W. J. STILL.

TUBULAR HEAT INTERCHANGING APPARATUS.

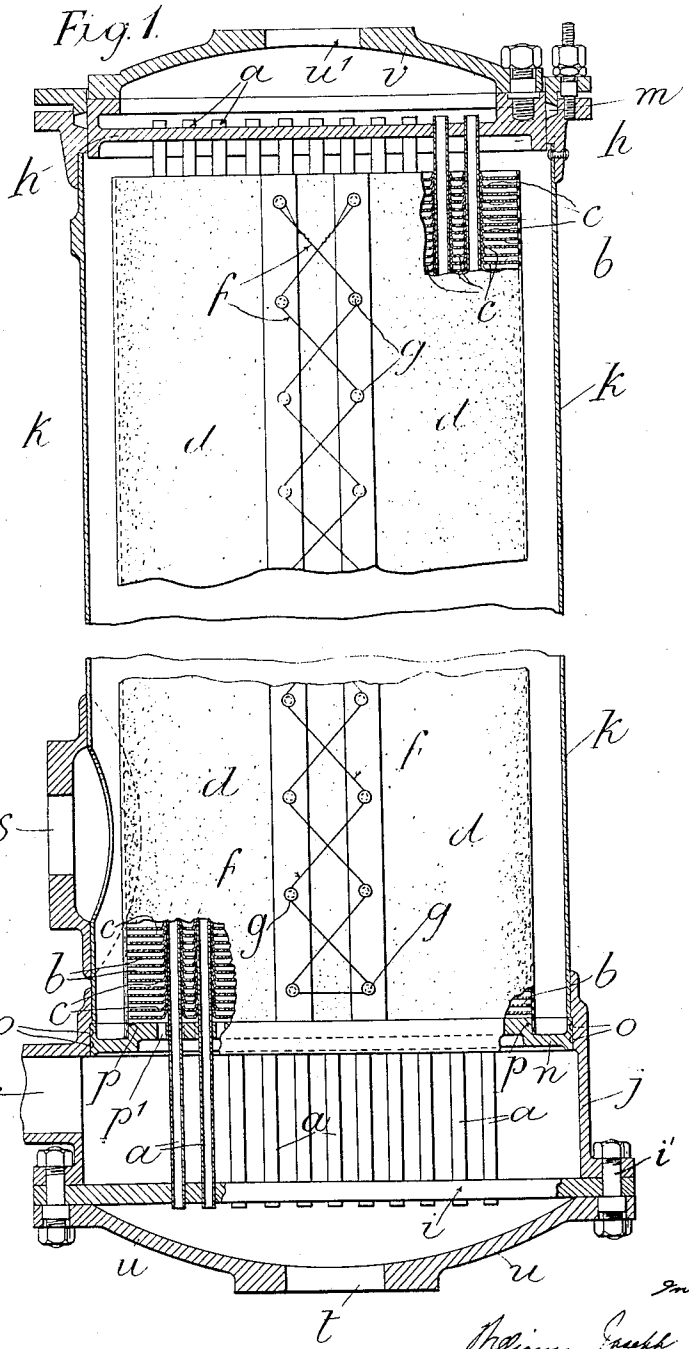
APPLICATION FILED NOV. 11, 1913.

1,101,969.

Patented June 30, 1914.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 2.

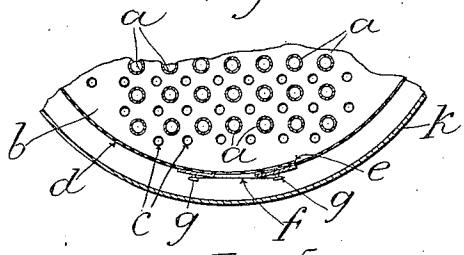


Fig. 6.

