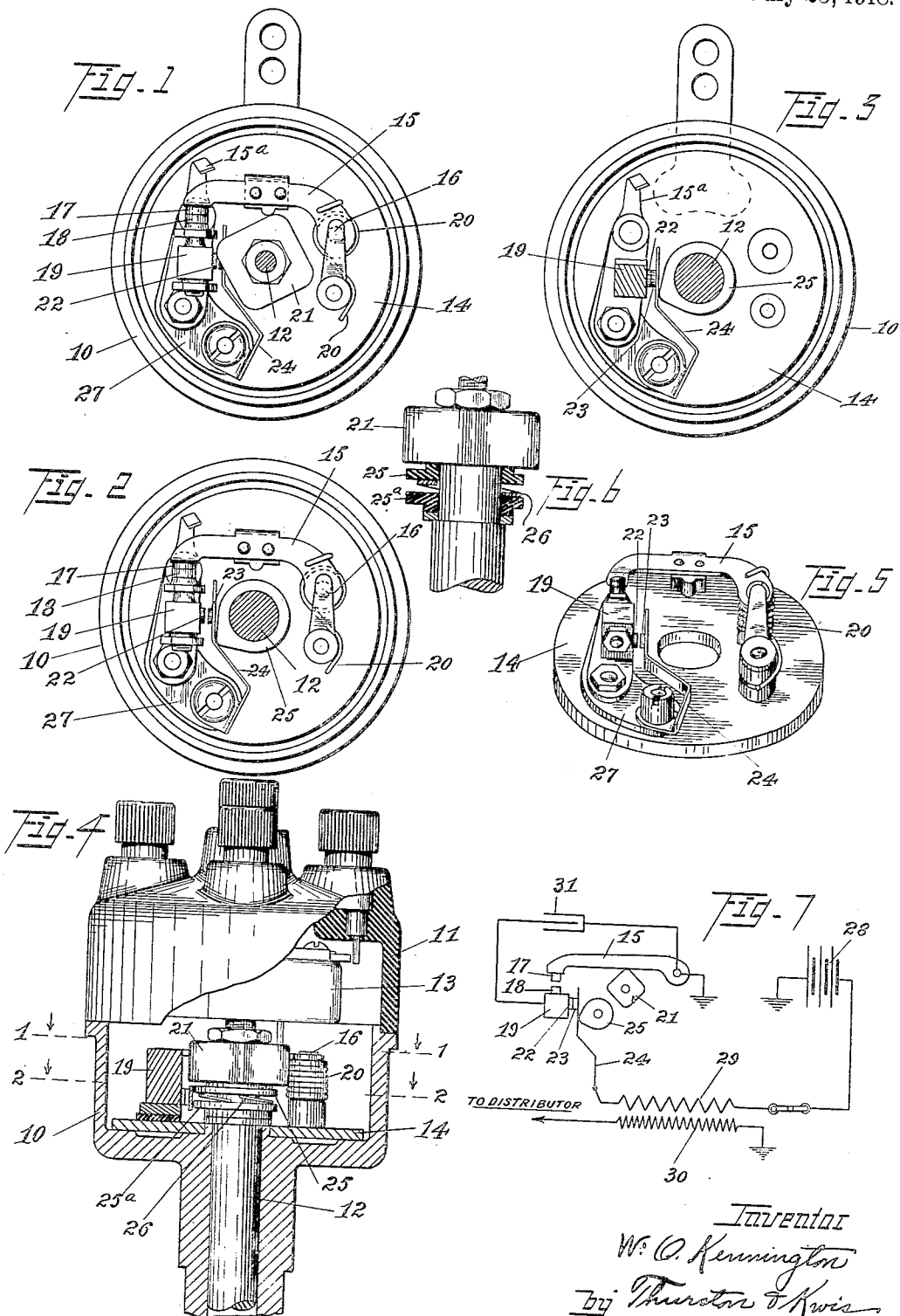


W. O. KENNINGTON.
 MEANS FOR CONTROLLING ELECTRIC CIRCUITS.
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Inventor
 W. O. Kennington
 by *Thurston & Kwois*
 Attorneys

UNITED STATES PATENT OFFICE

WILLIAM O. KENNINGTON, OF DETROIT, MICHIGAN, ASSIGNOR TO REMY ELECTRIC
COMPANY, OF ANDERSON, INDIANA, A CORPORATION OF INDIANA.

