Aug. 17, 1937. I. J. KNUDSON 2,090,208

HEAT EXCHANGER

Filed Aug. 30, 1933

Fig. 1.

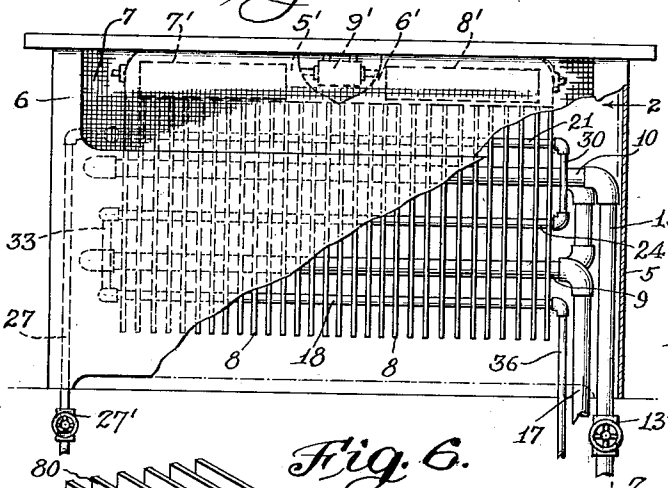



Fig. 2.

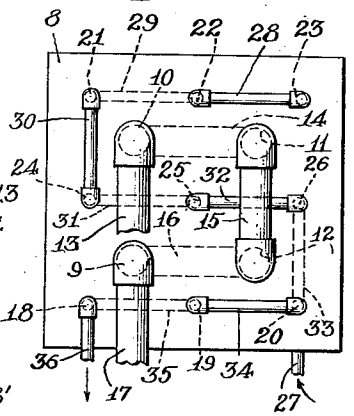



Fig. 6.

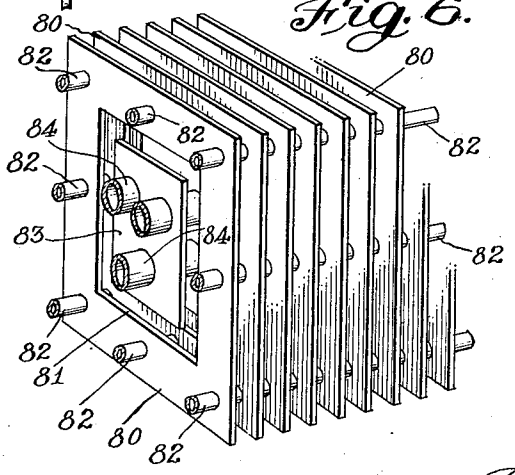



Fig. 3.

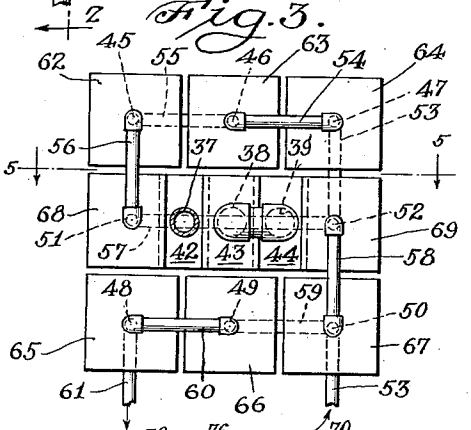



Fig. 5.

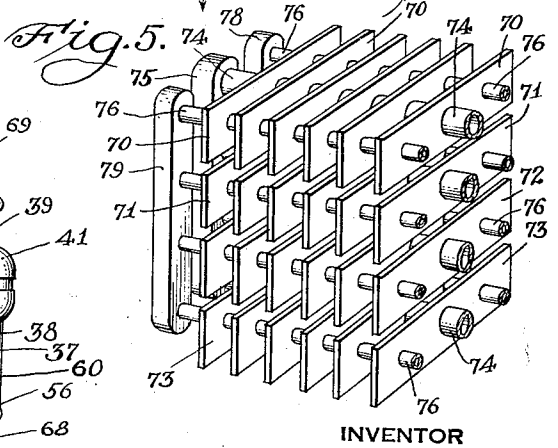
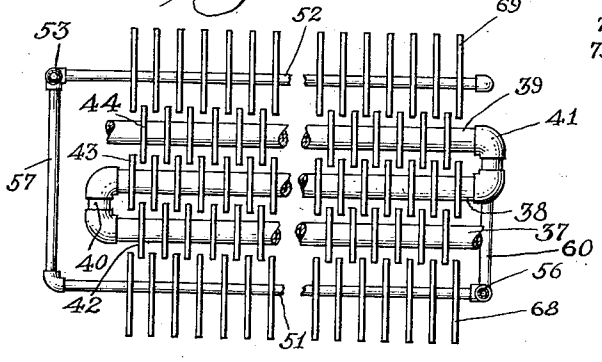



Fig. 4.




