L. H. ROGERS.

ROTARY AIR AND GAS PUMP.

APPLICATION FILED FEB. 7, 1906.

944,912.

Patented Dec. 28, 1909.

5 SHEETS—SHEET 1.

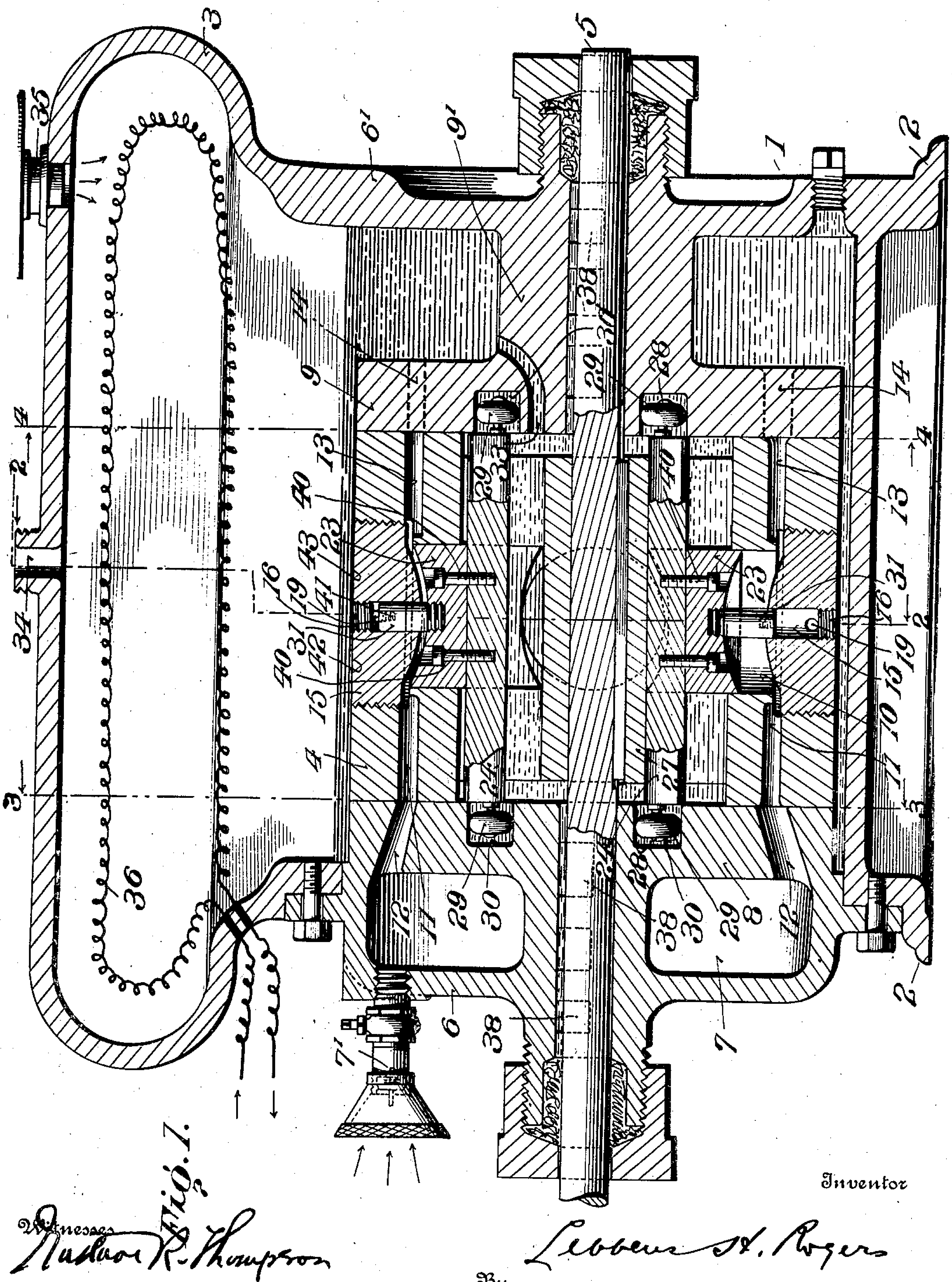

Fig. 1.

Witnesses

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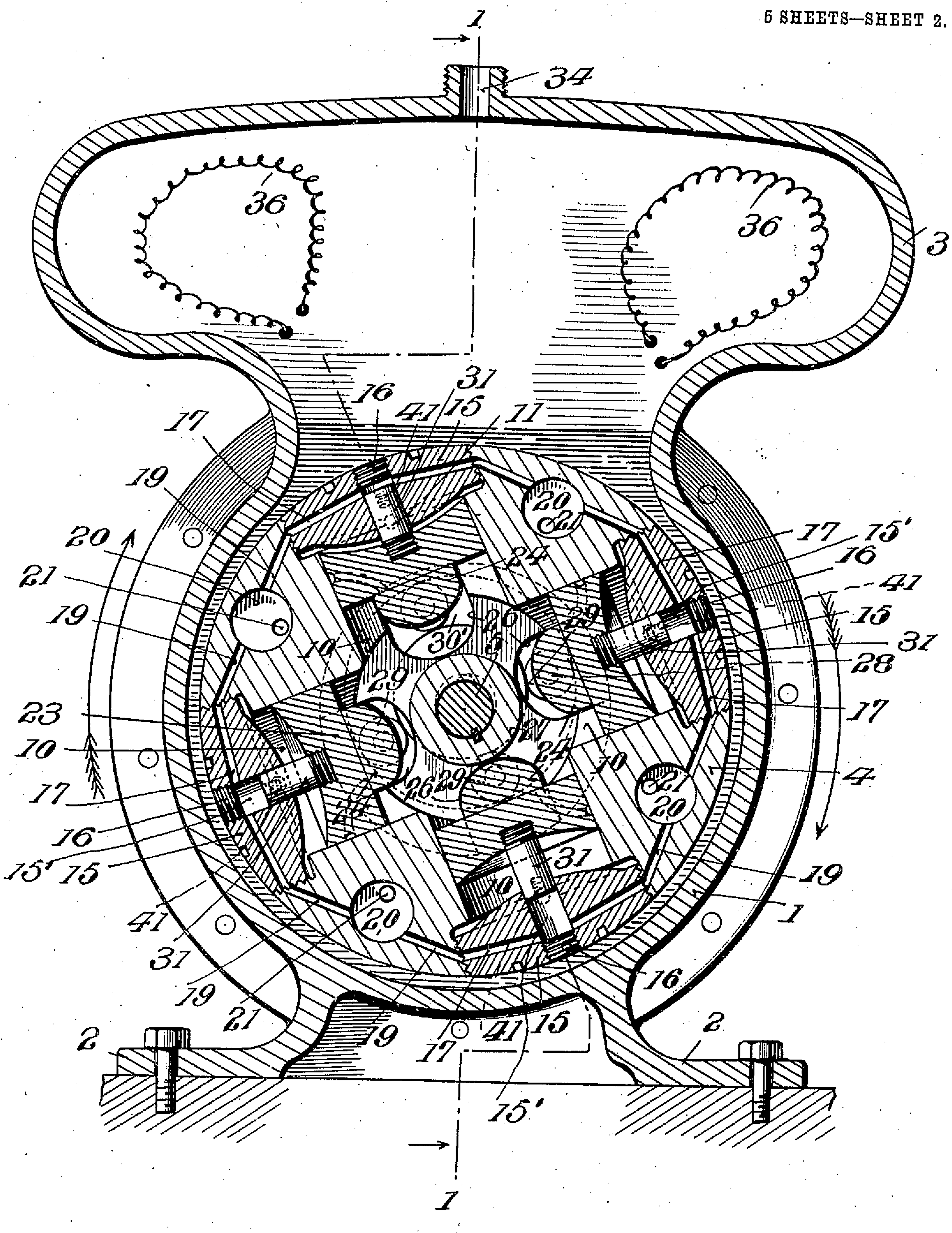

Fig. 2.

