Aug. 27, 1935. F. E. HUBBS 2,012,910

CONDENSER FOR REFRIGERATING SYSTEMS

Filed March 27, 1935 3 Sheets-Sheet 1

Fig. 1.

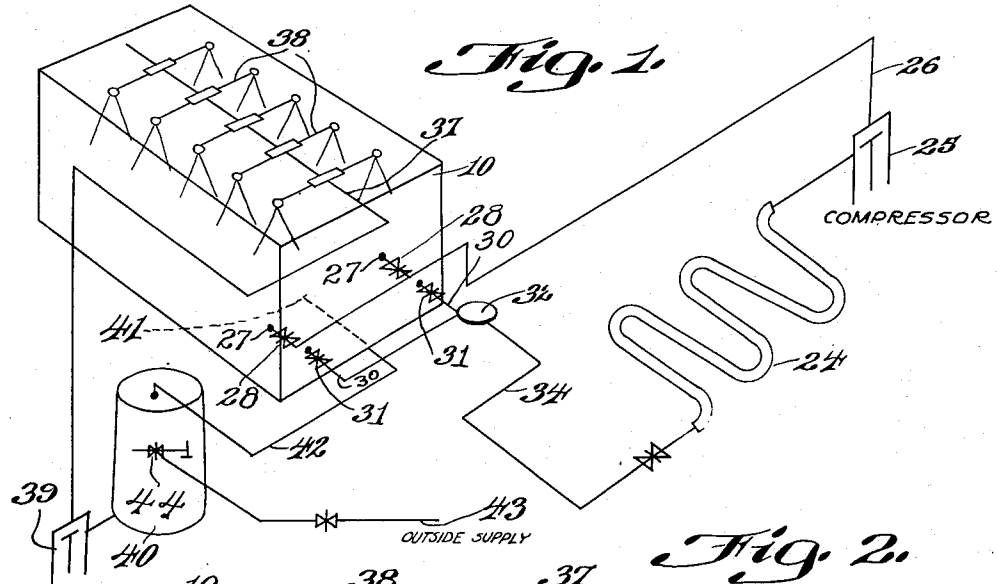
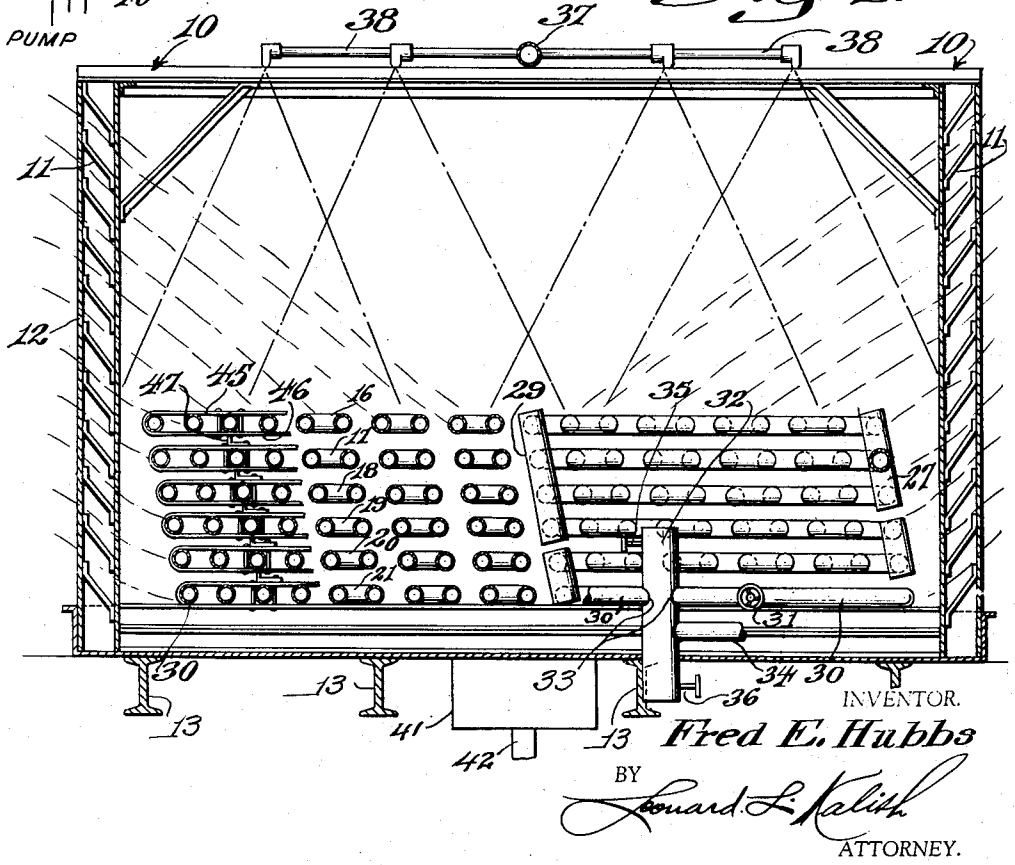



