

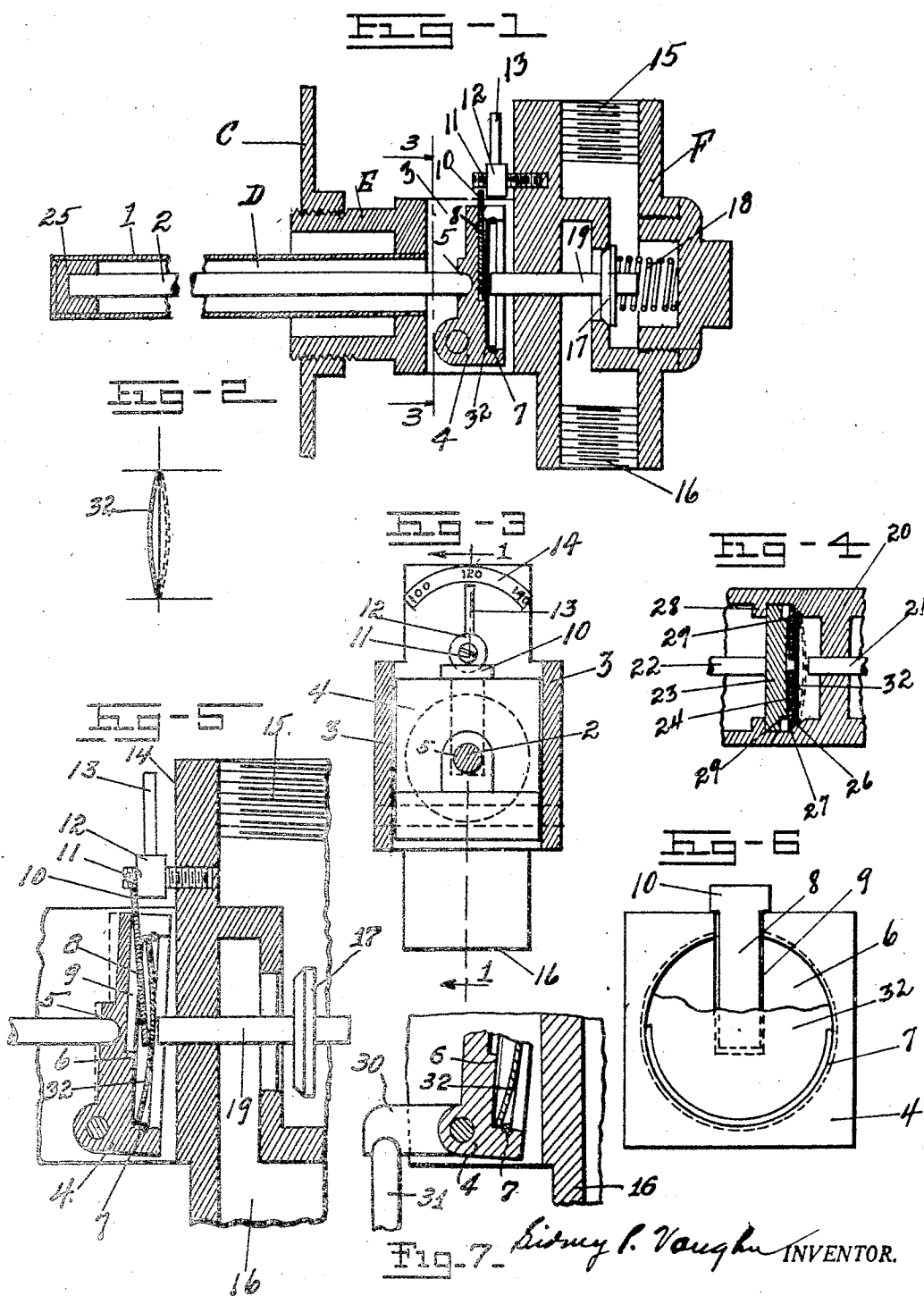
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THERMOSTATIC SNAP VALVE

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THERMOSTATIC SNAP VALVE

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This invention relates to snap acting thermostatic control devices adapted to operate valves, electric switches, etc., and particularly to snap acting valves especially adaptable to the requirements of hot water heaters, ovens, and other devices heated by gas, wherein it is desired to control the temperature by regulating the amount of gas burned.

