No. 632,763. Patented Sept. 12, 1899.

H. SMITH.

EXPLOSIVE GAS ENGINE.

(Application filed May 17, 1899.)

(No Model.)

Fig. 1.

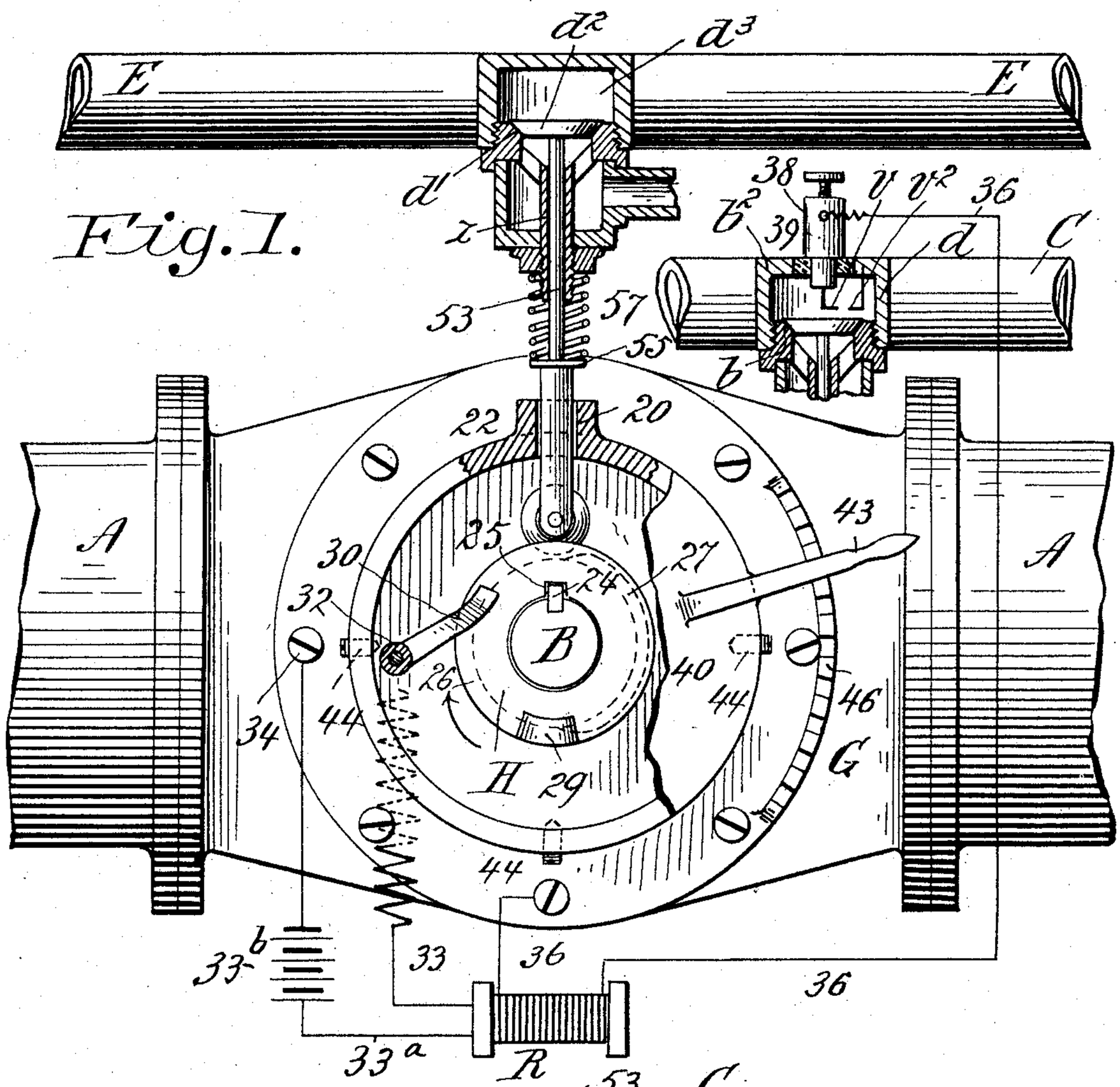


Fig. 2.

