Aug. 20, 1935. G. H. CLARK ET AL 2,012,221

HYPERPYREXATOR

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Fig. 1.

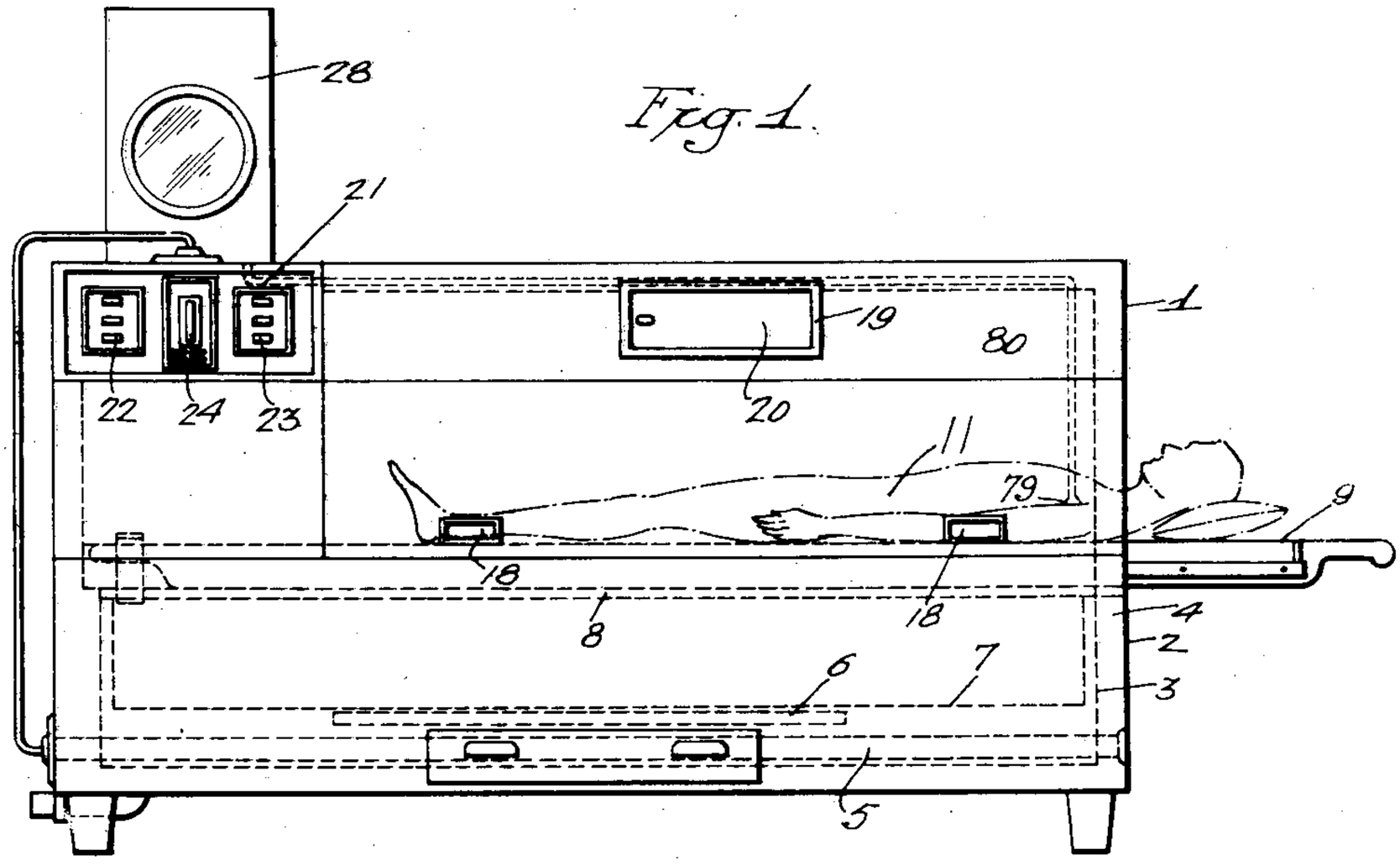

Fig. 2.