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# UNITED STATES PATENT OFFICE

2,090,208

## HEAT EXCHANGER

Irving J. Knudson, Kenilworth, Ill.

Application August 30, 1933, Serial No. 687,427

1 Claim. (Cl. 257—9)

This invention relates to a heat exchanger adapted for use either as a heating device or as a cooling device.

Temperatures of rooms or the like have heretofore been affected by the use of suitable heat exchangers. Radiators or other heating devices have been used for increasing the temperature and evaporators or the like have been used for decreasing the temperature. These devices have been used separately, and sometimes they have been used conjointly, but they have always been constructed as separate units and this has involved a duplication of devices and parts for heating and cooling, has required more space than is usually available in residential buildings, and has rendered installation expensive.

The primary object of my invention is to provide a heat exchanger in a single unit adapted for heating or for cooling and which can be compactly made and installed in much less space and more conveniently than has heretofore been possible with separate heating and cooling units.

The rate of change in temperature of a fluid such as air flowing through or past a heat exchanger is proportionate to the surface area of the exchanger with which the fluid may contact, and a further object of my invention is to provide a compact heat exchanger unit adapted for heating or for cooling wherein the entire structure provides a contact surface for the fluid and thereby contributes to the efficiency of the unit when used for heating or when used for cooling.

A further object of the invention is to provide a heat exchanger in a single unit with a heating conduit and a cooling conduit and with fins engaged with both conduits whereby the heating conduit and fins constitute an extension of the contact surface of the cooling conduit and assist the cooling conduit in cooling a fluid passed through the exchanger when a cooling medium flows through the cooling conduit, and whereby the cooling conduit and fins constitute an extension of the surface of the heating conduit and assist the heating conduit in heating a fluid passed through the exchanger when a heating medium flows through the heating conduit.

Selected embodiments of the invention are illustrated in the accompanying drawing wherein

Fig. 1 is a front elevation, partly broken away, showing one form of my invention;

Fig. 2 is an end view substantially on the line 2—2 on Fig. 1;

Fig. 3 is a view similar to Fig. 2 showing another form of construction;

Fig. 4 is a horizontal sectional view on the line 5—5 on Fig. 3;

Fig. 5 is a detail perspective view illustrating another form of the invention; and

Fig. 6 is a detail perspective view illustrating another form of the invention.

In the preferred form of the invention, the heat exchanger is preferably arranged in a cabinet 5 which is open at the bottom and has a restricted opening 6 in its front wall provided with a reticulated covering 7. A fan or blower is provided in the cabinet 5 to circulate the air, that is, cause the air to flow or pass through or past the exchanger, or natural circulation of the air as induced by the temperature change in the exchanger may be relied upon to effect circulation. Two blowers having housings 5' and 6' are mounted in the upper part of the cabinet 5 with the inlets thereof positioned to receive air flowing from the exchanger. The outlets 7' and 8' of the housings face toward the opening 6 so that air discharged from the housings passes out through the reticulated covering 7. A motor 9' is positioned between the housings 5' and 6' and drives the fans mounted in the housings, and this motor is controlled by switch means (not shown) suitably located on the cabinet 5.

In the form of the invention shown in Figs. 1 and 2, a plurality of large plates 8 are arranged in spaced parallel relation and pipes 9, 10, 11 and 12 for a heating medium are extended through all of the plates. An inlet pipe 13, having a valve 13' therein, is connected to one end of the pipe 10 and the other end of this pipe is connected to the adjacent end of pipe 11 by the connection 14. The opposite end of the pipe 11 is connected to the adjacent end of the pipe 12 by a connection 15, the opposite end of the pipe 12 is connected to the adjacent end of the pipe 9 by a connection 16, and the opposite end of the pipe 9 is connected to an outlet pipe 17. The four pipes thus being connected provide a single conduit through which a heating medium may be circulated, and it is to be understood that the number of pipes forming the conduit may be increased or decreased according to the capacity required for the heat exchanger unit. I have referred to the pipe 13 as the inlet and the pipe 17 as the outlet but the pipe 17 may be used as the inlet and the pipe 13 as the outlet, if desired and if this is done a valve, like the valve 13', will be provided in the pipe 17. The inlet pipe 13 leads from a suitable source of heating medium such as steam, hot water or the like and the outlet pipe

leads back to the source or elsewhere, as may be desired.

