

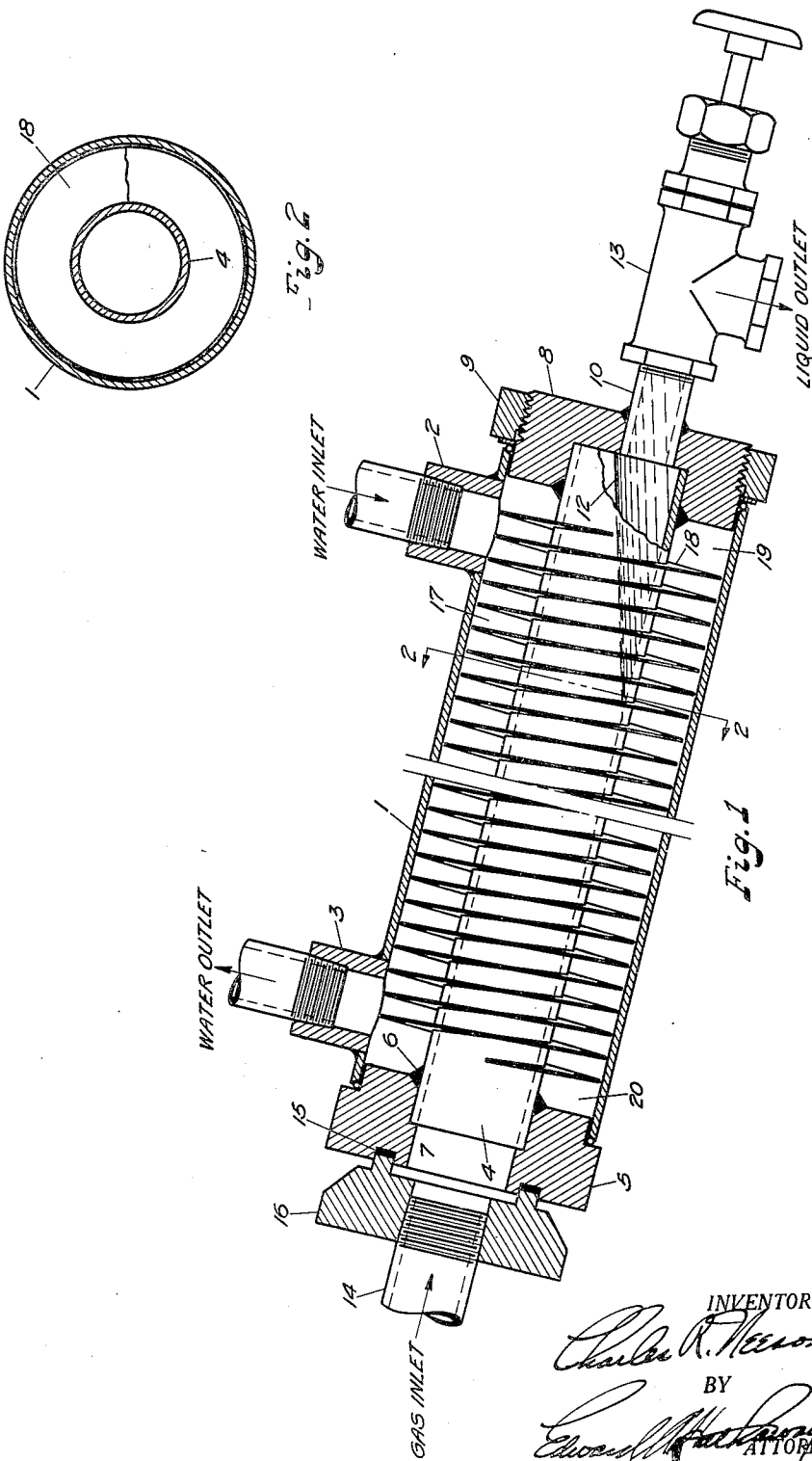
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C. R. NEESON

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CONDENSER

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INVENTOR
Charles R. Neeson
BY
Edward M. Neeson
ATTORNEY

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CONDENSER

Charles R. Neeson, New Rochelle, N. Y., assignor,
by mesne assignments, to Baldwin-Southwark
Corporation, a corporation of Delaware

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This invention relates generally to condensers and more particularly to refrigerant condensers and a method of operation thereof.

In condensers for refrigerating purposes, particularly in commercial refrigeration, it is desirable to have apparatus which is economical in construction and operation, and easy to dismantle for cleaning purposes. Efficiency in commercial refrigeration equipment is continually becoming more important, and this can be partly accomplished in the condensers by maintaining the water passages thereof clean. It is essential in order that the water passages may be easily cleaned, or to encourage the operator to clean the same, that the structure be so arranged that the operator may have easy access to the internal parts and passages. It is thus an object of my invention to provide an improved water cooled condenser which is simple in construction, economical in manufacture and maintenance, and yet has a high degree of efficiency.

