

March 8, 1966

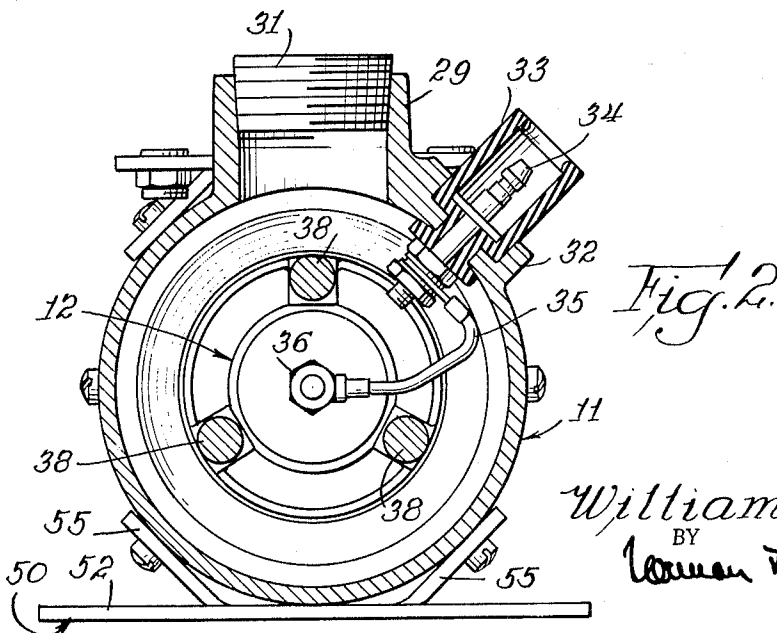
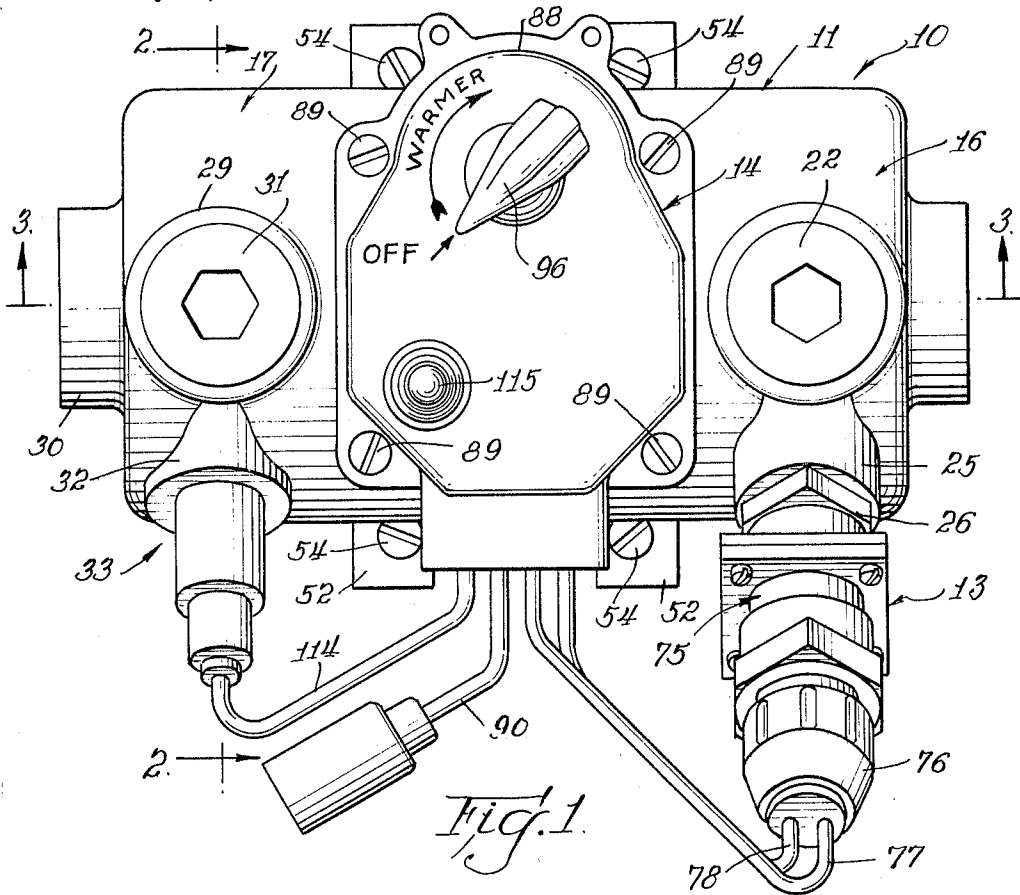
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3,239,650