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6 SHEETS—SHEET 3.

Fig. 3.

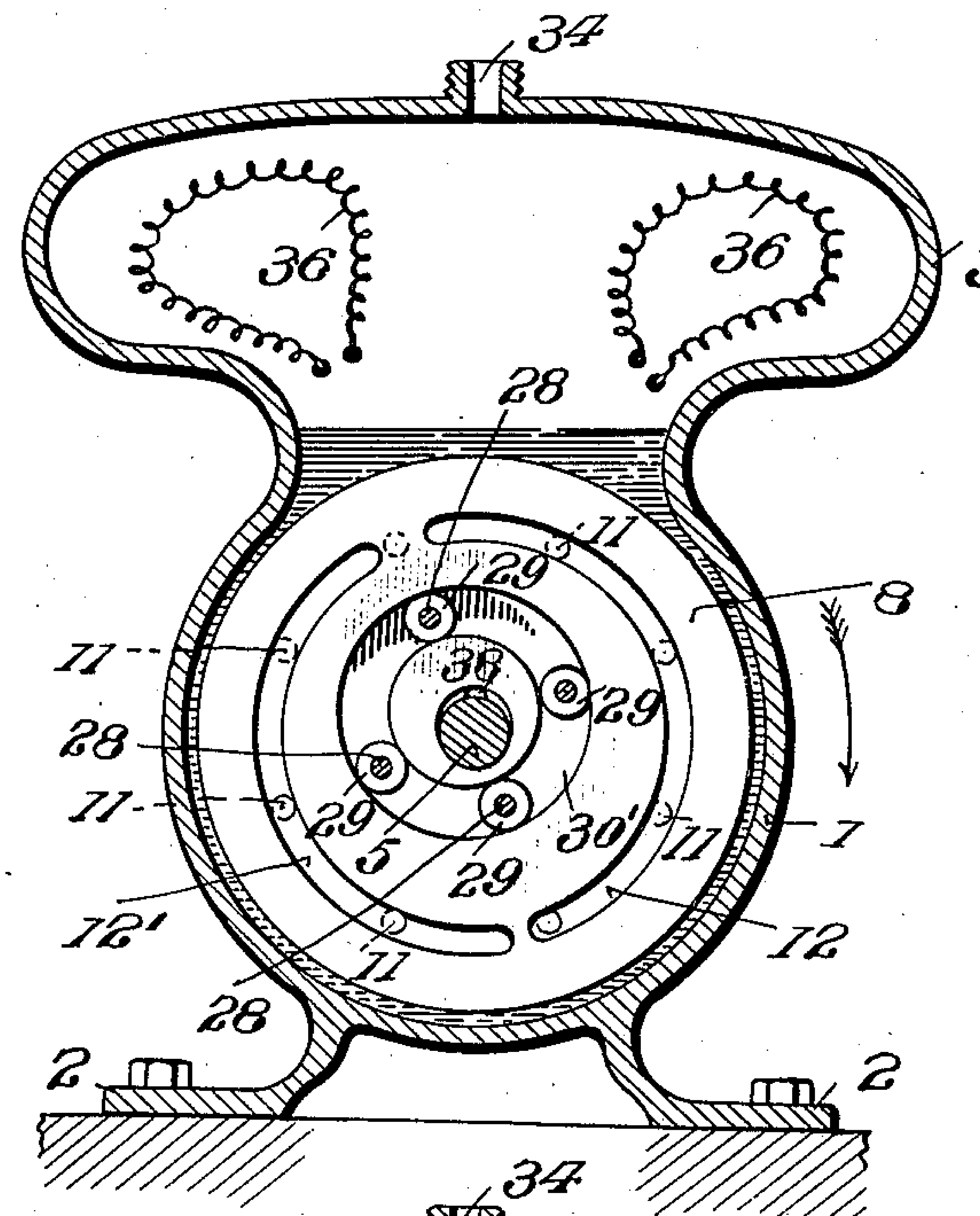
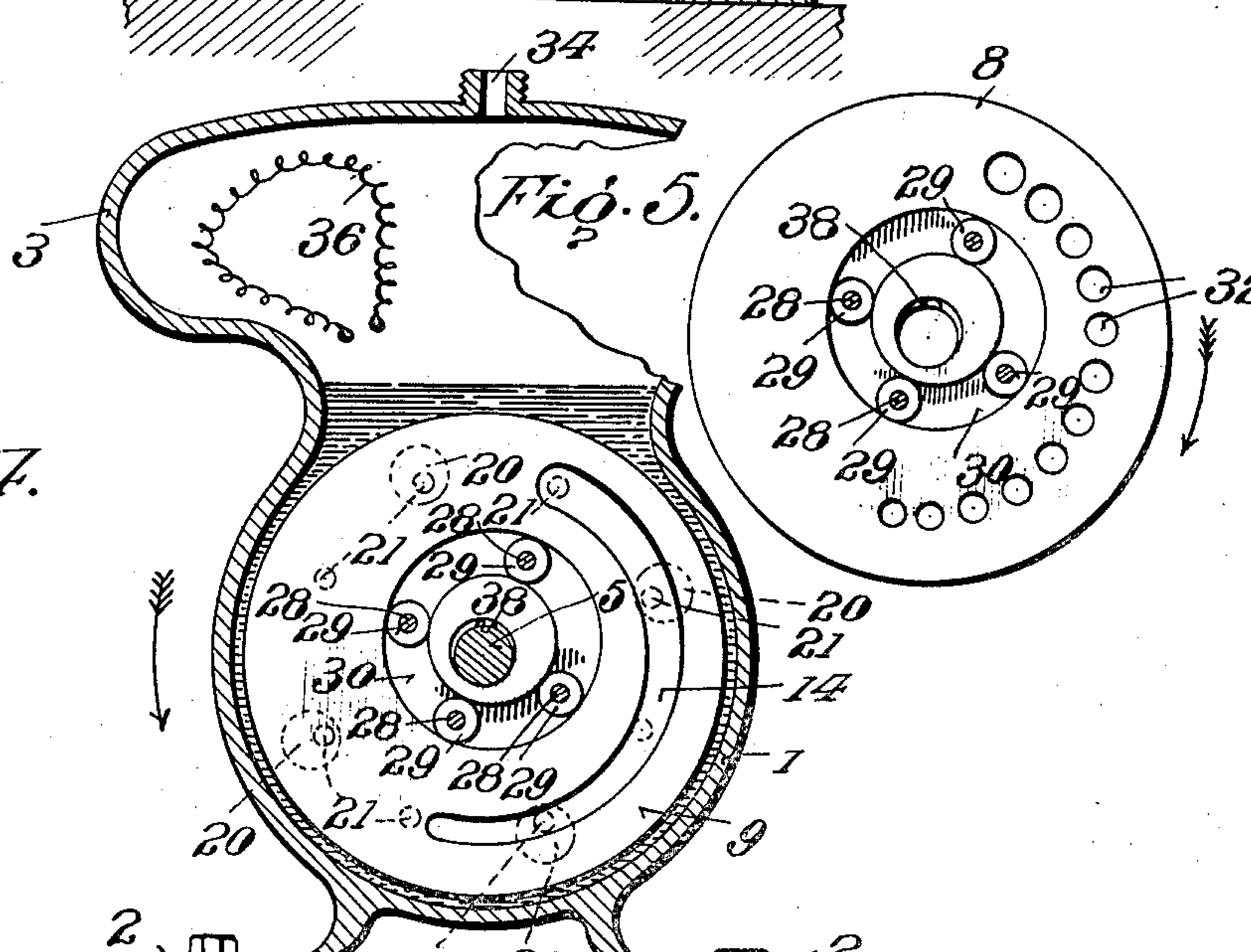


Fig. 4.

