Aug. 28, 1923. 1,466,652

F. BATTER

PORTABLE MOUNTAIN AIR SANITARIUM

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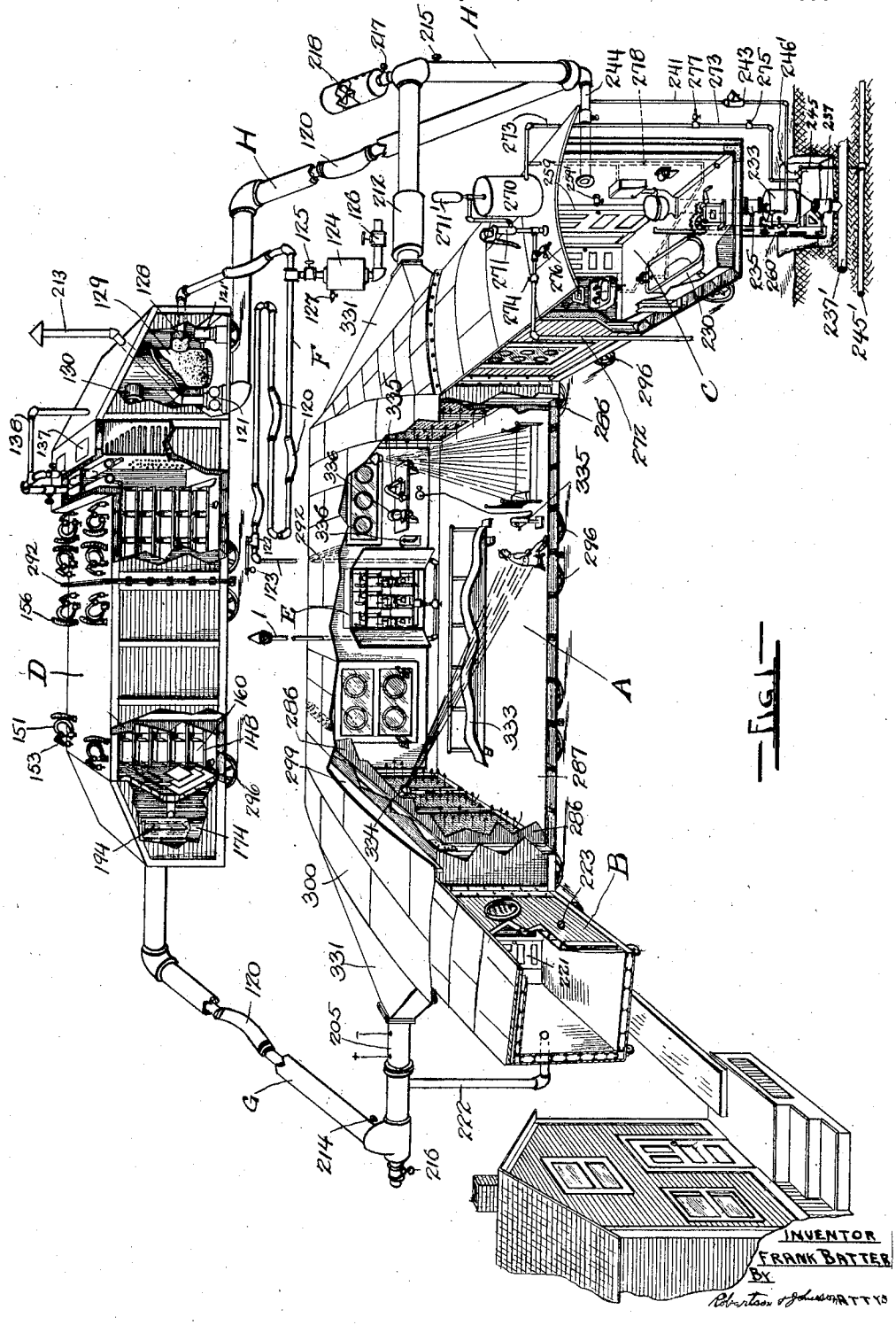


Fig. 1

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F. BATTER

PORTABLE MOUNTAIN AIR SANITARIUM

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Fig. 2.

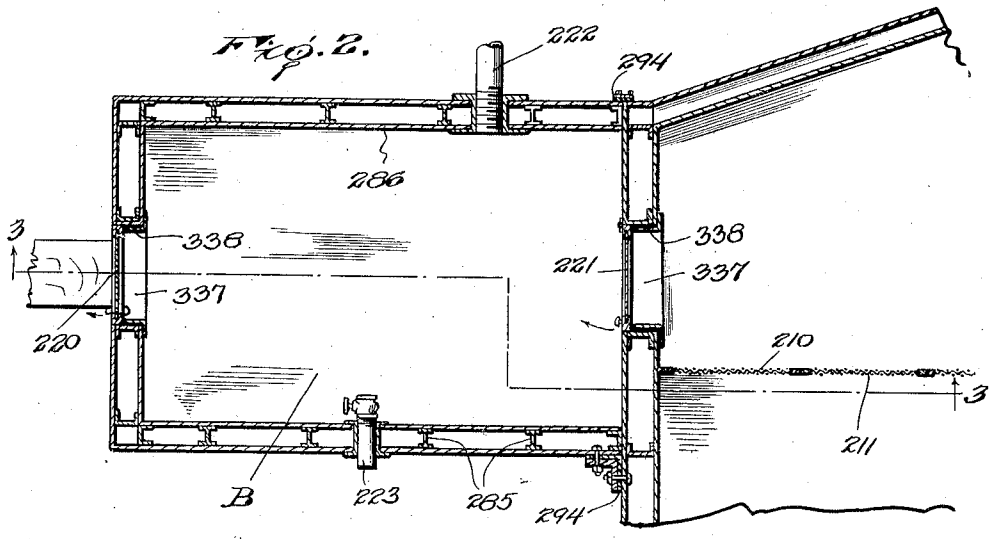


Fig. 3.

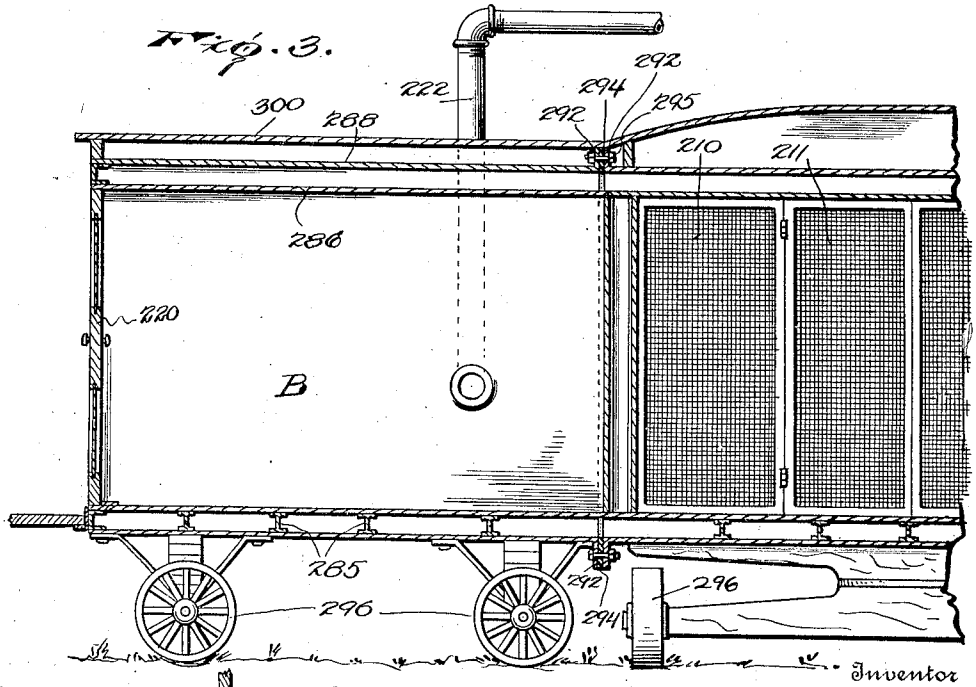
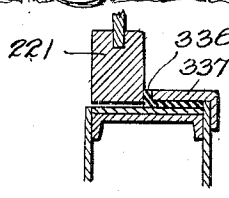


Fig. 4.



