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E. K. KINTNER
PASTEURIZING APPARATUS

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2 Sheets-Sheet 1

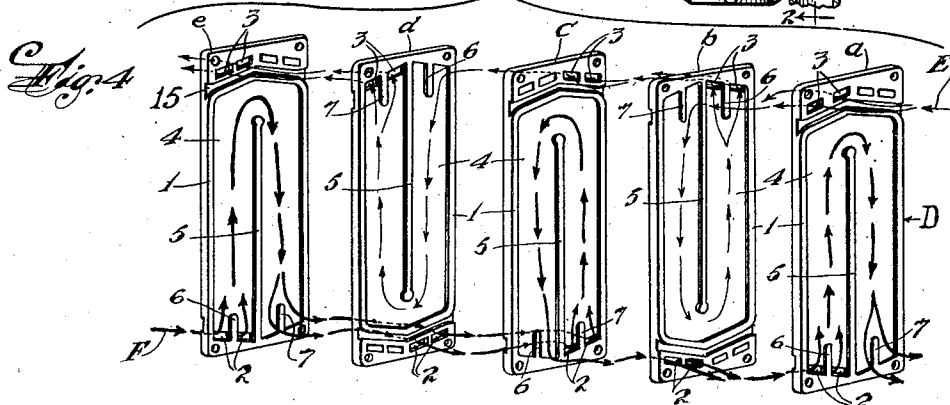
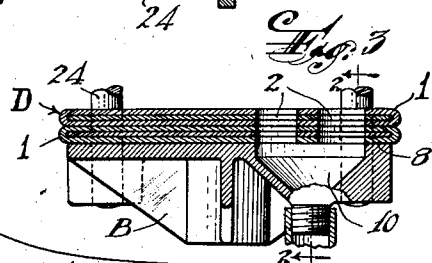
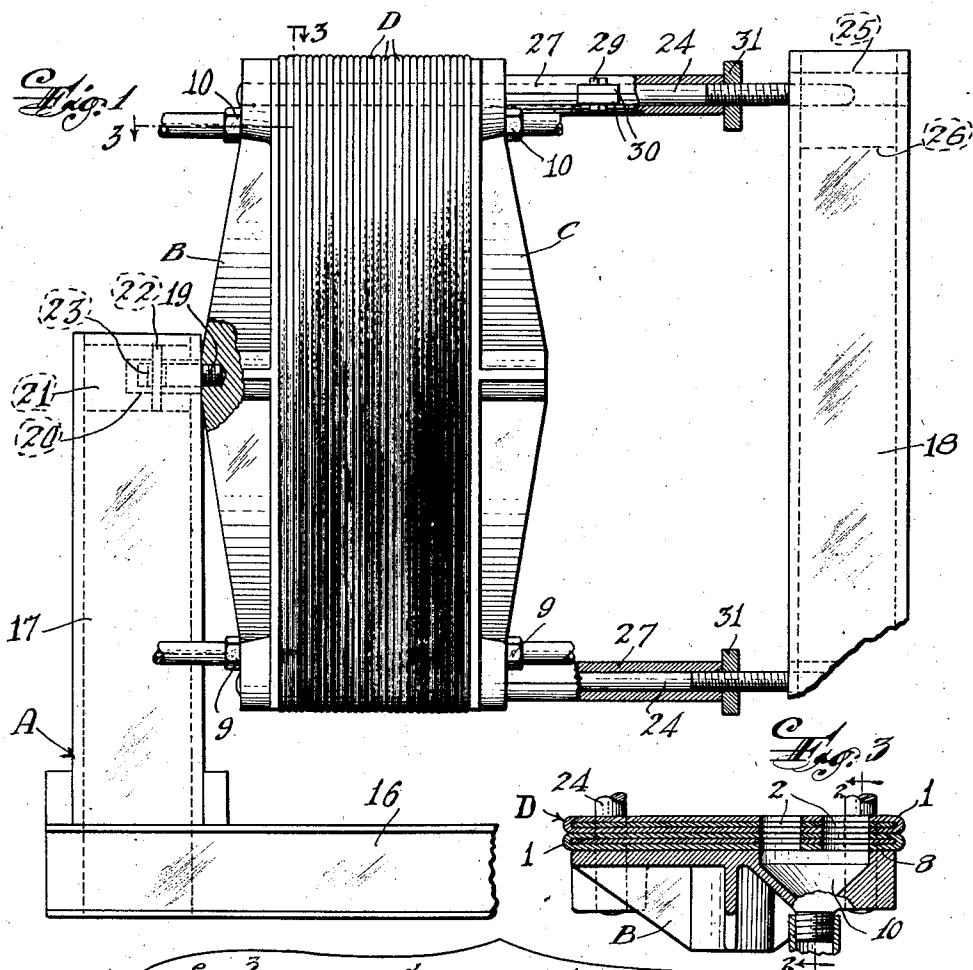