Fig. 5.



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5 SHEETS—SHEET 4.

Fig. 6.

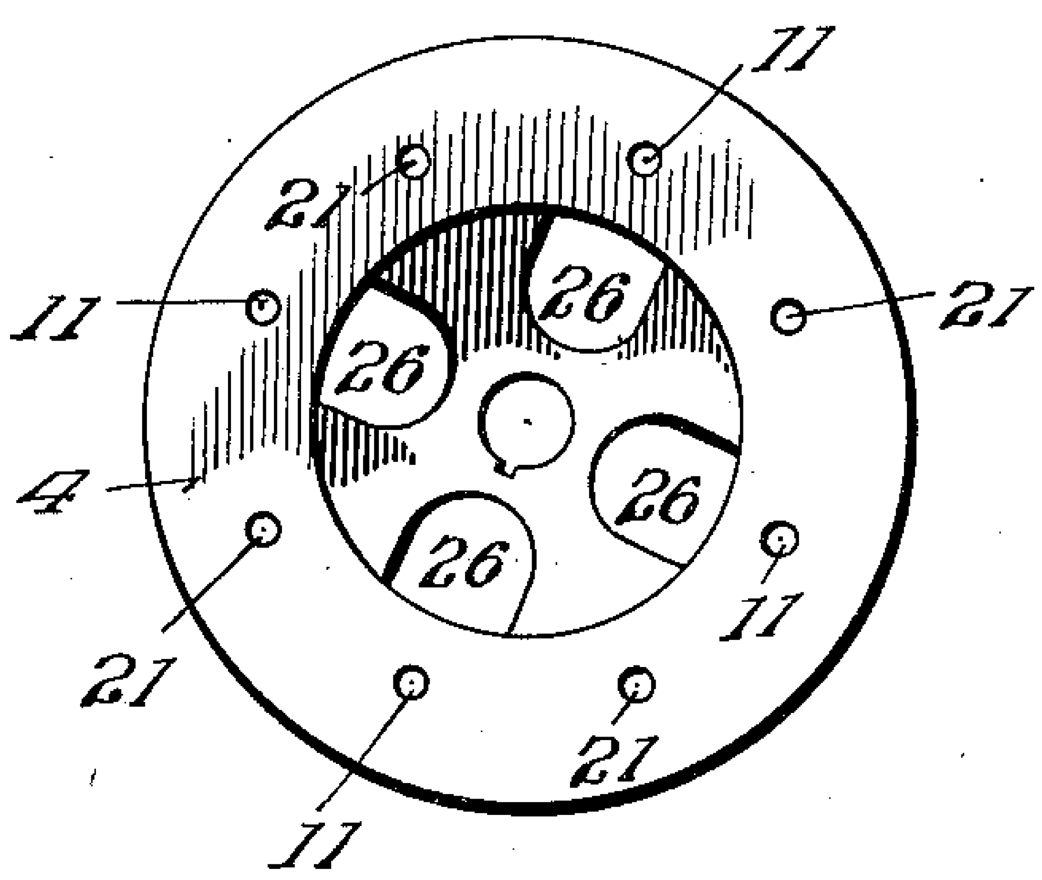


Fig. 7.

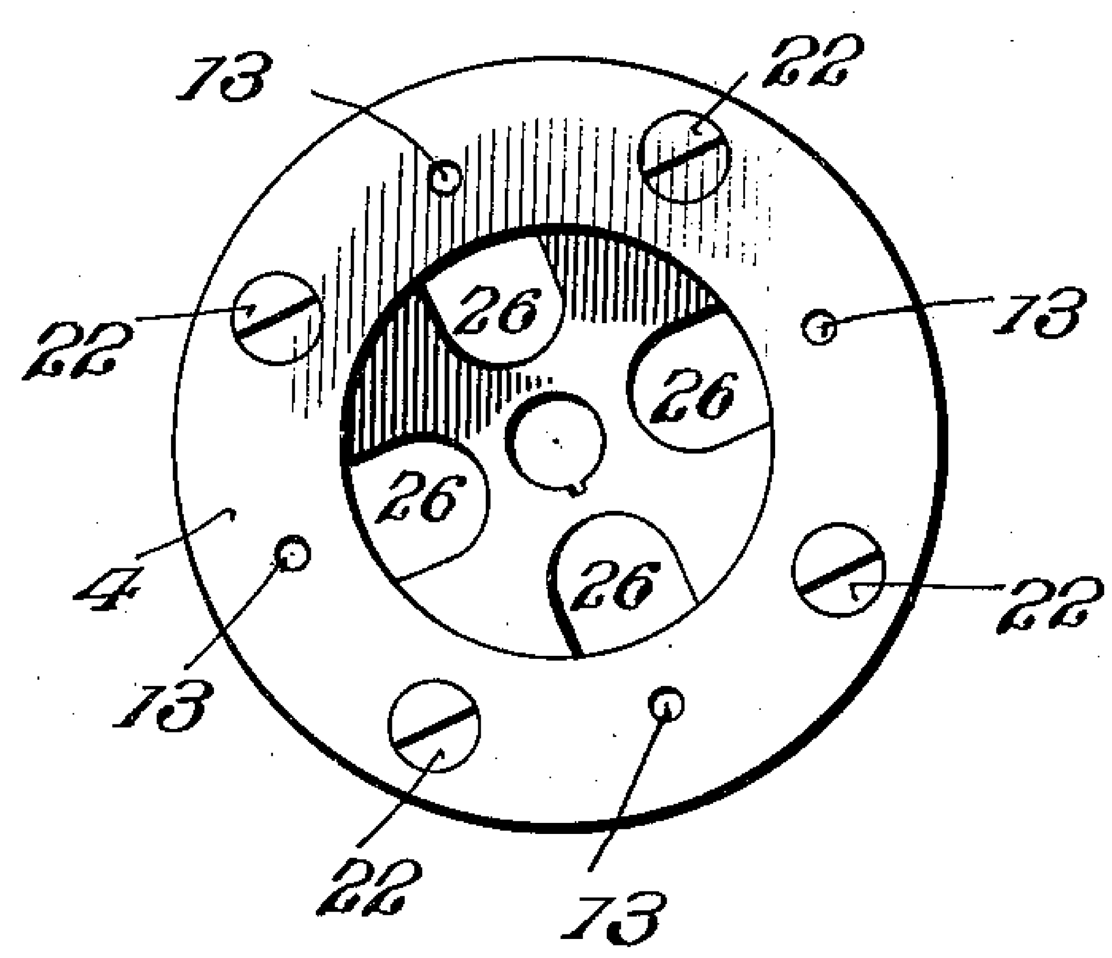


Fig. 8.

