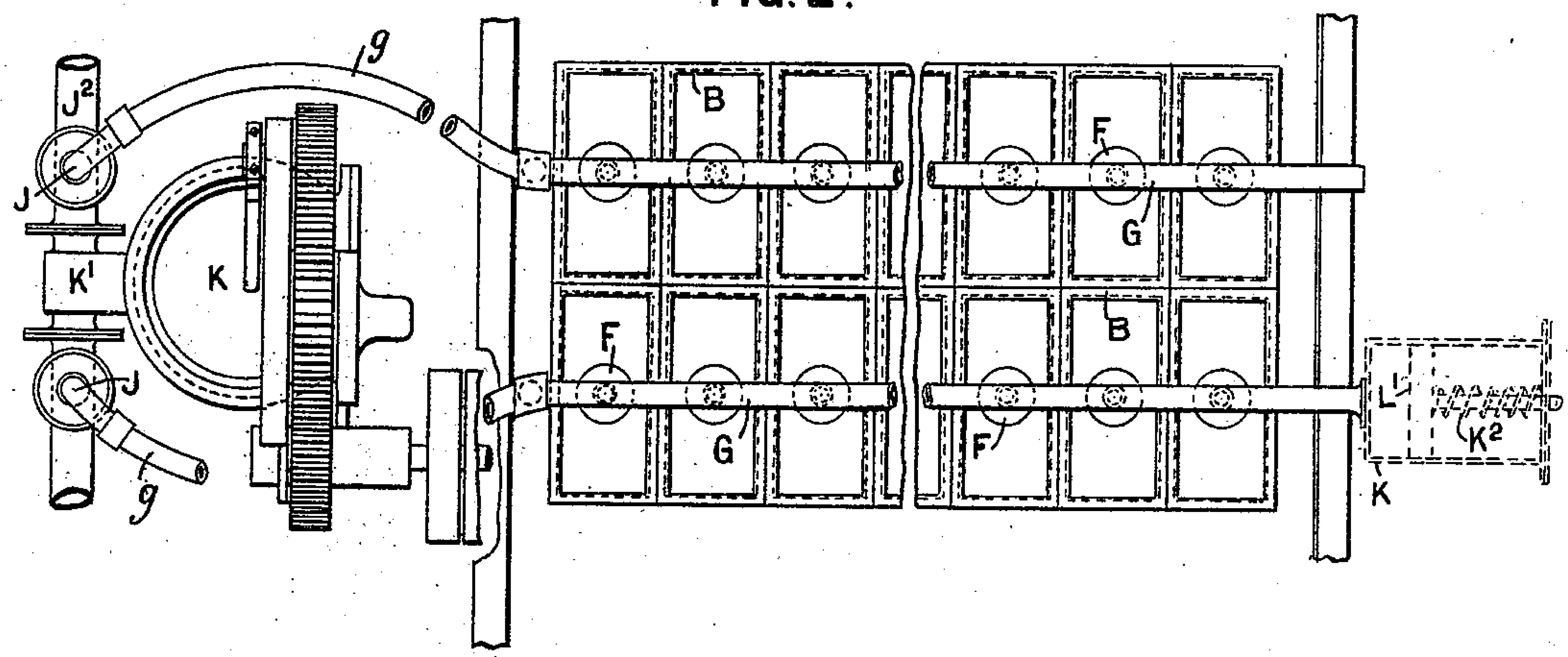
(No Model.) 2 Sheets—Sheet 1.

J. PRICE & M. C. BANNISTER.

ICE MAKING APPARATUS.

No. 525,156. Patented Aug. 28, 1894.

FIG. 2.