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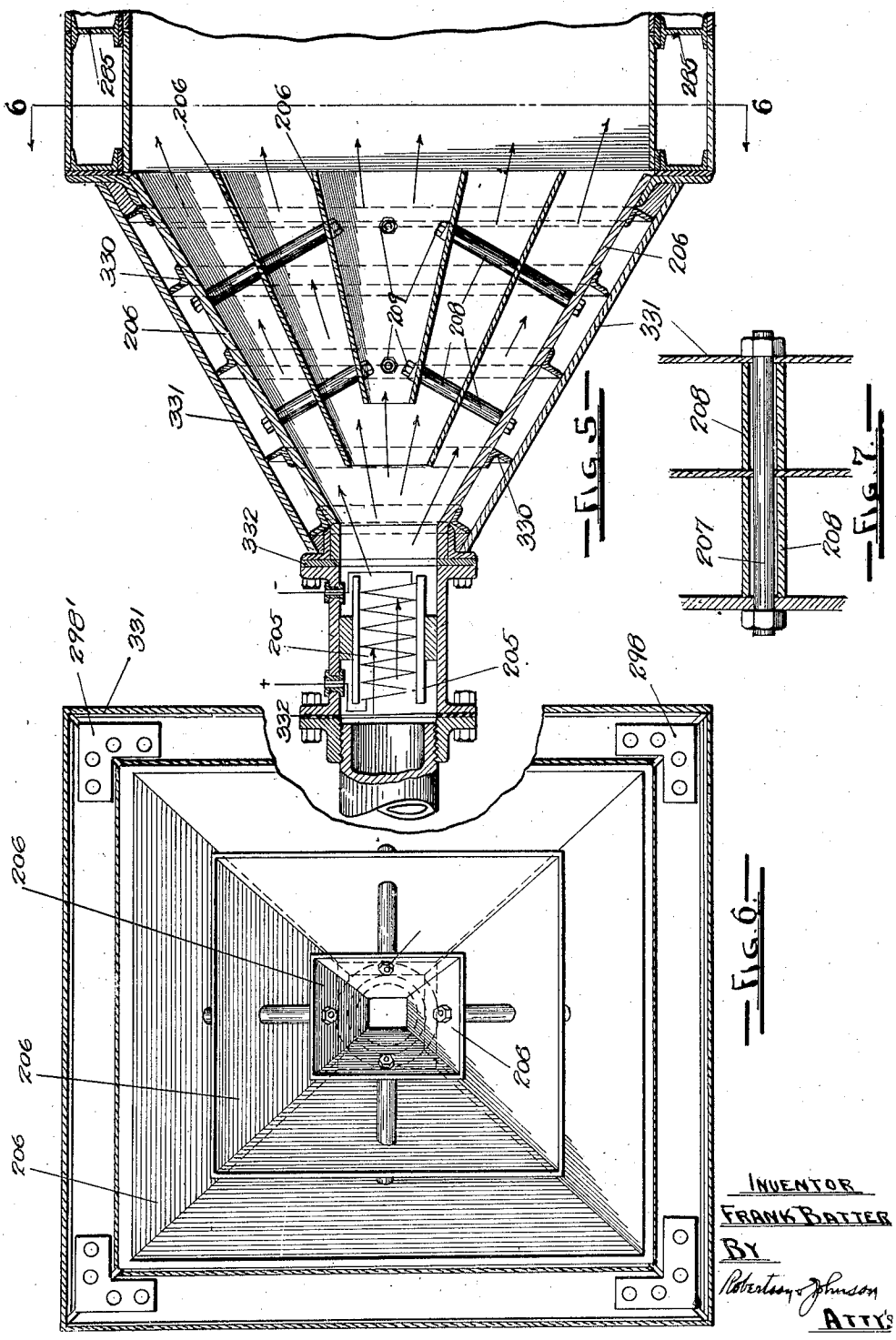


FIG. 5

FIG. 7

FIG. 6

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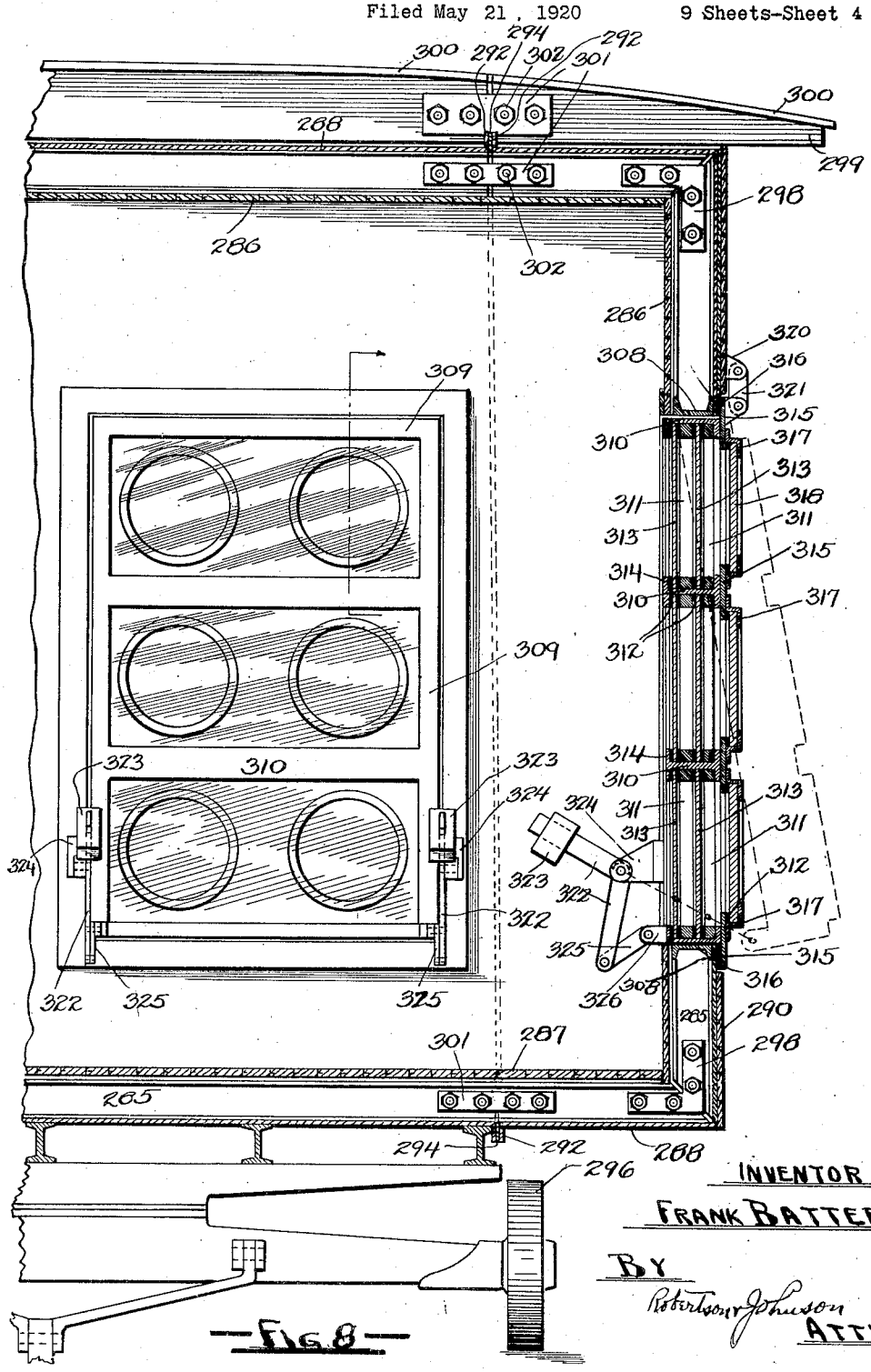


Fig. 8

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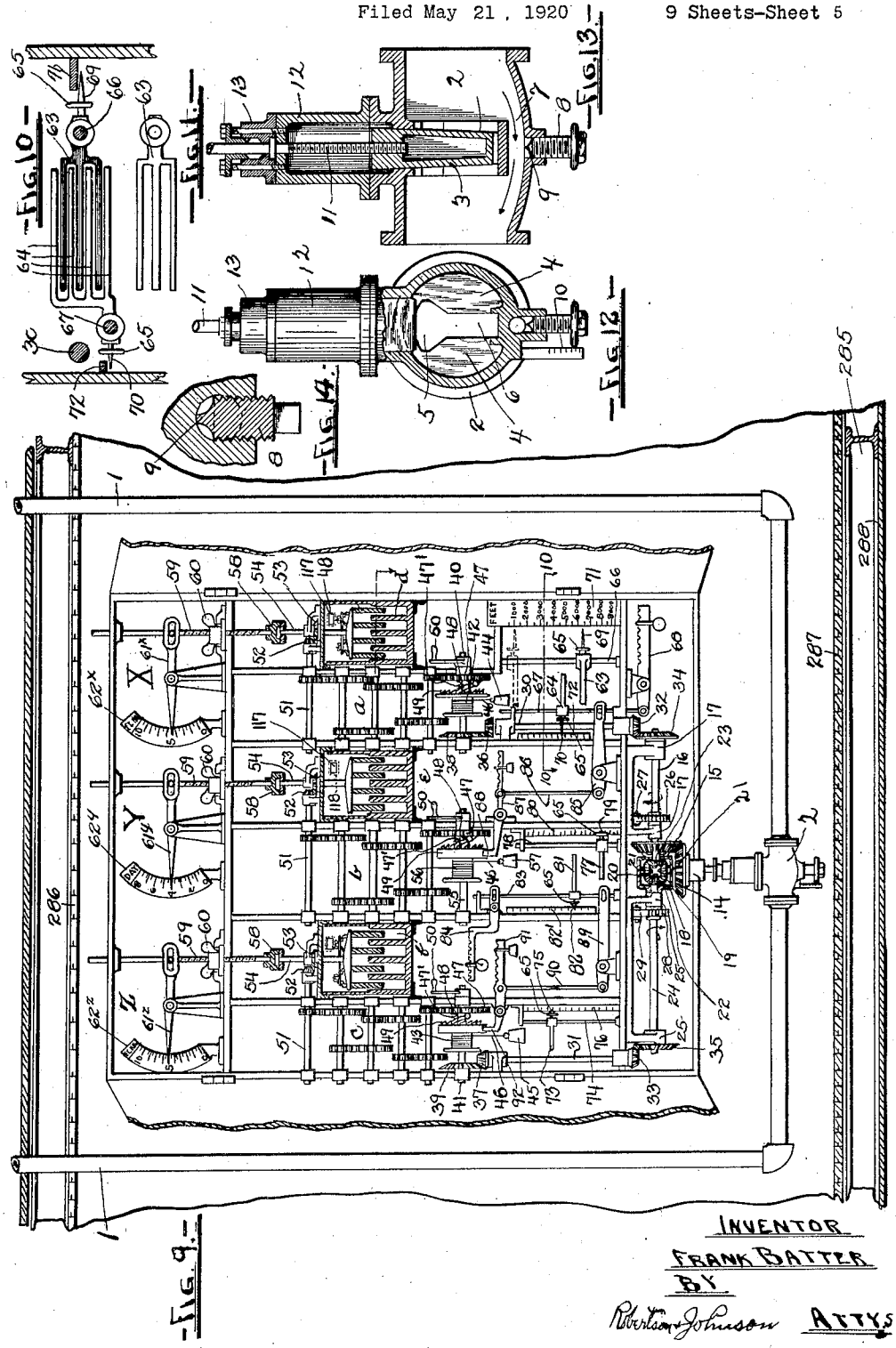


Fig. 9.

