

Jan. 18, 1966

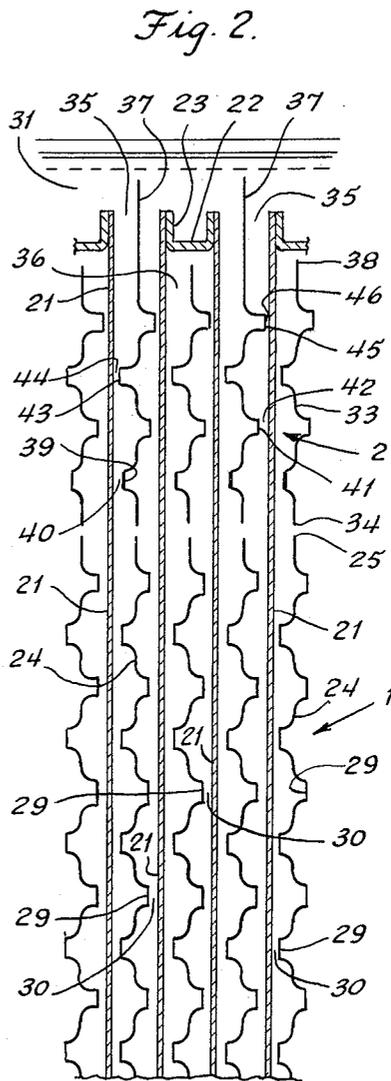
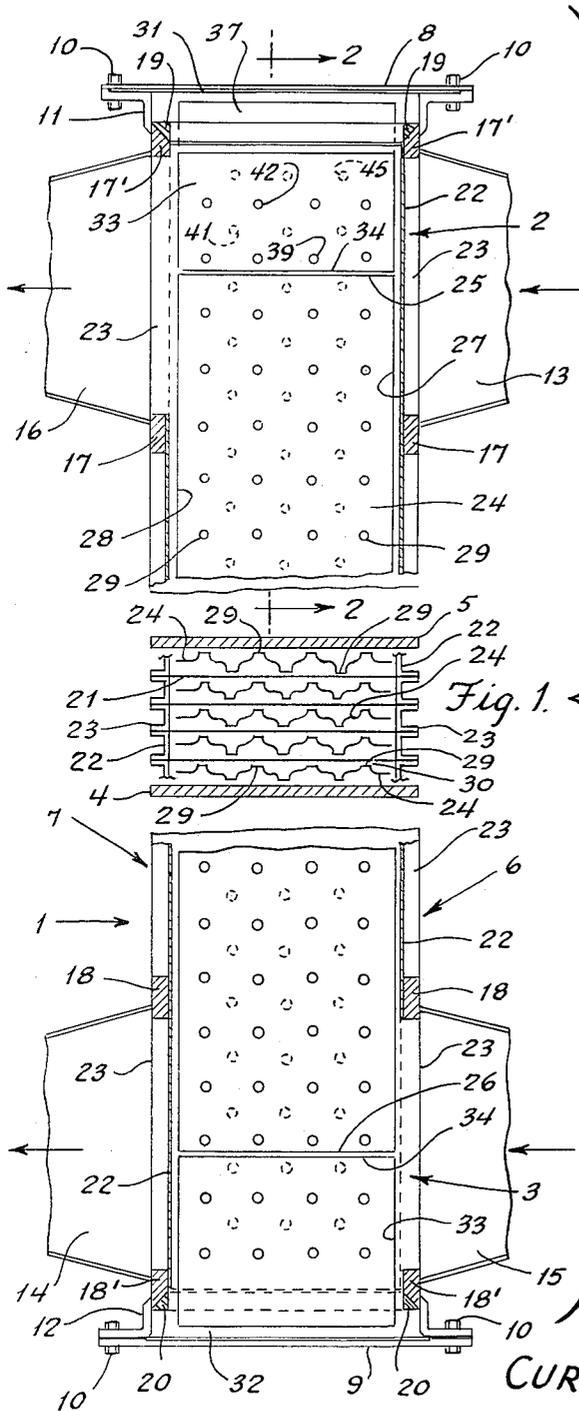
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3,229,763

FLEXIBLE PLATE HEAT EXCHANGERS WITH VARIABLE SPACING

Filed July 16, 1963

3 Sheets-Sheet 1



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FLEXIBLE PLATE HEAT EXCHANGERS WITH VARIABLE SPACING

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3 Sheets-Sheet 2

Fig. 3.