Fig. 2.




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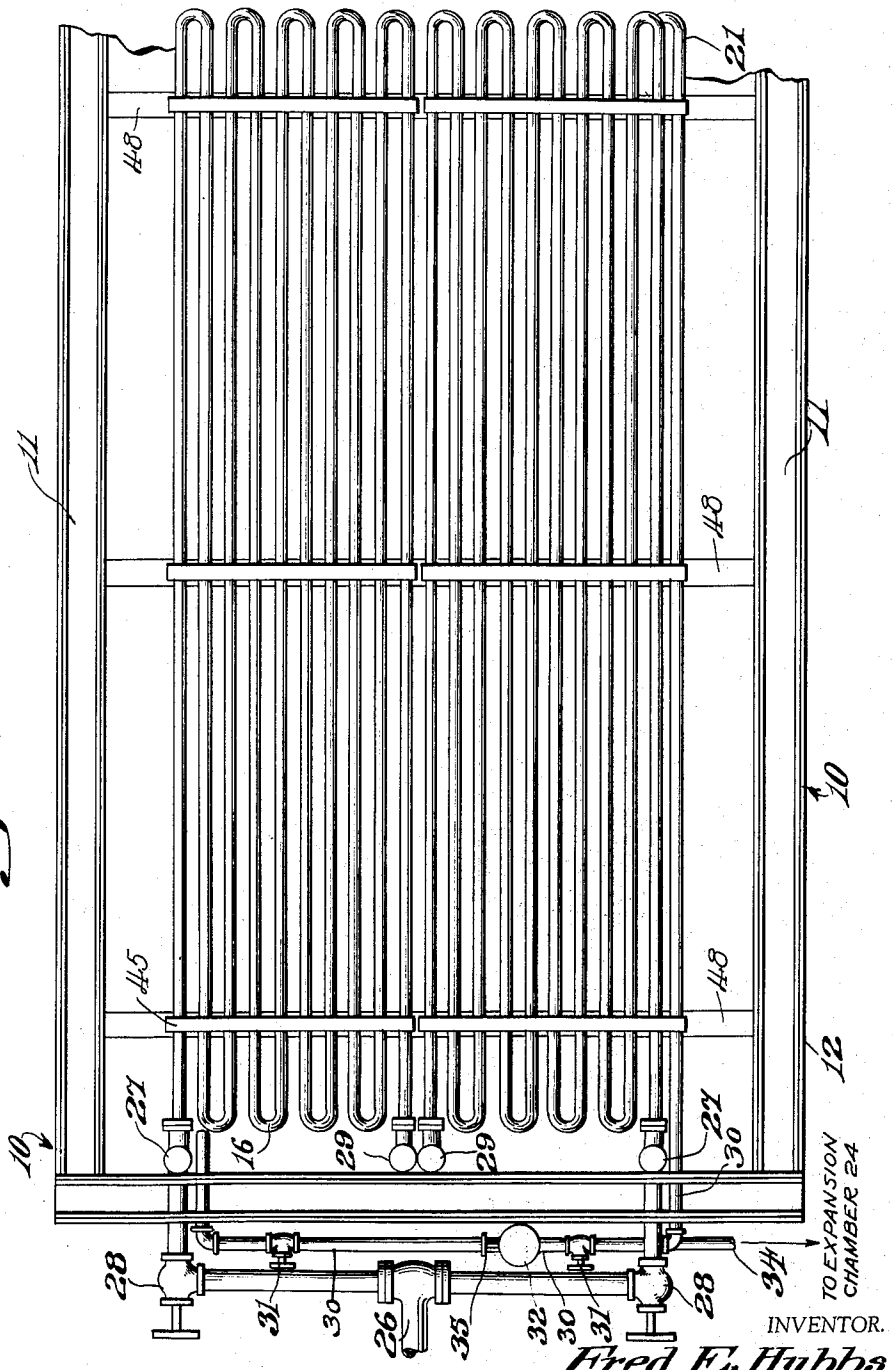



