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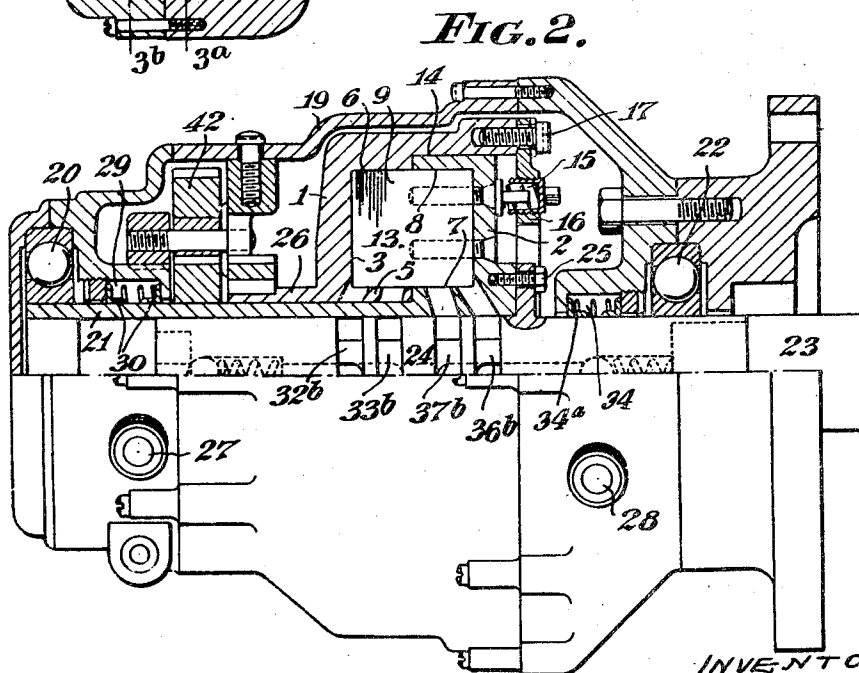
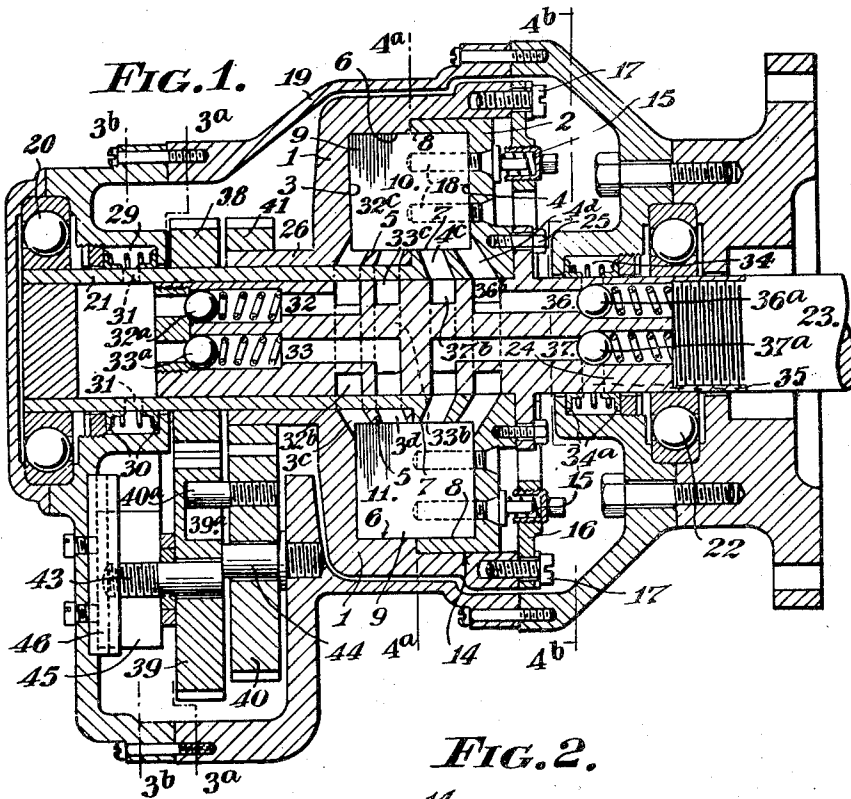
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2,453,271

