whistle valve. The rear end portion of the plate 18^a, indicated by the reference character 65, is shown as of a smaller diameter to permit the free passage of fluid from the passage 56 in the casing 10 to the chamber 22 formed therein and thence to the whistle valve and whistle.

Screw threaded into the cap 14 is a stud 66, the exposed end portion of which may be adjustably positioned with respect to the cap and secured in such adjusted position by means of a jam nut 67 for limiting the rearward movement of the piston or abutment 16, thereby determining the movement of the

valve member 28 with respect to its valve seat 27, while an annular rib 68 serves to limit the movement of the piston in the opposite or forward direction, and also to keep the piston in proper alignment with the bore 13. For providing further adjustment of the whistle valve actuating means, the rod 17 may be adjusted longitudinally with respect to the piston and secured in such adjusted position by means of the jam nut 19.

The operation of the device is as follows:

Inasmuch as the fluid pressure from the air compressor or the like, is substantially constant, and so long as the degree of operating pressure maintained in the train line, chamber 21 and chamber 22, is substantially uniform, the piston 16 and valve element 28 will remain in the position shown in Fig. 1 of the drawing, but if, for any reason, the train line is "bled" or the pressure therein reduced, as, for example, by the giving of a rope signal by a member of the train crew, thereby reducing the pressure in the train line and chamber 21, the substantially maximum operating pressure retained in the chamber 22 by reason of the seating of the valve member 28 and valve 57 on their respective seats, will force the piston 16 rearwardly of the casing and longitudinally of the bore 13 in a manner to cause the head portion 30 of the rod 17 to engage the wall portion 32 of the valve member 28, and to withdraw the said member 28 from engagement with the valve seat 27, thereby permitting the fluid pressure in the chamber 22 to escape through the pipe 25 and operate the whistle 26. While the piston 16 is being moved rearwardly in the casing and the valve member 28 removed from its seat 27, the camming surface 64 of the annular groove 63 will engage the end of the valve stem 58 and move the valve 57 away from its seat 60 against the action of the spring 62, thereby permitting fluid from the compressor or other source of supply to enter the chamber 22 through the port 53, chamber 54 and passage 56, thus providing a fluid pressure directly from the source of supply for continuously operating the whistle or other signalling device so long as the vent in the train line remains open. Although a portion of the fluid pressure from the source of supply will enter the train line and escape through the vent therein, it will be understood that inasmuch as the whistle 26 is capable of being operated by comparatively low pressure, there will be sufficient fluid pressure entering the chamber 22 to continue the operation of the whistle, notwithstanding the fact that a portion of the pressure from the source of supply may enter the train line while it is being "bled".

Upon closing the vent in the train line, a portion of the fluid from the air compressor or other source of supply will continue to enter the chamber 22 by way of the passage

56, and, at the same time, a portion of the fluid from the chamber 49 will pass through the opening in the tube 52 and port 51 into the train line by means of the pipe 24 and into the chamber 21 by way of the port 23 formed in the casing.

It will be noted that the opening in the tube 52 is of greater cross sectional area than that of the port 53, and that, by reason of this fact, a greater amount of fluid will pass into the train line and chamber 21 in a given period of time than will pass through the communicating ports and passages into the chamber 22. As the pressure in the train line and chamber 21 builds up, the piston 16 will be moved longitudinally and forwardly of the casing 10 to cause the valve member 28 to engage the valve seat 27, thereby preventing further escape of fluid from the chamber 22, but still permitting the fluid pressure to enter the said chamber 22 by way of the passage 56, and as the pressure in the chamber 21 continues to build up, the piston 16 will continue its forward movement in the casing against the relatively low pressure in the chamber 22 and against the action of the spring 37, thereby compressing the spring 37 and securely seating the valve member 28 upon the seat 27. As the piston continues its forward movement in the casing after closing the whistle valve, the fluid pressure entering the chamber 22 will be built up and compressed by reason of the relatively greater pressure in the chamber 21, until the degree of pressure in the chamber 22 is substantially equal to the pressure in the train line and chamber 21, and when the piston has reached the position shown in Fig. 1, the valve stem 58 will occupy a position in the annular groove 63 of the plate 18^a as shown in Fig. 5 with the valve 57 in engagement with the seat 60, thereby preventing the escape of pressure from the chamber 22, it being understood that the spring 62 surrounding the outwardly extending portion of the valve stem 58 will be sufficiently strong to resist the pressure in the chamber 22.

