Oct. 17, 1961 P. BECKMAN 3,005,171

ELECTRICAL RESISTANCE TYPE THERMOMETER

Filed Aug. 19, 1960

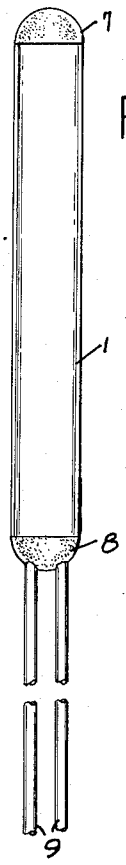


FIG. 1

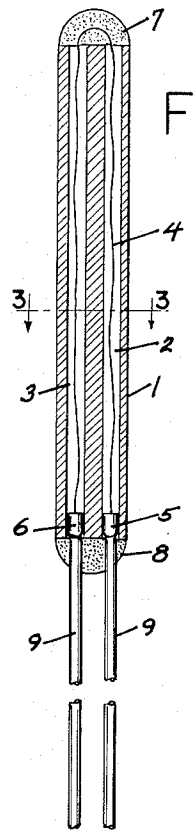


FIG. 2

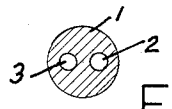


FIG. 3

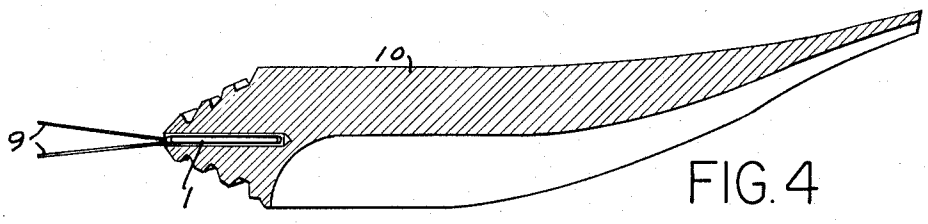


FIG. 4

INVENTOR.
Paul Beckman
BY
ATTORNEY

United States Patent Office 3,005,171 Patented Oct. 17, 1961

3,005,171

ELECTRICAL RESISTANCE TYPE THERMOMETER

Paul Beckman, Glen Olden, Pa.
(944 Henrietta Ave., Huntington Valley, Pa.)

Filed Aug. 19, 1960, Ser. No. 50,633
2 Claims. (Cl. 338—28)

This invention relates generally to resistance type thermometers and more particularly to a thermometer of micro-miniature size.

It is an object of my invention to provide an improved electrical resistance thermometer whose principles of construction are such that it can be effectively made in a simple and rugged manner in micro-miniature size, and, notwithstanding such minute size, will nevertheless record a broad range of temperatures.

It is another object of my invention to provide an improved electrical resistance type thermometer of extremely small size that will accurately produce an electrical resistance change in response to temperature completely independent of strain.

Other objects and advantages will be more apparent to those skilled in the art from the following description of the accompanying drawings in which:

FIG. 1 is a greatly enlarged elevational view of my improved resistance thermometer;

FIG. 2 is a longitudinal sectional view of FIG. 1;

FIG. 3 is a cross-sectional view taken on the line 3—3 of FIG. 2; and

FIG. 4 illustrates an application, among many possible others, in which my thermometer is inserted in a turbine blade.

As shown in the drawings my invention consists of an elongated body or bulb 1 preferably circular in cross-section and made of high temperature electrical insulation material such, for example, as alpha alumina or beryllia oxide. This bulb is preferably about .033" in diameter and .500" long although both of these dimensions may be smaller. The bulb is provided with two holes 2 and 3 extending lengthwise thereof substantially parallel to the bulb axis. A temperature sensitive electrical resistance element 4 of any usual and well-known material, whose electrical resistance varies with temperature through an adequate temperature range, extends through these holes in a loop formation and has its two ends suitably secured to connections 5 and 6. The reversing end of the filament is sealed by a suitable insulating cap 7 while the lead ends are similarly sealed by an insulating cap 8. Leads 9 of any suitable length extend from the thermometer. The bulb material 1, is preferably beryllia because of its very high thermal conductivity approximating metal aluminum and the temperature sensitive resistance element 4 is preferably .0002" to .001" in diameter, thus showing the extremely minute nature of the electrical element and the miniature size of the bulb itself. The leads 9 are preferably comprised of nickel or platinum tubing normally .007" O.D. or smaller and are cold swaged to the electrical resistance element 4.