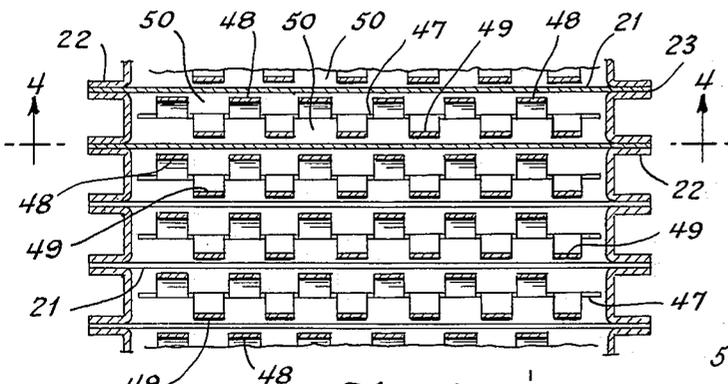


Fig. 5.

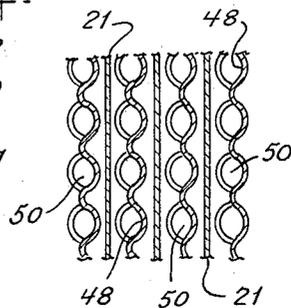


Fig. 4.

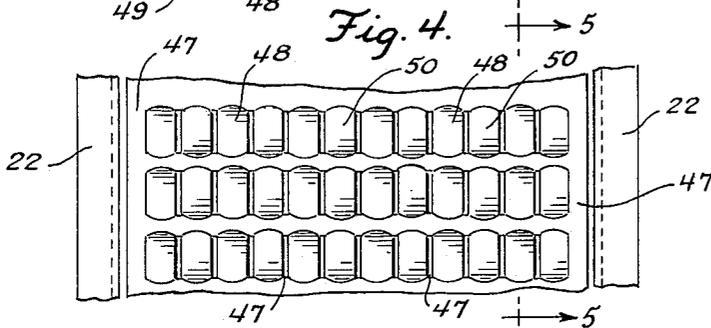


Fig. 6.

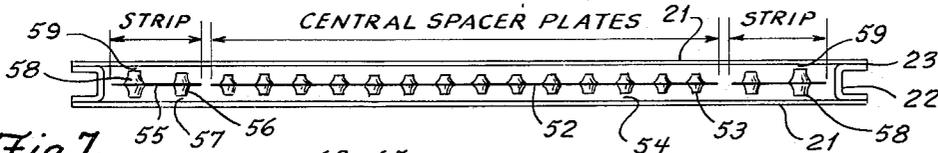


Fig. 7.

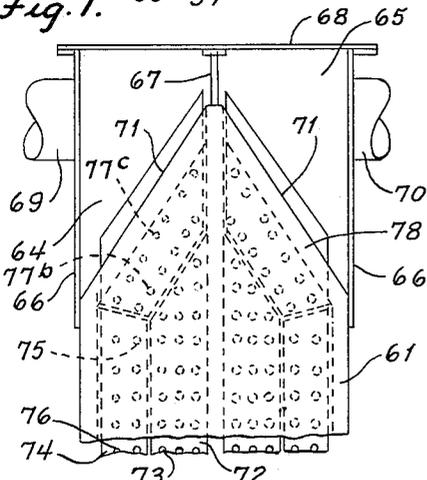
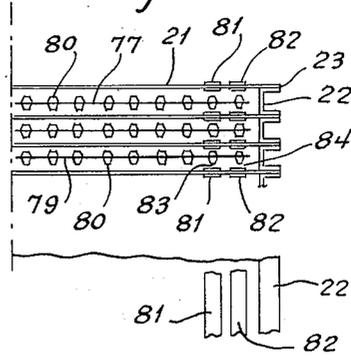


Fig. 10.



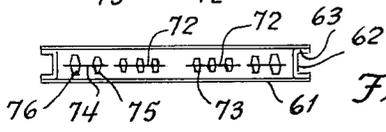
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Fig. 8.



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FLEXIBLE PLATE HEAT EXCHANGERS WITH VARIABLE SPACING

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3 Sheets-Sheet 3

Fig. 12.

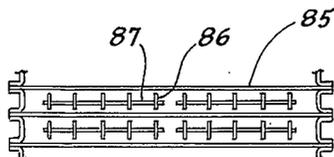
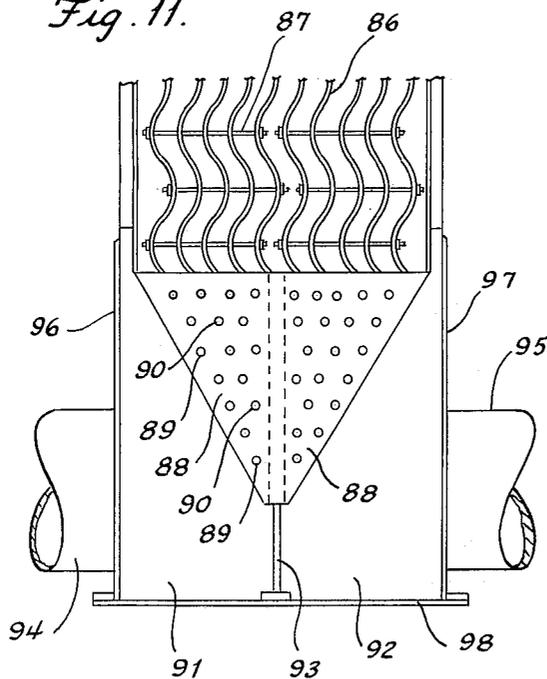


Fig. 11.