The principal object is to provide in a gas valve adapted to regulate the amount of gas burned, a simple, inexpensive, effective and reliable thermostatically operated snap acting device to operate the valve controlling the flow of the gas burned. In many snap acting valves a convexo-concave diaphragm disk made of spring metal is caused to snap into a reverse or concavo-convex form by pressure exerted on the normally convex side of the disk which in turn operates the valve. In all such mechanisms with which I am familiar this pressure is exerted by a lever of some form, and it is necessary that the end of the lever pressing against the center of the disk to move from a full convexo-concave position to a full concavo-convex position, or in other words it must follow through the center of the disk. Such a movement does not lend itself to a control of temperatures within a small range without the use of a high lever amplification which is not desirable in a device that must be reliable and positive in operation. It is therefore a further object of this invention to provide a means whereby a normally convexo-concave disk is forced or held in a nearly flat form with the middle of the disk near dead center so that only a very slight pressure is required on the convexo-concave side to cause the disk to snap past dead center to a concavo-convex or reverse form. With such a means the temperature control may be regulated within a very small range and the high pressures usually necessary to snap the disk are reduced to a minimum.

Another object of my invention consists in the provision of an improved temperature adjustment.

A further object is to provide an improved snap valve that may be readily repaired or

inspected without impairing the operation of the valve.

These and other objects, that will be made apparent throughout the further description of my invention are attained by means of the device hereinafter described and illustrated in the accompanying drawing, in which:

Fig. 1 illustrates a section on line 1—1 Fig. 3 of a thermostatically operated gas valve of a waterheater embodying my invention, and showing the parts in the positions occupied when the water is hot or has reached a predetermined temperature; Fig. 2 is a sectional view of a normally convexo-concave diaphragm disk used in the snap acting device; Fig. 3 is a sectional view on line 3—3 Fig. 1 looking toward the body of the valve; Fig. 4 illustrates the principles as applied to the Grayson type of snap acting valve; Fig. 5 is an enlarged view of the snap acting device illustrated in Fig. 1, and shows the parts in the position they would occupy when the water is cold or below the predetermined temperature desired; Fig. 6 illustrates the face of what may be called the thermostat lever, and shows the diaphragm disk and amplification lever assembled therein. Fig. 7 illustrates a slight modification of the construction of Figs. 1 and 5.

Like numerals refer to like parts throughout the several views.

Referring to Fig. 1 the reference letter "C" indicates a heater tank having a thermostat D secured in place by the plug E. The thermostat D comprises an expanding metal tube 1 having a high coefficient of expansion, such as copper, and a metal rod 2 such as invar, having a low coefficient of expansion suspended within the tube and secured to the inner end thereof to a plug fastened or soldered in the end of the tube. The valve mechanism comprises the casing indicated as a whole by the reference letter F and is connected to the thermostatic plug E by a yoke like extension or bracket 3 between the walls of which is pivoted by its lower end a flat thermostatic lever 4 having a recess 5 formed in the back of the lever to receive the free end of the non-expanding thermostat rod 2. A circular recess having

its bottom 6 slightly concave is formed in the face or valve side of the flat thermostatic lever 4 (see Figs. 5 and 6) to receive a normally convexo-concave diaphragm disk 32 made of spring metal (see Fig. 2) which is held at its edge against the bottom of the recess in a nearly flat form by a ring 7 removably secured in an annular groove formed in the walls of the recess. In this assembly it will be observed that the convexity-concavity of the disk 32 is now very slight and that the middle of the disk is very near its dead center line. This feature makes it possible to obtain a temperature control within a very narrow range as it requires only a little pressure to push the middle of the disk past its dead center and cause it to snap into a concavo-convex form. In such an arrangement the amplification lever is subjected to a very little strain, due to the fact that the greatest pressure is normally required to start the middle of the disk toward the dead center line. A groove 9 of the proper width and depth is formed in the bottom 6 of the recess and extends from the center to the upper edge of the lever to receive a resilient lever 8, which may be termed the amplification lever, having a T shaped head 10 that supports it on the upper edge of the thermostat lever 4. The lower end of the amplification lever is positioned to press the middle of the convex side of the convexo-concave disk 32. Secured to the valve casing F above the T head 10 of the amplification lever 8 is a temperature adjustment device consisting of a screw slotted stud bolt 11 screwed into the valve casing and carrying a round nut 12 rotatably mounted thereon and having an arm 13 extending upwardly to a graduated dial 14 (see Fig. 3) formed in the valve casing. The stud bolt 11 is of sufficient length to extend over the T shaped head 10 of the amplification lever and hold it in position. The adjustable nut is so positioned that the T head 10 of the amplification lever will press against it when the thermostatic lever 4 is moved toward the valve, and the position of the nut 12 on the stud bolt will determine the temperature at which it is desired to cause the disk 32 to snap into a concavo-convex form to operate the valve 17. The valve body has a threaded inlet 15 and a threaded outlet 16, and connecting the inlet side with the outlet side is a valve 17 disposed concentrically on an axial line passing through the center of the disk 32. The valve 17 is held normally in its seat by a weak coiled spring 18 and is supported on a valve stem 19 passing through the valve body adjacent the disk 32. The end of the valve stem is slightly spaced from the dead center line of the concave side of the disk so that the valve will not be opened until the center of the disk is snapped past the dead center line by the amplification lever.