FLUID HEATER

Filed May 17, 1963

3 Sheets-Sheet 1



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FLUID HEATER

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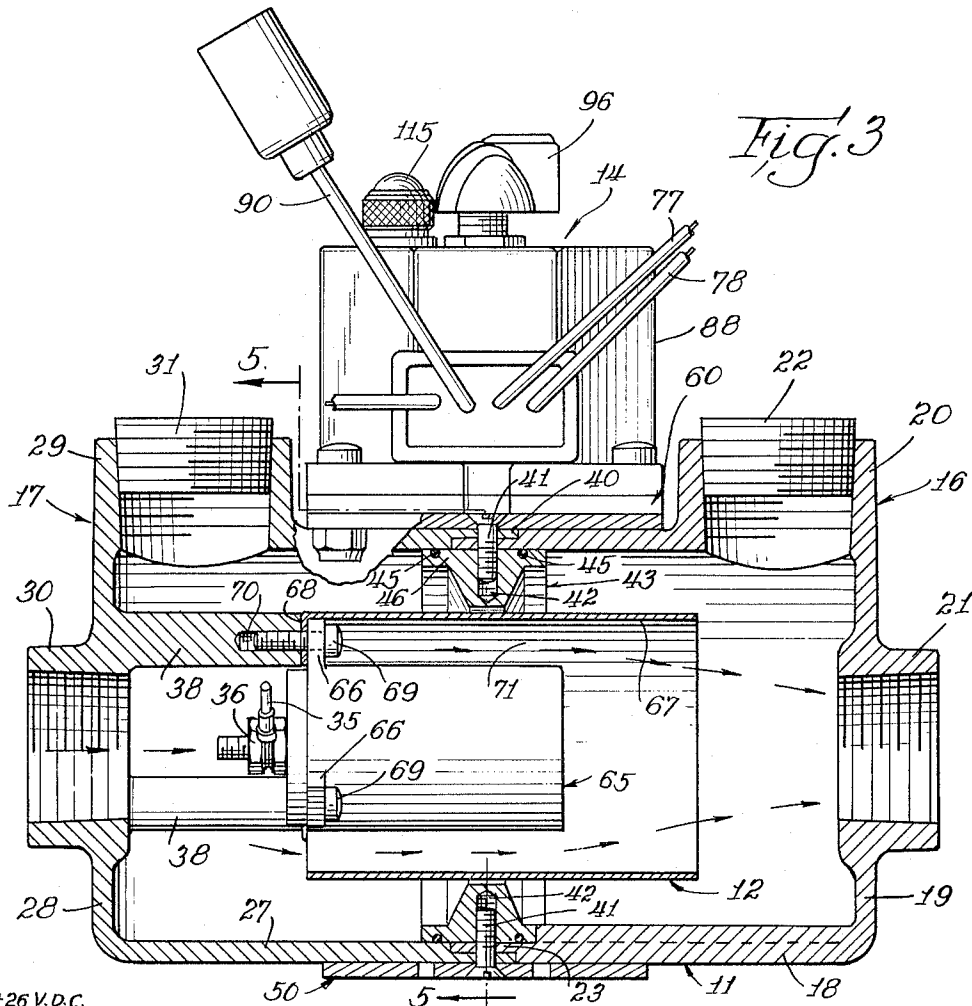


