G. H. REYNOLDS.

COMPRESSOR.

APPLICATION FILED MAR. 25, 1907.

978,937.

Patented Dec. 20, 1910.

6 SHEETS—SHEET 1.

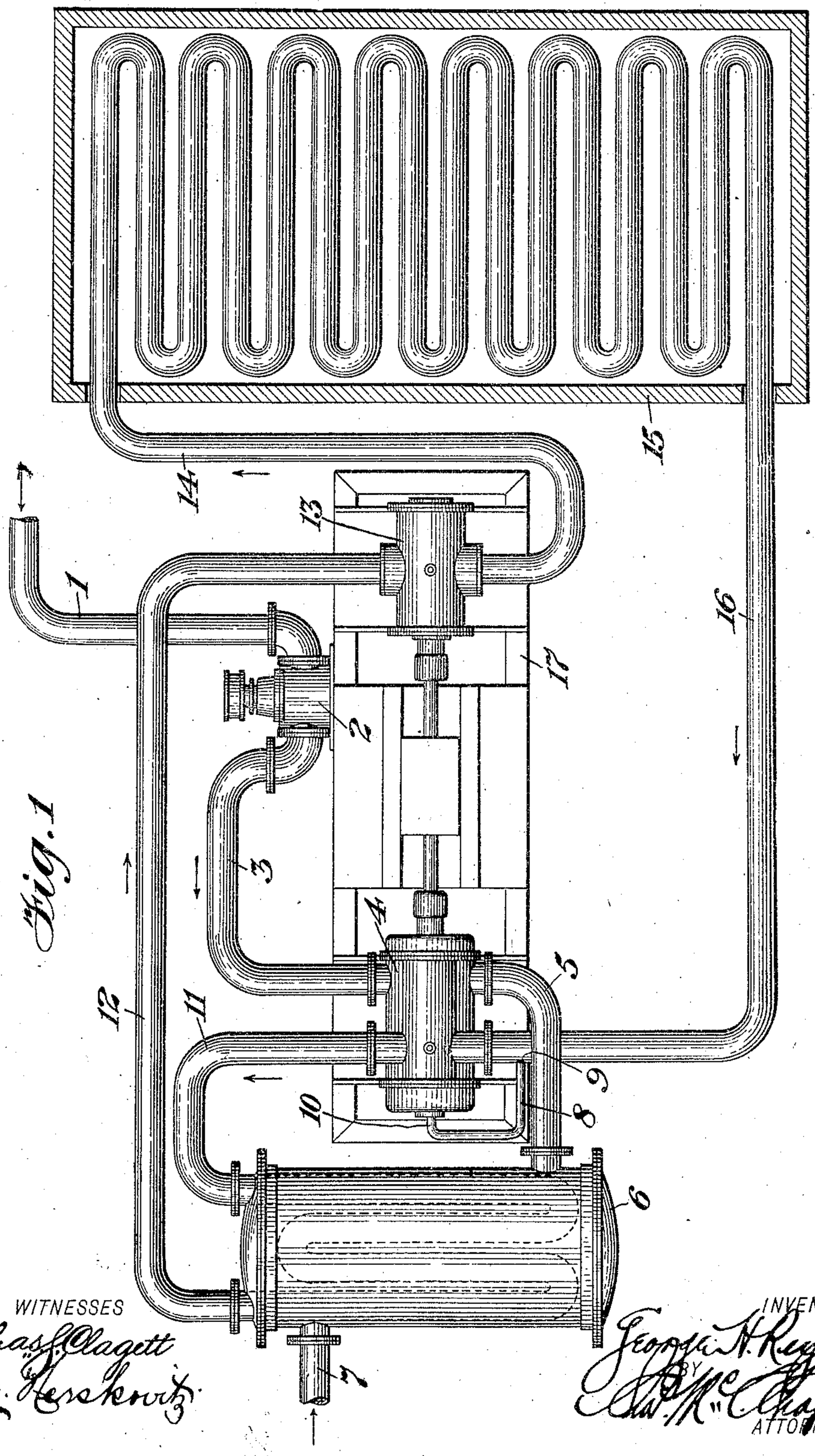

Fig. 1.

