

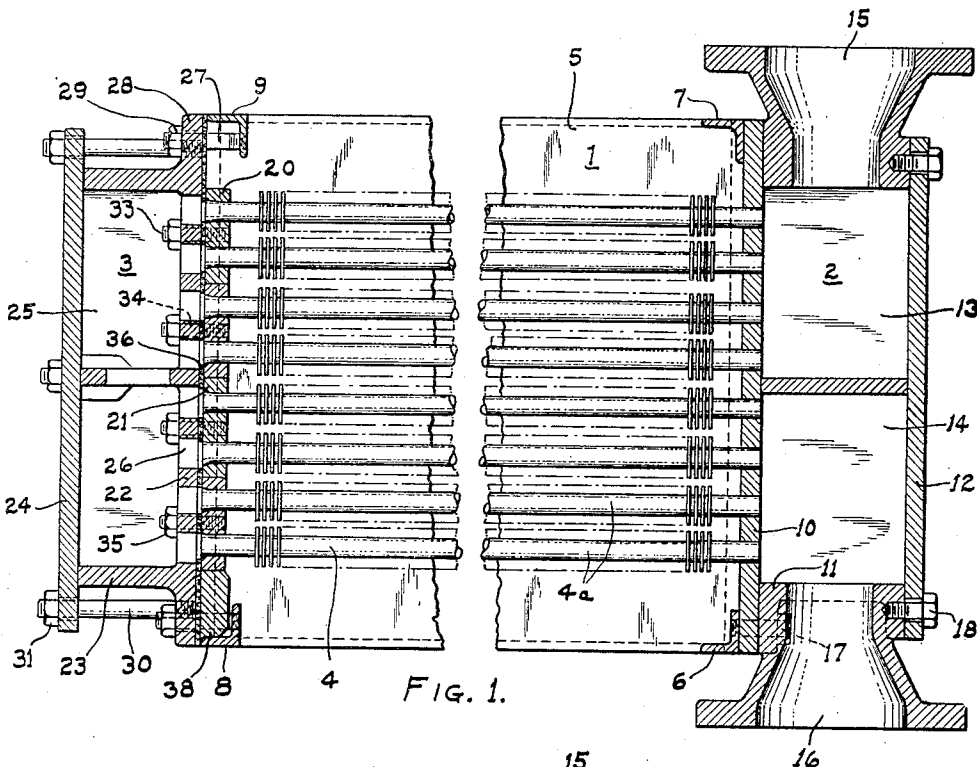
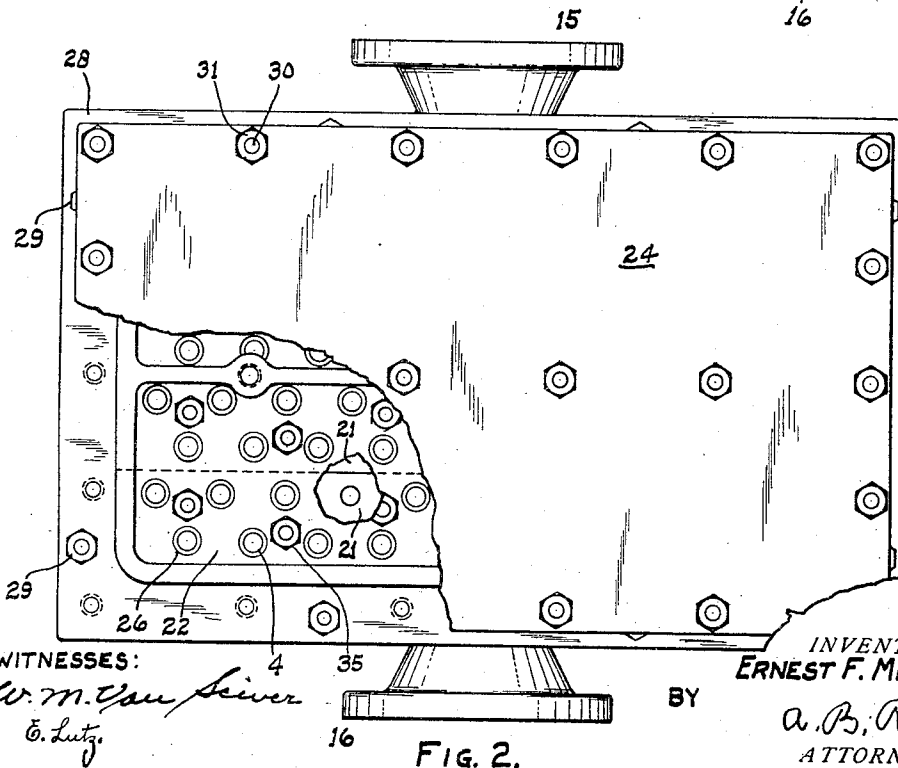
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HEAT TRANSFER APPARATUS

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WITNESSES:

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FIG. 2.

