To all whom it may concern:

Be it known that I, *Ralph F. Schneider*, a citizen of the United States, and a resident of the borough and county of the Bronx, city and State of New York, have invented a certain new and useful Improvement in Thermal Circuit-Closers, of which the following is a specification.

My invention relates more particularly to a type of thermal circuit closers commonly known as contact thermometers in which the mercury after reaching a predetermined degree is instrumental in bringing about for instance the electrical operation of an alarm. Heretofore it has been necessary to construct the tube of such thermometers with a plurality of terminals operating in conjunction with the usual bulb terminal and located at different degrees in order to provide the range of usefulness desirable and necessary in such an instrument. As the introduction of these tube terminals into said thermometers, in a manner to preserve the accuracy thereof, is a delicate and difficult operation, said instruments have heretofore been very expensive and troublesome to manufacture. The particular object of my improvement is to overcome these difficulties and objections and to provide a contact thermometer having only one terminal in the tube thereof in addition to the bulb terminal, and constructed in a manner to permit the degree at which the alarm is actuated to be varied in a simple and efficient manner. My invention will be fully described hereinafter and the features of novelty will be pointed out in the appended claims.

Reference is to be had to the accompanying drawings in which Figure 1 represents my improved thermometer in its normal condition; Fig. 2 is a similar view showing the said thermometer after the degree at which the alarm is actuated has been varied; and Fig. 3 is a similar view of another form of my improvement.

As shown in the drawings my improved thermometer comprises the customary bulb 5 and tube 6 in which a channel 7 is formed in communication with said bulb for the accommodation of the mercury column 8 in the usual way. The one or bulb terminal 9 is located in the bulb 5 so as to extend into the mercury therein in the known manner while a second single or tube terminal 10 is embedded in the tube 6 at any predetermined degree or neutral point so as to extend into the channel 7 in the path of the mercury column 8. In the form shown in Figs. 1 and 2 of the illustration the terminal 10 is located at the 90° point although this is only an example as will be clearly apparent from the description hereinafter and the tube 6 is provided with indications 11 of the customary kind which in the present example extend from zero to 90° and which in some cases may be omitted entirely as will also more clearly be brought out further on in the specification. The tube 6 as shown in the drawings is connected with a second tube 6' by means of a reduced portion 6", said second tube 6" being formed with a mercury channel 7' communicating with the channel 7 by means of what is technically known as a constriction 7' and being provided with indications 11" which commence at a figure indicating the degree at which the terminal 10 is located in the tube 6 and continue upwardly therefrom. Owing to the fact that in the illustration of my improvement as shown in Figs. 1 and 2 the said terminal 10 is located at 90° in the tube 6 the indications 11" thus begin at 90° on the tube 6'. The tubes 6 and 6" thus form continuations of each other and might be termed respectively a main section or tube and an auxiliary section or tube, an eyelet 6" being provided if desired at the free end of the tube 6" for suspending or supporting the instrument. The terminals 9 and 10 may be connected in any customary way with any suitable alarm indicating device such as an electric bell or the like, a source of electrical energy such as a battery being included in the circuit to actuate the alarm when the circuit is closed in this form of my improvement.