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3,229,763

FLEXIBLE PLATE HEAT EXCHANGERS WITH VARIABLE SPACING

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Filed July 16, 1963, Ser. No. 295,312

15 Claims. (Cl. 165-166)

This invention relates to flexible plate heat exchangers and is particularly concerned with such heat exchangers which are equipped with spacer members between the flexible plates and wherein such spacer members limit the flexing of the plates to varying extent at different positions of the plates.

In my application Serial No. 267,248 filed March 22, 1963, entitled Flexible Plate Heat Exchanger With Spacer Plates, now abandoned, the economic advantages of forming the walls of heat exchange chambers of thin and flexible material were pointed out. It was also pointed out there that, when the medium passed through one set of passages or one channel in a flexible plate heat exchanger is under a pressure considerably greater than that in the other set of passages or channel, substantial outward bulging of the walls or chamber carrying the pressure medium results. The necessity for controlling this bulging was also pointed out. Furthermore, the prior art means to achieve such control by dimples or studs formed out of or secured to the walls of the heat exchangers themselves were made mention of as were the drawbacks of the same.

The aforementioned copending application further disclosed applicant's invention for overcoming the prior art drawbacks in the spacing of flexible walls of heat exchangers by the provision of separate spacer plates or elements interposed in the channels between the plates and provided with means to limit the extent of deflection of such flexible walls. What the invention of that application overlooked, however, was the manner in which the life of the heat exchanger plates could be preserved by using specially related and formed internal spacer plates while still enabling effective cleaning of the channels to be carried out.

The instant invention accordingly is concerned with the provision of spacer plates which control the permissible spacing or flexing of the flexible wall plates adjacent the borders of the channels so that plate flexing and consequent weakening followed by possible failure is kept to a minimum here. Furthermore, the protection against undue flexing is such that it allows maximum flexing in the intermediate portions of the heat exchanger plates, but then, preferably gradually, reduces the possibility of flexing as the borders of the channel or chamber are approached. Thus there is a gradual diminishing of the flexing in the bordening areas in a manner to minimize the strain in these areas and thus enhance the life of the thin heat exchanger plates.

It is moreover desirable to enable the channels to be cleaned in spite of the presence of spacer plates which, near the borders, effects a spacing which reduces the flexing to a minimum. This is particularly a factor on the intake side of the system where plugging of the channels can readily occur by the presence of fiber or other material when carried by such liquids as cooking liquor in the pulp industry. In spite of the varying restriction of the flexing, however, the invention renders it easily possible to remove the pacer plates, particularly at the intake sides of the system, so that heating surfaces can be readily cleaned and any plugging or other closing by fibers or such material can be readily eliminated. Adequate provision is made for this in accordance with the invention.

It is, accordingly, the overall object of the invention to improve upon provision of spacer plates for flexible plate heat exchangers.

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Another object is to control the extent of flexing of the plates of flexible plate heat exchangers to different extents at different positions thereof.

Another object is to effect the control of the flexing of the plates of flexible heat exchangers in varying degree to provide the most control where it is most needed.

Still another object is to provide for removal of the spacer plates for cleaning at the inlet sides of the channels.

A further object is to provide for the diminishing of the flexing in an outward direction all the way around the borders of the heat exchange plates.

A still further object is to provide for achieving the foregoing objects in simple and economical manner with regard to construction, operation and maintenance.

Further and more detailed objects will in part be pointed out and in part be obvious as the description of the invention taken in conjunction with the accompanying drawing proceeds.

In that drawing:

FIG. 1 is a front elevation with the front cover plate removed of a heat exchanger in accordance with the invention, the removal enabling the spacer plate construction to be readily seen with the figure also having a fragmentary intermediate portion broken away and shown in section to show a complete section of the construction at this position;

FIG. 2 is a fragmentary vertical section on line 2-2 of FIG. 1 looking in the direction of the arrows and on a somewhat larger scale than that of FIG. 1;

FIG. 3 is a fragmentary horizontal section through an assembly of flexible plates and spacer plates therefor in accordance with the invention, showing a different type of spacer elements for providing uniform intermediate spacing;

FIG. 4 is a fragmentary vertical section taken on line 4-4 of FIG. 3 and looking in the direction of the arrows;

FIG. 5 is a fragmentary vertical section taken on line 5-5 of FIG. 4 and looking in the direction of the arrows;

