May 31, 1927. 1,630,312

W. A. RHODES

THERMAL TRANSLATING DEVICE

Filed Dec. 6, 1919

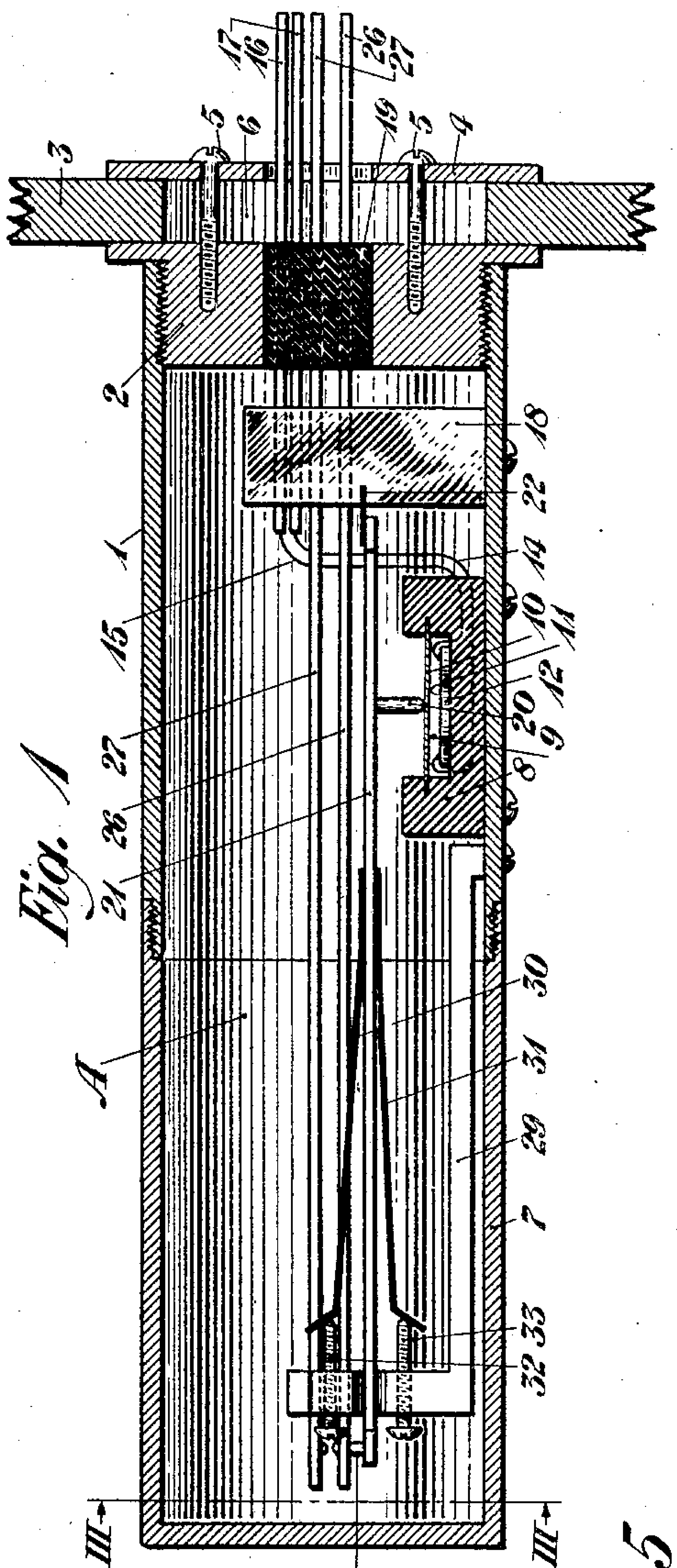

Fig. 1

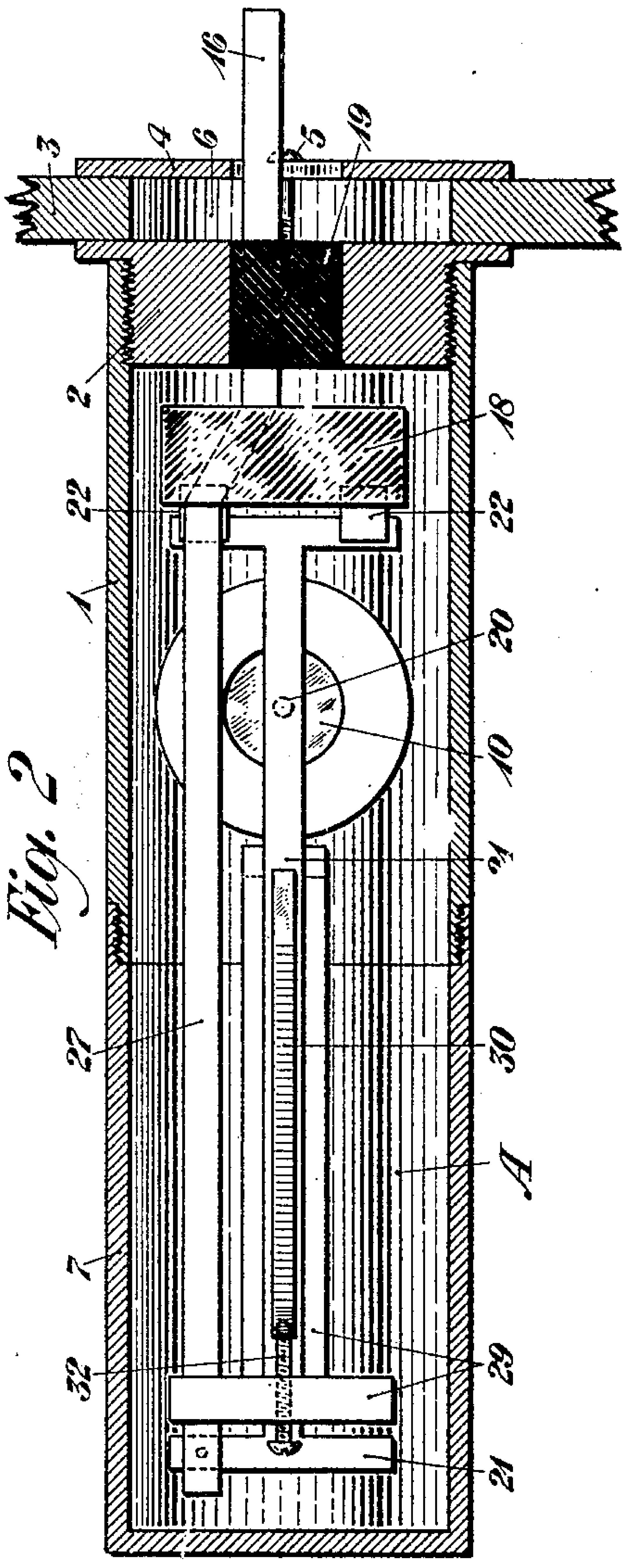

Fig. 2

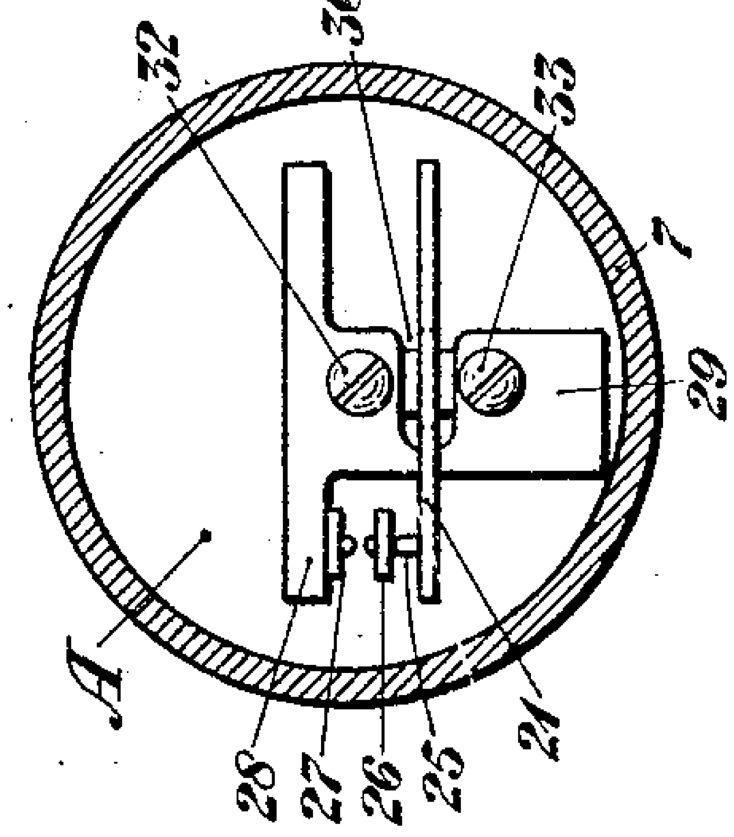

Fig. 3

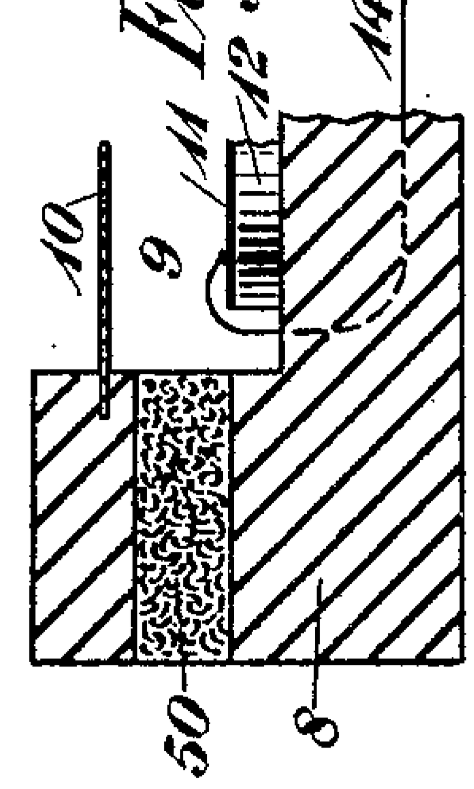

Fig. 5

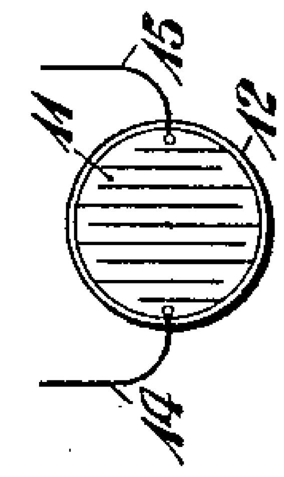

Fig. 4

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# UNITED STATES PATENT OFFICE.

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## THERMAL TRANSLATING DEVICE.

Application filed December 6, 1919. Serial No. 343,103.

This invention relates to thermal translating devices; more particularly, to devices of this character responsive to electric current for operating electric contacts.

The object of the invention is to provide a device of this kind, which is simple of construction, which is not affected by variations in temperature of the atmosphere or other surrounding media and whose interval of response may be readily and accurately adjusted.

These objects of the invention and certain other features described below are attained by certain methods and combinations of elements described in the following specification which has reference to certain specific forms of embodiments of the invention illustrated in the accompanying drawing, in which

Figure 1 is a side view of one form of device embodying the invention; Fig. 2, a plan view thereof, certain parts of the device being shown in section in Figs. 1 and 2; Fig. 3, a section of Fig. 1 taken on line III—III looking in the direction of the arrows; Fig. 4, a detail view of certain parts of the device and Fig. 5, a view showing a modification of a certain part of the device.

