Jan. 2, 1923. 1,440,451

F. J. FORD.

ROTARY INTERNAL COMBUSTION ENGINE.

FILED FEB. 12, 1920. 3 SHEETS-SHEET 1

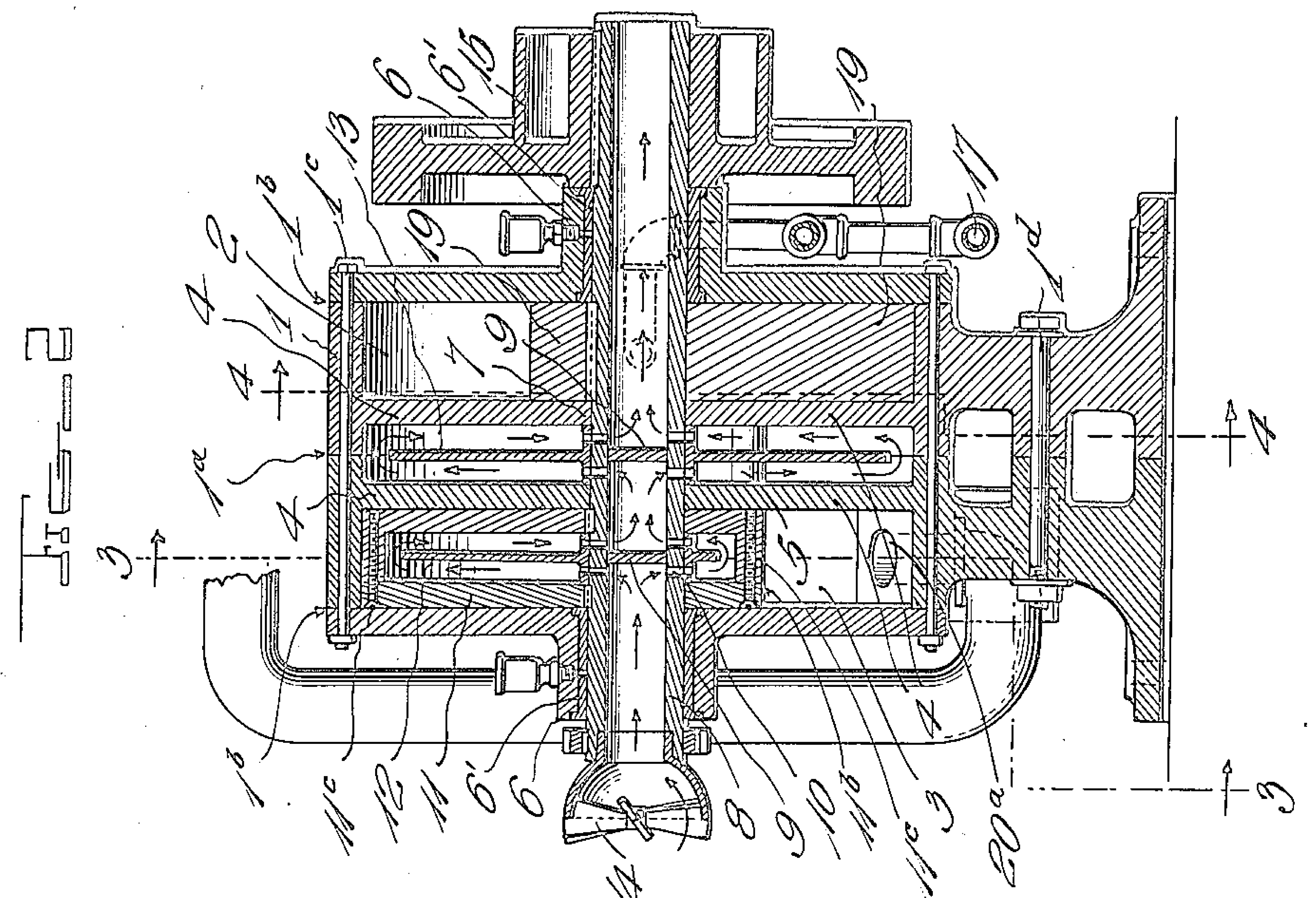

Fig. 2

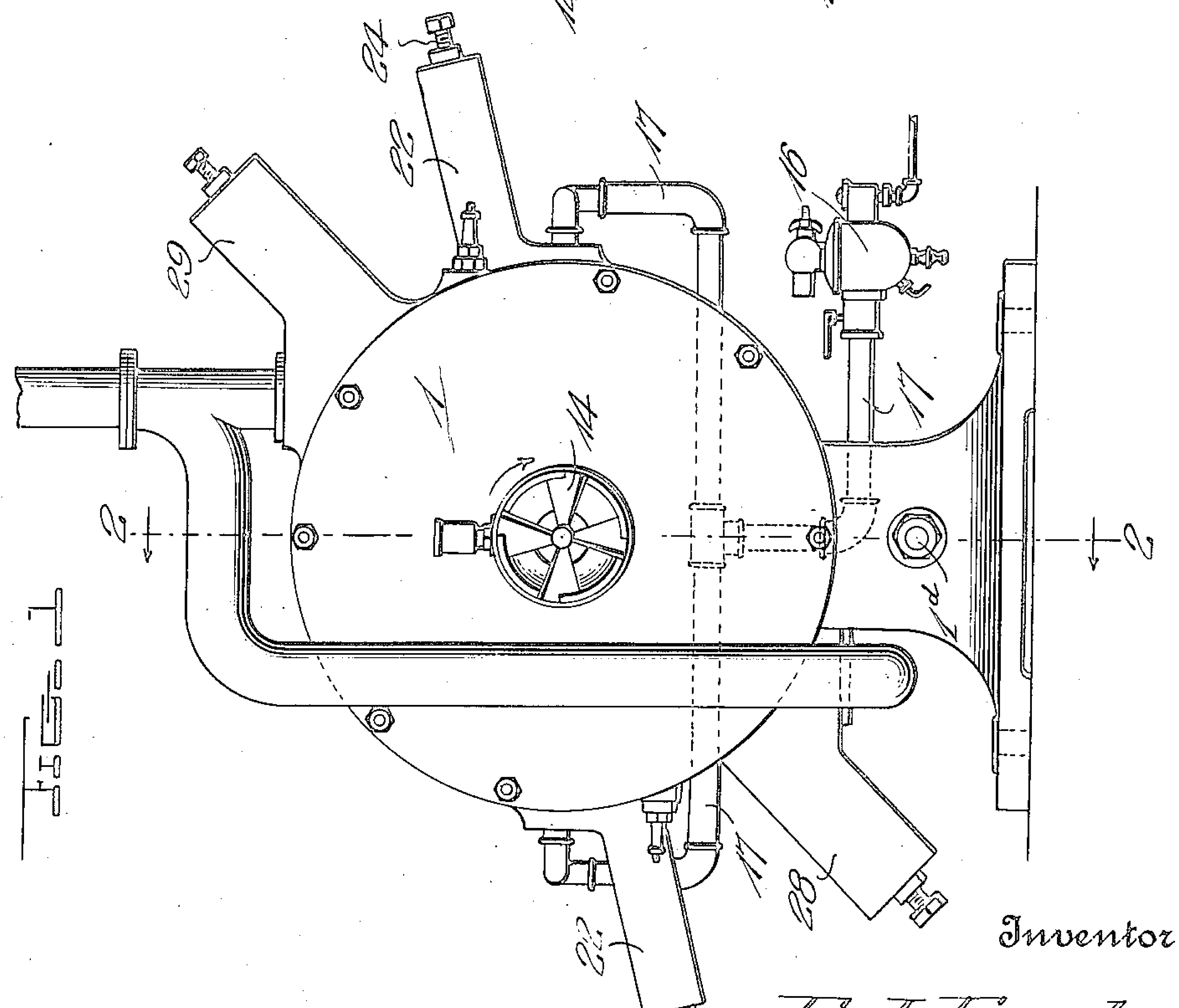