ROTARY ALTERNATING PISTONS PUMP

Filed Feb. 15, 1943

3 Sheets-Sheet 1



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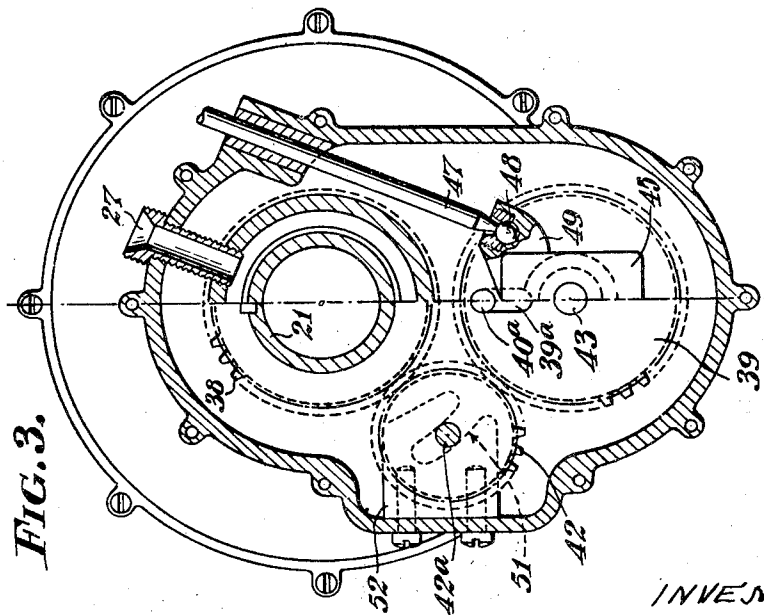
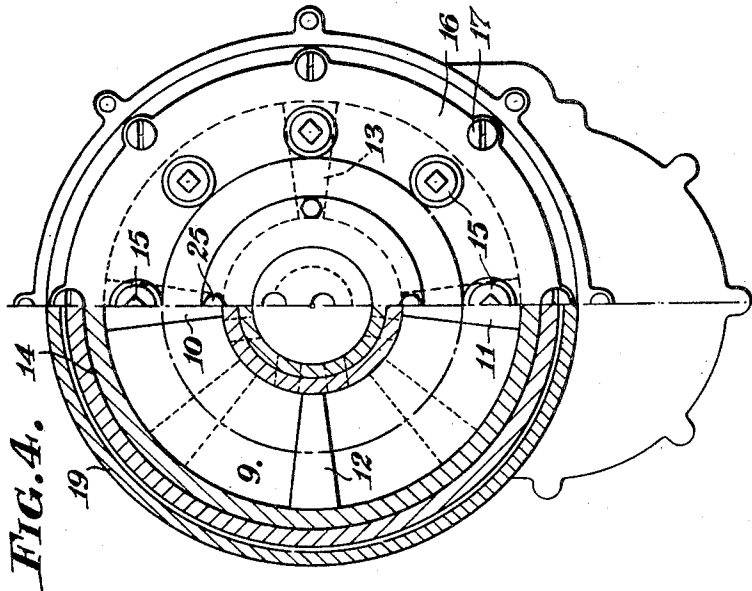
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ROTARY ALTERNATING PISTONS PUMP

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3 Sheets-Sheet 2



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ROTARY ALTERNATING PISTONS PUMP

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3 Sheets-Sheet 3

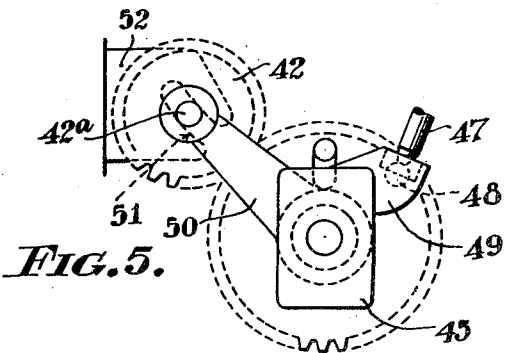


FIG. 5.

