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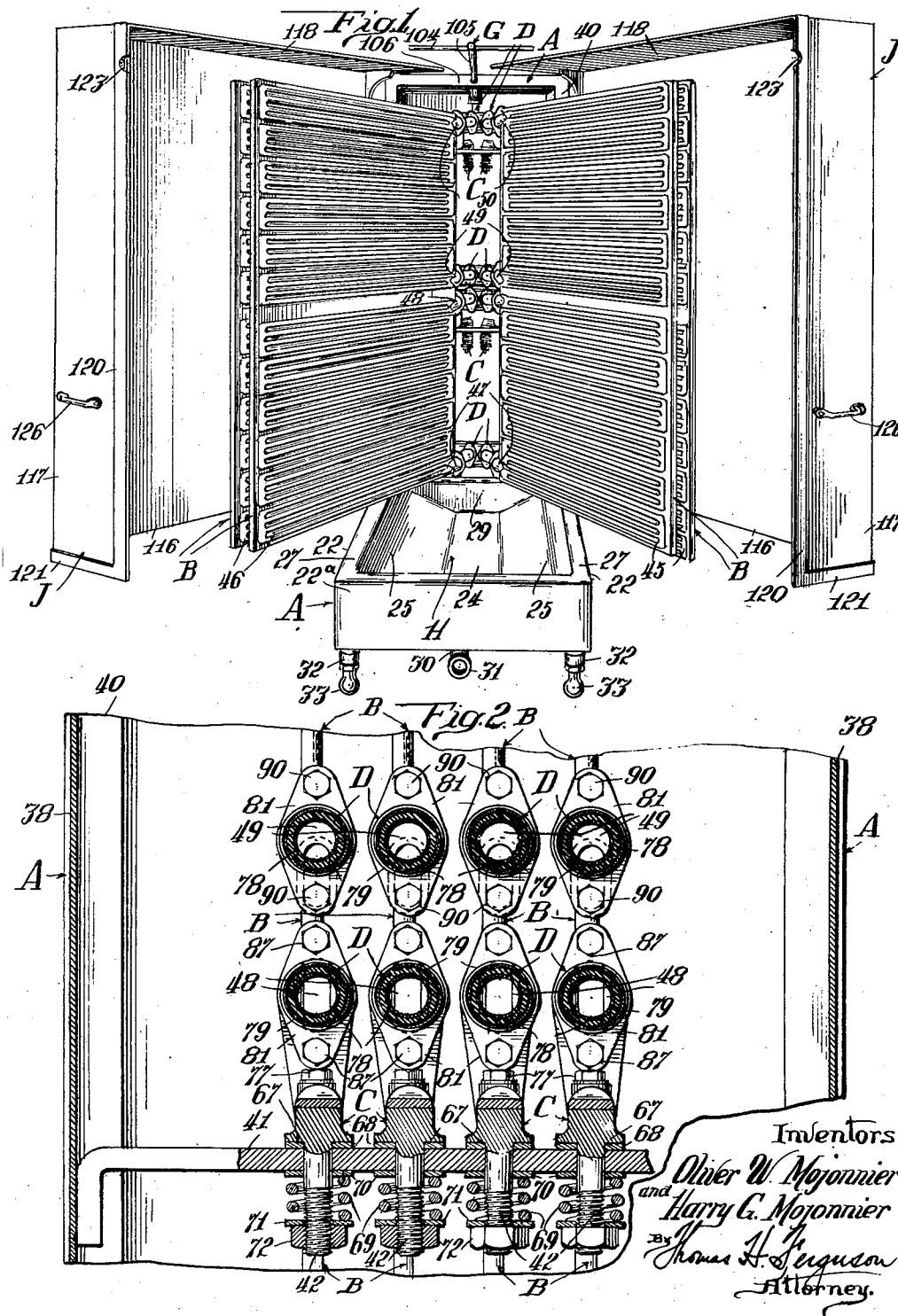
O. W. MOJONNIER ET AL

2,040,947

HEAT EXCHANGER

Filed April 17, 1935

4 Sheets-Sheet 1



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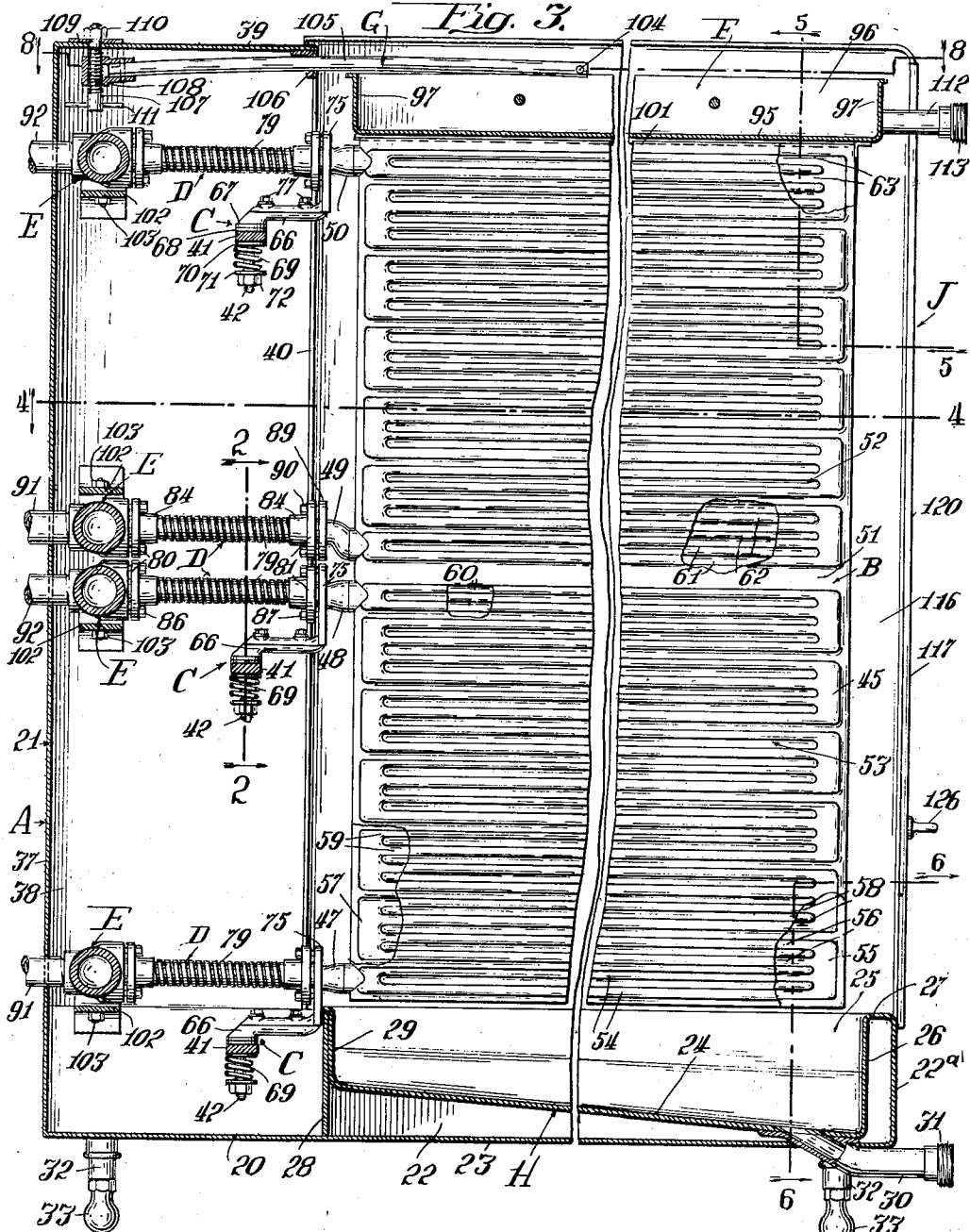
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4 Sheets--Sheet 3

