(No Model.)

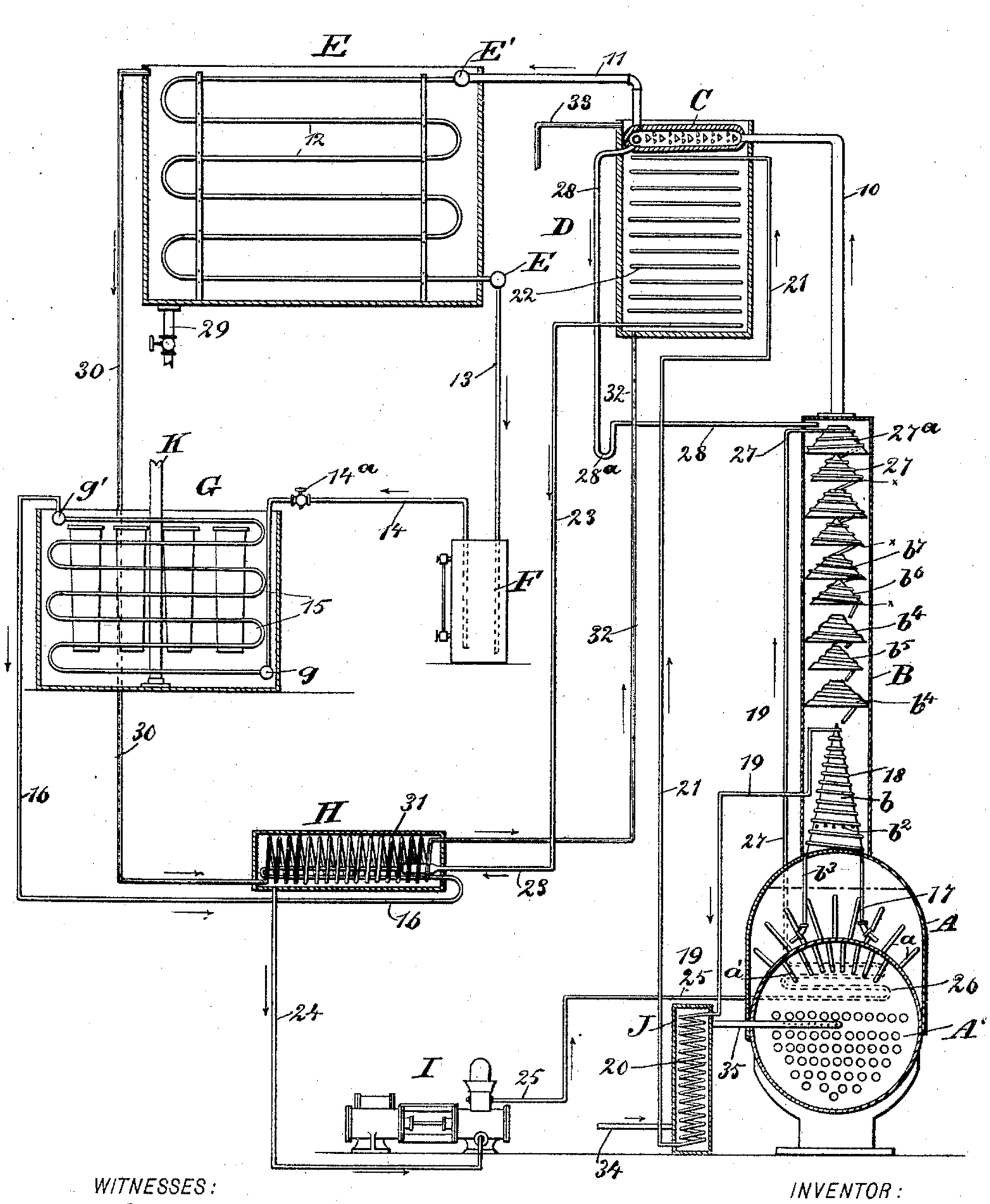
3 Sheets—Sheet 1.

M. J. PALSON.

ICE MACHINE.

No. 482,694. Patented Sept. 13, 1892.

Fig. 1.