Fig. 3.

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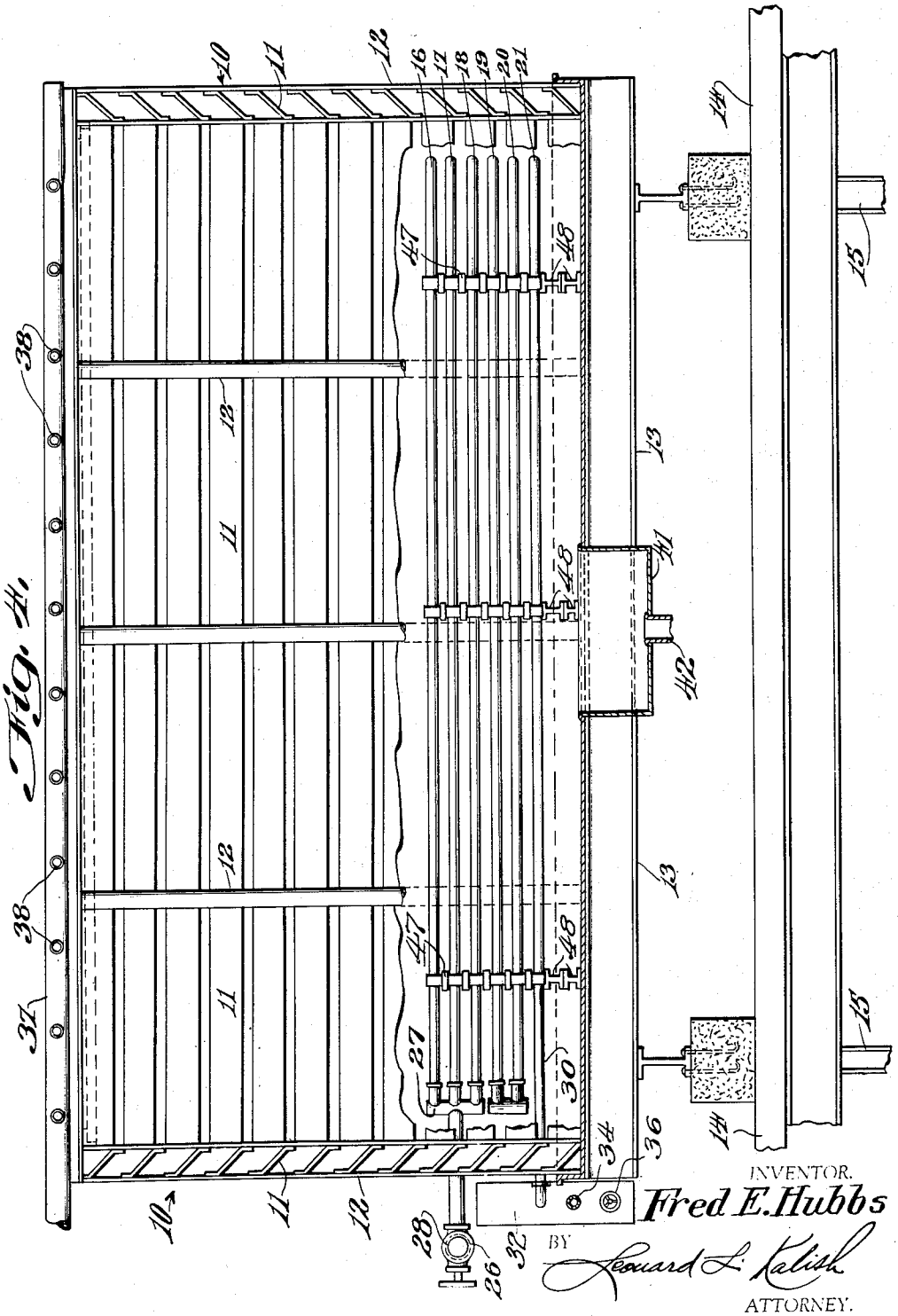



