No. 644,295. Patented Feb. 27, 1900.

J. G. LEPPER & W. F. DIAL.

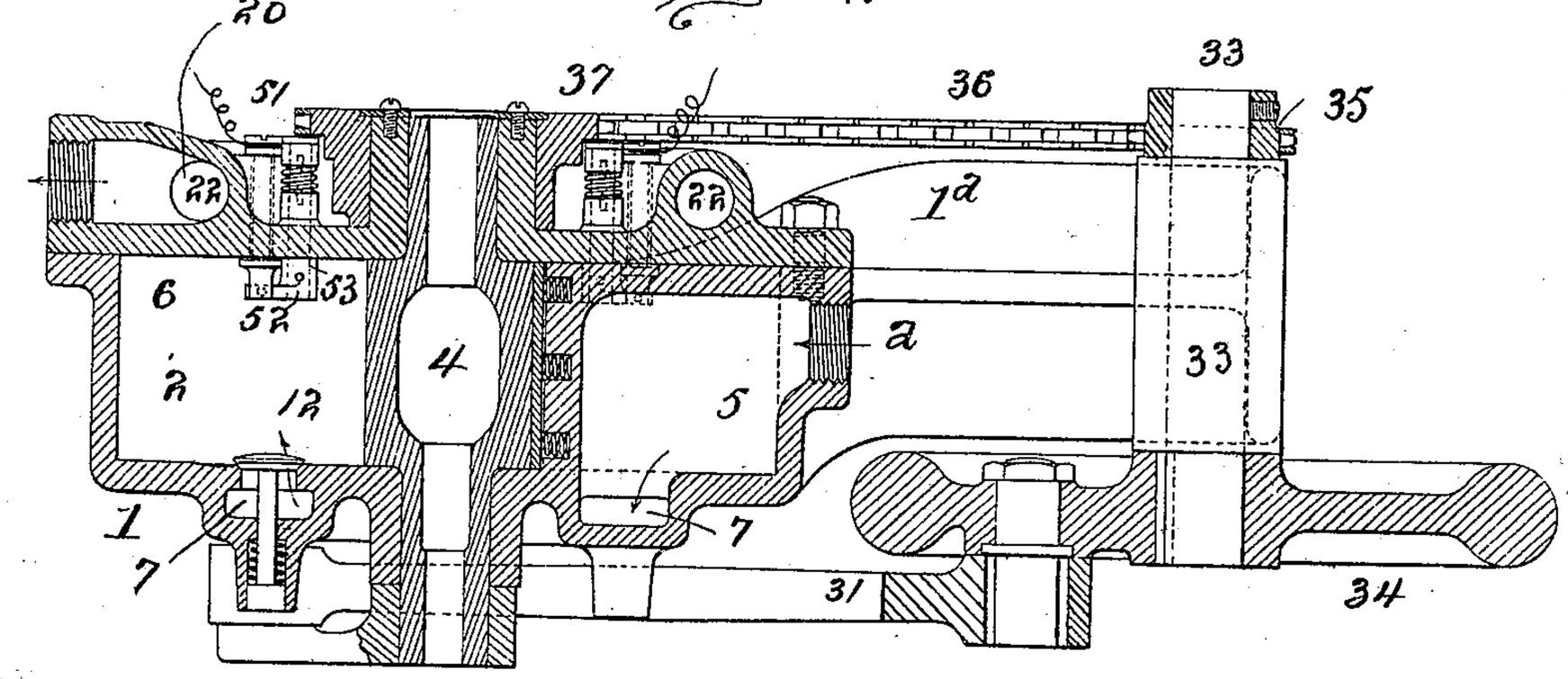
VAPOR OR GAS ENGINE.

