Oct. 5, 1937. R. K. DAWSON 2,094,774

HEAT EXCHANGE DEVICE

Filed Jan. 14, 1935 2 Sheets-Sheet 1

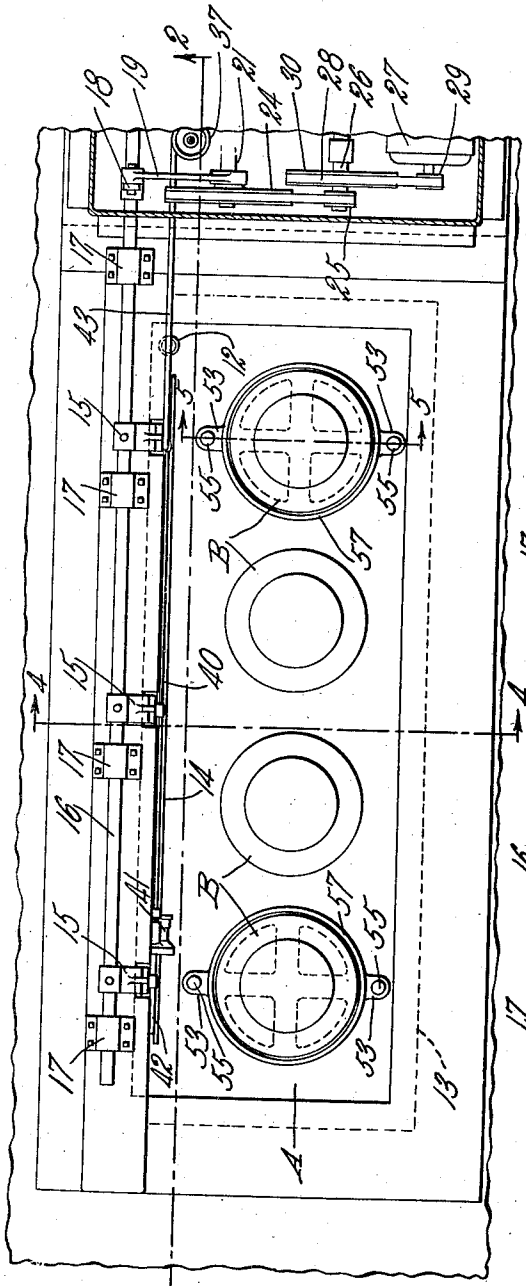


Fig. 1.

