Jan. 23, 1951

F. W. SCHROEPFER

VARIABLE STROKE PUMP

2,539,277

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5 Sheets-Sheet 1

Fig. 1.

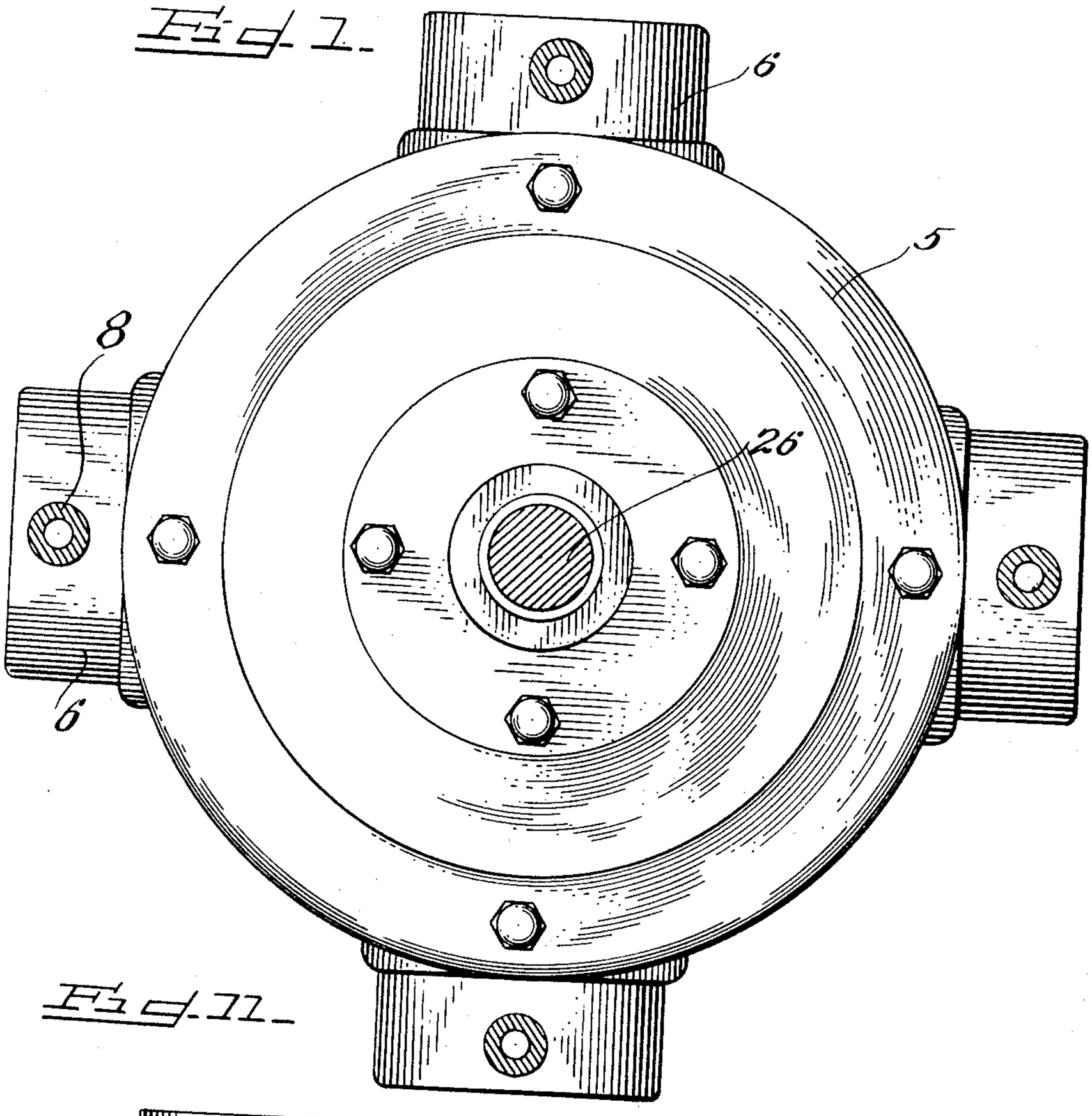
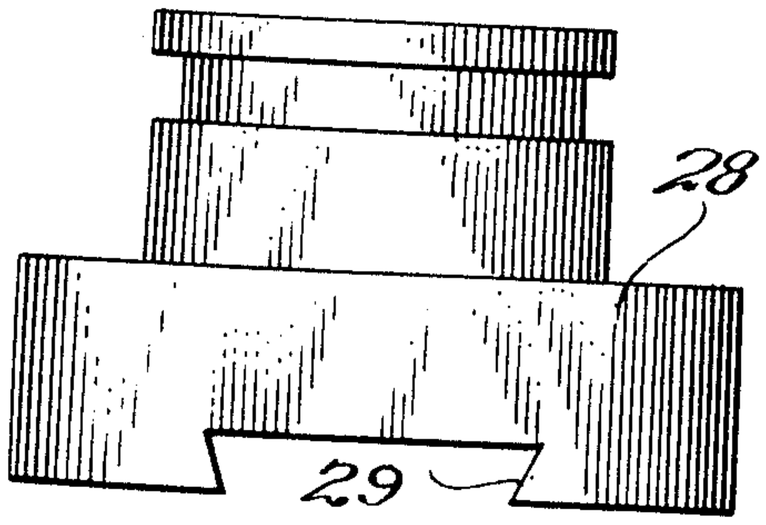


