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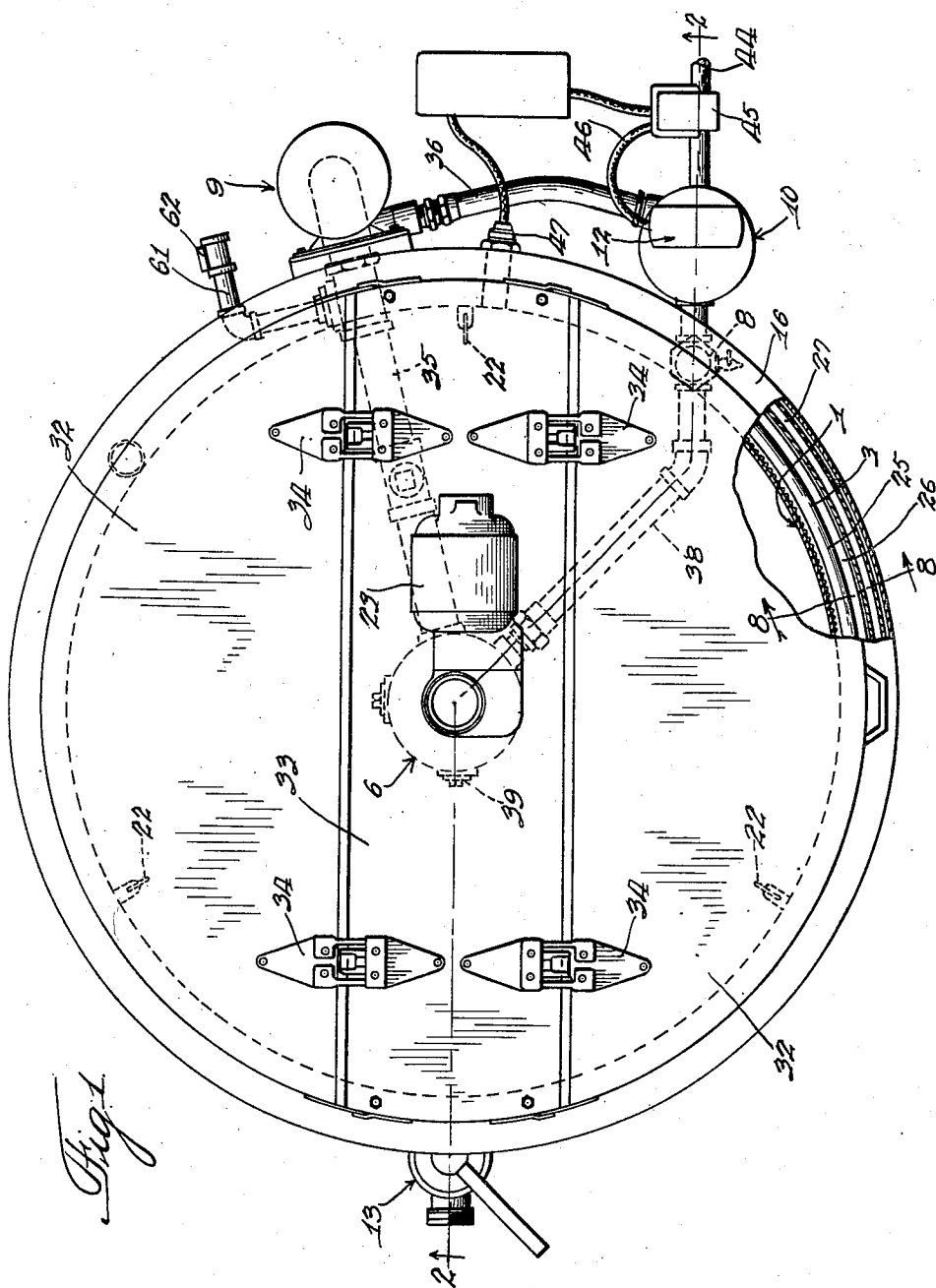
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HEAT-TRANSFER APPARATUS

