No. 804,783. PATENTED NOV. 14, 1905.

R. VARLEY.

CIRCUIT CONTROLLER FOR EXPLOSIVE ENGINES.

APPLICATION FILED OCT. 31, 1904.

Fig. 1.

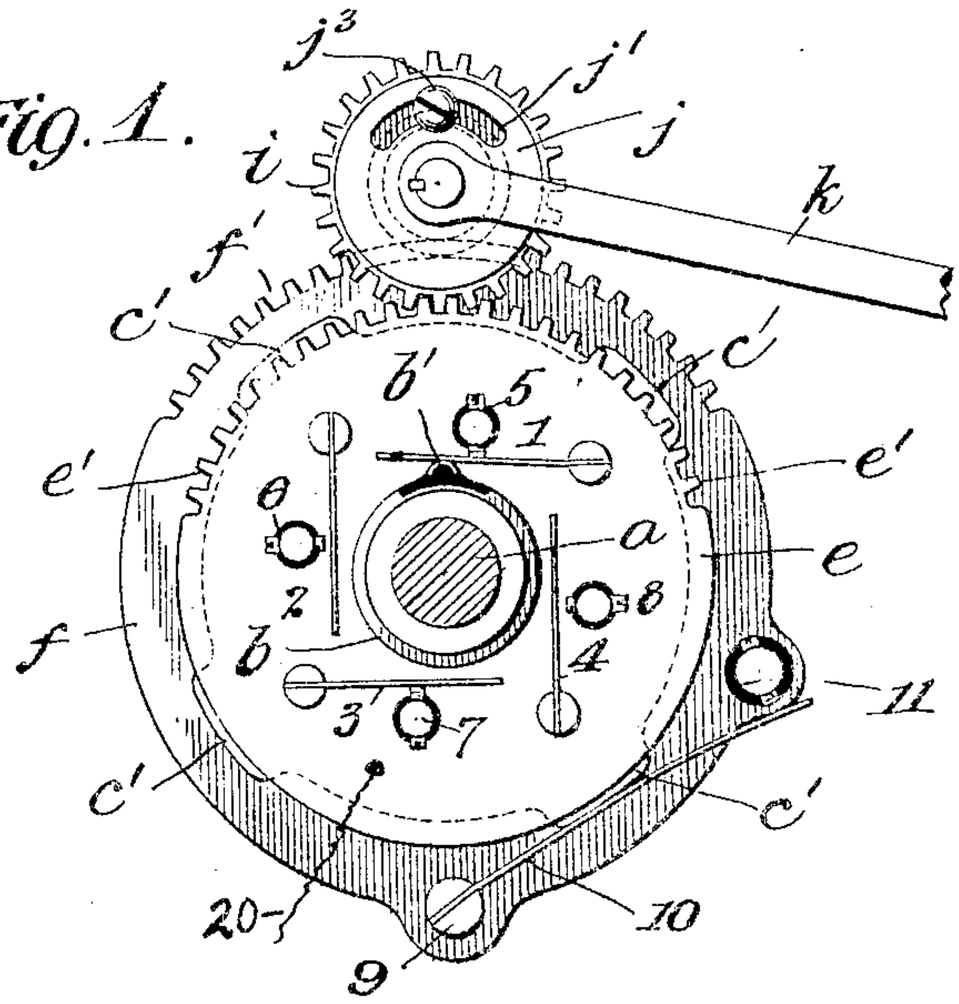


Fig. 2.

