F. WAGNER.

MAIN PRESSURE VALVE.

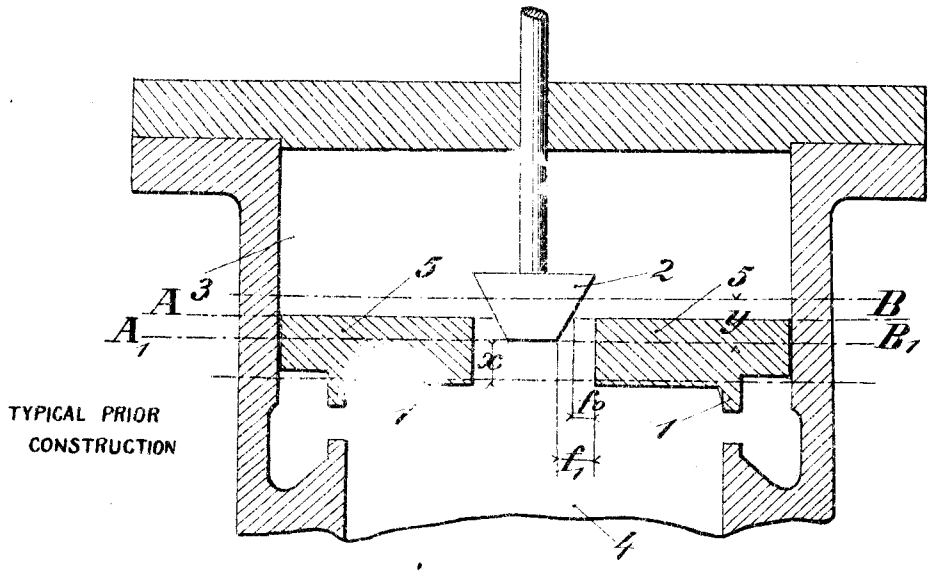
APPLICATION FILED OCT. 26, 1908.

1,106,757.

Patented Aug. 11, 1914.

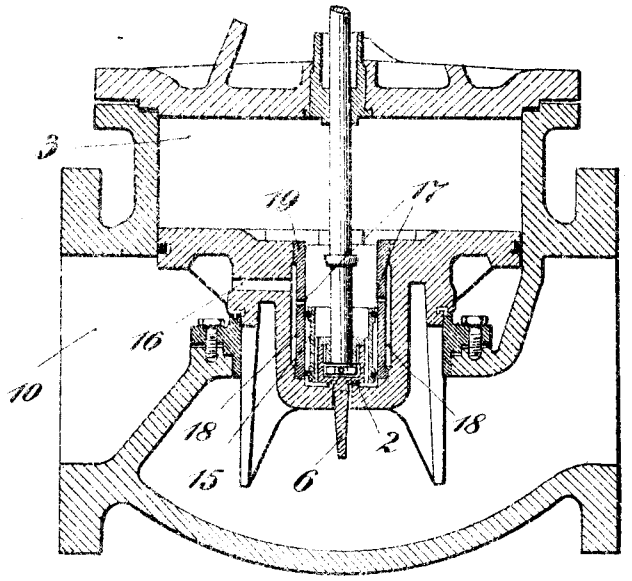
3 SHEETS—SHEET 1.

Fig. 1.



TYPICAL PRIOR CONSTRUCTION

Fig. 5.



Witnesses:

Edward Muller

Georg Otto

Inventor:

Fritz Wagner

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Patented Aug. 11, 1914.

3 SHEETS—SHEET 2.

Fig. 6.

