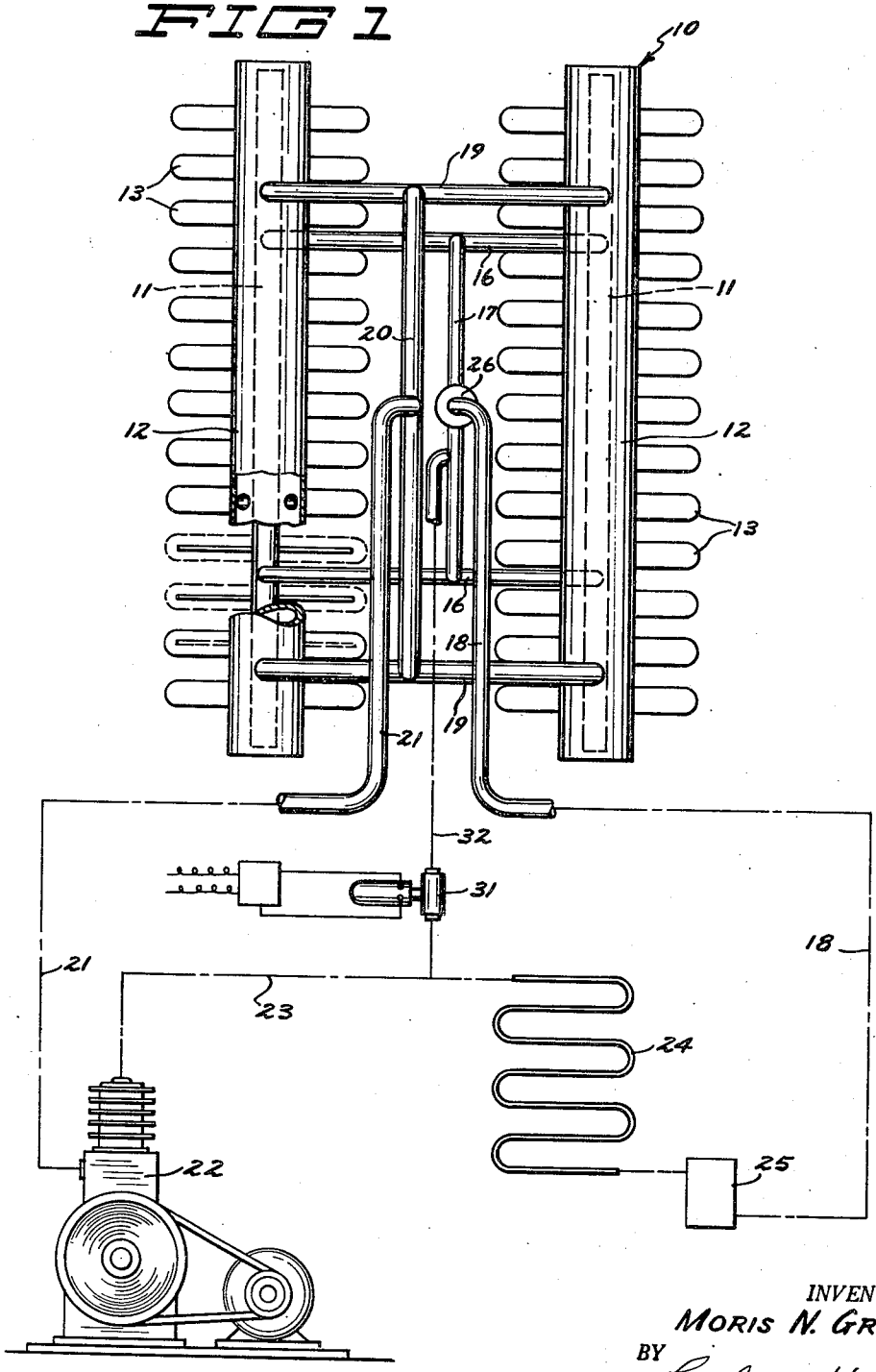
May 31, 1955 M. N. GROW 2,709,344

ICE MAKING MACHINE FREEZING COIL

Original Filed Oct. 7, 1948 2 Sheets-Sheet 1

FIG 1



INVENTOR.
MORIS N. GROW
BY
Carlsen & Hayle
ATTORNEYS

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FIG 2

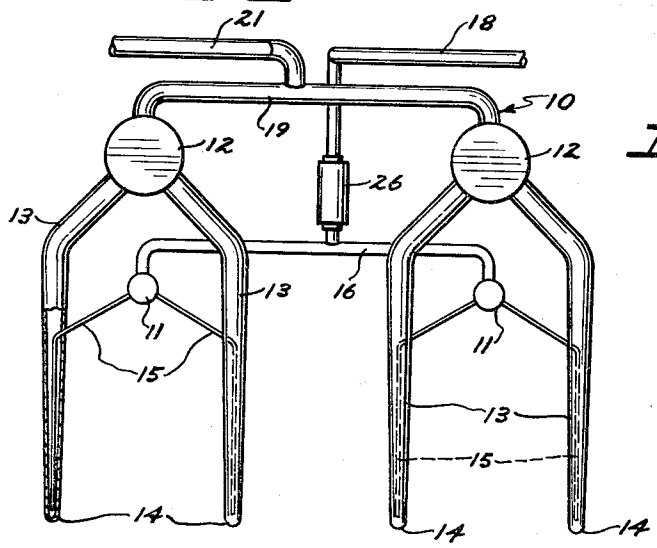
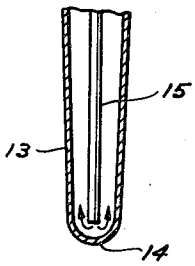


FIG 3



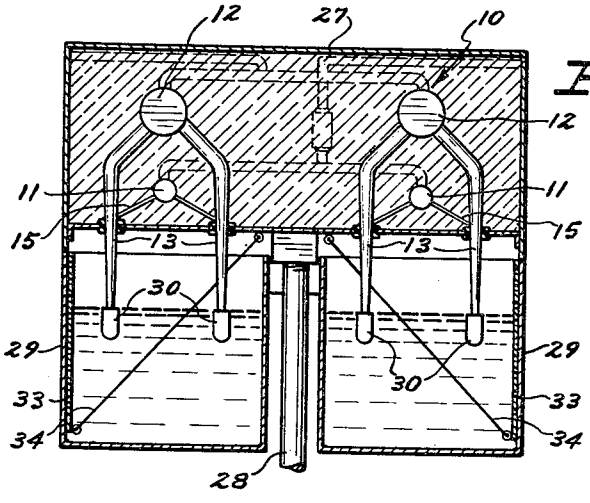
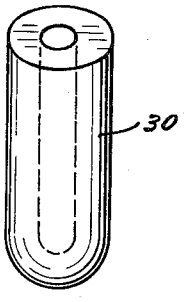


FIG 4

FIG 5



INVENTOR.
MORIS N. GROW
BY
Carlsen & Hazle
ATTORNEYS

United States Patent Office

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ICE MAKING MACHINE FREEZING COIL

Moris N. Grow, Edina, Minn.

Original application October 7, 1948, Serial No. 53,307, now Patent No. 2,585,240, dated February 12, 1952. Divided and this application August 24, 1951, Serial No. 243,469

1 Claim. (Cl. 62—106)

This invention relates to an apparatus for use in a compression type refrigerant circuit for manufacturing artificial ice. The application is a division of my application filed October 7, 1948, and which issued into Patent No. 2,585,240.

The primary object of my invention is to provide a compressed refrigerant supplied ice making device having a plurality of freezing fingers adapted to be suspended in water for the formation of ice thereon as the refrigerant is allowed to vaporize in the fingers and having means insuring a uniform flow of refrigerant to each of the fingers.

Another object of my invention is to provide an ice forming device wherein an evaporator is suspended in water and fed with an expanding refrigerant whereupon ice will form on the evaporator and having means for preventing the accumulation of oil in the evaporator.

Still another object of the invention is to provide a freezing coil having a plurality of evaporator tubes, feeder tubes, and header pipes and having a novel arrangement of the various tubes and pipes for economical manufacture of the coil and uniform feeding of refrigerant to the evaporators.

