E. HARTER.

HEAT EXCHANGE APPARATUS.

APPLICATION FILED MAY 12, 1919.

1,403,319. Patented Jan. 10, 1922.

3 SHEETS—SHEET 1.

Fig. 1

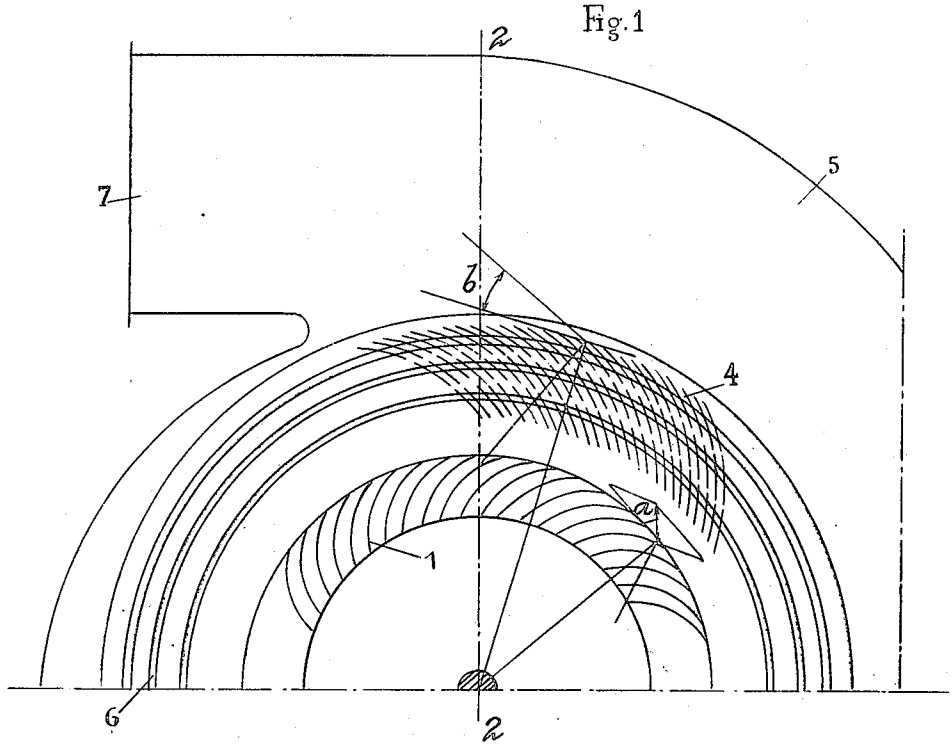


Fig. 3

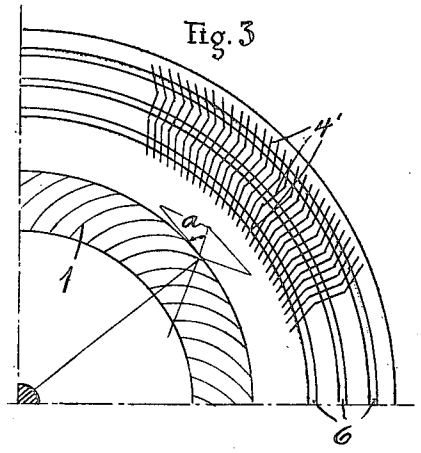
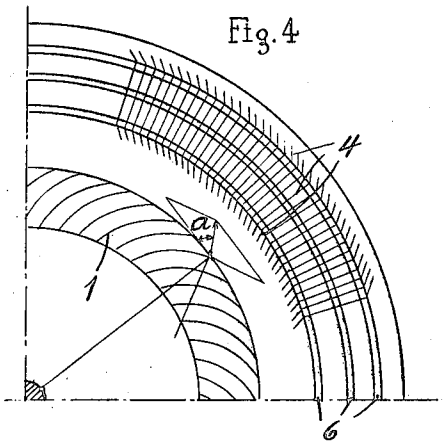


Fig. 4



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3 SHEETS—SHEET 2.

