E. LUCAS-GIRARDVILLE & G. MERCADIER.

APPARATUS FOR TRANSFERRING HEAT.

APPLICATION FILED APR. 24, 1911.

1,034,020. Patented July 30, 1912.

Fig. 1

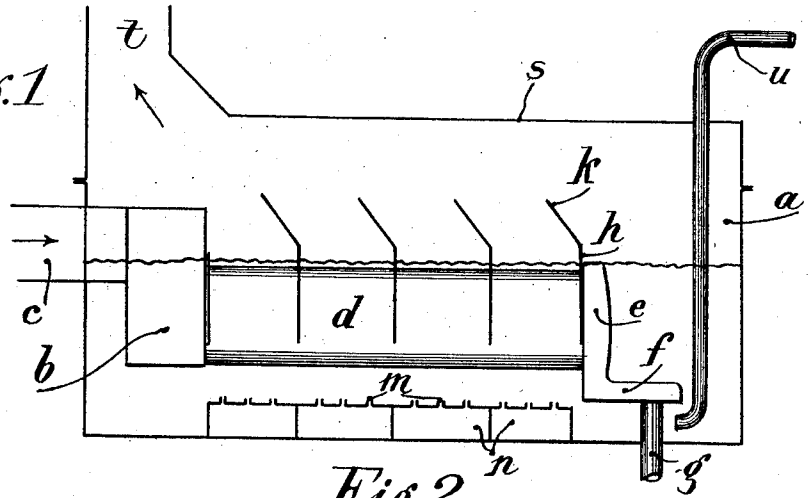


Fig. 2.

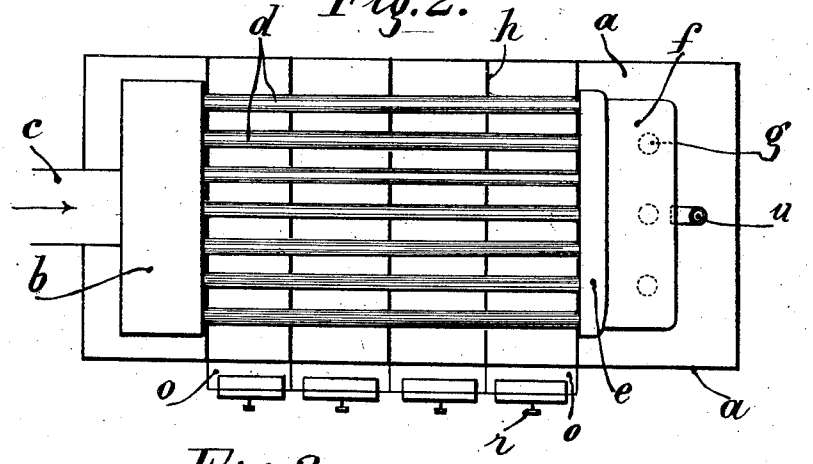


Fig. 3

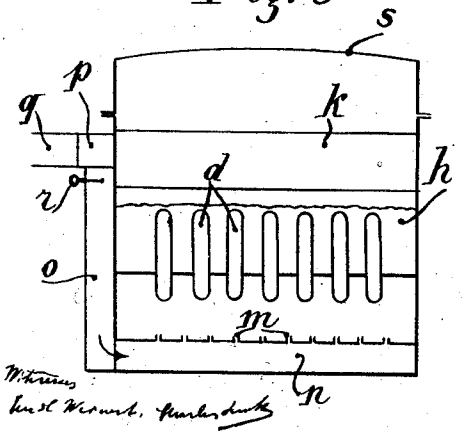
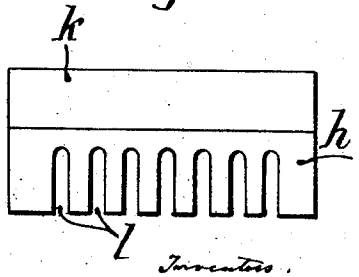


Fig. 4.



Witnesses,

Inventors.

UNITED STATES PATENT OFFICE.

EDMOND LUCAS-GIRARDVILLE AND GABRIEL MERCADIER, OF TONNEINS, FRANCE.

APPARATUS FOR TRANSFERRING HEAT.

1,034,020. Specification of Letters Patent. Patented July 30, 1912.

Application filed April 24, 1911. Serial No. 622,921.

To all whom it may concern:

Be it known that we, EDMOND LUCAS-GIRARDVILLE and GABRIEL MERCADIER, both citizens of the French Republic, and residing at Tonneins, France, have invented certain new and useful Improvements in Apparatus for Transferring Heat, of which the following is a specification.

