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E. MASLIN & C. THERYC.
REGENERATOR OR HEAT EXCHANGING APPARATUS.

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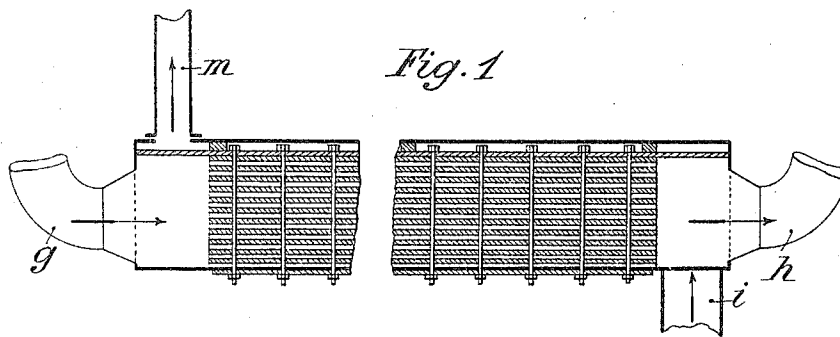


Fig. 1

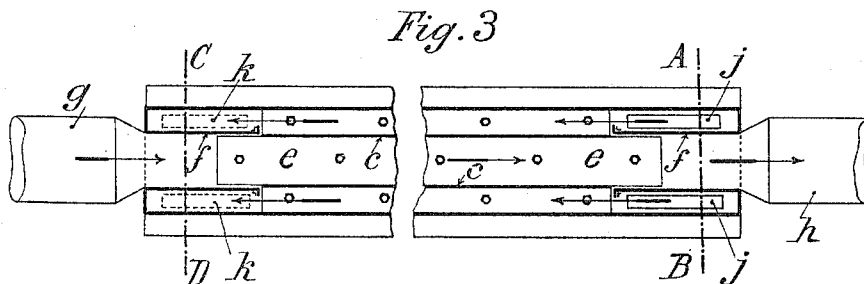


Fig. 3

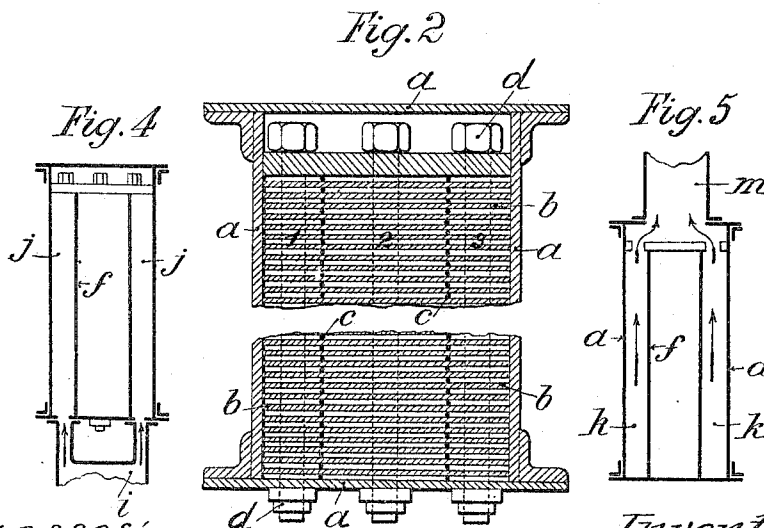


Fig. 2

Fig. 4

Fig. 5

Witnesses:

James L. Morris, Jr.
Ed. Kesler

Inventors

Emile Maslin
Charles Theryc

James L. Morris

Att'y.

UNITED STATES PATENT OFFICE.

EMILE MASLIN AND CHARLES THERYC, OF MARSEILLE, FRANCE,
ASSIGNORS TO SOCIÉTÉ ANONYME DES PROCÉDES MASLIN &
THERYC, OF MARSEILLE, FRANCE.

REGENERATOR OR HEAT-EXCHANGING APPARATUS.

No. 821,518.

Specification of Letters Patent.

Patented May 22, 1906.

Application filed February 5, 1902. Serial No. 92,736.

