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HEAT EXCHANGER AND METHOD OF MAKING SAME

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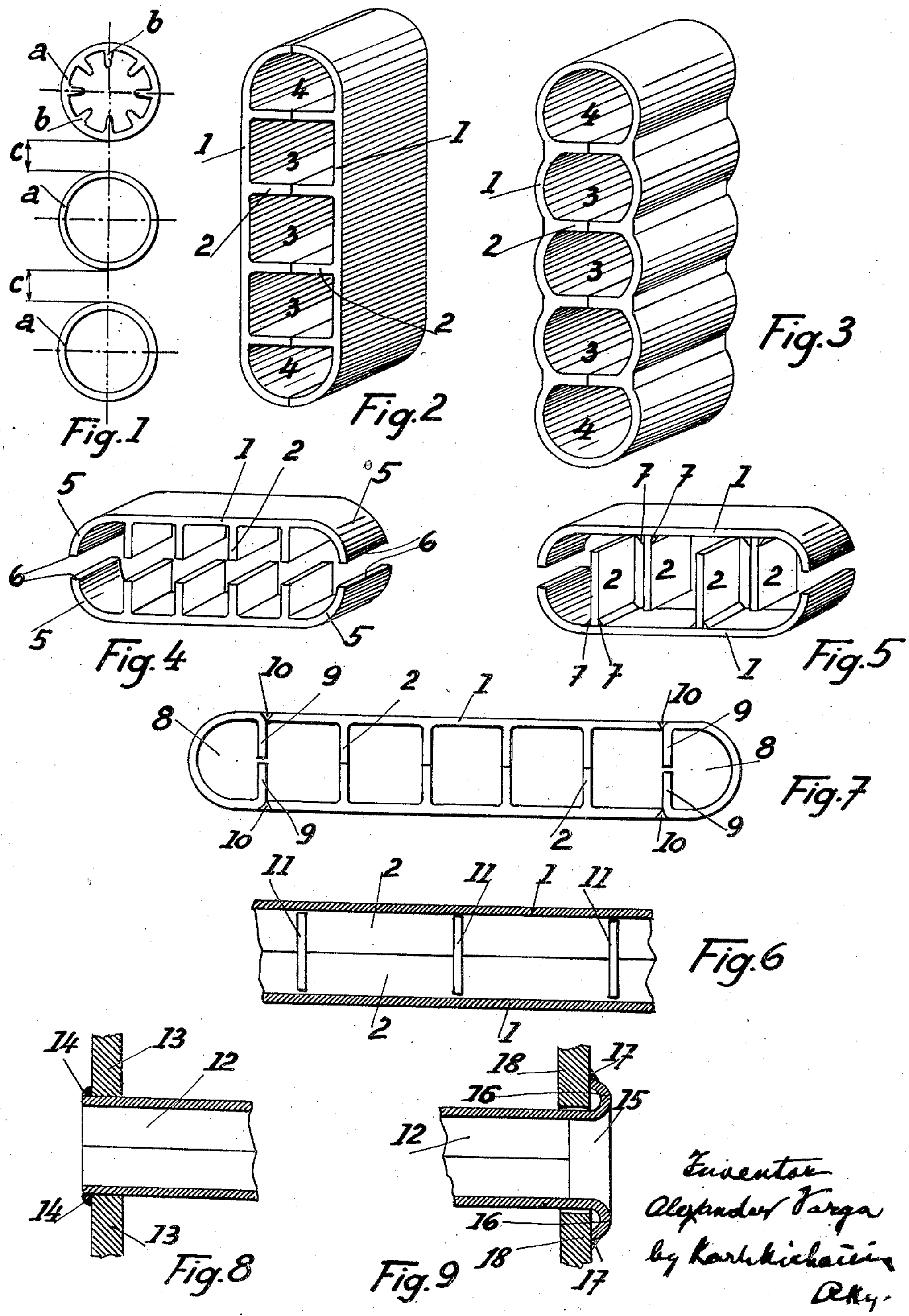

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HEAT EXCHANGER AND METHOD OF MAKING SAME

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5 Claims. (Cl. 29—157.4)

My invention relates to heat exchangers and more particularly to a new design of such devices, whereby they are rendered more efficient and can be produced more readily and with less cost than was hitherto possible.

As a rule apparatus serving for the exchange of heat between two media of different character (gaseous and liquid) are built up from tubes, the walls of which serve to transmit heat from one medium to the other. The same applies to heat exchangers serving for transmitting heat from one gaseous or liquid medium to another medium of a similar character. In most cases the heat transmission coefficients of the two media are different. In the case of boilers for instance a gaseous medium (smoke gas) flows on one side and liquid medium (water) on the other side of the heat exchanger tube. Water is known to possess a far higher heat transmission coefficient (about the hundred-fold) than gaseous substances and consequently the water could take up far more heat from the heat transmission wall, than the wall is capable of taking up from the smoke gases. Since the quantity of heat transmitted is proportional to the area of the heat transmitting wall, the size of this wall is always adapted, in the cases where heat shall be transmitted between media of different heat transmission coefficients, to the medium possessing the lower heat transmission coefficient. As a rule this would involve a great waste of space and material and in order to avoid this, the high heat conductivity of the metals is utilized in this sense that that side of the heat transmission wall, which is in contact with the medium having a lower heat transmission coefficient, is enlarged in order to increase its heat absorbing capacity. In this manner it is possible to transmit onto one and the same volume the double and in some cases even the treble of the quantity of heat.