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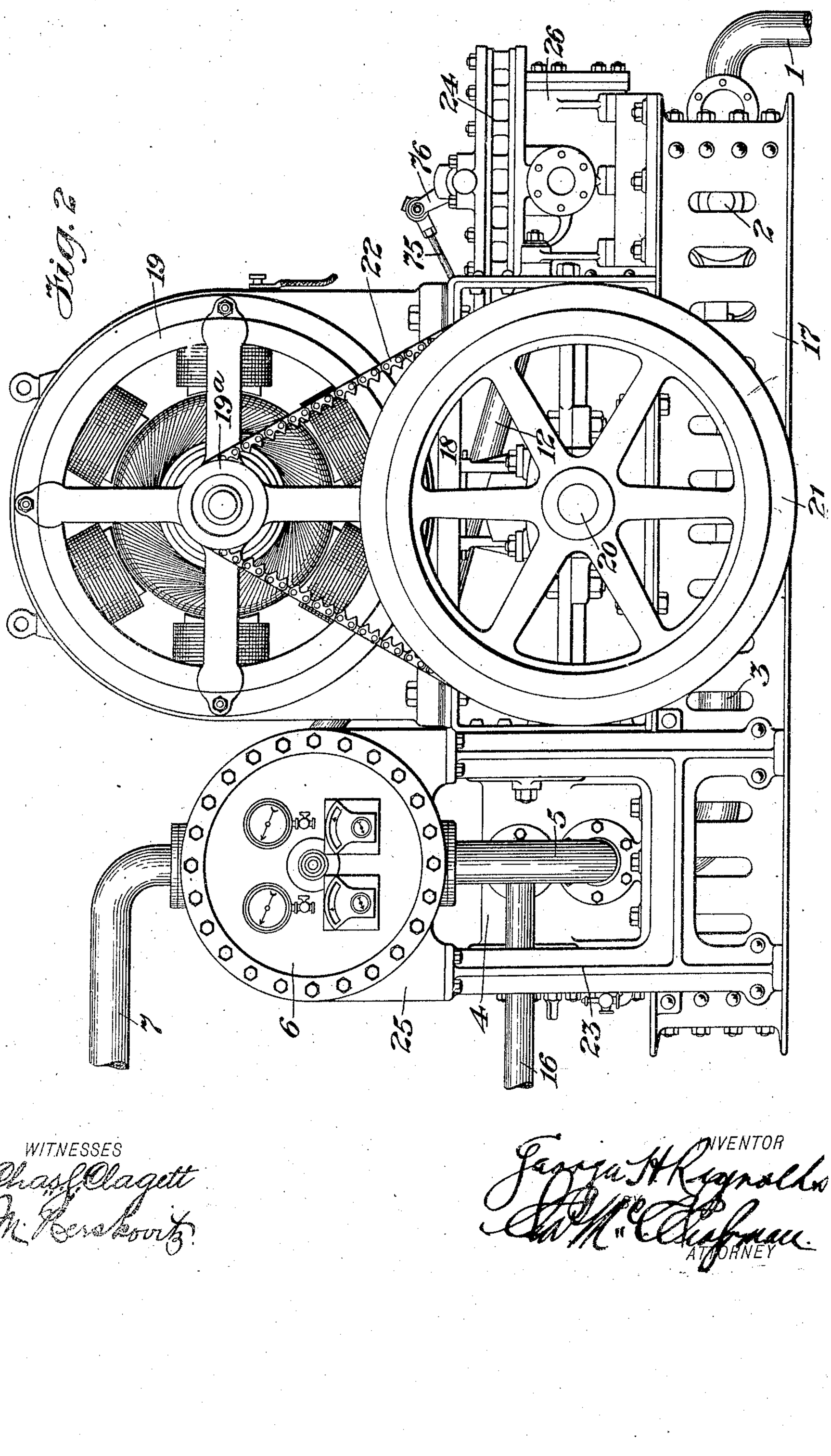
6 SHEETS—SHEET 2.

Fig. 2



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6 SHEETS—SHEET 3.

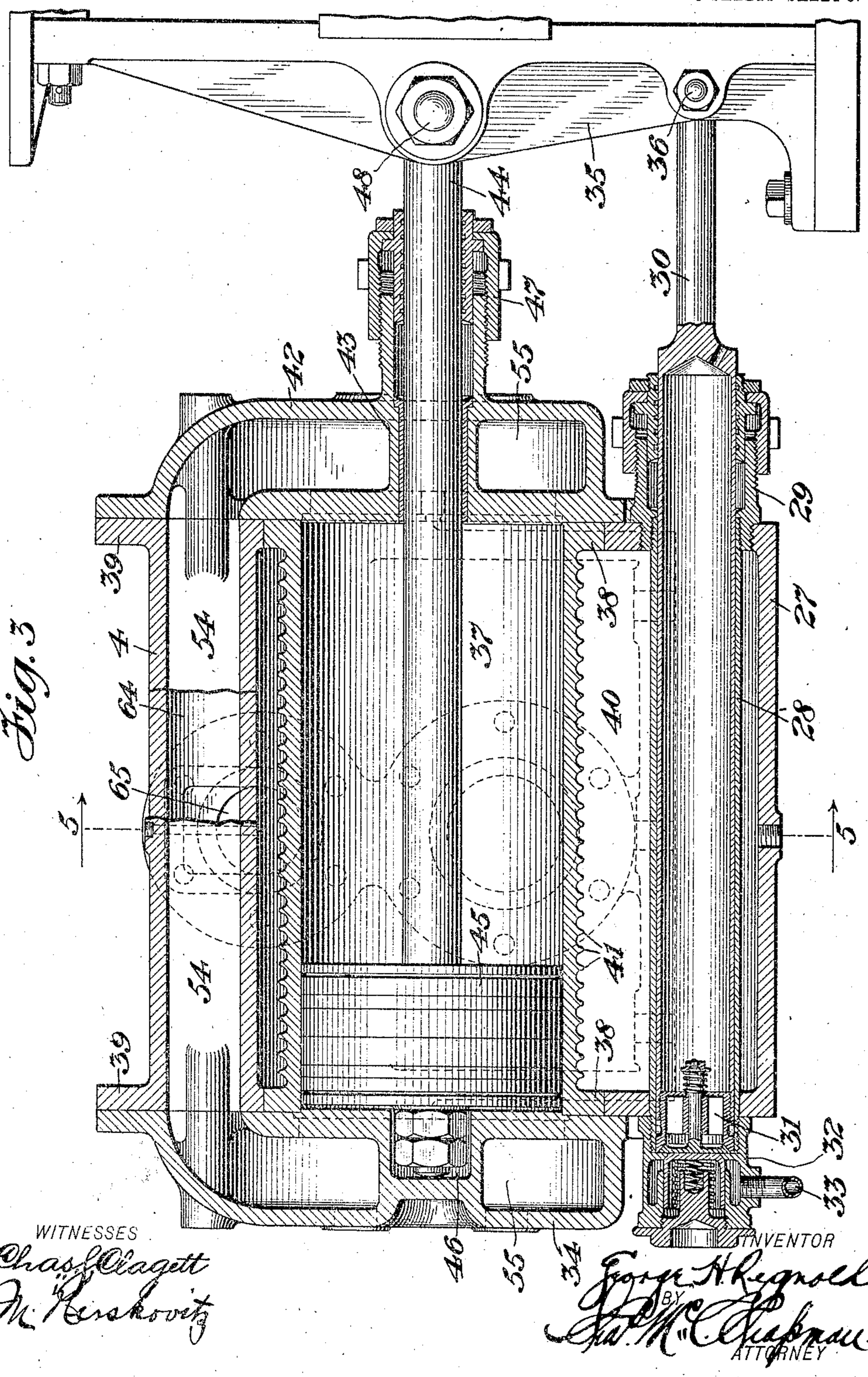

Fig. 3.

