May 9, 1933. J. A. POTTER 1,907,867

HEAT EXCHANGER

Filed Dec. 22, 1931 2 Sheets-Sheet 1

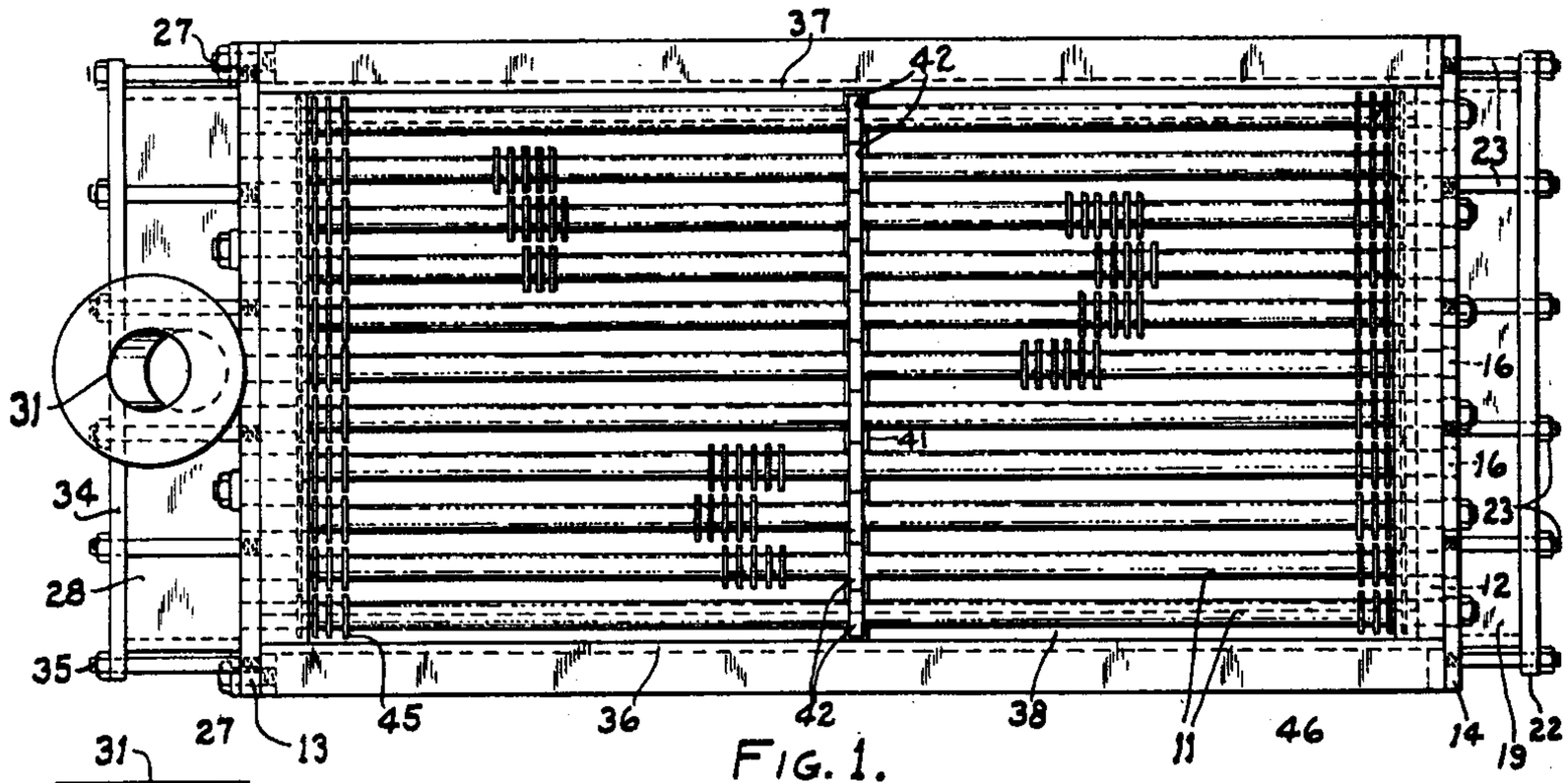

FIG. 1.