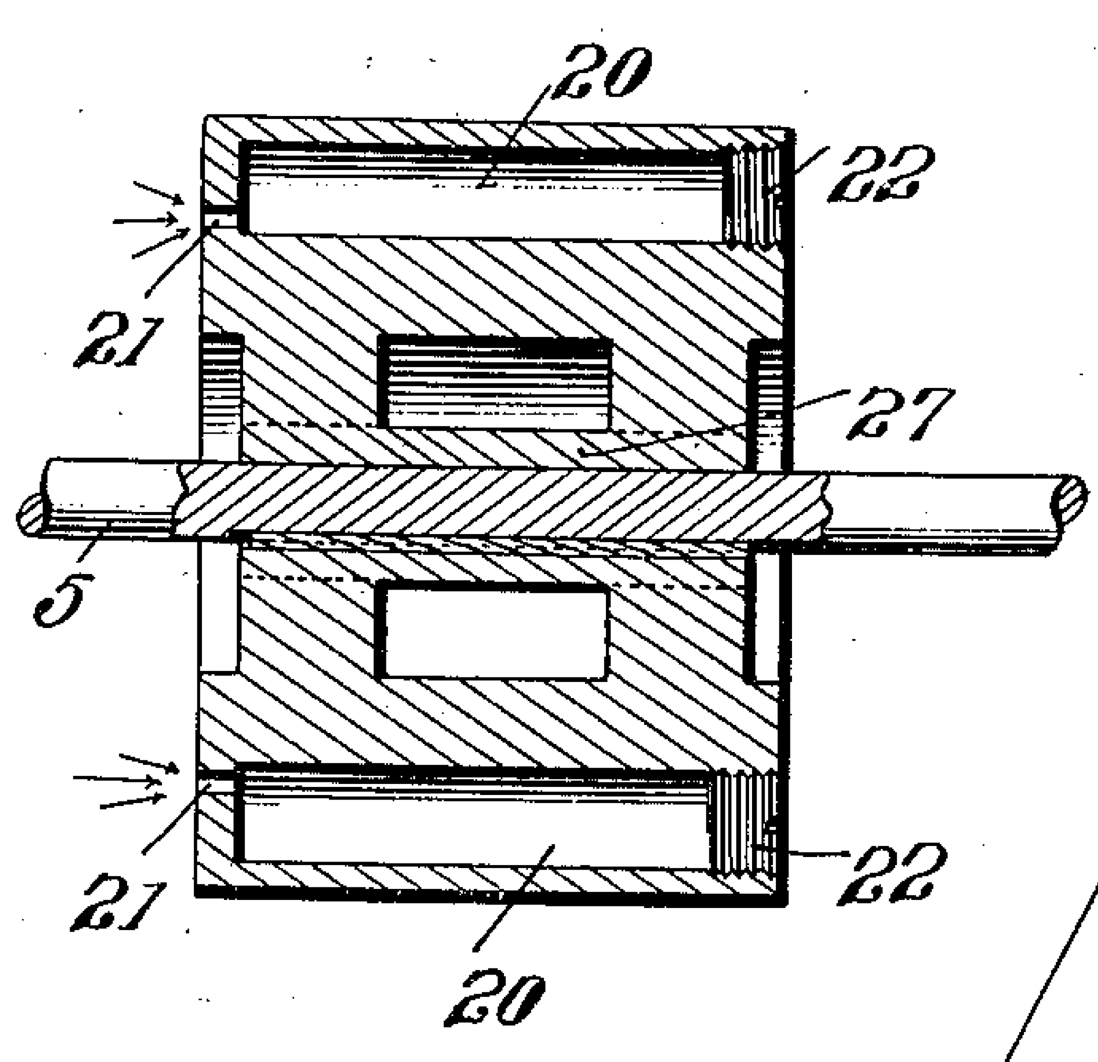
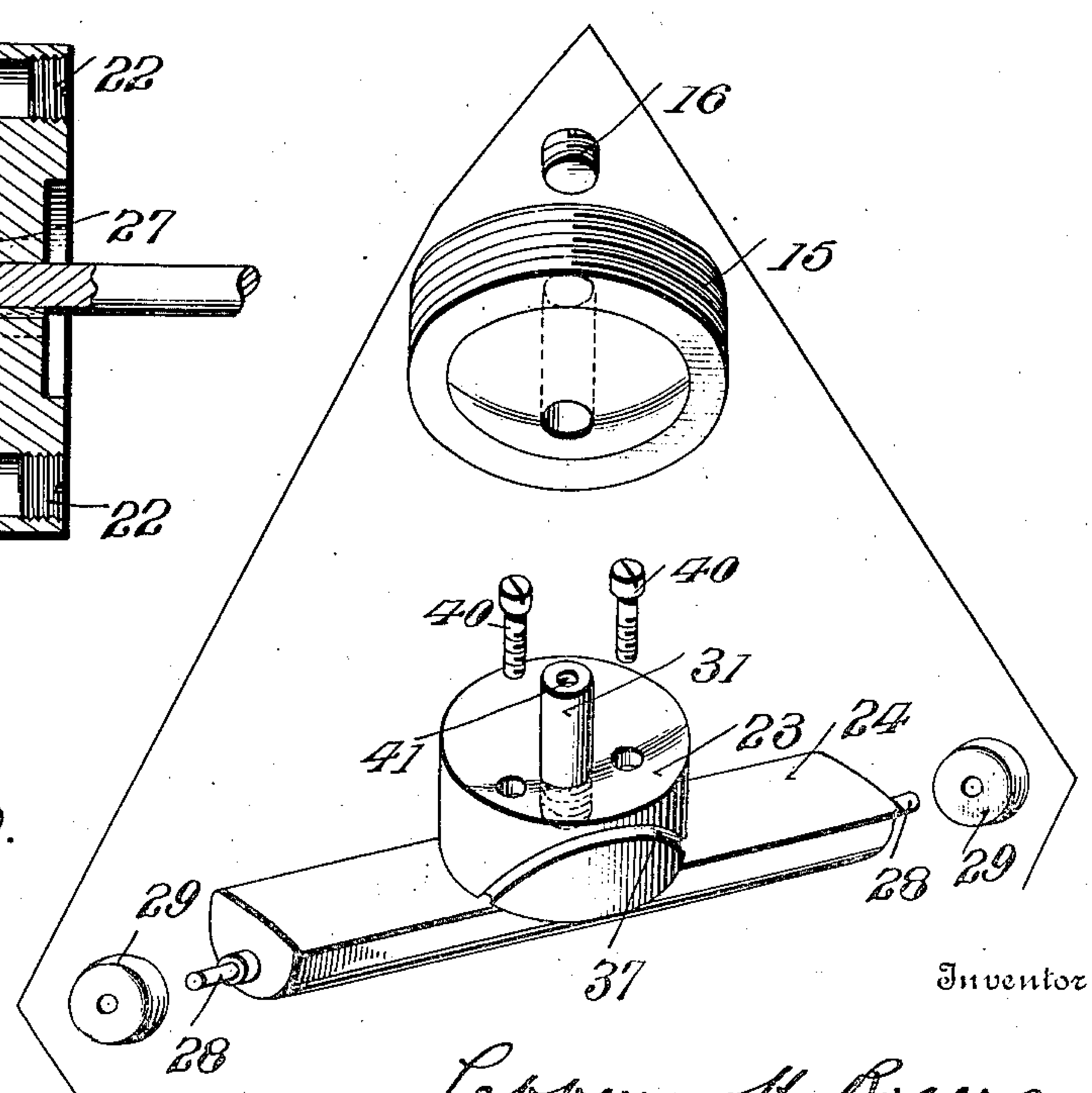


Fig. 9.