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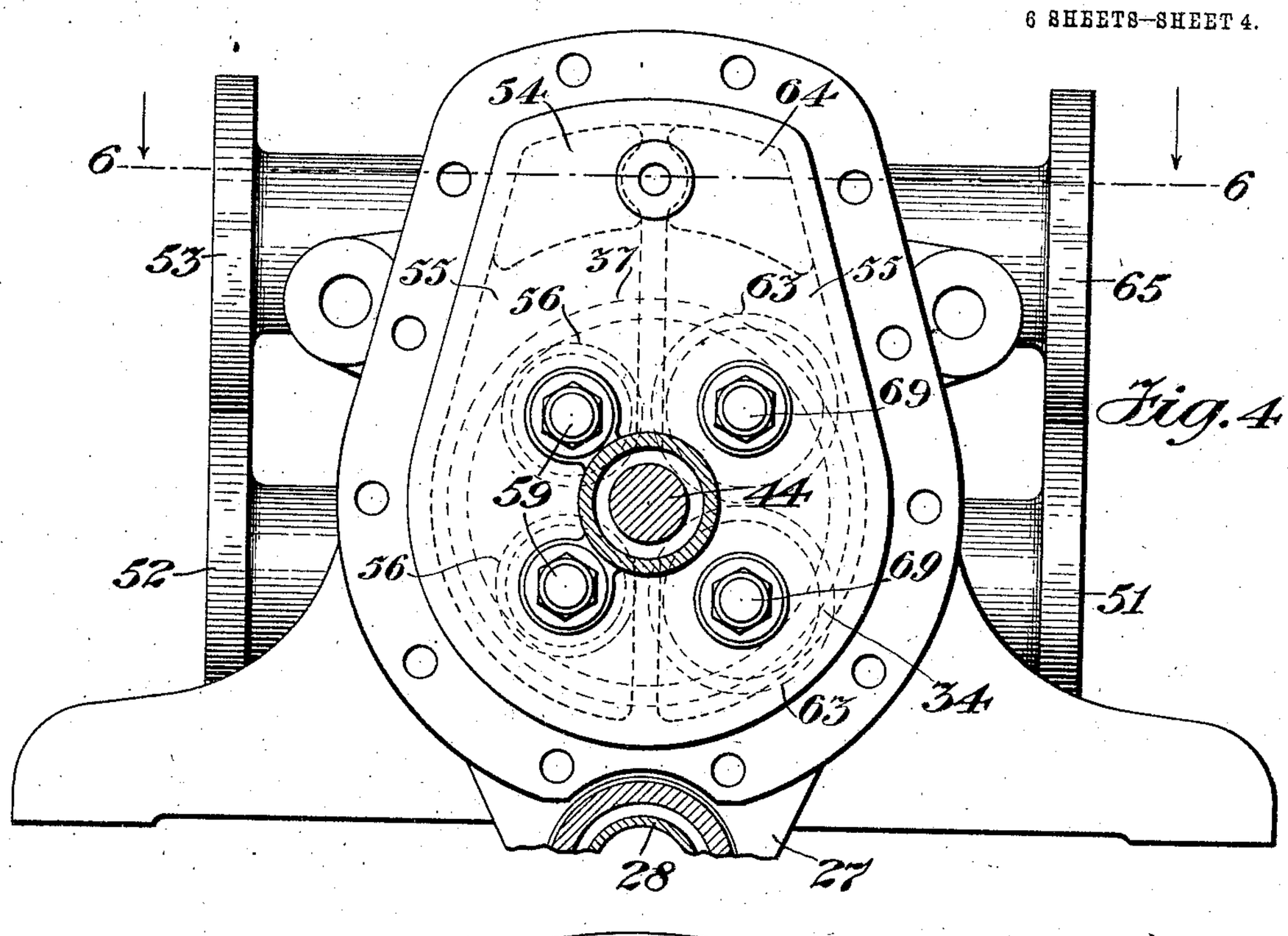