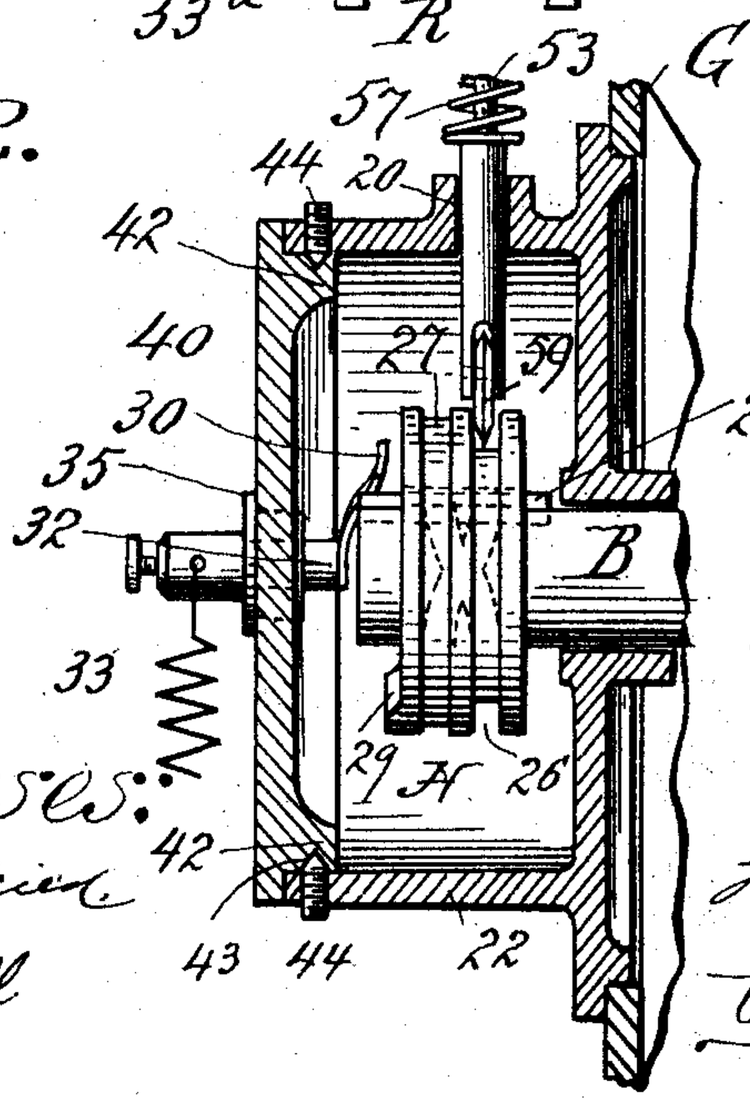
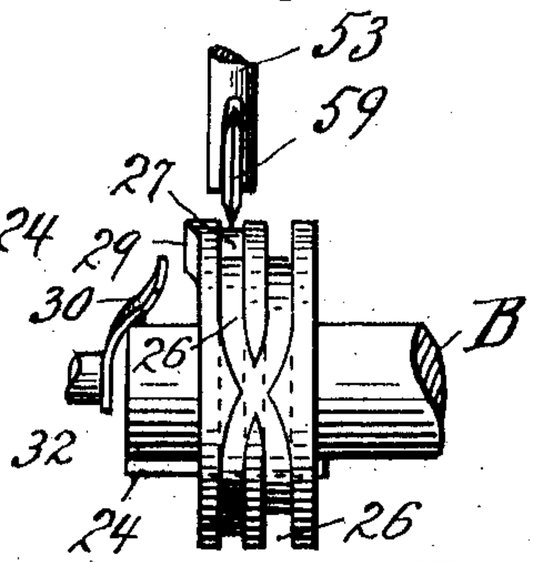


Fig. 3.



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UNITED STATES PATENT OFFICE.

HINSDALE SMITH, OF SPRINGFIELD, MASSACHUSETTS.

EXPLOSIVE-GAS ENGINE.

SPECIFICATION forming part of Letters Patent No. 632,763, dated September 12, 1899.

Application filed May 17, 1899. Serial No. 717,124. (No model.)

To all whom it may concern:

Be it known that I, HINSDALE SMITH, a citizen of the United States of America, and a resident of Springfield, in the county of Hampden and State of Massachusetts, have invented certain new and useful Improvements in Explosive-Gas Engines, of which the following is a full, clear, and exact description.

This invention relates to improvements in explosive-gas engines of the well-known class in which the reciprocating pistons have their working strokes as driven by the explosion of the gas ignited in the cylinders alternately—that is, in which each piston is positively driven forward by the exploded gas, returned expelling the dead gas, moved forwardly again to draw a new supply of gas into the cylinder, and then again forwardly driven by the next explosion of the gas. In engines of this character usually the main or driving shaft of the engine has two rotations to every working or explosion stroke of each piston, and it is required that once in every two rotations of the shaft an electric circuit will be made and broken to produce an igniting-spark in the explosion-chamber or an extension or continuation thereof for each cylinder, and also once in each two turns of the shaft, but at a different period from the said circuit closing and breaking, the exhaust-valve will be positively opened to permit seasonably the discharge of the dead gas on the return stroke of the piston following the working stroke effected by the closing of the circuit whereby the igniting-spark is made.