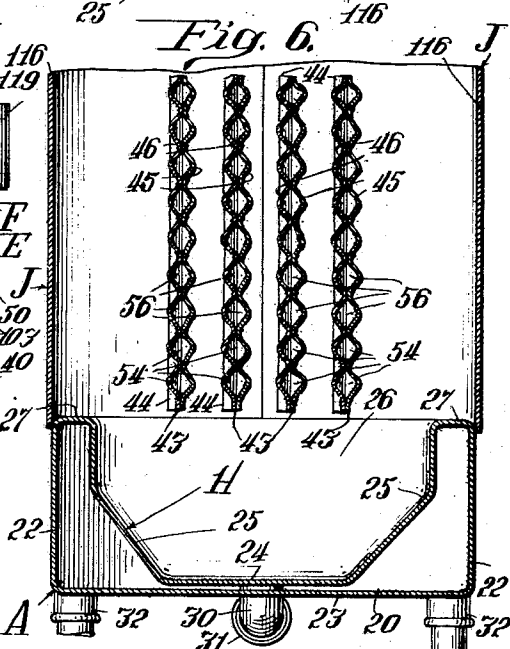
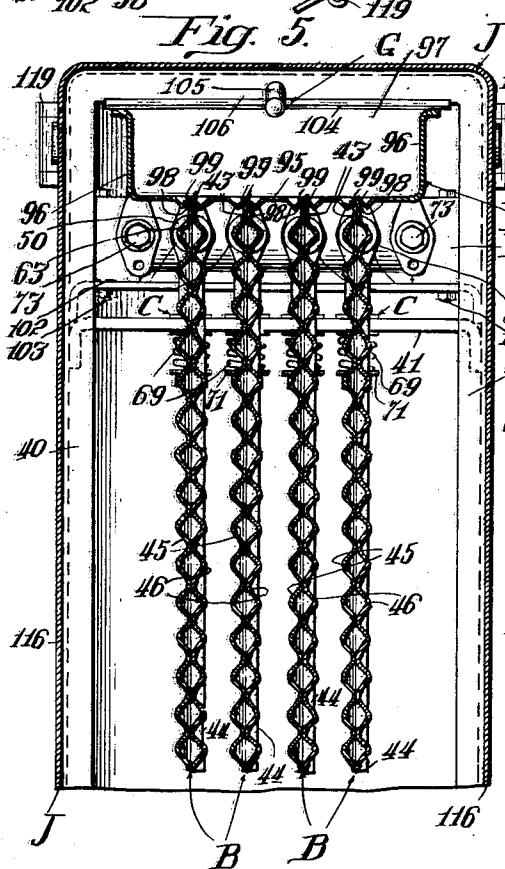
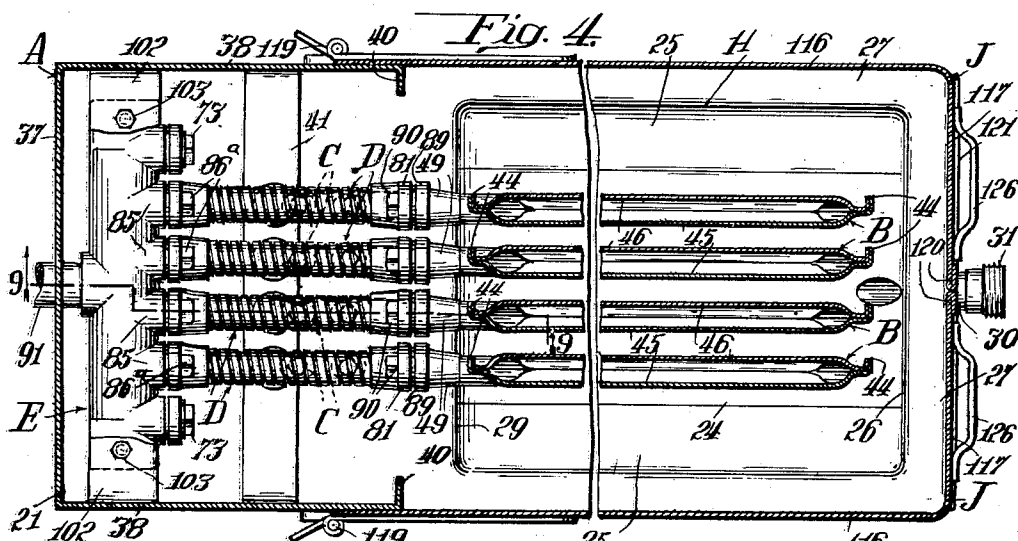


Fig. 7.

99 95

100 98 100

43 B 63

33

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UNITED STATES PATENT OFFICE

2,040,947

HEAT EXCHANGER

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Application April 17, 1935, Serial No. 16,834

30 Claims. (Cl. 257—184)

The present invention relates to heat exchangers generally, and has to do more particularly with exchangers wherein the temperature modifying sections are positionable side by side in operative relation. In some aspects it includes exchangers wherein the sections are movable into and out of said operative relation. In the latter class of exchangers the sections are too close together in their operative positions to permit of their being cleaned, but may be separated when the treating of the liquid is finished, so as to stand apart and thus be accessible for cleaning.

One object of the invention is to provide a novel supply pan or holder for the liquid to be treated and to support it in operating position firmly and securely upon the operatively assembled sections.