Filed Sept. 25, 1937

4 Sheets-Sheet 1



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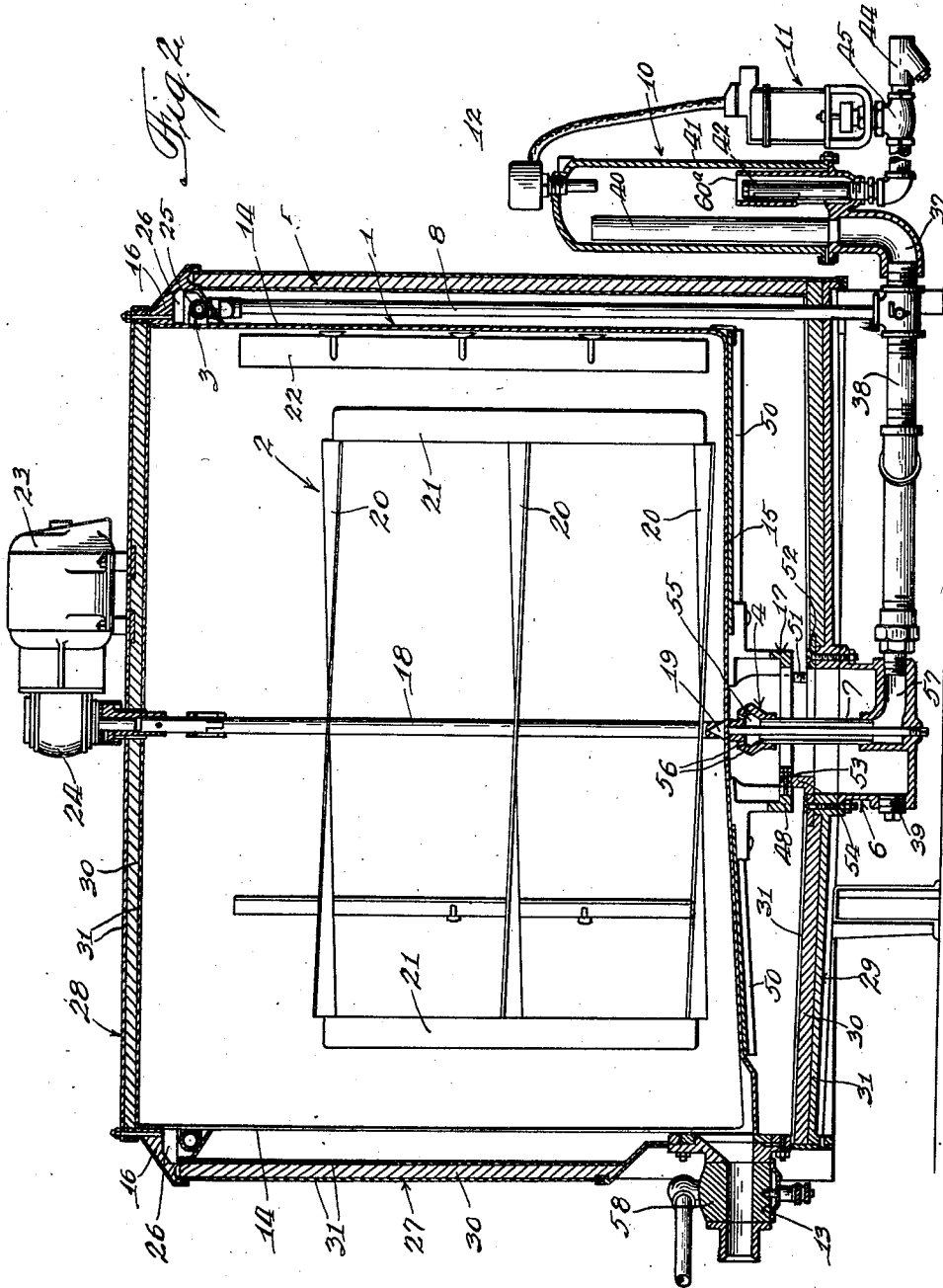
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HEAT-TRANSFER APPARATUS

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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