Fig. 10.

Fig. 11.

Fig. 13.

Fig. 12.

Fig. 14.

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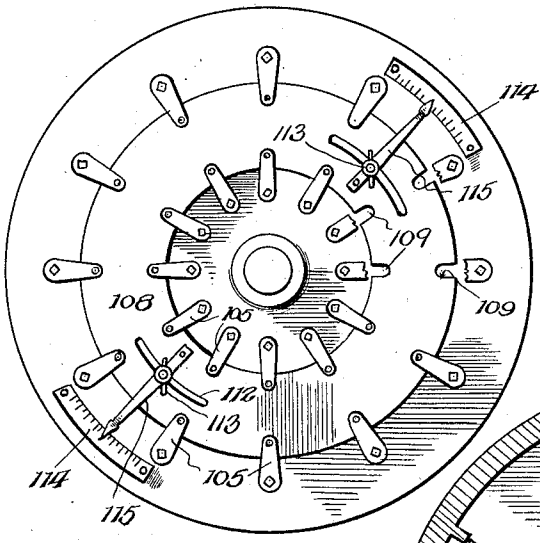


Fig. 15.

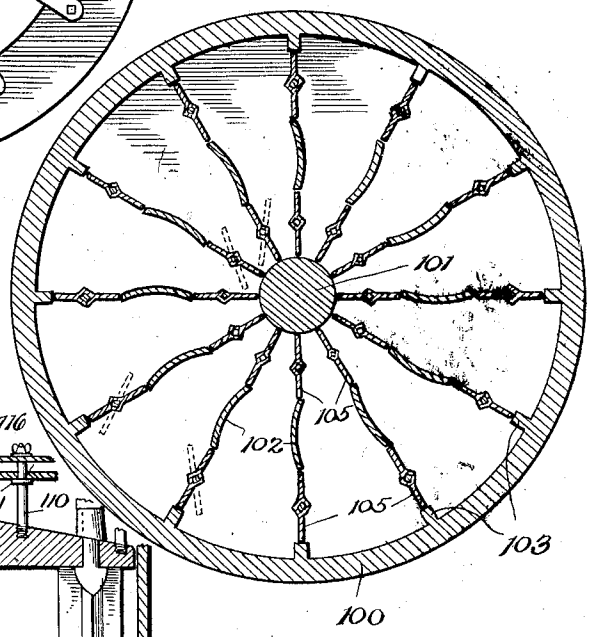


Fig. 16.

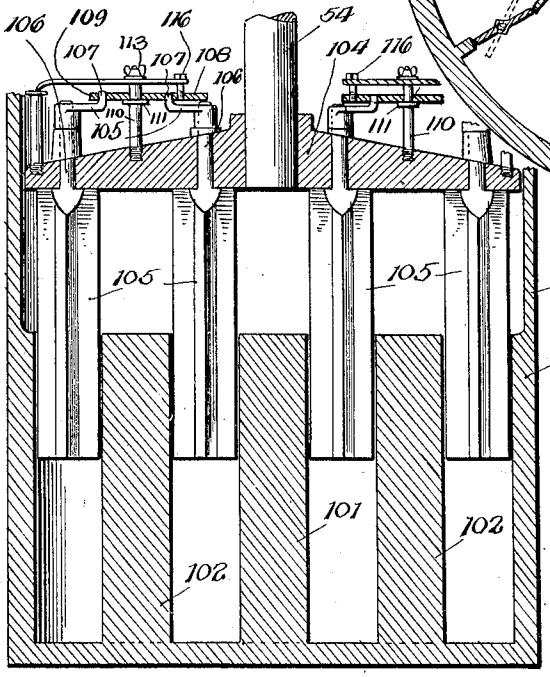


Fig. 17.

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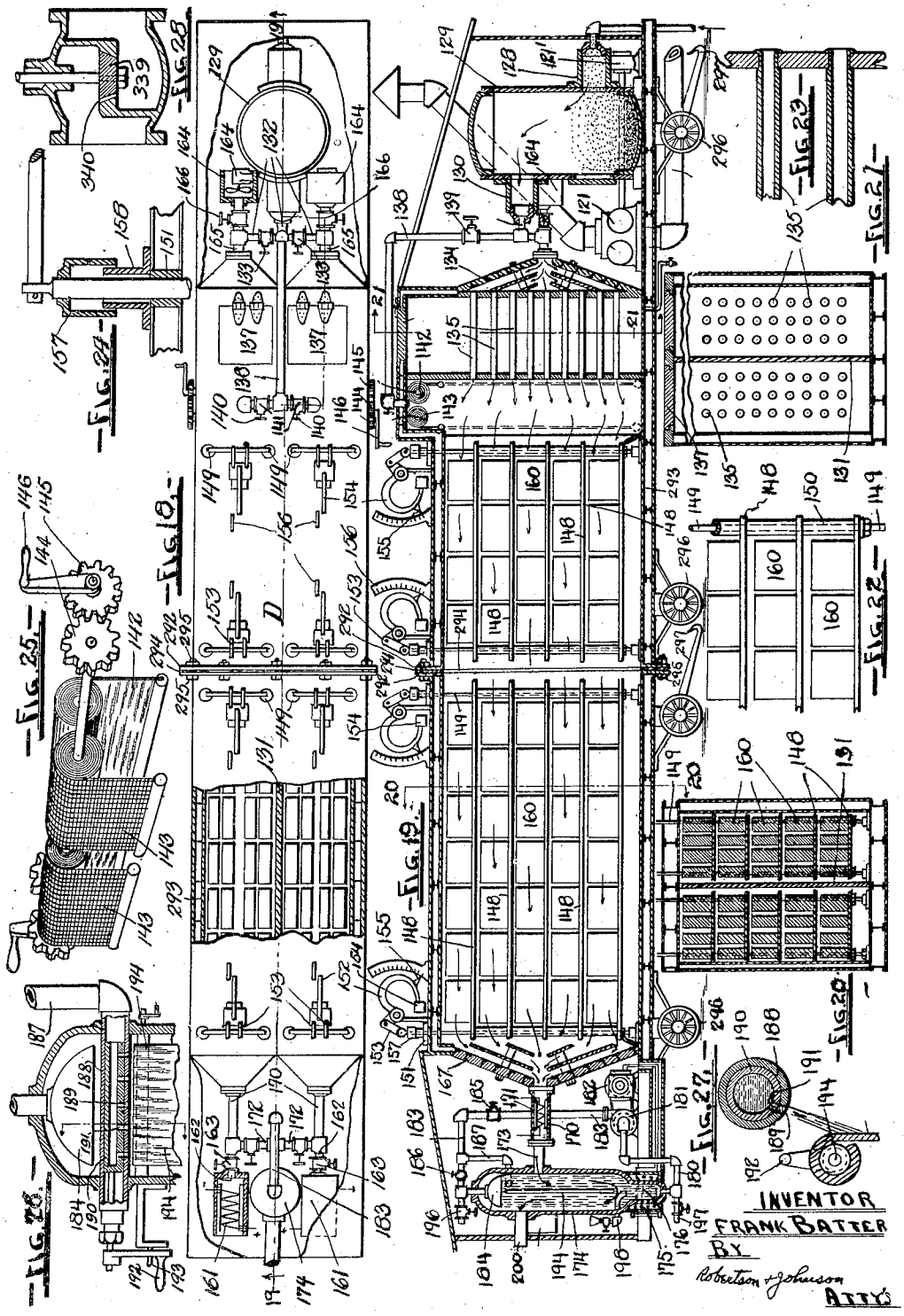
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Fig. 29.