Fig. 3

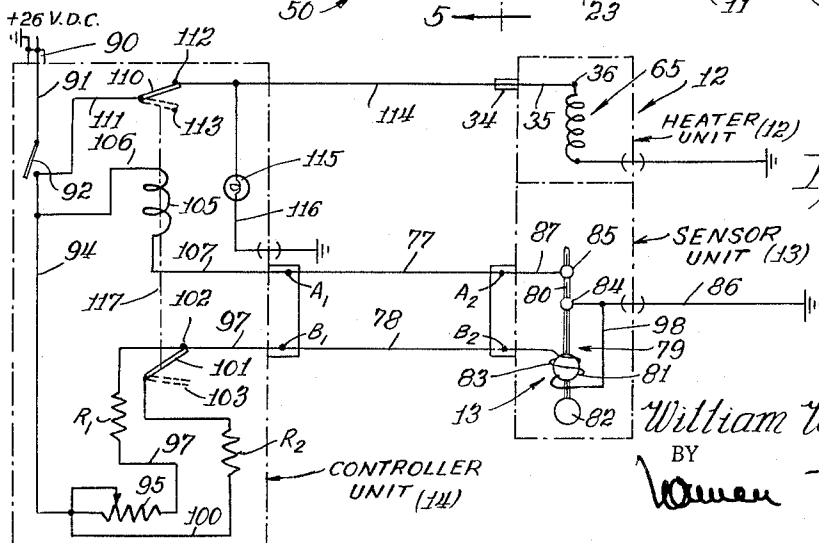


Fig. 6

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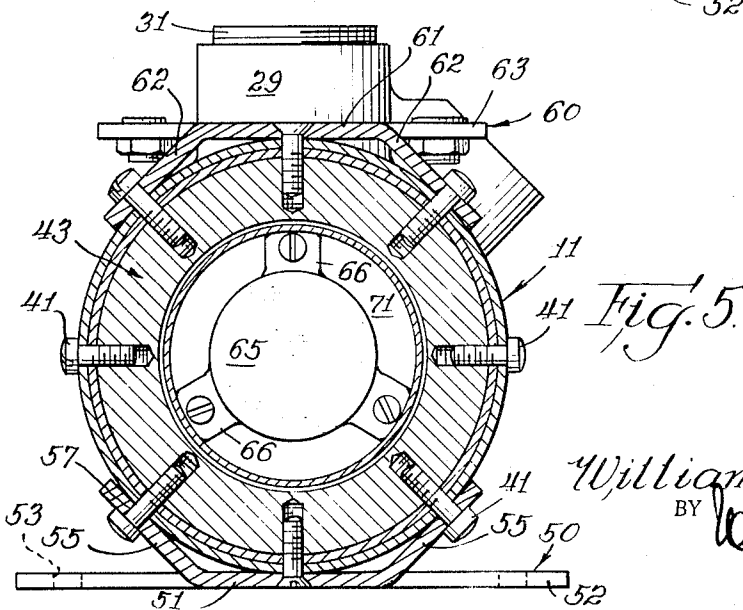
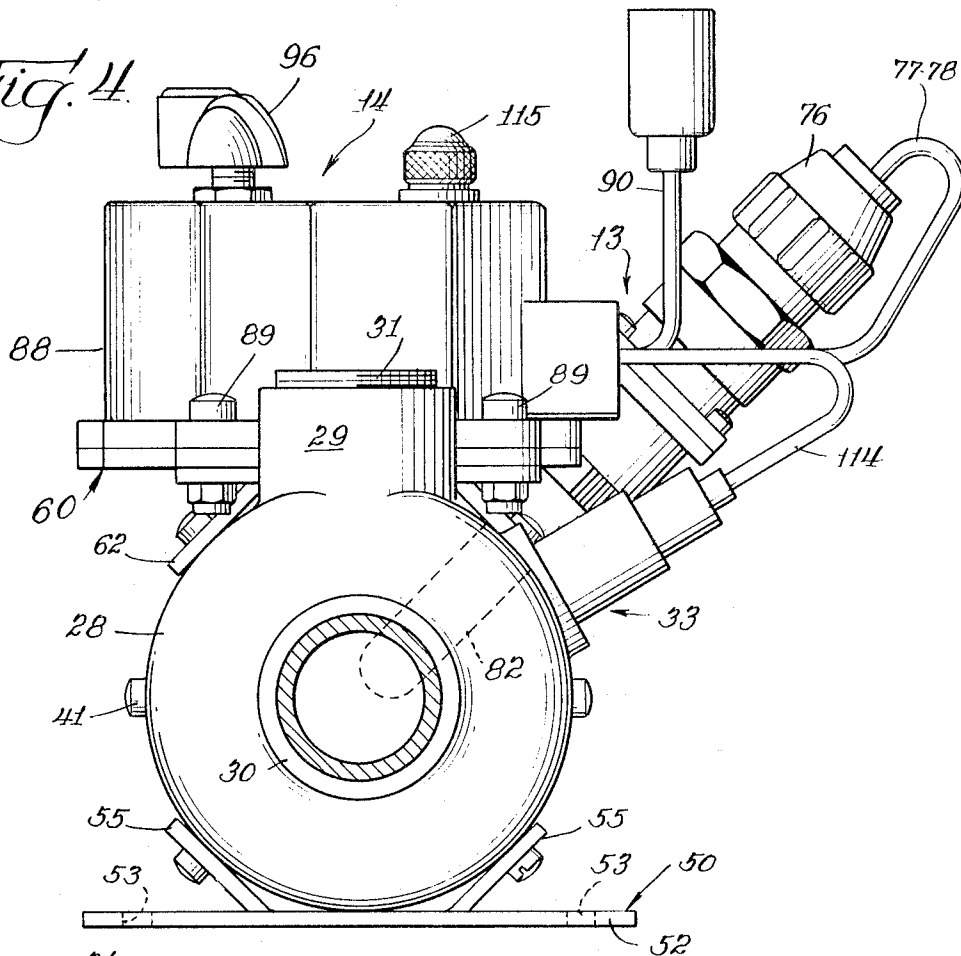
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3 Sheets-Sheet 3

Fig. 4.



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FLUID HEATER

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Filed May 17, 1963, Ser. No. 281,113
7 Claims. (Cl. 219—374)

This invention relates generally to heating apparatus and, more particularly, to improved means for heating and controlling the temperature of fluids or gases, particularly air.

Due to ever-increasing importance of military preparedness and attendant technological advancements of modern military science and warfare, current weapons and equipment for war have become increasingly complex as effort is made to increase their operational capabilities and effectiveness. This developmental advance has resulted in unforeseeable changes and requirements in equipment design and engineering which, for purposes of the present invention, are epitomized in the changes in and requirements for military tanks, weapon carriers, aircraft, space vehicles and like items intended to transport personnel. Considering the modern military tank as exemplary of the need and problems satisfied by the present invention, the addition of more and more complicated and space-consuming instrumentation and equipment to this class of vehicle has produced severe limitations on the interior spacing thereof, making considerably less room available for the living comforts of the operating personnel. Further, complexities of modern warfare have dictated that such equipment exhibit increased versatility of operation which, in the case of the modern-day tank, demands, among other things, that such a vehicle be capable of operating in various geographical areas, thereby subjecting the operating personnel to wide variations in temperature and climate. In order to fully satisfy these demands, dependable equipment for heating the interior of a tank throughout a considerable ambient temperature range is essential. At the same time, such equipment must be extremely compact and versatile in its application while maintaining high standards of safety, ruggedness and dependability of operation. Prior to this invention, previously known devices for this purpose have failed to satisfy these requirements.

It has been found that one of the more promising ways for meeting the above-indicated problem is to provide a heating system and apparatus which controls the temperature of air supplied to breathing masks worn by the tank personnel or, alternatively, to thermal suits as are familiarly employed, particularly in air and space vehicles.

It is to this general class of air or fluid heating equipment that the present invention pertains. In brief, this invention comprises a compact, lightweight unitary heating device or apparatus which is capable of withstanding heavy shock forces, while providing accurate and dependable temperature control of the heating medium, namely air, under a wide variety of climatic conditions. It is to be understood, however, that the improved features and principles of this invention are not necessarily restricted to the heating of air, but apply equally well to controlling temperatures of other fluids or gases. The preferred source of thermal energy for elevating the temperature of the heating medium or fluid according to this invention comprises electrical resistance heating means which are carried within and protected by an outer shell housing capable of being adjusted and mounted in a variety of positions to accommodate various installation requirements. Typically, air is supplied at forced draft from outside the vehicle and passed substantially end-wise through the heater housing, over the heating means therein for discharge to individual consumption stations, such as individual breathing masks. The shell hous-

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ing is maintained with safe external temperatures for safe contact by the user by internal shielding means and thermostatic control means are provided, enabling selective regulation of the outlet temperature for the heating medium or fluid according to the demands of the individual users. Normally each user is supplied with an individual heating apparatus, if individual control is desired, although more than one user may be supplied from each heating device, as required. Provision also is made for disposing controller means associated with the thermostatic control means either with or remotely of the heating device, if desired. The device and apparatus of this invention is further distinguished by improved simplicity of construction and operating means which afford improved versatility of installation and operation along with a simplified arrangement for the heating components, whereby the housing therefor and the temperature control system to be readily maintained and individually replaced and repaired without removing and tearing down the entire heating device for that purpose.

