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PRESSURE INTENSIFIER

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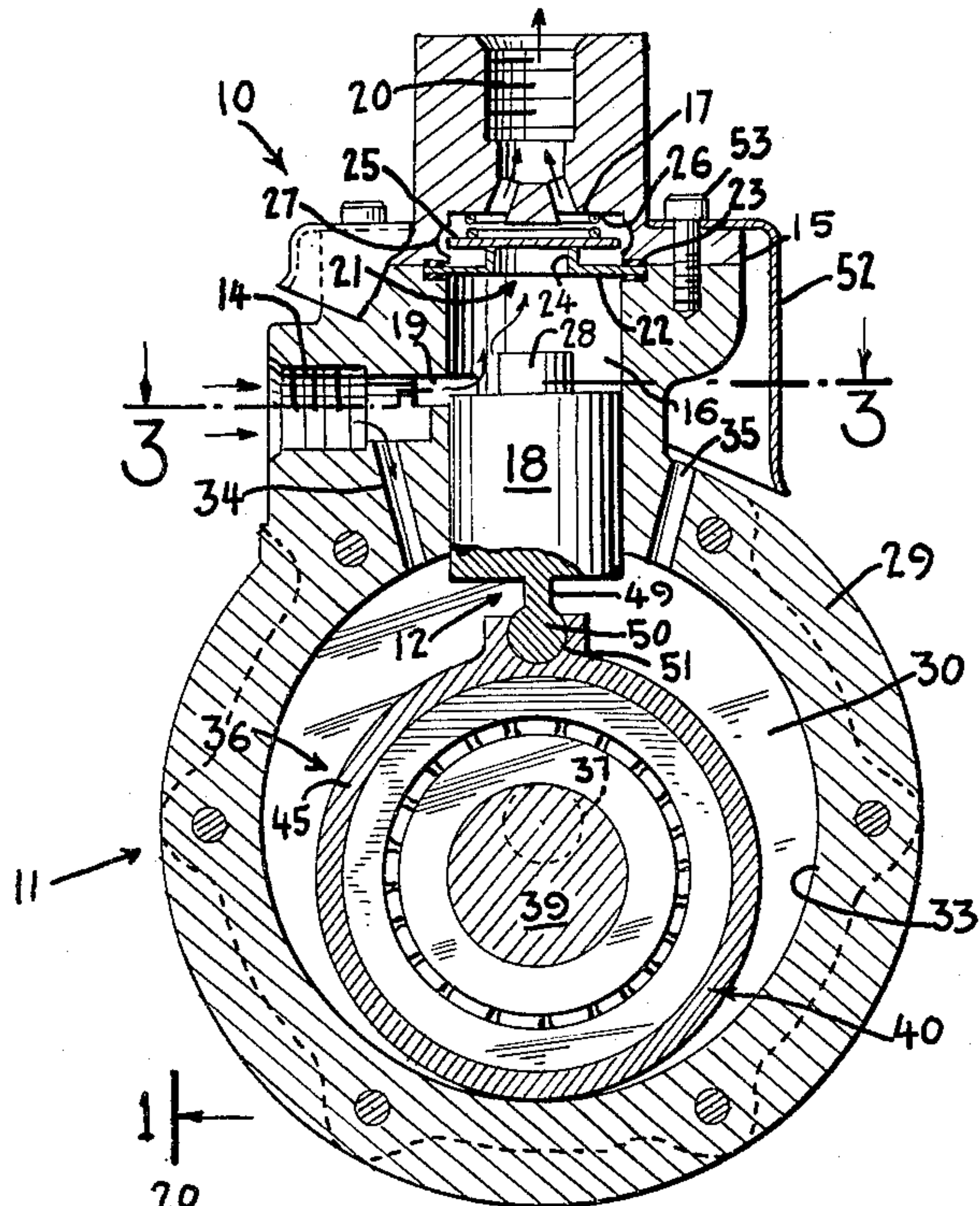


Fig. 1.

