Oct. 24, 1933. P. E. KLOPSTEG 1,931,731

THERMO REGULATOR

Filed Dec. 21, 1931

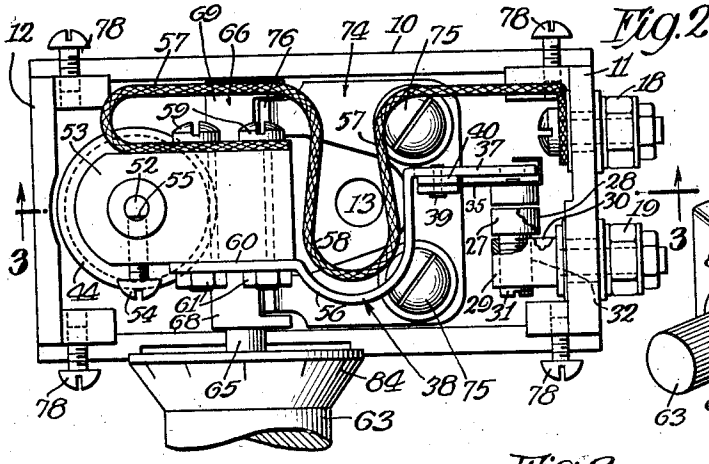


Fig. 2

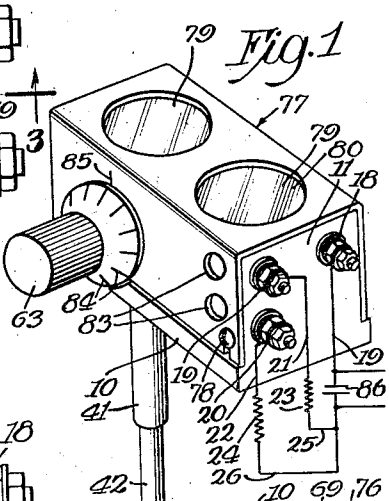


Fig. 1

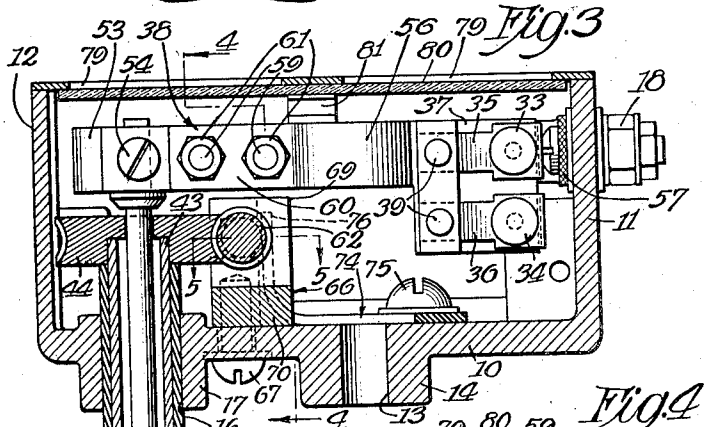


Fig. 3

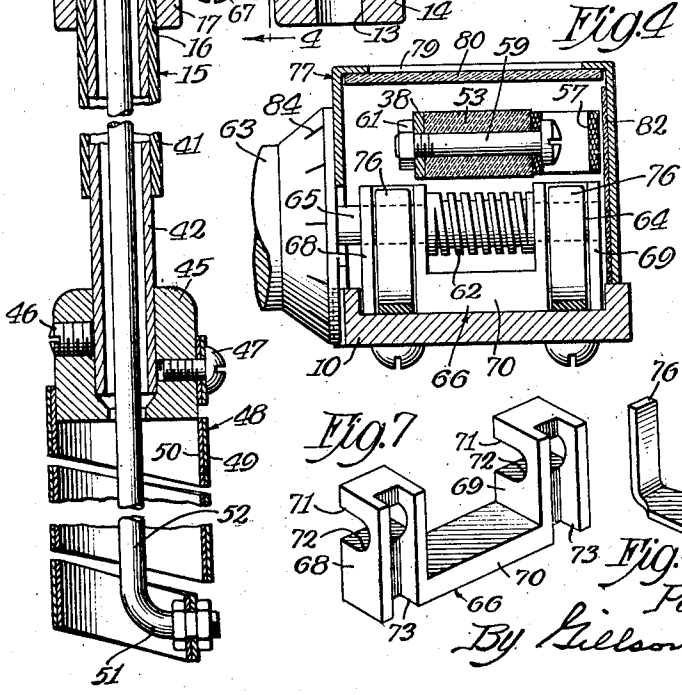


Fig. 4

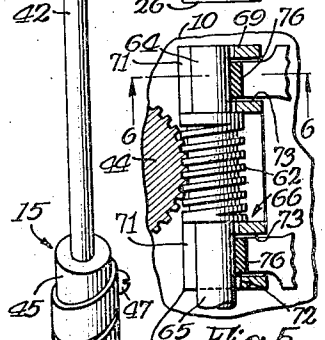


Fig. 5

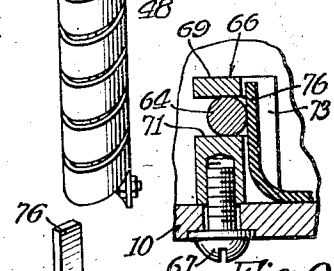


Fig. 6

Fig. 7

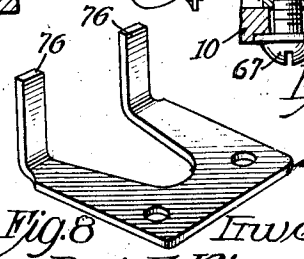


Fig. 8

Inventor

Paul E. Klopsteg

By Gilson, Mann & Co.

Attys.

Patented Oct. 24, 1933

1,931,731

UNITED STATES PATENT OFFICE

1,931,731

THERMO-REGULATOR

Paul E. Klopsteg, Evanston, Ill., assignor to Central Scientific Company, a corporation of Illinois

Application December 21, 1931
Serial No. 582,265

3 Claims. (Cl. 200—138)

This invention relates to thermo-regulators of the type shown in the De Khotinsky Patent No. 1,375,780, issued April 26, 1921 and has for its principal object to improve the same.

Further and other objects and advantages will become apparent as the disclosure proceeds and the description is read in conjunction with the accompanying drawing in which

Fig. 1 is a perspective view of the improved thermo-regulator;

Fig. 2 is a front view of the thermo-regulator with the cover removed;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2, the contact arm and its associated parts being shown in elevation;

Fig. 4 is a transverse, sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary sectional view taken on the line 5—5 of Fig. 3 showing particularly the novel mounting of the worm;

Fig. 6 is a fragmentary, sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is a perspective view of the journal guide employed in the worm assembly; and

Fig. 8 is a perspective view of the resilient clip which holds the worm in positive engagement with the worm gear.

But this specific illustration and the correspondingly specific description are for the purpose of disclosure only for it is realized that the invention may be variously embodied within the scope of the appended claims.

The thermo-regulator is primarily intended for use in controlling the temperature of electric ovens, but its use is not so limited. It may obviously be used wherever a thermostatic control of an electric current is desired.

As explained in the DeKhotinsky patent above referred to, the device includes a bi-metallic helix which contracts and expands in response to temperature changes in the ambient air and thereby actuates a movable contact to and from circuit closing position. When the circuit is closed, an electric heater is put into operation which thereby raises the temperature within the oven, expands the thermo-sensitive helix and after a given movement will open the heater circuit. A more detailed explanation of the device will be given as the description proceeds.

In its preferred form, the thermo-regulator comprises a base 10 having integral end walls 11 and 12. The base is securely mounted on the exterior of the oven by a screw (not shown) passing through the aperture 13 in the boss 14. The thermo-sensitive means, generally designated 15 passing through an aperture 16 in the boss 17 prevents the base from turning about the fastening screw as a pivot.