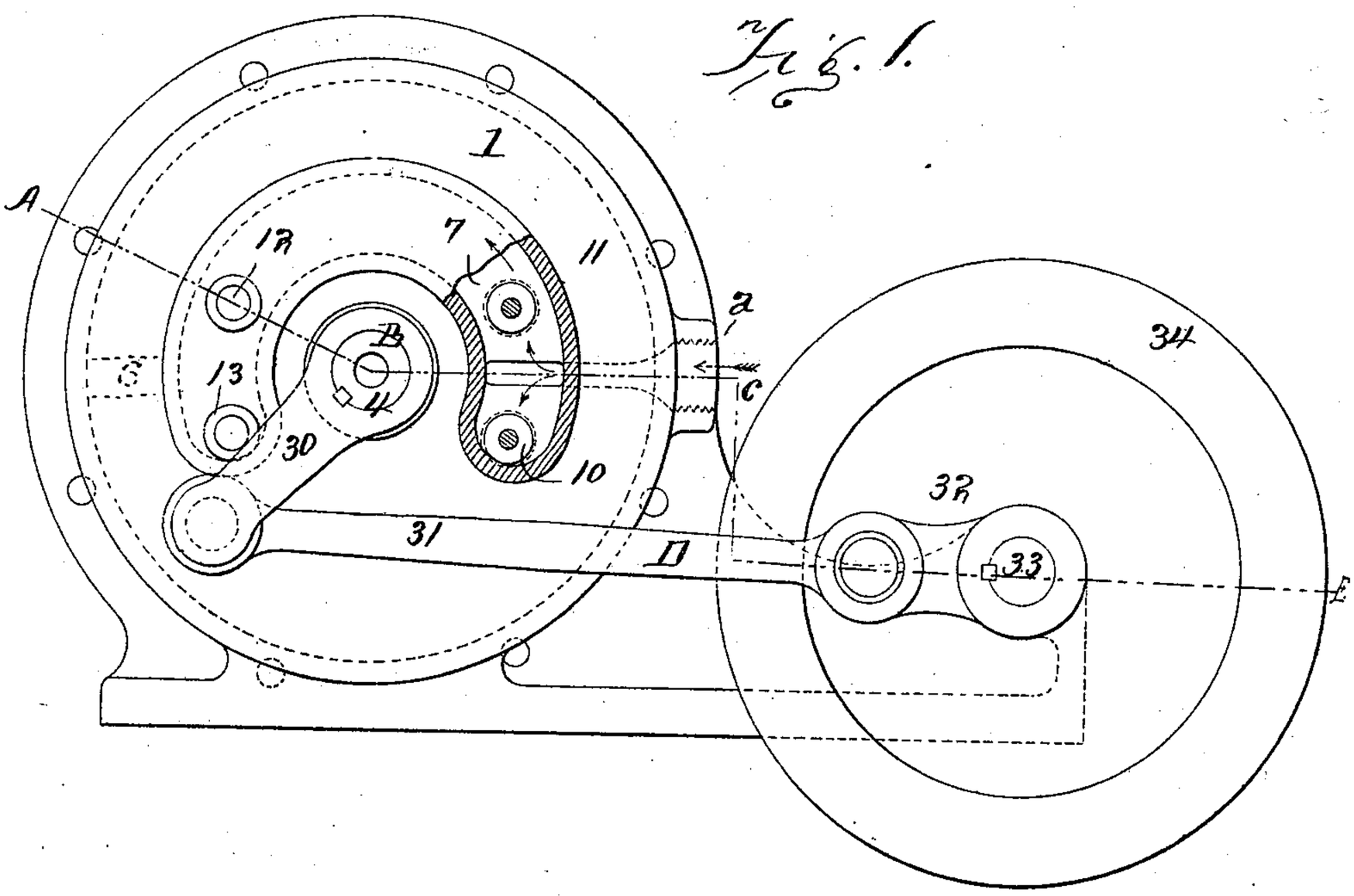
(Application filed Jan. 12, 1899.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1.





WITNESSES

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Fig. 5.

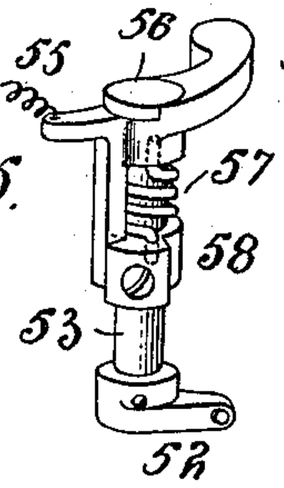


Fig. 4.