Fig. 11.



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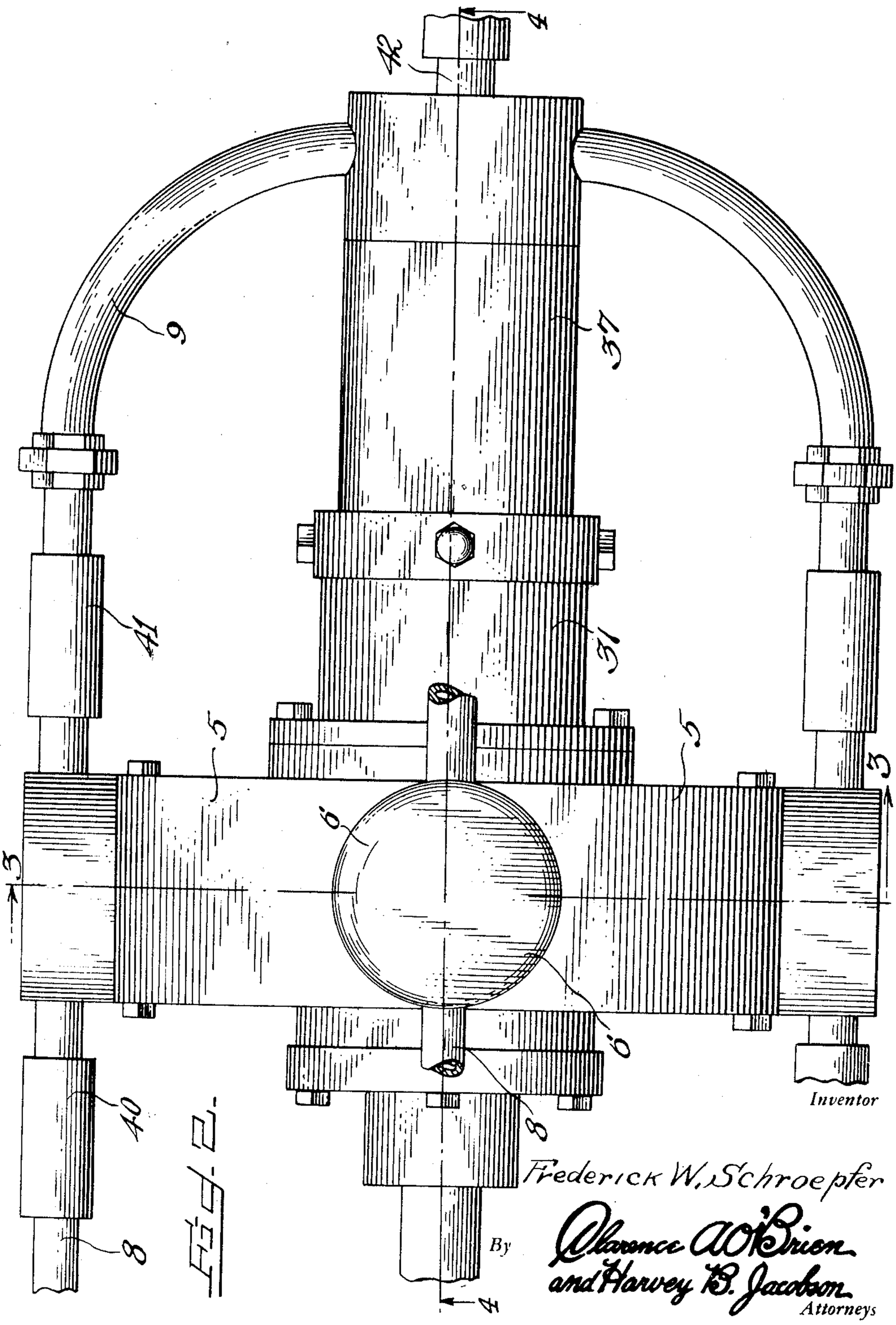

Fig. 2.

