E. F. PRALL.

GAS ENGINE.

APPLICATION FILED APR. 6, 1910.

976,691.

Patented Nov. 22, 1910.

2 SHEETS—SHEET 1.

Fig. 2.

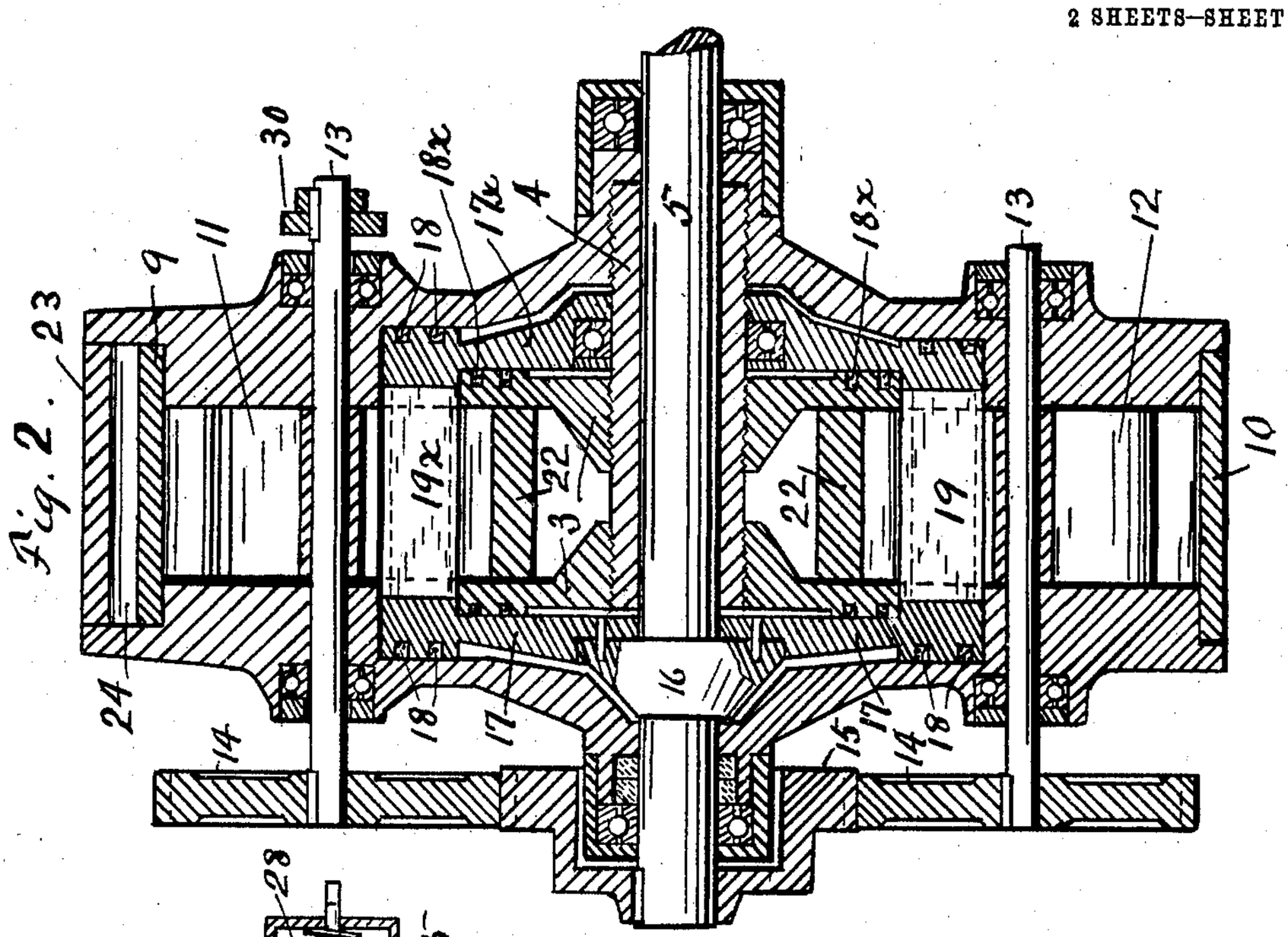
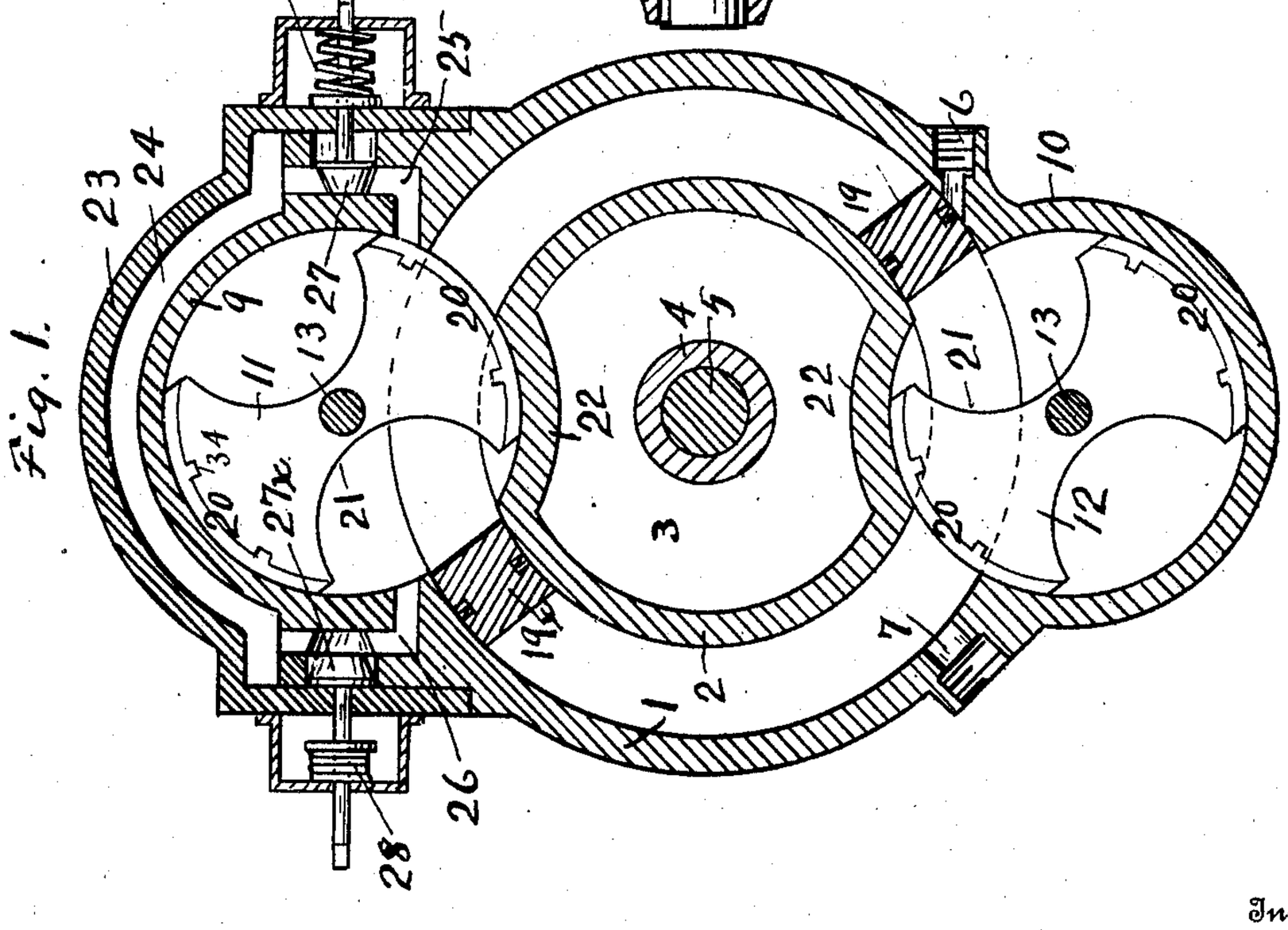


Fig. 1.



