No. 741,164. PATENTED OCT. 13, 1903.

F. M. RITES.

VALVE AND IGNITING GEAR FOR EXPLOSIVE OR INTERNAL COMBUSTION ENGINES.

NO MODEL. APPLICATION FILED JAN. 14, 1902.

2 SHEETS—SHEET 1.

Fig. 1.

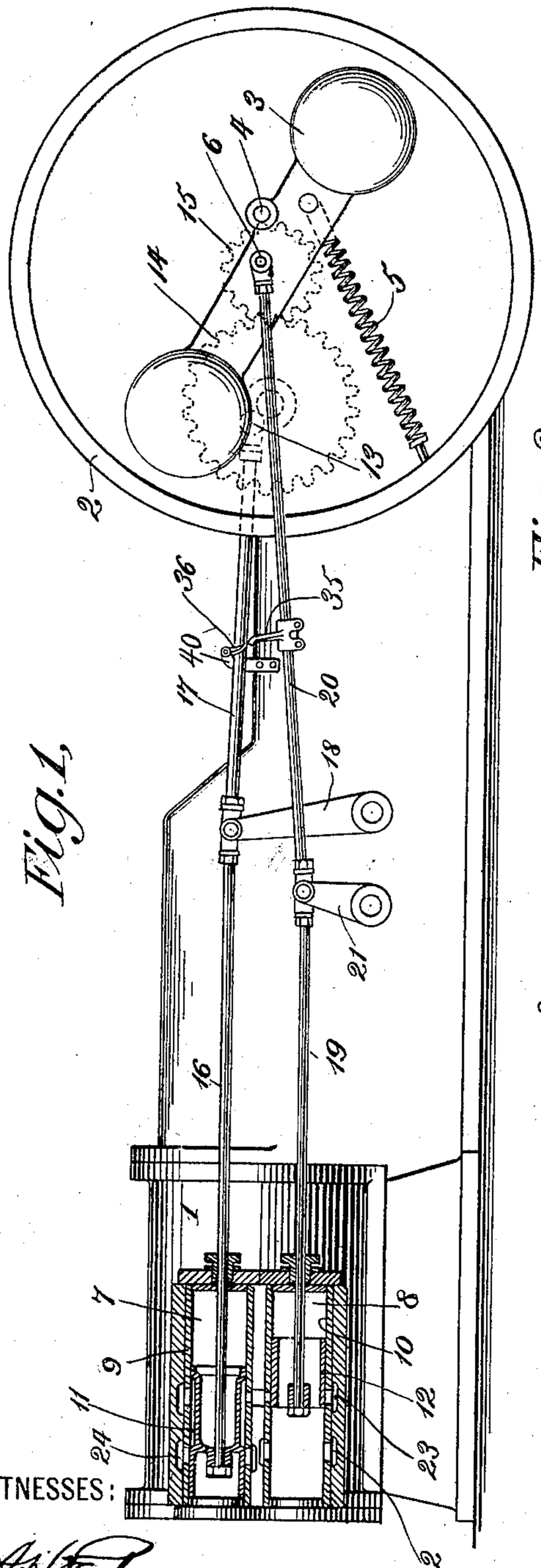


Fig. 2.

