Oct. 13, 1953 D. DALIN 2,655,352

EXTENDED SURFACE HEAT EXCHANGER

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Fig. 1.

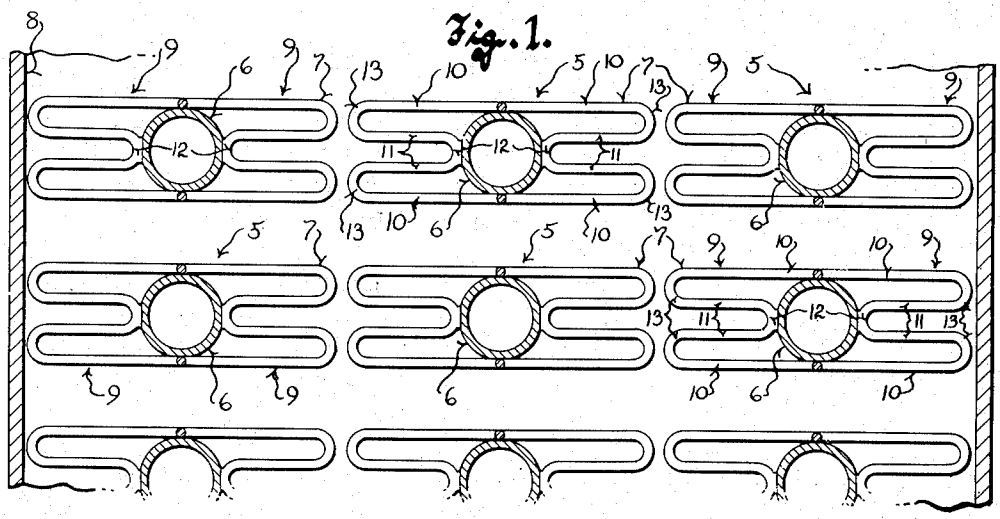

Fig. 2.

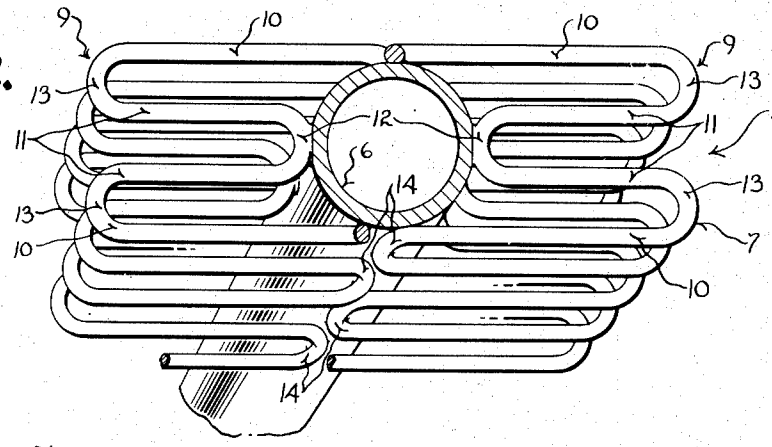

Fig. 3.

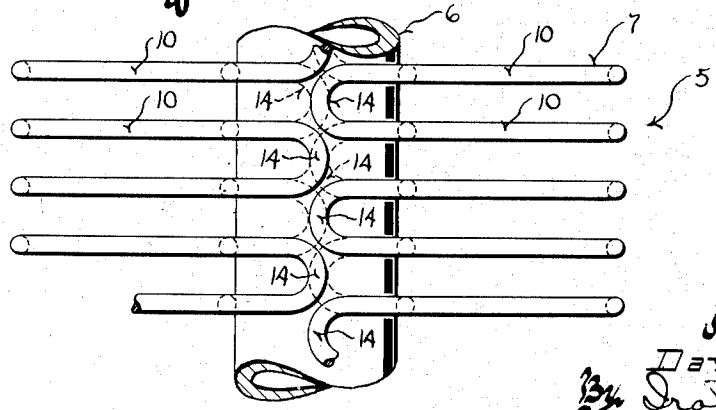

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Fig. 4.

