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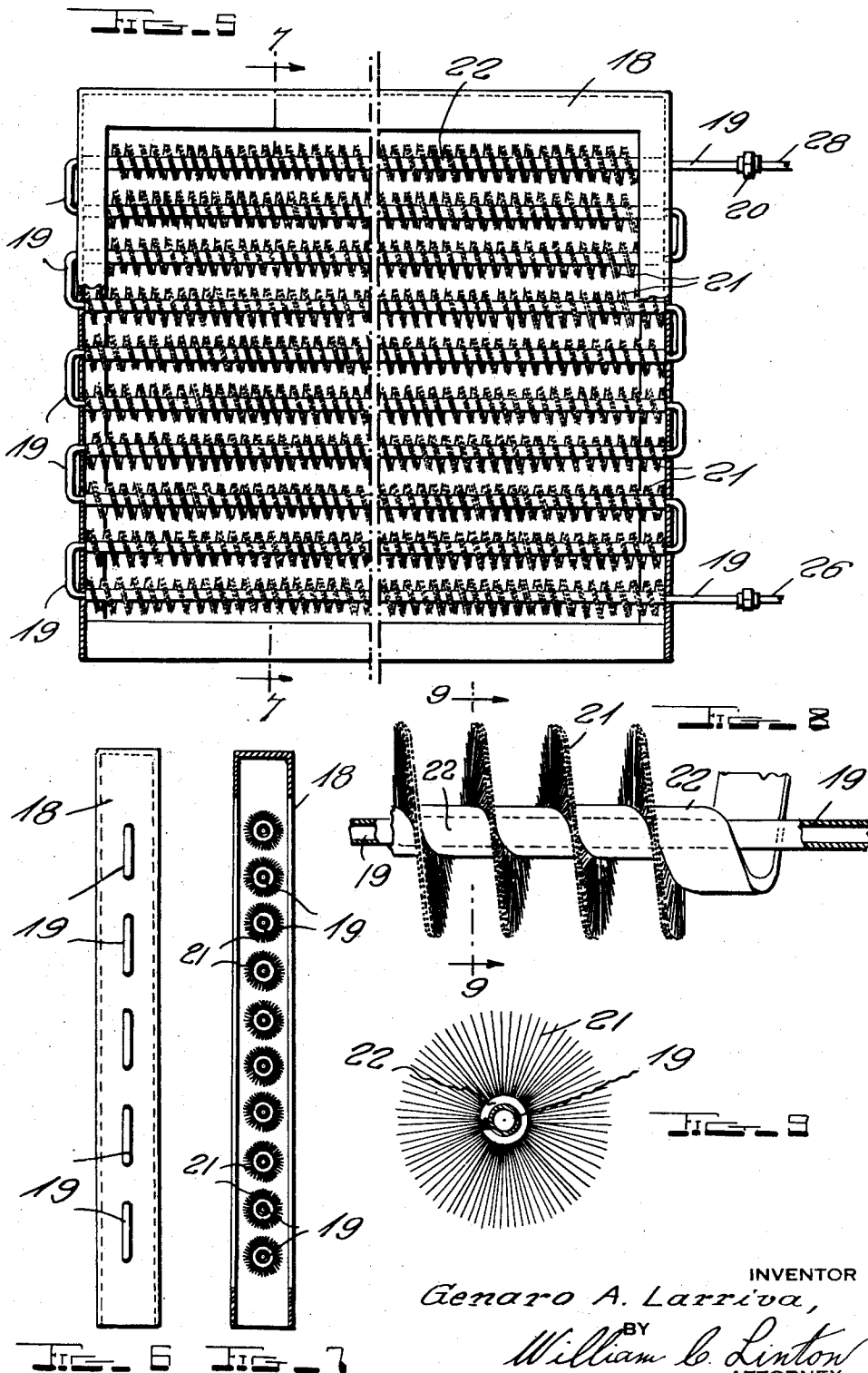
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CONDENSER

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CONDENSER

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4 Claims. (Cl. 257—65)

The present invention relates to condensers and is an improvement in air and water-cooled condensers particularly adaptable for use with refrigerating compressors.

The principal object of the present invention is to provide an economically produced and operated air and water-cooled condenser which can be operated by using a minimum amount of either or both air and water.

A further important object of the present invention is to provide a condenser which considerably increases the refrigerating capacity of refrigerating compressors when used in conjunction therewith and which can be economically produced and installed for use with refrigerating compressors requiring a relatively small amount of power for their operation.