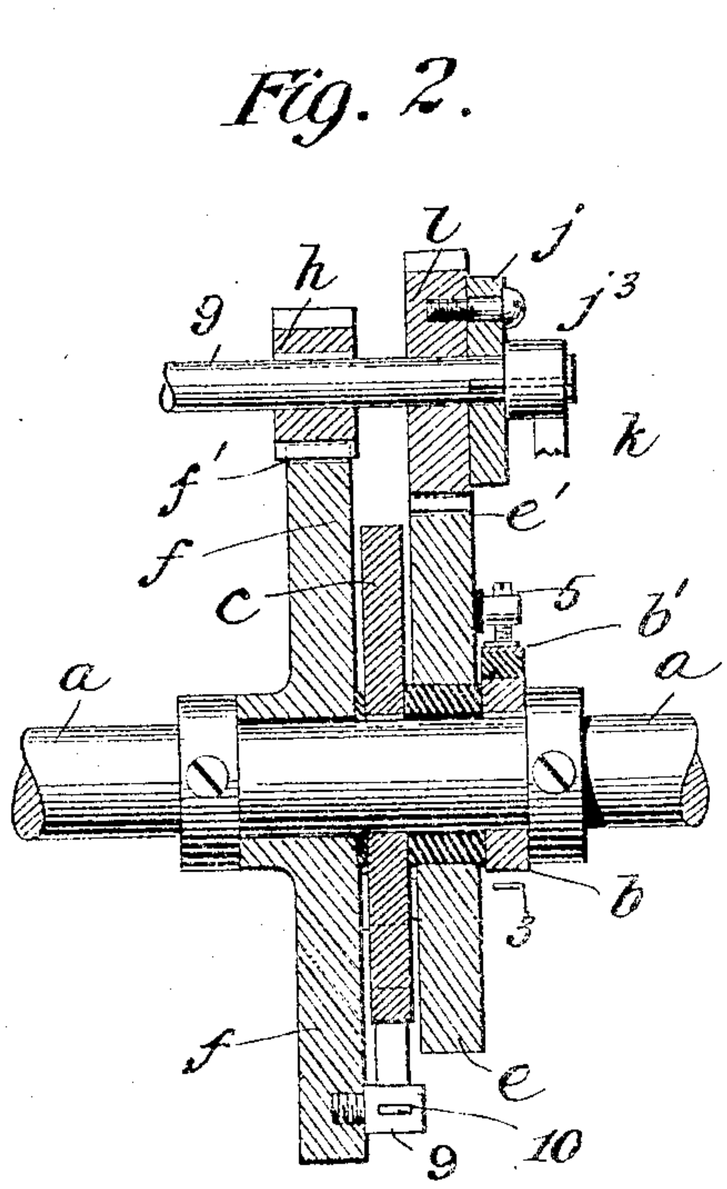
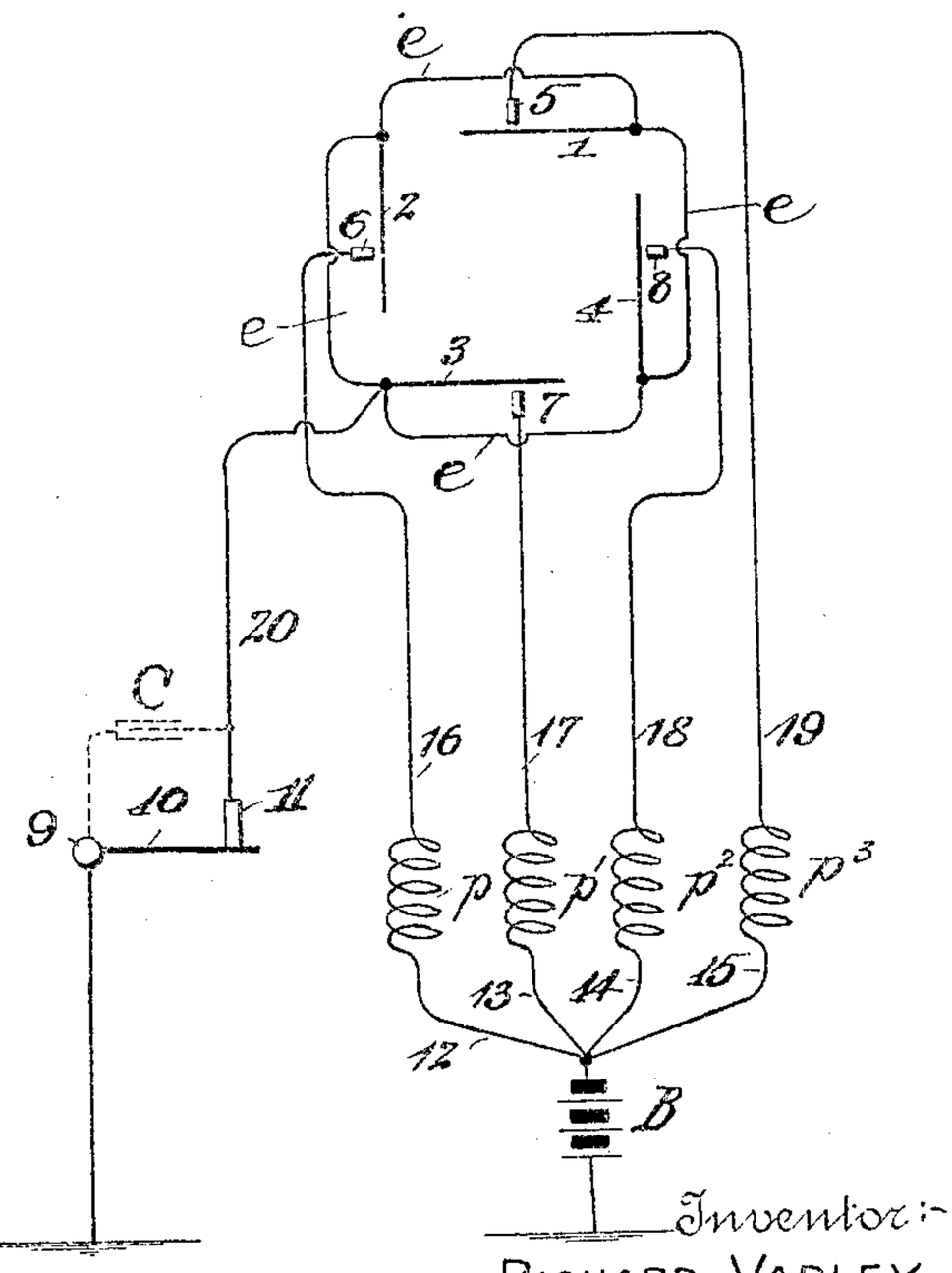


