

E. L. PEASE.
GILLED HEAT INTERCHANGING APPARATUS.
APPLICATION FILED APR. 6, 1917.

1,313,730.

Patented Aug. 19, 1919
2 SHEETS—SHEET 1.

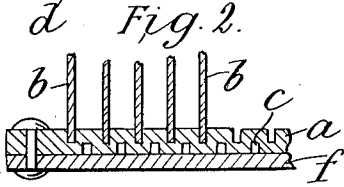
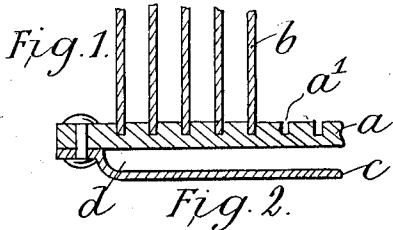


Fig. 3.

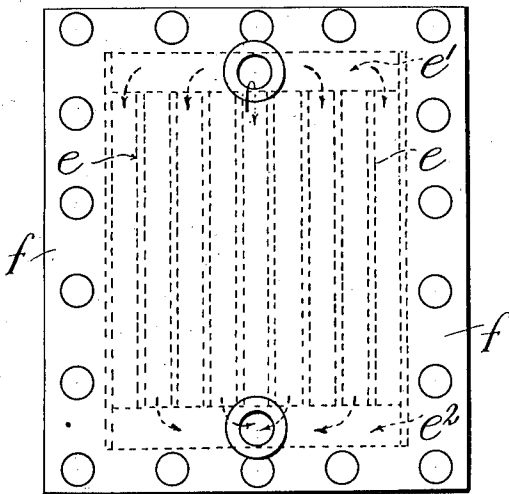


Fig. 4.

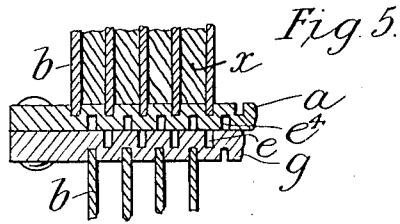
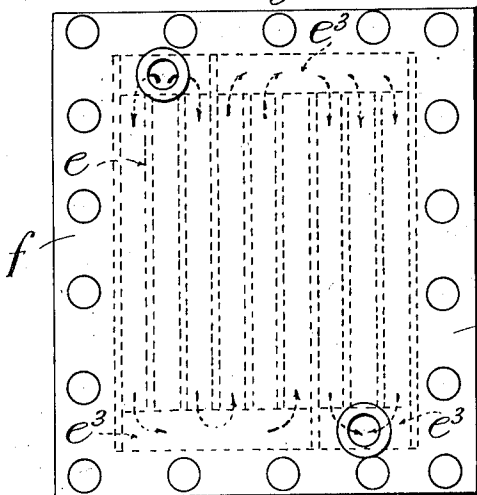


Fig. 6.

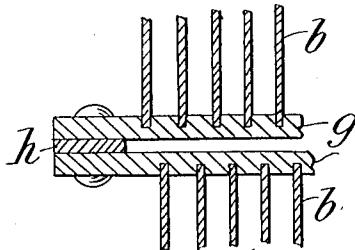


Fig. 7.

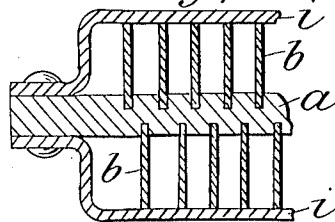


Fig. 8.

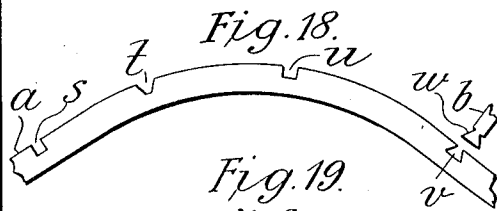
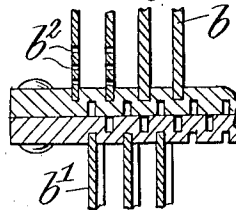
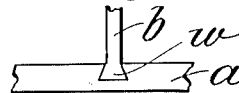


Fig. 19.