A still further object of the present invention is to provide an improvement in air and water-cooled condensers which have a relatively lower limit of cooling than condensers heretofore known but have all of the advantages inherent in known condensers cooled by evaporation.

It is also an object of the present invention to provide an arrangement which can be readily connected to condensers of existing refrigerating units for increasing the condensing capacity of said condenser and which does not necessarily require additional power for the operation thereof.

Further objects of the present invention will be in part obvious and in part pointed out in the following detailed description of the accompanying drawings.

In the drawings:

Fig. 1 is a cutaway perspective view of the preferred form of condenser according to the present invention.

Fig. 2 is a side cross sectional detail view of the exhaust end portion of the device shown in Fig. 1.

Fig. 3 is a front detail cross sectional view of one of the liquid cooling mats as mounted within the device shown in Fig. 1.

Fig. 4 is a front elevation of one of the liquid cooling mats with the central portion thereof broken away to show interior details.

Fig. 5 is a front elevation of one of the heat exchange mats forming a part of the present invention.

Fig. 6 is a side view of the device shown in Fig. 5.

Fig. 7 is a side cross sectional view taken on line 7—7 of Fig. 5.

Fig. 8 is an enlarged side detail view showing

the arrangement for mounting the cooling wires upon one of the gas pipes as used in the air-cooled mat.

Fig. 9 is a side cross sectional view taken on line 9—9 of Fig. 8.

Referring now more particularly to the accompanying drawings wherein like and corresponding parts are designated by similar reference characters, numeral 1 denotes a condenser casing having a detachable top 2 and a pair of diametrically opposed openings 3, 3', each formed in opposite end walls thereof with inlet opening 3 being shown in Fig. 1 and exhaust opening 3' being shown in Fig. 2. The lower side walls of casing 1, together with the bottom thereof form a liquid sump 4. A series of longitudinally extending bars 5 are connected at each end to two end walls of said casing and positioned above the sump 4 formed by said walls. The upper portion of the side walls of said casing 1 above said bars 5 have mounted thereon and extending vertically thereof a series of parallel rails 7 which extend to the top end of casing 1. Every other pair of said rails 7 has a series of equally spaced and horizontally extending plates 6, with the plates 6 of each pair of alternate rails 7 being grouped into two groups with the plates 6 of each group extending horizontally in line with one another and parallel to the plates of the second group, and the two groups of plates together forming three air passages which extend from the inlet opening 3 to the exhaust opening 3'.

Exhaust opening 3' is connected to an air duct 8 which has mounted therein an air exhaust fan (not shown) and which leads to a point outside of the area in which the air entering the air inlet opening 3 is situated. That is, for example, duct 8 leads to the outside of a room or building while the air to enter inlet 3 is taken from inside of the room or building.

A series of water-cooling mats consisting of a pair of detachable frames 10, each of which has a medium mesh screen 11 extending across the opening formed by said frame 10 and which frames can be detached from one another for permitting a water-absorbing material such as excelsior, that is, wood shavings 12, to be positioned between the screens 11, is detachably mounted within casing 1. Frames 10 have a water trough 13 formed by their top ends and a series of openings 14 extending through the base of said troughs 13 for conveying small streams of water from within said troughs to the moisture-absorbing material 12. The opposite or lower

ends of said frames 10 also have a series of coinciding openings 15 formed therethrough for permitting moisture from material 12 to pass therethrough to within the sump 4 in a lower part of casing 1. Each of these water-cooling mats are dropped into position by sliding the same downwardly, when top 2 is removed, between a pair of rails 7 which do not have plates 6 extending thereacross and said water-cooling mats thereby extend completely across casing 1 with the front face thereof in line with inlet opening 3.

