Jan. 16, 1934. A. H. BAER 1,944,056

COOLER FOR LIQUIDS

Filed Feb. 24, 1933 2 Sheets-Sheet 1

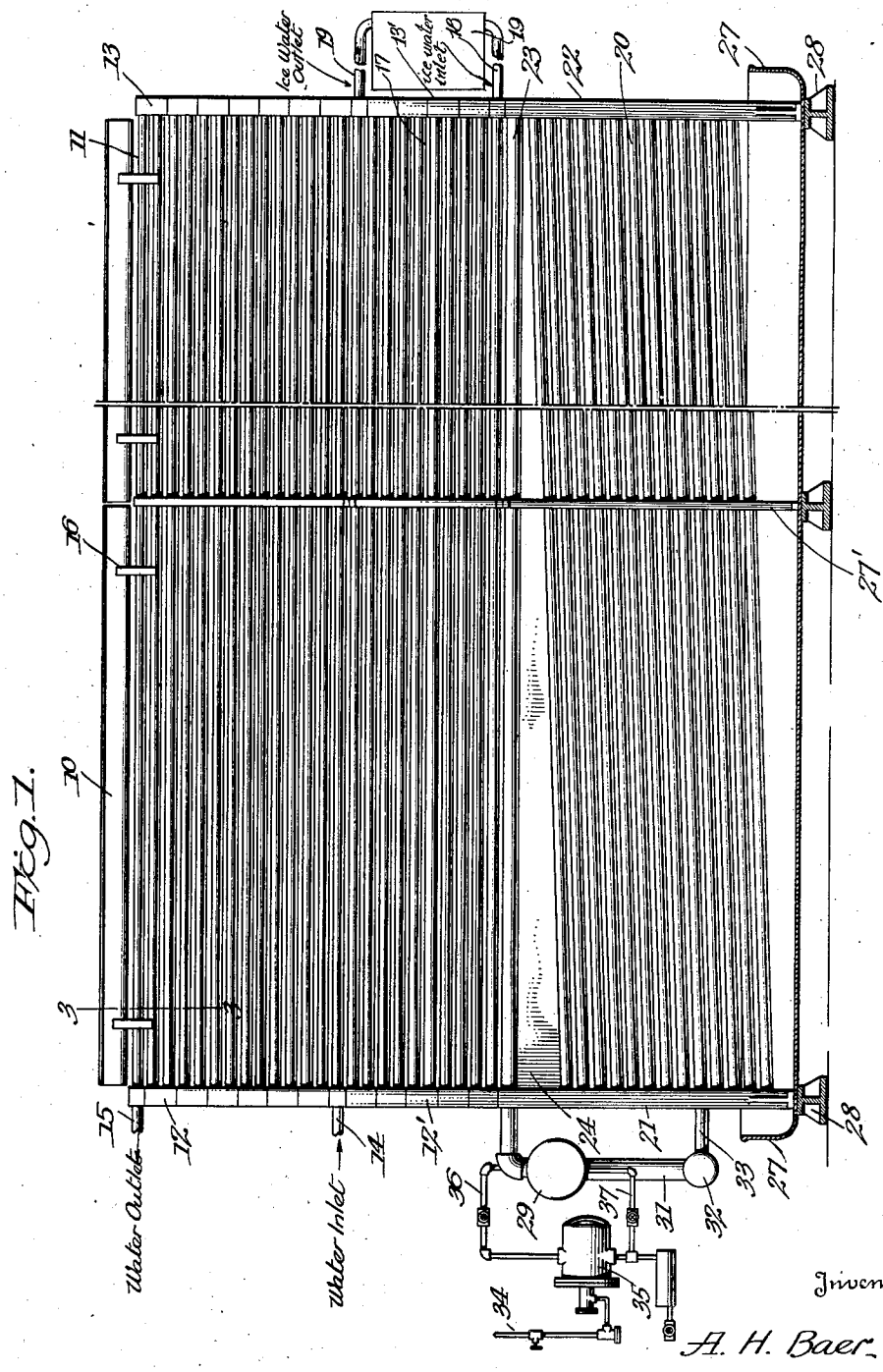


Fig. 1.

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Fig. 2.

