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PITOT HEAD

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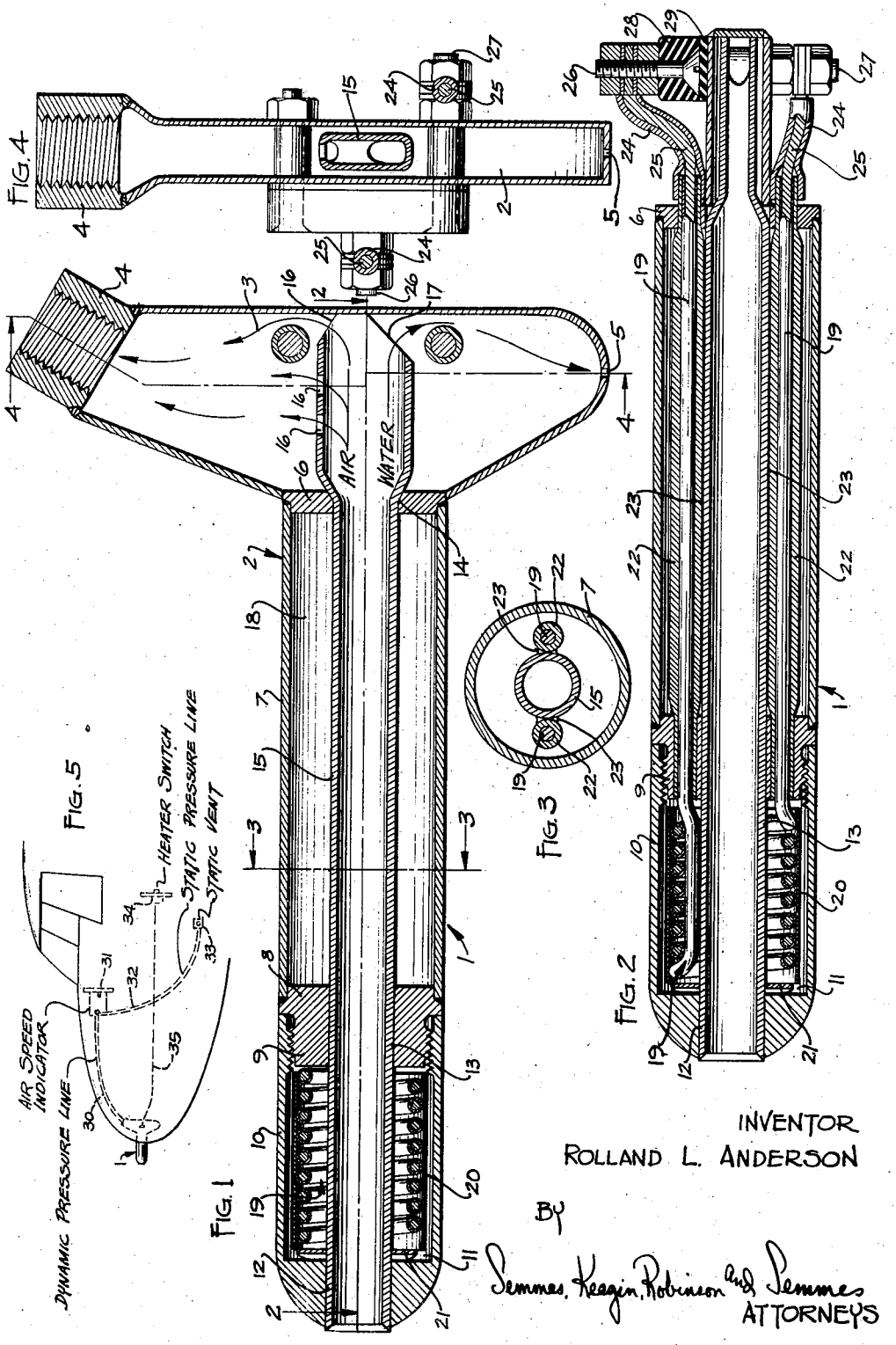


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

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PITOT HEAD

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The present invention relates to air speed measuring devices for aircraft and more particularly to a dynamic pressure, or Pitot head adapted for use with a separate or fuselage static pressure system, the head incorporating means for inhibiting freezing and water locking in the dynamic pressure system.

It is well known that air speed indicators become inaccurate and often fail when operating under certain adverse conditions. The principal of these are met in heavy precipitation, in dense cloud formations or spray, when water entering the Pitot tube, collects and results in waterlocks in the indicating instrument, upsetting the establishment of correct pressure differentials for accurate operation of the instrument. Another adverse condition is met in flying in sub-freezing temperatures which results in "freezing up" or clogging up the entrance to the Pitot tube with ice which likewise renders the indicating instrument inaccurate or inoperative.

