

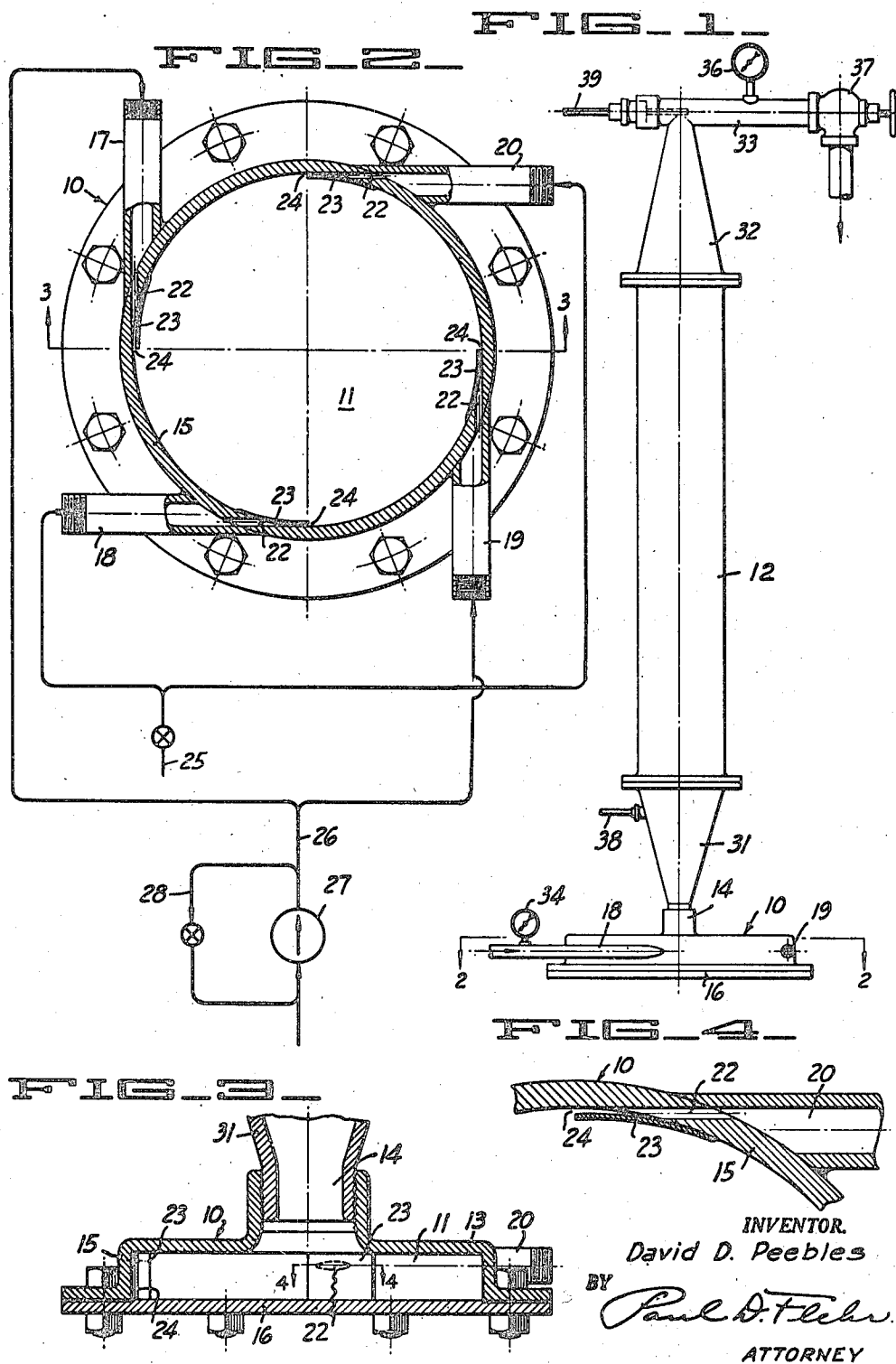
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D. D. PEEBLES

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HEATING APPARATUS

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HEATING APPARATUS

David D. Peebles, Hillsborough, Calif., assignor to
Golden State Company, Ltd., San Francisco,
Calif., a corporation of Delaware

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This invention relates generally to apparatus and methods for the heat treatment of various liquid food products, particularly lacteal materials such as whole milk, skim milk and whey.

