

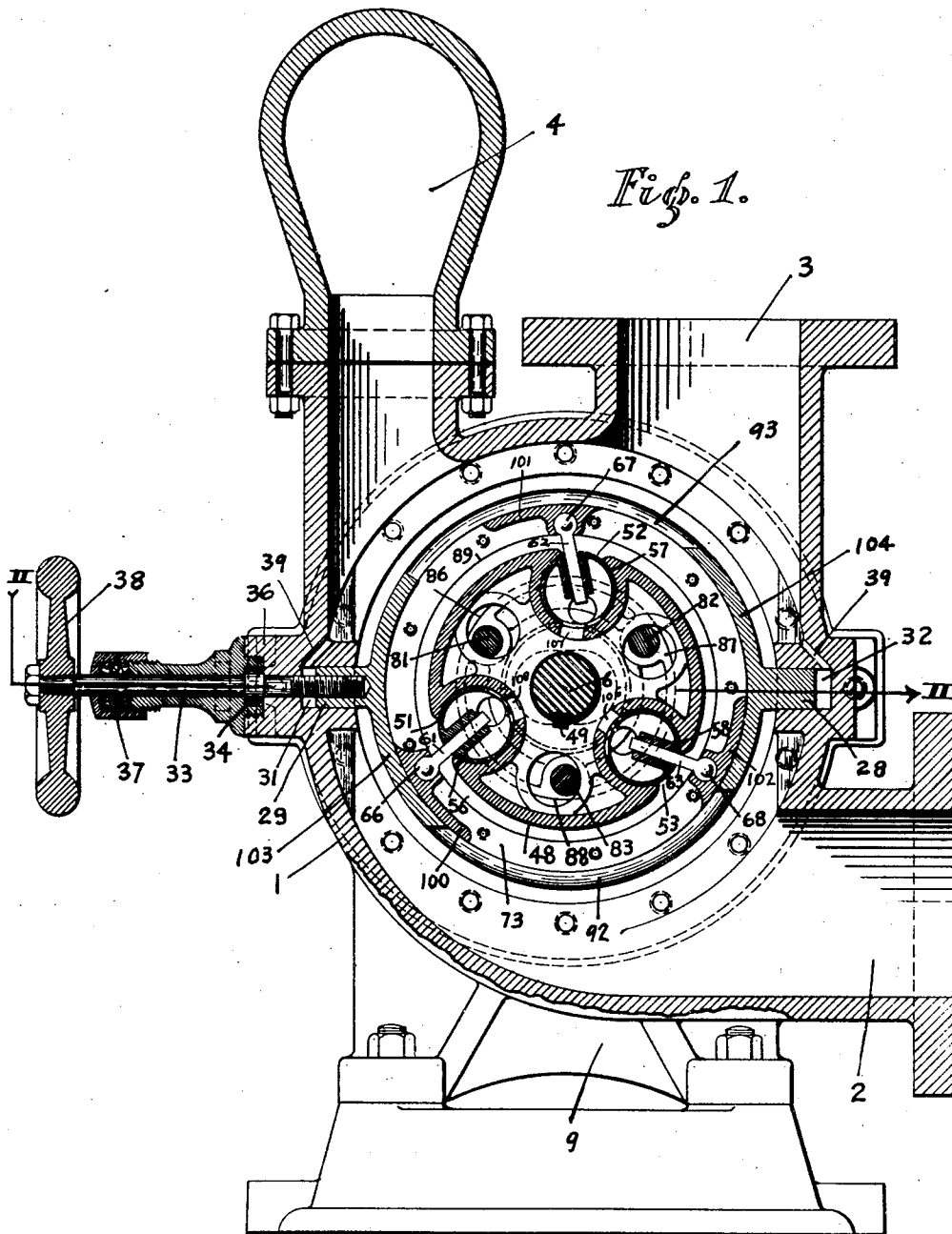
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PUMP.

APPLICATION FILED MAR. 8, 1919.

1,370,810.

Patented Mar. 8, 1921.

4 SHEETS—SHEET 1.



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4 SHEETS—SHEET 2.