Witnesses

Robt. J. Lang

G. H. Baker

Inventor

E. F. Prall,

By Benj. R. Catlin

Attorney

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2 SHEETS—SHEET 2.

Fig. 3.

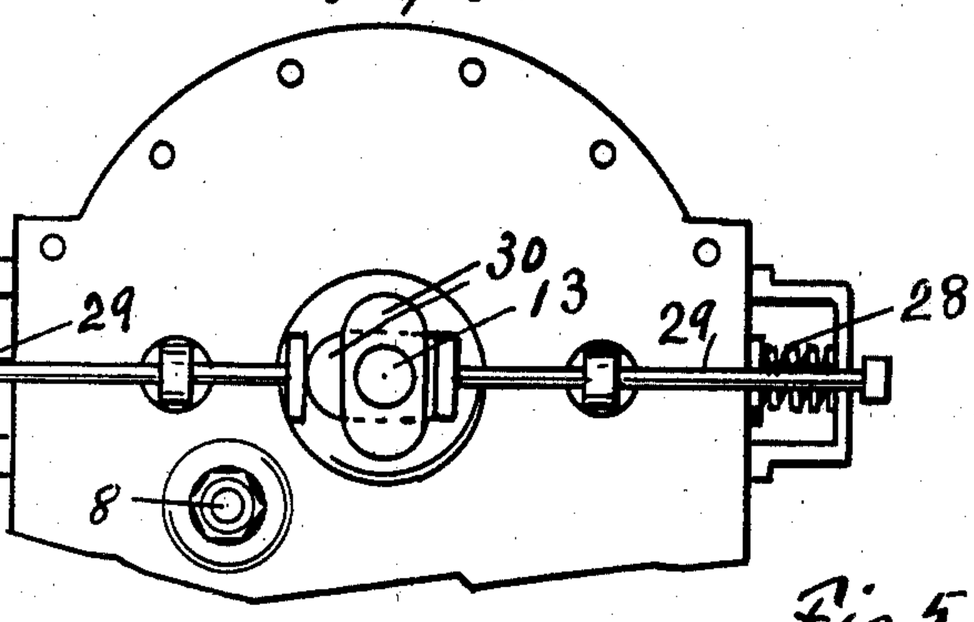
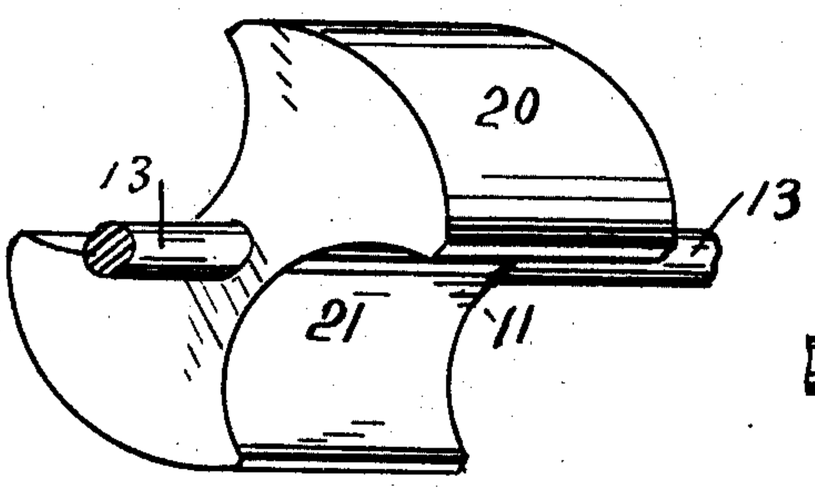


Fig. 4.

Fig. 5.