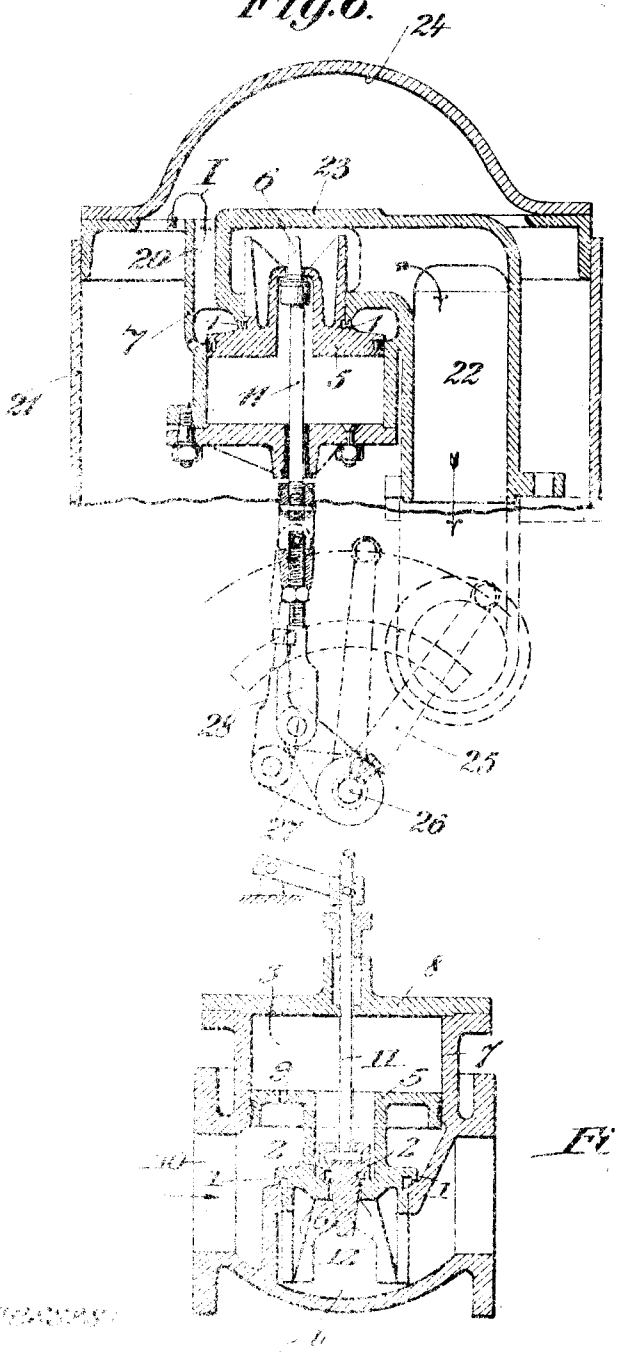


Fig. 2.

Witnesses:

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MAIN PRESSURE VALVE.

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1,106,757.

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3 SHEETS—SHEET 3.

Fig. 3.

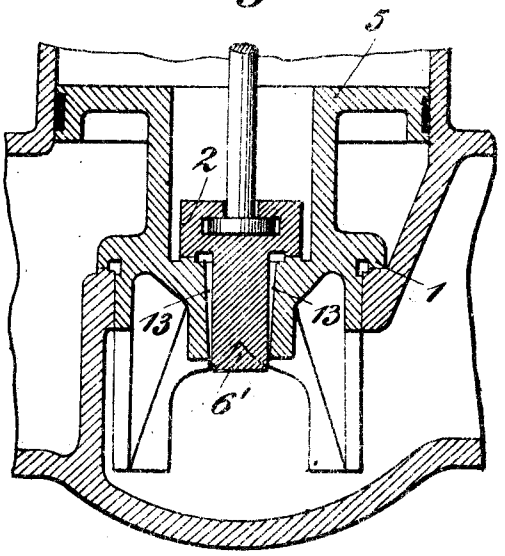
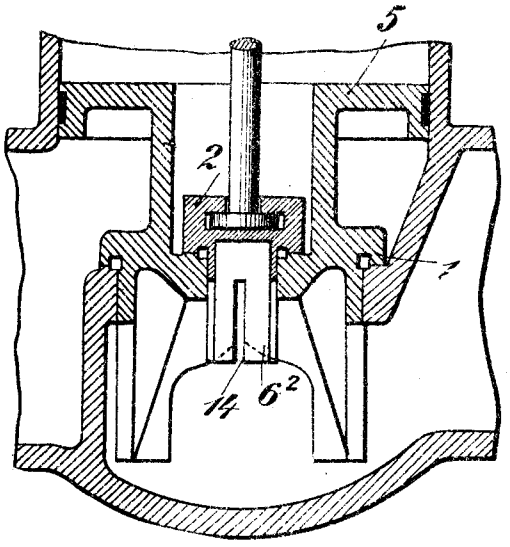


Fig. 4.



