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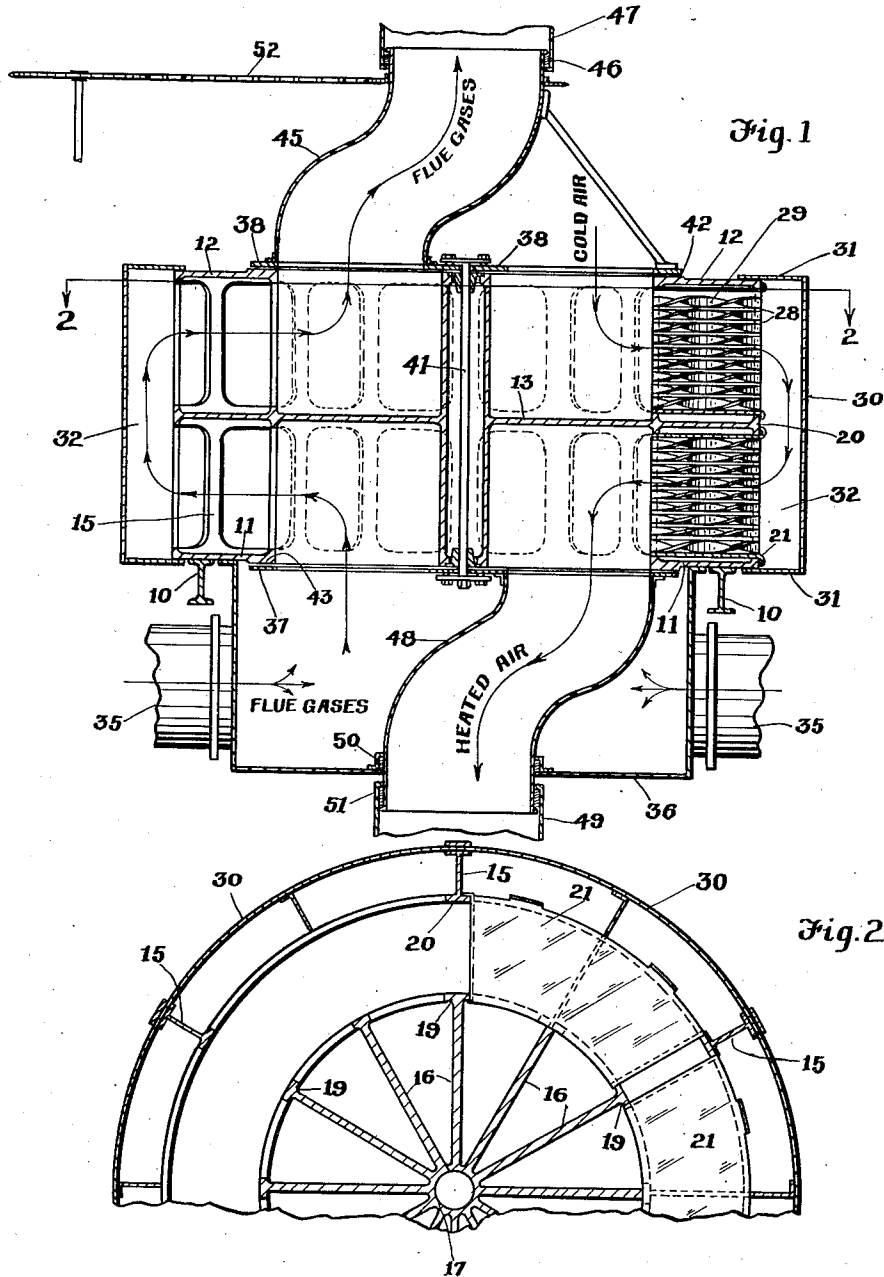
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FURNACE HEAT EXCHANGE APPARATUS

Filed Aug. 10, 1925

2 Sheets-Sheet 1



WITNESSES

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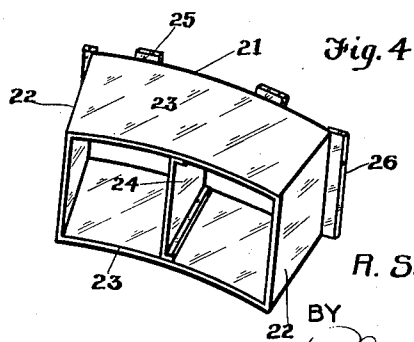
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FURNACE HEAT EXCHANGE APPARATUS

Application filed August 10, 1925. Serial No. 49,255.

