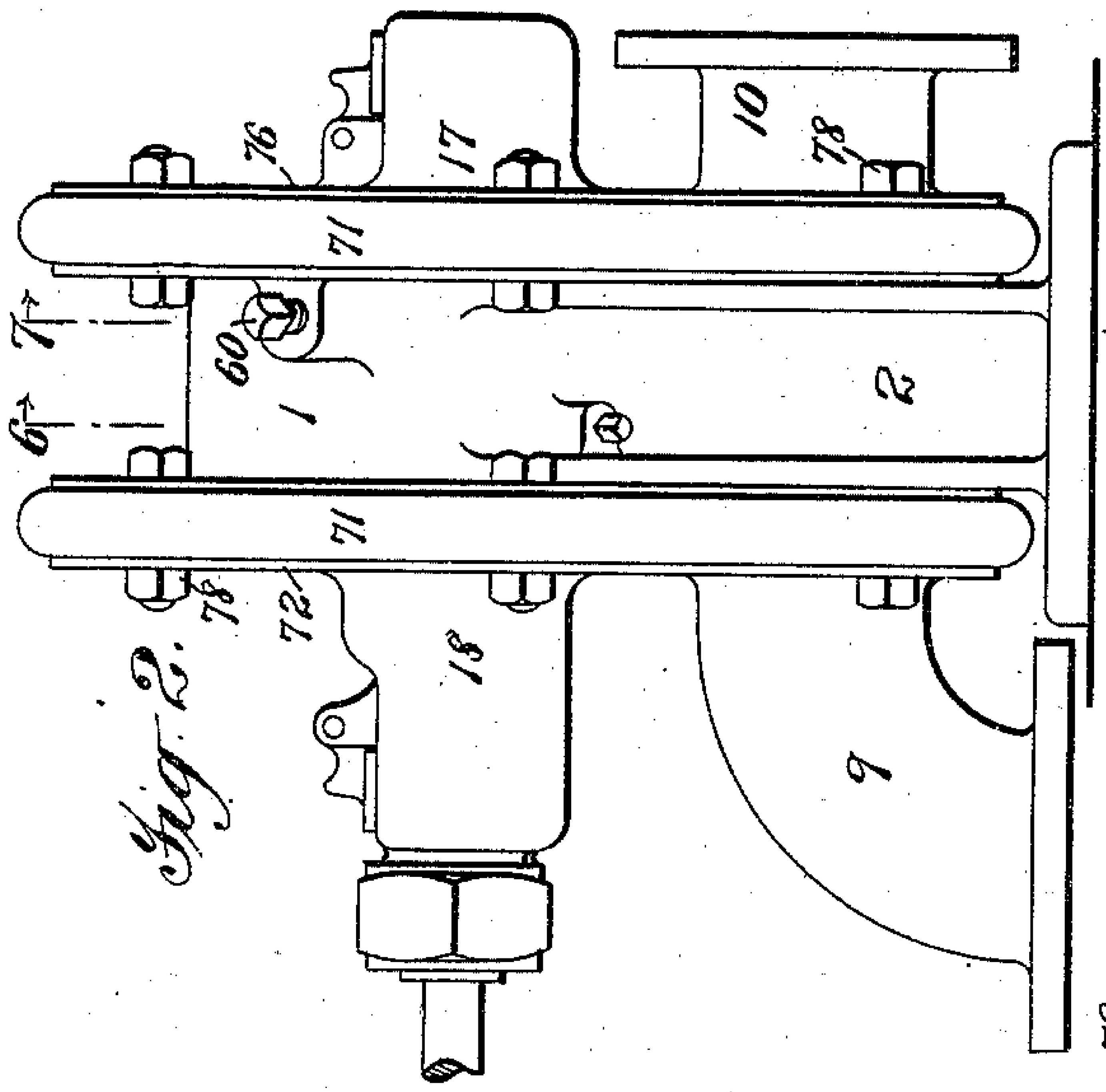
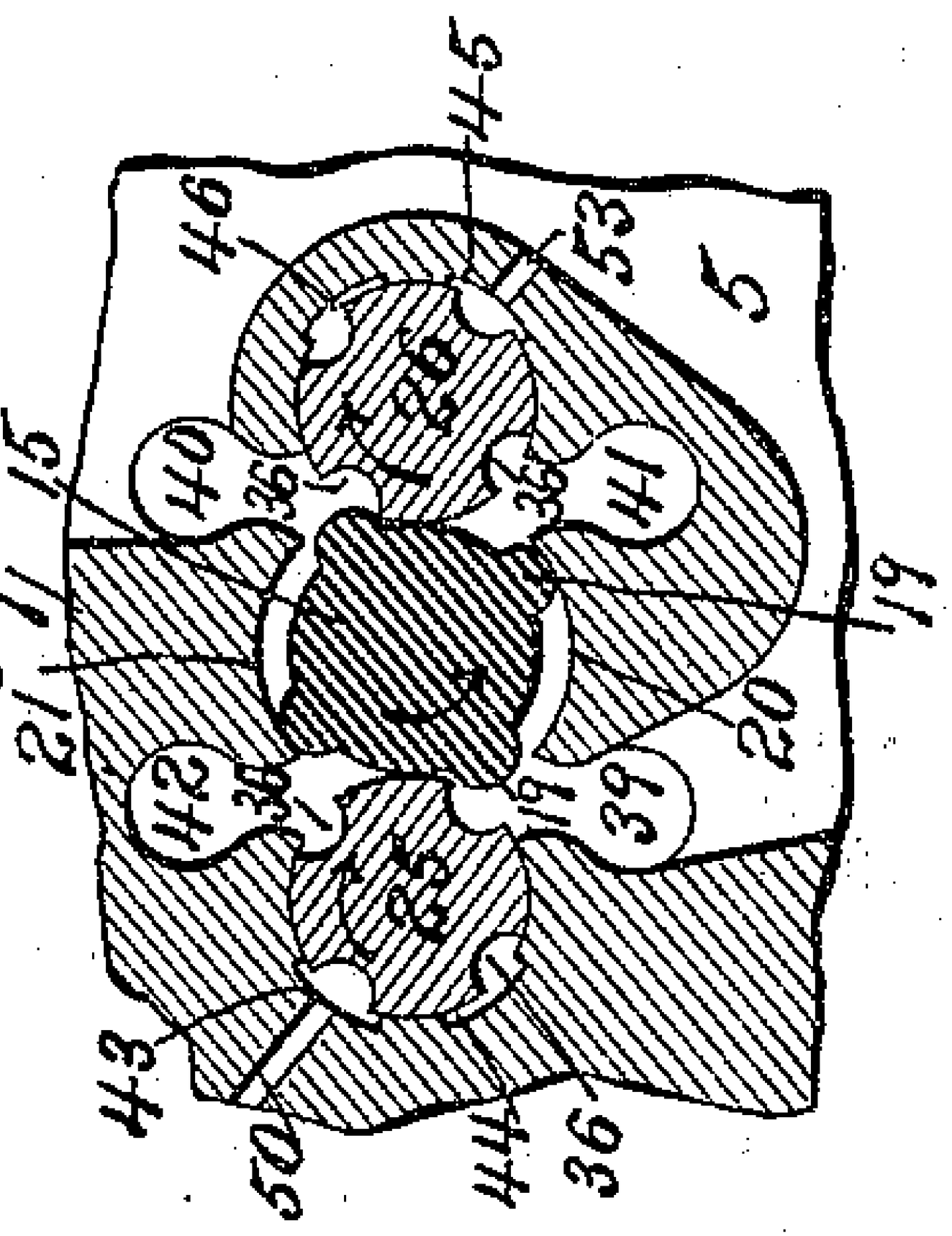
(No Model.) 2 Sheets—Sheet 1.