Fig. 4

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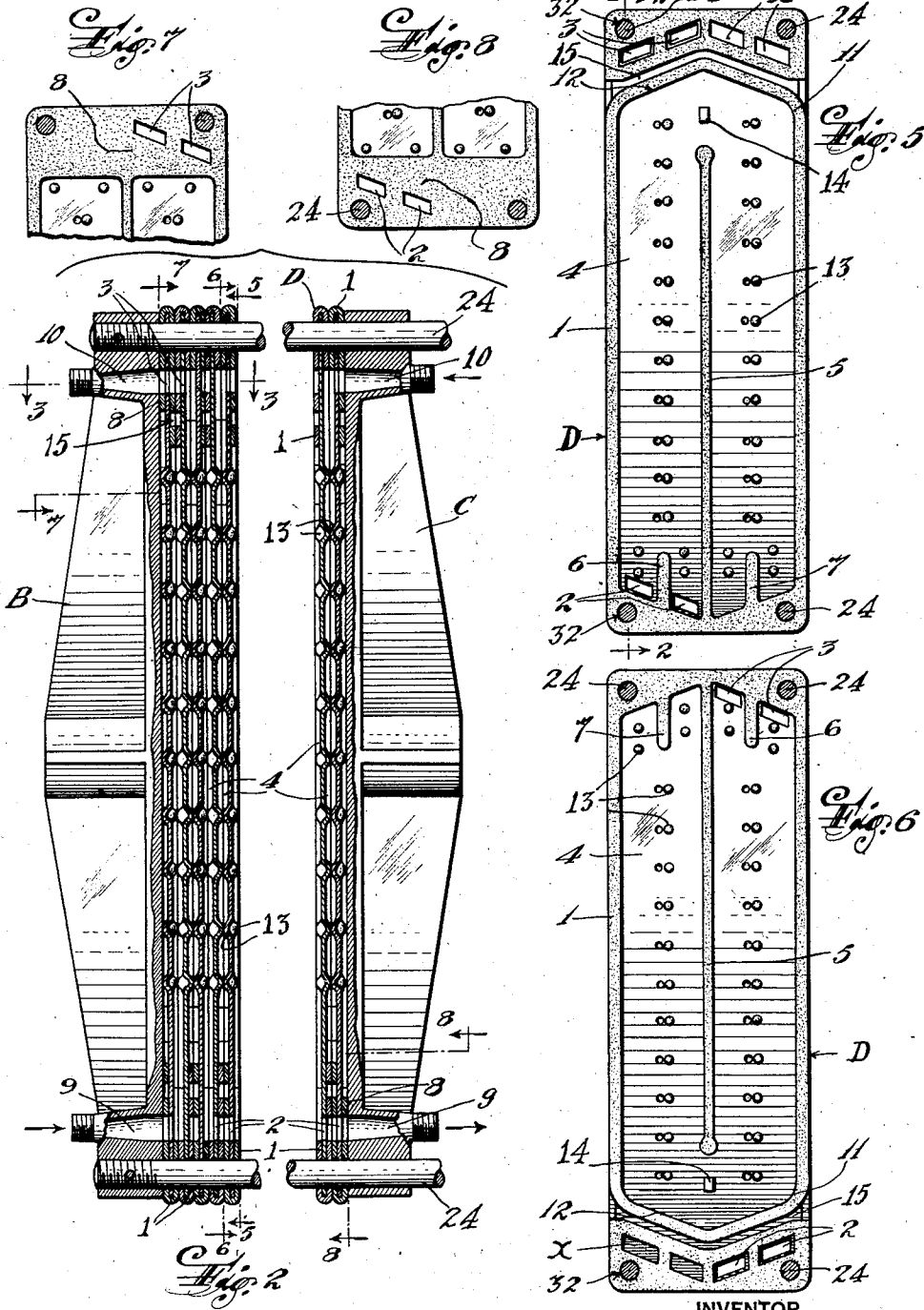
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2 Sheets-Sheet 2



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PASTEURIZING APPARATUS

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3 Claims. (Cl. 257—245)

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This invention relates to a heat exchanger and especially apparatus for pasteurizing liquids, particularly milk; and this application is a continuation in part of my application Serial No. 321,172, filed February 28, 1940.