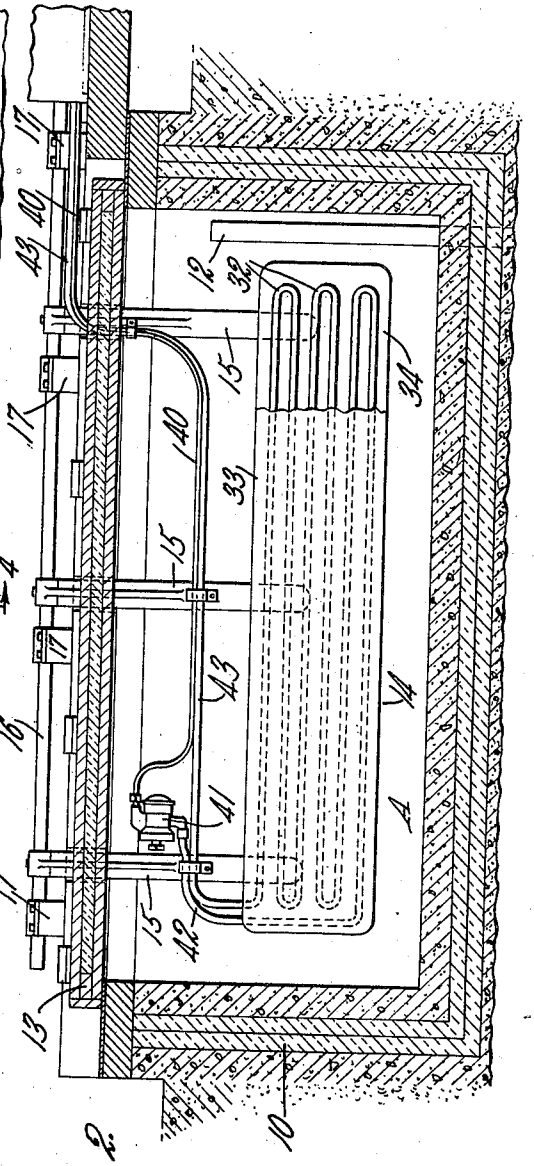


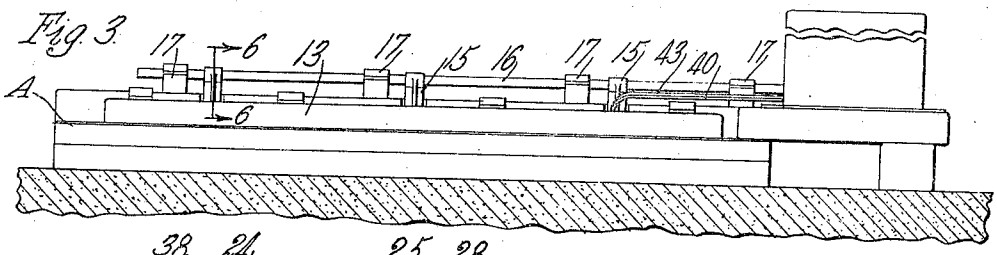
Fig. 2.

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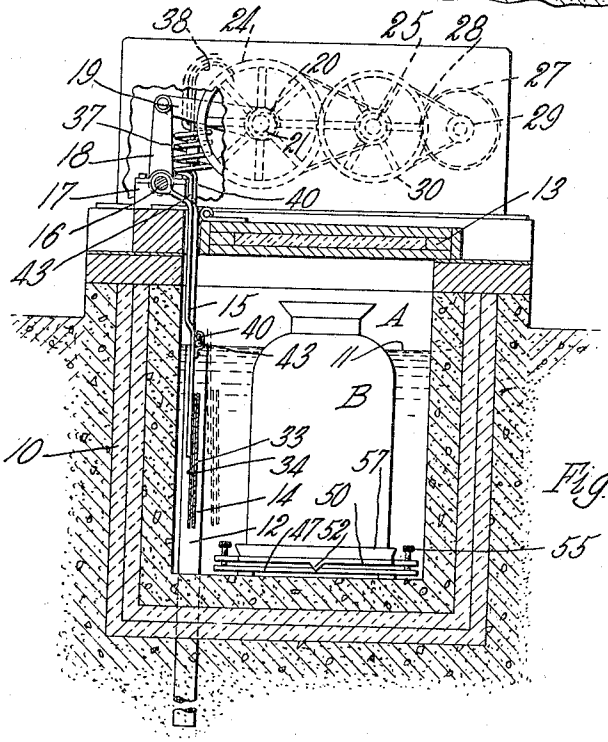


Fig. 4.

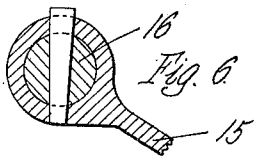


Fig. 6.

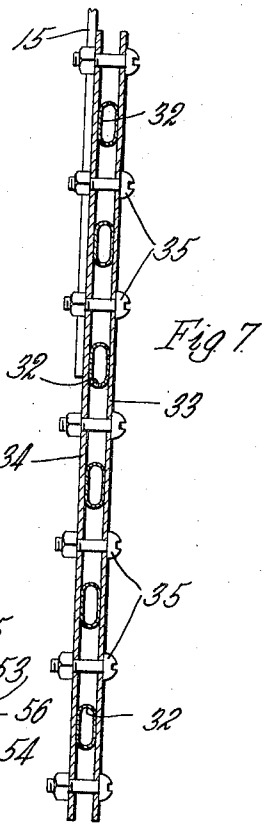


Fig. 7.