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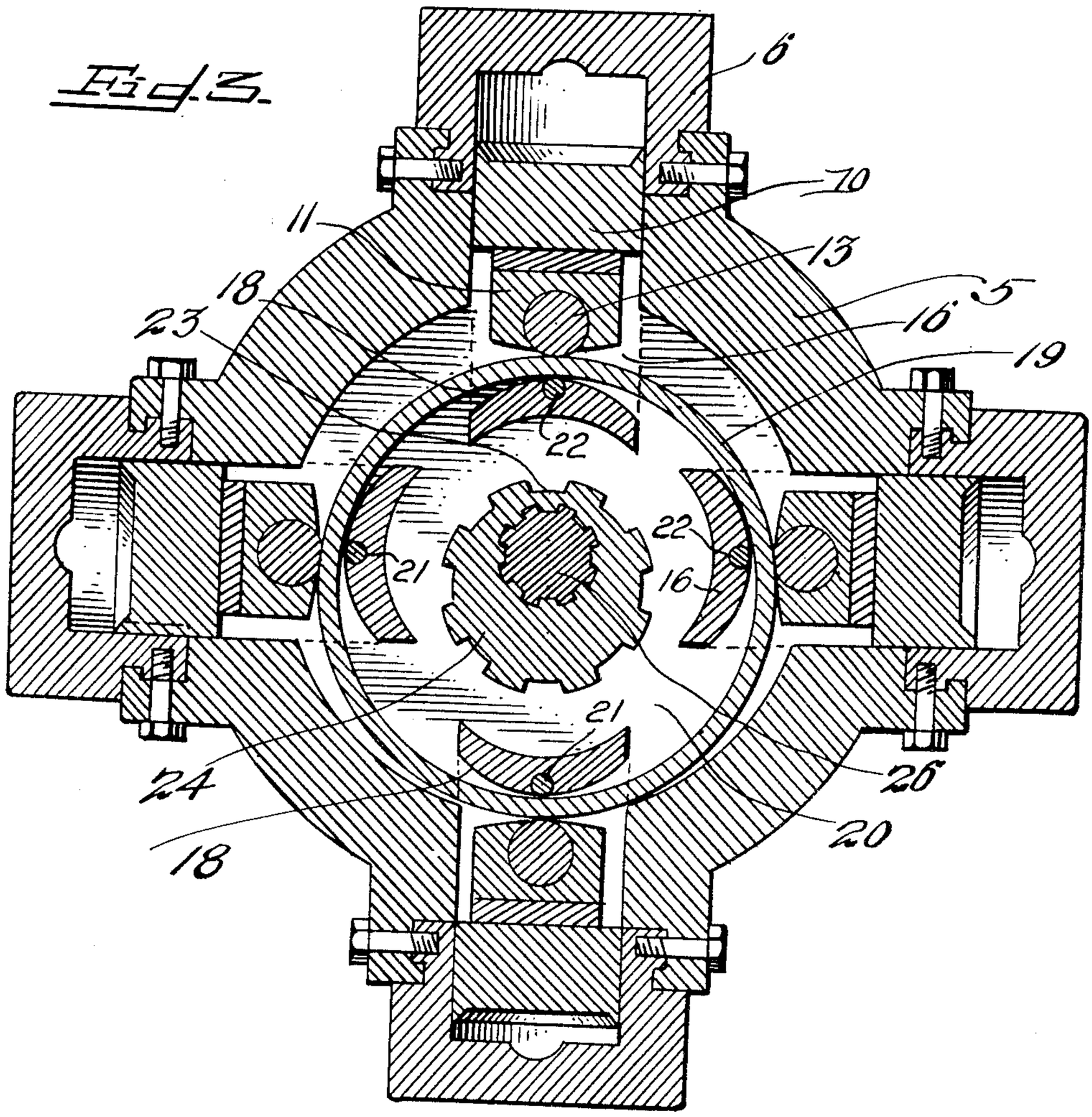
Fig. 3.