FIG. 6 is a view similar to FIG. 3 though with only a single pair of plates and a single spacer therebetween showing a further modified form of spacer plate construction;

FIG. 7 is a view similar to the upper portion of FIG. 1 of a further modification of the invention wherein variable spacing is provided all around the borders of the heat exchanger plates;

FIG. 8 is a horizontal section thereof;

FIG. 9 is a plan view of one of the removable end spacer plates per se;

FIG. 10 is a fragmentary horizontal section similar to FIG. 3 of a further modification wherein variation in spacing is achieved by means of spacer strips;

FIG. 11 is a fragmentary elevational view similar to the lower portion of FIG. 1 of a heat exchanger employing spacer construction in accordance with a further modification; and

FIG. 12 is a plan view looking down on FIG. 11 from the top thereof.

Considering the construction of the heat exchanger of the invention in detail, the heat exchanger as shown in FIGS. 1 and 2 can be considered as being composed generally of an elongated intermediate portion 1, and upper and lower end portions 2 and 3. Considered from the standpoint of these separate portions, it is to be generally understood that the embodiments of the invention of FIGS. 1 and 2, as well as the embodiments in the subsequent figures comprehend that, save for the upper and lower portions as shown here, and for side strips as added in subsequent showings, the intermediate portion is char-

acterized by the provision of spacer members throughout of uniform extent. The end portions shown in FIGS. 1 and 2 when considered vertically provide spacer members increasing in height from the intermediate portion towards the top and bottom ends. This variable increase in height of the spacer members correspondingly reduces the extent to which the flexible wall plates of the heat exchanger can flex at their ends.

The housing of the heat exchanger is generally made up of the front plate 4, omitted from the upper and lower showings in FIG. 1 but shown in the intermediate section, and a comparable back plate 5. The right and left sides throughout the principal portion of the height of the heat exchanger, as indicated generally at 6 and 7, are merely made up of the vertically extending U bars 22 between the sides of which the flexible plates are secured. The heat exchanger has top and bottom plates 8 and 9 which are removably secured by means of a series of bolts 10 to the flange of collars 11 and 12, thus sealingly secured about the upper and lower ends respectively of the heat exchanger.

The heat exchanger of FIGS. 1 and 2 is designed for countercurrent flow of the heat exchange media passed through the separate channels thereof. Thus one medium enters at the top and to the right through the inlet conduit 13 and passes out at the bottom left through its paired outlet conduit 14. The pair of conduits for the medium passed in heat exchange relationship therewith is made up of the inlet conduit 15 shown at the lower right hand side of FIG. 1 and its paired outlet conduit 16 shown at the left hand upper side thereof. At the upper part of the heat exchanger where the conduits 13 and 16 join up to the stack, filler pieces 17 and 17' are used for filling the exterior troughs provided by the U bars so that flow into and out of the respective channels can be effected without leakage. Similar sealings pieces are seen at 18 and 18' where the lower conduits 14 and 15 are joined to the stack. It is also to be noted that the upper filler pieces 17' are chamfered off in the line where their side and top U bars come together and have smaller filler pieces 19 secured thereto to fill the ends of the troughs of alternate ones of the U bars extending across the top. Similar filler pieces 20 are provided for similar purpose at the bottom of the heat exchanger.

As best shown in the intermediate sectional portion of FIG. 1 and in FIG. 2, the flat flexible heat exchanger plates 21 extend throughout the full height of the heat exchanger, they are secured together in spaced relationship throughout most of their vertical height by means of U bars 22 at their edges, whose sides 23 are welded in tight leak-proof joints to the edge portions of the plates 21. In the areas where the respective conduits 13-16 join the stack of the heat exchanger, it will be appreciated that every other one of the U bars will be removed to allow the fluid to flow into the channels provided between the heat exchanger plates. Thus the sections removed for one set of channels at the inlet 13 will correspond with the sections removed from the same channels at the outlet 14 leaving the remainder closed. The other set of channels will be open for flow of fluid therein to the inlet 15 and upwardly and outwardly through the outlet 16.

Similarly, alternate U bars at the top of the stack, which are also given the reference characters 22 and 23, since their nature is the same as that of the U bars for the vertical sides, will be removed from the channels opened up by the removal of sections of alternate U bars where the inlet 13 joins the stack. Thus the fluid, besides flowing in between the plates 21, can also well up into the chamber 31 at the head of the stack. The alternate channels are of course open to receive flow of the other medium through the inlet 15 and such channels are open to the chamber 32 at the bottom of the stack. Thus liquid or gas, entering through the inlet 15, may well down into the chamber 32 before flowing upward through its channels and out through the outlet 16. In this flow

the fluid entering at 15 will of course be isolated by the flexible heat exchanger walls 21 from the channels in which the fluid introduced at 13 flows down and out through the outlet 14.