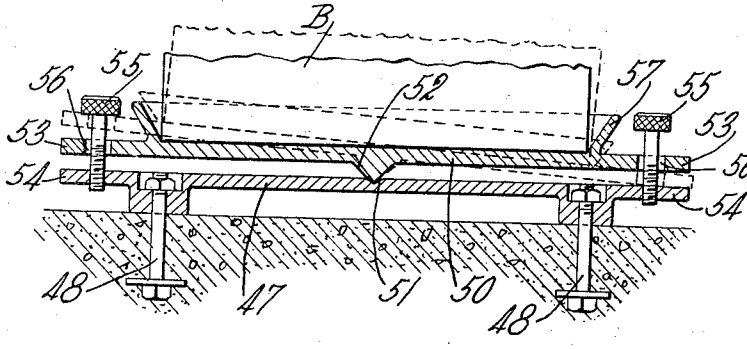


Fig. 5.

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HEAT EXCHANGE DEVICE

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17 Claims. (Cl. 31—4)

This invention relates to heat exchange or transfer devices of the kind in which heat is passed from one liquid to another through a wall of a container of one of the liquids.

The objects of this invention are to provide a device of this kind in which improved means are employed for effecting a rapid and efficient transfer of heat from one body of liquid to another; also to provide a device of this kind with means of improved construction for agitating the liquids during transfer of heat.

Other objects of this invention are to provide a heat transfer device in which agitation of one liquid is transferred to the container of the other liquid for agitating the other liquid during transfer of heat; also to movably support the container for one liquid in the other liquid and subjecting the other liquid to a back and forth movement for agitating the same, which back and forth movement produces a corresponding movement of the container and agitation of the liquid therein; also to provide a heat interchanger in which a single agitating device serves the purpose of modifying the temperature of a liquid and of agitating both the liquid which receives and that which gives up heat.

Other objects of the invention are to provide an improved milk cooler in which milk in cans or containers is agitated by agitation of the cooling water in which the cans or containers are immersed; also to provide an improved and simplified milk cooler which is efficient and rapid in its cooling action and which is of inexpensive construction and which can easily be kept clean; also to provide a cooler of this kind in which the cooling coils for the water are moved to provide agitation of the water.

Other objects of the invention will appear from the following description and claims.

In the accompanying drawings:

Fig. 1 is a fragmentary top plan view of a heat exchange device embodying this invention, with the cover removed.

Fig. 2 is a sectional elevation thereof on line 2—2, Fig. 1.

Fig. 3 is a fragmentary elevation thereof showing the upper portion of the heat exchange device.

Fig. 4 is a transverse sectional elevation thereof on line 4—4, Fig. 1.

Fig. 5 is a fragmentary sectional view on an enlarged scale, on line 5—5, Fig. 1.

Fig. 6 is a fragmentary section on line 6—6, Fig. 3.

Fig. 7 is a fragmentary sectional elevation of the paddle or agitator of the heat exchange apparatus.

By way of illustration, my invention is shown in the accompanying drawings as applied to a milk cooler of the type in which the usual metal milk cans are immersed in water in a tank for cooling the milk. It will be understood, however, that it is not intended to limit this invention for use in connection with milk coolers, since obviously any other liquid may be operated upon by means of the apparatus shown and also the apparatus may be used for heating liquids as well as for cooling the same by merely employing a heating fluid in place of a cooling fluid.

It is well known that in the transmission of heat from one liquid to another, the transfer of heat is greatly speeded up if both liquids are agitated or in motion during the transfer of heat, so that the film of liquid adjacent to the heat conducting wall is removed by this motion and mixed with the main body of liquid. In many cases, however, it is difficult to provide agitating means in both liquids, and particularly in the cooling of milk in milk cans, the employment of agitators in the milk involves not only mechanical difficulties, but also the difficulty of having such agitating means in sterile condition when inserted into the milk. By means of my improved apparatus, it is necessary only to employ a single agitating device to impart motion to both liquids.