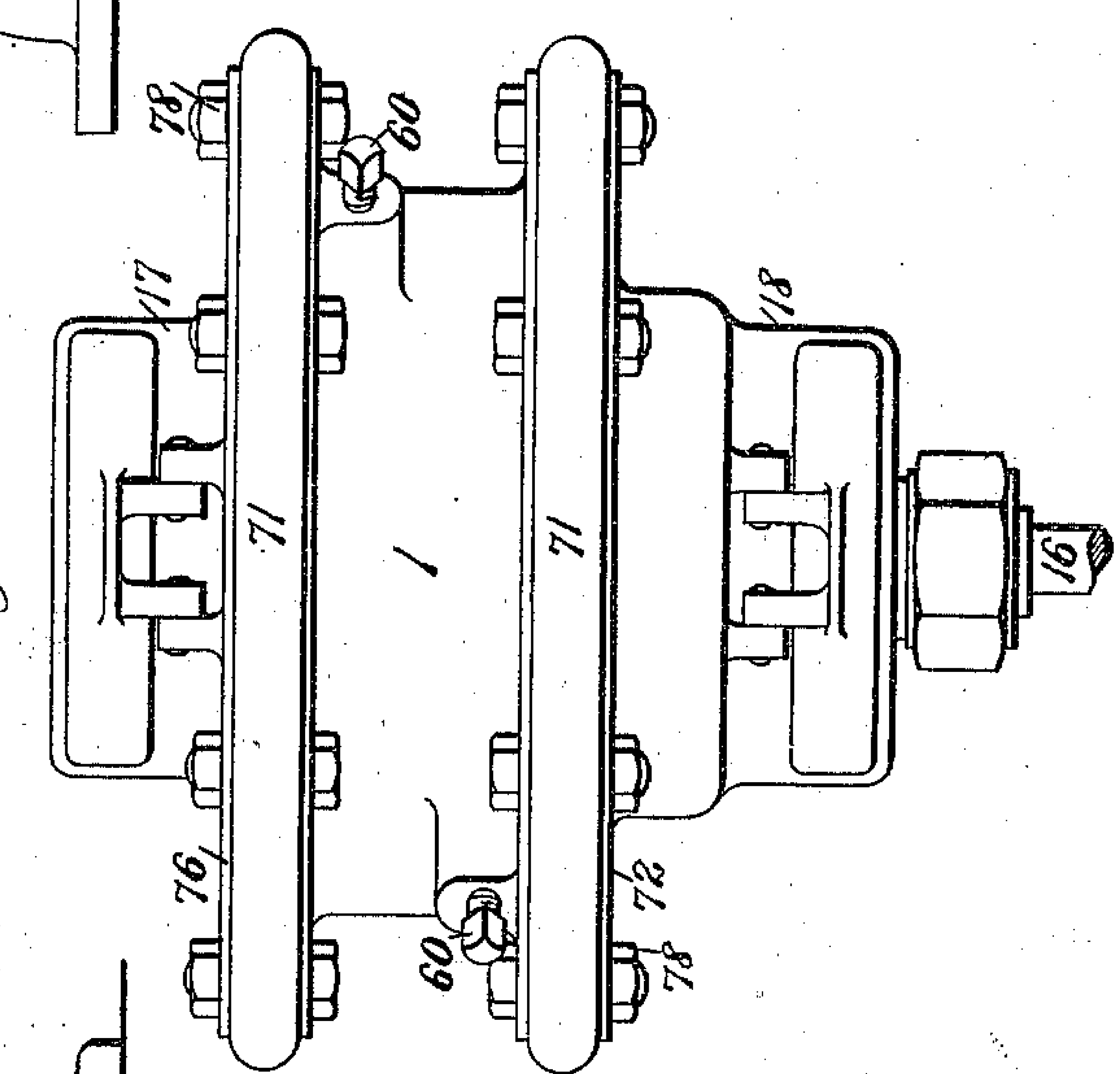
F. MARBURG, Jr. & D. C. STONE.

