

Aug. 31, 1937.

H. T. BLOM

2,091,907

PUMPING MECHANISM

Filed July 21 1933

2 Sheets-Sheet 1

Fig. 1.

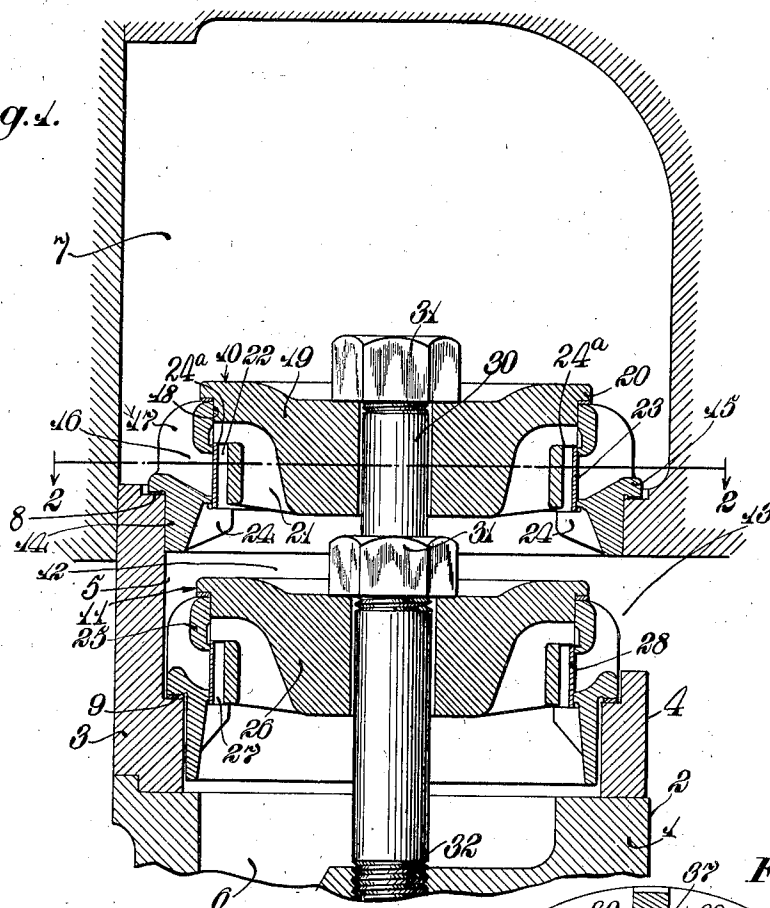


Fig. 2.

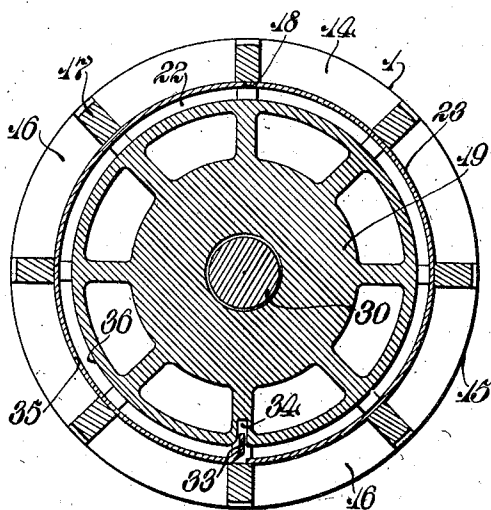
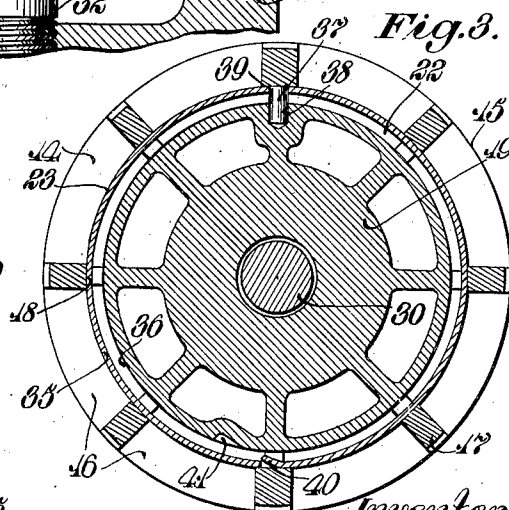


Fig. 3.