In the embodiment of the invention illustrated in the accompanying drawings, one of the liquids is contained in a suitable tank or container A, the walls of which may, if desired, be provided with a heat insulating layer 10. The tank or container shown in the construction illustrated is of a type adapted to be built into the ground and may be made of concrete, but it will be understood that any suitable or desired type of tank may be employed in place of the one shown. The other liquid may be contained in suitable cans or containers B, which, may, for example, be in the form of milk cans. When my improvements are applied to a milk cooler, water may be used in the tank A and the milk cans B are partly immersed in the water, which may extend approximately to the level 11 shown in Fig. 4, and this level may be controlled by means of an overflow pipe 12. 13 represents a cover or lid for the tank A.

Motion may be imparted to the liquid in the tank or container A in any suitable or desired manner, but for reasons that will hereinafter appear such motion is preferably of an intermittent or alternately reversing type. Any suit-

able or desired means may be provided for producing motion of this kind in the liquid in the tank A, and in the construction illustrated, a paddle or oscillatory plate 14 may be employed, that shown having arms 15 extending upwardly out of the liquid in the tank and secured to a rock shaft 16 suitably journalled in bearings 17 which may be mounted on the upper edge of one of the walls of the tank. An upwardly extending rocker arm 18 is also provided on the shaft 16 and motion may be applied to the arm 18 in any suitable or desired manner, for example, by means of a pitman or link 19 pivotally connected at one end to the rocker arm 18 and having the other end thereof extending about an eccentric 20 secured to a shaft 21, see Figs. 1 and 4. This shaft may be driven at a relatively low rate of speed in any suitable or desired manner. In the construction shown, a pulley 24 is secured to the shaft 21 and is driven by means of a belt from a small pulley 25 arranged on a shaft 26. When my invention is applied to a milk cooler, in which the water in the tank A is cooled by means of refrigerating apparatus, the compressor of the refrigerating apparatus (not shown) may be operated from the shaft 26. The shaft 26 may be in turn driven from an electric motor 27 by means of a belt 28 connecting pulleys 29 and 30 on the motor shaft and the compressor shaft 26 respectively. Consequently, when a refrigerating apparatus is employed in connection with my heat exchange apparatus, the oscillatory agitator or paddle 14 may be readily driven from the compressor of the refrigerating apparatus. When no refrigerating apparatus is provided, a similar drive for the agitator may be employed, or if desired, other means may be used for oscillating the agitator.

Means of any suitable or desired form may be employed for modifying the temperature of the liquid in the tank A for the purpose of modifying the temperature of the liquid in the container B. Such temperature modifying means may be employed within the tank or container A or outside of this tank. In the particular construction illustrated, I have incorporated the temperature modifying means in the paddle or agitator 14, but it will be understood that it is not intended to limit this invention to the construction illustrated, in which a temperature modifying fluid is passed through a coil of pipe forming a part of or secured to the agitator 14 and preferably, the pipe forming the coil is flattened or of oval-shaped cross section, as indicated at 32, and this coil may be arranged between two plates 33 and 34 secured together in any suitable manner, for example, by bolts 35, and the plates, furthermore, are preferably arranged in heat conducting relation or in contact with the coil or pipe 32. The arms 15 are, consequently, connected to one or both of the plates of the agitator. By means of the construction shown, the liquid in the tank A contacts not only with the coil 32, but also with the plates 33 and 34, thus providing an extended contact surface through which heat may be exchanged between the liquid and the fluid in the coil. The ends of the coil, or pipes leading to the coil, extend into immediate proximity to the oscillatory shaft 16 and may be connected in any suitable or desired manner with the source or supply of temperature modifying fluid arranged in fixed relation to the tank A. For example, one of the pipes may extend from the vicinity of the shaft 16 to a coil or loop 37, and the other pipe may terminate in a loop 38. Any other means for connecting the movable portions of a pipe or pipes leading to the coil with stationary pipes or conduits may be provided.

