Dec. 12, 1933. E. H. BEHRINGER ET AL 1,939,160

TEMPERATURE EXCHANGER

Filed Dec. 24, 1931

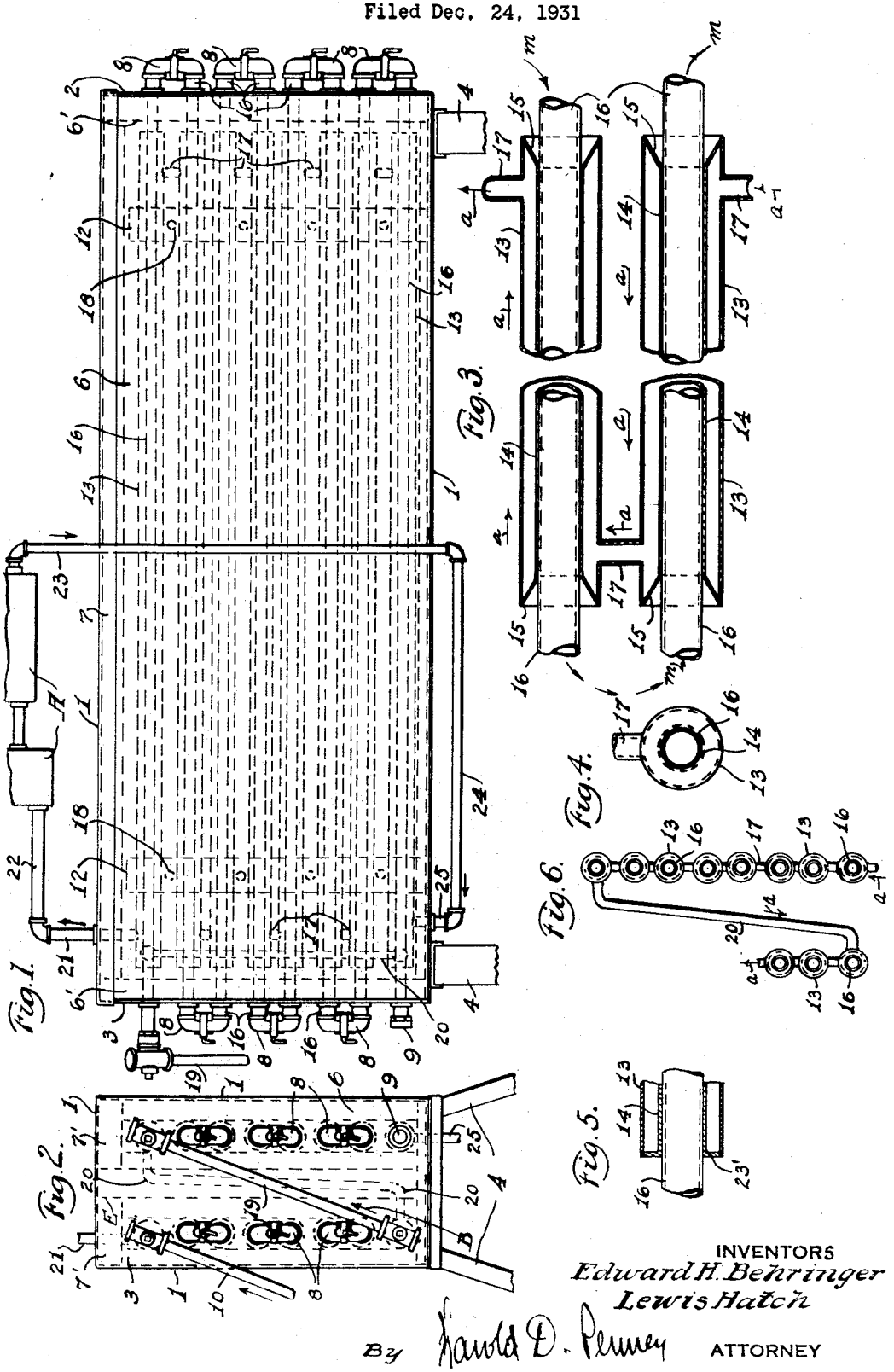


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

INVENTORS
Edward H. Behringer
Lewis Hatch

By Harold D. Penney ATTORNEY

Patented Dec. 12, 1933

1,939,160

UNITED STATES PATENT OFFICE

1,939,160

TEMPERATURE EXCHANGER

Edward H. Behringer, Glendale, and Lewis Hatch, New York, N. Y., assignors to Wisner Manufacturing Company, New York, N. Y., and E. Behringer Sheet Metal Works Inc., Newark, N. J.

Application December 24, 1931
Serial No. 582,970

8 Claims. (Cl. 257—237)

Our present invention relates to an improvement in internal tube cooling or pasteurizing devices, and is adapted to be used specifically, for the treatment of milk.

