Nov. 21, 1944. A. STOCKSTROM 2,363,451

THERMO-RESPONSIVE DEVICE

Filed Oct. 20, 1941 2 Sheets-Sheet 1

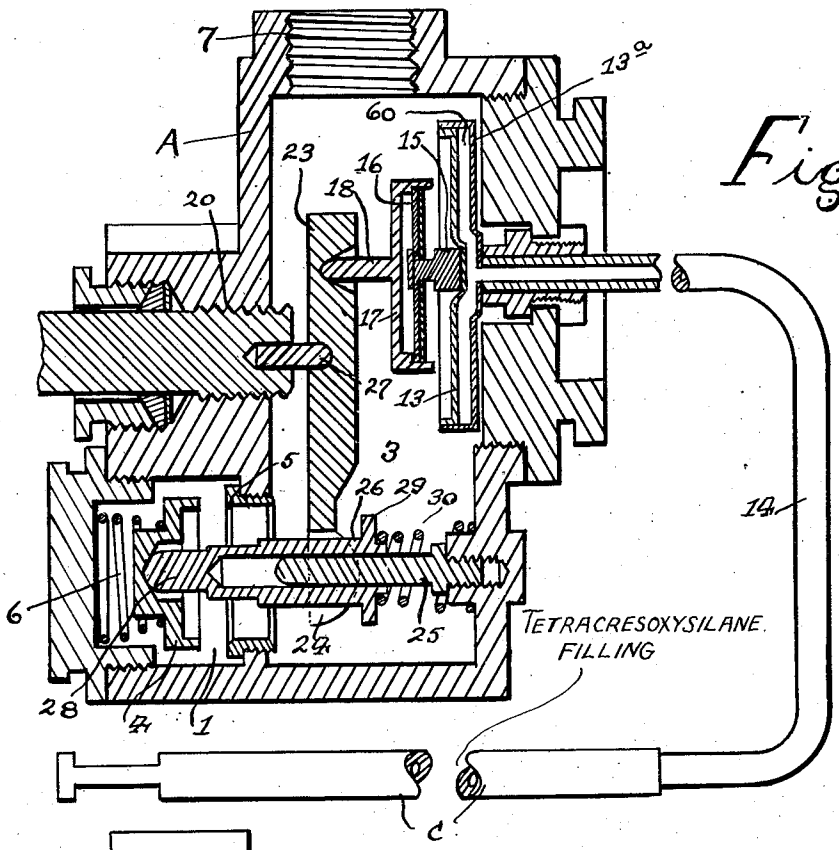


Fig. I

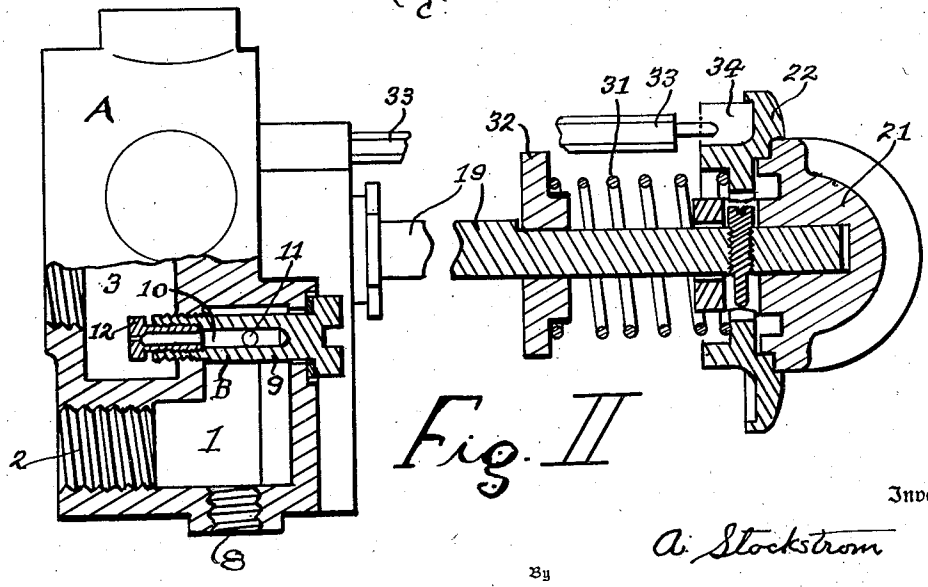


Fig. II

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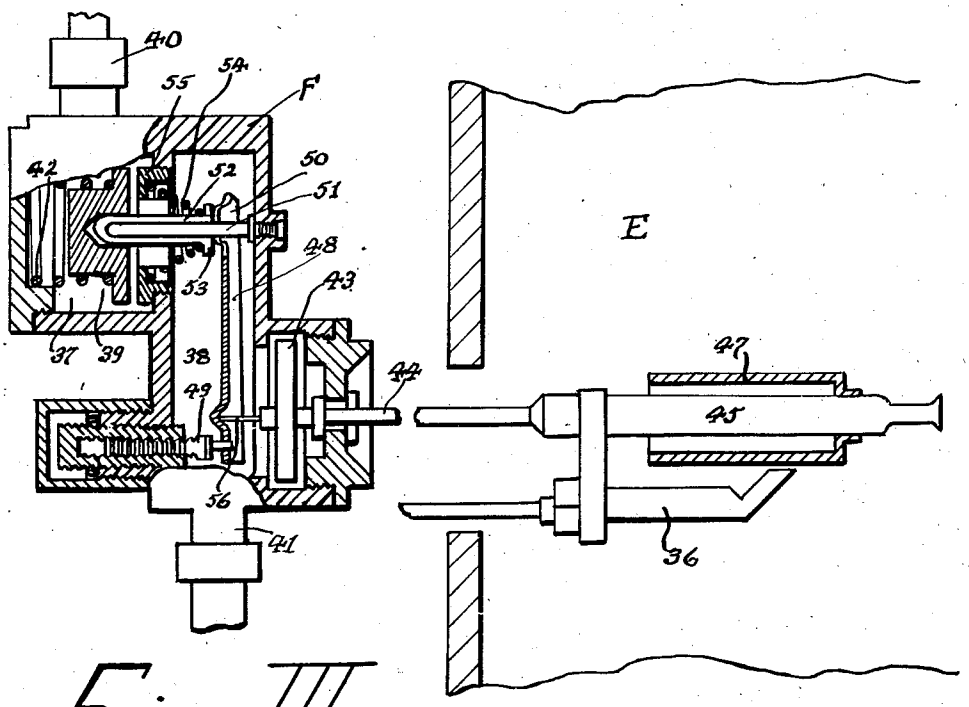


Fig. III

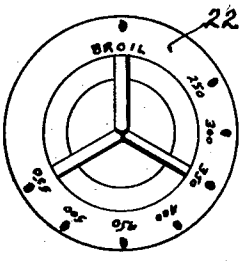


Fig. IV

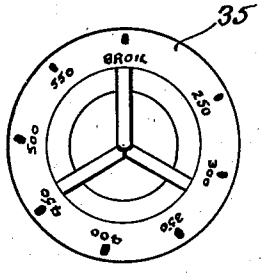


Fig. V

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UNITED STATES PATENT OFFICE

2,363,451

THERMORESPONSIVE DEVICE

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Application October 20, 1941, Serial No. 415,841

1 Claim. (Cl. 297—3)

The present invention relates to thermo-responsive devices and to such class of devices generally rather than specifically but by reason of the invention being particularly suited for and efficient in connection with gas ranges and constituting a decided improvement in thermostatic heat regulators and fuel control devices for gas ranges the invention is illustrated in the accompanying drawings in connection with gas ranges and described specifically in respect to its use on gas ranges.

It is to be understood however that the invention is not limited for use on gas ranges inasmuch as the invention provides a means of thermostatic response to the heat generated by any type of device and particularly for response to high temperatures.

Most gas cooking ranges today are provided with automatic thermostatic temperature control for the ovens of the range and likewise such ranges for a large part are provided with automatic main burner ignition which requires the provision of thermostatically operated safety fuel control valves, and in the accompanying drawings a thermostatically operated oven heat control is illustrated as is likewise a thermostatically operated safety valve. In connection with both of said devices they are of the so-called "liquid type" in that a liquid constitutes the thermal response medium which operates the mechanical parts of the devices to accomplish the desired result.

Thermostatically operated heat control devices as well as safety valves of the liquid type can and do vary widely in construction and hence the accompanying drawings are to be considered as merely illustrative of construction and not in any sense to constitute a limitation of the invention.

As a consequence of the foregoing the present invention resides primarily in the particular liquid utilized in devices of the aforementioned character as the thermal responsive means for actuating the devices.

