March 2, 1948. F. M. WOLF 2,437,144

FLUID COOLED FOUR-WAY VALVE

Filed Aug. 21, 1944

Fig. 1.

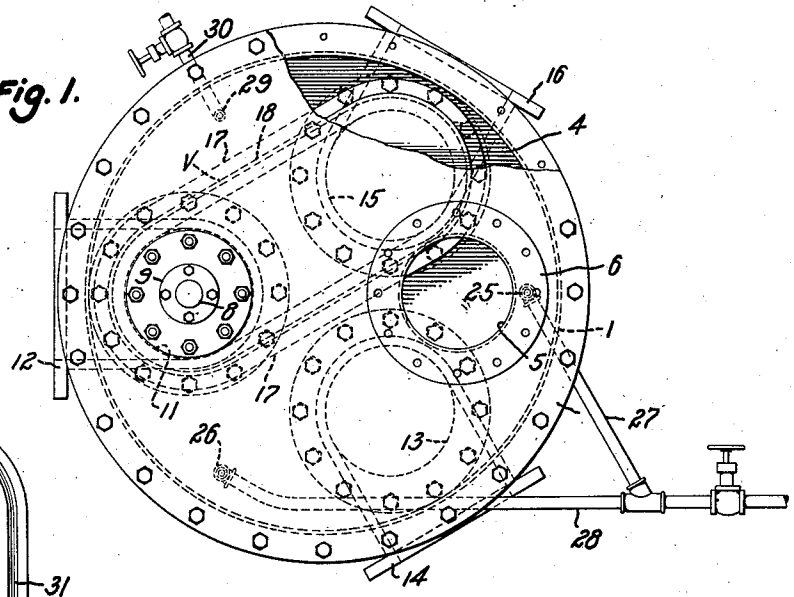


Fig. 3.

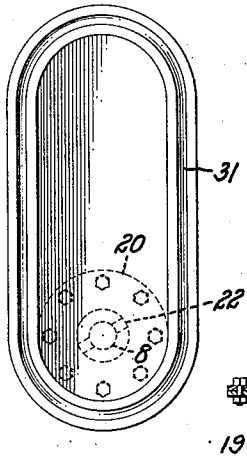


Fig. 2.

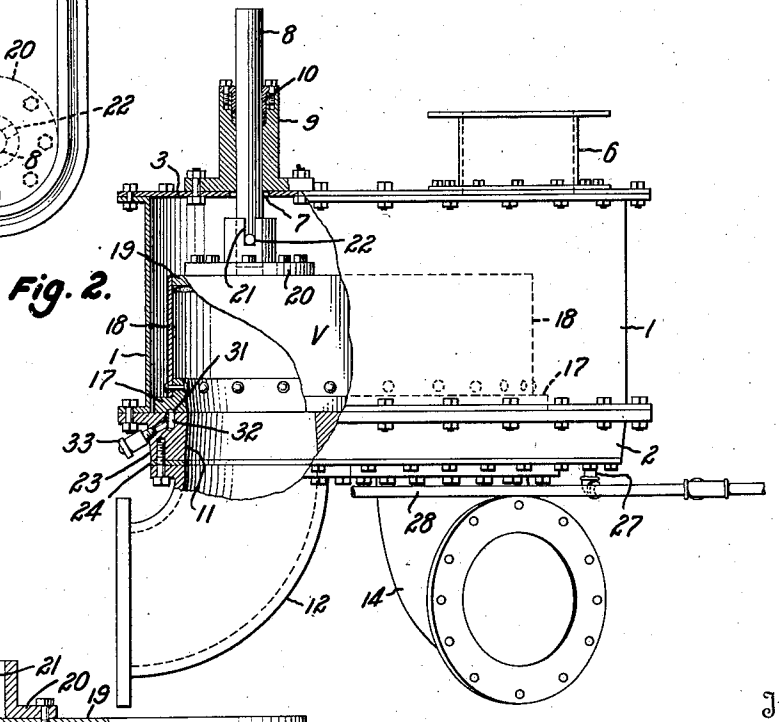
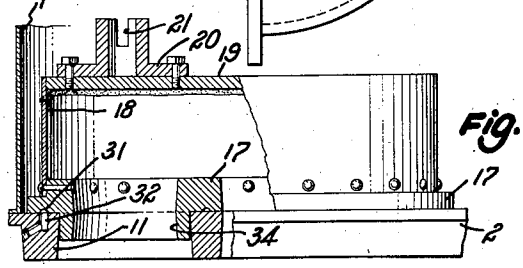


Fig. 4.