Fig. 2

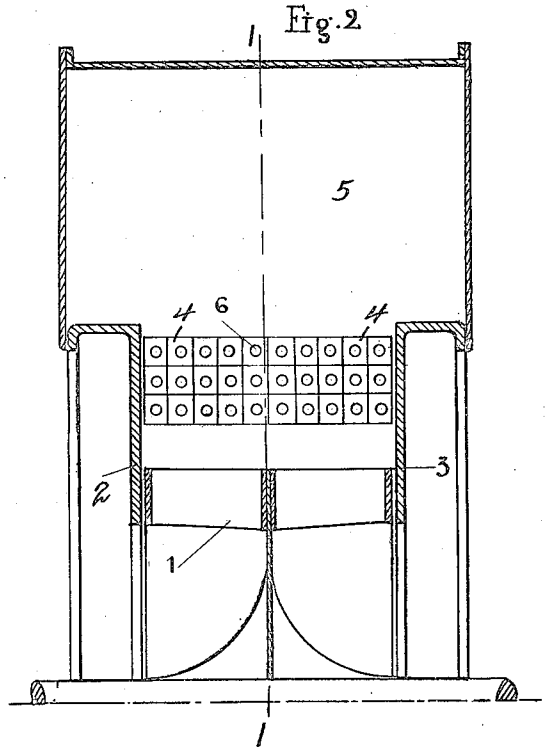
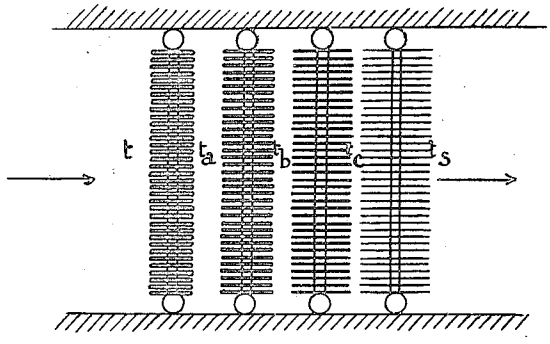


Fig. 5



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3 SHEETS—SHEET 3.

