(No Model.) 2 Sheets—Sheet 1.

G. L. WOODWORTH.

IGNITING APPARATUS FOR INTERNAL COMBUSTION ENGINES.

No. 579,921. Patented Mar. 30, 1897.

Fig. 1.

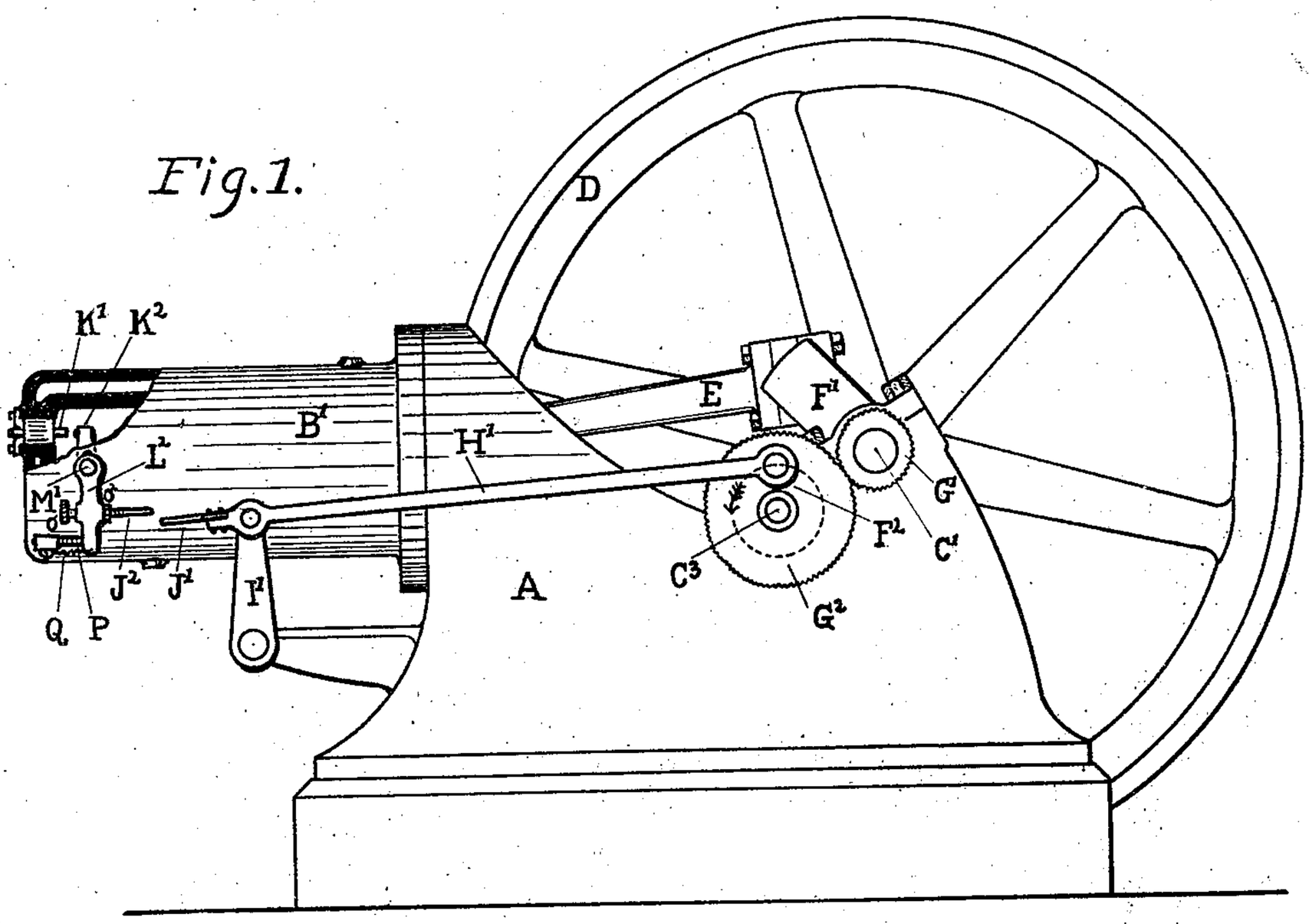
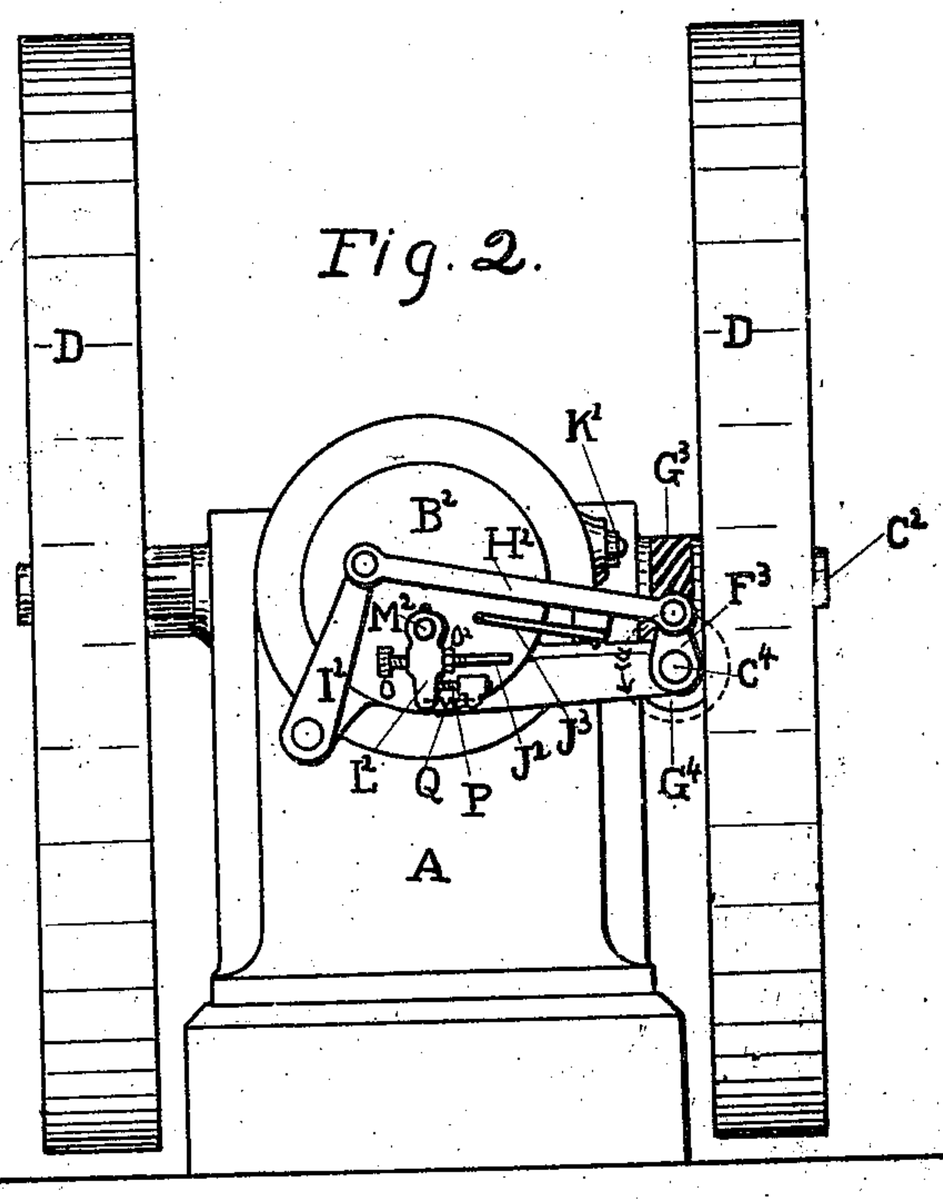