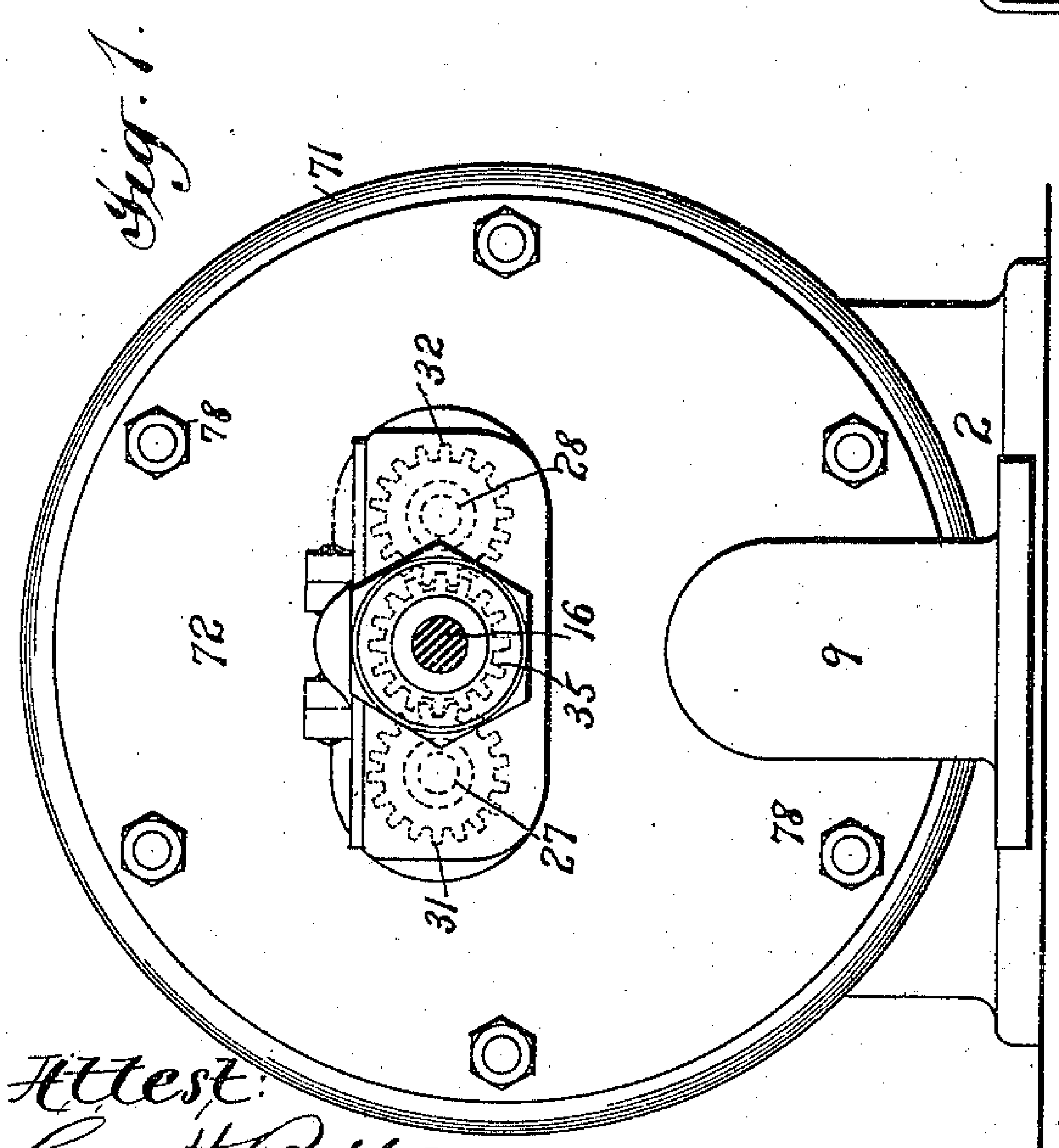
ROTARY PUMP.

No. 547,380. Patented Oct. 1, 1895.









Attest:
Geo. H. Botts.
Wm. Borst

Inventors
Franz Marburg Jr
Dennison D. Stone
by Philipp Munson & Phelps
Attys

ANDREW B. GRAHAM, PHOTO-LITHO. WASHINGTON, D.C.

(No Model.) 2 Sheets—Sheet 2.

F. MARBURG, Jr. & D. C. STONE.

ROTARY PUMP.

No. 547,380. Patented Oct. 1, 1895.

Fig. 5.