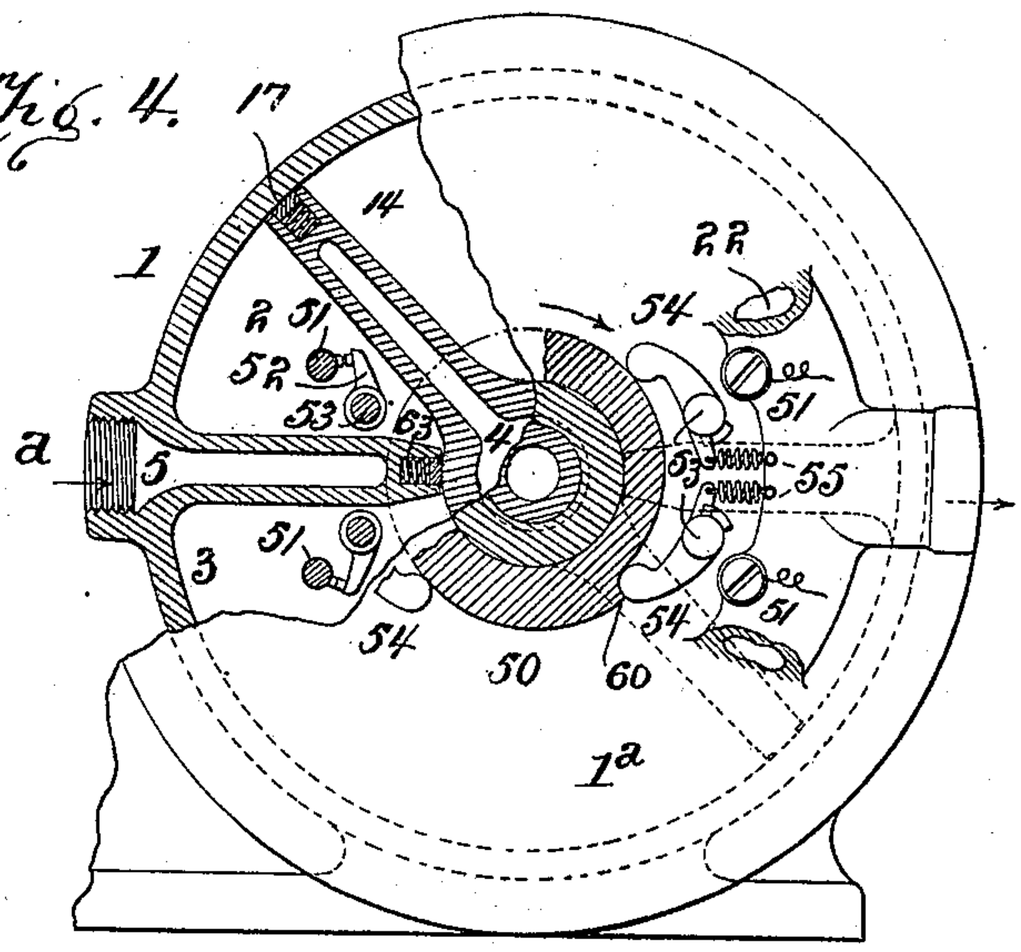


Fig. 6.