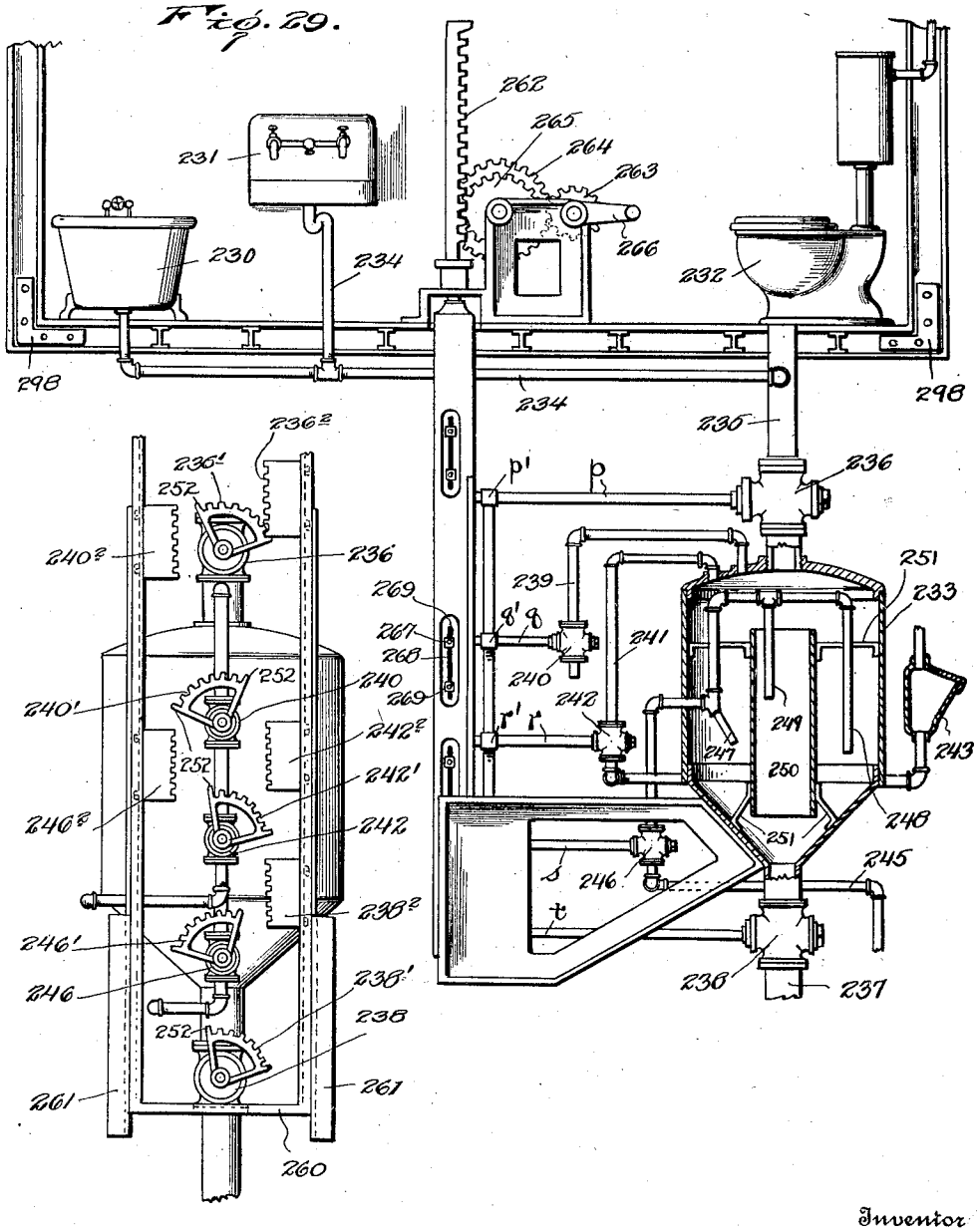


Fig. 30.

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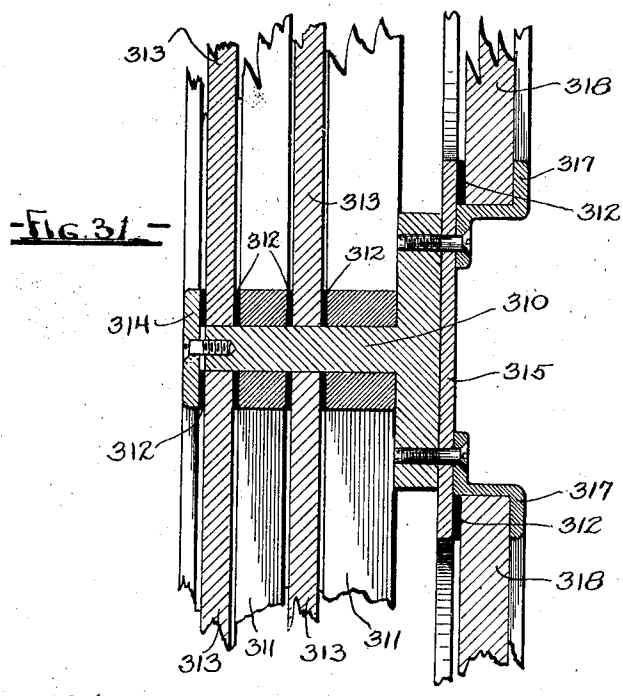


FIG. 31.

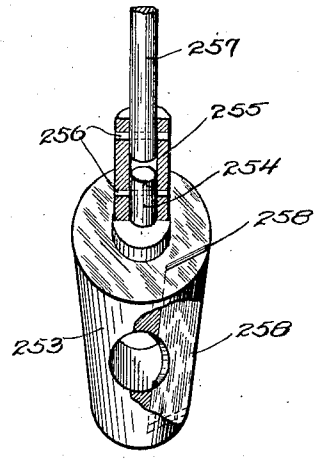


FIG. 34.

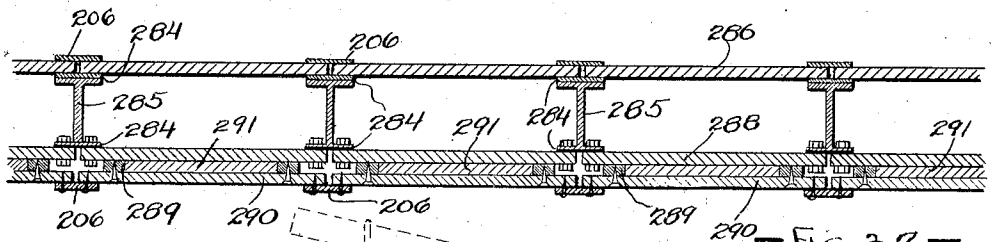


FIG. 32.

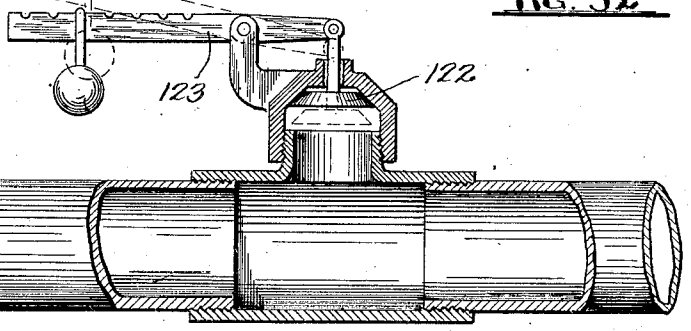


FIG. 35.

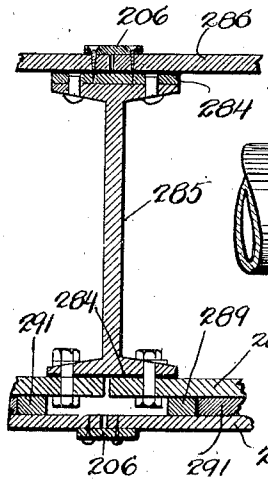


FIG. 33.

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Patented Aug. 28, 1923. 1,466,652

UNITED STATES PATENT OFFICE.

FRANK BATTER, OF LINNTON, OREGON.

PORTABLE MOUNTAIN-AIR SANITARIUM.

Application filed May 21, 1920. Serial No. 383,180.

To all whom it may concern:

Be it known that I, FRANK BATTER, a citizen of the United States of America, and a resident of Linnton, in the county of Multnomah and State of Oregon, have invented certain new and useful Improvements in Portable Mountain-Air Sanitariums, of which the following is a specification.

Generally the object of my invention is to provide a structure, preferably but not necessarily portable, in which can be artificially maintained such atmospheric conditions as to temperature, pressure (sub-atmospheric or atmospheric), humidity, etc., as may be dictated by the state of the patient, in which the duration of any given atmospheric condition, the time required to reach it and the time required to pass from one such condition to another may be controlled with nicety and, if desired, predetermined and in which the patient may live normally without interfering with such prescribed regimen. The importance of this control is apparent since it is essential that the change from a low to a high altitude or the reverse should not be too rapid for the person undergoing the change, the ill effects of too great speed being well known. Previous patents of mine, Nos. 904,172, 1,107,744 and 1,107,745 have dealt with the production of sub-atmospheric pressure or rarefied air conditions for simulation of high altitude. My present invention however differs in the control features above referred to and in many other ways from my inventions already patented. I now have in mind particularly the stimulation of transpiration of watery vapors and effete matter from the lungs and the control thereof including the prevention of excess transpiration which would subject the patient to too great strain, my present apparatus, while not limited to patients so affected being designed especially for the treatment of those who are tuberculous. (For authority on excess transpiration see Wood's Library of Standard Medical Authorities, book for October 1885 on Climatology and Mineral Waters of the United States, page 79.)

The invention relates to (1) structure, toilet room arrangements, etc.; (2) means for treating the air; (3) means for delivering, distributing and removing the air; (4) means for simulating a trip to, a stay at, and a return from a given higher altitude, i. e., means for controlling and when desired predetermining the duration of any selected atmospheric condition, the time required to reach it, and the time required to pass from it to some other selected atmospheric condition.

The general description of the sanitarium and the various parts composing it will be deferred until after the brief description of the figures, when it will be more readily understood.

Referring to the drawings:

Fig. 1 is a general view, mainly in perspective, and to some extent diagrammatic of the entire apparatus.

Fig. 2 is a horizontal section, and Fig. 3 is a vertical section through the vestibule and adjacent parts of the sanitarium.

Fig. 4 is a detail in horizontal section of parts shown in Fig. 2.

Fig. 5 is a central vertical section through the part of the apparatus admitting air to the living room.

Fig. 6 is a vertical section on the line 6—6, Fig. 5.

Fig. 7 is a sectional view of a detail of the structure shown in Figs. 5 and 6.

Fig. 8 is a vertical section through part of the living quarters, the window being shown also on the said view in interior elevation as well as in section in the place it actually occupies.

Fig. 9 is a front elevation, partly in section, of the main air control and rarefaction valve.

Fig. 10 is a detail section on the line 10—10, Fig. 9, looking in the direction of the arrows.

Fig. 11 is a plan view of one of the members illustrated in Fig. 10.

Figs. 12 and 13 are respectively transverse and longitudinal vertical sections of the main or rarefaction valve.

Fig. 14 is a detail view in section of a part of the said valve.

Fig. 15 is a top plan view of one of the governors having adjustable vanes.

Fig. 16 is a central horizontal section, and Fig. 17 a central vertical section of said governor.

Fig. 18 is a top plan, and Fig. 19 a vertical longitudinal section on the line 19—19, Fig. 18, of the air treatment house.

Figs. 20 and 21 are respectively transverse vertical sections on the lines 20—20 and 21—21 of Fig. 19.

Figs. 22, 23 and 24 illustrate details of construction of parts in Fig. 19.

Fig. 25 is a perspective on a larger scale of curtains shown in Fig. 19.

Figs. 26 and 27 are incomplete vertical sections of details of the humidifier illustrated in Fig. 19.

Fig. 28 is a section showing the construction of air valves in delivery side of the air line.

Fig. 29 is an end elevation, partly in section, of the toilet room and related apparatus, and Fig. 30 is an elevation at right angles thereto showing valve operating mechanism.

