A. GAIDE.

APPARATUS FOR DRYING AIR.

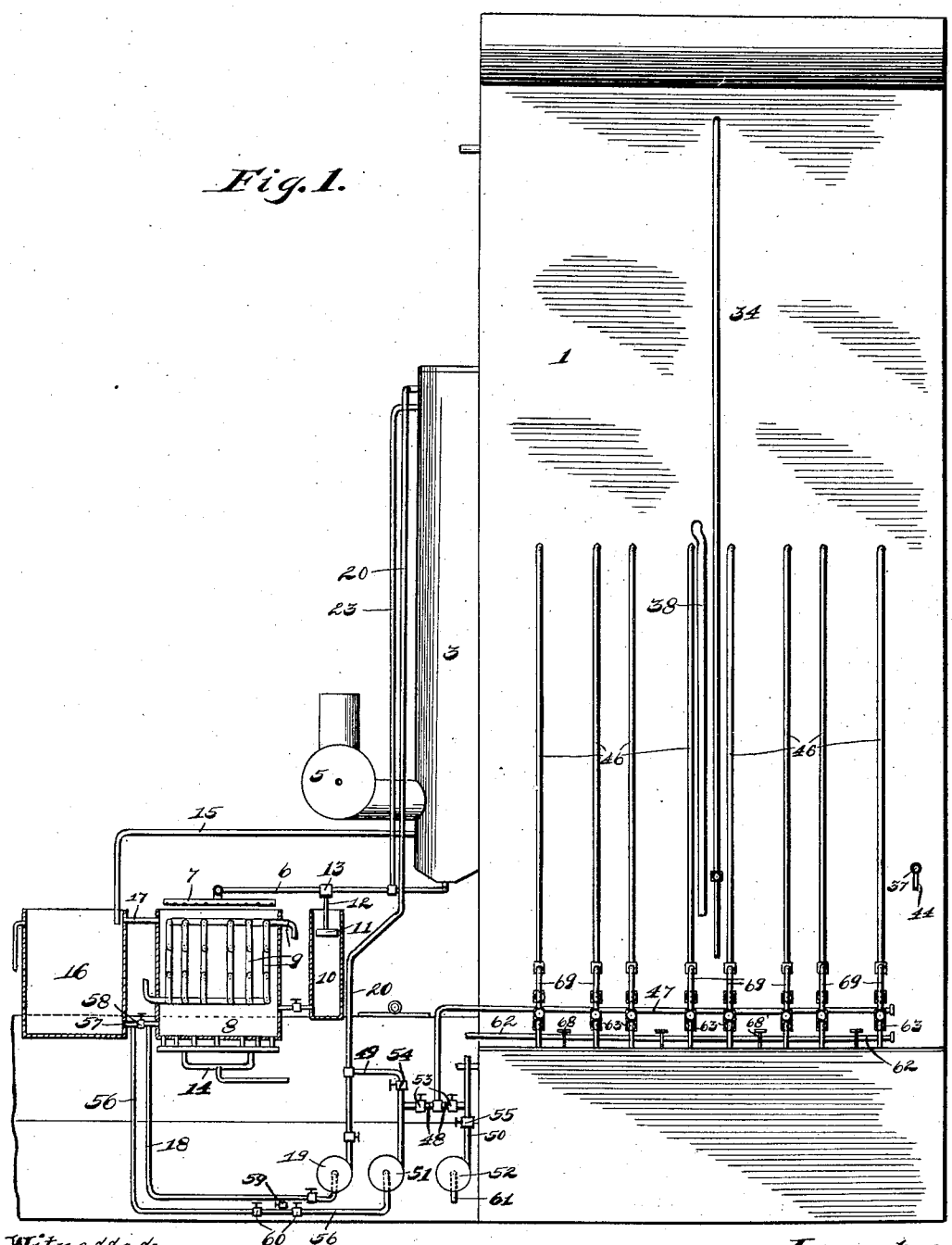
APPLICATION FILED NOV. 7, 1910.

1,024,887.

Patented Apr. 30, 1912.

7 SHEETS—SHEET 1.

Fig. 1.



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7 SHEETS—SHEET 2.

