May 21, 1935. W. M. GRAY 2,002,451

WATER HAMMER ELIMINATOR

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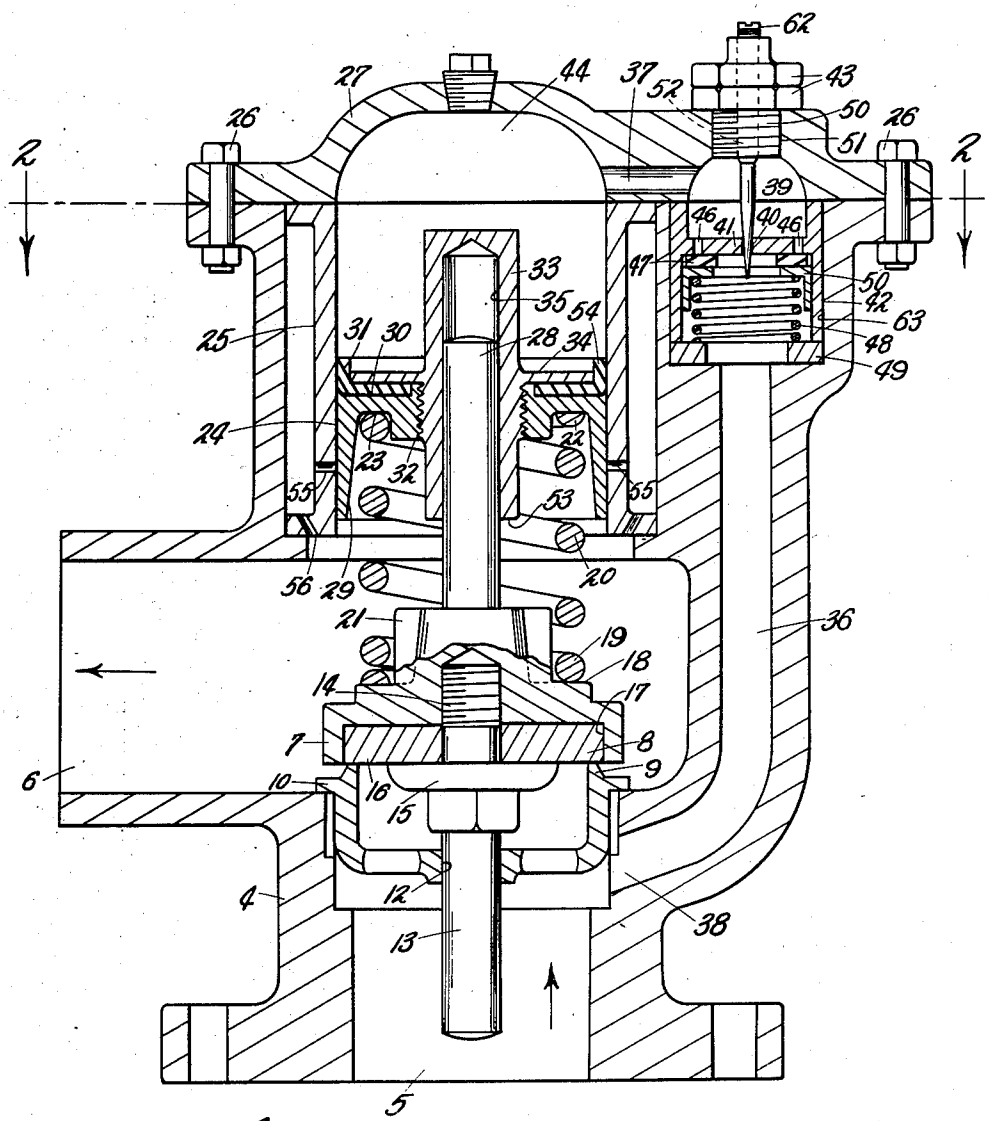