Fig. 7

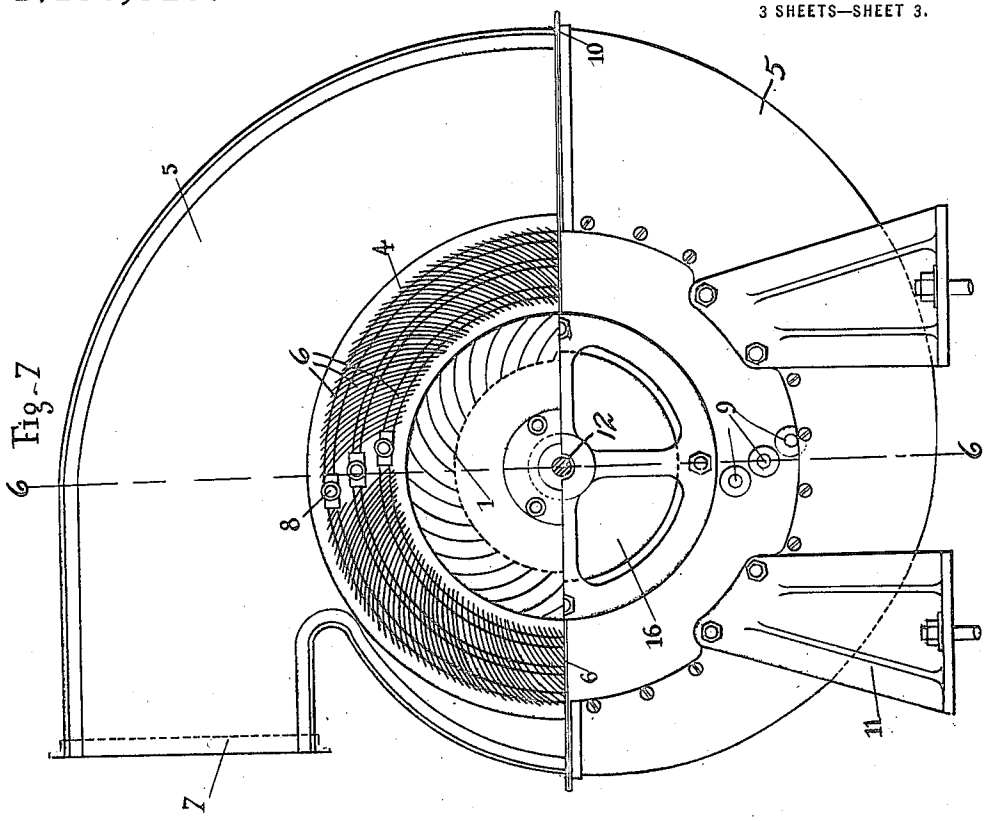
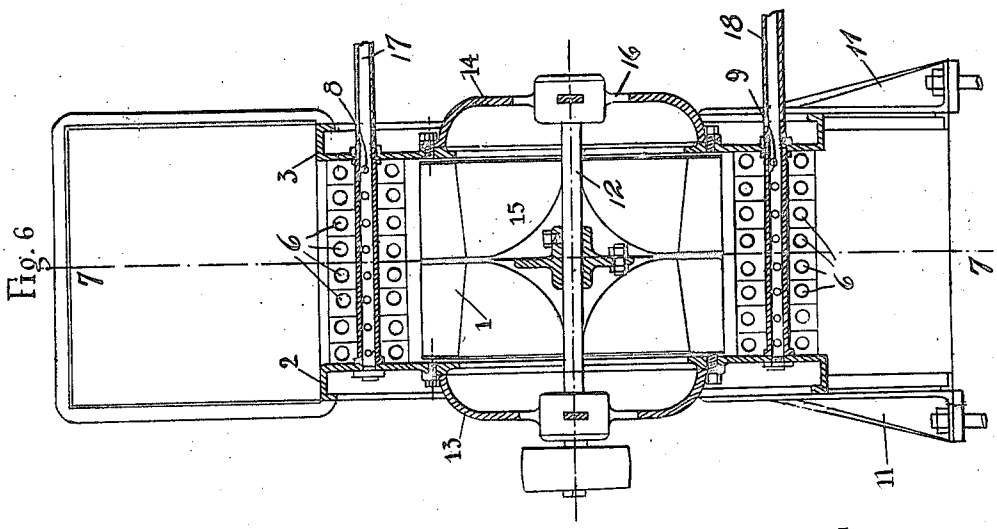


Fig. 6



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UNITED STATES PATENT OFFICE.

EMILE HARTER, OF PARIS, FRANCE.

HEAT-EXCHANGE APPARATUS.

1,403,319. Specification of Letters Patent. Patented Jan. 10, 1922.

Application filed May 12, 1919. Serial No. 296,655.

To all whom it may concern:

Be it known that I, EMILE HARTER, a citizen of the Republic of France, and a resident of 91 Rue de la Tombe-Issoire, Paris, France, have invented new and useful Heat-Exchange Apparatus, of which the following is a specification.

This invention relates to heat exchange apparatus and comprises a centrifugal fan, around which is arranged a heat exchange surface in contact with which passes the fluid, the temperature of which is affected by the blast from the fan. In apparatus of this general character heretofore used, the heat exchange surface is commonly formed by tubes, with plain walls, arranged concentrically with the fan axis. It has been proposed to augment the contact surface by providing the tubes with wings or fins arranged commonly at right angles to the tube. This arrangement is objectionable, however, since the blast from the fan impinges against the wings at a relatively great angle, and eddies are produced which so impede the blast that the efficiency of the apparatus is inadmissably reduced.

The object of the present invention is to remedy the defects by arranging the radiation wings on the tube at an inclination such that the blast from the fan meets the wings without shock and is guided by the latter to the collecting volute at such an angle that no eddies or other impediments occur. The wings form, as it were, the fixed guide vanes of a whirlpool chamber surrounding the fan.