Fig. 1

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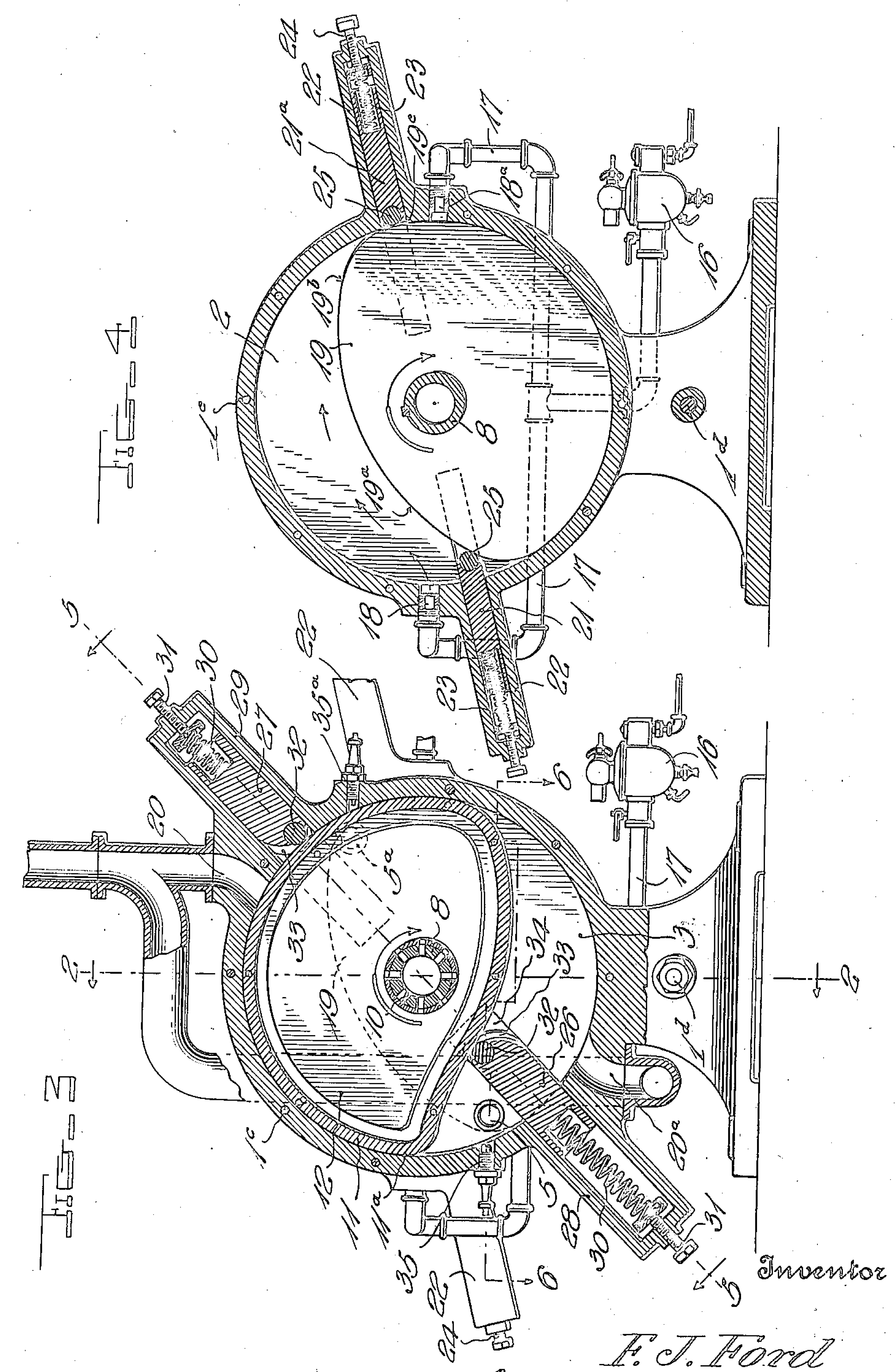