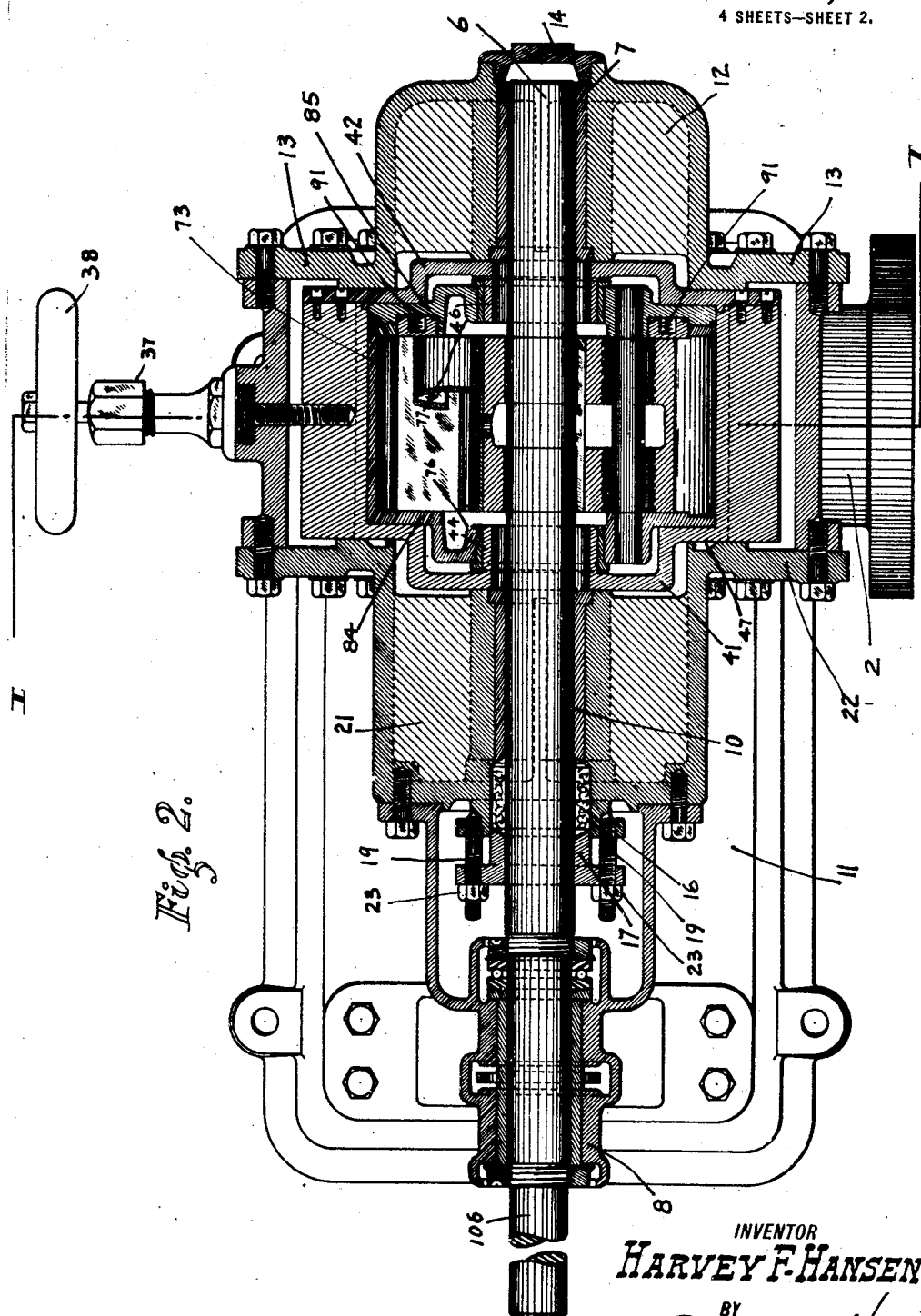


Fig. 2.

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4 SHEETS—SHEET 3.



