

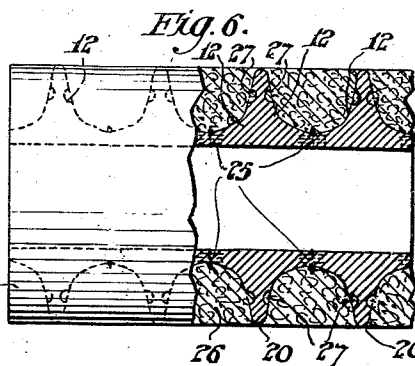
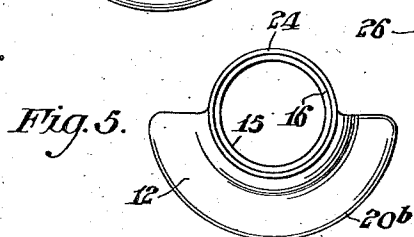
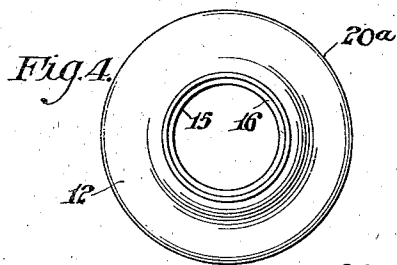
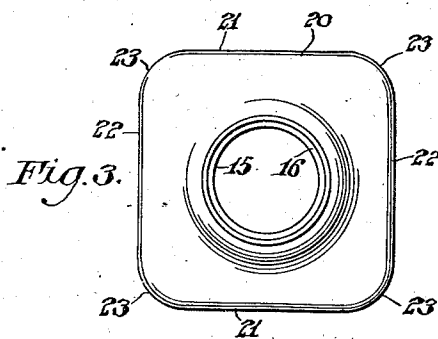
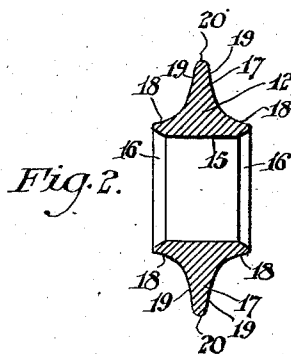
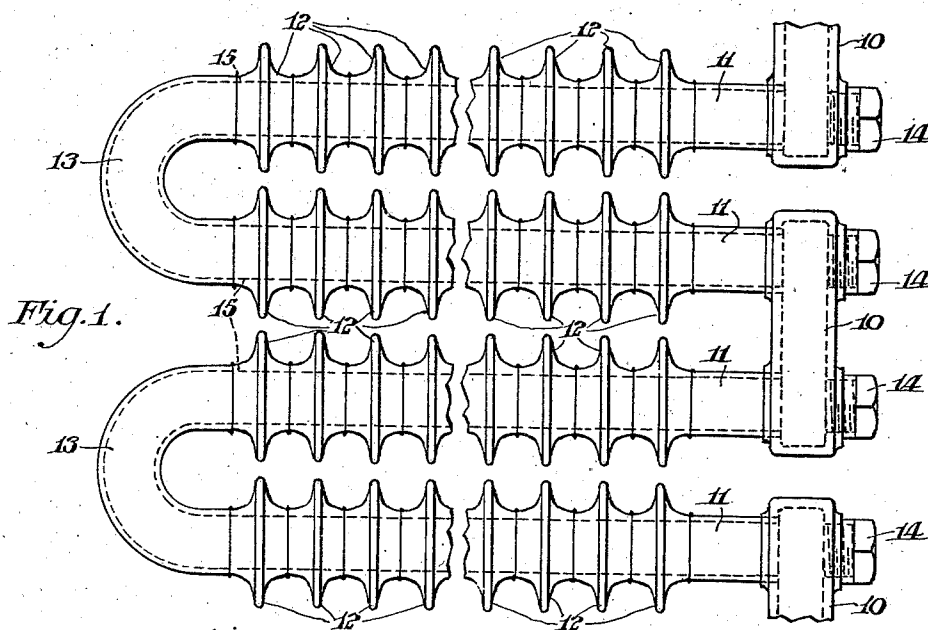
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J. H. ROHRER

2,146,352

HEAT EXCHANGER

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Inventor:
Josiah H. Rohrer,
By J. T. Wobensmith, Jr.
Attorney.

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HEAT EXCHANGER

Josiah H. Rohrer, Philadelphia, Pa., assignor of one-half to Day and Zimmermann, Incorporated, Philadelphia, Pa., a corporation of Maryland

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2 Claims. (Cl. 257—262)

This invention relates to heat exchangers and more particularly to a tube construction which may be readily assembled in accordance with the space available and with the heat transfer requirements. The invention further relates to an economizer assembled from a plurality of unit parts.