Fig. 3
Fig. 4

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Fig. 6

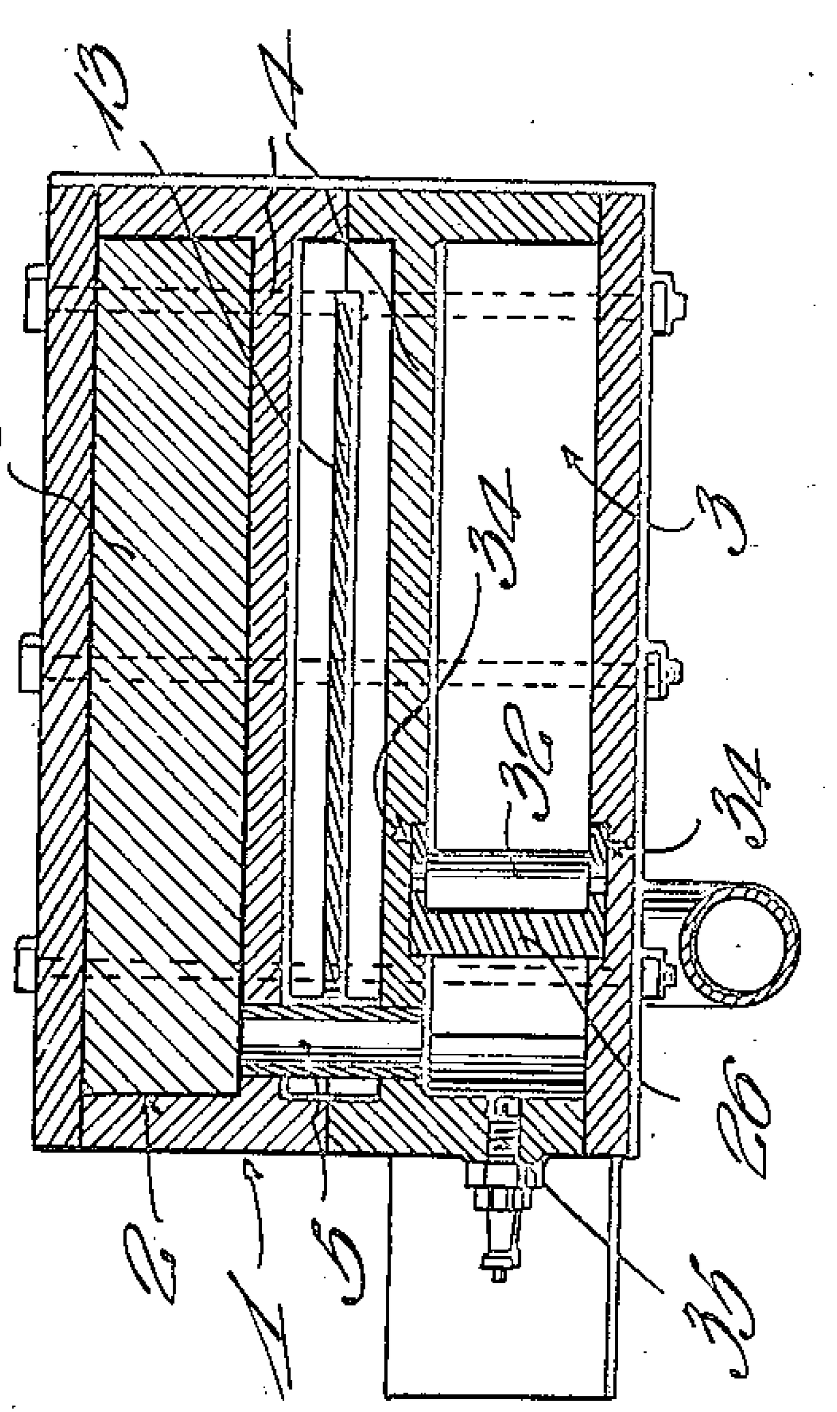


Fig. 9

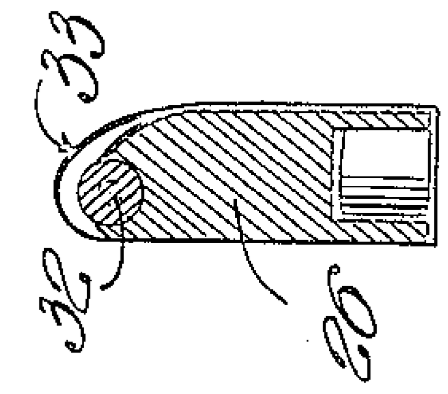


Fig. 8

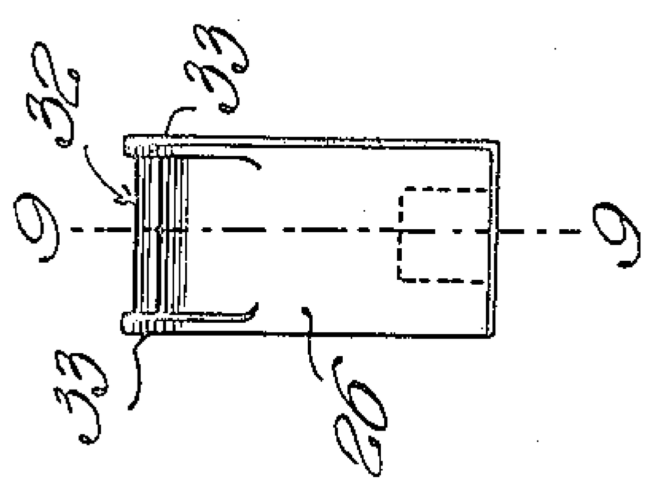