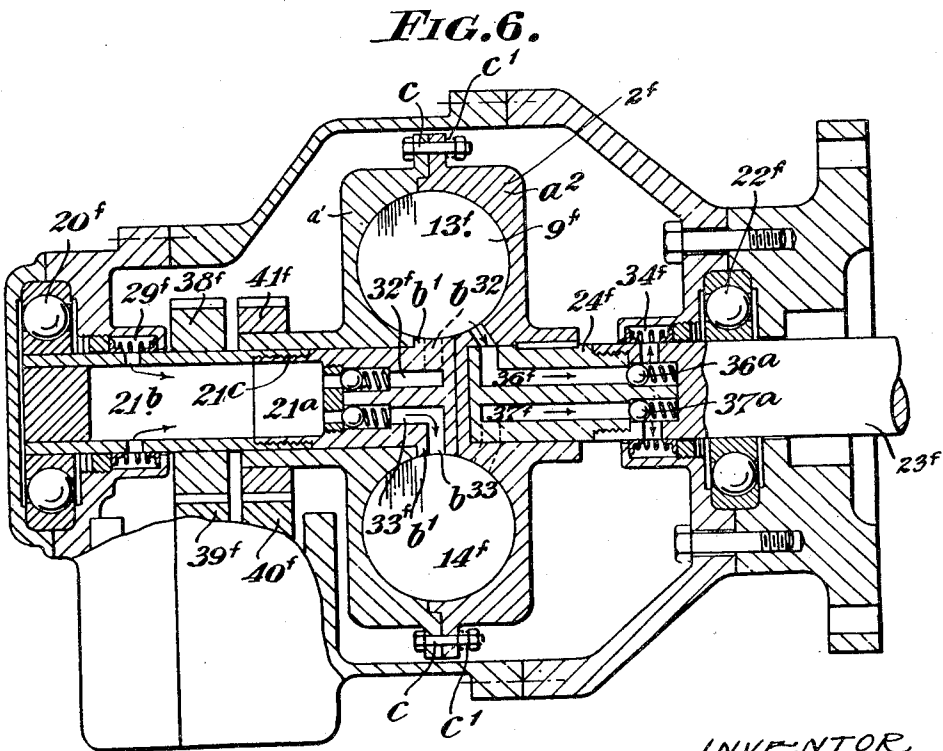


FIG. 6.

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ROTARY ALTERNATING PISTONS PUMP

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7 Claims. (Cl. 103—129)

1

This invention relates to rotary pumps, and compressors embodying pistons or blades which traverse an endless path in a continuous manner for producing distinctive pressure or compression and suction stages in substantially a continuous manner so that the pump or compressor can be driven smoothly with uni-directional rotation while having the mechanical advantages of the reciprocating piston type of pump. One object of the invention is to produce a double acting rotary pump provided with means for alternately increasing and diminishing working spaces to obtain a continuous lift and delivery of fluid. A still further object of this invention is to provide a rotary pump with simultaneous oppositely acting (i. e. pressure and expansion) stages and means for varying the output of the pump relatively to the prime mover of the pump. Further objects and advantages of the invention will be apparent hereinafter when referring to the accompanying sheets of drawings illustrating embodiments of the invention, and wherein

Figure 1 is a sectional side elevation of an embodiment in which two opposed relatively rotatable coaxial rotors in the form of annular bodies are formed with co-operating pistons operating in an annular working space within such bodies to provide a double acting pump.

Figure 2 is a half-sectional plan view of Figure 1.

