March 3, 1931. R. M. HYDE 1,794,692

CONDENSER

Filed June 14, 1928 2 Sheets-Sheet 1

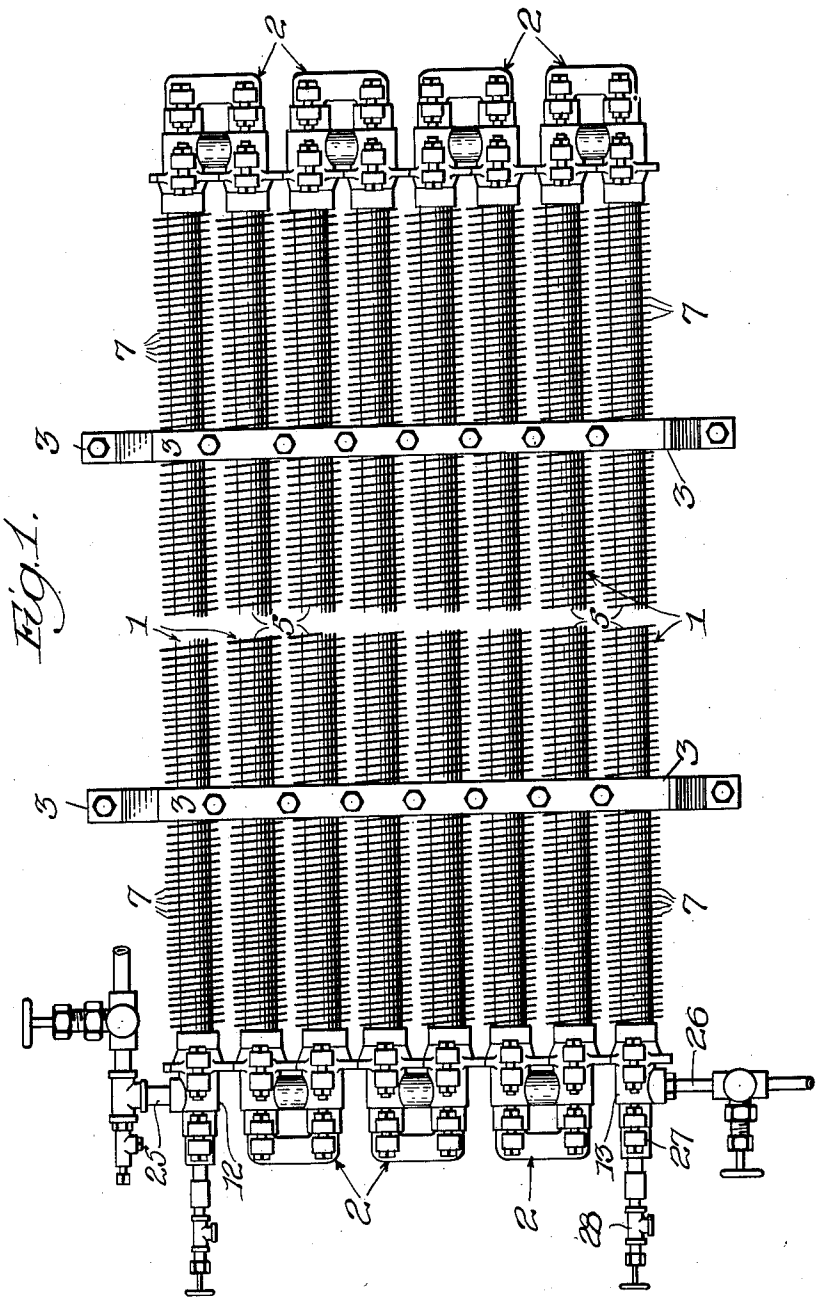



Fig. 1.

