

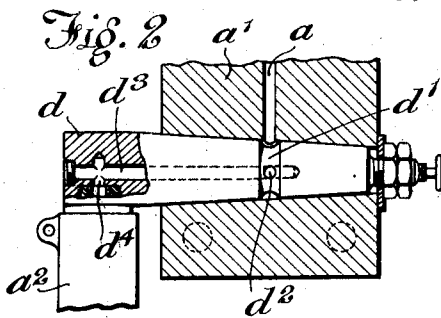
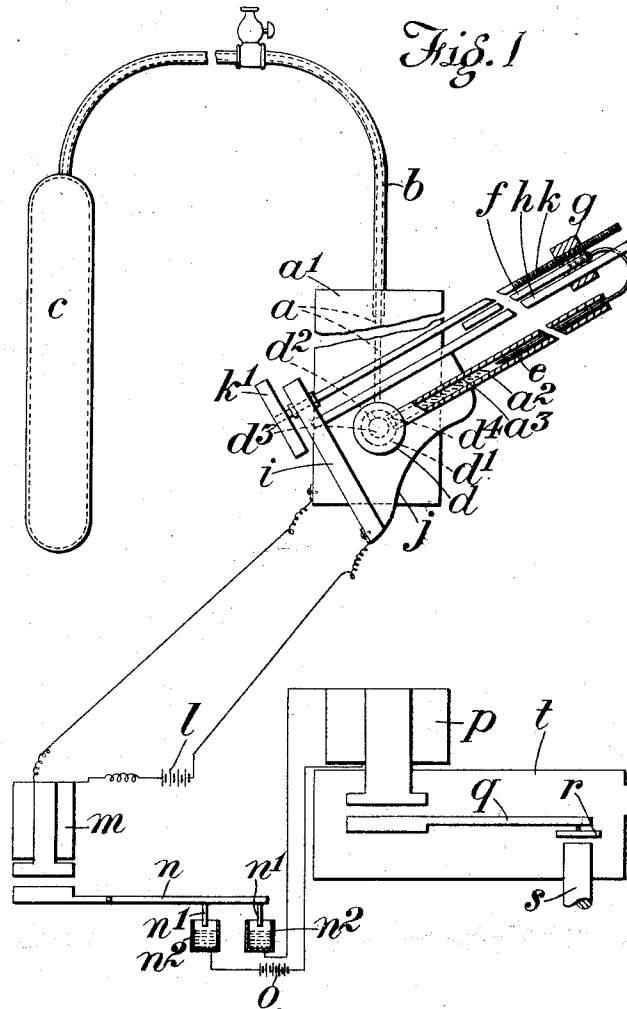
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MEANS FOR CONTROLLING THE TEMPERATURE IN FURNACES AND OTHER APPARATUS

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MEANS FOR CONTROLLING THE TEMPERATURE IN FURNACES AND OTHER APPARATUS.

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The present invention relates to means for automatically controlling the temperature in furnaces, ovens, retorts and other apparatus, of the kind in which expansion of air or
5 gas in a vessel, due to increase of temperature, causes a body of mercury to close an electrical circuit which actuates means to reduce the temperature, and the main objects of the invention are to provide devices of
10 this kind by the use of which the furnace or the like may be kept at any desired temperature with very fine accuracy of control, and also to provide devices for the said purpose operable within a large range of
15 temperatures and yet with great or fine accuracy of control where necessary, as for instance when the predetermined temperature to be maintained is comparatively low.

According to one feature of the present
20 invention, the electrical terminal with which the mercury co-acts to make and break the circuit aforesaid is adjustable and the part of the mercury container, containing the portion of mercury the upward or downward
25 movement of which closes or opens the aforesaid electrical circuit, is inclined to the vertical so that the direction of flow of the mercury therein is at an angle to its surface. Conveniently, the said part of the
30 mercury container is made adjustable so that the upper surface of the mercury therein may be more or less inclined relatively to the said direction of flow. By these provisions very fine accuracy of control may
35 be obtained as the distance the mercury travels under a particular pressure is greater when the mercury is inclined than when it is vertical and the arrangements for adjustment of the terminal provide for proper
40 initial adjustment of its position and variation of position from time to time as may be necessary in consequence of variation in the quality of the fuel used. When the inclination of the mercury is adjustable as
45 aforesaid the increase of travel of the mercury may be varied according to the temperature to be maintained, the adjustability of the terminal admitting of variation of its position according to the inclination of the
50 mercury. In this case, therefore, the instrument may be adjusted to operate within a large range of temperatures with very fine accuracy of control where it is necessary, that is, when the mercury is much inclined
55 from the vertical to adjust the instrument for comparatively low temperatures.

In order that the said invention and the manner in which it may be carried out may be clearly understood the said invention is hereinafter particularly described with reference to the accompanying drawing which
60 illustrates the preferred embodiment thereof.

Figure 1 is a diagrammatic side elevation, partly in section, showing one form of
65 controlling means according to the invention; and

Figure 2 is a vertical section, enlarged, showing a detail of the apparatus shown in Figure 1.