After the vent in the train line is closed and the movable parts of the device returned to the position shown in Fig. 1 the pressure in the train line and chamber 21 will retain the parts in the position shown until such time as the train line is again "bled".

For varying the period of time during which the whistle valve will remain open for operating the whistle after the vent in the train line is closed, a plurality of tubes 52 (Figs. 1, 7 and 8) may be provided with openings therein of various cross sectional areas, the said tubes being adapted to be positioned interchangeably in the casing between the chamber 49 and port 51. It will be obvious that by such an arrangement if a tube having an opening of relatively large cross sectional area is positioned in the casing, the period

of time during which the whistle valve remains open after closing of the vent in the train line will be of proportionately short duration, due to the fact that a greater amount of fluid pressure is permitted to pass from the distributor chamber 49 into the train line and chamber 21, thereby causing the pressure to build up more rapidly in the train line and chamber 21, after the vent in the train line is closed, and it will be obvious also that if a tube having an opening of relatively smaller cross sectional area be positioned between the chamber 49 and port 51, the period of time during which the whistle valve will remain open after the train line vent is closed will be of proportionately long duration, due to the fact that a lesser amount of fluid is permitted to enter the train line and chamber 21, thereby requiring more time to build up the pressure in the train line and chamber 21 to a degree sufficient to move the piston longitudinally of the casing and close the whistle valve.

If desired, a compression spring 69 of suitable strength, depending upon the degree of operating pressure used, may be provided and suitably positioned between the stationary cap 14 and movable abutment or piston 16 for assisting the pressure in the chamber 21 in moving the piston longitudinally of the bore 13 to seat the valve member 28.

As an additional precaution against the entrance of dust, cinders or other foreign matter to the valves or valve actuating parts of the device, the pipe 24 may be provided with a screen 70 adapted to be held in proper position by means of a flange portion 71 positioned between the end of the pipe 24 and a shoulder 72 formed on a portion of the casing.

It will be obvious from the foregoing specification that the present invention provides, among other features, a novel construction and arrangement whereby a suitable signalling device may be operated by the fluid pressure employed to operate an air brake system when a vent in the system is opened and wherein the elements employed for controlling the operation of the signalling device are automatically actuated by the fluid pressure from a suitable source of supply and the pressure in the air brake system.

It will be obvious also that the present invention provides novel means whereby the operation of the signalling device may be continued so long as the vent in the air brake system remains open, and also provides a construction and arrangement whereby the period of time between the closing of the vent in the train line and the closing of the signal actuating means may be varied as desired.

Obviously, the present invention is not limited to the precise construction and arrangement shown and described, as the same may be variously modified without departing

from the spirit and scope of the invention as set forth in the appended claims. Moreover, all of the features of the invention need not be used conjointly, as the same may be used to advantage in variously different combinations and sub-combinations.

What I claim as my invention and desire to secure by Letters Patent is:

1. A fluid pressure operated valve comprising a casing having a centrally disposed longitudinal bore formed therein, a movable abutment positioned in said bore in a manner to form a plurality of chambers within said casing, an outlet valve communicating with one of said chambers, means carried by said abutment and connected to said valve for opening and closing the valve when the abutment is moved longitudinally of said bore, a pipe of an air brake system communicating with the other of said chambers, means for admitting fluid under pressure to said chambers and system, an inlet valve for controlling the passage of fluid to and from said one of said chambers in a manner to cause the fluid pressure in said last mentioned chamber to open said inlet and outlet valves when a vent in said system is opened and the fluid pressure in said other of said chambers is reduced, and means for controlling the passage of fluid to the other of said chambers and said system in a manner to cause the fluid pressure in the said other of said chambers to close said inlet and outlet valves when the vent in the system is closed and pressure in said other of said chambers is restored.

2. A fluid pressure operated valve comprising a casing having a centrally disposed bore extending longitudinally therethrough, a movable abutment positioned in said bore in a manner to form a valve opening pressure chamber and a valve closing pressure chamber within said casing, an outlet valve communicating with said valve opening pressure chamber, means carried by said abutment and connected to said valve for opening and closing the valve when said abutment is moved longitudinally of said bore, a pipe of an air brake system communicating with said valve closing pressure chamber, means for admitting fluid pressure to said chambers and system, an inlet valve for controlling the passage of fluid to and from said valve opening pressure chamber in a manner to cause the fluid pressure in said last mentioned chamber to move said abutment in one direction longitudinally of said bore to open said outlet valve when a vent in said system is opened and the pressure in said valve closing pressure chamber is reduced, interchangeable means for controlling the passage of fluid to the said valve closing pressure chamber and said system in a manner to cause the fluid pressure in the said valve closing pressure chamber to move said abutment in the opposite direction longitudinally of said bore to close said outlet

valve when the vent in the system is closed and pressure in the said valve closing pressure chamber is restored, and means carried by said abutment for opening said inlet valve.