Witnesses.

Edelbert Miller

Georg Otto

Inventor:

Fritz Wagner

UNITED STATES PATENT OFFICE.

FRITZ WAGNER, OF GROSS LICHTERFELDE, NEAR BERLIN, GERMANY.

MAIN PRESSURE-VALVE.

1,106,757. Specification of Letters Patent. Patented Aug. 11, 1914.

Application filed October 26, 1908. Serial No. 459,665.

To all whom it may concern:

Be it known that I, FRITZ WAGNER, a subject of the German Emperor, and resident of Ferdinandstrasse 20, Gross Lichterfelde, near Berlin, Germany, have invented certain new and useful Improvements in Main Pressure-Valves, of which the following is a specification.

The invention relates to main-pressure valves of the class which are operated through the medium of the fluid pressure upon the valve body, or upon an equilibrium piston, one side of which piston is under the pressure existing in the pressure generating chamber and which at the same time, closes a separate pressure chamber or so-called equilibrium chamber which is in constant communication with the pressure generating chamber and which can also communicate with the outlet chamber through an auxiliary or relief valve or throttle valve.

The invention is the result of a study of the conditions which produce in the aforesaid valves the hammering or vibrating actions by reason of the inability of the main valve to become stationary at once after having moved into a new position and owing to the momentum of the moving main valve whereby said valve is carried, according to its speed, more or less beyond the position at which it should stop. This, for example, with the motion of the main valve toward the equilibrium chamber produces a compression of the pressure fluid within the said chamber, thus forming a cushion which throws the main valve back in the opposite direction and beyond the proper position. In consequence the passage of the auxiliary valve opens suddenly beyond the regular position and so contributes to the vibrating action as long as it remains open. A direct result of the foregoing action is the continued variation in pressure in the equilibrium chamber, because the constant to and fro motion of the main valve naturally alters the size of the outlet of the auxiliary valve all the more suddenly as the relative movements of the main and the auxiliary valves increase. As the main valve can only come to a proper rest when the pressures are equal at both sides of the equilibrium piston, it will be obvious that the vibration of the valve can be prevented by maintaining the same pressure ratios at the front and back of the equilibrium piston during the displacement of the main valve and with this object I provide for the speedy compensation in the inflow to and the outflow from the equilibrium chamber.

The fact that the momentum of the main valve and consequently its travel beyond the real median position is all the greater in direct proportion with the momentary variations of pressure in the equilibrium chamber, has led me to the conclusion that the cross-section of the outlet opening of the auxiliary valve must be allowed to vary but as little as possible even when the relative movements of the main and auxiliary valves differ greatly or suddenly from whatever causes. By this means only will it be possible to obviate a sudden reduction in pressure in the equilibrium chamber and consequently also to prevent the momentary strong excess of pressure on the equilibrium piston which causes the vibration of the valve.

According to this invention to obviate the vibrations of the valves I maintain equal pressure on both sides of the piston after the opening of the auxiliary valve by forming a throttling member connected to or acting in conjunction with the auxiliary valve in such a manner as to maintain the difference between the smallest and the largest throttle opening sufficiently low. For this purpose the throttle passage may be cylindrical, tapering or other convenient form and fitted with a slow tapering or other throttling plug or with a hollow valve having suitable ports. It is, moreover, advisable to provide an arrangement for the expeditious filling of the equilibrium chamber immediately after the auxiliary valve is closed.

The invention is illustrated in the accompanying drawings, which show a diagram and several forms of construction by way of example.

Figure 1 is a diagrammatical view showing the actions which take place during the vibrations of the valves now in use. Fig. 2 is a vertical section through a valve constructed according to the present invention having a slightly tapered plug. Fig. 3 is a vertical section of a valve having a tapering throttling passage. Fig. 4 is a vertical section of a valve fitted with a sliding throttle. Fig. 5 is a vertical section of a valve pro-

vided with an arrangement for speedily filling the equilibrium chamber after the closing of the auxiliary valve. Fig. 6 is a vertical section showing my improved valve applied as steam regulator for locomotives.

