

Aug. 31, 1965

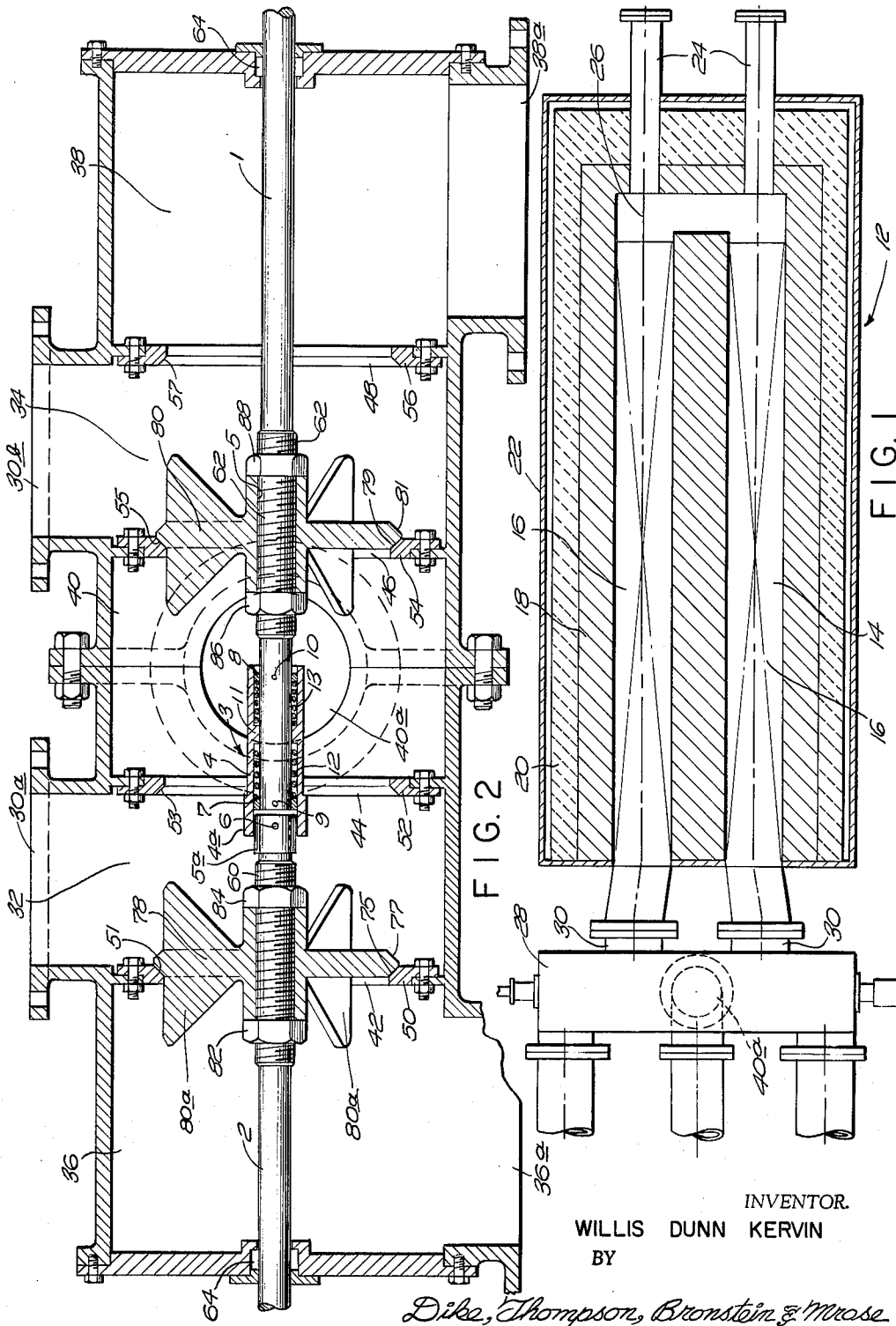
W. D. KERVIN

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VALVE CONTROL MECHANISM

Filed Dec. 27, 1962

2 Sheets-Sheet 1



INVENTOR.
WILLIS DUNN KERVIN
BY

Dike, Thompson, Bronstein & Morse
ATTORNEYS

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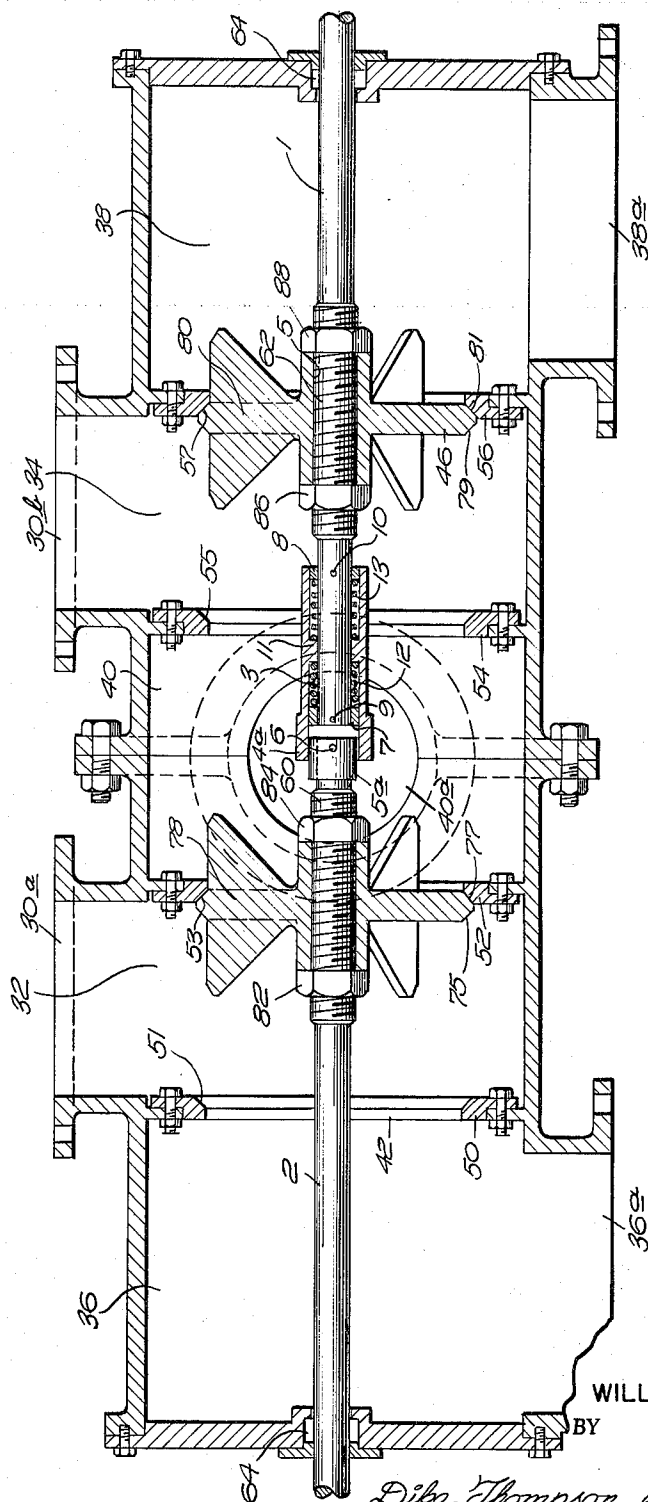


FIG. 3

INVENTOR.
WILLIS DUNN KERVIN

BY

Dike, Thompson, Bronstein & Morse
ATTORNEYS

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VALVE CONTROL MECHANISM

Willis Dunn Kervin, Johnson City, Tenn., assignor to Carbonic Development Corporation, Johnson City, Tenn., a corporation of Delaware

Filed Dec. 27, 1962, Ser. No. 247,565

5 Claims. (Cl. 137—309)

The present invention relates to a valve control mechanism for reversing the direction of flow of fluid through a furnace, particularly a regenerative furnace, at periodic intervals. More particularly, the invention relates to an improvement over the valve control mechanism described and shown in U.S. Patent No. 2,737,970 which requires four separate valve discs, floatingly mounted on an actuating rod, and a plurality of bellows, which function as seals. Such bellows have proved to be troublesome because they tend to break due to fatigue caused by continuous flexing. This destroys the seal provided by such bellows and causes fluid leakage. Furthermore, the bellows are apt to cock the valve discs to thereby interfere with proper sealing. The four valve discs cooperate with four axially aligned valve seats to control fluid flow through five ports of the mechanism, i.e., two inlet ports, two delivery ports and one outlet port.

The valve control mechanism of the present invention eliminates the necessity of such bellows and is more rugged, has a longer life, requires less repair and is much simpler, easier and inexpensive to make, than the mechanism described in the above patent, with fewer parts. Thus, the mechanism of the present invention has only two valve discs instead of four and there are no leakage paths past the closed valves, which require bellows type seals, as in the case of the mechanism shown in the patent.