Fig. 4.

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# UNITED STATES PATENT OFFICE

2,012,910

## CONDENSER FOR REFRIGERATING SYSTEMS

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Application March 27, 1935, Serial No. 13,319

8 Claims. (Cl. 257—37)

The present invention relates to certain new and useful improvements in refrigerating systems whereby the cost of the refrigerating system may be materially decreased and whereby the head pressures or condensing temperature of the refrigerant may be materially reduced with a resultant saving of power and an increase in the capacity of the system.

The present invention consists of certain novel cooling and condensing means for the refrigerant including certain novel features of construction in such cooler and condenser means, whereby the above mentioned objects are attained.

The present invention further consists of other novel features of construction, all of which will appear more fully from the following detailed description.

For the purpose of illustrating the invention, there is shown in the accompanying drawings one form thereof which is at present preferred, since the same has been found in practice to give satisfactory and reliable results, although it is to be understood that the various instrumentalities of which the invention consists can be variously arranged and organized and that the invention is not limited to the precise arrangement and organization of the instrumentalities as herein shown and described.

Referring to the drawings in which like reference characters indicate like parts:

Figure 1 represents a more or less schematic perspective view of the refrigerating system embodying the present invention.

Figure 2 represents a vertical transverse cross-sectional view of the refrigerant cooling and condensing means.

Figure 3 represents a top plan view of the same.

Figure 4 represents a side elevational view of the same partly in section.

It has been the practice heretofore in refrigerating systems to cool and condense the compressed refrigerant delivered by the compressors or other equivalent or corresponding means, by a supply of water which is previously reduced to the desired temperature by spraying through a cooling tower or the like;—the water from the refrigerant condenser coils or chambers being again returned to be re-cooled and then reused in the refrigerant condensing coils or chambers.

So too, it has been the practice to effect a cooling of this water either by natural draft or by forced draft, and the cooling of the water has also been effected either by spraying or by permitting the water to fall down and to pass over successive more or less horizontal trays or platforms or baffles.

According to the present invention, the cooling and condensing of the refrigerant is effected not so much by virtue of any pre-cooling of the water, but is effected essentially by spraying the water directly against the outer surfaces of the refrigerant condenser with sufficient impact to break up the water jets on such condenser surfaces into fine particles to a very fine film of water around the condenser surfaces and at the same time prevent the formation of any of the slimy or jelly-like sediment or incrustation which is so common in all open water systems. Simultaneously with this, a natural draft of air is caused to flow over and between the pipes of the refrigerant-condenser coils causing an evaporation of some of the fine particles or fine layer of water directly off the refrigerant condenser surfaces so that a more or less direct action of the air upon the condenser surfaces is obtained through the evaporation of the water from such surfaces producing what may be fairly called a "wet bulb" effect.