Prime objects of my invention are to provide a heat exchange apparatus of the plate type which shall embody a novel and improved construction and arrangement of heat exchange plates, whereby rapid travel of liquid between the plates shall be ensured with consequent high efficiency in heat exchange; and to provide in such an apparatus novel and improved means for ensuring the expulsion of air from the passages or spaces between the heat exchange plates so that the flow of liquid through said passages shall be smooth and there shall be no air pockets to interfere with efficient transfer of heat between the plates and the heating and heated liquids.

Another object is to provide a heat exchanger of the plate type wherein the liquid shall flow in thin film-like sheets between the plates and the plates for forming the liquid flow spaces shall be identical and will form the flow spaces directly between adjacent plates without the necessity for spacer frames between the plates, whereby the apparatus shall be simple and can be produced at relatively low cost.

Further objects are to provide a pasteurizing apparatus of the plate type which shall include plates of novel, improved and simple construction to provide fluid passages of large capacity, permit the plates to be made thin to insure efficient transfer of heat, and prevent warping or bending of the plates under pressure of the liquids flowing therebetween; and to provide novel and improved means for mounting and clamping the plates together to ensure against uneven or warping strains.

A further object is to provide heat exchange plates which shall have novel and improved rubber gaskets to provide effective and sanitary seal of the passages between the plates and to protect the plates against injury through handling.

Other objects, advantages and results of the invention will appear from the following description when read in conjunction with the accompanying drawings in which

Figure 1 is a side elevational view of a heat exchanger constructed in accordance with my invention with portions broken away and shown in section for clearness of illustration.

Figure 2 is an enlarged fragmentary sectional vertical view approximately on the line 2—2 of Figure 3.

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Figure 3 is a fragmentary horizontal sectional view on the line 3—3 of Figure 1.

Figure 4 is an exploded perspective view showing five of the heat exchanging plates and diagrammatically illustrating the fluid flow paths.

Figure 5 is a transverse sectional view on a reduced scale taken on the plane of the line 5—5 of Figure 2.

Figure 6 is a similar view taken on the line 6—6 of Figure 2, and

Figures 7 and 8 are fragmentary transverse vertical sectional views on the lines 7—7 and 8—8 respectively of Figure 2.

For the purpose of illustrating the invention, I have shown it embodied in a heat exchanger comprising a frame A upon which are mounted a pair of head plates B and C between which are clamped a plurality of heat exchange plates D.

All of the heat exchange plates D are in general of the same construction, preferably being formed of approximately twenty gauge sheet metal, for example stainless steel, and being generally rectangular in shape.

Each plate has a rubber gasket or packing 1 at each side thereof and extending along the marginal portions of the plate to abut the corresponding packing of adjacent plates when a plurality of plates are clamped together, so as to form liquid tight passages between the adjacent plates. Each plate has a pair of transverse ports 2 extending therethrough at one end thereof and another pair of ports 3 at the other end thereof. The ends of the ports 2 at one side of the plate and the ends of the ports 3 at the opposite side of the plate are disposed inwardly of the gasket 1 so as to be capable of conducting liquid into the flow space that is formed between said side of said plate and one side of the next adjacent plate. The other ends of the ports 2 at the opposite side of the plate and the other ends of the ports 3 are bounded by portions of the corresponding gaskets 1.

With this construction it will be observed that each side of the heat exchange plate has a flow space 4 that is bounded by the corresponding side of the plate and the gasket 1, said flow space being complementary to a correspondingly shaped flow space of an adjacent plate so as to provide a passage between each two adjacent plates for the flow of liquid.

Each flow space is divided into a plurality of channels; as shown, a flow-directing rib 5 extends along the longitudinal median line of each side of the plate from the first-mentioned

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ends of the ports to a point in spaced relation to the other end of the flow space. Also, preferably the first-mentioned ends of the ports 2 and 3 that lead into the respective flow spaces 4 are separated by stream-dividing ribs 6. A similar stream-dividing rib 7 is disposed on each plate so as to be located between the ports of the next adjacent plate when the plates are clamped together.

The plates differ slightly in the arrangement of the ports 2 and 3 as shown in Figure 4 where some of the plates have the ports 2 and 3 adjacent the same longitudinal edge of the plate while other plates have the ports 2 adjacent one longitudinal edge of the plate and the ports 3 adjacent the opposite edge of the plate. The plates are clamped together as shown in Figure 1 with the gaskets of adjacent plates directly abutting each other and with the ports 2 and 3 of the respective plates so related that one liquid may circulate through the ports at one end of the plates, for example the ports 3 and through certain of the flow passages between the plates, while another liquid may be circulated through the other ports, for example the ports 2 at the other end of the plates and through other of the flow passages between the plates.

