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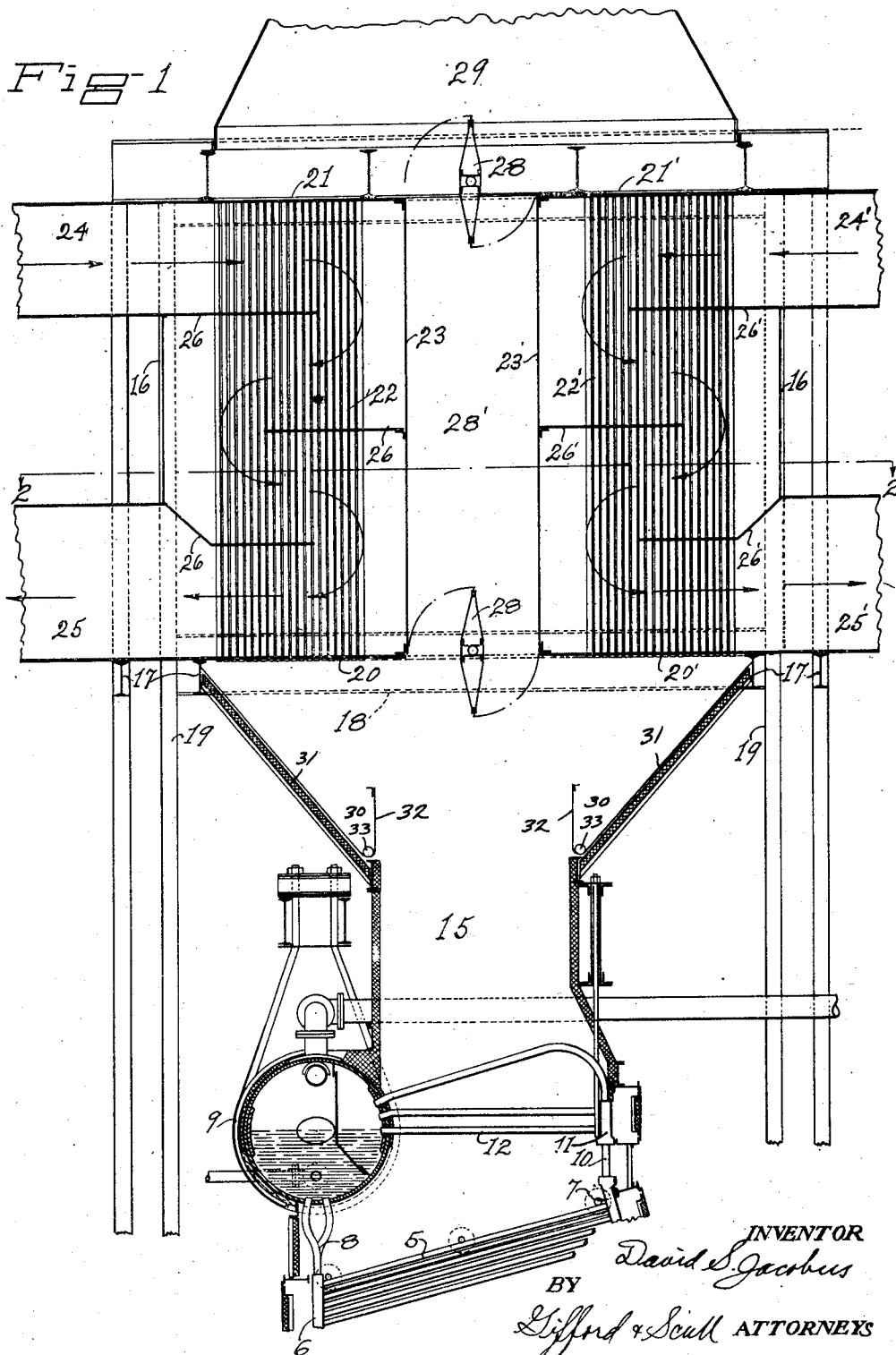
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1,779,276