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HEAT TRANSFER APPARATUS

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My invention relates to heat exchanger or other apparatus embodying a tube bundle comprising tube supporting plates, a series of tubes extending therebetween and fluid chambers associated with the tube plates; and, more particularly, it relates to an improvement upon the heat exchanger disclosed in the copending application of John A. Potter, filed January 6, 1931, Serial No. 507,017, entitled Heat exchanger, and assigned to the assignee of the present application.

In the aforesaid copending application, a heat exchanger is provided with tube bundles fastened at one or both ends to sectionalized tube plates. The sectionalized tube plates are disposed adjacent to each other in planular relation. The headers or chambers for conveying a supply of fluid to the tubes are fastened directly to sectionalized tube plates on at least one end of the heat exchanger and assist in forming the seal between the joints of the sectionalized tube plates and also provide for the desired direction of fluid flow through the tubes. The advantages of this heat exchanger are numerous, one of the most important being that the unitary header may be removed, the tube bundles pulled out, and the sectionalized tube plates either completely removed for replacing a tube if sectionalized tube plates are utilized at both ends of the heat exchanger, or spread apart for replacing a tube without removing a tube bundle if sectionalized tube plates are utilized only at one end of the heat exchanger.

It is necessary, however, to periodically clean the tubes, and it is sometimes advantageous to plug a broken tube out of the circulating path of the media passing through the heat exchanger, so that the heat exchanger, and attendant apparatus need not be taken immediately out of service for repair. To accomplish the above results in heat exchangers as constructed in the aforementioned copending application, the unitary header members must be completely removed, which removal entails the loosening of a large number of bolts which are necessary for adequately sealing the chambers which contain circulating fluid, and also in heat ex-

changers, entails the handling of a heavy and cumbersome header.

It is an object of my invention to provide sealing means for a tube plate section which is effective to prevent leakage between the interior space of the tubes and the space communicating therewith and the space external to the tubes.

A further object of my invention is to facilitate the cleaning or plugging out of tubes in a heat exchanger of the type disclosed in the application aforesaid.

It is another object of my invention to provide a cleaner or header for a heat exchanger effectively sealed with respect to associated sectionalized tube plate and which has a closure member, removable without disturbing the sectionalized tube plate or the sealing means therefor, to afford easy access to the ends of the heat exchanger tubes.

A further object of my invention is to provide a heat exchanger having headers provided with closures removable to expose the tube ends.

A further object of my invention is to provide a heat exchanger having a tube and tube plate assembly detachable with respect to headers and the headers having detachable closures, all of the attaching devices being externally accessible to facilitate assembly and dismantling.

A further object of my invention is to provide, with a tube bundle and tube plates, at least one of the tube plates being sectionalized, a shell structure having a crossbar upon which the lowermost of the superposed tube plate sections is arranged to rest.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in accordance with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a sectional view of a heat exchanger showing an embodiment of my invention applied thereto; and,

Fig. 2 is an end view of the heat exchanger shown in Fig. 1, with a portion of the closure broken away, and with a portion of the dummy tube sheet also broken away.

I have illustrated my invention applied

to the reversing chamber of a heat exchanger, but it is to be understood that my invention may be applied to either or both ends of a heat exchanger, and I do not wish to be limited to the construction shown in the drawing except insofar as specifically set forth in the appended claims.

Referring now to the drawing for a better understanding of my invention, the heat exchanger illustrated by way of example comprises a shell assembly 1 together with headers 2 and 3 connected by tubes 4. Where, as illustrated, the apparatus is used for air cooling or the like, the shell assembly may consist of side plates 5 connected by transverse angles or bars 6, 7, 8, and 9.