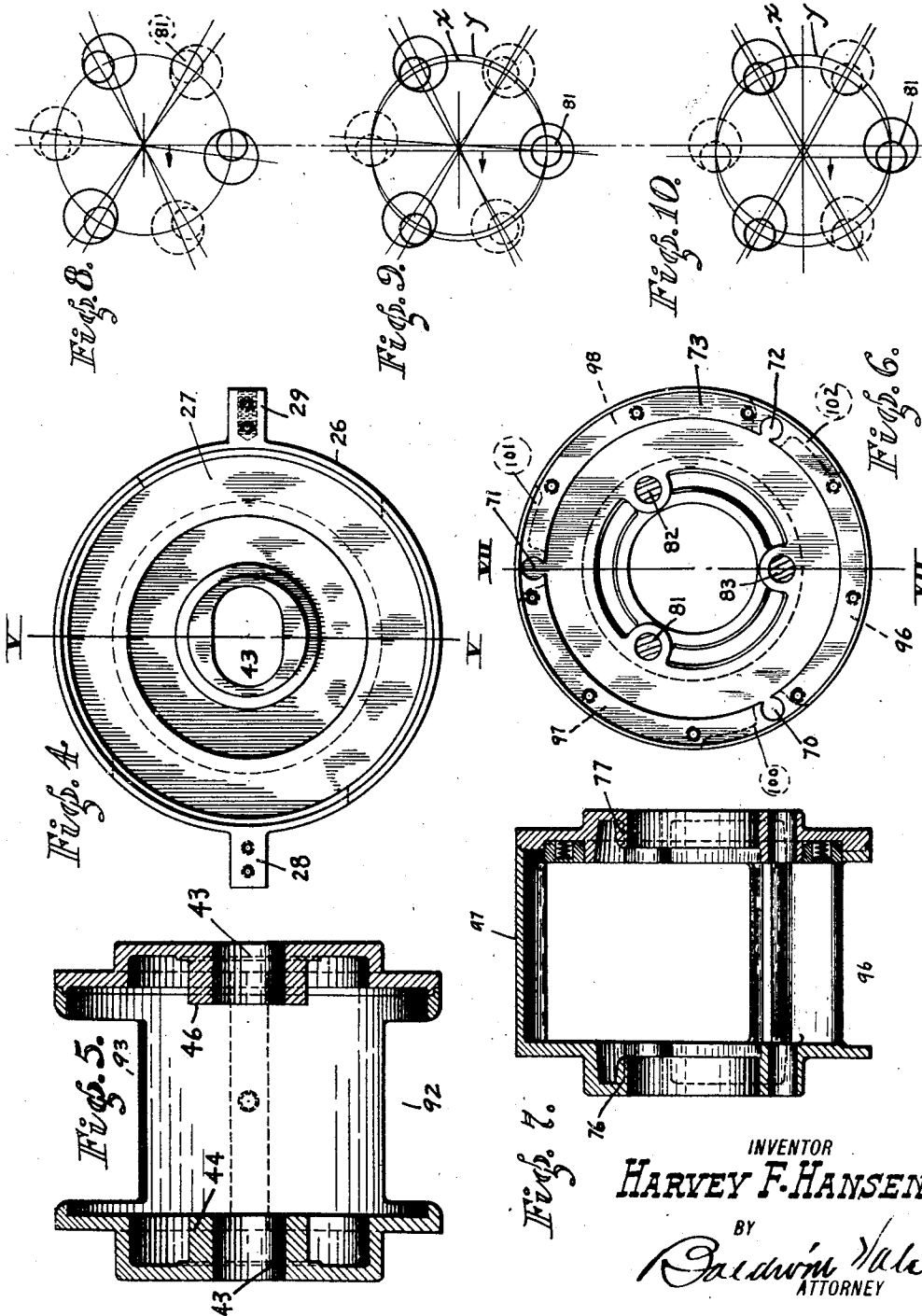
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4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

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1,370,810.

Specification of Letters Patent.

Patented Mar. 8, 1921.

Application filed March 8, 1919. Serial No. 281,531.

To all whom it may concern:

Be it known that I, HARVEY F. HANSEN, a citizen of the United States, and a resident of the city of Oakland, county of Alameda, State of California, have made a new and useful invention—to wit, an Improvement in Pumps; and I do hereby declare the following to be a full, clear, concise, and exact description of the same.

The invention relates particularly to rotary pumps of the vane type. Among the objects of the invention are to provide means for varying the capacity of the pump by varying the displacement therein, and reverse the direction of flow without reversing the direction of rotation of the pump.

Another object is to provide means for gradually increasing the capacity of the pump in handling viscous and slow-flowing fluids, by gradually increasing the velocity of flow as the inertia of the liquid is overcome.

A further object is to provide means whereby the capacity of the pump may be automatically varied in accordance with the suction or pressure exerted by the pump.

Other objects and advantages will appear as this description progresses.

In this specification and the annexed drawings, the invention is illustrated in the form considered to be the best, but it is to be understood that the invention is not limited to such form, because it may be embodied in other forms, and it is also to be understood that in and by the claims following the description, it is desired to cover the invention in whatsoever form it may be embodied.

In the accompanying four sheets of drawings,

Figure 1 is a cross section of a pump constructed in accordance with this invention taken on the line I—I Fig. 2.

Fig. 2 is a plan view from above of the same in cross section taken on the line II—II Fig. 1.