Fig. 2.



Witnesses.

E. B. Wright

Albert W. Smith.

Inventor.

Geo. Lyman Woodworth.

By John Richards Atty

(No Model.) 2 Sheets—Sheet 2.

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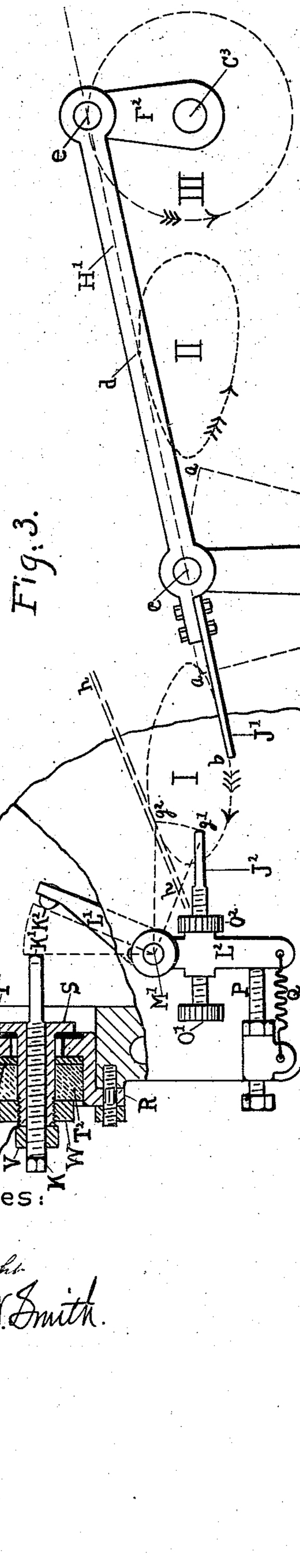

Fig. 3.