MEANS FOR CONTROLLING ELECTRIC CIRCUITS

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To all whom it may concern:

Be it known that I, WILLIAM O. KENNINGTON, a subject of the King of Great Britain, residing at Detroit, in the county of Wayne and State of Michigan, have invented a certain new and useful Improvement in Means for Controlling Electric Circuits, of which the following is a full, clear, and exact description.

This invention relates to a controlling means for electric circuits, especially those employed in connection with certain forms of motive means or prime movers such as internal combustion engines. The invention has particular utility in electrical apparatus employed on engine driven motor vehicles and especially in connection with ignition apparatus for such engines, although it is not necessarily confined to such use.

In certain types of electrical apparatus or electric circuits employing a battery as a source of current, such for example as ignition and lighting apparatus utilized on motor vehicles in association with an internal combustion engine employed as a prime mover, it is often desired that the circuit be automatically opened when the engine stops or comes to rest, to prevent the depletion of the battery and possible destruction or injury to other elements of the system. For example: In the so-called battery ignition systems wherein a storage battery either alone or in conjunction with a generator is employed as the source of current, unless the primary circuit is opened when the engine comes to rest, the battery will discharge through the primary circuit and may injure or destroy the induction coil which is always designed for an intermittent and not continuous or steady passage of current therethrough.

It is a well known fact also that when an internal combustion engine stops the crank shaft of the engine always turns backward through a portion of a revolution before coming to rest, due primarily to compression of gas in one or more of the cylinders.

In carrying out my invention I take advantage of this backward movement or what may be called "back kick" of the engine, in the control of the circuit or circuits by causing it to operate or cause the operation of a circuit controlling switch.

In the embodiment of my invention here shown this switch is in the primary ignition

circuit and may be and preferably is associated with the circuit breaker or timer for such circuit, said switch comprising in effect a pair of auxiliary contacts which are preferably in series with the main contacts of the circuit breaker, and are held or maintained closed during normal operation of the engine and are opened or permitted to open by the back kick or backward movement of the engine just before it comes to rest, so that said circuit will be opened regardless of whether the engine comes to rest with the main circuit breaker or circuit breaker contacts open or closed.

In the adaptation of my invention for the purpose above stated, and in its association with the circuit breaker, I provide on the shaft which operates the circuit breaker (and preferably also the distributor segment) not only the main cam which periodically opens and closes the primary circuit, but also an auxiliary cam held frictionally on the shaft in such a manner that said auxiliary cam closes the switch and maintains the circuit closed at the auxiliary contacts as long as the engine is in normal operation, said contacts of the switch and the cam being so arranged that the latter, after closing the switch, slips on the shaft or remains stationary, but when the engine crank shaft kicks back or turns backward through a portion of the revolution in coming to rest, said cam moves with the shaft permitting the auxiliary contacts to separate.

My invention may be briefly summarized as consisting in certain novel details of construction and combinations and arrangements of parts which will be described in the specification and set forth in the appended claims.

In the accompanying sheet of drawings showing my invention in the embodiment above briefly explained, Figure 1 is a sectional plan view of a circuit breaker equipped with my invention, the section being taken substantially along the line 1-1 of Fig. 4, looking in the direction indicated by the arrows; Fig. 2 is a similar view with the circuit breaker cam removed and the operating shaft in section, the section being taken just below said cam; Fig. 3 is a sectional plan view showing the main contacts and circuit breaker lever removed, this section being taken substantially along the line 3-3

of Fig. 4; Fig. 4 is a view partly in side elevation and partly in vertical section, of the circuit breaker and distributor; Fig. 5 is a perspective view of the breaker plate and main and auxiliary contacts; Fig. 6 is an enlarged detached view of certain parts with the auxiliary cam in section; and Fig. 7 is a diagrammatic view of a portion of a battery ignition system equipped with my invention.