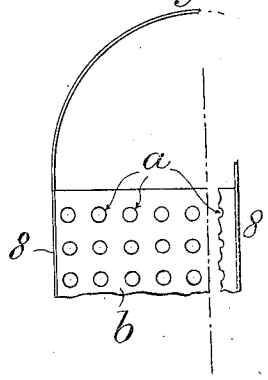
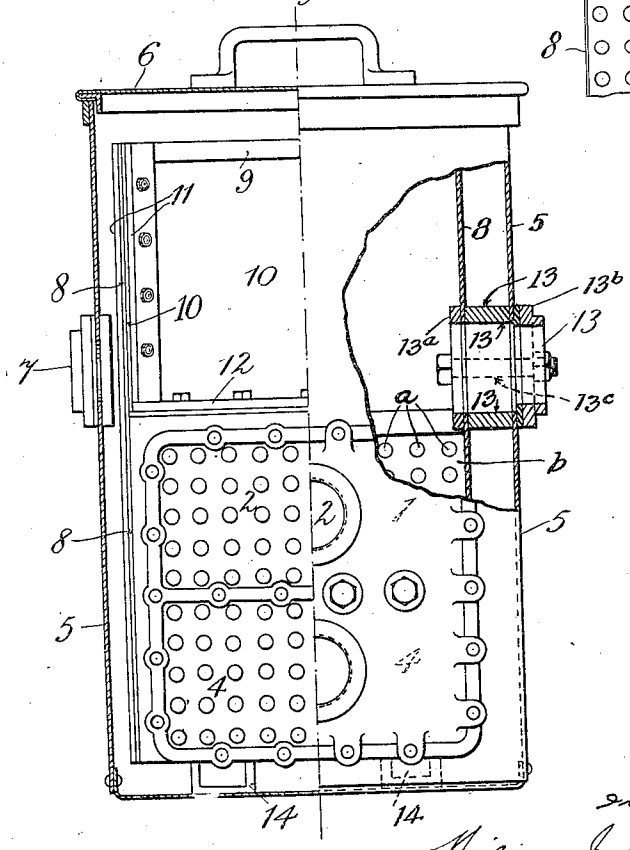


Fig. 5.



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3 SHEETS—SHEET 3.

Fig. 3.

