Oct. 6, 1953 W. M. GROSVENOR, JR 2,654,385

AUTOMATIC HYGROSCOPIC TYPE AIR VENT

Filed March 10, 1949

Fig. 2

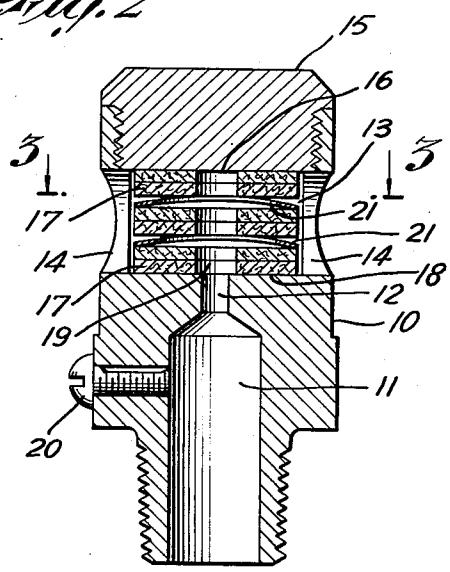


Fig. 1

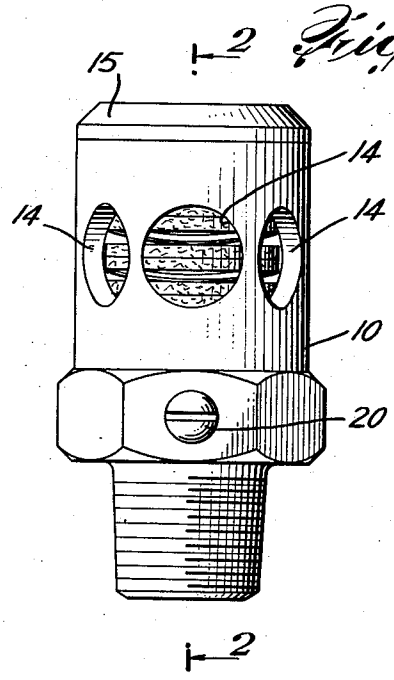


Fig. 3

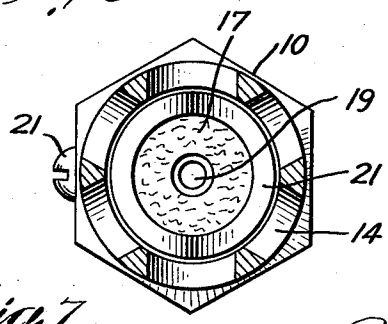


Fig. 6

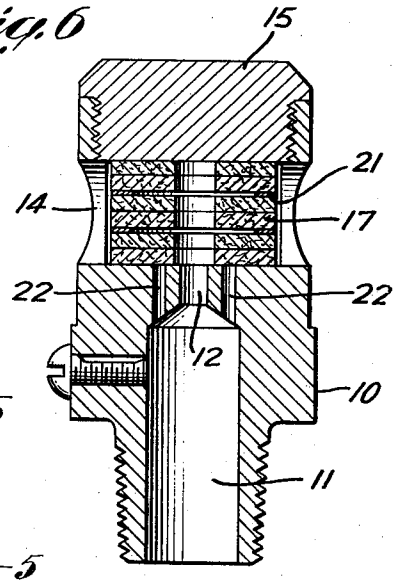


Fig. 7

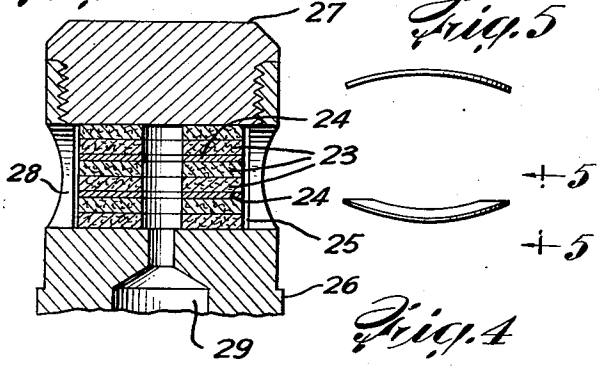


Fig. 5

Fig. 4

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AUTOMATIC HYGROSCOPIC TYPE AIR VENT

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6 Claims. (Cl. 137—197)

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This invention relates to an automatically operating steam vent valve permitting the passage of air therethrough and closing off the passage of steam when steam reaches the valve, the steam condensing so as to cause the valve to shut off, such a valve being especially adaptable for use in a steam heating system, or other system requiring venting of air or gas.

