Oct. 23, 1962 K. PARR 3,059,662

HOT WATER SUPPLY SYSTEM OR THE LIKE INCLUDING VACUUM CONTROL APPARATUS

Filed July 7, 1959

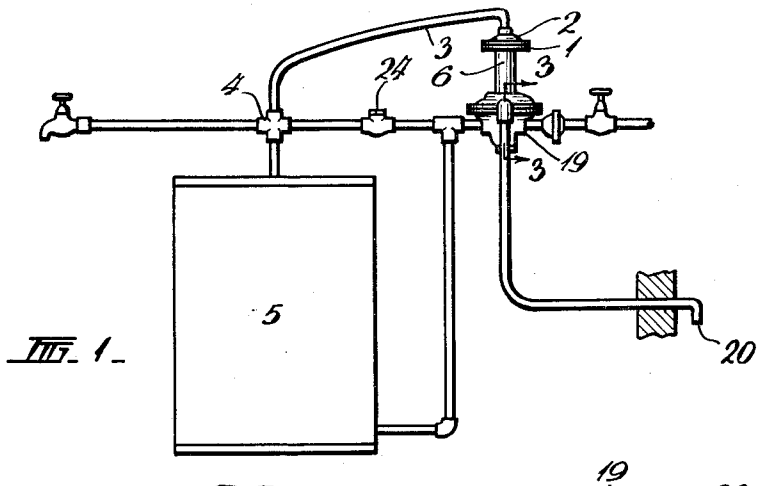

Fig. 1.

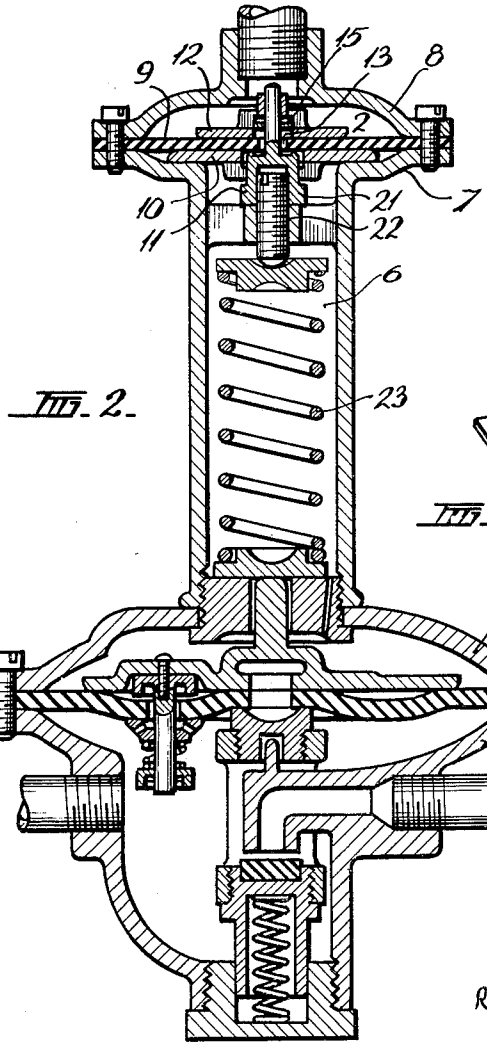

Fig. 2.

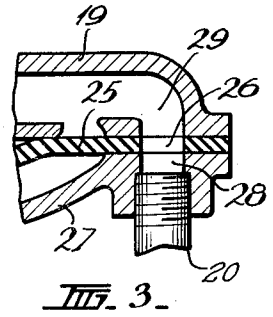

Fig. 3.

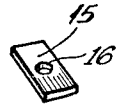

Fig. 4.

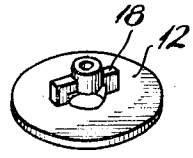

Fig. 5.

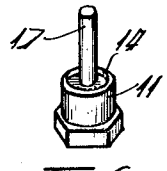

Fig. 6.

