

March 21, 1939.

J. L. CORCORAN

2,151,501

VALVE

Filed Nov. 10, 1937

3 Sheets-Sheet 1

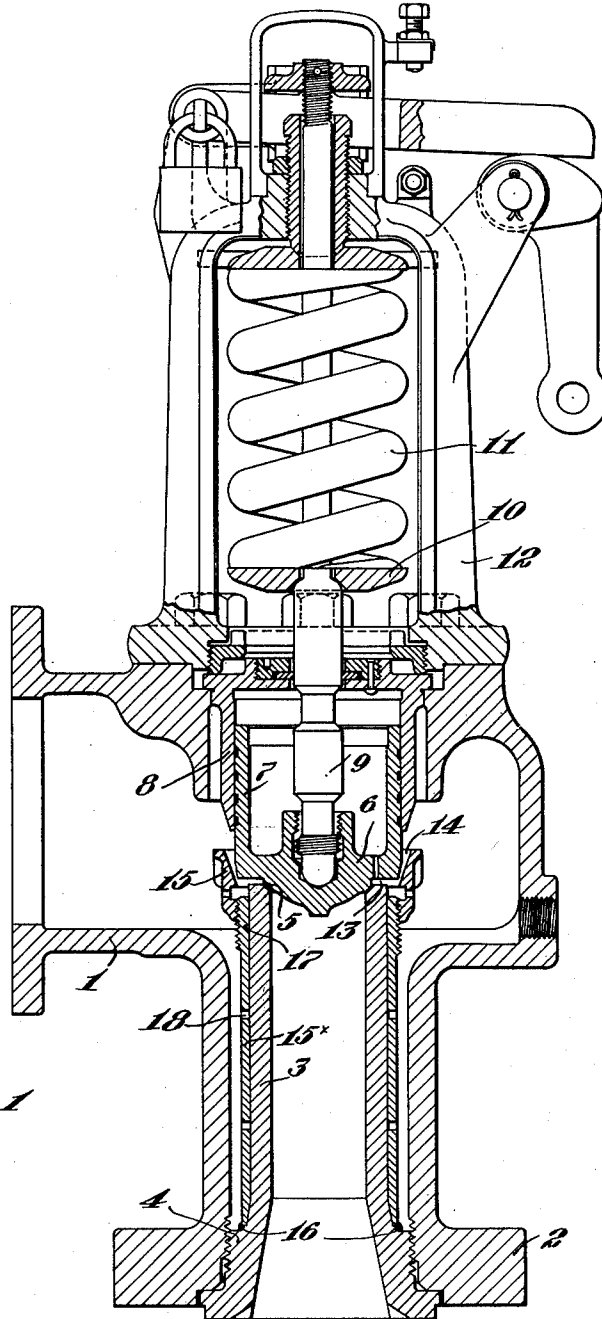


Fig. 1

Inventor
James L. Corcoran
by Roberts Cushman & Woodberry
Att'ys.

March 21, 1939.

