R. HENNIG.

IGNITION GEAR FOR INTERNAL COMBUSTION ENGINES.

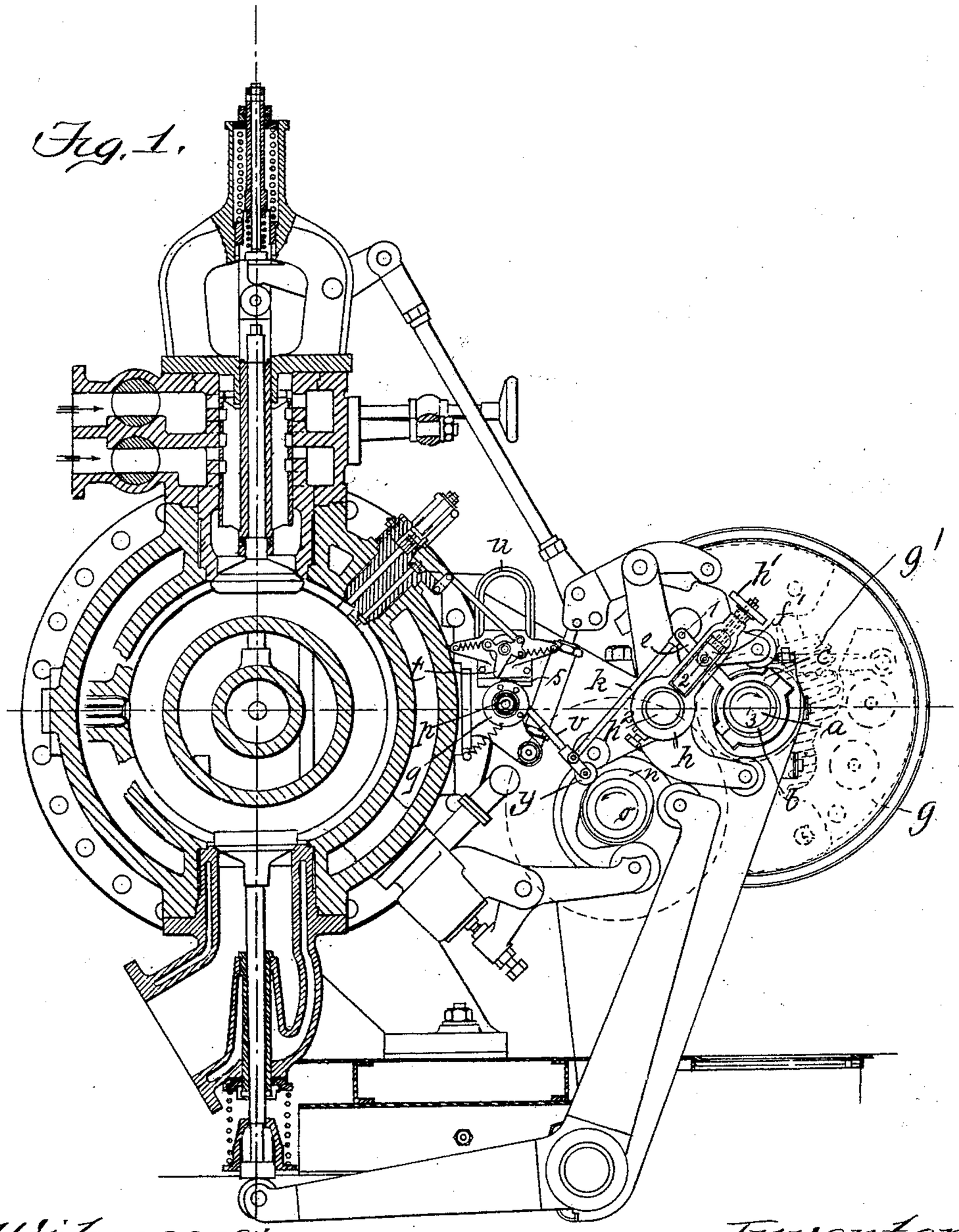
APPLICATION FILED MAR. 3, 1904.

916,312.

Patented Mar. 23, 1909.

5 SHEETS—SHEET 1.

Fig. 1.



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5 SHEETS—SHEET 2.