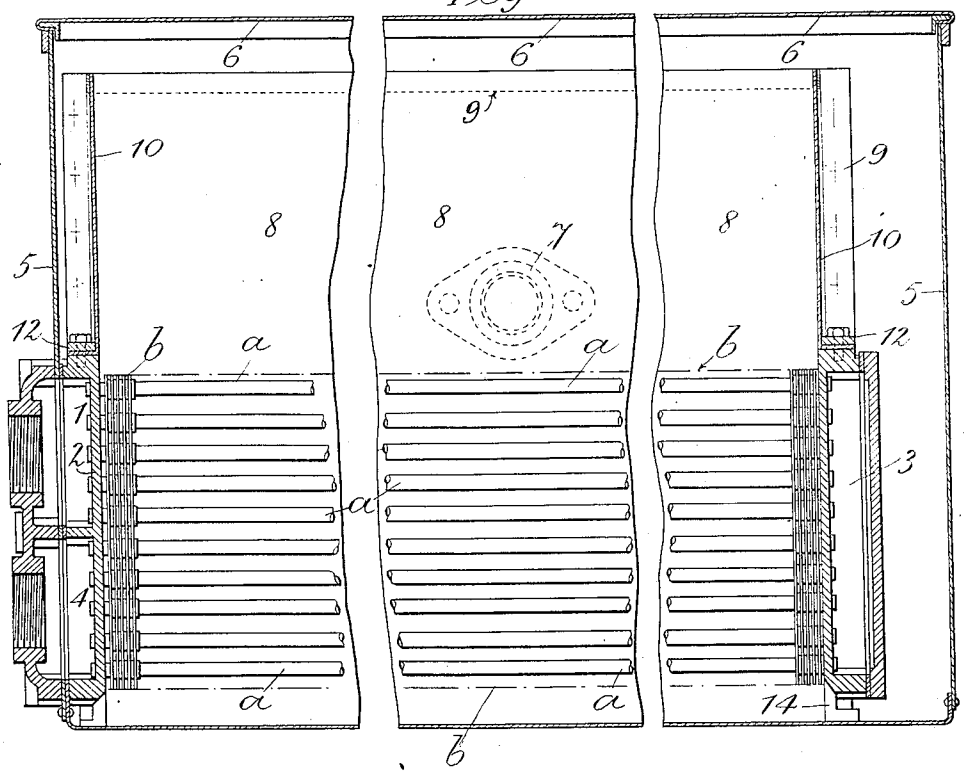
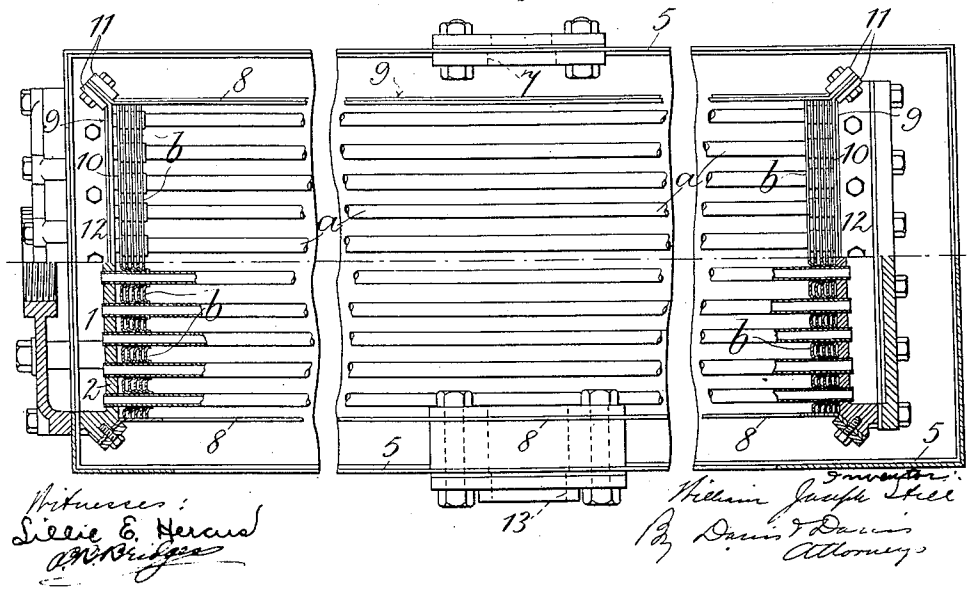


Fig. 4



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UNITED STATES PATENT OFFICE.

WILLIAM JOSEPH STILL, OF WEST EALING, ENGLAND.

TUBULAR HEAT-INTERCHANGING APPARATUS.

1,101,969. Specification of Letters Patent. Patented June 30, 1914.

Application filed November 11, 1913. Serial No. 800,335.

To all whom it may concern:

Be it known that I, WILLIAM JOSEPH STILL, a subject of the King of Great Britain and Ireland, residing at West Ealing, in the county of Middlesex, England, have invented Improvements in or Relating to Tubular Heat-Interchanging Apparatus, of which the following is a specification.

This invention relates to gilled tubular heat interchanging apparatus and it has for its object to effect certain improvements directed to the obtaining of effective fluid tight joints without the necessity of making these permanent, so that access can be easily gained to the interior of the apparatus when necessary, as for cleaning or inspection.

Broadly, the jointing is obtained by arranging material of a flexible character in contact with the edges of gills or flanges for example in such a manner that the contact referred to tends to be maintained by fluid pressure.

In the accompanying drawings, Figure 1 is a central vertical section of the upper and lower parts of an oil cooler of closed type according to the invention and Fig. 2 is a part horizontal section thereof. Fig. 3 is a sectional elevation, Fig. 4 a part sectional plan with cover removed and Fig. 5 a part sectional end elevation of a modified form of the invention. Fig. 6 is a part sectional end elevation showing a modified construction.

