April 19, 1932. A. H. SANBORN 1,854,810

THERMOMOTIVE DEVICE

Original Filed Aug. 17, 1929 2 Sheets-Sheet 1

Fig. 1.

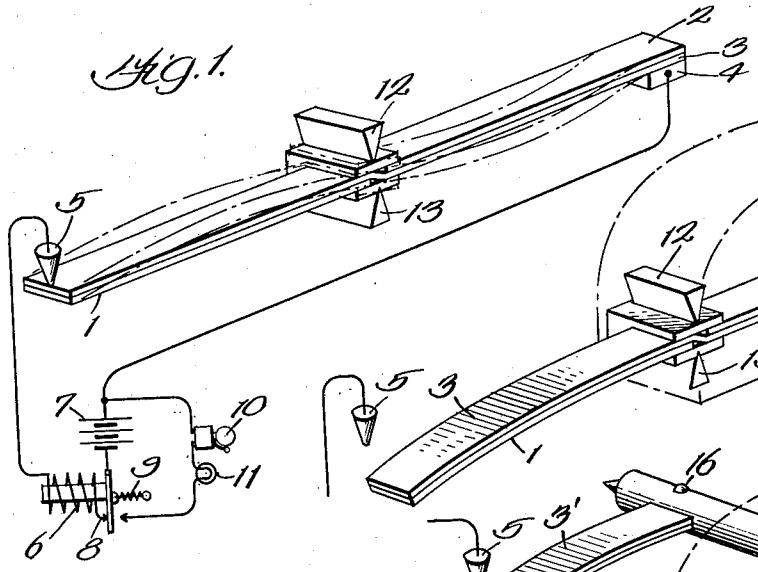


Fig. 2.

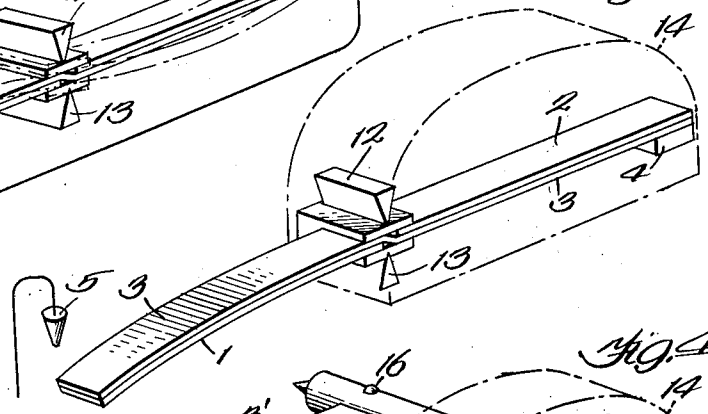


Fig. 4.

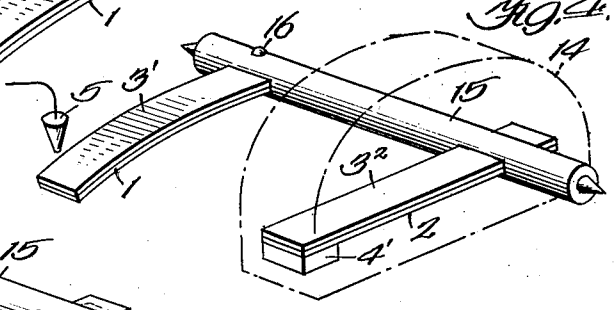


Fig. 3.

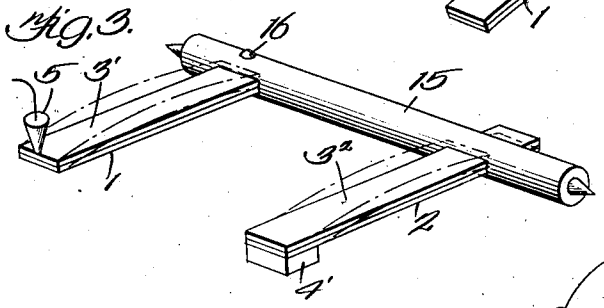


Fig. 6.