Witnesses

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5 SHEETS—SHEET 5.

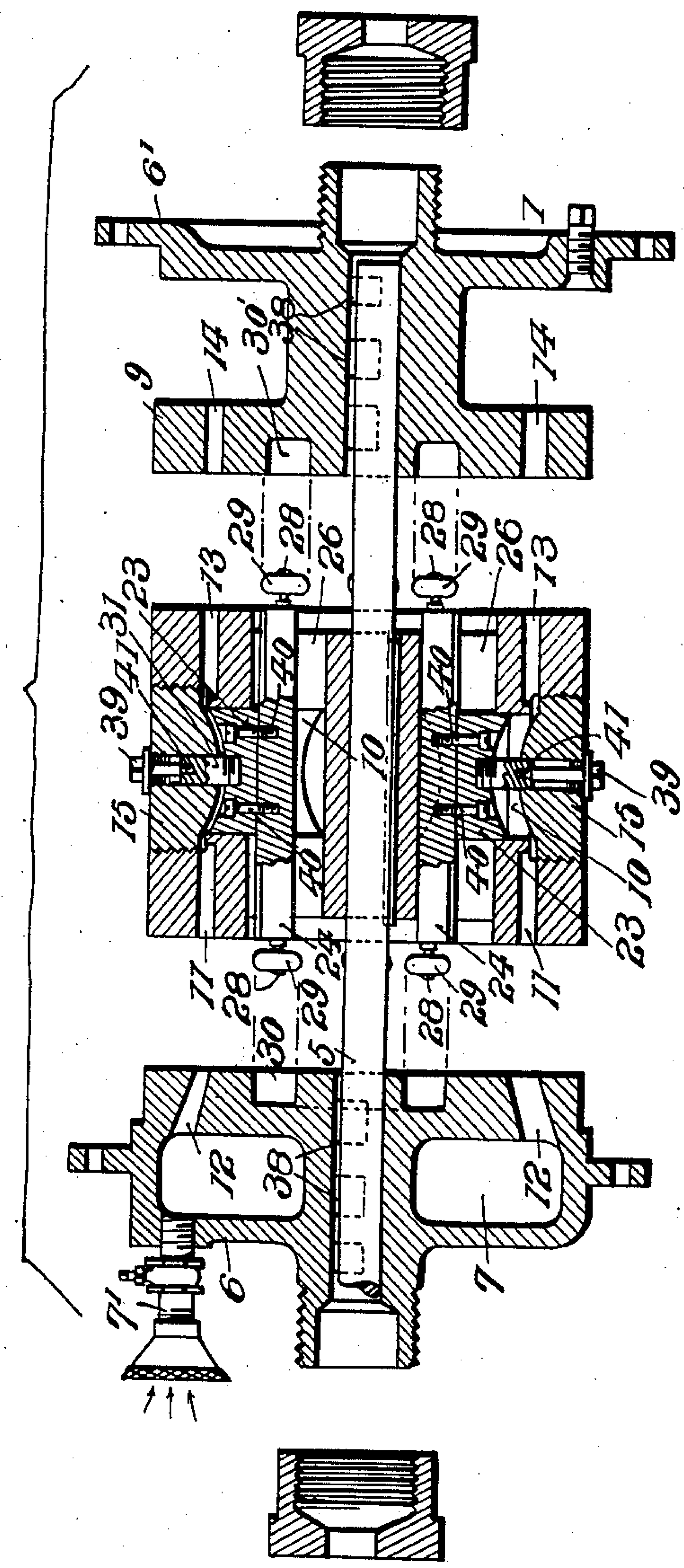

Fig. 11.

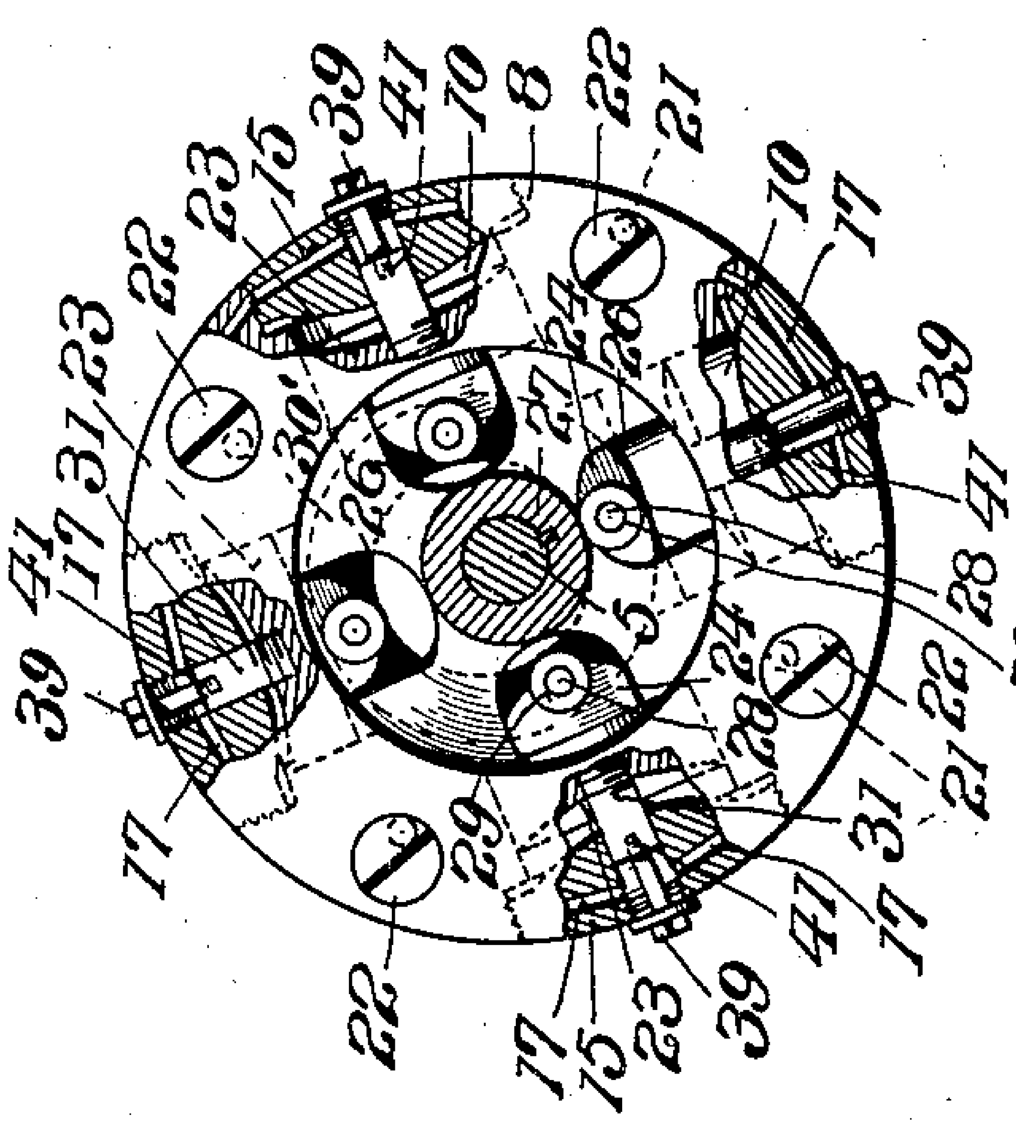

Fig. 10.

Witnesses

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UNITED STATES PATENT OFFICE.

LEBBEUS H. ROGERS, OF NEW YORK, N. Y.