Fig. 7

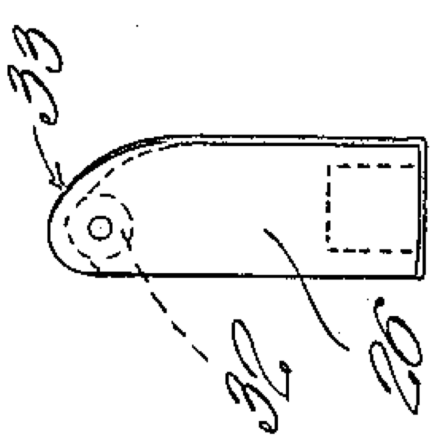
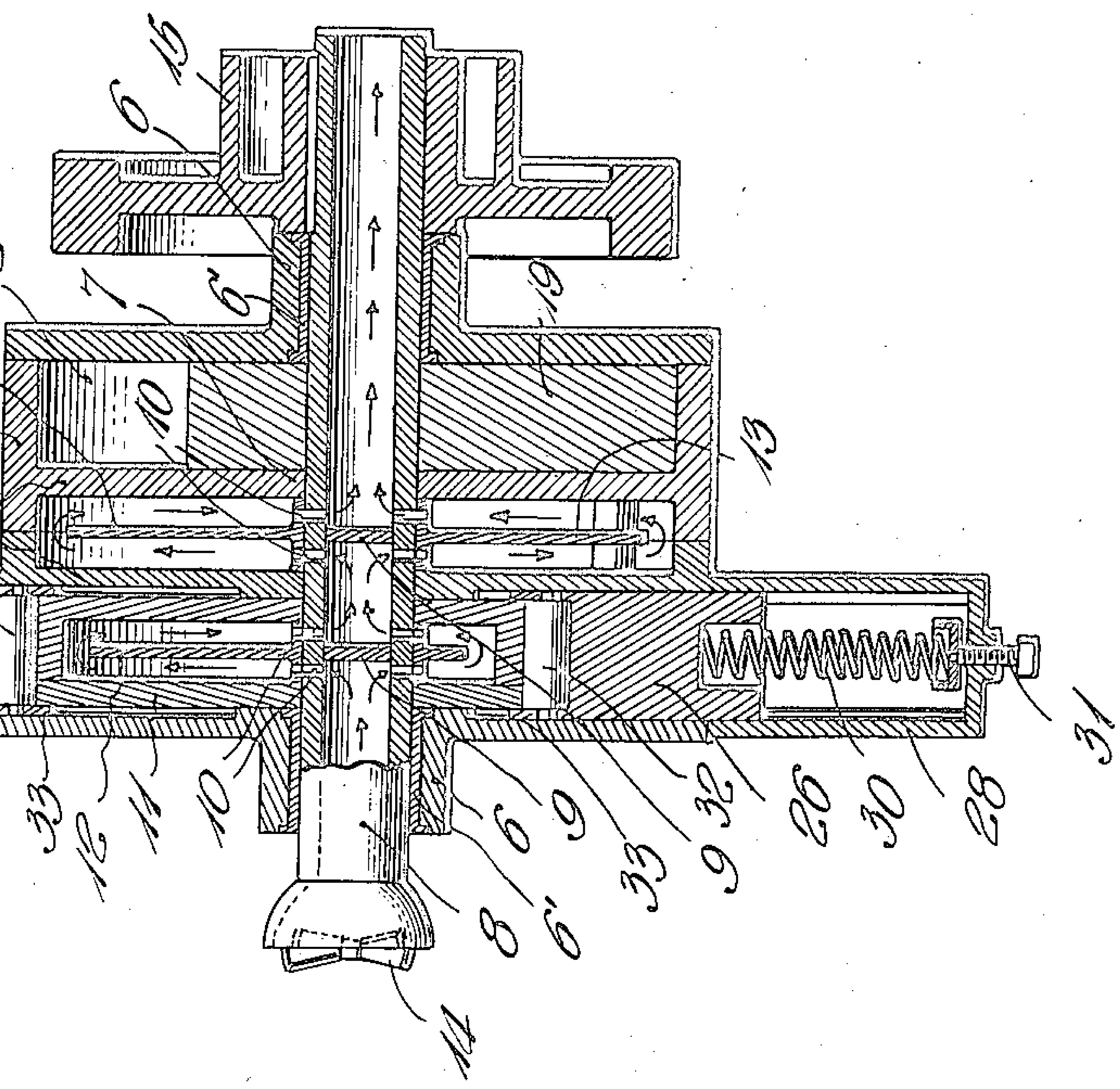


Fig. 5



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Patented Jan. 2, 1923. 1,440,451

UNITED STATES PATENT OFFICE.