To all whom it may concern:

Be it known that we, EMILE MASLIN and CHARLES THERYC, engineers, citizens of the Republic of France, residing at Marseille, France, have invented certain new and useful Improvements in Regenerators or Heat-Exchanging Apparatus, of which the following is a specification.

This invention relates to regenerators or heat-exchanging apparatus, and aims to provide an apparatus in a manner, as hereinafter set forth, for overcoming the objections hitherto existing and which arise when elongated concentric tubes are employed in order to obtain a sufficient heat-exchanging surface to secure a proper recuperation, the objection being that all the exterior surface of the tube is not in use and causes losses by radiation. Furthermore, when employed with fluids having a relatively high density if the tubes are made of very small sections the circulation becomes difficult. So, therefore, as before stated, it is the aim of this invention to overcome the objections aforesaid; and to this end the invention consists of the novel construction, combination, and arrangement of parts hereinafter specifically referred to, and illustrated in the accompanying drawings, which form a part of this specification, and wherein is shown the preferred embodiment of the invention; but it is to be understood that changes, variations, and modifications can be resorted to which come within the scope of the claims hereunto appended.

In the drawings, Figure 1 is a vertical section of the apparatus. Fig. 2 is a transverse section on a larger scale than Fig. 1. Fig. 3 shows a horizontal section of the apparatus. Fig. 4 is a section on A B, Fig. 3. Fig. 5 is a section on C D, Fig. 3.

We arrange in a sheet-iron box *a*, forming an outer casing, a series of thin sheets *b* of sheet-iron or any other suitable conducting material, which to the number of fifty, one hundred, or two hundred, according to requirements, are placed on top of one another, being only separated from each other by two metallic strips *c*, placed lengthwise all along the plates and determining by their thickness the distance between the different plates. The area of the plates is ex-

actly equal to the interior area of the box or casing in which they fit with easy friction. The plates are held down to the bottom of the casing and onto the separating-strips by a series of bolts *d*, passing completely through all of them. The number of these bolts and the pressure exerted by them should be sufficient to set up a slight squeezing or compression of the strips *c* along their whole length. Under these conditions if we consider the space or cell comprised between any two consecutive plates and the walls of the outer casing we see that it is divided into three longitudinal compartments 1, 2, and 3 by the separating-strips. The fluid-tight division between the compartment 2 and the compartments 1 and 3 is due to the aforesaid slight compression of the separating-strips produced by the pressure of the bolts *d*. As to fluid-tightness between the edges of the plates and the lateral walls of the outer casing, this does not exist; but it is not required, since such want of tightness has no other effect than to put the superposed compartments into communication with each other and the same fluid is circulating in all of them. This being so, suppose, as has been done in the drawings, that all the central compartments 2 serve to conduct the cold fluid to be reheated and that all the side compartments 1 to 3 serve to conduct the fluid to be cooled.

The separation of the hot and cold currents is complete in the interior of the recuperator along the whole length of the plates. It is necessary that this separation shall exist equally at the ends of the plates and that it shall not be possible for any mixture of the two fluids to take place at the end of the passages formed by the plates. A number of different arrangements may be adopted to attain separately the inclosure of the two liquids in a special collecting-chamber for each kind of fluid at their exit from the cells or passages formed by the plates of the recuperator. One of these arrangements is clearly indicated by the group of figures. The parts of the plates *b* which correspond to the intermediate compartment 2 extend at each end beyond the parts corresponding to the other compartments, as is seen at *e*, Fig. 3. In this way the compartments 2 are caused to

jut out at each end of the apparatus and can be fitted into a sleeve or sheath into which enters at one side the inlet-passage *g* for the cold fluid and at the other side the escape-passage *h* for the same fluid after being heated. The hot fluid enters by the passage *i*, which has two branches leading past one side and the other of the sleeve *f* into the two spaces *j*, inclosed between the sides of this sleeve and those of the casing *a*. After having traversed the compartments 1 and 3 and having there parted with its heat the fluid passes away through the spaces *k* in the escape-passage *m*.