In steam heating system radiators, it is well known that it is necessary to vent the air or gases in a radiator so that the steam as it enters the radiator can completely fill the same and then provide maximum heat transmission from the walls of the radiator. As the steam condenses in a radiator and when the supply is cut off, a vacuum will be formed therein. Previously, various types of valves have been employed for the purpose of venting the air from such an arrangement yet shutting off when steam reaches the same, but these have not been satisfactory for various reasons.

One type of such a valve is the well known thermostatic arrangement, the thermostat closing off the outlet of the valve when steam reaches the same. Such a valve is rather complicated in design and may be subject to erratic operation. The thermostat normally will not operate rapidly so that considerable steam may escape into the room.

One of the most important defects in a thermostatically controlled valve and in other types of previously known valves is their failure to close off and prevent the passage of steam into the room where its condensation may damage surrounding articles.

Another defect in previous valves is the noise involved as the valve vents, then closes and reopens.

One of the principal objects of the invention is to provide an automatic steam vent valve which will vent air or substantially dry gas from the radiator or other system but which will prevent the passage of steam or liquid therefrom.

In one aspect of the invention, a fibrous means capable of passing air when dry or substantially dry, is interposed between the inlet and outlet passageways in the body of a steam vent valve. The fibrous means has associated therewith, or in contact therewith, a means to accelerate opening or venting of the passageway between the inlet and outlet of the valve after the valve has closed off and air is present to be vented. The fibrous body is normally pervious to air but substantially impervious to water upon becoming wet; the steam condensing in or on the fibrous member so as to wet the same. A fibrous member by itself, however, will not normally

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function properly because of the difficulty in its reopening to a venting condition after it has once become wet. This difficulty is accentuated by the vacuum created inside of a radiator as the steam condenses therein.

In one form of the invention, a spring washer arrangement can be employed to assist in providing a passageway from the inlet passage of the valve to the outlet or to accelerate return of the fibrous member to a venting condition.

In another aspect of the invention, a solid metal washer or other arrangement in contact with or directly adjacent the fibrous member can be used, said metal washer or ring accummulating heat obtained or conducted from the radiator when the fibrous member is subjected to steam, and giving up such accumulated heat when the fibrous member is no longer subjected to steam so as to assist in the drying out and therefore the opening up of the fibrous body to permit the passage of air therethrough. Thus, the metal washer, heat storing, or heat conducting material will accelerate the return of the fibrous material to a venting condition.

The fibrous body preferably should be made of fibers capable, upon wetting with water or the like, of swelling a major amount when in an unconfined condition. Such a swelling should be reasonably rapid so that when the fibrous body is confronted with steam or condensed steam, it will swell sufficiently rapidly to close the passage between the inlet and outlet ports of the valve body in which it is located.

In a further and preferred aspect of the invention, a fiber can be employed, such as one of cellulose fiber, normally used in the manufacture of paper or paper board and which has not been subsequently treated so as to reduce the swelling characteristics such as by vulcanizing. Such a fiber will be termed herein as "untreated" cellulose fiber. Such a fiber normally is made from wood pulp.

As one example of such a fiber having unreduced swelling characteristics is a kraft process fiber. The body and fibers preferably can be chosen to have at least a predetermined real volume in relation to the active or actual space occupied by the fibrous body and to have a predetermined swell rate when unconfined. The term "active space" means the actual space occupied by the fibrous body or plurality of members after once wet by the steam or condensed steam. "Swell rate" can be defined as the percentage increase in thickness of the normally dry fibrous body per specified unit of time as it becomes wet. The choice of fibrous body preferably should be made so that when swelling of

the fibers composing the fibrous body occurs under unrestrained conditions, the swelling will more than cause the body to fill the active space occupied thereby.

The fibrous body when relatively dry can have intercommunicating pores therethrough which will be squeezed shut when the fibrous body becomes exposed to the steam or condensed steam and the body is confined between walls of a cavity restraining structure or arrangement. As previously mentioned, the valve body may have an inlet passage and an outlet passage with the fibrous body arranged to be interposed across said passage.

When the fibrous body becomes wet and is restrained, the body will absorb only enough condensed steam to create a pressure sufficient to prevent a further passage of steam, thus, within certain limits, the valve will function independent of pressure in the radiator or heating system in which it is used. Evaporation of liquid or condensed steam from the outer surface of the fibrous body will be replaced by condensed steam from the inlet passage of the valve. In a preferred form, the fibers of the fibrous body are substantially randomly oriented in substantially parallel layers. Preferably, the fibers are transverse of the passage between the inlet and outlet of the valve body as distinguished from a longitudinal arrangement.

