June 15, 1965 C. W. PARRIS 3,189,087

TUBULAR HEAT EXCHANGERS

Filed Oct. 6, 1958 3 Sheets-Sheet 1

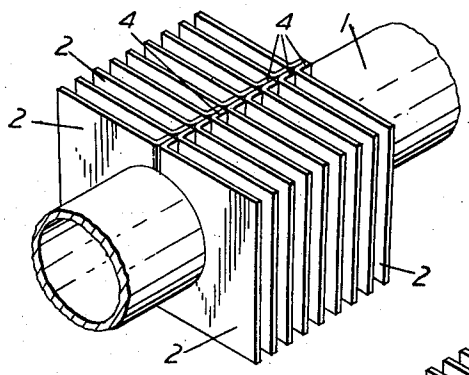


FIG. 1

FIG. 2.

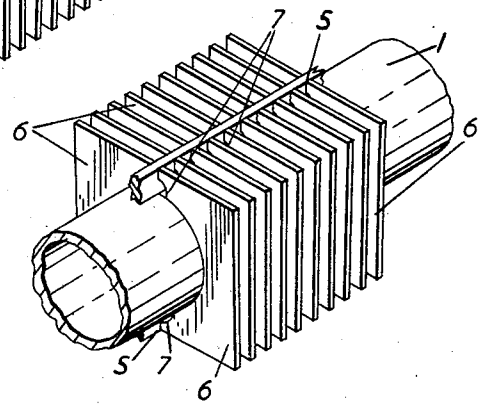
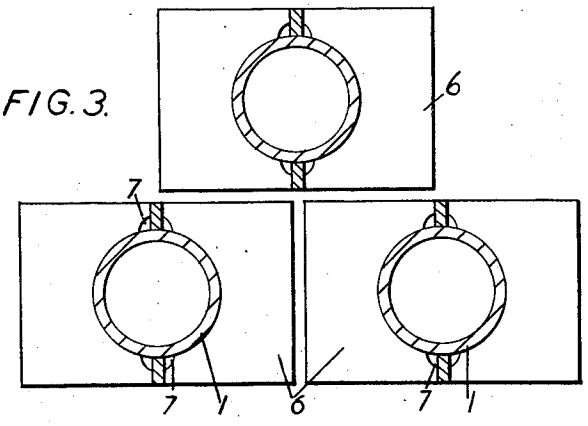


FIG. 3.



Inventor

Cyril Wright Parris

By Dowell & Dowell

Attorneys

June 15, 1965 C. W. PARRIS 3,189,087

TUBULAR HEAT EXCHANGERS

Filed Oct. 6, 1958 3 Sheets-Sheet 2

FIG. 4.

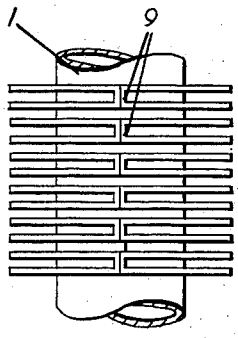


FIG. 5.

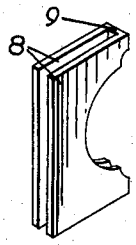
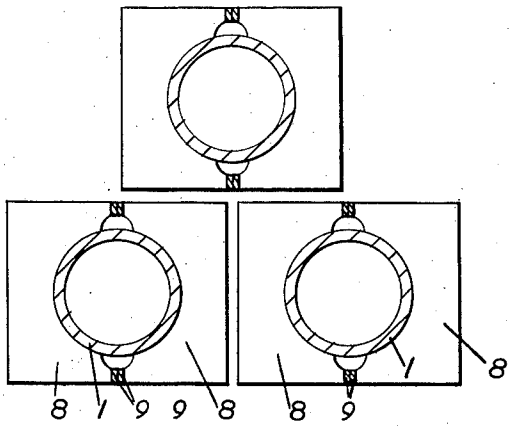


FIG. 6.



Inventor
Cyril Wright Parris
By Dowell Hoppell
Attorneys

June 15, 1965 C. W. PARRIS 3,189,087

TUBULAR HEAT EXCHANGERS

Filed Oct. 6, 1958 3 Sheets-Sheet 3

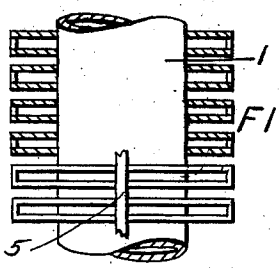


FIG. 7.

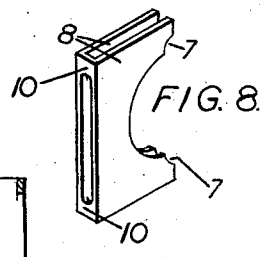


FIG. 8.

