(No Model.) 2 Sheets—Sheet 1.

J. CHAMBERS.

APPARATUS FOR COOLING AIR FOR REFRIGERATING, FREEZING, AND OTHER LIKE PURPOSES.

No. 280,131. Patented June 26, 1883.

Fig. 1.

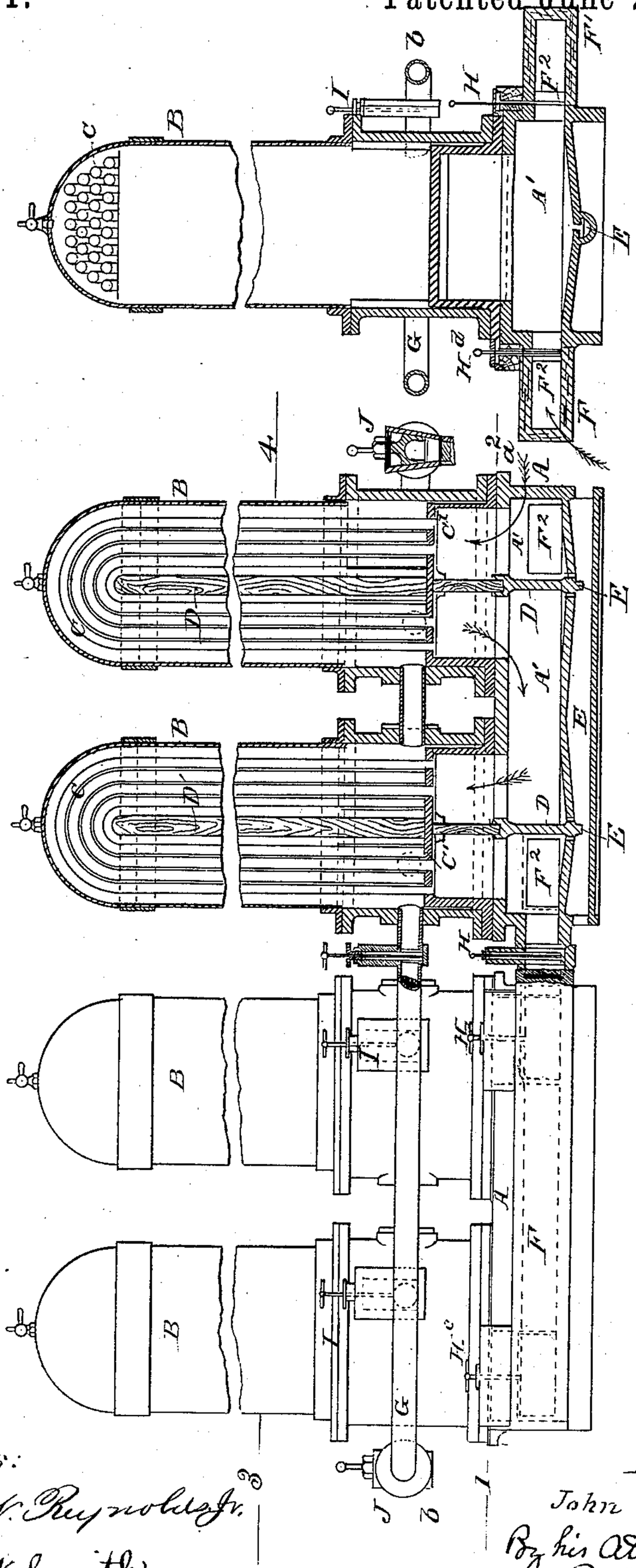

Fig. 2.

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Inventor:

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R. D. C. Smith

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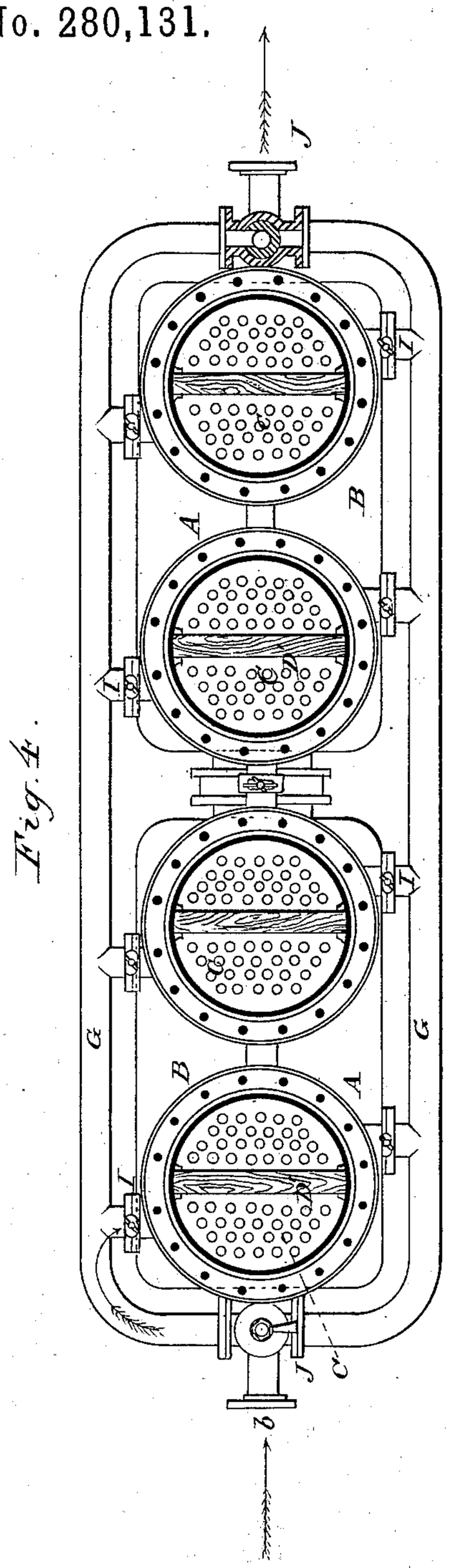

Fig. 4.

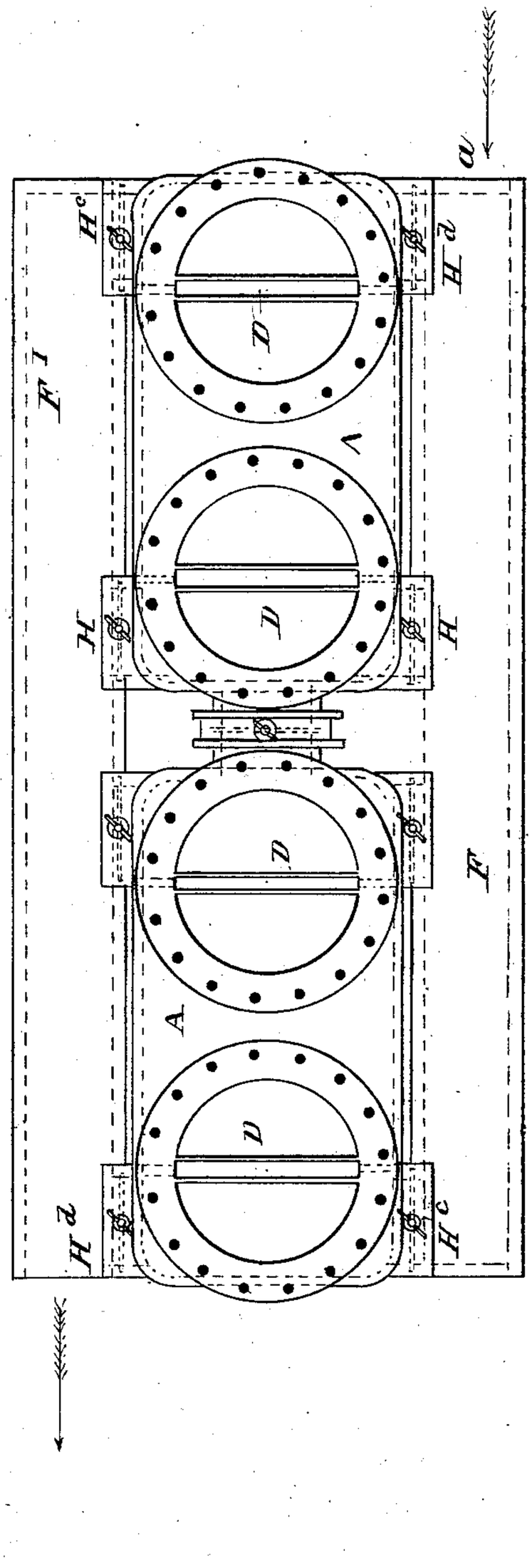

Fig. 5.