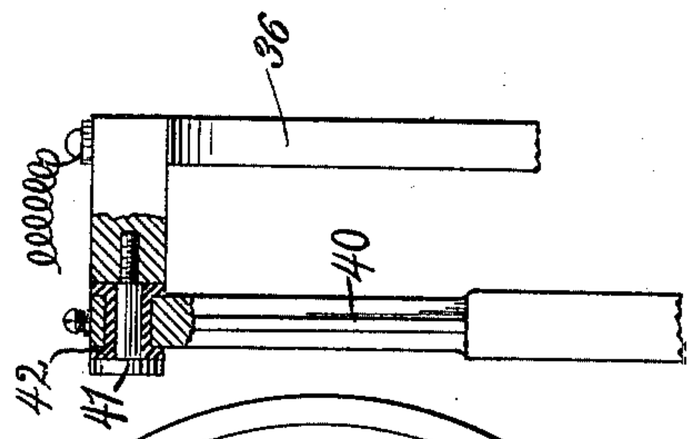
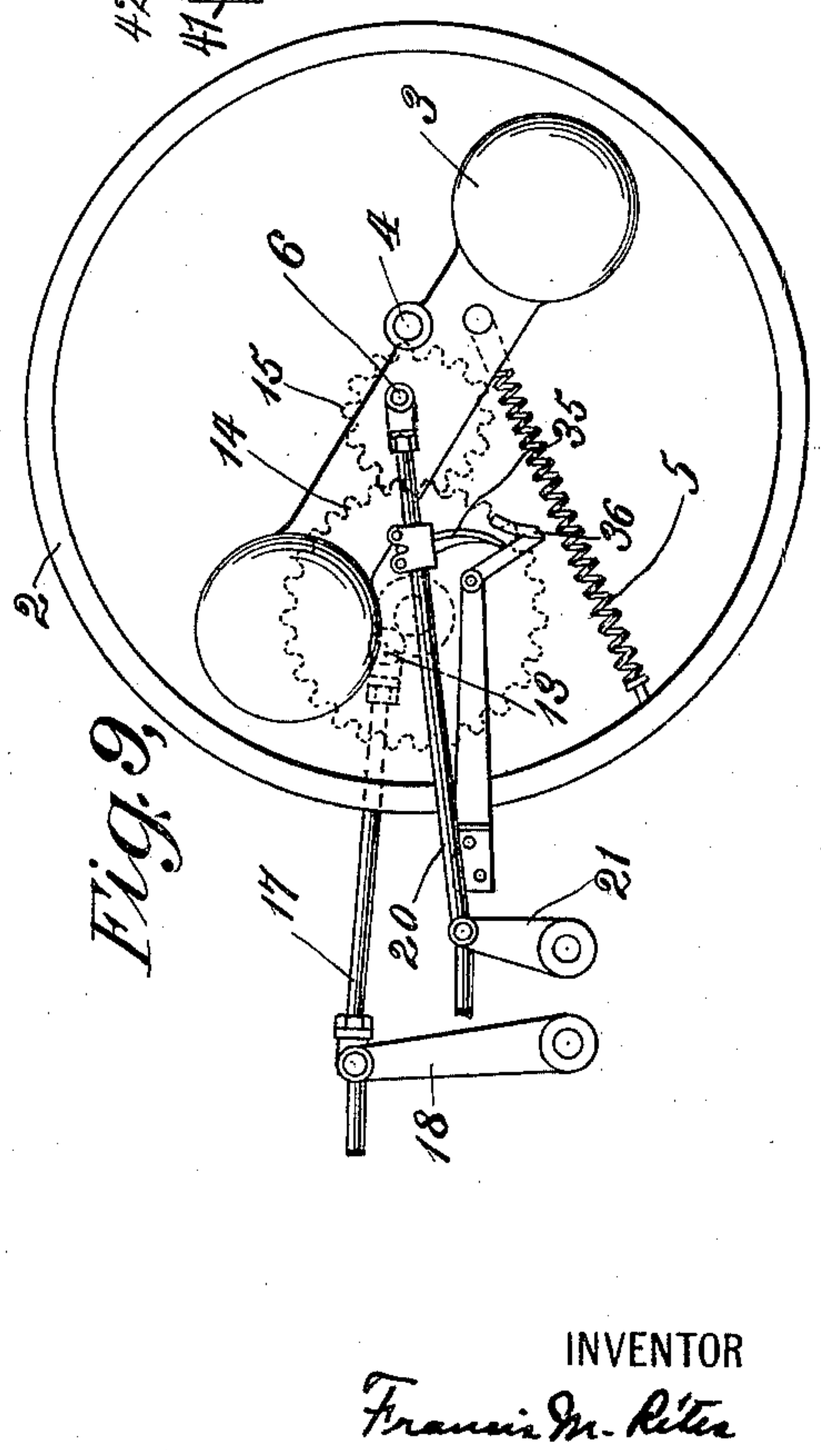