According to the present invention, any suitable open housing or shell 10 may be provided at any suitably exposed location, as for instance, upon a roof or upon a suitable tower or in any other suitable exposed position where it may have the advantage of free access of air. The four sides of the housing 10 are preferably formed with inclined louvers 11 which are inclined downwardly in an inward direction;—these louvers being suitably supported in spaced relation to each other upon suitable upright supporting members 12 which may be of any conventional construction.

The housing may be supported upon any suitable horizontal supporting structure such as the beams 13, roof 14, and/or columns 15 depending more or less on the installation in each case. Within the four louvered "walls" of the housing and generally at the bottom thereof, a suitable number of superimposed and somewhat offset condenser coils 16, 17, 18, 19, 20 and 21 are provided, each condenser coil being bent back upon itself in a horizontal row a sufficient number of times and preferably so arranged that its inlet and outlet are at the same end of the coil. In the particular embodiment of the invention shown, two similar stacks of condenser coils are shown side by side for greater capacity, although it is to be understood that a single stack may be employed, or two or three stacks may be provided side by side and in "parallel" with each other and independently "valved" so that one or more may be rendered inoperative at will without affecting the operation of the other. The parallel lines of each coil are generally equidistantly spaced with respect to each other, and each successive coil of each "stack" is offset in a direction generally transversely of the pipes by a fraction of the distance between successive pipes of the coil, so that the pipes of the uppermost coil will be spaced above and generally intermediate the successive pipes of the lowermost coil, as indicated particularly in Figure 2.

It will be understood, that while the coils 16,

17, 18, 19, 20 and 21 are generally referred to as "condenser" coils, or "condenser" passageways, or "refrigerant-condensing" passageways, there may be some refrigerants which under some conditions may not actually "condense" to the liquid form, but which give up their heat without going into a liquid state. This may be the case on extremely hot and humid days with refrigerating systems using carbon dioxide gas as the refrigerant. Hence, wherever the term "condenser" or the term "condenser coils" or "condenser passageways" is used, as for instance in the claims, it is intended to apply to the same structure even though the refrigerant in some instances may be cooled without actual condensation to the liquid state. Hence, the term "cooling" coils or "refrigerant-cooling" passageways might be a more accurate statement, but the term "condenser" is used as this term is the more accepted term in the art.

The expanded refrigerant from the expansion chamber 24 of the refrigerating system is compressed by any suitable compressor 25 and from the compressor it is delivered through suitable pipe lines 26 to an inlet manifold 27 (through suitable control valves 28 to the inlet ends of two or more of the uppermost condenser coils, as for instance, the condenser coils 16, 17 and 18, whereby these uppermost condenser coils are connected in parallel with each other. The outlets of these three uppermost condenser coils are connected through manifolds 29 to the next lower condenser coil, as for instance, the condenser coil 19 which is then connected in "series" with the next succeeding condenser coils 20 and 21 so that the condensed refrigerant is finally discharged from the condenser stacks through the single outlets 30 from where it is delivered through suitable valves 31 into an upright separator chamber 32, the inlets 33 of which are spaced substantially from its upper and lower ends and the outlet 34 of which is somewhat beneath the inlets 33 but somewhat above its bottom. The top of the separator chamber 32 is provided with a valve opening 35 at its top for periodically drawing off the non-condensible gases which develop in the system and with a lower valve opening 36 through which the relatively non-volatile liquids such as oil and other matter may be drawn off periodically and thus removed from the system. From the outlet 34, the condensed refrigerant is returned to the expansion chamber 24 of the refrigerating system through a suitable valve and/or other refrigerant controlling means.