Another object is to arrange the supply holder so that it will efficiently and with certainty apply the liquid to the liquid treating sections when in operative relation.

Another object is to provide novel hinge and fluid supply connections which are applicable where the heat transferring sections are movable, the same being of such character that different kinds of controlling fluids may be used without leaking or otherwise passing into the liquid under treatment.

Another object is to provide a hinge construction for movable heat exchanging sections such that they may be moved far enough apart for cleaning with a minimum of occupied floor space.

Another object is to so construct the hinges of the movable exchanger sections that the latter may be opened to any desired position and maintained there easily and without auxiliary devices and yet may be moved therefrom to other like positions with the application of slight pressure.

Another object is to construct the exchanger sections with different zones and to arrange for supplying different controlling fluids to the different zones if desired.

These various objects, and others which will appear hereinafter, are attained by the preferred embodiment of the invention which is fully disclosed in the following detailed description taken in connection with the accompanying drawings, while the scope of the invention is particularly pointed out in the appended claims.

The embodiment of the invention which we have chosen as preferred is one employing hinged sections but it will be understood that certain features of the invention will be applicable to other types of exchangers, the restrictions,

whether to the hinge type or otherwise, being clear from the language of the claims.

In said drawings, Fig. 1 is a perspective view of a heat exchanger constructed and arranged in accordance with the present invention, the liquid supply pan or holder being removed and the parts opened up after the manner employed when cleaning the same; Fig. 2 is a sectional elevation through certain hinge and tubular connections connecting with and leading to the temperature modifying sections, the plane of section being indicated by the line 2—2 of Fig. 3; Fig. 3 is a view illustrating certain of the parts in side elevation and others in central vertical section; Fig. 4 is a horizontal section through the same parts, the plane of section being indicated by the line 4—4 of Fig. 3; Fig. 5 is a partial vertical section of the structure, the plane of section being indicated by the line 5—5 of Fig. 3; Fig. 6 is a similar partial vertical section, the plane of section being indicated by the line 6—6 of Fig. 3; Fig. 7 is a sectional view of a portion of the supply pan and an associated exchanger section, upon an enlarged scale, illustrating how the pan fits upon and retains the section; Fig. 8 is a plan view of the various parts, the upper portion of the cabinet covers and frame being shown in section, the plane of section being indicated by the line 8—8 of Fig. 3; and Fig. 9 is a vertical section through one of the connecting hinges and the associated tubular connections located midway of the height of the exchanger, the plane of section being indicated by the line 9—9 of Fig. 4. Throughout these views like characters refer to like parts.

The principal parts of the exchanger include a main frame A, a series of vertical liquid modifying sections B, associated hinges C by which the sections B are pivotally mounted upon the frame A, tubular connections D for supplying the liquid controlling fluid to the interiors of the sections B, manifolds E with which the tubular connections D are in direct communication, a liquid holder or pan F from which the liquid to be treated passes down over the outer surfaces of the sections B, pressure mechanism G for maintaining the holder F in proper position upon the sections B and the sections properly spaced apart, a collecting basin H at the bottom of the sections B into which the treated liquid flows, and suitable cabinet covers J which inclose the various sections and associated parts.

The main frame A includes a base portion 20 and an upright portion 21. The base portion 20 is of box-like construction and comprises vertical walls 22, a bottom 23, and an end wall 22^a.

The box formed by these walls and bottom, opens upward and receives the collecting basin H. The latter is formed with a bottom 24, side walls 25 and an end wall 26, the side walls converging downward as clearly shown. The side and end walls of the basin H are united by horizontal portions 27 to the side and end walls, respectively, of the base portion 20 of the frame A. Preferably these parts are composed of sheet metal and the various sheets are first properly shaped and then secured together by welding. The side walls 22 and bottom 23 of the base portion 20 are connected near the inner end of the collecting basin H by a transverse partition 28 which is similarly secured in place by being welded to the parts with which it connects. The inner end 29 of the basin H is secured to the partition 28, preferably in like manner. The bottom 24 of the collecting basin is inclined downward toward the front of the exchanger and near its front end is provided with a tubular outlet 30. A connection 31 is provided at the outer end of the tube 30 so that the same may be suitably coupled to other piping, as may be desired. After the liquid is treated by passing over the sections B, it passes into the basin H and on through the outlet 30 to any other suitable receptacle. The bottom 23 of the base portion 20 of the frame A is provided with short legs 32 and ball feet 33. The latter engage the supporting surface on which the exchanger stands.

The vertical portion 21 of the main frame A is also box-like in formation, and includes a back 37, vertical walls 38 and a top wall 39. The lower ends of the back 37 and side walls 38 are secured to the bottom 23 of the base portion 20. All these parts, as before, are secured together in any suitable way, as by welding. In order to strengthen the forward edges of the walls 38, they may be provided with vertical flanges 40. The opposing walls 38 are also connected at intervals by cross bars 41 which are secured at their opposite ends, by welding or otherwise, as desired. These cross-bars serve as parts of the hinge structure C. These bars 41 are apertured at proper intervals and the pintles 42 of the hinges C pass through the openings thus provided.

The sections B, by which the heat passes from the controlling fluid to the liquid under treatment, or vice versa, are preferably constructed in the way pointed out in our prior application Serial No. 724,242, filed May 7, 1934, for improvements in Heat exchange elements. According to this construction, two plates are pressed up so as to provide reverse counterparts having elevations and depressions. These counterparts are brought together face to face and welded along meeting lines and surfaces. The result is the production of a section or unit having an outer irregular surface and inner passages. The outer surfaces are in general character corrugations, provided to increase the superficial area. The corrugations, being matched in the manner stated, also provide the interior spaces or channels, which are arranged in sets so as to provide one or more continuous passages for the controlling fluid, which is admitted to the section, or to a zone of the section, at one point, and withdrawn at another. In the embodiment illustrated, the plates 45 and 46 meet at their peripheries and are there welded together except that at points, where the inlets 47, 48, 49 and 50 are located, there must be a separation between the plates to provide entrance to the interiors. The peripheries of the plates 45 and 46 when welded together form relatively

sharp edges or fins 43 at their tops and bottoms and the meeting edges are bent laterally along the front and rear of the section to provide lateral strengthening flanges 44.

The extent of travel of the controlling fluid through the sections may be greatly varied and the number of different heat exchange media which are to be used may also be varied. In the present instance, each section B has its plates abutting along a central band 51 and in this way the section is divided into an upper zone 52 and a lower zone 53. In this embodiment one controlling fluid enters through the inlet opening 47, passes through two lower passages 54 to the end passage 55 and back through similar passages 56 to an end passage 57. This direction of travel back and forth is continued through the remaining passages 58, 59 of the lower zone 53, until the end of the course is reached by the fluid passing through the remaining passages 60 to the outlet 48. Similarly, a second controlling fluid may be admitted through the connection 49, passed to and fro through passages 61, 62, and continued in its to and fro travel until the final passages 63 are traversed, and then the second fluid leaves the zone 52 of the section at the outlet connection 50.