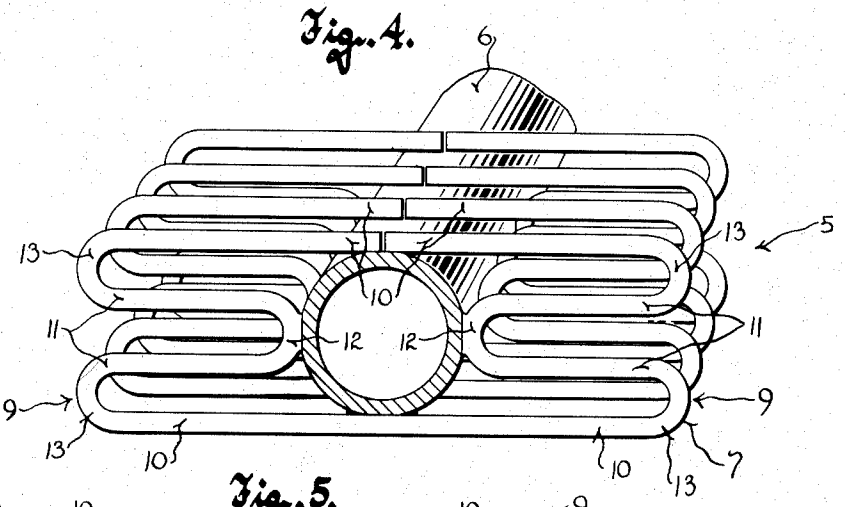


Fig. 5.

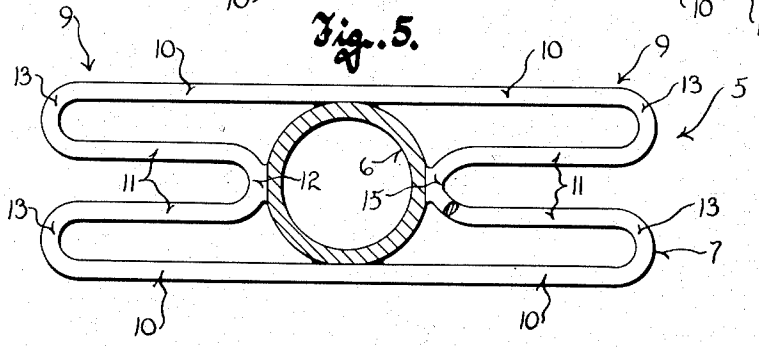


Fig. 6.

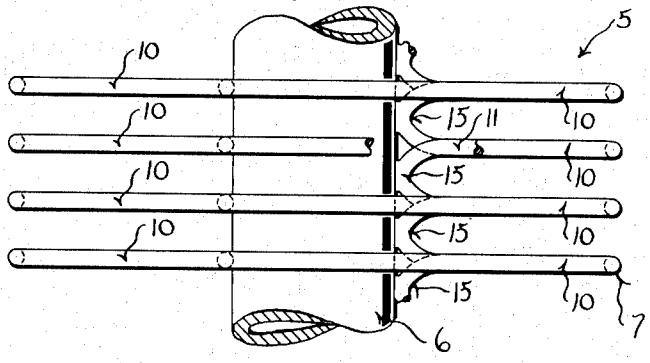
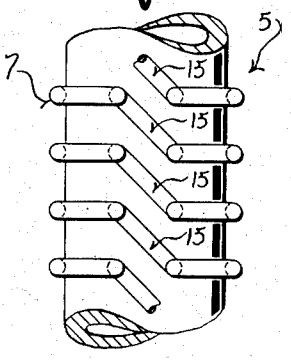


Fig. 7.



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2,655,352

UNITED STATES PATENT OFFICE

2,655,352

EXTENDED SURFACE HEAT EXCHANGER

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Application December 2, 1950, Serial No. 198,793

3 Claims. (Cl. 257—262.16)

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This invention relates to heat exchangers and has as its purpose to provide improved extended surface especially adapted for use on heat exchangers of the type employed in the flue gas passes of steam generating plants and the like.

The extended surface to which this invention relates is on the order of that illustrated in Patent No. 2,469,635, issued to David Dalin and Gustav V. Hagby, May 10, 1949, wherein boiler fluid containing tubes are provided with wire-like elements secured thereto and positioned to extend in two diametrically opposite directions from the tubes.

In the development of this type of extended surface the problem of securing the elements to the tubes led to a unique method of welding individual rod-like elements to the tubes. This method and the resulting structure forms the subject matter of the copending application of David Dalin, Serial No. 82,572, filed March 21, 1949, now Patent No. 2,584,189, granted February 5, 1952. With that method the elements are secured to the tubes in longitudinal rows equispaced around the circumference of the tube with the elements projecting radially therefrom. Certain of the elements are then bent so as to dispose all of them in parallel planes, and since, as explained at length in the aforesaid Patent No. 2,469,635, the attainment of maximum efficiency requires that all of the extended surface elements be of the same length determined by the pertinent factors of the installation, the outer ends of the elements of necessity were spaced different distances from the center of the tube. Hence, if the tubes were arranged side-by-side with the elements thereon axially in line and with those on one tube pointing toward those on an adjacent tube, the spacing between the ends of the elements on adjacent tubes could not be uniform. To obtain the desired uniform spacing the tubes had to be offset with respect to each other; but this introduced an objectionable construction problem and also increased the overall space required for an assembly of given capacity.