Fig. 3



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UNITED STATES PATENT OFFICE.

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CIRCUIT-CONTROLLER FOR EXPLOSIVE-ENGINES.

No. 804,783. Specification of Letters Patent. Patented Nov. 14, 1905.

Application filed October 31, 1904. Serial No. 230,692.

To all whom it may concern:

Be it known that I, RICHARD VARLEY, a citizen of the United States, residing at Englewood, in the county of Bergen and State of New Jersey, have invented certain new and useful Improvements in Circuit-Controllers for Explosive-Engines, of which the following is a full, clear, and exact description.

This invention relates to circuit-controllers adapted for the control of the ignition-circuit of explosion-engines. The electrical apparatus for supplying what is known as the "jump-spark" for igniting the explosive charge in such engines usually consists of an induction-coil whose primary circuit includes a battery, a circuit-closer to be actuated automatically by the engine at the instant the charge is to be fired, and a hand-switch, while the secondary circuit leads to the cylinder of the engine and has its terminals approaching each other therein, so that when a current is induced in the secondary circuit a spark will jump across the terminals and fire the charge. It is also common to use in connection with this apparatus a vibrating circuit-controller actuated by the magnetism of the induction-coil whenever the primary circuit is closed and the function of which is to give a series of interruptions of the primary current and a consequent series or torrent of sparks at the terminals of the secondary during the interval that the primary circuit is elsewhere closed.