At the top of the louvered housing 10, one or more outer headers 37 are provided, from which spray pipes 38 extend, having suitable spray openings or nozzles or outlets directed generally downwardly at a suitable variety of angles so as to project fine jets of water downwardly against the stacks of condenser coils 16 to 21 inclusive. The water is supplied to the headers 37 and the spray pipes 38 by means of any suitable power-driven pump 39 from either a closed or open reservoir 40 preferably at a level beneath the lowermost level of the louvered housing and below the level of the condenser stacks. The water remaining after the evaporation on the surface of the condenser pipes is gathered in a suitable sump 41 at the bottom of the louvered housing from where it is delivered, by gravity, through suitable pipes 42 to the reservoir 40. From an outside water supply water is conducted to the reservoir 40 through a pipe 43 having a float-controlled valve 44 of any conventional type, whereby the water level in the reservoir 40 will be maintained more or less constant by the automatic addition thereto of the necessary quantity of water from the outside source of supply through the said float-controlled valve 44. This outside source may be any source of water such as city water, etc.

By offsetting the successive condenser coils or the successive layers of condenser pipes as indicated particularly in Figure 2, each of the successive layers of pipes is exposed to the water jets, so that each pipe may receive the direct impact from some of the water jets instead of relying on drippings from the upper pipes for its supply of water. By this means, not only is a fine dispersion of water produced over the surface of each and every condenser pipe, but each and every condenser pipe is also automatically kept free of the slimy or jelly-like incrustation which is otherwise generally formed on condenser surfaces, and thereby the full "evaporative" effect on the condenser coil surface is realized.

It is also to be understood that where reference is made to the location of the condenser coils as being in the "lower" part of the housing, its location is referred principally to the water jet projecting means 38 and 37. Thus, the condenser coils or passageways are in the lower part of the housing relative to the water projecting means. Needless to say, if desired the housing may be extended further down than is shown in the accompanying drawings without departing from the present invention. Such downward extension of the housing below the condenser coils or passageways to an extent greater that what is shown in the accompanying drawings may or may not have some advantage or disadvantage. It is therefore to be understood that the term "lower" is used herein relative to the water projecting means.

Each condenser coil is preferably bound between pairs of opposite metallic straps or bands 45 and 46 with suitable bolts connecting the two at suitable intervals intermediate the pipes. To support the successive condenser coils in spaced relation to each other, two or more angle irons 47 are strapped to each coil as indicated particularly in Figure 2;—the lower straps of the upper condenser coil resting upon the horizontal edges of the angle iron fastened to the lower condenser coil. The stacks of condenser coils may rest upon transverse I-beams 48 or other suitable supporting members extending transversely of the coils, and preferably directly beneath the lowermost strips as indicated particularly in Figures 4 and 2;—these beams 48 extending transversely of the several main I-beams 13 which form the bottom supporting structure of the tower and upon which the bottom plate of the tower also rests. These structural details or features of construction may be varied however.

The invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and it is therefore desired that the present embodiment be considered in all respects as illustrative and not restrictive, reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

Having thus described the invention, what is hereby claimed as new and desired to be secured by Letters Patent, is:

1. In a refrigerating system of the general character stated, refrigerant condensing means comprising a generally upright louvered housing

open on the sides for access of air, condenser passageways superimposed upon each other in the lower part of said housing in generally offset relation to each other, means associated with said housing and above said condenser passageways for projecting a multiplicity of water jets downwardly directly onto the outer surfaces of said condenser passageways, and means for gathering the water beneath said condenser passageways and for returning the same to said water projecting means; whereby the refrigerant within said condenser passageways will be cooled by the direct evaporation of water from the outer surfaces of said condenser passageways.

2. In a refrigerating system of the general character stated, refrigerant condensing means comprising a generally upright housing open on the sides for free access of air, a multiplicity of condenser coils superimposed upon each other in the lower part of said housing in generally offset relation to each other, means associated with said housing and above said condenser coils for projecting a multiplicity of water jets downwardly directly onto the outer surfaces of said condenser coils, and means for gathering the water beneath said condenser coils and for returning the same to said water projecting means; whereby the refrigerant within said condenser coils will be cooled by the direct evaporation of water from the outer surfaces of said condenser coils, and whereby the outer evaporative surfaces of said condenser coils will be kept generally free of foreign matter.