As before pointed out, the liquid to be treated will pass from the holder F down over the outer surfaces of the zones 52 and 53 of the sections B, and will receive a change in temperature in accordance with the particular media which are supplied to the respective zones. Thus, in some instances, the zone 52 might be a heating zone and the zone 53 a cooling zone. In such case, the liquid would first be heated up to a certain temperature and then cooled down to a certain other temperature. In the latter condition it would be taken from the exchanger through the outlet 30, as before indicated. Obviously, the sections B might take other forms and need not be of the stamped plate variety. The latter, however, has proven quite satisfactory and is accordingly illustrated.

When it comes to the mounting of the sections B, it is preferable to employ the hinge mechanism C, which has, in the case of each section, an axis of rotation which is positioned some distance back of the adjacent edge of the section. The benefit of this arrangement is that the rear portions of the sections, which lie nearest to the hinges, can be moved far enough apart to be readily cleaned without having a too great spread of the forward portions of the sections. This position of the axes of rotation at a considerable distance in the rear of the adjacent edges of the sections, permits a proper cleaning of the sections to be had, while requiring only a minimum of floor space. In the preferred construction, the hinges C mechanically support the various sections and the support thus given is quite independent of the tubular connections D by which the controlling fluid is supplied to the sections. In other words, there is a clear separation of the mechanical supporting function from the fluid conducting function.

As before pointed out, the hinge pin 42 extends, in the case of each hinge, through an opening in the cross bar 41. The pin 42 constitutes a vertical portion of the angular hinge member 66. At a point adjacent to the upper end of the pin 42, the member 66 is provided with a horizontal shoulder 67. Between this shoulder 67 and the upper face of the adjacent bar 41 is a friction producing material 68. This preferably is a washer, or ring, of fibre or like material.

Automobile brake lining material will serve this purpose quite well. The presence of this frictional member 68 brings about a ready holding of the section in any position to which it may be moved by hand. Without this member 68 in each of the hinges, the section, when moved from one position to another, might rotate back again on account of some irregularity in the hanging of the section, or because the floor, surface on which the exchanger is mounted is not level. This member 68 may be easily replaced when it becomes necessary to increase the frictional hold.

The friction produced by member 68 is also increased by the presence of a compression spring 69. This spring is coiled about the pin 42 and bears at its upper end against a washer 70 and at its lower end against a washer 71. These washers surround the pin 42. The upper washer 70 bears against the under side of the cross bar 41 and the lower washer bears against the face of a holding nut 72. The nut 72 may be raised or lowered to increase or decrease the compression of the spring 69, and hence the frictional action of the hinge mounting.

The angular member 66 of the hinge structure is connected to a similar angular member 75 in the form of a casting having a tubular portion 76 formed in it. This tubular portion, in the case of the lowermost connection 47, provides a passage which communicates with the interior of the zone 53 at its lower end. The same tubular portion 76, in the case of the connection 49, similarly provides a passage which communicates with the interior of the same zone at its upper end. Again, in the case of the connection 50, the portion 76 provides a connection with the upper end of the zone 52. In the embodiment shown, there is no hinge C associated with the inlet connection 49, providing for the admission of controlling fluid to the lower portion of the zone 52. In other words, in three cases there is a hinge associated with the tubular passage and in the fourth case there is a tubular passage without the hinge. The latter is the inlet passage 49. The tubular passage 76 may have its interior cross-section elongated, that is to say, oval or elliptical, or it may be otherwise shaped, so as to fit between the plates 45, 46 of the section, which plates are spread apart at the inlet and outlet points so as to provide for the attachment of the tubular portions mentioned. Preferably the tubular portions of the connections 47, 48, 49 and 50 are secured to the plates 45 and 46, by welding, as in other instances. The horizontal arms of the hinge members 66 and 75 are secured together in any suitable way as by screws 77.

The tubular connections D, which lie between each section B, and the associated manifolds E, preferably consist in each instance of a tube 78 of rubber or other like material, capable of being readily flexed between its ends. The tubular member 78 is preferably protected by a flexible armored covering 79. The tubular hose connection, thus provided, is similar in all respects to that which is employed for conveying steam, air or other fluids between relatively movable parts, as in train couplings. Indeed, well known "rubber ammonia hose" may be used for the purpose. In providing terminal flanges 80 and 81 upon the hose connection, the fibrous portion of the hose is passed into an opening which is provided with threads or teeth 82 shaped so as to bite into the material of the hose. The interior of the adjacent end of the hose is then forced outward into firm engagement with the teeth 82 by a bushing

83 which is inserted within the end of the hose and pressed out firmly against it. A small lip 84 of the flange member also embraces the end of the armor 79 and protects the latter. The flange 80 at the one end is, in the case of each of the flexible connections D, connected to an outlet 85 of the associated manifold E. Screws 86 pass through openings in the flanges 80 into threaded openings in the manifold and a tight joint is formed between the flange member 80 and the associated faced member 85.

At the other end of the flexible connection D, the flange 81 may be connected to straight inlets 47, 48 or 50 or to the curved inlets 49. The former inlets are associated with the hinges, as before explained, while the latter are made, in a sense, independently of the hinge members. Thus, in Fig. 9, the inlet 48 is associated with a hinge and the inlet 49 is made directly from the hose to the section without using a hinge member. When the flange 81 cooperates with a hinge member 75, then screws 87 extend through openings in the flange 81 into threaded engagement with the vertical flange-like portion of the member 75. In all of these cases, suitable packing 88 may be employed between the members drawn together by the screws.

Where there is no hinge C in association with the flexible connection D, then, the flanged member 81 is connected to a flange 89 formed upon a tubular member 93 forming part of the inlet 49. In this case screws 90 secure the flanges 81 and 89 together, as before. In this instance, the tubular member 93 is functionally the same as the tubular member 76, but has its forward end offset with reference to the axis of the connection, so as to be fitted into the proper part of the upper zone 52 of the section. In this case, the end of the tubular member 93 is cut away so as to provide a shoulder 94 and an extension 95. The latter enters the opening provided by spacing the plates 45 and 46 of the section at the point where the connection is to be made. The extension 95 is passed into the opening provided by the spaced plates 45 and 46, until the shoulder 94 abuts against the edges of the plates. Then the parts are secured together, preferably, as before, by welding. Although we have referred particularly to the connection 49 employing the tubular part 93 in describing the details of the connection, it must be understood that the tubular portions 76 are similarly shaped and connected, each as clearly shown in the case of the tubular portion 76 in the case of connection 48, shown most clearly, perhaps, in Fig. 9. The central portion of each manifold E is provided with a pipe connection, the same being an inlet pipe 91 or an outlet pipe 92, according as the manifold is an inlet manifold or an outlet manifold.