Such an arrangement of the wings increases not only the mechanical efficiency of the apparatus, but also greatly augments its heat exchange capacity.

The invention comprises also certain improvements relative to the arrangement and construction of the wings, hereinafter described or shown in the accompanying drawings in which—

Fig. 1 is a vertical section on the line 1—1, Fig. 2, through the upper portion of an apparatus in which my invention is embodied in one form;

Fig. 2 is a transverse section on the line 2—2, Fig. 1;

Figs. 3 and 4 are partial sections corresponding to that of Fig. 1, but showing modified wing arrangements;

Fig. 5 is a more or less diagrammatic section showing a modified wing arrangement.

Fig. 6 is a section on the line 6—6, Fig. 7, through an air cooled condenser constructed in accordance with the invention; and

Fig. 7 is a section on the line 7—7, Fig. 6, the lower portion of the apparatus being shown in side elevation.

The present apparatus comprises a fan 1 arranged between side plates 2 and 3. Between the latter and surrounding the fan is the heat exchange element through which the blast from the fan passes to the collecting volute 5 (Figs. 1 and 2). The heat exchange element comprises a series of tubular rings 6 concentric with the fan 1. Through the tubes flows the liquid, the temperature of which is exchanged with that of the blast from the fan. On the tubes are inclined wings or gills 4 which form fixed guide vanes for the blast from the turbine ventilating fan. The gills of the first element present the same angle a as made by the air leaving the vanes of the centrifugal runner 1 with the tangent. The gills of the last element are arranged at the angle b to guide the air without shock into the collecting volute 5 and to give it the direction of the outlet nozzle 7.

Figures 1, 3 and 4 show different ways of arranging the fixed vanes 4 by varying the position of the gills upon the tubes of the heat exchange apparatus.

Figure 1 shows a heat exchange apparatus in which all the elements have curved and inclined gills.

In Figure 3 the gills 4 are inclined only upon the innermost and outermost series of tubes 6, while they are normal to the tubes in the intermediate elements.

In Figure 4 the gills 4 of the innermost and outermost tube series are bent, but the inclination is confined to a portion—about one third—of their depth.

The construction indicated in Figures 1, 3 and 4 is predicated upon an identical number of gills upon each of the tubes 6 in order to obtain the effect of continuous fixed vanes.

The fixed vanes may be discontinuous and the gills of the different tube series arranged to divide the stream of air within the heat exchange apparatus and thus ensure an intimate contact between the molecules of air and the dispersal surface of the condenser tubes (see the gills 4′ in Figure 3).

In certain cases, a sufficient division of the current of air is obtained by placing upon all the tubes an equal number of gills per unit of length, the successive elements having different diameters.

On the other hand, taking the case of a condenser or air-heater composed of several tube-elements having gills arranged in the direction of the air current (scheme of Figure 5), each of the elements supplied with steam or vapor assists in turn in raising the temperature of the air. This temperature t degrees becomes after each element successively t_a, then t_b, then t_c, and lastly t_s degrees at the end of the condenser. The hot fluid being in the condenser at a constant temperature, it follows that the actual difference of temperature between the steam and the air is different in the plane of each of the elements; it is greatest in the plane of the first and least in the plane of the last.

Moreover, the quantity of heat transmitted by the dispersal surface of a tube is proportional to the difference of temperature, and since for constructional reasons the gills affixed to the tubes have a uniform thickness, this thickness is generally too small for the first element and too great for the last; or again, if the surface of the gills be considered, this surface is too large for the first element, and too little for the last, in relation to the diameter of the tubes.

It is therefore necessary, if it is desired to obtain the best heat transmission from the condenser element, to modify in each case the characteristics of the gilled tube. If not, either the gilled surface of certain elements is not entirely utilized for heat transmission, or else the thickness of the gills is too great for the quantity of heat transmitted by their surface. In both cases, the metal is badly employed and there is a useless deadweight; the excess of surface creates a loss of pressure.