As shown, the header 2 includes a tube plate 10, a header structure 11 and a removable closure 12 defining chambers 13 and 14 communicating with the tubes 4 and with inlet and outlet connections 15 and 16. The header structure 11 is preferably detachably connected to the shell assembly and to the tube plate 10 by means of bolts 17, and the closure 12 is preferably detachably connected to the header structure 11 by means of screws or bolts 18 accessible externally so that access to the tubes through the chambers 13 and 14 may be had.

The header 3 includes a tube plate 20, consisting of sections 21 disposed adjacent to a plate portion or dummy tube plate 22 of the header structure 23, and a removable closure 24 defining a return chamber 25 communicating with the tubes 4 through openings 26 provided in the plate member 22. The header structure 23 is connected to the shell assembly 1 by bolts 27 anchored to the latter and extending through openings provided in flanges 28 of the header structure 23 and nuts 29 which fit the bolts outside of the flanges 28. The closure 24 is connected to the header structure 23 by means of bolts 30 having nuts 31 engaging the outer plates of the closure plate.

Each tube plate section 21 has one or more bolts or threaded stems 33 anchored thereto, extending through openings 34 in the plate member 22 and having nuts 35 bearing against the chamber side of the plate member. By tightening the nuts 35, it will be apparent that the tube plate sections may be drawn toward the plate member 22.

Where a sectionalized tube plate construction is employed, it is necessary that the tube plate sections shall be effectively sealed, if leakage is to be prevented. Hence, gasket means 36 is arranged between each tube plate section 21 and the plate member 22 and is effective to prevent leakage between the space within the tubes and the chamber 25 and the space external to the tubes. By tightening the nuts 35, the tube plate sections 21 may be drawn toward the plate member 22 so as to make the gasket joints fluid-tight.

The shell assembly 1 is provided with support blocks 38 upon which the lowermost tube plate section 21 is adapted to rest, the other tube plate sections 21 being arranged in superposed relation with respect thereto. The blocks 38, therefore, serve to support the tube plate sections 21 in position so that the header structure may be assembled, the bolts or stems 33 lining up with the openings 34 and permitting of the plate member 22 being readily brought into proper position.

The closure plates 12 and 24 may be readily removed to expose the ends of the tubes, and it is, therefore, possible to close or stop a tube, if it should leak or break, without further dismantling of the structure than removal of one of the closure plates.

If it is desired to expose the tube plate sections 21 for manipulation incident to replacement or removal of a tube as more fully explained in the application aforesaid, this may be readily accomplished by the present construction, it being merely necessary first to remove the closure 24, whereupon the nuts 35 will be exposed for removal; and, after removal of the nuts 35, and the nuts 29, the header structure 23 including the plate member 22 may be removed, whereupon the sections 21 are exposed for tube removal or replacement in the manner stated. While it is possible to remove or replace a tube from the sectionalized end of the heat exchanger without further dismantling than removal of the header structure 23, in such installations that space is available only at the opposite end, I prefer to disconnect the tube bundle including the tubes and the connected tube plates; and this may be done by disconnecting the bolts 17, the header structure 23 being also disconnected.

Each tube plate section 21 has the bolts or stems 33 anchored thereto so distributed, that, with tightening of the nuts 35, substantially uniform pressure may be exerted by each tube plate section against the gasket 36 to effect sealing. It will be apparent that any suitable form of gasket may be used so long as it effectively seals the joint between each tube plate section 21 and the plate member 22 to prevent leakage between the interior space of the tubes and the chamber 25 and the space external to the tubes.

While I show openings in the plate member 22 somewhat larger than the tubes 4 for affording communication between the chamber 25 and the tubes, it will be apparent that any suitable arrangement of openings for this purpose may be provided, it being only necessary that communication shall be afforded between the chamber 25 and the tubes and that the plate member 22 shall present adequate seating surface for the gasket means.