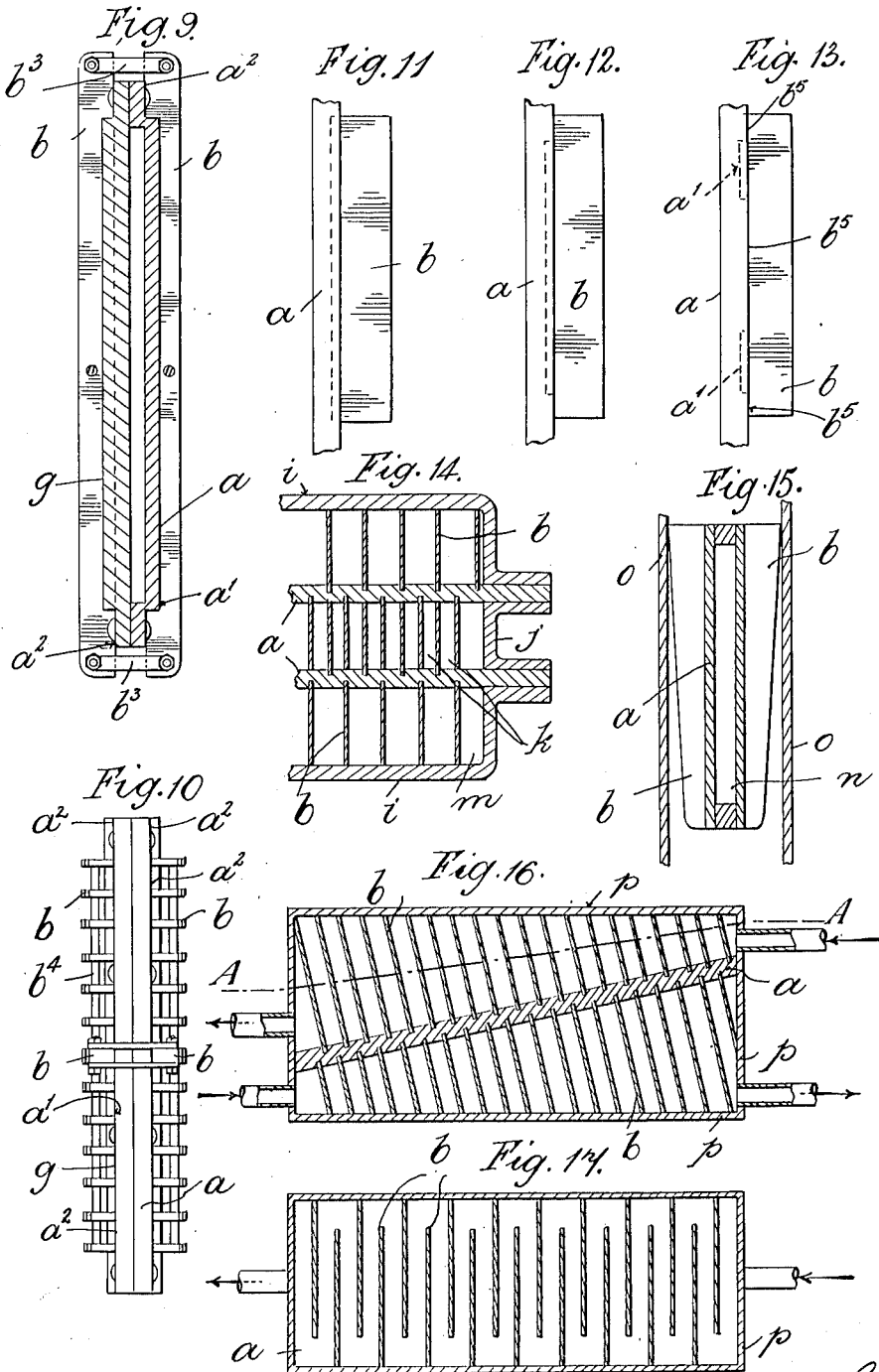


Edward Lloyd Pease
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UNITED STATES PATENT OFFICE.