One of the purposes of this invention is, therefore, to provide an extended surface heat exchanger of the type here under consideration wherein the tubes may be arranged in a common plane transverse to the direction of gas flow with the individual rod-like elements of the extended surface on one tube axially in line with those of the others, while at the same time the spacing between the ends of adjacent elements is uniform.

Another purpose and object of this invention

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is to provide an extended surface heat exchanger wherein the individual extended surface elements are formed of wire having good heat conductivity and wherein the lengths of the conductance paths afforded by the elements are automatically equalized in service.

Still another object of this invention is to provide an extended surface heat exchanger so designed and constructed that a substantial part or all of the extended surface for each tube may be prefabricated from wire to facilitate its application and securement to the tube.

Still another object of this invention is to provide an extended surface heat exchanger especially adapted for use in economizers and similar convection zones of steam generating plants which is far more economical to produce than comparable extended surface heat exchangers heretofore available.

With the above and other objects in view, which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the herein disclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate several complete examples of the physical embodiments of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a sectional view through the flue gas pass of a steam boiler having banks of heat exchangers employing one form of the extended surface of this invention mounted therein;

Figure 2 is a perspective view at an enlarged scale of a portion of one of the tubes shown in Figure 1;

Figure 3 is a plan view of the tube shown in Figure 2;

Figure 4 is a perspective view at an enlarged scale similar to Figure 2 but showing a modified form of extended surface;

Figure 5 is a cross sectional view through one of the tubes having another form of extended surface attached thereto;

Figure 6 is a bottom elevational view of the tube and its extended surface shown in Figure 5; and

Figure 7 is a side elevational view of the tube and its extended surface shown in Figure 6.

Referring now particularly to the accompanying drawings in which like numerals indicate like

parts, the numeral 5 designates generally a heat exchanger having tubes 6 and extended surface 7 mounted within a gas pass 8 to effect heat exchange between hot combustion gases flowing through the gas pass and boiler fluid flowing through the tubes. It should be understood, however, that though this invention is especially advantageous in heat exchangers of the type shown in Figure 1, it is not limited thereto but instead will serve equally well in many other types of service.

The important feature of this invention resides in the way in which the extended surface 7 is constructed and mounted upon the tubes.

To achieve the purposes of this invention the extended surface preferably is formed from long lengths of wire having the desired high heat conductivity as, for instance, copper wire, bent and shaped to provide two diametrically opposite rows of substantially W-shaped elements 9.

In that form of the invention shown in Figures 1 to 3, inclusive, the row of W-shaped elements 9 on one side of the tube is formed separately from the row of W-shaped elements on the opposite side of the tube, whereas in that form of the invention shown in Figures 5 to 7, inclusive, the rows on both sides of the tube are formed from the same length of wire; while in that form of the invention shown in Figure 4 each pair of diametrically opposite W-shaped elements is formed from a single length of wire separate from that forming the next adjacent pair of W-shaped elements.

In all instances, however, each W-shaped element has a pair of outer legs 10 and a pair of inner legs 11 connected together by an inner loop 12 and to the outer legs by outer loops 13. The legs of each W-shaped element are substantially parallel to one another, equispaced and lie in a common plane normal to the axis of the tube. The spacing between the outer legs is preferably slightly less than the outer diameter of the tube so that the legs can embrace the tube and upon application thereto hug the tube closely.

The length of the outer legs with respect to the location of the loop 12 joining the inner legs is such that upon proper application of the element to the tube the loop 12 bears against the adjacent side of the tube. With the element thus secured the outer loops 13 are equispaced from a plane containing the axis of the tube and perpendicular or normal to the center line of the W-shaped element.