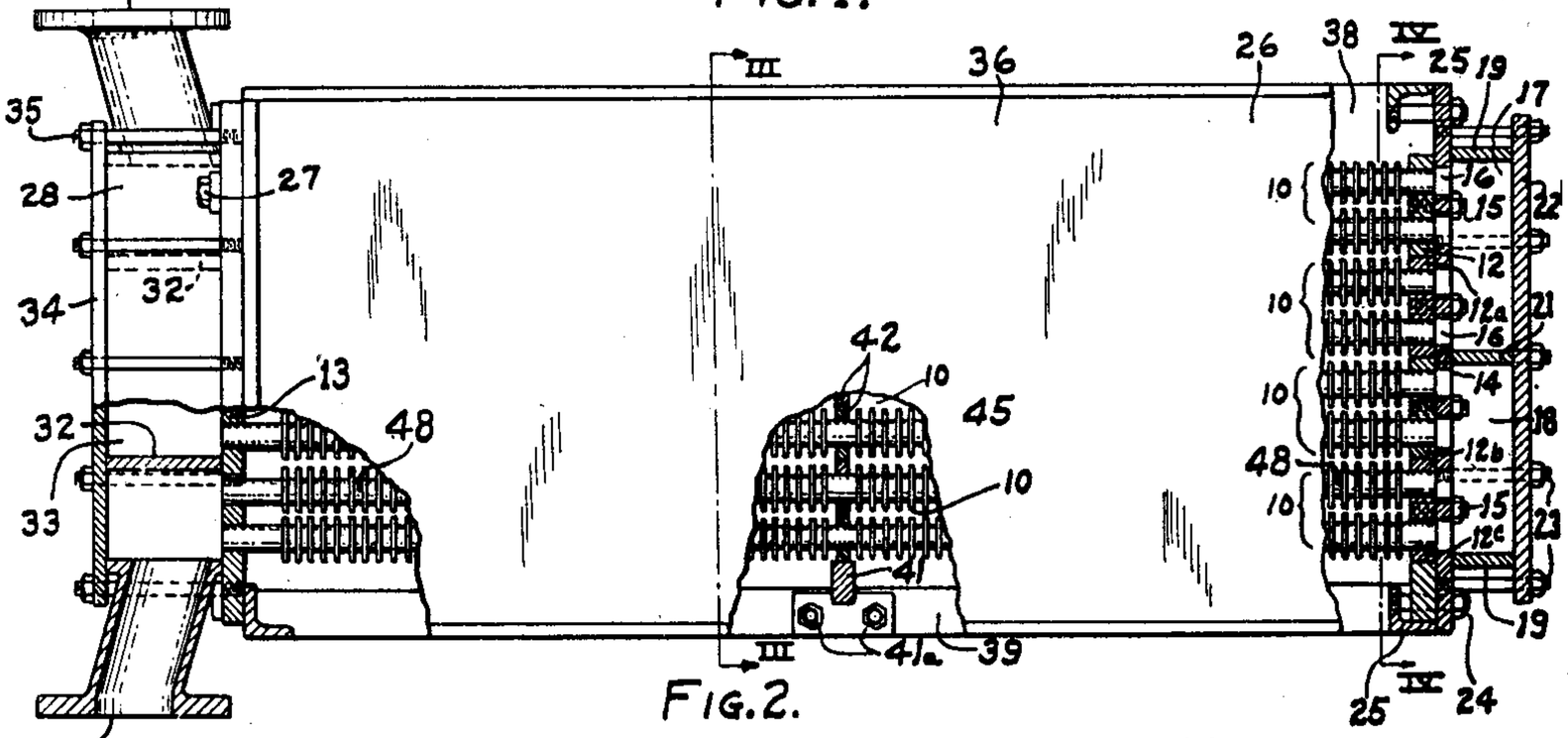

FIG. 2.