The main object of this invention is to provide new and improved heating apparatus, especially useful for regulating the temperature of air supplied to individuals located in confined spaces.

Another object of this invention is to provide a new and improved fluid heating apparatus which is particularly versatile in application and operation.

Still another object of this invention is to provide a new and improved heating apparatus, as aforesaid, which is rugged, compact, dependable and safe in operation and which is particularly adapted for use in locales where space limitations are of prime consideration.

Another important object of this invention is to provide new and improved heating apparatus for regulating the temperature of air supplied to personnel within confined spaces which includes means for satisfying their individual temperature requirements.

Still another important object of this invention is to provide new and improved heating apparatus, useful in confined areas, which is capable of being mounted in a variety of positions without impairment of its operational dependability and efficiency.

The above and further objects, features and advantages of this invention will appear to those skilled in the art from the following description of the embodiment thereof illustrated in the accompanying drawings.

In the drawings:

FIGURE 1 is a top plan view of heating apparatus according to the present invention;

FIGURE 2 is a cross-sectional view taken substantially at line 2—2 of FIGURE 1 and looking in the direction of the arrows thereon;

FIGURE 3 is another cross-sectional view taken substantially along line 3—3 of FIGURE 1 and looking in the direction of the arrows thereon;

FIGURE 4 is an end elevational view of the apparatus illustrated in FIGURE 1, looking at the left-hand end thereof;

FIGURE 5 is a cross-sectional view taken substantially along line 5—5 of FIGURE 3; and

FIGURE 6 is a schematic circuit diagram of the control means employed with the apparatus seen in the foregoing figures.

Having thus described this invention, the best mode presently contemplated for carrying out its teachings and concepts shall be set forth hereinafter so as to enable those skilled in the art to which it pertains to make and use the same.

Turning now to the drawings, it will be understood from FIGURES 1—5 that the improved heating apparatus

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of this invention, indicated generally by numeral 10 in FIGURE 1 includes a generally cylindrical shell housing, designated generally at 11 in FIGURE 1, which will be described in greater detail presently. As best shown in FIGURES 2 and 3, heating means 12 is mounted within the housing 11 for electrical energization as controlled by a thermostatic temperature control system comprising temperature thermostat sensor means 13 (see FIGURES 1 and 4) and a controller means 14 therefor. These comprise the major components of the heating apparatus of this invention and such now will be described in particular detail, substantially in their above-indicated order of appearance.

The shell housing 11, as will be best understood with reference to FIGURES 1, 2 and 3 of the drawings, is made up of a pair of end-to-end related, similar housing portions, namely, outlet portion 16 and inlet portion 17 as viewed in FIGURES 1 and 3. Each of the portions 16 and 17 is preferably cast or otherwise suitably formed of a lightweight, rigid material, such as aluminum or aluminum magnesium alloy, particularly selected for its ability to resist corrosion. As seen in FIGURE 3, the right-hand or outlet portion 16 is formed with a cylindrical body wall 18 formed integrally with an enclosing wall 19 at one end thereof.

The cylindrical body wall 18 includes a cylindrical boss projection 20 forming an outlet means for the passage of fluid from the interior of the shell housing. End wall 19 is likewise formed with a cylindrical boss portion 21, located substantially on the axial centerline of the housing, and providing another or alternate outlet means therefrom. Both of the outlet means 20 and 21 are internally threaded for receptive connection with suitable connective means for piping or conduit utilized to convey heated fluid to a point of consumption. As shown, it is contemplated that only one such outlet means 20 or 21 will be utilized at any one time in normal installation and, to that end, boss portion 20 is illustrated with a plug closure means 22 fitted therein.

The left-hand end of housing wall 18, as seen in FIGURE 1, is formulated with a recessed or annular inset shoulder defining an annular lip portion 23 of reduced cross-sectional dimension from the remaining thickness of the wall portion 18. Such lip portion 23 is further provided with a plurality (eight, as shown) of spaced bolt receptive openings (unnumbered) for purposes which will appear presently.

In addition to the two outlet boss portions or means 20 and 21, housing portion 16 is also formed with a third cylindrical boss 25, best seen in FIGURE 1, which projects externally of the cylindrical body wall 18 thereof at an offsetting angular relation with respect to outlet boss portion 20. This boss 25 is receptive of suitable threaded fitting means 26 associated with the housing for the thermostatic sensor means 13 as illustrated in FIGURE 1.

The inlet housing portion 17 of the shell housing, as previously mentioned, is substantially similar to the outlet portion 16 hereinabove described and, as shown, such is formed with a cylindrical body wall 27 closed over at one end by end wall 28; each of said walls 27 and 28 being integrally cast with separate projecting inlet boss portions or means 29 and 30 respectively. As with the outlet housing portion 16, it is contemplated that in normal usage only one such inlet means 29 or 30 will be utilized at a time and therefore a plug closure means, such as member 31, is provided for threading engagement with interior threads of the inlet means 29 (see FIGURE 3). The body wall 27 is also provided with a second cylindrical boss means 32, as seen in FIGURE 1, projecting outwardly of its exterior and disposed with its axis at a position of angularity with respect to the central axis of inlet means 29 thereon. The second boss means 32 connectively receives an insulated electrical connective

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means 33 (see FIGURE 2) housing an electrode assembly 34 which is joined, internally of the inlet housing 17, to an electrical conductor means 35 having connection with terminal means 36 associated with the electrical heating means 12.