The fibrous body may consist of one unit or may consist of a plurality of layers or individual bodies or wafers. The spring or washer elements may be placed as desired in the stack between various bodies or exteriorly thereof.

In a further aspect of the invention, a wood fiber which has had some subsequent chemical and/or physical treatment can be employed if it has a sufficiently rapid swell rate.

One of the main advantages of the invention is that the valve will permit air to be vented from the system but will not allow steam to escape therefrom. The valve combination can be manufactured and assembled economically with ease, particularly because of the lack of critical adjustments necessary in the structure and assembly.

These and other objects, advantages, and features of the invention will become apparent from the following description and drawings which are merely exemplary.

Figure 1 is an elevation view of one form of the invention with the valve in venting condition.

Figure 2 is a sectional view taken along the line 2—2 of Figure 1, Figure 2 being at right angles to the view shown in Figure 1.

Figure 3 is a sectional view taken along the line 3—3 of Figure 2.

Figure 4 is a side view of one of the springs looking in the direction of Figure 1.

Figure 5 is a side view looking in the direction 5—5 of Figure 4.

Figure 6 is a sectional view of a valve arrangement similar to Figures 1 and 2 with the fibrous members expanded and in closed position, together with a modified form of inlet passage to the fibrous body.

Figure 7 is a modified form of the invention showing solid rings instead of springs used between the fibrous members for vent accelerating purposes.

Valve body 10 (Figs. 1, 2) can be made of metal or any other suitable material, said body having an inlet passage 11 with a restricted aperture 12 leading to the fibrous body cavity 13. Fibrous body cavity 13 may have suitable apertures or outlet passages 14 for permitting the escape of air therefrom, said passages being of sufficient size to assist in the drying action of the fibrous body when reopening is required. Cap 15 is screw-threadedly engaged with valve body 10 to form the top of cavity 13. Bottom wall 16 thereof serves as one wall of the restraining walls of fibrous body cavity 13. A manually operable quick vent valve 20 may be provided for the purpose of quick venting of the valve manually if desired.

The fibrous body of the form shown in Figures 1 and 2 comprises a plurality of fibrous elements or wafers 17 located between wall 16 of cap 15 and wall 18 of the valve body, the fibrous elements having central apertures 19 therethrough. The fibrous bodies or elements will be described in detail hereafter.

The fibrous body or elements in cavity 13 preferably are made from a kraft process fiber although other similar fibers can be employed. As an example of one type of satisfactory fibrous body, the fiber thereof in its manufacture can be medium well-cooked and beaten and the fiber board made on a conventional wet machine. Preferably, the fibers are arranged in parallel layers with the fibers in each layer randomly oriented therein.

As an example of the characteristics of a satisfactory fibrous body, one can be used having an apparent density of from 0.80 to 1.40 with an initial swell rate for the first minute of more than 5% when exposed to water with the body unrestrained. In one suitable fiber, the initial swell rate is 20% for the first minute and will swell 70% in 5 minutes, such fiber being a kraft process fiber manufactured as described above. The swell rate is not necessarily a straight line relationship but must be rapid or quick during the first minute. The particular swell rate of the fibrous body also is related to the real volume of the fibers. Another example is a wood fiber having some chemical treatment, such a fibrous body having a swell rate of 5% in the first minute and 21% in 5 minutes.

The real volume of the fibers of the fibrous body preferably should be a certain predetermined volume of the active space of the fibrous body. If the real volume of the fibers is at least 50% of the volume of the active space thereof, it has been found that the fibrous body or elements will satisfactorily close off and prevent the flow of steam from the valve.

In the form shown in Figures 1 and 2, a dished spring metal washer arrangement 21, 21 is employed between the middle pair of fibrous discs and the two outer pairs. The springs can take the form shown in Figures 4 and 5, it being noted that Figure 5 is at right angles to Figure 4. It is, of course, evident that other types of similar dished springs or springs having other shapes may be used for the purpose. With such an arrangement, the springs introduced into the stack of fiber discs help to compress the discs on the drying part of the cycle of operation of the radiator vent valve so that breaking of the vacuum or venting occurs with sufficient rapidity to produce satisfactory operation and quick opening of the valve. The springs may be placed in various locations and may be on top of the pile or the bottom thereof as desired. In the case of a single fibrous body, the spring washers can be arranged

on either side thereof or there may be washers on both sides.