Obviously, the manifolds E will have in service that number of outlets 85 which is required by the flexible connections D. In the embodiment illustrated, each manifold is shown as provided with six outlets 85, but only four are in use as there are only four cooperating tubular connections D. Where there is an excess of openings 85, the extra ones may be closed by plugs, as in the case illustrated, where the first and sixth (counting from one end to the other) is closed by a plug 73.

It will be noted also that each manifold or header E is supported by a cross-bar 102 which extends between the side walls 38 of the frame casing and is suitably flanged and secured thereby by suitable means such as welding. Bolts 103

pass through openings near the ends of the bars 102 and serve with suitable nuts to secure the manifolds in place. The manifolds may be hung from the bars 102 or they may rest thereon. Both of these ways are illustrated. Thus, the upper manifold near the center of the exchanger is hung from its bar. This is the structure associated with the fluid inlet 49. All the other manifolds E rest upon their bars 102. These are found in association with the inlet 47 and the outlets 48 and 50.

It will be seen that, in operation, the sections will be firmly held by the hinges C, and there will be no strain upon the tubular connections D, by reason of the mounting of the sections. It will also be seen that each section has good substantial tubular connections made with it. The result is an efficient arrangement of great durability. Indeed, by using rubber ammonia hose together with the substantial structure shown, it will be possible to use ammonia brine and other cooling media without breaking down the apparatus or permitting the liquid controlling fluid to obtain access to the liquid under treatment. The structure is also such as to enable high pressure to be used. Likewise when the medium is a heating medium then steam or hot water may be equally well employed. Both the sections and their tubular connections are well built to meet all conditions of service efficiently.

The holder F is preferably an elongated pan having a bottom 95 and vertical walls 96 and ends 97. This oblong pan is intended to be placed directly upon the sections B when the latter are close together side by side in readiness to receive the liquid to be treated. The bottom 95 of the holder F is therefore provided with a series of sets of depressions. Each set of depressions is produced by giving the material of the bottom 95 a W-shaped cross-section. In each set there is thus a central groove 98 and two outer companion grooves 99. The former opens downward and the latter upward. These sets of grooves run lengthwise of the holder and are spaced the same distance apart as the tops of the sections B, when the latter are in operative position.

As before stated, the walls forming the central groove 98 and the two companion grooves 99 have the general outline of the letter W. This outline, when analyzed, consists of a central inverted V-shaped groove, the groove 98, and two upright V-shaped grooves, the grooves 99. The walls of the central groove 98 are provided with a series of openings 100. These are preferably small holes drilled through the material and arranged in staggered relation, the holes in one wall being offset with reference to those in the other wall, as clearly indicated in Fig. 8. The holes 100 in the walls of the groove 98 are preferably near the points of the grooves 99, as clearly shown in Fig. 7.

The liquid to be treated passes through these openings 100 and is directed against the outer walls of the associated section on opposite sides of the fin 43 which engages tightly within the groove 98. Because of the thinness of the fin 43 and the pointedness of the groove 98, it is possible to get a good tight fit; then by having the holes 100 well down near the bottoms of the outer grooves 99 the liquid is directed in a most satisfactory way against the opposite sides of the section and passes thereover in properly distributed films. The adjacent edges of the W-shaped bottom structure assist in this, the liq-

uid passing from the edges just outward of the openings in a suitable spray or film-like stream. Thus, the lower edges located at the points of the W section, serve as lips from which the liquid flows in its passage to the opposite walls of the associated section.

Since there are several of these grooves 98 it follows that there are several points of support for the holder F. And, too, it is clear that preferably there is one groove 98 for each section B. Consequently, the engagement of the bottom of the pan F with several sections provides a good support for the pan. In many installations the support thus obtained may suffice. Not only is the holder properly supported but the fitting of the section fins 43 into the grooves 98 properly spaces the sections, or "centers" them, relatively to each other when side by side in operative relation.

However, if it is desired to support the holder F more securely in its operative position upon the assembled sections B, then a clamping mechanism G may be employed. This mechanism includes a pivoted frame made up of a cross-bar 104 and a fulcrum lever or bar 105. The cross-bar 104 is adapted to press at its outer ends downward upon the rim of the holder F. This auxiliary frame is fulcrumed to the main frame by passing the bar 105 through a reinforced opening in a short depending wall 106 upon the upright portion of the frame A. The end of the bar 105 distant from the cross bar 104, is actuated by an adjusting screw 107. The end of the bar 105 is secured to a head 108 and the latter has threaded engagement with the exterior of the screw 107. The screw 107 in turn is swiveled in a reinforcing plate 109 secured to the upper surface of the top 39 of the frame. The screw 107 rotates freely in the plate 109. A nut 110 is threaded upon the end of the screw 107 and maintains the screw in proper position so as to be rotated in its bearing plate 109. As the screw 107 is rotated by the hand bar 111, the head 108 is moved up and down by reason of its traveling upon the screw 107. This movement causes the frame bar 105 to oscillate about its fulcrum at the supporting point 106, and, in this way, pressure upon the holder F is applied or removed through the agency of the cross-bar 104. When pressure is applied to the holder, it is forced down firmly upon the supporting sections, and, on the other hand, when all pressure is removed from the holder and the cross-bar 104 is sufficiently raised, the holder may be removed by hand from the sections. It is of course clear that the holder must be removed from the sections in order that both may be properly cleaned.

It will be noted that the forward end of the holder F is provided with a tubular connection 112 on which is a threaded connection 113 so that the same may be properly attached to a supply pipe for furnishing the liquid to the holder.

When the parts are assembled, the liquid to be treated, such as milk, will be supplied through the pipe 112 to the holder F and from the latter distributed over the sections B and from the sections the treated product will be received into the basin H and withdrawn through the outlet connections made with the pipe 30.

