T. H. RAY.

ICE MAKING MACHINE.

APPLICATION FILED DEC. 18, 1909.

962,241.

Patented June 21, 1910.

4 SHEETS—SHEET 1.

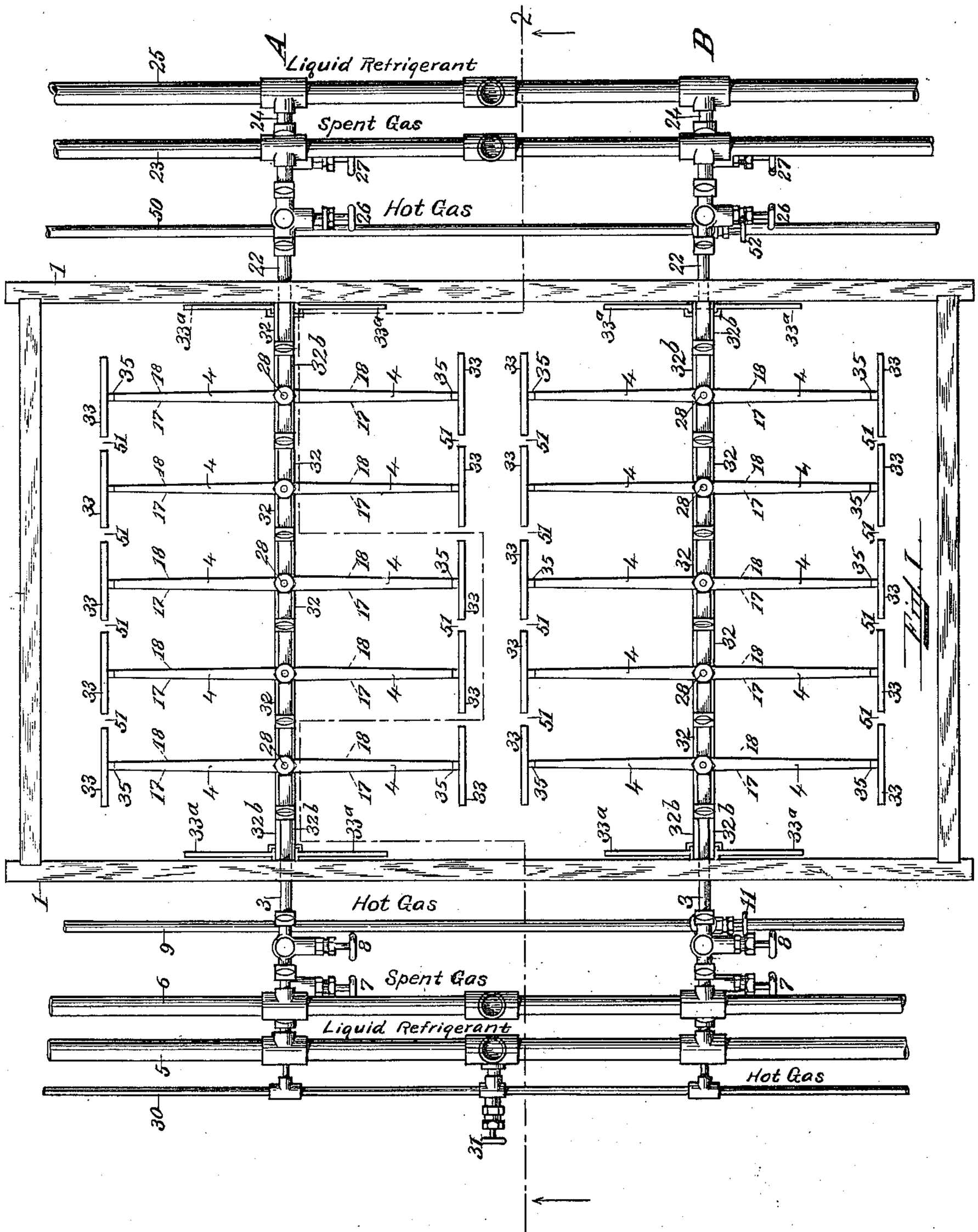


Fig. 1.

Witnesses:
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H. E. Remick.