AIR HEATER

Filed Nov. 14, 1925

2 Sheets-Sheet 1



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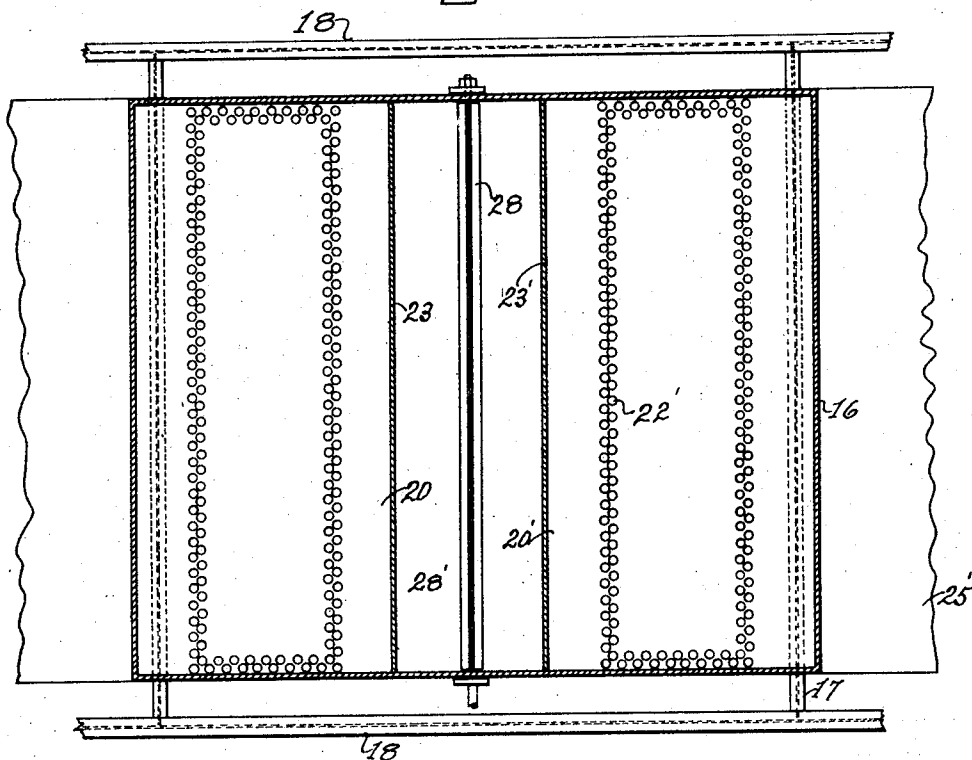
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Fig. 2.



UNITED STATES PATENT OFFICE

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AIR HEATER

Application filed November 14, 1925. Serial No. 68,995.

This invention relates to an air heater that is especially useful in connection with waste gases from steam boilers, although it is not restricted to this use.

5 The invention will be understood from the description in connection with the accompanying drawings, in which Fig. 1 is a vertical section through an illustrative embodiment of my invention, and Fig. 2 is a horizontal section along the line 2—2 of Fig. 1.
10 The air heater is shown in connection with enough of a steam boiler to indicate how the same is used with such a boiler. Reference character 5 indicates a bank of tubes of a
15 water tube boiler that is connected to headers 6 and 7, the header 6 being connected by means of the nipples 8 to the steam and water drum 9, the header 7 being connected by means of nipples 10 to the header 11 which
20 is, in turn, connected by the circulating tubes 12 to the drum 9, all in the manner well understood in this art.

The hot products of combustion from the furnace (not shown) of the boiler pass across
25 the tubes 5 and the tubes 12 into the flue 15, which is widened to accommodate the air heater box 16, which is supported upon I-beams 17 that rest upon cross beams 18 which are, in turn, supported by means of the up-
30 right supports 19.

The bottom of the air heater box is made of two perforated plates 20 and 20', which extend from the outer edges of the box inwardly to within a short distance of each other, and
35 the upper end of the box comprises two similar plates 21 and 21'. Two sets of tubes 22 and 22' are expanded into the holes in the bottom and top plates of the air heater box, and plates 23 and 23' which extend entirely across
40 the box connect the inner edges of the top and bottom plates, so as to provide a by-pass channel or duct 28' through the central part of the box, with the two sets of tubes located on opposite sides of this channel or duct. Air
45 ducts or conduits 24 lead into the box 16 on opposite sides thereof near the top, and air ducts or conduits 25 and 25' lead away from corresponding sides near the bottom. The spaces within which the tubes 22 and 22' are
50 located are provided with staggered baffle

plates 26 and 26' to cause a plurality of air passes across the tubes.

Dampers 28 are provided between the plates 23 and 23' for the purpose of closing the by-pass duct 28' between the plates 23
55 and 23' in part or entirely, and a gas flue 29 is provided at the top of the air heater box 16.

A V-shaped trough or catch basin 30 is provided on each side of the flue 15, one side 31 of these troughs being parallel with the sloping side walls above the flue 15, and the other side 32 being vertical. These troughs are located directly below the sets of tubes 22 and 22', and will serve as cinder catchers, and will also catch the water that may be used to wash
65 the tubes 22 and 22'. Outlets from the troughs 30 are indicated at 33.

The operation is as follows: When it is desired to obtain the maximum amount of air heating from the waste gases from the
70 boiler, the dampers 28 are turned so as to close the space through the middle of the air heater box 16, and all the waste gases are thereby caused to pass through the tubes 22 and 22'. Air is drawn or forced across the
75 tubes 22 and 22' a plurality of times, entering through the ducts 24 and 24', passing around the edges of the baffles 26 and 26', and finally out through the ducts 25 and 25'. It will be understood that ducts
80 25 and 25' will usually be connected to the same duct, and that ducts 24 and 24' may also be similarly connected to each other. For instance, if the heater is used to heat combustion air for the boiler furnace, the waste
85 gases of which supply the heat to the air heater, ducts 25 and 25' may connect to a common duct leading to the combustion space of the furnace. The total quantity of air to be heated is thus divided and each part
90 heated by a separate set of tubes 22, 22'. When it is not desired to use all of the waste gases from the boiler for heating air, dampers 28 are opened to an extent corresponding to the amount of waste gases it is desired to by-pass, so that less than the whole amount of waste gases pass through tubes 22 and 22', and thus escape into the smoke
95 stack 29 without giving up their heat to the
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air that is circulating across the outside of the tubes.