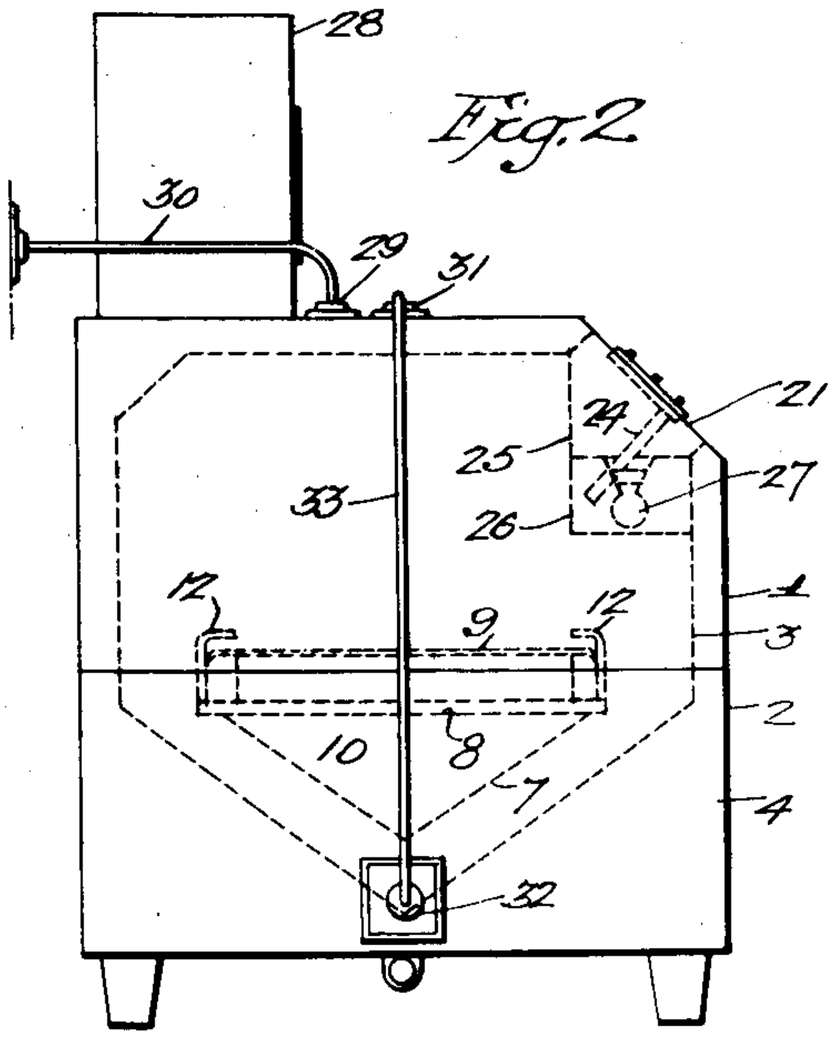

Fig. 3.