Inventor:
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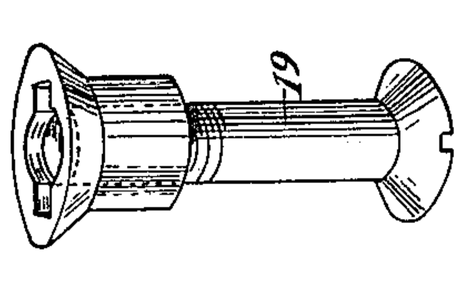


Fig. 3.




Fig. 2.

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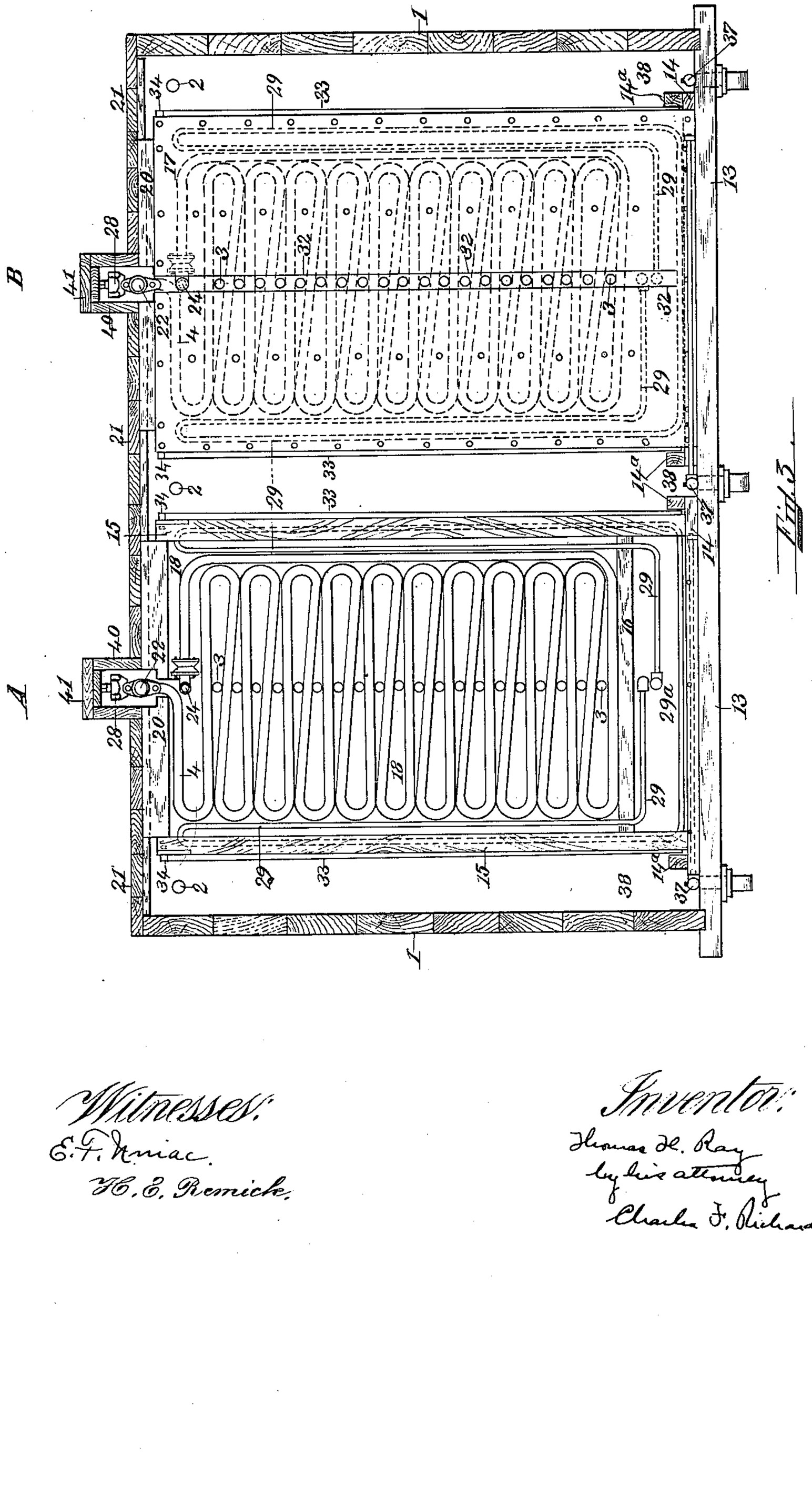


Fig. 3.