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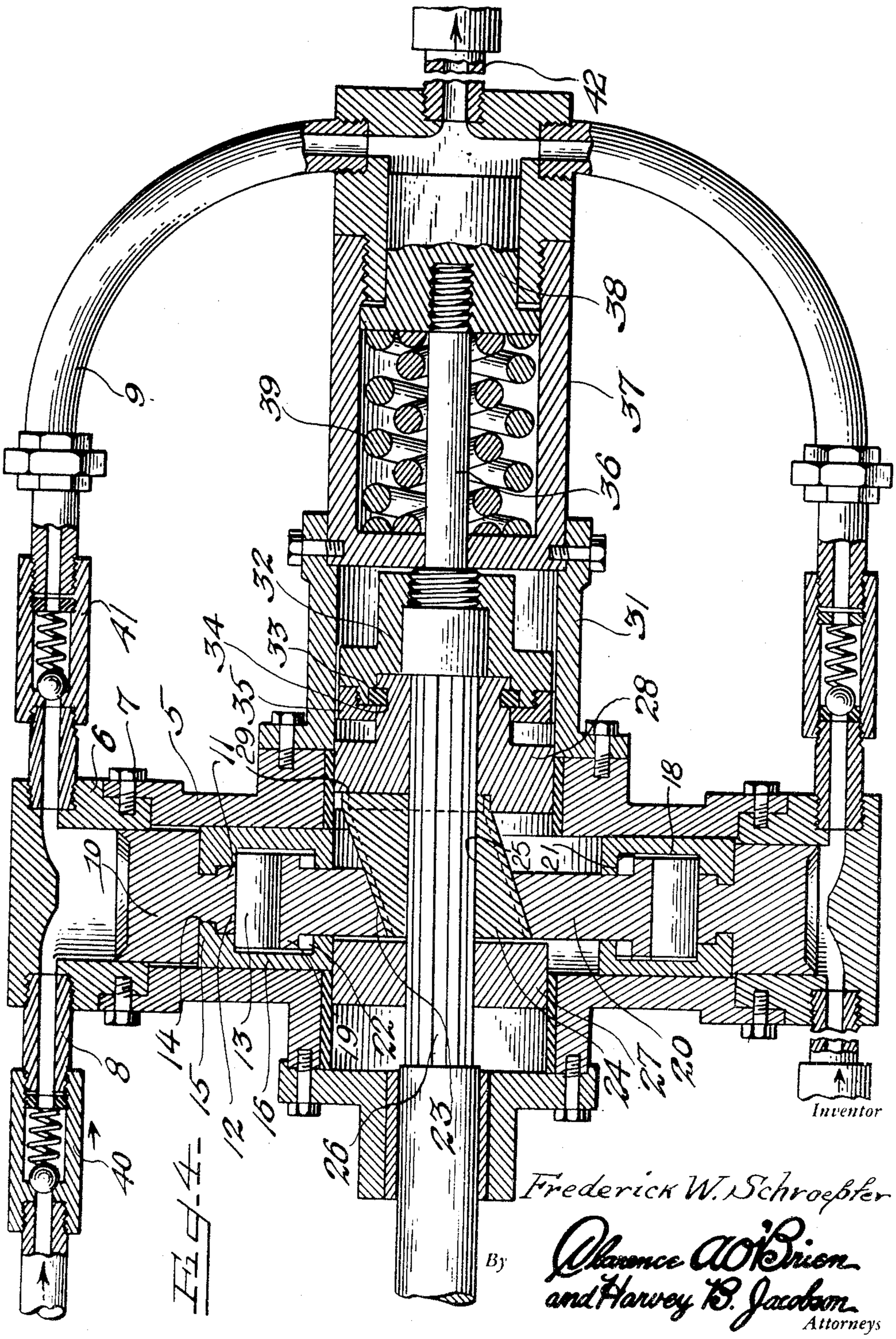

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Fig. 5.