Referring now to the drawings, 10 represents the circuit breaker casing and 11 the distributor cap which forms a part of the casing. The circuit breaker and distributor being shown in this case is one unitary structure, as is common with ignition apparatus, although the construction of the distributor or its association with the circuit breaker forms no part of the present invention. A shaft 12 which operates the circuit breaker, as well as the distributor segment 13 and auxiliary contacts or auxiliary switch in which my invention is directly involved, extends up into the casing as is shown in the drawings, particularly in Fig. 4, this shaft and the casing itself being ordinarily arranged in vertical position, although whether or not the shaft is vertical is quite immaterial to the invention. This shaft 12 will be driven by the engine through the usual or any desired transmitting mechanism. Located in the casing and in this case carried by a plate 14 at the base of the casing, are the main circuit breaker contacts which include a circuit breaker lever 15 pivoted at 16 and carrying at its free end a contact or contact point 17 which engages a stationary contact 18 carried by a post or stud 19 extending upwardly from the plate 14. The circuit breaker in this case, is closed by a spring 20 which engages the lever 16 and is positively opened by a cam 21 which is fixed to the shaft 12 in position to engage the lever 16. The cam as here shown is a four-point cam designed for a four-cylinder engine, it being understood that the number of points or cam projections on the cam will depend upon the number of cylinders of the engine for which the ignition apparatus is designed. A spring 15^a which in this case is bent up from flat stock is adapted to be engaged by the lever near the outer end thereof so as to prevent the lever being thrown too far by the action of the cam at high speeds.

The circuit controlling switch or auxiliary contacts previously referred to are also located in the casing and are below the main contacts and circuit breaker lever 15. These auxiliary contacts include a stationary contact or contact point 22 carried by the post 19, and a movable contact or contact point 23 which is carried by a leaf spring 24 supported by the breaker plate. This spring normally tends to move this contact 23 away

from the stationary contact 22 to open the circuit and is designed to be pressed inwardly toward the contact 22 so as to hold the contacts in engagement during the normal operation of the engine.

This switch is controlled by an auxiliary cam located beneath the main cam 21 adjacent the contact carrying spring 24. The auxiliary cam is mounted on the shaft 12 but is not fixed thereto but on the other hand has a friction fit on the shaft. To secure yielding or frictional driving action between the shaft and cam, this cam is preferably composed of two parts 25 and 25^a, between which is a spring washer 26 which tends to spread the cam members 25 and 25^a apart and hold them yieldingly or frictionally against a pair of oppositely disposed abutments or shoulders, one on the shaft directly beneath the cam element 25^a and the other on the lower side of the main cam 21. It is not essential that this cam be thus formed in two parts, and this construction is adopted solely for mechanical reasons. Each part of the cam 25—25^a is provided with a nose or cam point shown clearly in Figs. 2 and 3, and the parts are so located with respect to the spring 24 that as the shaft is revolved the cam will engage the contact spring 24 and bring the auxiliary contacts into engagement. The degree of friction of the cam on the shaft is such that the rotation of the shaft will cause the cam to close the switch or auxiliary contacts and after the switch is closed the cam is held stationary and will slip on the shaft, thus maintaining the circuit closed at this point as long as the engine is in operation. When, however, the engine stops and moves backward before coming to rest, as previously explained, the shaft 12 moves a few degrees in the reverse direction and during this backward rotation or backward movement the auxiliary cam moves with the shaft and permits the switch or auxiliary contacts to be opened. Thus, regardless of whether the engine stops with the main circuit breaker contacts in engagement, the circuit will be opened when the engine comes to rest. It will be observed in passing, that the spring 24 is so formed that it may be closed by the auxiliary cam 25—25^a, regardless of the normal direction of operation of shaft 12. This feature renders the device universal to the extent that it may be used with any design of engine, that is to say, whether the engine requires the shaft 12 to be rotated normally in one direction or the other.

In the embodiment of my invention here shown the post 19 carrying the contacts 18 and 22 and the spring 24 carrying the auxiliary contact 23, are all insulated from the breaker plate and from the casing by a strip of insulating material 27 which is secured to the face of the breaker plate.