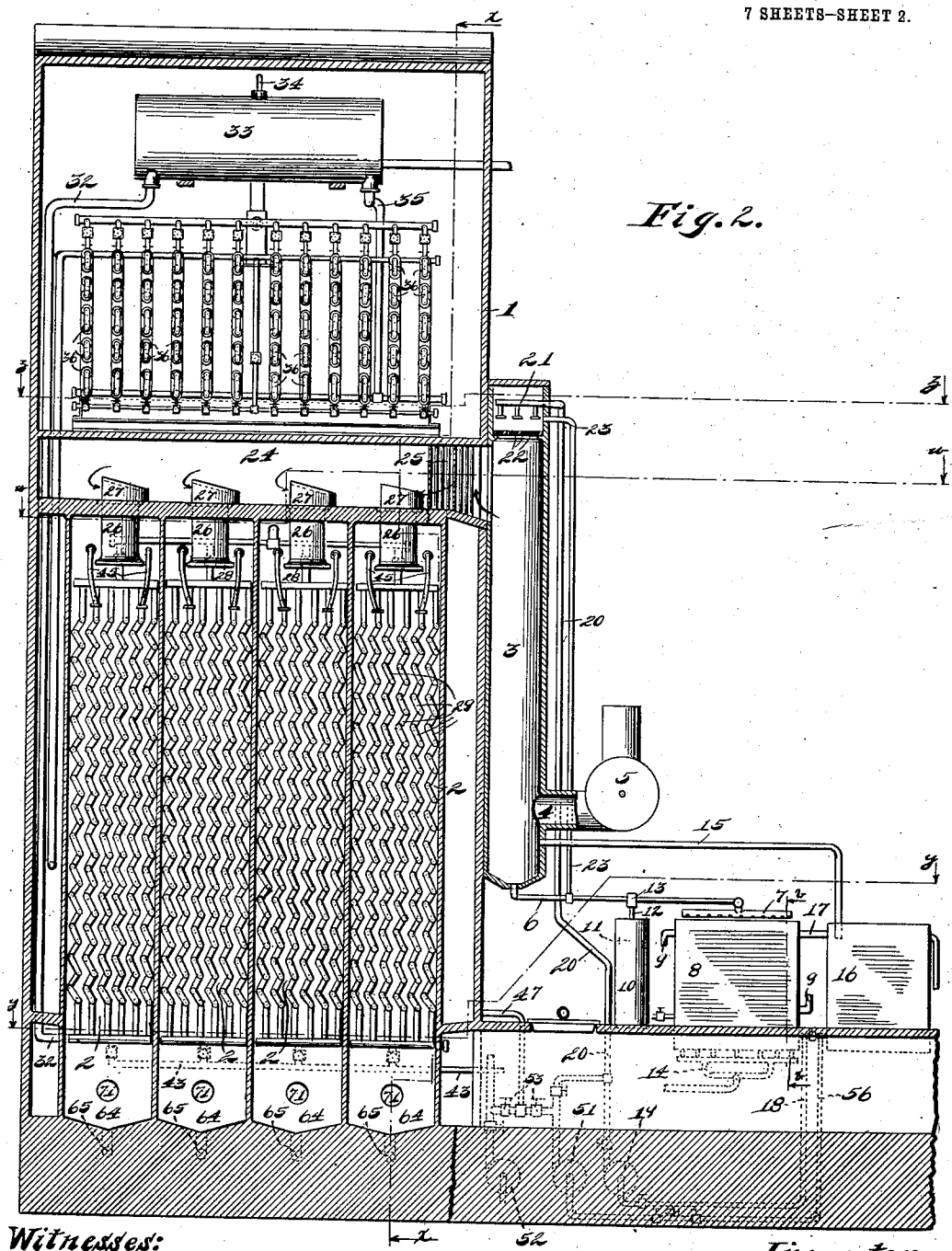

Fig. 2.

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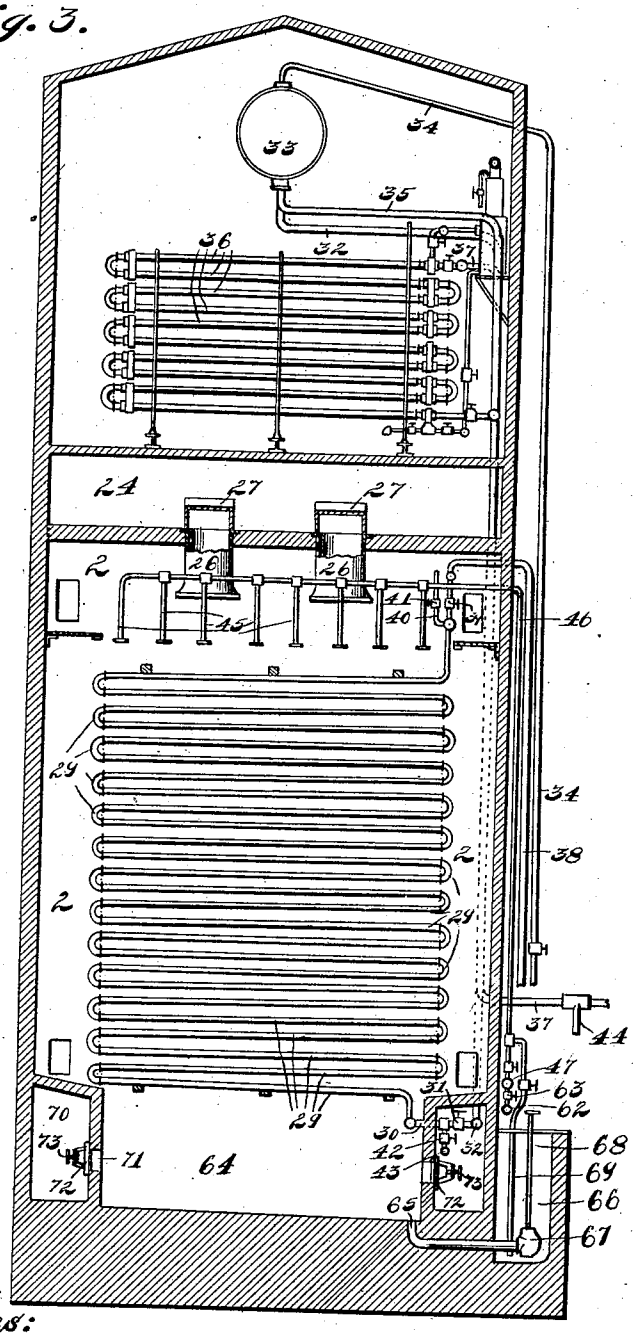
7 SHEETS—SHEET 3.