This invention relates to a new system for transmitting heat which is particularly used with apparatuses serving to condense vapor or to cool liquid.

The improved system is based upon the use of the two following devices:—1. A tank filled with a liquid surrounding the tubes through which the fluid to be condensed or to be cooled circulates, the liquid in said tank being maintained in ebullition by means of a gas which is finely divided in said liquid. 2. Partitions in the tank which are arranged perpendicularly to the direction of movement of the fluid to be condensed or cooled, whereby a convenient regulation of the distribution of the gas can be obtained in all the parts of the tank so that the temperature is always in strict accordance with the local effect to be attained.

In the accompanying drawings the invention is shown by way of example, in its application to a surface condenser for steam.

Figure 1 is a longitudinal section of the apparatus. Fig. 2 is a ground plan of the apparatus the upper parts being removed. Fig. 3 is a cross section. Fig. 4 represents a constructional detail.

In a tank *a* a box *b* is arranged which receives the steam to be condensed. The steam is supplied to the box *b* by the pipe *c*. In the tank a series of flat tubes *d* are arranged parallel the one with the others. These flat tubes *d* which receive the steam from the box *b* are connected at the other end of the tank with a collector chamber *e* having at its lower end a flat horizontal outflow *f* from which the water of condensation flows into a pipe *g*. Upon the flat tubes *d* partitions *h* are transversely mounted which have an upper part *k* (Fig. 4) inclined toward the box *b* and notches *l* at the lower end by means of which they are mounted upon said tubes *d*. These partitions divide the tank *a* into a certain number of separate compartments. The extreme partitions *h* are placed against the box *b* and against the collecting chamber *e* respectively. Below the tubes *d* a horizontal partition *m* is arranged at a suitable distance from the bottom of the tank, the chamber thus formed being separated by vertical partitions into as many compartments *n* as there are separate compartments formed in the tank *a* by the partitions *h*. The horizontal partition *m* is perforated. Air is supplied to the compartments *n* from a conduit *o* mounted at the side of the apparatus and which receives the air from a reservoir *p* (Fig. 3) to which the air is supplied by a pipe *q*. There are as many conduits *o* as there are compartments *n* to be supplied with air. Each conduit *o* has a valve *r* by which the quantity of air supplied from the conduit *o* to the compartment *n* may be regulated. The lid *s* of the tank *a* has a flue *t* through which the air saturated with vapor escapes.

The apparatus operates as follows:—The steam to be condensed is supplied to the tubes *d* and air is blown into the compartments *n*. The water of the tank bubbling considerably covers completely the tubes *d*. The quantity of air admitted is regulated for each compartment so that the air after having traversed the liquid escapes from the tank completely saturated with vapor. The quantity of water which is lost by evaporation is replaced through the intermediary of a supply pipe *u* which terminates at a short distance above the bottom of the tank and which is arranged at the outlet end of the tank. Thus a circulation of cold water is established under the partitions *h*, said cold water being conducted toward the hot parts of the tubes *d*. Owing to the inclined upper parts *k* of the vertical partitions *h* the water thrown over from one compartment into the other in consequence of the ebullition of the said water in the tank is always moved from the right to the left, that is to say from the cooler part of the apparatus to the hotter part of the same, the drops coming from the vapor taken along by the outflowing air being always directed toward the left hand end of the apparatus.

In the condensers more commonly used water is employed as cooling fluid. This water flows out of the apparatus after having taken from the condensed steam only the calories which are required for the heating of the cooling water so that considerable quantities of water have to be used whereby the use of a condenser becomes very often impossible. If however the cooling water would be allowed to evaporate, it would ab-