3. A fluid pressure operated valve comprising a casing having a centrally disposed bore extending longitudinally therethrough, a movable abutment positioned in said bore in a manner to form a valve opening pressure chamber and a valve closing pressure chamber within said casing, an outlet valve communicating with said valve opening pressure chamber, means carried by said abutment and connected to said valve for opening and closing the valve when said abutment is moved longitudinally of said bore, a pipe of an air brake system communicating with said valve closing pressure chamber, means for admitting fluid pressure to said chambers and system, an inlet valve for controlling the passage of fluid to and from said valve opening pressure chamber in a manner to cause the fluid pressure in said last mentioned chamber to move said abutment in one direction longitudinally of said bore to open said outlet valve when a vent in said system is opened and the pressure in said valve closing pressure chamber is reduced, interchangeable means for controlling the passage of fluid to the said valve closing pressure chamber and said system in a manner to cause the fluid pressure in the said valve closing pressure chamber to move said abutment in the opposite direction longitudinally of said bore to close said outlet valve when the vent in the system is closed and pressure in the said valve closing pressure chamber is restored, means carried by said abutment for opening said inlet valve, adjustable means for limiting the movement of said abutment in said one direction, and means formed in said casing for limiting the movement of the abutment in said opposite direction.

4. A fluid pressure operated valve comprising a casing having a centrally disposed bore extending longitudinally therethrough, a cap secured to said casing in a manner to close one end of said bore, a valve fitting secured to the opposite end of said casing and having a passage extending longitudinally therethrough and a valve seat formed therein, a signalling device communicating with said passage, a valve member slidably mounted in said fitting and co-operable with said valve seat for preventing the passage of fluid to said signalling device, a movable abutment positioned in said bore in a manner to form a valve opening pressure chamber and a valve closing pressure chamber within said casing, means carried by said abutment and connected to said valve member in a manner to permit of the relative movement of said means with respect to said member, means for admitting fluid under pressure to said chambers for moving said abutment in one

direction or the other according to the relative fluid pressure in the respective chambers, an inlet valve for controlling the admission of fluid to said valve opening pressure chamber, means carried by said abutment for actuating said inlet valve, and a plurality of tubes having variously different sized openings formed therein for controlling the passage of fluid to said valve closing pressure chamber.

5. A fluid pressure operated valve comprising a casing having a centrally disposed bore extending longitudinally therethrough, a cap secured to said casing in a manner to close one end of said bore, a valve fitting secured to the opposite end of said casing and having a passage extending longitudinally therethrough and a valve seat formed therein, a signalling device communicating with said passage, a valve member slidably mounted in said fitting and co-operable with said valve seat for preventing the passage of fluid to said signalling device, a movable abutment positioned in said bore in a manner to form a valve opening and signal operating pressure chamber and a valve closing pressure chamber within said casing, a rod carried by said abutment and adjustable with respect thereto, said rod being connected to said valve member in a manner to permit of the relative movement of said rod with respect to said member, resilient means associated with said member and rod and adapted to hold said member yieldingly in one direction with respect to said rod, means for admitting fluid under pressure to said chambers for moving said abutment in one direction or the other according to the relative fluid pressure in the respective chambers for moving said valve member into and out of engagement with said valve seat, means for straining the fluid admitted to said chambers, an inlet valve for controlling the admission of fluid to said valve opening and signal operating pressure chamber, said abutment having means formed thereon and co-operable with the stem of said inlet valve to open the inlet valve when the said valve member is removed from said valve seat, and to permit the inlet valve to close when said valve member is in engagement with said valve seat.

6. A fluid pressure operated valve comprising a casing having a longitudinal bore and a distributor chamber formed therein, a movable abutment positioned in said bore in a manner to form a valve opening pressure chamber and a valve closing pressure chamber within said casing, said pressure chambers being adapted to communicate with said distributor chamber, a pipe of an air brake system communicating with said valve closing pressure chamber and said distributor chamber, a signal device operatively connected to said valve opening pressure chamber, an outlet valve member operatively con-

nected to said abutment for controlling the passage of fluid pressure to said signal device, an inlet valve positioned between said valve opening pressure chamber and said distributor chamber, means carried by said abutment for actuating said inlet valve, and means for controlling the passage of fluid pressure from said distributor chamber to said valve closing pressure chamber and said pipe, said means comprising a plurality of tubes having openings of variously different cross sectional areas formed therein and adapted to be positioned interchangeably in said casing between said distributor chamber and said valve closing pressure chamber.