A binding post 18 is insulatedly mounted on the wall 11 of the base and is connected by conductor 19 (Fig. 1) to one side of a power line. Two other binding posts 19 and 20 are similarly mounted on the same wall and are connected by means of conductors 21 and 22, respectively, to the heating elements 23 and 24 which are in turn connected by conductors 25 and 26 to the other side of the power line.

A pair of relatively fixed contact members 27 and 28 are adjustably supported in metallic contact holders 29 and 30 which are in effect continuations of the binding posts 19 and 20. These contacts, it will be understood, are insulated from the base and from each other.

The contacts 27 and 28 are adjustable for position by rotating the threaded shanks 31 and 32 which are in threaded engagement with the contact holders 29 and 30, respectively.

A pair of movable contacts 33 and 34 are mounted on thin, resilient supporting members 35 and 36 which are in turn clamped to the web 37 of a contact arm, generally designated 38, by small rivets 39. A spacer 40 holds the contacts away from the web 37 for a purpose later to be described.

The moving contacts 33 and 34 are controlled by the thermo-sensitive means 15 extending into the oven in the path of circulating air. This means comprises a tubular stem 41 tightly fitted within the bore 16 and telescopically supporting a worm gear shaft 42 which projects a slight distance beyond the stem 41 into the interior of the housing, as indicated at 43. A worm gear 44 is rigidly secured to this end of the shaft.

The outer end of the worm gear shaft is supplied with a collar 45 that is prevented from having relative rotation with the shaft 42 by a set screw 46. Mounted on the collar by means of a screw 47, or similar means, is a bimetallic helix 48 composed preferably of an outer layer 49 of invar, and an inner layer 50 of brass. The outer extremity of the helix is rigidly fastened to the bent end 51 of a torque shaft 52 which is mounted within the hollow worm gear shaft 42 and projects through the worm gear 44, the latter constituting a bearing for its inner end.

An insulating block 53 slips over the inner end of the torque shaft and is held in place by a set screw 54 that seats upon a flattened edge 55 of the shaft to insure that there will be no relative movement between the block and the shaft.

The insulating block 53 carries the contact arm 38 which, in the form shown in the drawing, has a bowed mid-section 56 that merges with the web 37. The contact arm is at all times in electrical connection with the binding post 18 by means of a braided ribbon conductor 57 which is bent inwardly at 58 and fastened to the insulating block 53 by machine screws 59, 59. The machine screws are adapted to pass through the block and the web 60 of the contact arm so that

by applying the nuts 61, 61, the braided conductor 57 and the contact arm will be simultaneously clamped to the insulating block. The use of a highly flexible braided conductor between the binding post 18 and the insulating block 53 offers little or no resistance to the movement of the contact arm and, therefore, is highly desirable.

Assuming that the temperature of the oven is such as to cause the helix 48 to contract, it will be seen that the torque arm will be slightly rotated to the right (Fig. 2) bringing the moving contacts 33 and 34 against the fixed contacts 27 and 28, thereby energizing the heaters 23 and 24. The purpose of mounting the moving contacts 33 and 34 on the thin resilient supporting members 35 and 36 now becomes apparent, for this insures that a slight torque produced on the torque shaft by the contraction of the helix 48 will cause both heaters to be put into operation, whereas if the contacts were mounted on the less resilient contact arm itself, it might happen that only one contact would be made with the result that one heater would be left out of operation.

One distinct advantage of the thermo-regulator thus far described over the regulator shown in the DeKhotinsky patent resides in the elimination of the base 10 and the thermo-sensitive means from the electrical circuit. In the embodiment of the invention disclosed in the drawing, the electrical circuit from the binding post 18 to the binding post 19 or 20 may be traced from conductor 57, screw 59, contact arm 38, contact supporting members 35 and 36, moving contacts 33 and 34, fixed contacts 37 and 38, contact supports 29 and 30 back to the binding posts 19 and 20. By eliminating the casing and thermo-sensitive means from the electrical circuit, electrical resistance is somewhat cut down and there is no danger of shock to the person manipulating the thermo-regulator by contact with the casing.