Fig. 4

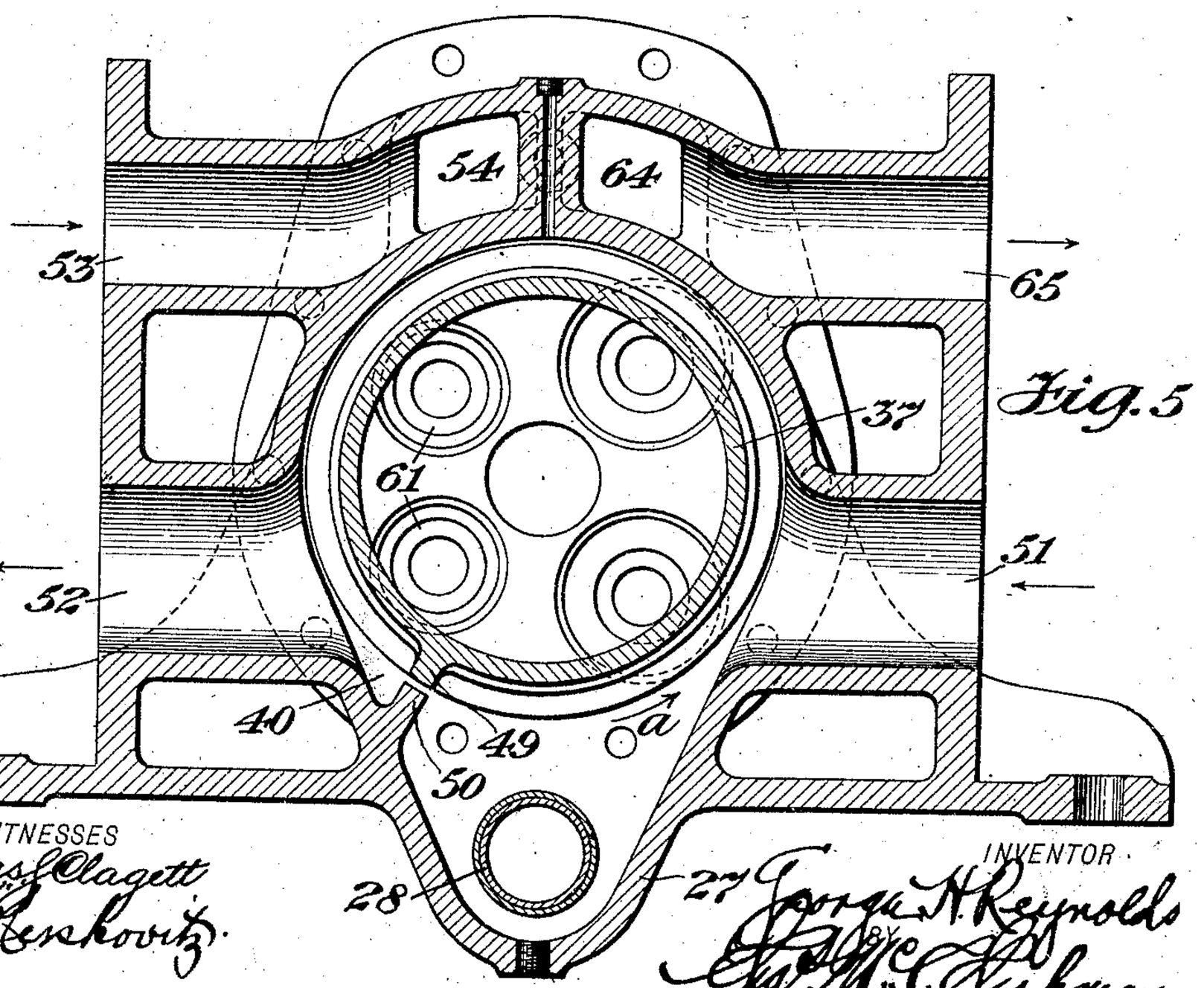

Fig. 5

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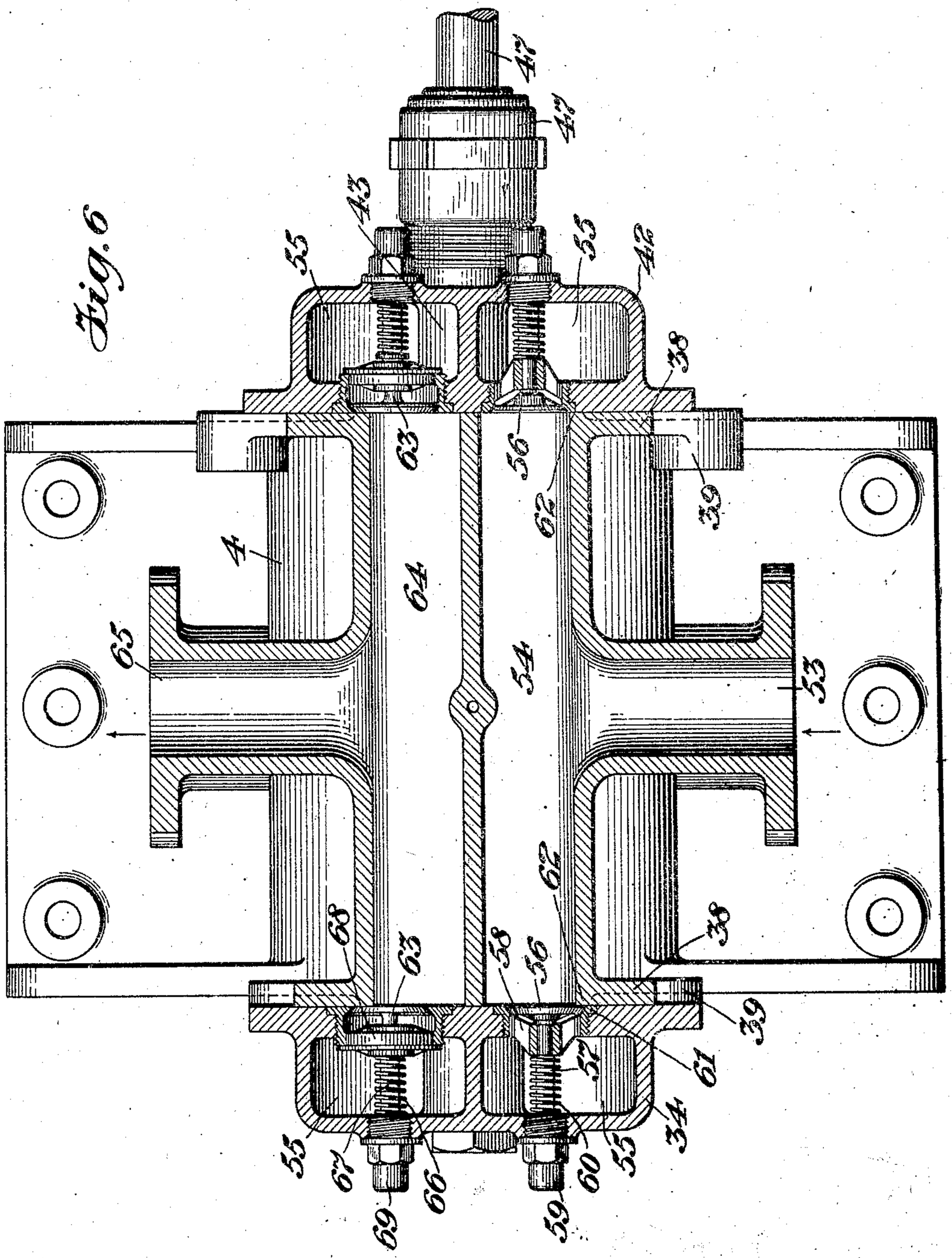
6 SHEETS—SHEET 5.