ROTARY AIR AND GAS PUMP.

944,912. Specification of Letters Patent. Patented Dec. 28, 1909.

Application filed February 7, 1906. Serial No. 299,968.

To all whom it may concern:

Be it known that I, LEBBEUS H. ROGERS, of New York, N. Y., have invented a new and useful Improvement in Rotary Air and Gas Pumps, which invention is fully set forth in the following specification.

This invention relates to air and gas pumps, and more particularly to the kind of pumps known as "rotary pumps". While the invention is specially adapted to compression of air, it may be used for the compression of any other gas, or as a simple pump, or as a vacuum pump.

In my application, Serial No. 223,913, filed September 9, 1904, Serial No. 231,800, filed November 7, 1904 and Serial No. 243,868, filed February 2, 1905, I have shown compressors of this type in which a rotary drum provided with longitudinal channels having air inlet and outlet ports revolves in a suitable casing, said drum having pistons in the shape of closely fitting bars working in the channels in the drum and actuated by suitable cam faces carried by the casing. In these compressors oil or other suitable fluid under pressure has been introduced back of the reciprocating pistons to avoid clattering noises, friction, and for other purposes in the operation of the compressor.

The present invention embodies improvements upon the structures of the said applications and is designed to simplify the general construction whereby the parts may be exactly fitted with less manipulation, time and expense; to provide improvements in the application of fluid pressure for forcing the piston trunnions outward against the cam track on the compression stroke, thereby reducing clattering noises; to permit the piston drum to run in an oil seal through which the compressed air in whole or part is compelled to pass, thereby enabling the drum to run with less friction; to more effectually balance pressures on the drum and to insure at all times a supply of oil or other fluid under pressure behind the pistons; to provide for a freer exit of compressed air from the piston chambers with a consequent reduction of loss of energy dissipated by waste heat; and to generally improve the construction and operation of compressors of this type.

With these objects in view, the invention consists of the improved features of construction hereinafter described and then pointed out in the claims.

While the invention is capable of receiving various mechanical expressions without departing from the principle thereof, the preferred embodiment is shown for the purpose of illustration in the accompanying drawings, in which,

Figure 1 is a vertical longitudinal section on the lines 1—1 of Figs. 2, 3 and 4; Fig. 2 is a vertical transverse section on the line 2—2 of Fig. 1; Fig. 3 is a vertical transverse section on the line 3—3 of Fig. 1, looking toward the left; Fig. 4 is a vertical transverse section on the line 4—4 of Fig. 1; Fig. 5 is a view showing a modification of the cam plate; Figs. 6 and 7 are views showing respectively the left and right-hand ends of the piston-carrying drum; Fig. 8 is a longitudinal section taken through the piston drum, showing the air chambers; Fig. 9 is a perspective view of one of the pistons and drum closures with parts separated to more clearly illustrate the construction; Fig. 10 is an end view of the piston drum with parts broken away; and Fig. 11 is a longitudinal sectional view through the drum and part of the casing, with the ends of the casing separated to more clearly illustrate the manner of assembling the structure.

Referring to the drawings, 1 is a casing, the body portion of which is cylindrical in shape, resting on a base 2, and is provided with a top portion enlarged into an oil receiving and condensing dome 3. Within the cylindrical portion of the casing is a piston carrying drum 4, the diameter of which is slightly less than the interior diameter of the inclosing cylindrical casing, while its length is preferably less than its own diameter. This drum is mounted on and is fast to a shaft 5, having supports in bearings in the cylinder heads 6, 6′, which latter may be separable from the casing, or one may be integral therewith and the other separable. Within head 6 is an air receiving chamber 7, closed on one side by the outer wall or head 6 of the casing, and on the other side by a cam plate 8, against which abuts the face of the air receiving end of the drum 4. The opposite or compressed air delivery end of the drum bears against a cam plate 9 on a projection or hub 9′. As here shown, the cam plate is integral with the head, yet it is obvious that it may be made separable and secured to the head by means of bolts or by other fastening devices.

The piston drum 4 which is mounted between cam plates 8 and 9 is of slightly less diameter than the interior diameter of the compressor casing, thereby permitting a free access of oil or other fluid beneath and around the drum, and is formed preferably of a single casting. Within the drum are a plurality, four as illustrated, of cylindrical piston channels 10 radially disposed, each of said piston channels communicating in succession by an air inlet passage 11 with a slot or passage 12, in the cam plate 8, in communication with air receiving chamber 7, and similarly each of said piston channels 10, also communicate by a compressed air exit passage 13 through slot or passage 14, indicated by dotted lines in cam plate 9. Each of said piston channels at its outer end is provided with a removable closure, such as a screw plug 15, the outer face of which is flush with the sides of the drum and partakes exteriorly of its contour, and has a central opening 15′ closed at its outer end by a small screw plug 16, the purpose of which will appear later. Radially extending from this central opening in the plug 15 are passages 17, registering with corresponding passages 19, in the drum wall.

Referring to Figs. 2 and 8, the piston drum is provided with a series of longitudinally arranged air chambers 20, extending practically the length of the drum, one end being closed by the wall of the drum, except as to an air inlet opening 21, and the other end closed as by means of a screw plug 22. These air chambers 20 communicate with each other by way of passages 19 in the walls of the drum casting and passages 17 and the central openings in plugs 15, and are at all times subject to atmospheric pressure through passages 12 in cam plate 8, opening into air receiving chamber 7. It will thus be seen that the openings 15′ in plugs 15 are always in communication with a space in which is maintained atmospheric pressure. Within said cylindrical piston channels 10, reciprocate pistons 23, mounted on and secured to said piston carrying bars 24, the latter being preferably flat on their outer faces and rounded on their inner faces to conform to the base of the guide channels 26, thereby giving greater strength to the shaft bearing 27, than would be the case were the channels cut rectangular. Each of said piston carrying bars 24, is provided at its extremities with trunnions 28, having thereon bushings 29, which engage a circular eccentric cam track 30, in cam plates 8, 9, thereby giving to said bars a reciprocating movement as the shaft 5 rotates. The outer face of each piston 23 is slightly concave, the object of which is to enable the piston at the end of its inward stroke to retain a bearing within the piston channel 10, and seal the latter space from the oil space at the back of the pistons. Each of said pistons 23, is also provided with a supplementary piston or plunger 31, subject at all times to atmospheric pressure, and is secured thereto by means of a threaded connection or may be made integral with the compression piston 23. The plungers 31 work in openings or piston channels 15′ in closures 15 and by reason of the convex inner portion of said closure the piston 31 is not permitted to leave said channel 15 at the end of its downward stroke, thereby maintaining at all times, a separation between the air chambers 20 communicating with said piston spaces 15′ through channels 17, 19 and the air compression piston spaces 15.

In my prior applications 231,800 and 243,868 above referred to, I have shown and described cam plates on whose bearing faces were half circular grooves so positioned as to register with open passages in the end rings on the piston drum leading to and from the air compression channels in the drum. These half circle grooves offer limited passage especially for exit of the compressed air to escape toward the reservoir, and to overcome this, I have devised the following construction.