The pipes may be connected in any suitable manner with a source of temperature modifying fluid. For example, steam, hot water, or other heating medium may be passed through the pipes and the coil 32, if it is desired to heat the water in the tank A. Similarly brine or other cooling fluid may be passed through the pipes, if it is desired to cool the liquid in the tank A. In the accompanying drawings, I have illustrated a construction by means of which the refrigerant compressed in the refrigerating apparatus (not shown) may be passed through the coil 32. In this case, one of the pipes 40 extending to the coil from the loop 38 may pass to a suitable expansion valve 41 also carried by the agitator 14, and the expanded refrigerant may, consequently, pass to the coil 32 through a pipe or conduit 42 connecting with one end of the coil 32. The other end of the coil is connected with a pipe 43, which in turn connects with the coil or loop 37.

In the operation of the apparatus thus far described, the agitator or paddle 14 will move to a limited extent as indicated by the full line and broken line positions of the agitator in Fig. 4. This movement of the agitator results in a circulation of the liquid in the tank A so that liquid flows past the temperature modifying coil. Furthermore, the paddle in its movement forces the liquid in the tank A toward and from the containers B for the other liquid. This not only causes circulation of the liquid in the tank A about the walls of the container B, but also exerts a certain pressure or force, alternately in opposite directions against the cans or containers B. I have found that by movably supporting the containers B, the pressure exerted on the same by the liquid may be used to move the containers B, and this movement in turn produces a movement of the liquid in the containers B which provides the necessary agitation. This movement or agitation of the liquid in the containers B continually causes the film of liquid adjacent to the walls of the containers B to be mixed with the liquid in the interior portions of the containers, thus providing a continuous mixing or agitation of liquid in the containers, which results in a very much more rapid exchange of heat than takes place in cases where the containers B are stationary.

Any suitable or desired means for movably supporting the containers B may be provided. In the particular construction shown, tiltable or pivoted supports for the containers B are arranged in the bottom of the tank upon which the cans or other containers may be placed. For example, the support may include a fixed base member 47 arranged on the bottom of the tank A and secured thereto by means of bolts 48 suitably anchored in the tank bottom. On this base, a movable or tiltable support 50 is arranged, which may have a swinging, rocking or pivotal connection with the base 47 in any suitable or desired manner. In the construction illustrated, the base 47 is provided with a recess or notch 51 into which a pivot member or edge 52 of the support 50 may engage. This provides for a swinging or rocking movement of the support 50 on the base 47 and this movement may be limited by ears or projections 53 on the support 50 which engage with portions 54 at opposite sides of the base 52. If desired, means may be provided for limiting

the swinging or tilting movement of the support 50 on its base, and for this purpose, adjusting or set screws 55 may be provided which have suitable threaded engagement with the base 47 and extend loosely through enlarged apertures 56 of the supporting member 50. By adjusting these screws, it will be obvious that the movement of the support 50 relatively to the base 47 may be regulated as desired, and furthermore, the bolts 55 serve the purpose of holding the support 50 in operative relation to the base 51. On the upper face of the support 50, a suitable flange 57 may be provided into which the bottom of the container B may extend for holding the container in operative position on the supporting member 50.

It will be noted that the pivotal axis about which the supporting member tilts or swings with reference to the tank extends in a direction approximately parallel to the shaft 16, or in other words, the pivotal member 52 extends crosswise of the direction of movement of the paddle or agitator 14 and consequently, as the paddle moves toward the container B, the liquid will be forced against the side of the container nearest to the paddle, thus exerting pressure on this side of the container and forcing the same to swing away from the paddle. As the paddle moves in the opposite direction, the pressure of water on the portion of the container B nearest to the paddle or agitator would be less than on the opposite side, so that the container B will be tilted toward the paddle. It has been found that this tilting movement of the container B is sufficient to produce a motion of the liquid within the container B in such a manner as to very materially decrease the length of time required to effect the transfer of heat from one liquid to the other.