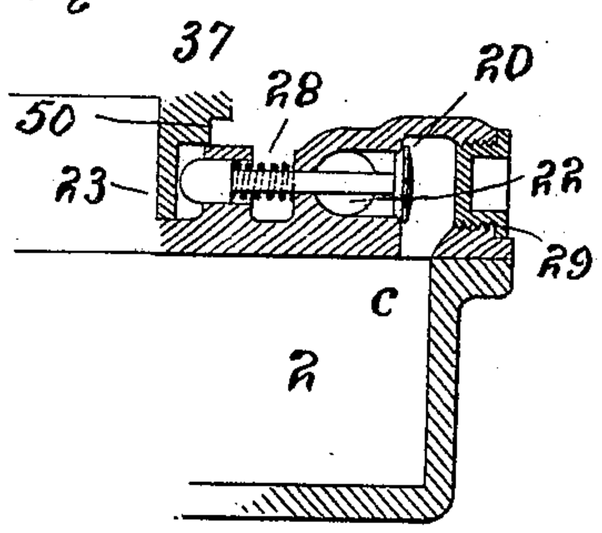
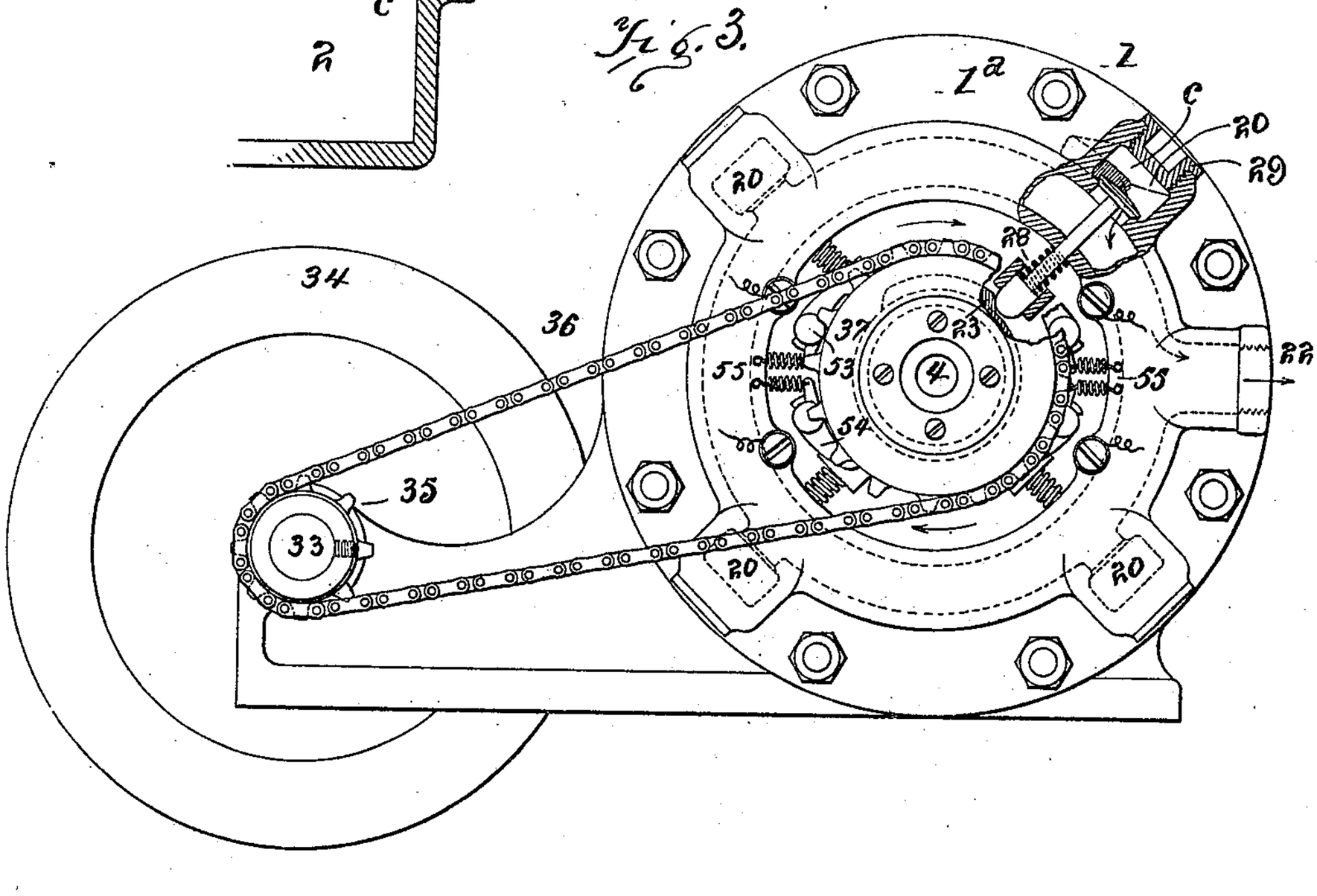


Fig. 3.



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UNITED STATES PATENT OFFICE.

JOHN G. LEPPER AND WILBUR F. DIAL, OF BRIDGEPORT, CONNECTICUT.

VAPOR OR GAS ENGINE.

SPECIFICATION forming part of Letters Patent No. 644,295, dated February 27, 1900.

Application filed January 12, 1899. Serial No. 701,933. (No model.)

To all whom it may concern:

Be it known that we, JOHN G. LEPPER and WILBUR F. DIAL, residing at Bridgeport, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Vapor or Gas Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to engines which are driven by the explosion or combustion of vapor, such as petroleum, naphtha, or the like.

The object of the invention is to simplify and improve an engine of the general class described, in which what is termed the "four-cycle" propulsion system is utilized, by the employment of double-acting pistons in "cylinders" or working chambers arranged as segments of circles, the pistons being connected by arms or levers which rock about a central axis and the power being conveyed from the oscillating or rocking support of the pistons to a driving crank-shaft; and the improvement consists in certain improved constructions and combinations of mechanical elements, which will be summarized in the claims.

Figure 1 is an elevation of the engine from the side of the crank connection, part of the supply-chamber being broken away to show valves and seats. Fig. 2 is a section on the irregular line A B C D E, Fig. 1. Fig. 3 is an elevation from opposite side of the engine from that shown in Fig. 1, parts being broken away to show valve and operating mechanism. Fig. 4 is an elevation of cylinder, with parts broken away on different planes. Fig. 5 is a perspective of the moving part which actuates the sparker or igniter. Fig. 6 is a broken detail section of one of the exhaust-valves in its working position, showing escape-passage from cylinder.