Referring to Figs. 3 and 4, in the face of each of the cam plates 8, 9, which are formed on or cast integral with the casing heads, are half circle slots 12, 14 which are cut through the cam plates. Slot 12 is so positioned that it opens into passage 11 on the atmospheric pressure side of drum 4, while slot 14 is so positioned that it lies opposite passages 13 on the pressure side of said drum. Slot or opening 14 on the pressure side may assume a variety of forms. The one shown in Fig. 4 gradually widens from one end to the other, the narrow end corresponding to the beginning of the outward or compression stroke of the piston. Although I have described above a slot having a varying width, I may use a slot of uniform width or a combined groove and slot in which the openings are bored through the bottom of the groove, or I may use a series of holes 32, Fig. 5 of uniform or varying diameter; however, the form preferred is a slot having a varying width as described above. Groove 12′ in the face of cam plate 8 has for its object to provide means for applying air under reservoir pressure to the pressure side and air admission end of the drum to balance the pressure exerted on the correspondingly opposite end of the drum. This feature has been set forth in my application 243,868 above referred to, and is not herein specifically claimed.

Mounted above the compression cylinder and forming a continuation of the same is a dome 3, which however may be separate and secured to the said casing by bolts or by other fastening means. The dome space communicates through opening 14, with the compression side of the piston drum and by a passage or passages 33, shown in full lines Fig. 1, with the spaces in rear of the pistons. The dome is provided with a delivery opening 34, to the pressure reservoir not shown, and also has an oil supply connection 35, for introducing oil into the cylinder casing. In cold weather, the oil in the compressor may become viscous or even solid during periods of rest, and to overcome this objection a heating coil 36 may be placed within the casing, through which a current may be passed to heat the oil. The capacity of dome 3, is such that it will hold all oil that may accidentally be forced upward from a round cylinder 4 at any one time, and also to contain all bubbles and froth which may result from forcing the air in contact or through the oil.

During the rapid rotation of the piston drum, the pistons 23, tend to press against that side of the piston channels back from the direction of revolution, thereby increasing wear on the rearward side of the pistons. To relieve this wear, I have provided each piston 23, with a groove 37, clearly shown in Fig. 9, and in dotted lines Fig. 1. This groove extends up and across the rear face of the piston and is at all times in communication with the oil space back of the pistons and is filled with oil under reservoir pressure. The result of this oil pressure on the piston is to force the latter away from the rear side of the piston channel sufficiently to relieve said back pressure and thereby reduce friction and wear on the said parts.

In Fig. 1 are shown chambers 38, in the bearings of shaft 5, which are in communication with the oil space in the piston drum and have for their purpose to counteract the pressure of the shaft against that portion of its bearings on the atmospheric pressure side of the drum, as fully set forth in my application Sr. No. 231,800 above referred to and therein claimed, and therefore constituting no part of the present invention.

In assembling the compressor, and in order to avoid difficulties that may arise in locating the pistons within their channels to properly correspond to their positions along the cam tracks, I have devised the following means for regulating the piston positions during the act of assembling the parts. Referring to Figs. 10 and 11, having fixed upon a given position for the drum 4 relative to the cam tracks 30, 30′ and having introduced the piston carrying rods into the drum and secured thereto the pistons 23 by bolts 40, screw plugs 15 are inserted and the small plugs 16 removed and replaced by bolts 39, taking into screw threaded sockets 41 in plungers 31. These bolts are of such lengths as to bring their respective pistons 23, into the predetermined position relative to the cam tracks, thereby enabling the drum when introduced into the cylinder to register its piston trunnions, with the cam tracks in the faces of the cylinder heads when the latter are placed in position. One of the cylinder heads may be integral with the casing, that at the pressure end of the cylinder being preferred, the opposite head being removable. In either case, the method of assembling the pistons will be the same. The assembling bolts 39 are now removed as through a manhole not shown, and replaced by plugs 16. Instead of having the assembling bolts 39 of different lengths, they may be all the same length, the threaded sockets in plungers 31 being of different depths. To facilitate the insertion and removal of the plugs 15, two holes 42, 43, are sunk in each plug face for the reception of a dowel wrench of any approved form.

The operation of the device as thus far described is as follows: The parts of the compressor having been assembled, oil or similar liquid is introduced into the cylinder through oil supply port 35, and finds its way through passage 33 into the drum spaces behind the pistons. The final level of oil should be slightly above the bottom of the piston at its most elevated throw and preferably above the top of the opening 14. Port 34 is put in connection with the pressure reservoir not shown. Assuming that the top of the drum 4 in Fig. 1 is moving away from the observer, while in Figs. 3 and 4 the direction of the arrows indicate the direction that the drum would take if present and moving past the cam faces, the top piston 23 will then be at the end of its outward stroke, and on the point of moving inward to draw in air by way of passage 11, slot 12, air inlet chamber 7, and valved inlet 7′. During the next half revolution, while piston 23 is on its instroke, the passage 11 is in open communication with the half circle slot 12, in cam face 8 and air enters, and the piston space is filled with air at atmospheric pressure. The exit passage 13 leading from the said piston channel is during the same half revolution closed by the solid portion of cam plate 9, which constitutes a cut-off for said passage. During the same half revolution, the air chambers 20, which are located intermediate the piston spaces 10, and which communicate with the spaces 15′ above plungers 31 and with each other, are in communication through passages 21 with slot 12, and therefore said chambers 20 are at all times in communication with the atmosphere and there is at all times during a complete revolution of the drum an atmospheric pressure on each plunger 31. The total air pressure exerted on said piston during its inward stroke is that on the concave face of the piston plus that on the end of plunger

31. The back of said piston is exposed to an opposing reservoir oil pressure against which the piston works. The power for moving the piston against this oil pressure is applied through shaft 5, first to the drum, thence to the trunnions, causing the same to bear against the outer cam track. As the air inlet passage 11 passes out of register with slot 12 and on to the cut-off or solid face of the cam plate 8, the pressures on the said piston are distributed as follows: To the rear of piston 23, the oil pressure is that of the reservoir. On the face of the piston within the piston channel 10 the pressure is now practically that of the reservoir since the said channel has been placed in communication therewith by registry of passage 13 with slot 14 and the oil seal in the casing. The effective area for the exertion of the reservoir pressure on the face of the piston is less however than that on the back of the piston which is also subjected to reservoir pressure. This difference arises from the construction and arrangement of the plunger 31 and atmospheric air chambers 20. On the face of each plunger 31, there is maintained atmospheric pressure. The total pressure therefore on the face of piston 23, during its second half revolution is made of the reservoir pressure as above described and air pressure on plunger 31. There is therefore an excess of reservoir oil pressure on the back of the said piston during this second half revolution which causes the piston to force its increment of air outward through the oil seal into the pressure reservoir and this excess of pressure furthermore urges the piston trunnions against the outer cam track on the second half revolution of the drum. The trunnions therefore run on the same cam track during the entire revolution of the drum. At the time when the piston reaches the terminus of its outward stroke the compressed air outlet 13 passes onto the solid face of cam plate 9, which latter serves as a cut-off for said passage, and the piston channel is closed for the reception of a new charge of air, and to again repeat the cycle of operations.

In order that the air within the piston channel during the compression stroke of the piston may not be unduly compressed before its discharge, thereby wasting heat to the neighboring parts of the drum, I have provided as above described a slot or series of openings through the cam plate 9, at the pressure end of the drum and on the compression side thereof, said openings being graduated in size to correspond to the rate of delivery of compressed air from said drum whereby the air may have freedom of escape to the pressure reservoir and without compelling the trunnions to work against the inner cam track, as might be the case were such provisions not made. In case the temperature surrounding the compressor lowers sufficiently to congeal the oil during periods of rest, the oil may be readily heated to the working temperature by means of the heating coils previously described or as set forth in my Patent #800,765.

The casting of the drum in one piece having a closed periphery and circular piston channels, enables me to do away with the separate end rings for closing the ends of the longitudinal piston channels shown in my prior constructions above referred to, and thereby simplifies the construction.