In a device of this kind, it is necessary to provide means for controlling the temperatures at which the circuit will be opened and closed. This is accomplished by means of a worm 62 meshing with the worm gear 44. Upon rotating the worm by means of the control knob 63, the worm gear shaft 42 displaces the inner end of the helix 48 a proportional distance which has the effect of changing the temperature at which the closing of the circuit takes place.

Experience has shown that the back lash inherent in the worm gear assembly shown in the DeKhotinsky patent detracts from the accuracy of the device. Novel means are, therefore, provided for overcoming this defect.

The worm 62 is provided with bearings 64 and 65, the latter of which is extended beyond the edge of the base 10 and is rigidly connected to the control knob 63. The bearings are held in longitudinal alinement with respect to the worm gear by means of a journal guide 66 fastened to the base 10 by screws 67. The guide comprises arms 68 and 69 joined together by a connecting web 70 of substantial cross section. The arms each have an open slot 71 corresponding in width to the diameter of the worm bearings. The base of the slots are rounded as at 72 and communicate with transverse channels 73.

When the journal guide is screwed to the base in its appropriate position, the worm bearings rest within the slots 71 but the guide is so positioned that the rounded bases 72 of the slots do not force the worm into firm engagement with the worm gear. This, however, is accomplished by a resilient clip 74 fastened to the base by screws 75 and provided with arms 76 which are adapted to fit within the channels 73 of the journal guide, and press against the bearings. The resilient arms 76 cause an engagement of the worm with the worm gear which is devoid of back-lash and which will remain that way regardless of wear, since the wear is taken up by the resilience of the clip.

A cover, generally designated 77, is adapted to slip over the end walls 11 and 12 of the base and enclose the thermo-regulator. The cover is held in place by screws 78 and the front portion is provided with windows 79 to expose the interior of the device. To prevent dust and other deleterious matter from entering the housing, it is preferred that the windows 79 be provided with a glass closure 80 which is held against the front of the cover by resilient lugs 81.

The cover may be provided with an insulated sheet 82 on the side which is adjacent to the braided conductor 57 in order to insure that the casing will not become electrified.

A pair of apertures 83 provided in the cover give ready access to the contact carrying screws 31 and 32.

Although the thermo-regulator is not equipped with an absolute scale for indicating the temperatures directly, the control knob is provided with graduations 84 cooperating with the index 85 on the cover so that comparative readings may be taken.

Preferably a condenser 86 is connected across the conductors 19 and 26 to prevent arcing between the fixed and moving contacts.

From the above, it will be apparent that the improved regulator is more sensitive to heat fluctuations and more accurate in temperature control than the DeKhotinsky device above identified.

What I claim, therefore, is:

1. In a device of the class described, a relatively fixed contact, a movable contact, thermo-sensitive means connected to the movable contact including a bimetallic helical coil, means for regulating the thermo-sensitive means including a worm having end bearings, a worm gear adapted to intermesh therewith, a journal guide for holding the worm in proper alinement with relation to the gear, and a resilient clip pressing on the bearings to cause firm engagement of the worm with the gear.

2. In a device of the class described, a relatively fixed contact, a movable contact, thermo-sensitive means connected to the movable contact, means for regulating the thermo-sensitive means including a worm having end bearings, a worm gear, a journal guide adapted to fit over the bearings and hold the worm in proper alinement with relation to the gear, and resilient means urging the worm into firm engagement with the gear.

3. In a device of the class described, a relatively fixed contact, a movable contact, thermo-sensitive means connected to the movable contact, means for regulating the thermo-sensitive means including a worm having end bearings, a worm gear, a journal guide having longitudinally extending open slots receiving the bearings and transverse channels communicating with the slots, and a resilient clip provided with arms adapted to fit into said channels and urge the worm into firm engagement with the gear.

PAUL E. KLOPSTEG.