In order to mount the heating means 12 within the shell housing, the inlet housing portion 17 thereof is formed with three rod-like mounting pads or pedestals 38, 38 arranged about the perimeter of inlet means 30 extending within the hollow interior of the inlet housing portion 17, as best illustrated in FIGURES 2 and 3 of the drawings.

The internal wall of cylindrical body wall 27 of the inlet housing portion 17 is also formed at one end with an annular shoulder to form an annular mounting lip 40 which matingly overlaps and seats with lip extension 23 of the outlet housing portion 16, previously described, when such two housing portions are assembled to formulate the shell housing. In this latter regard, the lip extension 40, like the lip 23, is formed with a plurality of spaced openings for reception of bolt connector means 41 at substantially 45° intervals around the periphery or circumference of the shell housing.

In assembling the shell housing portions 16 and 17, the same are joined in end-to-end relationship as shown in FIGURE 3 of the drawings, with the mating lip portions 23 and 40 in overlapping relationship. The several bolt connectors 41 are then inserted through the openings in such lip portions for threading engagement with openings 42 formed in an internally disposed annular sealing ring 43 which bears a substantially trapezoidal shaped cross-section, as illustrated in FIGURE 3. It will be noted that a pair of spaced O-rings 45, 45 also are provided between the outer annular wall of the sealing ring 43 and the adjacent internal surfaces of the wall portions 18 and 27 of the two housing components 16 and 17. This construction provides an effective sealed interconnection of the two housing portions 16 and 17 with the O-rings 45, 45 preventing leakage of fluid therepast. The sealing ring 43 also serves as an internal baffle means to substantially block off the flow of fluid around and past the outside of the heater means 12, as will be amplified presently hereinafter.

Thus it will be seen that the shell housing 11 comprises a dual part assembly composed of the substantially similar inlet and outlet housing portions placed coaxially end-to-end in their assembled relationship. It will be noted also that inlet means 30 at one end thereof is aligned substantially coaxially with the outlet means 21 at the other end thereof, while the alternate inlet and outlet means 29 and 30 have their axes disposed at substantially right angles to the axis of the shell housing assembly.

In order to provide a convenient and effective means for mounting and attaching the shell housing assembly 11 to various support surfaces, a simple and convenient adjustable mounting bracket 50 is provided, the features of which will be best understood from FIGURES 2-5. As shown therein, the mounting bracket 50 includes a planar mounting base 51 comprising a pair of coplanar, laterally spaced parallel mounting legs 52, 52 (see FIGURE 1), each provided with openings 53, 53, adjacent their outer ends, receptive of mounting bolts 54, 54 or like connective devices. The central portion of the mounting base 51 extends integrally between the spaced mounting legs 52, 52, with lateral portions thereof bent upwardly or angularly outwardly of its general plane of formation, substantially at 45°, to provide spaced ear portions 55, 55 for connection with the shell housing 11 (see FIGURE 5).

With particular reference to FIGURE 5 of the drawings, it will be appreciated that the mounting ear portions 55, 55 are each provided with an opening 57 receptive of a selected one of the connective bolt means 41

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utilized to interjoin the two housing portions 16 and 17 at their overlapping ends as previously described. It will be appreciated from FIGURE 5 in particular that there are eight such connective means 41 which are disposed at substantially 45° intervals of angular separation about the periphery or circumference of the cylindrical housing 11 and that the mounted bracket 50 is joined to the shell housing by two selected connective means 41. With this arrangement, the two shell housing portions 16 and 17 may be disposed at various positions of relative rotation so as to locate the alternate inlet and outlet means 29 and 30, especially, at various selected positions of angularity about the longitudinal axis of the shell housing. This also applies to the mounting bracket 50. In a similar fashion, without rotating the shell housing portions 16 and 17 relative to one another, the mounting bracket may be disposed at various positions about the circumference of the shell housing, or, that is, connected to the latter at the positions dictated by selected pairs of the connective means 41, 41.

Thus, it will be appreciated that the means utilized for interconnecting the shell housing portions 16 and 17 and mounting bracket means 50 affords an extremely versatile arrangement productive of a wide variety of mounting positions for the heater devices of this invention, as well as a wide variety of operational positions for installing the housing portions 16 and 17. This versatility of relative rotational interpositioning of the housing portions 16 and 17 and mounting bracket also affords corresponding versatility in positioning the secondary boss means 25 and 32 thereof so as to afford various operating positions for the thermostatic sensor means 13 and the electrical connector means 33, as required by various circumstances encountered at installation.

It will be seen, particularly from FIGURES 1 and 5, that another support bracket 60, similar to mounting bracket 50 above described, is provided comprising a planar base plate portion 61 and a pair of connective ear portions 62, 62, struck angularly outwardly therefrom for connection to the shell housing by pairs of the connective means 41. This bracket affords an attachment and support means for the thermostatic controller means 14. For all intents and purposes, mounting bracket 60 is substantially identical to the previously described mounting bracket 50, except that the base plate portion 61 thereof is formulated with a somewhat lesser lateral dimension so that the parallel spaced mounting leg portions 63, 63, which provide the connective support with the controller means 14, are of less length than the corresponding leg portions 52, 52 of mounting bracket 50.