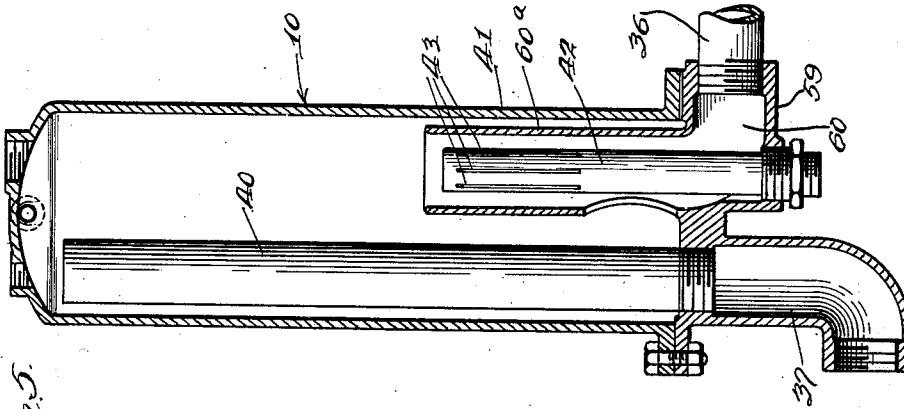


Fig. 5.

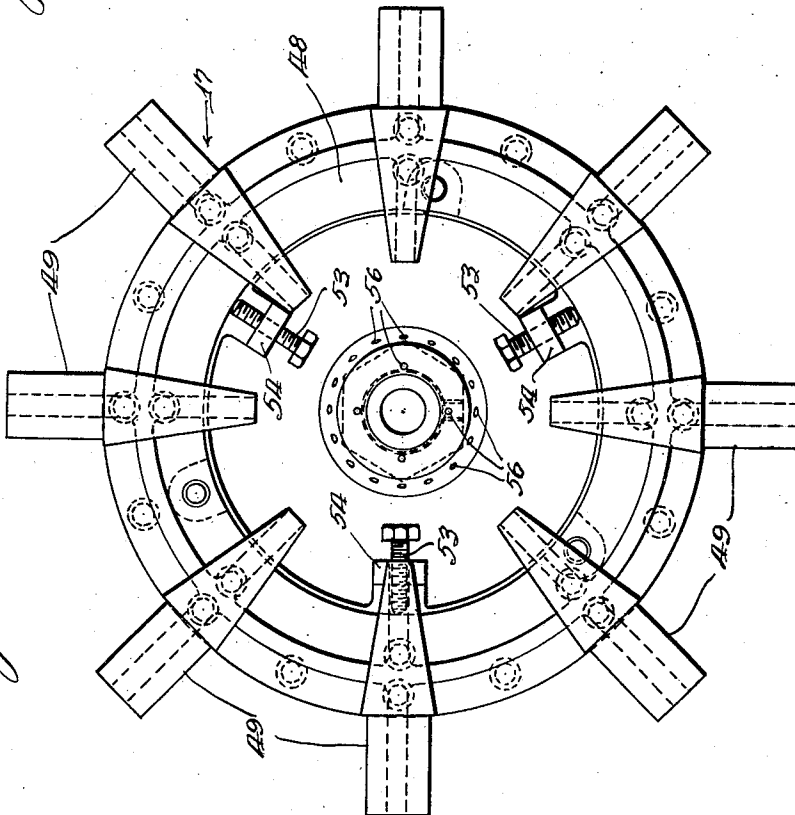


Fig. 3.