Fig. 6



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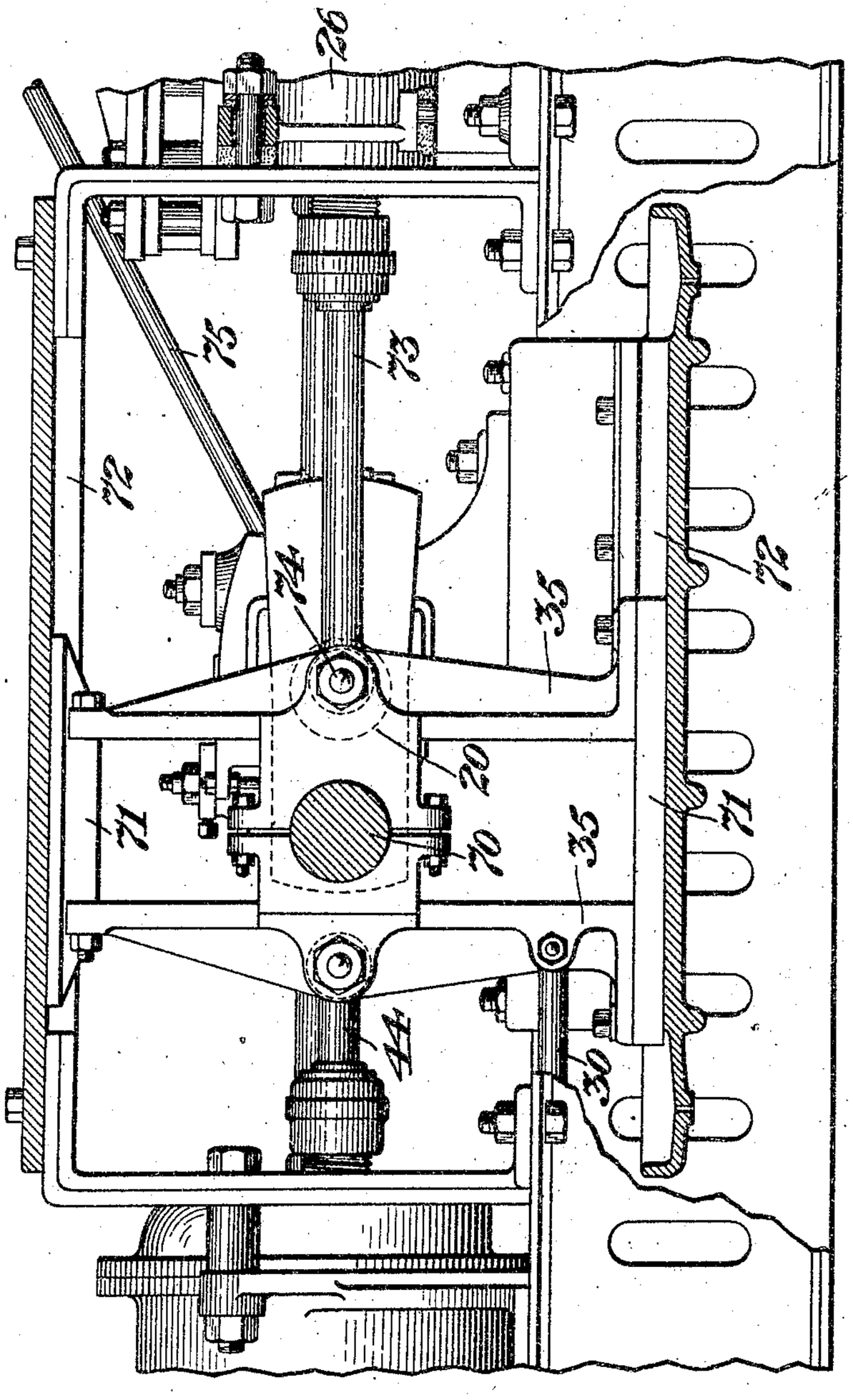
6 SHEETS—SHEET 6.

Fig. 7.



WITNESSES

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UNITED STATES PATENT OFFICE.

GEORGE H. REYNOLDS, OF MANSFIELD DEPOT, CONNECTICUT, ASSIGNOR TO THE REYNOLDS ICE MACHINE COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

COMPRESSOR.

978,937. Specification of Letters Patent. **Patented Dec. 20, 1910.**

Original application filed October 31, 1906, Serial No. 341,391. Divided and this application filed March 25, 1907. Serial No. 364,513.