One mode of constructing economizers which has heretofore been and is now being employed is to mount, on the exterior of tubes which carry the fluid to be heated, a plurality of separate cast fin blocks or a block having a plurality of fins thereon. The purpose of using auxiliary fin blocks of this character is to increase the area of the exterior surface available for contact with the hot gases passing thereover. In the structures of this type the tube and the fins mounted thereon usually have different coefficients of expansion and, upon heating, small spaces develop between the interior surfaces of the fin blocks and the adjacent exterior surface of the tubes on which they were mounted. These spaces reduce very sharply the efficacy of the heat transfer from the gases passing over the exterior surfaces of the fin blocks to the fluid in the interior of the tubes. In addition to this objection the heat exchangers of this type are also objectionable because the assembly of the unit can not be accomplished without the difficulties arising from the necessity for shrinking or otherwise securing the fin blocks on the tubes.

Some attempts have been made also to construct heat exchangers from sheet metal but these are wholly unsuitable with the high pressures and temperatures employed in the economizers for modern steam generating plants.

The sheet metal constructions also usually have spaces in the interior in which boiler scale may collect, with resultant decrease of heat transfer, and in addition, the fluid carrying interior space, by reason of its construction, cannot be cleaned.

With heat exchangers or economizers of the types heretofore available also, the structure could not readily be assembled in its entirety at the place of installation, but must be assembled, shipped to the place of use and thus subjected to possible injury.

It is an object of the present invention to provide a tube construction for heat exchangers or economizers which overcomes the difficulties and objectionable features heretofore encountered.

It is also an object of the present invention to provide an economizer which may be readily assembled from unit parts and in desired sizes.

It is also an object of the present invention to provide a heat exchanger or economizer which is simple in construction, and which has a large heat transfer surface on the exterior and a suitable heat transfer surface in the interior thereof with the outer surface shaped to effect substantially uniform heat transfer to the inner surface.

It is a further object of the present invention to provide an economizer composed of a plurality of units and preferably unit forgings which may be quickly and easily assembled by welding.

It is a further object of the present invention to provide a heat exchanger or economizer which may be assembled in accordance with the heat transfer requirements.

It is a further object of the present invention to provide an economizer which will be satisfactory at high pressures and temperatures.

It is a further object of the present invention to provide a heat exchanger or economizer having exposed surfaces which are particularly adapted to receive a coating or covering for regulating and controlling the heat transfer characteristics.

Other objects of the invention will appear from the annexed specification and claims.

The nature and characteristic features of the invention will be more readily understood from the following description, taken in connection with the accompanying drawing forming part hereof, in which:

Figure 1 is a front elevational view of an economizer or heat exchanger assembly embodying the main features of the present invention;

Fig. 2 is a vertical central sectional view of a heat exchanger unit forging prior to assembly, illustrating certain details of construction;

Fig. 3 is an end elevational view of a preferred form of heat exchanger unit which may be employed in the heat exchanger assembly;

Fig. 4 is an end elevational view of a modified form of heat exchanger unit which may be employed in the heat exchanger assembly;

Fig. 5 is an end elevational view of a further modified form of heat exchanger unit which may be employed in the heat exchanger assembly; and

Fig. 6 is a fragmentary view partly in elevation and partly in vertical central section showing a further modified form of heat exchanger unit and the application to the exterior of assembled units of a suitable covering.

It will, of course, be understood that the description and drawing herein contained are illustrative merely, and that various modifications

and changes may be made in the structure disclosed without departing from the spirit of the invention.

Referring more particularly to Fig. 1 of the drawing, it will be seen that the preferred assembled form of the heat exchanger or economizer of the present invention includes a plurality of headers 10, a plurality of connecting tubes 11, a plurality of heat exchange units 12 and a plurality of return bends 13.

The headers 10 may be of any desired construction with suitable space in the interior thereof for the passage within the header 10 of the fluid to be heated, and may be of metal with plugs 14 threaded therein opposite the connecting tubes 11.

The connecting tubes 11 may also be of any preferred construction, and these connecting tubes are secured in any preferred manner to the headers 10.

The heat exchange units 12, which are of particular importance in connection with the present invention, may be made in a number of different shapes but are each constructed in one piece as forgings or otherwise weldable units. The assembly may include units 12 all of the same external shape or may include units of different external shapes, as hereinafter more fully referred to.

The preferred form of heat exchanger unit forging is illustrated in detail in Figs. 2 and 3, and includes an inner cylindrical surface 15 for direct contact in the assembly with the liquid to be heated.

The unit forging 12 as illustrated in Fig. 2 is provided at the extremities of the inner surface 15 with chamfered portions 16 for welding. This unit forging 12 is accordingly suitable for use as an intermediate unit of the assembly by being arranged in co-axial relationship with other and similar unit forgings and with the inner surfaces 15 in alignment.

The unit forging 12 is also suitable as an end unit of a series terminating adjacent a header 10 for connection to one of the connecting tubes 11, or as the other end unit of a series of units terminating at one of the return bends 13 for connection thereto.

The chamfered portions 16 permit of welding the units together end to end in any desired manner but are particularly suitable for flash welding in the assembling of the heat exchanger at the place of installation from headers 10, return bends 13 and unit forgings 12.