Fig. 3.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 6,

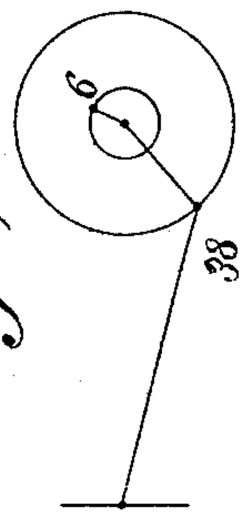


Fig. 8,

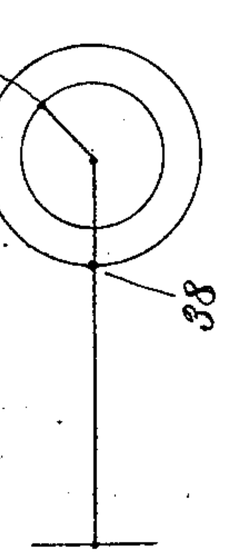


Fig. 5,

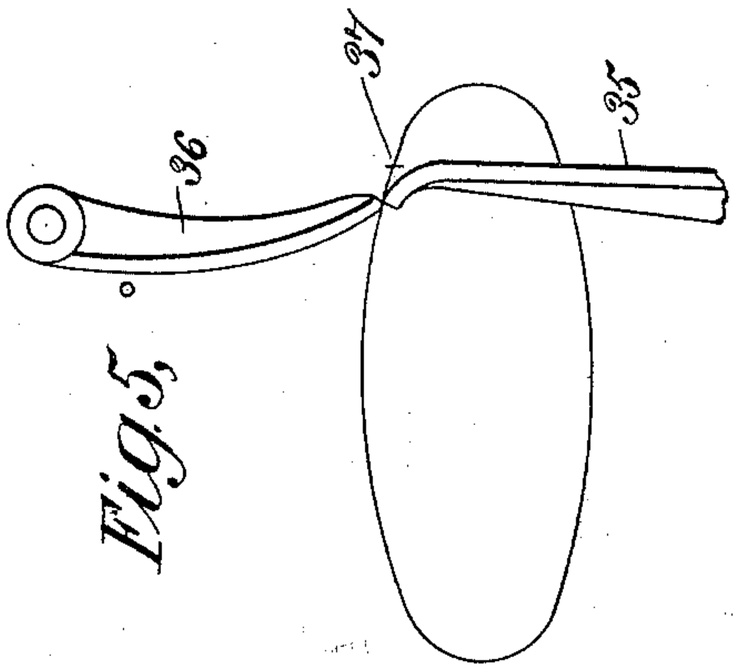


Fig. 7,

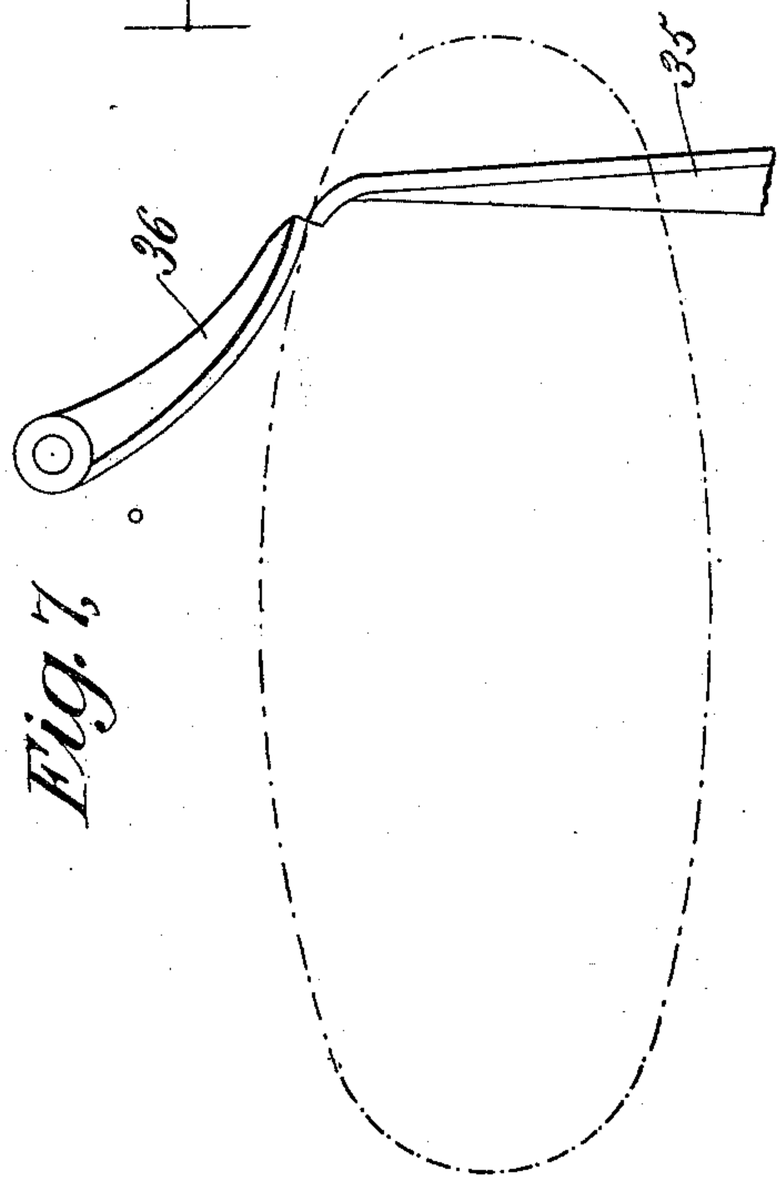


Fig. 3,

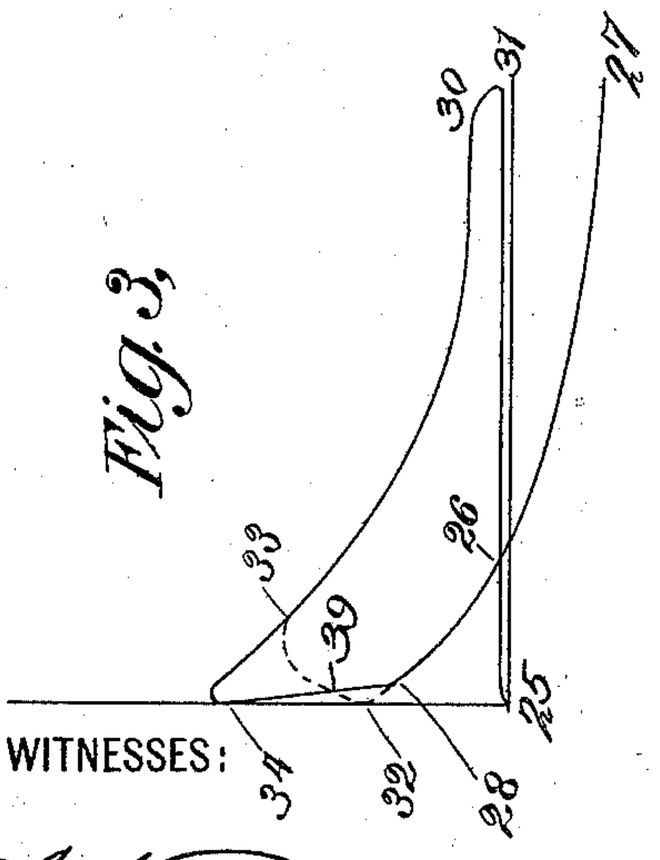
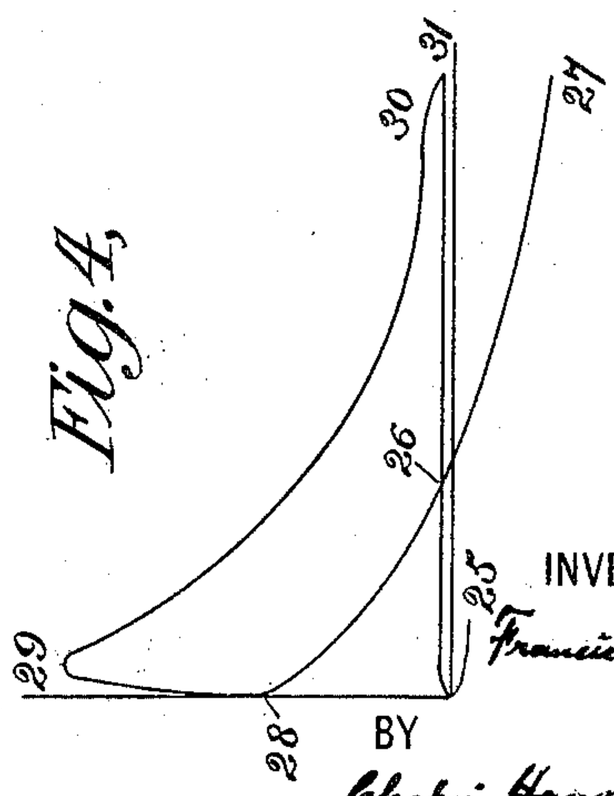