Fig. 1

Inventor

Wallace M. Gray

By Murray and Zugelter

Attorneys

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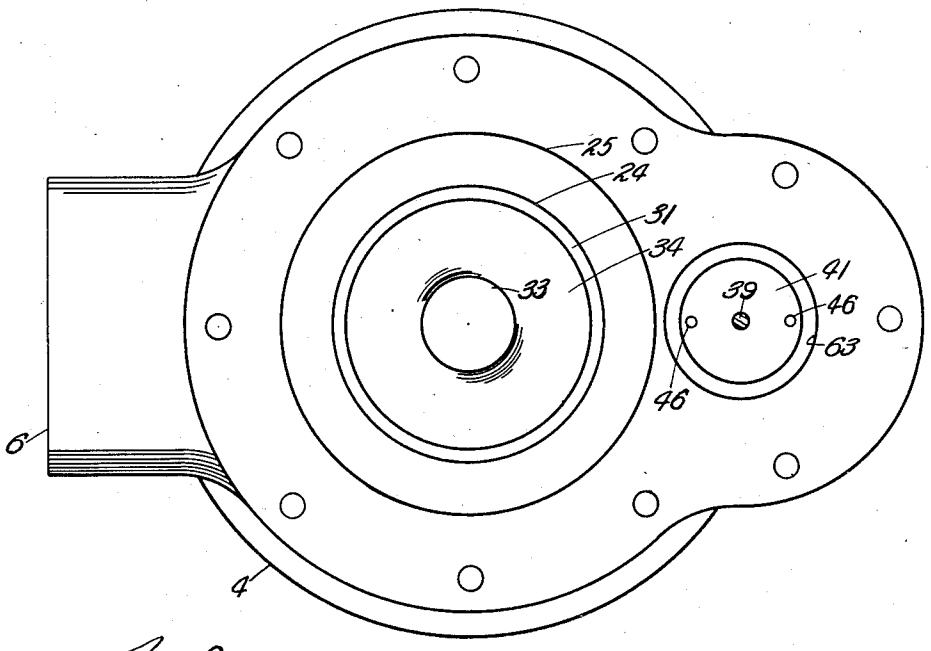

Fig. 2

Inventor

Wallace M. Gray

By Murray & Zugelter

Attorneys

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WATER HAMMER ELIMINATOR

Wallace M. Gray, Cincinnati, Ohio

Application January 21, 1935, Serial No. 2,768

6 Claims. (Cl. 137—71)

The invention relates to an improved water hammer eliminator such as may be connected to water mains or supply pipes in a well-known manner to preclude destructive vibration, chattering, and noise resulting from sudden closing of a valve or valves connected with the supply pipe or main.

An object of the present invention is to provide an improved form of water hammer eliminator which is constructed of fewer parts than any good hammer eliminator procurable or known at present, and which operates at least as effectively and reliably as any of the more complicated or elaborate devices of its kind.

It is also an object of the present invention, to produce an effective water hammer eliminator which is very simple and inexpensive, and which may be easily assembled, or adjusted in the event that servicing is required.

A further object of the invention is to so construct a water hammer eliminator that extreme abuse or subjection thereof to the hardest kind of service will not result in breakage or excessive wearing of the working parts, the device being, moreover, fool-proof by reason of its extreme simplicity.

The foregoing and other objects are attained by the means described herein and disclosed in the accompanying drawings in which:

Fig. 1 is a view showing the improved device in vertical cross-section.

Fig. 2 is a cross-sectional view taken on line 2—2 of Fig. 1.

While water hammer eliminators are well-known and have been in general use for many years, they have been improved and rendered effective by the successive addition of working parts and adjustable elements, until the modern devices have assumed the proportions and characteristics of a complex mechanism. Said improved modern devices have become bulky and expensive, and the use therein of many and delicate parts to secure the performance desired, has increased both the cost of manufacture and the cost of maintenance. By means of a more practical and less cumbersome arrangement of simple constituents, I have produced a water hammer eliminator which is not only simpler, smaller, and less expensive than kindred devices heretofore known, but one which performs the desired function equally as well or better than the known devices, with but a fraction of the usual servicing and care.