In that form of the invention shown in Figures 1 to 3, inclusive, wherein all of the W-shaped elements at one side of the tube are formed from a single length of wire, adjacent W-shaped elements are connected by sections of wire which may be in the form of loops 14. These loops lie alongside the tube alternately at opposite sides thereof. The resulting row of connected W-shaped elements which, of course, is prefabricated or preshaped, is quickly and easily applied to a tube as a single unit. The row of W-shaped elements at the opposite side of the tube is, of course, also prefabricated in the manner described, and attention is directed to the fact that the two rows are so applied that the loops connecting the adjacent elements of one row are interposed between those of the other row. This enables the elements or rows of elements to be secured to the tube by resistance welding machines in which the electrodes are sets of wheels between which the assembly moves, one set of wheels acting upon and welding the loops 14 to opposite sides of the tube while another set rides along the median plane of rows of W-shaped elements to secure the inner loops 12 to the tube.

In that form of the invention shown in Figures 5 to 7, inclusive, wherein the elements at one side of the tube are formed from the same length of wire as those on the other side of the tube, adjacent pairs of W-shaped elements are connected by crossovers 15 which extend obliquely across the tube; while in that form of the invention shown in Figure 4 each pair of diametrically opposite W-shaped elements is separate from all the others. In this latter case the individual pairs of W-shaped elements are assembled upon the tube in proper spaced relationship.

In all cases it will be readily apparent to those versed in this art that the length of the conductance path afforded by each individual leg of each element is automatically established. In other words, considering adjacent outer and inner legs 10 and 11 of any W-shaped element, it will be seen that although the actual length of the outer leg is greater than that of the inner leg the fact that they are joined by the outer loops 13 will automatically cause the conductance paths of the two legs to be equalized and such equalization will automatically take into account differences in heat conductivity of the two legs occasioned by surface conditions thereof. This equalization of the conductance paths enables the tubes to be arranged in common planes with the individual legs of the elements on adjacent tubes in axial alignment and thereby overcome the hereinbefore stated objection of extended surface which consists of individual rod-like elements.

It will also be readily apparent to those skilled in this art that the present construction reduces the number of welded connections required to secure the extended surface to the tubes.

What I claim as my invention is:

1. An extended surface heat exchanger, comprising: a plurality of spaced parallel tubes positioned with their axes lying in a common plane; an extended surface on each of said tubes, said extended surface comprising two diametrically opposite rows of wire elements on each tube with the elements on adjacent tubes facing each other, each of said elements having a serpentine formation with a plurality of substantially parallel spaced legs lying in a common plane transverse to the tube axes, the outer legs of each element embracing and being secured to the tube and the loops connecting the inner legs being secured to the tube, the legs of the elements on one tube being axially aligned with the legs of the elements on adjacent tubes, and the outer loops of all of the serpentine elements on the same side of each tube which connect the ends of the legs remote from the tube being spaced the same distance from a plane perpendicular to the legs and containing the axis of the tube.

2. In an extended surface heat exchanger: a metal tube; a pair of diametrically opposite extended surface elements for the tube each comprising a continuous length of wire bent into substantially the shape of a W so as to have a pair of outer legs, and a pair of inner legs connected to one another and to the outer legs by loops; and means securing the elements to the tube with the plane of the defined W's normal to the axis of the tube and with the outer legs of the W's embracing and joined to the tube with good heat conducting connections and with the loops joining the inner legs bearing against and connected to the wall of the tube with a good heat conduct-

ing connection; the loops connecting the outer legs with the inner legs being equispaced from a plane containing the axis of the tube and normal to the center line of the W-shaped elements, and all of the legs being parallel to one another with the legs of one of the two elements in line with those of the other element and the outer legs of one element substantially coterminous with the outer legs of the other element.

3. In an extended surface heat exchanger: a metal tube; two diametrically opposite rows of spaced extended surface elements on the tube, each row being formed of a continuous length of wire of good heat conductivity bent into a succession of W-shaped elements each of which has a pair of outer legs and a pair of inner legs connected to one another and to the outer legs by loops, the outer legs extending beyond the loop joining the inner legs, said W-shaped elements being connected to one another by sections of the same wire from which they are formed extending generally lengthwise of the tube alternately

at opposite sides thereof; and means securing the two rows of elements to the tube with all of the legs parallel and those of one row coaxial with those of the other and with all of the legs embracing and fixed to the tube with good heat conducting connections and with the loops joining the inner legs bearing against and fixed to the tube with good heat conducting connections.

DAVID DALIN.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,093,256	Still	Sept. 14, 1937
2,112,743	Poole	Mar. 29, 1938
2,268,680	Von Linde	Jan. 6, 1942

FOREIGN PATENTS

Number	Country	Date
452,231	Great Britain	Aug. 19, 1936
559,107	Great Britain	Feb. 3, 1944