Witnesses:
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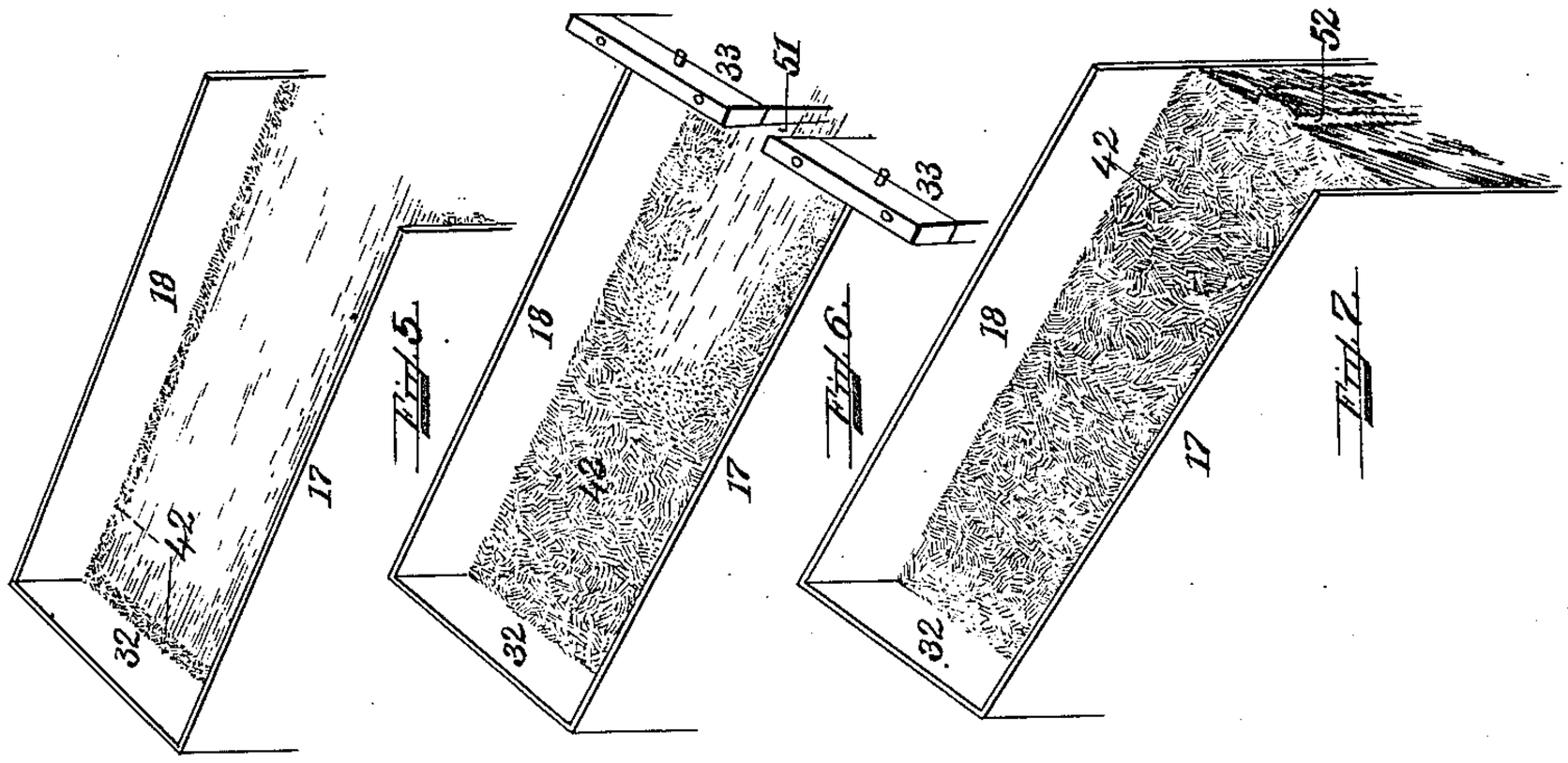


Witnesses:

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# UNITED STATES PATENT OFFICE.