3. In a refrigerating system of the general character stated, refrigerant condensing means comprising a generally upright louvered housing open on the sides for access of air, condenser passageways superimposed upon each other in the lower part of said housing in generally offset relation to each other, a separator chamber connected to the outlet of said condenser, means associated with said housing and above said condenser passageways for projecting a multiplicity of water jets downwardly directly onto the outer surfaces of said condenser passageways, and means for gathering the water beneath said condenser passageways and for returning the same to said water projecting means; whereby the refrigerant within said condenser passageways will be cooled by the direct evaporation of water from the outer surfaces of said condenser passageways.

4. Refrigerant condensing means for refrigerating systems comprising a generally upright housing open on the sides for free access of air, a plurality of generally horizontal condenser coils vertically superimposed upon each other in the lower part of said housing, means associated with said housing and above said condenser coils for projecting a multiplicity of water jets downwardly directly onto said plurality of condenser coils, means beneath the lowermost of said condenser coils for gathering the water, means for returning the water to said water projecting means, and means for directing the air passing through the walls of said housing from outside to the inside in a generally downward direction towards said condenser coils; whereby the refrigerant within said condenser coils may be cooled by the direct evaporation of water from the outer surfaces thereof.

5. Refrigerant condensing means for refrigerating systems comprising a generally upright housing open on the sides for free access of air, a plurality of generally horizontal condenser coils vertically superimposed upon each other in the lower part of said housing, each condenser coil being confined between pairs of opposite retainer members tending to hold the several parts of the coil in alignment in generally the same plane, and spacer members fastened to said coils adapted to space the successive coils above each other and for supporting each coil above the other, means associated with said housing and above said condenser coils for projecting a multiplicity of water jets downwardly directly onto said plurality of condenser coils, means beneath the lowermost of said condenser coils for gathering the water, means for returning the water to said water projecting means, and means for directing the air passing through the walls of said housing from outside to the inside in a generally downward direction towards said condenser coils; whereby the refrigerant within said condenser coils may be cooled by the direct evaporation of water from the outer surfaces thereof.

6. In a refrigerating system of the general character stated, refrigerant condensing means comprising a generally upright louvered housing open on the sides for access of air, condenser passageways superimposed upon each other in the lower part of said housing, means associated with said housing and above said condenser passageways for projecting a multiplicity of water jets downwardly directly onto the outer surfaces of said condenser passageways, and means for gathering the water beneath said condenser passageways and for returning the same to said water projecting means; whereby the refrigerant within said condenser passageways will be cooled by the direct evaporation of water from the outer surfaces of said condenser passageways.

7. Refrigerant condensing means for refrigerating systems comprising a generally upright housing open for free access of air, a plurality of superimposed condenser coils in the lower part of said housing, means associated with said housing and above said condenser coils for projecting a multiplicity of water jets downwardly directly onto said condenser coils, means beneath the lowermost of said condenser coils for gathering the water, means for returning the water to said water projecting means, and means for directing the air passing through said housing in a direction generally towards said condenser coils; whereby the refrigerant within said condenser coils may be cooled by the direct evaporation of water from the outer surfaces thereof.

8. In a refrigeration system, refrigerant-cooling means comprising a generally upright housing, refrigerant-cooling passageways in the lower part of said housing, means associated with said housing and above said refrigerant-cooling passageways for projecting a multiplicity of water jets downwardly directly onto the outer surfaces of said refrigerant-cooling passageways, means for gathering the water beneath said refrigerant-cooling passageways and for returning the same to said water-projecting means, and means for causing air to flow through said housing and about said refrigerant-cooling passageways; whereby the refrigerant within said refrigerant-cooling passageways may be cooled by the direct evaporation of water from the outer surfaces of said passageways.

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