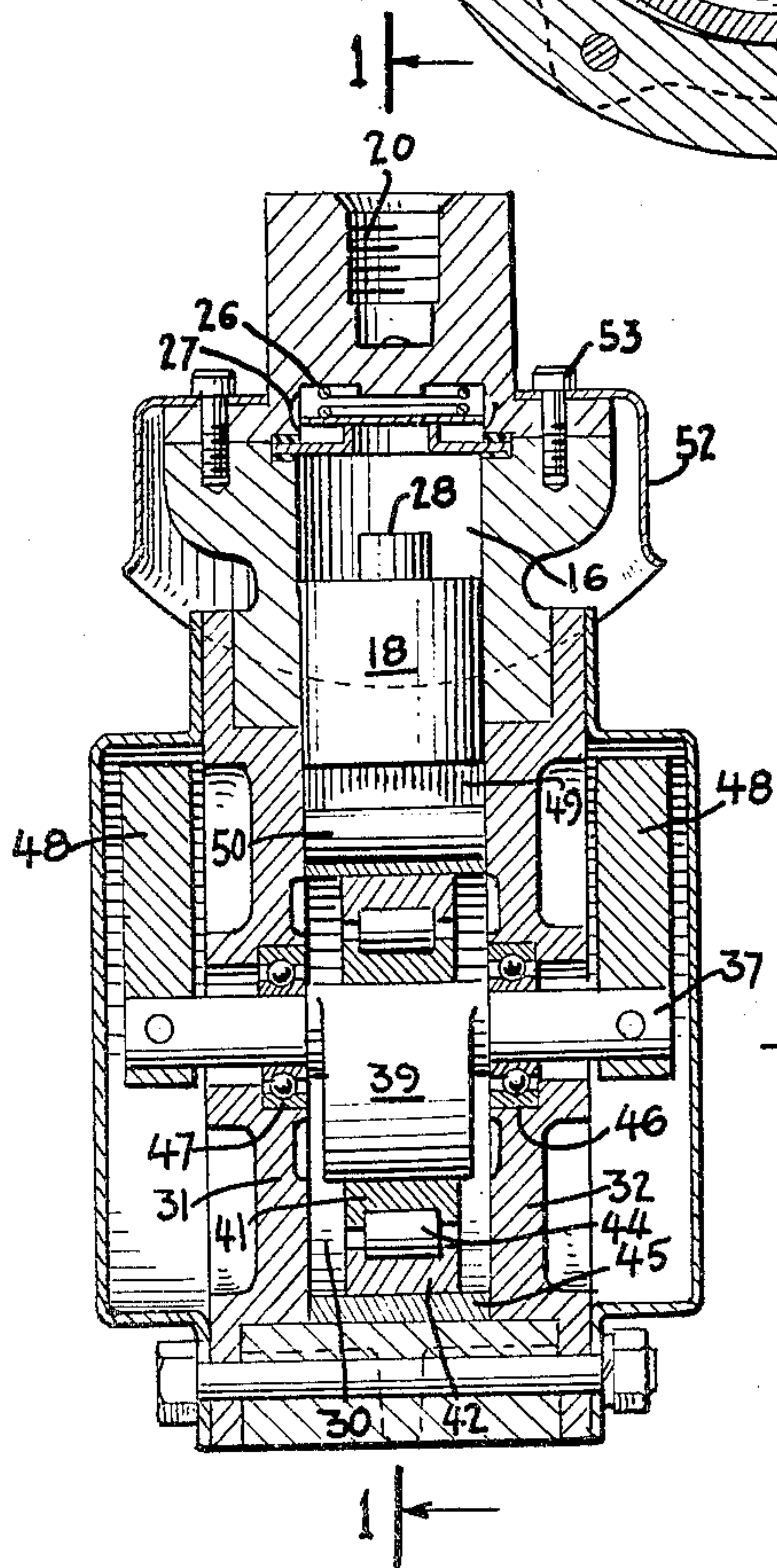


Fig. 2.