Similar characters of reference denote similar parts in each of the several views.

Reference character A in the drawing designates the casing of the relay, this casing being comprised of a sleeve 1 threaded at its right end and screwed over a base block 2 which is clamped to a vertical supporting plate 3 by means of a circular plate 4 and screws 5, the plate 3 being provided with a circular opening 6 of smaller diameter than the outside diameter of the plate 4. A cap 7 is screwed on to the left end of sleeve 1. A block 8 of heat insulating material, such as hard rubber or composition, is secured to the wall of sleeve 1 and provided with a circular recess 9, a part of which is closed air-tight by means of a resilient diaphragm 10, which may be constructed of thin sheet steel for example. Inside the air-tight chamber is a heating element 11 which is preferably a metallic filament such as beaten gold leaf or chemically deposited metal supported by a thin disc 12 of glass or similar material. The filament in the present instance is in the shape of a circular disc slitted alternately from opposite sides as indicated in Fig. 4, so that current which is led thereto by conductors 14 and 15 is forced to take a circuitous passage through the disc and cause a relatively large rise in the temperature thereof. The conductors 14 and 15 are associated with terminals 17 and 16 which extend through a block 18 of insulating material, secured to the sleeve 1, and through an opening in the block 2, which opening is sealed by an insulating compound 19. The diaphragm is normally distorted so as to be convex inwardly to the chamber 9 so that when the air inside the chamber 9 is heated to a certain temperature it will snap upwardly into an operated position owing to the pressure of the air. In this movement the diaphragm engages a stud 20 fixed to the lower side of an I-shaped bar 21, which is hinged by means of thin flexible metal strips 22 to the block 18. The bar 21 is provided adjacent its left end with a stud 25 which bears against the lower side of a contact spring 26, which cooperates with a spring 27, both of these springs being mounted in and extending through the block 18 and the filling 19 of the base block 2. The upper face of the spring 27 bears against a projection 28 of an L-shaped member 29 of insulating material which is secured by screws to the sleeve 1, as indicated in Fig. 1. The projection 28 serves to prevent the spring 27 from continuing its upward movement when pressed by spring 26 as the latter is lifted by the member 21, so that a firm closure of the contact may be attained. A slot 36 is provided in member 29 to permit the upward and downward movements of bar 21. A pair of springs 30 and 31 are provided to bias the bar 21 to the position shown in the drawing, these springs being affixed at their right end to the upper and lower sides of the bar respectively, and bent adjacent their left ends so as to cooperate with adjustment screws 32 and 33 which are mounted in the member 29. It will be observed that by manipulation of these screws the normal position of the bar 21 may be raised or lowered. Further adjustment of the relay may be attained by bending the contact springs 26 and 27, as is usual in the art.

In the operation of the relay the controlling circuit is connected to the terminals 16 and 17 and the circuit which is to be controlled is associated with the contact spring terminals 26 and 27. A flow of current in the controlling circuit of sufficient strength and duration will cause, after a certain interval of time, such heating and expansion of the air in the chamber 9 as to cause the diaphragm to snap upwardly and lift the bar 21 from its normal position so that the same operates the contact 26—27, thus permitting flow of current through the circuit controlled by these contacts. When the operating current ceases to flow, the filament cools and the air in the chamber contracts, so that after a certain interval of time the pressure of the spring 31 causes the diaphragm to spring back to its normal position, thus opening the contact and stopping the flow of current in the circuit associated therewith. It will be observed that because of its resiliency the diaphragm snaps from one position to the other, so that the contact 26—27 opens and closes rapidly, thus reducing the arcing to a negligible amount.

The time interval which elapses between the instant when the current begins to flow through the filament and the time when the relay responds thereto by operating its contacts may be adjusted, as described hereinbefore, by manipulation of the adjustment screws 32 and 33 and by bending of the contact springs 26 and 27. Further adjustment can be made by rotating the entire relay about its longitudinal axis so as to change the convection currents in the air chamber 9 and thus vary the interval of time required to bring about the requisite rise in the temperature of the air in the chamber. This adjustment may be made by loosening the screws 5 which serve to bind the block 2 and the plate 4 against the sides of the supporting plate 3 and rotating the entire casing about the longitudinal axis into the desired angular position.