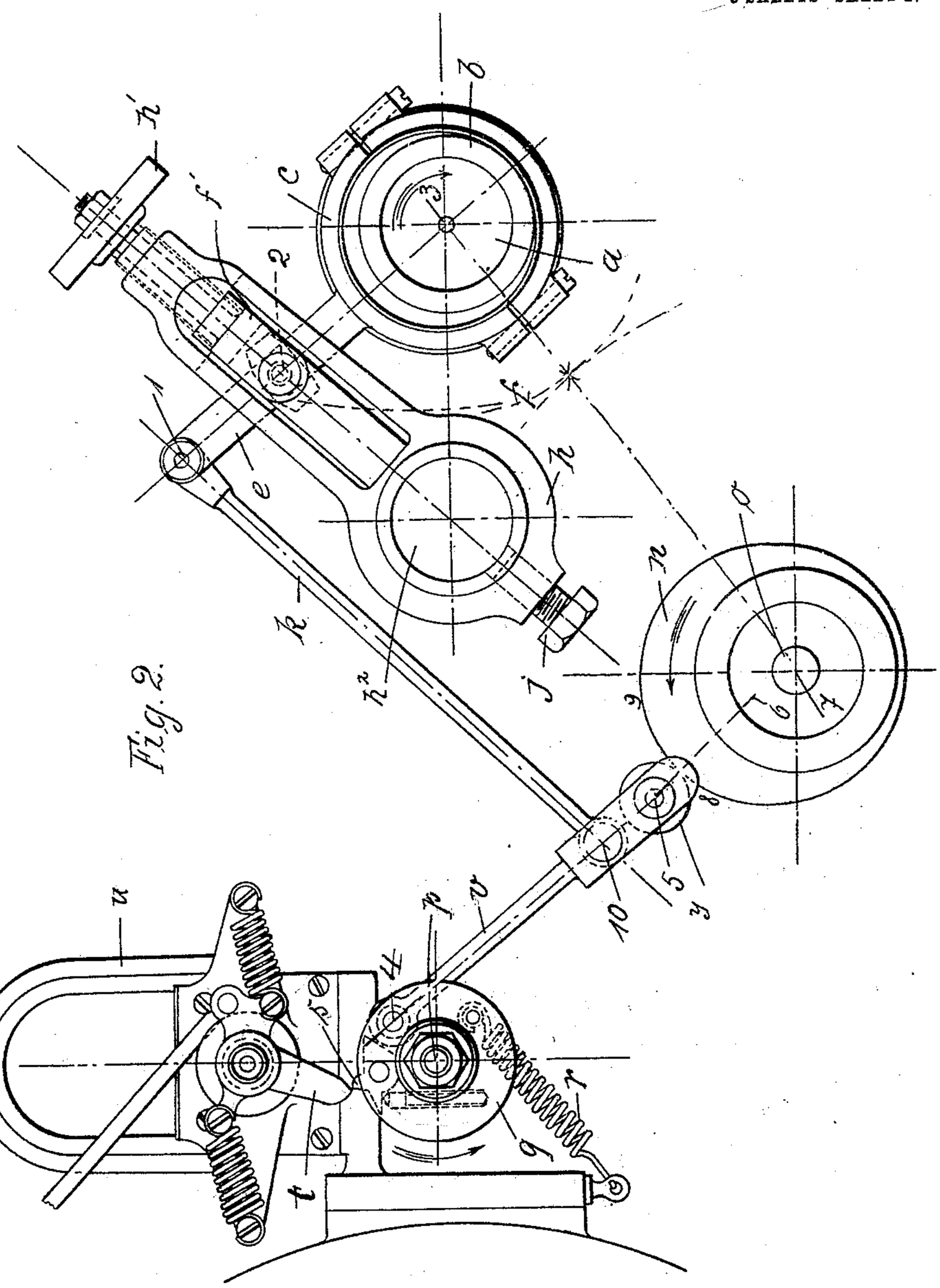

Fig. 2.