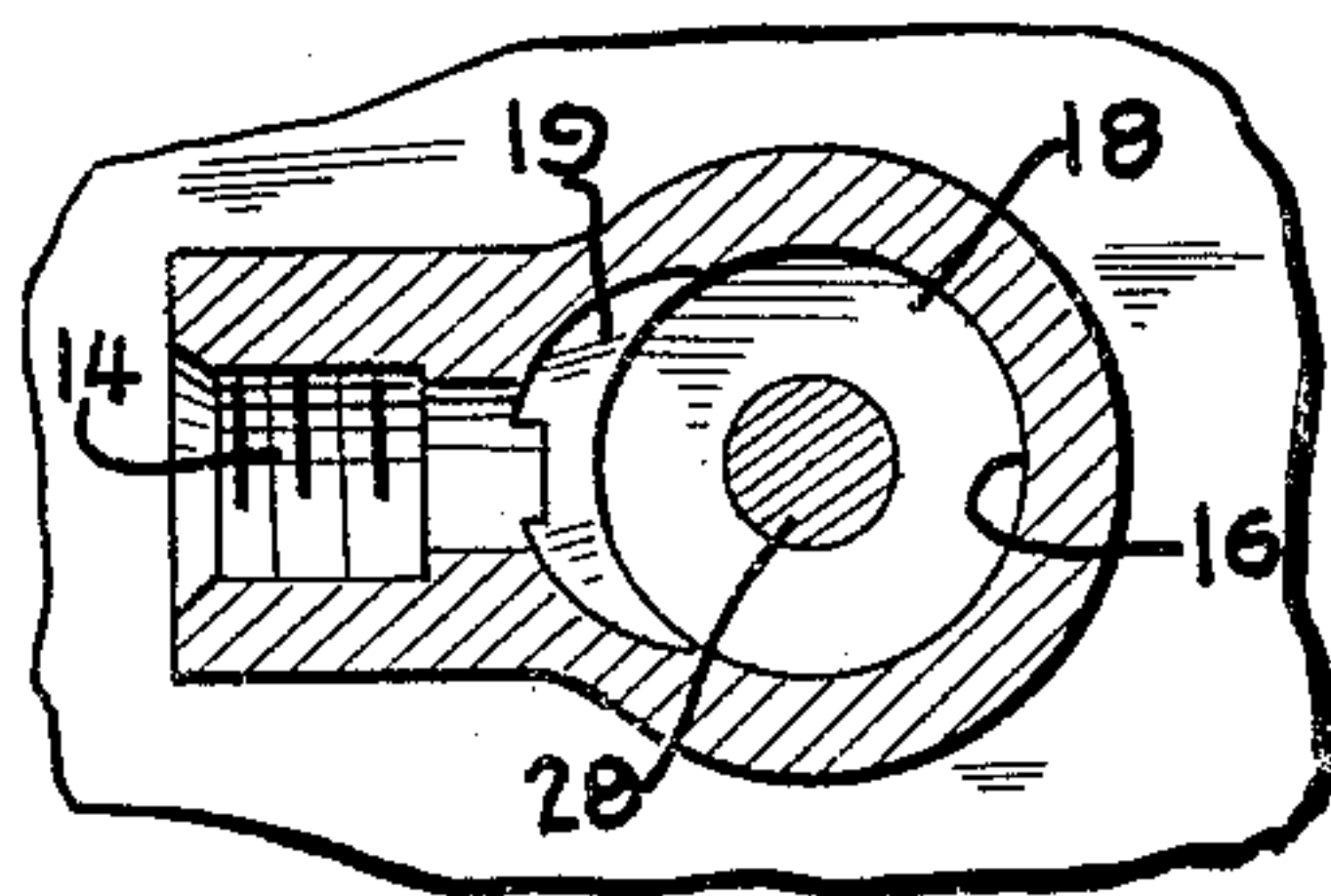


Fig. 3.