Fig. 3.



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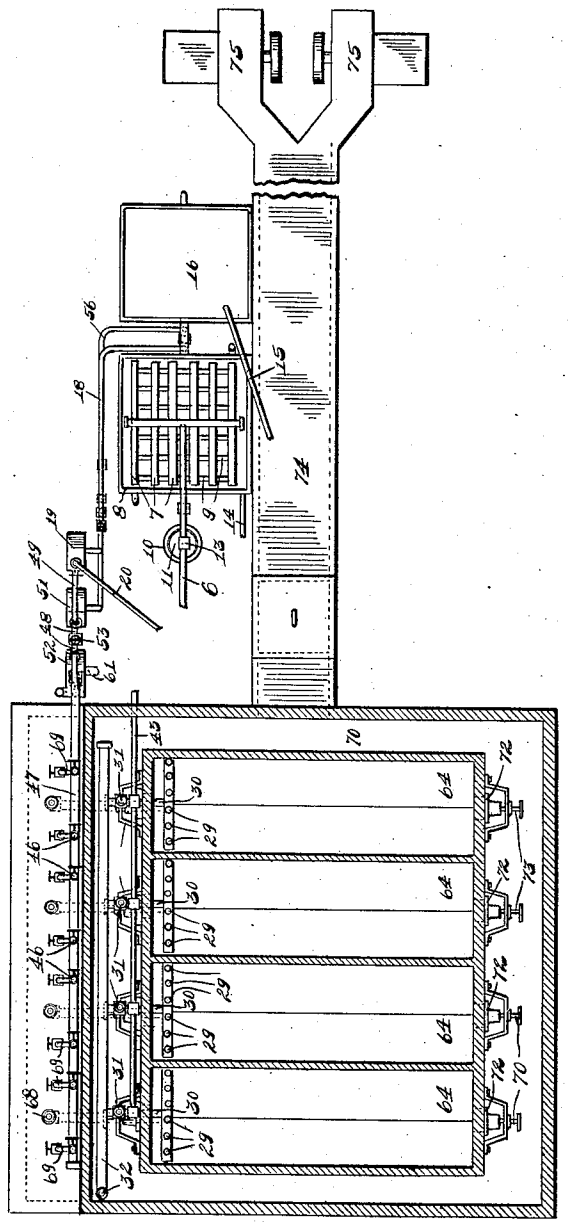
7 SHEETS—SHEET 4.

Fig. 4.