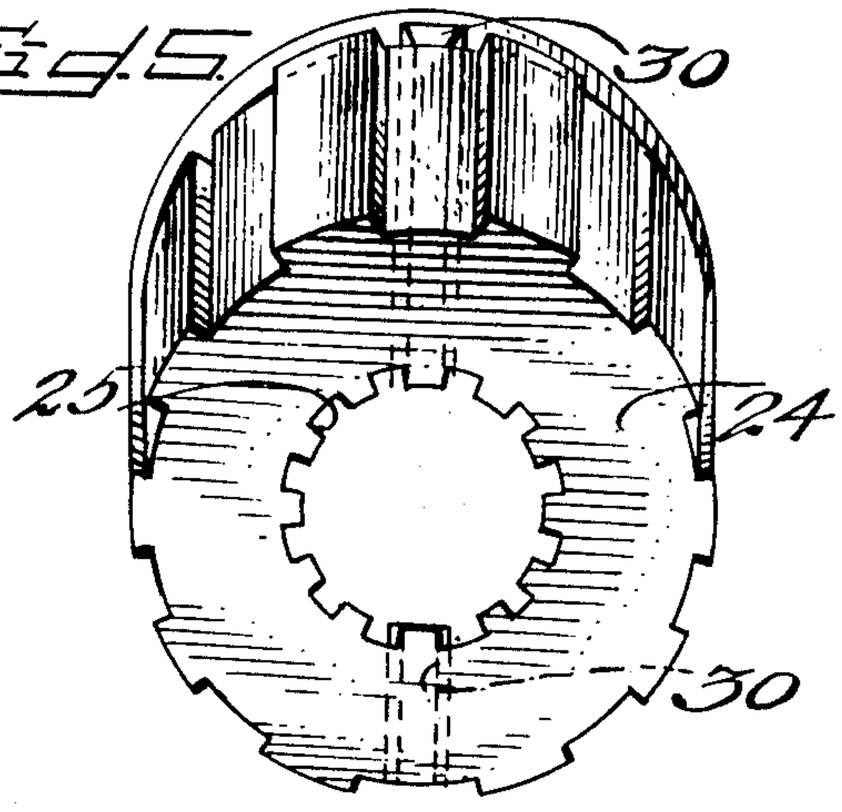


Fig. 6.

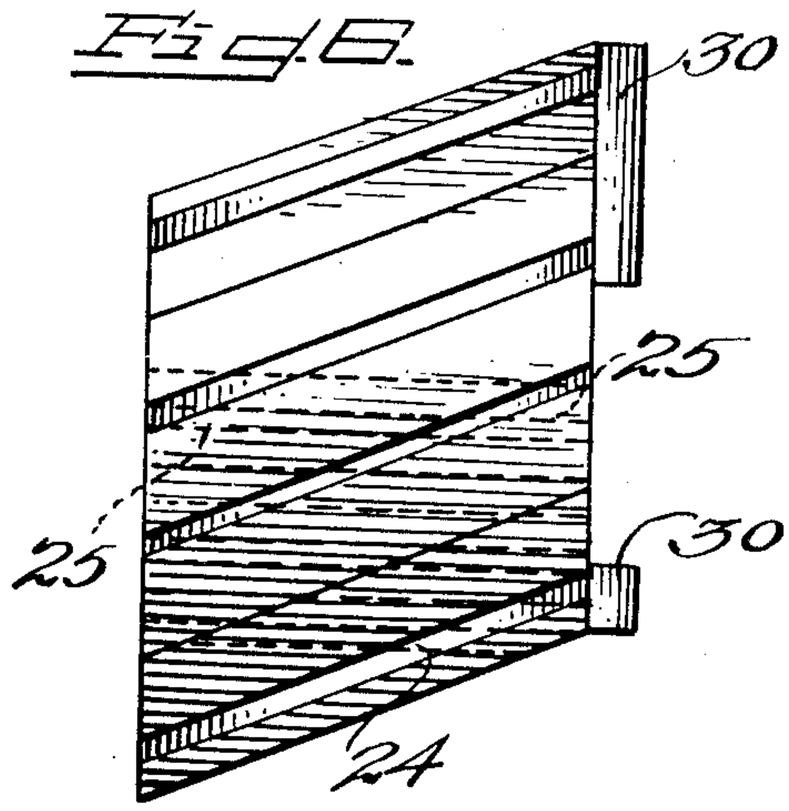


Fig. 7.

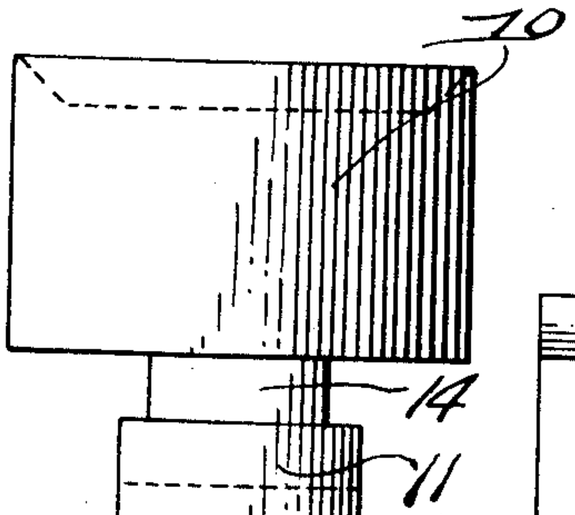


Fig. 8.