The ordinary type of circuit-closer for the primary circuit is a mechanical device, such as a cam, placed upon one of the shafts of the engine at such a point that a spring or similar circuit-controlling element will be actuated at the right instant in the rotation to ignite the charge. These mechanical circuit-controllers require an appreciable amount of time in their engagement, dwell, and disengagement with the spring or other actuated device, depending in a given construction upon the speed of the shaft, so that during a large part of the operation of the engine the interval during which the circuit is closed is longer than is actually necessary to ignite the charge, the surplus of the period of closure resulting in an unnecessary consumption of the battery.

It is accordingly one of the objects of my invention to provide a construction of circuit-closer which will automatically open the primary circuit after a predetermined interval of closure, regardless of the fact that the circuit-closer itself may still be in its closed condition. Again, in the operation of such engines it is necessary to "advance" or "retard" the spark in accordance with changes of speed of the engine. This circuit-opener which I have devised is also actuated by the engine and it is adjustable with respect to the circuit-closer, so that for a given speed of the engine the period during which the circuit will remain closed is exactly what is required for that speed, and the battery is used under the most economical conditions. When the speed is increased, however, it is desirable to maintain the same period of closure of the circuit, so that the certainty of firing the charge will be maintained. When the speed of the engine is increased, the time of the closure of the circuit is "advanced," and in order to carry out the theory of my invention the time of the opening of the circuit should also be advanced; but inasmuch as both the closing and the opening are dependent upon the movement of the engine it is necessary to provide that the advance of the circuit-opener shall not be so rapid as the advance of the circuit-closer, so that the actual interval or period of closure will be the same at all speeds. This I accomplish by means of a timing apparatus, which moves the said closer and the circuit-opener through a certain ratio of movement obtained by an arrangement of gearing or system of levers which will afford the required approximately constant interval of closure at all speeds. One way of carrying out this idea will hereinafter be described with reference to the accompanying drawings; but it will be understood that various modifications may be made in the gearing for obtaining the proper ratios and that the construction may be modified variously without departing from the general scope of the invention.

In the accompanying drawings, Figure 1 is an elevation of a circuit closing and opening device and the means for operating it adapted for a four-cylinder engine. Fig. 2 is a central vertical section of the same, and Fig. 3 is a diagram of the circuits specifically relating to the invention.

a represents the main shaft or a shaft driven by an explosion-engine. Keyed upon this shaft are two cam-disks *b* and *c*, respectively, the former having one insulated cam-lug *b'*

and the latter having four cam-lugs c' c', &c., spaced ninety degrees apart. Adjacent to the disk b and mounted loosely upon the shaft is a disk-like element e, having a gear-segment e' formed on a portion of its periphery and carrying upon its face next to the disk b four contact-springs, (indicated, respectively, by 1, 2, 3, and 4.) These springs stand in the plane of the disk b and normally out of contact therewith, but in a position to be struck and moved by the cam-lug b' successively at each ninety degrees of its rotation. Behind each of the springs is a contact-screw held in a post, said screw and posts being indicated, respectively, by 5, 6, 7, and 8. The posts are insulated from the disks. Adjacent to the disk c and mounted freely upon the shaft is another disk-like element f, also having a gear-segment f' on a portion of its periphery, but of longer pitch diameter than the segment on the element e. The disk f carries a grounded post 9, to which is fixed a contact-spring 10, resting normally against a contact-screw 11, suitably mounted in and insulated from the disk f. This spring 10 is in position to be struck and raised from the screw by each of the cam-lugs c' as they pass it in the rotation of the shaft.

g is a short shaft, suitably mounted in bearings (not shown) above shaft a. Keyed upon it is a pinion h in mesh with segment f', and loose upon it is another and larger pinion i in mesh with segment e'. Adjacent to the pinion i is a disk j, keyed upon the shaft and having a concentric slot j', through which a clamping-screw j^3 passes. This screw screws into the pinion i, and by screwing it in tightly until its head presses against the disk j the said disk and the pinion i become clamped together and the pinion accordingly made fast to the shaft. By loosening this screw the pinion can be turned without rotating the shaft. On the end of shaft g is a crank-arm k, by which the shaft can be rotated through any desired portion of a revolution and the connected parts correspondingly moved. This can also be accomplished by applying the crank or other operating device to any one of the interconnected parts.