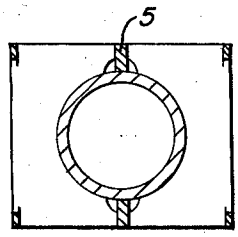


FIG. 9.

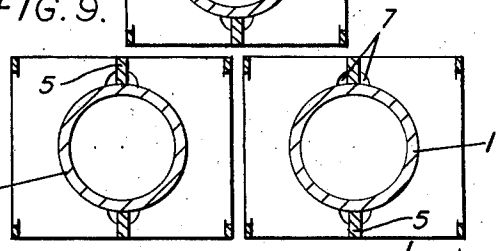


FIG. 10.

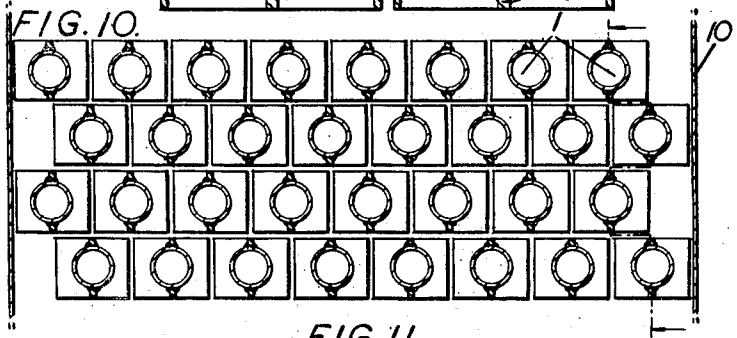
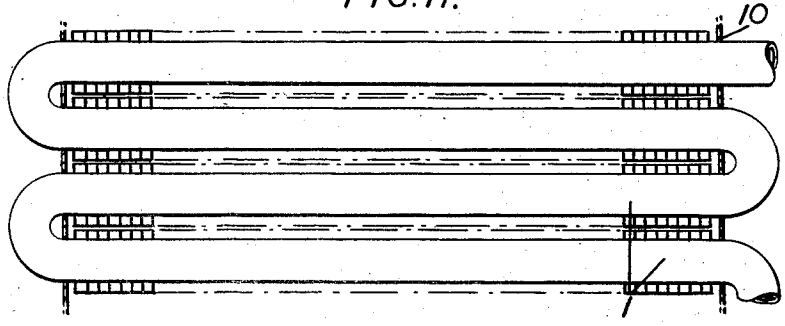


FIG. 11.



Cyril Wright Parris Inventor

By Dowell & Dowell Attorneys

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TUBULAR HEAT EXCHANGERS

Cyril Wright Parris, Wakefield, England, assignor to E. Green & Son Limited, Wakefield, England, a British company

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Claims priority, application Great Britain, Mar. 6, 1958, 7,259/58; Apr. 9, 1958, 11,255/58
3 Claims. (Cl. 165—181)

This invention relates to tubular heat exchangers having heat-exchanger tubes provided with gills, ribs or fins (hereinafter referred to simply as "gills") on their outer surfaces. The invention provides constructional improvements which have been devised primarily for heat exchangers for use with heated gases from nuclear reactors but may have other applications to heat exchangers that require tubes having extended surfaces enclosed within a confined space.

According to the invention, an improved externally gilled heat-exchanger tube is provided in which the gills are made in halves each of which extends substantially half way round the tube and is welded thereto by resistance welding. Tubes constructed in this way have the great advantage that they can be arranged close together in a heat-exchanger in such a way that the two halves of each gill project into spaces on opposite sides of tubes where their is an active flow of fluid between the tubes whereas the junctions between the gill halves occupy the comparatively stagnant regions lying in front of and behind the tubes in relation to the direction of flow and fluid in the spaces between the tubes. Advantageously, each gill is of oblong rectangular shape divided into halves along its shorter axis. This arrangement not only avoids the empty spaces between the tubes which must occur when tubes having circular gills are used, but also increases the effectiveness of the gills by increasing the area of gill surfaces in contact with the moving stream of fluid between the tubes as compared with the area in contact with the fluid in the comparatively stagnant regions lying in front of and behind the tubes in relation to the direction of fluid flow.