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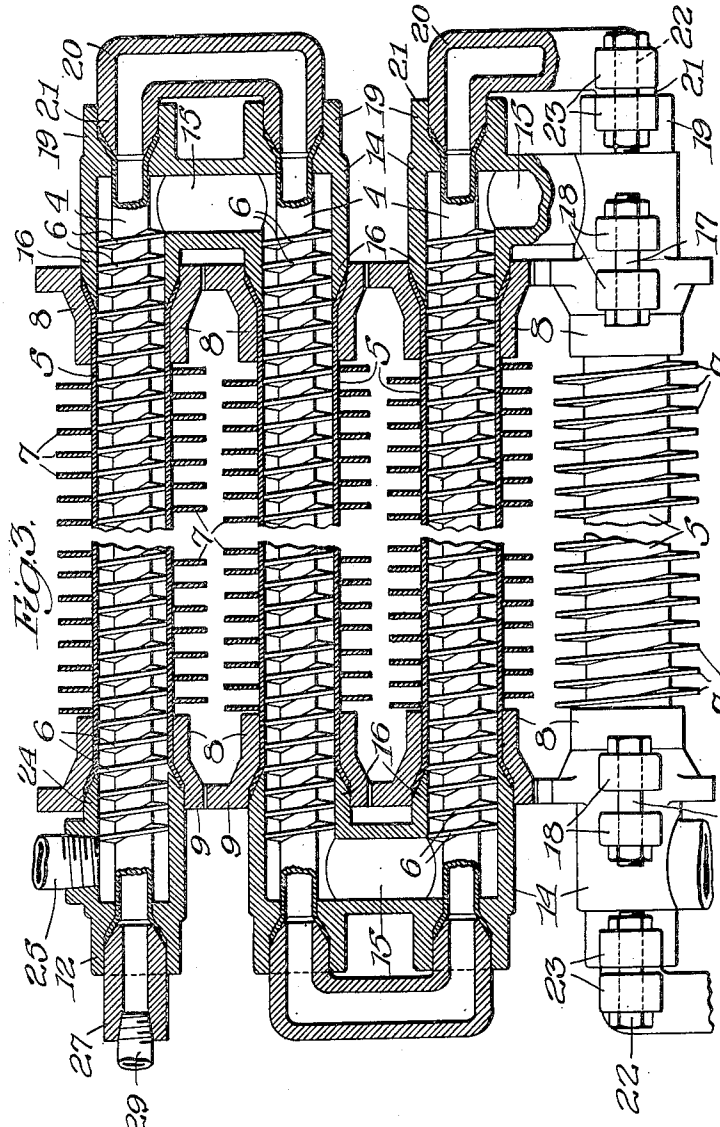


Fig. 3.

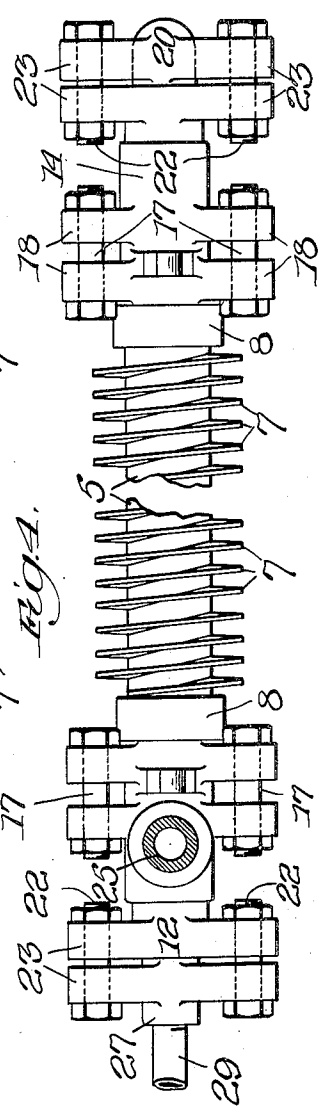


Fig. 4.

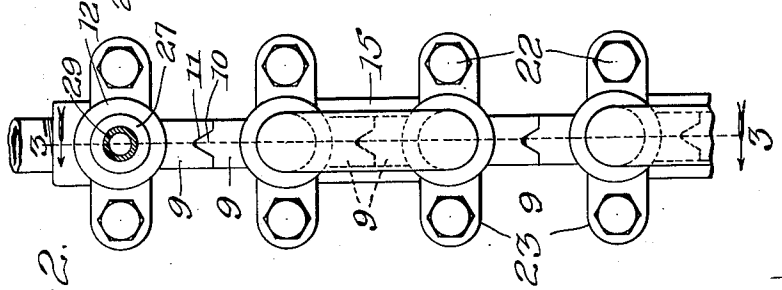


Fig. 2.

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Patented Mar. 3, 1931 1,794,692

# UNITED STATES PATENT OFFICE

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## CONDENSER

Application filed June 14, 1928. Serial No. 285,292.

This invention relates to double flow condensers for mechanical refrigerating systems.

In these condensers as heretofore made, the double flow passages have been made of inner and outer pipes of relatively heavy wall section, which materially retards the heat transfer through the pipes between the circulating fluids as well as to the surrounding atmosphere. Also these heavy pipe sections have made the entire assembly heavy, awkward to handle and assemble, and costly to manufacture.

One of the objects of my invention is to provide tubes of relatively thin metal wall section so that a more rapid transfer of heat can be had between the tubes and to the surrounding atmosphere, and thus provide a far more efficient condenser as well as one which is lighter in weight, less bulky, and consequently less expensive to make and more easily handled and installed.