The object of this invention is to provide devices having parts in common and which are of extreme simplicity and cheapness of construction for both producing the igniting-spark at just the proper instant in the complete operation of the engine and operating the exhaust-valve of the explosive-gas engine; and the invention consists in the combination, with both the exhaust-valve of the engine and the contact member or part comprised in the sparking-circuit, which contact member is mounted on a rotatably-adjustable support, of a device mounted on and rotatable bodily with the main shaft or any suitable shaft of the engine and also axially movable and serving to alternately once during every two of its rotations make and break the circuit and to also open and then permit to be closed the exhaust-valve; and the invention furthermore consists in the constructions and combinations of parts, all substantially as hereinafter described, and set forth in the claims.

The invention is illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation, with some parts broken away and in vertical section, of the central portion of a two-cylinder explosive-gas engine of substantially the construction illustrated and described in an application for Letters Patent of the United States filed by me May 17, 1899, Serial No. 717,124. Fig. 2 is a central vertical section through the casing at one side of the middle of the engine, through which the main or crank shaft is extended, the novel devices being seen in elevation as viewed at right angles to Fig. 1. Fig. 3 is a side view of the single part which operates the exhaust-valve and causes the making and breaking of the sparking-circuit, this part being understood as having made half a rotation from its position shown in Fig. 2 and also having been axially moved from that position.

Similar characters of reference indicate corresponding parts in all of the views.

In the drawings, A A represent the two cylinders of the gas-engine, arranged endwise opposite and united by the intermediate casing G, in which is journaled the main and crank shaft B, understood as rotated in the usual manner by the connection with the crank thereon of the pistons which work back and forth in the cylinders.

C represents a common cylinder extension-conduit which, as explained and illustrated in my aforesaid application for patent, has connection with and forms continuations of the explosion-chambers of both the cylinders, and *d* represents the chamber-inclosing casing having the ingress-port and valve-seat opening *b* and the inlet-valve b^2 and the circuit terminal *v* and v^2 within the casing *d*, which is in communication with the cylinder extension-conduit C, and in which casing the spark is produced at the proper instant as the engine runs to secure the explosion of the gas which has been drawn into and compressed within the cylinders and extension-conduit C. E represents a second cylinder

extension-conduit having connection in common with the outer ends of both the cylinders, also as described in my aforesaid application for patent, this conduit having centrally thereof the chamber-inclosing casing d^3, having the valve-seat and outlet-port d', seating on which is the normally spring-closed exhaust-valve d^2, the depending stem 53 of which is guided in and plays through the tubular valve-stem guide z, and has at its lower end portion the shoulder or rest 55, reacting against which is the valve-closing spring 57.

The lower extremity of the valve-stem 53 extends through an aperture 20 therefor in the cylindrical casing 22, formed as a part of and extended outwardly beyond the central hollow engine-body G, and in which casing 22 the extremity of the main crank-shaft B is located.

Splined to slide axially on the end of the shaft B is the cam-disk H, 24 representing the longitudinal spline or rib on the shaft and 25 the groove corresponding thereto. The said disk H is constructed with the two peripheral grooves 26 26, the courses of both grooves for the greater portion thereof being in parallel planes perpendicular to the axis of the disk; but at one side of the disk and as shown in Fig. 3 in full lines and in Fig. 2 in dotted lines the said grooves cross each other, this appliance being in substance an endless worm. The lower extremity of the exhaust-valve stem, which preferably is provided with a swiveling-roller 59, engages in the aforesaid double-crossing peripheral groove 26, and as the shaft rotates because of such engagement of the extremity of the valve-stem therein, which stem, while having a rectilinear reciprocating movement in its guide z and is constrained against any lateral movement, is first for one rotation of the shaft and disk in the right-hand groove and in the next rotation of the disk in the left-hand groove, successively crossing from one to the other, imparts the endwise or axial reciprocating motion to the cam-disk H, and it is to be perceived that in the left-hand groove 26 of the cam-disk is the cam-surface 27, which rises or is prominent beyond the periphery of the base of the groove and extends throughout about one-half of the circumference of such groove in which it is located, so that once in every two rotations of the crank-shaft and the disk H the exhaust-valve stem 53 will be forced radially a slight distance relatively to the length of the shaft and the exhaust-valve d^2 will for the proper interval be held open for the exhaust of the cylinders. On the outer end face of the cam-disk H is the comparatively short face-cam 29, adjacent which is the contact-plate or flat spring 30, which is supported on the inner end of the binding-post 32. From this binding-post an electric wire 33 runs to connection with the inner spiral of a well-known form of Rumkoff or spark coil R, the wire 33^a continuing backwardly from the inner spiral to a binding-post 34, understood as being a part of the engine casing or body which is in electrical connection, through the journals for the crank-shaft B, with said shaft; but it is understood that the binding-post 32 and the contact-plate are insulated from the engine-body and crank-shaft by the bushing 35 of non-conducting material. 33^b represents the battery or generator. A second circuit, comprising the outer spiral of the spark-coil R, the wires 36, and for simplicity and convenience the conduit C, which is a metallic continuation of the engine-body, is provided, one of the terminals v of this circuit being mounted on the binding-post 38, insulated at 39, while the other terminal v^2 is supported in metallic connection with and by the casing d. The cam-disk H in every other rotation of the crank-shaft B, owing to its spline connection therewith, and, furthermore, because of the engagement in the double endless worm-groove 26 thereof of the extremity of the exhaust-valve stem, is so moved endwise on the shaft as to bring the end face-cam 29 into the plane of the contact-plate 30, whereby under the rotation of the cam-disk the spark-circuit will be momentarily closed and so that the spark-coil R becomes so vitalized for the instant as to establish a live circuit through the electrical connection 36 and the aforesaid metallic parts of the engine-body, which circuit upon becoming broken produces the spark between the proximate terminals v v^2 of this second circuit for the explosion of the gas in the cylinders and in the continuations thereof, with which the exhaust-valve chamber is in common communication.