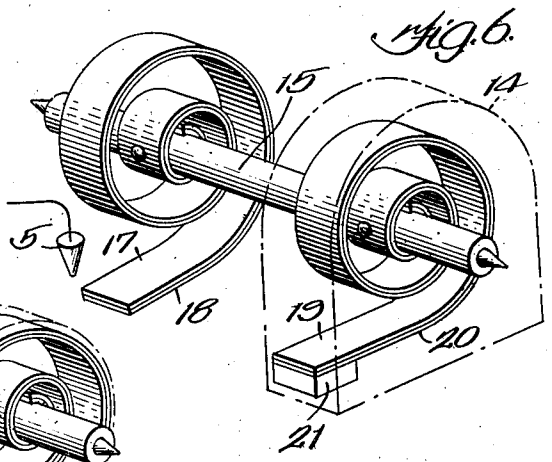
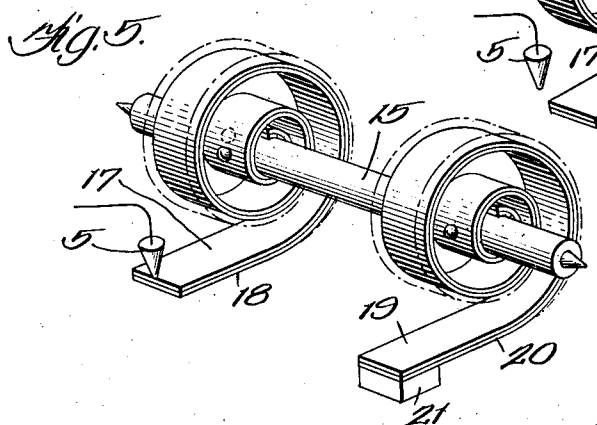


Fig. 5.



Inventor:
Arthur H. Sanborn
By S. L. Scragg Atty

April 19, 1932. A. H. SANBORN 1,854,810

THERMOMOTIVE DEVICE

Original Filed Aug. 17, 1929 2 Sheets-Sheet 2

Fig. 7

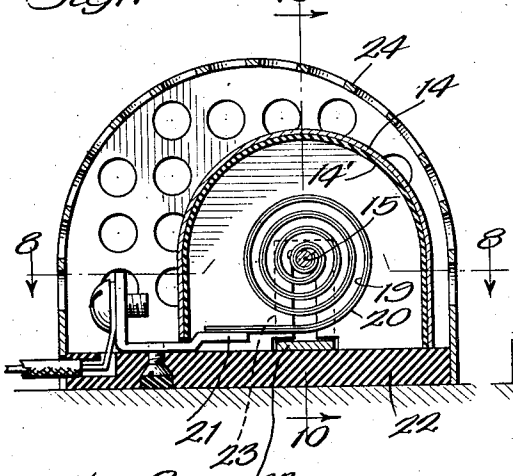


Fig. 10.

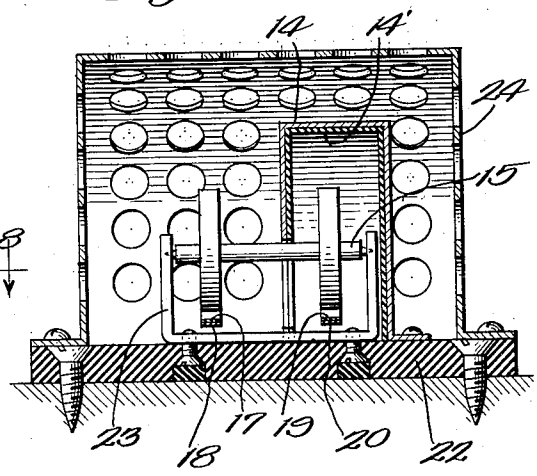


Fig. 8.

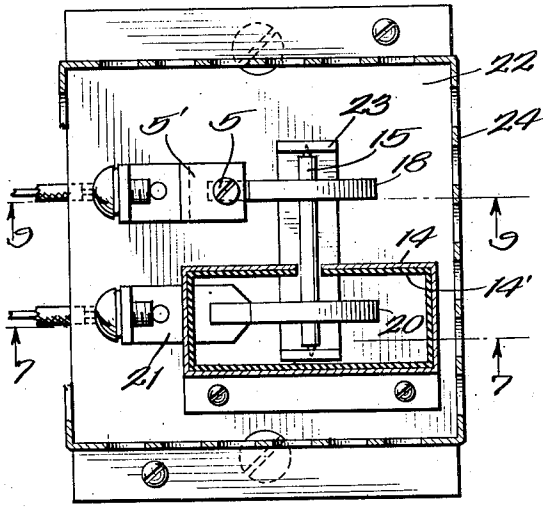


Fig. 11.