As above stated, the device illustrated is adapted for a four-cylinder engine. In such an arrangement four induction-coils are usually employed; but these may all operate on a single battery and a single condenser. Such a battery is indicated at B, and the condenser is shown in dotted lines at C. The battery is connected to ground (which in this class of machinery is usually a part of the frame of the machine) on one side and leads from the opposite side through four independent branches 12, 13, 14, and 15 to the respective primary coils p, p', p^2, and p^3 of the four induction-coils. The corresponding secondary coils are not illustrated. From the opposite end of the primary coils lead the conductors 16, 17, 18, and 19 to the respective contact-screws 6, 7, 8, and 5. The springs 1, 2, 3, and 4 are electrically connected together by means of the metallic disk upon which they are commonly mounted, and from this disk a wire 20 leads to the insulated contact-screw 11, which connects with spring 10 and the grounded post 9 to complete the circuit.

Normally while the shaft a is rotating the spring 10 is resting against insulated contact 11 and the circuit is closed at that point. When cam b' strikes, say, spring 1 and lifts it into contact with screw 5, a circuit is closed which may be traced as follows: from ground to battery B, wire 15, primary coil p^3, wire 19, contact-screw 5, spring 1, disk e, wire 20, insulated contact-screw 11, spring 10, and post 9 to ground. This energizes the primary coil of one of the induction-coils, and, assuming that the coil is equipped with a vibrator, the circuit is rapidly interrupted during the period of closure, and a torrent of sparks is caused to jump across the terminals of the secondary, which are exposed in the cylinder of the engine, and the charge is fired. Immediately after the circuit is closed between spring 1 and screw 5 one of the lugs c' on the disk c strikes the spring 10 and lifts it from the screw 11, thus breaking the circuit and preventing the further consumption of battery, notwithstanding the fact that the cam b' may not yet have allowed spring 1 to withdraw itself from screw 5. This time interval during which the circuit is closed and the sparks are generated can be predetermined by shifting the position of the disk f with respect to that of disk c on the shaft a—that is to say, by making the angle of the arc between the time when spring 1 is engaged by the cam b' and the time when spring 10 is engaged by cam c' more or less. This adjustment can be effected by loosening the screw j^3 and turning by hand the pinion i, while permitting the other pinion to remain stationary. This, it will be seen, will rotate disk e, and the direction and extent of its rotation will determine the time interval between the closing and the opening of the circuit. In practice the proper adjustment of this time interval is such as will just ignite the charge when the engine is running at its slowest speed. Now it will be obvious that when the speed of the engine is increased this time interval would ordinarily become less, because the angle of the arc between the point of closure and the point of opening of the circuit is traversed more quickly than before. Hence unless this shorter interval is compensated for the engine will skip explosions. It is therefore a part of this invention to provide for this necessary compensation. The increase in speed of the engine is accompanied, as usual, by an advance of the spark. This advance in the present instance is accomplished by turning the crank-arm k in a di-

rection to throw disk *e* in the opposite direction to which the shaft *a* is rotating. This allows cam *b'* to engage the springs at earlier points in its rotation. At the same time that disk *e* is advanced it will be seen that disk *f* is also advanced; but by reason of the difference in gearing the disk *f* advances more slowly and to a less extent than the disk *e*, with the result that at the new point of adjustment the arc between the points where the cam *b'* strikes a spring and where a cam *c'* strikes spring 10 is greater than before, and the time interval of the closed circuit remains substantially the same as before. This compensation continues throughout any advancing of the spark or increase of speed, and the reverse action takes place in decreasing the speed. Just what ratios the gearing shall have is best determined by experiment, but a proper ratio can readily be obtained by operating an engine through its range of speeds with various gears.

In the preceding description the circuit was traced for one cylinder of the engine only; but it will be obvious that the primaries of the four coils will be successively closed and opened by the improved device in the manner explained in connection with primary p^3.