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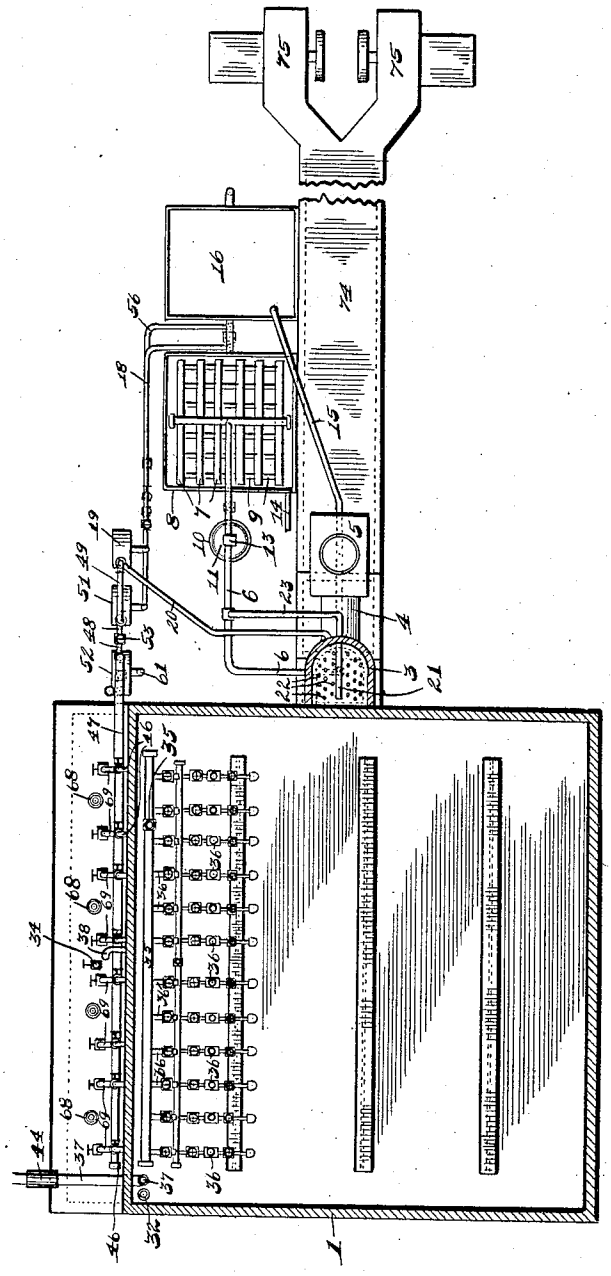
7 SHEETS—SHEET 5.

Fig. 5.



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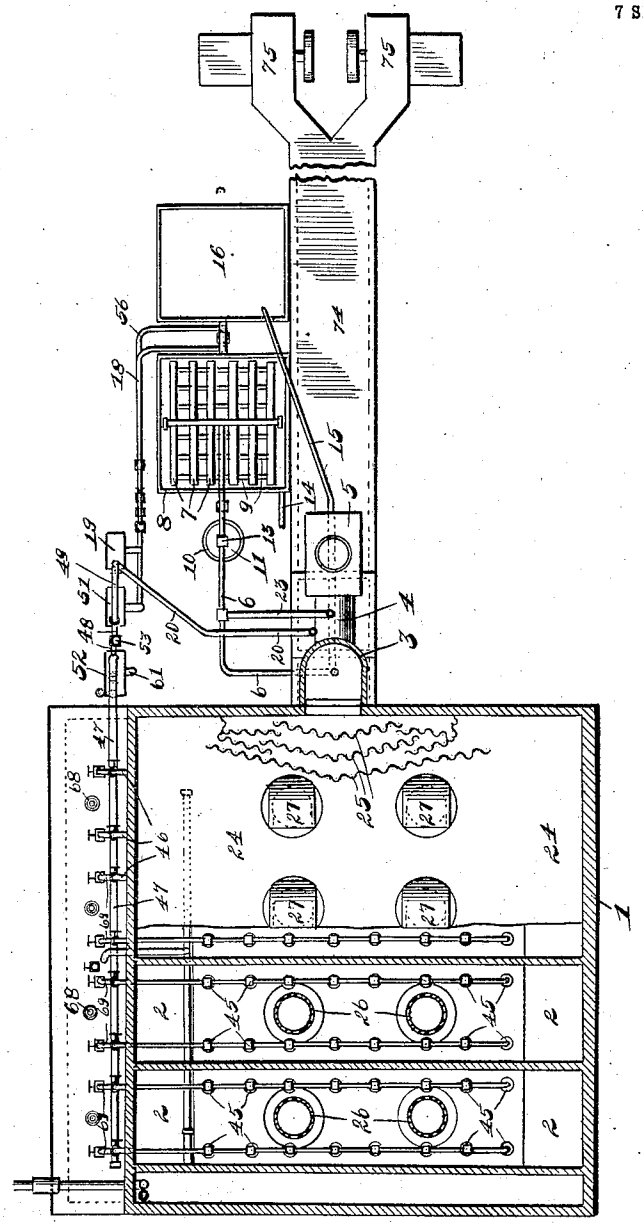
7 SHEETS—SHEET 6.

Fig. 6.



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1,024,887. Patented Apr. 30, 1912.

7 SHEETS—SHEET 7.

Fig. 7.

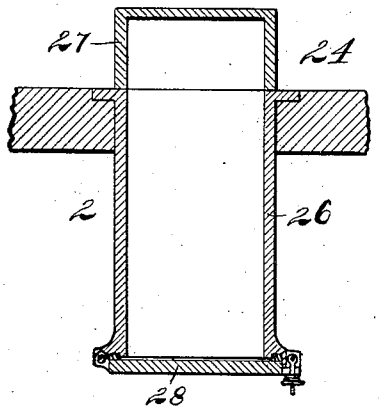


Fig. 8.