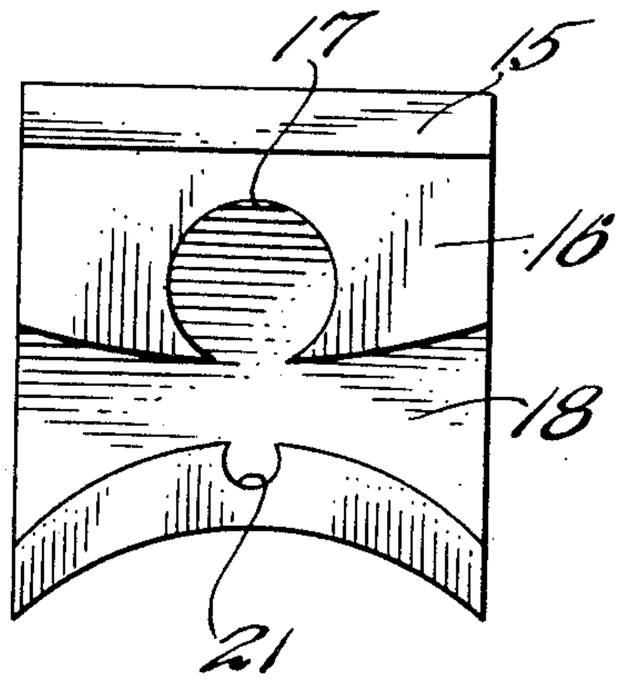


Fig. 9.

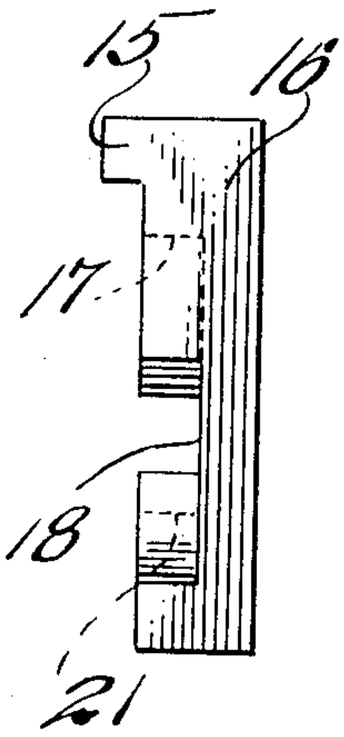
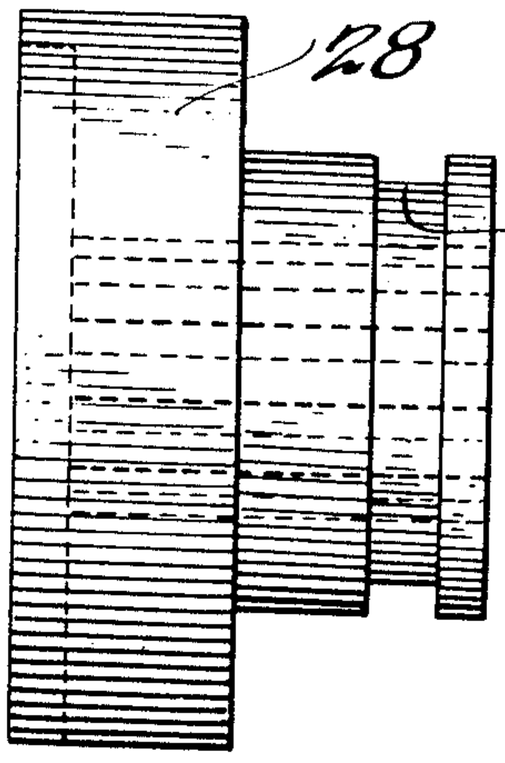


Fig. 10.



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UNITED STATES PATENT OFFICE

2,539,277

VARIABLE STROKE PUMP

Frederick W. Schroepfer, Baltimore, Md., assignor of ten per cent to Martin A. High and ten per cent to William N. Schaefer, both of Baltimore, Md., and ten per cent to Fluid Transmissions Research Corporation, Baltimore, Md., a corporation of Maryland

Application March 9, 1945, Serial No. 581,733

3 Claims. (Cl. 103—38)

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The present invention relates to new and useful improvements in pumps and more particularly to means for automatically adjusting the stroke of the pistons of the pump in accordance with the requirements or loads to which the pump is subjected.

