April 19, 1955 M. L. DOUGLAS 2,706,761

APPARATUS FOR MAKING THERMOMETERS

Filed April 19, 1951

Fig. 1

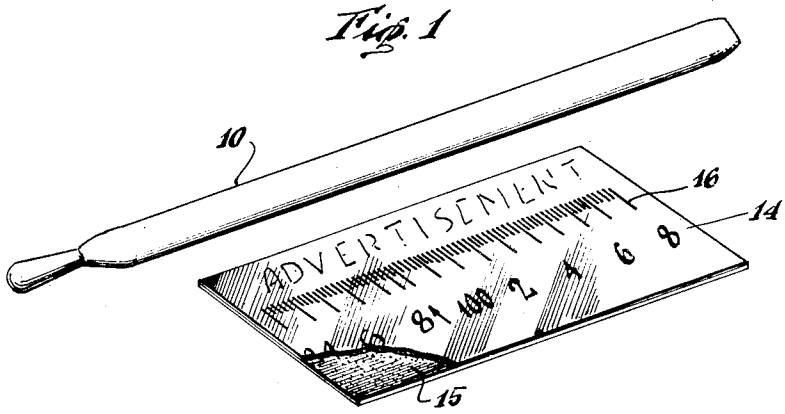


Fig. 2

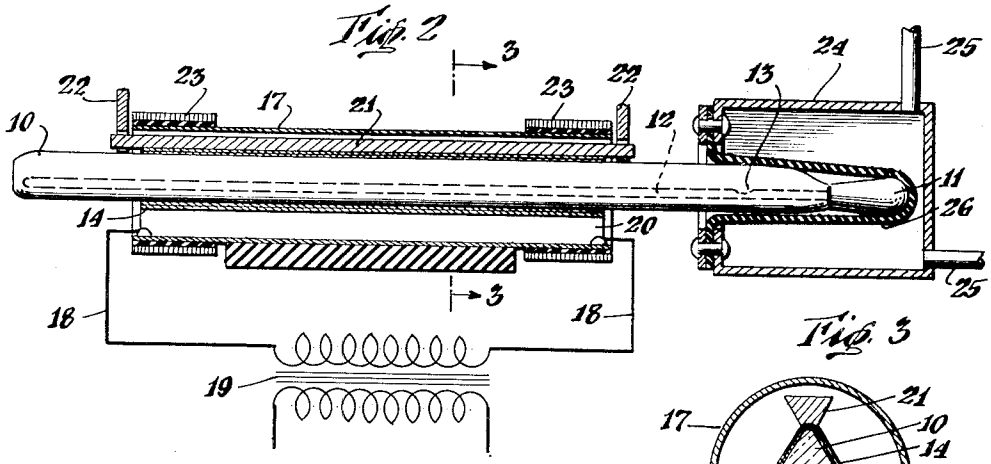


Fig. 3

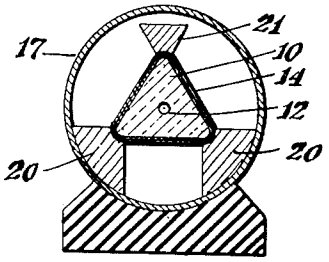


Fig. 4

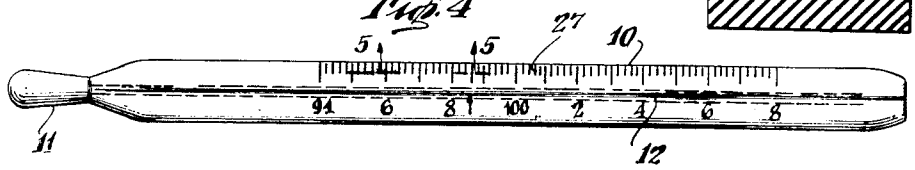
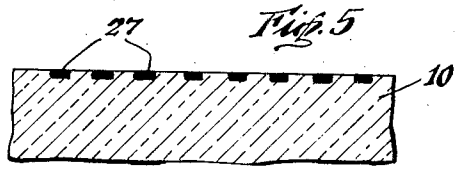


Fig. 5



INVENTOR
Marvin L. Douglas
BY Duell and Kane
ATTORNEYS

United States Patent Office 2,706,761 Patented Apr. 19, 1955

2,706,761

APPARATUS FOR MAKING THERMOMETERS

Marvin L. Douglas, New York, N. Y., assignor to Becton Dickinson and Company, Rutherford, N. J., a corporation of New Jersey

Application April 19, 1951, Serial No. 221,898

1 Claim. (Cl. 219—19)

This invention relates to an improved thermometer and especially a thermometer of the clinical type. The present invention also contemplates the designing of a machine and the teaching of a method by means of which thermometers of this nature may be commercially produced.