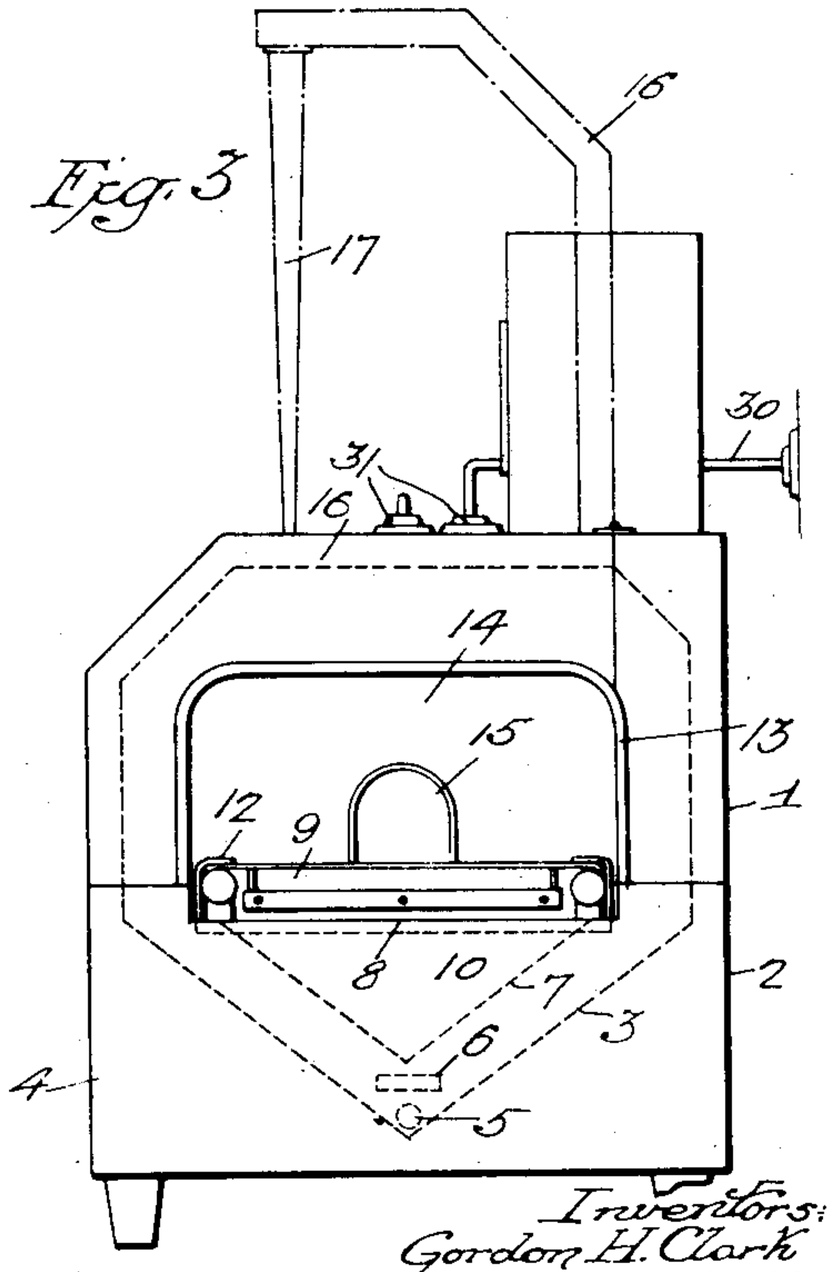

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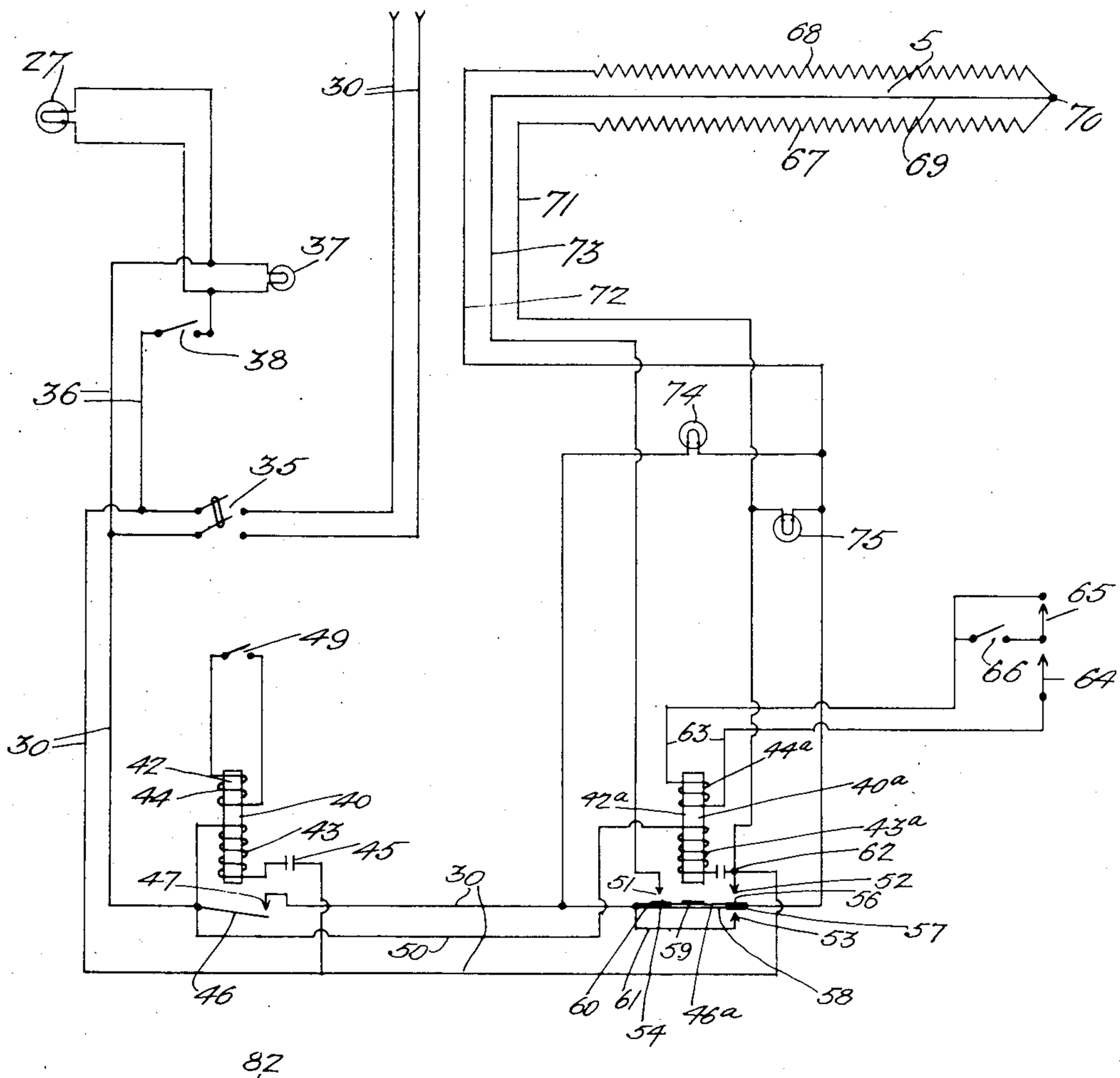
Fig. 4.