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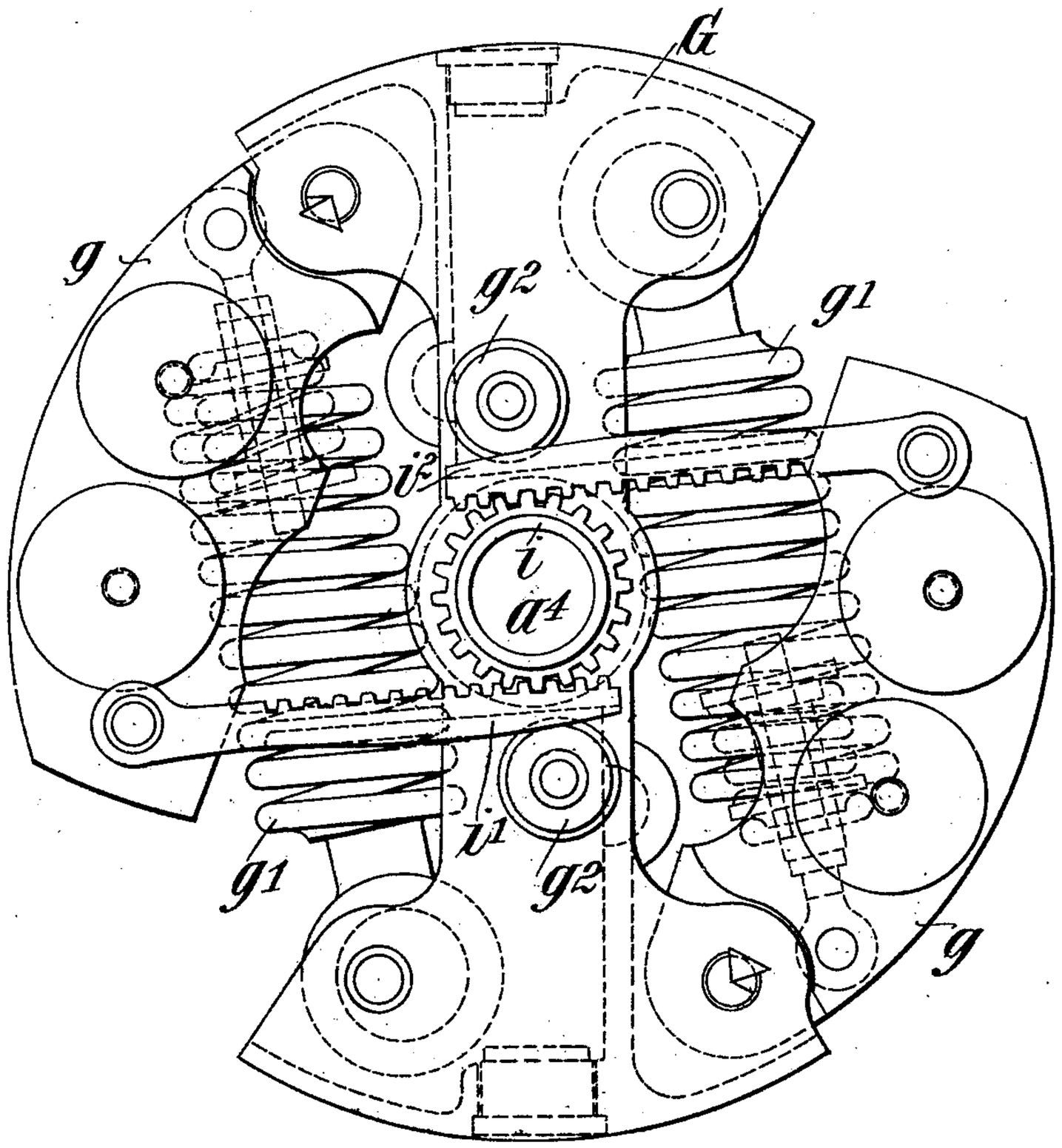
5 SHEETS—SHEET 3.

Fig. 3.