Fig. 4,



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No. 741,164. Patented October 13, 1903.

UNITED STATES PATENT OFFICE.

FRANCIS M. RITES, OF ITHACA, NEW YORK.

VALVE AND IGNITING GEAR FOR EXPLOSIVE OR INTERNAL-COMBUSTION ENGINES.

SPECIFICATION forming part of Letters Patent No. 741,164, dated October 13, 1903.

Application filed January 14, 1902. Serial No. 89,645. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS M. RITES, a citizen of the United States, residing in Ithaca, county of Tompkins, and State of New York, have invented certain new and useful Improvements in Valve and Igniting Gear for Explosive or Internal-Combustion 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 appertains to make and use the same.

My invention relates to improvements in valve and igniting gear for explosive and internal-combustion engines; and it consists in operating variable igniting-gear directly from variable cut-off valve-gear operated by a shifting eccentric of variable throw and in causing the variation in angular sweep of an eccentric-rod operated thereby, as the throw of such eccentric varies to vary the operation of the igniting-gear.

My invention consists, further, in details of combination, construction, and arrangement of the parts, as hereinafter pointed out in the claims.

The objects of my invention are to obtain increased economy and greater efficiency of operation of explosive and internal-combustion engines and to make the mechanism for accomplishing this as simple and effective as possible.

In the accompanying drawings I have illustrated one embodiment of my invention.

In the drawings, Figure 1 shows a side elevation of the valve and igniting gear of an explosive-engine, the valves and valve-chambers being sectioned. Fig. 2 is a detail view showing the method of mounting one of the contact-cams of the igniting-gear. Figs. 3 and 4 are corresponding diagrams showing typical indicator-cards, Fig. 3 showing the card corresponding to an earlier cut-off and earlier ignition and Fig. 4 showing a typical card corresponding to later cut-off and correspondingly later ignition. Fig. 5 is a detail view showing, on a larger scale than Fig. 1, the contact-cams, the path of which one of these cams follows when the valve-gear is adjusted for early cut-off being indicated. Fig. 6 is a diagram showing the position of the eccentric and crank-pin at the time when ignition begins, with the valve-gear adjusted as in Fig. 5. Figs. 7 and 8 are views similar to Figs. 5 and 6, respectively, but corresponding to a later cut-off. Fig. 9 is a view illustrating an alternative position of the contact-points.

The engine shown in Fig. 1 is of the four-cycle type; but the invention is equally applicable to two-cycle engines or to engines having a higher cycle than four.

Referring now to Fig. 1, the said figure shows an engine-cylinder 1 and a fly-wheel 2, upon which is pivoted a governor-weight 3, the pivotal point being at 4. The particular governor shown is of my invention and is covered by United States Letters Patent No. 534,579, dated February 19, 1895, and is in common use and requires no specific description. Centrifugal movement of the weight is opposed by a governor-spring 5. Weight 3 carries a valve-actuating device 6, which in the instance shown is an eccentric of the pin type. 7 designates a valve-chamber within which is the main admission-valve of the engine, and 8 designates a similar chamber, within which is a cut-off valve. The valve-chambers are shown as cored out in the cylinder-casting and are provided with liner-bushings 9 and 10, in the sides of which the ports are cut accurately. The main admission-valve 11 and the cut-off valve 12 are valve-sleeves.