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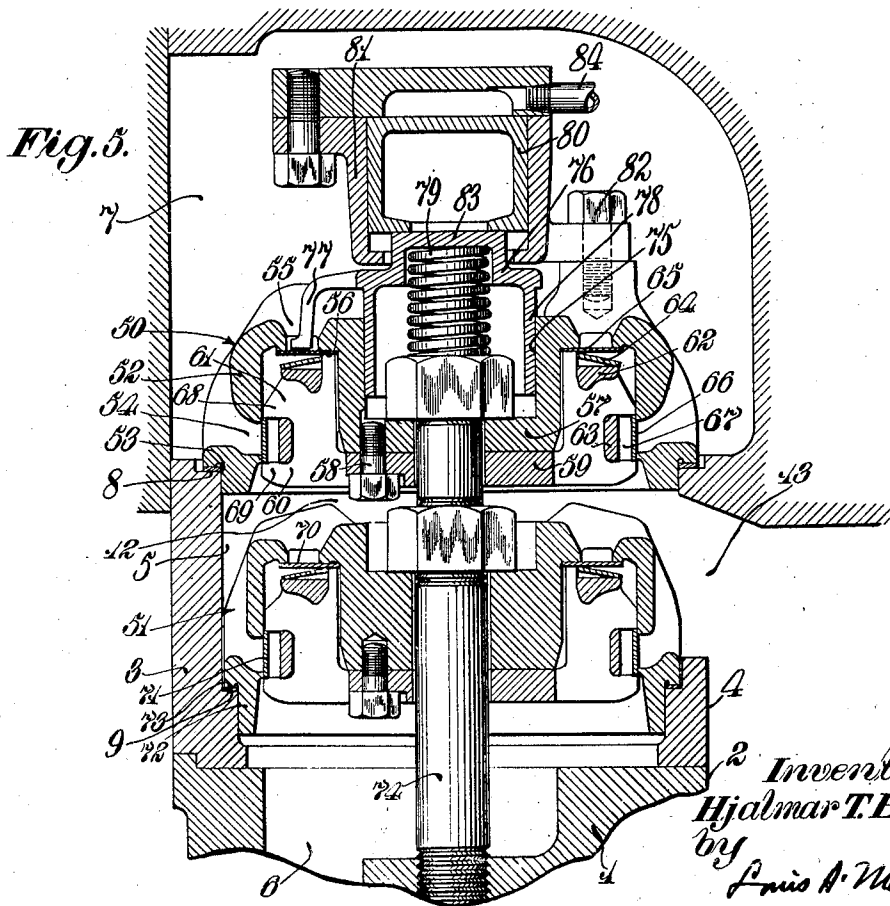
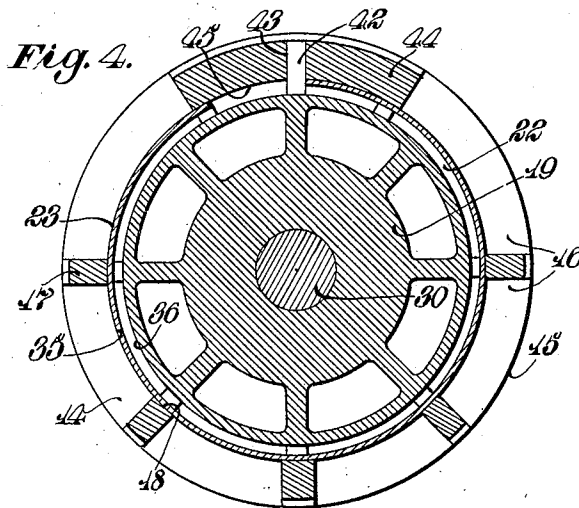
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PUMPING MECHANISM

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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PUMPING MECHANISM

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Application July 21, 1933, Serial No. 681,526

32 Claims. (Cl. 277—21)

This invention relates to valve mechanisms, and more particularly to valve mechanisms especially designed to use in compressors or pumps.