WITNESSES:

N. R. Davis

C. Sedgwick

INVENTOR:

M. J. Palson

BY Munn & Co.

ATTORNEYS

(No Model.) 3 Sheets—Sheet 2.

M. J. PALSON.

ICE MACHINE.

No. 482,694. Patented Sept. 13, 1892.

Fig 2

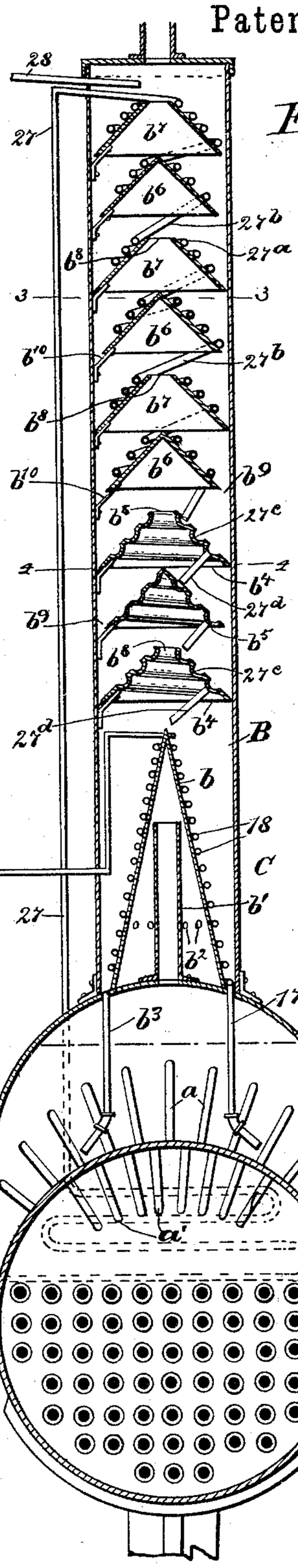


Fig. 3.

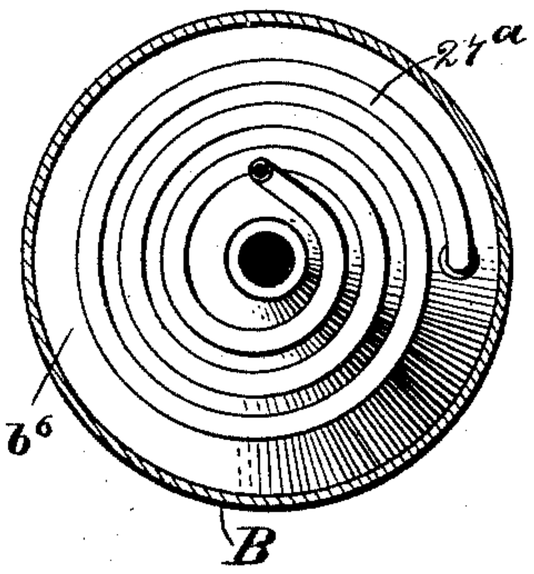
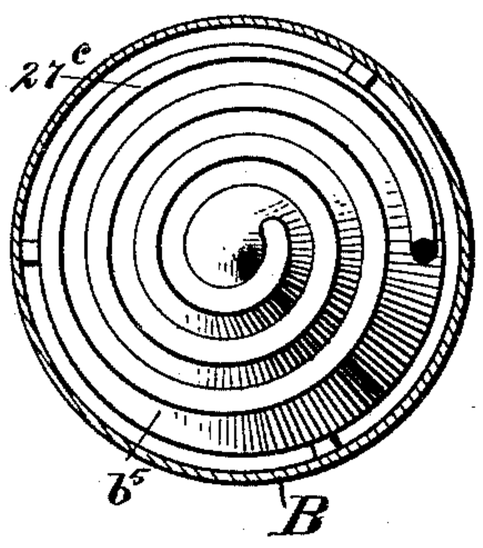


Fig. 4.



WITNESSES:

H. R. Davis.

C. Sedgwick

INVENTOR:

M. J. Palson

BY Munn & Co.

ATTORNEYS

(No Model.) 3 Sheets—Sheet 3.

M. J. PALSON.

ICE MACHINE.

No. 482,694. Patented Sept. 13, 1892.