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UNITED STATES PATENT OFFICE.

JOHN CHAMBERS, OF TE MATA, NEW ZEALAND.

APPARATUS FOR COOLING AIR FOR REFRIGERATING, FREEZING, AND OTHER LIKE PURPOSES.

SPECIFICATION forming part of Letters Patent No. 280,131, dated June 26, 1883.

Application filed September 9, 1882. (No model.) Patented in England April 27, 1882, No. 1,984.

To all whom it may concern:

Be it known that I, JOHN CHAMBERS, of Te Mata, New Zealand, at present residing at Manchester, in the county of Lancaster, in the United Kingdom of Great Britain, have invented certain new and useful Improvements in Apparatus for Cooling Air for Refrigerating, Freezing, and other like Purposes, (for which I have received Letters Patent in Great Britain, No. 1,984, dated April 27, 1882;) and I do declare that the following is a clear and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in apparatus for cooling air, in which the air is caused to pass through pipes (surrounded by a refrigerated substance) so arranged that the moisture in the air in excess of saturation is separated from the air and removed as water, thereby making it practicable to have a very compact arrangement of cooling-pipes located either within or outside of the chamber or space to be cooled, and freed from the liability of the air-passages being closed by the formation and lodgment of snow or ice within the pipes or in the passages. In all similar arrangements heretofore constructed this stoppage of the air-passages has caused serious trouble and has been considered by many as an insurmountable difficulty. Saturated air contains aqueous vapor in varying quantities, dependent upon the temperature of the air; but, invariably decreasing with every reduction of temperature, the excess of moisture forms into such infinitesimal drops that they are held in suspension in the air. It is this moisture in excess of saturation that causes the trouble in this class of air-cooling arrangements; and the object of my invention is the removal of this moisture in a liquid state. The methods I employ to thoroughly effect this removal are threefold in their nature: first, to remove as much of this surplus moisture as possible before congealing; second, to liquefy and then remove all that does congeal by the action of the air to be cooled while passing through the pipes; third, when necessary, to raise the temperature of the ingoing air by giving it a slight compression. These operations will be more clearly understood by reference to the accompanying drawings; but before proceeding to describe them I would remark that my invention does not consist of or include any method of producing cold, but only in the necessary apparatus for its absorption and distribution. The cold may be produced by the melting of ice or by the vaporization of any of the well-known condensable gases; but the appliances for producing a refrigerated liquid are not shown.

Figure 1, Sheet 1, of the annexed drawings is a longitudinal elevation of the apparatus, part in view and part in section. Fig. 2, Sheet 1, is a transverse vertical section. Fig. 3, Sheet 2, is a plan view on the line 1 2. Fig. 4, Sheet 2, is a plan view on the line 3 4.

Similar letters refer to similar parts throughout the several views.

A, Figs. 1, 2, 3, and 4, is a rectangular base subdivided into compartments or depositing-chambers; A′, Figs. 1 and 2, depositing-chambers in base A; B, Figs. 1, 2, and 4, casings or cylinders containing pipes; C, groups of bent pipes in casing B; C′, tube-sheets into which both ends of the tubes C are fixed; D, Figs. 1, 2, 3, and 4, mid-feather or partition dividing base A; D′, Figs. 1 and 4, mid-feather between legs of pipes C; E, Figs. 1 and 2, drain-pipe underlying the depositing-chamber A′; E′, Fig. 1, semi-partitions across drain-pipes E; F, Figs. 1, 2, and 3, air-inlet pipes; F′, Figs. 2 and 3, air-outlet pipes; F², Figs. 1 and 2, openings in passages into compartments A′; G, Figs. 1, 2, and 4, brine-pipes; H, Figs. 1, 2, and 3, slides or gates in air-pipes F and F′; I, Figs. 1, 2, and 4, cocks or slides in brine-pipes; J, Figs. 1 and 4, three-way cocks in brine-pipes.