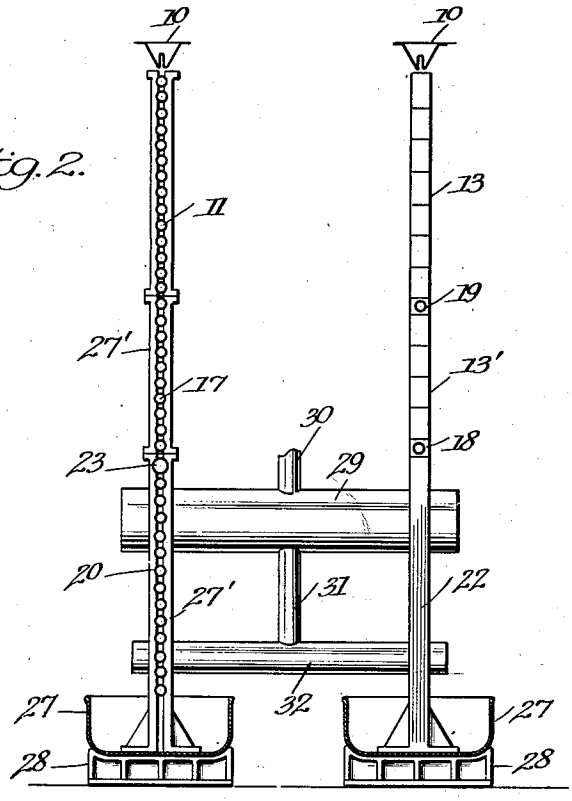
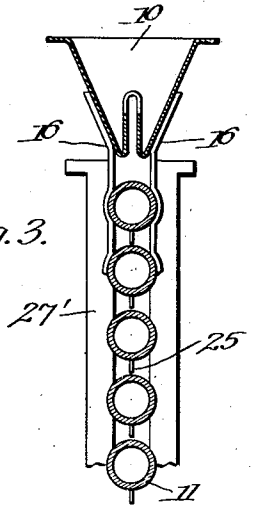


Fig. 3.



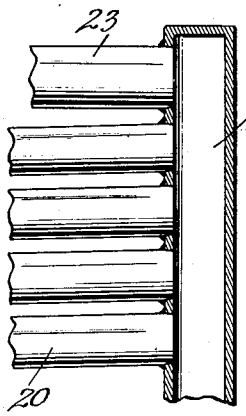


Fig. 4.

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UNITED STATES PATENT OFFICE

1,944,056

COOLER FOR LIQUIDS

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Application February 24, 1933. Serial No. 658,425

8 Claims. (Cl. 62—141)

My invention relates to an improved cooler for liquids, intended particularly for cooling beer wort before fermentation, but also suitable for cooling any other desired liquid. It is an object of my invention to provide improved cooling means for cooling a liquid in successive steps in a continuous operation.

Another object of the invention is to provide cooling means utilizing a volatile liquid refrigerant, such cooling means being so constructed and arranged as to promote active circulation as a result of the boiling of the refrigerant, thus increasing the efficiency of the mechanism.

Another object of the invention is to provide a mechanism whereby it is possible to store refrigerating capacity in advance for use during relatively short operating periods, whereby it is possible to operate the cooling mechanism efficiently with refrigerating machinery which is of smaller maximum capacity than has heretofore been required, thus reducing the original cost of refrigerating machinery as well as upkeep and other expenses. This feature is of value also in case of a sudden breakdown of the refrigerating plant, since the cooling operation can be continued with the stored refrigerant instead of shutting down the cooling means.

Referring to the drawings, which are made a part of this application and in which similar reference characters indicate similar parts:

Fig. 1 is a side elevation of one unit of my improved cooler,

Fig. 2, a figure partly in section, showing at the right hand side an end view of the mechanism of Fig. 1, looking toward the left, and at the left hand side showing a section of the unit, such section being taken at the right of a center support hereinafter described,

Fig. 3, an enlarged vertical section on line 3—3 of Fig. 1, looking toward the right, and

Fig. 4, a horizontal section of a portion of an ammonia header.

In the drawings, reference character 10 indicates a distributing trough of known type from which liquid, such as beer wort, flows down over the pipes of a unit which trough may be in one or more sections. Said pipes are arranged in three sections, the pipes 11 of the uppermost section being parallel horizontal pipes supported at their ends by rectangular end sections 12 and 13. These pipes are preferably connected by return bends in known manner and water is supplied to the series at the water inlet marked 14, the water passing upward from one pipe to the next and finally to the water outlet shown at 15. It is intended that this water may be supplied from a cooling tower or spray pond, a hydrant, a deep well or running stream or any other of the usual sources at what may be called source temperature. Obviously the actual temperature may vary considerably according to the source, a larger or smaller quantity being circulated according to the height of the temperature. The distributing trough is supported from the upper pipes of this uppermost section by means of brackets such as shown at 16 or in any other suitable or conventional manner.