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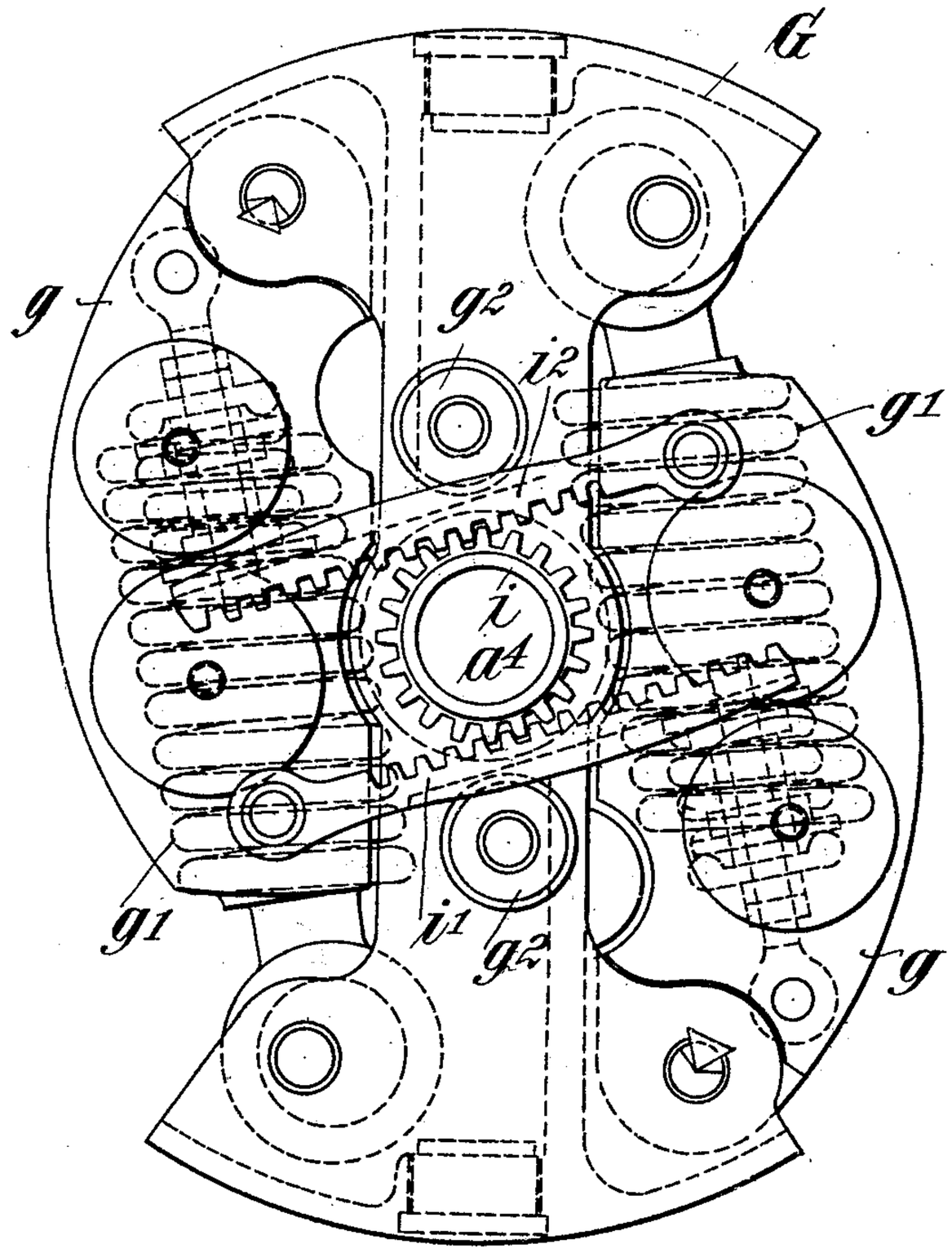
5 SHEETS—SHEET 4.

Fig. 4.