In the normal condition of the instrument in the form illustrated in Figs. 1 and 2 the mercury column 8 as it rises under the influence of heat will finally reach and engage the terminal 10, thus closing the circuit and sounding the alarm. This contact between the said column 8 and the terminal 10 will take place at 90° owing to the fact that the terminal 10 is located in the tube 6 at this point and the mercury column 8 is arranged to properly cooperate therewith to secure this result, so that the alarm in this case will be automatically actuated when 90° of heat has been reached in the vicinity of the instrument. The degree at which the
alarm is to be automatically sounded may be varied in the following manner. For instance it is desired to have the alarm actuated when a temperature of 120° is reached, the terminals 9 and 10 are disconnected from the alarm circuit and the bulb 5 for instance subjected to a sufficient degree of heat to cause the mercury column 8 to rise beyond the terminal 10 and finally to force itself beyond the constriction 7 and pass into the tube 6. This is continued until the end of the mercury column 8 is opposite or registers with the indication 11 on said tube 6 designating 120° as shown in Fig. 2 after which the bulb 5 is removed from the influence of the heat above mentioned and the thermometer permitted to cool. That portion of the mercury column remaining in the tube 6 below the constriction 7 will thus gradually return to its normal state and will fall until the normal condition of the mercury is again reached whereupon it will be found that the end of the mercury column in this normal state now stands opposite 60° in the tube 6. That portion of the mercury column 8 which through the heating of the bulb 5 has passed into the tube 6 will be prevented by the constriction 7 from returning to the tube 6 as the thermometer cools so that the mercury column 8 in the tube 6 has by the above operation been decreased in length a distance corresponding to 30°. As will be readily apparent, the thermometer must now be subjected to 120° of heat before the mercury column which has been shortened 30° as described, will reach and contact with the terminal 10 so that in this condition of the instrument the alarm will be sounded at 120° instead of at 90° as before, it being of course understood that the terminals 9 and 10 have been re-connected with the alarm circuit. If the alarm is to be sounded at any degree above 120° the same proceeding is followed and the column 8 still further shortened by heating the bulb 5 to a higher degree and causing the column 8 to rise higher in the tube 6 or until said column reaches the indication 11 designating the degree at which the alarm is to be sounded. It will of course be understood that the mercury may be caused to enter the tube 6 in any other manner than by the application of heat to the bulb when it is desired to shorten the mercury column and change the degree at which the alarm is sounded. If the alarm is to be again sounded at 90° the mercury in the tube 6 is returned to the tube 6 by shaking the thermometer or in any other way to force it back beyond the constriction 7 and thus again bring the said column 8 to its original height and condition. The arrangement so far described is intended for sounding an alarm when the temperature rises to a predetermined point, or in other words is a heat alarm. When an instrument for sounding an alarm when the temperature drops to a predetermined point is desired, or in other words a frost alarm, to be sounded, the arrangement shown in Fig. 3 is used. In this form of my improvement the terminal 10 as before is located at a predetermined neutral point on the tube 6, say 70° and the mercury column 8 normally extends into contact therewith as is clearly shown in Fig. 3. The terminals 9 and 10 as shown diagrammatically are in circuit with batteries 12 and a relay 13, the latter controlling a circuit including a battery 14 and an alarm 15. Thus as long as the mercury column 8 remains in contact with the terminal 10 the relay circuit will be closed and the alarm circuit will be maintained in an open or broken condition by said relay. As soon as a drop in temperature causes the mercury column 8 to drop below and out of contact with the terminal 10 the relay circuit will be broken and the battery circuit will be closed by the relay and the alarm 15 immediately actuated. In the normal arrangement shown in Fig. 3 the alarm will accordingly be sounded as soon as the temperature drops below 70°. The tube 6 in this form contains a portion of the mercury column 8 and beyond the constriction 7 is provided with a scale 11 commencing at zero and reading upward, the length of said column in the tube 6 in cooperation with the scale 11 visibly indicating the degree below which the alarm will be sounded. In the illustration the instrument being in its normal state, the mercury in the tube 6 thus stands at 70° which is the degree at which the terminal 10 is located. If it is desired to have an actuation of the alarm at a degree below the degree at which the terminal 10 is located in the tube 6 the length of the mercury column 8 in the said tube 6 is increased by simply transferring a portion of the mercury from the tube 6 to the tube 6. This may be accomplished by shaking the instrument or in any other way and in any case increases the length of the column 8 in the tube 6. If for instance an alarm at approximately 40° is desired an amount of mercury corresponding in length to the distance occupied by 30° is transferred to the tube 6 and thus added to the column 8 which is thus increased in length to this extent. At the same time the column of mercury in the tube 6 will be decreased this much in length so that said mercury will now stand at 40° on the scale 11 indicating that an alarm will be sounded when the temperature drops below 40°. In other words the mercury column 8 will now remain in contact with the terminal 10 for a longer period than before so that the relay circuit will remain closed a correspondingly longer time and
the alarm circuit opened to sound the alarm only after the temperature drops below 40°. It will be readily apparent that by transferring more or less mercury from the tube 6° to the tube 6 the degree at which an alarm is had may be more or less lowered as desired. To again bring the instrument to its normal condition the amount of mercury which has been removed from the tube 6° is simply returned thereto in any desirable manner. When a heat alarm at a different degree from that at which the instrument is set is desired the length of the mercury column 8 in the tube 6 is decreased to cause a longer period of time to elapse before contact between the mercury column and the terminal 10 takes place, while when a frost alarm at such different degree is desired, the length of the said mercury column 8 is increased to cause a longer period of time to pass before the contact between said mercury column and the terminal 10 is broken. It will thus be seen that the alarm may be automatically sounded through the medium of the thermometer at any desired degree either of heat or cold, within the range of the instrument by simply varying the length of the mercury column in the manner described and without necessitating any change in the terminal 10 or without necessitating a plurality of such terminals. The tube 6° acts as a container for the mercury which in the one case is taken from the column 8 and which in the other case is added thereto and the indications 11° and 11° in cooperation with the mercury in the tube 6° designate the different degrees at which the alarm will be automatically sounded or in other words designate the degree at which the instrument is set. By locating the terminal 10 at different points along the tube 6° during manufacture and arranging the mercury column 8 accordingly the degree at which the alarm in the normal condition of the device may be caused by the particular instrument in question may be changed. For instance said terminal 10 might be located at 60° to cause the alarm normally to be sounded at approximately this point, the operation being the same as herein described when an alarm at a higher or a lower degree is desired. As the point at which the terminal 10 is located is initially determined usually by finding the neutral degree and is therefore known it will be obvious that all of the indications 11° on the tube 6 may be omitted or that said tube may be simply supplied with a single indication 11° opposite to the terminal 10 and designating the degree at which it is located.