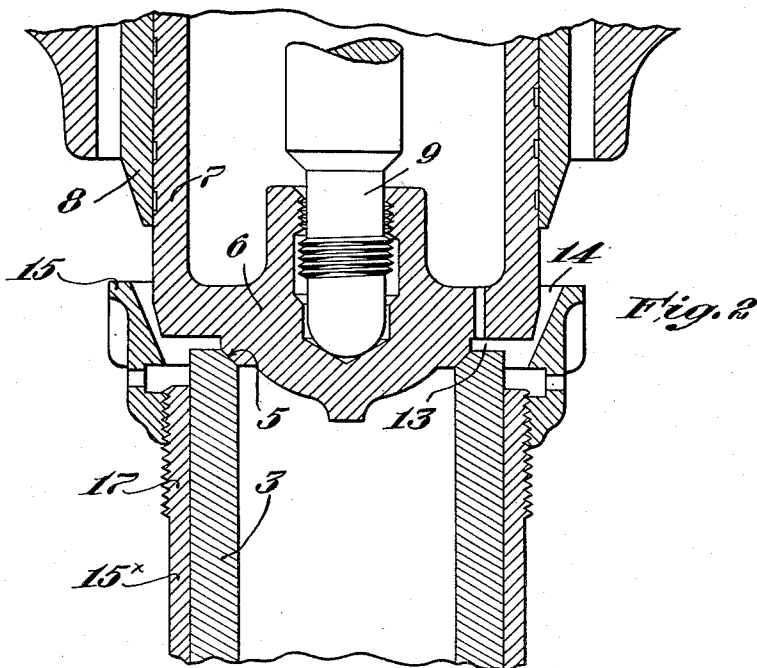
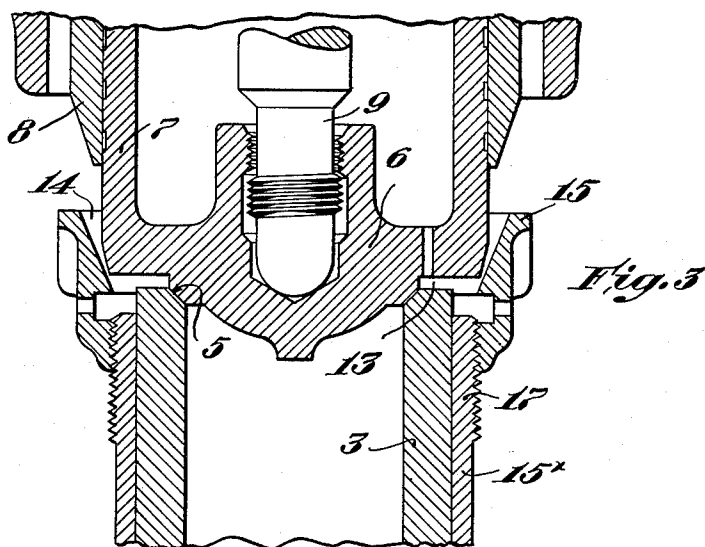
J. L. CORCORAN

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VALVE

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3 Sheets-Sheet 2



Inventor
James L. Corcoran
by Robert Ashman & Woodbury
Attys.

March 21, 1939.