The mercury container, which is outside
70 the furnace or the like consists of a tubular part a in an upright fixed portion a^1 the upper part of which tubular part is connected to the end of a tube b communicating with the air vessel c , (which is within
75 the furnace or the like) and a movable tubular part a^2 of glass or other electrical insulating material. One end of this movable part a^2 is secured in a metal trunnion d in the fixed portion a^1 and communicates
80 through passages d^1, d^2, d^3, d^4 in the trunnion d with the lower end of the tubular part a of the mercury container. As shown in Figure 2, the trunnion is in the form of a
85 rotary plug having in its periphery an annular groove d^1 into which the lower end of the part a opens in all positions into which the trunnion may be turned. A radial passage
90 d^2 connects the groove d^1 with the inner end of an axial bore-hole d^3 in the trunnion, and the part a^2 opens at the outer end of the trunnion into the other end of the bore-hole
95 by way of a second radial passage, as shown at d^4 . The trunnion d is slightly conical and ground into its bearing in the part a^1 and secured therein by a screw-nut after the manner of a plug-cock. The angularly adjustable parts are shown in an inclined position
100 in Figure 1, and directed vertically downwards in Figure 2. It will be seen that the trunnion d constitutes an adjustable connecting part between the container a and the tube a^2 . Within the part of the adjustable part a^2 of the mercury container above the mercury a^3 therein, an
105 electrical terminal e in the electrical operating circuit is axially arranged, the said terminal being the end of a wire which passes out of the upper end of the said adjustable part a^2 and is bent round and
110 secured to a rod f which is slidably secured in a carrier g working on a carrier rod h

parallel to the said adjustable part. The end of the carrier rod *h* contiguous to the trunnion *d* is secured in a metal plate *i* which is carried by the said trunnion 5 through the medium of a block of electrical insulating material *j* secured thereto. The said metal plate *i* also carries a screw *k* with hand wheel *k*¹ which screw is engaged with a screw thread in the carrier *g*. By turning 10 this screw the position of the carrier *g* and consequently the position of the electrical terminal *e* in the mercury container may be very finely adjusted, a coarse adjustment being made by sliding the rod *f* to which 15 the outer end of the terminal wire or conductor *e* is secured, in the carrier *g* in which it is retained after adjustment by a clamping set screw, not shown. The fixed portion *a* of the mercury container is in the aforesaid 20 electrical circuit and electrical current passes through it to the mercury when the circuit is closed. The adjustable part *a*² of the mercury container with the other parts carried by the trunnion *d* may be moved round 25 by hand in an arc from a vertical to a horizontal or nearly horizontal position, the parts remaining in their adjusted position by the friction of the trunnion *d* in its bearing. The electrical circuit is through the 30 part *a* trunnion *d* and mercury *a*³ to the terminal *e*, when in contact with the mercury, rod *f*, carrier *g* and *h* and plate *i*. In the circuit is a battery *l* and electromagnet *m* which, when the circuit is closed by the 35 mercury *a*³ contacting with the terminal *e*, is energized and operates the pivoted armature *n*. This armature *n* has on it two metal pins *n*¹, *n*¹ located and working in two mercury cups *n*², *n*² which are in another electrical circuit comprising a battery *o* and 40 electro-magnet *p*. When the armature *n* is actuated the pins *n*¹, *n*¹ are depressed into contact with the mercury in the cups *n*², *n*² and close the second electrical circuit thereby energizing the electro-magnet *p* which 45 actuates a pivoted armature *q* carrying a valve or damper *r* which is situated adjacently to the mouth of the gas supply pipe *s* to the furnace so that as the armature *q* is actuated the valve or damper *r* closes or 50 opens the gas supply pipe more or less. The mouth of the gas supply pipe *s* and armature *q* are located in a chamber *t* to which the fuel is supplied. When therefore the mercury *a*³ is caused to rise in the 55 part *a*² of the mercury container, by expansion of the air in the vessel *c* due to rise of temperature in the furnace, until the mercury contacts with the terminal *e*, the first electrical circuit is closed, thereby closing 60 the second circuit and operating the

damper *r* to reduce the fuel supply to the furnace. These relay provisions do not constitute part of the present invention apart from the main feature thereof.

In order to allow attainment of the desired temperature in the first instance an adjustable relief valve is provided in the pipe *b* which valve is opened or allowed to open while the said temperature is being attained and when the said temperature is reached the said valve is closed the purpose being to prevent undue pressure in the air bulb. This feature however does not constitute part of the present invention apart 75 from the main feature thereof.

By turning the trunnion *d* and parts carried by it more and more from the vertical to the horizontal the surface of the mercury *a*³ in the part *a*² becomes greater and greater 80 and the distance the mercury travels under a given increase of pressure is increased the result being a very accurately acting adjustment of the control.

In cases where no provision for variation 85 of the delicacy of the control is needed the part *a*² may have a fixed inclined position at any angle to the horizontal according to requirements.

What I claim as my invention and desire 90 to secure by Letters Patent is:—

1. In a circuit closing device, the combination of a container, an electrically conducting liquid therein constituting one terminal of an electric circuit, a tubular trunnion 95 rotatable about its longitudinal axis and in open communication with the chamber in all positions of the trunnion, a tube of insulating material carried fluid tight at one end by said trunnion and opening into the same, 100 and an electrical contact piece extending into the other open end of said tube, which contact piece is normally located above the level of the liquid in said container and constitutes the other terminal of said circuit. 105

2. In a circuit closing device, the combination of an upright tubular mercury container, a horizontal tubular trunnion mounted at the bottom thereof and rotatable about its longitudinal axis, said trunnion having 110 an annular groove that opens into the said container in all positions of the trunnion and is connected to the interior of the trunnion, a glass tube mounted by its lower end on said trunnion and opening fluid tight 115 into the same, an electrical terminal in the form of a wire extending endwise into the upper end of said glass tube, and means carried by said trunnion for adjusting said wire in said tube. 120

In testimony whereof I affix my signature.
NAT HARRIS FREEMAN.