An intermediate section comprises a series of pipes 17 which are also horizontal and parallel and are connected at their ends to the rectangular end sections 12' and 13', these pipes being also preferably connected by return bends whereby liquid entering at 18 may pass through all the pipes of the intermediate section, leaving the same at 19. The return bends of the uppermost and intermediate sections are so formed that one may rest immediately upon the next below, while the intermediate section rests immediately upon a lower section hereinafter described. The intermediate section is intended for the use of ice water, brine, or other suitable liquid which can be precooled by the main refrigerating plant the means for this purpose being indicated at 19'. In this way it is possible to store refrigerating capacity in advance in large amount, the liquid being precooled during the off peak period when no beer cooling (or cooling of other liquid) is being done by the unit. The ordinary refrigerating load in a brewery is a great deal larger during the three or four hours used in wort cooling than at any other time in the day and the maximum capacity of the refrigerating plant must be equal to this load. By storing precooled liquid the maximum plant capacity can be reduced, and such reserve as is still available beyond the normal refrigerating load which exists between the wort cooling periods is used to accomplish the precooling.

The lower section of the cooler comprises pipes 20 which are preferably parallel to one another but which are inclined upwardly from a header 21 to a header 22. The header 21 is an intake manifold common to all the pipes. This intake manifold is also preferably of rectangular cross-section, similar to the end section 12 but the pipes are welded to it and to the outlet manifold 22 in the manner illustrated in Fig. 4, outlet manifold 22 being also preferably of rectangular cross-section, similar to end section 13.

At its upper end the outlet manifold 22 has

connected thereto a return pipe 23. This return pipe has a relatively wide drip strip 24 for conducting the liquid which is being cooled down to the next pipe and the other pipes of the three sections are preferably provided with narrow drip strips 25 such as shown in Fig. 3. An intermediate support is indicated at 27', this being of ordinary notched type and fitting about the pipes, to which it is held by clamping bolts in usual manner. All the parts are made of non-corrosive material, such as galvanized or tinned steel and their arrangement is such as to permit of thorough cleaning after each beer cooling period. This is also true of the catch pan 27 for each unit, which is supported by feet 28 and in which the units stand, as illustrated in Fig. 2.

In the operation of the more or less similar devices heretofore used for cooling beer wort and the like, difficulty has been encountered in the operation of the section for volatile refrigerant, such as ammonia, wherein there was frequently a violent boiling of the refrigerant and a surging of much liquid mixed with the evolved gas or vapor back to the compressors in the main refrigerating plant. When in this condition the mixture of liquid and gas is very troublesome to handle. In order to avoid these troubles I have combined with the inclined group of pipes in the lowermost section, each connected to a common inlet manifold and a common outlet manifold, which outlet manifold is connected to a common large return pipe 23, a surge drum 29. The inclined relation of the pipes 20 promotes the circulation of the refrigerant mixture of gas and liquid back through the return pipe 23 to the surge drum. In this drum the gas is separated from the liquid, the gas passing off through a pipe 30 to the refrigerant compressors and the liquid passing down through a pipe 31 to a feed header 32 connected, as by branch pipes 33, to the intake manifolds 21 of the various units. For replenishing the supply of ammonia in the lowermost sections of the various units there is connected to the surge drum an ammonia inlet pipe 34 leading to a float-controlled valve 35 from which pipes 36 and 37 lead to the surge drum 29.

The upwardly inclined pipes in the lower section with a common vertical header for all of them at each end, a common outlet pipe for gas and liquid from the upper part of the outlet header to the accumulator and a return for the separated liquid to flow from the accumulator down to the lower part of the inlet header, gives a good control of the boiling liquid, while, at the same time, it allows a very active boiling of the liquid and surging of gas and liquid mixed as it forms in each pipe, which action of itself increases the heat absorbing rate of the pipes. The active boiling and surging, of course, will carry an increased quantity of mixed liquid and gas from the outlet header through the common outlet pipe, back to the accumulator, where it is separated. This controls the operation and prevents liquid from flowing to the compressors, in a troublesome quantity. It provides a liquid cooler section that is self-circulating and self-controlling, when combined with the usual accumulator and trap.

I have shown the float-controlled feed valve at the left of the cooler adjacent the intake header, but it will be understood that the accumulator and float-controlled feed valve for additional refrigerant supply might be conveniently placed at the opposite end of the cooler, near the vertical common outlet header for the inclined pipes. In that case, the liquid outlet from the accumulator would carry the liquid supply underneath the cooler to the common vertical inlet header at the opposite end.