J. L. CORCORAN

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3 Sheets-Sheet 3

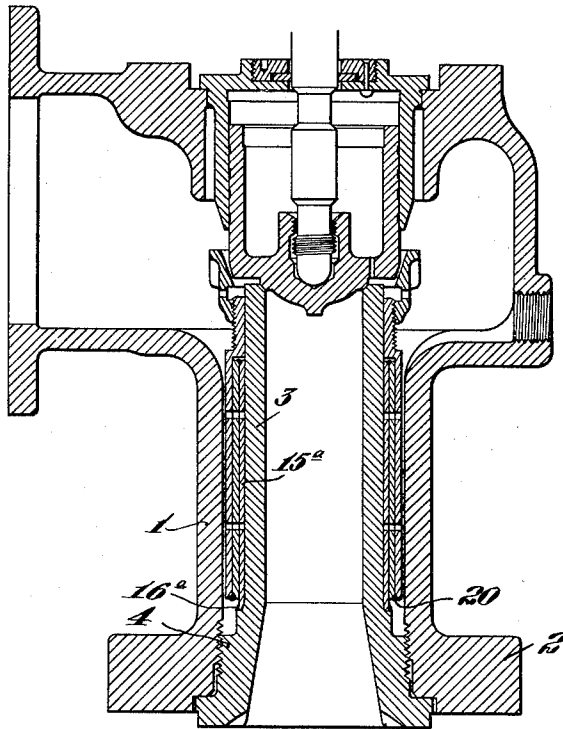


Fig. 4

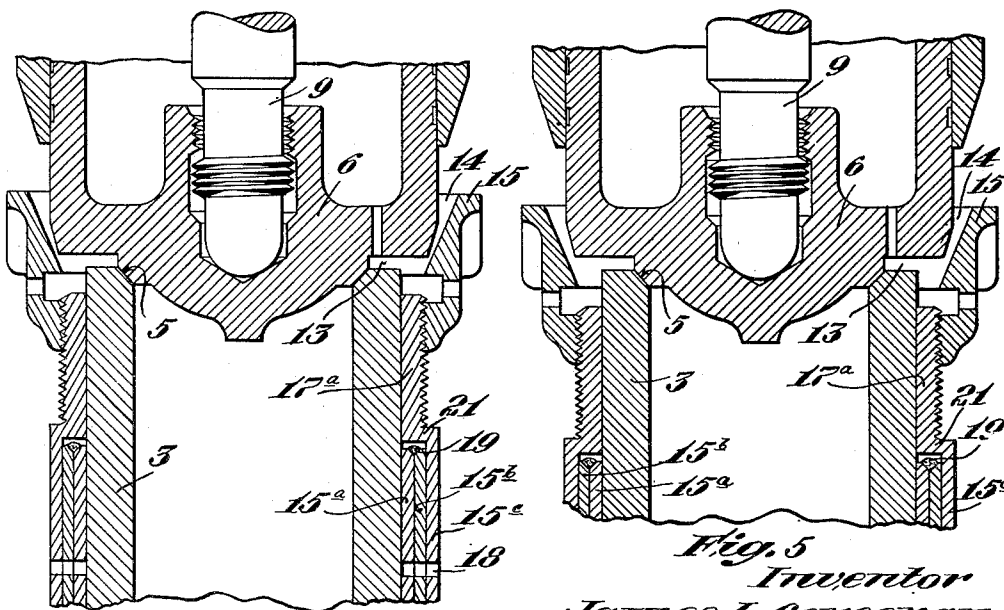


Fig. 6

Fig. 5

Inventor
James L. Corcoran
by Robert C. Ashman & Woodberry
Att'ys.

UNITED STATES PATENT OFFICE

2,151,501

VALVE

James L. Corcoran, Bridgeport, Conn., assignor
to Manning, Maxwell & Moore, Incorporated,
New York, N. Y., a corporation of New Jersey

Application November 10, 1937, Serial No. 173,791

10 Claims. (Cl. 137—53)

This invention pertains to safety valves such as are used upon steam generating apparatus to relieve excess pressure, and relates more particularly to spring-loaded valves of the kind in which the blow-down is determined by the use of a blow-down ring and huddling chamber, for example such as is illustrated in the patent to Hopkins No. 1,925,323, dated September 5, 1933.

The specifications for safety valves which are insisted upon by some users demand that the valve be set or adjusted while the boiler is under static conditions, that is to say, when there is no load on the boiler, and that when, thereafter, the boiler pressure is brought up to working conditions, the valve shall operate with a definite percent blow-down, that is to say, it will pop and reseat at the upper and lower limits, respectively, of a predetermined range of boiler pressures. Valves making use of the huddling chamber principle, and having an adjustable blow-down ring may be designed so as to meet the above-noted requirement so long as they are subjected only to the action of saturated steam, as when they are used as boiler safety valves,—the patent to Hopkins, above referred to, being illustrative of a valve capable of meeting such requirements.

When valves of the general type just described (although made of materials capable of withstanding superheater conditions) are applied to a superheater of the integral type (that is to say a superheater which is heated by the boiler gases) no particular difficulty is encountered in obtaining a proper setting, since, even under static boiler conditions, the integral superheater receives a substantial amount of heat from the boiler gases and thus the temperature at the superheater valve does not differ substantially during setting from that which it has when the boiler has been brought up to working conditions.

However, when the valve is applied to a superheater of the independent fired type, a very different problem is presented. Static conditions in such an apparatus mean that when the boiler is brought up to no load conditions, the superheater is not fired at all, or at least not sufficiently to increase, to any great degree, the heat of the steam which passes through it from the boiler. Thus while the superheater valve is being set, it is little or no hotter than the saturated steam delivered by the boiler. On the other hand, when the boiler is brought up to working load and the superheater is fired to operating temperature, the superheater valve is subjected to conditions greatly different from those under which it was set, in particular to a tem-

perature rise which causes a substantial expansion of the valve parts. Thus if the valve be of a design such that it is wholly satisfactory for use with saturated or slightly superheated steam, the same valve, when used on a separately fired superheater, may have its blow-down so modified as to cause the valve to chatter, that is to say, to open and then close so quickly that the steam pressure does not drop appreciably below the popping point at any time, a type of operation which is highly objectionable. Such chatter could be stopped (assuming the valve to be of proper design) by a slight adjustment of the blow-down ring under working conditions, but since the regulations require the setting to be made under standard conditions, such adjustment is not permissible, even though it be possible to make it, when the valve has been heated up to superheater temperature.

The principal object of the present invention is to provide a safety valve of the type referred to, suitable for use, for example, upon a separately fired superheater, and which is self-compensating for any changes in conditions such as may take place between the setting while the boiler is under no load and the conditions which prevail when the generating apparatus is at full load.

A further object of the invention is to provide a safety valve wherein the position of the blow-down ring is varied automatically in a predetermined ratio to changes in temperature to which the valve may be subjected, thereby to prevent chatter of the valve when after setting at a relatively low temperature it is exposed to a substantially higher temperature.