The engine shown in Fig. 1 being of the four-cycle type, valve 11 is operated by a crank-pin 13, (shown in dotted lines,) driven by reducing-gears 14 and 15, the latter mounted upon the crank-shaft of the engine, said gears having a ratio of two to one. Valve 11 may be operated from the crank-pin 13 by any suitable means. I have shown for the purpose a valve-stem 16, a valve-rod 17, and a rocker-arm 18. The cut-off valve 12 I have shown as driven from the eccentric 6 by a valve-stem 19, a valve-rod 20, and a rocker-arm 21.

Numeral 22 designates the admission-port of the cut-off-valve chamber, numeral 23 a port connecting valve-chambers 7 and 8, and numeral 24 the port leading from the valve-chamber 7 to the engine-cylinder. In the operation of this valve-gear, since the cut-off valve 12 reciprocates twice to each reciprocation of the main admission-valve 11, the

admission-valve permits the entrance of an explosive charge to the engine-cylinder during alternate strokes only; but the cut-off valve determines the duration of the admission period during such admission-stroke, cut-off taking place earlier or later, according to the load on the engine, the valve-gear being adjusted to that end by the governor.

Referring now to the indicator-cards shown in Figs. 3 and 4, and at first to Fig. 4, line 25 26 is the admission-line, the point 26, the point of cut-off, being variable. After cut-off the charge in the cylinder expands, as represented by line 26 27. On the return stroke the charge in the cylinder is compressed along the same line 27 26 and to a point above admission-pressure, (designated by numeral 28.) The card shown in Fig. 4 is that corresponding to a position of the valve such that ignition takes place near the dead-center. Therefore the line 28 29 represents the rise in pressure after ignition and the line 29 30 the expansion in the engine-cylinder during the working stroke, 30 being the point of release. Line 31 25 is the exhaust-line.

In Fig. 3 the same numerals are used as in Fig. 4; but the point of cut-off being earlier the area of the card is less. As in Fig. 4, point 28 is the point of ignition, ignition in this case taking place before the dead-center is reached. If ignition should take place on the dead-center, as in Fig. 4, instead of at an earlier point, the compression-line would extend from point 26 past 28 to a point 32, as indicated by dotted line 28 32, and the dotted line 32 33 indicates what would be the ignition-line under such circumstances; but because the charge in the cylinder is compressed to a less extent under the circumstances indicated in Fig. 3 than under those indicated in Fig. 4 ignition will take place more slowly, the more so since the piston is advancing and ignition is not complete until the point 33 is reached.

The area inclosed between points 28 32 34 in Fig. 3 represents negative work due to ignition having taken place before the dead-point is reached; but since ignition takes place under these circumstances when the charge in the engine-cylinder is at nearly its greatest compression-pressure and the pressure is continually growing higher as the piston nears its dead-point ignition will take place rapidly and will produce a relatively higher pressure in the engine-cylinder than if ignition took place at the dead-point when the piston is advancing. Therefore the area inclosed between points 28 32 34, representing the negative work due to back firing, is relatively small as compared with the area between points 28 29 33 34, representing that portion of the card which would be lost if ignition took place at dead-center. It is apparent, therefore, that a material increase in efficiency results from advancing the point of ignition—that is to say, causing it to occur at an earlier period in the cycle as the cut-off changes from a later to an earlier point. One mechanism by which this variation of the point of ignition may be obtained is illustrated in the drawings. Upon the valve-rod 20 is mounted a contact-arm 35. The extremity of this arm moves in a path which is substantially elliptical, the size of the ellipse being determined by the throw of the eccentric at the particular instant. The throw is greater for late cut-offs than for early cut-offs. This contact-arm 35 may make contact with another contact-arm 36, which may be pivotally mounted and insulated from the engine-frame. To this end arm 36 may be supported from a bracket 40 by means of a pin 41, Fig. 2, insulated from said bracket by a bushing 42. These contact-arms are included in the igniter-circuit of the engine in the well-known manner, constituting the means by which the said circuit is interrupted and the spark produced. Comparison of Figs. 5 and 7, which show the contact-arms and the path of arm 35 under conditions of early cut-off and late cut-off, respectively, will show that ignition, which takes place when the contact-arms separate, occurs at an earlier point in the cycle of the engine under the circumstances of Fig. 5 than under those of Fig. 7, point 37 in Fig. 5 indicating a position of contact-arm 25 corresponding to the crank-pin position at which ignition takes place under the circumstances of Fig. 7. The same is illustrated in Figs. 6 and 8, in which numeral 6 indicates the position of the eccentric at the time of ignition in each case, and numeral 38 indicates the position of the crank-pin at the same time.