EDWARD LLOYD PEASE, OF DARLINGTON, ENGLAND.

GILLED HEAT-INTERCHANGING APPARATUS.

1,313,730.

Specification of Letters Patent.

Patented Aug. 19, 1919.

Application filed April 6, 1917. Serial No. 160,305.

To all whom it may concern:

Be it known that I, EDWARD LLOYD PEASE, a subject of the King of Great Britain and Ireland, residing at Darlington, in the county of Durham, England, have invented Improvements in or Relating to Gilled Heat-Interchanging Apparatus, of which the following is a specification.

This invention relates to apparatus in which one or more flat or curved or flat and curved metal slabs or plates, that is to say slabs or plates having flat or curved surfaces, or flat and curved surfaces at different parts thereof, as distinguished from metal slabs or plates bent to a corrugated, zig-zag or like shape in section, and metal strips or gills, are employed to facilitate the transmission of heat from one fluid to another, whether the primary end in view be the elevation or reduction of temperature, or both.

Broadly the invention consists in the building up of apparatus comprising one or more flat or curved or partly flat and partly curved metal slabs or plates of the kind referred to and separately made strips or gills; an intimate connection between such slabs or plates (hereinafter referred to generically as plates) and the strips or gills (hereinafter referred to as gills) being effected by appropriate sawing or equivalent cutting of the plates that results in slits or slots being formed therein in which the gills are fixed, or by fixing the gills in cast metal plates at the time of casting the plates. The gills in each case are rolled metal, for instance iron or steel.

The invention, while generally applicable, is particularly so to radiators for general warming purposes and included in its object therefore is the production of such a radiator that can be manufactured at a cost less than has hitherto been possible where a given duty is concerned.

The invention in its narrower aspect consists in the building up of apparatus with plates one or more of which has separately made metal gills secured therein and which, when associated in proper relationship, form separated passageways for the flow of the fluids between which an exchange of heat is to take place when the apparatus is in use.

In some cases it may be convenient to employ plates of a grade of steel that can be cut comparatively easily by a milling machine having a gang of tools adapted to plow a series of parallel grooves in one face of the

plate for the reception of the gills. With such a construction the sawcuts or other slots may be made of a width equal to the thickness of the gills, the plate being then stressed in a direction to cause the cuts or slots to gape without producing a permanent set, thereby permitting the gills to be readily inserted, after which the plate can be permitted to return to its normal condition when the gills will be found to be firmly gripped. Or the gills may be otherwise fitted tightly in the cuts or slits, it may be by the aid of calking, or by compressing the metal of the plate on each side of them. Or, as above stated, cast metal plates may be used in which the gills become fixed at the moment of casting.

The accompanying illustrative drawings show various constructions of heat interchanging apparatus embodying the invention. In these drawings Figure 1 shows in horizontal section, part of an apparatus adapted to form a heat radiator. Fig. 2 shows in horizontal section and Fig. 3 in side elevation part of another construction of heat radiator and Fig. 4 is a similar view to Fig. 3 showing a modification thereof. Figs. 5, 6, 7 and 8 are horizontal sections showing other forms of heat interchanging apparatus. Fig. 9 is a part transverse vertical section and Fig. 10 a corresponding part plan, showing a modified construction of heat radiator. Figs. 11, 12 and 13 are part end elevations showing modifications. Fig. 14 is a horizontal section and Fig. 15 a vertical section, showing portions of other modified constructions. Fig. 16 is a vertical section and Fig. 17 a sectional plan on the line A A of Fig. 16, showing a further construction of heat interchanging apparatus according to the invention. Figs. 18 and 19 are explanatory detail views hereinafter referred to.