To all whom it may concern:

Be it known that I, GEORGE H. REYNOLDS, a citizen of the United States, residing at Mansfield Depot, county of Tolland, and State of Connecticut, have invented a new and useful Improvement in Compressors, of which the following is a description.

This invention relates to compressors for various types of machines and apparatus, and particularly to compressors for refrigerating apparatus such as shown, for example, in my application Serial No. 341,391, filed October 31st, 1906, of which this application is a division.

Among the objects of my invention may be noted the following: to provide a mechanism by means of which gas or other fluid can be effectually compressed for any desired use; to provide a compressing mechanism which is double acting and capable of compressing the fluids twice for each reciprocation of the piston; to provide a compressor wherein the fluid compression chamber is so constructed as to enable the same to be quickly cooled so as to cool the fluid, to readily receive and effectually deliver the fluid, and to take care of any quantity necessary for an apparatus of practically any capacity; and to provide various improved features of construction which render the compressor effective in operation, durable and compact.

With the above objects in view, and others which will be detailed during the course of this description, this invention consists in the parts, features, elements and combinations of elements hereinbefore described and claimed.

In order that my invention may be readily understood, I have shown the same, in the accompanying drawings, in connection with an ice machine such as shown in my application aforesaid and in said drawings: Figure 1 represents diagrammatically all the essential details of the apparatus constituting an ice making or refrigerating machine wherein my invention of this application is an important feature: Fig. 2 shows a side elevation of so much of the said apparatus as is deemed necessary to illustrate the general arrangement of the parts of the same and the particular disposition of the compressor made the subject of this application: Fig. 3 is a longitudinal, vertical section of the compression cylinder of my invention together with the primer pump, showing the pistons and a portion of the driving means for the latter, the location only of the valves in the ends of the compression cylinder being shown in dotted lines, in order to avoid confusion of parts: Fig. 4 is an end elevation of the compression cylinder, a portion of the primer pump cylinder being shown in section: Fig. 5 is a vertical cross section of the compression cylinder substantially on the line 5—5 of Fig. 3, the arrows showing the direction of sight and the piston being removed: Fig. 6 is a longitudinal section of the compression cylinder on the line 6—6 of Fig. 4 looking in the direction of the arrow, and the figure also showing the end chambers of the compression cylinder in section, in order to illustrate the valve construction and disposition; and Fig. 7 is a vertical, longitudinal section of the central portion of the apparatus showing the position of the driving shaft and crank and the connection of the latter with the piston driving frame.

In order that the compressor made the subject of this application may be readily understood, the principles of operation of the apparatus, in connection with which it is shown for example, will be briefly set forth in connection with the diagrammatic view of Fig. 1. The water which is employed as a cooling medium for the gas in the refrigerating apparatus is conveyed to the latter by connection with any suitable water main, plug or spigot, through the water inlet pipe 1, the pump 2 being employed for causing the proper circulation of water through the apparatus, and the water, after leaving the pump, being driven through the pipe connection 3, to the compressor 4, and from the latter through the pipe 5 to the cooling tank 6, and from the latter through the pipe 7 to the sewer or any suitable drain. As will be presently disclosed, the compression cylinder or tank has combined with it a primer pump mechanism which, in the diagram of Fig. 1, is illustrated by the small pipe connection 8 tapped into the return pipe of the air circulating system at the point indicated by 9, the other end of said primer pump be

ing tapped into the compression cylinder at 10, in order to illustrate that the compression cylinder may be primarily supplied with air and thereafter constantly supplied with air in order to keep up the volume of gas or other circulating medium. The gas on leaving the compression tank passes through the pipe or conduit 11, into the cooling tank, 6, and through coils or pipes therein, passes therefrom through the conduit 12 to the expansion cylinder 13, thence passing through the conduit 14 to the "cold" room, or other place or point of refrigeration indicated in the diagram of Fig. 1 at 15. After accomplishing its work in the cold room, the gas passes through the return conduit 16, to the expansion cylinder, where it is again compressed and compelled to re-perform its work. With this general statement of the character of the apparatus in which my compressor may be used, and its principle or mode of operation, the following detailed description of my invention will be readily understood.

Viewing Fig. 2, the juxtaposition of the several parts of the apparatus in which my compressor may be used, the relation of the latter as contemplated by my invention, and the manner in which the several mechanisms are combined, in order to form a simple and compact refrigerating apparatus, will be seen and understood; and in said view the main frame is indicated at 17, which supports pillow blocks or journal bearings for the driving shaft 20, which latter carries at one end the driving wheel 21, which may, if desired, be a sprocket wheel driven by a sprocket chain 22. At one end the main frame supports, or is formed into the frame structure 23 carrying the compression mechanism 4, and upon said frame a superstructure 25 is mounted, which carries a cooling cylinder 6. At the opposite end of the main frame the latter supports a frame structure 26 which carries the expansion mechanism generally indicated by 24, together with its allied valve mechanism. This general disposition of parts places the driving shaft 20 transversely and centrally of the frame structure, gives balance and compactness to the several devices of the apparatus and brings the several essential mechanisms into intimate relation, so as to form a compact and economical arrangement from which all vibration is practically eliminated. This arrangement of parts also places the compression and expansion cylinders substantially in the longitudinal axis of the apparatus and enables them to take the direct thrusts of the driving shafts in and along their longitudinal axes without strain upon the apparatus or any of its mechanisms. Furthermore, by the arrangement just described of the several mechanisms of the apparatus I am enabled to mount the driving motor 19 directly above the driving shaft and in such position that its driving pulley or sprocket wheel 19ª may receive the sprocket chain 22 and impart direct drive to the driving wheel 21.