The present invention, apart from the previous arrangements, contemplates a variation in the successive elements of a heat exchange apparatus, the nature, the surface and the thickness of the tube gills, as a function of the temperature difference between the fluids. The conductivity of the metal and the thickness of the gills will vary in direct ratio to the temperature difference and the surface of the gills in inverse ratio.

Figure 6 represents the vertical section of a fan-condenser, according to the present invention, and Figure 7 represents one half in transverse section and one half in elevation.

The centrifugal turbine 1 is placed between the plates 2 and 3 of the whirlpool chamber, as well as the concentric elements of the condenser 6, the supply pipe 8 and condensation pipe 9 of which serve as distance pieces to the plates 2 and 3 of the whirlpool chamber.

The collecting volute 5 of the fan is in two parts connected by means of angle-irons 10, and is fixed by means of screws to exterior flanges of the plates 2 and 3.

Cast iron legs 11 are provided for fixing the apparatus upon the ground, against a wall, or to the ceiling.

The wheel or runner 1 may be an impulse or a reaction turbine according to the pressure to be obtained; its construction is such that the air enters without shock, the very numerous ribs obviate slip of the air current, and the constant section vanes deliver the air with a minimum loss of pressure.

The shaft 12 of the runner is supported in two ball bearings carried in two bearing covers 13 and 14 fixed by bolts upon the plates 2 and 3 of the whirlpool chamber.

The covers 13 and 14 are apertured for the passage of the induced air. The condenser consists of several concentric elements or tubes 6, the number of which depends upon the air temperature which it is desired to obtain at the exit nozzle 7, and upon the air delivery of the apparatus.

The tubes are mounted upon bronze manifolds 8 and 9 diametrically opposite and slightly offset in relation to each other so as to present the least resistance to the air current. The supply pipes 8 receive the steam connection 17. The condensation pipes 9 are connected to the condensed water return 18.

Upon the annexed drawing the condenser fan is shown with two eyes, but may be made with one. The belt drive may if desired be replaced by direct coupling to an electric motor.

The operation is as follows:

On the one hand, the hot fluid, which is steam, is led to the manifolds 8 of the condenser 6 by suitable piping 17. Upon contact with the steam, the dispersal surface of the tubes becomes heated; the condensed water by its own weight travels to the manifolds 9 and thence to the water return pipes 18. At starting the air is set in motion by the rotation of the wheel or runner 1 which creates a depression at 15. The air drawn into the apparatus enters by the apertures 16 formed in the bearing covers 13 and 14, penetrates into the vanes of the wheel 1, leaves the latter at an angle of a, encounters at this angle the gills of the first condenser-element tubes, traverses successively the other elements of the condenser becoming heated in contact therewith, and finally moves into the volute 5 which leads it to the exit nozzle 7.

In certain cases the tubes 6 may be supplied with hot water, or cold water if it is required to cool by ventilation a part of a factory or other space.

The invention may be applied to all uses of hot or cold air, to drying and heating industrially, to chilling as well as to cooling of motors with utilization of the heated air.

Having thus particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. A heat exchange apparatus comprising a fan turbine, an enclosing casing, and heat exchange tubes arranged in the casing around the periphery of the fan and provided with radiation fins extending in the direction of the normal path of travel of the discharge from the impellers of the fan turbine.

2. A heat exchange apparatus comprising a fan turbine, an enclosing casing, and heat exchange tubes arranged in the casing around the periphery of the fan and provided with radiation fins extending in the direction of the normal path of travel of the discharge from the impellers of the fan turbine, the fins on certain of said tubes having a different angle from those on certain other of said tubes to cause a change in direction of flow of the discharge from the fan, but so arranged as to prevent material impediment to the flow or the formation of objectionable eddies therein.

3. A heat exchange apparatus comprising a fan turbine, an enclosing casing, and radially spaced heat exchange tubes arranged within the casing around the periphery of the fan, in combination with radiation fins on said tubes, the fins on one tube being thicker than the fins on another tube radially spaced therefrom, for the purpose specified.

In testimony whereof I have signed my name to this specification.

EMILE HARTER.

Witnesses:

W. DEFÉVRIMONT,

JACQUES LEJEUNE.