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## PRESSURE INTENSIFIER

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3 Claims. (Cl. 230—57)

The present invention relates to pneumatic pressure intensifiers, and, more particularly, to pressure intensifiers of the combined compressor-engine type wherein the engine is driven by the source of fluid pressure to be intensified by the compressor.

In many instances, applications for high pressure pneumatic fluid exist where only low pressure fluid is available. This is particularly true in pneumatic applications where pressures of 3,000 to 5,000 pounds per square inch are required and the available air supply has a pressure of about 40 to 100 pounds per square inch. It is desirable under these circumstances to utilize the available low pressure fluid and compress it to the pressure required, in an efficient and inexpensive manner, by an apparatus which is low in cost, is light in weight and has a minimum space requirement.

Heretofore, apparatus designed for this purpose has not been entirely satisfactory for one or more reasons, namely, that the apparatus was costly to manufacture because of complex valving, had excessive weight and space requirements, lacked the desired volumetric efficiency, lacked a sufficient output pressure to input pressure ratio, or required power from a source other than the available fluid under pressure.

Accordingly, an object of the present invention is to provide a pneumatic pressure intensifier which is simple and economical to manufacture.

Another object is to provide such apparatus which utilizes the available low pressure fluid as its power source.

Another object is to provide such apparatus which has a large output pressure to input pressure ratio and thereby is efficient in operation.

Another object is to provide such apparatus which has a small space requirement and is light in weight.

A further object is to provide such apparatus which has a high volumetric efficiency.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In accordance with the present invention, the foregoing objects are accomplished by providing apparatus for increasing the pressure of a gaseous medium under pressure, for example air, which comprises a compressor including a cylinder bore having an intake port and an exhaust port, a piston mounted for reciprocation in the cylinder bore, and valve means for the exhaust port; a rotary engine operable by gaseous medium under pressure and adjacent the compressor and including a cylindrical chamber having its central axis intersecting the central axis of the cylinder bore perpendicularly and having an inlet port and an outlet port, a piston drum in the chamber, and eccentric means for mounting the drum for rotary movement within the chamber; coupling means for connecting the drum and the piston to cause rotary movement of the drum to thereby effect reciprocation of the piston; and conduit means adapted for connection to a supply of gaseous medium under pressure and in fluid flow communication with the intake port and the inlet port, whereby a portion of the medium supplied is utilized to drive the engine and the remainder thereof is compressed to increase its pressure.

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A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawing forming a part of the specification, wherein:

FIG. 1 is a longitudinal sectional view of the apparatus in accordance with the present invention.

FIG. 2 is a sectional view taken along the line 2—2 on FIG. 1.

FIG. 3 is a sectional view taken along the line 3—3 on FIG. 1 illustrating certain details of construction.

Referring to the drawing in detail, the pressure intensifier in accordance with the present invention generally comprises a compressor 10, a rotary engine 11, and connecting means 12 through which the engine drives the compressor. Conduit means 14 provide a common low pressure fluid supply to the compressor and the engine.

The compressor 10 comprises an upper casing 15 having a cylinder or bore 16 therein, a head 17 for closing the upper end of the bore 16, a piston 18 mounted for reciprocation in the bore 16, an intake port 19 in the side wall of the bore 16 just above the piston when it is in its lower position (FIG. 1) and in fluid flow connection with the conduit means 14, an exhaust port 20 in the head 17, and exhaust valve means 21 positioned in the bore adjacent the exhaust port 20 to control the flow of compressed fluid therethrough.