Fig. 5.

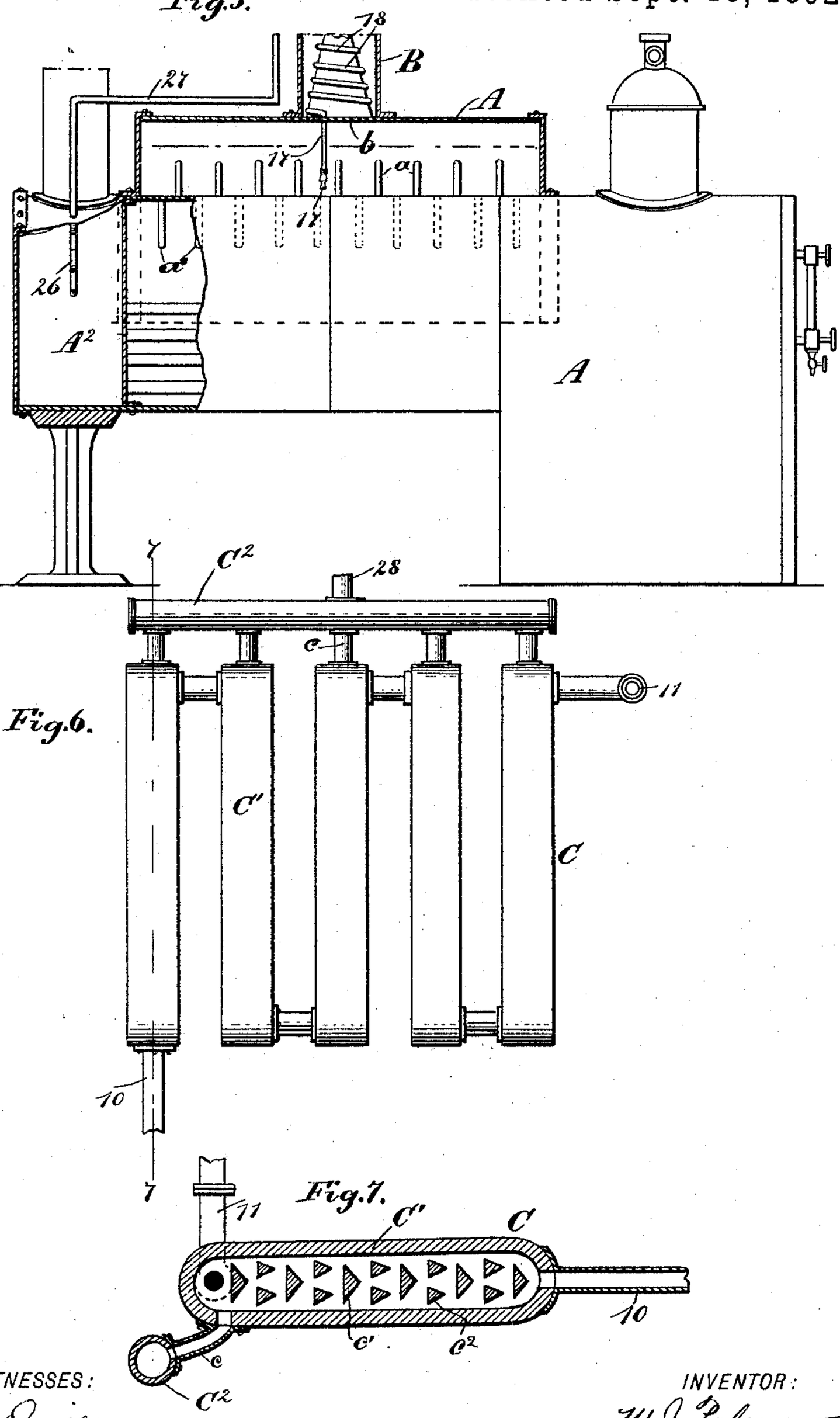


Fig. 6.

Fig. 7.

WITNESSES:

W. R. Davis.

C. Sedgwick

INVENTOR:

M. J. Palson

BY Munn & Co.

ATTORNEYS.

UNITED STATES PATENT OFFICE.