Referring to Fig. 1, *a* represents part of a metal plate or slab which has been formed with sawcuts or grooves *a*¹ to receive gills *b* that are in contact with one of the fluids between which there is to be an interchange of heat. A flanged back plate *c* provides a space at *d* for the other fluid to be dealt with.

In Fig. 2 the plate *a* in addition to being formed with grooves *a*¹ for the gills *b* is machined at the back to produce a number of vertical channels *e* collectively covered by a flat plate *f*, the said channels being either

connected together in multiple by transverse header channels e^1 and e^2 at each end, as shown in Fig. 3, or in series by shorter transverse header channels e^3 as shown in Fig. 4.

- 5 The area of contact of the medium with the plate a at the side opposite to the gills b is, in some cases, of extreme importance and when the plate a is channeled, as in Fig. 2, this area may be increased by replacing
10 the flat plate f with another channeled plate g , as shown in Fig. 5, the channels e^4 in this plate being staggered in relation to the channel e in the plate a . The plate g in this figure is also shown as provided with
15 gills b although these may be dispensed with if so desired.

Fig. 6 illustrates two plates a , separated by a distance frame h . Either of the plates a , or both, may be provided with gills b .

- 20 In some cases the spaces between gills b at one side of a plate a , may, as shown in Fig. 5, be filled by solid material x , such as the brickwork of a furnace, which it may be desired to cool or from which it may be
25 desired to abstract heat for the warming of air or water, or for other purposes.

A further modification is shown in Fig. 7 where gills b are arranged at opposite sides of a slotted plate a and two flanged cover plates i are clamped to the plates a , to form a casing. Such an arrangement would be
30 suitable for the cooling of oil flowing between the gills b in one set by water flowing between the gills in the opposite set.

- 35 The gills at one side of the structure may be arranged in the same way as the gills at the other side, as shown in Figs. 5 and 6, or they may differ to suit the requirements. Thus, the number of gills b at opposite sides
40 of the structure may differ, as may also their direction, as shown in Fig. 8, when the gills b^1 at one side are less in number than those b at the opposite side and are inclined to the vertical, while the gills b are vertical. All
45 the gills may be parallel to each other, as in the example shown in Figs. 1 to 7, or some may be arranged at different angles to others as shown in Fig. 8. In the same way, the gills, or some of them, may be per-
50 forated as shown at b^2 Fig. 8. The gills may be equal in length to the plates a and f (Figs. 2, 3 and 4) or plates a and g (Fig. 5), or longer as shown in Fig. 9, and they may be all of one thickness, as in Figs. 1
55 to 7 inclusive, or arranged in sets of different thickness as in Fig. 8, or in groups of one thickness separated by a single gill of greater thickness, as shown in Figs. 9 and 10, the latter being convenient when it is
60 found necessary to utilize the gills to resist, to some extent, the fluid pressure within the radiator that tends to separate the plates. When the gills are longer or wider than the plates, as in Figs. 9 and 10, the overhang-
65 ing end portions may, for the purpose men-

tioned, be tied or connected by transverse links b^3 , the upper ends of gills b on one side of the radiator being thus connected to opposite upper ones on the other side and lower ones on one side to opposite lower ones on the other side as shown. The effect of tying together any pair of gills as referred to may also be communicated to other gills not directly tied, by passing rods b^4 or the like transversely through perforations in the various gills, as shown in Figs. 9 and 10. The radiator shown in these figures may be taken to represent in transverse section and plan respectively the radiator shown in Fig. 5.

The saw cuts need not necessarily extend the full length of the plate, as shown in Figs. 11 and 12, and the gills may either be equal in length to the sawcuts as in Fig. 11, or be longer, as in Fig. 12, in which latter case the gills will be narrower beyond the sawcuts so as to abut against or clear the plate as desired.

Where the length of the sawcuts or slits a^1 might be thought to produce undue weakening of a slab, such slits may, as shown in Fig. 13, be interrupted and metal be cut away from the gills b at corresponding points b^5 to permit them to be connected to the plate.