Obviously, the various parts which enter into the heat exchanger here depicted, may be covered, when in assembled position, by any suitable covers. In the present instance, there are two covers J which are in the form of box-like doors each

having a main wall 116, a forward flange 117 and a top flange 118. The side walls are hinged to the upright walls 30 of the main frame A in any suitable way as for example by means of the hinges 119. The forward and top flanges 117, 118 may be strengthened by ribs or additional vertical portions 120 and horizontal portions 121. The portions 120 are also cut away at 123 with semi-circular openings so as to provide a passageway for the supply pipe 112. Suitable handles 126 are provided to enable the covers to be drawn together and pulled apart. When in closed position, the covers may be held by any suitable means. When so closed, they will fit about and against the horizontal portion 20 of the base A. When spread apart, there will be ample room for the movement of the sections B into properly separated positions for cleaning.

The various parts of the exchanger, with few exceptions, are composed of metal. The metal used may of course be greatly varied in composition. The present exchanger is suited especially for the treating of milk and has been designed, built and used for that purpose. When such is the case, the metal used is one that will meet the requirements, sanitary and otherwise, incident to that service. Many kinds of stainless steels and alloys will meet these requirements.

Obviously, as before indicated, the holder may be used with sections which may be variously supported. Likewise, the tubular connections may be used with sections hinged or otherwise movably mounted, in a manner quite different from the mounting specifically disclosed. Similarly, other modified uses will be suggested to persons skilled in this art. Likewise, many changes may be made in the details of the structure when disclosed without departing from the spirit and scope of the invention. We therefore do not wish to be limited to the details presented but aim to cover by the terms of the appended claims all those alterations and modifications which rightly come within the purview of our invention.

We claim:

1. A heat exchanger for liquids comprising a plurality of heat exchanging sections positioned side by side in spaced relation for operation, each of said sections having at its top a thin fin-like edge, and a removable liquid distributing holder having a plurality of cooperating grooves side by side into which said thin edges of said sections nicely fit, said section edges serving as supports for said holder, said holder having outlet means in the walls of said grooves to supply liquid to both sides of each of said sections.

2. A heat exchanger for liquids comprising a plurality of heat exchanging sections positioned side by side in spaced relation for operation, each of said sections having at its top a thin fin-like edge, a removable liquid distributing holder having a plurality of cooperating grooves side by side into which said thin edges of said sections nicely fit, said section edges serving as supports for said holder, said holder having outlet means in the walls of said grooves to supply liquid to both sides of each of said sections, and pressure means for keeping said holder tightly seated upon said edges.

3. A heat exchanger for liquids comprising a plurality of heat exchanging sections positioned side by side in spaced relation for operation, each of said sections having at its top a thin fin-like edge, and a removable liquid distributing holder having a plurality of cooperating grooves side by side into which said thin edges of said sections nicely fit, said holder having two outlet means

for each said section positioned respectively on opposite sides of each associated section edge for supplying liquid to the opposite sides of the section.

4. A heat exchanger for liquids comprising a plurality of heat exchanging sections positioned side by side in spaced relation for operation, each of said sections having at its top a thin fin-like edge, a removable liquid distributing holder having a plurality of cooperating grooves side by side into which said thin edges of said sections nicely fit, said holder having two outlet means for each said section positioned respectively on opposite sides of each associated section edge for supplying liquid to the opposite sides of the section, and pressure means for keeping said holder tightly seated upon said edges.

5. A heat exchanger for liquids comprising a plurality of heat exchanging sections movable relatively to one another away from operative positions in which they stand close together side by side to positions in which they are accessible for cleaning, each of said sections having at its top a fin-like edge, and a removable liquid distributing holder resting upon said fin-like section edges when the parts are in operative position, said holder having spaced fin-receiving cooperating grooves into which the section edges nicely fit, said holder thereby keeping said sections in proper spaced relation for operation and said sections supporting said holder, and said holder having outlet means in the walls of said grooves to supply liquid to both sides of each of said sections.

6. A heat exchanger for liquids comprising a plurality of heat exchanging sections movable relatively to one another away from operative positions in which they stand close together side by side to positions in which they are accessible for cleaning, each of said sections having at its top a fin-like edge, a removable liquid distributing holder resting upon said fin-like section edges when the parts are in operative position, said holder having spaced fin-receiving cooperating grooves into which the section edges nicely fit, said holder thereby keeping said sections in proper spaced relation for operation and said sections supporting said holder, said holder having outlet means in the walls of said grooves to supply liquid to both sides of each of said sections, and pressure means for keeping said holder tightly seated upon said edges.

7. A heat exchanger for liquids comprising a plurality of heat exchanging sections movable relatively to one another away from operative positions in which they stand close together side by side to positions in which they are accessible for cleaning, each of said sections having at its top a fin-like edge, a removable liquid distributing holder resting upon said fin-like section edges when the parts are in operative position, said holder having spaced fin-receiving cooperating grooves into which the section edges nicely fit, said holder thereby keeping said sections in proper spaced relation for operation, said holder having two outlet means for each said section positioned respectively on opposite sides of each associated section edge for supplying liquid to the opposite sides of the section.

8. A heat exchanger for liquids comprising a plurality of heat exchanging sections movable relatively to one another away from operative positions in which they stand close together side by side to positions in which they are accessible for cleaning, each of said sections having at its top a fin-like edge, a removable liquid distributing holder having two outlet means for each said section positioned respectively on opposite sides of each associated section edge for supplying liquid to the opposite sides of the section.

ing holder resting upon said fin-like section edges when the parts are in operative position, said holder having spaced fin-receiving cooperating grooves into which the section edges nicely fit, said holder thereby keeping said sections in proper spaced relation for operation, said holder having two outlet means for each said section positioned respectively on opposite sides of each associated section edge for supplying liquid to the opposite sides of the section, and pressure means for keeping said holder tightly seated upon said edges.

9. A heat exchanger for liquids comprising a plurality of heat exchanging sections positioned side by side in spaced relation for operation, each of said sections terminating at its top in a thin fin-like edge, and a removable liquid distributing holder having a plurality of sets of depressions in its bottom, each said set being provided by a W-shaped cross-section of the material, the central groove of such cross-section receiving the associated section edge with a nice fit, the section edges serving as supports for said holder and the edges and grooves serving as centering means, the walls of said central groove being perforated near the lower edges of the W-shaped formation with long rows of holes to direct the liquid from said edges inward against opposite sides of the associated section.

10. A heat exchanger for liquids comprising a plurality of heat exchanging sections positioned side by side in spaced relation for operation, each of said sections terminating at its top in a thin fin-like edge, and a removable liquid distributing holder having a plurality of sets of depressions in its bottom, each said set being provided by a W-shaped cross-section of the material, the central groove of such cross-section receiving the associated section edge with a nice fit, the section edges serving as supports for said holder and the edges and grooves serving as centering means, the walls of said central groove being perforated near the lower edges of the W-shaped formation with long rows of holes to direct the liquid from said edges inward against opposite sides of the associated section, and retaining means operative to press downward upon said holder to keep the same in assembled and working position on said sections.