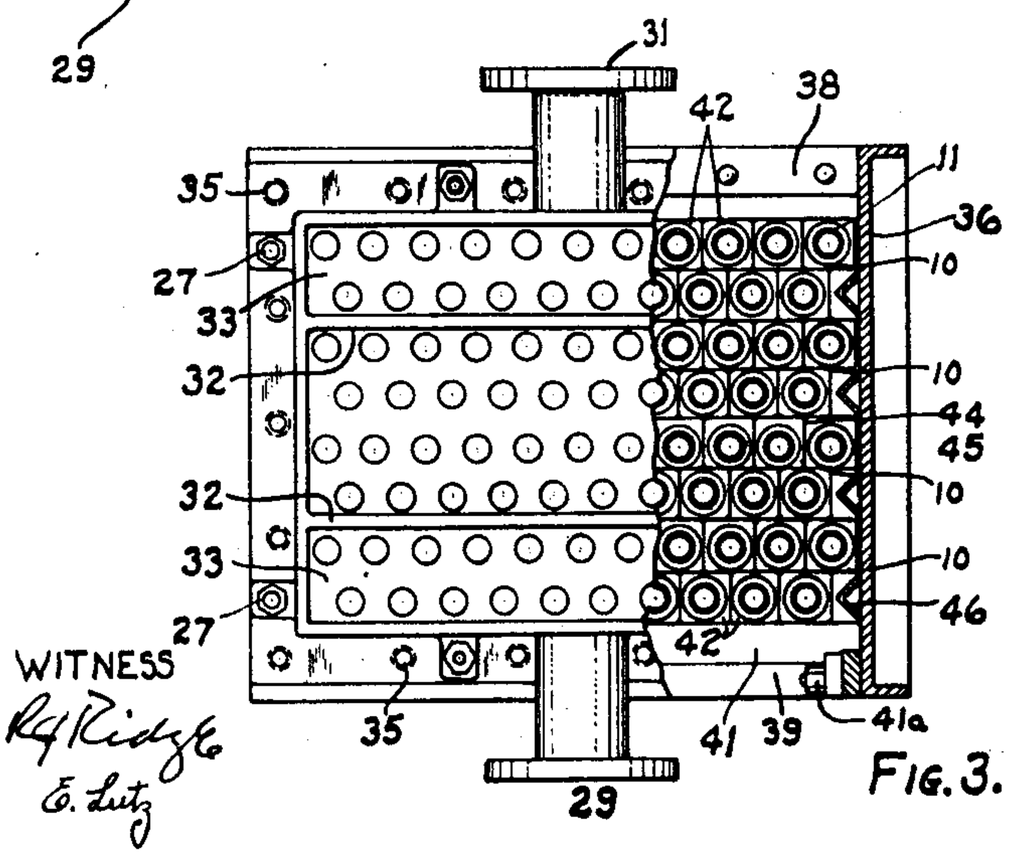

FIG. 3.

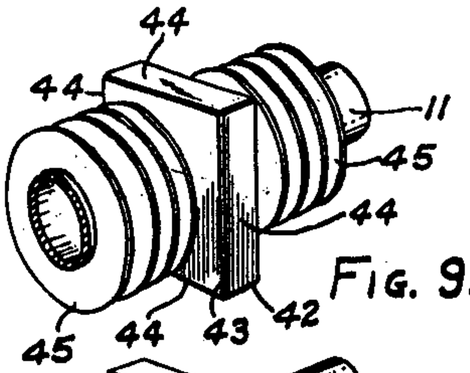

FIG. 9.

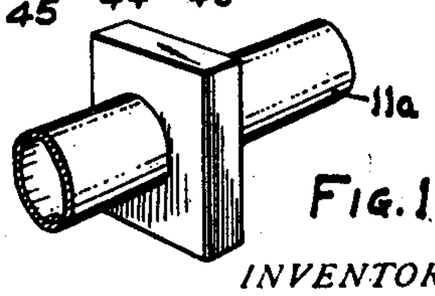

FIG. 10.