Attempts, which have not proven entirely satisfactory, have been made in the past to overcome water locking of the Pitot system, such as by the provision of valving and air pumps in the plumbing between the Pitot head and the instrument, by means of which the operator could periodically blow out the system. This, however, is an expensive and cumbersome system, creates the possibility of leaks in the dynamic pressure lines, requires the attention and manipulation of an operator, and is, at best, only a temporary rectification of the trouble. Prior attempts have also been made to automatically separate, trap and drain water entering the system before it reached the lines connecting the Pitot tube with the instrument. These attempts have not proven entirely satisfactory because of the water separating principles employed and the complexity of the required structure.

Electric heating elements have heretofore been employed adjacent the tips of Pitot static tubes to prevent icing. Much of the efficiency of these heaters has been lost by conduction through other parts of the unit to the atmosphere, and by the necessity of a heavy current supply for the heater because of these losses.

It is therefore one of the objects of this invention to provide a Pitot head for a Pitot static air speed indicating system which provides for water separation from air entering the dynamic pressure tube by simple physical laws, and not requiring baffling or other separating means or separate traps.

Another object of the invention is to provide a

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Pitot head of the above character, in which the separated water is drained from the lowest point in the system regardless of the normal attitude of the plane, and in which there is a large ratio between the drain orifice and the nose opening of the Pitot tube, thus providing substantially full dynamic pressure to the indicating instrument.

Still another object of the invention is to provide a Pitot head of the above character, which incorporates an electric heater arranged symmetrically about the nose of the Pitot tube and along the length thereof to give even distribution of heat to all required critical areas, and in which dead air space is provided about the tube in non-critical regions to prevent heat loss and thereby increase the efficiency of the heating system.

A further object of the invention is to provide a Pitot head of the above character having a Pitot tube of relatively large diameter, extending in a straight line from the nose or entrance thereof to the rear dynamic pressure chamber of the head.

A still further object of the invention is to provide an electrically heated Pitot head constructed so that the heating element may be removed and replaced without the breaking and resealing any of the Pitot system, and without special tools.

With the above and other important objects and advantages in view, the invention comprises the parts and combinations hereinafter set forth with the understanding that various changes may be made therein, by those skilled in the art, without departing from the spirit of the invention.

In order to make the invention more clearly understood, a preferred embodiment thereof is made the subject of illustration in the accompanying drawings, in which:

Figure 1 is a vertical transverse sectional view of a Pitot head constructed in accordance with this invention.

Figure 2 is a horizontal transverse sectional view taken along the line 2—2 of Figure 1 looking in the direction of the arrows.

Figure 3 is a cross sectional view taken along the line 3—3 of Figure 1 looking in the direction of the arrows.

Figure 4 is a cross section view taken along the line 4—4 of Figure 1 looking in the direction of the arrows.

Figure 5 is a diagrammatical representation of the nose portion of an airplane showing the installation of the Pitot tube.

Referring more particularly to the drawings,

there is shown a Pitot head, designated generally as 1, preferably of the type supplying only the dynamic pressure to an airspeed indicating instrument, the head functioning in conjunction with a separate, static pressure system. Preferably also, the head 1 is of the type adapted for mounting in the fuselage of an airplane, usually projecting forwardly from the nose of the fuselage into the airstream, as indicated diagrammatically in Figure 5, though obviously it may be externally mounted in accordance with usual practice.

The head 1 comprises a casing 2 forming a rear, laterally flattened and vertically elongated, dynamic pressure chamber 3 to the extreme upper end of which is secured an internally screw threaded nipple 4, by means of which a dynamic pressure line leading to the airspeed indicating instrument may be connected. In the lowest point of the wall of the chamber 3 is drilled a single, small drain orifice 5.

Secured to the forward wall of the chamber 3, substantially intermediate the nipple 4 and the orific 5, is a circular disc 6 to which is secured one end of a cylindrical sleeve 7 which extends forwardly from the chamber 3 but is partitioned therefrom by the disc 6. Secured into the forward end of the sleeve 7 is a plug 8 which projects forwardly from the sleeve in an externally screw threaded extension 9 onto which is screw threaded a nose piece 10 of the same diameter as the sleeve 7. The nose piece 10 is internally bored axially to form, with the plug 8, an enclosed heating chamber 11. The forward end of the nose piece is preferably rounded.

The nose piece 10, the plug 8 and the disc 6 are respectively provided with axially aligned apertures 12, 13 and 14 through which pass a Pitot tube 15. This tube is straight from end to end, extending from substantially flush with the front of the nose piece 10 to the inner face of the rear wall of the chamber 3. The tube 15 preferably is made of a high heat conducting metal, such as heavy wall copper tubing, and is of relatively large inside diameter to present a substantially large opening to the airstream. The rear portion of the tube 15, lying within the chamber 3, is laterally flattened somewhat and provided with a plurality of upwardly opening air discharge ports 16, formed such as by drilling and/or beveling the end of the tube from the top, while the lower wall of the tube is provided with a downwardly opening water discharge port 17 formed, such as by beveling the end of the tube from the bottom wall.