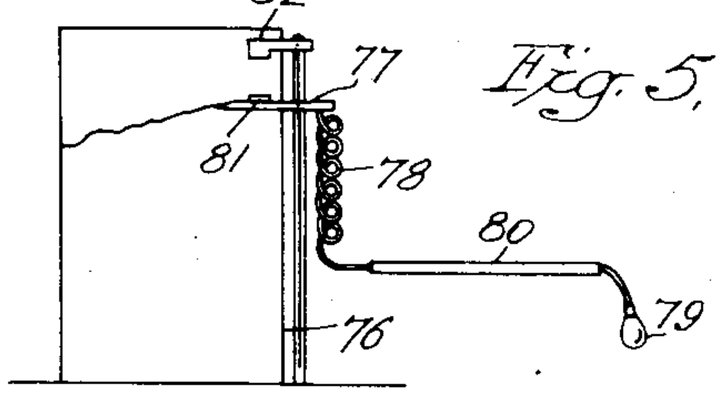


Fig. 5.

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HYPERPYREXATOR

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Application August 30, 1932, Serial No. 631,082

4 Claims. (Cl. 174—177)

This invention relates to treatment apparatus and more particularly to apparatus for treating the human body by the application of heat. Many ailments of the human body respond to heat treatment, and it has heretofore been proposed to take advantage of this fact by applying heat to a patient's body in various ways. The principal object of the present invention is to provide a novel device or apparatus for accurately producing any desired degree of "fever heat" in the human body without the sensation of heat and in a manner which is entirely safe to the patient.

Another object of the invention is to provide novel apparatus of this nature wherein the heat-generating means is at all times controlled directly by the body temperature of the patient.

A further object of the invention is to provide novel apparatus wherein the heat treatment of the patient's body is carried out in successive continuous steps under control of means responsive to the temperature of the air about the patient and the heat-generating means is at all times under control of the body temperature of the patient.

A still further object of the invention is to provide a treatment device in the form of a cabinet adapted to receive the patient's body in recumbent position and embodying novel features of construction which enhance the operation of the device and enable the attainment of the desired end.

A preferred form of the construction of the apparatus is illustrated on the accompanying drawings to which reference may be had in connection with the following detailed description.

In the drawings:

Fig. 1 is a side elevational view of the device with a patient therein;

Fig. 2 is an end view of the device from the left end thereof as illustrated in Fig. 1;

Fig. 3 is an end view of the device looking at the same from the right end;

Fig. 4 is a schematic wiring diagram, illustrating the electrical circuits of the device; and

Fig. 5 is a schematic detail view of the body temperature control mechanism which constitutes an important feature of the invention.

Referring to Figs. 1 to 3 of the drawings for a clear understanding of the mechanical construction of the device, the cabinet is designated 1 and is preferably formed of a ply wood body 2 having a metal lining 3 therein and arranged so as to provide dead air space 4 between the body and the lining. Experience has shown that "dead air" offers the most sanitary and effective means of heat insulation, particularly when used in a body treatment device, such as that herein disclosed. The dead air space 4 then serves to insulate the heated interior to prevent heat transmission to the outer air and thus render the device more efficient.