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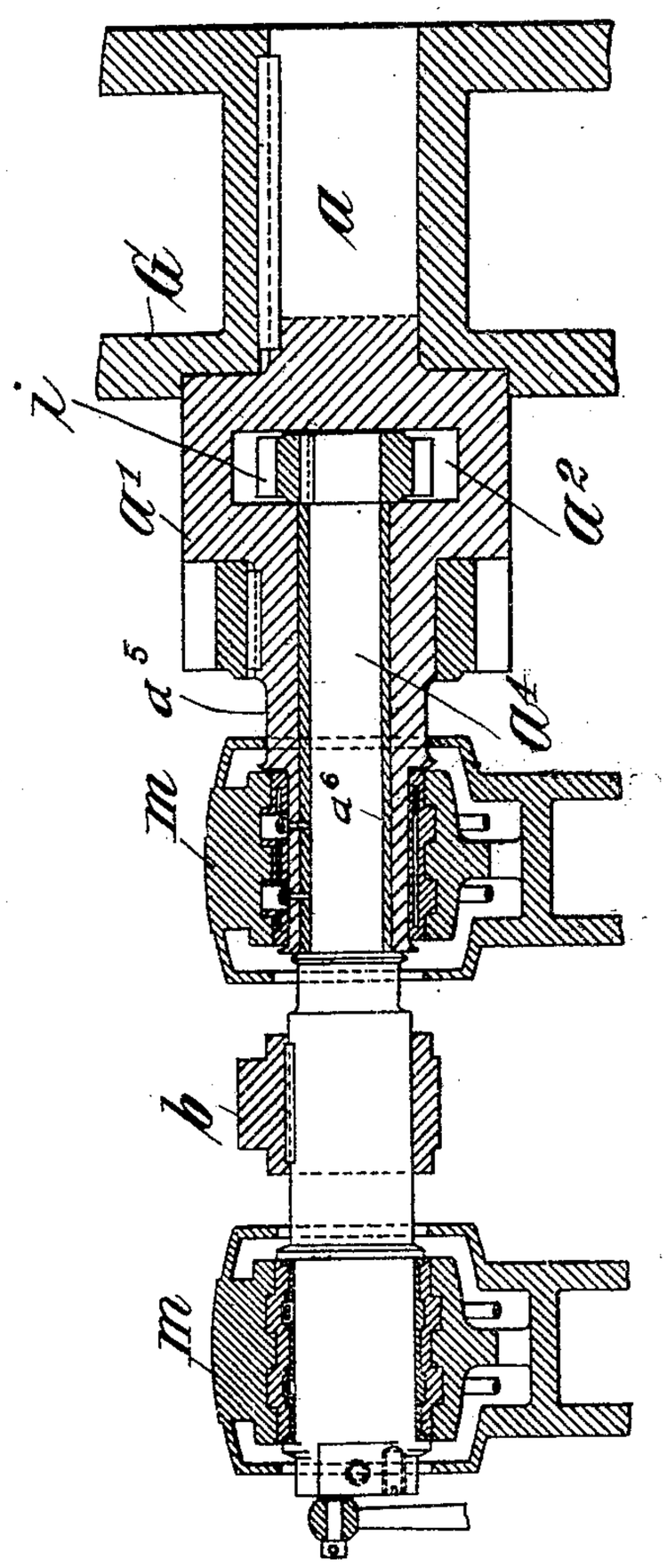
5 SHEETS—SHEET 5.

Fig. 5.



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UNITED STATES PATENT OFFICE.

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IGNITION-GEAR FOR INTERNAL-COMBUSTION ENGINES.

No. 916,312. Specification of Letters Patent. Patented March 23, 1909.

Application filed March 3, 1904. Serial No. 196,392.

To all whom it may concern:

Be it known that I, RUDOLF HENNIG, a subject of the Emperor of Germany, residing at Zweibrücken, Pfalz, Bavaria, Germany, have invented certain new and useful Improvements Relating to Ignition - Gear for Internal-Combustion Engines, of which the following is a specification.

This invention has for its object, in order to obtain the maximum thermal duty from the explosive gases, to vary, by automatic mechanism, the time of ignition of the compressed mixture of air and gas in the cylinder of the internal combustion engine, so that the combustion of the mixture of air and gas takes place as nearly as possible in the neighborhood of the inner dead point. Such variation or control of the time of ignition is necessary, since, when the engine is running with a light load, the mixture of gas and air is mixed with a greater quantity of the exhaust gases and burns more slowly than when the engine is running with a heavy load; such variation is also required when the speed of the engine is altered, since the released elements of the ignition-mechanism require time to effect the interruption of the current.

The variation in the time of ignition is generally effected by hand in a known manner, more especially on starting the engine, where the speed of rotation must increase from zero to the normal. On the other hand, within the range of speeds in which the governor acts, fine adjustment by hand is extremely difficult. It, therefore, follows that this fine adjustment should be effected by the governor and the coarse adjustment by hand.