The principal feature of the present device is to provide a temperature interchanging structure wherein packed and threaded joints are eliminated, this feature, in a tubular apparatus being of considerable importance, in that owing to the constant interchange, during use, of extremes of temperature from extremely cold to pasteurizing temperatures, the metal tubes constituting the milk and refrigerating coil system of such apparatus are subjected to constant contraction and expansion, thus tending at all times to break down gaskets, packings and the like, and thereby permit leaking of the fluids therein.

Where the device is used as a cooler for hot milk leaving the pasteurizer, leaky joints either in the milk tubes or the refrigerant tubes cause trouble and loss.

The present invention therefore aims to make the coil devices into substantially one interconnected unit without packing or gasket sealed joints of any kind, but with freedom of movement so that the two coil units are free for individual expansion.

The present device may also be used, without alteration as a milk preheater and pasteurizer by substituting hot water or steam at proper temperatures for the refrigerant hereinafter described.

Further advantages are the provision of a device of the nature disclosed which is more sanitary, easy to clean, easily operated, thoroughly insulated from external or internal temperature changes or losses, except at the point where the interchange of temperature between one set of tubes and another is the primary function. In this construction provision is made to allow a certain amount of movement between the milk carrying tubes forming the milk coil unit and the refrigerant carrying tubes supporting said milk coil forming the refrigerant coil unit.

Wherever the words "refrigerant tubes" or "refrigerant unit" are used it will be understood to mean that a refrigerant may be used or hot water or steam at proper temperature may be used to use this device as a preheater or pasteurizer as well as a refrigerator.

In the drawing,

Fig. 1 is a side view of the improved temperature interchanging device.

Fig. 2 is the milk inlet and outlet end.

Fig. 3 is an enlarged view showing the detailed construction in preferred form of the heat interchanging tubes.

Fig. 4 is an end view of one of the interchangers shown in Fig. 3.

Fig. 5 is a modified form of heat interchanging tube construction.

Fig. 6 is a fragmentary end view of the milk and refrigerant coil units removed from the casing to show the refrigerant transfer duct.

Tubular coolers of this type have been in use for a number of years and they have been heretofore assembled with ordinary pipe fitting connections, that is, the tubes are threaded and fitted into headers, glands, bends and nipples to form coils and if it were possible, as above indicated, to keep the temperature throughout the entire coolers uniform, such construction would be more or less satisfactory but where there is a difference of sometimes more than 100° F. between the two fluids passing through the heat interchangers, the continued contraction and expansion of the threaded connections tends to break them down and permit them to leak.

It has also been the practice in the past, in a coil system of such an interchanger with gaskets and packing glands or unions to allow for expansion and contraction of the coil tubes at desired points and a constant interchange of temperature has broken these down and caused such gaskets and packing joints to leak. Thus replacements of gaskets and repacking has to be done, at added expense.

In the present instance, there are two separate systems of coils used in our construction and as will be noted the system comprises a milk unit coil for carrying milk through the apparatus to be either chilled or heated for pasteurizing, the milk entering therein at any temperature and a second unit coil system surrounding the first system in which a refrigerant, or a heating medium in liquid or steam form, may be passed in counter direction to the milk flow. Both of these coil systems are distinct from each other and allow for the proper interplay of expansion between the two systems and prevent leakage between them.

The device comprises an outer sheet metal casing forming a complete enclosing housing having sides, a top and bottom generally denoted by 1, Figs. 1 and 2, and end plates 2—3, these including side plates 6 and a cover 7, being joined to form a completely enclosing housing for the dual, internal coil system. This housing is supported on a frame which includes legs 4.

Said end and side plates are metallically

mounted, as shown in the present instance, on inner corner angle irons or bars, each alike and numbered 6'. The plates, as shown in Fig. 2, may be reinforced by inner centrally disposed bars, as E, and on opposite sides of this bar are top reinforcing bar portions 7'.

The projections external to the housing are the in-going or milk inlet pipe 10, Figs. 1 and 2, and the out-going milk or discharge pipe 9, and also the milk transfer pipe 19, Fig. 2 wherein the milk after passing from the last coil unit at the bottom of the left hand side of Fig. 2 passes upwardly in the direction of the arrow B to the top coil of the right hand milk unit, and after passing down through the coils as will be described in detail, the milk is discharged at the point 9. The milk tubes are made of copper or bronze or nickel silver and are interiorly tinned to prevent contamination thereof.

The ends of the milk tubes 16 are also exposed as indicated at 16, at both housing ends 2 and 3, Figs. 1 and 2, and are connected to return bends known as milk return caps 8 and which, being well known, will only be briefly described. As shown in Figs. 1 and 2 these return caps 8 are used to join up or pair adjacent ends of milk tubes 16 and these caps are made so that they may be readily detached and moved out of the line of the said milk tubes 16 so that after a run of milk, the return caps 8 may be opened for access to the interior of the tubes 16 on both ends 2 and 3 of the housing 1, and the tubes thoroughly scoured, cleansed and sterilized and prepared for the next run of milk.