11. A heat exchanger for liquids comprising a plurality of heat exchanging sections movable relatively to one another away from operative positions in which they stand close together side by side to positions in which they are accessible for cleaning, each of said sections terminating at its top in a thin fin-like edge, and a removable liquid distributing holder for spacing said sections, said holder having a plurality of sets of depressions in its bottom, each said set being provided by a W-shaped cross-section of the material, the central groove of such cross-section operating when the holder is properly positioned upon the sections to receive the associated section edge with a nice fit, the section edges and grooves serving as centering means, the walls of said central groove being perforated near the lower edges of the W-shaped formation with long rows of holes to direct the liquid from said edges inward against opposite sides of the associated section.

12. A heat exchanger for liquids comprising a plurality of heat exchanging sections movable relatively to one another away from operative positions in which they stand close together side by side to positions in which they are accessible

for cleaning, each of said sections terminating at its top in a thin fin-like edge, and a removable liquid distributing holder for spacing said sections, said holder having a plurality of sets of depressions in its bottom, each said set being provided by a W-shaped cross-section of the material, the central groove of such cross-section operating when the holder is properly positioned upon the sections to receive the associated section edge with a nice fit, the section edges and grooves serving as centering means, the walls of said central groove being perforated near the lower edges of the W-shaped formation with long rows of holes to direct the liquid from said edges inward against opposite sides of the associated section, and retaining means operative to press downward upon said holder to keep the same in assembled and working position on said sections.

13. A heat exchanger for liquids comprising a plurality of sections hinged to swing to and fro between operative positions in which they stand close together side by side to positions in which they are separated and accessible for cleaning, each of said sections terminating at its top in a relatively sharp edge and a liquid holder adapted to rest upon the upper edges of said sections when the latter are in operative position, said holder having reentrant grooves for receiving the sharp edges of said sections, each groove having two rows of holes, one for supplying the liquid to one side of the section and the other for supplying the liquid to the other side of the section, said interfitting grooves and edges serving as means for centering said holder with said holes positioned as stated relative to said sections.

14. A heat exchanger for liquids comprising a plurality of sections hinged to swing to and fro between operative positions in which they stand close together side by side to positions in which they are separated and accessible for cleaning, each of said sections terminating at its top in a relatively sharp edge, a liquid holder adapted to rest upon the upper edges of said sections when the latter are in operative position, said holder having reentrant grooves for receiving the sharp edges of said sections, each groove having two rows of holes, one for supplying the liquid to one side of the section and the other for supplying the liquid to the other side of the section, said interfitting grooves and edges serving as means for centering said holder with said holes positioned as stated relative to said sections, and pressure means for maintaining said holder down tight upon said sections.

15. A heat exchanger for liquids comprising a plurality of sections having fin-like upper edges, said sections being hinged to swing to and fro between operative positions in which they stand close together side by side to positions in which the sections are separated and accessible for cleaning, and a liquid holder adapted to rest upon the upper edges of said sections when the latter are close together in operative position, said holder having inverted V-shaped depressions along its under side adjacent to each other in position to receive in the central grooves thereof the upper edges of said sections and to thus center the same when they are close together in operative position, the walls of said depressions being provided with long rows of perforations to direct the liquid against opposite sides of each operatively positioned section, said holder being supported solely by said sections when the parts are in operative position.

16. A heat exchanger for liquids comprising a plurality of sections having fin-like upper edges, said sections being hinged to swing to and fro between operative positions in which they stand close together side by side to positions in which the sections are separated and accessible for cleaning, a liquid holder adapted to rest upon the upper edges of said sections when the latter are close together in operative position, said holder having inverted V-shaped depressions along its under side adjacent to each other in position to receive in the central grooves thereof the upper edges of said sections and center the same when they are close together in operative position, the walls of said depressions being provided with long rows of perforation to direct the liquid against opposite sides of each operatively positioned section, said holder being supported solely by said sections when the parts are in operative position, and retaining means operative to press downward upon said holder to hold the same in assembled and working position upon said sections.

17. A heat exchanger for liquids comprising a main supporting frame, a plurality of sections mounted on said main frame and movable from operative positions side by side to positions in which they are separated and accessible for cleaning, a liquid holder adapted to rest upon and be supported by the upper edges of said sections when the latter are side by side in working relation, said holder having perforations through its bottom through which perforations the liquid is supplied to said sections, an auxiliary frame for retaining said holder upon said sections, said auxiliary frame being fulcrumed at one point to said main frame and bearing at another point against the top of said holder, and means for actuating said auxiliary frame at another point to vary the pressure of said auxiliary frame against said holder.

18. A heat exchanger for liquids comprising a main supporting frame, a plurality of sections mounted on said main frame and movable from operative positions side by side to positions in which they are separated and accessible for cleaning, a liquid holder adapted to rest upon and be supported by the upper edges of said sections when the latter are side by side in working relation, said holder having perforations through its bottom through which perforations the liquid is supplied to said sections, an auxiliary frame for retaining said holder upon said sections, said auxiliary frame comprising a cross-bar and lever arm, said cross-bar being adapted to engage and press downward on said holder, said lever arm being fulcrumed to said main frame at a point in its length distant from said cross-bar, and means acting on said arm at still another point in its length to rock the same about its fulcrum to vary the holding pressure on said holder.

19. A heat exchanger for liquids comprising a main supporting frame, a plurality of sections mounted on said main frame and movable between operative positions side by side to positions in which the sections are separated and accessible for cleaning, a liquid holder adapted to rest upon and be supported by the upper edges of said sections when the latter are side by side in working relation, said holder having perforations through its bottom through which perforations the liquid is supplied to said sections, an auxiliary frame for retaining said holder upon said sections, said auxiliary frame comprising a cross-bar and lever

arm, said cross-bar being adapted to engage and press downward on said holder, said lever arm being fulcrumed at an intermediate point in its length to said main frame, said cross-bar being connected to said arm at one end, and screw mechanism at the other end of said arm acting between it and said main frame to rock said auxiliary frame to apply pressure to said holder.

20. A heat exchanger for liquids comprising a main frame, a plurality of liquid treating sections hinged at corresponding ends of the several sections to said main frame so as to swing to and fro between operative positions side by side to positions in which the sections are separated and accessible for cleaning, a liquid holder adapted to rest upon and be supported by the upper edges of said sections when the latter are side by side in working relation, said holder having perforations through its bottom through which perforations the liquid is supplied to said sections, an auxiliary frame for retaining said holder upon said sections, said auxiliary frame being fulcrumed at one point to said main frame and bearing at another point against the top of said holder, and means for actuating said auxiliary frame at another point to vary the pressure of said auxiliary frame against said holder.