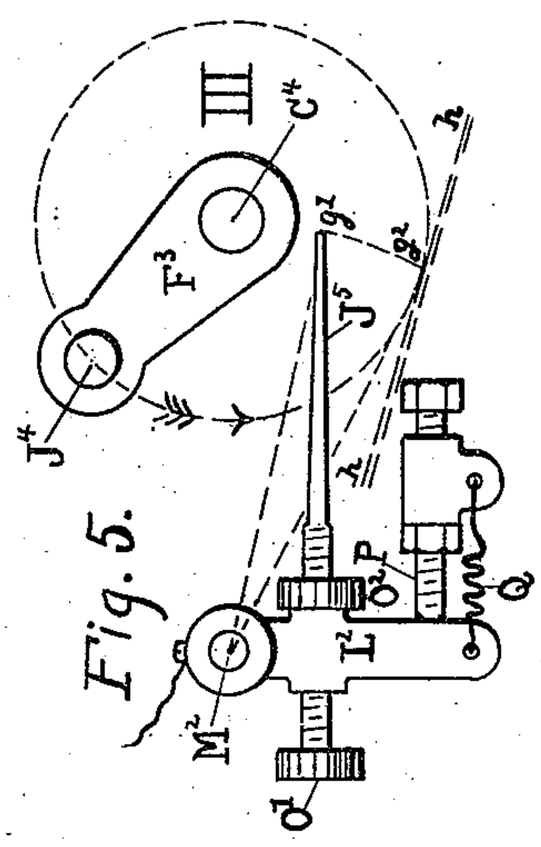

Fig. 5.

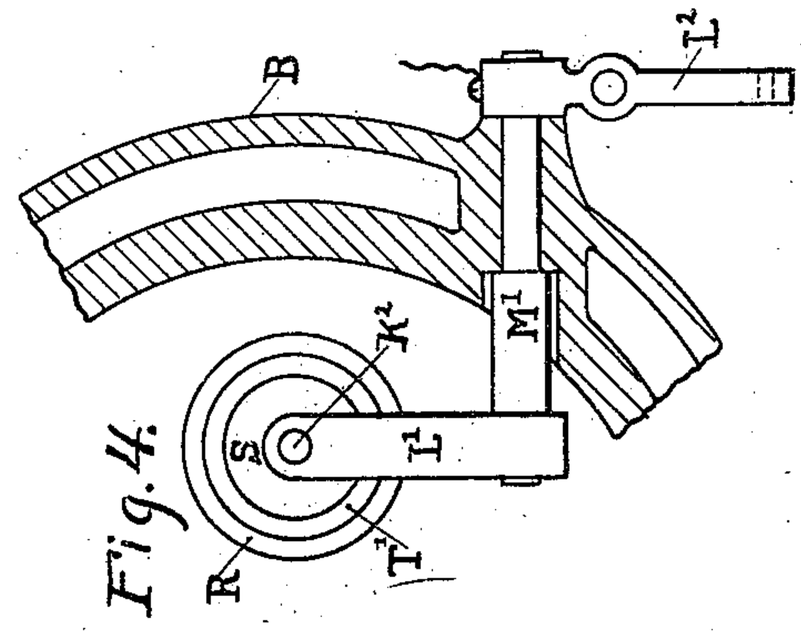

Fig. 4.

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UNITED STATES PATENT OFFICE.

GEORGE LYMAN WOODWORTH, OF STANFORD UNIVERSITY, CALIFORNIA.

IGNITING APPARATUS FOR INTERNAL-COMBUSTION ENGINES.

SPECIFICATION forming part of Letters Patent No. 579,921, dated March 30, 1897.

Application filed May 12, 1896. Serial No. 591,313. (No model.)

To all whom it may concern:

Be it known that I, GEORGE LYMAN WOODWORTH, a citizen of the United States, residing at Stanford University, in the county of Santa Clara and State of California, have invented certain new and useful Improvements in Igniting Apparatus for Internal-Combustion Engines, of which the following is a full, clear, and exact specification.

This invention relates to gas, oil, or other type of heat-engines operating by internal combustion and to apparatus for igniting the charges of gas or vapor in such engines.