Fig. 3 is a cross section similar to Fig. 1 with the rotating elements removed and the automatic capacity governor substituted for the manual governor shown in Fig. 1.

Fig. 4 is an end elevation of the subcasing with end cover removed.

Fig. 5 is a cross section of the same taken on the line V—V Fig. 4 with cover attached.

Fig. 6 is an end elevation of the carrier ring with flange removed.

Fig. 7 is a cross section of the same taken on the line VII—VII Fig. 6 with flange attached.

Figs. 8, 9 and 10 are progressive diagrams showing the cycles of action in varying the capacity of the pump from neutral to full pumping capacity.

Among the advantages of this pump is that the consumption of power is in direct proportion to the volume pumped against a set pressure. It is possible also to directly connect the pump to the motive power, such as an electric motor or other form of engine, without intermediate reduction gearing, as it is possible to gradually apply the load by varying the capacity of the pump. This is particularly advantageous in pumping heavy, viscous masses such as oil. The reduced capacity of the pump gradually overcomes the inertia of the column pumped against, without overloading the prime mover, or placing undue stress on the pumping element. As a fire pump this invention is particularly advantageous, as the capacity may be varied in direct proportion to the water discharged, without wasting water by passing it through by-passes or bleeders with a consequent waste of power. If a line of hose is suddenly shut off, the automatic governor proportionately controls the output of the pump and contrawise.

This present application bears some relation to the patent to H. A. Bullard, No. 1,210,042, issued December 26th, 1916, and at present owned by my assignee.

In detail, the construction illustrated in the drawings includes, the inclosing casing 1 having the inlet 2 and the outlet 3 and the air-chamber 4. The inlet 2 and the outlet 3 are substantially tangential to the cylindrical casing 1 which is concentric with the axis of the rotor. The drive shaft 6 is mounted in the bearings 7, 8 and 10, that are respectively bolted to the casing 1 and supported on the pedestal 9 fixed to the base 11. The bearing 7 is contained within the lateral extension 12 of the cover plate 13 on the casing and is closed at the outer end by the cap 14 to prevent leakage. The opposite extension of the shaft 6, between the bearings 8 and 10, is provided with the stuffing box 16 adapted to be filled with any suitable packing compressed by the gland 17 surrounding the shaft. The gland 17 is advanced by means of the stud bolts 19 fixed in the extension 21 of the cover plate

22 of the casing, and advanced by the nuts 23 threaded on the stud bolts 19 and bearing against the gland 17.

The subcasing 26 is cylindrical in cross section, having a central chamber 27, and is slidably supported within the casing on the lugs 28 and 29 slidable within the guide slots 31 and 32 respectively, provided internally on the diametric center line of the inclosing casing 1, whereby the subcasing is movable transversely within the main casing 1. This movement is accomplished by means of the spindle 33, threaded in the lug 29 and swiveled at 34 in the extension 36 of the casing. This spindle is surrounded by the stuffing box 37 to prevent leakage, and is manipulated by means of the convenient handle 38. The by-passes 39—39 communicate with the spaces intermediate the ends of the lugs 28 and 29 and the ends of the guide slots 31 and 32 within the interior of the casing, to equalize the pressure on the subcasing and counterbalance its movement. The ends of the subcasing are closed by the integral end 41, and the removable end 42 screwed thereto. These ends 41 and 42 are provided with the slots 43—43 respectively, clearing the shaft 6 and permitting the movement of the subcasing with respect thereto. These covers 41 and 42 are provided with the integral inwardly extending concentric necks 44 and 46 surrounding the shaft 6. The side-plates 13 and 22 suitably bolted to the inclosing casing 1 are drawn snugly against the ends of the subcasing to prevent leakage at these points, that are further packed by the annular tapered expansion ring 47, interposed between the cover 22 and the contiguous side of the subcasing, the tapered ring being compressed against the inclined side of the slot provided therefor and having a normal tendency to rise thereout of causes the ring 47 to bear snugly against the contiguous sides of the subcasing, and force it laterally against the opposite cover plate 13.

The rotor 48 is keyed at 49 on the shaft 6 and rotates concentrically therewith. This rotor is provided with the sockets 51, 52, and 53 extending across the rotor parallel with the shaft 6. The oscillating packing members 56, 57 and 58, oscillate freely within their respective sockets, within which they fit snugly enough to prevent leakage at points of contact. The vanes 61, 62 and 63 slide freely at radial angles within the oscillating packing members 56, 57 and 58 respectively. The outer ends of these vanes are provided with the round heads 66, 67 and 68 extending across their width and pivotally engaging sockets 70—71 and 72, Fig. 6, provided therefor at spaced intervals along the interior periphery of the carrier ring 73.

