

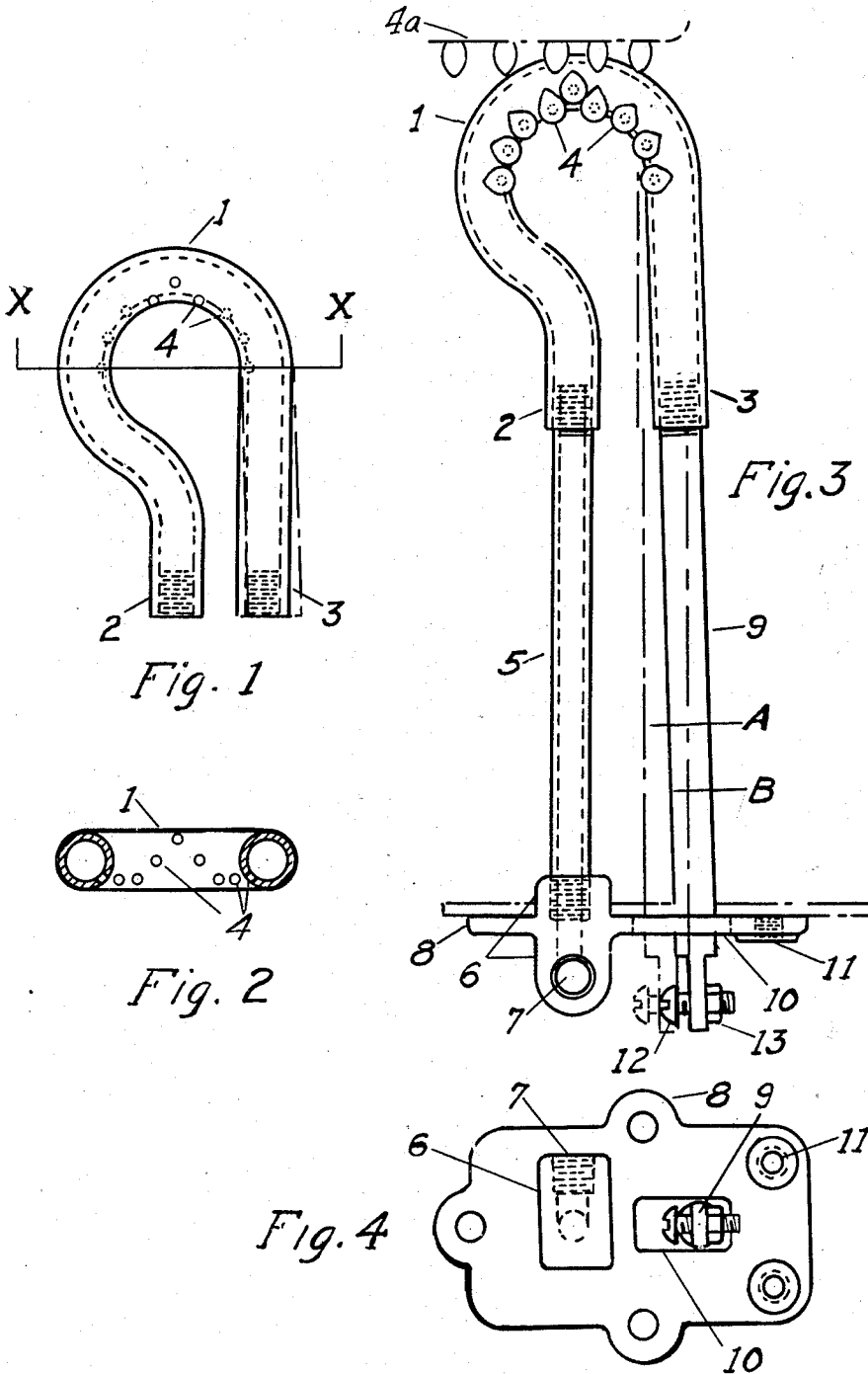
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THERMAL ELEMENT

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THERMAL ELEMENT

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The object of this invention is to provide an improved flame-responsive unit for the operation of automatic gas cut-off valves, switches, etc., the unit, or element, being of the general class described in Patent No. 2,000,294, issued to me May 7, 1935.

The present device is of simpler form and possesses advantages believed to be new in the art, particularly the elimination of a separate pilot burner usually employed to heat the element, and also the elimination of distortion of the element due to granular growth under high temperatures.

Referring to the drawing:

Fig. 1 is a plan view of the upper side of the element. Fig. 2 is a section on the line X—X of Figure 1. Fig. 3 is a plan view of the element assembled with other members, constituting a form of operating unit which may be more or less standard for various uses. Fig. 4 is an end view of Fig. 3.

Referring to Fig. 1, the element 1 consists of a metal tube, formed in circular fashion, of an alloy of chromium and nickel, with a trace of titanium. This alloy possesses low heat conductivity (as a result of the nickel content) and great strength under high temperatures. The titanium helps it to resist, although it does not entirely prevent granular corrosion.

The end portions of the tube 1 are turned outward and formed parallel, with the ends 2 and 3 threaded internally to receive other members of the operating unit.

Along the middle portion of the bend in tube 1, and on the inner side of the curve, are a number of small, spaced ports 4, most of which are located in a plane slightly below the center of the tube, as will be seen in Fig. 2. One port is located above the other ports of the tube, for lighting an adjacent burner 4a, as may be seen in Fig. 3.

Referring to Fig. 3, there is inserted in end 2 of the tube 1, an extension tube 5, having its opposite end screwed into a boss 6 in base plate 8, said boss being extended to the opposite side of the base plate and tapped for a connection to a source of gas supply at 7.