It is primarily an object of this invention to furnish a thermometer which may be subjected to the action of various substances such as antiseptic solutions and which may be used for prolonged periods of time without the legibility of the graduations being in any way affected; these indicia having an effective life as great as that of the thermometer itself.

A further object is that of providing a machine and the teaching of a method by means of which units of this type may be produced at a comparatively nominal figure; the method being capable of being practiced by relatively unskilled labor.

With these and other objects in mind reference is had to the attached sheet of drawings illustrating one practical embodiment of the invention and in which:

Fig. 1 is a perspective view of a thermometer prior to the application of graduations and other indicia thereto;

Fig. 2 is a sectional side view showing in somewhat schematic manner an arrangement of apparatus by means of which the desired indicia may be applied to the thermometer;

Fig. 3 is a transverse sectional view taken along the line 3—3 and in the direction of the arrows as indicated in Fig. 2;

Fig. 4 is a face view of a finished thermometer embodying the present teachings; and

Fig. 5 is a fragmentary sectional view in greatly enlarged scale and taken along the line 5—5 and in the direction of the arrows as indicated in Fig. 4.

Referring primarily to Fig. 1 the reference numeral **10** indicates the stem of a thermometer of the clinical type which is conveniently triangular in cross section and has applied to one of its ends the usual bulb portion **11**. The latter communicates with a bore **12** shown in Figs. 2, 3, and 4. In accordance with conventional construction this bore is formed with a constriction **13** at a point adjacent the bulb **11**. As will be understood the thermometer shown in all of the views herein has been completed to the point where graduations are to be applied so that the height of the heat responsive fluid within the bore **12** may be accurately determined. The present invention is primarily dedicated to the provision of these graduations and other incidental indicia which may appear upon the faces of stem **10**.

To provide these graduations it is intended to utilize a stain which will actually penetrate into and fuse into the stem surface and portions underlying the same. To this end a metallic salt is employed which preferably may be silver sulphide. This stain in the form of and desired indicia is disposed upon the proper area or faces of the thermometer stem. Such disposition may occur in any desired and acceptable manner. Conveniently, and as shown, a decalcomania may be employed which will include the usual upper transfer layer **14** mounted upon a base layer **15**. The graduations, numerals and other indicia indicated at **16** are provided by a stain of the type aforementioned and as part of layer **14**. Therefore, after the precise location of the unit upon the stem has been determined, that unit is applied so that the graduations and numerals will lie in planes corresponding to the exact temperatures as registered by the heat responsive fluid or

mercury within bore **12**. Prior to the application of the decalcomania to the stem the former is, of course, moistened in accordance with conventional practice. In any event, a proper union between the faces of the stem and layer **14** results and no relative movements will therefore occur between these parts.

Now with a view to effecting a fusion of the stain into the surface of the stem **10**, the thermometer is operatively disposed with respect to suitable heating apparatus. According to the present teachings this apparatus may involve a tube **17** having a length slightly in excess of the area of the stem to which the indicia is to be applied. That tube may be formed of stainless steel and embrace a very thin gauge. A thickness of around .01" is suitable in this connection. To the opposite ends of the tube leads **18** are connected and these may, in turn, connect to a power source **19**. Various current potentials may be employed. Suitable values are conveniently on the order of 300 amperes with three volts being utilized. With the length and gauge of tube **17** being properly related to the current value, infrared rays will be generated. These will be on the boundary of light visible to the human eye. Under these circumstances, maximum temperatures of around 1000° F. will be generated. At the same time such temperatures will not be substantially immediately produced on the surface of a stem contained within the tube. Rather a slow level of heat increase will occur involving a pre-heating stage and a final stage under which higher temperatures are developed which will assure a fusion of the stain into the surface of the stem. The thermometer may be supported within the tube in any desired manner. I have found that suitable strips **20** disposed within the tube and presenting surfaces against which the lower edge surfaces of the stem bear are entirely effective. Accordingly the two lower edge portions of the stem are properly maintained through the entire length of that portion of their bodies which lie within the tube. A further strip **21** bears against the upper edge of stem **10** to maintain the latter. Strip **21** may be disposed adjacent guide portions **22** to prevent its displacement. If the force of gravity be inadequate to assure a proper supporting relationship between stem **10** and strip **21** an auxiliary structure (not shown) to maintain strip **21** in projected position may be employed. Thus, any tendency towards deformation of this stem will be prevented. The mechanical expedients of this nature have not been illustrated in that they will be apparent to those skilled in the art.