Figure 3 is a sectional end elevation view, the left hand half of which is taken on the line 3a—3a of Figure 1 and the right hand half on the line 3b—3b of Figure 1.

Figure 4 is a sectional end elevation view with the left hand half taken on the line 4a—4a of Figure 1, and the right hand half on the line 4b—4b of Figure 1.

Figure 5 is a detail side elevation view showing a suitable device for obtaining speed variations of one main rotor element of the pump or the like relatively to an opposed main rotor element.

Figure 6 is a sectional side elevation of a modification.

Referring to Figures 1 to 5 inclusive of the drawings the rotary pump comprises two main rotor elements 1 and 2 of cylindrical form and formed with opposed endless annular channels 3 and 4 respectively, the element 1 having parallel concentric inner and outer walls 5 and 6 respectively and the element 2 having corresponding inner and outer concentric cylindrical walls 7 and 8 respectively to provide an endless enclosed annular working space 9 which accommodates a diametrically opposed pair of radial pistons 10

2

and 11 fixed inside the rotor 1 and a diametrically opposed pair of radial pistons 12 and 13 fixed inside the rotor 2. The rotor 2 has its cylindrical periphery 14 seated closely in a correspondingly shaped recess in the rotor 1 and is seated firmly in position by spring plungers 15 carried by an annular plate 16 fixed by screws 17 to the open end of the rotor 1. Screws 18 (only those appropriate to the pistons 10 and 11 being shown) fix the pistons to their rotors.

A housing 19 entirely encloses the two rotors, and is provided at one end with a bearing 20 for a hollow shaft 21 integral with the rotor 2, and at the other end with a bearing 22 for a shaft 23 screwed relatively fixedly into a co-axial shaft 24 fixed by studs 25 also to the rotor 2 so that the shafts 21, 23 and 24 rotate as a single shaft. The rotor 1 has an integral hollow shaft 26 loose upon the shaft 21.

The rotors are geared together in such manner that if the driving shaft 23 is driven uni-directionally at a uniform speed the pistons 10 and 11 of the rotor 1 will travel for nearly half a complete rotation at a progressively changing and a greater speed than the pistons 12 and 13 so as to increase the distance between the trailing faces of the pistons 10 and 11 and the leading faces of the pistons 12 and 13, whereupon the reverse action takes place (i. e. the pistons 10 and 11 progressively lose speed) for nearly the remaining half of the said complete rotation. This provides a double acting pump effect because the diametrically opposed progressively increasing pair of working spaces can act as suction or intake spaces while the pair of progressively decreasing working spaces will act as compression spaces, it being understood that the four pistons divide the annular working space or chamber 9 into four equal segmental spaces when the pistons 10 and 11 are at right angles to the pistons 12 and 13 and that each such space varies from slightly over 0° between opposed piston faces to almost 180° between opposed piston faces and back again to slightly over 0° each revolution of the shaft 23.

The inlet port in the housing 19 for the fluid is indicated by the reference number 27 in Figure 2 and the outlet port by the reference numeral 28. The inlet port 27 communicates radially with an annular inlet passage 29 surrounding the hollow shaft 21 and sealed by annular spring loaded sealing rings 30, and this hollow shaft 21 is formed with radial inlet passages 31 so that inlet fluid can flow through axial inlet bores 32 and 33 in the shaft 21 by raising non-

3

return valves 32a and 33a, and will pass from these bores by radial openings 32b and 33b into annular channels 32c and 33c in the periphery of the shaft 21, and from thence through radial ports 3c and 3d into the appropriate workings spaces in the annular chamber 9, these ports being contiguous to the inner or smaller radius ends of the said pistons, so that each piston has an inlet port close to one side of it and an outlet port close to the other side of it.