FRED J. FORD, OF LOWELL, MICHIGAN.

ROTARY INTERNAL-COMBUSTION ENGINE.

Application filed February 12, 1920. Serial No. 358,279.

To all whom it may concern:

Be it known that I, Fred J. Ford, a citizen of the United States, residing at Lowell, in the county of Kent and State of Michigan, have invented certain new and useful Improvements in Rotary Internal-Combustion Engines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to rotary internal combustion engines.

One object of this invention is to generally improve upon engines of this character by providing a structure in which the compression rotor and actuating rotor serve as means to open and close the passage between the compression chamber and explosion chamber, thereby eliminating the usual valve or valves employed in other engines of this character.

A further object is to provide an improved cooling device and an operating structure which is especially designed to be kept relatively cool by this cooling device.

Other objects and advantages will be pointed out or implied in the following details of description in connection with the accompanying details in which:—

Fig. 1 is a side elevation of an engine constructed in accordance with this invention.

Fig. 2 is a vertical sectional view, the section being taken along the line 2—2 of Fig. 3.

Fig. 3 is a vertical sectional view, the section being taken substantially along the line 3—3 of Fig. 2.

Fig. 4 is a vertical sectional view the section being taken substantially along the line 4—4 of Fig. 2.

Fig. 5 is a sectional view, the section being taken substantially along the line 5—5 of Fig. 3.

Fig. 6 is a horizontal sectional view, the section being taken substantially along the line 6—6 of Fig. 3.

Fig. 7 is detail view illustrating one of the movable abutments in side elevation and detached from the body of the engine.

Fig. 8 is a front elevation of the abutment shown in Fig. 7.

Fig. 9 is a sectional view, the section being taken along the line 9—9 of Fig. 8.

Referring to these drawings in detail, in which similar reference characters correspond with similar parts throughout the several views, the invention consists in the details of construction hereinafter specifically described as follows:

The rotor casing is generally designated by the numeral 1, and is preferably formed in separable sections, as illustrated, for the sake of convenience in manufacturing and assembling the parts of the engine. When the parts of the casing are assembled as clearly illustrated in Figs. 2, 5 and 6, the casing comprises a compression chamber 2, a combustion chamber or explosion chamber 3, a hollow partition 4 and two passages 5 and 5^a, the latter extending through the hollow partition for permitting gas to pass from the compression chamber to the combustion chamber. The casing 1 also comprises bearings 6 and 7, the latter constituting the central portion of the hollow partition. These bearings may be provided with bushings 6′ of any appropriate material for reducing friction and wear, and within these bearings is mounted a hollow shaft 8 having partitions 9 therein, and having apertures or fluid passages 10 extending laterally or radially therethrough, one set of these passages being in open communication with the hollow partition, and the other set being in open communication with a hollow actuating rotor 11.

Two baffle plates 12 and 13 are secured in and extend radially from the hollow shaft 8, each of these baffle plates being disposed between two apertures 10 or between two sets of these apertures, and the baffle plates are also spaced from the inner surfaces of the hollow partition and actuating rotor, so that air may pass between the baffle plates and inner surfaces. Moreover, the baffle plates extend approximately to the inner peripheries of the hollow elements 4 and 11, so that when air is drawn through the hollow shaft 8 and hollow elements 4 and 11, the latter are cooled substantially throughout their entire extent by their contact with the air.

A fan 14 is secured in an enlarged end portion of the shaft 8, and one of such fans may be employed at each end of the shaft 8 when desirable. When the shaft 8 rotates in the direction indicated by the curved arrow in Fig. 2, air is thereby drawn into the hollow shaft 8, but cannot pass directly therethrough because of the partitions 9, and therefore it passes through the first set of apertures 10 adjacent to the fan 14, and thence around the baffle plate 12 and through the second set of apertures 10 into the hollow shaft 8. From this portion of the shaft, between the partitions 9, the air passes through the third set of apertures 10, around the baffle plate 13, through the fourth set of apertures 10 and thence out of the end of the shaft 8 opposite to that at which it entered, as indicated by the arrows in Fig. 2.

The combined fly-wheel and belt-pulley 15 may be provided for transmitting motion and power from the shaft 8 to any machine or device to be driven thereby.