Further subsidiary features of the invention will appear from the following more detailed description of several examples of heat exchangers and heat exchanger tubes constructed according to the invention, reference being made to the accompanying drawings in which:

FIGURE 1 is a fragmentary perspective view of a heat exchanger tube,

FIGURE 2 is a view similar to FIGURE 1 of a modified form of heat exchanger tube,

FIGURE 3 is a fragmentary section of a portion of a heat exchanger taken at right angles to the axes of the heat exchanger tubes,

FIGURE 4 is a fragmentary view of another modified form of heat exchanger tube,

FIGURE 5 is a perspective view of a gill stamping for use in making the tube shown in FIGURE 4,

FIGURE 6 is a fragmentary section of a portion of a heat exchanger using gill tubes constructed as shown in FIGURES 4 and 5, the section being taken at right angles to the axes of the tubes,

FIGURES 7, 8 and 9 are views corresponding to FIGURES 4, 5 and 6 respectively showing another modified form of a heat exchanger tube,

FIGURE 10 is a fragmentary sectional view of a portion of a heat exchanger which may embody heat exchanger tubes of a form shown in FIGURE 1, or in FIGURES 2 and 3, or in FIGURES 4, 5 and 6, or in FIGURES 7, 8 and 9, and

FIGURE 11 is a corresponding sectional view of the same heat exchanger taken in a plane at right angles to FIGURE 10.

The heat exchanger tube shown in FIGURE 1 of the drawing comprises a cylindrical tube 1 having external gills made in halves 2, each gill half 2 being of substantially square shape so that the complete gill made up of the two halves is an oblong rectangle having longer sides substantially twice as long as its shorter sides. Each half gill has a semi-circular recess at one side which fits round the external surface of the tube 1 so that each gill-half extends substantially half way round the tube as shown in FIGURE 1. The extremities of the gill-halves which meet together on opposite sides of the tube when the complete gill is in position on the tube have short extensions bent at right angles to the general plane of the gill so as to form flanges or lugs 4.

Both the tube 1 and the gill-halves 2 may be made of mild steel, the gill-halves being resistance welded to the tube 1 and the flanges or lugs 4 at the extremities of each gill-half being resistance welded to the corresponding lugs on the opposite half of the gill. The welding operation may be carried out by means of an automatic welding machine of a known type in which the two halves of each gill are pressed into position against the tube 1 and welded to the tube and to one another simultaneously.

The flanges or lugs 4 act as spacers between the gills and also as a means of stiffening the tube so as to increase the maximum length of tube that can be supported in a heat exchanger without the need for any intermediate support to prevent undue deflection or vibration. The flanges or lugs 4 are in close abutment with one another so as to form continuous ribs that extend along the top and bottom of the tube when the tube is supported with the longer sides of the gills horizontal.

Although the construction shown in FIGURE 1 has been found satisfactory in use, difficulty has been experienced in manufacturing it, partly because the flanges or lugs 4 cause difficulty in the mechanical handling of the gill-halves in automatic welding machines and partly because slight errors in the dimensions of the parts may cause the welds between the flanges or lugs 4 to be completed, thereby short-circuiting the welding current, before the weld between the gill halves and the tube 1 can become effective.

FIGURES 2 and 3 show a modified construction which overcomes the difficulties referred to above by providing the tube 1 with two metal strips 5 welded to it so as to form stiffening ribs extending along the top and bottom of the tube. In this construction the gill-halves 6 are generally similar to the gill-halves 2 shown in FIGURE 1 but are without the extensions forming the flanges or lugs 4.

In the construction of the gill tube shown in FIGURE 2, the strips 5 are first welded to the tubes, preferably by projection welding, and then the gill-halves 6 (which are constructed to fit round the tube 1 on opposite sides of the strip 5) are resistance welded to the tube 1 and strips 5.

As can be seen in FIGURES 2 and 3, the extremities of the gill-halves 6, where they meet the strips 5, are cut away as shown at 7, so that the extremities that make contact with the strips 5 are spaced away from the external surfaces of the tube 1. This serves to clear the welds joining the strips 5 to the tube, and also reduces the area of contact between the extremities of the gill-halves and the strips 5, thereby reducing the current-carrying capacity of the joints between the gill-halves 6 and strips 5 sufficiently to ensure that the gill-halves are welded to the tube 1 even if the extremities of the gill-halves 6 make contact with the strips 5 before the gill-halves are in effective contact with the tube 1.

The machine used for welding the gill-halves to the tube may be of any known type capable of pressing the

two halves of each gill into position against the tube and then passing a welding current from one gill to the other so as to effect resistance welding of the gills to the tube by the flow of current from one gill-half to the tube through the contacting surfaces of that gill-half and the tube and thence from the tube to the other gill-half through the contacting surfaces of that gill-half and the tube. Current also flows through shunt paths which includes the contacting surfaces between the flanges or lugs **4** of opposite gill-halves **2**, or between the extremities of the gill halves **6** and the strips **5**. Care must be taken to ensure that the short circuiting effect of these shunt paths does not prevent effective welding of the gill-halves to the tube **1**. This is greatly facilitated when the extremities of the gill-halves are cut away as shown at **7**, because the resulting reduction in the area of contact of the gill halves with one another or with the strips **5** reduces the total welding current necessary to ensure completion of the weld between the gill-halves and the tube **1**.