What I claim is:

1. In a rotary compressor or pump, the combination of a casing, a compression drum revoluble therein and provided with reciprocating pistons, the rears of said pistons being subject to the pressure within the said cylinder and means for maintaining an area of atmospheric pressure on the face of each piston.

2. In a rotary compressor or pump, the combination of a cylinder, a compression drum therein provided with radial piston channels having openings at the ends of said drum, pistons in said channels, the rear faces of said pistons being subject to the pressure within the casing and means for applying atmospheric pressure to the front face of each piston on its compression stroke.

3. In a rotary compressor or pump, the combination of a casing having an oil compartment therein, a revoluble piston carrying drum in said casing, a conduit leading oil to the rear of said pistons from said compartment, and means for the application of atmospheric pressure to the face of each piston on its compression stroke.

4. In a rotary compressor or pump, the combination of a casing, an oil receiving dome thereon, a compression drum revoluble in said casing, reciprocating pistons in said drum, the rear faces of said pistons being subject to the pressure within the casing and means for applying the atmospheric pressure to the front face of each piston on its compression stroke.

5. In a rotary compressor or pump, an integral cast-metal drum having piston channels therein opening at the ends of said drum and air chambers communicating with each other and having openings in one face of said drum and in operative relation to said piston channels.

6. In a rotary compressor or pump, a drum having a piston channel therein opening at the end faces of the drum, and an air chamber in said drum having an opening in one face of said drum, said chamber being in operative relation to said piston channel.

7. In a rotary compressor or pump, an integral cast-metal drum having a plurality of cylindrical piston channels and openings in the end faces of said drum leading to said

channels, said channels having openings on the periphery of said drum and provided with removable closures, and a series of air chambers in said drum communicating with each other through said closure and with the atmosphere through openings in one face of the drum.

8. In a rotary compressor or pump, an integral cast-metal drum, having cylindrical piston channels therein, openings in the end faces of said drum leading to said channels, and having peripheral openings leading to said channels, the said last openings having removable closures.

9. In a rotary compressor or pump, the combination of a casing adapted to contain a body of oil, a dome mounted on said casing and in open communication therewith, a piston carrying drum mounted to rotate within said casing and having at one end air inlet ports and at the other end compressed air outlet ports opening into said casing.

10. In a rotary compressor or pump, the combination of a cylindrical casing, a dome above said casing, an air inlet chamber, oppositely disposed cam plates, one of which forms a wall of said air chamber and the other supported on and extending from the opposite end of the casing, a revoluble drum, having piston channels mounted between said plates, and provided with cam operated pistons, said plates having slots opening into and out of said channels, said second plate having a passage for leading oil under pressure from the interior of said casing back of said pistons.

11. In a rotary compressor or pump, the combination of a cylindrical casing, an air inlet chamber at one end of said casing, a revoluble integral cast-metal drum in said casing and having piston channels therein, cam plates, one forming one wall of said air chamber, the other supported on and extending from the opposite end **wall** of said casing, a plurality of cam operated pistons in said drum and slots in said cam plates communicating with said piston channels, the second of said plates having a passage connecting the interior of the casing with the spaces back of the pistons.

12. In a rotary compressor or pump, the combination of a casing, an integral cast-metal drum in said casing having a plurality of radially extending cylindrical piston channels, pistons in said channels, cam plates fast to the heads of said casing engaging said pistons to reciprocate the same, and having slots therein, opening into and out of said piston channels, one of said plates also having a passage or passages leading from the spaces behind the pistons to the interior of said casing for leading oil under pressure to the backs of pistons.

13. In a rotary compressor or pump, the combination of a casing, a compression drum in said casing, radially disposed cylindrical piston channels in said drum, pistons therein and subject to the fluid pressure within said casing on their rear faces, a plurality of communicating air chambers in said drum in communication with each other and with the atmosphere, and means for applying the fluid pressure in said chambers to the face of each piston on its compression stroke.

14. In a rotary compressor or pump, the combination of a casing, a compression drum in said casing, radially disposed cylindrical piston channels in said drum, subject to the fluid pressure within the casing on their rear faces, pistons therein, said drum having a plurality of communicating air chambers in communication with the atmosphere, and plungers fast to said pistons and subject to the air pressure in said chambers.

15. In a rotary compressor or pump, the combination of a casing having in one end wall an air inlet chamber, oppositely disposed cam plates integral with the end walls of said casing, a compression drum revolubly mounted in the chamber, pistons in said drum operated by cam tracks in said cam plates, an air inlet slot in one of said cam plates on the atmospheric pressure side of said drum and an air exit slot in the second cam plate on the pressure side of said drum opening into said casing, a conduit through said second cam plate leading to the rear of said pistons from the interior of said casing and means for applying atmospheric pressure to the face of each of said pistons on its compression stroke.

16. In a rotary compressor or pump, the combination of a revoluble integral cast-metal drum having piston channels therein and cam actuated pistons in said channels, one end of said drum having air inlet ports to said channels and the opposite end of said drum having ports for delivering compressed air from said channels, cam plates bearing against the ends of said drum and each having an extended opening therein registering with said ports during a partial revolution of said drum, and one of said plates having a solid portion acting as a cut-off during the remainder of said revolution, the cam plate at the pressure end of said drum having a passage therein for supplying fluid under pressure to the backs of said pistons.

17. In a rotary compressor or pump, a cylindrical casing having therein a body of oil, a compression drum mounted to revolve in said casing and of a diameter slightly less than the inner diameter of the casing to enable an equal distribution of reservoir pressure by said body of oil to the peripheral surface of said drum and a dome constitut-

ing the top of said casing for receiving and condensing oil spray and bubbles resulting from compressed air passing through said oil.

18. In a rotary compressor or pump, a casing, a drum therein, pistons in said drum having trunnions, cam plates each provided with a cam track eccentric to said drum and engaging said trunnions, slots or openings in said cam plate to receive and deliver air from said drum, the delivery slot varying in width from one end to the other.

19. In a rotary compressor or pump, a casing, a compression drum therein having circular piston channels and pistons therein, each of said pistons having a groove on the side opposed to the forward rotation of the drum and communicating with a fluid pressure supply.

20. In a rotary compressor or pump, a casing, a compression drum therein having a plurality of piston channels, pistons provided with cam actuated trunnions in said channels, plungers fast to said piston faces and having screw threaded sockets, and means engaging said sockets for adjusting said pistons in their channels during the assembling of said compressor.

21. In a rotary compressor or pump, a drum having a piston channel and a piston therein, said drum having a fluid pressure chamber open to a source of constant pressure and to a part of the piston face during both the intake and delivery stroke of the piston.

22. In a rotary compressor or pump, the combination of a casing having therein a body of oil, a rotary compressor drum in said casing having compressed air outlets opening beneath the surface of the oil, a dome constituting the top of said casing and a heating coil within the casing.

23. In a rotary compressor or pump, the combination of a casing having therein a body of oil, a rotary compressor drum in said casing having compressed air outlets opening beneath the surface of the oil, and a dome constituting the top of said casing for receiving oil displaced by the air expelled from the compressor drum.

24. In a rotary compressor or pump, the combination of a casing containing a body of oil, a drum within said casing having piston channels and pistons therein, said drum being mounted to revolve in said body of oil and having passages delivering through one end of the drum and beneath the oil level.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

LEBBEUS H. ROGERS.

Witnesses:

L. HARDING ROGERS, Jr.,

LELAND DE GRAAF.