The part 1, which contains the explosion-chambers, is generally cylindrical in form. In this cylinder are two chambers 2 3, each something less than a semiannular recess around a hollow shaft 4, and these chambers are separated from each other by partitions 5 6. The cylinder 1 is preferably a casting with cover 1^a bolted thereon. The partition 5 is hollow and receives the explosive mixture or gas by a pipe connecting to the casing at *a*. The gas passes from the partition to the supply-chamber 7, which chamber is a curved passage at the side of the cylinder 1, extending past both the partitions 5 6 and communicating with the explosive-chambers 2 3 at each side of each of said partitions through inlet-valves 10 11 12 13.

The hollow shaft 4 has its bearings in the hubs projecting from the ends of the cylinder 1 and is made hollow for the purpose of allowing an air circulation to keep down the temperature. As shown clearly in the drawings, this hollow shaft opens freely to the external atmosphere. Shaft 4 has rigid arms of similar construction extending from the shaft, and projecting in opposite directions into the chambers 2 3. These arms are alike and are preferably hollow and connected with the hollow shaft to permit air circulation. One of these arms is shown at 14. The arms may have packing, as indicated at 17, bearing against the casing, and the sides or edges of the arms fit the ends of chambers 2 3, so that these arms are, in effect, pistons which swing in the curved chambers 3 2, alternating toward and from the fixed partitions 5 6.

As indicated in Fig. 1, the valves 11 12 open from chamber 7 into the upper chamber 2 of the cylinder, and the valves 10 13 open into the lower chamber 3. As will be more fully explained, valve 11 opens at the proper time to admit the explosive gas or vapor to one side of arm or piston 14, and the movement of the arm 14 away from the partition 5 and toward partition 6 draws or sucks in gas behind the piston, the suction operating the inlet-valve. As the piston or arm 14 completes its stroke and starts to swing back the valve 11, which is merely a check-valve, closes and confines the gas in chamber 2, where it is compressed by the backward movement of said arm or piston 14. At the proper instant of time, when arm 14 is near the partition 5, the gas is ignited, preferably by the electric sparking device, which will be described. The ignition and explosion drives arm 14 again toward partition 6, this time developing power which is available for mechanical purposes. When the arm or piston 14 has completed its stroke, it again swings back toward partition 5, and this time the exhaust-valve 20, opposite valve 12, is open to permit the escape of the gas which has thus been used. The exhaust-

valves 20, as shown, are arranged with their stems in a direction radial to the central shaft and casing. Space is thus economized, and an easy and steady cam movement can be provided to control the valves, the cam being centrally arranged with reference to such valves.

As indicated in Fig. 3 and shown in detail in Fig. 6, there is an exhaust-passage *c* leading from each of the chambers 2 3 in position to allow the escape of the spent products of combustion as the piston makes its return stroke.

There being two pistons and each being double acting, it will be understood that each rocking movement of the pistons toward or from partitions 5 6 may be effected by one active propulsive explosion on one of the pistons, while the other pistons are compressing or exhausting the gases in their respective chambers. The check-valves 10 11 12 13 being similar in construction and the exhaust-valves 20 being similar to each other, it is only necessary that the valves be operated in proper sequence and the explosions produced at the proper times in order to secure a practical continuity of explosions.

The shaft 4 has a crank-arm 30, connected to a pitman 31, which pitman connects to crank 32 on shaft 33. Shaft 33 carries fly-wheel 34 and a sprocket-wheel 35. The oscillation or rocking of crank 30 rotates crank 32 and of course the shaft 33, which is supported in suitable bearings. The crank 32 determines the amount of oscillation of the crank-arm 30 and of course the stroke of the pistons, which are rigidly connected to shaft 4, to which crank 30 is secured. Rotation of shaft 33 and sprocket-wheel 35 drives sprocket-chain 36, which chain drives sprocket 37 on the cylinder-head 1^a and concentric with shaft 4. Sprocket-wheel 37 has a cam 23 connected thereto. Cam 23 by its rotation lifts or opens each one of the valves 20. The length of the cam-face determines the time these valves shall remain open. As indicated by the drawing Fig. 3 and as will be understood by engineers skilled in this art, the exhaust-valves will be opened in succession and will each remain open during one piston-stroke or during about one-half of a rotation of the shaft 33 and fly-wheel 34. As each valve 20 is opened the spent gas is exhausted into passage 22, which leads around the cylinder-head 1^a and so to any convenient escape. Valves 20 are automatically closed by springs 28 when the position of the cam permits.