With reference now to FIGURE 3 of the drawings, the heater means 12, as therein illustrated, comprises an electrical resistance coil means disposed on an insulated core, indicated generally at 65; the same being formulated as a substantially cylindrical unit having three mounting ears 66, 66 projecting laterally outwardly from the base end thereof for connection with the mounting pads 38, 38 extending from the end wall 28 of the inlet housing portion 17. Heater coil unit 65 is surrounded by a cylindrical insulating tube 67 having three mounting lugs 68 directed radially outwardly of one end thereof (see FIGURE 3) for connection along with the mounting ears 66 of the heater unit 65 to the mounting pads 38, 38. Connection of the heating coil unit 65 and the tube 67 to the mounting pads 38 is effected by connective bolt means 69, 69, or other suitable means, threadingly received in openings 70, 70 formed inwardly of the innermost ends of the mounting pads 38, 38. It will be recognized that the tube 67 is disposed coaxially within the sealing ring 43 and coaxially about the cylindrical heater unit 65; the same being separated from the latter by an annular space 71 to form an annular passageway for the flow of fluids between the heater unit 65 and the interior walls of the tube 67. It will be recalled that in the previous description of the sealing ring 43, a baffling

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function was attributed thereto. This will now be recognized and understood in considering the relationship of the sealing ring to the tubular member 67 since the sealing ring extends between the interior wall of the cylindrical shell housing 11 and the exterior wall of the tubular member 67 so as to substantially block off and prevent the flow of air therepast. This system effectively channels air or other fluid entering the inlet means 29 or 30 at the left-hand end of the shell housing as viewed in FIGURES 1 and 3, for example, through the annular spacing or passageway 71 between the exterior of the heating unit 65 and the interior walls of the tubular member 67. The tube 67 therefore acts somewhat as an insulator means by absorbing and reflecting the radiant energy from the heating unit 65, which heat energy is then wiped off by the passage of the fluid along passageway 71 as it proceeds axially through the tubular member to the outlet end of the shell housing. This desirably maintains the exterior surface of the shell housing at acceptable surface temperatures for bodily contact despite the elevated temperatures of the heater element and the fluid immediately surrounding the latter.

Energization of the heater unit 65 takes place over the electrical conductor 35 joined between its associated terminal 36 and the electrode connector means 34; the circuitry and operation therefor being schematically set forth in FIGURE 6 of the drawings, as will be described in greater detail presently.

Referring now to FIGURES 1, 2, 4 and 6 of the drawings, the thermostatic sensor means 13 and controller means 14 therefor, as well as their operational relationship, will now be described. As depicted best in FIGURE 1 of the drawings, the thermostatic sensor means 13 preferably comprises a protective outer housing 75 adapted for connection at one end with the fitting means 26 whereby the same is joined to the boss portion 25 on the outlet housing portion 16. The opposite end of the protective housing 75 includes protective cap and insulated electrical connective means 76 whereby insulated electrical conductors 77 and 78 may be connectively associated in circuit with a mercury thermostat 79 (see FIGURE 6) protectively encased within housing 75.

As best seen in FIGURE 6, the mercury thermostat comprises a conventional unit, which is similar to a mercury thermometer, having a capillary tube 80 through which a body of mercury rises and falls as ambient temperatures increase and decrease. The capillary tube is constructed with two wells or bulbs 81 and 82 which contain mercury. The lowermost of the bulbs 82 is exposed to the heated air or fluid within the shell housing as indicated by its position shown in dotted lines in FIGURE 4; the air or other fluid being heated by the device of this invention passing through the inlet means at one end of the shell housing over a heater unit 65 for discharge via one of the outlet means 21 or 22 at the opposite end of the shell housing as above discussed. In so doing, the fluid heated by the thermal output of the heater unit 65 passes over and around the bulb 82 of the mercury thermostat of the sensor means 13 so as to responsively activate the mercury therewithin, according to known principles.

The other bulb or well 81 of the mercury thermostat is surrounded by a heater winding 83 which is periodically energized in accordance with the periodic energization of the heater unit 65, of which greater detail will appear hereinbelow. The capillary tube additionally is invaded at two points, 84 and 85, by electrode probes comprising electrical conductors 86 and 87, respectively, spaced along the axial length of the capillary tube 80. Conductor means 86 is coupled to ground, while conductor 87 is joined to conductor 77 leading to controller means 14 as previously mentioned. While, as above stated, the lower mercury well or bulb 82 is subjected to the thermal influence of the fluid discharged from the shell housing,

the upper well or bulb 81 is remote therefrom and insulated within the protective housing 75 for the sensor unit.

As seen in FIGURES 3 and 4, the controller means 14 is a unitary device comprising a housing 88 removably joined to the upper mounting bracket 60 by bolt means 89. Energization of the heater unit 65 is controlled by the controller means 14 and the sensor means 13 associated therewith. To this end (see FIGURE 6), a source of electrical energy 90, typically in the order of 26 volts D.C. supplies line conductor 91 having an on-and-off line control switch 92 which controls energization of the heating device of this invention as will now be set out.

When line switch 92 is closed, electrical energy flows therethrough to the controller unit 14 via conductor 94 which is coupled to a variable potentiometer 95 selectively operable by the individual user; controller knob 96 (see FIGURE 3) being provided exteriorly of the controller unit housing 88 for that purpose. Potentiometer 95 is in series circuit with a fixed resistance R1 over conductor 97 which is joined to conductor 78 at a convenience terminal connector B1. Conductor 78 extends between terminal connectors B1 and B2 and is joined at the latter to the heater winding 83 associated with upper bulb or well 81 of the mercury thermostat. The winding 83 is also coupled to ground over conductor 98 and the grounded conductor 86, associated with the first probe point 84 of the mercury thermostat.

From the above-described portion of the illustrated control circuitry, set out in FIGURE 6, it will be appreciated that when line switch 92 is closed, circuit is completed through potentiometer 95 and the thermostatic heater coil 83 to ground, thereby energizing the latter with a constant energy value which is, however, selectively variable in accordance with the setting of the variable potentiometer 95 according to recognized principles.