A series of heat exchange units, as best disclosed in Figs. 5, 6 and 7 of the drawings and which are formed within a frame 18, are each likewise slid between a pair of said rails 7, which do not have plates 6 extending thereacross, with the water-cooling mats alternating with the heat exchange units in their relative positions. A pipe 19, which extends backward and forward from one side to the opposite side of said frame 18, as shown, thereby has the major portion thereof positioned within and extending across the central opening formed by said frame 18. Tube 19 is preferably of a heat-conductive material such as a lightweight metal, for example aluminum, but may also be of a corrosion resisting metal like copper, and the portions thereof extending within the central opening of frame 18 have a series of wires 21 in contact therewith and extending substantially at a right angle therefrom and which wires are retained upon said pipe 19 by a band 22, which retains the bent ends of the wires 21 against the pipe 19. Said wires 21 are also preferably of a heat-conductive material, such as aluminum or magnesium, and, likewise, band 22 may be formed from a thin sheet of metal such as aluminum or the like. The upper end of pipe 19 is connected by a coupling 20 to a pipe 28, which conducts the compressed gas from a compressing unit, that is, a refrigerating compressor, for example. The lower end of pipe 19 is connected by a coupling to a pipe 26, which conducts the condensed liquid from the pipe 19 to a storage tank 25 therefor, which is positioned within the sump 4 of casing 1. A pipe 27, having a considerable portion thereof extending back and forth within said sump 4, is connected to the lower portion of tank 25 at one end and to expansion valves and evaporators in the refrigeration system (not shown) before being returned through suction line to said compressing unit at the opposite end thereof for conveying the liquid to the compressor. The height of the liquid within the sump 4 of casing 1 is controlled by a float valve 35 connected to a water supplying conduit 36. The liquid within the sump is conveyed upwardly by an electrically driven water pump 32 with a pipe 34 connecting the pump with said sump and a pipe 30 leading upwardly from the pump and to each of the troughs 13 through an opening formed in the side of casing 1.

In operation, the pipes 27 and 28 are connected to the evaporator and compressor of a refrigerating system (not shown) whereby the refrigerant may be caused to circulate therethrough and also through the pipes or coils 19 of the heat exchange units 18 and the reservoir tank 25. The exhaust fan within duct 8 is placed in operation and, likewise, pump 32 is operated by supplying current to motor 31. Liquid is then drawn by pump 32 from the sump of casing 1 and supplied by pipe 30 to each of the troughs 13, where it is distributed to the excelsior 12 by means of opening 14. Said excelsior is completely damp-

ened by absorbing the water and as air is drawn in and enters the first water-cooling mat 10, as shown by the arrows in Fig. 1, it passes first through screen 11 and through the loosely associated excelsior 12, contacting the moisture upon the surfaces of the various pieces of excelsior, causing the evaporation of the moisture and the consequent cooling thereof and, at the same time, being cooled itself by the evaporation of the water. Any dust, lint or the like within the air will adhere to the damp surface of the excelsior, thereby cleansing the same.

The air, after passing through the first water-cooling mat 10 is divided into three streams, one above the other, by the plates 6 and these three streams pass through the heat exchange unit 18, contacting the wires 21 which have drawn heat from within the pipe 19 by conduction and are cooled by these cooled streams of air. The upper stream of air will contact the upper third portion of pipe 19, while the second or intermediate stream will contact the intermediate third of pipe 19, which is somewhat cooler than the upper third and the lower or third stream of air will contact the lower third portion of pipe 19, which is still cooler than the intermediate third, since the gas under pressure within the pipe 19 is cooled, first by the first stream of air and then upon passing through the intermediate portion of pipe 19, is cooled by the second stream of air and then passes through the lower portion of pipe 19 for being cooled by the third stream of air, after which it is conducted by pipe 26 to tank 25.

The air is conducted in three streams to the second water-cooling mat 10, where it is again cooled to its new and slightly higher established wet-bulb temperature by contacting the liquid upon the excelsior positioned within the second mat. The top stream of air will be hotter than the intermediate and lower stream of air, with the intermediate stream warmer than the lower stream. The liquid passing downwardly through the excelsior 12 will contact the upper or hotter stream of air and cool the same by the evaporation of a portion of the liquid and, at the same time, be cooled itself by the evaporation of a portion thereof. It will next meet the second or intermediate stream of air which is somewhat cooler than the top stream of air and will cool the same and, at the same time, be further cooled by the further evaporation of a portion thereof. The remaining portion of the downwardly moving liquid will be contacted by the lower or third stream of air which is the coolest of the streams of air and will cool the same, at the same time, being further cooled by the further evaporation of a portion thereof. This cooled liquid will then pass from openings 15 downwardly to the sump of casing 1 and the temperature of the water within the sump of casing 1 will be substantially equal to the wet-bulb temperature of the air which enters the opening 3. The three streams of air, after leaving the first of the mats 10, continue first through heat exchange unit 18 and then through a water-cooling mat 10 and alternately cools the gas within each of the pipes 19 and is cooled to its new wet-bulb temperature. After passing through a series of mats 10 and 18, the air enters duct 8 and passes outwardly in such a manner as to not affect the wet-bulb temperature of the air to enter opening 3.

The condensed gases, which have been cooled in pipes 19 and which are now a liquid, pass into tank 25 and from there through pipes 27 for fur-

ther use in the refrigerating system, by going through valves and evaporators in said system to the compressor. However, the liquid within the sump of casing 1, which has been cooled, cools the further condensed refrigerant within the tank 25 and pipe 27 by conduction.