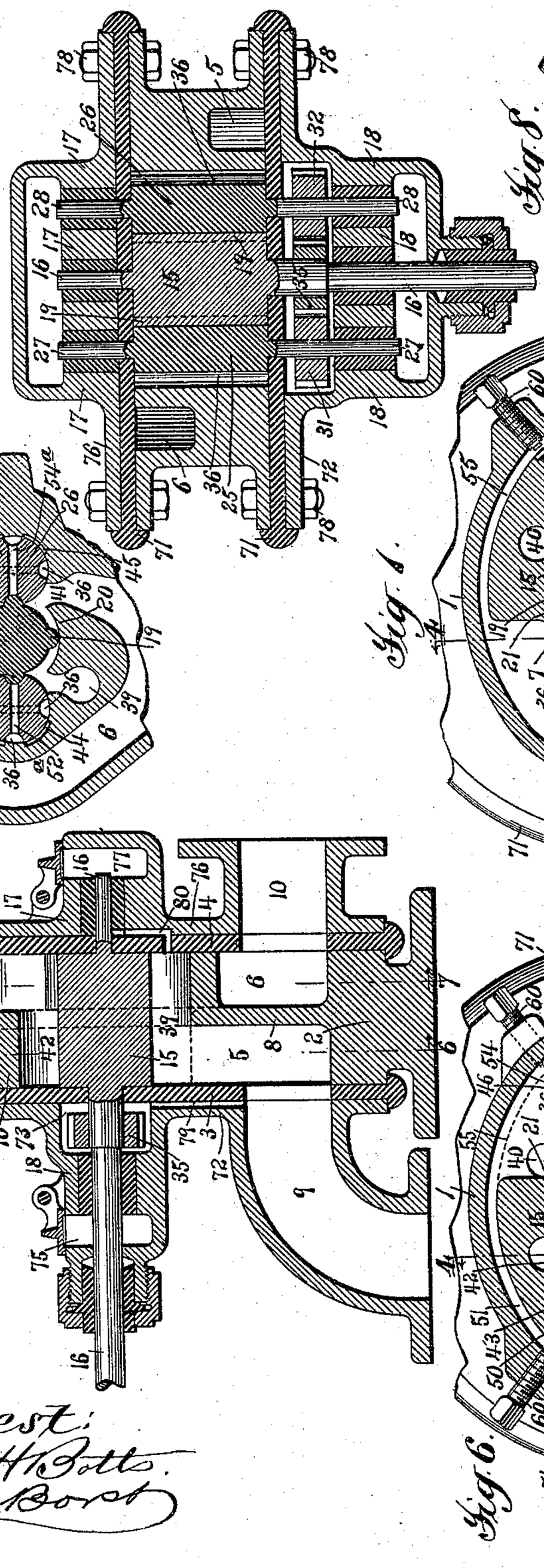


Fig. 8.

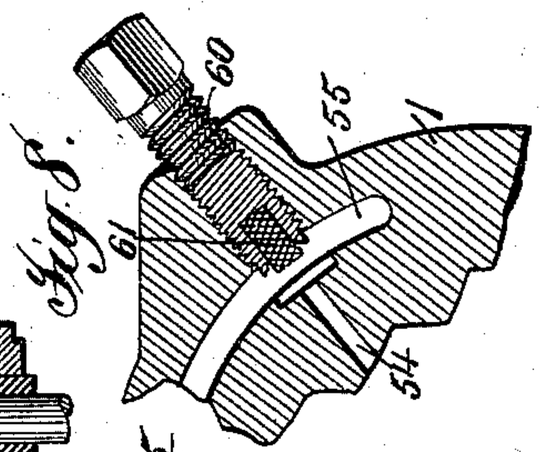


Fig. 10.

Fig. 1.

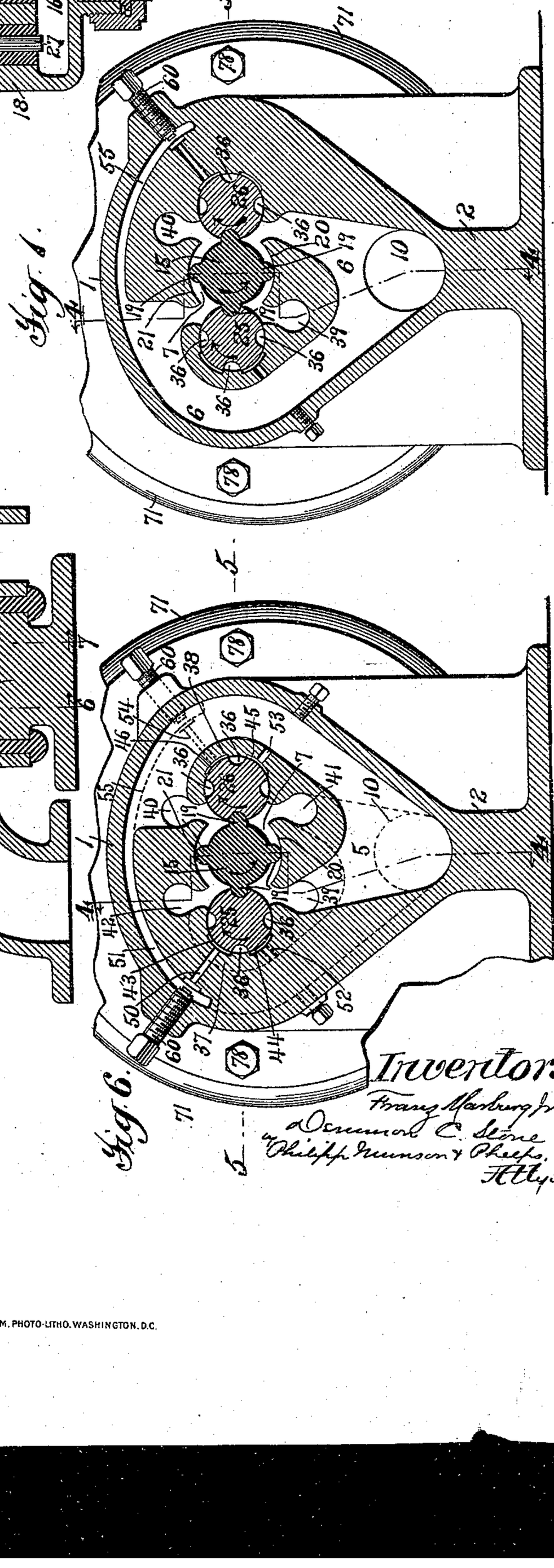


Fig. 4.

Fig. 6.