This carrier ring 73 is cylindrical in form

and fits concentrically within the subcasing and is rotatable with respect thereto, on the hubs 76 and 77 encircling the extensions 46 and 44 surrounding the slots 43 in the subcasing. The carrier ring is driven synchronously with the rotor through the intermediary of the pins 81, 82 and 83 having their opposite ends fixed in the sides 84 and 85 of the carrier ring and extending thereacross through the openings 86, 87 and 88 provided in the rotor. These openings are of sufficient size to allow for the necessary differential movement in the rotor and the carrier ring when the latter is moved eccentrically to the rotor by the movements of the subcasing which gives two centers of operation. See Figs. 8, 9 and 10. The interposition of the driving pins 81, 82 and 83 in contacting engagement with the holes in the rotor relieves the vanes 61, 62 and 63 of all driving action, leaving them free to oscillate in their planetary movement around the drive shaft 6, in accommodating themselves to their variations in angle of inclination between the rotor and the carrier ring, both of which they pivotally engage.

To insure lateral contact between the ends of the rotor and the carrier ring, the annular packing ring 89 is interposed and forced against the side of the rotor by the expansion of the coil springs 91. This annular ring 89 overlaps the eccentric path of the rotor within the carrier ring against which it bears snugly and prevents leakage at this point. The introduction of the packing rings 47 and 89 insures the proper and constant sealing of the movable parts against each other, at the same time allowing for a certain lateral resiliency to take up wear and avoid the necessity for setting the contacting parts too close in original adjustment.

The inclosing casing 1 is divided horizontally on its center diameter by the interposition of the subcasing 26 with the extended lugs 28 and 29 hermetically fitting and sliding within the sockets 31—32 provided therefor in the casing 1. Passage through this subcasing is through the inlet port 92 and the outlet port 93 formed in the periphery of the subcasing between its sides, see Fig. 5. These ports 92 and 93 are respectively opened and closed by the ports 96, 97 and 98 formed in the periphery of the carrier between its sides and between the peripheral shoes 100, 101 and 102, rotatably sealed against the interior periphery of the subcasing. The carrier is divided into three distinct chambers between the vanes 61, 62 and 63 and the periphery of the rotor sealed by the oscillating packing members 56, 57 and 58, the carrying capacity of which chambers may be varied at will, as will hereinafter be more fully described. The positions of the vanes with respect to the inlet

ports 92 and 93 are timed so that there is a closed interval between two adjacent vanes in passing the peripheral walls 103 and 104 of the subcasing, for instance, the distance
 5 between the ends of the shoe 102 and the beginning of the shoes 100 and 101 is slightly less than the length of the unbroken wall 103 of the subcasing, which is likewise true on the opposite side with respect to the wall
 10 104, whereby the fluid taken in between any two vanes on the inlet side 2 of the inclosing casing is confined between those walls in passing the division wall 103 before discharging into the upper half of the inclosing
 15 casing communicating with the discharge side 3.

This invention operates substantially as follows:

Power is applied to the protruding end
 20 of the shaft 6 at 106 to rotate this shaft preferably in a clockwise direction. Referring to Fig. 1, the subcasing and the rotor being in concentric or "neutral" relation, rotation has no displacing effect, and the
 25 pump will operate without result, requiring only the power necessary to overcome the inertia and friction of the parts, the centers of operation being coincident as shown in Fig. 8. When the governor handle 38 is
 30 rotated in a clockwise direction, the right-hand thread on the spindle 33 engaging the lug 29, will force the subcasing laterally to the left, as shown in Fig. 9. This reduces the distance between the periphery
 35 of the rotor and the interior periphery of the subcasing on the right-hand side, with a similar enlargement of the distance between these elements on the left-hand side, giving a crescent-shaped space as illustrated
 40 by the cycles of operation X—Y. This will cause the pump to transfer a small quantity of fluid from the intake side 2, to the discharge side 3 of the casing with each revolution of the rotor and the dividing vanes.
 45 Continued rotation of the governor handle 38 in the clockwise direction will increase the distance between the cycles of operation X and Y likewise increasing the capacity of the pump by increasing the volumetric
 50 capacity of the space between any two vanes and the wall 103, until the maximum capacity is reached. This operation is facilitated by the synchronous compensating drive between the carrier ring and the rotor previously
 55 described. The fluid is pumped in at the port 92 and out of the port 93 of the subcasing as the various shoes 100, 101 and 102 pass thereacross, dividing off a quantity of the fluid in accordance with the capacity
 60 of the space between the vanes. As these shoes 100 to 102 cut across the edge of the wall 104, the fluid elevated in the upper half of the casing is prevented from returning through the subcasing, because of
 65 the squeezing action that would be exerted