Potentiometer 95 is also coupled to a second resistance R2 in a parallel circuit comprising conductor 100, resistance R2 and a movable relay contact 101. Relay contact 101 is movable from a normal deenergized position, indicated in full lines in FIGURE 6, whereat the same engages a contact 102 in circuit with conductor 97 to an energized position (shown in dotted lines in FIGURE 6) whereat the same engages dead contact 103. Operational movement of relay contact 101 is brought about by energization of a relay coil means 105 which is in circuit with conductor 94 via conductor 106 and with the second electrode probe point 85 of the mercury thermostat over conductors 107, terminal junction A1, conductor 77, terminal A2 and conductor 87 which is joined to probe point 85. When mercury bridges probe points 84 and 85, the relay coil circuit is completed to ground via the grounded conductor 86.

The relay operating coil 105 in addition to operating movable contact 101 above described, also operates a second movable contact 110 which is in circuit with the line conductor 90 over switch 92 and intervening conductor 111. Relay contact 110 moves between a normal deenergized position, shown in full lines in FIGURE 6, whereat the same engages fixed contact 112 to an energized position as shown in dotted lines in that figure, whereat the same engages a fixed dead contact 113. Contact 112 is in circuit with the heater unit 65 via conductor 114, the electrode connector means 34, conductor 35 and the terminal connector 36 at the heating unit 65. Typically, the heater unit may be of the order of 250 watts. A ready light circuit is also included to indicate when the heater unit 65 is energized and such comprises an incandescent bulb 115 supplied over conductor 116 which is coupled between the heater unit supply conductor 114 and ground.

It will be understood from the foregoing that when line switch 92 is closed, the heater unit 65 is normally energized over conductor 111, closed relay contacts 110 and 112, conductors 114 and 35 to ground. At the same

time, the ready light circuit is energized to visually notify the operator that the heating unit is energized. Simultaneously, normal "cycle power" energy is supplied to the winding 83 of the sensor unit 13 over the ground circuit including conductor 94, variable potentiometer 95, resistance R1, conductors 97 and 78, winding 83 associated with the mercury thermostat and conductors 98 and 86 to ground. The coil 83 for the mercury thermostat is also periodically pulsed or supplied with additional energy whenever the heater unit 65 is energized. The circuit for supplying such additional energy to the thermostat coil includes line conductor 91, line switch 92, conductor 94, potentiometer 95, parallel circuit conductor 100, resistance R2, closed relay contacts 101 and 102, conductors 97 and 78, heater winding 83 and conductors 98 and 86 to ground. By so periodically applying additional energy to thermostat winding 83 in accordance with the energization of the heater unit 65, the mercury thermostat anticipates the action of the heater unit and, more particularly, the increased temperature of the fluid being heated by the latter. This anticipating action eliminates oversurges in the temperature of the effluent air or other fluid discharged by the device of this invention, as will now be described.

Whenever relay coil 105 is energized, the heater unit 65 is deenergized and the aforedescribed anticipating function provided by the excess pulse energy over the alternate controller circuit including resistance R2 is interrupted. This is brought about whenever the mercury in the capillary tube 80 of the sensor unit elevates to a level sufficient to bridge and close contact between electrode probe points 84 and 85 so as to complete electrical circuit through the relay coil 105, conductors 107, 77, 87 and 86 to ground. This relay energizing circuit is the circuit which passes through the terminal connectors A1, A2 and is therefore hereinafter referred to as the "A circuit." When the "A circuit" is thus established, the relay coil causes relay contacts 101 and 110 to move to their dotted line positions as illustrated in FIGURE 6, to deenergize the heater unit 65 and likewise deenergize circuit through resistance R2 which supplies the additional "pulse" heat energy to the winding 83 of the mercury thermostat. As soon as such additional energy is removed from the sensor unit winding 83, the mercury in the capillary tube 80 drops quickly, breaking contact or circuit between the probe points 84 and 85 therein, thereby deenergizing the relay coil 105 and reestablishing power to the heating coil of the heater unit, as well as reactivating the additional "pulse" power to the sensor unit winding 83 over the controller circuit including resistance conductor 100, resistance R2 and relay contacts 101 and 102.

It will be recognized, of course, that the potentiometer 95 and the fixed resistance R1 in circuit therewith serve to determine the lower operating limit for the thermostatic sensor unit. That is to say, the variable setting of the potentiometer, as determined by the individual user's demands, serves to establish a selected "cycle power" heat normally supplied to the thermostatic winding 83 whenever line switch 92 is closed. Thus, "cycle" heat energy therefore determines a minimum or lower elevational limit for the column of mercury in the capillary tube 80. As the temperature of the fluid being heated by the heater unit 65 is elevated, such elevated temperature is sensed by the secondary bulb 82 established in the stream of moving fluid to elevate the level of the mercury toward probe point 85. When the temperature of the fluid or air being heated, assisted by the pulse heat energy supplied to the winding 83, elevates the level of the mercury within the capillary tube sufficiently to establish circuit connection between the probe points 84 and 85 in the capillary tube, the relay coil 105 is energized, as aforedescribed, the heater unit 65 is deenergized and the control cycle is repeated.

From the foregoing, it is believed that those familiar with the art will readily recognize and appreciate the novel features and aspects of the present invention and the manner in which the same meets the hereinabove set forth objectives. Further, while the present invention has been described in association with a particular embodiment thereof illustrated in the accompanying drawings, it will be recognized and understood that the same is not necessarily limited to such specific embodiment, but is susceptible to numerous changes, modifications and substitutions of equivalents without departing from the spirit and scope of this invention. It is therefore intended that this invention be unlimited by the foregoing, except as may appear from the following appended claims.