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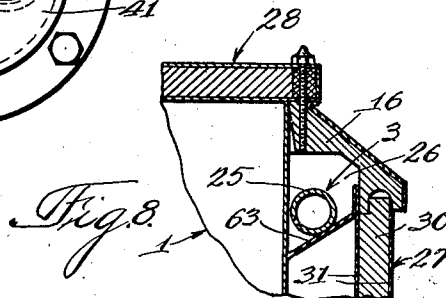
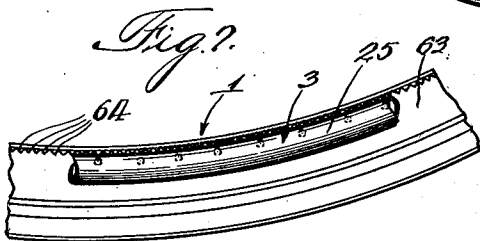
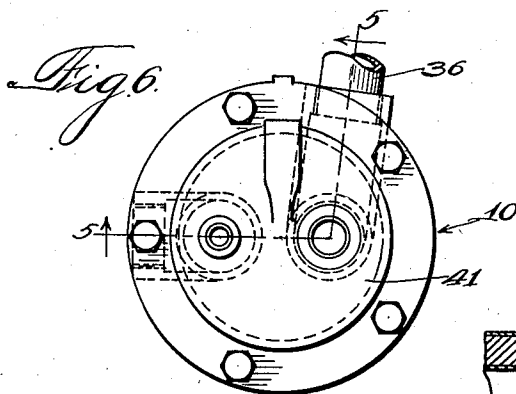
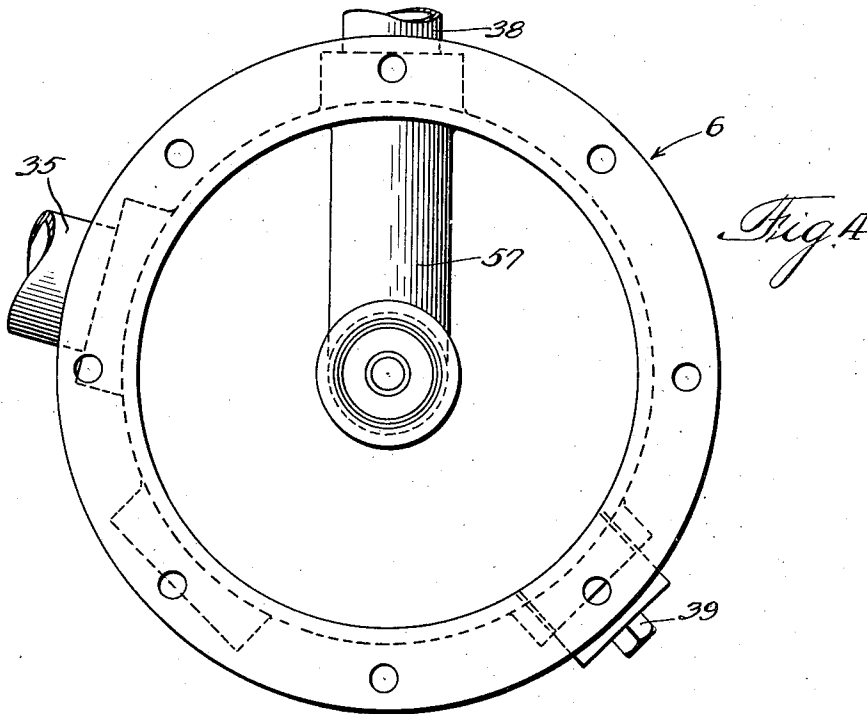
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HEAT-TRANSFER APPARATUS

Filed Sept. 25, 1937

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,196,012

HEAT-TRANSFER APPARATUS

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Application September 25, 1937, Serial No. 165,712

4 Claims. (Cl. 257—189)

My invention relates to heat-transfer apparatus. More specifically, it relates to heat-transfer apparatus comprising a tank for containing a liquid with respect to which heat is to be transferred and means for causing a film of heat-transferring liquid to flow over the outer surface of the walls of the tank.

One of the objects of my invention is to provide heat-transfer apparatus of the type indicated which will be efficient and rapid in the transfer of heat.

A further object of my invention is to provide improved heat-transfer apparatus of the type indicated, in which means are provided for causing a film of heat-transferring liquid to flow downwardly over the outer surface of the side walls of the tank and for causing a film of heat-transferring liquid to flow over the bottom surface of the tank.

A further object of my invention is to provide improved means for supplying steam to heat the liquid which is being circulated to effect the transfer of heat.

A further object of my invention is to provide improved means for draining and recirculating the heat-transfer liquid. Further objects and advantages of the invention will be apparent from the description and claims.