In this form of the invention dimple type spacer plates are positioned in the channels or spaces between the flexible heat exchanger plates 21. Considered from the standpoint of the full height of the heat exchanger these spacer plates are made up into intermediate sections and upper and lower end sections. The intermediate sections, which extend throughout the majority of the height of the heat exchanger, are indicated at 24 having top and bottom edges at 25 and 26 and right and left side edges 27 and 28. Thus, as seen, they are spaced to a small extent from the bases of the U beams forming the vertical sides of the channels. Also plates 24 have uniform dimples formed according to a uniform pattern extending alternately from opposite sides of that plate, as seen at 29. Their height is such as to leave substantial spacing, 30, between the ends of the dimples 29 and the opposed surfaces of the plates 21. These spaces 30 not only allow flexing of the main portions of the heat exchanger plates to the desirable extent, but they also allow ample room for removal of the spacer plates for cleaning them and cleaning their channels.

At its upper and lower portions 2 and 3, however, the heat exchanger here is provided with short spacer plates 33 formed with dimples which increase in height upwardly from the line 25 and downwardly from the line 26. Considering only one of these plates, 33, since both top and bottom are alike, reference is made to FIG. 2 wherein each such plate is seen to commence at a line 34. Every other alternate plate, however, extends up out of the alternate open channels 35, the intermediate channels being closed as indicated at 36. Accordingly, the extending set of end spacer plates 33 has portions 37 extending therefrom out through the openings 35 to be grasped for removal of these end spacer plates when the top 8 is removed from the heat exchanger. The shorter end plates terminate at the line 38 below the bases 22 of the channels of the U bars.

Moving upwardly then from the line 34 as seen in FIGS. 1 and 2, it will be seen that the first row of dimples 39 is only of a little greater height than the uniform height dimples 29 formed from the plates 24. Accordingly, the space 40 between the ends of dimples 39 and heat exchanger plates 21 is only a little less than the space 30. The next upper row of dimples 41 is a little higher, leaving a smaller space 42, with the next row 43 extending still higher with a smaller space 44 and, finally, the uppermost row of dimples 45 extends so that little space 46 is permitted for flexing of the plates 21 at this position. By this means it will be readily apparent that the flexing of the plates 21 will be controlled so as to allow the smallest amount at the position closest to the top and bottom joining of the flexible plates with their U bars and to allow a gradually increasing amount in a direction away from that joining position until full flexing, to the extent permitted by the intermediate spacer plates 24 is achieved. In this way the angles formed by the flexing plates, and consequent failures of the plates adjacent the joining sections, are reduced.

Though chemical cleaning of the channels in the heat exchanger is supposed to keep both the heating surfaces of the flexible plates and the surfaces of the spacer plates free from scaling, or plugging, it can sometimes happen that plugging by fiber or other material carried by the liquor occurs. When it does occur it will be at the intake end. For this reason, then, it is important to be able to remove the end plates, such as 8 and 9, to get at and remove the material causing the plugging. Additionally, after operation of the heat exchanger has been carried on for a long period of time scale builds up on the heating surfaces of the flexible wall plates, in spite of the efforts to keep these clean by chemical cleaning. By

having the respective channel systems open at top and bottom inlets the short spacer plates 33 therein can be readily removed by grasping their projecting portions 37, once the end plates 8 and 9 have been removed. The shortness of these plates facilitates removal of them in spite of scale that may have built up opposite their dimples. Once the end plates 33 have been removed, the large intermediate spacer plates 24 can be caused to fall or can be readily removed in other manner. The short spacer plates 33 at the closed ends of the channels may not be so readily removable but that is not of too much importance for the build up of scale would not be too significant at those positions. Also, as already pointed out, any plugging takes place at the inlet end.

The invention construction as just described enables the make up of combinations of various upper and lower variable spacing plates with various types of uniform spacing intermediate spacer plates. All such plates can be of the same general construction, i.e., all having integral upstruck dimples for effecting the spacing, or the variable spacing spacer plates can be constructed in one manner while the larger intermediate spacer plates can be constructed in a different manner.

As an example of a different form of construction readily applicable for use as intermediate spacer plates, reference is made to the showing in FIGS. 3, 4 and 5. Here the intermediate spacer plates, indicated at 47, may be almost wholly made up of offset material so as to provide very full uniform spacing without materially interfering with the flow other than to render it turbulent. Hence, as seen in FIGS. 3 and 4, the plate material is principally in the form of columns alternating between a series of offsets of the plate material to one side and then the other of the center plane, as seen at 48 and 49. These columns of offsets extend a uniform distance first to one side and then the other of the central joining plane. Fluid within the channel besides flowing in the spaces between the ends of the offset projections, such as 48 and 49 and the flexible wall plates, can flow down through the channels 50 bordered by the columns of the spacer member. Additionally, the fluid can flow behind the projections and out at the other side of the plates creating turbulence in doing so. Thus the spacer plate, as seen in these figures, could readily be substituted for the intermediate spacer plate 24 in FIG. 1.