By referring to Fig. 7, wherein I have shown conventionally or diagrammatically the circuit connections which may be employed advantageously, it will be seen that the main contacts of the circuit breaker and the auxiliary contacts of the controlling switch are connected in series relation in the primary circuit which includes a storage battery 28 and the primary 29 of an induction coil, the secondary 30 of which will be connected in the usual manner to the rotating segment of the distributor. In this instance one side of the battery is grounded while the other side of the battery is connected to one terminal of the primary coil 29, whose other terminal is connected to the contact carrying spring 24, the circuit being completed through the two sets of contacts by reason of the fact that the circuit breaker lever 15 is grounded as indicated. With circuit connections as here shown, it is necessary that the contact spring 24 as well as the post 19 carrying the stationary contacts be insulated from the casing and that the auxiliary cam 25—25^a be insulated or formed of insulating material. Preferably the two parts of this cam are formed of hard insulating material, such as fiber.

As shown in Fig. 7, the contacts of the circuit breaker are bridged by a condenser 31. Preferably there is no condenser across the auxiliary contacts 22, 23, for in that event the spark which is produced when the circuit is broken at the auxiliary contacts is too weak to cause ignition. However, the arrangement or disposition of condensers is a feature not material to my invention in its broadest aspects.

While I have shown one adaptation or specific use of my invention, I do not wish to be confined to the same, as the invention may be used to advantage in other circuits or for other specifically different purposes, and while I have shown a specific construction which in practice has proven to be very efficient, I do not desire to be confined to the exact details or arrangements shown, but aim in my claims to cover all changes, modifications and arrangements which do not involve a departure from the spirit and scope of my invention as expressed in the broadest of the appended claims.

Having described my invention, I claim:

1. In an electric circuit adapted to be employed in connection with an internal combustion engine, a switch, and a switch controlling device adapted to be operated by the engine and serving to cause the switch to be operated when the crank shaft of the engine turns backward in coming to rest.

2. In an electric circuit adapted to be employed in connection with an internal combustion engine, a switch, and a switch controlling device operated by the engine and serving to maintain the switch closed when

the engine is in normal operation and to be shifted so as to cause the opening of the switch when the crank shaft of the engine turns backward through a portion of the revolution in coming to rest.

3. In an electric circuit adapted to be employed in connection with an internal combustion engine, a switch, and a switch controlling device, said device being operatively connected to the engine and serving to hold the switch closed during normal engine operation and to permit the switch to open when the crank shaft of the engine turns backward through a portion of a revolution in coming to rest.

4. In an electric circuit adapted to be employed in connection with an internal combustion engine, a controlling switch comprising a movable switch member normally tending to move to open position, and a switch controlling device operatively connected to the engine and serving to shift said movable switch member and to hold the switch closed during normal engine operation, and to be moved away from said switch member so as to permit the switch to open when the crank shaft of the engine turns backward when the engine is coming to rest.

5. In an electric circuit adapted to be employed in connection with an internal combustion engine, a circuit controlling switch, a shaft adapted to be rotated by the engine, and a switch operating member having a friction fit on said shaft and adapted to be automatically displaced relatively to said switch when the engine stops running.

6. In an electric circuit adapted to be employed in connection with internal combustion engines, a circuit controlling switch comprising a stationary contact and a movable switch member normally tending to move to open position, a shaft adapted to be driven by the engine, a circuit controlling cam having a frictional fit on the shaft, said cam being arranged adjacent said switch member and serving to maintain the switch closed during normal engine operation, and to move away from said switch member so as to permit the same to open when the engine comes to rest.

7. In combination in an electric circuit adapted to be employed in connection with internal combustion engines, a circuit controlling switch, a shaft adapted to be driven by the engine, and a switch controlling device which is stationary while the engine is running and which turns with the shaft when the engine starts and when it comes to rest.

8. In an electric circuit adapted to be employed in connection with an internal combustion engine, a circuit controlling switch including a movable switch member, a shaft adapted to be driven by the engine, a circuit controlling device adapted to engage

and disengage said movable switch member so as to cause closure and opening of the switch, said device having a frictional driving engagement with the shaft and being held stationary after it causes the closure of the switch and moving away from said switch member so as to permit the switch to open upon the reverse movement of the shaft when the engine is coming to rest.