The device of the present invention is of the type wherein a main valve is yieldingly maintained seated by reason of the pressure of fluid of the main being imposed upon valve and plunger surfaces of unequal area. Invention is not claimed in the broad idea of applying this principle, but rather in the combination of simplified means hereafter referred to.

The device of this invention is adapted to be connected with a water main or other fluid supply line, either at the end thereof or at an intermediate point, or in a branch thereof, preferably at a location adjacent to a valve for drawing fluid from the main or branch. The function of the device is to vent or overflow a portion of the fluid under pressure in the main or supply line, so as to absorb the shock or hammer resulting from the inertia of the moving column of fluid when the valve for drawing fluid from the main is suddenly closed. The occurrence of oscillatory shocks or surges in the fluid line, resulting in destructive vibration and noise, is well-known to those skilled in the art wherefore it is deemed unnecessary to describe the condition in detail.

The accompanying drawings illustrate the water hammer eliminator of the present invention, the character 4 indicating the body of the device in which are formed the fluid inlet port 5 and a discharge port or vent passage 6. The port 5 may be placed in communication with the vent passage 6 by means of a movable valve 7 having a seating disc 8 which normally rests upon a stationary annular valve seat member 9 suitably supported by the body of the device upon an annular flange 10. The stationary seat member 9 is provided with a concentric or center aperture 12 adapted to slidably receive the pilot spindle 13 of the movable valve 7. The elements 12 and 13 provide a guide for the valve as it moves vertically to the opened and closed positions. In the embodiment shown, the disc 8 is maintained in a fixed relationship with the valve element 7 by means of a screw threaded connection 14 between the pilot spindle and a central threaded bore of said member 7, there being a pressure flange 15 on the spindle to engage the lower face 16 of the valve disc for holding said disc in the socket or depression 17 of member 7. It is to be understood that various other approved means may be employed for piloting the valve and securing the renewable disc 8 in position.

The upper portion of the movable valve element 7 has formed thereon a shoulder 18 for supporting the lower convolution 19 of a heavy compression spring 20, which spring is kept centered upon the shoulder by means of an upwardly extending boss or stud 21. An upper convolution 22 of the

spring is adapted to forcefully abut a bearing surface or abutment 23 of a piston or plunger 24 which is slidably mounted in a cylinder 25 supported in fixed relation to the body of the device. The cylinder 25 may be integral with the body, or removable as shown in Fig. 1, the removal thereof being effected by withdrawing a series of bolts or other fastening devices 26 and lifting the cap or cover 27. The cylinder 25 is supported in axial alignment with the valve 7, its pilot shaft 13, and the secondary pilot or guide shaft 28 which extends vertically from the boss or stud 21. While the piston or plunger 24 may be of any approved design, there is disclosed herein one which has a skirt or depending cylindrical wall 29, the upper face 30 of which supports a packing ring or cup 31 of leather, rubber or other similar material designed to preclude leakage of fluid past the piston or plunger. The skirt portion 29 may be screw threaded as at 32, onto a flanged sleeve or guide piece 33, so that the packing ring or cup may be clamped between the flange 34 and the upper surface 30 of member 29. A concentric smooth bore 35 of the sleeve 33 is adapted to slidably receive the guide or post 28, whereby the plunger or piston is maintained in proper concentric relationship with the bore of cylinder 25.