A reversion to the FIG. 1 dimple plate construction with an additional modification is illustrated in the sectional view in FIG. 6. Here, besides having short spacer plates at the ends providing variable spacing, the channels between the walls 21 have spacer strips up and down their sides providing variable spacing there also. Thus the intermediate spacer plate 52 equipped with spacer dimples 53 of uniform height extending from both sides of the central plane thereof provides uniform spacing as seen at 54 for almost the whole of the distance across the assembly. In the channels and at each side of the plate 52 however, spacer strips 55 are provided having a column of inner spacer dimples 56 allowing a smaller spacing 57 than that permitted at 54. Then there is an outer column of spacer dimples 58 leaving only a little spacing between their ends and the plates 21 adjacent the outside edges of the construction. These vertical spacer strips of variable spacing effect, as shown here in cross section, extend throughout the height of the intermediate plate and at both sides thereof, as seen in this figure.

FIGS. 7, 8 and 9 show a construction including spacer plates providing varying spacing of both the ends and sides of the heat exchanger plates. Here the flexible heat exchanger plates, generally indicated at 61, have inwardly inclining top edges 71 coming toward each other to form substantially a V. As in the previous forms, the plates 61 are secured together in spaced relationship by means of U bars 62 having sides 63 between which the edge portions of the plates 61 are welded. Above and below the assembly of plates the heat exchanger has end cham-

bers 64 and 65 enclosed within the side wall 66, separated from each other by a partition 67 and enclosed by a removable top plate 68. Conduits 69 and 70 communicate respectively with the end chambers 64 and 65 and comparable conduits communicate with comparable chambers which would be present at the opposite end, so that countercurrent flow as in FIG. 1 can be achieved.

The spacer plates in this instance are made up as a number of strips. Innermost and covering the major portion of the height are the intermediate strips 72 formed with sets of dimples 73 all of the same height projecting upwardly from the strips to permit uniform flexing of the plates 61 in this portion thereof. Then, as in the FIG. 6 form, vertical side strips 74 are provided in each channel at each side of the assembly. These side strips are formed with a first inner column of dimples 75 of somewhat greater height than the uniform dimples 73 of the strips 72 so they restrict the flexing of the plates 61 to greater extent. The strips 74 have an outer column of dimples 76 whose height is increased further so as to further limit the flexing of the plates 61 closely adjacent the vertical side edges thereof.

At the top and bottom end positions the conduits such as 69 and 70 communicate with the end chambers 64 and 65. These lie above the ends of the heat exchanger plates with one set of alternate channels being open to the chamber 64 and the other set to the chamber 65. The intermediate closed channels are closed by means of U bars as seen at 62 and 63. Separate end spacer plates 77 and 78 are provided in the ends of the channels here with the plates 77 being positioned in the open ended channels and having projecting portions 77a extending out above their channels. These may be grasped for removing the plates 77 after the end plate 68 has been removed. The plates 78 lie in the upper end of the intermediate closed channels.

Both of the plates 77 and 78, like the side strips 74, are formed with rows of oppositely extending spaced dimples 77b and 77c. The dimples 77b, like the dimples 75, are of somewhat greater extent than the dimples 73 of the intermediate plate 74 in order to limit the flexing of the heat exchanger plates at this position by a further small amount. The dimples 77c, however, extend up further to reduce the permissible flexing of the heat exchanger plates close to their joined edges to a still further extent.

It will be appreciated that, like the FIG. 1 form, removal of the end plate 68 will enable removal of the spacer pieces 77 with consequent removal of the intermediate strips 72 from whichever end of their channels happen to be open. Likewise the side strips 74 would be removable unless scale has built up in the narrow bordering area that they occupy to an extent to render that removal too difficult. In the event, however, that these strips cannot readily be removed, it makes little difference in view of their position along the edges.

A somewhat different approach is illustrated in the showing in FIG. 10. Here the heat exchanger plates 21 are the same as in FIG. 1 but the spacer plates 79 extend throughout the entire height and width of those heat exchanger plates. The spacer plates 79 are formed with columns and rows of spacer dimples 80 as illustrated in the previous forms with the dimples 80 here being of uniform height throughout the extent of the plates 79. Here reduction of the flexing of the heat exchanger plates adjacent their edges is effected vertically, as seen in FIG. 10, by means of flat spacer strips 81 and 82 secured to the heat exchanger plates 21 in overlying relationship with respect to the dimples in the two outermost columns. The same arrangement can of course be employed at the top and bottom of the heat exchange plates.