The primer pump which is employed to pump or force into the receiving or return chamber of the compressor the circulating and refrigerating medium, is carried in the lower portion of the compressor frame structure, as indicated at 27, such portion of the frame receiving the pump cylinder 28, which is secured to the frame by a suitable coupling at one end, generally indicated by 29, and forming a part of the stuffing box for the piston 30, the forward end of which latter is tubular and operates within the cylinder and carries at its front end the head containing the outlet valve 31 as usual. The outer end of the cylinder is secured to the frame section 27 by means of the outlet-valve coupling-portion 32 of usual construction, a conduit 33 from which extends to the adjacent head 34 of the compression chamber. The piston 30 of the pump is connected to the cross-head or reciprocating driving frame 35 by means of the pivot bolt 36. By using the primer pump, the apparatus, in which my compressor is an important part, may be provided primarily, and at all times during its operation, with sufficient gas to insure its successful, constant and automatic operation.

The compression mechanism of my present invention is shown more particularly in Figs. 3, 4, 5 and 6, and referring thereto, the cylinder of the compressor is indicated by 37 and is preferably made of brass, and is provided at each end with a flange 38, which surrounds the cylinder and affords a bearing for the same within the main frame 4, the latter having corresponding flanges or bearings 39 surrounding the cylinder 37, the frame and cylinder thus forming a water-jacket 40. The periphery of the cylinder 37 is provided with circumferential corrugations or flanges 41, which give to the exterior of said cylinder a greater cooling surface or area. The hollow heads 34 and 42 at the opposite ends of the frame 4 close the latter and the cylinder at both ends, and the head 42 affords a bearing at 43 for the piston 44 carrying the head 45, which operates within the cylinder 37, the opposite head 34 of the frame being provided with a recess 46 for the reception of the outer end of the piston 44, which extends beyond its head 45. A suitable bushing and stuffing-box construction, generally indicated at 47, surrounds the piston at the cylinder head 42 for the usual purposes, and the said piston 44 is pivotally connected at 48 with the reciprocating frame 35, and substantially midway of the latter.

The cylinder 37 is also provided with a longitudinally extending frame 49,—see Fig. 5,—located so as to coöperate with an oppositely disposed flange 50 projecting from the inside of the frame portion 27, above the primer pump cylinder 28, and into the space 40 constituting the water-jacket surrounding the cylinder 37. These two flanges 49 and 50 are so proportioned that they do not engage each other, but stand slightly separated so as to permit the passage of water, and yet constitute a baffle preventing the free flow of water past them, and compelling the great volume of water to take passage around the cylinder 37 in the direction of the arrow *a*, thus providing a means whereby practically the full flow or volume of water will pass around the cylinder and come in contact with substantially every portion of the surface thereof. By this construction, although water is baffled in its free passage around the bottom of the cylinder 37 and is compelled to take the course around and over the top of said cylinder, it may, however, pass to some extent between the two flanges and it will, moreover, accumulate in the chamber afforded by the frame portion 27 around the primer pump cylinder 28 and will, in this chamber, form an eddy and receive an agitation sufficient to prevent the water from remaining quiet in said chamber 27 and becoming heated therein. The water, which is the cooling medium for the gas, is, as previously described, taken from any main or tap and pumped to the water-jacket of the compression chamber by means of the pump 2 and enters the said compression chamber through the conduit 3 and the inlet 51 of the frame of the compressor and passes from said water-jacket through the outlet 52, and then passes into the cooling tank 6, of the apparatus. The air or gas returning from the cold room through the conduit 16,—see Fig. 1,—enters the compression cylinder through the inlet 53 which communicates with the passage 54 extending across the top of the frame 4, which in turn communicates with the chamber 55 of the head 34 and a corresponding chamber in the opposite head 42; if the air is supplied by means of the primer pump shown in Fig. 6, it will be conveyed directly to the chamber 55 of the head 34 by means of the conduit 8, as shown in Fig. 1.

Bearing in mind that Fig. 6 is a horizontal section substantially on the line 6—6 of Fig. 4, looking in the direction of the arrows, and that the chambers 55 are shown in transverse, horizontal section on a plane considerably below that of the line 6—6, it will be understood that, in Fig. 6, the bottoms of the passages 54 and 64 are the curved top of the water-chamber 40 and that the passages 53 and 65 communicate with the passages 54 and 64, respectively, at a right-angle. Hence, in Fig. 6, through the several valves 56 and 63 appear to be cooperating with the passages 54 and 64, they are, in point of fact, considerably below the latter so as to coöperate with the chamber 37, as will be readily understood upon reference to Figs. 3 and 5. With this preliminary explanation, the following description will be understood.

From the chamber 55, the air passes to the cylinder 37, in front of and behind the piston head 45 through the inlet valves disposed in the passages between the chambers 55 and the cylinder 37,—see Fig. 6,—said inlet valves each consisting of the beveled disk 56, carried by stem 57 journaled at one end in spider 58, and at the other in the outer wall of head 34, a screw-cap 59 affording the latter journal-bearing. The spring 60 surrounding the stem 57 operates to hold the valve head 56 against its seat, afforded by a flanged ring 61 screwed into the adjacent framing of head 34. In order that the valve heads 56 may be limited in their forward movement, the adjacent ends of the cylinder 37 are caused to overlap said valve heads as at 62, and act as a stop, thus also preventing said heads, should they break, from falling into the cylinder 37. After entering the cylinder 37 and being compressed therein either in front of or behind the piston, the gas will be passed through the outlet valves at opposite ends of the cylinder, which are generally indicated by 63, into the end chambers 55, and from thence will proceed along passage 64 and outlet 65 to the conduit 11,—see Fig. 1,—to the cooling chamber 6. The outlet valves are held in position by means of the spring 66 surrounding the stem 67, the latter being journaled at the opposite ends in a spider 68 and screw-plug 69, respectively held in the opposite walls of the head 34.