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HEAT EXCHANGER

Filed Dec. 22, 1931 2 Sheets-Sheet 2

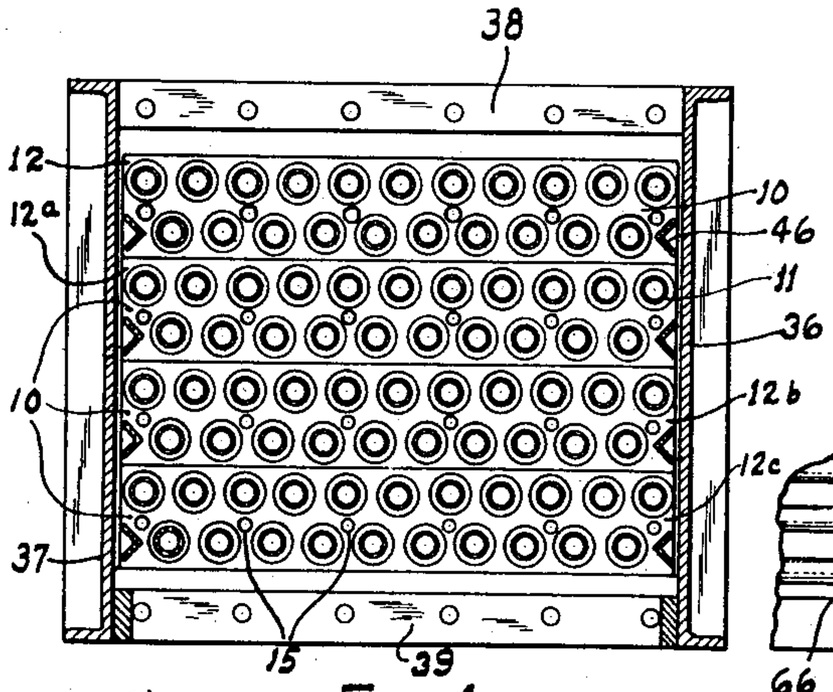

FIG. 4.

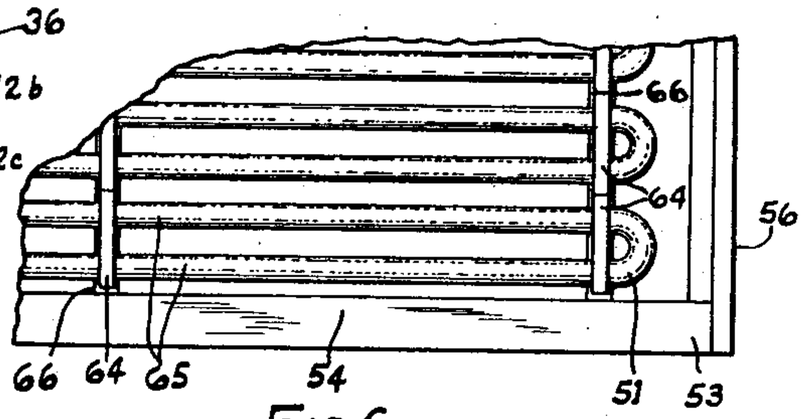

FIG. 6.