When the thermostat is subjected to a temperature above a predetermined operating temperature the position of the parts appears as illustrated in Fig. 1. When the thermostat is subjected to a temperature below a predetermined operating temperature the position of the parts appears as illustrated in Fig. 5. The temperature may be regulated by positioning the lever 13 of the temperature adjusting nut 12 to the desired operating temperature on the dial 14. (Fig. 3.) When the thermostat tube 1 expands it pulls the nonexpanding thermostat rod 2 away from the thermostat lever 4 which will follow the rod due to the spring action obtained in the disk 32, thus permitting the disk to attain a slightly convexo-concave form. When the thermostat tube 1 contracts it pushes the nonexpanding rod 2 toward the thermostat lever which pushes the lever toward the valve a distance corresponding to the temperature change. Since the thermostatic lever 4 carries the amplification lever and disk assembly with it, a point is reached where the head 10 of the amplification lever makes contact with the temperature adjusting nut 12 which causes the lower end of the amplification lever 8 to press against the middle of the disk 32. If the movement is continued and the pressure against the disk increased the disk will snap into a reverse or concavo-convex form and open the valve. Due to the inherent spring tension in the disk it will return to a convexo-concave form when the pressure against it is relieved. That is to say, the lever 8 in the contraction of the tube 1 is flexed until it exerts a pressure on the disk 32 sufficient to snap it from its normal convexo-concave form over dead center to concavo-convex form, in which movement of the disk the valve 17 is, of course, opened. In the expansion of the tube 1 the operation described proceeds in the opposite direction; the pressure of the lever 8 upon the disk gradually diminishes until the inherent spring tension in the disk overbalances the pressure of the lever thereon, whereupon the disk snaps back over dead center to its normal convexo-concave form.

It is apparent that the general principle of providing a means to forcibly hold a normally convexo-concave spring disk in a nearly flat form, or so that the middle of the disk will be near the dead center line, to reduce the pressure necessary to cause the disk to snap past dead center to a concavo-convex form, thus making it more sensitive to temperature changes, may be readily applied to other types of thermostatic snap acting devices and valves. Fig. 4 illustrates the application to a thermostatic valve invented by J. H. Grayson and described in Patent No. 1,699,468. Numeral 20 designates the body of the valve. Numeral 21 designates the valve stem and numeral 22 designates the thermo-

stat nonexpanding rod, the end of which moves a distance corresponding to temperature changes in the thermostat expanding tube. Between the valve stem 21 and the thermostat rod 22 is arranged the snap acting assembly, comprising a diaphragm disk 32 which rests on an annular shoulder 26 formed in the valve body, and which is operated by double levers 24 pivoted or resting on a second shoulder 27 formed in the valve body. The double levers 24 are held against the disk 32 by a plunger 23 which is moved according to temperature changes by the thermostatic rod 22. The face of the plunger pressing against the amplification levers is slightly concave and the periphery of the face terminates in an annular shoulder 29 which presses against the amplification levers near their pivotal point and acts as a fulcrum. In the Grayson patent the plunger has its shoulder beveled to a sharp point to make an annular line contact with the amplification levers which has a tendency to bend the levers at that point when the pressure becomes excessive, whereas in my invention the free ends of the amplification levers are pressed against the center of the disk by the center of the plunger until the center of the disk has almost reached the dead center line, after which the shoulders of the plunger press against the fulcrum point of the levers and completes the snap movement. Bearing in mind that the pressure necessary to snap a disk into a reverse form gradually decreases as the center of the disk approaches the dead center line it will be seen that the plunger having a slightly concave face pressing against the amplification levers is to be preferred to the plunger having a beveled shoulder if the valve is to be operated within a small temperature range.

In the drawing the valve is shown in a horizontal position and moving parallel with the axis of the thermostat. Should it be desired to operate a vertical valve or a valve whose axis is at right angles to the axis of the thermostat rod it is only necessary to add an arm to the thermostat lever at right angles to the disk face of the lever as shown at 30 in Fig. 7 and to cause the thermostat rod to press against the arm in a direction parallel with the disk face as indicated at 31.