Thus as shown in Figs. 1 and 2 and especially on both ends of Fig. 1 the milk tubes are connected in pairs by the return caps between the milk inlet 10 and the milk outlet 9. This latter member is also provided with the usual means for cleansing and sterilizing.

As shown in Fig. 3 each milk tube 16 is a separate element in the milk coil unit and is in a single piece from housing ends 2 to 3. Each milk tube 16 is mounted and operatively supported within an associate double walled refrigerant tube 13—14 by being pushed through the inner refrigerant tube 14 which thereby surrounds the milk tube 16, but with a very close contact between the contacting surfaces of said tubes. The inner refrigerant tube 14 is encased and surrounded by an outer refrigerant tube 13 which is spaced away therefrom, and the tubes 13, 14 are closed and mutually connected at their opposite ends by a closing flange 15 which is shown as being outwardly flared, whereby the assembling entry of the milk tube 16 is facilitated and longitudinal expansion and contraction of the tubes 13 and 14 under temperature changes is permitted.

The flared flange or web 15 is preferably integral with and expanded from the inner tube 14 outwardly into a flare and at its point of contact with the end of the outer tube 13, is welded thereto, to make the end connections between the inner and outer refrigerant carrying tubes unitary, and without packing.

The outer refrigerant tubes 13 have alternately connected at suitable points, near their ends, connecting nipples 17, Fig. 3 and as shown in Fig. 1, in dotted lines, these short nipple connections 17 are welded to connect the alternate ends of adjacent refrigerant carrying tubes 13—14 to form a continuous coil from top to bottom in both tiers which are shown in Fig. 2. Resting at their lower ends on the bottom wall of the housing and engaging opposite sides of the respective tiers are supporting plates or strips 12, as shown in Fig. 1. Bolts or rods 18, which support said tubes at suitable points, hold these plates together.

In order to connect the refrigerant carrying tubes 13 and 14 on the right hand tier of Fig. 2 to the left hand tier and to cause a counter circulation of the refrigerant against the flow of milk, there is located in the interior of the device and at one end thereof a bypass pipe 20 shown in Figs 1, 2 and 6.

As will be seen this pipe 20 connects the upper refrigerant coil of the right hand tier to the lower refrigerant carrying coil of the left hand tier at the ends thereof, as in Fig. 1, whereby the refrigerant is carried upwardly in the left hand carrying coil, Fig. 2, passes outwards through the pipe 21 and through pipe 22 to the refrigerating apparatus diagrammatically shown at A, Fig. 1 after which the refrigerant is carried downwardly by pipe 23 from the cooling apparatus A and through pipe 24 and up through pipe 25 back into the forward end of the lower right hand refrigerant carrying coil, Figs. 1 and 2. The refrigerant inlet pipe 25 and the outlet pipe 21, Fig. 2, are broken away at their outer ends for convenience.

It will thus be noted that the milk enters at any temperature in the milk inlet pipe 10, passes from the left hand end of Fig. 1, through the top milk tube, to the right hand end of the housing and is there deflected by the return cap 8 to the next milk tube and return cap 8 in the left hand tier of Fig. 2, and is thus successively carried across and down until it reaches the lower milk tube in the left hand tier, Fig. 2, and thence the milk is carried upward in the direction of the arrow B, by the transfer pipe 19 to the upper milk tube in the right hand tier, Fig. 2, and alternately down to the milk discharge point 9.

The refrigerant is passed in just the reverse path to that described for the milk, the refrigerant at its lowest temperature entering where the milk is being discharged at its coolest point and following the same path as the milk, but in an opposite direction, thus having a counter flow of the refrigerant against the flow of the discharging milk as previously described.

The counter flow action of the two liquids is illustrated in Fig. 3, wherein the milk enters the milk tube 16 in the direction of the arrows *m*, while the refrigerant enters the tubes 13—14 by the lower right hand nipple 17, and flows in the direction of the arrows *a*.

If this device is used as a preheater the same counter flow occurs. The milk may enter at 10 at atmospheric or other temperature while a heated fluid may be introduced at the inlet 25 so that during counter flow operation the hottest portion of the preheating fluid will be entering at the discharge point 9 where the milk is coming out the hottest.

It will thus be seen that in the use of this cooler that the changes of temperature which, by contraction or expansion cause unequal changes in the length of tubing of both coils, the milk tubes may expand or contract within their slip positions as supported by the inner refrigerant tubes 14 and the group refrigerant coil unit, formed by the combined welded tubes 13 and 14 and the nipples 17 is free to expand and contract without rupture or leakage, they being connected to each other to form a single welded, unitary

connection. The refrigerating transfer pipe 20 is also welded to its associate tubes 13.