Keith Parr
INVENTOR

BY
Richardson, David & Nordon
ATTORNEYS

United States Patent Office 3,059,662
Patented Oct. 23, 1962

3,059,662

HOT WATER SUPPLY SYSTEM OR THE LIKE INCLUDING VACUUM CONTROL APPARATUS

Keith Parr, 59 Coorie Crescent, Rosanna, Victoria, Australia

Filed July 7, 1959, Ser. No. 825,535
Claims priority, application Australia July 10, 1958
6 Claims. (Cl. 137—116.5)

This invention relates to improvements in hot water supply systems and the like and refers particularly, but not exclusively, to the class of apparatus known as pressurised hot water storage and supply systems.

In such pressurised hot water storage and supply systems, the hot water is usually supplied to the storage tank by means of a gravity feed from an overhead or elevated tank the inlet to which is provided with a float-operated control valve. However, this type of valve is noisy in use and has a tendency to leak under high inlet pressure conditions. To overcome these disadvantages and to provide a greater control over the inlet pressure to the storage tank, the overhead or elevated tank is eliminated and a pressure reducing valve is used to reduce and govern the fluctuating main inlet pressure flow to the storage tank. In order to relieve any excess pressure which may develop in the storage tank, say through expansion of the water in the storage tank while it is being heated, and to relieve a vacuum which may occur in the system, a pressure relief valve and a vacuum relief valve may be used in conjunction with the reducing valve.

In a correctly arranged system of this type, the pressure relief and vacuum relief valves are adapted to operate on the pressure inlet side of the storage tank in order to prevent hydraulic shock or pressure hammer in the tank and to overcome the highest degree of vacuum likely to be encountered such as that caused by failure of main pressure supply due to bursting of the main or other cause. Further, in this type of system, a non-return or check valve is used to direct the cold water inlet flow from the reducing valve to the bottom of the storage tank and to allow excess water from the top or hot water outlet of the tank to flow to the pressure relief valve for discharge. Accordingly, if a vacuum is produced at the hot water outlet of the tank, as for example by opening a hot water tap located well below the level of the tank when the pressure supply to the tank has been cut off or greatly reduced, the check valve would prevent the vacuum being relieved except through the storage tank and this could severely damage the tank.

One object of the invention is to provide means for preventing and/or relieving vacuum in hot water storage and supply systems of the type referred to, or other fluid systems and which is capable of positive and sensitive operation after long periods of disuse.

A further object is to provide an improved vacuum control apparatus in a hot water storage and supply system which enables the vacuum to be relieved otherwise than through the storage tank.

Other objects of the invention reside in the novel combination and arrangement of parts and in the details of construction hereinafter illustrated and/or described in the drawings, in which:

FIGURE 1 is a diagrammatic representation of a hot water system of the type referred to incorporating a vacuum relief valve according to the invention,

FIGURE 2 is a sectional view of a vacuum relief valve in accordance with the invention mounted on the casing of a reducing valve,

FIGURE 3 is a section taken along the line 3—3 of FIGURE 1,

FIGURE 4 is a perspective view of a feather valve as used in the valve shown in FIGURE 2,

FIGURE 5 is a perspective detail view of a pressure plate as used in the valve shown in FIGURE 2, and

FIGURE 6 is a perspective detail view of a valve closing member for the valve shown in FIGURE 2.

Referring to FIGURE 1, a vacuum relief valve **1** is provided comprising a valve chamber **2** with a pressure inlet **3** directed to the outlet **4** of a hot water storage tank **5** and an equalising outlet **6** communicating with the atmosphere. The vacuum relief valve **1** comprises a valve body **7** and cover plate **8** between which is clamped a circular flexible diaphragm **9** of synthetic rubber or other suitable material (FIG. 2), pressure supporting means in the form of an annular pressure plate **10**, a valve closing member **11** adapted to seat against the diaphragm **9** and a suitable weight **12** to depress the diaphragm **9** to assist in closing of the valve.

The diaphragm **9** has a circular orifice **13** at its center and is clamped between upper and lower portions of the valve chamber **8** and **7**. The valve closing member **11** is mounted in the valve body **7** and is provided with a narrow annular chamfered seating face **14** which is normally engaged by a portion of the diaphragm adjacent to the orifice **13** so that communication is thereby prevented between the upper and lower portions of the valve chamber **2**.