The lower part of lining 3 is preferably substantially V shaped as illustrated for a purpose which will appear more clearly hereinafter. A heating unit 5 is disposed centrally of the cabinet adjacent the lower apex of lining 3 and extends longitudinally of the cabinet substantially the full length thereof. Immediately above the heating unit, there is disposed a vaporizing pan 6 which is coextensive with a portion of the heating unit, as illustrated clearly in Fig. 1. This pan is filled with water during each treatment and the proper amount of vapor is thus developed so that the treatment is given in a saturated atmosphere. A V-shaped metallic heat deflector 7 is positioned above the lower V-shaped portion of lining 3 and conforms generally in shape with such portion. The deflector runs longitudinally of the cabinet substantially the length of the lining 3. A horizontally disposed board 8, which is adapted to support stretcher 9, constitutes with reflector 7 a chamber which houses the dead air space 10. This dead air space insulates the board 8 from the direct heating effect of the heating unit and thus avoids any discomfort or danger to the patient. It will now be noted that heat deflector 7 and the lower part of lining 3 define passages from the heating unit to the upper cabinet space above the patient and are adapted to direct, reflect, and deflect the heat and heated air currents from the heating unit to the upper part of the cabinet.

Stretcher 9 is, of course, adapted to support the patient, shown at 11, within the cabinet in a recumbent position. The stretcher is slidably supported by board 8 and to this end suitable brackets 12 are attached to the board and serve as retaining guides for the stretcher. When fully positioned within the cabinet, one end of the stretcher extends outside the cabinet, as illustrated clearly in Fig. 1, and the patient is so positioned that his head is positioned outside the cabinet as illustrated. The end of the cabinet has an opening 13 therein which is sufficiently large to permit the removal of the patient, after treatment, on the stretcher. During treatment, the opening 13 is closed by a suitable rubber curtain 14 which has an opening 15 therein that conforms generally in shape with the patient's neck and fits thereabout.

The cabinet has a hinged cover 16 which may be opened and maintained in opened condition by suitable props 17, this cover being shown in open position in the broken-line illustration of Fig. 3. Thus the interior of the cabinet is easily accessible for any purpose. In order to facilitate raising of the cover when desired, recessed handles 18 are provided. There is also provided in the cover a window 19 having a slidable clo-

sure member 20 which may be used either as a ventilator or for observation purposes. When a patient has reached fever temperature, the window may be opened to allow the fever to recede if desired.

The cabinet cover extends longitudinally over the greater part of the length of the cabinet, and adjacent the cover there is provided a stationary panel 21 which serves to support switches 22, pilot lights 23 and a mercury contact thermometer 24. These elements will be more fully discussed in connection with the wiring diagram. The thermometer is shown more clearly in Fig. 2 and it will be noted that it extends into the cabinet so as to be responsive to the air therein. The lining 3 is formed so as to provide an enclosure 25 for the electrical elements including those supported by panel 21. There is also provided a perforated enclosure 26 which serves to house and protect a flood light 27, which is adapted to illuminate the interior of the cabinet. A temperature-recording instrument 28 is supported at this end of the cabinet and is adapted to record the body temperature of the patient and to control the heat treatment, as will be more fully explained hereinafter. A suitable receptacle 29 is adapted to receive an electrical connection 30 leading to a suitable source of alternating or DC current. Receptacle 29 is electrically connected to receptacle 31 and the latter receptacle is adapted for connection to a receptacle 32 by a removable conductor cord 33. Receptacle 32 is connected to the heating unit and it will be apparent that electrical energy from the source is transmitted via the conductors and receptacles to the unit. The reason for providing this arrangement is to enable shipment of the device in several parts.

Referring now to the diagram of Fig. 4, the supply line 30, which, as stated above, may be connected to any suitable alternating or DC current source such as the usual 110 volt, 60 cycle commercial source, has a double pole line switch 35 connected therein which is adapted to interrupt the flow of current at any time. Connected across the supply line on the load side of switch 35, by means of conductors 36, is a pilot light 37, which is one of the pliot lights above mentioned and designated generally by reference character 23. This pilot light indicates, of course, whether or not the apparatus is energized at any particular time. A manually operable switch 38 is connected in one of conductors 36. The interior flood light 27 mentioned above, is connected across conductors 36 by conductors 39. When switches 35 and 38 are closed, light 27 will, of course, be energized and will serve its intended purpose. The supply lines 30 are connected to relays 40 and 40*a*. Relay 40 comprises a magnetic core 42 having windings 43 and 44 wound thereon. These windings are preferably wound in superposed relation, although for clarity of illustration, they are shown herein as being wound about different parts of core 42. The windings constitute a transformer, winding 43 acting as the primary and winding 42 as the secondary. Winding 43 is serially connected with a condenser 45 across supply lines 30. The relay also comprises a hinged or pivotal armature 46 which is adapted to engage and make electrical contact with a stationary contact 47. Windings 43 and 44 are designed so as to constitute a "step-down" transformer, that is, the ratio of primary turns to secondary turns is such as to give a substantial reduction in voltage. The reason for this will appear more clearly hereinafter. Winding 43 and condenser 45 are so designed as to have equal reactance values, so that these elements constitute a resonant circuit. As is well known, in a series resonant circuit, the current flow is a maximum and the design of the relay is such that for maximum current flow through the primary winding with the secondary winding open-circuited, the relay will be energized and the armature 46 will make contact at contact 47.