Referring now to Fig. 7, it will be seen that the driving shaft 20 is provided with a crank 70 with which a Scotch-yoke coöperates to actuate the driving frame 35 to which the pump piston 30 is pivoted, and to which also the piston 44 is pivoted, as previously described. This driving frame is composed of the uprights, one of which has already been indicated as 35, and the cross-bearings, top and bottom, 71, which latter slide in ways 72 at top and bottom respectively of the frame structure which is grooved for the purpose and which must be obviously lubricated for ease of movement. The expansion mechanism 26 contains a cylinder wherein operates a piston driven by the rod 73, also pivoted to the driving frame 35, as at 74. Thus the driving shaft operates through the Scotch-yoke to drive the frame or pistons for both the compressor and expansion mechanisms, and also the piston for the

primer pump. The pitman rod 75 is also connected to the driving shaft and at its opposite end coöperates with the valve mechanism as at 76,—Fig. 2,—of the expansion chamber for the functions of that apparatus, but this mechanism forms no part of the present invention, and consequently has not been illustrated in detail.

Having described the details of my invention as I now contemplate the same, the following mode of operation will be readily understood, bearing in mind the preliminary description of operation of the apparatus as a whole. The gas pumped into the end chambers 34 and 42 by means of the primer pump, or entering the same by the return pipe 16, will pass through the inlet 53,—see Fig. 5,—along the passage 54 in opposite directions into the chambers 55 of the said opposite heads 34 and 42. Accordingly as the piston is moving one way or the other, the gas will enter through the inlet valves into one end of the cylinder and pass out of the latter through the outlet valves in the same end of the cylinder. Passing into the chamber 55 from the passage 54 the gas will enter the cylinder through the inlet valves, be compressed in said cylinder and expelled through the outlet valves into a chamber 55, and will then traverse the passage 64 and outlet 65 and proceed through the conduit previously described to the cooling cylinder. The water which is used as a cooling medium for the gas will be forced by the pump through the conduit 3 to the inlet 51 of the compression chamber, entering the water-jacket 40 and having a normal tendency to descend into the space surrounding the primer pump cylinder, but the baffle flanges or plates 49—50 will prevent the flow of water in that direction and cause the same to back up and pass around the cylinder in the direction of the arrow *a*, thus passing entirely around the cylinder and eventually leaving the compression chamber through the outlet 52, whence it will pass to the cooling tank through the conduit 9 through the cooling tank 6, and thence through the waste pipe 7. Obviously the baffle plates 49—50 cause the water to flow back upon and around the pump cylinder, thus creating agitation in the chamber of the frame section 27, and causing the water to eddy around the pump cylinder and remain constantly cool in the said chamber.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A compression mechanism including among its essential elements a double-acting compression chamber comprising a cylinder; a water-jacket surrounding the same; inlet and outlet ports arranged at opposite sides of the jacket at the bottom thereof; valve-chambers at opposite ends of the cylinder; inlet and outlet valves connecting the said valve-chambers with the said cylinder; parallel inlet and outlet passages extending along the top of said compression chamber and connecting said valve-chambers; and inlet and outlet ports extending from said passages to the outside of said cylinder at opposite sides thereof and parallel with and above the first-mentioned ports.

2. A compression mechanism comprising a frame supporting a cylinder; a water-jacket surrounding the cylinder; a primer-pump carried by the frame within the water-jacket; air chambers at each end of the cylinder; inlet and outlet valves communicating with said chambers and the cylinder; connections between the primer-pump and one of the chambers; and inlet and outlet passages connecting with the chambers.

3. A compression mechanism comprising a cylinder; a water-jacket surrounding the cylinder; a baffle in the jacket located at the bottom of the cylinder; a water inlet at one side of the jacket near its bottom; and a water outlet at the other side of the jacket near its bottom, whereby water may be caused, by said baffle, to pass entirely around said cylinder.

4. A compression mechanism comprising a cylinder; a water-jacket surrounding the same having a chamber in the bottom thereof; a primer-pump located in the chamber; a water inlet to the jacket; a water outlet from the jacket; and a baffle located in the jacket in the path of the water so as to compel the same to take its course around the cylinder from the inlet to the outlet and so as to create an agitation of the water in the said chamber around the primer-pump.

5. A compression mechanism comprising a cylinder; a water-jacket surrounding the cylinder; air chambers at opposite ends of the cylinder; inlet and outlet valves connecting the cylinder with the chambers; a water inlet near the bottom of the cylinder on one side; an air inlet near the top of the cylinder above the said inlet; a water outlet on the opposite side of the cylinder near the bottom of the latter; and an air inlet above the said water outlet.

6. In combination a compression mechanism including a cylinder; a piston operating therein; a water-jacket surrounding the cylinder; air chambers and passages leading to and from the said cylinder; a primer-pump supplying the cylinder with gas; means supplying the jacket with water; and means for actuating the piston and pump including a reciprocating frame having right-line movements and pivotally connected to the said piston and pump so as to impart direct thrusts thereto.

7. In combination a compression mechanism including a cylinder and piston reciprocating therein: means for supplying

gas to the cylinder; a jacket surrounding the cylinder; means supplying water to the jacket; a rotary shaft; a frame operatively connected to the shaft; means for confining said frame to right-line reciprocations; and a pivotal connection between the piston and said frame.

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses.

GEORGE H. REYNOLDS.

Witnesses:

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