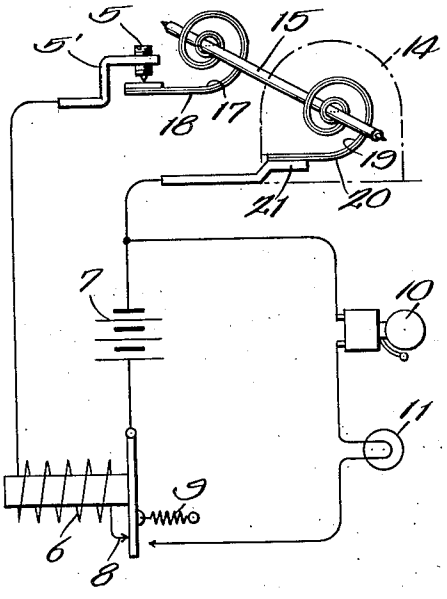
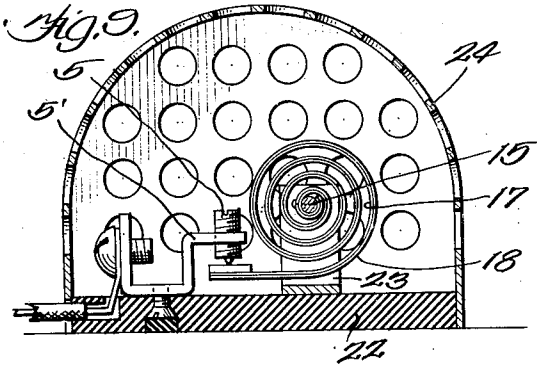


Fig. 9.



Inventor
Arthur H. Sanborn
By L. L. Cragg Atty.

Patented Apr. 19, 1932

1,854,810

UNITED STATES PATENT OFFICE

ARTHUR H. SANBORN, OF CHICAGO, ILLINOIS, ASSIGNOR TO YAXLEY MANUFACTURING COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

THERMOMOTIVE DEVICE

Original application filed August 17, 1929, Serial No. 386,537. Divided and this application filed July 31, 1930. Serial No. 472,017.

My invention relates to switching mechanism having operating means in the form of heat responsive devices. The heat responsive device I employ is inclusive of a unitary member having two portions which are flexible in response to changes in temperature, there being provision for retarding the effect of temperature changes upon one of said member portions with respect to such effect upon the other member portion. In the preferred embodiment of the invention this unitary member is inclusive of invar metal having substantially no coefficient of expansion and brass coupled therewith, the brass portion being constrained by the invar portion to flex in response to temperature changes. In the preferred embodiment of the invention the member upon which the temperature effect is retarded is provided with a hood for this purpose. This hood confines a body of air in which this member portion is received and serves to retard the effect of temperature changes upon this member portion with respect to such effect upon the other member portion. The two member portions are desirably coiled and in similar directions, two similar ends of these portions being in substantially fixed relation and the other end of one of these member portions being movable and the other end of the other member portion being fixed. The relative positions of the contacts of the switch are governed by these two members. In one embodiment of the invention, said movable end also serves as a contact and may, if desired, normally engage a complemental contact to normally maintain a suitable circuit closed, such as a circuit containing a relay that governs a normally open alarm circuit. The device is desirably so adjusted that both the hooded and unhooded portions thereof will be similarly and sufficiently simultaneously affected upon rise in temperature of 1° Fahrenheit or less per minute as not to disturb the circuits. When the device is subject to rise in temperature of more than 1° Fahrenheit per minute, the hooded and unhooded portions of the member will be sufficiently dissimilarly affected to occasion the alarm. If there is a sudden fire in the region of the device the hooded portion, that may be also a switch contact, will separate from the contact complemental thereto since the hood about the other portion of the flexible member will prevent the sudden rise in temperature from quickly affecting it, so that the flexible member is, in effect, subject only to the sudden rise in temperature at the portion thereof that controls the switch when the sudden temperature rise is first initiated. Ultimately the hooded portion will be similarly affected to again bring the switch contacts into engagement, but the local alarm circuit will remain closed since the circuit of the relay that controls it was also opened at the relay armature when the relay circuit was first opened. The temperature range in which the device is to operate may be varied, if desired, by suitable adjusting means.