This invention relates to furnace air preheaters and particularly to a preheater of the type shown in my co-pending application Serial No. 49,256.

5 In the preheater of the type shown in my co-pending application, I make use of a stationary substantially cylindrical drum which is positioned with its axis horizontally disposed and has radial partitions forming passages through the drum which contain heat exchange material. A valve mechanism rotatable about a horizontal axis connects the passages through the drum with the various furnace gas and air flues to permit an exchange of heat between the heated gases and the cold air.

Such a construction is not always well suited for a furnace room which has limited space horizontally but plenty of space vertically, and it is one object of my invention to so construct and arrange a furnace preheater that it may be built into the furnace stack or arranged above a furnace or otherwise so positioned as to use the minimum of floor space and make use of the vertical space adjacent the furnace.

It is also a further object to so construct and arrange the parts of a device of this type that the heat exchange material may be readily withdrawn through the vertical side wall of the casing without interfering with the operation of the device.

Other objects and advantages will be readily apparent to one skilled in the art in view of the following disclosure.

In accordance with my invention, I provide a stationary casing having passages therethrough so arranged that heated gases and cold air may flow in a substantially vertical direction through the casing, and I so arrange the parts that the heat exchange material may be readily removed for cleaning without interfering with the operation of the apparatus. A suitable valve mechanism which is preferably rotatable is provided to connect the heated gas and cold air flues alternately with the passages through this casing, and this mechanism is arranged to rotate preferably about a vertical axis.

Referring to the drawings which illustrate one embodiment of my invention,—

Fig. 1 is a vertical section partly in elevation showing somewhat diagrammatically a construction embodying this invention; 55

Fig. 2 is a section partly broken away and partly in elevation on the line 2—2 of Fig. 1;

Fig. 3 is a perspective view of the casing tipped over onto a horizontal axis and having various parts removed for the sake of clearness of illustration; 60

Fig. 4 is a perspective view of one of the removable box structures arranged to carry the heat exchange material;

Fig. 5 is a plan view of one of the rotary valve plates; and 65

Fig. 6 is a vertical elevation of the same valve plate.

Referring to the drawings, I have there shown a casing or drum which is substantially cylindrical in shape and is arranged to be mounted with its ends in horizontal planes. In order to hold heat exchange material therein and permit its removal laterally of the casing, I so arrange the parts that the gases may flow substantially horizontally through the heat exchange material, but in a generally vertical direction. To this end I arrange two series of boxes of heat exchange material, one above the other, and provide partitions and connecting passages which cause the gases to pass from the center radially of the drum through one series of boxes, thence vertically through a passage near the periphery of the drum and finally inwardly and radially through the other set of boxes to the valve mechanism which conducts the gases to the proper flues. As illustrated, I provide a central partition in the casing so arranged that boxes of heat exchange material may be mounted above and below this partition and removed laterally through the sides of the casing. Rotary valve plates are mounted one above and the other below the casing and these have openings therethrough arranged to connect on one side with passages in the casing and on the other with revolvable pipes which have their outer ends concentric with the drum and are so arranged that the pipes may revolve about the axis of 100

the drum. The valve pipes are connected with the furnace gas and air flues, so that heated furnace gases and cold air may pass through the casing alternately and successively in contact with the heat exchange material.