THOMAS H. RAY, OF SOMERVILLE, MASSACHUSETTS.

## ICE-MAKING MACHINE.

962,241. Specification of Letters Patent. Patented June 21, 1910.

Application filed December 18, 1909. Serial No. 533,805.

*To all whom it may concern:*

Be it known that I, THOMAS H. RAY, a citizen of the United States, residing at Somerville, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Ice-Making Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention resides in improvements over what is described in United States Letters Patent No. 923,298, for ice making machines, dated June 1, 1909.

Where a single block of ice is formed by the union of two pieces, on two parallel freezing plates with their respective "cross-cuts," the plane of union results in a line of cleavage, along which the block will sometimes split, if it receives the right kind of a blow.

Now one of the objects of my invention is to do away with this plane of cleavage, and I do so by providing an independent third coil and freezing plate, arranged parallel with the cross-cuts, and at right angles to the two parallel freezing plates. By the use of this construction, a single block of ice is not made by the union of two smaller pieces, but by the growth of a single piece formed by the three independent freezing surfaces, and the two cross-cuts partially closing the mouth of the ice forming space between the three ice forming surfaces. There is consequently no line of cleavage, and no splitting along it. A further result of this construction is that the independent third coil greatly increases the power of the machine to produce cold, and hence greatly hastens the production of the block of ice. If the independent third coil intersects the parallel or "cross" coils so as to make two ice forming spaces, obviously two blocks may be made in a shorter period of time than would be required by the two parallel coils without the dividing coil, to make a single block, containing substantially the same amount of ice. If a larger number of blocks is desired, then there may be provided three or more parallel or "cross" coils, and an independent dividing coil intersecting the parallel or "cross" coils at right angles, so that there may be formed by the "cross" coils and the intersecting coil, as many spaces as there are blocks of ice desired. In fine, by the use of the independent third or dividing coil, in combination with my cross-coils and cross-cuts, I reduce the time heretofore required to make a block of ice; and I also do away with the objectionable line of cleavage in the resulting block of ice.

Another object is to provide means whereby a block of ice frozen to a freezing plate by a freezing coil, may be released from the plate practically simultaneously, and I attain this object by the use of an auxiliary hot-gas pipe lying in the plane of the coil, and between the coil and the outer edge of the freezing plate.

In the drawings illustrating the principle of my invention and the best method of embodying the same, now known to me, Figure 1 is a plan view of my invention; Fig. 2 is a longitudinal section on line 2—2, Fig. 1, showing the "cross" coils and the "dividing" coil at right angles thereto; two of the "cross" coils having two "cross-cuts" removably secured and mounted across the ends thereof, and parallel with the "dividing" coil; and one freezing plate on the "dividing" coil being broken away to show the coil couplings. Fig. 3 is a transverse vertical section on line 3—3 Fig. 2, and shows the cross-coils, and additional hot gas piping for disengaging ice from the freezing plates on the cross-coils; the freezing plate of one coil, being removed the better to show the coils and frame. Fig. 4 is a perspective view to show more clearly the spaces in which blocks of ice may be formed by means of two or more cross-coils and a dividing-coil and also how the cross-cuts, which partially close the mouth of each space, may be removably secured to the ends of the cross-coils. Figs. 5, 6 and 7, diagrammatically show the development of a block of ice in one of such ice forming spaces. Fig. 8 shows in perspective a tie-bolt, the adjustable heads of which, while they secure the freezing plates to the opposite sides of a coil, are flush with the freezing surfaces of the plates.

A suitable water tank 1 is provided having water outlets 2; while in it, for the sake of illustrating a small ice plant, are arranged the freezing apparatus of two ice machines A, B. Each machine, as A, has a dividing-coil 3, having at a suitable distance apart, two or more parallel cross-coils 4, 4, at right angles thereto and meshing therewith, see Figs. 2 and 3. Each dividing-coil may be supplied with cold liquid from a liquid-feed-header 5 connected with the

bottom of an accumulator, not shown; while the return end of each dividing-coil is connected to a return header 6, leading, say, to the suction side of an ammonia compressor.