The heat exchange unit 12 is constructed, as referred to above, as a forging of a single body of metal and is preferably provided with a portion 17 extending outwardly and generally perpendicular to the end to end axis of the unit to provide a fin, flange or rib. This flanged portion 17 has the surfaces thereof which face toward the ends of the unit 12 preferably shaped substantially in accordance with the uniform heat transfer characteristic curve of the forged metal.

The portions of the surface of the flange 17, indicated at 18, which are relatively close to the interior surface 15, extend substantially toward each other and represent the flatter portion of the curve, while the portions of the surface of the flange 17, indicated at 19, which are more remote from the interior surface 15 correspond to the ascending or outwardly extending branch of the heat transfer characteristic curve. The surfaces of the flange 17 are connected at their outer extremities by a rounded edge portion 20. The

shaping of the surfaces of the flange 17 provides for a substantially equal distribution of the heat absorbed at the exterior surface of the flange 17, and including surfaces 18 and 19, and passing through the walls of the unit to the interior surface 15, so that a substantially uniform temperature prevails along the interior surface 15 of the unit 12.

The heat exchanger unit 12 is also preferably shaped in end elevation as illustrated in Fig. 3, the bounding edge portion 20 of Fig. 3 being composed of straight portions 21 and 22 connected by suitable curved portions 23. The respective edges 20 in an assembly including units of this character are thus substantially bounded by pairs of parallel planes. In place of the conformation shown in Fig. 3, the edge portion may be generally circular in outline as shown in Fig. 4, at 20^a and in the assembly of units of this character the respective edges 20^a are bounded by a cylindrical surface.

The edge portions may also, if desired be made as a segment, as shown in Fig. 5, at 20^b, with a portion of the projecting flange or fin omitted and the remaining portion of the interior space 15 enclosed by a wall 24 of substantially uniform thickness.

As has been heretofore indicated, the economizer or heat exchanger of the present invention may be assembled by welding together, as by means of the welds 25, a plurality of the forged units 12, the adjoining chamfered portions 16 being united by the welding so that the thickness of the wall at the place of welding is not decreased by the welding, as indicated in Fig. 1. To one end unit of the series a connecting tube 11 for connection to the header 10 is welded, the other end of the series being welded to a return bend 13. The other end of the return bend 13 is also welded to another series of assembled forgings 12 which are welded together in the same manner, and are connected to another connecting tube 11 and to another header 10.

The fluid to be heated in the economizer is passed in a direction generally opposed to that of the flow of the hot gases passing over the exterior surfaces, so that if the hot gases pass downwardly from the top, the liquid to be heated is introduced at the lowermost header 10, passes successively through one tube loop to the next header 10, and, in the same manner to the uppermost header 10.

It is frequently found desirable, after installation, and particularly where the tubes are exposed to radiant heat to vary or change the heat transferring capacity and the tube construction of the present invention is particularly suitable for this purpose.

After assembly if it is desired to reduce the heat transferring properties of the tube construction, a coating of refractory material 26 in plastic condition may be applied upon the exterior of the assembly or a portion thereof. A relatively large surface for adherence and support of the refractory material 26 is provided with the construction of the present invention. It is desirable, in some instances, however, to lock the refractory material 26 in place and for this purpose indentations 27 in the form of slots or recesses may be provided in the flange 17 as indicated at 27.

In the foregoing description, the transfer of heat as it occurs in an economizer has been pointed out, i. e. the transfer of heat is from hot gases flowing over the exterior surfaces to liquid 75

to be heated flowing within the interior. The apparatus of the present invention is, however, equally suitable for transfer of radiant heat, or for transfer in the opposite or outward direction through the walls of the heat exchanger, so that heat may be transferred from a hot liquid passing within the interior to a cooler gas passing over the outer surface.

I claim:

1. A heat exchanger comprising an assembly of similar units united end to end by welds, each unit having an interior fluid contact passage arranged in alinement with similar passages in the adjoining units, each of said units having an outer gas contact face, said outer faces each comprising a plurality of curved surfaces meeting similar curved surfaces of adjoining units at the ends of the unit, said curved surfaces extending outwardly from their ends and towards each other to provide an outwardly extending flange,

said curved surfaces terminating in an outer edge distant from the interior passage, and refractory material disposed in spaces defined by said continuous curved surfaces.

2. A heat exchanger having a plurality of similar units assembled in series to form a tubular section having an interior fluid contact passage arranged in alinement with similar passages in the adjoining units, each unit including a forged single body of metal having an outer gas contact face, said outer gas contact face including a plurality of curved surfaces extending from the edge of the unit toward each other and outwardly to provide an outwardly extending flange, the curved surfaces terminating in an outer edge distant from the interior passage, refractory material disposed in spaces between adjoining flanges, and refractory locking spaces formed in said curved surfaces.

JOSIAH H. ROHRER. 20