Other advantages and objects of the invention will be apparent from the following drawings in which:

FIG. 1 shows an embodiment of the valve control mechanism of the present invention in combination with a regenerative furnace, the furnace being shown in section.

FIG. 2 is an enlarged view in section of the valve control mechanism with the valve discs in positions for fluid flow in one direction through the furnace.

FIG. 3 is a view like FIG. 2 except that the valve discs are shown in positions for fluid flow through the furnace in a direction opposite from FIG. 2.

With reference to the drawings, 12 represents a regenerative furnace which has a hair-pin type chamber 14 through which fluid is directed. Positioned within each of the legs of chamber 14 is a mass 16 of heat regenerative material for storing and giving up heat, e.g., alumina or silicon carbide, and having fluid passages therethrough, e.g., staggered rows of circular, linear and parallel passages. Such masses are shown diagrammatically in FIG. 1. Chamber 14 is surrounded by a high temperature fire resistant refractory material 18 and an insulating brick material 20 which also serve as the sustaining walls.

A gas sealing metallic shell 22 surrounds the sustaining wall 20. Burners 24 connected with reaction space 26 of chamber 14 between the ends of the two heat regenerative masses 16 are used to raise the temperature of the furnace to the desired operating range, whereupon they are shut off. The fluid valve control mechanism 28 is communicably connected with the ends of the hairpin chamber 14 by conduits 30 to reverse the flow of fluids through such chamber at periodic intervals.

The fluid valve control mechanism 28 comprises a first valve housing 32 having a delivery port 30a in communication with one of the conduits 30, and a second valve housing 34 spaced from said first valve housing 32 and in alignment therewith and having a delivery port 30b in communication with the other conduit 30. A first fluid

chamber 36, having an inlet port 36a, is positioned adjacent to and in alignment with the first valve housing 32 on the side most removed from the second valve housing 34. A second fluid chamber 38, having an inlet port 38a, is positioned adjacent to and in alignment with the second valve housing 34 on the side most removed from the first valve housing 32. Positioned between valve housings 32 and 34 and in alignment therewith is a third fluid chamber 40 having an outlet port 40a. The walls of the valve housings and fluid chambers may be made from any suitable material, preferably of a metallic nature. Aligned valve ports 42, 44, 46 and 48 are positioned between each valve housing and its adjacent fluid chambers and have positioned therein valve seat members 50, 52, 54 and 56, having tapered seating surfaces 51, 53, 55 and 57. The valve seat members may be made from any suitable metallic material, preferably of a bronze alloy.

Extending substantially through the center of the aligned valve ports are two axially aligned actuating rod members 1 and 2, having spaced threaded portions 60 and 62 and being connected, the substantially centrally located end of 1 with the substantially centrally located end of 2, by the spring-loaded coupling 3. The rods are slidably journaled in bearing members 64 positioned on opposite side walls of the valve control apparatus and may be reciprocated in their bearings by any desired power actuating means (not disclosed). Valve discs 78 and 80 are situated approximately midway on each threaded portion 60 and 62, respectively, each unthreaded inside cylindrical bore surface 5 of valve discs 78 and 80 having been machined to fit tightly over the threads of threaded portions 60 and 62 respectively and locked in place on the threaded portions by nuts 82, 84, 86 and 88 threaded over the threaded portions. The valve discs may be made of any suitable material but are preferably of a bronze alloy of sufficiently different composition than the valve seats to prevent seizing. Each valve disc has three integral guide wings 80a spaced 120° apart.

Valve disc 78 has opposite tapered seating surfaces 75 and 77 adapted to alternately nest with the tapered seating surfaces 51 and 53 of the valve seats 50 and 52, respectively, depending upon the direction in which the rods 1 and 2 have been reciprocated. Similarly valve disc 80 has opposite tapered seating surfaces 79 and 81 adapted to alternately nest with the tapered seating surfaces 55 and 57 of the valve seats 54 and 56, respectively, depending upon the direction in which the rods 1 and 2 have been reciprocated. Seating surface 79 engages surface 55 just subsequent to the engagement of surface 51 by surface 75 upon reciprocation of rods 1 and 2 to the left as described hereafter; surface 81 engages surface 57 just subsequent to the engagement of surface 53 by surface 77 upon reciprocation of rods 1 and 2 to the right as described hereafter.