The tube 15 may be a close fit in the apertures 12, 13 and 14 but preferably, it is silver soldered or similarly secured in the apertures 13 and 14 in order to make a chamber 18, formed by the tube 7, disc 6 and plug 8, airtight. In this connection it might be mentioned that all permanent joints between the several parts may be made by silver soldering.

Coiled about the tube 15, in the nose chamber 11, is an elongated, electrical resistance heating element, designated generally as 19, and which may be of any suitable, conventional design. The coiled heating element is spaced radially, both from the tube and the chamber wall, such as by coiling it within a sleeve 20, preferably of heat insulating material which may be spaced radially from the tube conveniently, such as by suitable spring washer means 21 interposed between the end of the chamber, the tube and sleeve 20.

The ends of the heating element 19 are passed from the ends of the coil rearwardly through a pair of small, metal tubes 22 extending parallel with and engaging the Pitot tube 15, with their opposite ends passing through and making a tight fit with, or fused in aligned apertures in the plug 8 and disc 6. In order to increase the heat conductivity between the tubes 22 and the tube 15, the tubes 22 may be silver soldered to the tube 15, as indicated at 23 in Figures 2 and 3.

The rear ends of the tubes 22 terminate just beyond the rear face of the disc 6, adjacent opposite side walls of the chamber 3, and have fitted thereon flexible insulating conduits 24, through which short conductors 25 connect the opposite ends of the heating element respectively with a pair of terminal posts 26 and 27. One of these posts, 26, is insulated from the head, such as by an insulating strip 28 and insulating washer 29, while the post 27 may consist of one of a pair of bolts passing through the chamber 3 and attaching the insulating strip 28 thereto, as shown in Figure 4.

In use, the Pitot head may be installed in the airplane as indicated, for example, in Figure 5, being suitably secured to the fuselage structure with at least the nose piece 10 extending through an aperture in the nose of the fuselage. An upwardly extending line 30 connects the nipple 4 with the dynamic pressure fitting of an air-speed indicating instrument, indicated at 31, while the static pressure fitting of the instrument may be connected by a downwardly extending line 32 to a static vent 33 opening through the skin of the fuselage at an optimum location thereon. The heater terminals 26 and 27 are sutiably connected to a source of electric current through a switch 34 by conductors indicated diagrammatically as 35.

If the airplane is traveling through a region of heavy precipitation, for example, a considerable amount of water will enter the Pitot tube and travel rearwardly with the airstream. Because of the relatively large diameter of the tube 15, a portion of this water will separate from the airstream in the tube 15, flowing along the bottom of the tube, and discharge downwardly directly through the port 17 into the bottom of the chamber 3 where it drains through the orifice 5 under pressure of the air in the chamber 3. Smaller drops which may be carried, as such, by the air into the chamber 3, will readily settle to the bottom of the chamber and likewise drain out. It has been found in practice, that the vertically elongated dynamic chamber and introducing a straight, large diameter Pitot tube intermediate its length, provides for completely satisfactory separation of water from the dynamic air without baffling the air stream in any way. This is an important feature of the invention, not only resulting in economy and simplicity of manufacture, but also resulting in more efficient operation by eliminating the possibility of water bridging the spaces between baffles and adjacent surfaces of the head.

It is to be noted that the cross sectional area of the orifice 5 is small with respect to that of the tube 15 (the area ratio of the orifice to the entrance opening of the tube being approximately 1–18), which thereby assures substantially full dynamic pressure in the chamber 3 and accurate air speed indication by the instrument connected therewith.

The heating unit 19 is only used in subfreezing temperatures where danger of the Pitot tube icing up may exist. Under such conditions, the heat-

ing element serves as an efficient ice preventing or de-icing unit. In the first place, the major heat is localized, concentrated and symmetrically distributed about the most critical portion of the Pitot tube—its nose—and heats this portion by radiation through the confined chamber 11. In the second place, the heavy wall of high heat conducting material of the tube, and the insulation provided by the dead air space in the chamber 18 between the tube and the outer sleeve 7, efficiently conducts the heat to other, but less critical parts of the head. In this latter connection, it may be pointed out that the chamber 18, since it is sealed off from the remainder of the head, may, if desired, be evacuated and still further increase its efficiency as an insulator. In either case, the chamber 18 effectually inhibits heat loss through radiation to the atmosphere and thereby reduces otherwise high wattage for the heater and its current consumption. Additional heating efficiency is also obtained by fusing the tubes 21 to the wall of the tube 15, as described above.

It is to be noted also, that the heating element may be easily removed and replaced simply by disconnecting its ends from the terminal posts 26 and 27, unscrewing the nose piece 10 from the plug 8, and withdrawing the element from the head.