sorb not only the calories required for its heating but further the calories which are necessary for its vaporization. The latter quantity of heat is far the most considerable as one kilogram of water to be heated from 15 to 100° degrees consumes 85 calories, while it consumes 537 calories to be vaporized at 100°. Unfortunately, if the water for condensation would be heated to 100° as would be necessary with the condensers of known constructions to obtain a notable vaporization, the water of condensation would have a far too elevated temperature which is quite inadmissible. The corresponding tension of the steam would be too high and the condenser would not be able to fulfil its principal purpose. It therefore is necessary in order to obtain a considerable vaporization of the cooling water to preserve in the condenser a region having a low temperature of 40° for example. In order to attain this result numerous devices have been proposed already which either comprised means for obtaining in the tubes of the condenser a circulation of air into which previously atomized water had been injected, or which comprised means for obtaining a continuous flow of water directed upon said tubes, an air current being passed over the water films. It is however necessary, in order to avoid the inconveniences of the condensers which simply use air currents resulting in the transmission of heat by direct contact of a gas (air saturated with steam or not) with the parts to be cooled, to have these parts continuously surrounded by water. The quantity of atomized water or the quantity of water applied as water films must obviously be much more considerable than the quantity of water which would suffice to saturate the air at the highest temperature which this air can reach. Herefrom follows that either an excessive quantity of water has to be used for the cooling or that special devices have to be employed for sending the water in excess back to the condenser. Further with the devices of known constructions the conditions of saturation of the air are not perfect unless the surfaces to be cooled are made very large. The film of water which bathes the surfaces to be cooled offers to the air only the surface of said parts to be cooled. The atomized water drops which do not come in contact with said cooling surfaces can take the heat for vaporization only from the air itself, the calorific capacity of this air, its mass and its conductivity being very feeble. This vaporization will therefore be very limited. Besides it will not give any other result, in contributing to the saturation of the air, than to diminish accordingly the evaporating capacity of the surfaces to be cooled.

The various processes which have been hitherto employed for the construction of condensers lead only to the construction of cumbersome apparatuses which use much water or require special auxiliary devices for producing the circulation of the cooling water, whereby the condensers are complicated. The device according to this invention however is of such a construction that the steam pipes are always submerged in a liquid, into which finely divided air is injected from below in order to realize an artificial tumultuous ebullition. The total surface of the air bubbles is much larger than the surface of the tubes to be cooled. The heat required for the vaporization of the water is principally transmitted by the mass of the liquid from the walls of the steam tubes. The rapid displacement of the liquid molecules as well upon the surfaces to be cooled as in the mass submitted to vaporization, insures a rapid transmission of the heat and experience has proved, that under the conditions set forth there has been obtained:—1—The almost instantaneous saturation of the air; 2.—Varying temperatures from one point of the tank to the other, said temperatures being however always the same for every distinct point.

Owing to the condensation of the steam the quantities of steam contained in the consecutive parts of the steam tubes become gradually smaller from the inlet to the outlet. The heat transmitted very soon comes only from the condensed water. This condensed water has to flow out of the condenser at a temperature of not more than 40°. The temperatures of the liquid in the tank must therefore be lower than 40° near the outflow ends of the steam tubes and this is the more necessary as the transmission of the heat from the steam to the cooling water is effected at these parts of the steam tubes not with the total surface of the tube as is the case at the parts of the tubes which contain the steam, but only with a small part of said surface, the condensed water collecting upon the bottom of the tubes. The weight of the vapor contained for example in one kilogram of air saturated at 30° is 0.029 kilogram. If the injection of air were regulated in such a manner that its temperature was not higher than 30° at any part of the condenser, the weight of the air required for the condensation of one kilogram of steam in the tubes would be very considerable. This weight is however considerably reduced by providing the partitions in the casing below the steam tubes and dividing the tank into separate compartments by the vertical partitions h, the quantity of air supplied to each of the lower compartments n being regulated by means of the valves so that it gradually decreases from the right to the left, the temperature of the bath being of course uniform for

each part or compartment of the tank and varying from 30° at the right to 95° at the left. The economy is realized owing to the fact that the ebullition of the water in the tank is produced at a temperature which is as close as possible to that of the steam to be condensed and that the number of calories to be removed is not considerable in the regions of middle or of low temperature.

With this improved condenser any kind of water may be used as the sediments which are found in a liquid continuously stirred do not adhere to the walls. They can be removed simply by washing.

The principal advantages of this apparatus are:—that it requires little space in comparison with its capacity, that any kind of water can be used for cooling and that only a small quantity of water is required. Owing to these advantages the apparatus is particularly adapted for engines and everywhere where water is expensive or of a bad quality.

We claim:—

Improved apparatus for transferring heat comprising in combination a device for injecting a gas through numerous small holes into the lower part of a tank containing the cooling liquid, and flat tubes in said tank through which passes the steam to be condensed or cooled, transverse partitions which separate the cooling tank into compartments in which the temperature decreases gradually from the left to the right, and similar partitions in the chamber from which the air is injected, substantially as described and shown and for the purpose set forth.

In witness whereof we have hereunto set our hands in the presence of two witnesses.

EDMOND LUCAS-GIRARDVILLE.
GABRIEL MERCADIER.

Witnesses:
A. DE CAEEALADE,
M. LEFORTE.