When steam condenses and reaches the fibrous elements 17 (Fig. 6), the elements will expand and flatten out the springs 21 and thus close off passage between inlet 11 and outlet 14 of the valve. The pressure exerted by the fibrous body within the restraining cavity will serve to close off the interstices between the fibers and thus prevent passage of steam therethrough. In the form of the invention shown in Figure 6, there are auxiliary ports 22 on either side of the central aperture 12, said ports 22 leading to the fibrous bodies 17.

In a further modified form of the invention, fibrous elements 23 (Fig. 7) may have metal washer elements 24 with apertures therein placed in the stack of fibrous elements, said fibrous elements being held in cavity 25 of valve body 26 by screw-threadedly engaged cap 27. The fibrous elements are located between outlet passages 28 and inlet passage 29. The metal discs or washers 24 are selected so that they will be of sufficient size to retain enough heat following venting to assist in drying of the fibrous elements and thus accelerate venting thereof in a manner similar to the vent accelerating action of the springs in the previously described form.

The metal springs of Figures 1 to 3, inclusive, also may have some benefit derived through the retention of heat thereby to assist in accelerating the opening of the fibrous elements involved. It is, of course, apparent that the valve body may be so designed that the valve body itself will serve as a heat retaining member and thus assist in the vent accelerating action on the fibrous elements of the steam vent valve.

The steam vent valve of the present invention can be used in various places where it is desired to vent air or gas from a space and yet prevent the passage of steam therefrom and at the same time promptly break a vacuum occurring in the system after the steam condenses in the system or is cut off. Various modifications can be made in the details of the construction described without departing from the spirit of the invention except as defined in the appended claims.

I claim:

1. In an automatic steam vent valve, the combination comprising a valve body having a cavity with inlet and outlet passages therein, a fibrous means located in said cavity between said inlet and outlet passages directly controlling flow through said cavity, said fibrous means passing air to said outlet and being impervious to the passage of steam thereto, and metallic vent accelerating spring washer means in contact with said fibrous means for assisting in the initial opening up of the passage between said inlet and outlet passages after said fibrous means has closed off said passage due to the presence of steam and the fibrous means is no longer subjected to steam.

2. In an automatic steam vent valve, the combination comprising a valve body having a cavity with inlet and outlet passages therein, a plurality of fibrous wafers located in said cavity between said inlet and outlet passages, said fibrous wafers passing air to said outlet and being impervious to the passage of steam, and spring washer vent accelerating means inserted between said fibrous wafers for assisting in the opening up of the passage between said inlet and outlet passages after said fibrous wafers have closed off said passage due to the presence of steam and the fibrous means is no longer subjected to steam.

3. In an automatic steam vent valve, the combination comprising a valve body having a cavity with inlet and outlet passages therein, a plurality of fibrous wafers located in said cavity between said inlet and outlet passages, said fibrous wafers passing air to said outlet and being impervious to the passage of steam and heat retaining metal washers in contact with and between said fibrous wafers for assisting in drying out said fibrous wafers to open up the passage between said inlet and outlet passages after said fibrous wafers have closed up said passage due to the presence of steam.

4. In an automatic steam vent valve, the combination comprising a valve body having a cavity with inlet and outlet passages therein, a fibrous means located in said cavity between said inlet and outlet passages directly controlling the flow through said cavity, the real volume of the fibers of said fibrous body being at least 50% of the active volume of the fibrous body with a swell rate of at least 5% in the first minute, the fibers being randomly oriented in substantially parallel layers, and metallic spring washer vent accelerating means connected with said fibrous means for assisting in the initial opening up of the passage between said inlet and outlet passages after said fibrous means has closed off the passage due to the presence of steam.

5. In an automatic steam vent valve, the combination comprising a valve body having a cavity with inlet and outlet passages therein, a plurality of fibrous wafers located in said cavity between said inlet and outlet passages, the real volume of the fibers of said fibrous body being at least 50% of the active volume of the fibrous body with a swell rate of at least 5% in the first minute, the fibers being randomly oriented in substantially parallel layers, and dished spring vent accelerating means between said fibrous washers for assisting in the opening up of the passage between said inlet and outlet passages after said fibrous means has closed off the passage due to the presence of steam.

6. In an automatic steam vent valve, the combination comprising a valve body having an annular chamber with outlet passages in the walls thereof, an inlet passage connected to said chamber, a closing cap for said chamber, a plurality of fibrous wafers between said cap and the inlet passage wall of said chamber, said wafers being across the passage between said inlet and outlet passages, the real volume of the fibers of said wafers being at least 50% of the active volume thereof and having a swell rate of at least 5% the first minute, the fibers being randomly oriented in substantially parallel layers, and vent accelerating dish like spring washer means between said wafers for assisting in opening up the passage between the inlet and outlet.

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