thereon because of the difference in volumetric capacity on opposite sides of the rotor with respect to the subcasing and by the sealing off by the wall 104 and the carrier and rotor. Any slight pulsations that
 70 may result from the cut-off of the vanes in discharging would be absorbed by the cushioning effect of the air-chamber 4 communicating with the upper half of the inclosing casing, reacting against the static head of
 75 the fluid pumped. It is obvious that the capacity of the pump has the possibilities of infinite variations from zero to full capacity.

If it is desired to reverse the action of
 80 the pump, that is to draw the liquid back through the discharge 3 and discharge it through the inlet 2, the governor-handle 38 is turned in a counter-clockwise direction which forces the subcasing to the right, giving
 85 the greater volumetric capacity between the rotor and the carrier ring on the right-hand side, resulting in reversing the flow of the fluid through the pump without reversing the direction of rotation of the rotor
 90 shaft 6. All of the variations in volumetric capacity are possible in pumping in either direction. Obviously the shaft 6 may be rotated in either direction with similar functioning of the parts, but the present design
 95 is intended to be run in the direction described. The by-passes 39—39 opening the static head pressure to the spaces 31 and 32 behind the lugs 28 and 29 counterbalance the pressure on the opposite side of the sub-
 100 casing, making its movement free and easy, by means of the governor mechanism. The interior of the rotor is open to the sockets 51, 52 and 53 through the ports 106, 107 and 108 communicating with the ports leading
 105 into the interior of the oscillating packing members 56, 57 and 58 permitting any leakage passing the vanes to enter the sockets and pass into the interior of the rotor, wherein it is confined between the stuffing box 16
 110 and the end cap 14 sealing the shaft, the pressure gradually building up in the interior of the rotor until it is equal to the static head being pumped against, in this manner equalizing the pressure on all operative
 115 parts and effectively sealing the whole interior of the pump against leakage, also counterbalancing the displacement of the various vanes in entering and receding from their respective oscillating packing mem-
 120 bers 56, 57 and 58; their operation being synchronized the advance of one is equal to the retraction of its companion members. This interior counterbalancing of pressure will form the subject of a separate applica-
 125 tion for patent. The automatic governor illustrated in Fig. 3 consists of the lateral chamber 111 preferably formed integral with the inclosing casing 1, the upper portion of which communicates therewith
 130

through the by-pass 112, whereby the same static pressure exists in the chamber 111 that exists in the upper half or discharge side of the inclosing casing. For accessibility this chamber is closed by a bolted-on cover plate 113 permitting access thereto. The guide opening 31 is also open to the interior of the chamber 111 permitting access to the lugs 29 to which the link 114 is pivoted at 115. The chamber 111 is provided with an upward cylindrical extension 116, bored and finished to receive the reciprocating cup leather piston 117 therein, fixed on the piston rod 118 between the shoulder 119 and the threaded nut 120 screwed onto the piston rod above the piston. The calibrated spring 121 is confined between the nut 120 and the adjustable plug 122 threaded in the cap 123 fixed in the upper end of the cylinder 116 through which the piston rod slides freely. The upper end of this cap is provided with the lock nut 124, and the upper end of the plug is squared at 126 to receive a wrench for screwing it into and out of the cap 123 to vary the tension of the spring 121 bearing against the piston, the desired tension being fixed by setting up the nut 124. The descent of the piston is limited by the nut 127 threaded thereon and set by the jam nut 128 to regulate the descent of the piston, the nut 127 abutting the top of the plug 122. The lower end of the piston rod 118 is provided with the yoke end 129 pivoted at 131 to the extension 132 of the bell-crank lever 133 fulcrumed at 134 on a pin extending across the chamber 111. The upper end of the bell-crank is pivoted at 136 to the link 114. The bell-crank is provided with an abutment 137 existing on the stem 138 threaded in the cap 139 fixed in the lower end of the chamber 111 and surrounding the stem 138 with a stuffing gland as at 141, the lower end of the same being squared as at 142 for reception of a wrench for adjusting the stem within the cap 139. The abutment 137 is pivoted on the end of the stem 138 to limit the upward rise of the piston 117, the rise and fall of this piston operating through the connecting bell-crank mechanism exerts a lateral push and pull on the subcasing to which it is attached, in accordance with the variations of pressure existing within the chamber 111 acting against the piston. As the pressure increases in the upper half of the inclosing casing, it is communicated through the by-pass 112 forcing the piston upward, permitting the piston to ascend against the pressure of the expansion spring 121. This throws the subcasing over to the right decreasing the capacity of the pump until the pressure lowers in the upper half of the casing and in the chamber 111 restoring the piston to its calibrated level,