In Fig. 5 we have disclosed another form of connecting the refrigerant tubes together, the milk tube 16 being slip mounted within the refrigerant tube 14 as previously described and which is surrounded by the spaced outer refrigerant tube 13 and a straight flange 23', developed or rolled out from the end of either one of the tubes 13 or 14, is welded to the edge of its companion refrigerant tube to form a single member having a square end instead of a flared end as described and shown in Fig. 3.

The entire interior of the housing 1 may be filled and packed with a suitable insulation, not shown, consisting of granular cork, or the like, so that the coil system may be thoroughly insulated against temperature losses.

It will be noted that we have in the present construction one set of coils for the milk, which isolate the milk completely from contact with the refrigerant coil and are freely suspended for expansion and contraction slip therein, and therefore are free to expand or contract without adding their strains of expansion and contraction to that of the refrigerating coil system and the refrigerating coil system is of unitary construction and without connection with the milk carrying coil system, and therefore the refrigerant coil system is free to expand or contract independently of the expansion and contraction of the milk carrying coils. This is an important feature as in structures of this kind the milk tubes are usually made of copper and bronze whereas the refrigerant coil system may be made of steel tubing the metal of which has a different coefficient of expansion and contraction from that of the milk tubes and by permitting each of these systems to contract and expand independently of each other a break down of any of the joints is prevented and an apparatus is provided that will last very much longer, with less break down for repair, than apparatuses made and put up with gaskets, threaded connections and couplings, or stuffing boxes.

We claim:

1. A temperature exchanger of the class described comprising a housing, dual coil units in said housing, each of said units including mutually connected outer double walled tubular members for receiving a fluid of one temperature, and mutually connected inner pipe sections peripherally engaging the inner walls of said respective members for receiving fluid of another temperature, said members and said sections being capable of independent expansive and contractible movement.

2. A dual tubular coil for the purpose described comprising a refrigerant pipe having inner and outer spaced tubular members unitarily connected at their opposite ends to close said ends and a liquid conducting pipe slip-mounted therein.

3. A dual tubular coil for the purpose described comprising an external refrigerant pipe having inner and outer spaced tubular members unitarily connected at their opposite ends to close said ends and an inner liquid conducting pipe slip-mounted therein.

4. A dual tubular coil for the purpose described comprising a plurality of external, communicating refrigerant pipes having inner and outer spaced tubular members unitarily connected at their opposite ends to close said ends and a plurality of inner communicating liquid conducting pipes slip-mounted therein.

5. A dual tubular coil for the purpose described comprising a plurality of external, communicating refrigerant pipes having inner and outer spaced tubular members welded together at their opposite ends and to each other and connected inner liquid conducting pipes slip-mounted therein.

6. A temperature exchanging device comprising in combination a housing, a refrigerant supply apparatus, a source of fluid to be cooled, plural vertical pipe assemblies disposed in said housing and including parallel double walled tubes, said walls having mutually closed ends, nipples joining said tubes at their ends and forming a continuous series, tube sections connecting the respective top and bottom tubes of said series with said apparatus, pipe sections slip-mounted in said tubes in temperature exchanging relation, said latter sections being engaged with the inner walls of said tubes and having their terminals projecting beyond said ends, means connecting pairs of said terminals and forming a continuous series, and pipe sections connecting the respective top and bottom sections of the last mentioned series with said source.

7. A temperature exchanging device comprising in combination a housing, a refrigerant supply apparatus, a source of fluid to be cooled, plural vertical pipe assemblies disposed in said housing and including parallel double walled tubes having closed ends, nipples joining said tubes adjacent their ends and forming a continuous series, tube sections connecting the respective top and bottom tubes of said series with said apparatus, pipe sections slip-mounted in said tubes in temperature exchanging relation, said latter sections being engaged with the inner walls of said tubes and having their terminals projecting beyond said ends, means connecting pairs of said terminals and forming a continuous series, pipe sections connecting the respective top and bottom sections of the last mentioned series with said source, and means for opening the first mentioned means for cleaning the first mentioned pipe sections.

8. A device for reducing the temperature of a movable heated liquid comprising in combination a rectangular housing having in its end walls opposed openings, a metal pipe coiled through said openings and having in two of the latter inlet and discharge terminals whereby to provide a connected path for movement of the liquid in one direction, said pipe having parallel portions in said housing; and means for moving a cooling fluid in the opposite direction over said portions; said means including a tube having an inner wall section for each of said portions, an outer wall section spaced from each inner section and terminally unitary with the latter, nipples connecting adjacent outer sections at their terminals, an external refrigerator, and pipe portions passing through the wall of said housing and connecting two of said terminals to said refrigerator.

EDWARD H. BEHRINGER.
LEWIS HATCH.