Carbureted gas from a carbureter indicated at 16 is supplied to the compression chamber through the medium of an inlet pipe 17 which is provided with two inlets, as indicated at 18 and 18ª in Fig. 4; and after this gas has been compressed by a compression rotor 19, it passes from the compression chamber 2, through the passages 5 and 5ª and enters the combustion chamber 3. After combustion has taken place in the chamber 3, and has performed its function of rotating the rotor 11 through approximately half a revolution, the products of combustion escape through the outlets or exhaust ports 20 or 20ª.

In order to enable the compression rotor 1ª to perform its function of compressing the gas, it is not only necessary to close the passages 5 and 5ª before combustion takes place, but it is also necessary to provide an abutment which prevents the gas from being continually pushed in advance of the compressing portion 19ª of the compression rotor. Such abutments are shown at 21 and 21ª, these abutments being diametrically opposed and mounted for reciprocatory motion in a radial direction, radially extending guides 22 being provided for holding these abutments. The guides 22 are hollow and communicate with the interior of the compression chamber. Springs 23 press these abutments radially inward, and adjusting screws 24 are provided in the outer ends of the guides 22 for increasing or diminishing the tension of the springs 23. Each of the abutments is preferably formed in two pieces, viz, the main body which is apertured to receive the springs 23, and a cylindrical contact member or roller 25 which is preferably formed of steel or other very hard material, or material which minimizes the wear thereof and of the periphery of the compression rotor.

Two diagonally disposed and radially movable abutments 26 and 27 are mounted to reciprocate in guides 28 and 29, springs 30 being provided for pressing these abutments inward, and adjusting screws 31 being provided for regulating the tension of these springs. These abutments are provided with cylindrical bearing elements or rollers 32 which may be of the same material described for the elements 25. Each abutment 26 is preferably formed with spaced flanges or end extensions 33 (see Figs. 7, 8 and 9), the space between these extensions being substantially equal to the thickness of the actuating rotor 11. The plain inner surfaces of the combustion chamber are formed with grooves or channels 34 in which the abutments 26 are slidingly fitted, the depth of each channel 34 being substantially equal to the thickness of the flange 33 which is seated therein, so that the inner surfaces of the flanges 33 are flush with the contiguous inner surfaces of the combustion chamber. This construction and arrangement minimizes the leakage of gas between the abutments 26 and actuating rotor 11.

Two spark-plugs are provided at 35 and 35ª for igniting the gas within the combustion chamber, these spark-plugs being located adjacent to the passages 5 and 5ª respectively, and the latter being located adjacent to the abutments 26 and 27.

Referring to Figs. 2, 4 and 5, it will be seen that the compression rotor 19 fits closely against the plain inner surfaces of the compression chamber, and that the actuating rotor 11 has its plain sides fitted closely against the corresponding plain surfaces of the combustion chamber 3, and therefore, the members 11 and 19 constitute positive and efficient means for opening and closing the passages 5 and 5ª during each complete revolution of these rotors. Now, by referring to Fig. 3, in which the rotor 19 is indicated by a curved dotted line, it will be seen that the port 5 is now closed by the compression rotor, and that the actuating rotor 11 has passed a distance (beyond the passage 5) sufficient to provide a triangular combustion space bounded by the abutment 26, the rotor 11 and the walls of the chamber 3.

The operation of this engine is as follows: Assuming that the triangular compression space above the abutment 26 is filled with carbureted gas and that the spark-plug 35 has ignited this gas, the consequent explosion of the gas forces the rotor 11 around in the direction of the curved arrow in Figs. 3 and 4, and as the compression rotor 19 is rigidly united with the actuating rotor through the medium of the shaft 8, the compression rotor moves from the position shown in Fig. 4 toward the abutment 21ª. After it has moved a slight distance from the position shown in Figs. 3 and 4, it ceases to close the passage 5ª, but the latter remains closed by means of the actuating rotor 11 until the latter has moved through approximately 150° from the position shown in Fig. 3, whereupon both ends of the passage 5^a will be opened and permit the compressed gas to pass from the compression chamber to the combustion chamber. In the meantime, however, the expansion of the products of combustion continues to force the rotors around, and the compression rotor co-acts with the abutment 21^a to compress the gas which has entered through the port or inlet 18. In this connection, it should be understood that after the compression rotor 19 has moved through approximately 30° from the position shown in Fig. 4, it has closed the inlet 18, while the arcuate surface 19^b has permitted the abutment 22^a to move inward and prevent forward movement of the charge of gas being compressed. However, when the rotor 11 has turned until it has moved out of closing position relative to the passage 5^a, and before the rotor 19 moves into the closing position relative to this passage, a large portion of the compressed charge of gas passes from the compression chamber, through the passage 5, into the combustion chamber 3, and the passage 5^a is now closed by the compression rotor 19. Immediately upon the passage 5^a being thus closed, the charge is ignited and adds renewed impetus to the actuating rotor. The compression rotor also constitutes a suction rotor, that is, means for tending to create a vacuum, so that the gas is sucked into the compression chamber from the inlet pipe 17, and the operation of sucking in the gas is as follows:

After the rotor 19 has moved into such position that the abutment 21 or 21^a bears against the arcuate or convexed portion 19^b, and the port 18 or 18^a is opened, the suction space (bounded by the abutment, rotor 19 and contiguous wall of the casing) begins to enlarge and tends to create a vacuum, so that gas from the pipe 17 flows in to fill this partial vacuum. In this connection, it may be assumed that the port 18 has just been opened by the port-closing convex surface 19^c of the rotor, and has moved through 10° beyond the port 18. It will be seen that there is a comparatively small space for receiving gas from the inlet 18. However, when the rotor has moved an additional 10°, the space is more than twice as large as before, and that it is still larger when the rotor has moved to the position shown in Fig. 4. It will also be seen that the inlet 18 is closed by the rotor 19 about the time or shortly after the latter opens the inlet 18^a; likewise, the exhaust ports 20 and 20^a are closed and opened by the concentric arcuate portion 11^a of the actuating rotor 11.

From the foregoing description, it will be seen that this type of engine entirely eliminates the use of valves, substituting therefor the compression rotor and actuating rotor. In other words, the compression rotor 19 performs the triple function of compressing the gas, sucking in the charges of gas and controlling the flow of gas through the inlets or ports 18 and 18^a; and the actuating rotor 11 performs the five functions of rotating the shaft 8, controlling the exhaust of the products of combustion through the exhaust ports 20 and 20^a, forcing the products of combustion through these ports when the latter have been opened by the convex surface 11^a, automatically opening and closing the ports 5 and 5^a, and pressing the abutments 26 and 27 outward.

For the sake of convenience and economy in manufacturing this engine, the separable portions of the casing are joined at 1^a and 1^b, bolts 1^c and 1^d being provided for securing these portions together. Likewise, the separable portions of the hollow rotor 11 are joined at 11^b, and screws 11^c are employed for securing these sections together. This enables the manufacturer to conveniently assemble the parts, especially placing the baffle plates 12 and 13 within the respective hollow members.

Although I have described this embodiment of my invention very specifically, it is not intended to limit this invention to these exact details of construction and arrangement, but changes may be made within the scope of the inventive ideas as implied and claimed.

What I claim as my invention is:—

1. In a rotary internal combustion engine, a rotor casing comprising a compression chamber, an explosion chamber and a hollow partition, the partition being disposed between said compression chamber and explosion chamber and provided with a passage through which gas can pass from the compression chamber to the explosion chamber, a hollow rotor-shaft journalled in said rotor-casing, a compression rotor secured on said rotor-shaft and being operable within said compression chamber to compress gas, a hollow actuating rotor on said rotor-shaft and in said explosion chamber and adapted to be rotated by the force of explosions in said explosion chamber, and a fan mounted in and fixed to an outer end of said hollow shaft externally of said casing, so as to engage the outer air and cooperate with the shaft for forcing air through said hollow partition and hollow actuating rotor.

2. In a rotary internal combustion engine, a rotor-casing comprising a compression chamber, an explosion chamber and a hollow partition, the partition being disposed between said compression chamber and explosion chamber and provided with a passage through which gas can pass from the compression chamber to the ex-

plosion chamber, a hollow rotor-shaft journalled in said rotor-casing, a compression rotor secured on said rotor-shaft and being operable within said compression chamber to compress gas and constituting a valve operable to close and open said passage, and an actuating rotor on said rotor-shaft and in said explosion chamber and adapted to be rotated by the force of explosions in said chamber, said actuating rotor constituting a valve operable to open and close said passage, the angular relation of said compression rotor and actuating rotor being such that said compression rotor closes said passage substantially immediately after it has been opened by said actuating rotor, said hollow shaft being provided with partitions, apertures on opposite sides of the partitions, and radial baffle plates which extend respectively into said hollow actuating rotor and hollow partition, said apertures being located to establish an open-communication between said hollow-shaft and the hollow actuating rotor and partition.

In testimony whereof I have hereunto set my hand.

FRED J. FORD.