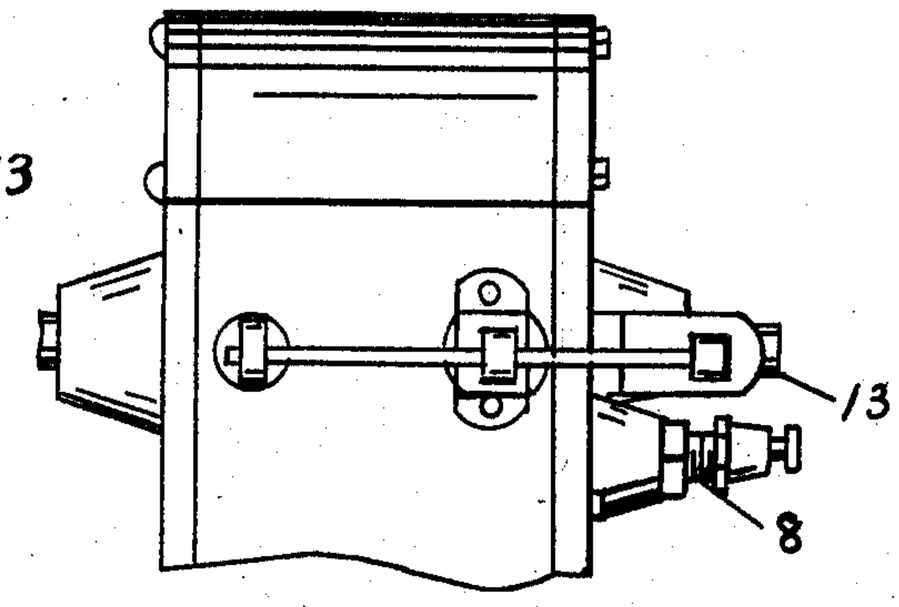


Fig. 7.

Fig. 8.

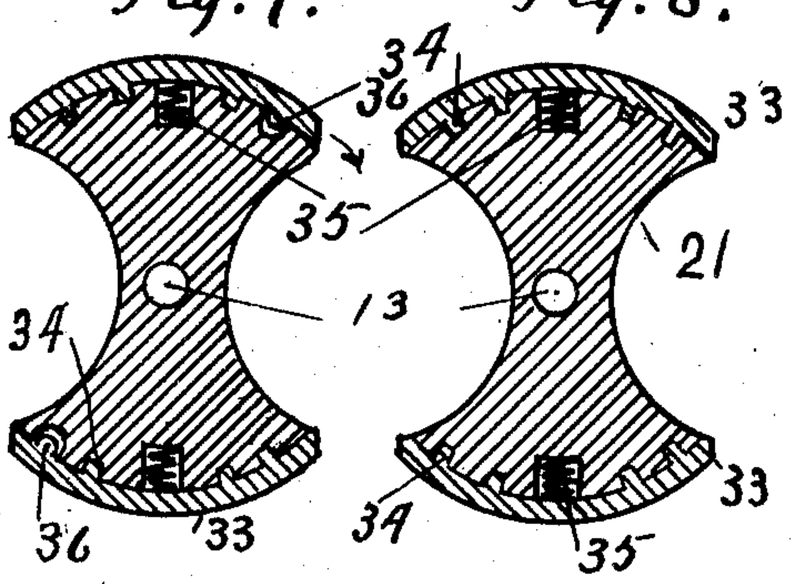


Fig. 6.