An object of this invention is to provide an improved valve mechanism. A further object is to provide an improved valve mechanism especially designed to use with compressors or pumps, and extremely simple in design and efficient in operation. A further object is the provision of an improved valve mechanism of the combined inlet and discharge type, the inlet and discharge valve structure being arranged in an improved and extremely compact manner. Still another object is to provide an improved valve for such a valve mechanism and improved valve positioning and guiding means. These and other objects will, however, subsequently more fully appear.

In the accompanying drawings there are shown several forms which the invention may assume in practice.

In these drawings,—

Fig. 1 is a sectional view showing one illustrative form of the improved valve mechanism.

Fig. 2 is a cross sectional view taken substantially on line 2—2 of Fig. 1.

Fig. 3 is a view similar to Fig. 2 showing a modified form of valve and valve positioning and guiding means.

Fig. 4 is a view similar to Fig. 2 showing a further modified form of valve and valve positioning and guiding means.

Fig. 5 is a view similar to Fig. 1, showing a still further modified form of construction.

In the illustrative embodiment of the invention shown in Figs. 1 and 2, there is shown a portion of a compressor or pump cylinder, 1, having a bore 2, said cylinder member being provided with a head 3 having a chamber 4 communicating with the bore 2 and constituting an extension of the cylinder bore, or a counterbore. Within the cylinder head is arranged a series of recesses 5 each of which receives one of my improved valve mechanisms, and of which recesses but one is shown. These recesses communicate with a discharge chamber 6 formed in the cylinder and with an inlet chamber 7 formed in the head. Each recess provides coaxial, axially spaced shoulders 8 and 9, and upon these shoulders there are respectively seated an inlet valve mechanism 10 and a discharge valve mechanism 11. These valve mechanisms are almost identical in general design. Between the valve mechanisms there is a chamber 12, communicating, through a lateral passage 13, with the cylinder bore; and fluid flows through the inlet valve mechanism 10,

through this chamber, to the compressor cylinder; and from the compressor cylinder past the discharge valve mechanism 11. It will be obvious that, in a smaller compressor, for example, single inlet and discharge mechanisms may be used for each working end of the compressor cylinder, and that the space relation of the valve mechanisms to the cylinder may be varied to suit the designer.

The inlet valve mechanism 10 comprises an outer annular valve cage member 14 having an annular flange 15 seated on the shoulder 8 and having a series of radially located flow ports 16 separated by vertical ribs 17, and also a cylindrical portion fitting within the chamber 5 adjacent the shoulder 8. Fitting a bore 18 formed in the valve cage member 14 is an inner valve cage member 19 having a radial flange 20 seated on the upper surface of the valve cage member 14, and a series of radially located flow ports 21 communicating with the upper end of an annular valve chamber 22 formed between the parts 14 and 19 and within which an improved annular valve 23 is arranged. The passages 21 also communicate with the chamber 12 at the bottom of the valve cage member 19. Formed integral with the outer valve cage member 14 are inwardly projecting portions or ledges 24 which underlie, support and guide the valve 23 during the movements thereof. It is thus evident that the valve cage members 14 and 19 cooperate to form a valve cage within which the improved valve is arranged. As previously stated, the valve cage and valve of the discharge valve mechanism are substantially identical to those described above in regard to the inlet valve mechanism and in a similar manner the valve cage members 25 and 26 cooperate to form a valve chamber 27 within which the improved discharge valve 28 is arranged, the discharge valve being guided and positioned within the valve chamber in a manner identical to that above described in regard to the inlet valve. The outer valve cage member 25 of the discharge valve mechanism is seated on the shoulder 9 previously mentioned. In the present construction, the valve cages are held in position on their seats by a center stud 30 common to both valve mechanisms and having threaded thereon nuts 31, 31 respectively engaging the inlet and discharge valve cages. The stud is threadedly secured at 32, within the casing of the cylinder 1, as shown in Fig. 1.