This sequential closing action of two valve ports, one slightly after the other, by singular movement of the rods 1 and 2 is provided by the resilient coupling 3 between the ends of rods 1 and 2. This coupling consists of a sliding cylinder 4, whose only fixed connection is to rod 2 through its connection to the enlarged collar 5a, which is fixed firmly to rod 2 and is received within an enlarged end of the cylinder 4. Collar 5a and cylinder 4 are firmly fixed to the rod 2, for example by tapered pin 6 which extends through rod 2, collar 5a and cylinder 4 and whose ends are peened to prevent dislocation. Collar 5a can be integral with rod 2. The inner surface of cylinder 4 slides axially over the machined outer surfaces of collars 7 and 8, which are firmly pinned, for example by pins 9 and 10, respectively, to an end portion of rod 1 slidably received within the cylinder with the outer surfaces of collars 7 and 8 in slidable but close fitting contact with

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the inner surface of cylinder 4 and with collars 7 and 8 located on opposite sides of the centrally located, thickened wall portion 11 of cylinder 4.

To insure smoothness of traverse of the machined inner surface of cylinder 4 over the machined outer surfaces of collars 7 and 8, pins 9 and 10 can be slightly shorter in length than the outside diameter of collars 7 and 8, respectively, so that the ends of the pins can be driven below the outside surfaces of the collars 7 and 8. The remainders of the pin channels in the collars 7 and 8 can then be filled with metal, for example, with an electric welding device; any protruding metal can then be buffered to make the surfaces of the collars 7 and 8 in the area of pin location smooth for effective sliding of the inner surface of cylinder 4.

Between 7 and the thickened portion 11 of cylinder 4 and between collar 8 and portion 11 are springs 12 and 13, respectively. Each spring is of suitable strength so that when rod 1 is pushed to the left, spring 13 will transmit thrust from collar 8 to portion 11, which being part of cylinder 4 connected through pin 6 to rod 2, will push valve disc 78 toward valve seat 50 until the disc surface 75 engages seat surface 51. At the same time valve disc 80 is pushed toward, but not into engagement with, seat surface 55, the two valve discs moving together through the spring coupling. The force to firmly engage disc surface 75 against seat surface 51 and thereby seal the valve port 42 is transmitted through spring 13 during its compression as rod 1 continues to advance to the left within and with respect to cylinder 4, which is prevented from further movement to the left due to engagement of disc surface 75 with seat surface 51. Rod 1 completes its travel to the left, as aforesaid, to compress the spring 13 and provide the aforementioned firm engagement of seat surface 51 by disc surface 75 of disc 78 held firmly in place on rod 2 by jam nuts 82 and 84. The completion of such travel brings the disc surface 79 of disc 80 into firm engagement with the seat surface 55 to seal the port 46. In this fashion ports 42 and 46 are closed by a single thrust of rod 1 to the left, port 46 closing just after port 42. At the same time ports 44 and 48 are open to provide fluid flow through the furnace in one direction. This condition of the valve mechanism is shown in FIG. 2.

Similarly, when rod 1 is pulled to the right, spring 12 transmits thrust from collar 7 to portion 11, which pulls valve disc 78 out of engagement with valve seat 50 (to thereby open port 42) toward and into engagement with valve seat surface 53, i.e., the disc surface 77 is brought into engagement with seat surface 53. At the same time valve disc 80 is pulled out of engagement with seat surface 55 (to open valve port 46) toward but not quite into engagement with valve seat surface 57, the two valve discs moving together through the spring coupling. The force to firmly engage disc surface 77 of disc 78 against seat surface 53 to seal port 44 is transmitted through spring 12 during its compression as rod 1 continues to advance to the right with respect to cylinder 4 which is prevented from further movement due to engagement of disc surface 77 with seat surface 53. Rod 1 completes its travel to the right to thereby compress the spring 12 as aforesaid until the disc surface 81 of disc 80 is brought into firm engagement with seat surface 57. In this fashion ports 44 and 48 are closed by a single thrust of rod 1 to the right, port 48 closing just after port 44. At the same time ports 42 and 46 are open to provide fluid flow in an opposite direction through the furnace. This condition of the valve mechanism is shown in FIG. 3. Rod 1 may be considered an actuating rod and rod 2 an actuated rod actuated by rod 1.

To achieve tight closure the distance between seat surfaces 55 and 57 of the portion of the valve closer to the operator (undisclosed power actuating means) should be greater, for example by $\frac{1}{8}$ -inch for a valve of 12-inch internal diameter, than the distance between seat surfaces 51 and 53.

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When the valve discs are in the positions shown in FIG. 2, fluid flows from inlet port 38a through fluid chamber 38, valve housing 34, delivery port 30b, the hairpin chamber 14 in the furnace, delivery port 30a, valve housing 32, fluid chamber 40 and out the outlet port 40a.