When the upper, or pressure, portion of the valve chamber **2** is subjected to pressure from a hot water system, the diaphragm **9** is sealingly pressed against the valve closing member **11** and is supported over the major portion of its area by the pressure plate **10**.

Application of a vacuum to the pressure portion of the valve chamber causes the atmospheric pressure exerted on the diaphragm **9** and pressure plate **10** to lift the pressure plate **10** from its seating in the valve body **7**. This movement then imposes an increased lifting force on the portion of the diaphragm **9** in contact with the valve closing member **11**, and also applies a bending moment to the portion of the diaphragm **9** in contact with the seating face **14**. This bending moment further assists in opening the valve and greatly reduces any tendency of the diaphragm **9** to stick to the valve closing member **11**.

The valve will remain open while subjected to vacuum but will close when the pressure has been equalised, this closing action being assisted by a weight **12** which rests on the upper surface of the diaphragm **9**.

In order to increase the rapidity of closing of the valve, an auxiliary feather valve **15** is provided to close the orifice **13**. The feather valve **15** is a rectangular plate of thin sheet metal and is retained in position by a central hole **16** which fits over a stem **17** attached to the valve closing member **11**. Passage of air to relieve a vacuum lifts the feather valve **15** from its seating on the upper surface of the weight **12**, excessive displacement being prevented by the bridge piece **18**. When the air pressure on both sides of the diaphragm **9** is equalised, the feather valve **15** immediately falls to close the orifice **13**. The low inertia of the feather valve **15** enables this action to take place very quickly and if any reverse pressure is applied to the relief valve, the closing action of the diaphragm **9** against the seating **14** is assisted in consequence.

Preferably, a vacuum relief valve as described above is combined in service with a valve unit **19** of the type described in my U.S. Patent No. 2,921,597, issued January 19, 1960. This unit comprises pressure reducing and relief means and a vacuum relief means.

In this case the pressure inlet of the vacuum relief valve **1** is connected by suitable piping to the hot water outlet **4** of a storage tank **5** and the equalising outlet **6** is connected to the discharge outlet of the valve unit **19** so that a common outlet to the atmosphere **20** is provided for the vacuum relief valve **1** and the valve

unit 19. Such a connection may conveniently be effected by mounting the vacuum relief valve 1 directly on the upper flanged cover member of the valve unit 19 so that the equalising outlet 6 of the vacuum relief valve is in direct communication with the discharge passageway of the valve unit 19. In such an arrangement, the valve closing member 11 of the vacuum relief valve 1 is formed integrally with a lock nut 21 mounted on the screw 22 controlling the setting of the diaphragm controlling spring 23 in the said valve unit 19.

Such a hot water storage and supply system normally incorporates a check valve 24 permitting one-way flow toward the right in FIG. 1 to allow excess pressure caused by thermal expansion in the hot water storage tank 5 to be relieved as previously described.

The installation of valves in accordance with the invention may be facilitated by providing communication with the atmosphere from the exhaust side of the diaphragm 25 and the vacuum relief valve unit from one side of the valve casing (FIG. 3). An orifice 26 is provided in the portion of the diaphragm 25 which is clamped between the valve body 27 and cover plate 19, and corresponding openings 28, 29 are provided to communicate with the orifice 26. This arrangement permits replacement of the diaphragm 25 without disconnecting the atmospheric communication pipe 20 from the valve body 27.

It will thus be apparent that my invention provides improved vacuum control valves which are capable of positive and sensitive operation after long periods of disuse and which, when used in hot water storage and supply systems, enable any vacuum which develops to be relieved otherwise than through the storage tank.