In the apparatus described we have shown only three compartments for the circulation of the gas or fluid; but for larger apparatus it may be of advantage to increase the number of these compartments and to aim at having some unequal number, it being understood that the two outer compartments need only have about half the area of the others.

In this manner one may increase the total area of the plates without increasing the size of the compartments, which should, moreover, be reduced, if possible, to secure an effective action, as the transmission of the heat is effected laterally by the conductivity of the plates.

It is to be understood that in this recuperator the whole of the surfaces of the plates without exception coöperate in the transmission of the heat, which result is not even attained in the theoretical recuperator composed of two concentric tubes, as only the surface of the interior tube acts in this case for the exchange of heat, and the surface of the exterior tube, although greater than that of the interior one, becomes not only inactive as regards recovery of the heat, but forms, on the contrary, a serious source of loss by radiation by reason of its great surface. Moreover, in such an apparatus with concentric tubes the contact of the fluids on the metallic walls is by no means as perfect as in the present recuperator, where the fluids are divided or "laminated" into very thin sheets.

The means of compression—*i. e.*, the bolts and nuts—may be replaced by any other suitable arrangement.

It is evident that instead of causing the two fluids to circulate in opposite directions, so effecting an absolute exchange of their calories, (the fluid which enters cold leaving hot, and vice versa) one may cause the two fluids to circulate in the same direction, in which case they will both leave the apparatus at the same temperature, equal to the mean between their respective temperatures at the entrance.

What we claim, and desire to secure by Letters Patent of the United States, is—

1. A regenerator or heat-exchanging apparatus consisting of a casing, a plurality of superposed parallel flat plates arranged therein,

distancing-strips interposed between the said plates and in connection with the casing forming a pair of side compartments and an intermediate compartment, said intermediate compartment of greater length than said side compartments and said compartments extending parallel with respect to one another, an inlet-pipe for the fluid for said intermediate compartment at one end of the casing, an outlet-pipe for the exhaust of the fluid from said intermediate compartment at the other end of the casing, an inlet-pipe for the entrance of another fluid to the side compartments at that end of the casing to which said exhaust-pipe is connected, an outlet-pipe for the exhaust of the fluid from said side compartments at that end of the casing to which the inlet-pipe for the intermediate compartment is connected, and means for tightening together the constitutive parts of the apparatus.

2. A regenerator or heat-exchanging apparatus comprising a casing, a plurality of superposed parallel flat plates arranged therein and having an extension at each end of less width than the body portion of the plate, distancing-strips interposed between the said plates and in connection with the casing forming a pair of side compartments and an intermediate compartment of greater length than the side compartments, an inlet-pipe for the fluid for said intermediate compartment at one end of the casing, an outlet-pipe for the exhaust of fluid from said intermediate compartment at the other end of the casing, said inlet-pipe and said outlet-pipe in connection with the casing forming chambers at each end thereof communicating with the side compartments, an inlet-pipe for the entrance of another fluid to the chambers at one end of the casing; an outlet-pipe for the exhaust of fluid from the said chambers at the other end of the casing, and means for securing together the constitutive elements of the apparatus.

3. A regenerator or heat-exchanging apparatus comprising a casing, a plurality of superposed parallel flat plates arranged therein and having an extension at each end of less width than the body portion of the plate, distancing-strips interposed between the said plates and in connection with the casing forming a pair of side compartments and an intermediate compartment of greater length than the side compartments, an inlet-pipe for the fluid for said intermediate compartment at one end of the casing, an outlet-pipe for the exhaust of fluid from said intermediate compartment at the other end of the casing, said inlet-pipe and said outlet-pipe in connection with the casing forming chambers at each end thereof communicating with the side compartments, said casing provided with a

pair of inlets for the chambers at one end thereof, said casing provided with a pair of outlets for the chambers at the other end thereof, a fluid-supply pipe communicating
5 with said inlets for the chambers, and an exhaust-pipe communicating with said outlets for the chamber.

In testimony whereof we have hereunto

set our hands, in presence of two subscribing witnesses, this 22d day of January, 1902.

EMILE MASLIN.
CHARLES THERYC.

Witnesses:

THOMAS MEIPPEN,
ALPHONSE PUGET.