Two valves 7, 8, Figs. 1 and 2, control the communication between each dividing-coil 3 and the liquid-feed-header 5 and the return-header 6. A hot-gas-header 9 connects with each dividing-coil 3, by means of a branch-pipe 10 which has a valve 11 and enters the feed end portion of the dividing-coil ahead of the feed-valve 7.

A rectangular wooden frame is provided for each cross-coil 4, Figs. 2 and 3, and rests upon the floor 13 of the tank. At a short distance up from the bottom piece 14 of the frame, there is secured between the side pieces 15 of the frame, a horizontal cross-bar 16 upon which the bottom of the cross-coil rests; the coil being confined in the plane of the frame by two metal freezing plates 17, 18, which substantially cover the front and back of the frame. To give additional support to the cross-coils in their respective frames, and to stiffen the plates, tie-bolts 19, Fig. 8 pass through the plates and under the loops of the coils. The holes for the bolts in the plates are reamed out so that the heads of the bolts are flush with the plates, and do not affect the smoothness of the blocks of ice. Two pieces of wood 20, to serve as supports for the covers 21 of the tank; fit in between, but also project above, the top portions of the two opposite freezing-plates 17, 18; and are fixed in position by rivets.

Extending over the dividing-coil 3, and in its vertical plane, are two pipes; one, 24, a feed pipe leading from a liquid-header 25, connected with the bottom of an accumulator, not shown, but readily understood; and the other, 22, a return-pipe leading into a return-header 23. The feed end and the return end of each cross-coil 4 are, by suitable connections, connected respectively with the above mentioned feed-pipe 24 and return-pipe 22, in which, before they connect with their respective headers, are two valves 27, 26. A valve 28 controls communication between each cross-coil 4 and the return-pipe 22.

To hasten the disengagement of ice formed on so much as constitute the outer edge and bottom portions of the plates 17, 18, Fig. 3, I make use of an auxiliary hot-gas-pipe 29 which lies within the frame and in the plane of the cross-coil. It has a valve 49 and connects with a hot-gas-header 50 receiving hot gas, as from the above mentioned compressor, and enters a space $29^a$ formed between the cross-bar 16 and the bottom piece 14 of the frame. The hot-gas-pipe then passes up, through the cross-bar and between the bends of the cross-coil and the sides of the frame, then down and through the cross-bar; next through the bottom space $29^a$, and up and down, in like manner, on the opposite side of the cross-coil; and back through the bottom space, and out to the next coil; where it repeats its course. After leaving the last coil, it passes through valve 31 and connects with a hot-gas-return-header 30, connected to the cold-liquid-header 5 for the dividing-coil, through a valve $31^a$, so that, when desired, the condensed hot gas, at compressor pressure, may be permitted to enter, and do refrigeration in the dividing-coil.

The feed-pipe 24 for the cross-coils 4, 4, is likewise connected to the hot-gas-header 50, from which the hot gas may be controlled by valve 52.

The horizontal pipes of the dividing-coil 3 pass through holes in the cross-coil plates 17, 18, and mesh with the loops of the cross-coils; while covering each side of the dividing-coil, between the plates of the adjacent cross-coils, is a vertical freezing plate 32, Figs. 3 and 4, mounted and secured by rivets 19, passing through the opposite plates and resting upon the tops of the pipes, see Fig. 2, constituting the dividing-coil. The sides of these plates 32 abut and closely fit against the cross-coil plates 17, 18. To close the bottom of the space formed by these four plates 32, 32, 17, 18, a wooden block $32^a$ is provided and riveted in position. It is through this space that the pipe $29^b$ connecting the hot-gas-pipes 29 in the cross-coil frames, passes.