My improvements consist in fixed and movable electrodes within the cylinder or the combustion-chamber thereof, the movable electrode mounted on an oscillating fulcrum-stem passing through the walls of the cylinder or combustion-chamber and actuated by mechanism outside the heated chamber capable of adjustment as to the point of ignition in respect to the piston without altering other functions and moving quickly at the point of engagement in an elliptical or circular orbit.

My improvements also include various details of a constructive nature, hereinafter explained in connection with the drawings, in which—

Figure 1 is a side elevation of a common gas-engine provided with my improved igniting apparatus at the side. Fig. 2 is an end elevation of a similar engine also provided with my improved igniting apparatus placed at the end. In Fig. 3 is a diagram illustrating the movements of the tripping-bar that operates the movable electrode, also a section of the main cylinders, showing the manner of mounting and insulating the stationary electrode. Fig. 4 is a detail of Fig. 3, showing the movable electrode and its mountings. Fig. 5 is a diagram showing the engagement and operation of the movable electrode by a tripping device moving in a circular path.

Similar letters of reference are employed to designate corresponding parts.

Referring to Figs. 1 and 2, the references are made coincident as far as possible, the igniting apparatus being in one case operated by a shaft parallel to the crank-shaft and in the other case transverse thereto. A are main frames, and B' B^2 the engine-cylinders. C' C^2 are the main crank-shafts, and D fly-wheels thereon.

In Fig. 1 a portion of the cylinder is broken away to better show the construction.

In Fig. 1, E is the connecting-rod, F' the main crank, and C^3 a second shaft driven by the tooth-wheels G' G^2, these wheels having a proportion of one to two when the engine works on the four-stroke cycle, one to one on a two-stroke cycle, and one to three on a six-stroke cycle. On the shaft C^3 is placed a crank F^2, to which is attached a motion rod or bar H', attached at the other end to a vibrating support I', and projects beyond to hold the trip-bar J', which engages the trip-bar J^2, as will be hereinafter explained.

Referring to Fig. 2, the second shaft C^4 is placed parallel to the cylinder B^2 and is driven by bevel, spiral, or other gearing G^3 and G^4 from the main crank-shaft C^2, so as to revolve at one-half the rate of the latter when the motor works on the four-stroke cycle. On the end of this shaft C^4 is placed a crank F^3 to operate the motion bar or rod H^2, the other end of which is attached to the vibrating support I^2. On the bottom, preferably, of this rod H^2 is attached the first flexible trip-bar J^3, corresponding to J' in Fig. 1. Other elements to be described are identical and the divergence thus far has been to show the adaptation of my invention to two common types of auxiliary gearing for internal-combustion engines. The trip-bars J' and J^3 may be rigid, but are best made with a section that permits flexure, also may be integral or attached to rod H'. I prefer to make them in the form of a cantaliver or leaf-spring.

Referring next to the diagram Fig. 3, in which the lines are identical with the axes of the element which bear the same references in Fig. 1, it will be seen that by rotation of the crank F^2 the point *e* moves through the circle III, the point *d* through the distorted ellipse II, the point *c* through the arc *a a*, and the point *b* through the distorted ellipse I. It will also be seen that the trip-bar J' in Fig. 1 is attached to a point corresponding to *b* in Fig. 3, and the flexible bar J^3 in Fig. 2 is attached at a point corresponding to *d* in Fig. 3, so that both these bars J' and J^3 move in elliptical orbits I and II.

In Fig. 3, K′ is the stationary and K² the movable electrode, the latter set on a vibrating arm L′, fixed to an axis M′, that passes through the side of the combustion-chamber, as in Fig. 1, or through the end of the chamber M², as in Fig. 2. On the outside of the combustion-chamber a second vibrating bar L² is fixed to the fulcrum or axis M′, and through this is inserted the trip-bar J², which is engaged by the trip-bar J′ as the latter moves through the elliptic orbit.

The trip-bar J² is made adjustable, so that by varying its length the point of release or disengagement is changed. Obviously trip-bar J² can be made integral with the axis M′, but this construction gives a fixed point of release. I prefer to make it with a screw-threaded extension which passes through lever L² and is further provided with a thumb-screw O′ and a jam-nut O², as shown. By reason of the tripping or engaging bars J′ or J³ being flexible instead of rigid release from bar J² is more sudden, with less strain in the working parts. Also before release good contact is insured between the electrodes K′ and K². The adjustment is best done along or parallel to the tangent line *h h* to the curve or on the flat side of the ellipse II, where there is no considerable change of position or action in a direction perpendicular to the curve. The range of the angular displacement *g′ g²* of the electrode K² and of the vibrating arms L′ L² is limited by a stop-screw P, a constraining-spring Q being provided to rapidly return these arms to the stop P as soon as the trip-bars J′ and J² disengage at the point *g²*, thus causing a spark between the electrodes K′ K², kindling the charge in the combustion-chamber.