More specifically, as illustrated in Figure 4, it will be observed that a stream of liquid which may be hot water is designated E and shown in light dot and dash lines, said stream entering the port 3 of the right hand plate *a* into the flow passage between the plate *a* and the next adjacent plate *b*, downwardly through one of the channels of said flow passage and then upwardly through the other channel and outwardly through the port 3 of the plate *b*; thence through the port 3 of the plate *c* into the flow passage between the plates *c* and *d*, then downwardly through one of the channels of said flow passage and upwardly through the other channel, thence outwardly through the ports 3 of the plate *d* and through the ports 3 of the plate *e*.

Another stream which may be a stream of pasteurized milk is designated F and illustrated in heavy dot and dash lines. This stream flows inwardly through the ports 2 of the plate *e* upwardly through one flow channel of the fluid passage between the plate *e* and the plate *d*, downwardly through the other channel of said passage and outwardly through the ports 2 of the plate *d*; thence the stream passes through the ports 2 of the plate *c* into the liquid passage between the plates *c* and *b*, then outwardly through the ports 2 of the plate *b* and inwardly through the ports 2 of the plate *a* into the liquid passage between the plate *a* and the next adjacent plate which is not illustrated. It will be understood that the number of plates can be increased as desired to continue the flow of the streams of liquid as much as desired.

The liquid streams are conducted from the end heat exchange plates through the corresponding head plates B and C by ports 9 which communicate with the ports 2 of the exchange plates and by ports 10 which communicate with the ports 3 of the exchange plates.

Generally it is desirable that the liquid shall not enter between the end heat exchange plate and the head plate B or C adjacent thereto. Accordingly the end plates may have their sides that abut the head plates constructed as shown in Figures 7 and 8 where it will be seen that the gasket at the side of the heat exchange plate that abuts the head plate is extended as indi-

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cated at 8 to surround the corresponding ports 2 or 3, said portions 8 of the gaskets preventing flow of liquid from the ports 9 or 10, or from the ports 2 or 3 into the spaces between the end exchange plates and the head plates.

As shown, each port 9 and 10 of the head plates is of a size and shape to register with the two ports 2 and 3 respectively of the corresponding end exchange plate.

The walls of each flow space formed by the corresponding gasket 1 at the end of the flow space adjacent the extremity of the flow dividing rib 5, is curved at 11 and inclined at 12 so as to ensure expulsion of air from the liquid passages between adjacent plates.

Further to insure expulsion of air and to provide adequate spreading of the liquid throughout the liquid passages, each side of each heat exchange plate may have a plurality of protuberances 13 that may be arranged in rows longitudinally of the flow channels and about corresponding protuberances of adjacent plates. A similar protuberance 14 may be formed on each side of the exchange plate at the juncture of the two flow channels of each liquid passage. With this construction, the main portions of the adjacent plates are held in spaced relation to each other by the protuberances, and the protuberances cause turbulence in the stream of liquid so as to expedite spreading of the liquid in the liquid passages and expulsion of air therefrom.

With the structure so far described it will be seen that when the plates are clamped together, there will be two liquid flow channels between the abutting sides of adjacent plates and the liquid will flow in one direction through one channel and in the opposite direction through the other channel, both longitudinally of the plate. The liquid will be spread into a thin film-like stream and will travel much more rapidly than is possible with corrugated plates known in the art so that there will be an efficient exchange of heat through the plates from the heating liquid to the heated liquid.

If desired in the manufacture of the plates, the ports 2 and 3 may be merely outlined by weakened zones so that the particular ports desired for use may be formed by punching out the metal within the outlines, and the rubber gasket may be applied so that it will serve as proper packing for any one of the sets of ports that may be punched out. Unpunched ports are shown at X.

As usual, a leak groove 15 may be formed through the gasket between the ports and the flow spaces of each plate, said grooves opening at the edges of the plate so as to conduct any liquid that may leak from the liquid passages outwardly to the edges of the plates so as to avoid contamination of the liquid flowing through the liquid passages.

The rubber gasket or packing is preferably vulcanized to each plate as by painting successive layers of unvulcanized rubber composition on the plate, permitting each layer to dry before the application of the next layer, and then applying a final layer of unvulcanized rubber composition and vulcanizing the whole under a pressure of approximately 2500 pounds. This provides a sanitary structure, the vulcanization of the gaskets to the plates throughout the area of the contacting surfaces of the gasket and the plate eliminating possibility of crevices between the gaskets and plates in which foreign matter might accumulate.