The construction described has the advantage that the paddle or agitator effects an agitation of both of the liquids which are being treated and that, consequently, it is unnecessary to provide any agitator within the container B. When this invention is used in connection with milk coolers, it has the advantage that the time for cooling a can of milk is very materially reduced, full cooling having been effected with my improved apparatus in one third of the time required in similar apparatus without agitation. By reducing the time required for cooling, the development of bacteria in the milk is correspondingly reduced. The agitation of the milk in the container B as herein described also avoids any possibility of contamination of the milk such as might happen if an agitator were inserted into the milk in the can. Furthermore, it has been found that the agitation of the milk in the cans which has been described also results in the removal of odors from the milk. The construction described also has the advantage that the tank A can easily be kept clean, since the temperature modifying coil 32 is movably mounted, so that the space between the tank wall and the coil 32 is readily accessible for cleaning.

It will be noted that in Fig. 1 only two tiltable supports for the containers B are provided while two other containers rest directly upon the floor of the tank A. It will, of course, be understood that tiltable supports may be provided for all of the containers B, but when my invention is used on a milk cooler for use on dairy farms, it is customary to place the cans containing fresh, warm milk on the tiltable supports, and after they have become cooled, they may be removed from the supports and placed on the floor of the tank while other cans containing fresh warm milk are placed on the tiltable supports. Motion of the containers B is, of course, only necessary during transfer of heat and after the liquid in the containers B has attained approximately the temperature of the liquid in the tank A, the liquid in the containers B may be maintained at this temperature without agitation.

It has been found that by means of the improvements described, agitation of the liquid in the containers B can be provided without any additional expenditure of power than that required for agitating only the liquid in the tank A.

I claim as my invention:

1. A heat exchange device including a container for liquid, a container for another liquid pivotally mounted on said first container to oscillate about a substantially horizontal axis lying approximately in a central upright plane of the second container and having a heat conducting wall, and means for agitating the liquid in said first container, said agitation imparting movement to said second container about said axis to produce movement of liquid in said second container, whereby exchange of heat between said liquids through a wall of said second container is accelerated.

2. A heat exchange device including a container for liquid, means for modifying the temperature of said liquid, a container for another liquid movably mounted on said first container in a substantially balanced position, and having a heat conducting wall, and means for agitating the liquid in said first container, said agitation imparting movement to said second container to produce movement of liquid in said second container, whereby exchange of heat between said liquids through a wall of said second container is accelerated.

3. A heat exchange device including a container for liquid, a second container for liquid movably mounted on said first container in a substantially balanced position and having a heat conducting wall to permit transfer of heat from the liquid in one container to the liquid in the other container, and means for imparting movement to the liquid in said first container alternately in opposite directions to agitate the same and to produce movement of said second container and thus produce agitation of the liquid therein.

4. In a heat exchange device, the combination of a container for a liquid, a second container having a heat conducting wall and at least partly immersed in said liquid, a tiltable support for said second container, and means for imparting agitation to said liquid by causing a portion thereof adjacent to said second container to flow alternately in opposite directions to cause said second container with its tiltable support to move alternately into different positions, to agitate the contents of said second container.

5. In a heat exchange device, the combination of a container for a liquid, a second container having a heat conducting wall and extending into said liquid, a pivoted tiltable support arranged in said first container to receive the bottom of said second container, and agitating means for alternately causing the liquid adjacent to said second container to move in opposite directions in a path substantially at right angles to the axis of the pivot of said support, to cause said second container to tilt first in one direction and then

in another direction, to agitate the contents of said second container.