It will be seen from the foregoing that the construction embodying the intermediate cooling section will level out the total refrigerating demands of any brewery or analogous plant wherein liquid is cooled intermittently and also will reduce the maximum size of refrigerating plant required. This is also of great convenience in case of a break down in a refrigerating plant during the wort cooling period or during any period of maximum or heavy load. The whole arrangement tends to economy in that a greater amount of work can be done with fewer cooling units, and it makes for efficiency in that the operation is smoother and more uniform and continuous.

It will be obvious to those skilled in the art that many variations can be made in the mechanism illustrated in the drawings and described in the specification, all without departing from the spirit of the invention, for example, supplementary refrigerating units operating at higher evaporating temperatures and this with greater efficiency may be used to cool the intermediate section, such units being operated only during the wort cooling period or multiple effect compressors suited to operate at two temperatures during the wort cooling period or during the full time may be used. A multiple suction or duel suction compressor may be used for precooling brine or other fluid for the middle section of a higher temperature than the fluid for the lowermost section, or it could be used for circulating the regular volatile refrigerant through the middle section of the cooler at a higher temperature than in the lowest section; therefore I do not limit myself to what is shown in the drawings and described in the specification but only as indicated in the appended claims.

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

1. In a cooler for liquids, a distributing trough, a series of pipes arranged to have the liquid from the trough flow successively over them, said series comprising a lower section supplied with volatile refrigerant, an intermediate section supplied with intermediately cooled liquid, an upper section supplied with liquid at a higher temperature, the pipes of the lowermost section being inclined upwardly from the inlet end toward the outlet, and means individually connected to said pipes of the lowermost section for receiving the refrigerant therefrom and for separating the liquid from the gas.

2. A device as in claim 1, including means for returning the liquid refrigerant from the separating means to the lower section of pipes.

3. In a cooler for liquids, a distributing trough, a series of pipes arranged to have a liquid from the trough flow successively over them, said series comprising a lower section supplied with a volatile refrigerant, an intermediate section supplied with liquid at an intermediate temperature, an upper section supplied with liquid at a higher temperature, common means for receiving the discharge from said lower section of pipes, a surge drum communicating with said discharge-receiving means, a return pipe for gas connected to said surge drum, and means for returning liquid refrigerant from said surge drum to the pipes of said lower section.

4. A method of cooling beer wort and the like where the load is irregular comprising bringing the wort or other liquid successively into contact with liquid current cooled instrumentalities in at least three steps, the liquid current for the first step being at approximately source temperature, that for the second step being precooled and that for the third step being a highly volatile refrigerant, precooling liquid for the second step between peak loads only, and storing the precooled liquid.

5. In a cooler for liquids, a distributing trough, a series of pipes arranged to have the liquid from the trough flow successively over them, said series comprising a lower section supplied with a volatile refrigerant, an intermediate section supplied with liquid at an intermediate temperature, an upper section supplied with liquid at a higher temperature, and means connected to the intermediate section for pre-cooling between peak loads the liquid used therein.

6. In a cooler for liquids, comprising a distributing trough and a series of pipes arranged for the liquid to flow successively over them, the combination of one or more upper sections, using liquid cooling means with a lower section using volatile refrigerant for cooling, in which the refrigerant flows through upwardly inclined passages from an inlet chamber common to all passages to an outlet chamber common to all passages, then through one or more horizontal passages to a chamber where liquid and gas refrigerant are separated, then to the common supply chamber.

7. In a liquid cooler, a lower section using a volatile refrigerant, said section comprising a vertical series of inclined pipes, common inlet and outlet headers connected respectively to the lower and higher ends of the pipes in said series, means for separating gas and liquid refrigerant, a substantially horizontal passage leading from said outlet header to said separating means, one or more sections above said lower section, each upper section comprising a series of pipes supplied with cooling liquid at a higher temperature than in the lower section, and a distributing device for supplying liquid to be cooled, the sections of pipes being so arranged that the liquid to be cooled flows successively over the pipes of the upper and lower sections, substantially as set forth.

8. In a liquid cooler, a lower section using a volatile refrigerant, said sections comprising a vertical series of inclined pipes, a common inlet header connected to the lower ends of said pipes, a common outlet header connected to their higher ends, a gas and liquid separator, a passage leading from the outlet header to said separator, a passage leading from the separator to the bottom of the inlet header, one or more upper sections each comprising a plurality of pipes arranged in series above said lower section, and a distributing device arranged to supply liquid to be cooled, such liquid flowing successively over the upper and lower pipes in said sections whereby it is progressively cooled.

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