The secondary winding 44 is connected, via conductors 48, to a body control switch 49 which forms a part of the body temperature-recording instrument. For the immediate present, it suffices to state that switch 49 is controlled in direct accordance with the body temperature of the patient and this switch is normally open so as to open-circuit the secondary winding but closes when a predetermined body temperature is reached to short-circuit the secondary winding. When this occurs, current flows in the secondary circuit and the mutual inductance effect between windings 43 and 44 causes a variation in the inductive reactance in winding 43 to disturb the resonant condition above mentioned. At such time, the current flow through the primary winding is materially reduced and is insufficient to maintain the relay energized. Armature 46, accordingly, opens the line circuit at contact 47.

If the secondary winding is wound in the same sense or direction as the primary winding, as illustrated, the magnetic flux set up by the secondary current will aid the primary flux and tend to maintain the relay energized. In practice, however, the ampere turns, and therefore the flux, of the secondary is of such value as to prevent this tendency of the secondary flux from interfering with the operation. If desired, the secondary winding may be wound in the opposite sense or direction and the secondary flux would then oppose the primary flux and would not tend to maintain the relay energized but rather would assist in deenergizing it.

Relay 40*a* is designed similarly to relay 40 and comprises a similar magnetic core 42*a*, a similar primary winding 43*a* and a similar secondary winding 44*a*. The primary winding 43*a* of this relay is also connected serially with a condenser 45*a*, similar to condenser 45, across the line. To this end, the upper extremity of winding 43 is connected, via conductor 50, to one of lines 30 at the pivotal point of armature 46. Relay 41 also comprises a hinged or pivotal armature 46*a*, which, however, is adapted for cooperation with stationary contacts 51, 52 and 53. Contact 51 is arranged so as to be engaged by a contact segment 54 carried by armature 46*a* when the armature is in its raised or uppermost position. Contact 52 is similarly arranged and adapted for engagement by contact segment 56 when the armature raises. Contact 53 is disposed beneath the armature and arranged for engagement by contact segment 57 when the armature is in its lowermost position. Contact segments 56 and 57 are integral or electrically connected together and are insulated from contact segment 54 by the central insulating portion 58 of the armature. This portion carries a magnetic segment 59 which is attracted by core 42*a*. Contact segment 54 is mounted upon and electrically connected to the metallic end 60 of the armature. The stationary contact 53 is connected, via conductor 61, to one of lines 30 at the pivotal point of the armature.

Contacts 51 and 52, as well as contact segments

56 and 57, are connected to the heating unit 5 in a manner to be described in detail below. The series circuit comprising winding 43*a* and condenser 45*a* is connected to contact 52, as at 62. It will be obvious that this series circuit, which is also resonant when the secondary winding is open-circuited, is at all times connected across the supply lines 30. Relay 40*a* is thus adapted to operate in the same manner as relay 40. When the secondary winding 44*a* is open-circuited, the resonant condition exists and the relay is energized. When, however, the secondary circuit is short-circuited, the resonant condition is disturbed and the current through the primary winding is so reduced as to deenergize the relay. Secondary winding 44*a* is connected, via conductors 63, to the contact thermometer 24, previously mentioned. Thermometer 24 comprises contacts which are engageable by the mercury to provide thermostatic switches 64 and 65. Switch 64 is adapted to operate at a predetermined temperature, preferably 130° F., while switch 65 is adapted to operate at a higher predetermined temperature, preferably 160° F. In other words, these switches remain open so long as the temperature of the air in the cabinet is below their predetermined temperatures at which they are designed to close. Thermostatic switch 64 is serially connected with secondary winding 44*a* and with a manually operable switch 66. Thermostatic switch 65 is shunted about switch 66, as illustrated. When switch 66 is closed, thermostatic switch 64 is rendered effective and will function to short-circuit the secondary winding 44*a* at the above-mentioned predetermined temperature. If switch 66 is opened, however, thermostatic switch 64 is rendered inoperative to short-circuit the secondary winding but it will, nevertheless, close at its predetermined temperature. When the predetermined temperature of switch 65 is reached, viz., 160° F. in the preferred example, the switch will close and cause the short-circuiting circuit to deenergize relay 40*a* in the manner above specified.