The stationary drum comprises two annular portions 11 and 12 between which is located a partition 13 extending substantially through the center of the drum. This forms a drum which is open at its ends and is closed centrally. These parts are connected together by I-beams 15 (Fig. 3). Radial partitions 16 are located in the two compartments formed on opposite sides of the central partition 13, these radiating from a hollow hub-portion 17 which is provided for the passage of a shaft intended to connect the rotary valve plates.

The radial partitions do not extend to the peripheries of the rings 11 and 12 and of the central partition 13 but stop at the flanged portions 19. It will be noted that there are six of the I-beams 15 and twelve of the partitions 16 shown in the drawings, hence the opening between two adjacent I-beams communicates with two spaces between adjacent sets of partitions 16. Each opening between the I-beams and the peripheries of the rings and the central partition is surrounded by a flange 20 arranged to support a container carrying the heat exchange material.

The heat exchange elements are disposed in the space between the flanges 19 and 20 and for the sake of convenience in assembling they may be placed in a box 21 as illustrated in Fig. 4 which is shaped to fit this particular space. This box is open-ended and has side walls 22 and other side walls 23. The side walls 23 are connected by a partition 24 to form two separated passages, the walls 22 and partitions 24 forming continuations of the radial partitions 16 in each space. This box 21 has projecting lugs and flanges 25 and 26 adapted to rest on the flanged portion 20 of the drum casing, the opposite edges of the box resting on the flange 19.

The heat exchange elements may be made of suitable material such as alternately arranged flat strips 28 and twisted metal pieces 29 which extend radially of the supporting box 21 in such a manner as to provide substantially horizontal passages for the cold air and heated gases.

Suitably fastened across the tops of the I-beams 15 are the peripheral cover plates 30 which have inwardly extending side portions 31 arranged to cooperate with the rings 11 and 12 in such a way as to form a passage 32 which communicates with the spaces in the heat exchange boxes on each side of the central partition 13. It will therefore be seen that any gas or air which enters one end of the drum between the partitions 16 must turn when it strikes the central partition 13, and

pass radially out through the heat exchange elements in their boxes 21 and into the vertical passage 32, thence around the end of the central partition 13 and back through the heat exchange boxes in the other half of the casing and thence between the radial partitions and outwardly from the drum, as indicated clearly by the arrows in Fig. 1.

In order to provide a valve mechanism to transmit the gases and air to the casing in the proper order, I utilize a construction which comprises revoluble pipes arranged to connect the passages between the partitions 16 alternately with cold and hot gas flues. As illustrated, the flue gases may enter through pipes 35 into the space within a casing 36 which is supported below the drum. Rotary valve plates 37 and 38 are mounted at the bottom and top respectively of the drum casing. These plates, which are provided with openings 39 and 40, shown in Fig. 5, are connected together by a shaft 41 passing through the hollow hub portion 17 and suitably mounted in bearings within the hub. The upper plate 38 is supported on the bearing surfaces 42 formed on the top side of the outer wall 12 and the lower plate is suspended by the shaft 41 in sliding contact with a bearing surface 43 on the under wall of the drum. Any suitable bearing supports may, however, be provided for these rotary plates. Since the two plates are bolted to the central shaft 41, they must revolve together.

The exit pipe 45 for the flue gases is suitably supported on the top plate 38 and communicates through a bearing 46 with the uptake flue 47. The upper end of the pipe 45 is circular in cross section and arranged to revolve in the bearing 46, while the lower end of the pipe is shaped to fit and to be suitably connected to the peripheral wall of the larger opening 39 in the top plate 38, whereby the pipe may revolve about the axis of the drum and of the concentric pipe 47 while the end connected to the valve plate 38 sweeps successively across the open passages between the partitions 16. The heated air pipe 48 is similarly shaped and connected with the larger opening in the lower rotary plate 37 in such a manner as to transmit the heated air from the drum to the downtake air flue 49 which leads to the furnace stoker. This pipe 48 passes through an opening in the lower wall of the casing 36 which has suitable bearings 50 therein arranged to prevent the escape of gases through the joint. The end of the pipe also projects into a suitable bearing stuffing box 51 in the upper end of the pipe 49. These pipes and valve plates are arranged to be rotated by any suitable power driving mechanism such as the chain and sprocket drive 52 suitably connected to the upper pipe 45. The smaller opening 40 in the upper plate connects directly with the external atmosphere whereby cold air may

be admitted to the heat exchange elements. The smaller opening in the lower plate 37 communicates with the space within the casing 36 whereby the heated flue gases coming from the furnace through pipe 35 may enter the heat exchange boxes and transmit their heat thereto.