Fig. 31 is an enlarged sectional detail showing the window construction.

Figs. 32 and 33 are vertical sections illustrating details of construction.

Fig. 34 is a perspective view of the preferred form of valve for use in the discharge connections from the toilet room.

Fig. 35 is a detail elevation, partly in section, of the safety valve.

General description.

Referring to Fig. 1, A is the main living room of the sanitarium; B the vestibule; C the toilet room; D the air treating house in which is located also the suction pump; E the main air control; F connections between E and D; G connections between D and A; H connections between A and D. It being understood that the sanitarium structure is air tight and sufficiently strong to enable sub-atmospheric pressure to be maintained therein, the general operation of the apparatus may now be explained as follows: External air is drawn in through the main or rarefaction air valve and control section E from which it passes in rarefied condition through the connections F to the air treating house D where it is subjected to the desired treatment and passes through the connections G to the living room A, in so doing being spread out and delivered in a gentle continuous current of substantially the cross section of the living room A across which it passes continuously with avoidance of eddies or back drafts to the opposite side of the living room where it is collected and from which by the connections H it passes to the pump in the air treatment house and so to the atmosphere. The vestibule B for entrance and exit and the toilet room C are shown as separate wings which is a convenient but not essential arrangement. The vestibule is an air lock, and the pressure conditions in the toilet room and the sewer connections are so controlled as to permit normal use of the toilet fixtures without interference with the artificial atmospheric conditions in the toilet room. While the structural details are some of them novel, the essential point in this connection is the provision of an air tight and sufficiently pressure resistant structure and the description of such details will be postponed to enable the more vital features to be taken up first. It is noted at this point however that I prefer to make the entire structure portable although of course this need not be done and to build it in separate sections each of which is in effect a truck, means being provided for insuring the air tight connection of the separate sections and for making separable or knock-down parts of the roof, walls and floor which would otherwise give the trucks too great width.

In the detailed description I will begin with the main valve and control and follow the course of the air through the apparatus and then describe the vestibule, toilet apparatus and structural features.

Main valve and control.

Referring particularly to Figs. 1 and 9 to 17: Air enters the screened pipe 1 preferably above the roof and is drawn past the main valve 2, the position of which is determined by the control apparatus about to be described. This valve is closed and opened and the duration of its location in any given position determined by the said control apparatus, which may be set to operate in a predetermined manner without precluding manual control of the operation to vary that originally prescribed. Three timers X, Y and Z are provided. X acting to close the valve at a rate which may be varied, Z acting to open the valve at a rate which may be varied and Y acting to determine the length of time during which the valve shall occupy a position to which it has been moved by timer X. Each position of the valve 2, due regard being had to the capacity and uniform movement of the suction pump, represents a particular altitude (i. e. the average barometric pressure at that altitude) and properly calibrated altitude scales form part of the control apparatus as will shortly appear.

In the embodiment illustrated each of these timers is a clock movement provided respectively with ordinary clock trains *a*, *b*, *c*, of which *b* is an eight day train, with governors *d*, *e*, *f*, *d* and *f* having the same construction and with various scales, stops, etc. The timers are interrelated, X as it stops starting Y, and Y as it stops starting Z.

For the main valve 2 I prefer a gate valve having a gate 3 shown with opposite wedge shaped faces which co-act with the seat 4. The opening controlled by the gate 3 will be seen from Fig. 12 to have an enlarged part 5, the sides of which converge toward

a narrower and uniform part 6, the result being that as the valve begins to close the volume of air passing through the valve decreases rather rapidly for a given movement of the gate until the uniform part of the opening is reached and that the reverse of this operation occurs in the opening of the valve. As the full volume of air passing through the completely open valve in a given time is greater than the necessarily limited capacity of the drying material in the air treatment house D, it retains a good deal of moisture. The rather rapid decrease in volume referred to insures a rather rapid but not immediate reduction in humidity as the valve begins to close, and the rather rapid increase in volume as the valve finishes opening insures a rather rapid but not immediate increase in humidity. This protects the patient from too rapid a change in humidity while furnishing him air of the desired humidity. For the sake of safety the complete shutting off of ventilation by closure of the valve is prevented by providing a by-pass 7 necessarily open at all times and which is rendered adjustable by a screw plug 8 having a pointed end 9 and co-operating with a scale 10 as indicated in Figs. 12 and 13.

The gate 3 is raised and lowered by a screw threaded rotary stem 11 passing up through the chamber 12 and stuffing box 13, the said stem being provided with a bevel gear 14 in mesh with a bevel gear 15 loose on the shaft 16 mounted in stationary brackets 17. The bevel gear 15 carries a differential gear box 18 provided with bevels 19 and 20 rotatably carried by studs 21 and in mesh with bevels 23 and 22, fast respectively to shaft 16 and to shaft 24, rotatably mounted in brackets 25. Shaft 16 carries a ratchet wheel 26 co-operating with a holding pawl 27 and shaft 24 is provided with a corresponding ratchet 28 and oppositely facing pawl 29. This construction permits the valve to be closed by rotation of shaft 16 in the direction of the arrow in Fig. 9 and to be opened by the rotation of the shaft 24 in the direction of the arrow in Fig. 9 without in either case any interference with the other shaft. The shafts 16 and 24 are driven in opposite directions respectively by upright shafts 30 and 31 provided respectively with bevels 32, 33 meshing with bevels 34, 35 on the shafts 16 and 24, these upright shafts being mounted in suitable brackets and having bevels 36 and 37 respectively meshing with bevels 38 and 39 on the clock motor shafts 40 and 41 provided respectively with the drums 42, 43 and with weights 44, 45 carried by cables 46 passing over the drums in the usual way. Shafts 40 and 41 have loose gears 47 which, through the respective trains *a* and *c*, are connected to the rotatable element of the corresponding governor as will shortly appear. These gears 47 carry pawls 48 co-acting with the driving toothed heads 49 on the drums 42, 43, being spring pressed away from said heads by the springs 47'. Each of said shafts 40, 41 carries a crank 50 which may be used in rewinding. The final shaft 51 of the clock trains *a* and *c* carries bevel 52 in mesh with bevel 53 splined on the rotatable shaft 54 of the corresponding governor *d* or *f*.

The middle of timer Y is provided with a clock motor shaft 55 carrying a drum 56 over which passes a cable 46 to which is secured weight 57. On the shaft, 55, as on the shafts 40 and 41, is a loose gear 47 carrying the pawl 48 and spring pressed by the spring 47' away from the toothed driving head 49.

The shaft 55 is provided with a crank 50. Gear 47 drives the eight day train *b* terminating in the shaft 51 having bevel 52 in mesh with bevel 53 on shaft 54 of governor *e*. Each of the rotatable vertically slidable governor shafts 54 is connected by a knuckle joint 58 carried by the releasably locked screw threaded rod 59 which may be adjusted vertically by turning the corresponding wing nut 60. Pivoted needles 61^x, 61^y, 61^z are operatively connected as shown to their respective rods 59 and co-operate with corresponding scales 62^x, 62^y, 62^z, of which scales 62^x and 62^z are speed scales being marked to indicate in feet the change in altitude accomplished in an hour for any given position of the needle. With the movable vanes of the governors at right angles to their direction of movement, the speed range chosen is from 100 feet per hour, which of course is very slow, to 1000 feet per hour which also is not rapid. As will hereinafter appear the difference in speed is due to the change in the extent of immersion of the vanes in the heavy liquid oil or mercury through which they move. The middle scale 62^y indicates the length of time, eight days, required for the weight 57 to drop through its entire range of movement. Various stops for the weights are provided and in the illustrated mechanism take the form of adjustably mounted grids (Figs. 10 and 11). The timer X is provided with two such grids, 63 and 64 which are adjustably mounted by set screws 65, the first on stationary rod 66 and the second on rod 67 and are suitably guided in the frame and supported by counterweighted lever 68 to which its lower end is pivotally connected. One set screw 65 has a pointer 69, and the other a pointer 70 co-operating respectively with the altitude scales 71, 72, these scales being marked in feet to indicate altitudes which will be simulated when the pointers register with the corresponding indication, the grid in use acting to stop the timer and

determine the extent to which the valve will close, the grid on the movable rod acting also to start the timer Y, which in turn starts the valve opening timer Z. The fingers of the grids are staggered so that they do not interfere with each other. Only one grid 73 is needed for the timer Z, said grid being adjustable on the fixed rod 74 with the aid of set screw 65 and having pointer 75 co-acting with altitude scale 76. The middle timer Y has a grid 77 adjustable on fixed rod 78 by set screw 65 having pointer 79 which co-operates with time scale 80. It is also provided with an adjustable grid 81 with set screw 65 and pointer 82 co-operating with the time scale 82′ and adjustable on the upright rod 83 guided in the frame as indicated and counter-balanced by weighted lever 84 pivoted on the frame. The timers are interconnected so that they operate in sequence, the counterbalanced rod 67 being connected with the long end of lever 85 pivoted on the frame, the short end of the said lever being connected by a link 86 with one arm of a counterweighted lever 87 pivotally mounted on the frame and having its other arm terminating in a braking surface 88 for co-action with the periphery of the toothed head 49 of the drum 56. Timer Y has its counterbalanced rod 83 connecting with the long end of lever 89 pivoted to the frame and having its short end connected by link 90 with counterweighted lever 91 pivoted to the frame and having its short arm provided at its end with a braking surface 92 for co-operating with the periphery of the toothed head 49 of the drum 43. The connections between the movable rods and the counterweighted and other levers are such as to afford a little lost motion, the pin and slot connections illustrated being suitable. The downward movement of the grids on the movable rods is slight and makes no material difference in the accuracy of the altitude scales even when no account is taken of it in calibrating them.