In the drawings—

Figure 1 is a plan view of a film flow heat-transfer apparatus embodying my invention;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a plan view of the tank-supporting spider and the jet means for causing a film flow over the bottom of the tank;

Fig. 4 is a plan view of a liquid drainage receptacle or sump underneath the tank;

Fig. 5 is a sectional view of a mixing chamber or reservoir substantially on the line 5—5 of Fig. 6;

Fig. 6 is a plan view of this mixing chamber;

Fig. 7 is an enlarged detail plan view showing a portion of the tank with the cover removed; and

Fig. 8 is a vertical sectional view on the line 8—8 of Fig. 1.

Referring to the drawings in detail, the construction shown comprises a tank 1 for containing a liquid with respect to which heat is to be transferred, means 2 for stirring and agitating the liquid in the tank to cause all parts of the liquid to come in contact with the heat-transfer surfaces, means 3 for causing a film of heat-transferring liquid to flow downwardly over the outer surface of the side walls of the tank 1, means 4 for projecting a film of heat-transferring

liquid radially outwardly from the central portion of the bottom of the tank 1 over the outer tank surface, a heat-insulating housing 5 surrounding the tank and spaced therefrom to provide space for the liquid film flow, a drainage receptacle 6 (Fig. 5) underneath the housing for receiving the liquid which flows over the tank surfaces, a conduit 7 extending upwardly from the drainage receptacle 6 for supplying liquid for the radial film flow, a conduit 8 extending through the bottom wall of the housing upwardly in the space between the side wall of the tank and housing for supplying liquid for said downward flow film, a pump 9 for withdrawing liquid from the drainage receptacle and delivering it to both the conduits, a liquid reservoir 10 in the line between the pump 9 and conduits 7 and 8, means 11 for supplying steam to said liquid receptacle, thermostatic means 12 for controlling the supply of steam, and a discharge outlet 13 for the liquid in the tank 1.

The tank 1 may be of any suitable material which will not be injured by the liquids with which it is in contact, stainless steel being suitable for this purpose. It is, in general, cylindrical in form having cylindrical side walls and a slightly sloping bottom wall 15. The upper edge of the cylindrical portion is supported on the annular breast portion 16 of the insulating housing. The lower sloping bottom 15 is supported on a spider 17 (Figs. 2 and 3) which is adjustable to a limited extent, both vertically and laterally. The stirring and agitating means 2 comprise a rotatable vertical shaft 18 supported on a conical step bearing 19 on the bottom of the tank 1, a plurality of radially-extending, stirring blades 20 secured to this shaft, a plurality of vertically-extending blades 21 secured to the ends of the radially-extending blades 20, a plurality of stationary blades 22 secured to the side walls of the tank 1, and a motor 23 and transmission 24 for driving the vertical shaft 18.

The means 3 for causing the downward flow film comprises an annular distributing pipe 25 lying in an annular chamber 26 surrounding the upper portion of the tank and the vertically-extending pipe 8 for supplying liquid to this annular conduit. The heat-insulating housing 5 comprises a cylindrical portion 27 surrounding the tank 1, an upper cover portion 28 secured to the breast portion of the insulating housing and a lower bottom portion 29 lying underneath the tank. In general, the walls of this heat-insulating housing may be formed of a layer of heat-insulating material 30, such as cork, held in place

between two metal wall members 31 which may, if desired, be of stainless steel.

For affording access to the tank, the cover portion of the insulating housing may be provided with a pair of doors 32 hinged to the central portion 33 of the cover, as indicated at 34. The motor 23 and transmission 24 for driving the agitator may be mounted on this central portion 33 of the cover.

The circulation of the heat-transferring liquid is from the sump or receptacle 6 underneath the tank, through the conduit 35 (Figs. 1 and 4) leading to the pump 9, from the pump 9 to the mixing reservoir 10 through the conduit 36, from the mixing reservoir 10 to the conduits 7 and 8, through the conduits 37 and 38, and from the conduits 7 and 8 to form a film flow along the outer surface of the tank 1, the film flow draining into the sump 6.

If it is desired to drain the liquid from the sump 6 and from underneath the tank 1, the drain plug 39 (Figs. 1, 2 and 4) may be unscrewed to enable the escape of the liquid. The liquid is discharged from the mixing reservoir by means of a standpipe 40 (Figs. 2 and 5) located within the casing 41, the lower end of which stand pipe is in communication with the discharge conduit 37 leading from the mixing reservoir. When the water is pumped into the reservoir, it fills the reservoir and then flows downwardly through the standpipe 40 into the conduit 37 leading to the conduits 7 and 8.