In the operation of the engine the admission and cut-off valves permit the entrance of the explosive charge to the engine-cylinder at the proper times in the ordinary manner. The exhaust-valve mechanism of the engine is not shown; but any ordinary exhaust-valve mechanism may be used. The cut-off valve controls the point of cut-off of the explosive charge and is adjusted to vary the point of cut-off in accordance with the load of the engine by the shifting of the governor-weight. As the time for ignition in each cycle of operations of the engine approaches the contact-pieces 35 36 come into contact, and at the time of ignition these contact-pieces separate, because the piece 35 travels away from piece 36, and the interruption of the igniter-circuit thereby caused produces the spark to ignite the charge. As the point of cut-off is varied by the governor, the point of ignition is also varied to the proper extent.

The point of ignition for any particular point of cut-off and the range through which the point of ignition varies with variation in cut-off will necessarily be varied, according to the circumstances of the case, and such variation may be effected by properly locating and proportioning the arm 35 and by placing the said arm on one side or the other of the eccentric-rod, by properly locating the

center of the swinging arm 36, and by varying the angle through which the valve-rod sweeps. Engines which compress their charges to different degrees of compression require different periods of ignition and require the point of ignition to vary between different limits. Variation in the clearance-space in different engines also requires variation in the point and range of ignition, as do different grades of explosive mixtures. All such variation in the point of ignition for any particular cut-off and the range of variation of ignition with variation in cut-off may be effected as above described, for every point located upon the rigid combination of the eccentric-rod and an arm to one side or the other thereof moves in a different path with a different stroke and a different angular advance from any other point, and by properly selecting some such point any desired variety of variation of the point of ignition can be obtained to suit any combination of conditions. Fig. 9 illustrates one such alternative arrangement, the parts being substantially the same as in Fig. 1, except that the fly-wheel is placed closer to the engine-cylinder, the valve-rod 20 is much shorter, so that its angularity is much greater, and the arm 35 projects downward instead of upward. With the parts arranged as shown in this figure points in the path of arm 35 move considerably in advance of corresponding points in the path of said arm when placed as shown in Fig. 1.

It is obvious that igniting devices of different character than those above illustrated may likewise be controlled in the same manner by appropriate mechanism and that various different forms of contact devices or other current-varying means adapted for operating electric igniters may be devised and arranged to be operated by the governor or shifting eccentric in accordance with the change in the point of cut-off. Therefore I do not limit my invention to uses in connection with any particular type of variable cut-off gear or to use with engines of any particular cycle or to any particular type of igniting mechanism or to the particular construction of the contact devices shown in the drawings.

It is also obvious that while one element of the contact mechanism may be mounted on the eccentric-rod of the cut-off mechanism, as shown, the other instead of being mounted on the frame of the engine, and thus be stationary, may be mounted on some moving part of the engine, like the secondary valve-rod, which has a motion at half the speed of the other, and thus would make contact every other revolution instead of every revolution, as shown.

In stating in certain of the following claims that the current-varying device of the igniting mechanism is coupled to the variable cut-off valve-gear I do not mean to imply that such current-varying device is necessarily actually mounted upon a part of the valve-gear, but only that it is coupled to operate in harmony with the operation of the valve-gear.

What I claim is—

1. In an explosive or internal-combustion engine, the combination with a shifting eccentric of variable throw, and a member driven thereby having a combined reciprocating and oscillatory movement, of igniting mechanism comprising means connected to said member at a point having an oscillatory motion, and variably operated thereby to produce ignition in accordance with variation in throw of the eccentric.