It will now be clear that in this type of preheater the flue gases introduced through the pipe 35 into the casing 36 pass upwardly through one of the openings in the plate 37 into about one half of the passages between the partitions 16 and thence horizontally outwardly through the heat exchange material in the box 21 and into the passage 32 between the beams 15. There the gas turns and passes over the central partition wall 13 and back through the second set of heat exchange elements, through the pipe 45 and the uptake flue 46. The cold air similarly travels downwardly, as indicated by the arrows in Fig. 1, through the two parallel sets of heat exchange boxes and into the heated air flue 49. By rotating the valve mechanism slowly the hot gases will pass through the heat exchange boxes for a sufficiently long time to permit them to give up the major portion of the stored heat. When the valve changes the path of the gas current the cold air rushes in and absorbs the heat thus temporarily stored in the metal strips 28 and 29.

The partitions 16 of the drum, the walls 23 of the boxes and the I-beams 15 define the radial passages and prevent the hot gases being short circuited into the cold air flue, and vice versa. Also, the plates 37 and 38 have blank portions 55 of such size and shape that as the valve plate sweeps across the two adjacent passages between the radial partitions, there can be no short circuiting of gas from one passage to the next. The boxes may be easily removed for cleaning purposes by removing the plates 30 and drawing the box out radially of the casing. By replacing the cover plate 30, the preheater may be continued in operation without interruption while the heat exchange material is being cleaned. If desired, extra boxes of cleaned material may be kept on hand to replace boxes which are removed for cleaning.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Heat exchange apparatus comprising a stationary casing, compartments in said casing having openings in a vertical wall, heat exchange material removably positioned in said compartments and withdrawable through said openings, and continuously rotatable valve mechanism arranged to transmit heated and cold gases alternately and successively through said heat exchange material.

2. Heat exchange apparatus comprising a stationary cylindrical casing having its axis

arranged vertically and having openings through its peripheral wall, partitions in the casing forming passages therethrough, heat exchange material removably positioned in said passages and withdrawable through said openings, and means including a continuously rotatable valve mechanism arranged to transmit heated and cold gases alternately and successively to said passages and the heat exchange material therein.

3. Heat exchange apparatus comprising a stationary casing having openings in its top and bottom, walls forming passages through the casing which communicate with the openings, heat exchange material located in the passages, and rotary valve mechanism arranged to connect supplies of heated and cold gases alternately and successively with the openings to admit the gases simultaneously to different passages for effecting a heat exchange therebetween, said heat exchange material comprising a series of metal elements disposed radially to the axis of rotation of said rotary mechanism.

4. Heat exchange apparatus comprising a stationary casing having openings in its top and bottom, radially disposed partitions and walls defining passages between said openings, heat exchange material therein, means above and below the casing for supplying heated and cold gases, and a rotary valve mechanism arranged to connect said passages alternately and successively with the heated and cold gas supplies.

5. Heat exchange apparatus comprising a stationary casing having openings in its top and bottom, partitions and walls forming passages therebetween, heat exchange material in the passages, a rotary valve mechanism above and another below the casing having openings communicating with the passages in the casing and flues cooperating therewith to transmit heated and cold gases successively and alternately to the passages for effecting a transfer of heat therebetween.

6. Heat exchange apparatus comprising a casing having a central partition forming two substantially cylindrical spaces, radial partitions cooperating therewith to form sector like passages on each side of the central partition, said casing having openings in its top and bottom communicating with the sector passages, means forming communications between the sector passages around said central partition, heat exchange material in said passages, and valve mechanism arranged to transmit heated and cold gases alternately and successively to said passages for effecting a transfer of heat therebetween.