The heating unit 5, hereinbefore mentioned, comprises two heating elements 67 and 68, which are each preferably of 1000 watt capacity. One end of each of these units is connected together and to a common conductor 69 at 70. The other extremity of element 67 is connected to contact 52 of relay 40*a* via conductor 71. The other extremity of heating element 68 is connected to contact segments 56 and 57 carried by armature 46*a* via conductor 72. The common connecting point 70 is connected to contact 51 of relay 41 via conductor 73. It will be noted that with relay 40 energized so as to close the line circuit, the heating elements 67 and 68 will be connected either in parallel or series relation depending upon the condition of relay 40*a*. Normally, the secondary winding of this relay is open-circuited and the relay is, therefore, energized in the manner above explained, its armature 46*a* contacting the upper contacts 51 and 52. At such time, the heating elements will be connected in parallel relation through a circuit which may be traced as follows:—From the lower line 30, to the connecting point 62 and from thence through a parallel branch including conductor 51 and heating element 67 to the common point 70 and also through another parallel branch including contact 52, contact segment 56, conductor 62 and heating element 68 to the common point 70. From point 70, the circuit proceeds through the common conductor 73, contact 51, contact segment 54 and the upper line 30. A visual indication of the parallel connection of the heating elements will be given by pilot light 74 which is connected between conductor 72 and the upper line 30. As will be apparent from inspection, this pilot light is connected across the line in parallel with the heating elements and, therefore, receives a portion of the incoming energy.

If, however, relay 40*a* becomes deenergized, its armature 46*a* dropping and engaging contact 53, then the heating elements will be connected in series through a circuit which may be traced as follows:—From the lower line 30 to connecting point 62 and from thence through conductor 71, heating element 67, heating element 68, conductor 72, contact segments 56 and 57, conductor 61, to the upper line 30. It will be observed that at this time, the common conductor 73 is open-circuited at contact 51. A visual indication of the series connection of the heating elements will be given by pilot 75 which is connected between conductor 71 and conductor 72, as illustrated. It will be apparent from inspection that this pilot light is connected across the line in parallel with the heating elements when they are connected in series. It is to be noted that when the heating elements are connected in parallel relation, the total connected load is 2000 watts, while, when the heating elements are connected in series relation, the total load is 500 watts. In other words, when relay 40*a* operates at either of the predetermined temperatures above mentioned as governed by thermostatic switch 24, the load is materially reduced and the heating action is likewise reduced.

Referring now to Fig. 5 for a clear understanding of the body temperature-recording device 28, hereinbefore mentioned, such device comprises a rotatable cylindrical chart 76 and a pen 77 associated therewith and adapted to write or inscribe upon the chart. Attached to the pen is an electric Bourdon tube 78 which is connected to a bulb 79 by a small bored capillary tube 80. Bulb 79 is adapted to be applied to the patient's body in a manner to respond to the axilla, rectal, or mouth temperature of the patient, as indicated more clearly in Fig. 1. The bulb, capillary tube and Bourdon tube are filled with a suitable liquid which expands or contracts under change in temperature. Any change in the body temperature of the patient will cause an expansion or contraction of the Bourdon tube to move the pen 77 upward or downward. The pen is stationary horizontally and is adapted for vertical movement under the influence of the Bourdon tube.

A contact 81 is carried by the pen and a movable contact 82 is adjustable vertically. A vertical support 83 may carry both pen 77 and contact 82, the latter being adjustable along the support. Contacts 81 and 82 constitute the body temperature control switch 49, hereinbefore mentioned and these contacts are, of course, connected in circuit with the secondary winding 44 of relay 40. Contact 82 may be adjusted to any position corresponding to a predetermined temperature at which it is desired that the switch operate to short-circuit the secondary winding 44 and deenergize relay 40 in the manner previously explained. With contact 82 adjusted in a desired position, it will be apparent that if the body temperature of the patient rises sufficiently to cause the pen 77 to move upwardly a sufficient distance to cause engagement of contact 82 by

contact 81, relay 40 will be deenergized and the supply line opened.