9. In an ignition circuit for internal combustion engines, a main circuit breaker adapted to be operated periodically, a switch in series with the circuit breaker, and a switch operating device controlled by the engine and operating independently of changes in engine speed and serving to close and maintain the switch closed during normal engine operation and to permit or cause the switch to open when the crank shaft of the engine comes to rest.

10. In ignition apparatus for internal combustion engines, a pair of main circuit breaker contacts, a cam for controlling the same, a pair of auxiliary contacts, a cam for controlling the same, a shaft on which both cams are mounted, the first named cam operating the main contacts periodically and the second named cam serving to close the auxiliary contacts when the engine starts and to cause the opening of the same when the engine stops.

11. In ignition apparatus for internal combustion engines, a main circuit breaker, a switch having contacts in series with the circuit breaker contacts, main and auxiliary cams for operating the circuit breaker and switch, and a shaft on which both cams are mounted, said switch being maintained closed by the auxiliary cam only while the engine is running.

12. In ignition apparatus for internal combustion engines, a main circuit breaker, a switch having contacts in series with the circuit breaker contacts, main and auxiliary cams for operating the circuit breaker and switch, and a shaft on which both cams are mounted, said auxiliary cam maintaining the auxiliary contacts closed while the engine is running and being moved out of operating relation with said switch when the engine comes to rest.

13. In ignition apparatus for internal combustion engines, a circuit breaker, a switch comprising auxiliary contacts in series with the circuit breaker contacts, a shaft, a cam on the shaft for operating the circuit breaker, and an auxiliary cam on said shaft for operating the switch and having a friction fit on said shaft.

14. In ignition apparatus for internal combustion engines, a circuit breaker, a switch comprising auxiliary contacts in series with the circuit breaker contacts, a shaft, and cams on the shaft for operating the circuit breaker and switch, the circuit

breaker cam being fixed to the shaft and the other cam having a friction fit on the shaft whereby it may be held stationary during normal engine operation.

15. In ignition apparatus for internal combustion engines, a casing, a circuit breaker in the casing, and a switch including movable and stationary contacts in said casing and in series relationship with the circuit breaker, a shaft extending into the casing and having two cams, one fixed to the shaft and serving to control the circuit breaker and the other frictionally mounted on the shaft and serving to close the switch when the engine starts and to maintain the same closed during normal engine operation and to open the switch when the engine stops.

16. In a circuit breaker, a casing, main circuit breaker contacts and auxiliary contacts in the casing, a shaft extending into the casing, a main cam and an auxiliary cam mounted on the shaft for operating the circuit breaker and auxiliary contacts the main cam being rigidly and the auxiliary cam loosely mounted on the shaft, and yieldable means engaging the auxiliary cam for causing frictional driving engagement between said cam and the shaft.

17. In a circuit breaker, a casing, main and auxiliary contacts, a shaft extending into the casing, a main cam on the shaft for controlling the main contacts, an auxiliary cam composed of two parts loosely mounted on the shaft for controlling the auxiliary contacts, and yieldable means between said parts for forming frictional driving engagement between said auxiliary cam and the shaft.

18. In an ignition circuit for internal combustion engines, a primary circuit, a battery therein, a periodically actuated circuit breaker, and means for interrupting the primary circuit irrespective of the closed or open position of said circuit breaker after the engine has come to a position of rest, said means being adapted to reestablish the said primary circuit upon an initial forward rotation of the engine.

19. In an electric circuit for the ignition systems of internal combustion engines; a timing device including engine actuated contact members controlling said circuit; and means including engine actuated contact members for controlling said circuit upon reverse rotation of said engine.

20. In an electrical circuit for ignition systems of internal combustion engines, a timing device including contact members controlling said circuit during one direction of rotation of said engine; contact members for controlling said circuit upon a reverse rotation of said engine, and a common engine driven means for actuating both of said contact members.

21. In an electric circuit for ignition systems of internal combustion engines, a timing device including engine driven contact members for closing the circuit; an engine driven cam for opening said contact members to open the circuit; and means including contact members operable upon reverse

rotation of the engine for rendering said first mentioned contacts ineffective when opened by said cam.

In testimony whereof, I hereunto affix my signature. 10

WILLIAM O. KENNINGTON.