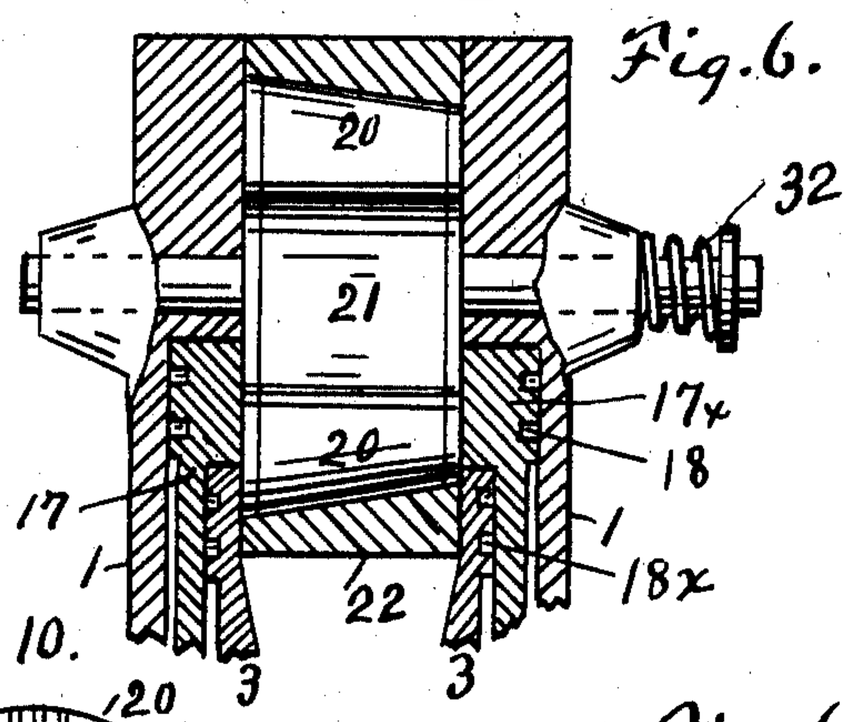


Fig. 9.

Fig. 10.

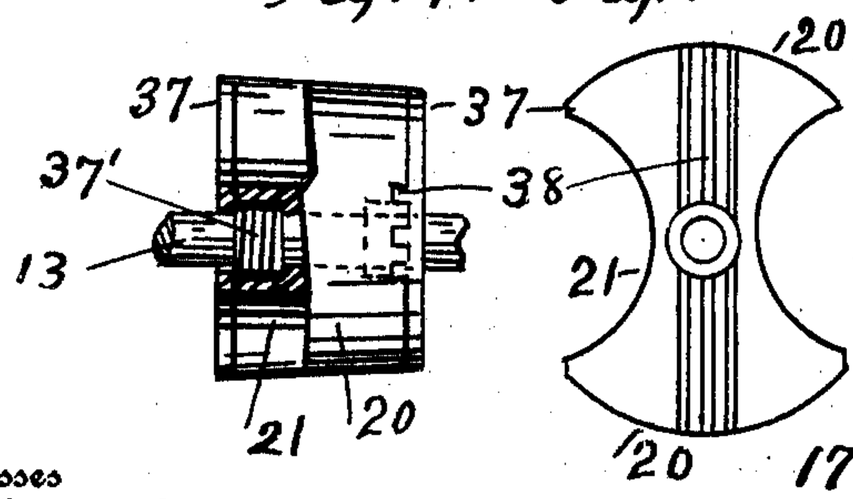
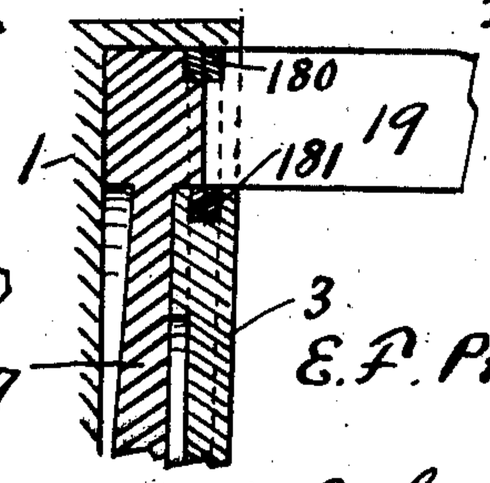


Fig. 6a.



Witnesses

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Inventor

E. F. Prall,

By Benj. R. Catlin,

Attorney

UNITED STATES PATENT OFFICE.

EDGAR F. PRALL, OF NEW YORK, N. Y.

GAS-ENGINE.

976,691. Specification of Letters Patent. Patented Nov. 22, 1910.

Application filed April 5, 1910. Serial No. 553,565.

To all whom it may concern:

Be it known that I, EDGAR F. PRALL, a resident of New York, in the county and State of New York, have invented certain new and useful Improvements in Gas-Engines; and I do hereby 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 pertains to make and use the same.