The sparking or ignition apparatus is operated by a cam 50 on sprocket-wheel 37. Each chamber 2 3 has near each end a contact-piece 51, connected outside the casing by wire to a battery or source of electrical supply or energy and projecting into the explosion-chambers, these pieces being suitably insulated from the casing. A lever 52 near each piece 51 is connected to a short rock-shaft 53, which shaft extends through the casing and has an arm or lever 54 outside the casing, each of said arms 54 being held toward the cam 50 by a spring 55. The rotation of the cam 50 by the sprocket 37, with which this cam is connected, causes the rocking of shafts 53. The arms 52 of these shafts are held in contact with the contact-surfaces on pieces 51 until the rocking of shafts 53 in the succession made necessary by the rotation of cam 50 causes one or another of the arms 52 to swing quickly away from piece 51, thus producing a spark as the contact-surfaces separate.

As indicated in Fig. 5, the arm 54 is not rigid with rock-shaft 53, but is held thereon by a head 56. A coiled spring 57 connects the arm 54 to a collar 58, which is rigidly connected to the rock-shaft, as by a set-screw. Thus a pressure applied to the end of arm 54 will increase the tension of spring 57 and so compress arm 52 more firmly against piece 51 as the slowly-rising cam rotates; but when the shoulder 60 of the cam permits spring 55 to suddenly rock the arm 54 the spring 57 becomes active to rock shaft 53 and swing contact-arm 52 quickly away from piece 51, thereby causing a spark.

It will be understood from the foregoing that the engine operates in the following manner: The wheel 34 being started by hand or otherwise causes crank 33 to swing, and this swings the pistons. The first movement of one of these pistons sucks in gas from passage 7 through one of the inlet-valves, the opposite valve being held closed by the compression of air or gas in the chamber. A continuation of the movement reverses the piston movement, compressing the gas first drawn in. As this reaches its extreme compression the spark in that end of that chamber ignites the gas, causing the next oscillation or stroke of the piston, and when this is completed the escape-valve in that chamber opens and remains open during the return of the piston. Such sequence being the same on each side of each piston, the operation is very rapid, and the strokes of the piston are practically uniform.

The spaces between partitions 5 6 and the hub on shaft 4 may have packing, as indicated at 63.

The arms 54 may be of such length as to produce the sparking movement in the proper sequence.

A gas, naphtha, or petroleum engine made on this general plan is very compact and light and is epecially adapted to the propulsion of cycles and motor-wagons and small launches. A number of such engines may be connected to a single driving or propeller shaft—such, for instance, as shaft 33, extended. Access is had to passage 22 near each valve 20 through screw-cap 29. The annular projection of passage 22 on the piston-cover makes a convenient seat for the valves 20, which are arranged radially, and a convenient support

for posts 51, which are transverse to the piston-cover. The sparking mechanism is mainly inclosed by this passage 22, being thus protected from accident or obstruction.

Our description relates to the machine in the best form known to us; but we contemplate changes and modifications within the limits of our claims.

We claim—

1. In an explosive-engine of the character described, the cylinder having chambers and oscillating pistons as described, the shaft connected to such pistons and having a crank thereon, a pitman connected to said shaft and a second shaft having a rotating crank connected to said pitman, a sprocket-wheel on the second shaft, and a sprocket-chain leading back to a sprocket and cam wheel concentric with the first shaft, and exhaust-valves connecting to the cylinder-chambers and operated by said sprocket and cam wheel, all combined substantially as described.

2. In an explosive-engine of the character described, the cylinder and oscillating pistons, the shaft concentric with the cylinder and supporting the pistons, the sparking and exhaust mechanism, and a cam-wheel, concentric with the shaft and driven continuously in one direction, said cam-wheel controlling the sparking and exhaust mechanism to insure the described sequence of explosion and exhaust, all the specified elements in combination, substantially as described.

3. In a gas-engine, the cylinder having chambers separated by fixed radial partitions as described, the annular projection on the cylinder having escape-passages from the cylinder-chambers, the exhaust-valves at the entrance of said escape-passages having their stems arranged radially to the cylinder, the cam-wheel arranged concentric to said valves in position to operate on the valve-stems successively, and means for operating said cam-wheel continuously in one direction, all combined substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

JOHN G. LEPPER.
WILBUR F. DIAL.

Witnesses:
N. H. HOYT,
C. N. WORTHEN.