Another object of my invention is to use drawn seamless tubes and thus avoid leaks in the tubes by having no joints in the same.

A further object of my invention is to provide spiral fins on the inner tubes and have the fins fit within the outer tubes to make spiral the passages between the tubes and thus increase the length of travel of the fluid between the tubes to insure a greater amount of heat transfer without increasing the length of the tubes.

A further object of my invention is to provide spiral fins on the exterior of the outer tubes so as to increase the heat radiating surface thereof and thus insure a more rapid transfer of heat from the outer tubes to the surrounding atmosphere.

The invention consists further in the matters hereinafter described and claimed.

In the accompanying drawings—

Fig. 1 is a front elevational view of a condenser constructed in accordance with my invention;

Fig. 2 is an end view of the same;

Fig. 3 is a vertical sectional view taken on line 3—3 of Fig. 2; and

Fig. 4 is a top plan view of the condenser.

As shown in Fig. 1, the condenser of my invention comprises a group of tube sections 1, 1 alternately connected together at their opposite ends by couplings 2, 2 to provide continuous and unbroken passages through the condenser from end to end. In the particular form of condenser shown, the tube sections 1, 1 are approximately the same in length, are arranged substantially parallel and in the same plane so that the condenser presents a flat assembly enabling it to be secured flatwise against a wall or other support by straps 3, 3, which embrace the front and rear sides of the tube sections 1, 1 and are bolted together between the tube sections and to the wall, respectively.

Each tube section 1, as shown in Fig. 3, consists of a pair of inner and outer tubes 4, 5, both being of drawn seamless tubing of copper, brass, or other suitable material. With the tubes being seamless, no joints are provided in them whereby they may leak, and moreover, the walls of the tubes may be made relatively thin for the rapid transfer of heat therethrough to or from the fluids or gases which are circulated through the tubes.

A spiral fin 6 of a continuous strip of suitable heat transferring material, such as thin copper or brass, is spirally wound about the inner tube 4 before the latter is inserted in the outer tube 5. The fin 6 is wound edgewise on the tube 4 and may be soldered or otherwise secured thereto, as by the clamping action of the fin in being wound on the tube. The fin 6 extends radially outward from the tube 4, and has a height approximating the inside diameter of the outer tube 5 so as to engage the inner wall of said outer tube and provide a spiral passage for the flow of liquids or gases between the tubes. Thus the length of flow between the tubes is materially increased, and the liquids or gases remain longer in contact with the inner tube than they otherwise would should the fin be omitted. By making the tubes 4, 5 of thin metal, very little space is taken up by the walls of the tubes, with the result that sufficient space may be provided between the tubes to accommodate the spiral fin strip 6.

A spiral fin 7 of the same character is wound about the outer tube 5 and provides an

increased heat radiating surface for the outer tube.

The couplings 2, 2 comprise a number of cast members of which 8, 9 constitute the base members which are arranged at the opposite ends of the outer tubes 5, 5 and have bores or openings therein of a size to snugly receive the ends of said tubes, as shown in Fig. 3. The members 8, 8 have lugs 9, 9 which extend toward and engage one another for spacing the tube sections 1, 1 apart. Where the lugs meet they have a tongue and groove connection 10, 11 for keeping the tube sections in the same plane. (See Fig. 2.) Where the members 8 engage about the outer tubes 5, the latter are free of the spiral fin formation 7, as shown in Fig. 3.

The outer ends of the bores in the members 8 are enlarged and tapered so that when the ends of the outer tubes 5 are clamped therein, they will be expanded outward against the tapers in the bores to make leak-proof joints, as required for the handling of gases or liquids.

The ends of the outer tubes 5 are expanded in this way at the intake and outlet ends of the assembly by fittings 12, 13 and elsewhere by members 14, 14. Each member 14 is in the form of a conduit having a substantially U-shaped passage 15 by which the ends of the adjacent outer tubes 5, 5 are connected. Each member 14 has a pair of nipples or tubular projections 16, 16 at the ends of the passage 15, and said nipples extend into the outer ends of the bores in the associated members 8, 8 and overlap the outer ends of the tubes 5 in said bores for expanding said tube ends into tight contact with the tapers in the bores on clamping the member 14 to the associated members 8, 8 by bolts 17, 17, as shown in the drawings. The members 8 and 14 have lugs 18, 18 for the bolts, as shown.