MAGNUS J. PALSON, OF GLOUCESTER, MASSACHUSETTS, ASSIGNOR OF TWO-THIRDS TO WILLIAM H. PERKINS AND LORING B. HASKELL, OF SAME PLACE.

ICE-MACHINE.

SPECIFICATION forming part of Letters Patent No. 482,694, dated September 13, 1892.

Application filed March 23, 1891. Serial No. 386,060. (No model.)

To all whom it may concern:

Be it known that I, MAGNUS J. PALSON, of Gloucester, in the county of Essex and State of Massachusetts, have invented a new and Improved Ice-Machine, of which the following is a full, clear, and exact description.

The invention relates to absorption ice-machines in which aqua-ammonia is treated to form anhydrous ammonia-gas, which is condensed and then permitted to expand into gaseous form in a refrigerator, the gas after performing its functions in the refrigerator being absorbed by weak ammonia-liquor from the still, the aqua-ammonia thus formed being again utilized in the production of ammonia-gas, the process being continuous.

In ice-making machines involving the process thus generalized their relative economy is the measure of their success, the resultant being gaged by the proportion which the resulting ice bears to the fuel consumed.

The object of my invention is to increase the efficiency of machines of this character and promote economy in their operation.

To these ends the invention consists in the novel construction, combination, and arrangement of parts, as hereinafter described and claimed.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar reference characters indicate corresponding parts in all the figures.

Figure 1 is a vertical elevation, partly sectional, of an absorption ice-making plant constructed in accordance with my invention, it being understood that in practice the several elements of the apparatus are arranged on the several floors of a building in the most practicable and convenient manner. Fig. 2 is a vertical cross-sectional elevation of the still and its furnace and the analyzer. Fig. 3 is a horizontal section on line 3 3, Fig. 2. Fig. 4 is a horizontal section on line 4 4 of Fig. 2. Fig. 5 is a side elevation of the furnace or boiler and the still and showing a part of the analyzer. Fig. 6 is a plan view of the separator for condensing and precipitating the aqueous vapor of the ammonia-gas; and Fig. 7 is a vertical cross-sectional view on the line 7 7, Fig. 6.

Referring to Fig. 1, the apparatus comprises, in general terms, a still A, arranged in connection with a furnace or boiler A′, a chamber B in direct communication with said still and which I term an "analyzer," and a separator C for condensing and precipitating any aqueous vapor that may accompany the ammonia-gas from the analyzer, said separator being arranged in a reducer or cooler D for reducing the heat of the weak liquor forced from the still. The separator C is connected with the condenser E, in which the ammonia-gas, now anhydrous, is liquefied, and from said condenser such liquefied ammonia passes to a receiver F, from which it is allowed to escape in gaseous form, as desired, to the refrigerator G, whence after performing its functions as a refrigerant it passes to the absorber H, where it meets and is absorbed by the weak liquor forced from the still. The resulting strong aqua-ammonia is pumped by a pump I to the still. The circulating water employed in the condenser E is caused to pass to the absorber and through the same to the reducer D, from which it is permitted to escape. The weak ammonia-liquor forced from the still is, before being passed to the absorber H, conveyed into the analyzer B, and then caused to traverse a feed-water heater J. From the feed-water heater J the weak liquor passes to and through the reducer D, and from the latter to the absorber H.

The course of the ammonia-gas is as follows: From the still A it passes directly to the analyzer B, thence by the pipe 10 to the separator C by pipe 11 to the coils 12 of condenser E, by pipe 13 to the receiver F, by pipe 14 to the coils 15 of the refrigerator G, and by pipe 16 to the absorber H. The weak ammonia-liquor which is permitted to escape, as desired, under the pressure of gas in the still enters pipe 17, the inlet of which is near the bottom of the still, thence to the coil 18 in the bottom of the analyzer B, thence by pipe 19 to the coil 20 in feed-water heater J, thence by pipe 21 to the coil 22 of reducer D, and finally by pipe 23 to the absorber H, where it meets and absorbs the gas from the refrigerator G, as before mentioned. The strong aqua-ammonia is drawn from the absorber H by the pump I through the pipe 24 and is forced by pipe 25 to the coil 26 in the smoke-

box A^2 of the boiler A′, from whence it passes by the pipe 27 to the analyzer B, entering the latter at the top, and finally entering the still, as hereinafter explained. The water of condensation from the separator C gravitates through the pipe 28 to the top of the analyzer, said pipe being formed, preferably, with a trap or goose-neck 28^a.