In the treatment of lacteal materials and other liquid food products containing components sensitive to heat, it is frequently necessary to heat the material to temperatures ranging from say 175 to 300° F., for short periods of time. Conventional heaters or heat exchangers of the tubular type are not well adapted for this purpose because it is difficult to avoid overheating or burning, and it is difficult to prevent incrustation or building up of solid material upon the walls of the heat exchange tubes.

In place of tubular heaters it has been proposed to employ heaters of the type in which steam is directly introduced into the liquid material. While such equipment avoids incrustation, it has been found that simple injection of the steam into a body of liquid tends to cause localized overheating with resulting burning of the material.

It is an object of the present invention to provide an improved apparatus and method for heating lacteal materials and like food products, which will utilize direct contact of steam with the liquid material, but which will avoid objectionable burning.

A further object of the invention is to provide an apparatus and method of the above character enabling accurate control over the time period of heat treatment, and without undesired retention or carry back of a portion of the treated material.

Further objects of the invention will appear from the following description in which the preferred embodiment has been set forth in detail in conjunction with the accompanying drawing.

Referring to the drawing—

Figure 1 is a side elevational view illustrating diagrammatically apparatus incorporating the invention, and capable of carrying out the present method.

Figure 2 is a cross-sectional view on an enlarged scale taken along the line 2—2 of Figure 1, and diagrammatically indicating piping connections.

Figure 3 is a cross-sectional view taken along the line 3—3 of Figure 2.

Figure 4 is a cross-sectional detail on an enlarged scale taken along the line 4—4 of Figure 3.

The apparatus illustrated in the drawing consists generally of a heater 10 formed to provide

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an inner treatment chamber 11. The outlet from the heater, as will be presently explained, connects with the timing or retention tank 12.

The heater 10 is circularly contoured and consists of a top wall 13, provided with the axial outlet 14, and an annular peripheral wall 15. Bottom wall 16 is formed by a removable plate. Preferably the heater is disposed horizontally, although in certain instances it may be disposed vertically and connected to tank 12 by an elbow.

For the introduction of liquid and steam into the heater 10, a plurality of pipes 17, 18, 19 and 20 connect tangentially through the peripheral wall 15. The number of these pipes may vary according to requirements. In this instance pipes 17 and 19 serve to introduce liquid, while pipes 18 and 20 are for introduction of steam. A special orifice means is provided for communication between these pipes and inner chamber 11, whereby the introduction is distributed over substantially the entire length of the distance between walls 13 and 16. In the construction illustrated in Figure 4 pipe 20 for example connects with an orifice 22 which is simply a round hole bored tangentially through the wall 15. A metal plate 23 is fixed across the outlet of opening 22, whereby communication with the interior of the chamber 11 is confined to a narrow slit 24 which communicates tangentially with chamber 11. Orifice means of this type can be used for both introduction of liquid and steam, but is particularly desirable for introduction of steam as will be presently explained.

As illustrated diagrammatically in Figure 2 pipes 18 and 20 are shown connected to the common steam supply pipe 25. Pipes 17 and 19 are connected to the common liquid supply pipe 26. A suitable pump 27 serves to supply the liquid to pipe 26, and to enable adjustment of pressure and flow rate, this pump can be provided with a valve controlled by-pass line 28.

The size of the timing or retention tank 12 depends upon the time period of retention desired. Where the period of heat treatment is to be relatively short, this tank can be omitted in entirety, or one can depend upon the prolonged heat treatment occasioned by the piping connected to the outlet 14 of the heater. The retention tank illustrated is cylindrical and disposed in an upright position. It has a lower conical shaped portion 31 for connection with the outlet 14. It has an upper conical shaped portion 32 which connects to the delivery pipe 33, which for example may lead to vacuum evaporating equipment. To facilitate pressure and temperature control pres-

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sure gauges 34 and 35 can be provided, discharge pipe 33 can be provided with throttling valve 37, and thermometers or like temperature measuring devices 38 and 39 can be provided in connection with the lower and upper ends of tank 12 in order to check the temperatures of the liquid material at the beginning and at the end of the retention period.