The inner tubes 4, 4 are longer than the outer tubes 5, 5 and extend therethrough and beyond the ends of said outer tubes. This enables the inner tubes 4, 4 to extend through the members 14, 14 so that said tubes are out of communication with the passages 15 in the members 14. The outer ends of the inner tubes 4 extend into tubular projections 19, 19 on the outer sides of the members 14 and are clamped therein by having their outer ends expanded into tight contact with taper portions in said projections 19, as shown in Fig. 3. This is accomplished by conduit members 20, 20 one for each intermediate member 14 and having nipples or tubular projections 21, 21 to enter the projections 19 and, when being clamped to the members 14, 14 by bolts 22, 22, to expand the tube ends, as described. The conduit members 14 and 20 have side lugs 23, 23 for the bolts 22.

The conduit sections 20, 20 couple the adjacent ends of the inner tubes 4, 4 together at each coupling 2, and establish a continuous and unbroken passage for gas or liquids through the condenser assembly through its inner tubes.

The inlet and outlet fittings 12, 13 have nipples or tubular projections 24 which extend into the bores in the adjacent members 8 for clamping the ends of the associated outer tubes 5 therein and also for connecting the inlet and outlet pipes 25, 26, respectively, with the passages between the inner and outer tubes. The inner tubes 4 at said fititngs 12, 13 extend through the same and have their outer ends expanded and clamped therein by nipples 27, 27 to which the inlet and outlet pipes 28, 29 for the inner tubes are clamped. The fins 6 on the inner tubes 4 may extend into the fittings 12, 13 and into the base members 14, respectively, so as to begin and terminate the spiral pasages made by said fins within said members, as shown in Fig. 3.

Suitable valves may be provided in the inlet and outlet pipes for controlling the flow of liquids and gases through the double set of passages which are provided by the double set of tubes.

The condenser shown and described is simple in construction and operation. The double flow passages provided by coupling the inner and outer tubes permit the circulation of one fluid, such as water, through one set of tubes, say the inner tubes, and the other passage permits the refrigerant, such as compressed ammonia gas, to be cooled by the water to be circulated through the outer tubes. By circulating the water and the refrigerant through the respective tubes in opposite directions, the coldest water is brought into contact with the coldest refrigerant for extracting the greatest possible volume of heat from the refrigerant.

With the tubes 4, 5 of drawn seamless tubing or other relatively thin metal, the weight of the condenser assembly is considerably reduced, thus allowing it to be readily and easily handled in the making, installation and repairs. The thin metal tubes also enable the outer diameters of the tube sections to be reduced and thus avoid the bulky structures as heretofore used. Moreover, the thin metal tubes with their fins increase the heat transferring properties of the condenser and make it highly efficient and effective.

While I have shown and described my invention as applied to a condenser for refrigerating systems, it is of course to be understood that the invention is not to be so limited except as pointed out in the annexed claims.

I claim as my invention:

1. A condenser for refrigerating systems, comprising a group of tube sections, each section consisting of inner and outer tubes having relatively thin walls for the rapid transfer of heat therethrough, and coupling members at the opposite ends of the tube sec-

tions for alternately connecting them together in a manner to provide a double flow passage therethrough, said coupling members having complementary tapered portions to engage and expand the tube ends engaged thereby to make tight joints between the tubes and the members on clamping the latter together.

2. A condenser for refrigerating systems, comprising a group of tube sections, each section consisting of inner and outer tubes having relatively thin walls for the rapid transfer of heat therethrough, and coupling members at the opposite ends of the tube sections for alternately connecting them together in a manner to provide a double flow passage through the tube sections, said coupling members having lugs extending toward and engaging each other for spacing and maintaining the tube sections in alignment.

3. In a condenser for refrigerating systems, a pair of tube sections arranged in side by side relation, each tube section consisting of inner and outer tubes having relatively thin metal walls for the rapid transfer of heat therethrough, and a coupling at one end of the tube sections comprising base members and inner and outer conduit members, the latter serving to connect the outer and inner tubes, respectively, said base and inner conduit members having bores with tapered portions to receive the associated tube ends, said inner and outer conduit members having tubular projections to enter said bores and expand the tube ends into tight contact with the tapered portions thereof on clamping the members together, and means for clamping said members together.

4. In a condenser for refrigerating systems, a pair of tube sections arranged in side by side relation, each tube section consisting of inner and outer tubes having relatively thin metal walls for the rapid transfer of heat therethrough, and a coupling at one end of the tube sections comprising base members and inner and outer conduit members, the latter serving to connect the outer and inner tubes, respectively, said base and inner conduit members having bores with tapered portions to receive the associated tube ends, said inner and outer conduit members having tubular projections to enter said bores and expand the tube ends into tight contact with the tapered portions thereof on clamping the members together, lugs on said members, and bolts engaging said lugs for clamping the members together, said base members having additional lugs for spacing the tube sections and maintaining them in lateral alignment.

In testimony whereof I affix my signature.

ROLLIN M. HYDE.