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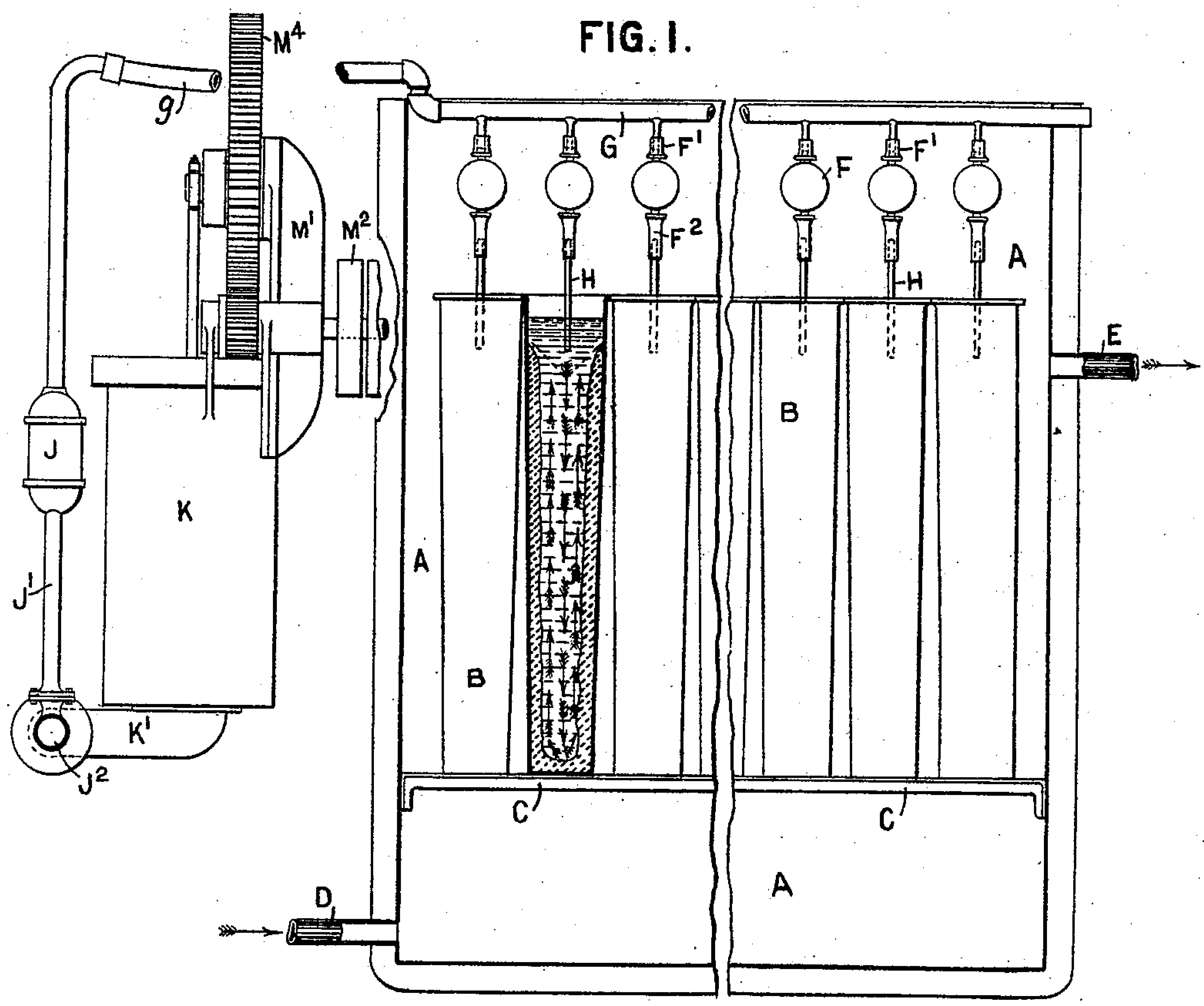