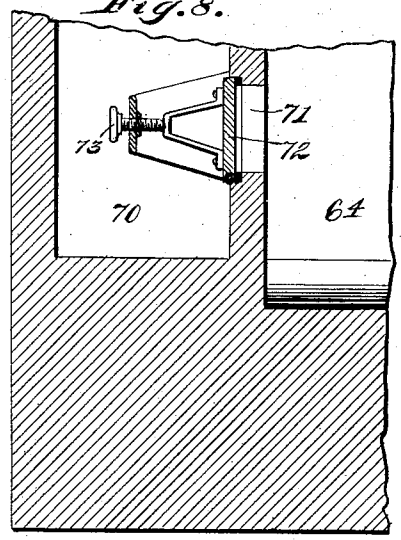
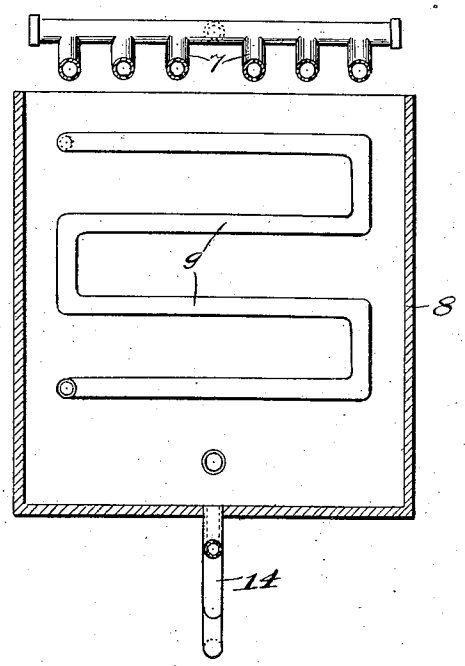


Fig. 9.



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UNITED STATES PATENT OFFICE.

ALBERT GAIDE, OF CHICAGO, ILLINOIS.

APPARATUS FOR DRYING AIR.

1,024,887. Specification of Letters Patent. Patented Apr. 30, 1912.

Application filed November 7, 1910. Serial No. 591,058.

To all whom it may concern:

Be it known that I, ALBERT GAIDE, a citizen of the United States, and a resident of the city of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Apparatus for Drying Air, of which the following is a specification.

My invention relates to improvements in apparatus for drying air and has for its object the provision of an apparatus for this purpose which shall be of simple construction and efficient in operation.

The invention consists in the combinations and arrangements of parts hereinafter described and claimed.

The invention will be best understood by reference to the accompanying drawings forming a part of this specification, and in which—

Figure 1 is a side elevation of an apparatus embodying my invention, Fig. 2, a vertical section of the same, Fig. 3, a section of the apparatus taken on line *x—x* of Fig. 2, Fig. 4, a section of the apparatus taken on line *y—y* of Fig. 2, Fig. 5, a section of the apparatus taken on line *z—z* of Fig. 2, Fig. 6, a section taken on line *w—w* of Fig. 2, Fig. 7, an enlarged detail section showing one of the pipes employed in the apparatus for admitting the air from the mist chamber into one of the refrigerating chambers, Fig. 8, an enlarged detail section showing the door employed for sealing the openings between the discharge chambers for the refrigerating chambers and the dry air chamber, and Fig. 9, an enlarged section taken on line *v—v* of Fig. 2.

The preferred form of construction as illustrated in the drawings comprises a suitable building 1 provided in its lower portion with a plurality of separate refrigerating chambers 2 arranged in a row as shown. On the side of the building 1 adjacent the end of the row of refrigerating chambers is arranged a vertically disposed inlet chamber 3 as shown. In its lower portion chamber 3 is provided with inlet 4 communicating with a fan 5 for the purpose of introducing air into said chamber. A main outlet pipe 6 leads from the bottom of chamber 3 to a sprinkling system 7 arranged over a cooling tank 8 which is equipped with brine coils 9 connected with any suitable refrigerating system. A float tank 10 is placed adjacent tank 8 in open communication with the bottom thereof and a float 11 is arranged in tank 10 as shown. Float 11 is carried by a valve stem 12 arranged to operate a valve 13 in pipe 6. A system of air pipes 14 is arranged under tank 8 to introduce jets of air into the bottom thereof and thus thoroughly circulate the water therein around the coils 9. By this arrangement it will be observed that water in tank 8 coming through pipe 6 will be maintained to a constant level and that any excess of water over and above that necessary to maintain such level will accumulate in the bottom of chamber 3.