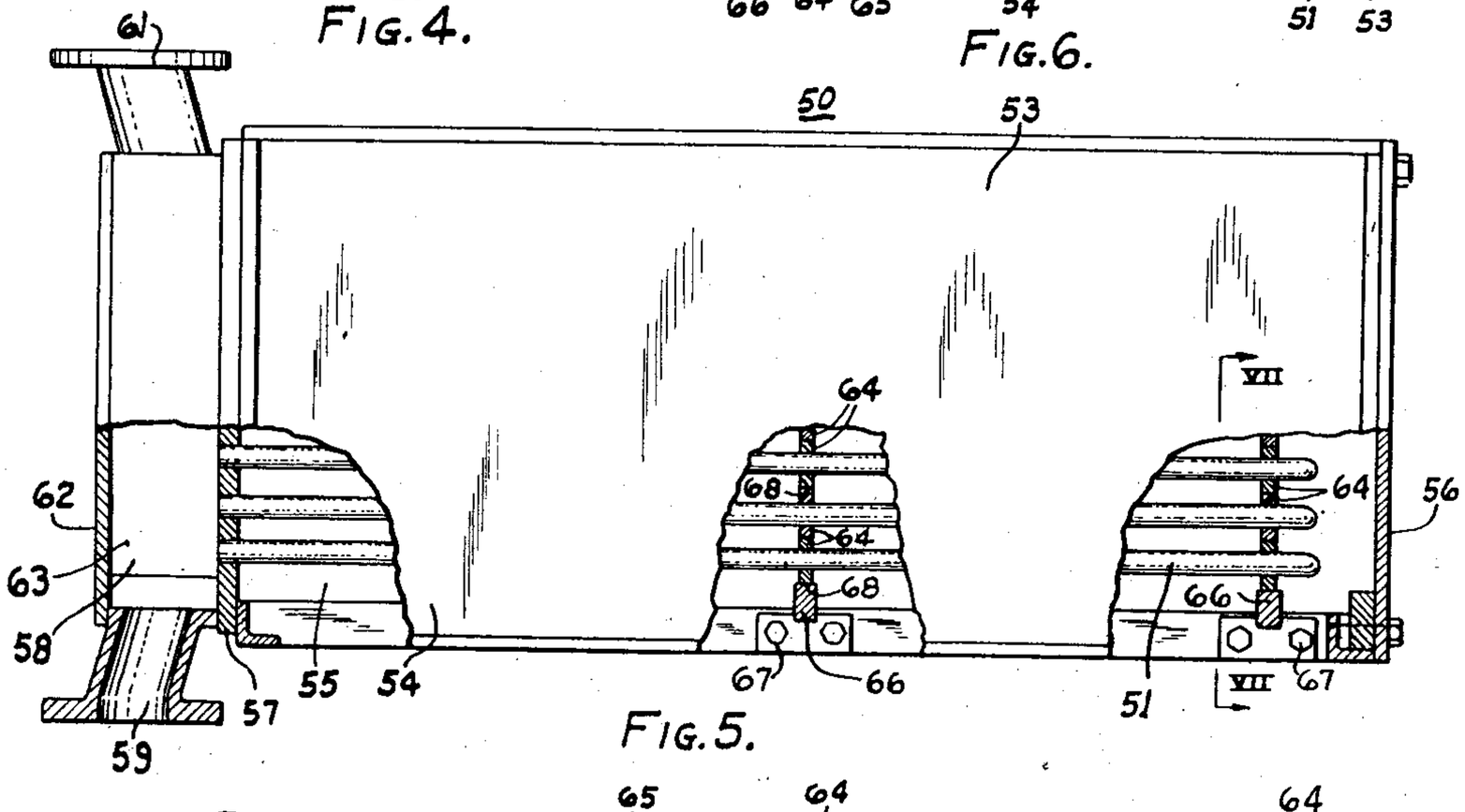

FIG. 5.

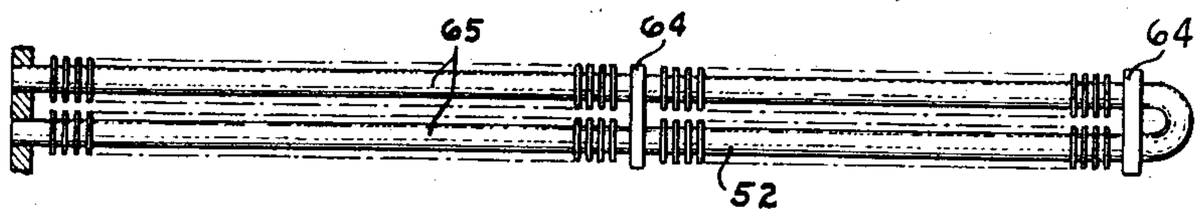

FIG. 8.