The improved inlet and discharge valves 23 and 28 are identical in form. As shown in Fig. 2 the inlet valve 23 is formed of a strip of flat steel bent annular in shape and having formed at one

end an inwardly bent portion 33 guided within a slot 34 formed in the inner valve cage member 26. The flow openings 16 are surrounded by arcuate valve seating surfaces 35 struck from the axis of the valve mechanism, while the inner cage member is provided with a cylindrical abutment surface 36 concentric with the valve seating surfaces with which the valve engages when in its open or unseated position. Above this abutment surface are the radial lower edges 24a of the walls separating the upper ends of the passages 21. During opening and closing movements of the valve, the valve is supported and guided by the underlying projections 24 formed on the outer valve cage member 14 and by the surfaces 24a just described. The inwardly bent portion 33 cooperating with the slot 34 prevents bodily rotative movement of the valve about the axis of the valve mechanism, thereby preventing the ends of the valve from moving into a position in which leakage could occur. The unbent end of valve 35 will slide over the fixed end during opening of the valve.

In the modification shown in Fig. 3, the inwardly bent portion 33 on the valve and the cooperating guide slot 34 are omitted and the valve is held against rotative movement by a pin 37 carried within a bore 38 formed in the inner valve cage member and passing through an opening 39 formed in the valve intermediate the ends of the latter. One end of the valve is inwardly bent at 40, and the inner abutment surface 36 of the inner valve cage member is slotted or notched at 41 to receive this bent valve end when the valve is in its open or contracted position. It will be understood that the ends of the valve slide the one along the wall of the surface 36 and the other along the outer surface of the first end.

In the species of Fig. 4 a still different arrangement of the valve and valve locating pin is to be found. In this form, passing of the ends of the valve the one over the other is avoided and the valve is shortened to permit it to engage the surface 36 without overlapping of its ends. In accomplishing this, it is necessary to provide a relatively wide imperforate portion 44, and the spaced ends of the valve 23 are held from movement circumferentially from this portion by a pin 42 held in a bore 43 within the portion 44; and the latter has a curved portion 45 engaged by the valve ends.

In the three forms of the invention above described, when the compressor piston moves in one direction, fluid is drawn in from the inlet chamber 7 past the inlet valve 23 (which is in its innermost, open, contracted or compressed, position at that time) through the chamber 12 and passage 13 to the cylinder bore 2. At this time the discharge valve 28 is in its normal, expanded, closed position shown. Upon movement of the piston in the opposite direction the fluid compressed within the cylinder holds the inlet valves 23, which close of their own elasticity as soon as intake ceases, in their closed position shown, while the discharge valves are opened, permitting the compressed fluid to flow into the discharge passage 6. When the valves move into their open position, they are held in position against the inner cylindrical or arcuate abutment surfaces 35, and as they move towards their closed position they expand into engagement with the arcuate valve seating surfaces surrounding the flow passages.

In the modified form of construction shown in Fig. 5, the cylinder and head constructions are

very similar to those described above, and likewise the chambers 5, 12 and passage 13 are approximately the same, and the valve mechanisms are arranged in similar manner in the chamber 5 for receiving the same. In this form of the invention the structure of the valve mechanisms is somewhat different in that each valve mechanism includes a plurality of valves, and the valves for each valve mechanism are different in form. The inlet valve mechanism is indicated at 50 and the discharge valve mechanism at 51. The inlet valve mechanism includes an outer cage member 52 provided with an annular shoulder 53 seated on the shoulder 8. Formed in the walls of the outer valve cage member are flow passages 54 similar to the flow passages 16 and likewise separated by vertical ribs. Formed in the upper portion of the valve cage member 52 are additional flow passages 55 surrounded by an inner plane valve seat 56 lying in a transverse plane. This valve cage member is provided with an inner annular hub portion 57 having secured thereto by screws 58 an inner valve cage member 59. This common valve cage member is provided with flow passages 60 and 61 and has formed thereon annular ribs 62 and 63, the annular rib 62 forming a stop for a bowed annular spring 64 for holding an annular plate or "wafer" valve 65 against the valve seat 56. The annular rib 63 forms a stop for a split annular valve 66, similar to the valve 35 above described. The valve 66 is guided within an annular valve chamber 67 formed by upper and lower projections 68 and 69 formed by vertical ribs separating the flow passages in the inner valve cage member.