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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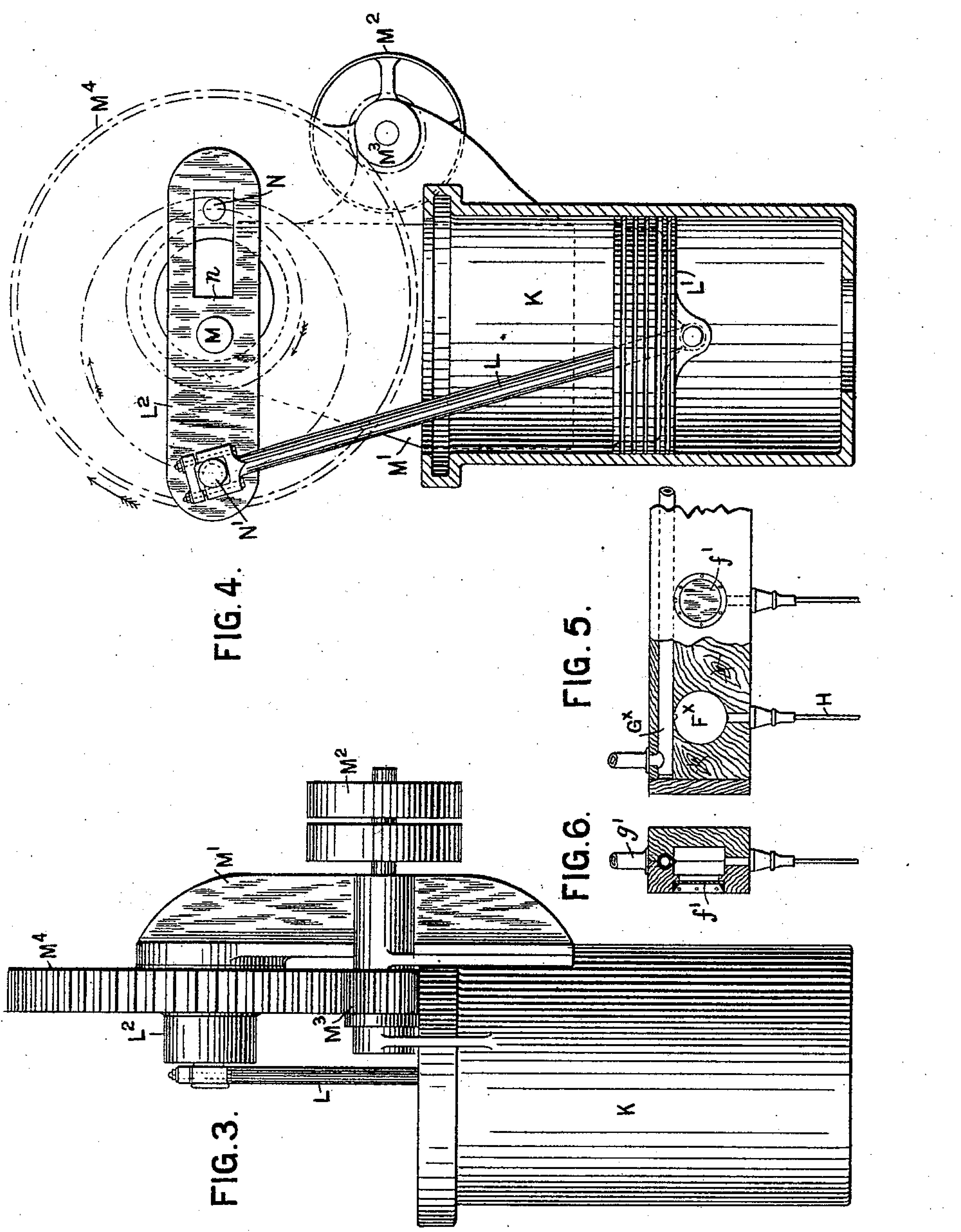

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UNITED STATES PATENT OFFICE.

JOSEPH PRICE, OF LIVERPOOL, AND MAUNSEL C. BANNISTER, OF SEACOMBE, ENGLAND.

ICE-MAKING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 525,156, dated August 28, 1894.

Application filed June 30, 1892. Serial No. 438,621. (No model.) Patented in England June 23, 1890, No. 9,716.

To all whom it may concern:

Be it known that we, JOSEPH PRICE, residing at Liverpool, in the county of Lancaster, and MAUNSEL CASSWELL BANNISTER, residing at Seacombe, in the county of Chester, in the Kingdom of England, subjects of the Queen of Great Britain, have invented certain new and useful Improvements in Ice-Making Apparatus, (which have not been patented to ourselves or to others with our knowledge or consent in any country, except in England, No. 9,716, dated June 23, 1890,) of which the following is a specification.

This invention relates to certain improvements in refrigerating apparatus employed for the manufacture of ice and has for its object the making of transparent ice. The reason for the opacity of ice ordinarily made in ice making machines is the presence of an enormous number of air bubbles. These air bubbles are occluded air and gases in the water and as the water is reduced in temperature and freezes it is no longer capable of holding the gases in occlusion. These, therefore, separate in small globules. We effect the separation of these globules by causing an intermittent reciprocating current in the water flowing against the surface of the ice on its upward journey and thus as it were scraping off the bubbles of air as they form on the said surface.

Our invention consists of certain details in the construction of such an apparatus which we will first describe with reference to the accompanying drawings and we will then point out in the claims the novel parts and combinations.

In the drawings—Figure 1 is a sectional elevation of an ice making apparatus to which the invention has, in part, been applied; Fig. 2, a plan of Fig. 1; Figs. 3 and 4, a side elevation and part elevation (partly in section) respectively of the pump shown in Figs. 1 and 2; and Figs. 5 and 6, longitudinal and transverse sections, respectively, of the injection chamber.