The closeness of spacing of the gills which can conveniently be obtained with the constructions shown in FIGURES 1 to 3 is limited by the fact that sufficient clearance must be left between adjacent gills to enable mechanical grippers to grip each gill half during the process of welding without risk of contact with the previously welded gill-half. Where a very close spacing of the gills is desired therefore, it is convenient to use the modified construction shown in FIGURES 4 to 6 in which the gill-halves are made in pairs each cut from a single sheet bent double so that each sheet makes two gill halves **8** joined together by bridge pieces **9** which, in the construction shown, are located at the extremities of the pairs of the gill-halves that extend round the tube **1**.

Each pair of gills constructed as shown in FIGURE 5 can be held by grippers inserted in the space between the members of the pair. Each pair of gills can then be welded to the tube without any risk of contact of the grippers with the gill-halves previously welded.

In the construction shown in FIGURES 4, 5 and 6 the pairs of half gills **8** are constructed to fit round the tube **1** and to make contact with one another at their extremities so that each half gill is welded both to the tube **1** and to the extremities of the other half gill. FIGURES 7, 8 and 9 show a modified construction in which the tube **1** has strips **5**, welded to it as described with reference to FIGURES 2 and 3, the pairs of half gills **8** being welded to the tube **1** and to the strips **5**. FIGURES 7, 8 and 9 also show a modified method of making the pairs of half gills so that the members of each pair are joined together at their outer edges by means of bridge pieces **10**. This construction has the advantage over that shown in FIGURES 4 to 5 in that the outer edges of the members of each pair of half gills are directly tied together and can therefore be gripped strongly by expanding grippers without risk of deformation.

The pairs of half gills shown in FIGURES 4 to 6 and in FIGURES 7 to 9 have cut-away portions **7** which serve the same purpose as those described with reference to FIGURES 2 and 3.

FIGURES 10 and 11 of the drawings show a heat exchanger according to the invention in which gilled tubes **1** constructed as shown in FIGURE 1 or FIGURES 2 and 3, or FIGURES 4 to 6, or FIGURES 7 to 9, are mounted in parallel rows in casing **10** for effecting heat exchange between a liquid which flows horizontally through the tubes and a gas which flows in a vertical direction in the space between the tubes. The tubes are

set with the longer sides of the gills horizontal so that their shorter sides are parallel with the direction of flow of the fluid in the spaces between the tubes. The spacing of the the rows and of the tubes in the rows is so chosen in relation to the dimensions of the gills that the latter almost completely fill the space between the tubes when looked at in a direction parallel to the cases of the tubes as shown in FIGURE 11. This arrangement not only avoids empty spaces between the tubes but also increases the effectiveness of the gills by increasing the area of the gill surface in contact with the moving stream of fluid between the tubes as compared with the area in contact with the fluid in the comparatively stagnant regions lying immediately above and immediately below the tubes.

The invention is particularly suitable for tubular heat exchangers in which a liquid flowing within the heat exchanger tubes is heated by a hot gas flowing under pressure in a pressure vessel within which the tubes are packed together as closely as their gills will allow.

I claim:

1. A heat-exchanger tube having external gills made in halves which extend substantially half way round the tube on opposite sides thereof and are joined to the tube by electric resistance welding, wherein the half-gills on one side of the tube have extremities spaced from the external surface of the tube and joined to the corresponding extremities of the half-gills on the opposite side of the tube by means including electric resistance welding.

2. A heat-exchanger tube having stiffening ribs extending along the top and bottom of the tube and joined thereto by resistance welding, and external gills made in halves which extend substantially half way round the tube on opposite sides thereof, wherein the half-gills on one side of the tube have extremities spaced from the external surface of the tube and joined to the ribs by electric resistance welding.

3. A heat-exchanger tube having external gills made in halves which extend substantially half way round the tube on opposite sides thereof and are joined to the tube by electric resistance welding, wherein the half-gills on one side of the tube have extremities spaced from the external surface of the tube and joined to the corresponding extremities of the half-gills on the opposite side of the tube.

References Cited by the Examiner

UNITED STATES PATENTS

1,382,220	6/21	Murray	257—181
1,775,706	9/30	Trane	257—129
2,325,507	7/43	Guirl et al.	219—79
2,329,944	9/43	Schakenbach	219—95
2,343,387	3/44	Sargent et al.	165—130
2,449,840	9/48	Brown	257—183
2,519,084	8/50	Tull	257—236
2,608,388	8/52	Miller	257—236
2,699,923	1/55	Walworth	257—262.16
2,709,074	5/55	Gannon	257—262.16
2,804,286	8/57	Pintarelli	257—262.16

FOREIGN PATENTS

981,567	1/51	France.
617,606	2/49	Great Britain.

CHARLES SUKALO, *Primary Examiner.*

HERMAN BERMAN, HERBERT L. MARTIN, PERCY L. PATRICK, *Examiners.*