In Figs. 1 and 2 the cooling liquid is caused to flow through a series of tubes *a* to which are secured a series of plates *b* forming gills, the said plates being punched with holes to receive the tubes and in which the tubes are fixed. The oil to be cooled is caused to flow into the spaces between these gills through holes *c* in each, the holes in one gill *b* being staggered or displaced with respect to the holes in the gill *b* next in order, but in lieu of uniting the gills peripherally to form an outer confining wall or casing, which would entail permanent jointing, the spaces are closed circumferentially by a jacket of a material of a more or less yielding or elastic nature, such as vulcanite substitutes, for example vulcanized fiber, or, it may be, ductile metal, that will form a close joint with the gills and prevent oil leaking or short-circuiting between them. Such a jacket is shown as comprising a single sheet *d* of the appropriate material of a dimension equal in one direction to at least the overall distance between the uppermost and lowermost gills *b* and in the other direction to encircle the gills with an appreciable overlap, the edge portions *e* at the joint being brought into intimate contact with each other by suitable fastening means, as for example lacing means, a lace *f* in this case being shown as passed alternately around hooks or studs *g* secured to the sheet of material. The effect of this lacing is to cause the jacket to bind itself uniformly to the exterior edges of the several gills, it being of course important that the contour of the gills in face view shall not present any flat sides or edges with sharp angles but a curvilinear outline so that the jacket will wrap snugly around the gills.

In the particular example now being described, the tubes *a* project beyond the uppermost and lowermost plates or gills *b* and extend vertically through a top plate *h* and a bottom plate *i* into which they are expanded. The bottom plate *i* is larger than the top plate *h* so that it can be secured, as by bolts i^1, to the flanged lower end portion *j* of an outer casing *k* adapted to be slipped into position over the top plate *h*, a joint between the latter and the outer casing being made by means of a stuffing box *m*, to allow for expansion and contraction of the tubes. The oil entering the apparatus is separated from the oil leaving the apparatus by means of a diaphragm *n* having annular grooves *o* turned in its periphery which is adapted to take into an annular recess in the part *j* of the casing *k* and form a practically liquid tight joint therewith. This diaphragm is formed with a ring part *p* of the same external diameter as the gills *b* and around which the flexible covering material or jacket *d* also tightly extends so as to effectually close the joint between the ring and adjacent gill. Conveniently, the outlet may be at *r* at one side of the lower part *j* of the outer casing *k* near the bottom plate *i* with the inlet *s* immediately above the diaphragm *n* which separates the inlet and outlet. In this way the oil is caused to ascend around the jacket *d* of the cooling unit to the top where it then enters the spaces between the gills *b* and descends to the outlet, the diaphragm *n* being perforated at p^1 like the gills for outlet of oil. As the oil is supplied to the cooler under pressure, the pressure of the oil outside the

flexible jacket *d* will be greater than on the inside thereof with the result that it will act to force the flexible jacket tightly against the peripheries of the gills *b*. The water or cooling medium inlet *t* is made centrally in a plate *u* which may serve as a base and is connected to the lower portion *j* of the outer casing *k* by the bolts i^1 that secure the lower plate *i* of the cooling unit thereto. The outlet w^1 for the water or equivalent may be similarly disposed centrally in a cover *v* secured to the top plate *h* of the cooling unit.