7. Heat exchange apparatus comprising a cylindrical casing having its axis arranged substantially vertically and having openings in its top and bottom and in its periphery, a centrally disposed horizontal partition located between the ends of the casing, radial

partitions forming sector like passages through the casing on opposite sides of said central partition, means forming vertical passages communicating with the sector passages around the outside of the said central partition, heat exchange material within the casing, and a valve mechanism arranged to transmit heated and cold gases alternately through the passages in the casing.

8. Heat exchange apparatus comprising a substantially cylindrical casing having openings in its top and bottom ends, a series of radial partitions and a central horizontal partition forming sector like spaces in the casing, walls forming vertical passages communicating with the ends of the sector like passages, heat exchange material removably mounted in said sector like passages, and valve plates and pipes communicating therewith which are rotatably mounted to transmit heated and cold gases alternately to the sector like passages to effect a heat exchange therebetween.

9. A furnace air preheater comprising a cylindrical casing having openings in its top and bottom walls for the passage of gas therethrough and openings in its vertical peripheral wall, partitions within said casing forming passages communicating with the openings in the top and bottom of the casing, heat exchange material withdrawable through the openings in the peripheral wall and located in said passages, and valve mechanism comprising valve plates and revoluble pipes above and below the casing, said plates, pipes and partitions within the casing being so constructed and arranged that heated gas and cold air may be passed alternately through heat exchange material within said casing to effect a heat exchange therebetween.

10. A regenerative heater comprising a stationary cylindrical casing divided internally into a plurality of separated radial passages, heat absorbing material within said passages, and a rotatable valvular device having channels therein positioned to selectively and successively conduct a hot gas and a gas to be heated to and away from said passages.

11. A regenerative heater comprising a casing divided internally by partitions into a plurality of substantially U-shaped passages, regenerative material disposed within said passages, means for selectively passing a hot gas and a gas to be heated through said material comprising a valvular device having channels therethrough arranged to communicate with the ends of said passages, and movable about an axis to communicate with different passages.

12. A regenerative heater comprising a casing, an annulus of regenerative material within said casing, means for selectively feeding hot gases and gases to be heated to said annulus, said means and said annulus being relatively rotatable, and partition means in

said casing defining gas flow channels for successively passing gases through said annulus a plurality of times.

13. A regenerative heater comprising a casing, an annulus of regenerative material within said casing having radial passages therethrough, means for selectively supplying gaseous heat exchange mediums to successive groups of said passages, said means and said annulus being relatively rotatable, and partition means positioned to define in cooperation with the walls of said casing gas flow channels connecting different groups of passages in series, whereby gas passing through one group is redirected to pass through another group.

14. A regenerative heater comprising a casing, an annulus of regenerative material within said casing having radial passages therethrough, means for selectively feeding a hot gas and a gas to be heated to said passages, means for selectively discharging said gases, said feeding and discharge means and said annulus being relatively movable about an axis, and partition means cooperating with said passages and positioned to direct the gases through said annulus a plurality of times in opposite radial directions.

15. A regenerative heater comprising a casing, an annular mass of regenerative material within said casing having a plurality of radial passages therethrough, means for selectively feeding a hot gas and a gas to be heated to successive groups of said passages, for flow therethrough, partition means to redirect said gases after flow through said first mentioned groups through other groups of said passages and means for selectively discharging said gases.

16. A regenerative heater comprising a casing, regenerative material annularly positioned in said casing, partitions dividing said material into separated portions, flow passageways in said casing for conducting gases through selected portions in series, an outlet for a gas to be heated, an outlet for a gas to be cooled, and flow control means relatively movable with respect to said flow passageways and successively communicating said flow passageways alternately with a gas to be heated and a gas to be cooled, and with said outlets.

Signed at Worcester, Massachusetts, this 24th day of July, 1925.

R. SANFORD RILEY.