Devices of the character described have proven far from satisfactory in that the thermo-responsive fluids which have been utilized has necessitated or confined the satisfactory use of these devices to temperatures not in excess of 550° F. while it is necessary, as will hereinafter appear, to deal with and control with temperatures which are in excess of 650° F.

As a general statement it can be said that devices of the character here dealt with have in the past been objectionable, inefficient and not commercially adaptable for use in connection with high temperature work because the thermo-responsive medium of the devices has had too low a decomposition temperature; has had a low boiling point; has had high vapor pressure and high cost; has so greatly restricted the operating temperatures of gas ranges as to curtail undesirably the functions of the ranges; along with other specific objections as will hereinafter appear.

With devices of the character described as heretofore known and in use, the thermo-responsive liquid of the devices are quite apt to and frequently do break down or decompose and render the devices inoperative if the thermo-responsive medium is subjected to a temperature in excess of 650° F. It has been found that in range ovens, particularly in ranges used in hotels, restaurants and the like, temperatures in excess of 650° F. are often necessary in order to braise and sear meats.

In many ranges, particularly domestic ranges, a single oven and a single burner, which burner is under the control of the baking oven temperature regulator, are utilized for both baking and broiling operations. The temperature necessary to be reached for successful and proper broiling operation is much higher than that utilized in baking operations but since the thermo-responsive element of the control device is in the combination baking and broiling oven and responsive to the heat generated therein it is often difficult if not impossible, with control devices utilizing any of the liquid thermo-responsive mediums heretofore in use, to reach the desired broiling temperature or if it is reached the life of the temperature control device is shortened or destroyed by the intense heat to which the thermo-responsive medium of the baking oven temperature control device is subjected. In many instances it is impossible to reach the desired broiling temperature because the thermo-responsive medium sets up a throttling action on the gas flowing to the combined broiler and baking burner.

The lives of devices of the character here being discussed as made in the past and at the present time are also jeopardized in another manner and which when it occurs will in the majority of instances completely destroy the devices by rendering them so inaccurate as to amount to rendering them inoperative. In the manufacture of ranges the heat control devices are calibrated at the factory and if for any reason during use the devices become inaccurate they are re-cali-

brated by service men. Either at the factory or by the service men's carelessness or mistake in setting a calibration by over-adjustment will permit the range burner or burners to generate in the range ovens a temperature much in excess of 650 degrees and when this occurs the value of the thermo controlled devices are destroyed.

It is therefore the primary object of the present invention to provide a thermo-responsive fluid which will stand temperatures greatly in excess of 650 degrees and by so doing obviate the recited short-comings of liquid heat control devices as now known and used.

In providing such a thermo-responsive liquid for use in heat regulators for high temperature use, this liquid has certain attributes not true of thermo-responsive liquids as heretofore known. These attributes comprise extremely high boiling points and extremely low melting points taken together with the ability to withstand high temperatures without breaking down or decomposing, all of which assures accuracy and durability of the devices over a greater temperature range than has been possible with thermo-operated devices in the past.

In the drawings, which are illustrative of two specific applications of the inventive thought:

Fig. 1 is a sectional view through an automatic thermo-responsive heat regulator embodying the present invention.

Fig. 2 is a view, partly in section, illustrating the gas by-pass and illustrating the temperature setting dial of the device.

Fig. 3 is a sectional view of a thermo-operated fuel safety control valve and its application to a gas range.

Fig. 4 is a front view of a heat control dial for the present high temperature device.

Fig. 5 is a heat control dial such as found on present temperature heat control devices.

It being desirable in domestic ranges and particularly combination oven and broiler ranges and in respect to safety valves to have a thermostatically controlled temperature range greater than the hereinbefore normal range of 250° F.–550° F., I provide for this by utilizing in the thermo-responsive devices a thermo-responsive medium or liquid of the organo-silicon group of compounds.

In devices heretofore known and in use it has been common practice to utilize diphenyl compounds as a heat responsive medium but these have the undesirable characteristic of boiling at about 650° F. and if subjected to a temperature in excess of 650 degrees there is grave danger of these compounds breaking down to the extent that the device with which they are used becomes inoperative. Respecting the organo-silicon compound mentioned above, tetracresoxysilane remains liquid even when subjected to temperatures as low as 25° F. below zero and its boiling point is approximately 800° F. The attributes of this material is such that when used as the thermo-responsive medium in a thermo-responsive device said device can be safely used to accurately operate at much higher temperatures than have such devices in the past.