The operation of this part of the apparatus will now be described: In the inoperative position of the control the respective weights are supported in their highest position by the grids on the stationary rods adjusted to their highest position. The valve 2 is then open. If it be desired to simulate a trip to an altitude of say 5,000 feet the grid 64 is adjusted on the counterweighted rod 67 till its pointer 70 is opposite 5,000 on the scale 72. The grid 63 is moved down out of the way and timer X starts to close the valve. The grid 81 is adjusted on the counterbalanced rod 83 to the desired point on the time scale 82′. This scale and scale 80 are calibrated for a particular position of the needle 61ʳ and when the needle is in that position will indicate directly the length of time during which the desired simulated altitude is to be maintained. It would be possible to provide a series of such scales corresponding to different adjustments of the needle 61ʳ, though but one is shown. The grid 73 is adjusted to the point 5,000 or other desired point on altitude scale 76. It is apparent that the timer X having started will continue until the weight 44 reaches the grid 64 during which time the valve is moved toward closed position by the gearing connections already described and that the rod 67 is then moved down slightly by the weight and through the lever connections described the brake 88 is released and the weight 57 of the timer Y is then in turn released. The position of the valve therefore remains unchanged until the weight 57 is intercepted by the grid 81 whereupon the rod 83 moves down slightly and through the lever connections above described releases the brake 92. The weight 45 then begins to descend and through the gearing connections above explained the valve is moved toward the open position until weight 45 is intercepted by grid 73. In this way a trip at a predetermined speed to a predetermined altitude, a stay at that altitude for a predetermined time and a return therefrom at a predetermined speed may be simulated. If however it should prove desirable as, for instance, because of a change in the condition of the patient, to alter the original plan the various grids adjustable on the fixed rods, or any of them, may be brought into play to supersede the automatic control so that a given condition may be maintained for as long or short a time as desired and the change to a higher or return to a lower altitude may be manually as well as automatically controlled.

This discussion of the control apparatus has assumed that the range of speed of the governors of the timers X and Y was limited to from 100 to 1000 feet per hour, but a much more rapid rate may be attained should this be desirable by adjusting the governors *d* and *f*. The governor *e* has its vanes in invariable angular relation with reference to their path of rotation.

Referring more particularly to Figs 15, 16 and 17, all three of the governors have cylindrical casings 100 each provided with a central post 101 and with a circular row or rows of sationary vanes or abutments 102 and preferably with stationary radial ribs 103. The shaft 54 above referred to is co-axial with the casing and carries a head 104 from which depend series of vanes 105 occupying the spaces between the post, abutments and ribs and rotatable in the annular paths thus formed. It will be understood that the number of the rows of abutments and of vanes may be varied as well as the number of abutments and vanes in

each row. The casing contains heavy oil or mercury to retard the movement of the vanes which in the governor *e* are mounted in one invariable position, i. e., at right angles to their path. As above explained, in both forms of governor the shaft 54 with the head 104 and the vanes 105 carried thereby may be raised and lowered to change the retarding effect of the governor, raising them increasing and lowering them decreasing the speed as will be obvious. In the governors *d* and *f* provision is also made for adjusting the angle of the movable vanes. This is accomplished by pivoting each vane in the head 104 and providing it with a crank 105 connected to the head by a suitable shank 106. Both series of vanes are so constructed, the cranks of the two rows extending oppositely and having offset portions 107 cooperating with a ring 108 provided with slots 109 in each edge for that purpose and mounted on stationary pins 110 fixed to the head 104 and having supporting collars 111, the rings 108 having arc-shaped slots 112 receiving the ends of said pins which are provided with wing nuts 113 whereby the ring 108 may be clamped in any position of adjustment. To indicate the angle of the vanes, scales 114 are provided for co-action with pivoted pointers 115 pivoted on the upper ends of opposite pins 110 and having their other ends secured to the ring 108 by set screws 116. Hand holes 117 are provided in the otherwise closed casings, covers 118 being provided for the hand holes, the casing being air tight to avoid evaporation and consequent change in quantity or density of the liquid and the openings beings necessary for purposes of adjustment of the vanes. It will be noted that when the vanes have been set to some other angle than the right angle to their path the speed scales of the timers X and Y no longer indicate the true speed, and it would be possible if this were thought preferable to provide a series of speed scales each calibrated for a given vane angle. It has been thought best to provide two adjustments rather than to give the governors normally an excessive speed range.

Air treatment house and connections.

Referring more particularly to Figs. 1, 19 to 28: In the various pipes constituting the connections F, G and H flexible sections 120 are provided thus making the parts of the apparatus separable. From the main control valve the air drawn in by the suction pump 121 passes through the pipes constituting the connection F, past the safety valve 122 illustrated in Fig. 35 and provided with the weighted lever 123, normally holding the valve closed, opening if pressure in living quarters falls too low, and closing again on restoration of proper conditions. The air drawn through valve 2 expands and thus becomes cooler and there is a consequent tendency to condensation on the part of the moisture in the air, the connections being circuitous to promote this effect. 124 is a trap to receive water of condensation, valves 125 (inlet), 126 (blow-off) and 127 (vent) being associated therewith. Air from the connection F enters an enlarged thimble 128 in the upright cylinder 129 which provides at its bottom below said thimble a dead air space into which any dust, pollen, etc., settles, the speed of the expanding air being lessened. From the cylinder 129 the air passes through another thimble 130 at a higher level. At this point it is noted that the main portion of the air treatment house D is divided by a central partition 131 into two parts designed for alternate use. The air from the thimble 130 may pass by either branch 132, each governed by a valve 133, to one or the other of these parts of the air treatment house. If it follows either of these courses it passes through a plurality of channels formed by diverging plates 134 which break up the air and deliver it to the pipes 135 in the refrigerator 136 which may contain ice, freezing mixture or the like, covers 137 being provided for supplying it.

The air may thus be refrigerated as well as cooled by expansion before passing to the drier, but whether the air is cooled in one or both of these ways it has its remaining moisture in the form of a cloud or mist which is more quickly and completely absorbed by the hygroscopic material than the moisture in warm air would be.

In lieu of subjecting the air to refrigeration which ordinarily is unnecessary, by shutting off the valves 133 it may be allowed to pass by the pipe 138, the valve 139 therein being open, the appropriate one of the valves 140 in the cross pipes 141 being opened and the other closed. The air is delivered at the top of the air treatment house between curtains raised when the refrigerator is in use but let down at other times. The first of the curtains 142 is impervious, being of cotton, duck or the like and the second 143 is of wire mesh permitting the air to pass. The shafts on which they are mounted are provided respectively with gears 144, 145 in mesh and rotatable to raise or lower the curtains by crank 146. The air thus passes to the air drying chamber in which are located racks having horizontal shelves 148, vertical rods 149 with spacing sleeves 150 therein, the said rods passing through the roof of the air treatment house and through stuffing boxes 151, which are protected by caps 157 over sleeves 158 (see Fig. 24). The racks are suspended from steel-yards 152 to which the rods 149 are connected by links 153, the steel-yards hav-

ing weights 154 and pointers 155 co-operating with scales 156. These racks carry blocks 160 of hygroscopic material for the purpose of taking up moisture from the air. It will be obvious that as the blocks absorb moisture they become heavier and that this is indicated on the outside of the air treatment house by the movement of the pointers of the steel-yards over their scales, so that when the drying material in one-half of the air treatment house is no longer capable of efficient service, that half may be shut off by proper manipulation of the valves and the air led through the other half. In order to dry out the material I provide at the far end of the air treatment house at each half thereof an electric heater 161 connected by pipe 162 controlled by a valve 163 with one of the halves of the air treatment house and at the other end an electric fan 164 connected by a pipe 165 having valve 166 with the other end of each half of the air treatment house. After shutting off the air from one half the material therein may be dried out by turning on the corresponding heater 161, turning on the corresponding fan 164 and properly manipulating the valve so that the air is heated and drawn through by the fan. After being dried the air is collected by converging baffles 167, the construction being substantially the same as that at the entrance end of the air treatment house. It then passes through the pipe 170 containing an electric heater 171 whereby its temperature may be raised before it passes by valved cross pipe 172 and pipe 173 to the humidifier 174. There is great advantage in drying the air first before humidifying it since in this way a definite degree of humidity can be insured, and it is also important to provide heating means since the amount of moisture which the air can take up depends at a given pressure on its temperature, and the amount of transpiration that can be effected in the lungs of the patient is determined by the temperature to which his lungs raise the air and the margin of capacity for increase of humidity remaining to it. By first drying the air and then heating it to the desired degree, and afterwards humidifying it to saturation, this margin may be controlled. Tables giving moisture content per cubic foot of air heated to various temperatures and humidified to saturation are accessible in scientific works. It is also desirable to heat the water used in the humidifier and accordingly I provide an electric heater 175 at the bottom or well 176 of the humidifier. In order that the same water may be circulated again and again through the humidifier I provide a pipe 180 connecting the well 176 with the pump 181 driven by the motor 182 and the pipe 183 connecting the pump with the spray nozzle 184, valves 185 and 186 being located in said latter pipe. Just below the nozzle another pipe 187 which branches from the pipe 183 passes through the humidifier casing. The portion 188 of said pipe within the humidifier is provided with holes 189 and within the pipe is rotatably mounted a hollow cylinder 190 having holes 191 which may be brought into registration with the holes 189, a valve thus being constituted, and means for operating it being provided in the shape of a crank 192 with which a stop 193 co-operates. Just below and adjacent the said valved pipe 188 is rotatably mounted a roller 194 which is provided with a curtain of absorptive material as cotton or wool blanket, the curtain being so located that water from the holes in the pipe 188 strikes the upper part of it at an angle. It is possible to shut off the spray and use only so much of the curtain as may be desirable, spraying the same by means of the valve controlled pipe 188. It is also sometimes desirable to avoid use of the circulating system, in which case it is shut off by means of the appropriate valves, and water is admitted at the top through the valved pipe 196 and permitted to pass out at the bottom through the valved pipe 197. A funnel and filling pipe are also provided as indicated at 198. The air entering the humidifier by the pipe 173 and passing down around the curtain leaves the casing through the pipe 200 near the upper part of the humidifier.