In Fig. 3 the stationary or fixed electrode K′ is best supported on a removable plate R, bolted to the end or side of the engine-cylinder. The stem K is made adjustable and held in the threaded part S, which is insulated electrically by means of the porcelain, earthenware, or mica rings T′ T². The inner ring T′ is preferably made of mica and the outer one, T², of porcelain. The part U is an asbestos washer which is placed between the insulating-rings and the metal parts and serves as a packing and also takes up expansion due to heat. W is a nut to secure part S. V is a jam-nut for the stem K. The passage into the cylinder covered by the plate R is made large enough to permit access to the movable electrode K² for cleaning or other purpose.

In the diagram Fig. 5 is shown how the trip-lever J⁵, which operates the movable electrode, can be actuated by a part J⁴, moving in a circular path. The lever J⁵ is preferably made both flexible and adjustable. The other elements involved are the same as in the preceding figures. It is obvious, however, that the engaging member moving in the curved path or orbit and the engaging member operating the sparking electrodes can either or both be made flexible and their action remain the same, also that either of the electrodes K′ or K² can be insulated from the cylinder B. The electrodes K′ and K² are preferably connected in series with an inductance-coil and battery or small dynamo.

It will be seen that in my igniter the mechanism employed to operate the sparking terminals or electrodes is external, and therefore not exposed to injurious heat. Another considerable advantage is the ease with which the point of ignition may be varied. Further, this adjustment may even be performed while the engine is running.

Having thus explained the nature and objects of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In igniting apparatus for internal-combustion engines, a motion-rod driven by the engine from a crank or eccentric and connected at a second point to a vibrating support, and in combination therewith a flexible tripping or engaging bar which engages, actuates a second trip-bar, and disengages suddenly by reason of its flexure, in the manner substantially and for the purposes as hereinbefore set forth.

2. In igniting apparatus for internal-combustion engines, an engaging part driven by the engine in a curved path, and in combination therewith an adjustable engaging part operating the sparking electrodes, and so placed in relation to said part moving in a curved path, that its line of adjustment lies along or parallel to the tangent to said path at or near the point of release, substantially as set forth.

3. In igniting apparatus for internal-combustion engines, an actuating part driven by the engine, the engaging portion of which has a periodic motion of oscillation with respect to any line lying in the plane of motion, said actuating part during a certain portion of its travel engages, gives motion to, and disengages with an external adjustable electrode lever or stem, which is so placed relatively to the path or locus of the actuating part, that the line of adjustment lies along or parallel to the tangent to said path or locus, at or near the point of release or disengagement.

4. In igniting apparatus for internal-combustion engines, a flexible engaging part driven by the engine in a curved path, and in combination therewith an adjustable engaging part operating the sparking electrodes, and so placed in relation to said part moving in a curved path, that its line of adjustment lies along or parallel to the tangent to said path at or near the point of release, substantially as set forth.

5. In igniting apparatus for internal-combustion engines, an engaging part driven by the engine in a curved path, and in combination therewith an adjustable flexible engaging part operating the sparking electrodes, and so placed in relation to said part moving in a curved path, that its line of adjustment lies along or parallel to the tangent to said

path at or near the point of release, substantially as set forth.

6. In igniting apparatus for internal-combustion engines, the stationary electrode K′ insulated electrically by the inner ring T′ and the outer ring T^2, secured by the nut W or its equivalent, and in combination therewith the asbestos-packing cushion U, interposed in the manner substantially as described.

7. In igniting apparatus for internal-combustion engines, the fulcrum-stem of the movable electrode made with an external adjustable trip-lever J^2 which engages periodically with a part driven by the engine in a curved path, said adjustable trip-lever J^2 when varied in length changes the point of disengagement, in the manner and for the purposes as hereinbefore described.

8. In igniting apparatus for internal-combustion engines, an engaging part driven by the engine in a curved path, an external adjustable engaging part mounted on an oscillating fulcrum-shaft with an internal sparking electrode thereon, a stationary insulated sparking electrode, means for separating the electrodes, and a suitable source of electrical energy connected to the electrodes, combined in the manner substantially as described.

In testimony whereof I have hereunto affixed my signature in the presence of two witnesses.

GEO. LYMAN WOODWORTH.

Witnesses:
JAMES L. KING,
W. T. GROVER.