21. A heat exchanger for liquids comprising a main frame, a plurality of liquid treating sections, each section having an outer surface over which the liquid to be treated flows and an interior for the liquid controlling fluid, hinges connecting each section to said main frame, the axis of rotation of the hinges of each section being parallel to and spaced a definite distance from the adjacent edge of the section, the different axes of rotation being spaced apart and parallel to each other, said hinges permitting the sections to swing apart from operative positions in which they stand close together side by side to cleaning positions in which the sections are swung apart, the space between each section and its axis of rotation permitting better access to that portion of the section adjacent to said axis when said sections are spread apart, fluid conducting inlet and outlet members connected to said main frame, and flexible connections respectively between said members on the one hand and the inlet and outlet openings of said sections on the other hand, said flexible connections being for the controlling fluid to enter and leave said sections.

22. A heat exchanger for liquids comprising a main frame, a plurality of liquid treating sections, each section having an outer surface over which the liquid to be treated flows and an interior for the liquid controlling fluid, hinges connecting each section to said main frame, the axis of rotation of the hinges of each section being parallel to and spaced a definite distance from the adjacent edge of the section, the different axes of rotation being spaced apart and parallel to each other, said hinges permitting the sections to be swung apart from operative positions in which they stand close together side by side to cleaning positions in which the sections are separated, the space between each section and its axis of rotation permitting better access to that portion of the section adjacent to said axis when said sections are spread apart, fluid conducting inlet and outlet members connected to said main frame, the distance between said members and the section, in the case of each section, being greater than the distance between the section and its axis of rotation, and flexible connections respectively between said members on the one hand

and the inlet and outlet openings of said sections on the other hand, said flexible connections being for the controlling fluid to enter and leave said sections.

5 23. A heat exchanger for liquids comprising a main frame, a plurality of liquid treating sections, each section having an outer surface over which the liquid to be treated flows and an interior for the liquid controlling fluid, hinges connecting
10 each section to said main frame, the axis of rotation of the hinges of each section being parallel to and spaced a definite distance from the adjacent edge of the section, the different axes of rotation being spaced apart and parallel to each
15 other, said hinges permitting the sections to be swung from operative positions in which they stand close together side by side to cleaning positions in which they are separated, the space between each section and its axis of rotation permitting better access to that portion of the section
20 adjacent to said axis when said sections are spread apart, fluid conducting inlet and outlet manifolds connected to said main frame, and flexible connections uniting said manifolds respectively to the section interiors to convey the
25 controlling fluid to and from the same.

24. A heat exchanger for liquids comprising a main frame, a plurality of liquid treating sections, each section having an outer surface over
30 which the liquid to be treated flows and an interior for the liquid controlling fluid, hinges connecting each section to said main frame, the axis of rotation of the hinges of each section being parallel to and spaced a definite distance from
35 the adjacent edge of the section, the different axes of rotation being spaced apart and parallel to each other, said hinges permitting the sections to be swung individually from a nested operative position in which they stand close together side
40 by side to cleaning positions in which the sections stand apart, the space between each section and its axis of rotation permitting better access to that portion of the section adjacent to said axis when said sections are spread apart, fluid conducting inlet and outlet manifolds connected to
45 said main frame, and flexible connections uniting said manifolds respectively to the section interiors to convey the controlling fluid to and from the same, said manifolds being positioned farther from the adjacent edges of said sections than
50 their respective axes of rotation.

25. A heat exchanger for liquids comprising a main frame, a liquid treating section having an
55 outer surface over which the liquid to be treated flows and an interior for the liquid controlling fluid, means including flexible connections for delivering and receiving the controlling fluid as it enters and leaves said section, apertured hinge
60 members secured to said frame, oscillatory hinge members having in each case a pin for entering the aperture of the corresponding hinge member and a shoulder for cooperating with a face of said member, and a frictional member between the
65 said shoulder and face of at least one hinge whereby said section may be moved to any desired position and when so moved will remain where placed.

26. A heat exchanger for liquids comprising a main frame, a plurality of heat exchanging sections, each section having an outer surface over
70 which the liquid to be treated flows and an interior for the liquid controlling fluid, means in-

cluding flexible tubular connections for delivering and receiving the controlling fluid as it enters and leaves said sections, suitable hinges for each said section securing the same pivotally to
5 said main frame, and friction producing means in at least one of the hinges of each section to retard its movement and serve to hold the same in the position in which placed but permitting
10 of its ready removal therefrom upon the application of a relatively small moving force.

27. A heat exchanger for liquids comprising a main frame, a plurality of heat exchanging sections, each section being divided into separated zones, each zone having its interior for the liquid
15 controlling fluid and its outer surface over which the liquid to be treated flows, a plurality of hinges connecting each section to said main frame, said hinges permitting the sections to swing from operative positions in which they stand side by side close together to positions in which the sections
20 are swung apart, inlet and outlet headers connected to said main frame, one pair of headers for each zone, and flexible connections respectively extending from the said headers of each zone to inlet and outlet openings in said
25 section for each zone, one pair of headers and associated connections serving to supply one controlling fluid to one set of zones of the different sections and the second pair of headers and associated connections serving to supply another
30 controlling fluid, if desired, to a second set of zones of the same sections.

28. A heat exchanger for liquids comprising a plurality of heat exchanging sections positioned
35 side by side in spaced relation for operation, each of said sections having at its top a thin fin-like edge, and a removable member having a plurality of cooperating depressions side by side into which said thin edges of said sections nicely fit, whereby
40 said sections are accurately spaced for operation.

29. A heat exchanger for liquids comprising a main frame, a plurality of heat exchanging sections, hinges connecting each section to said
45 main frame, said hinges permitting said sections to swing apart for cleaning and alternatively to occupy operative positions in which they stand close together side by side, fluid conducting inlet and outlet members, and flexible connections respectively between said members on the one
50 hand and inlet and outlet openings of said sections on the other hand, said flexible connections being for the controlling fluid to enter and leave said sections.

30. A heat exchanger for liquids comprising a main frame, a plurality of heat exchanging sections, hinges connecting each section to said
55 main frame, said hinges providing a substantially vertical axis of rotation to permit the sections to be set close together side by side for operation and alternatively separated for cleaning, fluid conducting inlet and outlet members, the distance of said members from the section, in the case of each section, being greater than the distance between the section and its axis of rotation, and flexible connections respectively between said
60 members on the one hand and inlet and outlet openings of said sections on the other hand, said flexible connections being for the controlling fluid to enter and leave said sections.

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