That portion of the cylinder which is above the piston or plunger, is placed in fluid communication with the entry port 5, by means of a passage or duct 36 and an associated passage 37. At the location 38, the passage 36 is in constant fluid communication with the inlet port 5, and consequently with the main line of fluid under pressure. The passage 36 has interposed therein a governor valve comprising the needle 39 and a seat therefor 40. The seat or aperture 40 may be formed in the diaphragm or wall 41 of a cylindrical and valve cage 42 which is supported in a bore or opening 63 of the body of the device. The valve 39—40 may be adjusted at the exposed end 62 of the needle, and located in the adjusted position by means of lock nuts 43 or the like to permit a slow leakage of fluid in either direction between the top end of cylinder 25 and the inlet port 5. Provision is made also for a rapid displacement of water from the chamber 44 or the upper portion of cylinder 25, to the inlet port 5, by way of a one-way valve comprising the series of apertures 46 in diaphragm 41, and an annular ring shaped seat member 47 which may be normally urged into closed position upon the apertures 46 by means of a compression spring or the like 48. The lower end of said spring rests upon a suitable support or abutment 49, while the upper portion of the spring abuts a plate or elevator 50 which supports the closure element or valve member 47. From the foregoing it will be understood that a pressure of fluid in the passage 36 may leak slowly into the chamber 44 through the valve 39—40, but not through the valve 46—47, whereas a pressure of fluid in the chamber 44 greater than that in the passage 46 and port 45, will be relieved promptly and rapidly by reason of an automatic opening of valve 46—47, as well as through the fixed leak passage at 40.

While the manner of supporting the needle of the governor valve may be altered, if desired, there is illustrated an internally and externally threaded plug 50, the external threads of which engage a threaded aperture 51 of the cap or cover 27, while the internal threads 52 are engaged by the threads of the needle, some of which threads are shown at 62.

It is to be observed that only two springs are employed for the proper operation of the device, the one spring 48 functioning to yieldingly maintain a closed condition of the one-way valve 46—47, whereas the heavy compression spring 20 functions always to yieldingly urge the valve member 7 and the piston or plunger 24 in opposite directions. Both of the springs used are compression springs, and neither need be made adjustable.

A means is provided for relieving any excess pressure in the chamber 44 above the piston 24, as the piston reaches its lower limit of movement while the main valve 8—9 is closed. At said lower limit of movement, the lower end 53 of the sleeve 33 would be in substantial abutment upon the stud 21, with the spring 20 substantially fully compressed. At this position of the piston or plunger, the periphery or edge 54 of the cup or washer 31 will be disposed slightly below the bleeder passages 55, so that the excess pressure in chamber 44 may be relieved and conveyed to the waste conduit or outlet 6, through the plurality of openings or bores 56. The circumstances under which fluid will bleed through the relief openings 55 and 56 will be explained in a subsequent paragraph.

In an explanation concerning the operation of the device, it will be assumed that the inlet port 5 is in fluid communication with the main or a branch thereof containing fluid normally under pressure. The relative positions of the various parts will then be as illustrated, the valve 8—9 being closed, the valve 46—47 being closed, the needle valve 39—40 being set at a predetermined opened position, and the piston or plunger 24 being partially depressed against the resistance of spring 20. With the elements in the aforesaid normal relationship, no fluid will pass from the waste discharge outlet 6. In the event of a surge of water pressure, however, occasioned usually by quickly closing a valve which had been drawing fluid from the main, an excess force will be directed against the lower face 16 of the movable valve part 8 for opening the valve 8—9 and relieving the shock or excess pressure of fluid through the waste passage or port 6. Upon the sudden opening of the valve 8—9, the spring 20 will transmit the movement of valve part 7 to the piston or plunger 24 thereby to compress the fluid in chamber 44 and cause it to promptly relieve through the passage 37, valve 46—47, passage 36 and inlet port 5. A small portion of the fluid thus relieved will pass through the needle valve 39—40 also, but the one-way valve 46—47 is constructed to relieve the greater portion of the fluid compressed within the chamber 44. When the pressures at 5 and 44 are thus equalized the valve 8—9 will slowly close at a rate dependent upon the adjustment of the needle valve which again permits a flow of fluid under pressure from the main, through the inlet 5 passage 36 and passage 37, whereby to slowly force the piston or plunger 24 downwardly for closing the valve 8—9 against the resistance of spring 20. It will be observed that the upper face of the piston or plunger has a larger area than does the face 16 of valve part 7, so that equal pressures of fluid upon the top of the piston and that much of the lower face 16 as is included within the internal diameter of the seat member 9, will result in a constant downward urging of the plunger and valve part 7 in obedience to a well-known law of mechanics.