The invention is designed primarily for use in connection with hydraulic pumps adapted for use as the driving element of a variable speed fluid power transmission mechanism and comprises a pump accumulator and a fluid motor of the reciprocating piston type and connected by a closed fluid circuit so that the fluid pressure generated by the pump acts as a driving pressure for the motor.

The variable stroke pump is a variation of the sliding wedge type in which a movable hub can change the position of the cam with respect to its center. This change of position varies the stroke of the piston. This, in turn, makes it possible to use a constant speed motor against a varying pressure.

The main feature of the variable stroke pump is the circular cam which rotates continuously. In the central part of this cam is cut an opening whose sides are inclined to the axis of rotation. Into this opening is fitted a hub touching the sides of the opening. This hub is longer than the cam is thick; further the hub is splined to the cam and input shaft in such a way as to permit sliding along the shaft but not relative rotation.

In "neutral" position the hub is located so that the center of cam coincides with the center of rotation. By sliding the hub along the shaft the sides of which are inclined to the axis of rotation the cam is forced off center causing it to act as an eccentric and giving the pistons a reciprocating motion. The outer edge of the cam is so designed and fitted that there is positive action, on rollers, for both strokes of the piston. The combination pressure regulator and spring type accumulator is a radical departure from normal accumulators, its function being different.

The purpose of this accumulator is not to maintain a uniform pressure, but to gradually increase or decrease the unit pressure of the fluid in the accumulator according to the demand. Springs and nests of helical springs, which can furnish

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high forces through a variety of deflections are available.

A novel feature of this device is that when the valve to the fluid motor is closed, the fluid from the pump fills the accumulator causing the hub in the pump to move to a "neutral" position automatically so that there is no movement of the pistons and no need to interrupt the operation of the prime mover.

In order to compensate for variations in pressure demand automatically and without interrupting the operation of the prime mover I have, therefore, provided a mechanism for accomplishing the purpose which is of simple and practical construction, efficient and reliable in performance, relatively inexpensive to manufacture and otherwise well adapted for the purposes for which the same is intended.

Other objects and advantages reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming part hereof, wherein like numerals refer to like parts throughout, and in which:

Figure 1 is an end elevational view of the pump.

Figure 2 is a side elevational view thereof.

Figure 3 is a sectional view taken substantially on a line 3—3 of Figure 2.

Figure 4 is a sectional view taken substantially on a line 4—4 of Figure 2.

Figure 5 is an end elevational view of the adjustable hub for the eccentric.

Figure 6 is a side elevational view thereof.

Fig. 7 is a side elevational view of one of the pistons.

Figure 8 is a side elevational view of one of the connectors between the piston and eccentric.

Figure 9 is an edge elevational view thereof.

Figure 10 is a side elevational view of the coupling bearing for the hub, and

Figure 11 is a similar view showing the dovetail slot for connecting one end of the hub thereto.

Referring now to the drawings in detail wherein for the purpose of illustration I have disclosed a preferred embodiment of the invention, the numeral 5 designates the annular pump housing generally having a plurality of radially disposed cylinders 6 connected to the edges of the housing

by means of bolts 7. Each of the cylinders have fluid intake and exhaust pipes 8 and 9 attached thereto.

A piston 10 works in each of the cylinders 6 and is formed with a stem 11 on its inner end having a transversely extending recess 12 at the inner end of the stem for receiving a roller bearing 13, one edge of the roller bearing projecting beyond the inner end of the stem of the piston as shown to advantage in Figure 3 of the drawings.

Outwardly of the recess 12 the stem 11 is formed with an annular groove 14 adapted for receiving a flange 15 formed at one edge of a connector 16, a pair of the connectors being positioned at opposite sides of the stem 11 of the piston as shown to advantage in Figure 4.

The opposed faces of the connectors are formed with recesses 17 to receive the ends of the roller 13 and the opposed faces of the connectors are also formed with grooves 18 flared at each end for receiving the annular flanges 19 formed on the opposite sides of an eccentric 20.

The opposed faces of the connectors 16 are further formed with recesses 21 at one edge of the grooves 18 to receive roller bearings 22 with which the inner surfaces of the flanges 19 engage. As will be noted from an inspection of Figure 3 of the drawings, the sides of the roller bearings 13 and 22 project from their respective recesses to provide a bearing surface for the inner and outer surfaces of the flanges 19 of the eccentric 20.