The reference character 29 indicates the inlet for the water or other cooling agent to the condenser E, and as said water overflows it passes by pipe 30 to the coil 31 in the absorber H, from which it passes by pipe 32 to the reducer D, finally escaping from the latter by the pipe 33.

34 and 35 indicate, respectively, the inlet to the feed-water heater J and the injector-pipe entering the boiler.

The general plan of the apparatus and the various connections being thus understood, I will proceed to describe the invention in detail.

The still A, in which the aqua-ammonia is vaporized, is preferably constructed directly upon the shell of the boiler A′ and in arched form, the boiler in the form shown being of the locomotive pattern, and into said still project in porcupine form a series of tubes *a* for the better dissemination of the steam heat from the boiler. Further, a series of pendent tubes *a′* extend from the still into the boiler. The tubes *a* communicate with the steam-space of the boiler and the tubes *a′* communicate with the interior of the still. The shell of the chamber B, which is in the form of a stand-pipe, is mounted directly on the still A, and I term the same an "analyzer," in that the ammonia-gas therein is freed from most of its aqueous vapor, and there is a mutual coaction therein between the outgoing gas, the outgoing weak liquor, and the incoming strong liquor, as next explained. At the bottom of the analyzer B, on the shell of the still A, a conical casing *b* is constructed and the same is entered by a vertical pipe *b′* from the still A, said pipe *b′* extending to near the top of the chamber formed by the casing *b*, as shown in Fig. 2, and serving to conduct to such chamber the ammonia-gas generated in the still, the gas escaping from the case *b* to the analyzer B through apertures b^2. The apertures b^2 are produced in the case *b* a distance from its bottom, whereby should any liquor be forced into the pipe *b′* by a sudden or abnormal ebullition in the still it will be arrested by the conical case *b*, and if in sufficient quantity to overflow through the apertures b^2 will gravitate back to the still through the pendent pipe b^3. As the ammonia-gas escapes from the apertures b^2 it passes upward in the analyzer B and strikes against the baffle-partitions b^4 b^5 b^6 b^7, which are in the form of cones. The cones b^4 b^5 alternate and the former are formed with open upper ends b^8, their lower outer edges contacting and forming a closed joint with the inner surface of the analyzer B, while the baffle-partitions b^5 (of which only one is shown) are each formed with a closed top and spaced at the outer edge from the shell of the analyzer B. The baffle-partitions b^6 alternate with the partitions b^7 and, like the cones b^5, are closed at the top and spaced from the shell B, as at b^9, while the conical partitions b^7, like the partitions b^4, are open at the top, as at b^8, and form a close contact with the inner surface of the shell B. Arms b^{10} serve to secure the several partitions to the shell B. Thus the ammonia-gas will be directed against the successive baffle-cones and alternately caused to pass from the top of one to the lower edges of another, and vice versa, whereby much of the aqueous vapor accompanying the gas will condense and gravitate back to the still A.

As a further means of effecting the condensation of the aqueous vapor, the incoming strong ammonia-liquor is availed of to some extent, the pipe 27, by which said liquor is conducted back to the still, being formed within the analyzer B into a series of coils 27^a, which are preferably arranged in single succession to conform to and contact with the baffle-cones b^6 b^7, the bottom spiral of one coil connecting, as at 27^b, with the upper spiral or apex of the next lower succeeding coil. The lowermost coil terminates near the center of the uppermost baffle-cone b^4, and said cones b^4 and the cone or cones b^5 are formed with spiral depressions or corrugations 27^c on their upper surface, which are practically a continuation of the helical coils 27^a, the short pipes or tubes 27^d serving to conduct the ammonia-liquor from the groove 27^c of one cone to that of the next succeeding one.