Operation of the apparatus described, and carrying out the present method, can now be explained as follows: Pump 27 is adjusted to deliver the liquid material to be treated to the heater 10 at the desired flow rate and pressure. The heater and the retention tank 12 are maintained completely filled with liquid, and the flow rate is maintained constant. Liquid and steam are continuously injected into the periphery of the heating chamber 11 and because of the relatively narrow elongated orifices 24, the steam actually enters the chamber 11 as a sheet whereby it contacts a relatively large surface area of the liquid material. Tangential introduction of liquid and steam causes rapid swirling of the liquid material in chamber 11 with an acceleration of the whirling speed as the stream of material flows inwardly and passes through the outlet 14. Some swirling continues as the liquid passes upwardly through the retention tank 12. In the heating chamber 11 transfer of heat from the steam to the liquid material heats the latter to the desired temperature level, which may vary between say 175 to 300° F. or even higher. It should be understood that this temperature range is specified by way of example rather than limitation. After being heated to the desired elevated temperature the liquid material remains in the chamber 11 for only a short interval of time, after which it passes into the retention tank 12 and gradually progresses upwardly through this tank to the discharge pipe 33. Thus the heat treatment can be prolonged for a predetermined period of time, after which the material can be abruptly cooled, as for example by permitting it to expand in a partial vacuum.

Because of the manner in which steam is introduced and contacted with the liquid, detrimental localized burning of the material is prevented. In addition there is no tendency for the equipment to mix back or retain portions of the liquid material for an undue period of time beyond the desired time of retention. This is because the material is positively and progressively transferred through the heater 11 and from this heater through the retention tank. Once liquid has been contacted with the inflowing steam it is not again contacted thereafter, but is immediately caused to flow inwardly toward the outlet 14. The dimensioning of chamber 11 contributes to this result in that the height of the chamber is relatively small and preferably a minor fraction of its diameter.

I claim:

1. Apparatus for heating a liquid by direct contact with steam, which comprises, a casing providing a circular peripheral wall and end walls forming an internal circular chamber, the length of said chamber measured in the direction of its axis being a minor fraction of the diameter of said chamber, said peripheral wall having a plurality of apertures extending therethrough and spaced circumferentially of said wall, each of said apertures extending substantially the length of said peripheral wall and being directed in the same circumferential direction tangential to the inner face of said peripheral wall, said apparatus

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having a liquid conduit connected to one of said apertures to deliver liquid into said chamber tangentially of said peripheral wall, one of said end walls having a centrally disposed outlet therein so that said liquid spirals inwardly in said chamber and discharges through said outlet, said apparatus having a steam conduit connected to another of said apertures to deliver steam into said chamber tangentially of said peripheral wall into contact with the outer peripheral surface of the spiral of liquid in said chamber so as to uniformly and rapidly heat said liquid.

2. Apparatus for heating a liquid by direct contact with steam, which comprises, a casing providing a circular peripheral wall and end walls forming an internal circular chamber, the length of said chambers measured in the direction of its axis being a minor fraction of the diameter of said chamber, said peripheral wall having a plurality of apertures extending therethrough and spaced circumferentially of said wall, each of said apertures extending substantially said length of the peripheral wall and being directed in the same circumferential direction tangential to the inner face of said peripheral wall, said apparatus having a liquid conduit connected to one of said apertures to deliver liquid into said chamber tangentially of said peripheral wall, one of said end walls having a centrally disposed outlet therein so that said liquid spirals inwardly in said chamber and discharges through said outlet, said apparatus having a steam conduit connected to another of said apertures to deliver steam into said chamber tangentially of said peripheral wall and parallel to the outer peripheral surface of the spiral of liquid in said chamber, said orifices being in the form of narrow slits having their major dimension parallel to the axis of said chamber so as to cause said steam to uniformly and rapidly heat said liquid.

3. Apparatus for heating a liquid by direct contact with steam, which comprises, a casing providing a circular peripheral wall and end walls forming an internal circular chamber having a vertical axis, the length of said chamber measured in the direction of its axis being a minor fraction of the diameter of said chamber, said peripheral wall having a plurality of apertures extending therethrough and spaced circumferentially of said wall, each of said apertures extending substantially the length of said peripheral wall and being directed in the same circumferential direction tangential to the inner face of said peripheral wall, said apparatus having a liquid conduit connected to one of said apertures to deliver liquid into said chamber tangentially of said peripheral wall, the upper one of said end walls having a centrally disposed outlet therein so that said liquid spirals inwardly in said chamber and discharges through said outlet, said apparatus having a steam conduit connected to another of said apertures to deliver steam into said chamber tangentially of said peripheral wall into contact with the outer peripheral surface of the spiral of liquid in said chamber so as to uniformly and rapidly heat said liquid, and a vertically extending retention tank having a downwardly converging conical shaped portion at its lower end connected to said centrally disposed outlet so that the heated liquid spirals upwardly in said retention tank.

DAVID D. PEEBLES.

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