A further object of the invention is to provide automatic means for changing the position of the blow-down ring or its equivalent in response to temperature changes and which will be sensitively responsive through a wide temperature range, but which may be incorporated in a valve casing of substantially normal dimensions.

Further objects and advantages of the invention will be made manifest in the following more detailed description and by reference to the accompanying drawings, wherein

Fig. 1 is a side elevation, partly in vertical section, of a safety valve embodying the present invention;

Fig. 2 is a fragmentary vertical section to larger scale showing the valve seat and valve feather of Fig. 1, and showing the blow-down ring in the position which it occupies relatively to the valve seat during the setting of the valve under static conditions;

Fig. 3 is a view similar to Fig. 2, but illustrative

of the change in the position of the blow-down ring relatively to the valve seat when the valve is subjected to high temperature;

Fig. 4 is a fragmentary view, generally similar to Fig. 1, but illustrating a modified form of thermal motor for automatically changing the position of the blow-down ring;

Fig. 5 is a fragmentary section, to larger scale, showing the valve seat and valve feather and illustrating the relative position of the blow-down ring at the time the valve is set under static conditions; and

Fig. 6 is a view similar to Fig. 5 but showing the relative position of the parts when the valve has been subjected to high temperature.

Referring to Figs. 1, 2 and 3, the numeral 1 designates the valve casing, which may be of any suitable material, for example a casting or forging, having the attaching flange 2 at its lower end. At this point it may be noted that whereas, for convenience in description, reference is herein made at times to the "upper" or "lower" part of the valve casing, such and similar expressions are merely for convenience in description and are not intended in any way to limit the position in which the valve may be mounted during use.

Within the lower part of the casing there is arranged the tubular bushing 3 which is secured to the casing at the point 4, and which is provided at its upper end with a surface 5 constituting the valve seat. The valve feather 6 which cooperates with the valve seat to regulate the flow of fluid upwardly through the bushing 3, is as here shown provided with a cylindrical skirt portion 7 which slides in an annular guide member 8 secured to the upper part of the valve casing. The valve is normally held seated by means of the stem 9 which is provided with a collar 10 against which bears the loading spring 11 which is housed in the bonnet 12.

The outer portion of the feather 6 overhangs the seat 5 and this overhanging portion is normally spaced from the upper end of the bushing 3 so as to leave an annular space or "huddling chamber" 13 into which the steam first passes when the valve feather lifts from its seat. The discharge passage 14 from the chamber 13 is defined by the blow-down ring 15, the parts as above described all being in general of a well-known type, and if desired, may embody the specific details more fully disclosed in the above-named patent to Hopkins.

In accordance with the present invention the exterior of the bushing 3 throughout its upper portion at least is smoothly cylindrical the external diameter of the bushing being such as to leave an annular space between it and the inner wall of the lower part of the casing. A sleeve member 15^x telescopes over the cylindrical part of the bushing 3, preferably fitting with a free sliding fit over the bushing and preferably being permanently secured as, for example, by welding at the point 16 to the lower part of the bushing. At its upper part the sleeve 15^x is provided with the thickened, externally screw-threaded annular portion 17 which constitutes a support for the blow-down ring 15, the latter being internally screw threaded for engagement with the part 17. The screw-threaded connection between the blow-down ring and the support 17 permits manual adjustment of the blow-down ring axially, relative to the valve seat, thereby to make the initial adjustment of the valve under static boiler conditions.

The sleeve 15^x is of some material having a

high coefficient of expansion, as compared with the material of the bushing 3, so that when the valve parts are subjected to temperature variations, the length of the sleeve 15^x tends to change more rapidly than the length of the bushing 3. This sleeve 15^x may thus be considered as a thermal motor operating, in response to temperature changes, automatically to move the support 17 up and down relative to the valve seat, and thus to move the blow-down ring 15 correspondingly. Preferably the sleeve 15^x is furnished with openings as indicated at 18 so that when the valve opens, escape pressure fluid which enters between the sleeve and the bushing may freely pass out and thus establish flow of fluid between the parts 3 and 15^x. This assures that the sleeve 15^x will have a temperature closely approximating that of the fluid which escapes over the valve seat.

The material of the sleeve 15^x is so chosen and the parts are so dimensioned that if the blow-down ring be properly set for static boiler conditions, that is to say when the valve is subjected only to saturated steam, the sleeve 15^x will expand more rapidly than the bushing 3 when the parts are later subjected to a high temperature, as for example when the valve is mounted on an independently fired superheater and the generating apparatus is brought up to working conditions, whereby such expansion of the sleeve 15^x will raise the blow-down ring 15 thereby decreasing the effective area of the discharge passage 14. With such a restricted discharge passage the valve will function properly even when the valve (being mounted on an independently fired superheater) blows in response to the pressure of superheated steam.