Additionally it has been found that this material will not attack stainless steel, iron, copper or brass, even at high temperatures, and this is a highly desirable attribute inasmuch, as will appear, the heat-responsive medium is confined within a bulb, tube and bellows which must for practical reasons be made of some metallic material.

Explaining now the particular use of the aforementioned material as a thermo-responsive medium in a domestic oven automatic temperature control device, and referring particularly to Figs. 1 and 2 of the drawings which illustrate a commercially practical liquid type oven heat regulator, A designates a housing to the chamber 1 to which fuel is delivered from a suitable source of supply through an inlet 2. Fuel is permitted to pass from the housing chamber 1 to a larger adjacent housing chamber 3 under the control of a valve 4 which is normally urged towards its seat 5 by a spring 6. The chamber 3 delivers fuel to the oven or other burner with which the device is associated through its outlet 7.

Ordinarily the range is equipped with a constant burning pilot light and fuel for said pilot is delivered from the housing inlet chamber 1 through a pilot outlet opening 8.

Those familiar with automatic oven temperature control are aware that the device being explained acts to control the delivery of fuel to the oven burner when the desired temperature within the oven has been obtained and operate to permit the flow of fuel to said oven burner until said predetermined temperature is reached and will operate to permit the flow of fuel after the predetermined temperature has been reached in the oven and then the oven temperature falls off. However it is ordinary practice not to shut off the fuel completely to the oven burner during the use of the oven but to at all times permit a very low fire at the burner. This is accomplished by providing a bypass and this is designated as an entirety in Fig. 2 of the drawings at B. This bypass comprises a bolt 9 having therein a passageway 10 which is in communication with the fuel inlet chamber 1 through an opening 11. The passageway 10 of the bolt discharges into the fuel outlet chamber 3 through a suitable nozzle 12.

The regulator housing A and the parts therein can if desired be positioned remote to the oven or other chamber the heat in which is to be controlled but within said oven or chamber there is positioned a metallic bulb C which is connected to an expansible chamber composed of a pair of diaphragms 13 and 13a positioned in the housing by a tube 14.

The chamber, tube and bulb are completely and entirely filled with the thermo-responsive medium tetracresoxysilane and it has been found that to obtain the best and most accurate operation the tube, bulb and chamber should be evacuated and filled with the thermo-responsive medium under a high vacuum so as to exclude all air.

As will appear, the device operates by reason of the expansion and contraction of the thermo-responsive medium in response to the temperature to which the bulb and tube or any portion of the thermo-responsive medium carrying parts of the device are subjected. The operation is limited however entirely to the expansion and contraction of the thermo-responsive medium itself and there is a complete absence of the generation of any vapor pressure within the closed system which contains the thermo-responsive medium or material.

The chamber diaphragm 13 is provided with an extending pin or stud 15 having attachment to a disc 16 carried in separated relationship to the bottom of a housing or carrier 17 from which extends a stud or pin 18.

The disc and its housing constitute a compensator to compensate any response or action of the thermo-responsive medium to heat exterior of the oven so as to assure that the device responds only to the temperature within the oven or chamber within which the temperature is to be controlled. Further description of this element of the device is unnecessary as compensators are well understood by those familiar with inventions of the present character.

An operating shaft 19 has its inner end rotatably mounted within the housing A as at 20 and its other end carries an operating handle 21 which will be conveniently positioned as for instance on the front panel of the range. A dial 22 is associated with the operating handle and will carry on its face temperature indications up to the maximum temperature range of which the device is capable of operation.

Within the fuel discharge chamber 3 of the housing a lever 23 at one end bears against the compensator stud or pin 18 and has its other end forked as at 24 to straddle a fixed stem 25 and the valve operating sleeve 26 which is mounted for reciprocation on said fixed stem. Intermediate its length the lever is fulcrumed on a pin or stud 27 carried by the inner end of the temperature setting shaft 19.

The valve operating sleeve 26 has one end 28 engaging the valve in opposition to the spring 6 while its opposite end is provided with a head 29 behind the forked end of the lever. Behind the sleeve head 29 a coil spring 30 having a tension greater than that of the spring 6 tends through the valve sleeve to normally hold the valve in an open position.

Thus it will be seen that when the thermo-responsive fluid within the closed system expands it will exert a pressure upon the lever 23 to rock said lever on its fulcrum 27 and move its forked end against the tension of the coil spring 30 and thus permit the valve 4 to move toward or to its seat under the tension of the coil spring 6. Reduction in temperature and the consequent contraction of the thermo-responsive medium will permit the spring 30 to move the valve away from its seat, all as is well understood by those familiar with devices of the present nature.