By placing the end of the duct 28' and also the ends of the two sets of tubes 22 and 22' directly in communication with the waste gas flue 15, any closing of the dampers 28 will not unbalance the two sets of air heating tubes 22 and 22', each taking an equal amount of the hot gases, no matter what the position of the dampers. This equalizing of the gas flow is aided by locating the sets of tubes 22, 22' symmetrically around the duct 28'. By dividing the total amount of air to be heated and sending each part over only a part of the total heating surface, the velocity of the air is one-half what it would be if all the air were sent over the same path over all the heating surface and the frictional resistance to flow thus reduced to one-fourth what it otherwise would be.

As the waste products of combustion pass upwardly through the flue 15 and spread outwardly on both sides, soot, dust and cinders will collect and drift downwardly into the troughs 30, from which they can be removed through the openings 33. Also, any water that may be used to wash the soot, etc., out of the tubes 22 and 22' will be caught in the troughs 30 and pass out through the openings 33 without getting into the boiler proper. This is rendered possible because the tubes of the heat transfer device are offset from the direct line of travel of the gases from the boiler.

This invention is particularly useful where a stack draft is used without any induced draft fan, as a much higher capacity can be obtained with the use of the by-pass at peak loads than without the use of the by-pass. When the by-pass dampers 28 are opened the gas which flows through the by-pass will cause the gases in the stack to be hotter than would be the case if all of the gases were to flow through the air heaters, and this increases the stack draft. At the same time, the frictional resistance to the flow of the gas as a whole is diminished and both effects combine to give a greater amount of draft at the boiler uptake, thereby making it possible to operate the boiler at a higher rating than without the by-pass. With the particular arrangement used, the gases that are by-passed flow directly upward with a minimum amount of resistance, which makes it possible to operate at a higher rating than would otherwise be possible when the by-pass dampers are open.

I claim:

1. A heat transfer device for heating air by hot gases, comprising two sets of gas ducts each set comprising a plurality of small tubes, a by-pass duct, a gas flue connected to the ends of all of said ducts, means to pass separate streams of air over each of said sets of gas

ducts, and means to control the flow of gas through said by-pass duct.

2. A heat transfer device for heating air by hot gases, comprising two sets of gas ducts each set comprising a plurality of small tubes, a by-pass duct, a gas flue connected to the ends of all of said ducts, means to pass separate streams of air over each of said sets of gas ducts, and means to control the flow of gas through said by-pass duct, said sets of gas ducts being symmetrically disposed on opposite sides of said by-pass duct.

3. A heat transfer device for heating air by hot gases, comprising two sets of gas ducts, a by-pass duct between said sets, a gas flue connected to the ends of all of said ducts, means to control the flow of gas through said by-pass duct, air ducts having inlets and outlets at opposite ends of said sets of gas ducts to direct separate streams of air over each set of gas ducts, and baffles in said air ducts extending across said gas ducts.

4. A heat transfer device for heating air by hot gases, comprising two sets of gas ducts, a by-pass duct between said sets, a gas flue connected to the ends of all of said ducts, means to control the flow of gas through said by-pass duct, and air ducts having inlets and outlets at opposite ends of said sets of gas ducts to direct separate streams of air over each set of gas ducts, said air ducts being arranged to direct each air stream back and forth across its set of gas ducts, with the air first contacting with the ends of the gas ducts farthest from the gas flue.

5. A heat transfer device for heating air by hot gases, comprising two sets of vertical gas ducts, a by-pass duct between said sets, a gas flue connected to the lower ends of all of said ducts, means to control the flow of gas through said by-pass duct, and air flues to direct separate streams of air over each of said sets of gas ducts, said air ducts being arranged to direct each air stream horizontally across the upper ends of its gas duct and then back and forth to the lower ends of said gas ducts and then horizontally outward.

6. A heat transfer device for heating air by hot gases, comprising two sets of gas ducts made up of tubes arranged in rectangularly shaped groups, a by-pass duct between said sets, a gas flue connected to the ends of all of said ducts, means to pass separate streams of air over each of said sets of gas ducts by causing the air to enter at the top and leave at the bottom, and means to control the flow of gas through said by-pass duct.

7. A heat transfer device for heating air by waste gases, said device being offset horizontally from the direct path of the waste gases said sides providing parallel walls on opposite sides of the gas path through said device.

8. A heat transfer device for heating air by waste gases from a boiler, said device being located above said boiler and offset from the

direct line of travel of gases from the boiler,
and a catch basin located directly beneath
said device.

5 9. A heat transfer device for heating air
by waste gases from a boiler, said device com-
prising a plurality of sets of vertical gas
ducts offset from the direct line of travel of
gases from the boiler with a gas passage be-
tween said sets of ducts, and a trough beneath
10 said ducts.

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