The leads are preferably anchored to the resistance bulb by mechanical friction inside the holes after which

the globules 7 and 8 of insulating ceramic cement are applied thereby providing a gas proof barrier for the full limit of operation from minus 300° to 2000° F.

To protect the filaments from drafts or local temperature fluctuations, reverse strands of the filament are placed in close proximity to each other and will feel essentially the same temperature when exposed to rapid cooling and heating rates. Another factor to be considered is the high resistivity necessary for the insulator at temperatures above 1000° F. In this connection my invention utilizes the resistivity of pure alpha alumina or beryllia oxide, plus the electrical insulating chacateristics of air space between the wires and the inside walls of each hole in the bulb, it having been noted that the resistance filament is loosely disposed within the holes 2 and 3 thereby constituting an unbonded filament.

The use of an unbonded loosely disposed filament eliminates errors that are generally introduced into conventional resistance thermometry wherein the standard methods of winding resistance wires over insulated mandrels introduces a strain error on temperature readout because of the high strain gage factor of these materials being tightly wound on the mandrel. Consequently such wires feel the thermal coefficient of expansion of the mandrel plus the resistance change due to stress relieving of the wire under tension.

Thus it is seen that my invention provides a construction that not only allows the thermometer to be made in extremely small sizes in the form of a bulb but also eliminates the introduction of errors by thermal effects or a change in resistance due to thermal expansion of the structure for supporting the filament.

It will, of course, be understood that various changes in details of construction and arrangement of parts may be made by those skilled in the art without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. An electrical resistance type thermometer having an elongated bulb of insulating material provided with a pair of substantially parallel holes extending continuously throughout the length of the bulb, a lead at one end of one of said holes and another lead at the corresponding end of the other of said holes, and a temperature sensitive element of electrical conducting material extending through one of said holes in spaced relation to the wall thereof and reversely crossing over the end of the bulb and back through the other of said holes in spaced relation to the wall thereof, the ends of the filament being connected to the leads at one end of the bulb.

2. The combination set forth in claim 1 further characterized in that an insulation cap of ceramic material embeds the cross-over portion of the filament and seals the ends of the passages adjacent to said cross-over thereby to anchor the cross-over portion of the filament.

References Cited in the file of this patent

UNITED STATES PATENTS

834,162	Northrup	Oct. 23, 1906
2,579,271	Polye	Dec. 18, 1951
2,721,480	Pierce	Oct. 25, 1955

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,005,171 October 17, 1961

Paul Beckman

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 1 to 3, for "Paul Heckman, of Glen Olden, Pennsylvania," read -- Paul Beckman, of Huntington Valley, Pennsylvania, --; line 12, for "Paul Heckman, his heirs" read -- Paul Beckman, his heirs --; in the heading to the printed specification, lines 4 and 5, for "Paul Beckman, Glen Olden, Pa. (944 Henrietta Ave., Huntington Valley, Pa.)" read -- Paul Beckman, 944 Henrietta Ave., Huntington Valley, Pa. --.

Signed and sealed this 17th day of April 1962.

(SEAL)
Attest:

ESTON G. JOHNSON
Attesting Officer

DAVID L. LADD
Commissioner of Patents

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,005,171 October 17, 1961

Paul Beckman

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 1 to 3, for "Paul Heckman, of Glen Olden, Pennsylvania," read -- Paul Beckman, of Huntington Valley, Pennsylvania, --; line 12, for "Paul Heckman, his heirs" read -- Paul Beckman, his heirs --; in the heading to the printed specification, lines 4 and 5, for "Paul Beckman, Glen Olden, Pa. (944 Henrietta Ave., Huntington Valley, Pa.)" read -- Paul Beckman, 944 Henrietta Ave., Huntington Valley, Pa. --.

Signed and sealed this 17th day of April 1962.

(SEAL)
Attest:

ESTON G. JOHNSON
Attesting Officer

DAVID L. LADD
Commissioner of Patents