A further object is to provide an improved arrangement between the cooling water passage and the condenser tube. In usual commercial forms of refrigerant condensers, the compressed gas from the refrigerating compressor is conducted into a relatively large tank through which cooling water tubes pass. The tubes by having open ends may be easily cleaned, but such an arrangement is expensive due to the multiplicity of water cooling pipes and to the size of the condenser. In my improved condenser, however, I have provided a very simple arrangement comprising, specifically, a single outer tubular water casing such as a standard piece of pipe provided with a water inlet and outlet, a condenser tube or pipe extending through said casing and secured in removable end closures for the outer casing, and flow directing and heat transfer elements, preferably in the form of a continuous spiral sheet metal fin, carried by the outside of the condenser pipe and within the outer water pipe.

It is a further object to provide an improved arrangement whereby favorable efficiency will be obtained, and in one specific aspect of the invention this is accomplished by providing an arrangement whereby the cooling water and the inflowing refrigerant gas to be condensed have very material velocities. For instance it has heretofore been the practice to have a cooling water velocity of say in the neighborhood of 80 ft. per minute while the ammonia gas flows at so low a velocity that it is practically zero. On the other hand with my improved arrange-

ment it is contemplated that a water velocity may be had in the neighborhood of 400 ft. per minute while the refrigerant such for instance as ammonia may have a velocity as high as 2600 ft. per minute. The relative efficiency of my arrangement compared to the prior devices is readily appreciated when it is considered that the velocity of the fluids is a factor in obtaining greater heat transfer. In addition, by having a greater rate of heat transfer the condenser may be made small and therefore cheaper. To accomplish the foregoing object in the specific aspect of the invention as illustrated herein, the continuous spiral fin previously mentioned is arranged to cause the water to be circulated with a high rotational velocity around the outside of the refrigerant pipe.

A still further and more specific object is to permit easy cleaning of the circular water passage formed by the fin and to accomplish this the condensing pipe is arranged to be bodily removed with the spiral fins from the outer casing, thereby leaving the water passage between successive coils of the fin entirely open and easily accessible.

Other objects and advantages will be understood by those skilled in the art from the following description of the accompanying drawing wherein

Fig. 1 is a longitudinal section through the condenser, the refrigerant pipe and circular fins thereof being shown in elevation; and

Fig. 2 is a transverse section taken on line 2-2 of Fig. 1.

In the drawing there is shown, merely for purpose of illustrating one specific embodiment which the invention may take, an outer pipe or casing 1 having condensing water inlet and outlet pipe connections 2 and 3 welded or otherwise suitably secured to said outer pipe 1. A condensing tube 4, in which the refrigerant such for instance as ammonia is condensed, is received in a suitable recess of head 5 and welded thereto at 6, the head having a suitable opening 7 communicating with pipe 4. It will be noted that this head has a flange somewhat larger than the outside diameter of pipe 1 and suitable packing is interposed between the inside of said flange and the beveled end of pipe 1. The other end of the condenser tube is similarly secured in a head 8, whose maximum outer diameter is preferably slightly less than the inner diameter of pipe 1, thereby permitting this head with the condenser tube to be drawn through the left end of pipe 1. How-

ever, to secure the condenser tube and heads in position, a nut 9 has threaded engagement with head 8, thereby permitting the two heads to be drawn tightly against the packing interposed at each end of pipe 1 while the welded joints between the condenser pipe 4 and the heads 5 and 8 insure against leakage of water into the refrigerant condenser pipe 4 or escape of refrigerant gas or liquid into the water section.

The refrigerant outlet pipe 10 has communication with the condenser pipe at a point offset from its center, thereby permitting the condensed refrigerant to easily flow from the condenser pipe and to also permit the outlet 10 to be completely sealed by a relative small amount of liquid refrigerant, thereby preventing flow of gas into the outlet. It will, of course, be understood that in the preferred operation, this device is slightly inclined with the outlet 10 at the lowest point whereby the liquid refrigerant will assume a level 12. Any suitable valve mechanism 13 may be connected to pipe 10, this valve being of such exterior form that it may be drawn through pipe 1 when nut 9 is removed, it being understood that this nut or removable flange is of sufficient internal diameter as to pass over even the largest portion of the valve or its operating handle. A suitable gas inlet pipe 14 having a screwed on flange 16 is connected to the inlet head 5 which is provided preferably with an annular sealing groove 15. The flange 16 carrying an annular flange which fits into a groove 15, is clamped to the head 5 as by bolts extending through suitable lateral ears on the two members 5 and 16.