Substantially the same arrangement of ports and valves is provided for the outlet port 26 which registers at its inner end with an annular outlet passage 34 surrounding the shaft 24 and sealed by rings 34a, and communicating with outlet bores 36 and 37 in the shaft 24 via radial ports 35 and non-return valves 36a and 37a located in the outlet ends of the two parallel bores 36 and 37. These said bores are in constant communication with annular channels 36b and 37b in the periphery of the shaft 24, the fluid under pressure from the rotors passing from the working chamber 9 via radial ports 4c and 4d and the channels 36b and 37b to the bores 36 and 37.

In practice the rotor 2 will be rotated at constant speed from the shaft 23 and rotary motion in the same direction as rotor 2 will be imparted to the rotor 1 by means of gear wheels 38, 39, 40 and 41 and an idler wheel 42, see Figures 3 and 5, which maintains constant driving connection between gear wheels 38 and 39. The speed of rotor 1 will vary throughout each revolution, alternately being slightly above and slightly below that of rotor 2. This cycle is obtained by offsetting the axes of gear wheels 39 and 40 as shown in Figure 1 and providing in the gear wheel 39 a radial channel 39a receiving a lateral pin 40a. By adjusting the axle 43 of the gear wheel 39 transversely relatively to the axle 44 of gear wheel 40 the speed variation of the rotor 1 can be varied. To achieve this variation the axle 43 is fixed in a slidable block 45 guided by guide bars 46, the adjustment being by means of a push-pull, or threaded, axially adjustable rod 47 having a ball and socket connection 48 with a lug 49 of the block 45. The idler wheel 42 is carried by an axle 42a at the outer end of an arm 50, such axle 42a being guided in an arcuate slot 51 in a fixed plate 52.

As a modification, the rotor bodies 1 and 2 can be secured together relatively fixedly and an intermediate rotor member provided as shown in Figure 6 in which two substantially similar rotor bodies a^1 and a^2 are bolted together by bolts c and in which the beforesaid radial pistons 10f and 11f (not shown) are fixed in relation to these two rotor members a^1 and a^2 and the radial pistons 13f and 14f are fixed at diametrically opposed points to the periphery of a rotor disc b^1 integral with a hollow shaft 21a threaded as at 21c into fixed relationship with a shaft 21b. The relatively fixed rotor members a^1 and a^2 are fixed to the fixed extension 24 of the driving shaft 23f so that the pump now comprises an outer rotor (instituted by the parts a^1 and a^2) driven at uniform speed from the shaft 23f and an inner rotor b^1 driven (as the beforesaid rotor 1) at varying speeds by reason of the beforesaid arrangement of gear wheels 38f, 39f, 40f, and 41f. The inlet bores 32f and 33f can, as shown, communicate by radial inner ends b32 and b33 directly with the annular working space 9f which simply by way of example, is shown as of circular cross-section instead of rectangular cross-section as shown in the previous example. Compression

4

springs c^1 can be provided with the bolts c to obtain the requisite resiliency in the engagement of the wall of the working space 9f with the radial pistons 1 equivalent to the effect obtained by the beforesaid spring loaded plungers 15f, which are not required in the present embodiment. The arrangement of inlet and outlet ports, passages and associate valves is substantially the same in the present embodiment as in the prior described embodiment as will be evident by comparison of Figure 6 with Figure 1 of the drawings.

I claim:

1. A rotary pump or compressor comprising two rotor bodies, a driving shaft fixed to one of said rotor bodies, a driven shaft coaxial with the driving shaft and fixed to the other rotor body, means pressing the two rotor bodies into close bearing contact with each other, an annular working chamber formed in the opposed faces of the two rotor bodies concentrically in relation to said shafts, radial pistons located in said working chamber and subdividing the working chamber into a number of working spaces, said radial pistons comprising two sets arranged in diametrically opposed pairs, one set being fixed in relation to one rotor and the other set being fixed in relation to the other rotor, inlet and outlet ports on opposite sides of each radial piston, inlet passages in said driven shafts communicating with said inlet ports, outlet passages in said driving shaft communicating with said outlet ports, non-return valves controlling the flow of fluid to and from said ports, and means transmitting rotation from the driving to the driven shaft to provide at each complete rotation of the driving shaft alternate acceleration and deceleration of one rotor relatively to the other, whereby the successive opposed faces of the pistons move towards each other and away from each other during each rotation of the driving shaft.