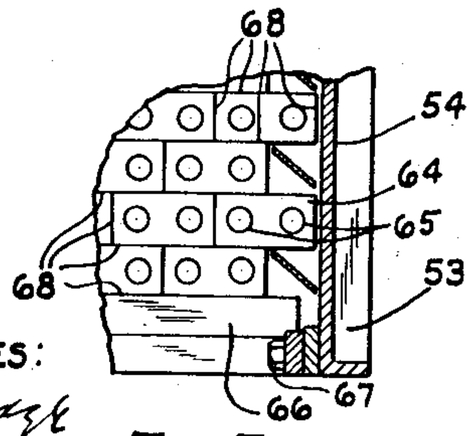

FIG. 7.

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Patented May 9, 1933 1,907,867

UNITED STATES PATENT OFFICE

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HEAT EXCHANGER

Application filed December 22, 1931. Serial No. 582,617.

My invention relates to heat exchange apparatus, and it has for an object to provide an improved means for supporting portions of the tubing thereof.

This invention is particularly applicable to heat exchangers, having intermediate tube supports and employing finned type tubing, as difficulty has been experienced in the past in constructing such a heat exchanger due to the necessity of making some provision for the replacing of defective tubing. It will be apparent that the conventional solid tube sheet for supporting the tubing intermediately of the length thereof is out of the question, as the tube with fins attached would not pass through the holes in the tube sheet when being replaced.

It has been proposed to provide a solid tube sheet with holes large enough for the fins to pass through when the tube is being replaced. With this construction, the fins of the tubing rest on the bottom of each hole in the tube sheet to support an intermediate portion of the tube. It will be apparent that this is an undesirable arrangement as the pitch or distance between tubes would have to be increased over a desirable amount; otherwise the thickness of metal between holes in the tube sheet would be very thin. Furthermore, it is a poor arrangement to carry the weight of the tubes through the fins which are usually of thin material.

It is, therefore, a further object of my invention to provide an improved supporting means for finned tubing, that will provide for the renewing of tubes, and which will be free from the disadvantages outlined above.

In practising my invention, I provide a tube that has a supporting element carried thereby, which is adapted to engage in stacked relation the elements of adjacent tubes when assembled in a bundle. I further provide a supporting structure or a bar attached to some solid portion of the heat exchanger upon which the stacked elements rest. With this construction, as many intermediate tube supports as are necessary may be provided. Furthermore, this arrangement is also very desirable for supporting the free or floating ends of a hairpin type tube, whether it be a plain or a finned tube.

A further object of my invention is to provide a supporting structure for heat exchange tubes which structure embodies a plurality of elements carried by the tubes and which engage one another in stacked relation when the tubes are assembled in a heat exchanger, a portion of which carries the stacked elements.

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

Fig. 1 is a plan view of a heat exchanger embodying my improved supporting structure;

Fig. 2 is a side view of the heat exchanger shown in Fig. 1 with parts broken away;

Fig. 3 is an end view of the heat exchanger shown in Fig. 2 and is partly in end elevation with a cover removed and partly in section taken along the line III—III of Fig. 2.

Fig. 4 is a sectional view taken along line IV—IV of Fig. 2;

Fig. 5 is a side elevation, with parts broken away, of a heat exchanger using hairpin tubes;

Fig. 6 is a fragmentary plan view of Fig. 5;

Fig. 7 is a sectional view of a detail and is taken on line VII—VII of Fig. 5;

Fig. 8 is a plan view of a finned type hairpin tube;

Fig. 9 is a partial view in perspective, of my improved finned tube; and,

Fig. 10 is a view similar to Fig. 9 illustrating a plain tube.

Referring now to Figs. 1 to 4, I prefer to show a heat exchanger that is used for air cooling, and which includes a plurality of tube bundle units 10, each of which includes a series of finned tubes 11 secured at one end in tube plate sections 12, 12*a*, 12*b* and 12*c*. The opposite ends of all of the tubes 11 are secured in a unitary tube plate 13.