The invention will be more fully explained in connection with the accompanying drawings in which Fig. 1 diagrammatically indicates one embodiment thereof minus the retarding hood, one circuit that may be employed in conjunction therewith, being also indicated; Fig. 2 is a view similar to Fig. 1 but indicating the hood in place and illustrating the effect thereof, the circuit diagram being omitted except for the contacts thereof; Fig. 3 is a diagrammatic illustration of another embodiment of the invention minus the retarding hood; Fig. 4 is a view similar to Fig. 3 with the retarding hood present; Fig. 5 is a diagrammatic view of the preferred embodiment of the invention minus the retarding hood; Fig. 6 is a view similar to Fig. 5 with the retarding hood present; Fig. 7 is a sectional view illustrating the preferred mechanical construction of the invention diagrammatically illustrated in Fig. 6, this figure being taken on line 7—7 of Fig. 8; Fig. 8 is a sectional view on line 8—8 of Fig. 7; Fig. 9 is a sectional view on line 9—9 of Fig. 8; Fig. 10 is a sectional view on line 10—10 of Fig. 7; and Fig. 11 is a diagrammatic illustration showing one employment of the structure shown in Figs. 5 to 10 inclusive.

In the construction shown in Fig. 1 the strips of invar metal 1 and 2 are assembled with a strip 3 of brass, the invar strips being upon opposite faces of the brass strip. One

invar strip is intimately joined with and throughout one half of the brass strip and the other intimately joined with and throughout the other half of the brass strip. One end of the flexible member comprised of the invar and brass strips is provided with a fixed anchorage 4. The other end of this member is movable to have engagement with a switch contact 5 constituting one terminal of a circuit here shown as being normally closed, the flexible member constituting the other terminal of this circuit. This normally closed circuit includes a relay 6, a battery 7 and an armature of the relay, together with a normal contact 8 of this armature. Upon separation of the flexible member from the contact 5, the local circuit containing the relay 6 is opened, whereupon the retractile spring 9 moves the armature of the relay from its normal contact into engagement with the alternate contact of this armature, whereby a local alarm circuit is closed. The alarm circuit illustrated includes a signal bell 10 and an incandescent lamp 11. After the local circuit has been once opened it cannot be reclosed by the mere engagement of the contact 5 by the flexible member complemental thereto since there would then be another gap in the circuit at the contact 8. The flexible member is provided with knife edge mountings illustrated at 12 and 13. Fig. 1 indicates the flexible member 1, 2, 3, 4 with all of its parts equally subject to temperature changes. The dotted lines in this figure indicate a flexure of the flexible member, due to temperature rise, which will not remove this flexible member from engagement with the contact 5 since the flexing in each portion of the flexible member counteracts the flexing of the other insofar as changing the contacting relation of said member with this contact 5 is concerned. The structure of Fig. 1 is completed, in accordance with the preferred embodiment of my invention, by the addition of a hood 14 which surrounds the flexible member portion that is inclusive of the invar strip 2 and the half of the brass strip 3 that is coupled therewith. This hood confines a body of air in which the contiguous member portion is received and serves to retard the effect of temperature changes upon this member portion with respect to such effect upon the other member portion. The hood may have a heat insulating lining 14'. If the temperature rise is slow, such as 1° Fahrenheit or less per minute, the hood will permit the flexible member to flex, as indicated in Fig. 1, in which event the relay circuit will remain closed. If the temperature change is more than 1° Fahrenheit per minute, the hood will retard the effect of the temperature change upon the hooded portion 2, 3 of the flexible member, so that the unhooded portion of the flexible member will be so flexed, during a sufficient interval, to open the relay circuit and permit the armature of the relay to establish the local alarm circuit that contains the responsive devices 10, 11.