As pointed out in said Letters Patent No. 923,298, that part of the frame constituting the sides 15 of the "unit", projects slightly beyond the edges of the freezing plates 17, 18, Fig. 4, so as slightly to insulate the "cross-cut" 33, the adjacent vertical partition $33^a$, Fig. 4, of which, were there not this slight insulation from the freezing-plates, would tend to conduct so much heat from the outside surface of the cross-cut, that useless ice would form on the outside thereof, and might seriously interfere with harvesting the resulting block of ice. This cross-cut has projecting from the middle of the side of its head 34, a lock member 35 which may be dropped down into a socket member 36 arranged in the top of the sides 15 of the frame. The bottom piece 14, Figs. 3 and 4, of each cross-coil frame, projects out beyond the sides and serves to sustain a notched wooden tie-piece $14^a$ which in turn receives and retains the bottom portions of the cross-cuts 33. As a consequence of the above construction, there are formed by the two freezing-plates, on the cross-coils, and the two freezing-plates on the dividing-coil, two freezing spaces, the mouths of which are partially closed by opposite cross-cuts; this slight opening or mouth 51 being absolutely necessary in order to permit proper agitation of the water, to insure the formation of

a clear block of ice. To produce this agitation, air-pipes 37, Figs. 2 and 3, with holes therein, are laid along the floor of the tank, in the aisles 38 between and parallel with the dividing-coils 3, 3; branch air-pipes 39 being similarly laid between the cross-coils 4, 4.

Arranged over the common cross-return-pipe 22 of the cross-coils, is a housing 40, Fig. 3, raised above the covers 21 of the tank, and provided with a removable cover 41, so as to render the return-valves in the common cross-return-pipe accessible.

The ice-machine A, and hence its duplicate B, has now been described. To use it, the dividing-coils 3, 3, are flooded with liquid ammonia from the common-liquid-header 5; the liquid begins to boil in both of the dividing-coils, and the circulation is completed through the common-return-header 6. Likewise all of the cross-coils 4, 4, are flooded independently of the dividing-coils 3, 3, by a supply of freezing liquid from the common-feed-header 25; said liquid boiling in the cross-coils and circulating through the common-return-header 23. As every block is formed in the same way, a description of the formation, and of the harvesting, of two blocks of ice by any two cross-coils and the dividing-coil, and the cross-cuts, will be sufficient.

As the ammonia in the cross-coils 4, 4, and that in the dividing-coil 3, boil, ice 42, see Figs. 1 and 5, begins in each freezing space to form on the parallel freezing-plates 17, 18, on the cross-coils 4, 4, and the two freezing plates 32 on the dividing-coil. That is, one piece of ice in each freezing space, forms along the two plates 17, 18, of the two cross-coils 4, 4, and one plate 32 of the dividing-coil 3. As appears in Fig. 6, each piece, as 42, grows out toward the center of the ice forming space; the inner faces of each pair of cross-cuts 33 forming the outer end portion of the block. In this way, the water, agitated by the pipes 37, 39, in each of the two freezing spaces, is constantly forcing any impurities in the water out through the mouth 51 between the cross-cuts 33, 33, and is being gradually frozen and formed into two single solid blocks of ice by said two cross-coils, four cross-cuts, and one dividing-coil; each resulting block since its origin, always having been only one piece, and hence with no line of cleavage; one of the results desired to be attained. Further, by the use of the dividing-coil, in connection with but independent of the cross-coils, I have great additional power for freezing, and two blocks of ice can be frozen in a shorter time than would be required by two cross coils with no dividing coil, to freeze an equal amount of ice, but all in one block.

To harvest the blocks of ice, the inflow of refrigerant liquid into the dividing-coil 3, and into the cross-coils 4, 4, is stopped by closing the valves 7, 27, controlling the pipes leading from the dividing-coil feed-header 5, and the cross-coil feed-header 25. Next, the hot gas valves 11, 49, 52, are opened. Hot gas at compressor pressure, flows into the dividing-coil 3, into the cross-coils 4, 4; and also into the auxiliary hot-gas-coils 29, 29, in the cross-coil frames. The hot gas condenses and gives out its heat through the various coils. The water, confined between the plates and frame of each cross-coil, and that between the plates of the dividing coil, and the plates of the cross-coils, becomes warm, and, in turn, raises the temperature of all of the freezing plates sufficiently to melt the films of ice holding the blocks to the plates. It is to be noted here that the warm water about the coils is confined there by the plates, and hence much available heat that would otherwise be immediately lost, could this water freely escape, is saved. While the hot gas and liquid are melting the blocks off the plates, the cross-cuts 33, 33, may be disengaged from their respective blocks by pouring warm water through one of the holes 34ª in the head 34, and into one side of each cross-cut; the water, see Fig. 4, passing down one side of the vertical partition 33ª and up the other. When the cross-cuts 33, 33, have become disengaged from the blocks, they may be lifted out of their connections; the mouth of each ice forming space, thereby becoming open; and the block, being free from the plates, may be freely floated out of the space; the freezing-plates 17, 18, Figs. 1 and 4, on the cross-coils, flaring outwardly slightly. In this way each block of ice may be harvested quickly and conveniently.