While the arrangement shown in Figs. 1, 2 and 3 is desirable and satisfactory under most conditions, the employment of a single sleeve 15^x as the thermal motor, is not practically possible under some conditions, for example where the movement of the blow-down ring must be substantial and when the permissive height of the valve casing is limited. To meet such a situation the arrangement shown in Figs. 4, 5 and 6 may be employed. In these figures similar numerals refer to parts corresponding to those of Figs. 1, 2 and 3, but in this instance the single sleeve 15^x is replaced by a plurality of coaxial sleeve members 15^a, 15^b and 15^c. The member 15^a is preferably of a material having a high coefficient of expansion and this sleeve telescopes with a sliding fit over the bushing 3 and is permanently secured, as by welding, to the bushing as indicated at 16^a (Fig. 4). The second sleeve 15^b is of a material of a relatively low coefficient of expansion, as compared with the sleeve 15^a, and is permanently secured to the upper or free end of the latter at the point 19 (Fig. 5) by welding or the like. The third sleeve 15^c is of a material having a high coefficient of expansion and telescopes over the sleeve 15^b and is permanently secured to the lower end of the latter as by welding at the point 20 (Fig. 4). Preferably this outer sleeve 15^c is furnished with an inwardly directed shoulder at 21 to which the blow-down ring support 17^a is permanently and, if desired, integrally joined. The support 17^a and the outer sleeve 15^c thus form a housing enclosing the sleeves 15^b and 15^a. The ring 15 has screw-threaded engagement with the support 17^a to permit of manual adjustment, but in response to temperature changes the thermal motor comprising the sleeves 15^a, 15^b and 15^c produces a movement of the support 17^a together with the ring 15 axially of the valve seat

and relatively to the latter, so that at high temperatures the ring 15 is caused to rise as indicated in Fig. 6, and thus to reduce the effective area of the discharge passage 14. This reduction in the effective area of the discharge passage results in a proper operation of the valve when delivering super-heated steam even though the valve is originally set at the temperature of saturated steam.

While certain desirable forms of thermal motor have been suggested herein for moving the blow-down ring in accordance with temperature variations, it is to be understood that the invention is not limited in its broader sense to the particular form of motor, but is regarded as broadly inclusive of any type of motor which operates in response to the changed conditions to which the valve is successively subjected at setting and in actual operation. It is further to be understood that the invention is not necessarily limited to the other precise details herein disclosed nor in fact to embodiment in the specific type of valve illustrated, but is to be regarded as broadly inclusive of all equivalents and of employment under all equivalent factors.

I claim:

1. A pop safety valve of the kind having a casing, a valve seat therein, a valve feather cooperating with the seat, the feather being so designed as to provide a huddling chamber below it, and a blow-down ring cooperating with the valve feather to define a discharge passage whose area varies as the valve lifts from its seat, characterized in having adjusting means operative automatically to vary the position of the blow-down ring relatively to the valve seat in response to temperature change to which the valve may be subjected.

2. A pop safety valve of the kind having a casing, a valve seat therein, a valve feather cooperating with the seat, the feather being so designed as to provide a huddling chamber below it, and a blow-down ring cooperating with the valve feather to define a discharge passage whose area varies as the valve lifts from its seat, characterized in having a support for the blow-down ring which is relatively movable with respect to the valve seat, and a thermal motor, responsive to temperature variations, operative to move said support with the ring axially of the valve seat.

3. A pop safety valve of the kind having a casing, a valve seat therein, a spring-loaded valve feather cooperating with the seat, the feather being so designed as to provide a huddling chamber below it, and a blow-down ring cooperating with the valve feather to define a discharge passage from the huddling chamber, characterized in having a support for the blow-down ring which is relatively movable with respect to the valve seat, said support being constructed and arranged to move automatically in response to temperature changes thereby progressively to decrease the capacity of the discharge passage as the temperature of the valve rises, and temperature responsive means for so moving said support.