The bleeder passages 55 and 56 perform only in the event that an excessive constant pressure

happens to build up in the main which connects with inlet 5, when such excessive pressure is sufficiently high to result in lowering of the piston or plunger 24 to its extreme lowermost limit, at which the shoulder or face 53 abuts or substantially abuts the member 21. When the piston or plunger is thus depressed or lowered to the maximum extent of its travel, the bleeder ports or passages 55 are uncovered by reason of the cup or washer 31 traveling downwardly to a point below such ports or passages, whereupon the fluid of the chamber 44 will bleed through the passages 55 and 56 and be released through the waste pipe or outlet 6. The emergency pressure relief thereby provided, insures against damage to the working parts of the device and prevents the formation of permanent leaks at the joints and gaskets thereof.

Attention is directed particularly to the fact that the main spring 20 tends always to urge the valve part 7 and the plunger 24 in opposite directions, there being no spring used to force the plunger toward the valve. Any downward movement of the plunger is initiated or occasioned either by gravity or by a pressure of fluid upon the upper surface of the plunger. The plunger thereby is rendered quite free of movement in an upward direction, so that the chamber 44 may have part of its fluid rapidly and instantly relieved through the passages 37, 46 and 36 upon the occurrence of successive surges of vibration in the main or in the inlet 5. The device of this invention is found to respond promptly and with great effectiveness for the elimination of hammering, strains and noises that result from sudden closing of a valve withdrawing fluid from the main to which the device is connected.

It is to be understood that the number and size of valves such as 46—47 to be employed, will vary according to the character of service in which the device is to be placed, and this is true also of the bleeder ports and passages 55 and 56. The only adjustment required is that of the needle valve. Due to the extreme simplicity of construction, and the reduced number of parts necessary to perform the function desired, the device may be very inexpensively manufactured, and any servicing that should become necessary may be performed with a minimum of labor and a great saving of time.

It is to be understood that various modifications and changes may be made in the structural details of the device within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A water hammer eliminator comprising in combination: a body having an inlet port for fluid under pressure and a waste discharge port to be placed in fluid communicative relationship with the inlet port, a valve normally barring communication between said ports, a cylinder, and a plunger therein movable toward and from the valve, said cylinder having a fluid chamber above the plunger, means constantly yieldingly urging the plunger away from the valve and tending always to reduce the capacity of the said fluid chamber, a by-pass providing for a restricted flow of fluid from the inlet port to the fluid chamber above the plunger, and means providing for a copious flow of fluid in the opposite direction, upon application to the valve of a sudden high pressure surge of fluid in the inlet port sufficient to open the valve and move the plunger.

2. A water hammer eliminator comprising in combination: a body having an inlet port for fluid under pressure and a waste discharge port to be placed in fluid communicative relationship with the inlet port, a valve normally barring communication between said ports, a cylinder, and a plunger therein movable toward and from the valve, said cylinder having a fluid chamber above the plunger, means constantly yieldingly urging the plunger away from the valve and tending always to reduce the capacity of the said fluid chamber, a by-pass providing for a restricted flow of fluid from the inlet port to the fluid chamber above the plunger, and means operative upon filling of the fluid chamber to its full capacity, for relieving fluid pressure directly into the waste discharge port.

