June 10, 1930. G. F. JONES 1,762,272

ROTARY FAN AND HEAT EXCHANGER

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Fig. 2

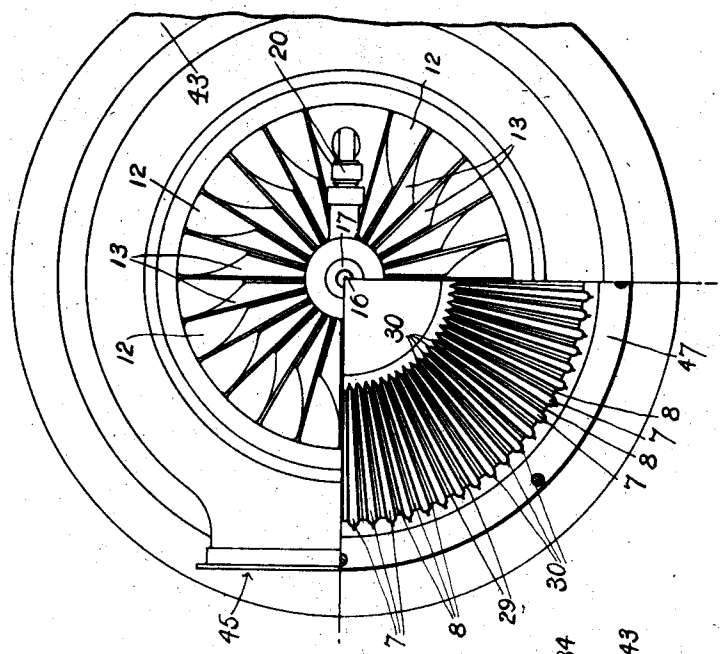
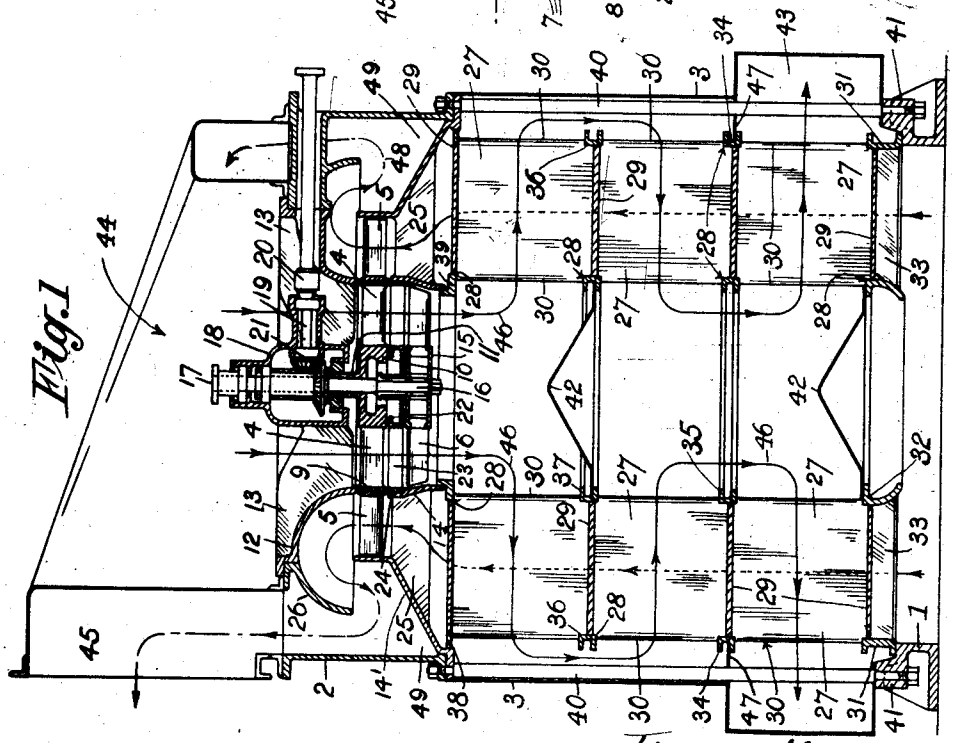


Fig. 1



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ROTARY FAN AND HEAT EXCHANGER

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This invention relates to heat exchange apparatus applicable for many purposes, say for use with the furnaces of steam generating plants, and has for one of its objects the provision of apparatus in which the hot gases travel rapidly in a vertical direction so that the tendency for all solid matter is to fall back into the furnace or ash pit by gravity.