I claim:

1. A device for heating and controlling the temperature of fluids, particularly gases, comprising: a substantially cylindrical housing having inlet means at one end and outlet means at the opposite end thereof for passage of fluid substantially axially therethrough, electrical resistance heater means mounted within said housing for heating the fluid, tubular means surrounding said heater means and extending between the latter and the inner walls of said housing in spaced relationship with the same to insulate said housing walls from the thermal output of said heater means, means extending between said tubular means and said housing preventing the passage of fluid therebetween and channelling the flow of said fluid between said heater means and tubular means, and means for controlling the temperature of the fluid discharged from said outlet means comprising electrical circuit means including thermostatic means operatively responsive to the temperature of fluid heated by said heater means and electrical relay means in circuit with said thermostatic means, said heater means and a source of electrical energy; said relay means being operable for automatically deenergizing said heater means in response to operation of said thermostatic means at a predetermined maximum temperature limit of said fluid sensed by said thermostatic means and for energizing said heater means at temperatures of said fluid below said maximum limit; said thermostatic means comprising a mercury thermostat having a mercury containing sensor bulb disposed within said housing and subject to the temperature of fluid heated by said heater means, an additional mercury containing bulb disposed remotely of said sensor bulb and having an electrical winding adjacent thereto which is normally energized to heat said thermostatic means at ambient temperatures independently of the temperature sensed at said sensor bulb means; said winding also being in electrical circuit with said heater means and said relay means whereby the same is also periodically energized with said heater means to provide an additional ambient temperature at said thermostatic means to cause the latter to operatively anticipate the sensing reaction of said sensor bulb means to the heat being supplied to said fluid by said heater means, thereby to prevent oversurges of the fluid's temperature beyond said maximum limit.

2. The combination as set forth in claim 1 in which said means for controlling the fluid temperature includes adjustable resistance means in circuit with said winding and the source of electrical energy whereby to impose a constant selectable ambient to said thermostatic means independently of the energization of said winding in accordance with energization of said heater means thereby to establish a minimum operating level for the mercury of said thermostat.

3. A unitary heating device comprising, in combination, a unitary housing having a cup-like inlet portion and a similar outlet portion, each with a substantially cylindrical side wall and an end wall enclosing one end thereof, such portions being adapted for interconnection at their open ends in coaxial relationship with the end

and side walls of said inlet portion each having an inlet means therethrough for selective connection with a source of fluid to be heated and the said side and end walls of said outlet portion having corresponding outlet means therethrough for the selective discharge of said fluid from said housing; removable means closing over a selected said inlet means and a selected said outlet means in operation connecting means detachably interjoining the said inlet and outlet portions with their opposed end portions overlapped, said connective means including annular ring means disposed within said housing and extending between adjacent opposed overlapping ends of said inlet and outlet portions and having means effecting sealed connection with the latter; said connective means serving to interconnect said inlet and outlet portions in a plurality of selected positions thereof whereby the respective inlet and outlet means formed in the side walls thereof are disposable in selected positions of relative angularity, heater means mounted coaxially within said housing including an electrical resistance heating coil and a tubular member mounted thereabout to form a substantially annular fluid passageway between said heating coil and tubular member, said tubular member serving to reflect heat energy generated by said heating coil to effectively insulate the walls of said housing therefrom, and control means having circuit means for selectively energizing said heater means including temperature responsive sensor means for sensing the temperature of fluid heated by said heater means prior to the discharge thereof through said outlet means; and relay means in electrical circuit with said sensor means and heater means and operatively responsive to a predetermined maximum temperature sensed by said sensor means to deenergize said heater means.

4. The combination as set forth in claim 3 including another heating coil in electrical circuit with said heater means and located adjacent said sensor means to periodically elevate the temperature thereof in accordance with periodic energization of said heater means for the purpose of providing an ambient at said sensor means anticipating the temperature of said fluid to be sensed by said sensor means and thereby prevent oversurge of said fluid temperature beyond said maximum limit.

5. A device for heating and regulating the temperature of fluids, particularly gases, comprising a substantially cylindrical housing having coaxially aligned inlet and outlet means at opposite ends thereof and alternate inlet and outlet means in the walls thereof; said housing comprising two coaxially related portions interjoined by detachable connector means operative at plural selected positions of relative rotation of said portions whereby said housing may be assembled with said alternate inlet and outlet means disposed at selected positions of relative angularity, means closing over a selected said inlet means and a selected said outlet means in operation, heater means mounted coaxially within said housing, tubular means mounted coaxially about said heater means and separated from the latter by an annular passageway and from the interior walls of said housing by an annular space, means extending between said tubular member and the interior walls of said housing to effectively block off said annular space and prevent the flow of fluids there-through thus channeling said fluids through said annular passageway, and means for selectively regulating the temperature of fluids heated by said heater means including selectively adjustable thermostatic means having heat responsive means thermally exposed to the fluid within said passageway to sense the temperature of the fluid prior to its discharge from said housing and means operatively controlled by said heat responsive means for automatically deenergizing said heater means in response to elevation of the fluid's temperature to a predetermined maximum temperature limit.

6. The combination as set forth in claim 5 including bracket means attachable to the exterior of said housing

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substantially at the junction of said two portions thereof by the same, said connector means interconnecting said two portions; said connector means being detachable and disposed at uniformly spaced locations about the exterior of said housing for attaching said bracket means at various selected positions about the circumference of said housing.

7. The combination as set forth in claim 5 including manually operable controller means having control means for selectively adjusting said heat responsive means and activating said heater means; said controller means being removably mounted to the exterior of said housing whereby the heating device may be operatively controlled from positions remote therefrom.

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