This invention relates to rotary internal combustion or gas engines.

The object of the invention is to provide such an engine of high efficiency, comprising few and simple parts, low friction, and thorough packing against loss of pressure, all as hereinafter described.

The invention consists in the construction hereinafter described and particularly set forth in the claims.

In the accompanying drawings which illustrate the invention and form part of the specification:—Figures 1 and 2 are central transverse and longitudinal vertical sections respectively of the improved engine; Fig. 3 is a partial side elevation of the same; Fig. 4 is a perspective view of a valve; Fig. 5 is a partial side view of the engine at right angles to Fig. 3; Fig. 6 is a partial section showing a modified valve, casing and piston packing; Fig. 6ª is a broken section showing a modified packing; Figs. 7 and 8 are transverse sections showing valves with modified packings; Fig. 9 is a plan view of a valve partly broken away; Fig. 10 is a rear side view of an end plate of such valve.

The engine comprises a stationary cylindrical casing 1, and an interior stationary drum 2 which is supported by its circular heads 3 on a sleeve 4 mounted on the main shaft 5 and supported in an end of the casing. The casing has an intake port 6, an exhaust port 7, and extending through an end of the casing, a suitable sparking plug 8 (not shown in detail). Opposite each other on the main casing body are two semicylindrical extensions 9, 10, which form supporting chambers for two rotary main valves 11, 12, which are alike, and each mounted on and turned by valve shafts 13, parallel with the main shaft and having gears 14 in mesh with gear 15 on the main shaft. Each shaft is suitably packed and is provided with ball bearings when desired, as shown.

The main shaft 5 has a flange or enlargement 16 to which is secured a circular plate or disk 17 forming part of the rotary piston structure and rotatable in the space between the casing and the proximate inner head 3. Around the outer portion of disk 17 are grooves for packing rings 18, behind which may be springs to maintain the rings continuously in firm contact with the outer casing notwithstanding wear incident to use. In a similar space at the opposite end of the casing, and rotatable on the sleeve 4, by a ball bearing, is a second circular body or disk 17ˣ, also packed toward the outer edge. The ends of the drum 2 also have packing rings, 18ˣ, on the sides adjacent disks 17, 17ˣ. Instead of or in addition to rings 18, 18ˣ in the faces of disks 17, 17ˣ and 3 expanding packing rings 180, 181, may be used in their peripheries. Secured to and connecting said disks 17, 17ˣ at diametrical points are two cross plates or pistons 19, 19ˣ, adapted to divide and to be carried around in the annular piston chamber between the casing and inner drum.

The valves 11 and 12 are each as long as the piston, and each has two segmental heads or parts 20, each occupying a quadrant of its valve chamber, the intermediate quadrants of the valve body being removed leaving two opposite concave sides 21. These valves are made and kept tight, as hereinafter described.

The inner drum 2 is formed with concave segments 22 the outer surfaces of which face the valve extensions 9, 10 and have a corresponding radius, so that the valves in turning fit snugly into said concave portions. The valve shafts are thus brought nearer together than would otherwise be possible with the same size of valve, ample room is provided for the passage of the pistons by the valves, and the several openings and closures are properly timed and effected without leakage of gas. The ends of drum 2 being circular extend beyond parts 22 and closely fit against the ends of the valves as they pass through the depressions.

Over the upper valve chamber is secured a cap or body 23 larger than said chamber whereby a compression chamber 24 is formed of considerable capacity. This chamber communicates with opposite ports 25, 26 leading from the casing of valve 11. Controlling said ports are valves 27, 27×, each having a stem and means for closing and openign it. For example, each rod has a spring 28 which tends to close the valve, the rod outside the casing being connected to another rod 29 which extends into the path of a cam 30 on the shaft 13, the two rods 29 being on opposite sides of the cam and in slightly different planes at their operative ends so as to be actuated by different portions of said cam. As the double cam 30 rotates it opens one valve 27 as it allows the other 27× to close under influence of its spring. Each portion of the cam acts on its rod twice in a rotation of the cam, and the portions of the cam are at right angles to each other and act quarterly.