To obtain a high velocity of the cooling water with a minimum volume of water and maximum cooling surface to thereby increase heat transfer, there is provided a spiral passage 17 around the condenser pipe 4. The formation of this passage is such that it may be easily removed with the condenser pipe and be readily cleaned. Specifically this water passage is formed by heat transfer means in the form of a relatively thin sheet metal spiral flange or fin, having co-axial openings in the successive convolutions thereof. The fins or spiral member may be forced upon pipe 4 so as to have sufficient intimate contact therewith to effect good heat transfer between the joined elements, this forced fit being of sufficient tightness to hold the fins and condenser pipe in a substantially fixed position with respect to each other, or if desired the fins may be welded at various points or dipped into a galvanizing bath. It will be noted that the fins 18 are preferably spaced from each of the heads 5 and 8 so as to form an inlet chamber 19 and outlet chamber 20, although the fins 18 are shown as preferably slightly overlapping the inlet and outlet openings 2 and 3. However, it will be noted that in any event even though the fins 18 were adjacent the heads 5 and 8 or were spaced therefrom to be entirely clear of the inlet outlet, the water will flow through inlet 2 and be given a spiral motion around the condenser tube as it flows through the successive convolutions of the condenser spiral passage 17. If desired the inlet 17 may be disposed more tangentially to pipe 1 so as to impart an initial whirling movement to the water, although for the greatest simplicity of construction the inlet is disposed with its axis intersecting the axis of the tube. The same relations apply to the outlet 3 except that if it is placed in a tangential point,

it would be on the opposite side to that of the inlet 2.

From the foregoing disclosure it is seen that I have provided an extremely simple arrangement of parts which not only are comparatively inexpensive but which are adapted to be easily secured together as by welding if such is desired and at the same time the arrangement is highly conducive to relative easy cleaning of the water passages. The device also has a high degree of compactness when it is considered that for a length of approximately 4 ft. and an outside diameter of 4 inches this would compare with prior multiple tube condensers for the same capacity which would be $4\frac{1}{2}$ ft. long and have a 10 in. diameter, the contrast being further seen by reason of my device having only one $1\frac{1}{2}$ in. diameter condenser tube as compared with eight 2 in. water tubes in the prior device just mentioned. This compactness and simplicity are brought about by my improved method of operation wherein the water is circulated at a high velocity and the gaseous ammonia enters the inlet 14 with a high velocity.

It will be noted that the spiral fin or flange 18 provides ample cooling surface for the condenser tube and yet its large amount of surface may be readily cleaned, even though the cooling surface is of a tortuous or normally inaccessible character, this being in distinction to those prior condensers where a large number of water tubes are employed in order to obtain sufficient simplicity for cleaning combined with a large amount of cooling surface.

While only one specific embodiment of the invention and the method of operating the same have been illustrated, it will of course be apparent to those skilled in the art that other modifications and changes may be made without departing from the spirit as set forth in the appended claims.

I claim:

1. A refrigerant condenser comprising an outer casing and an inner condenser tube spaced therefrom to provide a water passage, a spiral flange construction carried by said tube and disposed within said space, means forming a water inlet and outlet whereby cooling water flows from the inlet to the outlet through said space in a spiral path, means for supporting said condenser tube by said outer casing whereby said tube and its spiral flange may be axially removed bodily from said outer casing, a head having a flange engageable with the entire end of said outer casing to provide a closure therefor and having an axial opening, one end of said condenser tube being supported in said opening, and another head having a removable flange for entirely engaging the other end of said outer casing and being provided with an axial opening in which the other end of said condenser tube is disposed, said latter head being adapted when its flange is removed to pass through said inner casing upon removal of said condenser tube.

2. A refrigerant condenser comprising an outer pipe of cylindrical cross-section, an inner condenser pipe also of cylindrical cross-section and spaced from the outer pipe to form a water passage therebetween, means providing a heat transfer surface on the exterior of said condenser pipe, and means for removably securing said condenser pipe to said outer pipe including closure heads at each end thereof, one of which has provision whereby it may be axially moved through said outer pipe upon removal of said condenser tube.

3. A refrigerant condenser comprising an outer pipe of cylindrical cross-section, an inner condenser pipe also of cylindrical cross-section and spaced from the outer pipe to form a water passage therebetween, means providing a heat transfer surface on the exterior of said condenser pipe, means for removably securing said condenser to said outer pipe including closure heads at each end thereof, one of which has provision whereby it may be axially moved through said outer pipe upon removal of said condenser tube, and an outlet valve connected to said latter head and adapted also to be passed through said outer pipe.

4. A refrigerant condenser comprising an outer casing, an inner pipe spaced therefrom to form a water passage, means for supporting the ends of said condenser pipe by the ends of said outer

casing and a valve mechanism associated with one end of said condenser pipe, said condenser pipe, valve mechanism and a part of said supporting means being removable axially through said outer casing.

5. A refrigerant condenser comprising an outer pipe, an inner condenser pipe spaced from said outer pipe to form a water passage therebetween, radial fins on said condenser pipe and extending into said space, and means for removably securing said condenser pipe to said outer pipe including closure means at each end thereof, one of said closure means being adapted together with said condenser pipe and its radial fins to be moved axially through said outer pipe.

CHARLES R. NEESON.

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