The fine adjustment by the governor, according to practical experiments, must take place in such a manner that the time of ignition for an equal interval of range of load must be altered less by the governor at full load than at light loads, since with a light load the gaseous mixture in the cylinder highly charged with exhaust-gases requires much more time for combustion than the mixture used at full load. Thus, for a certain range, near full load, the time of ignition is hardly altered at all, but for the same range of load near the point of running idle, the time of ignition is altered very considerably. Moreover it is necessary to be able to adjust by hand, during running, the whole range of variation to be produced by the governor, since this range differs with different kinds of gas.

This invention takes account of these considerations and permits the time of ignition to be altered by hand during running of the engine; the time of ignition to be altered by the governor by a definite amount or degree from the maximum to the minimum load, this degree to be regulated practically by hand and to be fixed during running of the engine; and the adjustment of the point of ignition to be effected more rapidly by the governor at light load than at full load.

In the drawings:—Figure 1 is a sectional view of an explosive engine provided with an ignition gear constructed in accordance with the present invention. Fig. 2 is a detail elevation on an enlarged scale of the present ignition gear. Figs. 3 and 4 are detailed elevations of the governor mechanism in two different positions thereof. Fig. 5 is a fragmentary longitudinal sectional view illustrating the manner of mounting, and certain gear connections of the governor.

The governor shaft is designated *a* and rotates at the same speed as the engine shaft (not shown). The governor G, mounted on the way or side shaft *a* is of wheel form and is provided with the pivotally attached governor weights *g* which are pressed inward by spiral springs *g'*. Rack bars *i'* and *i²* are pivoted at the free ends of the weights *g*, the said bars being guided in their movements by rollers *g²*.

The bars *i'* and *i²* engage relatively opposite sides of a pinion *i* which is disposed in a recess *a²* of an enlargement *a'* of the shaft *a*. The pinion *i* is carried on a shaft *a⁴* which is disposed in a hollow shaft *a⁵* forming in effect an axial continuation of the shaft *a* and projecting integrally from the enlargement *a'* thereof, a bushing *a⁶* being interposed between the shafts *a⁴* and *a⁵*, the ends of which shafts are supported in bearings *m*.

The shaft *a⁴* carries an eccentric *b* which coöperates with an eccentric strap *c* having a projecting radial arm *e*. A link *k* is pivoted to the upper end of the latter and likewise to a rod *v* near the lower end thereof. The said rod *v* at its upper end is pivoted to a disk *q* having a central axis *p*, and at its lower end carries a roller *y* which is always engaged by a cam or tappet *n*. The latter is carried by a shaft *o* which rotates at half of the speed of the governor shaft *a* from which it is driven by suitably proportioned gear wheels shown by dotted lines in Fig. 1.

The disk *q* is held so that the roller *y* of the

rod v is always in contact with the cam or tappet n and for this purpose a spring r is employed. Said disk q is provided with a pawl s which engages and acts upon the spring controlled actuating or snap lever t of the magneto u, from which motion is transmitted in a well known manner to the ignition or contact breaker means.

The arm e, above referred to, passes through a guide member f which is pivotally mounted as at 2 in a bracket or slide piece f', the latter being adjustable longitudinally of a frame h by suitable screw mechanism which is operated by a hand wheel h'. The frame h is formed at its lower end to surround a fixed shaft h^2 which forms a pivotal axis for the frame in its adjustable movement, a set screw j threaded through the frame and engaging the shaft h^2, serving as a means to hold said frame at selected positions to which it may be adjusted.

The movement of the rod v to effect the ignition of the gases is controlled by the portion of the curved face of the cam n which lies between the points 8 and 9, the arc thus indicated having its radius from the point 6. The snapping off operation of the lever t from the pawl s occurs at some point (hereinafter termed the operating point) along the arc 8, 9, this point being in the line 5, 6, as shown in Fig. 1. It follows that the snapping off operation is timed in accordance with the location of the operating point. The cam n turns counterclockwise and therefore if this operating point be located at the right of the line 5, 6, when it contacts with the roller y, an earlier snapping off occurs and at the left of said line, a later snapping off occurs.