3. A water hammer eliminator comprising in combination: a body having an inlet port for fluid under pressure, a waste discharge port to be placed in fluid communicative relationship with the inlet port, a valve normally barring communication between said ports, a cylinder, and a plunger therein, both in axial alignment with said valve, said cylinder having formed in its side wall a bleeder port normally closed by the plunger and located to connect the waste discharge port with a chamber above the plunger when the plunger is moved to its lower limit of travel within the cylinder, a single heavy compression spring freely urging the plunger away from its lower limit of travel within the cylinder, while at the same time yieldingly urging the valve to the closed position, a by-pass providing for a restricted flow of fluid from the inlet port to the fluid chamber above the plunger, and means providing for a copious flow of fluid in the opposite direction, upon application to the valve of a sudden high pressure surge of fluid in the inlet port sufficient to open the valve and move the plunger.

4. A water hammer eliminator comprising in combination: a body having an inlet port for fluid under pressure, a waste discharge port to be placed in fluid communicative relationship with the inlet port, a valve normally barring communication between said ports, a cylinder, and a plunger therein, both in axial alignment with said valve, said cylinder having formed in its side wall a bleeder port normally closed by the plunger and located to connect the waste discharge port with a chamber above the plunger when the plunger is moved to its lower limit of travel within the cylinder, a single heavy compression spring freely urging the plunger away from its lower limit of travel within the cylinder, while at the same time yieldingly urging the valve to the closed position, a by-pass providing for a restricted flow of fluid from the inlet port to the fluid chamber above the plunger, said means comprising a single compression spring, an apertured diaphragm, and means urged by the spring for maintaining the diaphragm aperture closed upon movement of fluid from the inlet port to the plunger chamber.

5. A water hammer eliminator comprising in combination: a body having an inlet port for fluid under pressure, a waste discharge port disposed substantially at right angles to the inlet port to be placed in fluid communicative relationship with the inlet port, a reciprocable disc valve normally barring communication between said ports, a stem carried by said valve and extended in opposite directions axially of the valve, a guide for one extension of the stem, a single cylinder having an upper portion providing a fluid chamber, a single plunger in said cylinder, the

cylinder having formed in its side wall a bleeder port normally closed by the plunger and located to connect the fluid chamber of the cylinder with the waste discharge port when the plunger is moved to a lower limit of travel within the cylinder, a sleeve having a closed top and carried by the plunger concentrically therewith, the other extension of the stem being reciprocably received in the sleeve, said sleeve providing also a stop for limiting movement of the plunger toward the valve, a compression spring freely urging the plunger away from its lower limit of travel to maintain the bleeder port closed while at the same time yieldingly urging the valve to the closed position, a by-pass providing for a restricted flow of fluid from the inlet port to the fluid chamber above the plunger, and means providing for a copious flow of fluid in the opposite direction, upon application to the valve of a sudden high pressure surge of fluid in the inlet port sufficient to open the valve and move the plunger.

6. A water hammer eliminator comprising in combination: a body having an inlet port for fluid under pressure, a waste discharge port disposed substantially at right angles to the inlet port to be placed in fluid communicative relationship with the inlet port, a reciprocable disc valve normally barring communication between said ports, a stem carried by said valve and extended in opposite directions axially of the valve, a guide for one extension of the stem, a single cylinder having an upper portion providing a fluid chamber, a single plunger in said cylinder, the cylinder having formed in its side wall a bleeder port normally closed by the plunger and located to connect the fluid chamber of the cylinder with the waste discharge port when the plunger is moved to a lower limit of travel within the cylinder, a sleeve having a closed top and carried by the plunger concentrically therewith, the other extension of the stem being reciprocably received in the sleeve, said sleeve providing also a stop for limiting movement of the plunger toward the valve, a compression spring freely urging the plunger away from its lower limit of travel to maintain the bleeder port closed while at the same time yieldingly urging the valve to the closed position, a by-pass providing for a restricted flow of fluid from the inlet port to the fluid chamber above the plunger, and means providing for a copious flow of fluid in the opposite direction, upon application to the valve of a sudden high pressure surge of fluid in the inlet port sufficient to open the valve and move the plunger, said plunger being movable freely in the direction of the fluid chamber against only the fluid resistance of the chamber.

WALLACE M. GRAY.