Connections to and from living room.

From the humidifier the air passes through the connections G to the living room A being delivered thereto by means shown in Figures 5, 6 and 7 which is similar to the arrangement of baffle plates described in connection with the air treatment house. Before reaching these devices however the air passes an electric heater 205 by which the temperature may, when desirable, be raised. Beyond the heater the air passes through enlarging channels formed by diverging plates which are illustrated as forming truncated pyramids 206 supported and spaced apart by bolts 207 having sleeves 208 thereon. This construction breaks up the air and delivers it uniformly over the entire side wall of the living room, the base of the outer pyramid having the same inside dimensions as said wall and the air thus delivered occupying the entire cross section of the living room and passing gently through the same continuously in the same direction and without back currents or eddies, any danger of the patient breathing the same air over again or reinfecting himself being obviated. In front of this air delivery device as shown particularly in Figs. 1, 2 and 3, is arranged a screen partition 210 provided with a door 211. A like partition is

located at the other side of the room and beyond it an air receiving and collecting device constructed in the same way as the truncated pyramid arrangement just described is provided for receiving the air and conducting it to the connections H which lead to the suction pump 121 driven by an electric motor 121′ and so by the stack 213 to the outer air. A muffler 212 to prevent the noise of the pump reaching the living quarters is provided in the connections H.

Should it happen that the condition of the outside atmosphere is just what the patient needs the usual control and air treatment may be discontinued, the valve 214 in the connections G and the valve 215 in the connections H being closed and the inlet valve 216 and the outlet valve 217 being opened and a draft being created by turning on the electric fan 218 which draws air through the inlet valve 216, the rest of the connections G to the living room A and thence by part of the connections H through the outlet valve 217 and fan to the atmosphere.

Air vestibule.

In order to permit entrance to and egress from the sanitarium without interference with the artificial pressure conditions therein, I provide an air lock vestibule of simple construction provided with an outer door 220 and with an inner door 221 to the living quarters. A pipe 222 connects the interior of the vestibule with the connections G and the general suction system so that the pressure conditions in the vestibule may be the same as those in the living room. I also provide a valved pipe 223 to the outside so that by opening the same the air pressure in the vestibule may be equalized with that outside.

Toilet room.

Referring to Figs. 1, 29 and 30: The living quarters of the sanitarium include the toilet room C in which the same atmospheric conditions are maintained as in the main living room A. In order that this may be done without interfering with the normal use of the various toilet fixtures I have invented apparatus which will now be described. The toilet room may be provided with any usual fixtures as the tub 230, the lavatory 231 and closet 232. A drainage tank 233 is provided, the various toilet room fixtures being connected thereto by pipes 234 and 235. A discharge pipe 237 from the drainage tank 233 to the sewer 237′ or cesspool is provided. In the connections between the toilet fixtures and the tank is a valve 236 and in the aforesaid discharge connections from the tank a valve 238, pipe 239 furnishes a vent for the tank controlled by a valve 240 and pipe 241 controlled by the valve 242 and having a disinfectant receptacle 243 is connected to the air exhaust system by the pipe 244 which leads from the interior of the toilet room to the connections H. Pipe 245 controlled by valve 246 is arranged to deliver flushing water from main 245′ to the tank both near the bottom by the angular portion 247 and the vertical portion 248 and by the vertical portion 249 to the interior of the vertical cylinder 250 supported by braces 251 coaxially with the tank.

The valves 236 and 242 are normally open and the remaining valves closed, the atmospheric conditions in the drainage tank being thus the same as in the toilet room which permits the normal use of the toilet fixtures. When however it becomes necessary to empty the drainage tank the position of the valves is changed so that the valves 240, 238 and 246 are open and the remaining valves closed. This shuts off the toilet room from the tank and from the air exhaust system and throws it into communication with the atmosphere and sewer connections and admits flushing water.

The various valve stems p, q, r, s, t are parallel and may have their far ends supported in bearings p', q', r', etc. (omitted for clearness from Fig. 30). They have adjacent their far ends operating quadrants or sectors which may be located in the same plane for co-action each with one of a series of suitably located racks carried by an upright reciprocable frame 260 slidable up and down in brackets 261, extending through the floor of the toilet room into the same and having on its upper end a rack 262 with which meshes the last of a train of gears 263, 264 and 265 manually movable by the crank 266. The stem of valve 236 is provided with a toothed quadrant 236′ with which co-acts rack 236^2. The stem of valve 238 is provided with a quadrant 238′ operated by a rack 238^2. Valve 240 has on its valve stem toothed quadrant 240′ actuated by rack 240^2. Similarly valve 242 carries on the end of its valve stem a toothed quadrant 242′ actuated by a rack 242^2; so also valve 246 has a quadrant 246′ operated by rack 246^2. To avoid interference the quadrants are alternately oppositely faced and some of the valves are carried on one side of the reciprocating frame and some on the other facing the quadrants which they are designed to actuate. Each of the quadrants on the various valve stems is provided at each end with a long tooth 252 which enables the rack to pick up the corresponding quadrant and move it into mesh with the rack teeth in whichever direction the frame is moving.

The operation of the valves, assuming them to be in normal condition, that is, with the valves 236 and 242 open, is as follows: The reciprocating frame or cross head 260 carrying the various racks moves

down, the rack 236^2 coacting with quadrant 236′ starting to close valve 236. Shortly thereafter rack 242^2 begins to actuate valve 242 through its quadrant 242′. This closes the connection between the tank and the exhaust. The further movement of the cross head after the closing of these valves brings the rack 240^2 into mesh with the quadrant 240′ to open the vent valve 240. When this valve is open the rack 238^2 actuating the quadrant 238′ opens the valve 238 in the discharge pipe. Shortly after this valve starts to open the rack 246^2 actuating the quadrant 246′ opens the valve 246 in the water pipe admitting water for flushing the tank. It will be obvious that when the cross head is moved in the opposite direction the reverse movement will take place and the valves be restored to their normal position. The racks may conveniently be made adjustable by providing them with bolts 267 passing through slots 268 and having nuts 269 countersunk so as to be below the face of the frame.

The valves 236 and 238 are preferably constructed as shown in Fig. 34, the valve 253 having a stub 254 secured in a sleeve 255 by a pin 256, the said sleeve being secured by a similar pin to the valve stem 257 and the plug carrying a knife 258 disposed in a plane other than radial and projecting slightly beyond the surface of the plug so as to cut or scrape any solid matter from the valve seat.

The toilet room is provided with an emergency door 259 and a valved pipe 259′ leading to the outside. Pressures within and without the toilet room may be equalized by opening the valve in the pipe, and then door 259 may be opened.

Upon the roof of the toilet room I arrange a closed tank 270 fed by a force pump 271 with accumulator 271′, said pump being served by pipe 272 drawing water from a well or like source. The pipe 273 connects with flushing water pipe 245, this pipe having a valve 246′ by which it may be shut off from the service pipe to permit the tank 270 to be used, in which case valves 274 and 275 located respectively in pipes 272 and 273 are open. Pipes 272 and 273 are provided with valved connections 276, 277 for attachment of other service pipes if found desirable. Tank 270 through pipe 278 serves the fixtures in the toilet room.

Building construction.

The buildings are constructed with I beam studdings and stringers 285 upon which are secured the interior paneling 286 and the flooring 287 and also the exterior steel plating 288, the living quarters and the air treatment house thus constituting steel chambers. Secured to said steel plating 288 at suitable intervals are furring strips 289 (Figs 32–33) upon which are secured the outside panels 290 between which and said plating 288 is located heat insulating material 291, preferably asbestos or the like.

As already stated the sanitarium is formed by connecting together a number of separable sections of suitable length, these sections being connected separably by air tight joints formed by flanges 292 on the steel plating 288 or where, as in the case of the air treatment house the interior walls 293 are of metal on the said walls a compressible gasket, 294, which may be of rubber, being provided between the abutting flanges, the joints being secured together air tight by bolts 295, as shown in Figs. 18 and 19. The various sections are provided with wheels 296 and tongues 297 whereby the sections may be linked together for transportation. As shown in Figs. 32 and 33, various panels or plates 286, 288 and 290 are joined at the I beam studdings 285, gaskets 284, suitably of rubber, being provided between the beams and panels and the joints being covered by strips 206. The I beams are mitered at the corners and connected by suitable plates and bolts as shown at 298 in Figs. 8 and 29. Gaskets may be located throughout the structure wherever needed to make it air tight when set up.

For protecting the living quarters of the sanitarium from the heat of the sun wooden roof beams 299 and wooden roof 300 are provided, the top and bottom of the chamber as well as the wooden roof being provided with removable sections adjacent the edge thereof so that while by virtue of the flanges and gaskets designated as above indicated the structure remains air tight, parts of it are separable or knockdown so that the width of the enclosed sections or trucks may be suitably reduced for transportation. It will be noted that plates 301 and bolts 302 are provided for securing the knock-down parts to the main parts of the section and roof respectively.

Pressure resistant windows for lighting the living quarters are provided (Figs. 8 and 31). In the framework of the building is a window casing 308 constructed of steel channels. A steel window frame 309 having cross bars 310 and inner and outer series of smaller wooden frames 311, rubber gaskets 312 and glass panes 313 in the openings formed by the cross bars and clamped together by fastening strips 314 makes up a compact structure. This window structure is located in said window casing 308 and secured to a steel frame 315 on the outside of the building extending beyond the opening of the casing 308 and designed to co-operate with a gasket 316 located adjacent said cas-

ing on the outside of the structure. The frame 315 in order to protect the glass panes carries steel framing 317 for thick glass bull's eyes 318, the entire structure thus formed being hung from a pair of brackets 320 one at each side of the window on the exterior of the structure by links 321 pivoted to said brackets and to ears on the frame 315. Sufficient play is provided to enable the window to swing in and out, and counterbalances in the shape of levers 322 having weights 323 pivoted on brackets 324 and connected by links 325 with ears 326 at each side of the window at the bottom of the frame, overbalance the window and tend to open it, and will do so except when the pressure in the sanitarium is less than the pressure outside. There is thus no difficulty in handling this heavy structure. The arrangement insures air tight construction when higher altitudes are being simulated. It will be understood that in small windows sufficiently thick glass may be used so as to avoid the elaborate supplemental port hole construction shown.