To more clearly emphasize the objections which I seek to overcome I have shown a typical old construction in Fig. 1. The line A—B represents one of the median positions of the main valve 1 in respect of the auxiliary valve 2 provided for the same inlet and outlet flow in the equilibrium chamber 3. If for some reason, for example through reduced pressure in the outlet chamber 4, the main valve 1 which is here shown integral with the equilibrium piston 5 be suddenly driven downward, the variation in pressure will cause the main valve 1 to take a new median position toward the auxiliary valve 2 as is represented by the line A, B_1. The momentum will impel the main valve 1 to pass beyond the median line A_1 B_1 say to the extent of x. As hereby the outlet area of the auxiliary valve 2 has thus become enlarged by the annular space f_1 f_0, there will occur a momentary strong discharge from the equilibrium chamber 3. This discharge produces at the lowermost position of the main valve 1 an upwardly directed excess of pressure which drives the valve upward beyond the median line A_1 B_1 to about y. This produces an undue throttling of the outlet from the equilibrium chamber 3 while at the same time the pressure fluid which remains in the equilibrium chamber is compressed and by reason of the rush of pressure fluid from the pressure generating chamber into the outlet chamber forces the valve down again. The same cycle of actions is constantly repeated and the valve vibrates with the well known objectionable results. As these are all the more destructive the greater the displacements of the valve are, attempts have been made heretofore to limit the movements by combining the main valve and the auxiliary valve by means of a coupling adapted to prevent the main valve from making more than a slight individual movement without acting on the auxiliary valve. Valves constructed in this manner moreover are also found to be liable to give hard blows and an unpleasant noise or chattering while the various parts are strongly subjected to great strain and wear, each movement of the main valve being transmitted to the valve spindle, thereby causing the latter to support all the hard shocks of the blows.

In the valves shown in Figs. 2, 3 and 4 which are constructed according to my invention the auxiliary valve 2 is formed with a special throttling member 6 6^1, 6^2 respectively of such a kind as to insure only a very slightly altering cross-section of the passage for the fluid while allowing a comparatively long stroke of the main valve 1. The throttling member thus allows of a very graduated increase or decrease in the area of the passage.

In the constructional form shown in Fig. 2, the valve casing 7 is fitted with the main valve 1 and superposed equilibrium piston 5. The latter makes a fairly good fit with the periphery of the casing 7 and forms with the said casing and its cover 8 an equilibrium chamber 3 into which the pressure fluid, for example, steam, passes between the piston and the walls of the casing, and if desired through a bore hole 9 communicating with the pressure generating chamber 10. I have shown the piston with a piston ring to reduce wear on the piston. In practice this ring does not make a fluid tight packing but permits the desired restricted flow of steam to pass the piston to the equilibrium chamber when the pressures on opposite sides of the piston are unequal. It is of course evident that the piston ring may act as a packing and a separate hole 9 may be provided as shown in Fig. 2, but as previously stated, this hole is not ordinarily necessary. The valve spindle 11 carries the depending auxiliary valve 2 which is provided at its lower part with a slightly tapered plug 6 projecting into the outlet chamber 4 and shutting off the equilibrium chamber 3 from the chamber 4 when the valve is closed. It is to be noted that the tapered plug of the equilibrium member should be of such a length as to enable the area of flow through the equilibrium member during the full stroke of the main valve to be controlled under all pressures. When the auxiliary valve 2 is opened the tapered plug 6 is drawn into the cylindrical passage 12 and so provides an annular opening which is constantly being enlarged for the escape of the pressure fluid from the equilibrium chamber toward the service or outlet chamber. After a predetermined lift of the tapered plug, the volume of fluid escaping from the equilibrium chamber will be larger than that entering the same chamber and therefore a constantly increasing excess pressure will take effect beneath the piston. When the excess pressure exceeds the load on the main valve, the latter will be forced off its seat and be driven upward with the piston. This upward movement produces the gradual decrease of the outlet opening from the equilibrium chamber and simultaneously causes the compression of the pressure fluid within the said chamber. If this valve, be suddenly displaced from its median position A B to that of A_1 B_1 as described with reference to Fig. 1 and caused to travel beyond this line to the extent of the distance x, it will be evident that the variation in the annular opening f_1 minus f_0 is very slight, so that the upwardly directed excess of pressure is equally slight. If, now, this