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Also, preferably the rubber packing is caused to embrace the edges of the plates as shown in Figure 3, and with the packing so applied, it protects and reenforces the edges of the plates against bending or denting during handling of the plates. Furthermore, the gaskets projecting beyond the planes of the marginal portions of the plate will hold the adjacent plates in proper spaced relation to each other and ensure continuous fluid-tight contact of the gaskets of adjacent plates.

As hereinbefore indicated, the plates may be clamped together in any suitable manner and by any suitable apparatus. However, as shown in my above-mentioned copending application the apparatus may include a frame comprising a base 16 having a pair of spaced standards 17 and 18 thereon.

The head plate B is mounted on the standard 17 by a bolt 19 screw threaded into the head plate approximately centrally of its length and loosely mounted for moving in an opening 20 in a block 21 that is secured in the standard. To hold the port against being pulled out of the opening 20, a pin 22 passes through the block and loosely through a vertical transverse opening 23 in the bolt. In each of the upper and lower ends of the head plate are secured two rods 24, one end of each of which is loosely mounted in a socket 25 formed in a block 26 secured in the standard 18. The second head plate C is slidably mounted on the rods 24 to move toward and from the other head plate B. For securely clamping the head plate C in position and permitting easy and quick release thereof for cleaning or adjustment of the heat exchange plates I provide a sleeve 27 on each of the rods 24 formed of two complementary sections semi-circular in cross section to be applied to and removed from the rods from opposite sides thereof and separably secured together in any suitable manner as by one or more bolts 29 passing through lugs 30 on the sections. One end of each sleeve 27 abuts the head plate C while a nut 31 threaded on the rod 24 abuts the other end of the sleeve.

With this construction, the heat exchange plates may be assembled on the rods 24 between the head plates, each plate having an opening 32 to receive each rod. The sleeves 27 may then be placed in position and the nuts 31 tightened so as to firmly clamp the exchange plates between the head plates. Any inequalities or unevenness in the strains imposed upon the opposite ends of the plates by tightening of the nuts 31 are compensated by swivel action of the head plates and heat exchange plates as a unit about the connection of the bolt 19 to the standard 17, this connection permitting the head plates to swing both in a vertical and a horizontal plane.

The plates may be easily and quickly separated by simply loosening the nuts 31 and removing the sleeves 27 which permits the head plate C to be slid rapidly toward the standard 18 to provide adequate room for manipulation of the heat exchange plates.

Having thus described my invention, what I claim is:

1. A heat exchanger of the character described including a plurality of plates of approximately

the same size disposed in side-by-side relation and each having flat marginal portions in a plane common with the general plane of the plate, and a rubber gasket extending throughout the perimeter of each plate and embracing and extending around the edges of the plate from one side to the other and along said marginal portions at opposite sides of the plate, said gasket being directly vulcanized to said plate throughout the area of the contacting surfaces of the plate and gasket and projecting beyond the plane of said marginal portions, the gasket on each side of each plate being disposed in abutting relation to the gaskets of the next adjacent plates to form spaces between the adjacent plates for flow of liquid whereby the plate is devoid of crevices between the gaskets and the corresponding sides of the plates and said marginal portions of adjacent plates are held in spaced relation to each other to insure continuous fluid-tight contact of the gaskets of adjacent plates, said plates also having transverse ports for passage of liquid in a circuit through the spaces between the plates, and means for clamping the plates together.

2. A metallic heat exchanger plate having a rubber gasket extending throughout the perimeter of said plate and embracing and extending around the edges of the plate from one side to the other and along the marginal portions at opposite sides of the plate and directly vulcanized to the plate throughout the area of the contacting surfaces of the gasket and the plate, said marginal portions of the plate being flat from the edges of the plate inwardly beyond said gasket and the gasket projecting beyond the plane of said marginal portions, whereby said plate may be arranged in side-by-side relation to a similar plate with said gaskets of the adjacent plates directly abutting each other to form a space bounded by said plates and said gaskets for the flow of liquid.

3. The heat exchanger set forth in claim 1 wherein each plate has a transverse port there-through adjacent each end thereof, the end of one port at one side of said plate is disposed inwardly of said marginal gasket to conduct liquid into said flow space at said side of the plate, and said gasket has portions bounding the end of the other port at the same side of said plate to directly abut corresponding portions of the gasket of another plate and means for clamping the plates together.

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