The operation of the engine is as follows:—Piston 19 moving up from the position shown in Fig. 1 draws gasolene or other suitable vapor mixed with a proper proportion of air through the inlet 6, and said piston when it reaches the top of the cylinder passes under valve 11 which in turning closes the open way. The piston 19× has at the same time moved down and passed under or by the lower valve 12, and as it ascends it compresses the vapor and air that was drawn in by piston 19, said vapor and air being then prevented from escaping by valve 11 which at this time blocks the way in front of said piston 19, while it uncovers the right hand valved port 25 and thence the gas is permitted to escape in being compressed into chamber 24 by valve 27, which is now opened by its cam 30 for the purpose, said valve 27 being closed by its spring as soon as the piston 19 arrives in position to pass under valve 11; and as the piston emerges on the other side of the valve the latter closes behind the piston thus blocking the way to the rear. The valve 27×, which is now behind the piston, opens and permits the compressed gas stored in chamber 24 and still under pressure to escape into the space between the valve 11, which has now uncovered the left hand port 26, and the piston, when valve 27× is closed by its spring to prevent back firing. At this juncture an electric spark from the plug and suitable electric connections (not shown) ignites the gas, and the explosion (which cannot act backward by reason of the valves 11 and 27× having closed the open way) gives an impetus to the piston which drives it down and around until the exhaust 7 is reached, when the piston passes through the concave space in the valve 12 which has reached the correct position therefor. This piston in ascending on the other (right) side (the valve having been closed behind it) goes through the same operation as described in connection with the first piston.

By providing the two valves 11, 12, each having the two concave sides, and coöperating with the two opposite pistons, said valves need only turn as often as the main shaft, whereby the friction is much less than with more rapidly turning valves such as have generally been employed. While one piston is receiving the impulse of an explosion, the other piston is compressing a charge of vapor and air for the compression chamber, and drawing in a fresh charge for the following piston to compress. The valve 11 in rotating not only opens before and closes behind each piston in turn, but it controls communication of the piston chamber with the port 25, and also the exit from the compression chamber to the explosion chamber, and all without complication of parts or operation. It is important that valves 11 and 12 remain gas tight and to this end said valves may be made slightly tapered, the chamber being of corresponding shape, and the valve being drawn in by a spring 32 as shown in Fig. 6. This figure also shows how the outer flanged portions of the piston structure overlap the disks 3 making a close joint, and particularly if a packing (as 181) be provided between them.

The outer curved surfaces of the valve 11, or 12, whether the valve is cylindrical or tapered, may be provided with separate curved surface plates 33 having inside ribs 34 fitting grooves in the valve body to prevent leakage between the plates and body. Behind the plates are springs 35 which press the plates against the wall of the valve chamber. In Fig. 7 the plates are shown connected to the valve adjacent the forward edges of the heads by hinges 36, the purpose being to keep the forward edges of the plates in close to the valve body to prevent catching, while leaving the other edges free to move outward as required. In Fig. 8 such hinges are omitted. The ends of the main valves also have packing means. In Figs. 9 and 10 are shown end plates 37 having ribs 38 fitting grooves in the valve body. Behind each plate is an outwardly-pressing spring 37′.

My invention is not limited to all the details shown and described. For example, the means for controlling the valves in ports 25, 26 may be varied without departing from the invention, although the cam-operating device is simple and is preferred. So also the form of said valves may be varied and other modifications made within the scope of the invention. Some of the improvements described are applicable to steam engines as well as gas engines.

It will be seen that by using two disks and connecting them by the pistons the piston structure is rigidly connected to the shaft although one of the disks rotates on the fixed sleeve and is not directly connected to the shaft. The support of the pistons at both ends gives strength and prevents their being twisted out of position by the force of the explosions. Another advantage of the described two-disk construction is that it eliminates end thrust from the piston and main shaft since the gas pressure comes between the rigidly connected disks (and not between a disk and the head of the casing, as would otherwise be the case, thereby creating great friction).