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FLUID COOLED FOUR-WAY VALVE

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1 Claim. (Cl. 251—87)

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This invention relates to reversing valves for regenerating and similar furnaces, and is particularly concerned with the provision of a four-way valve for use in a nitric oxide furnace system such, for instance, as those described in U. S. application Serial No. 464,072, filed October 31, 1942, by Frederick G. Cottrell, now Patent 2,422,081, June 10, 1947, and in U. S. application Serial No. 498,896, filed August 16, 1943, by Farrington Daniels and William G. Hendrickson jointly with the present applicant, now Patent 2,421,744, June 10, 1947.

In a preferred embodiment of the invention the pressure chamber is a substantially vertical, substantially cylindrical, closed vessel the inside surface of the bottom of which is a horizontal plane surface constituting the aforesaid valve seat. Resting on the valve seat is an inverted trough-like member which is pivotally connected adjacent one end thereof to the top closure of the vessel through a shaft fixed to the trough-like member and journaled in said closure, which end overlies one of three ports provided in the bottom. The two remaining ports are equidistant from the first mentioned valve seat port. The trough-like member also overlies, adjacent its opposite end, one of the two remaining valve seat ports and couples the two ports so overlaid. The top closure of the vessel is provided with an inlet port in permanent communication with the pressure side of an air compressor or blower.

The under-surface of the valve seat member is webbed by projecting annular portions of the latter about the ports and about the periphery of said member, to which projecting annular portions there is attached a plate which co-operates with the valve seat member and its projecting annular portions to define a closed space. Pipe connections, let into said plate, are provided for circulating a fluid coolant through said closed space.

The invention will now be described in greater particularity, with reference to the accompanying drawing, in which

Fig. 1 is a plan view of the preferred form of the valve according to the present invention, with a portion of the cover plate broken away;

Fig. 2 is a sectional side elevation of the valve shown in Fig. 1, the portions broken away disclosing features of the interior construction of the valve;

Fig. 3 is a bottom plan view of the valve member of the device, and

Fig. 4 is a fragmentary sectional view similar to Fig. 2 but illustrating a modification of the valve construction.

In the drawing, 1 represents a substantially vertical, substantially cylindrical, flanged shell to which a valve seat member 2 and a cover plate 3 are bolted to provide a pressure chamber. Valve

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seat member 2 is of cast metal, and its upper surface 4 is machined to a plane surface. Parts 1 and 3 are of sheet steel, of suitable gauge.

Cover plate 3 is provided with an opening 5 which co-operates with a flanged nipple 6, bolted to cover plate 3, to provide an inlet port to the pressure chamber. The inlet port communicates, through suitable conduit, with the pressure side of an air compressor (not shown). Said cover plate 3 is provided also with an opening 7 for the admission of a shaft 8 into said pressure chamber. 9 is a bearing member bolted to a cover plate 3 in alignment with opening 7, in which bearing member shaft 8 is rotatably held. 10 is a conventional stuffing gland making gas-tight the connection between bearing member 9 and shaft 8. Shaft 8 is in axial alignment with the exhaust port of the valve, which exhaust valve will be described in the following paragraph.

Valve seat member 2 is provided with three spaced openings 11, 13 and 15 which openings co-operate with bolted-on elbows 12, 14 and 16, respectively, to provide three spaced ports in said valve seat member 2. Port 11, 12 is said exhaust port. Ports 13, 14 and 15, 16 are substantially equidistant from exhaust port 11, 12. One of the ports, 13, 14 and 15, 16 is adapted to be connected by suitable conduit to one end of a nitric oxide furnace (not shown), and the other of said ports is adapted to be connected to the opposite end of such furnace, to form a closed system including said pressure chamber and such furnace.