A supplemental outlet pipe 15 is connected with chamber 3 above the bottom thereof and below inlet 4 as shown. Pipe 15 leads to a tank 16 which is connected by means of an overflow pipe 17 with the upper portion of tank 8. Tank 8 is provided with a discharge pipe 18 leading to a suitable pump 19 which in turn is connected by a pipe 20 with a sprinkling system 21 arranged in the upper portion of chamber 3 as shown. Below sprinkling system 21 is arranged a perforated plate 22 adapted to direct a plurality of fine water jets downwardly through chamber 3. An overflow pipe 23 is connected with the upper portion of chamber 3 above plate 22 so as to maintain the constant level of water on said plate and thus a constant flow downwardly through chamber 3. By this arrangement it will be observed that the water cooled in tank 8 may be constantly supplied to the sprinkling system 21 and thus caused to flow downwardly through chamber 3 and that any water added to the water thus employed will accumulate in the bottom of chamber 3 and thus overflow through outlet pipe 15 into tank 16, this overflow constituting an accurate measure of the water added to the original volume of cooling water employed.

Above chambers 2 in building 1 is arranged a mist chamber 24 in open communication with the upper portion of chamber 3 below plate 22, vertically corrugated baffle plates 25 being interposed between the two chambers, so as to prevent unretarded entry to chamber 24 or chamber 23. Air pipes 26 are arranged to establish communication between mist chamber 24 and each of the refrigerating chambers 2. Each of the pipes 26 is covered by a hood 27 having an inclined top and an open side on the side farthest removed from chamber 3 as shown. Each of the pipes 26 is provided with a suit-

able sealing door 28 at its lower end, by means of which the same may be sealed air tight. Arranged in each of the refrigerating chambers 2 is a system of brine coils 29 as shown. The system of coils in each of the chambers 2 is connected by means of a pipe 30 having a valve 31 therein, with a pipe 32 leading to a brine tank 33 arranged in the uppermost portion of building 1. Tank 33 is provided with a valve vent pipe 34 for the ingress and egress of air and is connected by means of a pipe 35 with the lower portion of a system of double pipe brine cooler 36 in which ammonia is used as a refrigerant. The upper portion of coils 36 are connected with a pipe 37 leading to a suitable pump which in turn is connected with a pipe 38 leading to the upper portion of each of the system of coils 29 in chambers 2. A valve 39 is provided for cutting off the coils in each chamber from pipe 38 and a vent pipe 40 having a valve 41 is provided for admitting air to the upper portion of the coils in each of said chambers when desired. By this arrangement it will be observed that a constant circulation of brine may be caused in the system passing upwardly through coils 29, thence to the pump and thence through cooling coils 36 to tank 33.

Each of the pipes 30 is connected through a valve 42 with a pipe 43 leading to another pump which in turn is connected by means of pipe 44 with the pipe 37 leading to the upper portion of cooling coils 36. By this arrangement it will be observed that in case it is desired to empty the coils 29 in any one of the chambers 22, the same may be accomplished by closing valve 39, opening valves 41 and 42 and operating the pump connected with pipes 43 and 44 which will cause the brine contained in the corresponding coils 29 to be forced upwardly through the cooling coils 36, an equivalent volume entering and remaining in tank 33 until desired for future use.

Arranged in the upper portion of each of the chambers 2 are sprinkling systems 45 connected with pipe 46 which leads downwardly to a pipe 47 which in turn is connected by means of branch pipes 48 with pipes 49 and 50, respectively. Pipes 49 and 50 connect with pumps 51 and 52 as shown and valves 53 are interposed in pipes 18 so as to render it possible to connect or disconnect pipe 47 with either of the pumps 51 or 52. Valves 54 and 55 are also inserted in pipes 49 and 50 for controlling said pipes. Pipe 49 is connected at its upper end with pipe 20 leading to sprinkling system 21, and pump 51 is connected by means of a pipe 56 with a pipe 57 as in between tanks 8 and 16, a valve 58 being inserted in said pipe 57 between pipes 18 and 56 as shown. Pipes 18 and 56 are connected together through a valve 59 and valves 60 are inserted in pipe 56 on either side of valve 59. Pump 52 is connected by means of a pipe 61 with any suitable water supply, and pipe 50 leads to any desired water system, it being intended to connect the pipe 47 as a branch from any desired main water supply. Opposite the lower end of each of the pipes 46, pipe 47 is connected with a steam supply pipe 62 through a valve 63 arranged to introduce a jet of steam upwardly through the corresponding pipe 46. By this construction it will be observed that water may be taken from pipe 50, heated by the introduction of steam through valves 63 and introduced into the sprinkling system 45 of each of the chambers 2 when desired, and that water from either of the tanks 8 or 16 may also be supplied to said sprinkling system.