The instrument below the constriction 7° in each form is thus a complete contact thermometer while the tube 6° is a container or attachment making it possible to adjust the said instrument for automatically sounding an alarm at a predetermined degree and at different degrees above or below said predetermined degree as may be desired. My improvement thus necessitates the use of only a single tube terminal in addition to the customary bulb terminal and consequently simplifies the construction of the instrument and reduces the cost thereof, while at the same time the accuracy of said instrument is more easily maintained in manufacturing same owing to the fact that only one, instead of a plurality of terminals need be incorporated in the tube 6. My improved instrument may be used for any purpose or in any connection for which thermometers of the contact type are intended. It will of course be understood that means other than the construction 7° may be provided for preventing a ready travel of the mercury from the tube 6° to the tube 6.

Various other changes in the specific construction shown and described may be made within the scope of the claims without departing from the spirit of my invention.

1. The combination of a thermometer, two terminals combined therewith at spaced intervals, a column having electrical conductivity and arranged to cooperate with said terminals to close an electrical circuit at a predetermined degree of temperature and means adapted to divide said column into disconnected sections whereby the degree at which closing of the circuit takes place may be varied.

2. The combination of a thermometer, two terminals combined therewith at spaced intervals, a mercury column arranged to cooperate with said terminals whereby an alarm is actuated at a predetermined degree of temperature and means for retaining a portion of said column whereby the effective length thereof and the degree at which said action takes place may be varied.

3. The combination of a mercurial thermometer, a bulb terminal and a tube terminal combined therewith, a mercury column arranged to cooperate with said terminals whereby an alarm is actuated at a predetermined degree of temperature, means for dividing said column into disconnected sections whereby the effective length thereof and the degree at which said action takes place may be varied and means whereby the extent of said change and the degree at which the action will take place is indicated.

4. The combination of a thermometer, two terminals combined therewith at spaced intervals, a column having electrical conductivity and arranged to cooperate with said terminals to close an electric circuit at a predetermined degree of temperature and means for retaining a portion of said column whereby the effective length thereof and the degree at which said action takes place may be varied.
determined degree of temperature and a constriction in said thermometer at an intermediate point beyond which said column is arranged to be forced and whereby a portion thereof is normally retained to reduce the effective length of said column and vary the degree at which the closing of the circuit takes place.

5. The combination of a mercurial thermometer, a bulb terminal and a tube terminal combined therewith and adapted to be connected by the mercury column at a predetermined degree of temperature and means for dividing the mercury column into disconnected sections whereby the degree at which the connection is effected may be varied.

6. The combination of a mercurial thermometer, a bulb terminal and a tube terminal combined therewith and adapted to be connected by the mercury column at a predetermined degree of temperature and a container into which the mercury column is arranged to extend and whereby a predetermined portion thereof is retained and separated from the remainder of the column to reduce the normal length of said column and vary the degree at which said connection is effected.

7. A mercurial thermometer comprising a main tube, a bulb terminal and a tube terminal combined with said main tube and adapted to be connected by the mercury column at a predetermined degree of temperature, an auxiliary tube connected with said main tube and adapted to receive a portion of the mercury column whereby the normal length of the latter is reduced and the degree at which the connection between the terminals takes place may be varied and means for preventing the ready return of the mercury from the auxiliary tube to the main tube.

8. A mercurial thermometer comprising a main tube, a bulb terminal and a tube terminal combined with said main tube and adapted to be connected by the mercury column at a predetermined degree of temperature, an auxiliary tube connected with said main tube and adapted to receive and retain a portion of the mercury column separate from the remainder thereof whereby the normal length of the column is reduced and the degree at which the connection between the terminals takes place may be varied and a scale on said auxiliary tube adapted to indicate the reduction in length of said mercury column and the degree at which said connection will take place after said column has been reduced in length.

9. A mercurial thermometer comprising a main tube, a bulb terminal and a tube terminal combined with said main tube and adapted to be connected by the mercury column at a predetermined degree of temperature, an auxiliary tube connected with said main tube and adapted to receive a portion of the mercury column whereby the normal length of the latter is reduced and the degree at which the connection between the terminals takes place may be varied, a scale on said auxiliary tube adapted to indicate the reduction in length of said mercury column and the degree at which said connection will take place after said column has been reduced in length and a connection between said tubes whereby that portion of the mercury in the auxiliary tube is prevented from readily returning to the main tube.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

RALPH F. SCHNEIDER.

Witnesses:

JOHN A. KEHLENBECK,
FRITZ ZIDLER.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."