Another object of the invention is the provision of an apparatus of the above nature in which the cool fluids (air or gases) rapidly travel about horizontally whilst the transfer of heat takes place.

A further object of the invention is to provide a heat exchange apparatus which can be readily assembled or disassembled and in which replacement of the parts can be readily performed if necessary.

A still further object of the invention is the provision of a heat exchange apparatus wherein spaces in which stagnant gas or air can accumulate and obstructions in the gas or air passages are reduced to a minimum.

The above and other objects of the invention will be apparent by reference to the example illustrated in the accompanying drawings, in which:—

Fig. 1 is a vertical section through about the middle of a heat exchange apparatus according to my invention, and

Fig. 2 is a plan view of the apparatus, a portion of the upper part being removed to expose the interior.

In this example the apparatus comprises a base ring 1 supporting an envelope consisting of upper and lower cylinders 2 and 3 respectively, the upper cylinder surrounding a combined forced draught and induced draught fan with oppositely set blades 4 and 5, and a supplementary independently driven fan 6, and the lower cylinder surrounding three tiers of heat exchange chambers 7 and 8 for the independent passage of hot gases and of air respectively, said chambers being radial and located around a hollow core as shown.

The blades 5 are fixed around a ring-like partition 9 on the tips of the blades 4 and these blades 4 are fixed around a boss 10 on a driving sleeve 11 so that both sets of blades rotate together and due to their opposite inclination impel gases and air in opposite directions, the member 9 in conjunction with parts of the fan casing acting to separate the air and the gases.

The said parts of the casing include an annular plate 12 of hollow part-circular section as shown, the outside having curved guide vanes 13 and forming the inflow passage to the blades 4 and 6, there being also an annular part-conical member 14 surrounding the blades 6.

Blades 6 are mounted on a boss 15 secured to a shaft 16 which is continued upwardly through sleeve 11 and terminates in a coupling 17.

The guide vanes 13 support at their inner tips a housing 18 for the bearings of sleeve 11 and the shaft 16 as well as the bearings for a shaft 19 which, from a flexible coupling 20 and through bevel gearing 21, rotates the sleeve 11 to drive the combined fan. Further support for the sleeve and shaft 16 is provided by a boss 22 carried by ribs 23 on an annulus 24 which is received in a suitable groove in member 14, and the said ribs are curved so as to act as guide vanes for the supplementary blades 6.

The inflow passage for the induced draught is formed by the outside surface of member 14 and the inside surface of a hollow conical member 14′ which is connected to the member 14 by curved ribs 25 acting as guide blades for the inflowing induced gases. The outflow passage therefor is formed by the outer face of the plate 12 in conjunction with a corresponding ring 26 of part-circular section.

The heat exchange chambers 7 and 8 are formed from a plurality of shallow-spaced radially arranged plates 27 of rectangular form which are stepped at their corners 28, Fig. 1, and form the chambers by being continuously joined together alternately at their adjacent horizontal edges and their adjacent vertical edges 29 and 30 respectively, the said edges being curved outwardly as shown to permit of this and effect the spacing and produce flared or stream-lined mouths to the chambers. All of the chambers are radial and vertical but it will be apparent that

those (7) open at the top and bottom and forming the passages for the vertically moving hot gases alternate with those (8) that are open at the vertical sides and form the passages for the radially moving cool air or the air being heated.