The discharge valve mechanism is substantially identical in design to the inlet valve mechanism above described and includes a plate or "wafer" valve 70 and annular valve 71 substantially identical to the valves 65 and 66. The outer valve cage member 72 of the discharge valve mechanism is provided with an annular shoulder 73 engaging the shoulder 9, and the valve cages of both valve mechanisms are held in position on their seats by a center stud 74 common to both as in the preferred form of the valve mechanism shown in Fig. 1.

In this form of the invention when the pump piston moves in one direction, fluid is drawn from the inlet chamber 5 through the flow passages past the inlet valves 65 and 66 through the chamber 12 and passage 13 to the cylinder bore, the discharge valves being closed at that time. Upon movement of the pump piston in the opposite direction, the compressed fluid holds the inlet valves on their seats and the compressed fluid flows through the flow passages in the discharge valve cage past the discharge valves 70 and 71 into the discharge chamber 6.

Suitable unloading means is provided to cooperate with the inlet valve element 65. The hub portion 57 of the inlet valve is bored out as at 75 to provide a guide. A member 76, having arms 77 projecting into position to engage the upper surface of valve 65, and having a cylindrical portion 78 guided within the bore 75, is normally held, by a spring 79 in a position out of engagement with the valve. To move member 76 to unloading position a piston 80 is arranged in a cylinder 81 held by suitable means, such as one or more screws, one of which is shown at 82, to a boss on the cage 57. The piston 80 is adapted to engage a reduced portion 83 of the member 76 which projects into the open lower end of the cylinder 81 and to force member 76 downward and

open valve 65 when air is supplied through a connection 84. Air is supplied and vented relative to the several connections 84 by any suitable pilot valve, not shown.

5 As a result of this invention it will be noted that an improved combined inlet and discharge valve mechanism is provided which is extremely simple in design and having an improved valve element whereby all necessity of a separate valve spring is eliminated. It will further be noted that each valve unit, in its simpler form, is composed of but three parts, which are extremely simple in structure and which may be easily and cheaply manufactured. It will still further be noted 10 that by the provision of a plurality of valve mechanisms as in the modified form of construction shown in Fig. 5 it is possible to obtain a comparatively large valve lift area for a certain diameter of the valve bore, or, in other words, for a certain space occupied in the head by the valve. In the last species, a very advantageous combination of adequate unloading with abundant normal flow area is secured. These and other advantages of the improved valve mechanism will be 15 clearly apparent to those skilled in the art.

While there are in this application specifically described several forms which the invention may assume in practice, it will be understood that these forms of the same are shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. A compressor or pump valve comprising a strip of flat metal bent to a substantially cylindrical shape and having integral positioning and guiding means at one end thereof.

2. A compressor or pump valve comprising a strip of flat metal bent to a substantially cylindrical shape and having a single inwardly bent positioning and guiding end.

3. A compressor or pump valve comprising a strip of flat metal bent to a substantially cylindrical shape and having an opening for engagement with a valve guiding element and having ends arranged to overlap upon opening of said valve but not when said valve is closed.

4. A valve mechanism comprising a valve cage having an annular valve chamber, a radially expandible split annular valve arranged in said chamber and having an inbent end portion, said valve compressible to open, and means on said cage engaging said end portion of the valve for preventing substantial rotative movement of the valve in its chamber in either direction.