The lower portion of each of the chambers 2 is formed into a discharge chamber 64 provided with a drain pipe 65 leading to a drain passage 66 and controlled by a valve 67 which may be operated by a valve stem 68. Another valved drain pipe 69 leads from each of the pipes 46 to drain into passage 66 as shown. Surrounding chambers 64 is a dry air chamber 70 communicating with each of the chambers 64 through openings 71 equipped with sealing doors 72 adapted to be tightly closed by means of hand screws 73 arranged as shown. Dry air chamber 70 communicates with an air pipe 74 leading to fans 75 arranged to draw air therefrom and delivers as desired for use. By this arrangement it will be observed that each of the discharge chambers 64 may be entirely sealed from communication with dry air chambers 60 and that water therein may be drained therefrom without passing through any of the other discharge chambers.

In operation sufficient brine is supplied to the apparatus to completely fill coils 29 and 36 and tank 33 about one-fourth full. This brine is caused to circulate through the system as above explained and maintains chambers 2 and coils 29 at a very low temperature. Air is introduced through inlet chamber 3 where it passes through a spray or sprinkle of water, which is cooled in tank 8 as above described. The air passing through chamber 3 will be cooled proximately to the temperature of the water falling thereover which is maintained at about forty-five degrees Fahrenheit. Any aqueous vapor mist with this air will be cooled to the same temperature and if this aqueous vapor contains moisture above that necessary to saturation at the temperature produced, the excess of moisture will be condensed or precipitated and mingle with the water falling through chamber 3. Should the air happen to contain less moisture than that above specified, the active operation of chamber 3 is discontinued for the time being, inas-

much as the action of chamber 3 is only effective in removing moisture from the aqueous vapor over and above that necessary for saturation at the temperature produced. The remainder of the apparatus is designed and is well adapted to take care of any moisture not in excess of that necessary to saturation at the temperature produced, and when tests indicate that the moisture in the air or humidity is not in excess of this amount, the active operation of chamber 3 is discontinued as it is useless.

From chamber 3 the air passes to mist chamber 4 through the baffle plates 25 which serve to intercept any particles of water in suspension in said air and cause return of the same to chamber 3. From mist chamber 4 the air passes downwardly through pipes 26 into the different refrigerating chambers 2, any condensation in said mist chamber being prevented from entering said pipes by the hoods 27. The arrangement of the openings in the hoods 27 on their sides away from the entry opening to said chamber tends to prevent water carried in suspension in the air from entering pipes 26. In chambers 2 the air is subjected to the action of the brine coils 29 which are maintained at a temperature below the freezing point of water and a sufficient amount of the moisture in the air is condensed and frozen on the surface of pipes 29 to render the air sufficiently dry for use in blast furnaces or other purposes. By passing the air downwardly over coils 29 through which the cold brine is ascending, the incoming air which is warmest is subjected first to the action of the upper portions of coils 29 which are also the warmest but sufficiently cooled to partially reduce the temperature of the air and condense and freeze some of the moisture therein. As the air descends in chambers 2 it becomes cooler and cooler and consequently heavier and heavier thus assisting the fans in the circulation of the air, while the brine rising in coils 29 becomes warmer and warmer thus assisting in the circulation of the brine. By the use of inlet chamber 3 the air passing to chamber 2 may be always kept at a temperature sufficiently low to prevent the entry of enough moisture to collect on the uppermost coils 29 and drip to the lowermost, thus quickly clogging the system. The dry air passing to discharge chamber 64 passes out through the openings 71 into dry air chamber 70 and thus to the supply fans 75 as explained above.

Continual operation of the apparatus would ultimately result in the filling of the spaces between coils 29 with ice, and the accumulation of ice on the coils acting as insulation interferes with the rapidity of the action lessens the efficiency so that in time it is necessary to remove this accumulation of ice from the coils 29 in the different chambers. The apparatus is so operated that this accumulation of ice never occurs in two chambers at the same time, so that three of the chambers may be always in active operation. When it becomes necessary to "thaw out" or remove the ice from one of the chambers the corresponding valves 39 and 31 are closed, valves 41 and 42 opened, and the pump connected with pipes 43 and 44 operated to remove the brine from the coils in that chamber. Pipes 26 are sealed and openings 71 closed and hot water supplied to the corresponding sprinkling system 45 as above explained. This hot water flowing downwardly over the corresponding coils 29 will remove the ice therefrom by melting the same and the water accumulating in the corresponding discharge chamber 64 may be drained off through drain pipe 65 as above explained. Then the connections are changed to cause water from tank 16 to be supplied to the corresponding sprinkling system 45. This water, which is comparatively cold and never warmer than the outside atmosphere, will effect a preliminary cooling of the corresponding coils 29 and thus prevent the extraction of a corresponding amount of heat from the brine when reintroduced. After this is accomplished the brine is again supplied to the corresponding coils 29 and the operation of that chamber continued as before. It will be observed that the dry air withdrawn from the chamber 70 travels in a direction opposite to that of the air in chamber 24. The natural tendency is for the largest portion of the air to pass through the refrigerating chamber nearest to the withdrawing fans 75, but this tendency is counteracted by the inertia of the air entering chamber 24 which tends to carry the largest volume of air to the chamber most remote from the withdrawing fans. This results in an equalization of the volumes of air drawn through the different refrigerating chambers. The water withdrawn through drain pipes 65 may be run to a suitable tank and used for any desired purpose in the plant.