Having thus described the invention what I claim is:—

1. An engine comprising a casing having an inlet and an exhaust and two opposite semicylindrical valve-chamber-extensions, a stationary drum central in the casing, two opposite pistons between the casing and drum each being alternately a compression piston and a driven piston, a double-headed concave-sided rotary valve in each extension and adapted to permit the pistons to pass the same opening the passage before and closing the passage behind them, a compression chamber with connection to the piston chamber on the compression side, and with the piston chamber on the explosion side, said connections being on opposite sides of one of said rotary valves, as set forth.

2. An engine comprising a casing having an inlet and an exhaust and two opposite valve-chamber-extensions, a stationary circular drum with concave sides facing said extensions in the casing, two opposite pistons between the casing and drum, a double-headed concave-sided rotary valve in each extension and adapted to project closely in to said concave portions as the valves rotate, a compression chamber with connection to the piston chamber on opposite sides of one of the rotary valves, and means for controlling said connections.

3. An engine comprising a casing and opposite valve-chamber-extensions, a stationary drum in the casing, a main shaft, opposite pistons between the casing and drum, rotary valves in said extensions adapted to permit the pistons to pass, valve shafts parallel with the main shaft, driving means between the main shaft and the valve shafts, a compression chamber between the compression side and the explosion side of one of the rotary valves, and separate valves controlling the connection.

4. An engine comprising a casing and valve-chamber-extensions, a sleeve centrally supported in and by the casing, a shaft through the sleeve and casing, a drum supported on said sleeve, a piston adapted to rotate between said casing and drum and having one end secured to the shaft and the other end supported on said sleeve, and rotary valves in the extensions.

5. An engine comprising a casing, a stationary inner drum, a shaft, a sleeve supported in and by the casing around the shaft, a piston structure having two disk-ends one fixed to the shaft between the casing and the sleeve and drum and the other having a bearing on said sleeve between the casing and drum.

6. An engine comprising a casing with opposite valve-chamber extensions, a stationary inner drum having circular ends and opposite concave segments, pistons between the casing and drum, opposite rotary abutment-valves adapted to fit closely between said ends of the drum and in said concavities as the valves rotate and to permit the pistons to pass.

7. An engine comprising a casing with a valve chamber, a rotary abutment-valve, an inner stationary drum, a compression chamber with connections to opposite sides of said valve, means for controlling such connections, whereby gas is admitted under pressure on one side and passed from the compression chamber to the explosion chamber on the other side, and means for igniting the gas on the latter side.

8. An engine comprising a casing with a valve-chamber-extension, a rotary valve therein, a cap over said extension forming a compression chamber, said chamber having connections to opposite sides of said valve, and means for controlling said connections.

9. An engine comprising a casing, a central drum with circular heads or ends, a piston structure also with circular ends and with a cross plate adapted to travel in the space between the casing and drum, and packings between said ends.

10. An engine of the character described comprising a casing, a double piston, a main shaft therefor, opposite valve-chamber-extensions, rotary abutment valves therein, shafts for said valves, a driving connection between the shafts, a compression chamber, admission and outlet valves therefor, and cams driven by one of the shafts and controlling said latter valves.

11. A rotary abutment valve having two heads with convex outer faces comprising separate plates attached to the valve body, and means for maintaining tight joints between said plates and body.

12. A rotary abutment valve having two heads with convex outer faces comprising separate ribbed plates engaging grooves in the valve heads, and springs pressing the plates outward.

13. A rotary abutment valve having two heads with convex outer faces and interme-

diate concavities, and separate like-shaped plates forming the ends of the valve and connected thereto by tight joints.

14. A rotary abutment valve slightly tapering and having two convex heads and concave between said heads, a tapering seat for said valve, and a spring tending to hold the valve to its seat.

In testimony whereof, I have signed this specification in the presence of two subscribing witnesses.

EDGAR F. PRALL.

Witnesses:
R. McNULTY,
J. L. PRALL.