In the structure shown in Fig. 3, the unitary flexible member is inclusive of two brass strips 3', 3^2 which are respectively faced by the invar strips 1 and 2. The two pairs of unlike strips are coupled by a shaft 15 which may be pivotally mounted, at its ends, this shaft thus serving to incorporate the four metal strips into a unitary member. The flexible portion 1, 3' of the flexible member may be in fixed relation with the shaft as by means of a set screw 16. The flexible portion 2, 3^2 may have a fixed anchorage 4', at one end, and may pass through a slot in the shaft 15, at its other end, there to have sliding relation with said shaft. Fig. 3 illustrates how the two portions of the flexible member will flex alike, when subject to similar temperature rises, the contact 5 consequently remaining in constant engagement with the member portion 1, 3'. When, however, the member portion 2, 3^2 has the hood 14 applied thereto, as indicated in Fig. 4, this member portion will not initially respond to the selected sudden rise in temperature, the member portion 1, 3' then having opportunity to flex away from the contact 5 to open the relay circuit, with the results described.

The structures of Figs. 5 and 6 are generally similar to the structures of Figs. 3 and 4 and have the same operation with the exception that the heat responsive strips are coiled around the shaft in similar directions. The relay circuit will, with the apparatus illustrated, remain closed during temperature changes that are, in the example chosen, 1° Fahrenheit or less per minute, but when the temperature change is a rising temperature and is more than 1° Fahrenheit then the relay circuit will be opened, with the results stated.

Referring more particularly to Figs. 5 and 6, and also to the subsequent figures, one flexible member portion is inclusive of a brass strip 17 and an invar strip 18 which are together coiled about the shaft 15. One end of this member portion is fixed to this shaft and the other end of this portion is in separable engagement with the contact 5, this member portion itself, also constituting a contact complemental to the contact 5. The other flexible member portion is inclusive of a brass strip 19 and an invar strip 20 which are coiled and assembled with the shaft 15 similarly to the member portion 17, 18. Both coiled portions of the flexible member are coiled in similar directions and have two similar ends fixedly connected by the shaft 15 since, due to the coiling, it is unnecessary to provide the slipping relation which is present between the member 2, 3^2 and the shaft 15 of the structure shown in Figs. 3

and 4. The outer end of the member portion 19, 20 is provided with a fixed anchorage, as indicated at 21. For reasons which have been hitherto fully set forth, there will be no change in the relation of the contact 5 and the contact 17, 18 due to temperature rise, whether this rise is sudden or slow, if no provision is made for retarding the effect of temperature changes upon one of the members, as indicated in Fig. 5. If, however, the hood 14 is added, as indicated in Fig. 6, the contact 17, 18 will separate from the contact 5 upon rise in temperature if this rise is sufficiently rapid. The contact 5 may be in the form of a screw which is threaded into a bracket 5'. When the contact 5 is thus arranged, the extent of temperature rise, which is required to effect separation of the contact in the relay circuit, may be varied.

The implement is desirably mounted upon an insulating block 22. The shaft 15 may be journaled in the sides of a U-shaped bracket 23 which is secured to block 22. The entire structure may be covered by another hood 24 to guard the structure, this hood being provided with large perforations, so as to have no retarding effect of the temperature changes upon the structure, the hood 14 on the other hand, being preferably imperforate so as to have such retarding effect with relation to the flexible member portion enclosed thereby.

The present application is a division of my original application Ser. No. 386,537, filed August 17, 1929.

Changes may be made without departing from the invention.

Having thus described my invention, I claim:

1. A heat responsive device inclusive of a unitary member having two portions coiled in similar directions with two similar ends of said portions in substantially fixed relation and the other end of one of said member portions movable and the other end of the other of said member portions fixed, said coiled member portions being expansible and contractible in response to temperature changes, there being provision for retarding the effect of temperature changes upon one of said member portions with respect to such effect upon the other member portion, wherein there is a switch having one of two complemental contacts controlled by the movable member end.

2. A heat responsive device inclusive of a unitary member having two portions coiled in similar directions with two similar ends of said portions in substantially fixed relation and the other end of one of said member portions movable and the other end of the other of said member portions fixed, said coiled member portions being expansible and contractible in response to temperature changes, in combination with a hood for one of said member portions which confines a body of air in which this member portion is received and serves to retard the effect of temperature changes upon this member portion with respect to such effect upon the other member portion, wherein there is a switch having one of two complemental contacts controlled by the movable member end.

In witness whereof, I hereunto subscribe my name.

ARTHUR H. SANBORN.