Steam is supplied to the liquid in the mixing reservoir from a discharge nozzle 42 having a number of slotted orifices 43 in its side through which the steam is delivered to the liquid. Steam is supplied to this slotted nozzle 42 from a conduit 44 connected with the steam supply. The amount of steam supplied to the mixing reservoir is controlled by a motor-operated valve 45, which motor-operated valve in turn is controlled by the thermostat 12 subjected to the temperature at the upper end of the mixing reservoir 10. Any suitable thermostatic control and motor valve may be used for this purpose, that shown comprising a construction in which the thermostatic valve is controlled from the thermostat by means of a cable 46 connecting the thermostat with the motor-operated valve. If desired, means may be provided whereby when the temperature of the liquid in the processing tank 1 reaches a predetermined point, the thermostat 12 will be controlled in such a way that thereafter the temperature in the mixing chamber 10 will be maintained at a lower degree. Any suitable means may be provided for that purpose, that shown comprising a thermostatic element 47 subjected to the temperature of the material in the tank which acts in such a way as to switch the contact controlled by the thermostat in the mixing reservoir when the temperature of the liquid in the processing tank 1 reaches a predetermined point.

The spider 17 which supports the bottom of the tank comprises a central hub portion 48 from which radial arms 49 extend, to which may be secured radially-extending supporting members 50, on which the bottom of the tank 1 rests. The hub portion 48 may be adjusted vertically by means of screws 51 having a threaded engagement with a supporting ring 52 secured to the bottom wall of the housing, the hub portion 48 of the spider resting on the upper ends of said screws. The hub portion of the spider may be adjusted laterally by means of screws 53 threaded

into upwardly-extending ears 54 on the collar and engaging the hub 48. The distributing head 4 for causing the film to flow over the bottom surface of the tank has a central chamber 55 to which the liquid is delivered from the vertical conduit 7 and has a plurality of radially-extending jet openings 56 which deliver jets of liquid to the under surface of the tank 1, causing a film of liquid to flow radially and outwardly along the under side of the tank. The drainage receptacle or sump 6 underneath the tank is provided with a conduit 57 affording communication between the supply pipe 38 and the vertical standpipe 7. The discharge outlet 13 for draining the liquid from the tank 1 may be provided with a suitable rotary valve 58 for controlling the discharge. The lower casting 59 of the mixing reservoir is provided with a passage 60 for connecting the pipe 36 from the pump with the vertical discharge pipe 60^a surrounding the steam nozzle 42.

In use, the tank 1 is filled with a liquid to be treated, such as milk, or the like. Heat-transferring liquid in the desired amount is supplied to the circulation system through the supply pipe 61, which is then closed by means of the valve 62. The motor 23 is put in operation to start the agitation of the liquid in the tank 1, the motor for the pump 9 is started to put in circulation the heat-transferring liquid, and steam is admitted to the passage 44 leading to the thermostatically-controlled valve 45. The circulation caused by the pump 9 delivers the heat-transferring liquid to the annular distributing pipe 25 at the upper edge of the tank 1 to cause a downward film flow and also delivers liquid to the distributing head 4 which causes the radial film flow over the bottom surface of the tank 1. The flow from these films collects in the bottom of the heat-insulating housing 5 and flows down into the sump or drainage receptacle 6 from which it is drawn off by means of the pump 9 through the pipe 35. The thermostat 12 at the upper end of the mixing reservoir 10 controls the admission of steam in such a way as to maintain the desired temperature at the upper end of the mixing reservoir and this desired temperature in turn may be controlled by means of the thermostat 47 which is subject to the temperature of the liquid in the tank 1. This latter thermostatic control is such that until the temperature of the liquid in the tank 1 reaches the desired level the mixing chamber temperature will be relatively high, and such that when the desired temperature of the liquid in the tank has been reached the temperature maintained in the mixing chamber will be relatively lower. This thermostatic control relieves the operator from closely watching the heating and holding process as it automatically takes care of the entire operation from start to finish.