It is desirable that the field of heating as defined by tube **17** be substantially constant throughout its entire length. In this connection it will be apparent that heat exchange will occur, not alone due to contact between the air and the outer ends of the tube, but also because of the conductivity of leads **18** attached to the tube ends. To overcome this difficulty supplementary heating coils **23** may be mounted adjacent the ends of the tube. These will serve to raise the temperature at these zones and compensate for the heat losses which will normally occur.

The thermometer having been substantially completed and "pointed" prior to the steps involved in the present process, it is apparent that care must be exercised to prevent the thermally responsive fluid (such as mercury and alcohol) from having its temperature raised to a degree such that the unit will be damaged after it has been disposed within the heating tube. To this end the bulb **11** may extend into a compartment **24** disposed in line with the tube. Pipes **25** may serve to circulate a coolant through the compartment. The temperature of the coolant may be many degrees below freezing. The depth of the compartment should be such that the thermometer is accommodated therein to a point at least slightly beyond the constriction **13**. A flexible diaphragm or sack member **26** having high heat conductive properties may be associated with the compartment. The latter expedient will be resorted to especially if the coolant be of a liquid or else a gas which should not be permitted to escape. By such a construction it is apparent that the bulb of the thermometer, as well as portions adjacent thereto, may be maintained at very low tem-

peratures even although the body of the stem is highly heated.

In using an apparatus of this nature the thermometer is completed and tested in accordance with conventional techniques. It is also "pointed" so that the height of the fluid column individual to a given thermometer is determined. Then it is shaken down or subjected to the action of a centrifuge. In any event, the mercury or other registering fluid is retracted to a maximum extent within the bulb and parts adjacent thereto. The indicia embracing graduations, numbers, etc. is established on the faces of the stem and in proper relationship to the high and low points individual to that stem. Conveniently the indicia is thus provided by a decalcomania as heretofore described. In any event care should be utilized that none of the indicia extends around the corners or edge portions of the stem. Thereupon the unit is disposed in association with the apparatus as shown in Fig. 2. If now, current is caused to flow through leads **18** then an initial degree of heat will be generated adjacent the surface of stem **10**. This heat will gradually preheat those parts of the stem within the tube. The degree of this pre-heating will be such that it will result in a burning off of the backing of the decalcomania as well as other undesired portions of the same. This will not cause any displacement of the indicia **16** which at this stage will be supported upon the face or faces of the thermometer stem in their proper relative positions. The temperature will gradually increase to a point where the surface of the stem will reach almost 1000° F. Due to the infrared action the same temperature will not exist at a point adjacent bore **12** of the stem. This will be because of the slow rate of penetration of this form of radiation. The period of time to which the unit is subjected to this heat is insufficient for the temperature at points adjacent the bore to be raised to a critical degree.

In any event with the surface temperatures increased to a proper degree, an ion exchange will occur between the metallic salt providing the indicia **16** and the components of the stem. Consequently the graduations as indicated at **27** in Fig. 5 will fuse into the surface of the stem in a manner such that they will neither project beyond the surface of the latter nor be recessed into that surface. In other words, they will be flush and, to all practical purposes, the surface of the stem will be free from interruptions of any nature whatsoever. During the entire pre-heating and final heating steps any tendency of the registering fluid to move into the bore portion **12** within the tube **17** is effectively resisted by the action of the coolant. Consequently a thermometer results as shown in Fig. 4 in which the graduations, numerals, etc. are properly disposed with respect to the lens portion and the bore of the unit, and that will have a life in effect limited only by mishandling and breakage. Its surface may be subjected to the action of detergents and numerous wiping actions without in any way affecting the indicia which will remain a permanent part of the stem.

Thus, among others, the several objects of the invention as specifically aforenoted are achieved. Obviously numerous changes in structure may be resorted to both with respect to the thermometer and apparatus used in the present process. Also the steps of that process may be varied without departing from the spirit of the invention as defined by the claim.

I claim:

An apparatus for causing an ion exchange between the stem of a thermometer and a metallic salt stain applied to the surface thereof such that substantially permanent indicia is incorporated in said stem surface, said apparatus including in combination a straight tube to encircle said stem in spaced relationship thereto, means for supplying current of such character to opposite ends of said tube to cause the latter to generate infra-red rays within its bore, the ends of said tube being open so that the adjacent ends of a stem disposed therein will project beyond the tube ends, means disposed adjacent one end of said tube and providing a cooling chamber and a flexible sack member arranged within said chamber with its open end facing said tube to receive the bulb end of said thermometer stem.

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