The end-closing plate 40 for the casing 22, in which the endless-worm cam-disk is inclosed, and upon which plate 40 the binding-post 32 and contact-plate 32 are mounted, has within its edge and extending inwardly from its inner face the annular flange 42, which fits inside the open circular mouth of the casing 22 and is rotatable therein, said flange 42 having the peripheral groove 43, into which the conical ends of the retaining screw-plugs 44 engage. Thus the cap-plate 40 is rotatable, whereby the binding-post and contact 30 carried thereby may have a special revoluble movement imparted thereto, as occasion may require, for adjustment, so that the alternating contacts by the cam 29 on the plate 30 may be earlier or later in the cycles of the crank-shaft and cam-disk H for producing the spark most nicely timed for the perfect operation of the engine.

The cap-plate 40 is provided with the radial arm 43, which is constructed for a spring reaction to engage in and disengage from the series of notches 46 properly relatively arranged, the said radial and spring yielding arm 43 serving both as a means to turn the cap-plate 40 to adjust the contact 30 less far or farther around the path of the cam 29, as desired, and as a detent or locking device for the parts in their adjustments.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a gas-engine, the combination with a regularly-rotatable part or shaft of the engine, a spark-producing apparatus comprising a contact member, and a rotationally-adjustable support on which said contact member is mounted, of a disk endwise movable on, but rotating in unison with, said shaft provided with the double peripheral crossing grooves, and having a projection or cam at its end portion, a part having a fixed radial relation to said disk and engaged in the said groove thereof, whereby is effected under the rotation of said shaft and the disk therewith, the axial reciprocatory motion of the disk, so that on every other rotation of said disk said projection at the end thereof is brought into the plane of and impinges on said adjustably-supported contact member to make and break the igniting-spark circuit, substantially as described.

2. In a gas-engine, the combination with a regularly-rotatable part or shaft of the engine, and a spark-producing apparatus comprising a contact member 30, and a rotationally-adjustable support 40 on which it is mounted, of a disk endwise movable on, but rotating in unison with, said shaft, provided with the double peripheral and crossing grooves, having the peripheral cam 27, and provided with a projection or cam 29 at its end portion, the exhaust-valve of the engine provided with the valve-stem which while endwise movable has a fixed radial relation to said disk and engages in the said groove thereof, whereby is effected under the rotation of the shaft and the disk therewith, the axial reciprocatory motion of the disk insuring on every other rotation of said disk, respectively and properly timed, the operation endwise of the valve-stem, and the placing of said projection 29 in the plane of, and for impingement on said contact member to make and break the igniting-spark circuit.

3. In a gas-engine of the character described, the combination with the exhaust-valve, the shaft B, and the engine-body having the outwardly-opening cylindrical casing 22, provided with the guiding-aperture 20 and within which casing the extremity of said shaft protrudes, the exhaust-valve, the exhaust-valve stem guided for a reciprocatory movement through said aperture 20 axially in relation to the shaft, the disk splined and endwise movable on the end portion of the shaft, having the crossing peripheral grooves in which the extremity of the valve-stem engages provided with a peripheral cam for imparting an endwise thrust to the valve-stem, and having the endwise projection 29, the cap-plate 40 rotationally adjustably mounted on and closing the end of said cylindrical casing 22, and having the yielding lever-arm 43 engaging said notches 46, spark-producing appliances having a contact member 30 supported on said rotationally-adjustable cap-plate, and with which said projection 29 coacts, all substantially as described.

Signed by me at Springfield, Massachusetts, this 13th day of May, 1899.

HINSDALE SMITH.

Witnesses:
WM. S. BELLOWS,
M. A. CAMPBELL.