thus automatically maintaining a given pressure within the upper portion of the inclosing casing connecting with the various discharge members, such as fire hose, and the like. As the pressure rises to normal, the subcasing returns to its set position. An excessive pressure in the casing 1 is prevented by the automatic operation of the governor piston which rises and advances the subcasing to the set position determined by the height of the stem 138 fixed on the abutment 137. The governor may be set to operate between any limit of pressure by a mere adjustment of the nut 127 on the piston rod or the threaded stem 138 in an obvious manner. This automatic governor is particularly valuable in connection with fire pumps, in which the load may drop from the maximum to the minimum with the sudden shut-off of one or more of the leads from the pump. If the whole discharge is cut off suddenly, the governor operates to pull the rotor to the neutral position bringing the cycles of operation into coincidence and completely unloads the pump. If an intermediate or maximum output is required of the motor, the governor operates to regulate the capacity of the pump to meet the demand. The function of the automatic governor is in every respect similar to the manual governor shown in Fig. 1 but dispenses with the necessity of manual manipulation and the services of an operator. The function of regulating the capacity of the pump relieves the motor power of the possibility of an overload and eliminates the possibility of undue strain on pipe lines and the like, which the pump may be serving, the apparatus thus being as nearly as may be self-protecting and automatic in all its actions.

Having thus described this invention, what I claim and desire to secure by Letters Patent of the United States is:—

1. A rotary pump comprising an inclosing casing; a subcasing movable within said casing; a carrier within said subcasing; a rotor within said carrier; means for synchronously driving said rotor and said carrier; and vanes pivotally and slidably engaging said rotor and carrier respectively.

2. A rotary pump comprising an inclosing casing; a rotor concentrically rotatable in said casing; a subcasing surrounding said rotor; a carrier interposed between said rotor and subcasing; vanes interposed between said rotor and carrier; and means for moving said subcasing with respect to said rotor.

3. A rotary pump comprising an inclosing casing; a shaft journaled in said casing; a subcasing movable in said casing; a rotor fixed on said shaft; a carrier rotatable within said subcasing; synchronous driving means interposed between said rotor and

carrier; and vanes interposed between said rotor and carrier.

4. A rotary pump comprising an inclosing casing; a shaft journaled in said casing; a subcasing movable in said casing and having hubs surrounding said shaft; a carrier concentrically rotatable in said subcasing journaled on said hubs; a rotor fixed on said shaft; pins in said carrier engaging said rotor, and vanes interposed between said rotor and carrier.

5. A rotary pump comprising an inclosing casing; a shaft journaled on said casing; a subcasing movable in said casing and having hubs surrounding said shaft; a rotor concentrically mounted on said shaft and having transverse openings therethrough; a carrier concentric with said subcasing; pins in said carrier engaging said openings; and vanes interposed between said carrier and rotor.

6. A rotary pump comprising an inclosing casing; a shaft journaled on said casing; a subcasing movable in said casing and having hubs surrounding said shaft; a rotor concentrically mounted on said shaft and having transverse openings therethrough; a carrier concentric with said subcasing; pins in said carrier engaging said openings; vanes pivoted in said carrier and extending into said rotor; and oscillating packing members interposed between said vanes and said rotor.

7. A rotary pump comprising an inclosing casing; a subcasing within said casing; means fixed in said casing for moving said subcasing relative thereto; a carrier within said subcasing; a rotor within said carrier; means for synchronously driving said rotor and said carrier; and vanes pivotally and slidably engaging said rotor and carrier respectively.

8. A rotary pump comprising an inclosing casing; a rotor concentrically rotatable in said casing; a subcasing surrounding said rotor; a carrier interposed between said rotor and subcasing; vanes interposed between said rotor and carrier and means for varying the position of the subcasing relative to the inclosing casing and rotor.