2. A rotary pump or compressor comprising two rotor bodies, a driving shaft fixed to one of said rotor bodies, a driven shaft coaxial with the driving shaft and fixed to the other rotor body, means pressing the two rotor bodies into close bearing contact with each other, an annular working chamber formed in the opposed faces of the two rotor bodies concentrically in relation to said shafts, radial pistons located in said working chamber and subdividing the working chamber into a number of working spaces, said radial pistons comprising two sets arranged in diametrically opposed pairs, one set being fixed in relation to one rotor and the other set being fixed in relation to the other rotor, inlet and outlet ports on opposite sides of each radial piston, inlet passages in said driven shaft communicating with said inlet ports, outlet passages in said driving shaft communicating with said outlet ports, non-return valves controlling the flow of fluid to and from said ports, a train of gear wheels connecting the driving shaft to the driven shaft, two of the gear wheels of the train having contiguous opposed surfaces, a lateral projection carried by one of said two wheels of the train and a channel in the other of such two gear wheels slidably receiving said projection, and means to adjust the axis of one of said gear wheels substantially radially relatively to the axis of the other whereby a variable throw connection from one of said gear wheels to the other is provided to obtain alternating acceleration and deceleration of the driven shaft relatively to the driving shaft so that the successive opposed faces of the pistons move towards each other and away from each

5

6

other during each rotation of the driving shaft.

3. A rotary pump or compressor comprising two rotor bodies, a driving shaft fixed to one of said rotor bodies, a driven shaft coaxial with the driving shaft and fixed to the other rotor body, means pressing the two rotor bodies into close bearing contact with each other, an annular working chamber formed in the opposed faces of the two rotor bodies concentrically in relation to said shafts, radial pistons located in said working chamber and subdividing the working chamber into a number of working spaces, said radial pistons comprising two sets arranged in diametrically opposed pairs, one set being fixed in relation to one rotor and the other set being fixed in relation to the other rotor, inlet and outlet ports on opposite sides of each radial piston, inlet passages in said driven shaft communicating with said inlet ports, outlet passages in said driving shaft communicating with said outlet ports, non-return valves controlling the flow of fluid to and from said ports, a housing enclosing the said rotor bodies, bearings in said housing to support said shafts, a train of gear wheels connecting the driving shaft to the driven shaft, and a variable throw crank device connecting two of the gear wheels of the train to obtain alternating acceleration and deceleration of the driven shaft relatively to the driving shaft so that the successive opposed faces of the pistons move towards each other and away from each other during each rotation of the driving shaft.

4. In a rotary pump including a pair of rotors and having means adapted to transmit rotation of one rotor to the other in an alternating accelerating and decelerating manner when said rotors are rotated in the same direction, shaft means for rotatably supporting said rotors for uni-directional rotation having a plurality of inlet and outlet passages defined therein, an annular working chamber formed by said rotors concentrically surrounding the shaft means, a set of radial pistons fixed to one of the rotors, a like set of radial pistons alternating with the first set of pistons and fixed to the other rotor, inlet and outlet ports defined in said working chamber on opposite sides of each of said radial pistons, said inlet ports communicating with said inlet passages in said shaft means and said outlet ports communicating with said outlet passages, and check valves normally seated in the opposite ends of said shaft means from the said ports of the passages in said shaft means, said inlet passages extending from one end only of the said shaft means to the working chamber of the rotor, and the outlet passages extending only from the said working chamber to the opposite end of said shaft means from which extend said inlet passages, to thereby provide a substantially uni-directional flow of fluid axially through the said shaft means from one end thereof to the other by way of the said working chamber adjacent one side of each radial piston and out of the said chamber from the opposite side of each radial piston, and out of the other end of the said shaft means.