Still another object of my invention is to provide an ice making device utilizing an evaporating refrigerant and wherein said evaporation is concentrated in the desired freezing area for rapid ice making.

With these and other objects in view my invention broadly comprises a freezing coil assembly adapted to be supported over a body of water and having a plurality of hollow fingers depending therefrom with their closed lower ends submerged in the water, a refrigerant capillary tube extending into each finger for discharging refrigerant in the finger at a point near said lower end, and a means for supplying refrigerant under pressure to each of said capillary tubes forcing the refrigerant through the tube and against said lower end of the finger as it escapes from the tube.

The above mentioned and still further objects will be brought to light during the course of the following specification, reference being made to the accompanying drawings, in which

Fig. 1 is a plan view of the freezing coil and its connections with a somewhat diagrammatic presentation of the complete refrigeration circuit used therewith.

Fig. 2 is an end view of the coil with one of the freezing fingers or evaporators partially broken away to show the position of the capillary tube extending downwardly therein.

Fig. 3 is an enlarged sectional detail of the lower end of one of the evaporators with directional arrows showing the direction of flow of the refrigerant passing from the capillary tube into the evaporator.

Fig. 4 is also an end elevation of the coil showing the coil mounted over water containers with the freezing fingers depending in the water for the formation of ice jackets thereon.

Fig. 5 is a perspective view of an ice jacket manufactured by my device.

Referring now more particularly to the drawings and using reference numerals to denote like parts in different figures, the refrigerant coil, denoted generally by the number **10**, and comprising a plurality of integrally connected refrigerant carrying pipes and tubes, will first be described. The coil includes a pair of transversely spaced, generally parallel inlet or distributor pipes **11** and a pair of diametrically larger outlet pipes **12** thereabove. Each of the pipes **11** and **12** has its ends closed, as shown in Fig. 2. The freezing elements or evaporator tubes **13** are in the form of angular drop legs or hollow fingers which depend from both sides of and open into the outlet pipes **12**. These tubes or fingers taper gradually downward and are closed at their lower ends as at **14**. Between each pair of fingers **13** a pair of small diametered capillary or restrictor tubes **15** branch from each inlet pipe **11** and one of these tubes extends through the wall of each of the fingers and downwardly inside the finger to a point short of its closed end **14**. These tubes **15** are open at their lower ends to discharge into the evaporator tubes. Headers **16** connect the inlet pipes **11** at spaced intervals to feed them and retain their parallel relation, and these headers are in turn connected by a pipe **17** which is fed by a refrigerant supply tube **18**. Similarly, the outlet pipes **12** are connected by headers **19** which in turn are joined by pipe **20** which feeds into a return tube or suction line **21**.

The coil **10** is mounted over a tank or tanks of water, as shown in Fig. 4, with the lower end portions of the fingers **13** depending in the water. Refrigerant is supplied to the fingers causing the water surrounding the tip of each to freeze in the form of a jacket such as shown in Fig. 5. For this purpose the coil has connection with a conventional compression type refrigeration circuit in which the compressor **22** pumps a compression system refrigerant under pressure through tube **23** to the condenser **24** and receiver **25**. The liquid refrigerant then passes through feed line **18** connected to the receiver to an expansion valve **26** provided on the line adjacent its connection with pipe **17**. As the liquid passes through this valve some of the pressure is relieved to start vaporization of the liquid as it passes through pipes **17** and **16** and the distributors **11**. The liquid refrigerant then passes downwardly through the capillary tubes **15**, being discharged out the lower ends thereof, and boils upwardly in the evaporator tubes **13** from where it is returned through members **12**, **19**, and **20**, and suction line **21** to the low side of the compressor. Vaporization of the refrigerant in each finger **13** produces a low temperature causing the finger to withdraw heat from the surrounding water to form a jacket of ice around the submerged portion of the element.