Depending upon the temperature of the air entering opening 3, it is possible to operate the present device without supplying water to the trough 13 from time to time. If the incoming air is sufficiently cool, the same will cool the pipes 19, while the mats 10 will act as a filter for cleansing the same and thereby prevent wires 21 from being clogged with dirt and lint. If the temperature of the air be exceedingly high, the liquid can be permitted to rapidly pass downwardly through the excelsior 12 and will be cooled by the rapid evaporation of a portion thereof and will therefore cool the liquid or gas within the tank 25 and pipes 27 by conduction.

When it is desirable to replenish or renew the excelsior within the mats 10, top 2 can be removed and the mats 10 lifted outwardly from the casing 1 and the frames opened, permitting the ready removal of the old excelsior to be replaced by the new. Likewise, heat exchange units 18 can be readily removed by uncoupling couplings 20 when the gas supply to pipe 28 and tank 25 has been shut off and lifting the mat 18 outwardly from between its rails 7, whereupon, repairs or, when necessary, cleansing thereof can be conveniently carried out. The water-cooling mats 10 serve as filters and keep the air clean, allowing no dust or lint to settle on the surfaces of units 18. Further, the air contacting units 18 will be moisture-laden, but will have no free moisture, only water vapor, not water, thereon that might settle on these surfaces, therefore, no liming or corrosion will take place and no cleaning is required.

The moisture-absorbing material 12 is preferably formed from wood shavings, since the same readily absorbs moisture and, at the same time, presents a large surface area at numerous angles relative to the air passing thereby. Therefore, the air can more readily cause the evaporation of the moisture and, at the same time, is better cooled while travelling through a relatively short distance. However, any material having similar characteristics can be used with varying degrees of effectiveness.

By using the present condenser with a refrigerating unit, the head pressure of the refrigerator compressor is considerably reduced and, therefore, requires less horsepower to operate with the resulting saving in consumption of electrical current.

The present invention is capable of considerable modification and any such modifications or changes which are made to the structure herein described and disclosed and which come within the scope of the appended claims are deemed to be a part of the present invention.

I claim:

1. An improvement in condensers comprising a casing, the opposite ends of said casing each having an opening formed therethrough, a series of mats mounted within said casing with the faces thereof facing said openings, means for wet-

ting said mats from the top thereof, a series of heat-conductive pipes each spaced from and adjacent to one of the faces of one of said mats, means for drawing air in one of said openings past said mats, said pipes and out the other of said openings and means forming a plurality of separate air ducts between said mats and said pipes extending one above the other from one of said openings to the other of said openings.

2. A condenser aid comprising in combination a casing having opposed inlet and outlet openings, superposed air ducts arranged within said casing and communicating with said inlet and outlet openings whereby a plurality of air streams may be caused to flow through said casing, a water cooling mat mounted within said casing and extending across said air ducts, a heat exchange unit mounted in said casing in spaced relation to said water cooling mat and extending across said air ducts and means for supplying liquids to said mat and heat exchange unit whereby the liquids will be caused to flow downwardly across the air streams passing through said air ducts.

3. A condenser aid comprising in combination a casing having opposed inlet and outlet openings, a plurality of alternately arranged water cooling mats and heat exchange units adapted and arranged for progressive downward flow of the fluid to be cooled therein and mounted in spaced relation within said casing, a plurality of equally spaced and horizontally extending plates mounted within the spaces between said mats and heat exchange units and said plates establishing superposed air ducts within said casing whereby air streams may flow through said casing and the mats and heat exchange units mounted therein from the inlet opening to the outlet opening thereof.

4. A condenser aid comprising in combination a casing having opposed inlet and outlet openings, a series of longitudinally extending bars mounted within said casing dividing the latter into an upper compartment and a lower liquid collecting sump, two series of vertically extending rails each mounted upon one of the interior side walls of said casing above said bars, a series of frames slidably mounted between alternate pairs of said rails in each series thereof within the upper compartment of said casing and with the frame faces thereof facing said openings, said frames being supported upon said bars above the sump of said casing, a plurality of plates connected to the side walls of said casing between said alternate pairs of rails, said plates forming a plurality of air ducts one above the other between said frames and extending from one of said openings to the other of said openings, each alternate frame having a moisture absorbent material extending thereacross, the other of said frames having a condenser coil extending thereacross and adapted and arranged for the progressive downward flow of the fluid to be cooled therein, means for wetting said material from the top thereof and means whereby the excess liquid from said material may flow into the sump of said casing.

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