It is explained that the temperature of the incoming ammonia-liquor at the time it enters the coils 27^a is such that it will tend to condense the aqueous vapor, but is not such as to condense the ammonia-gas. The strong liquor as it traverses the coils 27^a partakes of the heat of the highly-heated outgoing gas, and such exchange of temperature is further effected when physical contact of the gas and liquor takes place while the liquor is traversing the spiral depressions 27^c, the arrangement being such that at the time of physical contact of the gas and liquor the temperature of the latter will be such as to preclude any possible deleterious effect on the gas, while it will none the less be receptive of the heat imparted by the gas. It is evident that the more heat of the outgoing gas that is imparted to the incoming liquor the less heat will be demanded of the boiler to volatilize such liquor, and thus the more conducive to economy will the process be. The incoming strong liquor is delivered by the lowermost tube 27^d to the top of the conical case *b*, around which traverses the helical coil 18, conveying the weak liquor from the still, and as the strong liquor gravitates down the case *b* and over the pipe 18 it is further heated by the hot weak liquor in the latter, from which arrangement it will be seen that the strong liquor will reach the still,

through pipe b^3, in a highly-heated condition, and will thus demand a minimum expenditure of heat to vaporize its ammonia.

To return to the ammonia-gas, the same passes from the pipe 10 to a separator C, the tubes C′ of which are in zigzag form, and from the separator leads the outlet-pipe 11 for the gas, the said pipe being arranged at the opposite terminal to the inlet-pipe 10, as shown most clearly in Fig. 6. The interior of each of the tubes C′ is constructed with transverse cross-bars c' c^2, Fig. 7, which in the form shown consist of single larger bars c', alternating and breaking joint, as it were, with pairs of smaller bars c^2, so that the course of the gas will necessarily be circuitous, causing it to impinge against the beveled forward faces of such bars, and thus causing the aqueous vapors to condense on the surfaces of the bars and eventually gravitate by connections c to the drum or manifold C^2, from which it passes by pipe 28 to the analyzer B.

The condenser E is constructed with a manifold or drum E′, to which the pipe 11 from the separator C leads, and with the several coils 12 of suitable form traversing the condenser. At the bottom the coils 12 deliver to a second manifold D^2, connected with the several coils, and which receives the now anhydrous liquid ammonia, which then passes to the receiver F, and from the said receiver it is permitted to escape in gaseous form through the pipe 14 and its expansion-cock 14^a to the manifold g at the bottom of the refrigerator G, to be distributed thereby to the several coils 15 of the refrigerator. From the latter, after performing its functions as a refrigerant, it passes to the manifold g' at the top of the refrigerator, and thence by pipe 16 to the absorber H. The absorber H is preferably of cylindrical form and, as before mentioned, is entered by the pipe 23, containing the weak liquor and by the pipe 16, containing the gas. The latter pipe within the absorber is bent one or more times on itself to form folds, the outlet of which is within a concentric case, which is entered at the opposite end by the terminal of the pipe 23. The gas and weak liquor meeting in the chamber formed by case h, the former is absorbed by the latter and heat is generated, which it is desirable to modify, and this is effected by the cold ammonia-gas in the folds and by the coils 31, containing the water or other circulating medium from the condenser E. The strong aqua-ammonia formed in the absorber is forced by the pump I into the analyzer through the pipe 25, the coil 26 in the smoke-box, and pipe 27, and the heat imparted to it while traversing the coil 26, it will be seen, is received from the waste heat passing from the boiler, and the arrangement is such that the said liquor is heated to the proper degree for its proper coaction with the gas in the analyzer.

It will be seen from the above description that the incoming strong liquor is heated, first, by the heat in the smoke-box A^2; secondly, by the outgoing ammonia-gas, and, thirdly, by the outgoing weak liquor, all the heat thus imparted being a utilization of heat that would otherwise not be availed of; also, the outgoing gas and outgoing weak liquor act on the strong liquor immediately as the two former leave the still, and consequently when they are hottest. The weak liquor by being passed through feed-water heater J not only enables the heat thus given up to be practically utilized, but it is brought to a temperature that enables it to be finally brought to the proper degree by the water in the reducer D, it being observed that the water is only fed to such reducer after having done service in the condenser E and absorber H, and in view of the prior reductions of the heat of the weak liquor the cooling action of the reducer is sufficient to complete the reduction; also, the arrangement of the separator C in the reducer D has the effect of maintaining the proper temperature in the separator for the better condensation of the aqueous vapor in the latter without so cooling such condensed vapor as to cause it to absorb any considerable quantity of the ammonia-gas. All the several features of the apparatus are therefore so combined as to practically utilize to the maximum degree the heat generated in the boiler, all the heat so saved being a distinct gain in the direction of economy.