In assembling the plant the base ring 1 is fixed around the mouth of a suitable shaft in communication with the boiler furnace and a bridge consisting of outer and inner rings 31 and 32 respectively and joined by ribs 33 is placed on the ring 1 as shown, after which the lowermost heat exchange chambers formed as above set out are placed with the stepped corners 28 securely engaging and bearing on the inner upper edges of the rings 31 and 32. Concentric outer and inner rings 34 and 35 are then placed on top of the chambers, the stepped corners of the plates which form the intermediate tier engaging the inner edges of the rings; concentric rings 36 and 37, the top tier of chambers, and concentric rings 38 and 39 are then placed in position in the order given, the stepped corners engaging the appropriate inner edges of the rings. Finally, the cylinders 2 and 3 and the parts constituting and driving the fan are placed in position and the whole clamped firmly in place by bolts such as 40 secured at their lower ends to bosses 41 in ring 1 and are secured at their upper ends to a flange at the foot of cylinder 2.

It is to be particularly noted that this arrangement permits of very easy assembly or disassembly or replacement of any one or more parts, the whole construction being very simple. During assembly baffle cones 42 are suitably placed in position on the rings 32 and 37.

The lower end of cylinder 3 is enlarged at 43 and suitably provided with an air outlet, and the outflow passage of the induction fan has an annular cowl 44 with a mouth 45 delivering into a smokeshaft or the like.

In use, rotation of the blades 4 and 5 by shaft 19, gear 21, and sleeve 11, produces, on the one hand an axial current of air, and on the other hand a vertically rising current of hot gases. The axial current of air is, as shown by arrows 46, diverted radially due to the upper cone 42 and passes through the chambers 8 of the top tier, then downwardly where it is baffled by an annulus 47 so that it passes radially inwards through the chambers 8 of the intermediate tier and then passes downwardly and again radially outwards due to the lower cone 42 through chambers 8 of the bottom tier, whence it passes into the enlarged part 43 of the cylinder 1 and is conducted to the furnace or other place. The hot gases pass practically straight up through the vertical chambers 7, as shown by arrows 48, and after passing the fan blades 5 are turned downwardly due to the arrangement of the parts as shown, whereby any solid matter is deposited and then the hot gases pass upwardly again and out at the mouth 45 to the smoke stack.

In some cases, such as with power-station steam generating plants, it is desirable that the forced draught shall be greater than the induced draught and it is also desirable that the forced draught may be variable. Accordingly, supplementary fan blades 6 may be appropriately rotated when desired and the relative volumes or velocities of the air and gas currents may be varied. It is to be understood that this supplementary fan is not essential in all applications of the invention and may be omitted in some cases with corresponding structural alterations.

It is to be particularly noted that the path of travel of the hot gases is vertically upwards during the transfer of heat and that they may have a high velocity, which is desirable, whilst any ash or like solid matter has ample facilities for dropping back by gravity and such ash as may have been retained, will, due to the path the gases take after issuing from the fan, be held in a collector 49 formed by the outer sloping surface of member 14′ and the inner surface of cylinder 2.

It is to be further noted that the mouths of the chambers are stream-lined or flared and thus the easy passage of the gases and the air is greatly facilitated.

The construction of the chambers and their arrangement further provides an exceedingly large surface through which the transfer of heat may take place.

The apparatus above described is to be regarded as an example only of how the invention may be carried into effect and many modifications are possible within the scope of the following claims.

What I claim is:—

1. Rotary fans for furnaces in which two sets of blades are provided, one set, the inner set, being mounted on the boss of the fan to force air in one direction in a central duct and the second set, the outer set, arranged in annular space around the central duct to force gas in the opposite direction through an annular outlet with a heat exchanger below the annular outlet through which gas to that outlet passes in one direction and air from the central duct passes in another direction.