5. A valve mechanism comprising a valve cage having an annular valve chamber, a radially compressible split annular valve arranged in said chamber and having an integral guiding portion at one end, and means on said cage engaging said guiding portion for positioning said valve in its chamber, said valve having the other end thereof 65 of formed to slip over the first mentioned end on opening of said valve.

6. A valve mechanism comprising a valve cage having an annular valve chamber, a radially expandible split annular valve arranged in said chamber and having an integral guiding portion, and means including a slot formed in said cage for receiving said valve guiding portion for positioning said valve in its chamber.

7. A valve mechanism comprising a valve cage 75 having an annular valve chamber, a radially

compressible split annular valve arranged in said chamber, said valve having an opening formed intermediate its ends, a guide pin carried by said cage and projecting within said valve opening for guiding said valve in its chamber, and said valve having ends formed to slip over each other upon compression of said valve.

8. A valve mechanism including a valve cage having an outer annular valve cage member, an inner valve cage member, said valve cage members cooperating to form an annular valve chamber, means for holding said cages in assembled relation, and a radially expandible split annular valve arranged within said valve chamber, said outer valve cage member providing a valve seat upon which said annular valve seats when in its outermost expanded position and said cage providing space for the free unseating movement of said valve throughout the full circumference of the latter.

9. A valve mechanism including a valve cage having an outer annular valve cage member, an inner valve cage member, said valve cage members cooperating to form an annular valve chamber, means for holding said cages in assembled relation, and a radially expandible split annular valve arranged within said valve chamber, said outer valve cage member providing a valve seat upon which said annular valve seats when in its outermost expanded position and said inner valve cage member providing a cylindrical abutment surface with which said valve engages when in its innermost contracted position.

10. A valve mechanism including a valve cage having an annular outer valve cage member, a cooperating inner valve cage member, said inner member being annularly grooved to provide a valve chamber, flow ports formed in said outer valve cage member and having surrounding valve seats, and a radially expandible split annular valve arranged in said valve chamber and when in its outermost expanded position engaging said valve seats.

11. In a pump valve mechanism, a pair of valve cages in alinement and one for an inlet valve and the other for a discharge valve and each providing a substantially cylindrically curved valve seat, and resilient inlet and discharge valves each substantially cylindrical in outline and of substantially like radius.

12. In a pump valve mechanism, a pair of valve cages in alinement and one for an inlet valve and the other for a discharge valve and each providing a substantially cylindrically curved valve seat, and resilient inlet and discharge valves each substantially cylindrical in outline and of substantially like radius, and each compressible inwardly, to reduce the radial dimension thereof, upon opening movement.

13. A combined inlet and discharge valve mechanism including an inlet valve cage, a plurality of inlet valves arranged within said cage, at least one of which is radially flexible and substantially cylindrical when in seated position, a discharge valve cage and a discharge valve arranged within said discharge valve cage.

14. A combined inlet and discharge valve mechanism including an inlet valve cage, an inlet valve arranged therein, a discharge valve cage, and a plurality of discharge valves, at least one of which is radially flexible and substantially cylindrical when in seated position, within said discharge valve cage.

15. A combined inlet and discharge valve mechanism including an inlet valve cage, an in-

let valve arranged therein, a discharge valve cage coaxial with said inlet valve cage, and a plurality of discharge valves, at least one of which is arcuate when in seated position, within said discharge valve cage.

16. A combined inlet and discharge valve mechanism including an inlet valve cage, a plurality of inlet valves arranged within said cage, at least one of which is arcuate when in seated position and flexible to change its curvature on opening, a discharge valve cage coaxial with said inlet valve cage, and a discharge valve arranged within said discharge valve cage.

17. A combined inlet and discharge valve mechanism including an inlet valve cage, a plurality of inlet valves arranged within said cage, a discharge valve cage, and a plurality of discharge valves arranged within said discharge valve cage, at least one, but not all, of said valves being substantially cylindrical when in seated position.