Pipes 18, 19, and 20 are extended through the plates 8 near the bottom edges thereof, pipes 21, 22, and 23 are extended through the plates near the top edges thereof, and pipes 24, 25, and 26 are extended through the plates substantially midway between the top and bottom thereof. An inlet pipe 27, having a valve 27' therein, is connected to one end of the pipe 23 and a connection 28 connects the opposite end of pipe 23 with the adjacent end of pipe 22, a connection 29 connects the other end of pipe 22 with the adjacent end of pipe 21, a connection 30 connects the opposite end of pipe 21 with the adjacent end of pipe 24, a connection 31 connects the opposite end of pipe 24 with the adjacent end of pipe 25, a connection 32 connects the opposite end of pipe 25 with the adjacent end of pipe 26, a connection 33 connects the opposite end of pipe 26 with the adjacent end of pipe 20, a connection 34 connects the opposite end of pipe 20 with the adjacent end of pipe 19, a connection 35 connects the opposite end of pipe 19 with the adjacent end of pipe 18, and an outlet pipe 36 is connected to the opposite end of pipe 18. These pipes being thus connected constitute a continuous conduit through which a cooling medium may be circulated. While I have designated the pipe 27 as the inlet and the pipe 36 as the outlet, the pipe 36 may be used as the inlet and the pipe 27 as the outlet, if desired, and if this is done a valve, like the valve 27', will be provided in the pipe 36. The inlet pipe 27 leads from a suitable source of cooling medium such as a refrigerant used in direct expansion or flooded refrigerating systems, or cooled brine, or the like, and this cooling medium is circulated through the conduit and flows out through the outlet pipe 36 back to the source or elsewhere, as desired.

The valves in the inlet pipes are selectively and alternately opened and closed so that a heating medium may be circulated through the heating conduit without circulating a cooling medium through the cooling conduit or so that a cooling medium may be circulated through the cooling medium without circulating a heating medium through the heating conduit, the medium selected depending upon whether it is desired to raise or lower the temperature of air circulated through the exchanger.

The plates 8 constitute fins for the conduits and these conduits preferably extend through all of the fins and the fins are arranged in intimate contact with the conduits to constitute an extension of the surfaces of the conduits. This may be accomplished by extending the conduits through openings in the fins and subsequently expanding the conduits into tight engagement with the edges of the openings; or the fins may be united with the conduits by brazing, soldering, galvanizing, tinning, welding or otherwise to obtain intimate contact of the fins with the conduits. Since the heating and cooling conduits preferably extend through all of the fins, the heating conduit as well as the fins constitute an extension of the surface area of the cooling conduct and assist in cooling air or other fluid passed through the exchanger when a cooling medium is circulated through the cooling conduit, and the cooling conduit as well as the fins constitute an extension of the surface area of the heating conduit and assist in heating air or other fluid passed through the exchanger when a heating medium is circulated through the heating conduit. Thus, the arrangement of the heating and cooling conduits in the fins is not only important for making a single unit for heating and for cooling, and for making the unit in a conpact form for economy in manufacture and convenience in installation, but it has the further utility of increasing the contact surface for air or other fluid to be treated by utilizing the cooling conduit as an extension of the contact surface for the heating medium and the heating conduit as an extension of the contact surface for the cooling medium, whereby the efficiency of the unit is increased without duplication of parts.

The rate of heat absorption is less than the rate of heat transmission and consequently I make the cooling conduit longer than the heating conduit.

In Figs. 1 and 2, the pipes 9, 10, 11, and 12 for the heating conduit are preferably located on the diagonals of the fin plates, and these pipes as well as the pipes for the cooling conduit are preferably disposed symmetrically as shown in Fig. 2 or they may be otherwise disposed to meet special conditions or for other reasons. While it is believed that the type of heat exchanger illustrated will be satisfactory for general purposes, it is recognized that the structure of buildings and other conditions may make it necessary to change the size and shape of the heat exchanger for satisfactory use and changes of this kind in the size, location and arrangement of the conduits and fin plates may be made as required while still retaining the essential characteristics and advantages of the invention.

The form of invention illustrated in Figs. 3 and 4 is similar to that illustrated in Figs. 1 and 2 except that instead of a single large plate 8, as shown in Fig. 2, I provide a plurality of small plates forming separate fins for each pipe of the conduits, and also show a different arrangement of the heating conduit pipes. These heating conduit pipes 37, 38, and 39 are arranged in side by side relation in the same horizontal plane and they are joined by connections 40 and 41 to provide a continuous conduit for the heating medium. Plates 42, 43, and 44 are mounted on the pipes 37, 38, and 39 respectively and these plates are arranged in substantial parallelism and overlap in or about the manner shown in Fig. 4. Pipes 45 to 52, inclusive, are arranged in parallelism and about the pipes 37 to 39 and these pipes are joined by connections 54 to 59 to form the cooling medium conduit. An inlet pipe 53 is connected to the pipe 47 and an outlet pipe 61 is connected to the pipe 48. As before explained, the pipe 61 may be the inlet pipe and the pipe 53 may be the outlet pipe.