Attest:
Geo. H. Botts.
Jno. Borst

Inventors
Franz Marburg Jr
Duncan C. Stone
by Philipp Thomson & Sheets.
Attys.

UNITED STATES PATENT OFFICE.

FRANZ MARBURG, JR., OF BROOKLYN, AND DEMMON C. STONE, OF YONKERS, NEW YORK; SAID STONE ASSIGNOR TO SAID MARBURG.

ROTARY PUMP.

SPECIFICATION forming part of Letters Patent No. 547,380, dated October 1, 1895.

Application filed June 26, 1894. Serial No. 515,730. (No model.)

To all whom it may concern:

Be it known that we, FRANZ MARBURG, Jr., a subject of the Emperor of Germany, residing at Brooklyn, county of Kings, and DEMMON C. STONE, a citizen of the United States, residing at Yonkers, county of Westchester, State of New York, have invented certain new and useful Improvements in Rotary Pumps and Like Apparatus, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to improvements in rotary pumps, engines, blowers, and like apparatus, it being the object of the present invention to provide apparatus of this character, the working parts whereof shall be almost wholly free from friction, and to thus increase the efficiency of the apparatus and render it capable of performing larger and heavier work than that of which such apparatus have heretofore been capable. Various efforts have heretofore been made in this direction; but although in some instances slight success has been met with, in that the friction of the working parts has been somewhat lessened, the difficulty has not been entirely overcome. Where, moreover, any degree of success has been attained it has only been so attained at the expense of simplicity, the constructions provided being complex, liable to frequent derangement, requiring frequent adjustment to keep them in running order and the constant care of a skilled attendant for that purpose, the parts quickly wear out, owing to the friction still existing, and thus destroy the efficiency of the pump, and at the same time such constructions have always been limited in capacity to very light or small work. By the improvements constituting the present invention, however, a construction is presented of great simplicity, in which, by a peculiar organization and arrangement of piston and abutments, the piston is perfectly balanced, and by a peculiar arrangement of the induction and eduction ports with reference to the piston the pressures upon the piston from these sources are perfectly equalized, the piston being thus almost entirely freed from friction. In what is considered its most preferred form the apparatus includes a piston-chamber, a piston located in the chamber, a pair of abutments on opposite sides of the piston and rotating in close contact therewith and with the walls of the piston-chamber, and a pair of induction and a pair of eduction ports communicating with the piston-chamber, the ports of each pair being arranged upon diametrically-opposite sides of the piston, so that the pressures from the ports of each pair exerted upon the piston will be opposed to each other in a right line and the pressures from the two pairs of ports be exerted crosswise of and at right angles to each other. The piston is provided on its periphery with piston-heads or projections, which, as the piston rotates, sweep over and in close contact with the walls of the piston-chamber, and each of the rotating abutments is provided with corresponding recesses or depressions for receiving the piston-heads or projections when thus rotated.

The improvements of the present invention also include other features, which will be hereinafter pointed out.

Although the various improvements constituting the present invention are in the main of general application, they have as a whole been designed with especial reference to rotary pumps, and in such an organization are peculiarly advantageous. The improvements will therefore, and for convenience, be described in connection with such pumps.

In the accompanying drawings, Figure 1 is an end view of the casing of a pump embodying the present invention, illustrating particularly the pump-casing, the power-shaft, and the gearing for rotating the piston and its abutments. Figs. 2 and 3 are respectively a side elevation and a plan view of the same. Fig. 4 is a sectional elevation on the irregular line 4 4 of Figs. 6 and 7, illustrating the piston, its shaft, the piston-chamber, the induction and eduction chambers, and the ports connecting said chambers with the piston-chamber. Fig. 5 is a horizontal section on the line 5 5 of Figs. 6 and 7, illustrating in addition to the mechanism shown in Fig. 4 the rotating abutments on opposite sides of the piston and the gearing connecting them to the piston-shaft. Fig. 6 is a section on the line 6 6 of Figs. 2 and 4 through the induc-

tion side of the pump. Fig. 7 is a similar view taken on the line 7 7 of Figs. 2 and 4 through the eduction side of the pump. Fig. 8 is a detail, which will be hereinafter referred to. Fig. 9 is a view similar to Fig. 6, illustrating the piston and abutments in different positions. Fig. 10 is a view similar to Fig. 7, lilustrating a modification, which will be hereinafter referred to.

Referring to said drawings, and particularly to Figs. 1 to 9, 1 represents the pump-cylinder, which is provided with a base 2 and closing-heads 3 4; 5 the induction-chamber, 6 the eduction-chamber, and 7 the piston-chamber, of the pump, the induction and eduction chambers being separated from each other by a vertical partition 8, integral with the casing and connected at their lower ends through flanged extensions or pipes 9 10, respectively, to the induction and eduction pipes or mains. The piston-chamber 7 is, as best shown in Figs. 6 and 7, oblong in cross-section and extends entirely across the casing between the heads 3 4. At its central position the piston-chamber is provided with a piston 15, carried by a shaft 16, journaled in bearings provided in the heads 3 4, one end projecting into a stuffing-box 17 on the outer face of the head 4 and the other through and beyond a similar stuffing-box 18 on the outer face of the opposite head 3 to connect with any suitable mechanism, preferably a dynamo. The piston 15 is provided with a plurality of equidistant piston-heads or projections 19, which, as the piston rotates, sweep over the faces of the central walls 20 21 of the piston-chamber and in sufficiently close contact therewith to prevent leakage between them and the walls. The heads or projections 19 are separated a distance apart slightly less than the length of the walls 20 21, for a purpose which will hereinafter appear. To secure the best results these piston-heads or projections should be semicircular in cross-section, as shown, and arranged in pairs, the heads or projections of each pair being arranged upon diametrically-opposite sides of the piston. Two pairs of such heads or projections are preferably employed. The piston-chamber also contains a pair of abutments 25 26, in diameter the same as the piston and carried by short shafts 27 28, journaled in the heads 3 4 and projecting into the stuffing-boxes 17 18. The shafts 27 28 are provided with pinions 31 32, which gear into a pinion 35 of the same diameter fast to shaft 16, by which said abutments are rotated synchronously with the piston. The abutments 25 26 are arranged upon opposite sides of and in the same plane with the piston, and are each provided with equidistant depressions or recesses 36, corresponding in number and arrangement upon the abutments to the heads or projections 19 upon the piston, so that as the piston and abutments are rotated the recesses will receive the heads or projections as they reach their central positions after leaving the walls 20 21. The abutments 25 26 rotate in close contact with the piston and with the end walls 37 38 of the casing, thus preventing leakage between them and the piston or the end walls 37 38 from one side of the piston-chamber to the other. These recesses 36, like the heads or projections 19, are semicircular in cross-section and are also of the same size as the heads or projections, so that in the central position of the heads the latter enter and fill the recesses. The distance between these recesses, also, is slightly less than the distance between the edge of each of the end walls 37 38 and the points at which the piston and abutments contact, for a purpose which will hereinafter appear.