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

1. An ice-machine comprising a still, an analyzer in communication therewith, a separator in communication with the analyzer and serving to finally separate the aqueous vapor from the gas, a condenser in communication with the separator, a refrigerator in communication with the condenser, an absorber communicating with the refrigerator, a feed-water heater having a coil which is connected with the still for the passage of the weak liquor, a reducer connected with said coil for further reducing the temperature of such liquor, and connections between the reducer and the absorber, connections between the absorber and the analyzer, and means for forcing the liquor from the absorber to the analyzer, substantially as described.

2. In an ice-machine having generating, condensing, and absorbing apparatus, an analyzer consisting of a chamber into which the gas generated is directed, coils in said analyzer for receiving the strong liquor from the absorber, and a separate coil also in said analyzer and adapted to receive the weak liquor passing from the vaporizing apparatus to the absorber, substantially as described.

3. In an ice-machine, the combination, with a generator, of a chamber above the generator and communicating therewith, a series of baffle-partitions in the chamber, and a strong liquor-supply pipe entering the top of the chamber and provided with a series of coils,

one above each of the baffle-partitions and discharging into the said chamber, substantially as described.

4. In an ice-machine, the combination, with a generator, of a chamber communicating with the generator, baffle-partitions in the chamber, the lower ones of which are provided with spiral depressions, and a supply-pipe entering the chamber at the top and provided with a series of coils above the upper baffle-partitions, substantially as and for the purpose specified.

5. In an ice-machine, the combination, with generating, condensing, and absorbing apparatus, of a chamber in communication with the generating apparatus, coils in said chamber at the top, to which coils the strong liquor from the absorbing apparatus is delivered, baffle-plates below said coils and formed with spiral depressions or corrugations, and a separate coil below said baffle-partitions, the latter coil being connected with the still for receiving the weak liquor passing to the absorber, substantially as described.

6. In an ice-machine, the combination, with generating, condensing, and absorbing apparatus, of a chamber, a shell or casing within said chamber and formed with outlet-openings near the bottom, and a pipe entering said shell from the generator and extending above the outlets thereof, substantially as described.

7. In an ice-machine, the combination, with generating, condensing, and absorbing apparatus, of a chamber between the generator and condenser, coils at the upper end of said chamber for receiving the strong liquor from the absorber, baffle-plates below the outlet of said coils, a conical shell at the bottom of the chamber having outlet-openings near its lower end, a pipe entering said conical shell from the generator and extending above the outlets thereof, and a helical coil around said shell, the coil forming the receiver of the weak liquor passing from the generator to the absorber, substantially as described.

8. In an ice-making machine having generating, condensing, and absorbing apparatus, the combination of a boiler and connections between the absorber and the still, said connections including a coil in the smoke-box of the boiler, substantially as described.

9. In an ice-making machine having generating, condensing, and absorbing apparatus, the combination of a chamber between the generator and condenser, a boiler, and connections between the absorber and said chamber, said connections including a coil in the smoke-box of the boiler, substantially as described.

10. In an ice-making machine having generating, condensing, and absorbing apparatus, the combination of an analyzer consisting of a chamber between the generator and condenser, connections between the generator and absorber for the passage of the weak liquor, said connections including a coil in the said analyzer-chamber, and connections between the absorber and chamber, said latter connections including a coil in the smoke-box of the boiler of the generator, substantially as described.

11. In an ice-machine having generating, condensing, and absorbing apparatus, the combination of an analyzer consisting of a chamber between the generator and condenser, a feed-water heater, connections between the generator and the absorber for the passage of the weak liquor, said connections including a coil in the analyzer and a coil in the feed-water heater, and connections between the absorber and the analyzer for the passage of the strong liquor, substantially as described.