From the foregoing, it will be apparent that I have provided a heat exchanger which has

many advantages. The tubes are accessible for cleaning and for stoppage or closure merely by removal of the header closure plates and a header structure may be removed to expose adjoining tube plate sections incident to removal or replacement of tubes, As the header structure adjacent to the sections of the sectionalized tube plate is provided with a plate portion in the form of a dummy tube plate and as draw bolts are provided for connecting the tube plate sections of the plate portion or dummy tube plate, it will be apparent that effective sealing can be provided in that it is merely necessary to provide suitable gasket means to seal the joints between the dummy tube plate and the tube plate sections. Furthermore, as the draw bolts for connecting the sections of the tube plate to the dummy tube plate extend into the circulating medium space, there is no need for sealing of such bolts. Upon reference to the drawing, the latter point will be clear, for it will be noted that each tube plate section beyond its tube group 4a is bounded by the sealing gasket and the draw bolts are arranged entirely within this sealing boundary, with the result that such bolts, particularly the nuts thereof, are in the circulating medium space with the result that there can be no leakage from such space to the exterior due to such bolts.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In a tubular heat exchanger, a tube plate element, a group of tubes connected to the element, a plate member having openings therein affording communication therethrough with the tubes, means for connecting the tube plate element to the plate member and effective to draw the plate element toward the plate member, and sealing means between the tube plate element and the plate member and effective to prevent leakage between the internal space of the tubes and the space communicating therewith and the space external to the tubes.

2. In a tubular heat exchanger, a tube plate comprising sections, a group of tubes connected to each section, a plate member having openings therein affording communication therethrough with the tubes, sealing means effective to prevent leakage between the sections and the plate member, and means for connecting the sections to the plate member and effective to draw the sections toward the latter.

3. In a tubular heat exchanger, a tube

plate comprising sections, a group of tubes connected to each section, a plate member having openings therein affording communication therethrough with the tubes, means for connecting the sections to the plate member and effective to draw the sections toward the latter, and gasket means between the sections and the plate member and effective to prevent leakage therebetween.

4. In a tubular heat exchanger, a tube plate comprising sections, a group of tubes connected to each section, a plate member having openings therein affording communication therethrough with the tubes, means for connecting tube plate sections to the plate member including threaded stems anchored to each tube plate section and extending through holes provided in the plate member and nuts carried by the stems for engaging the plate member at the side of the latter opposite to the tube plate sections, and sealing gasket means between each tube plate section and the plate member and effective to prevent leakage therebetween, said threaded stems of each tube plate section being distributed thereover to obtain distributed sealing pressure.

5. In a tubular heat exchanger, a shell assembly having terminal supporting block means, a tube plate comprising superposed sections with the lowermost section resting on said block means, a group of tubes connected to each tube plate section, a plate member having openings therein affording communication therethrough with the tubes, means for connecting the tube plate sections to the plate member and effective to draw the sections toward the latter, and gasket means between the sections and the plate member and effective to prevent leakage therebetween.

6. In a tubular heat exchanger, a tube plate comprising sections, a group of tubes connected to each section, a plate member having openings therein affording communication therethrough with the tubes, means for connecting the sections to the plate member including threaded stems carried by the sections, extending through holes provided in the plate member and having nuts for engaging the plate member at the side of the latter opposite to the tube plate sections, and means associated with said plate member to provide a chamber communicating with the tubes and including removable closure means for providing access to said connecting means.

7. In a heat exchanger, a pair of headers including tube sheets, header structures, and removable covers spaced from the tube sheets, said tube sheets, header structures and removable covers defining chambers communicating with the tubes; detachable connecting means between the tube plates and the header structures; one of said tube plates including a plurality of sections, the asso-

ciated header structure having a plate provided with openings affording communication therethrough with the tubes, and the detachable connecting means for the tube plate sections including threaded stems fastened to the sections, extending through openings in said header structure plate, and having nuts bearing against the latter at the chamber side; and sealing means for preventing leakage between the interior space of the chamber and of the tubes and the space external to the tubes.

8. In a tubular heat exchanger, a group of tubes, a tube plate connected to the tubes; header structure defining a chamber and provided with a plate member having openings therein affording communication therethrough with the tubes; gasket means between the tube plate and the plate member and encompassing the tube ends to prevent leakage between the interior space of the chamber and of the tubes and the space external to the tubes; means for connecting the tube plate to the plate member including a threaded stem attached to the tube plate within the gasket boundary, extending through an opening provided in the plate member, and a nut cooperating with the threaded stem and arranged to bear against the chamber side of the plate member, whereby the tube plate may be drawn toward the plate member to compress the gasket means to effect fluid-tight sealing; said header structure including a closure providing access to said nut and to the tube ends when removed; and detachable connecting means for the closure.

In testimony whereof, I have hereunto subscribed my name this 23rd day of Dec., 1931.

ERNEST F. MILLER.