18. A combined inlet and discharge valve mechanism including an inlet valve cage, a plurality of inlet valves arranged within said cage, a discharge valve cage coaxial with said inlet valve cage, and a plurality of discharge valves arranged within said discharge valve cage, at least one of said valves being arcuate when in seated position and having its axis of curvature lying in the common axial line of said cages.

19. A combined inlet and discharge valve mechanism including an inlet valve cage, a plurality of inlet valves arranged within said cage, an aligned discharge valve cage, and a plurality of discharge valves arranged within said discharge valve cage, at least one, but not all, of each of said types of valves being substantially cylindrical when in seated position.

20. A combined inlet and discharge valve mechanism including an inlet valve cage, a plurality of inlet valves arranged within said cage, an aligned discharge valve cage, and a plurality of discharge valves arranged within said discharge valve cage, at least one, but not all, of each of said types of valves being arcuately flexed when in seated position, said arcuate valves having their axes of curvature mutually aligned.

21. A pump valve mechanism including a valve cage having associated therewith a plurality of valves performing a common control function, said cage having seats for said valves and said valves having respectively reciprocatory and expansive and contractive movements relative to their respective seats.

22. A pump valve mechanism including a valve cage having associated therewith a plurality of valves performing a common control function, said cage having seats arranged respectively circumferentially and transversely of said cage and said valves moving respectively radially and bodily axially of said cage.

23. A pump valve mechanism including a valve cage having associated therewith a plurality of valves performing a common control function, said cage having respectively circular and cylindrical seats for said valves having substantially aligned axes and said valves arranged

to move respectively bodily longitudinally of and radially toward and from their respective seat axes.

24. A pump valve mechanism including a plurality of valves performing a common function but respectively moving in angularly related planes, and unloading means cooperating with one but not the other of said valves.

25. A pump valve mechanism including a valve cage having associated therewith respectively bodily reciprocable and radially compressible inlet valve devices, and unloading means for unseating one but not the other of said valve devices.

26. A valve mechanism comprising a valve cage having an internal chamber communicable with a pump discharge and having a peripheral inwardly facing valve seat, and a cylindrical discharge valve compressible inwardly to open.

27. A pump valve mechanism including a valve cage having associated therewith a plurality of valves, including a valve plane when seated and a valve whose seat-engaging surface is substantially cylindrical when said valve is seated, said cage having seats to which each of said valves conforms when so seated.

28. A pump valve mechanism including a valve cage having associated therewith a plurality of valves, including a valve circular in outline and plane when seated and a valve whose seat-contacting surface is substantially cylindrical when said valve is seated, said cage having seats to which each of said valves conforms when so seated.

29. A pump valve mechanism including a valve cage having associated therewith a plurality of valves, including a valve circular in outline and plane when seated and a valve whose seat-contacting surface is substantially cylindrical when said valve is seated, said circular valve lying within the cylinder extended of said surface and said cage having seats to which each of said valves conforms when so seated.

30. A pump valve mechanism including a round valve cage providing a plurality of valve seating surfaces whose elements are respectively parallel to a line parallel to the axis of the cage and parallel to a line perpendicular to the axis of the cage, and valves, including a valve whose seat-engaging surface is curved about an axis extending in the same direction as said cage axis, coacting with said seats.

31. A pump valve mechanism including a valve cage having associated therewith a plurality of valves and providing for said valves seats one of which is round and another of which lies in a surface of revolution whose axis extends through the other valve seat.

32. A pump valve mechanism including a round valve cage providing a plurality of valve seating surfaces whose elements are respectively parallel to a line parallel to the axis of the cage and parallel to a line perpendicular to the axis of the cage, and valves coacting with said seats and respectively moving expansively and contractively and bodily rectilinearly relative to their respective seats during opening and closing.

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CERTIFICATE OF CORRECTION.

Patent No. 2,091,907.

August 31, 1937.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, first column, line 4, claim 15, after "position" and before the comma insert the words and flexible to change its curvature on opening; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of December, A. D. 1937.

Henry Van Arsdale,

Acting Commissioner of Patents.

(Seal)