In actual practice the increasing of the heat transmitting area (the heating or cooling surface) is attained by means of a system of ribs such as are present for instance in the radiators of motorcars and room heating systems, in economizers etc. Hitherto, however, with a single exception, of which more shall be said herebelow, these ribs have always been mounted on the outer surface of the tubes. Apart from the fact that such outer rib systems can only be produced by casting, which means high first cost, these systems involve the drawback that in those cases, as for instance in locomotive boilers, where the outer medium is a pressure medium such as pressure water or steam, tubes with outer ribs cannot be used in view of their insufficient strength. However, if the outer medium has the higher heat transmission coefficient, their use would also be useless. It has therefore been suggested to fit the groups of smoke tubes in locomotive boilers, which formerly were always designed as plain tubes, with inner ribs (Serve tubes), in which, as shown in the uppermost tube in the system of tubes shown in Fig. 1 of the drawing affixed to this specification and forming part thereof, the tube wall *a* is fitted with radial inwardly directed ribs *b*, the surfaces of which serve to enlarge the heat absorption surfaces in contact with the inner medium of lower heat transmission coefficient. However, such tubes have not come up to expectations, since in view of the inner radial ribs forming constrictions and baffles they were clogged after a short time by the soot accumulating therein. Apart therefrom, the spaces *c* left between each adjoining pair of tubes form undesirable constrictions of the heat transmission area.

In the heat transmission bodies according to the present invention all these drawbacks are avoided. Such body is formed of a single outer wall of oblong closed cross section, which replaces a system of superposed or juxtaposed tubes as hitherto provided, and of inner ribs or partitions extending from the inner wall of this body and partly or altogether bridging the space between its two walls, thereby forming a plurality of superposed or juxtaposed conduits.

In this heat transmission body the individual conduits directly adjoin each other, so that the group of tubes or conduits formed in such body is not separated by undesirable spaces such as the spaces *c* in Fig. 1. Since the ribs themselves now form the walls of the conduits, no baffles leading to the accumulation of soot are present in such body. Preferably the inner ribs are so dimensioned, that they not only enlarge the heat absorption area of the outer wall, but also act towards bracing the outer walls of the body, which is important in the case where the outer heat exchanging medium is under increased pressure.

Obviously a heat transmission body according to this invention will be useful not only in connection with boilers, but in a general way in all devices serving to bring about an exchange of heat for heating or cooling purposes of any kind whatsoever.

The heat transmission body according to this invention may be produced in any desired manner, for instance all in one piece, for instance by casting, by forming the conduits in a solid blank having the outer configuration of the outer wall, by producing therein the conduits by boring, milling or pressing. It may further be produced from two halves, in which the conduits may be produced by planing and the like.

My invention also relates to all the methods, whereby such a heat transmission body can be produced in a simple, inexpensive and efficient manner and can be fitted in the tube supporting walls.

Figs. 2 to 9 of the drawing illustrate some embodiments of my invention.

In the drawing,

Fig. 1 is a diagrammatic end view of a tube assembly.

Fig. 2 is a perspective view of the first embodiment.

Fig. 3 is a similar view of a heat transmission body with outwardly curved side walls for each conduit.

Fig. 4 illustrates the production of such heat transmission body from a pair of rolled plates, while

Fig. 5 illustrates the production of the body from a pair of metal sheets, to which the ribs have been fixed by welding.

Fig. 6 is an axial longitudinal section of such body with expansion gaps provided on the ribs.

Fig. 7 illustrates the method of interconnecting the main parts of a heat transmission body of great width by welding.

Fig. 8 is an axial section of one end of a heat transmission body showing a way in which such end is fixed in place in the wall, and

Fig. 9 illustrates another mode of fixing the end of such body in such wall in a resilient manner.

Referring to the drawing and first to Fig. 2, 1 is the outer tube wall of oblong cross section and 2, 2 are transverse ribs mounted on the inner side of the tube wall 1, these ribs serving to take up and transmit onto the wall 1 part of the heat of the medium flowing in the conduits 3 and 4 formed between the ribs, these latter at the same time bracing the outer wall 1. Each pair of adjoining ribs 2 forms a conduit 3 of rectangular cross section, the two end conduits having a semicircular cross section and the conduits 3, 4 together replacing a system of tubes as hitherto used.

A heat transmission body of this kind may be produced by rolling and welding.