The means for delivering the air to the living room (Figs. 5–7) is strengthened by angle irons 330 located between the outer pyramid 206 and the pyramidal casing 331. Air tight joints having gaskets 332 are located at each end of the electric heater section of the connections to the air delivery structure. The living quarters of the sanitarium may be provided with gymnastic apparatus 333, curative electric lights 334, fan 335, instruments to determine atmospheric condition 336, etc., etc.

The doors 220 and 221 leading respectively to and from the vestibule are provided with inner casings 337 having gaskets 338 insuring an air tight closure (see Figs. 1 and 4).

Various devices for insuring the safety of the patient have already been described, one of them the employment of a by-pass for the rarefaction valve. This of course would be in itself ineffective to secure the desired result unless the other valves in the line were provided with some means for permitting a certain amount of leakage. Accordingly, as illustrated in Fig. 28, the various line valves have bodies 339 grooved as indicated at 340 so that the line can never be completely closed.

What I claim as my invention is:

1. In a sanitarium, an air tight living room, a suction pump, an air line between the outer atmosphere, said air tight living room and said suction pump, a valve interposed in said line between its inlet and the air tight living room, means for automatically moving said valve toward closed position, means for automatically moving said valve toward open position, differential gearing interposed between said opening and closing means and said valve, and devices for controlling said closing and opening means and for rendering the latter dependent on the former.

2. In a sanitarium, an air tight living room, a suction pump, an air line between the outer atmosphere, said air tight living room and said suction pump, a valve interposed in said line between its inlet and the air tight living room, means for automatically moving said valve toward closed position, means for automatically moving said valve toward open position, adjustable speed governors for said means, differential gearing interposed between said opening and closing means and said valve, and devices for controlling said closing and opening means and for rendering the latter dependent on the former.

3. In a sanitarium, an air tight living room, a suction pump, an air line between the outer atmosphere, said air tight living room and said suction pump, a valve interposed in said line between its inlet and the air tight living room, means for automatically moving said valve toward closed position, means for automatically moving said valve toward open position, adjustable speed governors for said means, differential gearing interposed between said opening and closing means and said valve, and devices for controlling said closing and opening means and for rendering the latter dependent on the former, said devices including a timer, its governor and means for adjusting the governor.

4. In a sanitarium, an air tight living room, a suction pump, an air line between the outer atmosphere, said air tight living room and said suction pump, a valve interposed in said line between its inlet and the air tight living room, said suction pump being adapted for drawing air through said valve, a series of timers each provided with a motor and a stop for co-operation with a movable element thereof, operative connections between said first motor and valve for moving the same toward closed position, operative connections between the third of said motors and said valve for moving it toward open position, the stops of the first and second motors having a limited movement, brakes for the second and third motors, and operative connections between said movable stops and the brake of the adjacent motor to release the same on operation of the stop.

5. In a sanitarium, an air tight living room, a suction pump, an air line between the outer atmosphere, said air tight living room and said suction pump, a valve interposed in said line between its inlet and the air tight living room, said suction pump being adapted for drawing air through said valve, a timer, operative connections between said timer and valve to move the valve toward closed position, a second timer, operative ad-

justable connections between the first timer and the second timer for releasing the same as the first timer stops, a third timer, operative connections between said third timer and valve to move the valve toward open position, and operative connections between the second timer and the third for releasing the same as the second timer stops.

6. In a sanitarium, an air tight living room, a suction pump, an air line between the outer atmosphere, said air tight living room and said suction pump, a valve interposed in said line between its inlet and the air tight living room, said suction pump being adapted for drawing air through said valve, three timers, each provided with a motor and with a stop for said motor, operative connections between the first timer and the valve for moving the same toward closed position, operative connections between the third timer and valve for moving the valve toward open position, the second and third timers being provided with brakes and the stops of the first and second timers having a limited movement, operative connections between the movable stop of the first timer and the brake of the second timer, operative connections between the movable stop of the second timer and the brake of the third timer, and a stop for the third timer.

7. In a sanitarium, an air tight living room, a suction pump, an air line between the outer atmosphere, said air tight living room and said suction pump, a valve interposed in said line between its inlet and the air tight living room, said suction pump being adapted for drawing air through said valve, three timers, each provided with a motor and with a stop for said motor, operative connections between the first timer and the valve for moving the same toward closed position, operative connections between the third timer and valve for moving the valve toward open position, the second and third timers being provided with brakes and the stops of the first and second timers being counterbalanced and having a limited movement, operative connections between the movable stop of the first timer and the brake of the second timer, operative connections between the movable stop of the second timer and the brake of the third timer, said connections permitting slight lost motion, and a stop for the third timer.

8. In a sanitarium, an air tight living room, a suction pump, an air line between the outer atmosphere, said air tight living room and said suction pump, a valve interposed in said line between its inlet and the air tight living room, said suction pump being adapted for drawing air through said valve, a series of timers each provided with a drum and weight motor and a grid below the weight for intercepting the same said grid being adjustable but otherwise immovable, the first two of said timers having also adjustable grids below the weights for intercepting the same mounted on movable counterbalanced rods the fingers of the grids being displaced with reference to each other so that the pairs of grids may pass without interference, and operative connections between each of said last named grids and the timer next succeeding it.

9. In a sanitarium, an air tight living room, a suction pump, an air line between the outer atmosphere, said air tight living room and said suction pump, a valve interposed in said line between its inlet and the air tight living room, said suction pump being adapted for drawing air through said valve, a timer, operative connections between said timer and valve to move the valve toward closed position, a second timer, a third timer, and operative connections between said third timer and valve to move the valve toward open position, said first and third timers being provided with adjustable stops having pointers, altitude scales with which said pointers co-operate, said scales being calibrated to indicate altitudes which will be simulated in the sanitarium when the pointers are in different positions.

10. In a sanitarium, an air tight living room, a suction pump, an air line between the outer atmosphere, said air tight living room and said suction pump, a valve interposed in said line between its inlet and the air tight living room, said suction pump being adapted for drawing air through said valve, three timers, a stop for the first timer, a stop for the second timer, operative connections between the stop of the first timer and the second timer for starting it when the first stops, operative connections between the stop of the second timer and the third timer for starting it when the second timer stops, independent manually adjustable stops for each timer, and altitude scales for the stops of said first and third timers.

11. In a sanitarium, an air tight living room, a suction pump, an air line between the outer atmosphere, said air tight living room and said suction pump, a valve interposed in said line between its inlet and the air tight living room, said suction pump being adapted for drawing air through said valve, three timers, a stop for the first timer, a stop for the second timer, operative connections between the stop of the first timer and the second timer for starting it when the first stops, operative connections between the stop of the second timer and the third timer for starting it when the second timer stops, independent manually adjustable stops for each timer and altitude scales for the stops of said first and third timers, the stops of the second timer being provided with pointers playing over time scales.

12. In a sanitarium, an air tight living room, a suction pump, an air line between the outer atmosphere, said air tight living room and said suction pump, a valve interposed in said line between its inlet and the air tight living room, said suction pump being adapted for drawing air through said valve, a series of timers each provided with a drum and weight motor, and an adjustable shelf below the weight for intercepting the same, operative connections between said first motor and valve for moving the same toward closed position, operative connections between the third of said motors and said valve for moving it toward open position, the shelves of the first and second motors having a limited movement, brakes for said second and third motors, and operative connections between said shelves and the brake of the adjacent motor to release the same when the corresponding weight is intercepted by and depresses its shelf.

13. In a sanitarium, a substantially air tight living room, a pipe for delivering air to said living room, means for passing air through said pipe, a rarefaction valve in said pipe comprising a valve blade, a valve seat having an orifice the part of which first closed by the valve blade is of greater area than that subsequently closed thereby.

14. In a sanitarium, a substantially air tight living room, a pipe for delivering air to said living room, means for passing air through said pipe, a rarefaction valve in said pipe comprising a valve blade, a valve seat having an orifice having a part of uniform width and a part of greater width gradually narrowing to said uniform width, a valve blade, and means for moving said blade successively over the wider part of said orifice and then over the narrower part of said orifice.

15. In a sanitarium, a substantially air tight living room, a pipe delivering air to said living room, means for passing air through said pipe, a valve in said pipe having means provided for varying the rate of delivery of air for a given amount of movement, and means for predetermining the rate of movement of the valve.

16. A sanitarium comprising an air tight chamber, means for delivering air thereto and for removing it therefrom, the inner surface of opposite walls of said chamber being substantially and respectively composed of the mouths of air delivering channels and the mouths of air removing channels, said channels consisting of substantially co-axial sleeves or shells of frusto pyramidal shape with their bases facing the chamber.

17. A sanitarium comprising an air tight chamber, a suction pump and connections for drawing air therethrough, air delivering and air collecting devices respectively at opposite sides of said chamber each having a plurality of spaced nested truncated pyramids presenting their bases toward the chamber, the outer pyramid of each device having its base of the same dimensions as the cross section of the room.

18. The combination in a sanitarium of an air tight living room, an air line in communication with the atmosphere and with said living room, a suction pump in said line beyond the living room for drawing air through said line and living room, and an air valve interposed in the line before the living room is reached and having a greater rate of change in capacity toward the beginning of its closing and end of its opening movement than at other times, and a chamber containing absorbent material in the line between the valve and the living room.

In testimony whereof I affix my signature in presence of two witnesses.

FRANK BATTER.

Witnesses:
M. JACKSON,
H. STOCKDALE.