4. A pop safety valve of the kind having a casing, a valve seat therein, a spring-loaded valve feather cooperating with the seat, the feather being so designed as to provide a huddling chamber below it, and a blow-down ring cooperating with the valve feather to define a discharge passage from the huddling chamber, characterized in having a blow-down ring support coaxial with the valve seat, the ring having screw-threaded connection with the support whereby it

may be moved manually in setting the valve, and temperature-responsive means operative automatically to vary the position of the support and ring relatively to the valve seat in response to temperature variations.

5. A pop safety valve of the kind having a casing, a valve seat and a seat support therein, a valve feather cooperating with the seat, the parts being so designed as to provide a huddling chamber below the feather, and a blow-down ring cooperating with the valve feather to define a discharge passage leading from the huddling chamber, characterized in having a blow-down ring support coaxial with the valve seat, and a sleeve, of a material having a high thermal coefficient of expansion, coaxial with the valve seat, the valve seat support having a relatively lower thermal coefficient of expansion, the blow-down ring support being mounted on said sleeve whereby variation in the temperature to which the valve is subjected causes the sleeve to expand or contract and thereby move the support and ring axially relatively to the valve seat.

6. A pop safety valve of the kind having a casing, a valve seat therein, a valve feather cooperating with the seat, the feather being so designed as to provide a huddling chamber below it, and a blow-down ring cooperating with the valve feather to define a discharge passage whose area varies as the valve lifts from its seat, the valve seat being at one end of an elongate tubular bushing fixed in the valve casing, characterized in having a sleeve of a material having a higher thermal coefficient of expansion than the bushing surrounding the bushing, one end of the sleeve being fixed and the other end being free to move axially relatively to the plane of the valve seat, the latter end of the sleeve constituting a support for the blow-down ring whereby expansion of the sleeve automatically moves the ring axially with respect to the valve seat.

7. A pop safety valve of the kind having a casing, a valve seat therein, a spring-loaded valve feather cooperating with the seat, the feather being so designed as to provide a huddling chamber below it, and a blow-down ring cooperating with the valve feather to define a discharge passage leading from the huddling chamber, the valve seat being at one end of a tubular bushing fixed adjacent to its other end to the casing, characterized in that a ring-supporting sleeve of a material having a higher thermal coefficient of expansion than said bushing telescopes over the bushing, one end of the sleeve being fixed to the bushing and its opposite end being disposed adjacent to the valve seat and being movable relatively to the latter, said movable end of the sleeve constituting a support for the ring, and means adjustably securing the ring to the support thereby to permit manual setting of the ring.

8. A pop safety valve of the kind having a casing, a valve seat therein, a valve feather cooperating with the seat, the feather being so designed as to provide a huddling chamber below it, and a blow-down ring cooperating with the valve feather to define a discharge passage from the huddling chamber, characterized in having a support for the blow-down ring which is relatively movable with respect to the valve seat, and a thermal motor comprising a bimetallic couple operative, in response to temperature change, to move the support and ring relatively to the valve seat.

9. A pop safety valve of the kind having a casing, a valve seat therein, a valve feather co-

operating with the seat, the feather being so designed as to provide a huddling chamber below it, and a blow-down ring cooperating with the valve feather to define a discharge passage whose area varies as the valve lifts from its seat, the valve seat being adjacent to one end of a tubular bushing fixed in the casing, characterized in having an annular ring support coaxial with the valve seat, and a thermal motor for moving the ring support axially of the seat, said motor comprising a plurality of concentric sleeves, certain at least of said sleeves being of a material having a coefficient of expansion substantially different from that of the bushing, said sleeves being coaxial with the bushing, one sleeve being secured to the bushing, and another of said sleeves being secured to the ring support.

10. A pop safety valve of the kind having a casing, a valve seat therein, a valve feather cooperating with the seat, the feather being so designed as to provide a huddling chamber below

it, and a blow-down ring cooperating with the valve feather to define a discharge passage whose area varies as the valve lifts from its seat, the valve seat being adjacent to one end of a tubular bushing, the other end of which is fixed to the casing, a ring support coaxial with the valve seat, and a thermal motor for moving the ring support axially relatively to the seat, said motor comprising a sleeve of material having a high thermal coefficient of expansion telescoping over the bushing and with that end of the sleeve which is remote from the seat fixed to the bushing, a second sleeve of a material having a lower coefficient of expansion telescoping over the first sleeve and with one end secured to the free end of the first sleeve, and a third sleeve of a material having a high coefficient of expansion telescoped over the second sleeve with one end fixed to the free end of the latter sleeve and with its other end secured to the ring support.

JAMES L. CORCORAN.