Fig. 4 illustrates a pair of rolled plates 1, 1 before the butt ends have been connected by welding. The heat transmission body is composed of two symmetrical halves produced by rolling, each half representing a number of juxtaposed T- or U- (channel) irons, the bases forming together the side wall of the body, while their free webs form a rib 2. The base portions 5 at either end of each half are bent into circular segments. If these two rolled halves are assembled with their ribs facing each other and abutting against each other, and if the butt ends 6 of the curved parts 5 are now connected by welding, the heat transmission body is finished and no connection by welding or otherwise is required between the ribs, since as a rule such a body is acted upon by an outer pressure, whereby the abutting ends of the ribs are forced onto each other, the longitudinal outer walls 1 being thereby enabled to take up a pressure of 15 to 20 atmospheres.

In order to enable the outer wall to withstand higher pressures, it may be curved outwardly between the individual ribs as shown in Fig. 3.

If the butt ends of the ribs are also connected by welding, a heat transmission body of this kind may also take up an inner pressure.

It is also possible to produce such a body by welding exclusively, as shown for instance in Fig. 5, where ribs 2 are fixed to the plates 1 forming the outer walls by welding along the edges at 7. However, here the ribs are preferably not arranged to abut against each other, but are mounted on the walls in staggered relation, the ribs of one half 1 extending between the ribs of the other half, since in this manner much welding work can be saved. With welded ribs such as here shown heat transmission bodies of any desired width may be produced.

It is, however, also possible to produce bodies with rolled side walls and ribs for greater width, if proceeding in the manner shown in Fig. 7. Here the rolled side walls 1 may be formed with abutting or with relatively staggered ribs according to Fig. 4 or 5. However, since the rolling of very large bodies is connected with difficulties, the ends of the body are here preferably formed by separate end portions 8 of semi-circular section, which are not rolled in one piece with the side walls 1, but are bent each from a separate plate or drawn after the manner of tubes. The straight edge portions 9 of these separate parts 8 form the ribs. These parts 8 are connected with the rolled side walls 1 at 10 by welding.

Since the ribs of the heat transmission body conduct the heat taken up by them in the direction of their width to the point where the heat is delivered on a longer path than the side walls 1 (in the direction of their thickness), the temperature of the ribs will be higher than that of the side walls. In view of the expansions taking place, owing to this difference in temperature, the ribs, as shown in Fig. 6, are preferably formed with indentures 11 produced for instance by sawing, these indentures forming expansion gaps.

In the tube supporting wall 13 a heat transmission body of the kind above described may be mounted for instance in the manner illustrated in Fig. 8, where the end 12 of the body is shown as being fixed in the wall 13 by forming a welding seam 14 all around the end of the body. In the case, where the tube is particularly large, I prefer providing for the required expansion by fixing the body in the wall in the manner shown in Fig. 9, where a piece of the ribs 15 at the end 12 of the body is cut off and the open edges of the side walls 1 are bent outwardly in heated condition to form a ring 16 of semi-circular cross section, the radius of which is chosen in accordance with the desired spring action, this ring being then fixed to the wall 18 by means of a welding seam 17. If such heat transmission body shall be replaced by another one, the welding seams are removed with the aid of the chisel and the bent edge portions 16 are rebent, whereafter the body can be withdrawn from the supporting wall and replaced by another one.

In the case of gases and liquids with lower temperature, and more particularly in the case of condensers, the fluid-tight fixing of the heat transmission body in the wall may be effected by means of a stuffing box.

Various changes may be made in the details disclosed in the foregoing specification without departing from the invention or sacrificing the advantages thereof.

I claim:

1. A tubular heat exchange body, particularly adapted for use in connection with smoke tube boilers and of the type affording passage on the inside for a gaseous medium, and on the outside for a liquid medium, comprising in combination a pair of rolled metal wall portions arranged in parallel spaced relation, curved end portions having a continuous smooth surface both on their inside and outside associated with said wall portions, welds joining together the abutting edges of said curved smooth end portions, each of said walls including a plurality of substantially parallel ribs formed integral therewith and projecting into the interior of said body, the two sets of ribs being juxtaposed so that the ribs associated with opposite walls abut against each other, said abutting ribs forming partitions subdividing the interior of said body into a plurality of conduits adapted as passages for said gaseous medium.

2. The heat exchange body of claim 1, wherein the end portions associated with each of the rolled metal wall portions are curved substantially through a quarter circle, the edges of each juxtaposed pair of end portions abutting against each other, and a weld joining said abutting portions together.

3. The heat transmission body of claim 1, in which heat expansion gaps are provided in the ribs.

4. The metallic heat transmission body of claim 1, in which separate curved end pieces with inwardly projecting ends bridge the space enclosed between the metal walls.

5. The method of producing a tubular heat exchange body particularly adapted for use in connection with smoke tube boilers and of the type affording passage on the inside for a gaseous medium, and on the outside for a liquid medium, which comprises rolling separate halves of said body each of which includes a metal wall portion, curved end portions having a continuous smooth surface both on the inside and on the outside and a plurality of substantially parallel ribs extending at a substantially right angle from said wall portion, all in one piece, and welding together the abutting edges of each two juxtaposed end portions so as to firmly unite the two halves of the body.

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