Resting on the plane surface of valve seat member 2 is an inverted trough-shaped valve member V. This latter essentially consists of a cast metal seating flange 17 of elongated form and of a size sufficient to extend from port 11, 12 to either port 13, 14 or port 15, 16, the seating bottom surface being machined to make a substantially gas-tight fit against the plane surface of member 2 and the ends being of semi-circular form to conform to said ports, an elongated endless band 18 of sheet metal riveted to member 17, and a similarly elongated top closure member 19 welded to band 18, these three elements co-operating to define a gas-tight inverted trough, which trough in turn co-operates with the upper plane surface of valve seat member 2 to define a passageway between either port 13, 14 or port 15, 16 and exhaust port 11, 12. Flanged element 20 is a tubular socket member bolted onto the top of top closure member 19 adjacent one end of the latter and axially aligned with exhaust port 11, 12. The tubular socket is adapted to receive the lower end of shaft 8, and the upper portion of the tubular socket is provided with a slot 21 for the reception of a pin or offstanding projection 22 carried on shaft 8 adja-

cent the lower end of the latter. When shaft 8 is in place in tubular socket 20 with pin 22 engaged in slot 21, the valve member V is pivotally connected to the pressure chamber, with one end over exhaust port 11, 12, and may be so slid or rotated—by suitable rotation of shaft 8 in bearing member 9—about this pivotal connection as to overlie either port 15, 16 (as shown in the drawing) or port 13, 14.

The lower or under surface of valve seat member 2 is webbed by reason of the projecting annular portions of the casting about openings 11, 13 and 15 and the outer projecting annulus 23. A metal plate 24, provided with three apertures coinciding with the three openings 11, 13 and 15, is bolted to these webbing elements to co-operate with the latter to provide an enclosed space at the bottom of the valve seat member 2. Plate 24 is provided also with two smaller threaded openings 25 and 26, into which are received pipe connections 27 and 28 for the introduction of fluid coolant (e. g., cooling water) into said enclosed space, and with a third smaller threaded opening 29, into which is received valved pipe connection 30 for the removal of fluid coolant from said space. Coolant admitted into the enclosed space beneath valve seat member 2 fills the space and contacts the under surface of member 2; the rate of flow of coolant through the space may be adjusted by the setting of the inlet and outlet valves.

For lubricating the seating surface of valve member V I may and prefer to provide a groove 31 in the bottom surface of seating flange 17 and a grease channel 32 in valve seat member 2, communicating at its inner end with groove 31, and to attach a pressure grease fitting 33 at the outer end of channel 32. By these cooperating means lubricating grease may be forced into and about groove 31 and between the seating surface of flange 17 and the upper surface of member 2.

As shown in Fig. 4, I may modify flange 17 to provide adjacent the pivoted end of the latter a depending annular collar 34 of such size and configuration as to fit loosely within opening 11. Opening 11 and collar 34 are in axial alignment with shaft 8. Collar 34 serves to stabilize the functioning of member V in pivoting over opening 11, and also to relieve strain on shaft 8, in the case where member V is very large.

In use, valve member V tends to remain in gas-tight co-operation with the upper surface of valve seat member 2 not only by reason of its weight but also by reason of the gas pressure obtaining in the surrounding portions of the pressure chamber, which gas pressure is always in excess of the gas pressure obtaining within the inverted troughlike valve member V. When valve member V is in the position shown in the drawing, air under pressure enters the pressure chamber through opening 5 from a source of compressed air, flows out of the pressure chamber and to the furnace through port 13, 14, returns

to the pressure chamber from the furnace (after being thermally treated for the production of nitric oxide therein) by way of port 15, 16 into the passageway provided by valve member V, and is exhausted from the valve through exhaust port 11, 12. Upon rotation of shaft 8, which operation can be effected either manually or mechanically, the nonpivoted end of valve member V is caused to overlie port 13, 14 whereupon the course of the air is modified to the extent that the air passes to the furnace by way of port 15, 16 and returns to the interior of valve member V by way of port 13, 14.

I claim:

The reversing valve mechanism comprising, in combination, a pressure chamber, defined by a housing provided with an inlet port, and a co-operating substantially horizontal plane surfaced valve seat member provided with three ports opening from below, one of said valve seat ports being an exhaust port equidistant from the other two valve seat ports; within said chamber and spaced from said housing a substantially horizontally oscillatable valve member supported upon said valve seat and pivotally connected adjacent one end thereof to a part of said pressure chamber to provide in co-operation with said valve seat a passageway which is in permanent communication with said exhaust port and which is adapted to be in communication with either one of the two remaining valve seat ports; and means for oscillating said valve member about its pivot and in contact with said valve seat to bring said valve member into communication with first one and then the other of the two remaining valve seat ports and thereby to couple first one and then the other of the latter with said exhaust port, additionally characterized in that the under-surface of the valve seat member is webbed by projecting annular portions of said member about said ports and about the periphery of the member, in that there is attached to said projecting annular portions a plate member cooperating with said valve seat member and its projecting annular portions to define a closed space, and in that there are provided means for circulating a fluid coolant through said closed space.

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