It is important to note the size and function of the tubes **15**. The primary purpose of these tubes is to feed the refrigerant to the various evaporators **13**. It is found, however, that effective distribution can only be accomplished if the tubes **15** have very small diametered passageways, such as in a conventional capillary tube, whereby only such small amounts of the refrigerant are allowed to escape from the distributors **11** as to retain the refrigerant under pressure in the distributors and as it passes into the upper end of each feeder tube. It must be remembered that the pressure is only partially reduced by the valve **26**. Accordingly, the pipes **11**, **16**, and **17** jointly form a chamber in which the refrigerant is held under considerable pressure and the only escape from which is through the tubes **15**. Pressure reduction takes place as the liquid passes downwardly through the tube **15**, the pressure from above operating to force the liquid downwardly so as to actually blow the liquid out the dis-

charge end of the tube and against the end **14** of the evaporator.

The importance of forcing the refrigerant downwardly through the capillary tube by pressure from above will now be discussed. It is well known that compression type refrigerants carry with them a refrigerant oil which, upon vaporization of the refrigerant, separates therefrom and settles at the bottom of the evaporator. This is clearly recognized in Patent No. 990,590, issued April 25, 1911, to W. T. Ray at page 1, lines 105 to 112. There the patentee provides for disconnecting the evaporators in an anhydrous ammonia coil in order that they might be inverted and emptied of the refrigerant oil or weak liquid which has settled in the bottom. In my invention this refrigerant oil would tend to collect in the bottom of the fingers **13**, eventually blocking the ends of the feeder tubes **15** with resultant stoppage of or unequal distribution of the refrigerant flow to the various fingers. It is found that by forcing the refrigerant down through the feeder tubes as I do, rather than merely allowing it to descend by gravity, it jets out the discharge end of the tube with such force as to blow any separating oil upwardly into the outlet pipe **12** and so prevents its settling in the bottom of the finger. Accordingly, the capillary tubes **15** are believed to feed the refrigerant to the evaporators in a novel manner. Furthermore, because of the limited length of these tubes, they are not restrictive to the flow of hot gas admitted to the tubes during the thawing operation to be described.

In use the coil is preferably mounted in an insulation packed housing such as **27** with the fingers **13** depending downwardly therefrom. The housing is then supported as by a jack **28** over an open top tank or tanks of water **29** with the lower end portions of the fingers submerged in the water. The refrigeration cycle is then made operative for a predetermined length of time causing the water surrounding the fingers to freeze in the form of jackets **30** around the ends of the fingers. When the jackets have reached the desired size the housing **27** is raised as by extension of the jack **28**. A valve **31** on line **32**, which connects high side line **23** with pipe **17**, is then opened and the hot gas is allowed to flow into the coil and through tubes **15** heating the fingers to release their jackets. The tanks **29** may be provided with hinged deflectors **33** which are raised with the housing to an inclined position under the fingers as by cables **34**

which deflect the jackets, as they fall, into a suitable receiver. The housing may then be lowered to repeat the operation.

My improved means of supplying the refrigerant to the many evaporator fingers insures equal distribution of the refrigerant to all fingers with resultant uniformity in the size of the ice jackets. Furthermore, the relative arrangement of the various tubes and pipes allows a maximum number of jackets to be made by the coil at a minimum coil construction cost. I have accordingly provided a device which economically and effectively carries out the aforementioned objectives.

It is understood that suitable modifications may be made in the structure as disclosed, provided such modifications come within the spirit and scope of the appended claim. Having now therefore fully illustrated and described my invention, what I claim to be new and desire to protect by Letters Patent is:

A device for manufacturing a plurality of small particles of ice comprising a refrigerant supply source having a feed line and a return line, and a refrigerant carrying coil adapted to be mounted over a body of water and manufacture small ice particles from the water, said coil comprising a distributor pipe connected to said feed line, means for supporting said pipe horizontally over the water, an evaporator outlet pipe disposed above and parallel to the distributor pipe, a plurality of hollow evaporator fingers connecting with the outlet pipe and depending therefrom on both sides of the distributor pipe with the lower end portions of the fingers hanging in the water, and individual feeder tubes extending from the distributor pipe one into each evaporator finger through a side wall thereof and downwardly therein to carry refrigerant to the lower portion of the finger for freezing the water around the finger.

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