6. In a heat exchange device, the combination of a container for a liquid, a second container having a heat conducting wall and at least partly immersed in said liquid, a tiltable support for said second container, means for imparting agitation to said liquid by causing a portion thereof adjacent to said second container to flow alternately in opposite directions to cause said second container with its tiltable support to move alternately into different positions, to agitate the contents of said second container, and means for limiting the tilting movement of said support.

7. In a heat exchange device, the combination of a container for a liquid, an oscillatory agitator in said container, a second container extending into the liquid in said first container, and means for supporting said second container in said first container in a manner to enable said second container to oscillate about an axis approximately parallel to the axis of oscillation of said agitator, whereby movement of liquid in said first container by said agitator results in corresponding oscillation of said second container to agitate the contents of said second container.

8. In a milk cooler, the combination of a container for water, a pivoted support in said container for a milk can, and arranged to permit a milk can to tilt in opposite directions from its upright position, and a paddle in said container movable toward and from the milk can in a direction substantially perpendicular to the pivotal axis of the support, to cause the movement of the water to produce corresponding movement of the milk can to agitate the milk.

9. The combination of a tank containing liquid, an agitating paddle arranged in said tank to produce circulation of said liquid, said paddle including a coil of pipe through which a temperature modifying medium may be passed, and a pair of plates arranged at opposite sides of said coil and secured in heat conducting relation to said coil.

10. The combination of a tank containing liquid, an agitating paddle arranged in said tank to produce circulation of said liquid, said paddle including a coil of pipe through which a temperature modifying medium may be passed, a pair of plates arranged at opposite sides of said coil and secured in heat conducting relation to said coil, means for pivotally supporting said paddle on said tank, and means for moving said paddle about said pivot.

11. The combination of a tank containing liquid, an agitating paddle arranged in said tank to produce circulation of said liquid, said paddle including a coil of pipe through which a temperature modifying medium may be passed, the pipe comprising said coil being flattened into substantially elliptical cross sectional shape, and a plate secured in heat conducting relation to a flattened face of said pipe.

12. In a milk cooler, the combination of a tank for a cooling liquid, a paddle pivotally mounted on said tank to oscillate to produce alternating movement of liquid in said tank, means for cooling the liquid in said tank, a support for a milk can pivotally mounted in said tank to permit a milk can to swing about the pivotal mounting to a limited extent to produce agitation of the milk in the can, the pivotal axis of the mounting of said support extending substantially parallel to the pivot of said paddle, whereby the paddle causes the liquid in said tank to move relatively to said container, to produce movement of said can about the pivot of its support.

13. A heat exchange device including a container for liquid, a second container having a wall of heat conducting material and extending into the liquid in said first mentioned container, a support in said first container on which said second container may rest, said support being pivotally arranged with reference to said first container to permit said second container to tilt, means for limiting the tilting movement of said support, and means for causing portions of the liquid in said first container to flow against said second container in a direction to cause said second container to move about the pivot of said support, to produce agitation of liquid in said second container.

14. A heat exchange device including a container for liquid, a container for another liquid movably arranged in said first container and having imperforate heat conducting walls to prevent mixing of said liquids, and a paddle arranged in said first container and movable toward and from said second container to impart movement thereto solely through the medium of the liquid in said first container to increase the passage of heat from one liquid to the other.

15. A heat exchange device according to claim 14, in which the paddle has mounted thereon a coil of pipe through which a temperature modifying medium may be passed.

16. A heat exchange device including a container for liquid, a container for another liquid, a tiltable support in said first container adapted to receive said second container, and a paddle arranged in said first container and movable toward and from said second container to impart movement thereto solely through the medium of the liquid in said first container.

17. A heat exchange device including a container for liquid, a container for another liquid movably arranged in said first container, and a substantially upright paddle arranged in said first container and mounted to swing toward and from said second container about an axis arranged above the paddle, to impart movement to said second container solely through the medium of the liquid in said first container.

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