The induction-chamber communicates with the piston-chamber 7 through a pair of ports 39 40, which enter the chamber upon diametrically-opposite sides of the piston 15 between the central and end walls 20 37 and 21 38, respectively, of the piston-chamber. The eduction-chamber communicates with the piston-chamber through similar ports 41 42, also arranged upon diametrically-opposite sides of the piston between the central and end walls 20 38 and 21 37, respectively. The several ports thus grouped about the piston and alternating with each other are preferably arranged, as shown, substantially equidistant from each other. From this arrangement of ports with reference to the piston, it results that the pressures from the ports of each pair exerted upon the piston will oppose each other in a right line, and the pressures from both pairs of ports be exerted upon the piston in directions crosswise of each other, and, the pressures from the ports of each pair being equal, the pressure upon the piston from these sources will thus be perfectly equalized.

The induction and eduction chambers of the pump are confined to the induction and eduction sides, respectively, of the pump, but their ports 39 40 and 41 42, as shown, extend over into the eduction and induction sides, respectively, of the pump, so that the piston may act its full width upon the water to be pumped.

To secure a still more perfect balancing of the working parts of the pump, means are provided for balancing pressures upon the abutments. As these abutments have thus far been described, they are each subjected at two points to pressures of two kinds, which act in different directions crosswise of each other—viz., induction-pressure from the ports 39 and 40, respectively, and eduction-pressure from ports 41 and 42. Such pressures might have a tendency to drive the abutments against the end walls of the piston-chamber and cause them to grind thereon and thus create friction. Such a movement of the abutments would to some extent affect the piston and the proper working of the pump. To overcome this the pressures on each abutment are equalized similarly to the piston in

the following manner: In the end walls 37 38 of the piston-chamber opposite the induction and eduction ports 39 42 and 40 41, respectively, are cut channels 43 44 and 45 46, respectively, which are each of the same length as the abutments. The channel 43 for abutment 25 communicates through a port 50 drilled through the cylinder 1, with an extension 51 of the induction-chamber 5, and the channel 44 for the same abutment communicates with the eduction-chamber 6 through a similar port 52. Similar ports 53 54, communicating with the induction and eduction chambers 5 6, respectively, are provided for the channels 45 46, respectively, of abutment 26, the port 54 connecting with an extension 55 of eduction-chamber 6 and port 53 directly with induction-chamber 5. The channels 43 44 45 46 are each of a width equal to the surface of the abutment exposed to pressure from the induction and eduction ports, or, in other words, to the distance between the edge of the end wall and the point of contact between the piston and abutment. From this construction it results that the same pressures—induction or eduction—will, as in the case of the piston, exist upon diametrically-opposite sides of the abutments, and the two pressures—induction and eduction—be exerted upon each abutment crosswise of and at right angles to each other, and thus be equalized upon each abutment.

The operation of the mechanism as thus far described is as follows: Motion being imparted to shaft 16 the piston 15 will be rotated in the direction of the arrow, Fig. 6, and the abutments through pinions 31 32 35 rotated in the directions of the arrows in the same figure. As the piston is thus rotated, its heads or projections 19 will sweep along the faces of the central walls 20 21, on opposite sides of the piston-chamber, from the induction-ports 39 40, respectively, to the eduction-ports 41 42, respectively, driving before them the water delivered from the induction-ports and delivering it against the abutments 25 26, by which it is deflected toward and delivered into the eduction-chamber 6 through eduction-ports 41 42 and thence to the main. The piston and abutments rotate in close contact, as before stated, and thus cut off communication across or between opposite sides of the piston-chamber. The piston-heads or projections 19 also, as before stated, make close contact with the walls 20 21, and thus prevent leakage back between them and the walls of the chamber of the water driven before them. Just before each piston-head leaves the side wall 20 or 21, the distance between the heads or projections being, as before stated, less than the length of the wall, the next following head or projection 19 will have arrived at the opposite end of the wall, and thus cut off communication between the eduction and induction ports on that side of the piston-chamber and prevent the water following the preceding piston from returning to the induction-port whence it was delivered. As each piston-head or projection 19 acts twice during a complete revolution of the piston, the capacity of the pump is considerable.