While I have illustrated and described the preferred construction for carrying my invention into effect, this is capable of variation or modification without departing from the spirit of the invention. I therefore do not wish to be limited to the exact details of construction set forth but desire to avail myself of such variations and modifications as come within the scope of the appended claims.

Having described my invention what I claim as new and desire to secure by Letters Patent is:

1. An apparatus for drying air comprising an inlet chamber; means for sprinkling said chamber with cool water; a main wa-

ter outlet for said chamber located near the bottom thereof; a supplemental water outlet for said chamber located above said main water outlet; a tank arranged to receive the water from said main outlet; a valve for said main outlet; a float controlled by a level in said tank and arranged to operate said valve; a refrigerating chamber in communication with said inlet chamber; and means for passing air through said inlet and then through said refrigerating chamber, substantially as described.

2. An apparatus for drying air comprising an inlet chamber; means for sprinkling said chamber with cool water; a main water outlet for said chamber located near the bottom thereof; a supplemental water outlet for said chamber located above said main outlet; a cooling tank arranged to receive the water from said main outlet; means for supplying the water from said cooling tank to said sprinkling means; a valve for said main outlet; a float controlled by the level in said tank and arranged to operate said valve; a refrigerating chamber in communication with said inlet chamber; and means for passing air through said inlet and then through said refrigerating chamber, substantially as described.

3. An apparatus for drying air comprising an inlet chamber; means for sprinkling said chamber with water; a main water outlet for said chamber located near the bottom thereof; a supplemental water outlet for said chamber located above said main outlet; a cooling tank arranged to receive the water from said main outlet; means for supplying the water from said cooling tank to said sprinkling means; a valve for said main outlet; a float controlled by the level in said tank and arranged to operate said valve; a refrigerating chamber in communication with said inlet chamber; a sprinkling system for said refrigerating chamber; means for supplying the water from said supplemental outlet to the refrigerating chamber sprinkling system; and means for passing air through said inlet and then through said refrigerating chamber, substantially as described.

4. An apparatus for drying air comprising a plurality of separate refrigerating chambers; individual air and water discharges for each of said chambers; means for opening or closing said discharges; a separate sprinkler system for each of said chambers; means for supplying warm water to each of said sprinkler systems separately; and means for passing air through said chambers, substantially as described.

5. An apparatus for drying air comprising a plurality of refrigerating chambers; cooling fluid coils in said chambers; a cooling system for said coils located above them; a tank located above said cooling system and connected with the bottoms of said coils; and means for forcing the fluid from said coils through said cooling system and into said tank, substantially as described.

6. An apparatus for drying air comprising a plurality of refrigerating chambers arranged in a row; a supply chamber in communication with each of said refrigerating chambers; means for admitting air to one end of said supply chamber; a discharge chamber in communication with each of said refrigerating chambers; and means for withdrawing air from said discharge chamber from the end corresponding to that at which the air is admitted to said supply chamber, substantially as described.

7. An apparatus for drying air comprising a vertically disposed inlet chamber; a sprinkling system arranged at the top of said inlet chamber; an air inlet arranged at the lower portion of said chamber; a plurality of refrigerating chambers arranged in a row adjacent said inlet chamber; a mist chamber arranged above said refrigerating chambers and in open communication with the upper portion of said inlet chamber below the sprinkling system therein; hooded pipes leading from said mist chamber into each of said refrigerating chambers; means for sealing said pipes; brine coils arranged in said refrigerating chambers; cooling coils arranged above said mist chambers; a tank arranged above said cooling coils and connected with said tank and with the bottoms of the coils in each of said refrigerating chambers; valves in each of said last named connections; means for forcing brine from the tops of said brine coils through said cooling coils and into said tank; a sprinkler system in the upper portion of each of said refrigerating chambers; means for supplying warm water to said last mentioned sprinkler system; a discharge chamber at the bottom of each of said refrigerating chambers; a drain pipe for each discharge chamber; a valve in each of said drain pipes; a dry air chamber surrounding said discharge chambers and in communication therewith; means for sealing the communication between said discharge chambers and said dry air chamber; and means for drawing air from said dry air chamber, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALBERT GAIDE.

Witnesses:
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JOSHUA R. H. POTTS.