While the invention has been described as applied to a four-cylinder engine, it is obvious that the same principle may be carried out with a single-cylinder or any multiple-cylinder engine. For a single cylinder only one of the springs 1 2 3 4 and its corresponding screw would be used; but the saving in consumption of battery brought about by my invention is most apparent in connection with a multiple-cylinder engine, where the circuit is closed a number of times during each rotation of the shaft and where the engine is running at high speed and the mechanical construction of the cams and springs is such that the dwell of the cam upon the spring is considerable, the battery is almost continuously on a closed circuit, and the use of my invention, which limits the time of closure to the time actually required for the spark, works a very considerable economy in the consumption of the battery.

It being desirable to have a clean sharp break of the circuit after the lapse of a definite time interval, and owing to the difficulty of accomplishing this with the same device that closes the circuit, the fact that I use a separate device to open the circuit after it has been closed is a valuable feature of the invention. I therefore claim a breaker associated with a maker of the circuit, regardless of the adjusting and compensating features of my invention.

The cams *c'* are preferably made of such length with respect to the cam *b'* that the latter will allow the spring with which it is in engagement to leave its contact-screw before spring 10 is allowed to close upon screw 11. This prevents the production of a second spark in the engine-cylinder immediately after the first, which would otherwise occur.

On account of the quick interruption of the primary circuit by means of cams *c'*, non-vibrator coils can be successfully used, and in that event a condenser will be placed across the contacts 9 and 11, as shown in dotted lines.

Having described my invention, I claim—

1. A circuit-controller for explosion-engines comprising a normally open circuit-maker and a normally closed circuit-breaker adapted to operate upon the same circuit, means whereby the same will be actuated successively by one shaft and means for simultaneously and unequally shifting the points in the rotation of the shaft where said devices shall be operated.

2. A circuit-controller for explosion-engines comprising a rotary shaft, two relatively fixed circuit-controlling elements, means carried by said shaft for actuating said elements respectively and in succession in each rotation of the shaft, and means for adjusting the relative positions of said elements with respect to each other and to the direction of rotation of the shaft whereby the time interval between the actuations of said elements will be approximately constant for all speeds of the shaft.

3. A circuit-controller for explosion-engines comprising a normally open circuit-maker and a normally closed circuit-breaker adapted to operate successively upon the same circuit and means for adjusting the time interval between the operations of said devices.

4. A circuit-controller for explosion-engines comprising a normally open circuit-maker and a normally closed circuit-breaker adapted to operate upon the same circuit, means whereby the same will be actuated successively from one shaft and means for adjusting the time interval between the operations of said devices.

5. A circuit-controller for explosion-engines comprising a normally open circuit-maker and a normally closed circuit-breaker adapted to operate upon the same circuit and means whereby the time interval between the operations of said devices will remain substantially constant for all speeds of the shaft.

6. A circuit-controller for explosion-engines comprising a normally open circuit-maker and a normally closed circuit-breaker adapted to operate upon the same circuit, means for simultaneously shifting the points in the rotation of the shaft where said devices shall be operated and means whereby the time interval between the operations of said devices will remain substantially constant for all speeds of the engine.

7. A circuit-controller for explosive-engines comprising a shaft, two cams thereon, two gear-segments concentrically mounted on

said shaft and each carrying a circuit-controller, said cams being adapted to respectively actuate said circuit-controllers and gearing engaging with the respective segments, said gearing being of such character that when actuated the segments will be moved through different arcs.

8. A circuit-controlling device consisting of a plurality of circuit-controllers arranged in succession around a rotary shaft and adapted to be actuated thereby and means for shifting all of them simultaneously forward or backward with respect to the direction of rotation of the shaft and at the same time altering the arc or arcs which separate them.

In witness whereof I subscribe my signature in the presence of two witnesses.

RICHARD VARLEY.

Witnesses:
FRANK S. OBER,
WALDO M. CHAPIN.