It will be observed that as the abutments are rotated so as to move the piston-heads from the central position or position of engagement with the recesses, as shown in Fig. 6, two of the recesses in each abutment will, as shown in Fig. 9, be uncovered and exposed to pressure from the induction and eduction ports in front of the abutment, resulting in an increase of pressure upon the abutments at those points. As soon, however, as this takes place, a corresponding change occurs on the opposite sides of the abutments, the two other recesses of each abutment coming into register with the pressure-equalizing channels 45 46 and 43 44, respectively, opposite the ports, the pressures on that side of each abutment being thus correspondingly increased and balancing the pressures from the ports. The distance between the recesses 36 in each abutment slightly exceeds the distance between the end wall and the point at which the piston and abutment contact, and also similarly exceeds the width of the equalizing-channels, so that but one recess in the abutment will be open at a time to pressure from each port and each equalizing-channel.

With piston-heads or projections and recesses of the form shown it will be observed, by reference to Fig. 9, that as the piston-head moving from the eduction-port arrives at its recess it engages one edge of the same, leaving the recess open and in communication, on all sides of the head engaging it, with the eduction-port. The recess continues open to the eduction-port during the further movement of the piston-head until the piston-head reaches its central position, when it fills the recess and instantly cuts off the eduction-pressure, when an instant of no pressure upon the head will ensue. The movement of the piston-head continuing beyond central position, the recess is instantly opened to the induction-port on the opposite side of the piston-chamber, and, with the piston-head, subjected to induction-pressure. The piston-head and its recess are thus subjected to but one pressure at a time, and this pressure is distributed over all portions of the recess and upon all sides of the piston-head during engagement and maintained constantly uniform until the piston-head and recess reach central position, when it is instantly cut off. This is a feature of importance, as with the pressure thus distributed over all portions of the recess and upon all sides of the piston-head all danger of friction between the piston-head and recess, and consequent wear and loss of power, is avoided. With any other form of head and recess the piston-head at and during the time of engagement would be subjected to induction and eduction pressures on opposite sides and the recess similarly subjected at different points to the same press-

ures, and as these pressures would of course vary relatively to each other, and the area of piston-head and recess exposed to both would also vary, as the piston-head and recess continued their movement the piston-head and recess would grind one upon the other and thus produce friction and consequent wear and loss of power. With such piston-heads and recesses, moreover, the pressures upon the abutments could not be as perfectly equalized as they can with piston-heads and recesses of the form shown, because it would be impossible to produce with accuracy upon that side of the abutment within the end walls of the piston-chamber variations in pressure corresponding to those occurring upon that side of the abutment exposed to pressure from the induction and eduction ports, and the abutment would be caused to grind upon the end walls of the piston-chamber. This feature of the present invention is therefore of further importance in this respect. In some cases these difficulties might not be so serious or material as to prevent the use of such other forms of heads and recesses, and while the form shown and described is preferred, as stated, the present invention is intended to include, broadly, other forms employed in an organization and arrangement of piston, abutments, and ports, such as shown and described.

As in ordinary pumps, in the present case if the pump stands idle for any length of time it becomes filled with air, the presence of which in the induction-chamber of the pump would, for a short time after starting, interfere with the perfect working of the pump. As the pump is started and during the beginning of its operation, the air would, in the construction illustrated, circulate between the induction and eduction chambers 5 6, through the ports 50 52 53 54 and recesses 36, such circulation continuing and the air leaking back to the induction-chamber so long as the induction-chamber remained unfilled with water. The air thus circulating would of course finally all be expelled as the pump continued its operation, but while any of it remained there would be a corresponding loss in efficiency. Although ordinarily such loss would not be considered a serious or material one, in some cases it may be desirable to avoid it and to bring the pump up more quickly to its maximum efficiency and to enable it to get perfect suction. Means are provided, however, in the present case for preventing this circulation of air, which will now be described. For this purpose the port 54, connecting the equalizing-channel 46 of abutment 26 with the eduction-chamber 6, is provided with a plug 60, screwed into the cylinder 1 and provided with a rubber tip 61, adapted to fit yieldingly in the outer end of the port 54, and the port 50, connecting the equalizing-channel 43 with the induction-chamber 5, is provided with a similar plug 60, adapted to be screwed down upon and to close the port 50. In starting up, therefore, if the ports 50 54 be closed by their plugs, all communication between the induction and eduction chambers, through the port 50 at one end of the pump and the port 54 at the other end, is cut off. As the abutment 25 rotates, therefore, the port 50 being closed, the recesses 36 of that abutment will take no air from the eduction-chamber, but only from ports 41 or 53, communicating with the induction-chamber and discharge the air they carry into the eduction-chamber 6, through port 41. When the pump is relieved of air, the ports 50 54 will be opened by unscrewing their plugs and communication opened between the equalizing-channels 43 46 and the induction and eduction chambers, respectively, to equalize the pressure upon the abutments opposite induction and eduction ports 39 40, respectively, and during the operation of the pump these ports remain open.

In constructing the pump-frame, the cylinder 1, with its vertical partition 8, will preferably be made of one casting and the partition be provided with lateral wings 70 on opposite sides and integral therewith, forming the piston-chamber 7. The heads 3 4 will each preferably be of brass and of annular form and provided with flanges 71. The section of piping 9 and the stuffing-box 18 also will preferably be formed integral with one end plate 72 of the pump-frame, and on this plate will preferably be formed a closed chamber 73 for receiving the gears 31 32 35, and, if desired, an oil-chamber 75 for lubricating the shafts 16 27 28. The section of piping 10 and stuffing-box 17, also, will preferably be integral with the other end plate 76 of the pump, and on this plate may also be provided, if desired, an oil-chamber 77 for lubricating the opposite ends of the shafts 16 27 28. The several parts of the pump-frame are secured together by bolts 78, passing through plates 72 76, heads 3 4, and casing 1, the flanged edges 71 of the heads, with the parts of the frame thus secured, lapping and resting upon the edges of the castings 72 76 and the casting 1, as shown in Fig. 4.