A plurality of plates 62 to 69, inclusive, are arranged, as hereinbefore described, upon the pipes 45 to 52, inclusive, in substantial parallelism with each other and with the plates 42 to 44. The plates 42, 43, and 44 are preferably arranged in slightly overlapped position, as shown, and the plates 68 and 69 also preferably slightly overlap the plates 42 and 44 but the other plates do not overlap, as shown in Fig. 3. This arrangement of the plates may, however, be changed as desired to overlapped or spaced relation as may be desirable.

These plates form fins on the heating and cooling conduits but in this embodiment each pipe of the conduits carries its own independent fins whereas in the construction of Fig. 2 the fins are common to all of the pipes. All of the fins in Fig. 2 will be heated by conduction from

the heating conduit or cooled by conduction from the cooling conduit whereas in Fig. 3 only those fins on the heating conduit will be heated by conduction therefrom and only those fins on the cooling conduit will be cooled by conduction therefrom, but all of the fins are arranged in close relation and those fins which are not heated or cooled by conduction will be heated or cooled by radiation, and in this way the cooling conduit and the fins thereon will assist in heating when a heating medium is circulated through the heating conduit and the heating conduit and the fins thereon will assist in cooling when a cooling medium is circulated through the cooling conduit.

In the embodiment of Fig. 5, a plurality of plates **70** to **73** are arranged in series, a heating pipe **74** for each series passes through the plates thereof, and the ends of these pipes are connected by headers **75**. Cooling pipes **76** also extend through the plates of each series and are connected by headers **78** and **79**. The heating pipes with their headers constitute a heating conduit and the cooling pipes with their headers constitute cooling conduits, and these conduits are connected with sources of supply of heating and cooling mediums. The plates of each series constitute fins for the pipes passing therethrough, and whereas the series of fins and pipes are spaced apart slightly the heating conduit and the cooling conduits pass through the fins of each series so that the cooling conduit and the fins constitute an extension of the contact surface of the heating conduit for heating and the heating conduit and the fins constitute an extension of the cooling conduits for cooling.

In Fig. 6, a plurality of plates **80** with central openings **81** are arranged on cooling pipes **82** and form fins therefor, and a plurality of plates **83** are arranged within the openings **82** on heating pipes **84** and form fins therefor. The pipes **82** may be joined by connections or headers to form a continuous cooling conduit and the pipes **84** may be joined by connections or a header to form a continuous heating conduit. In this form of invention the cooling conduit and its fins will be heated by conduction from the heating conduit and its fins and the heating conduit and its fins will be cooled by conduction from the cooling conduit and its fins.

While I have illustrated and described preferred forms of my invention, it is to be understood that these are capable of variation and modification and I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes and alterations as fall within the purview of the following claim.

I claim:

A heat exchanger comprising a plurality of series of fins, each series of fins including a plurality of fins arranged in face-to-face spaced apart relation, the series of fins being arranged in spaced apart superimposed relation one from the other, a heating conduit extending through each series of fins substantially midway between the ends of the fins, a cooling conduit extending through each series of fins substantially midway between the heating conduit and one end of each fin of the series, another cooling conduit extending through each series of fins substantially midway between the heating conduit and the other end of each fin of the series, said heating and cooling conduits terminating slightly beyond the outwardmost fins at each end of each series of fins, the heating conduits being in substantial alignment with each other, the respective cooling conduits on opposite sides of said heating conduit being in substantial alignment with each other, headers respectively connecting the aligned conduits at opposite ends thereof whereby the temperature of a heating medium circulated from a header at one end of the heating conduits through said heating conduits will be substantially uniform in all conduits and the temperature of a cooling medium circulated through each set of aligned cooling conduits from a header interconnecting corresponding ends of said conduits will also be substantially uniform, said conduits all being in heat exchanging relation with the fins through which they are extended whereby the heating conduits and the fins will assist the cooling conduits in cooling a fluid passed through the exchanger when a cooling medium is circulated through the cooling conduits, and the cooling conduits and the fins will assist the heating conduits in heating a fluid passed through the exchanger when a heating medium is circulated through the heating conduits.

IRVING J. KNUDSON.