As here illustrated, only two strips 81 and 82 are employed though it is to be understood that a greater number positioned further steps inwardly of the heat exchanger plates can be provided if desired. In any event these

strips are graduated down in thickness from the thicker strips 82 to the thinnest ones 81. The strips 81 will reduce the flexing of the plates 21 by leaving less space 83 between them and the ends of the opposed dimples 80 than is present in the absence of the strips 81. Still less space 84 is left between the opposed dimples and strips 82 inasmuch as the strips 82 are thicker. This arrangement of flat spacer strips then enables the employment of spacer sheets which are uniform throughout the height and breadth of the heat exchanger plates with variation spacing being achieved by means of the additional spacer strips 81 and 82 instead of by the previous means of varying the dimple height.

FIGS. 11 and 12 illustrate a further modification nevertheless embodying the principles of the invention. In this instance the heat exchanger plates shown at 85 are shaped like the plates of FIG. 7 having, in effect, rectangular intermediate portions and end portions diminishing in width in the form of a V. Here the control against undue flexing of the heat exchanger plates throughout their intermediate portions is achieved in a manner to assure uniformity of spacing with a construction of high strength.

The spacer construction is made up in what might be considered as a carpet. This carpet is composed of a plurality of strips of material set on edge and bent in the form substantially of a sine curve. The strips are in spaced apart side by side relationship and are retained assembled and spaced as desired by means of spacer bars extending between them. Such strips are shown at 86 and the spacer bars therefor at 87. The strips can be imperforate, or, if desired, may be perforated to allow flow through them.

The carpet may be made up of one complete assembly extending all the way across the channel of the heat exchanger and may thus replace the dimple plates 24 of the intermediate section, as seen in FIG. 1. In that instance the variable spacing upper and lower plates of FIG. 1 would be employed. Alternately, and as indicated in FIGS. 11 and 12, the carpet made up of the strips 86 and the bars 87 can be made up in two sections, one on either side of the vertical center line. Thus when angular end spacer plates, such as 88, are employed, with alternate ones thereof being removable as in the FIG. 7 form, the right and left hand carpet portions as viewed in FIG. 11 can be removed from alternate channels at the respective open ends thereof.

The end spacer plates 88 are formed with a pattern of dimples 89 and 90 in which are positioned, as regards dimples 89, closely adjacent the inclined edges of the spacer plates, and as regards dimples 90 spaced inwardly from the row of dimples 89. The heights of the dimples in the respective rows are selected as previously discussed for variable restricting the flexing of the heat exchanger plates as the secured edges thereof are approached.

The heat exchanger of FIG. 11 has end chambers 91 and 92 separated by partition 93 and bordered by side walls 96 and 97. Communication with the interior of these chambers is effected through conduits 94 and 95 in the manner previously explained.

The strips 86 out of which the carpet formation of FIGS. 11 and 12 is principally made, need not be metal though steel and aluminum are metals which can readily be used. Any other material of sufficient strength which will withstand the temperatures and pressures and, where desired, will be such as acid and corrosion resistant can be employed. Examples of such other material are fiberglass, wood, whether in its natural state or impregnated with a suitable plastic, or one of the harder, tougher and less expensive plastics themselves, of which polystyrene is an example. Such other materials, when used in making the strips 86 of FIGS. 11 and 12, or the spacer plates or strips of the other forms of the invention disclosed herein would generally be less expensive and would also be of low heat conductivity.

In the foregoing description taken in conjunction with the accompanying drawing, various embodiments of the invention have been illustrated and described. It will be clear to those skilled in the art, however, that such description and illustration are only by way of illustration and that other useful modifications and variations as would suggest themselves to those skilled in the art may be employed without departing from the spirit and scope of the invention. Thus it is to be understood that since certain changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

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

1. In heat exchanger construction, a pair of spaced flexible heat exchanger plates forming a channel for the passage of heat exchange medium therebetween, and spacer means separate from the plates mounted in said channel for limiting the flexing of said plates toward each other, said spacer means having an intermediate portion lying within a portion of said channel intermediate a pair of the borders thereof, said intermediate portion of the spacer means comprising a plate having a plurality of oppositely extending projections of uniform height spaced thereover to limit flexing of said plates toward each other to a uniform extent and said spacer means including bordering portions each comprising a plate having a plurality of oppositely extending projections which increase in height in the direction from the respective edge of the intermediate portion of the spacer means toward the respective border of the heat exchanger plates for limiting the flexing of bordering portions of said plates between said intermediate portion of said channel and said pair of borders thereof in varying degree.

2. In heat exchanger construction as in claim 1, said bordering portions of said spacer means being formed of thin light weight material.

3. In heat exchanger construction as in claim 2, said bordering portions of said spacer means being positioned all around the periphery of said intermediate portion of said spacer means.

4. Heat exchanger construction as in claim 1, said intermediate portion of said spacer means being formed as at least one intermediate dimple plate, said intermediate dimple plate being formed with edges, said bordering portions of said spacer means being formed as bordering dimple plates.