Although the ends of the piston and abutments work in close contact with the heads 3 4, leakage may occur between them and the heads and thence to chambers 73 75 77 and outside the pump-frame to the ground. To avoid this the chamber 73 is provided with a duct 79, communicating with the induction-chamber 5, and the stuffing-box 17 is also provided with a similar duct 80, communicating with the induction-port 39. Any water, therefore, which may leak out between the piston and abutments and the heads 3 4 will be returned to the induction-chamber and prevented from leaking outside the pump.

The construction illustrated in Fig. 10 is substantially the same as that of the preceding figures, except in certain particulars, which will be pointed out. The channels 43 44 45 46, instead of communicating with the induction and eduction chambers through

ports cut in the end walls of the piston chamber, as in the preceding figures, communicate therewith through cross-ports 50^a 52^a 53^a 54^a, cut in the abutments. Unlike the construction of the preceding figures, the equalizing-channels in the present case are not permanently connected to the induction and eduction chambers, but as the abutments rotate the channels 43 44 are connected first by one and then by the other of the ports 50^a 52^a with the induction and eduction ports 39 42, respectively, and the channels 45 46 similarly by ports 53^a 54^a with the induction and eduction ports 40 41, respectively. In this case, also, the extensions 51 55 of the induction and eduction chambers and the plugs 60 are omitted.

We are aware that it is not new to employ in a rotary pump a plurality (as three, for example,) of intermeshing gear-wheels revolving in the pump-chambers, the two outer wheels being balanced hydraulically by having in them ducts communicating between their opposite interdental spaces, and this we do not claim. In our pump the rotary piston and rotary abutments are not gear-wheels and do not drive each other by intermeshing teeth, but are and must be driven synchronously by suitable gear-wheels 31, 32, and 35. The piston-heads 19 are widely spaced and channels 43, 44, 45, and 46 are provided in the walls of the abutment-chambers and connected with the respective ports which admit the liquid for equalizing the pressure. These channels, as stated, extend the entire length of the abutment and each channel is equal in width to the distance between the edge of the end wall and the point of contact between the piston and the abutment—that is, the channel has a width equal to that of the surface of the abutment exposed to pressure. Preferably, the liquid is admitted to the respective channels by ducts arranged exteriorly of the abutment-chamber, and not through the abutment, as shown in Fig. 10, this latter construction not producing as good results with our arrangement of the channels as the construction shown in the principal views.

What is claimed is—

1. The combination with the pump-casing having in it the piston-chamber and the abutment-chambers, of the rotary piston provided with widely spaced piston-heads 19, arranged in pairs, the heads of each pair being situated upon diametrically opposite sides of the piston, a pair of rotary abutments which fit snugly in their chambers in peripheral contact, respectively, with the opposite sides of the piston, said abutments having recesses for engaging the heads 19 on the piston, and means for driving said piston and abutments in unison, the said pump-casing having in it a pair of induction ports and a pair of eduction ports grouped about the piston and alternating with each other, the ports of each pair being arranged on diametrically opposite sides of the piston, and also having formed in the walls of the abutment-chambers the respective channels 43, 44 and 45, 46, situated diametrically opposite the respective induction and eduction ports between which the abutment is situated, said channels being supplied through suitable ducts, as set forth, for equalizing the pressures upon the abutments.

2. The combination with the piston chamber 7, of the piston 15, situated in said chamber and provided with piston heads 19, adapted to sweep over the central walls of said chamber, an induction chamber 5, induction ports 39, 40, communicating with the piston chamber upon diametrically opposite sides of the piston, an eduction chamber 6, eduction ports 41, 42, also communicating with the piston chamber and alternating with said induction ports and also arranged upon diametrically opposite sides of the piston, a pair of rotating abutments 25, 26, located in and fitting snugly to the end walls of the chamber, and provided with recesses 36, for engaging the piston heads or projections, channels 43, 44, and 45, 46 in the end walls of said chamber diametrically opposite the induction and eduction ports 39, 42, 40, 41, respectively, and ports connecting said channels 39, 40 and 41, 42 with the respective induction and eduction chambers 5, 6, respectively, substantially as described.

3. The combination with a piston chamber 7, of the rotating piston 15, situated in said chamber and provided with piston heads 19, adapted to sweep over the central walls of said chamber, an induction chamber 5, induction ports 39, 40 communicating with the piston chamber upon diametrically opposite sides of the piston, an eduction chamber 6, eduction ports 41, 42, also communicating with the piston chamber and alternating with said induction ports and also arranged upon diametrically opposite sides of the piston, a pair of rotating abutments 25, 26, situated and fitting snugly in the end walls of the chamber and provided with recesses 36, for engaging the piston heads or projections, and channels 43, 44 and 45, 46 in the end walls of said chamber diametrically opposite the induction and eduction ports 39, 42, 40, 41, respectively, ports connecting with said channels 39, 40 and 41 42 with the induction and eduction chambers 5, 6, and a plug 60 for closing one of the equalizing ports of each abutment to prevent the circulation of air, substantially as described.

4. The combination with the pump cylinder 1, provided with a base and closing heads, and having in it an induction chamber 5 and eduction chamber 6, separated by a partition 8, a piston chamber 7, extending across the cylinder, abutment chambers adjacent to the chamber 7, induction ports 39, 40, opening into the piston chamber, eduction

ports 41, 42, leading from said chamber, and induction ports leading into the abutment chambers, as set forth, of the rotating piston 15, in the piston chamber, and the rotating abutments 25, 26, mounted in their respective chambers and fitting snugly to the walls thereof, substantially as set forth.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

FRANZ MARBURG, JR.
DEMMON C. STONE.

Witnesses:
J. J. KENNEDY,
G. M. BERST.