The exhaust valve means 21 includes a disc-like valve seat member 22 seated in an annular recess 23 formed in the bore 16 and having a tubular upwardly extending portion 24, a valve disc 25 positioned above the portion 24, and a spring 26 above the valve disc for urging the same to seat on the tubular portion of the seat member 22. The bore 16 is fluted adjacent the periphery of the valve disc 25 to form passageways 27 for enabling the fluid flowing through the portion 24 to get past the valve disc when the latter is unseated. A projection 28 on the upper end of the piston 18 is adapted to extend into the tubular portion 24 to obtain maximum compression of the fluid in the bore 16.

The rotary engine 11 comprises a lower casing 29 having a cylindrical chamber 30 defined by end walls 31 and 32 and a cylindrical side wall 33, an inlet port 34 in the wall 33 in fluid flow connection with the conduit means 14 and adjacent one side of the bore 16, an outlet port 35 in the wall 33 adjacent the bore 16 on the opposite side of the bore 16 from the inlet port 34, a piston drum 36 positioned eccentrically within the chamber 30 and having a smaller diameter than the chamber 30, and a shaft 37 on which the drum 36 is eccentrically mounted to provide continuous contact between peripheral surface of the drum and the inner side of the wall 33 as the shaft rotates.

The piston drum 36 comprises a cylindrical core section 39 attached to the shaft 37 for rotation therewith; a bearing assembly 40 having an inner race 41 mounted on the core section 39, an outer race 42 and roller bearings 44 between the races; and an outer cylindrical sleeve 45 mounted on the outer race 42 of the bearing assembly 40 for rotatory movement therewith. The sleeve 45 is dimensioned to contact the end walls 31 and 32 of chamber 30 to provide a fluid seal between the end walls and the edges of the sleeve 45.

The ends of the shaft 37 extend outwardly of the chamber 30 through openings 46 in the end walls 31 and 32 and bearings 47 are provided in the openings 46 about the shaft 37. Counterweights 48 are attached at the outer ends of the shaft 37 to dynamically balance the rotary piston drum 36 and thus provide smooth operation of the engine.

The connecting means 12 include a depending transverse extension 49 at the bottom of the compressor piston 18 terminating in a cylindrical portion 50, and a cylindri-



cal socket 51 provided on the piston drum 36 for receiving the portion 50 to provide a pivotal connection between the piston 18 and the piston drum 36. The connecting means portions 49, 50 and 51 also are dimensioned to be in fluid sealing contact with the end walls 31 and 32 of the chamber 30 so that a partition is provided in chamber 30 between the inlet port 34 and the outlet port 35. A truncated, inverted cup-shaped hood 52 is secured to the casing of the compressor 10 by a plurality of bolts 53 and overlies the outlet port 35 of the engine 11 whereby the cool expanded air leaving the port 35 is utilized to cool the compressor.

In operation, low pressure fluid from the common supply flows from the conduit means 14 through the ports 19 and 34 into the compressor bore 16 and into that portion of chamber 30 on the inlet side of the partition formed between the ports 34 and 35. The drum 36, by having fluid under pressure acting only on its left or inlet side, is forced toward the right (as viewed in FIG. 1) thereby causing its core section 39 and shaft 37 attached thereto to rotate in a counterclockwise direction. The sleeve 45 is restrained from rotation with core section 39 by its pivotal connection to the piston 18 and thus is displaced vertically and horizontally, maintaining its contact with the wall 33 as the core section 39 rotates within bearing assembly 40. The point on the inner side of wall 33 at which the peripheral surface of the sleeve 45 is in contact therewith moves continuously in a counterclockwise direction as the core section 39 rotates.

As the core section 39 rotates through 180° from the position shown in FIG. 1, the vertical movement of the sleeve 45 is transmitted through the connecting means 12 to move piston 18 upwardly and effect a compression stroke. As the piston starts its compression stroke, it covers and seals off the intake port 19 to confine the low pressure fluid in the bore 16 for compression. As the piston nears the end of its compression stroke, the pressure of the fluid in the bore 16 overcomes the resistance of spring 26 and lifts the valve disc 25 from its seat portion 24 thereby allowing the fluid to leave the bore 16 and flow through the passageways 27 to the exhaust port 20. When the unit is started, the spring 26 supplies a positive seating force to the valve disc as a back pressure is being built up.