Compensation for changes in room temperature is effected by making the casing A of the relay air-tight. Since changes in the room temperature cause like changes in the temperature of the air in the relay casing and of the air in the chamber 9, the resultant increase or decrease of pressure on one side of the diaphragm is balanced by a similar rise or fall in the pressure on the other side thereof.

The relay may be provided with additional contact springs which may be operated by the right end (Fig. 3) of the bar 21, these springs not having been shown in the drawing to avoid unnecessary complication thereof.

In the modification illustrated in Fig. 5 the compensation is effected by the use of a plug 50 of porous material embedded in the walls of chamber 9, so that when the air in the chamber expands or contracts slowly, as in response to changes in the temperature of the atmosphere, there is a leakage of air out of, or into, the chamber through the porous plug. The pressure of the air in the chamber will therefore not undergo a substantial change and the diaphragm will remain in its position. The casing A should in this case not be air tight.

It will be observed that, owing to the fineness of the filament and the minuteness of the chamber 9, the relay of this invention is operable by extremely small currents, such as are usual in telephony, for instance, although the same is not thus limited in use, it being understood that various changes and modifications may be made in the embodiment of the invention within the scope of the following claims without departing from the spirit and scope of the invention.

What I claim is:

1. A translating device comprising a fluid, means for confining said fluid, a diaphragm separating the confined fluid into two parts, means for heating the fluid on one side of the diaphragm and mechanism for translating the motion of the diaphragm on the other side thereof.

2. In a translating device, a fluid, means for confining the fluid, a device actuated by the changes in temperature of the fluid, a device for heating the fluid, and means for adjusting the direction of the convection currents caused by said last-mentioned device in heating the fluid.

3. In a translating device, a fluid, means for confining the fluid, a diaphragm actuated by changes in temperature of the fluid, and means for rendering said diaphragm non-responsive to variations in the volume of said fluid caused by variations in the temperature of the surrounding medium, said means comprising a second fluid and means for confining the same and causing the actuation of said diaphragm in opposite direction thereby.

4. In a translating device, means comprising a diaphragm for forming a chamber, fluid in the chamber for actuating said diaphragm in accordance with changes in volume thereof, a device for heating said fluid, means for adjusting the directions of the convection currents caused in said fluid by said heating device so as to govern the period of time required to raise the temperature of said fluid, a contact actuated by said diaphragm, means forming a second sealed chamber, fluid therein for actuating said diaphragm in opposite direction, so as to balance the pressures caused by like changes in temperature in the fluids of both chambers.

5. A casing, an eccentric chamber walled off within said casing by a partition comprising a diaphragm, fluid within said casing and within said chamber, heating means within the chamber and mechanism to be

actuated by the diaphragm within the casing outside the chamber, and a support on which the casing is adjustably mounted, so that the position of the said chamber can be changed to vary the rate of cooling by convection.

6. A cylindrical casing closed at both ends, means to attach one end adjustably to a support, an eccentric fluid chamber within the casing, a diaphragm serving as a partition between said chamber and the remainder of the interior of the casing, means for generating heat within said chamber and mechanism actuated by the diaphragm within said casing.

7. A cylindrical casing supported with its axis horizontal and adapted to be adjusted to any angle around said axis, an eccentric chamber within said casing having a diaphragm as part of its partition wall, heating means within said chamber and mechanism within the casing to be actuated by said diaphragm.

8. In a translating device a chamber, a fluid therein, heating means in said chamber, a diaphragm in the chamber wall and means to change the angular position of the chamber so as to adjust the rate of cooling by convection.

In testimony whereof, I have signed my name to this specification this fourth day of December, 1919.

WILLIAM A. RHODES.