12. In an ice-machine having generating, condensing, and absorbing apparatus, the combination of an analyzer consisting of a chamber between the generator and condenser, a boiler, a feed-water heater, connections between the generator and absorber for the passage of the weak liquor, said connections including a coil in the analyzer and a coil in the feed-water heater, and connections between the analyzer and absorber for conducting the strong liquor, said connections including a coil in the smoke-box of the boiler and a coil in the analyzer, substantially as described.

13. In an ice-machine having generating, condensing, and absorbing apparatus, the combination of a feed-water heater for the boiler of the generator and connections between the generator and the absorber for the passage of the weak liquor, said connections including a coil in the said feed-water heater, substantially as described.

14. In an ice-machine having generating, condensing, and absorbing apparatus, the combination of a feed-water heater, a reducer receiving water from the condenser, and connections between the generator and the absorber for conveying the weak liquor, said connections including a coil in the feed-water heater and a coil in the reducer, substantially as described.

15. In an ice-machine having generating, condensing, and absorbing apparatus, the combination of a separator between the generator and the condenser for separating the aqueous vapor from the gas and a reducer for reducing the temperature of the weak liquor, the separator being arranged in the reducer and the latter forming the receiver of the cooling-water from the condenser, and connections between the generator and the absorber, said connections including a coil in the reducer, substantially as described.

16. In an ice-machine, the combination, with a generator, condenser, absorber, and separator between the generator and condenser, of a reducer in which the separator is arranged, a feed-water heater for the boiler of the generator, a coil in the feed-water heater, and connections between the coil of the feed-water heater and the generator and reducer, substantially as described.

17. In an ice-machine, the combination, with a generator, a chamber above the generator, a condenser, a separator between the generator and condenser, an absorber, and a reducer in which the separator is arranged, having a coil and connected with the absorber, of a coil in chamber above the generator and communicating with the generator, a feed-water heater for the generator, and a coil in the feed-water heater and connected with the coil in the chamber and with the coil of the reducer, substantially as herein shown and described.

18. In an ice-machine, a separator for condensing the aqueous vapor of the gas, said separator having chambers arranged in zigzag form and each provided with transverse baffle-bars comprising a single large bar alternating with two smaller bars, substantially as described.

19. In an ice-machine having generating, condensing, and absorbing apparatus and a cooler or reducer for the weak liquor, a separator arranged to receive the gas, said separator being arranged in said reducer and consisting of chambers arranged in zigzag form and having transverse baffle-bars, substantially as described.

20. In an ice-machine having generating, condensing, and absorbing apparatus, the combination of a feed-water heater for the boiler of the generator, a reducer or cooler, a water-pipe coil in the absorber, connections between said coil and the body of the condenser and between the coil and the reducer, and connections between the generator and the absorber, the said connections including a coil in the feed-water heater and a coil in the reducer, substantially as described.

21. In an ice-machine, the combination, with a generator and a chamber above the generator and communicating therewith, of an apertured casing projecting into the chamber and a pipe communicating with the generator and projecting into the said casing, substantially as and for the purpose specified.

22. In an ice-machine, the combination, with a generator and a chamber above the generator and communicating therewith, of a conical casing projecting into the chamber and provided with apertures above its bottom and a pipe communicating with the generator and projecting into the conical casing nearly to the top thereof, substantially as herein shown and described.

23. In an ice-machine, the combination, with a generator, a chamber above the generator and communicating therewith, and an absorber, of a conical and apertured casing projecting into the chamber, a pipe communicating with the generator and projecting into the conical casing, and a coil around the conical casing, having one end leading into the generator and its other end in communication with the absorber, substantially as described.

24. In an ice-machine, the combination, with a generator, a chamber above the generator and communicating therewith, and an absorber, of a series of baffle-partitions in the chamber, a pipe in communication with the absorber, projecting into the chamber and provided with a series of coils above the baffle-partitions, and a coil in the chamber below the baffle-partitions and having one end leading into the generator and its other end in communication with the absorber, substantially as herein shown and described.

MAGNUS J. PALSON.

Witnesses:
SUMNER D. YORK,
LAURA MCQUINN.