While I have shown a finned tube in this embodiment as preferable, it will be understood that the plain tube 11*a* shown in Fig. 10 may be used. The tube bundle construction is similar to that disclosed in my copending application, Serial No. 507,017 filed January 6, 1931 and assigned to the Westinghouse Electric and Manufacturing Company.

The tube plate sections 12 to 12*c* may be secured together in the manner disclosed in the application referred to, but I prefer to show them aligned by and secured to a perforated tube sheet 14; which construction is disclosed and claimed in the copending application of Ernest F. Miller, Serial No. 583,521, filed Dec. 28, 1931 and assigned to the Westinghouse Electric and Manufacturing Company. This construction is best understood by referring to Figs. 2 and 4. The tube plate sections 12 and 12*c* are secured to the tube sheet 14, preferably by bolts 15. The tube sheet 14 has openings 16, which are aligned with the tubes 11, and provided communication between the tubes 11 and chambers 17 and 18. The chambers 17 and 18 are formed by the tube sheet 14, walls 19 and 21, and a cover 22 which is secured to the tube sheet 14 by bolts 23. The tube sheet 14 is secured by bolts 24 to transverse angle irons 25 forming a part of a shell structure 26.

The unitary tube sheet 13 is secured to the shell structure 26, preferably by bolts 27, and has secured thereto a box structure 28 which includes the inlet 29 and an outlet 31 for the cooling medium. The box structure includes partitions 32 to form chambers 33, the number of which depends on the number of passes the cooling medium makes in traversing the tube nest. The heat exchanger shown is of the four-pass type, although it will be understood that my invention is applicable to a heat exchanger of any number of passes. A cover 34 is secured to the tube plate 13 by means of bolts 35.

The shell structure 26 includes side walls 36 and 37 which with tube sheets 13 and 14 form an enclosure for the tube bundle units 10. The top and bottom of the shell structure are open forming an inlet 38 and an outlet 39 for media to be cooled.

A bar 41 extends transversely of the tubes 11 and is secured to the shell structure 26, preferably by bolts 41*a*. This bar 41 is the foundation of the support of the intermediate portions of the tubes 11 as will be described.

Each of the tubes 11 includes a block 42, preferably having chamfered corners 43 and contact surfaces 44, which surfaces are arranged outwardly of the outer edges of the fins 45 as shown best in Fig. 9. When the tubes 11 are assembled in a bundle, the contact surfaces of adjacent blocks 42 are engaged forming a stack as best shown in Fig. 3. The lower row of blocks 42 rest on the bar 41 which provides a foundation for the stacked blocks. A tortuous path for media to be cooled is provided by staggering the vertical rows of blocks, which is a preferred arrangement. Deflecting baffles 46 may be spaced in the shell 26 to direct over the tubes 11 the media passing through the shell. These baffles 46 extend from the tube sheet 13 to the tube plate sections 12 to 12*c* and are secured thereto.

In operation, a cooling medium enters the inlet 29, passes through the tubes 11, and the chambers 17, 18, and 33, and continues through the outlet 31. Media to be cooled enters the shell structure 26 through inlet 38, traverses the cooled tubes 11, and passes through the outlet 39. In apparatus of this class, provision must be made for the removal and renewal of tubes which have become defective in operation. The method of removing a tube from the tube bundle is similar to that described in my copending application referred to above and is as follows:

The bolts 23 and cover 22 are removed from the tube sheet 14 and walls 19, providing access to the bolts 15 which are also removed. Bolts 35 and cover 34 are next removed. The bolts 41*a* are removed and the foundation bar 41 dropped. This is desirable, as otherwise the tube fins 45 may be damaged as the intermediate portion of the tubes will sag as soon as the supporting blocks 42 leave the bar 41 when the bundle is being removed. The bolts 27 are next removed and the tube bundle units 10, including tube sheet 13 and the tube sheet sections 12 to 12*c*, are withdrawn from the end of the shell 26.