5. A rotary pump or compressor comprising two rotors, a driving shaft fixed to one of said rotors, a driven shaft coaxial with the driving shaft and fixed to the other rotor, an endless annular working chamber formed in one of the two rotor bodies concentrically in relation to said shafts, radial pistons located in said working chamber and subdividing the working chamber into a number of working spaces, said radial pistons comprising two sets arranged in dia-

metrically opposed pairs, one set being fixed inside the said endless annular working chamber by attachment to one of said rotors and the other set being fixed to the inner periphery of the other rotor so as to extend between the first set of pistons, inlet and outlet ports on opposite sides of each radial piston, inlet passages in said driven shaft communicating with said inlet ports, outlet passages in said driving shaft communicating with said outlet ports, non-return valves controlling the flow of fluid to and from said ports, housed in said passages in said shafts, and means transmitting rotation from the driving to the driven shaft to provide at each complete rotation of the driving shaft alternate acceleration and deceleration of one rotor relatively to the other, whereby the successive opposed faces of the pistons move towards each other and away from each other during each rotation of the driving shaft.

6. A rotary pump or compressor comprising a housing, a plurality of concentrically arranged shafts, a pair of rotors mounted within the said housing in driving and driven relation on said shafts, an endless enclosed annular working chamber in one of said rotors, radial pistons in said working chamber arranged at diametrically opposed positions fixed to the interior portion of said rotor, radial pistons fixed on the inner periphery of the other rotor at diametrically opposed positions so as to project between the before said pistons, one of said shafts being a driving shaft fixed to the said latter rotor, the said first rotor being formed as a fixed enlargement of one end of another one of the said shafts and rotating inside the first-mentioned rotor with its periphery shaped to complete the cross-sectional continuity of said working chamber; means transmitting rotation from one shaft to the other to provide at each revolution alternate acceleration and deceleration of one rotor relatively to the other, means controllable from outside the housing for adjusting the speed variation of one rotor relatively to the other, inlet passages in one of said shafts and outlet passages in the other of said shafts, a non-return valve in each of said inlet and outlet passages, said passages communicating with the annular working chamber on opposite sides of the said pistons, and an inlet opening in said housing connected to said inlet passages in one shaft and an outlet opening in said housing connected to said outlet passages in the other of said shafts.

7. A rotary pump or compressor comprising a housing, a plurality of concentrically arranged shafts, a pair of rotors mounted within the said housing in driving and driven relation on said shafts, an endless enclosed annular working chamber in one of said rotors, radial pistons in said working chamber arranged at diametrically opposed positions fixed to the interior of said rotor, radial pistons fixed on the inner periphery of the other rotor interposed between the before said pistons, one of said shafts being a driving shaft fixed to one of said rotors and another of said shafts being a driven shaft fixed to one of said rotors, the first-named rotor being formed as a fixed enlargement of one end of one of the shafts and rotating inside the other rotor with its periphery shaped to complete the cross-sectional continuity of said working chamber; a train of gear wheels connecting the driving shaft to the driven shaft, two of the gear wheels of the train having contiguous opposed surfaces and being slidable toward or away from each other, a lateral

projection carried by one of said two wheels of the train and a channel in the other of said two gear wheels for receiving said projection when the said wheels are slidably moved toward each other, and means operable from outside the housing to adjust the axis of one of said gear wheels substantially radially relatively to the axis of the other, whereby a variable throw connection from one of said gear wheels to the other is provided to obtain alternating acceleration and deceleration of the driven shaft relatively to the driving shaft, so that the successive opposed faces of the pistons move towards each other and away from each other on each rotation of the driving shaft, non-return valve controlled inlet passages in one of said shafts and non-return valve controlled outlet passages in another of said shafts, said passages communicating with the annular working chamber on opposite sides of the said pistons, an inlet opening in said housing connected to said inlet passages, and an outlet opening in said housing connected to said outlet passages.

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