The position of the operating point is determined by the position of the roller y of the rod v with relation to the operating face 8, 9 of the cam n. The adjustment of the position of the rod v on its pivot 4, for the purposes of changing the operating point and consequently the time of snapping off is effected in the two ways above indicated, first, manually by manipulating the hand wheel h' so as to move the arm e about the center of the eccentric b as an axis, whereby the link k and rod v will be correspondingly moved, and second, by the governor, in which operation the relation of the eccentric b toward the shaft a is changed, it being understood that the eccentric b rotates at the same speed as the shaft a and that the changed relation thereof is effected by causing the shifting of said eccentric in advance of the shaft a to cause an earlier snapping off, or the retardation of the eccentric with respect to the shaft a to cause a later snapping off, this movement of the eccentric with relation to the shaft a extending through an angle of approximately 140°. It is to be understood that the point e when the snapping off takes place, is situated on the upper portion of the curve described by it and adjacent to the frame h.

When the eccentric b turns in advance of the shaft a, the lower end of the arm e is shifted toward the right and the upper end of said arm toward the left with corresponding movements of the link k and rod v. When the eccentric b is retarded, the lower end of the arm e is shifted toward the left and the upper end of said arm toward the right, with corresponding movements of the link k and rod v.

During the rotation of the shaft a, the upper end of the arm e describes an ellipse, a portion of the curvature of which figures in the operative movement of the rod v in any of the positions in which the above described operating points may be varied, through the operation of either of the two means provided for this purpose.

Under different conditions of working, it may be desired to vary the range of adjustment of the governor means and consequently the range of movement of the rod v and this is accomplished by changing the location of the pivot 2 so as to increase or decrease the amplitude of movement of the upper end of the arm e in the direction of the link k and to accordingly vary the dimension of the elliptical curve in the direction of said link, the other dimension of said curve which is in the direction of the arm e being constant. In changing the location of the pivot 2, the frame h is turned on the shaft h^2 toward or away from the shaft a as far as necessary, and the screw j is tightened after the adjustment has been made so as to hold said frame against further movement. Movement of the frame h away from the shaft a reduces the variable dimension of the aforesaid elliptical curve and movement of the frame toward said shaft increases the variable dimension of the curve.

Having fully described my invention, I claim:—

1. An ignition-gear for internal-combustion engines, comprising a magneto-electric generator, a spring controlled actuating or snap lever for said generator, a rotary way- or side-shaft, a governor, an eccentric rotatably mounted on said shaft and controlled by said governor, a rod actuated by said eccentric, a pivotally-mounted guide for said eccentric-rod, a transversely-adjustable frame for said guide, a rotary cam, a rod one end of which presses against said cam, a link connecting said end of said rod to the free end of said eccentric-rod, a disk oscillated by said rod and a pawl on said disk coacting with the actuating or snap-lever of said magneto-electric generator.

2. An ignition-gear for internal-combustion engines, comprising a magneto-electric generator, a spring controlled actuating or snap lever for said generator, a rotary way-

or side-shaft, a governor, an eccentric rotatably mounted on said shaft and controlled by said governor, a rod actuated by said eccentric, a pivotally-mounted guide for said eccentric-rod, a guide-frame arranged transversely to said eccentric-rod, a support for said guide-frame, means for clamping said frame to said support, a slide-piece bearing said eccentric-rod-guide and arranged in said guide-frame, means operated by hand for moving said slide-piece in said guide-frame, a rotary cam, a rod one end of which presses against said cam, a link connecting said end of said rod to the free end of said eccentric-rod, a disk oscillated by said rod, and a pawl on said disk coacting with the actuating or snap-lever of said magneto-electric generator.

3. An apparatus for controlling the time of ignition in explosive engines, comprising an oscillatory rod, means engaging said rod for oscillating it, a governor for controlling the said oscillation, a second rod engaging said oscillating rod, actuating means for said second rod, an ignition gear connected to the said second rod and an adjusting device engaging said oscillating rod at a point intermediate the points of engagement of said oscillating means and said second rod and adapted when adjusted to alter the axis of oscillation of said oscillating rod.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

RUDOLF HENNIG.

Witnesses:

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