In carrying out our invention, we employ a series of injection chambers, preferably of a more or less globular form, and constructed of glass or of some other material of a low degree of conductivity.

In Figs. 1 and 2—A, is the freezing chamber, and B is a series of ice-tanks supported therein, as by cross bars C. The ice-tanks are filled with the water to be frozen, and the chamber A with the freezing medium. If the medium employed be brine, it may be supplied to the chamber A by a pipe D, from a refrigerating tank, and a second pipe E may serve for supplying brine from the upper part of the chamber to the refrigerating apparatus.

Above each ice-tank there are located one or more injection chambers F F. Each of these injection chambers is of a capacity sufficient to contain the amount of water required for one injection, and each chamber communicates at its upper end, by means of a flexible connection F′, with a common connecting tube G. The lower end of each chamber is provided with an injection nozzle H (preferably of bamboo) which dips into the water in the adjacent ice-tank and is also, by preference, connected with its chamber by a flexible connection F^2. The chambers are, in this case, supposed to be glass globes, each provided with a pair of necks for attachment to their flexible connections F′ and F^2.

The common connecting tubes G are each filled with air which is alternately attenuated and compressed, thus causing the injection chambers F F to be alternately filled and emptied. Each of the tubes G has free communication with the upper end of an air chamber (or chambers) J, which is or are connected in a suitable manner with any convenient form of alternate suction and force device, such, for example, as a cylinder K having a reciprocating piston, said cylinder being connected, say at its lower end, with the lower end of the said air chamber or chambers. In the arrangement shown in the drawings, several air chambers are all connected by branch pipes J′ with a main pipe J^2 which communicates with the lower end of the cylinder K by a branch K′.

The lower parts of the cylinder K and air chambers J and the pipes J′ J^2 and K′ connecting the same are filled with liquid, and the capacity of the cylinder bears such a relation to that of the air chambers that the liquid displaced on the down stroke of the piston will fill all the air chambers to the required height. It is preferable to so proportion these parts to each other and to the amount of liquid employed that the down stroke of the piston shall serve to fill the air chambers to the tops of their cylindrical portions, while the up stroke shall not empty them below their junctions with their respective branch pipes J′. The capacity of each air chamber is also proportioned in a similar manner to that of its series of injection chambers. It will thus be seen that there is an air cushion interposed between the pump cylinder K and the injection chambers, and that such air being a bad conductor of heat, the loss of heat from the ice-tanks by way of the injection tubes G is much less than if the entire connections between the pump and injection nozzles were filled with liquid. It is advantageous, however, to fill the pipes J′ J^2 and K′ with liquid as aforesaid, as, by this means, a much smaller body of air has to be operated upon, namely, that between the lower ends of the air chambers and the injection chambers.

The parts *g g* of the connecting tubes G G are by preference made flexible or capable of being readily disconnected, for the purpose of enabling the tubes, injection chambers, and nozzles to be moved out of the way when the ice-tanks are to be removed.

In some forms of ice refrigerating apparatus, the tanks of ice are periodically moved forward.

The arrangements for operating the piston within the cylinder K are preferably of such a nature as will impart a slow movement to the piston when attenuating the air in the air chambers J, connecting tubes G and injection chambers F, to fill the latter with water, and a quick return movement when compressing the air to expel the water from the injection chambers. Any suitable arrangement may be employed for this purpose.

In the drawings (Figs. 3 and 4) the rod L of the piston L′ is coupled to the crank arm L^2. This latter is mounted loosely upon the stud M which projects from the bracket M′. M^2 are the driving pulleys for imparting motion to the pinion M^3 which gears with the spur wheel M^4. The said spur wheel is also mounted loosely on another part of the stud M and rotates on a different center from the crank arm L^2. The driving pin N is fixed to the spur wheel M^4, and it follows that, as the spur wheel and the crank arm revolve on different centers, the pin travels eccentrically in the slot *n*, whereby the radius of its driving motion varies as it revolves, and it travels backward and forward in the slot. The spur wheel being in motion, the driving pin N and the connecting rod pin N′ describe the circles indicated by dotted lines, and the piston is raised on its up stroke with a suitably slow speed when attenuating the air, while, during the operation of compressing the air to expel water from the injection chambers, the piston falls rapidly to the bottom of the cylinder.

Instead of working several series of injectors from one piston and cylinder, each row may be operated independently.