When the core section 39 has completed its revolution, the piston 18 is returned to its starting position for the next cycle.

The fluid issuing from the outlet port 35 of the engine 11 flows up under the hood 52 and around the compressor 10 spilling out on the side of the compressor opposite the port 35. Since this fluid, in driving the engine, has done work, it has been cooled and, therefore, cools the compressor as it flows past.

With apparatus of the type described, it has been found that low pressure air of 50 pounds per square inch having a flow rate of 20 standard cubic feet per minute can be boosted to the very high pressure of about 2,500 pounds per square inch with a flow rate of approximately 2 standard cubic feet per minute, with the engine developing a speed of 5,500 revolutions per minute.

From the foregoing description, it will be seen that the present invention provides an improved and novel apparatus for providing a source of very high pressure fluid by increasing the pressure of available low pressure fluid.

As various changes may be made in the forms, construction and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

I claim:  
1. Apparatus for increasing the pressure of a gaseous medium under pressure comprising in combination a casing, said casing including a lower portion formed with a cylindrical chamber having a curved side wall and flat end

walls and an upper portion formed with a cylinder bore of a diameter equal to the distance between said flat end chamber walls and having a closed upper end, said bore extending downwardly into said lower casing portion intersecting said curved chamber wall and having a central axis perpendicularly bisecting the central axis of said chamber; a piston mounted for reciprocation in said cylinder bore; a rotary piston positioned in said chamber; eccentric means for mounting said rotary piston for rotary movement within said chamber; a coupling member rigidly attached to the lower end of said piston and having a cylindrical portion on the lower end thereof; means on said rotary piston providing a cylindrical socket receiving said cylindrical portion of said coupling member whereby rotary motion of said rotary piston effects reciprocating motion of said reciprocating piston; inlet port means for said cylindrical chamber provided in said casing adjacent one side of the intersection of said chamber and said bore; outlet means for said chamber provided in said casing adjacent the other side of said intersection; said coupling member having a width equal to the diameter of said reciprocating piston whereby said coupling member and said reciprocating piston seal said inlet port from said outlet port; intake port means for said bore provided in said casing intermediate the ends of said bore; exhaust port means for said bore provided in said casing in communication with the upper end of said bore; pressure operated spring biased valve means at said exhaust port; conduit means in said casing extending from the outer surface thereof including means for connecting a supply of gaseous medium under pressure thereto; passageway means connecting said conduit means and said inlet port for conducting gaseous medium under pressure to said chamber to drive said rotary piston; and passageway means connecting said conduit means and said intake port for conducting gaseous medium under pressure into said bore to be compressed by the upward motion of said reciprocating piston, said intake port being positioned to be sealed off by said reciprocating piston when it moves upwardly, thereby confining the fluid in said cylinder bore for compression.

2. Apparatus according to claim 1, wherein an inverted cup shaped hood of greater horizontal dimensions than said upper casing portion is mounted on said upper casing portion at a level adjacent the said end wall of said bore, said casing is provided with an external opening positioned inwardly of the periphery of said hood, and passageway means is provided in said casing connecting said outlet port to said opening for directing expanded gaseous medium into the volume enclosed by said hood, the lower edge of said hood being slanted upwardly from adjacent said opening to induce the expanded gaseous medium issuing from said opening to flow around and cool said upper casing portion.

3. Apparatus according to claim 1, wherein said means for mounting said rotary piston includes a shaft extending through said casing and having its ends positioned outwardly of said casing, eccentrically mounted weights are mounted on each end of said shaft to counter balance the rotary piston, and a cover secured to said casing is positioned over each of said weights.

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