For many purposes, where flat metal plates are used, it will be advantageous to plane out portions of the plate at opposite edge portions thereof, as shown for example at a^2 in the top and bottom edge portions of the plates in Figs. 9 and 10, before the grooves a^1 are cut in the plates. This provides an unutilized face portion for making the joint at these places and provides an easy entry for the grooving tools without forming longer grooves a^1 than are necessary.

In Fig. 14 there is shown a development of the arrangement according to Fig. 7, two plates such as a in Fig. 7, being separated by a frame j so that adjacent gills b of both plates are interengaged as shown. In this case, for example, the central spaces k might receive exhaust steam and the spaces m formed between the plates a and the covers i , might be supplied with water.

A form of apparatus suitable as a water cooler is shown in Fig. 15 where two plates a vertically arranged, form between them a water way n . Each plate is fitted with gills b . Air for cooling purposes is caused to pass between the gills b under the constraint of an outer casing o .

Figs. 16 and 17 show an apparatus providing for increased contact area and lessened speed of flow for fluids flowing in opposite directions; when approaching the point of discharge, to secure high efficiency. In this example, a plate a with gills at both sides is mounted at an angle within a built

up casing *p*. The course of the fluids will be understood from the arrows.

The gills may be fixed in position in the saw cuts or slits by any suitable method.

5 Where however gills are only required at one side of a plate, as in Figs. 1 to 6, and the plate is capable of being bent, it is preferred to first cut the plate while flat with a saw or other tool of a width less than the thickness of the gill. One such cut is shown at *s* in Fig. 18. The plate is then stressed so as to open the cut somewhat, as shown at *t* whereupon the cut is re-traversed by a tool of a width equal say to the thickness of the gill when it will assume the appearance shown at *u*. When the plate is re-straightened the cut will be as represented at *v*. Each gill *b* on the foregoing assumption will be grooved to provide a root such as shown at *w*. Obviously however a gill may be employed that has a root *w* produced by swelling or thickening the metal, as indicated in Fig. 19, in which case the first saw or like cut at *s* will be equal in width to the thickness of the gill and the second cut equal to the thickness of the root. The gill may be inserted into the cut at the time of re-straightening the plate or may be driven in from one end.

30 When the plate is not too thick to be stressed before being sawed, it may be so stressed and saw cuts made while in this condition which will consequently assume a dovetail form when the plate is straightened.

35 One cutting operation will thus only be required.

The width of the gills *b* in the region or regions where the temperature of the two fluids being dealt with more nearly approach equality, may be increased to compensate for such temperature variations, as described in the specification of another application filed by me 1st March, 1917, Ser. No. 151,802. For this purpose the gills may be made of taper shape, as in the example shown in Fig. 15 of the accompanying drawings, the smaller width of the gills being at the end of the gills with which the air first comes in contact.

50 What I claim is:—

1. Apparatus for the transmission of heat from one fluid to another, comprising substantially flat metal plates connected together and having between them a conduit for fluid, one of said plates having on one face thereof, outside said conduit, a number of parallel grooves extending in the same direction as that in which fluid is to pass through said conduit and metal gills tightly fixed in said grooves and in good metallic contact with the metal side walls thereof.

2. Apparatus for the transmission of heat from one fluid to another, comprising substantially flat metal plates connected to-

gether and having between them a conduit for fluid, one of said plates having on one face thereof, outside said conduit, a number of parallel grooves and metal gills arranged in said grooves the sides of which exert a powerful contractile force or grip on said gills.

3. Apparatus for the transmission of heat from one fluid to another, comprising substantially flat metal plates connected together and having between them a conduit for fluid, each of said plates having on one face thereof, outside said conduit, a number of parallel grooves extending in the same direction as that in which fluid is to pass through said conduit and metal gills tightly fixed in said grooves and in good metallic contact with the metal side walls thereof.

4. Apparatus for the transmission of heat from one fluid to another, comprising separate metal plates secured together and having between them a passage-way for fluid consisting of a number of adjacent channels in communication with one another at their ends, one of said plates having formed in its outer surface parallel grooves and separate metal gills tightly fixed in said grooves.