excess be small in comparison with the friction of the piston, there will be very little or no movement of the main valve beyond the median position A_1, B_1. The value of y must certainly be much lower than under ordinary conditions. The result of this is that, should a return motion take place, the value of x must become much less than before and the vibrations be damped. The main valve, therefore, comes to rest and remains floating in its median position in the pressure fluid. An essential feature in this arrangement is that there is no mechanical connection between the main valve and the auxiliary valve and that there is no contact between the two valves during the ordinary play, so that the valve-spindle receives no knocks or blows.

It is obvious that the main valve will always move gently and to a certain height only, while for the reasons explained with reference to Fig. 1, the valve will usually become stationary at once or certainly so after one or two vibrations; its active surface being then in such a middle position with regard to the tapering plug, as to insure an equal flow of fluid from and into the equilibrium chamber. In this position, the forces acting on the main valve, are balanced and so long as the auxiliary valve does not move, the main valve will remain stationary in its median position with regard to the tapering plug. With variations in the pressure, the main valve will rise or fall without individual vibrations until it has reached the median position corresponding to such momentary pressure. When further opening or closing of the auxiliary valve takes place the main valve follows it without vibration exactly as if both were mechanically connected together. These facts have been proved by careful experiments.

It is not necessary to furnish the auxiliary valve with a slow tapering plug for throttling the cylindrical passage, as a straight plug 6′ can be used, provided the passage 13 be made slightly tapering as shown in Fig. 3. Furthermore, the plug may be made hollow to form the throttling member 6^2, as shown in Fig. 4 with slots 14 and guided in a seating, in such a manner as to enable the slots to act similarly to the previously described throttling means.

For completely closing the main valve it is necessary to first close the auxiliary valve whereby naturally the outflow from the equilibrium chamber is entirely stopped. This causes an increase in pressure in the equilibrium chamber 3 whereby the equilibrium piston is forced down and the main valve closed. If the inflow is not sufficiently large it will lead to the formation of vacuum in the equilibrium chamber during the lowering of the piston tending to retard the motion of the latter and consequently also the closing of the main valve. To avoid this, it is required to effect a speedy inflow of the fluid into the equilibrium chamber. For that purpose the communication orifices of the two chambers may be enlarged, such as the boring 9 of the piston 5. However, this would at once require correspondingly increased dimensions of the auxiliary valve, because the discharge area of the auxiliary valve must approximate that of the equilibrium piston in order to insure for the speedy equalizing of the inflow and outflow in the equilibrium chamber. The enlargement of the auxiliary valve would necessitate an objectionable enlargement of the whole valve, corresponding increase in weight and decrease in sensitiveness of the auxiliary valve. The objections can be obviated by combining the auxiliary valve 2 with a slide valve 15 in the manner shown in Fig. 5, or in any other convenient manner; the said slide valve being adapted to open or close a port leading from the generating chamber 10 to the equilibrium chamber 3. The port 16 may lead into an annular space 18 formed with outlet orifices 17; said annular space being limited by the main valve and casing 19 of the slide valve respectively. With the opening of the auxiliary valve, the slide 15 closes the communication 17 between the generating chamber and the equilibrium chamber so that the inflow to the latter can only take place around or through a separate small opening in the equilibrium piston such as shown at 9 in Fig. 2 as may be preferred. With the closing of the auxiliary valve, the slide 15 uncovers the communication 17 completely and thus allows of the immediate re-fillling of the equilibrium chamber.

In the steam regulator for locomotives shown in Fig. 6, the valve casing 7 is similarly formed with an annular space 20 which takes the place of the steam generating chamber 10 described in Fig. 2. The steam from the dome 21 passes in the direction shown by the arrow I to the main valve. The outlet chamber 4 is here replaced by the steam outlet pipe 22. It is advisable to so place the steam regulator in the dome 21 as to dispose the upper part 23 of the valve casing near the cover 24 of the dome so as to cause the steam to strike against the cover 24 and release its water before passing through the open valve.