7. A fluid pressure operated valve comprising a casing having a longitudinal bore and a distributor chamber formed therein, a cap adapted to close one end of said bore, a movable abutment positioned in said bore in a manner to form a valve opening pressure chamber and a valve closing pressure chamber within said casing, said pressure chambers being adapted to communicate with said distributor chamber, a pipe of an air brake system communicating with said valve closing pressure chamber and said distributor chamber, means for admitting fluid under pressure to said chambers and said pipe, means for straining said fluid in its passage to said chambers and pipe, a signal device operatively connected to said valve opening pressure chamber, an outlet valve operatively connected to said abutment for controlling the passage of fluid pressure to said signal device, an inlet valve positioned between said valve opening pressure chamber and said distributor chamber, means carried by said abutment for actuating the said inlet valve, means adjustably mounted in said cap for limiting the movement of said abutment in one direction to vary the opening of said inlet valve, and means for controlling the passage of fluid pressure from said distributor chamber to said valve closing pressure chamber and said pipe, said means comprising a plurality of tubes having openings of variously different cross sectional areas formed therein and adapted to be positioned interchangeably in said casing between said distributor chamber and said valve closing pressure chamber.

8. A fluid pressure operated valve comprising a casing having a bore and a distributor chamber formed therein, means for closing one end of said bore, a movable abutment positioned in said bore in a manner to form a valve opening pressure chamber and a valve closing pressure chamber within said casing, an outlet valve positioned in the opposite end of said bore and adapted to communicate with said valve opening pressure chamber, said valve being operatively connected to said abutment in a manner to be opened and closed thereby when the abutment is moved longitudinally of said bore, a pipe of an air

brake system communicating with said valve closing pressure chamber, means for admitting fluid under pressure to said chambers and said system in a manner to cause the fluid pressure in said valve opening pressure chamber to open said valve when a vent in said system is opened and the fluid pressure in said valve closing chamber is reduced, and to cause the fluid pressure in said valve closing pressure chamber to close said valve when the vent in said system is closed and pressure in said valve closing pressure chamber restored, an inlet valve for controlling the passage of fluid to and from said valve opening pressure chamber, means for actuating said inlet valve, and means for varying the duration of time between the closing of the vent in said system and the closing of said outlet valve, said means comprising a plurality of tubes having openings of variously different cross-sectional areas formed therein and adapted to be positioned interchangeably in said casing between said distributor chamber and said valve closing pressure chamber and pipe.

9. A fluid pressure operated valve comprising a casing having a plurality of chambers formed therein, a valve communicating with one of said chambers, a pipe of the train line of an air brake system communicating with the other of said chambers, means for admitting fluid under pressure to said chambers and said train line in substantially equal degrees of pressure, valve actuating means positioned between said chambers, means for controlling the passage of fluid to said chambers and said train line and from one of said chambers in a manner to cause the fluid pressure in one of said chambers to open said valve when a vent in said train line is opened and to cause the fluid pressure in the other of said chambers to close said

valve when the vent in the train line is closed, and means associated with said valve actuating means for assisting the fluid pressure in said other of said chambers to close said valve.

10. A fluid pressure operated valve comprising a casing having a bore and a distributor chamber formed therein, means for closing one end of said bore, a movable abutment positioned in said bore in a manner to form a valve opening pressure chamber and a valve closing pressure chamber within said casing, an outlet valve positioned in the opposite end of said bore and adapted to communicate with said valve opening pressure chamber, said valve being operatively connected to said abutment in a manner to be opened and closed thereby when the abutment is moved longitudinally of said bore, a pipe of an air brake system communicating with said valve closing pressure chamber, means for admitting fluid under pressure to said chambers and said system in a manner to cause the fluid pressure in said valve opening pressure chamber to open said valve when a vent in said system is opened and the fluid pressure in said valve closing chamber is reduced, and to cause the fluid pressure in said valve closing chamber to close said valve when the vent in said system is closed and the pressure in said valve closing chamber is restored, an inlet valve for controlling the passage of fluid to and from said valve opening pressure chamber, means formed on said abutment for actuating said inlet valve, and means for varying the duration of time between the closing of the vent in said system and the closing of said outlet valve.

In testimony whereof I have signed my name to this specification, on this 7th day of February A. D. 1928.

PATRICK M. GRANT.