5. Apparatus for the transmission of heat from one fluid to another, comprising separate metal plates secured together and having between them a passage-way for fluid consisting of a number of adjacent channels in communication with one another at their ends, each of said plates having formed in its outer surface parallel grooves and separate metal gills tightly fixed in said grooves.

6. Apparatus for the transmission of heat from one fluid to another, comprising two metal plates connected together and fitting face to face and one of which has formed in its inner face a passageway for fluid closed sidewise by the adjacent plate and in its outer face a number of grooves and metal gills fixed in the latter grooves.

7. Apparatus for the transmission of heat from one fluid to another, comprising two metal plates secured together and having a passageway for fluid between them and each formed on its outer side with grooves, the grooves in one plate being staggered in relation to those in the other plate and separate metal gills fixed in the two sets of grooves.

8. Apparatus for the transmission of heat from one fluid to another, comprising two metal plates secured together, one of said plates having in its inner surface a number of channels connected together at their ends and closed sidewise by the adjacent plate and in its outer surface a number of grooves and separate metal gills fixed in said grooves.

9. Apparatus for the transmission of heat from one fluid to another, comprising two

metal plates secured together, each of said plates having in its inner surface a number of channels connected together at their ends and closed sidewise by the adjacent plate and in its outer surface a number of grooves and separate metal gills fixed in said grooves.

10. Apparatus for the transmission of heat from one fluid to another comprising two metal plates connected together and each formed with a number of passageways for fluid therein the passageways in one plate being staggered in relation to those in the opposite plate and a number of separate outwardly extending metal gills fixed in the outer side of each plate.

11. Apparatus for the transmission of heat from one fluid to another comprising a metal plate having a number of passageways for fluid in one side thereof, a number of separate outwardly extending metal gills fixed in the opposite side of said plate, a second plate fixed to the first mentioned plate and bearing against the side thereof in which the passages for fluid are formed, said second plate also having a number of passageways for fluid formed therein and in staggered relationship to the passages in the first mentioned plate and a number of outwardly extending metal gills fixed in the outer side of the second plate.

12. Apparatus for the transmission of heat from one fluid to another, comprising two metal plates secured together and each having in its inner surface channels connected together at their ends and closed sidewise by the adjacent plate and in its outer surface grooves and separate metal gills fixed in the two sets of grooves, the channels in the two plates being staggered in relation to one another and those in each plate being staggered in relation to the metal gills fixed to the same plate.

13. Apparatus for the transmission of

heat from one fluid to another, comprising metal plates connected together and one of which has formed therein on its inner side parallel channels opening into spaces common to them at their ends so that a number of such channels are connected in parallel between the inlet and outlet apertures of the apparatus, said channels and spaces being closed sidewise by the adjacent plate, the said channeled plate having in its outer side grooves staggered with relation to the channels on its inner side and separate metal gills fixed in said grooves.

14. Apparatus for the transmission of heat from one fluid to another, comprising metal plates connected together and each of which has formed therein on its inner side parallel channels opening into spaces common to them at their ends so that a number of such channels are connected in parallel between the inlet and outlet apertures of the apparatus, said channels and spaces being closed sidewise by the adjacent plate, each of said plates having in its outer side grooves staggered in relation to the channels on its inner side, and separate metal gills fixed in the grooves of the two plates.

15. Apparatus for the transmission of heat from one fluid to another, comprising substantially flat metal plates connected together and having between them a conduit for fluid, one of said plates having on one face thereof, outside said conduit, a number of parallel grooves extending in the same direction as that in which fluid is to pass through the said conduit and metal gills of varying width along their length, tightly fixed in said grooves.

Signed at Stockton-on-Tees, Co. Durham, this ninth day of March 1917.

EDWARD LLOYD PEASE.

Witnesses:

THOMAS ALFRED PALLISTER,
B. BEAT.