The present device provides for calibration both at the time of manufacture and while in use in the field. The temperature dial 22 is geared for rotation with the operating handle 21 and these two parts are held normally in operative engagement under the tension of the coil spring 31 which as abutted against a collar 32. To calibrate or adjust it is only necessary to push the dial inwardly and rotate it either to the right or to the left in accord with the error to be corrected.

An elongated stop pin 33 is carried by the housing A and is in the path of travel of an extending ear or lug 34 carried on the rear face of the dial 22. This construction will limit the permissible rotation of the temperature setting portion of the apparatus.

Figure 5 of the drawings illustrates a conventional temperature dial and temperature setting handle 35 and it will clearly appear that the temperature setting handle and dial can be moved very little beyond the 550 F. setting and that the "Broil" setting is only slightly beyond said highest temperature reading. Figure 4 however which illustrates the present temperature setting dial 22 makes it clear that the temperature can be increased far beyond the 550 degree setting and that the "Broil" setting is far removed from the 550 degree indication of the dial.

Where automatic ignition is used it is common practice to provide a safety valve which will cut off the flow of fuel to the main burner in the event the pilot light burner is not ignited and ready to ignite the main burner.

Figure 3 of the drawings illustrates a construction of this kind and here the oven or other chamber being heated is indicated at E and the constant burning pilot light at 36.

The principle of operation of the safety valve is similar to the automatic heat regulator and comprises a housing F having therein a fuel inlet chamber 37 and a fuel outlet chamber 38, communication between which is under the control of a valve 39. Fuel from some suitable source of supply is brought to the inlet chamber by a conduit 40 while fuel permitted to pass to the main burner is conveyed thereto from the outlet chamber 38 by a conduit 41.

The valve 39 is normally urged towards its seat and a closed position by a spring 42. In this construction there is also provided a collapsible and expansible chamber 43 connected by a capillary tube 44 with a bulb 45 which is disposed in the oven E. The chamber, pipe and bulb are completely filled with the particular thermo-responsive medium or material heretofore specifically described.

The bulb is closely associated with the constant burning pilot light 36 and is preferably provided with a shield 47 to prevent the flame of the pilot light actually playing upon the bulb. This close association however subjects the bulb to an extremely high temperature.

Within the fuel discharge chamber of the housing F a lever 48 is fulcrumed at one end upon an adjustable fulcrum pin 49 and has its remote end 50 forked or bifurcated to straddle a fixed pin 51 upon which is reciprocably mounted a valve engaging and operating sleeve 52. One end of this sleeve is seated within the valve while its other end is provided with a head 53 which is maintained in constant engagement with the end 50 of the lever by the tension exerted by a coil spring 54. The valve seat appears at 55.

The expansible and contractable chamber 43 is provided with an extending pin 56 which engages the lever 48 intermediate its ends.

With the construction thus described it will be seen that as long as the pilot burner is in operation the thermo-responsive fluid is heated and kept in an expanded condition which will cause the pin 56 of the expanded expansible and contractable chamber 43 to rock the lever upon its fulcrum and exert pressure through the valve operating sleeve 52 to hold the valve in an open position.

Should the pilot light become extinguished and the thermo-responsive medium become cool the spring 54 will move the valve operating sleeve and lever in a direction away from the valve and permit the spring 42 to move the valve to a closed position and thereby prevent the delivery of fuel to the main burner.

Thus it will be seen that this safety valve or device avoids the possibility of the delivery of fuel to the main burner in the event the pilot light burner is not ignited and ready to ignite the fuel delivered to the main burner.

It will be understood that in a gas range construction the bulb 45 and the thermo-responsive material therein contained is subjected to the

heat of the pilot light burner in addition to the heat built up in the oven by the operation of the main burner and that consequently the thermo-responsive medium must be such as to withsatnd temperatures of exceedingly high degrees.

The thermo-responsive devices illustrated in the drawings and specifically herein described constitute only two of many devices which could embody the present inventive concept and the invention accordingly should be limited only within the scope of the hereinafter appended claim.

I claim:

In a thermostatically operated device for use over a wide range of temperatures from a low of at least zero degrees F. to a high of approximately 800° F., a bulb in the zone of heat, an expansible and contractable chamber, a conduit interconnecting the bulb and the chamber, a thermo-responsive medium completely filling said bulb, conduit and chamber, said thermo-responsive medium being tetracresoxysilane.

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