Considering now the operation of the device as a whole and referring generally to the various views of the drawings and particularly to Figs. 4 and 5, let it be assumed that a patient has been properly placed within the cabinet and that the line switch 35 has been closed to energize the heating unit. Let us also assume that switch 66 has been closed and that contact 82 has been adjusted to the desired position. Relays 40 and 40*a* are now energized, as explained above, and the supply line is, therefore, closed and the heating elements 67 and 68 are connected in parallel. Under such conditions, the heating of the patient's body will be relatively rapid until the temperature of the air within the cabinet has reached 130° F. or the value at which switch 64 is adapted to operate. At such time, this switch will close and cause deenergization of relay 40*a* in the manner previously explained. This will connect the heating elements in series relation and reduce the load as above described. The heating effect is now materially reduced and the heating of the patient's body continues relatively slowly. When the temperature for which contact 82 has been adjusted is reached, the body control switch 49 will close as above explained and will cause deenergization of relay 40 to open the supply line. Thus the apparatus is shut off when the exact body temperature which it is desired to attain has been reached. Should the patient's temperature drop materially, the body control switch 49 will open and cause deenergization of relay 40. This will cause reenergization of the heating elements in the manner above described. It will be apparent then that the apparatus operates automatically in either direction and functions to maintain the desired body temperature.

The specific purpose of providing the selective switches 64 and 65 is to permit latitude in the treatment of various individuals. By the provision of this feature, the operation of relay 40*a* may be varied in accordance with the physical characteristics of the patient. The heating is accomplished in two continuous and successive steps and it is possible by virtue of switches 64 and 65 to govern the relative lengths of the two heating periods.

It is very important to note that by utilizing relays 40 and 40*a* of the design specified herein, a low voltage circuit is used in each instance to control the device in accordance with the body and air temperatures. This is an important feature since it eliminates entirely any hazard or danger to the patient due to the presence of high voltage. The relays are mounted within enclosure 25 and therefore are isolated from the patient.

From the foregoing description, it will be evident to persons skilled in the art that the present apparatus enables the obtaining of any desired degree of "fever heat" in a patient's body accurately, safely and without discomfort to the patient. The device is at all times under direct control of the body temperature of the patient and, therefore, excessive heat cannot be applied nor can insufficient heat to give the desired body temperature be applied. While a single preferred embodiment of the apparatus has been disclosed herein for the purpose of illustration, various changes and modifications may, of course, be made without departing from the spirit of the invention.

We claim:

1. Treatment apparatus comprising a cabinet, a stretcher slidable into and out of said cabinet for supporting a patient in a recumbent position within said cabinet, a supporting member for said stretcher, a heating unit extending longitudinally of said cabinet and disposed centrally below said supporting means, a vaporizing pan above said unit, a heat deflector below said supporting member and forming therewith a dead air chamber, and a reflector below said heat deflector and forming therewith passages for directing the heat and heated air currents from said unit into the space above the patient.

2. Treatment apparatus comprising a cabinet, means for supporting a patient in a recumbent position within said cabinet, a heat deflector below said supporting means and forming therewith a dead air chamber, a heating unit below said heat deflector, and a reflector below said heat deflector and forming therewith passages for directing the heat and heated air currents from said unit into the space above the patient.

3. Apparatus for producing and accurately controlling fever heat in the human body, comprising a cabinet adapted to receive a patient to be treated, means for raising the temperature of the patient's body at a relatively rapid rate under control of the air temperature within the cabinet until a predetermined temperature of the air is reached, so as to initially heat the patient's body at a rapid rate to a predetermined temperature less than the fever heat desired, and means for thereafter raising the temperature of the patient's body at a relatively slow rate under control of the body temperature itself until the desired fever temperature is produced in the body, said last means being adapted to maintain the said fever temperature accurately throughout the treatment.

4. Apparatus for producing and accurately controlling fever heat in the human body, comprising a cabinet adapted to receive a patient to be treated, a pair of electrical heating elements for raising the temperature of the patient's body, means normally connecting said heating elements in parallel relation across an electrical supply line, so as to initially heat the patient's body at a relatively rapid rate, means for controlling the said initial heating under the influence of the air temperature within the cabinet, means actuatable by said last means to connect said heating elements in series relation across the supply line when a predetermined temperature of the air is reached, so as to interrupt the rapid initial heating at a predetermined temperature of the body less than the fever heat desired and continue the heating at a relatively slow rate, means for controlling the slow heating under influence of the body temperature itself, and means actuatable by said last means to deenergize said heating elements when the desired fever temperature is produced in the body and to successively reenergize the heating elements to maintain the desired fever temperature throughout the treatment.

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