From the foregoing, it will be seen that the Pitot head according to this invention, will provide for accurate operation of the air speed indicating instrument under all weather conditions. It provides a simple, tight dynamic pressure system which does not have to be broken and resealed in maintenance, and is simple and economical to install.

I claim:

1. A Pitot head of the character described comprising a straight Pitot tube having a forward entrance opening, a casing forming a vertically elongated chamber enclosing the rear portion of the tube, said tube being positioned intermediate the height of the chamber and substantially perpendicular to the vertical axis thereof, the rear portion of the tube being provided with upwardly and downwardly directed ports, and means for connecting the upper region of the chamber with an instrument, there being a drain orifice in the casing adjacent the lowest point of the chamber.

2. A Pitot head of the character described comprising a straight Pitot tube having a forward entrance opening, a casing forming a vertically elongated chamber enclosing the rear portion of the tube, said tube being positioned intermediate the height of the chamber and substantially perpendicular to the vertical axis thereof, the rear portion of the tube being provided with upwardly and downwardly directed ports, and means for connecting the upper region of the chamber with an instrument, there being a drain orifice in the casing adjacent the lowest point of the chamber, the cross sectional area of said orfice means being substantially smaller than that of the tube.

3. A Pitot head of the character described comprising a straight Pitot tube having a forward entrance opening of substantially large diameter, a casing forming a vertically elongated chamber enclosing the rear portion of the tube, said tube being positioned intermediate the height of the chamber and substantially perpendicular to the vertical axis thereof, the rear portion of the tube being provided with upwardly and downwardly directed ports, and means for connecting the upper region of the chamber with an instrument, there being a drain orifice in the casing adjacent the lowest point of said chamber, the area ratio of said orifice with respect to said entrance opening being approximately one to eighteen.

4. A Pitot head of the character described comprising a straight Pitot tube having a forward entrance opening, a casing forming a vertically elongated chamber enclosing the rear portion of the tube, said tube being positioned intermediate the height of the chamber and substantially perpendicular to the vertical axis thereof, the rear portion of the tube being provided with upwardly and downwardly directed ports, and means for connecting the upper region of the chamber with an instrument, there being a drain orifice in the casing adjacent the lowest point of the chamber and means for heating the tube at least adjacent said entrance opening.

5. A Pitot head of the character described comprising a straight Pitot tube of high heat conductivity and having a forward entrance opening, a casing forming a vertically elongated chamber enclosing the rear portion of the tube, said tube projecting forwardly from the casing intermediate the height thereof and substantially perpendicular to the vertical axis thereof, the rear portion of the tube being provided with upwardly and downwardly directed ports, and means for connecting the upper region of the chamber with an instrument, there being a drain orifice in the casing adjacent the lowest point of the chamber, shell means surrounding the projecting portion of the tube and forming a circumferential chamber thereabout, an electrical heating element within said circumferential chamber and spaced from said shell means, the intermediate portion of said element being coiled about the tube adjacent the entrance opening thereof, and the end portions of said element extending substantially parallel with the axis thereof and adjacent opposite sides of the tube, and heat conducting means conductively connecting said end portions with said tube.

6. A Pitot head of the character described comprising a straight Pitot tube of high heat conductivity and having a forward entrance opening, a casing forming a vertically elongated chamber enclosing the rear portion of the tube, said tube projecting forwardly from the casing intermediate the height thereof and substantially perpendicular to the vertical axis thereof, the rear portion of the tube being provided with upwardly and downwardly directed ports, and means for connecting the upper region of the chamber with an instrument, there being a drain orifice in the casing adjacent the lowest point of the chamber, shell means surrounding the projecting portion of the tube and forming a circumferential chamber thereabout, an electrical heating element within said circumferential chamber, the intermediate portion of said element being coiled about the tube adjacent the entrance opening thereof, and the end portions of said element extending substantially parallel with the axis thereof and adjacent opposite sides of the tube, and heat conducting sleeve means having an intimate contact with said tube surrounding said end portions of the element.

7. A Pitot head of the character described comprising a T-shaped casing constituting a vertically elongated rear chamber and a horizontal tubular chamber extending forwardly therefrom intermediate the length thereof, partition means separating said chambers, a tubular nose piece detachably secured to the forward end of the tubular chamber axially thereof and forming a

heating chamber, a straight Pitot tube extending from within the rear chamber through said tubular chamber and heating chamber and spaced radially inwardly from the walls thereof, the rear portion of the tube being provided with upwardly and downwardly directed ports, and means for connecting the upper region of the chamber with an instrument, there being a drain orifice in the casing adjacent the lowest point of said rear chamber, an electrical heating element within said heating chamber surrounding the tube and having ends extending through said horizontal chamber, and external terminal posts carried by the casing and connected with said ends.

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