It will be obvious that other devices, the mechanical equivalent of a cylinder and reciprocating piston, could be employed for working the injection nozzles, such for example, as a collapsible bellows.

In Figs. 5 and 6 a modified form of injection apparatus is shown. The injection chambers are formed by a series of recesses $F^{\times}$ in the bottom of a wooden trough, the upper part $G^{\times}$ of which forms the common connecting tube for all the chambers or recesses. Each chamber is, as before, provided with a nozzle H connected flexibly thereto. A glass disk *f′* is provided in the side of each injection chamber so that the attendant is enabled at any time to see whether the chamber is working properly.

g′ is a short branch, whereby the series of chambers may be connected by a flexible pipe to the air chamber J as in Fig. 1.

The action of the apparatus is such that, on the in stroke of the piston L′, the liquid below it is drawn into the cylinder K and forms a partial vacuum in the air chambers J J, connecting tubes G G and injection chambers F F, causing the required amount of water to pass—preferably slowly—into the latter, from the ice-tanks below them. On the out stroke of the piston, the air is rapidly compressed and the water forcibly expelled from the injection chambers into the tanks, thus setting up a vigorous circulation of the water therein. The circulation, as seen by the arrows in Fig. 1, takes place down the center of the tank and up the face of the newly formed ice therein, thus washing off the air bubbles and impurities from the ice before they become frozen in and carrying them to the top of the tank. The size of the injection nozzles is so proportioned that the outflow of the water is throttled. The injection thus continues for some time after the piston has completed its down strike, the water being forced out of the chambers by the expansion of the air cushion. In this way, the duration of the injection can be much prolonged.

The injection chambers being flexibly connected with their common tube G and the nozzles being also flexibly connected to the chambers, the repeated pulsations which occur in such flexible connections cause the injection nozzles H to move about in the water in the tanks to an extent sufficient to prevent them from being frozen into the ice block. This movement of the nozzles also serves to distribute the circulation more equably throughout their respective tanks.

Suitable attachments may also be provided, where necessary or desirable, for controlling the flow of water into and out of the various injection chambers, and air chambers.

We claim as our invention—

1. In an ice making machine, the combination with a series of tanks and injecting noz-

zles, of a pumping device K and air chambers J J of capacity at least equal to the full charge drawn into them, whereby the liquid in the tanks is intermittently partially withdrawn and injected back, and air cushions are formed between this water and the water in the pump and in contiguous rows of tanks, and thus siphoning between the tanks is avoided.

2. The combination of a series of tanks and a pumping device causing alternate suction out of and the forcing of water into each of the series of tanks with an air chamber on the nozzle and above each tank of a capacity at least equal to the amount of water raised out of the tank at each pulsation, whereby siphoning from one tank to another becomes impossible.

3. In an ice making apparatus, the combination of a single pumping device, a series of air chambers having united capacity at least equal to the capacity of the pumping devices, a series of injecting nozzles having each a chamber F, the united cubical capacity of the chambers F being at least equal to the united cubical capacity of the air chambers and therefore of the pump, substantially as described.

4. The combination of an injecting and ejecting device K, a series of injecting devices F, H connected therewith, an air cushion placed between the pumping device and the water in the injecting device, whereby the water in the pump and the water in the injecting devices are kept from commingling or coming in contact with the same surface, substantially as described.

5. In an ice making apparatus, the combination of a series of freezing tanks, a nozzle pointing down into each tank, a pulsating device acting on numerous nozzles and a separate vessel F above each nozzle of a size amply sufficient to hold all the water from that nozzle drawn up at each pulsation whereby the water is prevented from siphoning from one can to the other through the pulsating apparatus.

6. In an ice making device, the combination of a pulsating device, an ample air chamber, a glass vessel F connected with that air chamber and a nozzle leading into the top of the ice tank from that vessel F whereby the action going on in each tank can be at once ascertained and each tank works independently of the others.

7. In an ice making apparatus, the combination of a tank adapted to contain liquid to be refrigerated and a pump having a vertical connection entering the top of said tank, the pump having a slow suction stroke and a rapid forcing stroke so that a portion of the liquid is slowly withdrawn from the top of the whole body thereof in said tank and then quickly re-injected vertically downward whereby the air bubbles are swept from the face of the ice and allowed to escape, substantially as set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

JOSEPH PRICE.
MAUNSEL C. BANNISTER.

Witnesses:
WM. P. THOMPSON,
G. C. DYMOND.