The valve 5 and its auxiliary valve 6 are operated in the usual manner by the engine-driver by means of the hand lever 25 fast on the rod 26 which moves the lever 27 in connection with the link 28 of the auxiliary valve rod 11.

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

1. In a valve the combination of a valve casing, a main valve having a piston portion

coöperating with a portion of said casing to form an equilibrium chamber, said chamber having a restricted inlet passage and an outlet passage, the latter being through said main valve, an auxiliary valve for controlling said outlet passage, and a throttling member carried by said auxiliary valve and projecting through said outlet, the throttling effect of said member varying but slightly upon comparatively large relative movements of said main valve and said member.

2. In a valve the combination of a valve casing, a main valve having a piston portion coöperating with a portion of said casing to form an equilibrium chamber, said chamber having a restricted inlet passage and an outlet passage, the latter being through said main valve, an auxiliary valve for controlling said outlet passage, and a throttling member carried by said auxiliary valve and projecting through said outlet, the throttling effect of said member varying but slightly upon comparatively large relative movements of said main valve and said member, said throttling member serving to maintain the outlet opening from said equilibrium chamber of less effective cross-sectional area than the inlet to said chamber until after the auxiliary valve has moved from its seat to a distance materially greater than the movement of said main valve against increasing compression in said equilibrium chamber.

3. In a valve the combination of a valve casing, a main valve having a piston portion coöperating with a portion of said casing to form an equilibrium chamber, said chamber having a restricted inlet passage and an outlet passage, the latter being through said main valve, an auxiliary valve for controlling said outlet passage, and a throttling member carried by said auxiliary valve and projecting through said outlet, the length of said member being so proportioned to its throttling action in different positions relative to the main valve and to the volume of said chamber and to the range of movement of said main valve against increasing compression in said auxiliary chamber, that upon opening the auxiliary valve and temporarily diminishing the pressure in said chamber, said main valve in opening against increasing compression in the equilibrium chamber and increasing throttling action will move a distance less than the preliminary movement of the auxiliary valve and prevent seating of the auxiliary valve.

4. In a valve the combination of a valve casing, a main valve having a piston portion coöperating with a portion of said casing to form an equilibrium chamber, an auxiliary valve manually operable to permit the escape of fluid from said chamber and the opening of said main valve, and supplemental means for controlling the movement of said main valve, said supplemental means including a passage communicating with said chamber and a throttling member within said passage, said passage and throttling member having relative movement upon the movement of said main valve and the throttling effect of said member varying but slightly upon comparatively large relative movements of said passage and member.

5. In a valve the combination of a valve casing, a main valve having a piston portion coöperating with a portion of said casing to form an equilibrium chamber, said chamber having a restricted inlet passage and an outlet passage, the latter being through said main valve, an auxiliary valve for controlling said outlet passage, and a throttling member carried by said auxiliary valve and projecting through said outlet, the throttling effect of said member varying but slightly upon comparatively large relative movements of said main valve and said member, said main valve having an inlet passage and a third valve serving to close said passage when said auxiliary valve is in its open position.

6. A valve comprising in combination a valve casing, a main valve in said casing, a piston connected with said main valve and forming a chamber in said casing, an auxiliary valve arranged in the outlet passage of said chamber, a throttling member connected with said auxiliary valve and projecting deeply into the outlet passage of said chamber to control the outlet of said chamber during the whole stroke of said main valve and constructed to allow in all open positions of said auxiliary valve of only a slight variation in the area of the outlet passage of said chamber when said auxiliary valve is moved from one into another position, and a slide valve encircling said auxiliary valve and connected with the latter, passages arranged to form a communication between the pressure generating side of the valve and said chamber when said auxiliary valve is in its closed position, said slide valve being adapted to close said passages if the auxiliary valve is opened, substantially as and for the purpose set forth.

In testimony whereof I have hereunto signed my name this 15th day of October 1908, in the presence of two subscribing witnesses.

FRITZ WAGNER.

Witnesses:

HENRY HASPER,

WOLDEMAR HAUPT.