9. A rotary pump comprising an inclosing casing; a subcasing within said casing; automatic means fixed within the casing and operated by the pressure therewithin for moving said subcasing relative thereto; a carrier within said subcasing; a rotor within said carrier; means for synchronously driving said rotor and carrier; and means pivotally and slidably engaging said rotor and carrier respectively.

10. A rotary pump comprising an inclosing casing; a rotor concentrically rotatable in said casing; a subcasing surrounding said rotor; extensions on said subcasing slidably mounted in said casing; a carrier interposed between said rotor and subcasing; vanes in-

terposed between said rotor and carrier and means for varying the position of the subcasing relative to the inclosing casing and rotor.

11. A rotary pump comprising an inclosing casing; a rotor concentrically rotatable in said casing; a subcasing surrounding said rotor and slidably mounted within said casing; a carrier interposed between said rotor and subcasing; vanes interposed between said rotor and carrier; automatic control means fixed within the casing and operated by the pressure therewithin for moving said subcasing relative thereto and conduits connecting the interior of the casing with the subcasing slide mountings for equalizing the pressure thereon.

12. A rotary pump comprising an inclosing casing; a shaft journaled in said casing; a subcasing movable in said casing and having hubs surrounding said shaft; means for moving said subcasing relative to said inclosing casing; a carrier concentrically rotatable in said subcasing journaled on said hubs; a rotor fixed on said shaft; pins in said carrier engaging said rotor, and vanes interposed between said rotor and carrier.

13. A rotary pump comprising an inclosing casing; a shaft journaled in said casing; a subcasing movable in said casing and having hubs surrounding said shaft; automatic means fixed within the casing and operated by the pressure therewithin for moving said subcasing relative thereto; a carrier concentrically rotatable in said subcasing journaled on said hubs; a rotor fixed on said shaft; pins in said carrier engaging said rotor, and vanes interposed between said rotor and carrier.

14. A rotary pump comprising an inclosing casing; a shaft journaled in said casing; a subcasing mounted within said casing and having hubs surrounding said shaft; extensions on said subcasing adapted to slidably position the same within said casing; automatic means fixed within the casing and operated by the pressure therewithin for moving said subcasing relative thereto; conduits connecting the interior of the casing with the ends of subcasing slide extensions for equalizing the pressure thereon; a carrier concentrically rotatable in said subcasing journaled on said hubs; a rotor fixed on said shaft; pins in said carrier engaging said rotor, and vanes interposed between said rotor and carrier.

15. A rotary pump comprising an inclosing casing; a shaft journaled in said casing; a subcasing movable in said casing and having hubs surrounding said shaft; a rotor concentrically mounted on said shaft and having transverse openings therethrough; means for varying the axes of eccentricity of said subcasing and said rotor; a carrier concentric with said subcasing; pins in said

carrier engaging said openings; and vanes interposed between said rotor and carrier.

16. A rotary pump comprising an inclosing casing; a shaft journaled in said casing; 5 a subcasing movable in said casing and having hubs surrounding said shaft; a rotor concentrically mounted on said shaft and having transverse openings therethrough; automatic means fixed within the casing and operated 10 by the pressure therewithin for moving said subcasing relative thereto; a carrier concentric with said subcasing; pins in said carrier engaging said openings; and vanes interposed between said rotor and carrier.
17. A rotary pump comprising an inclosing casing; a shaft journaled in said casing; 15 a subcasing movable in said casing and having hubs surrounding said shaft; a rotor concentrically mounted on said shaft and having transverse openings therethrough; means 20 for moving said subcasing relative to said inclosing casing and rotor; a carrier concentric with said subcasing; pins in said carrier engaging said openings; vanes pivoted in

said carrier and extending into said rotor; 25 and oscillating packing members interposed between said vanes and rotor.

18. A rotary pump comprising an inclosing casing; a shaft journaled in said casing; 30 a subcasing movable in said casing and having hubs surrounding said shaft; a rotor concentrically mounted on said shaft and having transverse openings therethrough; automatic means fixed within the casing and operated by the pressure therewithin for 35 varying the axis of eccentricity of said subcasing relative to said rotor; a carrier concentric with said subcasing; pins in said carrier engaging said openings; vanes pivoted in said carrier and extending into said 40 rotor; and oscillating packing members interposed between said vanes and rotor.

In testimony whereof I have hereunto set my hand at San Francisco, California, this 15th day of January, 1919.

HARVEY F. HANSEN.

In presence of—
BALDWIN VALE.