5. Heat exchanger construction as in claim 4, said intermediate portion of said spacer means having at least one pair of opposite ends, said bordering dimple plates being positioned at said one pair of end of said intermediate portion of the spacer means.

6. Heat exchanger construction as in claim 4, said bordering dimple plates being positioned all the way around said intermediate portion of the spacer means.

7. Heat exchanger construction as in claim 4, said bordering dimple plates being formed as narrow strips extending throughout substantially the full height of said intermediate spacer means.

8. In heat exchanger construction as in claim 1, each of said intermediate portion and bordering portions of the spacer means including a plate-like member and said plate-like member having the material thereof in adjacent rows offset laterally in a plurality of small offset portions extending alternately to one side and then the other of said plate.

9. In heat exchanger construction, a plurality of pairs of spaced flexible heat exchanger plates forming channels for the passage of heat exchange medium therebetween, every other one of said channels forming one passage means for the passing of one heat exchange medium through said heat exchanger, the remainder of said

channels forming another passage means for another heat exchange medium, separate pairs of inlet and outlet means for said heat exchange media for said one and another passages, means for sealing the portions of said heat exchanger plates between their edges save where said passages are in communication with said inlet and outlet means, said one passage being open at one end portion of said heat exchanger and said other passage being open at the other end portion of said heat exchanger, said pairs of inlet and outlet means including chamber forming means overlying said ends of said heat exchanger and having the interiors thereof in communication with said respective open passages, said chamber forming means being formed with removable end walls, spacer means positioned in said passages for limiting the extent of flexing of said flexible heat exchanger plates said spacer means comprising intermediate spacer members extending throughout the major portion of the extent of said passages between said ends thereof and separate end spacer members at the ends of said intermediate spacer members, said end spacer members positioned in passages formed with open ends having extending portions extending out through said open ends into the respective end chambers so that said extending portions may be gripped for removal of said end spacer members on removal of said end plates from said chambers, said intermediate spacer members having uniform lateral extent throughout and said end spacer members increasing in lateral extent in a direction away from said intermediate spacer members whereby flexing of said flexible plates will be permitted to substantially uniform extent throughout the portions of the same opposed to said intermediate spacer members and will be limited to increasing extent toward the borders of said passages.

10. In heat exchanger construction as in claim 9, said intermediate spacer members being formed of spaced sets of laterally extending spacer elements, the lateral extent of said spacer elements being uniform throughout said intermediate spacer members.

11. In heat exchanger construction as in claim 10, said intermediate spacer members comprising thin plates formed with dimples extending laterally therefrom, said dimples lying in rows extending alternately to one side and then the other of the dimple plate and said end spacer members being dimple plates formed out of thin sheet material and having rows of dimples in spaced relation extending laterally alternately from one side and then the other of said plates, said dimples in said rows of said end spacer members increasing in height in a direction from the end of said intermediate spacer members toward the borders of said passages.

12. In heat exchanger construction as in claim 11, said intermediate dimple plate spacer members being formed as separate elongated strips of thin plate material.

13. In heat exchanger construction as in claim 9, said spacer means including elongated spacer strips extending along the sides of said intermediate spacer members between the side edges thereof and said edge sealing means,

said spacer strips being formed with spaced laterally extending dimple members of greater lateral extent than the lateral extent of said intermediate spacer members.

14. In heat exchanger construction, a pair of spaced flexible heat exchanger plates forming a channel for the passage of heat exchange medium therebetween, and spacer means separate from the plates mounted in said channel for limiting the flexing of said plates toward each other, said spacer means having an intermediate portion lying within a portion of said channel intermediate a pair of the borders thereof formed to limit flexing of said plates toward each other to a uniform extent and said spacer means including bordering portions lying within portions of the channel at the borders thereof for limiting the flexing of bordering portions of said plates between said intermediate portion of said channel and said pair of borders thereof in varying degree, both the intermediate and bordering portions of said spacer means being formed of thin metallic sheet material and having a plurality of oppositely extending projections thereon, the projections on the bordering portions of the spacer means being of varying height as measured between the heat exchanger plates.

15. In heat exchanger construction, a pair of spaced flexible heat exchanger plates forming a channel for the passage of heat exchange medium therebetween, and spacer means separate from the plates mounted in said channel for limiting the flexing of said plates toward each other, said spacer means having an intermediate portion lying within a portion of said channel intermediate a pair of borders thereof formed to limit flexing of said plates toward each other to a uniform extent and said spacer means including bordering portions lying within portions of the channel at the borders thereof, for limiting the flexing of bordering portions of said plates between said intermediate portion of said channel and said pair of borders thereof in varying degree, both the intermediate and bordering portions of said spacer means being formed of economical non metallic sheet material of low heat conductivity and having a plurality of oppositely extending projections thereon, the projections on the bordering portions of the spacer means being of varying height as measured between the heat exchanger plates.

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