2. Blast apparatus for furnaces comprising a rotary fan having two sets of blades an inner set and an outer set, the blades of the sets being oppositely arranged, an air duct for the inner set and leading to the furnace and an annular gas outlet for the outer set connected to passages leading from the furnace, a heat exchanger below the annular outlet through which the air coming in by the duct is heated by the gas passing to the outlet, the gas in passing to the outlet being cooled by the air coming through the duct.

3. Blast apparatus for furnaces comprising a rotary fan having two sets of blades an inner set and an outer set, the blades of the sets being oppositely arranged, an air duct for the inner set and leading to the furnace and an annular gas outlet for the outer set connected to passages leading from the furnace, a heat exchanger below the annular outlet through which the air coming in by the duct is heated by the gas passing to the outlet, the gas in passing to the outlet being cooled by the air coming through the duct, a second fan being provided in the inner duct and co-axially with the fan having the two sets of blades, said second fan having means for driving it which means is independent of that which drives the fan having the two sets of blades.

4. Blast apparatus for furnaces according to claim 2 wherein the heat exchanger comprises a plurality of vertical gas passages for the outgoing gas and a plurality of horizontal passages radially arranged for air coming in by the duct.

5. Blast apparatus for furnaces, comprising a heat exchanger, a rotary fan mounted on the heat exchanger and having one set of blades arranged to drive initially cool air through the heat exchanger to the furnace and a second set of blades arranged to suck initially hot gases from the furnace through the heat exchanger, means for supplying the initially cool air from the heat exchanger to the furnace and means for conducting into the atmosphere the initially hot furnace gases exhausted from the fan.

6. Blast apparatus for furnaces including a heat exchanger comprising a plurality of superimposed units, a rotary fan mounted on the heat exchanger and having one set of blades arranged to drive air through the heat exchanger to the furnace and a second set of blades arranged to suck gases from the furnace through the heat exchanger, an upper cylinder surrounding the fan, a lower cylinder surrounding the superimposed units and means for securing the cylinders in superimposed relationship.

7. Blast apparatus for furnaces including a heat exchanger comprising a plurality of superimposed units, a rotary fan mounted on the heat exchanger and having one set of blades arranged to drive air through the heat exchanger to the furnace and a second set of blades arranged to suck gases from the furnace through the heat exchanger, and means for allowing solid matter to separate from the furnace gases.

8. Blast apparatus for furnaces including a heat exchanger comprising a plurality of superimposed units, a rotary fan mounted on the heat exchanger and having one set of blades arranged to drive air through the heat exchanger to the furnace and a second set of blades arranged to suck gases from the furnace through the heat exchanger, the units of the heat exchanger comprising radially arranged chambers in which the gases from the furnace are constrained to travel in a vertical path and the air is constrained to travel alternately in outward and inward radial paths.

9. Blast apparatus for furnaces including a heat exchanger comprising a plurality of superimposed units a rotary fan mounted on the heat exchanger and having one set of blades arranged to drive air through the heat exchanger to the furnace and a second set of blades arranged to suck gases from the furnace through the heat exchanger, the units of the heat exchanger comprising radially arranged chambers in which the gases from the furnace are constrained to travel in a vertical path and the air is constrained to travel alternately in outward and inward radial paths, an auxiliary fan being inserted in the path of the air to assist in driving said air through the heat exchanger to the furnace.

10. In a blast apparatus for furnaces the provision of a rotary fan having two oppositely arranged sets of blades and an auxiliary, separately driven fan arranged in the path of the fluid impelled by one of said sets of blades.

11. Blast apparatus for furnaces, comprising a heat exchanger, a rotary fan mounted on the heat exchanger and having one set of blades arranged to drive initially cool air through the heat exchanger to the furnace and a second set of blades arranged to suck initially hot gases from the furnace through the heat exchanger, means for supplying the initially cool air from the heat exchanger to the furnace, means for conducting into the atmosphere the initially hot furnace gases exhausted from the fan, and means for allowing solid matter to separate from the furnace gases.

In testimony whereof I affix my signature.

GEORGE FREDERICK JONES.