UNITED STATES PATENT OFFICE.

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MANUFACTURE OF THERMOMETERS.

SPECIFICATION forming part of Letters Patent No. 318,985, dated June 2, 1885.

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To all whom it may concern:

Be it known that I, JAMES JOSEPH HICKS, a subject of the Queen of Great Britain, residing at 8 Hatton Garden, in the county of Middlesex, England, meteorological-instrument manufacturer, have invented certain new and useful Improvements in the Manufacture of Thermometers, of which the following is a specification.

It is well known among manufacturers and experts that thermometer-tubes for some time after the manufacture and filling thereof are subject to a constant gradual shrinkage, which in time becomes so considerable that if the thermometer were divided and figured immediately after the manufacture and filling of the tube it would soon show a considerable inaccuracy, which in some cases amounts to a rise of one degree and even more above the correct indication within a period of twelve months. It has consequently been the practice of manufacturers, in order to produce thermometers which shall vary but little after their manufacture, to store the thermometer-tubes for months and even for years before pointing, dividing, and figuring them. This involves in some cases a considerable amount of capital lying idle in the shape of thermometer-tubes, which, combined with the breakages which sometimes occur, increases the cost of production.

Now, according to my invention I avoid these difficulties and manufacture thermometers in a comparatively short time which are more permanent and less liable to change or errors in their indications for given temperatures than thermometers made of tubes which have been stored for several years before being divided and figured.

In carrying my invention into effect I take a length of tubing, blow a bulb onto one end thereof, supply it with mercury or other fluid, and close it in a similar manner to that ordinarily adopted in the manufacture of thermometer-tubes, taking care to leave an enlargement, prolongation, or chamber at the upper end of the tube sufficiently large for the purpose hereinafter described. I then submit such thermometer-tubes to a prolonged annealing process, which I carry out in somewhat the following manner: I submit the thermometer-tubes for a period, preferably, of about sixteen days to a temperature above the highest point to which they are required to indicate—say from fifty to one hundred and fifty degrees above such highest point. The temperature, as also the period during which the thermometer-tubes are submitted to such temperature, may be varied. I, however, prefer to adopt those above stated; but in all cases in order to obtain the best results the annealing temperature must be above the point to which the thermometer when completed is required to indicate.

In order to insure the thermometer-tubes being submitted to as constant and unvarying a temperature in the annealing-chamber as is possible, I prefer to immerse them in some liquid which is maintained at the required temperature for the required time, being gradually raised to such temperature and gradually cooled before removing the thermometer-tubes therefrom. For this purpose I have found linseed-oil or mercury to answer well, as they do not injure the glass, while if water were employed the glass would be rendered rough, and would consequently require to be polished after removal from the annealing-chamber. The thermometer-tubes may, however, be immersed in other liquids or media during the annealing process, or they may be placed in a close chamber without any such liquid or media, provided care is taken to prevent the ingress of cold air to vary the temperature.

During the annealing operation the mercury rises in the tube to the enlargement, prolongation, or chamber at the upper end thereof, and such enlargment, prolongation, or chamber must be of such cubical contents as to give more than sufficient space for the expansion of the mercury or other fluid thereinto without risk of injury to the thermometer-tube.

After the thermometer-tubes have been treated in the manner above described they are pointed, divided, and figured in the ordinary way. If desired, the enlargement, prolongation, or chamber at the upper end of the bore may be scaled off, or it may be allowed

to remain, as it will be of no detriment, except in cases where it is required to produce thermometers of the shortest possible length.

The following are the results of some of my experiments: I have found that by submitting a number of thermometer-tubes (which when completed were required to indicate up to 120° Fahrenheit) to an annealing process in a bath of water at a temperature of 212° Fahrenheit for sixteen days, and then allowing them gradually to cool, a rise of from 1.1° to 1.8° has been produced in the indications of such tubes. I have found that by submitting a number of thermometer-tubes (which when completed were required to indicate up to 212° Fahrenheit) to an annealing process in a bath of linseed-oil or mercury at a temperature of 300° Fahrenheit for sixteen days, and then allowed gradually to cool, a rise of from 2.6° to 3° has been produced in the indications of such tubes. I have also found that when submitting a number of thermometer-tubes (which when completed were required to indicate up to 220° Fahrenheit) to an annealing process in a bath of linseed-oil or mercury at a temperature of 300° Fahrenheit, and then allowed gradually to cool, a rise in the indications of such tubes has been caused during the first week of from 1.5° to 2.4°; during the second week a rise of three to six tenths; during the third week a rise of from two-tenths to four-tenths; during the fourth week a rise of from zero to three-tenths, and during the fifth week a rise of from zero to two-tenths, thus showing that the greatest effect is produced during the first week of the annealing process.

It will thus be seen that by my process I cause much more contraction (nearly double) of thermometer-tubes in sixteen days than the maximum contraction known of thermometer-tubes which have not been submitted to my process, but which have been simply stored for a period of one year or more before pointing, dividing, and figuring the same, while in a single week I produce as much as or somewhat more contraction by my process than the maximum known of simply stored thermometer-tubes. By these means I produce thermometers which are practically or nearly invariable after their completion—that is to say, the column of which will always stand at the same heights for given temperatures provided the thermometers are not submitted to higher temperatures than those to which they are intended to indicate.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. The mode of treating thermometer-tubes, which consists in annealing the tubes intermediate of the filling and marking operations, substantially as set forth.

2. The process of annealing thermometer-tubes after they have been supplied with mercury or other liquid and sealed or closed, which consists in submitting them for a considerable time to a temperature above the highest point to which they are required to indicate and then pointing, dividing, and figuring, substantially as set forth.

3. The process of manufacturing thermometer-tubes, which consists in taking a length of tubing, forming an enlargement, prolongation, or chamber at the upper end, supplying the tube with mercury or other liquid, and sealing or closing it, submitting the tube for a considerable time to a temperature above the highest point to which it is required to indicate, and afterward pointing, dividing, and figuring it, substantially as set forth.

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