The eccentric 20 is formed with a central opening 23 which is inclined with respect to the axis thereof and a substantially cylindrical hub member 24 which is likewise inclined from its longitudinal axis is splined in the opening 23 for sliding movement therein. The hub member 24 is formed with an opening 25 in which the pump shaft 26 is splined, the hub member 24 likewise being slidable on the shaft.

A bearing 27 is also splined on the shaft 26 at one side of the eccentric 20 and a bearing 28 is also splined on the shaft 26 at the opposite side of the eccentric 20, the bearing 28 having a dovetailed groove 29 extending transversely at one side of the bearing and in which a dovetail rib 30 formed on the adjacent end of the hub 24 is slidably received.

The bearing 28 is slidably mounted in a cylindrical extension 31 connected to one side of the pump housing 5, the side of the bearing 28 opposite from the hub member 24 having a coupling 32 connected thereto by means of an annular key 33 positioned in an annular groove 34 in the bearing and connected to the coupling 32 by means of a cap 35 threaded to the coupling.

A stem 36 is threadedly connected at one end to the coupling 32 and projects into a cylinder 37 constituting an accumulator with the other end of the stem threaded into a piston 38 working in the cylinder. A coil spring 39 is positioned behind the piston 38 to yieldably urge the latter outwardly of the cylinder and thus urge the hub 24 in one direction while fluid pressure from the pipes 9 connected to the outer end of the cylinder 37 subjects the piston 38 to fluid pressure whereby to move the hub 24 in an opposite direction against the influence of the spring 39. Fluid pressure is supplied to the cylinder 37 through the pipes 9 from the pump cylinders.

Spring loaded check valves 40 and 41 are provided in the intake pipes 8 and discharge pipes 9 respectively.

By connecting the shaft 26 to a suitable prime mover (not shown) the pistons will be operated to pump fluid through the pipes 9 to the accumulator cylinder 37 and through the pipe 42 to a fluid motor (not shown) of conventional construction to perform useful work. The fluid from the fluid motor is returned to a reservoir (not shown) which feeds the pump 5 by means of the return pipes 8 to thus provide a closed system.

Pressure in the accumulator will be automatically regulated in accordance with the load subjected to the fluid motor.

Accordingly, in the operation of the device the hub 24 will be moved forwardly and backwardly in accordance with pressure subjected to the piston 38 whereby to adjust the eccentric 20 and vary the stroke of the pistons 10.

It is believed that the details of construction and manner of use of the device will be readily understood from the foregoing without further detailed explanation.

I claim:

1. A variable stroke pump comprising a housing having a plurality of radially extending cylinders provided with intake and discharge ports, pistons working in the cylinders, a pump shaft in the housing, an annular member in the housing interposed between said pistons and having an inclined central opening, a hub slidably splined in the opening and also slidably splined on the shaft in surrounding relation thereto, side edge flanges on the annular member, means connecting said annular member to said pistons and including flanged connectors at opposite sides of the annular member and roller bearings between said side flanges and the flanges of said connectors, and means for subjecting the hub to fluid pressure to slide the same and thereby adjust the hub eccentrically and longitudinally in the annular member for adjusting said annular member eccentrically of said shaft to vary the stroke of said pistons.

2. In a rotary pump, a rotary shaft, a pump piston, means for reciprocating said piston upon rotation of said shaft comprising a hub member circumscribing said shaft with a periphery inclined longitudinally of the shaft for rotation eccentrically by said shaft, an annular member circumscribing said hub member for eccentric rotation by said hub member and being connected to said piston to reciprocate the same upon such rotation of said annular member, said hub member being splined to said shaft and annular member for sliding along said shaft and in said annular member to variably adjust said annular member eccentrically of said shaft and thereby vary the stroke of said piston, and means to slide said hub member.

3. In a rotary pump, a rotary shaft, a pump piston, means for reciprocating said piston upon rotation of said shaft comprising a hub member circumscribing said shaft with a periphery inclined longitudinally of the shaft for rotation eccentrically by said shaft, an annular member circumscribing said hub member for eccentric rotation by said hub member and being connected to said piston to reciprocate the same upon such rotation of said annular member, said hub member being splined to said shaft and annular member for sliding along said shaft and in said annular member to variably adjust said annular member eccentrically of said shaft and thereby vary the stroke of said piston, and means to slide said hub member comprising a pressure opera-

tive plunger, a stem endwise movable by said plunger, and means connecting said hub member to the stem for rotation relative thereto and sliding movement thereby upon endwise movement of said stem.

FREDERICK W. SCHROEPFER.

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