When the valve discs are in the positions shown in FIG. 3, fluid flows from inlet port 36a through fluid chamber 36, valve housing 32, delivery port 30a, the hairpin chamber 14 in the furnace (flow through the furnace is reversed as compared to FIG. 2) delivery port 30b, valve housing 34, fluid chamber 40 and out the outlet port 40a.

While the description and drawings illustrate a particular embodiment of the invention the invention is not limited thereto, such invention being limited only by the following claims and equivalent constructions.

I claim:

1. Valve control mechanism comprising housing means having a first, second, third, fourth and fifth chamber and a first and second pair of aligned valve openings, one valve opening of the first pair providing communication between the second and third chambers and the other providing communication between said fourth and fifth chambers, one valve opening of said other pair providing communication between said first and second chambers and the other providing communication between said third and fourth chambers, each of said chambers having a port other than said valve openings, a pair of aligned valve discs, means operably connected to said discs for actuating said discs to close one pair of said openings and open the other pair and to alternately open said one pair and close the other, said last mentioned means comprising resilient coupling means between said valve discs to couple said discs for movement together initially during closing of each pair of openings until one of said discs closes one opening of said pair while the other opening of said pair is still open and for subsequent movement of the other disc with respect to said one disc until said other disc closes said other opening of said pair, said coupling including resilient means, said subsequent movement of said other disc with respect to said one disc acting through said resilient means to apply a resilient closing force to said one disc.

2. Valve control mechanism comprising housing means having a first, second, third, fourth and fifth chamber and a first, second, third and fourth valve opening in two pairs, said valve openings being aligned, one valve opening of one of said pairs providing communication between the second and third chamber and the other providing communication between said fourth and fifth chambers, one valve opening of said other pair providing communication between said first and second chambers and the other providing communication between said third and fourth chambers, each of said chambers having a port other than said valve openings, a pair of aligned valve discs, means operably connected to said discs for actuating said discs in one direction to open one pair of said openings and close the other pair and alternately in an opposite direction to close said one pair and open the other pair, each of said openings having a valve seat, said actuating means comprising an actuated member on which one of said discs is mounted and a second actuating member on which said other disc is mounted, means for resiliently coupling said two members for movement together initially during closing of each pair of openings until said one disc closes one opening of said each pair and for subsequent movement of said actuating member with respect to said actuated member until said other disc closes said other opening of said each pair.

3. Valve control mechanism according to claim 2, said resilient coupling comprising resilient means between said two members, movement of said actuating member acting through said resilient means to move said actuated member together with said actuating member during said initial movement when said actuated member is free to be so moved, said actuating member being moved relative to

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said actuated member against the force of said resilient means during said subsequent movement when movement of said actuated member is arrested by closing of said one opening by said one disc, said relative movement of said actuating member acting through said resilient means to resiliently urge said one disc against the valve seat of said one opening.

4. Valve control mechanism according to claim 3, said coupling comprising a hollow cylinder in one end of which an end portion of said actuating member is slidably received and having a thickened wall portion intermediate its ends forming a pair of opposite shoulders, said end portion of said actuating member extending into said cylinder beyond said thickened portion, the other end of said cylinder being attached to said actuated member, said end portion of said actuating member having a pair of axially spaced collars located on either side of said thickened wall portion, said resilient means comprising a spring biased between one of said collars and one of said shoulders and a second spring biased between the other collar and the other shoulder.

5. Valve control mechanism according to claim 4, the valve seats of one of said pairs of openings facing in a direction opposed to the direction in which the valve seats of the other pair face, said one of said pair of valve discs being located in said fourth chamber and the other in said second chamber, each valve disc having oppositely disposed valve surfaces for cooperating with the two valve

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seats of the two valve openings of the chamber in which said valve disc is located, movement of said valve disc axially in one direction in its chamber by movement of the member on which it is mounted in such one direction moving one of the valve surfaces out of engagement with one valve seat and the other valve surface into engagement with the other valve seat whereas axial movement of said valve disc in an opposite direction in its chamber by movement of said member on which it is mounted in said opposite direction moving said other valve surface out of engagement with said other valve seat and said one valve surface into engagement with said one valve seat, the distance between the valve seats of the valve openings of the chamber containing said one valve disc carried by said actuated member being less than the distance between the valve seats of the valve openings of the chamber containing the other valve disc.

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ISADOR WEIL, *Primary Examiner.*