2. In an explosive or internal-combustion engine, the combination with a rotary shaft, a governor-weight having an eccentric of variable throw, means for supporting said governor-weight from said shaft, and a spring resisting centrifugal action of said weight, of a member connected to and driven by said eccentric having a combined reciprocating and oscillatory movement, igniting mechanism comprising means connected to said member at a point having an oscillatory motion, and variably operated thereby to produce ignition in accordance with variation in throw of the eccentric.

3. In an igniting-gear for explosive and internal-combustion engines, the combination with a shifting eccentric of variable throw and an eccentric-rod, of igniting mechanism, comprising means connected to said eccentric-rod and partaking both of the oscillatory and of the longitudinal reciprocatory motion of said rod, and variably operated by said eccentric-rod in accordance with variation in angular sweep thereof.

4. In an igniting-gear for explosive and internal-combustion engines, the combination with a shifting eccentric of variable throw, and an eccentric-rod, of electric igniting mechanism comprising current-varying means having a member connected to the eccentric-rod and partaking both of the oscillatory and of the longitudinal reciprocatory motion of said rod, and variably operated thereby in accordance with variation in throw thereof.

5. In an igniting-gear for explosive and internal-combustion engines, the combination with a shifting eccentric of variable throw, and an eccentric-rod, of electric igniting means comprising contact-points, one mounted upon said eccentric-rod, and partaking both of the oscillatory and of the longitudinal reciprocatory motion thereof, and means for varying the time of separation thereof in accordance with variation in adjustment of the eccentric.

6. In an igniting-gear for explosive and internal-combustion engines, the combination with a shifting eccentric of variable throw, of an eccentric-rod driven thereby, and igniting mechanism comprising a member projecting to one side of said eccentric-rod in the plane of vibration thereof, and another member coöperating with said projecting member, whereby the point of ignition varies in accord-

ance with variation in angular sweep of said eccentric-rod.

7. In an igniting-gear for explosive and internal-combustion engines, the combination with a shifting eccentric of variable throw, of an eccentric-rod driven thereby, a contact-piece carried by said rod, and another contact-piece adapted to break contact with said first-named contact-piece at varying points according to the variation in angular sweep of said eccentric-rod.

8. In an igniting-gear for explosive and internal-combustion engines, the combination with a shifting eccentric of variable throw, of an eccentric-rod driven thereby, a contact-piece carried by said rod and projecting to one side of said rod in the plane of vibration thereof, and another contact-piece adapted to break contact with said first-named contact-piece at varying points, according to the variation in angular sweep of said eccentric-rod.

9. In valve and igniting gear for explosive and internal-combustion engines, the combination, with a cut-off valve controlling admission, a shifting eccentric and means comprising a valve-rod for driving said valve from said eccentric, of variable igniting mechanism having a contact-piece carried by the valve-rod, in the plane of vibration thereof and a swinging contact-piece adapted to make contact therewith.

10. In valve and igniting gear for explosive and internal-combustion engines, the combination, with a cut-off valve controlling admission, a shifting eccentric and means comprising a valve-rod for driving said valve from said eccentric, of variable igniting mechanism having a contact-piece carried by and projecting from said valve-rod, and a swinging contact-piece adapted to make contact therewith and partake of the angular movement thereof.

11. In a valve and igniting gear for explosive and internal-combustion engines, the combination with a valve and mechanism for operating the same, comprising an eccentric and an oscillatory eccentric-rod, of electrical contact-pieces, one of which is mounted upon said eccentric-rod and partakes of the oscillatory and longitudinal reciprocatory motion thereof.

12. In a valve and igniting gear for explosive and internal-combustion engines, the combination with a valve and mechanism for operating the same, comprising a shifting eccentric and an oscillatory eccentric-rod, of electrical contact-pieces, one of which is mounted upon said eccentric-rod, and partakes of the oscillatory and longitudinal reciprocatory motion thereof.

In testimony whereof I affix my signature in the presence of two witnesses.

FRANCIS M. RITES.

Witnesses:

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PAUL S. LIVERMORE.