The function of the steam control thermostat is to regulate liquid temperature at the point for which the thermostat is set. This thermostat may have two contact points, one of which limits the liquid temperature during heating while the other limits the liquid temperature while holding at the desired temperature. Thus, if the liquid in the tank is below pasteurizing temperature, the temperature in the mixing chamber may be maintained at approximately 160 degrees, but at the instant the temperature of the liquid in the tank reaches a pasteurizing or other predetermined temperature, the selector switch is operated in such a way that the steam-controlling thermostat thereafter controls at a lower temperature. The steam supplied to the reservoir 10

through the slots 41 mixes with the liquid supplied through the pipe 60^a, thus maintaining the liquid at the desired temperature.

5 The annular distributor pipe 25 is supported by a sheet metal member 63 which inclines downwardly and inwardly toward the tank for causing the liquid supplied through the spaced jet openings in the pipe 25 to drain toward the tank. This sheet metal member is provided with a series of
10 teeth 64, the crests of which engage the sides of the tank and cause the liquid to drain against the sides of the tank and flow downwardly along the sides of the tank.

15 Further modifications will be apparent to those skilled in the art and it is desired, therefore, that the invention be limited only by the prior art and the scope of the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

20 1. A heat-transfer apparatus comprising a tank for containing a liquid with respect to which heat is to be transferred, said tank having a substantially flat bottom and having side walls extending upwardly from the bottom, means for
25 directing a film of heat transferring liquid downwardly over the outer surface of said side walls and jet means for projecting a film of heat transferring liquid radially outwardly from the central portion of the bottom of the tank over the
30 outer surface of said bottom.

2. A heat-transfer apparatus comprising a tank for containing a liquid with respect to which heat is to be transferred, said tank having a substantially flat bottom and having side walls extending upwardly from the bottom, means for
35 directing a film of heat transferring liquid downwardly over the outer surface of said side walls and jet means for projecting a film of heat transferring liquid radially outwardly from the central portion of the bottom of the tank over the
40 outer surface of said bottom, a drain receptacle underneath said tank for receiving the liquid which flows over the tank surfaces, and means for withdrawing the liquid from said drain receptacle and delivering it to said film flow causing
45 means.

3. A heat-transfer apparatus comprising a tank for containing a liquid with respect to which heat is to be transferred, said tank having a substantially flat bottom and having side walls ex-
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tending upwardly from the bottom, means for directing a film of heat transferring liquid downwardly over the outer surface of said side walls and jet means for projecting a film of heat transferring liquid radially outwardly from the central
5 portion of the bottom of the tank over the outer surface of said bottom, a heat-insulating housing surrounding said tank and spaced therefrom to provide space for said liquid film flow, a drain receptacle underneath said housing for receiving
10 the liquid which flows over the tank surfaces, a conduit extending upwardly from said drain receptacle for supplying liquid for said radial flow film, a conduit extending through the bottom wall of the housing and upwardly in the
15 space between the side wall of the tank and the housing for supplying liquid for said downward flow film, means for withdrawing liquid from said drain receptacle and delivering it to both said conduits, and means for supplying
20 steam to the liquid supplied to both conduits.

4. A heat-transfer apparatus comprising a tank for containing a liquid with respect to which heat is to be transferred, said tank having a substantially flat bottom and having side walls
25 extending upwardly from the bottom, means for directing a film of heat transferring liquid downwardly over the outer surface of said side walls and jet means for projecting a film of heat transferring liquid radially outwardly from the central
30 portion of the bottom of the tank over the outer surface of said bottom, a heat-insulating housing surrounding said tank and spaced therefrom to provide space for said liquid film flow, a drain receptacle underneath said housing for receiving
35 the liquid which flows over the tank surfaces, a conduit extending upwardly from said drain receptacle for supplying liquid for said radial flow film, a conduit extending through the bottom wall of the housing and upwardly in the
40 space between the side wall of the tank and the housing for supplying liquid for said downward flow film, means for withdrawing liquid from said drain receptacle and delivering it to both said conduits, a liquid receptacle in the line between said pump and conduits in which a liquid
45 level is maintained, and means for supplying steam to said liquid receptacle below the liquid level.

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