Assuming the tube 48 to be defective, it is cut internally at both ends adjacent the tube sheet 13 and section 12*c*. The tube sections 12*c* and 12*b* are then pried apart, the tubes 11 of each section together with the baffles 46 deflecting to permit this movement. This operation provides access to the tube 48 and it is withdrawn through the space provided between the adjacent sections 12*b* and 12*c*. In withdrawing the tube 48, the block 42 carried thereby, leaves the stack and as the surfaces of the block are outwardly of the outer edge of the fin 45, the fins readily pass through the opening in the stack caused by the removal of the block 42. A new tube is then inserted, the tube ends remaining in the sheets having been removed, and the tube bundle reassembled in the shell, the steps in this operation being the reverse of the dismantling operation.

Referring now to Figs. 5 to 8, I have shown a heat exchanger 50 utilizing hairpin tubes which may be plain as shown in

Figs. 5, 6 and 7 or finned as shown at 52 in Fig. 8. The heat exchanger 50 includes a shell 53 having side walls 54 and 55 and an end wall 56. One end of the shell 53 is closed by a tube plate 57 in which the tubes 51 are secured. A header 58 is attached to the tube plate 57 and communicates with the tubes 51 to convey a heat exchange medium to and away therefrom. The header further includes inlet and outlet connections 59 and 61, respectively, for the heat exchange medium and a cover 62 for the large head opening 63.

Each of the tubes 51 has a plurality of blocks 64 secured thereto although but one block would be necessary on a relatively short tube. Preferably, the blocks 64 embrace both legs 65 of the tubes 51.

Foundation bars 66 are arranged below the tubes 51 and are secured to the shell 53, preferably by bolts 67. When the tubes are arranged within the shell 53 in a bundle, the blocks 64 are aligned one with the other in stacks best shown in Figs. 5 and 7. The blocks 64 engage one another providing a support for the tubes, the bottom rows of blocks resting on the foundation bars 66.

When it is necessary to renew a tube, the tubes 51 are withdrawn from the shell 53 and the cover 62 removed from the header 58 to gain access to the ends of the tubes 51. Both legs of the tube are internally cut adjacent the tube plate 57, and the defective tube withdrawn from the bundle. A new tube is then inserted and rolled into or otherwise secured to the tube plate 57 and the heat exchanger is then assembled. This procedure is the same for a finned tube as for a plain tube. As the contact surfaces 68 on the blocks 64 are arranged outwardly of the edge of the fin as in the prior embodiment, the opening, left in the stacked blocks due to the removal of the block 64 on the tube being removed, will be large enough to permit the fins to pass through.

From the foregoing description, it will be seen that I have devised a supporting means for the intermediate portion or for the floating end of a heat exchange tube that will fulfill its purpose and which will permit the renewal of tubes regardless of type. While I have shown my invention as applied to air coolers, it will be apparent to those skilled in the art that this supporting structure could be applied to heat exchangers for other services.

While I have shown by invention in two forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other 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 heat exchanger, the combination of a shell structure, a plurality of groups of finned tubes disposed therein; each of said groups including a series of tubes and a tube plate section in which one end of the tubes is secured; a unitary tube sheet at the opposite end of the tubes in which all of the tubes are secured, means for supporting said tube plate sections substantially in a common plane, supporting elements for each tube arranged intermediately of the ends thereof, said supporting elements engaging one another in stacked relation, and foundation means carrying said supporting elements.

2. In a heat exchanger, the combination with a shell structure having an inlet and an outlet for fluid to be treated; a plurality of groups of finned tubes extending through said shell structure, each of said groups including a series of tubes and a tube plate section secured to one end of the tubes, a unitary tube sheet secured to the other end of all of the tubes, means for securing the tube plate sections together substantially in a common plane, headers carried by the shell structure and communicating with the ends of the tubes, and means for conveying a cooling fluid to and away from the headers; of means for supporting the tubes intermediately of the length thereof including, a supporting block carried by each tube, the blocks engaging one another in stacked relation, and a bar removably secured to the shell structure for carrying said supporting blocks.

In testimony whereof, I have hereunto subscribed my name this 18th day of Dec. 1931.

JOHN A. POTTER.