Into the end of tube 1, at 3, is inserted an operating arm 9, which extends through a slot 10 in the baseplate 8 to a point where it may actuate a valve or switch (not shown), which may be secured to the baseplate 8 by means of the mounting holes 11. An adjustment screw 12 and lock nut 13 are provided to secure accurate adjustment of the arm 9 relative to the valve or switch to be operated.

To install the unit in an oven for instance, the element 1, and its extensions 5 and 9, are passed through a suitable opening in the sidewall of the oven, and the baseplate 8 is bolted to the side of the oven wall. Then gas is connected to the unit at the tapping 7, and is regulated by a "constant pilot" adjustment usually included as a part of an oven thermostat, which is not shown. The device is then ready for operation, it being assumed of course that the valve or switch which it is desired to operate has been mounted on the base plate 8 and the adjustment screw set as required.

Operation

Referring to Fig. 3, gas passes to the element 1 via the rigid support tube 5 and issues from the ports 4. On being ignited and regulated to a height about equal to the diameter of the tube, the flame will be found to burn with a blue color, contacting and instantly heating the tube 1 around its inner curve, whereupon the tube flexes outwardly, swinging the operating arm from position A to position B in about 6 seconds.

The bending action of the tubular element 1 is caused by a temperature differential between the area on the inner curve adjacent the flame and the area on the outer curve diametrically opposite. The higher temperature on the inner side, or rather inside curve, expands the tube more on that side and the tube tends to straighten, like a Bourdon tube. This bending action however does not exceed the elastic limit of the tube. When the flame is extinguished for any reason the tube immediately returns to its normal position.

Three factors are contributing causes for the above mentioned temperature differential. First, conduction of heat to the opposite side of the tube is retarded by the space within the tube, second, by the low heat conductivity of the material, third by the larger radiating surface on the outer curve of the tube as compared with the area on the inner curve.

It should be mentioned at this point that, although there is a sufficient temperature differential to operate the device, and provide ample movement, it is not excessive. If it were, a permanent warping of the tube would result when subjected to high temperatures, due to uneven granular growth. That is one of the faults inherent in prior devices, where the intense heat of a separate Bunsen burner is applied to a small and more or less isolated area. Large and quick action may be secured thereby, but at the risk of permanently changing the form of the element. In the present device the flame is a soft blue flame,

not so intensely hot, and is spread around a considerable area of the tube.

It will be observed that I do not use an orifice or cross hole for the introduction of primary air either in the tubular element 1 or in the support tube 5. Ordinarily it would be expected that this method would produce a yellow flame at the element ports 4, which would deposit carbon on the element tube. However the flame is blue, and no carbon deposits occur on the tube.

The reason for this is as follows: The gas, in passing slowly through the element tube 1, to the ports, becomes heated, which increases its volume and decreases its B. t. u. content. Therefore less secondary air is needed to complete combustion. By drilling the ports the correct size and properly spacing them, a sufficient amount of air is absorbed by the flame to give it a clear blue color, unless the burner is forced beyond its correct capacity.

Also, because of the low heat conductivity of the element tube 1 the flame, in contacting it, is not cooled sufficiently to interfere with combustion, and therefore no carbon is formed on the tube.

It should be noted also that the extension arm 9, amplifies movement of element 1 without any intermediate friction, and is not affected by heat in its transverse movement, as is the case in prior designs which support the element by tubes and transmit the movement by push rods, subject to friction and affected in their movement by local temperatures in the oven or chamber in which the element is located.

Although there is a great demand for automatic cut-off safety valves on gas appliances, the general use of small Bunsen pilots on these devices having minute orifices which quickly clog, and the problem of granular growth, have been sources of great trouble to appliance manufacturers, and as a result these devices have been condemned in various sections of the country. It is believed that the present invention effectively overcomes these difficulties.

I claim as my invention:

1. A flame-sensitive control unit comprising a curved metal tube having low heat conductivity and a high co-efficient of expansion, means for rigidly supporting said tube at one end while the other end remains free, a fuel supply connected at the supported end, the tube being provided

with burner port means along the inner side thereof for providing a heating flame adjacent thereto, whereby unequal heating of the tube is adapted to cause it to flex, within its elastic limit, and to return to its normal position when said flame is extinguished.

2. A flame responsive control unit including a section of hollow tube, of material having a high coefficient of expansion and low heat conductivity, said tube being bent in substantial circular form and positioned for operation with its curved portion in an approximately horizontal plane, one end of said tube being rigidly supported while the other end remains free to operate a control member, a fuel supply connected with said tube, burner port means provided in one side only of said tube, extending lengthwise along its curved portion between the top and bottom sides of said tube, thereby providing an elongated flame or series of flame contacting one side only of said tube, within the plane of its curvature, thus maintaining a higher degree of temperature on one side of the tube than on the other and causing it to flex in the plane of its curvature, and means connected with the flexing portion of said tube adapted to operate a control member.

3. A flame responsive control unit constructed in accordance with claim 2, and having offset port means on the upper side of said tube to provide a lighter flame, said lighter flame being adjacent to and ignited by the heating flame, and adapted to in turn ignite a main burner.

4. A flame responsive control unit including a section of hollow tube, of material having a high coefficient of expansion and a low heat conductivity, said tube being bent in a plane, in substantial circular form, one end of said tube being rigidly supported while the other end remains free to operate a control member, a fuel supply connected with said tube, burner port means provided in one side only of said tube, said one side lying in a plane transverse to said first mentioned plane, said port means extending lengthwise along its curved portion and positioned to provide a heating flame against said one side only, whereby unequal heating of the tube causes it to flex transversely in the plane of its curvature, and operating means connected to said free end of the tube to transmit its flexing movement to a control member.

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