It is apparent from the above description that many modifications in structural arrangement may be made without departing from the principles described and the spirit of the following claims:

I claim:

1. In a thermostatic device of the character described, the combination with a thermostatic element arranged to move according to temperature variations, and an element arranged to be operated, of a snap-action disk of spring material for operating said element, said disk being normally con-

vexo-concave in form and adapted to be sprung into a concavo-convex form by pressure against the convex side thereof, and means, independent of the thermostatic element, contacting the central portion of the disk on the convex side and the edge of the disk on the other side for supporting the same in a condition of less than normal convexity prior to the operation thereof, whereby the same is arranged to be moved over dead center by a small amount of movement thereof, the said thermostatic element being arranged in its movement to communicate movement to the disk over dead center whereby to spring to concavo-convex form.

2. In a thermostatic device, the combination with thermal responsive means and a heat controlling element arranged to be actuated according to temperature change, a movement amplifying lever pivoted at one end and arranged to have pivotal movement communicated thereto by the thermal responsive means, a second movement amplifying lever fulcrumed near one end on the free end of the first lever, an abutment for the end of said second lever close to said fulcrum, said second lever being resilient whereby to permit flexing thereof under pressure of the first lever, and a snap-action over-center element of spring material, said element being normally disposed on one side of dead center and adapted to be moved over-center by pressure against the back thereof, the free end of the resilient second lever being arranged to press against the back of said element, and the heat controlling element being arranged to be actuated from the front of the element.

3. In a thermostatic device, the combination with thermal responsive means and a heat controlling device arranged to be actuated according to temperature change, a movement amplifying lever pivoted at one end and arranged to have pivotal movement communicated thereto by the thermal responsive means, a second lever fulcrumed on the first lever, an abutment for the end of said second lever, and a snap-action element of spring material mounted on the first lever, said element being normally on one side of its dead center and adapted to be sprung into reverse condition by pressure against the same, the second lever being arranged to exert pressure on said snap-action element, and said element being arranged to communicate movement to the heat controlling device.

4. A thermostatic device as set forth in claim 3 including a screw thread adjustment for said abutment.

5. A temperature controlled device of the character described comprising in combination with a thermostatic element adapted to move upon temperature change, and a device to be moved according to temperature change, a fulcrum lever pivotally mounted so as to

be given pivotal movement by said thermostatic element upon temperature change, a snap action member of spring material mounted upon said lever and bodily movable therewith, said member normally being in a position on one side of its dead center but being adapted to move over dead center with snap action to reversed position, said member being disposed with reference to said device so as to move the same upon snap action thereof, and means moved by said lever and having engagement with said snap-action member to force the same over dead center by a predetermined movement of said lever.

6. In a device of the character described, the combination with a thermostatic element adapted to move upon temperature change, and a device to be moved according to temperature change, of a fulcrum lever mounted so as to be given pivotal movement by said thermostatic element, a snap-action element of spring material mounted on and bodily movable with said lever, said element being normally on one side of its dead center but being adapted to be forced over center to snap to reversed position, said element being disposed so as to move the device upon snap action thereof, and a secondary fulcrum lever fulcrumed on the first lever so as to be given pivotal movement when the first lever is actuated, the second lever having engagement with the snap-action element to force the same over dead center in a predetermined movement of said thermostatic element.

7. A device as set forth in claim 6 including a stationary adjustable screw for abutment with the second lever, whereby to predetermine the point of snap-action of the snap-action element in a specific temperature range.

8. In a device of the character described, the combination with a thermostatic element adapted to move upon temperature change, and a device to be moved according to temperature change, of a fulcrum lever mounted so as to be given pivotal movement by said thermostatic element, a snap-action element of spring material mounted on and bodily movable with said lever, said element being normally on one side of its dead center but being adapted to be forced over center to snap to reversed position, said element being disposed so as to move the device upon snap action thereof, and means engaging the snap-action element so as to force the same over dead center in a predetermined movement of the lever.

9. In a device of the character described, the combination with a thermostatic element adapted to move upon temperature change, and a device to be moved according to temperature change, a fulcrum lever pivoted at one end and engaged on the back thereof by the thermostatic element so as to be

given pivotal movement by said element upon temperature change, a snap-action member of spring material mounted on the front of said lever and bodily movable therewith, said member being normally in a position on one side of its dead center but being adapted when actuated to move over center abruptly to reversed position, said member being disposed with reference to said device so as to communicate abrupt movement thereto, and means carried on the front of said lever and having engagement with the snap-action member whereby in the movement of the lever to force said member over dead center in a predetermined movement of the thermostatic element.

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