It is not always necessary that the jacketing forming a joint with the tube gills should be wrapped around the same. For example, in the oil cooler shown in Figs. 3, 4, and 5 where the tubes *a* are arranged horizontally and the gills *b* disposed vertically, the cooling liquid is caused to enter the upper compartment 1 of a fixed header 2 so as to flow through the upper set of tubes *a* to a rear movable header 3 and return by the lower set of tubes *a* to the lower compartment 4 of the front header. The outer casing 5 of the cooler is rectangular in shape, provided with a removable cover 6 and having an oil inlet 7 at one side located at a height above the top of the gills *b* so that by providing flexible jointing side walls to such gills and fitting the outlet to one of the said walls, the oil can be constrained first to descend between the casing 5 and the jointing wall 8 and after passing below the latter to rise and flow uniformly between the gills. In the example, the flexible side walls 8, made of sheet lead, extend upwardly to near the top of the casing 5 where each is stiffened by a bar 9 of suitable metal, the ends of such walls being detachably clamped together with adjacent edges of end walls 10 by metal corner clamps 11. The lower edges of the end walls 10 may be clamped to the headers by metal bars 12. The oil outlet is shown as in the form of a ring or tube 13 clamped between the wall of the casing 5 and the adjacent lead wall 8 by means of washers 13^a, 13^b and bolts 13^c. Owing to the frictional resistance offered by the gills *b* to the flow of the oil, coupled with the fact that the outlet 13 is larger in area than the inlet 7, a difference in level exists at opposite sides of the walls 8, the head or pressure due to this difference serving, as in the previously described example, to keep the flexible walls 8 in contact with the gills and at the same time to insure a uniform upward movement of the liquid between the several gills.

As will be obvious, a single wall of lead or the like bent over, as indicated in Fig. 6, may be employed to engage the gills *b* at both sides of the apparatus.

The movable header 3 is provided with feet 14 resting loosely upon the bottom of the casing 5 so that relative movement can occur between the complete nest of tubes *a* and the outer casing to compensate for variations in temperature.

The tubular heat interchanging apparatus hereinbefore described instead of being used for cooling a liquid, for example oil, as hereinbefore described can be used for heating a liquid, in which case a heating fluid would be passed through the tubes *a*.

What I claim is:—

1. A heat interchanger comprising a set of gilled tubes and sheet material of a flexible character held in contact with edges of the gills and forming a fluid tight joint therewith.

2. A heat interchanger comprising a set of gilled tubes and sheet material of a flexible character held in contact with edges of the gills in a detachable manner and forming a fluid tight joint therewith.

3. A heat interchanger comprising a set of gilled tubes and sheet material of a flexible character arranged in contact with the edges of the gills so that fluid pressure can be caused to press the sheet material against the gills to make joint therewith.

4. A heat interchanger comprising a set of gilled tubes, sheet material of a flexible character arranged in contact with the edges of the gills and means to fasten together the adjacent edges of said material, for the purpose specified.

5. A heat interchanger comprising a casing having a liquid inlet and an outlet, a set of gilled tubes in such casing, and sheet material arranged in contact with the edges of the gills the said material and the gills, forming separated spaces through which the liquid must flow to pass to the outlet.

6. A heat interchanger comprising a casing having an inlet and an outlet, a set of gilled tubes in such casing, sheet material of a flexible character arranged in contact with the edges of the gills the said material and the gills, forming separated spaces through which the liquid must flow to pass to the outlet and means to fasten together the adjacent edges of said material.

7. A heat interchanger comprising a set of gilled tubes and a vertical wall of material of a flexible character arranged in contact with the edges of the gills and past one end of which liquid must flow before it can gain access to the spaces between the gills of the tubes.

8. A heat interchanger, comprising a nested set of horizontal tubes having rectangular gills thereon, a casing containing such set of tubes and to one end of which the set is secured, and walls of a flexible material adapted to engage the vertical edges of the gills under the pressure of a fluid and produce a series of isolated stream paths between the gills.

9. A heat interchanger comprising a cas-

ing having an inlet opening at one side thereof and an outlet opening at the opposite side, a nested set of gilled tubes in such casing, a wall of material of a flexible character arranged in contact with the gills at the side of the nest of tubes adjacent to the liquid inlet, a similar wall arranged in contact with the gills at the other side of the nest of tubes and having an opening therein in register with the outlet opening of the casing and a duct between the opening in the wall and the outlet opening, the liquid entering at the inlet being constrained to flow under the flexible walls and between the gills to the duct at the outlet.

Signed at U. S. consulate, London, this 31st day of October, 1913.

WILLIAM JOSEPH STILL.

Witnesses:
A. H. Stevens,
H. D. Jameson.