The working of the apparatus will be best understood by reference to the drawings. It is, however, to be assumed that the air-inlet pipe F is connected with a blower capable of displacing the requisite quantity of air against a maximum pressure of five pounds per square inch, and that the brine-pipe G is connected with a cold-producing arrangement, and that the cylinders B above the tube-sheet C′ are filled with a refrigerated non-congealable liquid kept in constant circulation from the cylinder B, where it absorbs the heat from the air

passing through the pipes C to the refrigerator of the cold-producing apparatus, where it parts with the heat previously absorbed. It is also to be assumed that saturated air (the condition of extreme disadvantage) at a temperature, say, of 80° Fahrenheit is discharged from the blower into the compartment A′ at *a*, while the refrigerated liquid is forced into the cylinder B through the three-way cock J at *b*, and that the air and brine follow the direction of the respective arrows. The air in the condition and at the temperature named will contain eleven grains of aqueous vapor per cubic foot; but when cooled to 33°, a cubic foot will be saturated with 2.25 grains, and the excess of 8.75 grains will have been deposited upon the metal surfaces of the pipes and chambers during the process of cooling. This surplus moisture first appears in infinitesimal globules, which by forcible contact with metal surfaces are soon aggregated into larger drops, and are swept along with the current of air, and at each downward termination of the pipes the accumulated water is lodged in the underlying depositing-chamber, while the air passes up and down another group of the pipes and again deposits the accumulated water, and so on through the series. The water lodged in the different chambers runs into the drain-pipe E, common to all the chambers, and is from thence conducted away. By this method of cooling the air it will be evident that there cannot be a formation of snow or ice until the air is cooled to 32°, and then only from the small percentage of moisture not previously deposited, and that whenever there is any formation it will always be in the groups of pipes farthest removed from the air-inlet. To liquefy and dislodge any such formation, I have only to reverse the current of the air, which I can readily do by opening slide H^c and closing slide H^d, and this without interruption of the flow of air through the apparatus. In the event of air entering the apparatus at a temperature of 32° or below, it would be practically dry and would cause no deposition; but assuming that air at this temperature carried sufficient moisture to congeal, or that there was a previous formation in the pipes, in such case I should clear the pipes by compressing the air sufficient to raise the temperature above the melting-point of ice. This is done by throttling the exit-passage. (A pressure of three pounds to the square inch will raise the temperature about 25°.) I also make provision for reversing the brine-current or withdrawing the brine altogether from either of the cylinders or casings containing the pipes. The drawings show four groups of pipes; but I do not limit myself to this number, nor to any particular size or shape of the casings containing the pipes, but use two or more, according to the number of degrees that the air has to be cooled. Then, again, to avoid complexity in the drawings, the slides are shown to reverse the air-current through each two of the groups of pipes; but in a working arrangement it will be found desirable to arrange the slides so as to control the air-current in each one of the series.

I am aware that prior to my invention a series of casings have been arranged and connected together by air and liquid pipes, said casings being provided with a series of air-tubes adapted to be surrounded with liquid. I therefore do not claim such, broadly; but

What I do claim, and desire to secure by Letters Patent, is—

1. In an apparatus for cooling air, a series of groups of pipes with intervening depositing-chambers, combined with an arrangement of slides whereby the current of air may be passed through all the series from right to left or from left to right, or diverted from passing through each one of the series in either direction, without interrupting the flow of air through the apparatus, substantially as described and shown.

2. In an apparatus for cooling air, the combination of a series of groups of pipes with intervening depositing-chambers, and the slides, with a pressure-blower, substantially as described, and for the purpose specified.

3. The continuous pipe G, provided with openings and cocks, as specified, in combination with intersecting casing-pipes provided with slides I, substantially as described, and for the purposes set forth.

4. The base A, provided with depositing-chamber A′, in combination with underlying drain-pipe E, substantially as described, and for the purposes set forth.

5. The base A, provided with depositing-chamber A′, in combination with underlying drain-pipe E, provided with semi-partitions E′, substantially as described, and for the purposes set forth.

6. The compartment A′, provided with openings F^2, in combination with air-pipes F F′, substantially as described, and for the purposes set forth.

7. The compartment A′, provided with openings F^2, in combination with air-pipes F F′ and a series of slides, H H^c H^d, substantially as set forth and specified.

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