While it is true that a small ridge of ice 52, Fig. 7, may be formed on each block, by reason of the slight space 51 between the adjacent edges of the cross-cuts, yet the cross-cuts, because of the warm water which has been poured into them, to disengage the block, give off enough heat to melt substantially all of the ridge and leave the face of the block formed by the cross-cuts, practically smooth.

To begin freezing a new crop of ice, the empty cross-cuts are placed in their normal working positions, and the return valves 28, 28, 8, of the cross-coils, and of the dividing-coil are cracked slightly. The liquid in the coils, being the condensed hot gas used in melting off the ice, and being at condenser pressure, begins, the moment its pressure is reduced, to boil, and refrigeration is again under way in all of the coils. As the hot gas in the auxiliary coils 29, 29, has been likewise condensed and is at compressor pressure, it can, by means of valves 31, 31ª, be fed back into the dividing-coil liquid-header 5 where the liquid is at a colder tem-

perature, but at a less pressure; the liquid in the auxiliary coils, however, doing refrigeration, while there.

To utilize the water spaces formed by the dividing-coil 3, the end cross-coils, and the adjacent parallel end of the tank; and also to prevent the formation of ice on the end of the tank, freezing plates $32^b$, similar to those 32, between the cross-coils 4, 4, on the dividing-coil, are mounted in a like manner on the dividing-coil between the end cross-coils and the end of the tank; and two cross-cuts $33^a$, are mounted on, and at right angles to, those plates, but adjacent to the end of the tank, by means of a lock member and socket as shown in Fig. 1. It will be plain that although the resulting block of ice must have one irregular face extending between the outside edges of the two cross-cuts, yet the block will be one quickly formed, and easily harvested; and further, upon the removal of these end cross-cuts $33^a$, $33^a$, the cross-coils 4, 4, will have some transverse play in the direction of the length of the dividing-coil 3, to aid in disengaging the other blocks of ice from the cross-coils.

Having described my invention in the best manner now known to me and desiring to protect the same in the broadest manner legally possible, what I claim is:—

1. In an ice machine, two parallel freezing-coils; a third freezing-coil at right angles thereto, but operated independently thereof; and one cross-cut for each parallel freezing-coil; each cross-cut being removably secured, at right angles to its respective freezing-coil; all designed to form within the space inclosed by the three coils and two cross-cuts, a block of ice without a plane of cleavage.

2. In an ice machine, two parallel freezing-coils; a third freezing-coil which intersects said two parallel freezing-coils, at right angles thereto, but which does not communicate therewith; a cross-cut removably secured to and at right angles with each end portion of each of said parallel coils; all designed to hasten the production of a given quantity of block ice.

3. In an ice making machine, two parallel coils; a frame containing each coil; two metal freezing-plates secured to the front and the back of the frame, and confining the coil within the frame; a third coil, designed to intersect at right angles said parallel coils and plates; said plates being provided with holes to permit the pipes of the third coil to pass therethrough and between the loops of the said parallel coils; a metal freezing-plate mounted on each side of the third coil; the vertical edges of said plates abutting the faces of the plates on the parallel coil plates, and the open space between the bottom edge portions of said plates being closed as by a block of wood; all designed substantially to retain between the freezing-plates, the water warmed in the process of harvesting.

4. In an ice machine, a rectangular wooden frame having a horizontal wooden partition near its bottom to divide the frame into two compartments; a freezing coil mounted in the upper compartment; a hot-gas-coil mounted in the lower compartment, and also between the sides of the frame and the freezing coil in the upper compartment; two metallic freezing-plates secured to the front and rear of the frame to close the compartments, and substantially prevent the escape of water which is within the compartments and surrounds the coils therein; all designed to heat all portions of the freezing-plates substantially uniformly and simultaneously.

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

THOMAS H. RAY.

Witnesses:
E. F. Uniac,
Wm. T. Ray.