I claim:

1. A hot water supply and storage system comprising a hot water storage tank having an inlet and an outlet, a combined pressure reducing and excess pressure relief and vacuum relief valve in said inlet, a check valve coupled to said inlet and outlet and constructed and arranged to direct inflowing water to said storage tank, and a second vacuum relief valve connected to the outlet of said storage tank, said second vacuum relief valve comprising a valve body, a removable cover on the valve body, a flexible diaphragm clamped between the valve body and the cover and provided with an opening therein, a rigid diaphragm supporting means seating in the valve body, an opening in the diaphragm supporting means, a valve closing member projecting through the opening in the diaphragm supporting means and providing a seat against which the diaphragm closes, an opening in the valve body through which fluid pressure may be directed against the diaphragm supporting means and one side of the disphragm, an opening in the cover through which fluid pressure may be directed against the other side of the diaphragm, and means to support the valve closing member in the valve body, the diaphragm supporting means surrounding the valve closing member and being capable of moving with the diaphragm when the pressure in the cover portion falls below the pressure in the body portion whereby the movement of the diaphragm supporting means applies a bending moment to the portion of the diaphragm in contact with the valve closing member in such manner as to assist in opening the valve and reducing any tendency of the diaphragm to stick to the valve closing member.

2. A vacuum relief valve comprising a valve body, a removable cover on the valve body, a flexible diaphragm clamped between the valve body and the cover and provided with an opening therein, a rigid diaphragm supporting means seating in the valve body, means defining an opening in the diaphragm supporting means, a valve closing member projecting through the opening in the diaphragm and diaphragm supporting means and providing a seat against which the diaphragm closes, means defining an opening in the valve body through which fluid pressure may be directed against the diaphragm supporting means and one side of the diaphragm, an opening in the cover through which fluid pressure may be directed against the other side of the diaphragm, a feather valve on said other side of the diaphragm to at least partly close the opening in the diaphragm, the feather valve being guided on the part of the valve closing member which projects through the opening in the diaphragm, and means to support the valve closing member in the valve body, the diaphragm supporting means surrounding the valve closing member and being capable of moving with the diaphragm when the pressure in the cover portion falls below the pressure in the body portion whereby the movement of the diaphragm supporting means applies a bending moment to the portion of the diaphragm in contact with the valve closing member in such manner as to assist in opening the valve and reducing any tendency of the diaphragm to stick to the valve closing member.

3. A vacuum relief valve as in claim 2, in which the feather valve comprises a thin metal plate which rests on the opening in the diaphragm.

4. A vacuum relief valve as in claim 2, in which the valve closing member is provided with a narrow chamfered face against which the diaphragm closes.

5. A vacuum relief valve as in claim 2, and further comprising a weight to assist in closing of the valve under low pressure.

6. A hot water supply and storage system comprising a hot water storage tank having an inlet and an outlet, a combined pressure reducing and excess pressure relief valve in said inlet, a check valve coupled to said inlet and outlet and constructed and arranged to direct inflowing water to said storage tank, and a vacuum relief valve connected to the outlet of said storage tank, said vacuum relief valve comprising a valve body, a removable cover on the valve body, a flexible diaphragm clamped between the valve body and the cover and provided with an opening therein, a rigid diaphragm supporting means seating in the valve body, an opening in the diaphragm supporting means, a valve closing member projecting through the opening in the diaphragm supporting means and providing a seat against which the diaphragm closes, means defining an opening in the valve body through which fluid pressure may be directed against the diaphragm supporting means and one side of the diaphragm, means defining an opening in the cover through which fluid pressure may be directed against the other side of the diaphragm, and means to support the valve closing member in the valve body, the diaphragm supporting means surrounding the valve closing member and being capable of moving with the diaphragm when the pressure in the cover portion falls below the pressure in the body portion whereby the movement of the diaphragm supporting means applies a bending moment to the portion of the diaphragm in contact with the valve closing member in such manner as to assist in opening the valve and reducing any tendency of the diaphragm to stick to the valve closing member.

References Cited in the file of this patent

UNITED STATES PATENTS

208,379	Downey	Sept. 24, 1878
213,118	Locke	Mar. 11, 1879
1,283,581	Smith	Nov. 5, 1918
2,117,907	Ogden	May 17, 1938
2,117,389	Yoder	May 17, 1938
2,157,554	McFarlin	May 9, 1939
2,546,678	Rockwell	Mar. 27, 1951
2,600,187	Bart	June 10, 1952
2,842,155	Peters	July 8, 1958
2,891,565	Mackey	June 23, 1959
2,921,597	Parr	Jan. 16, 1960
2,989,977	Matter	June 27, 1961