Aug. 2, 1932. A. G. KARKAU 1,869,814

IGNITER

Filed Sept. 21, 1928

FIG. 3

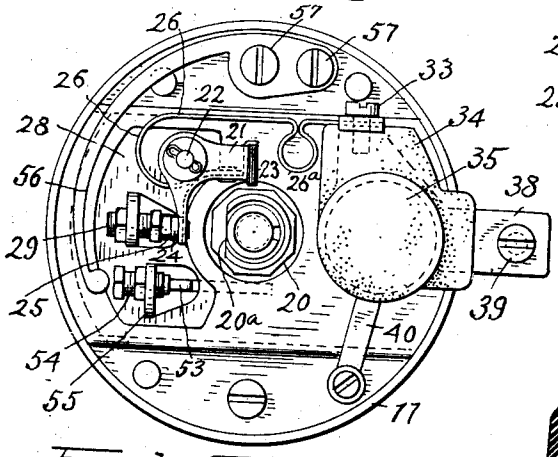


FIG. 5

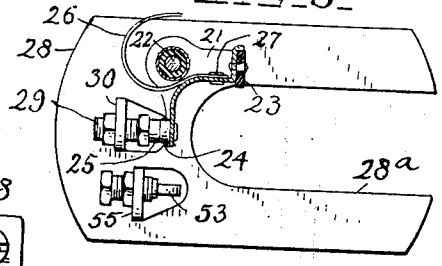


FIG. 2

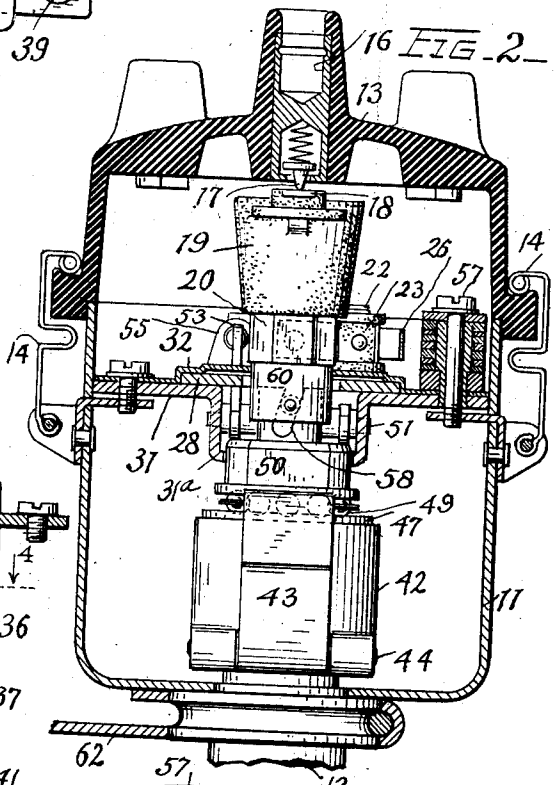


FIG. 1

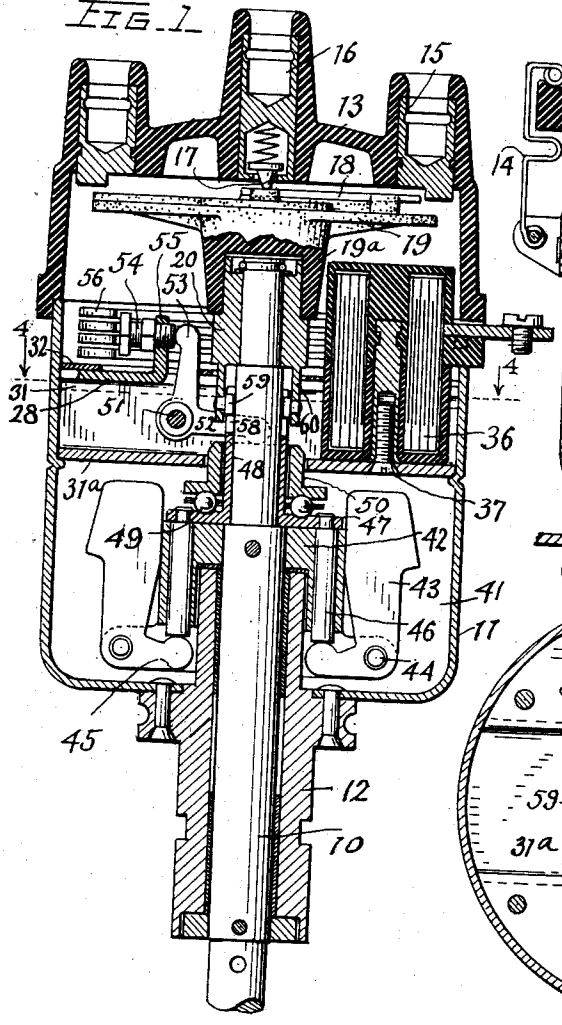
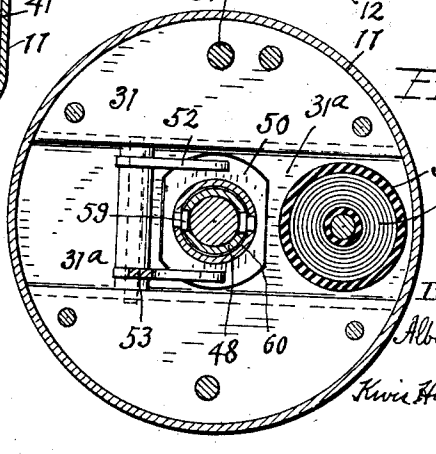


FIG. 4



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Patented Aug. 2, 1932 1,869,814

UNITED STATES PATENT OFFICE

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IGNITER

Application filed September 21, 1928. Serial No. 307,362.

This invention relates to igniters for internal combustion engines and has particular reference to the circuit breaker which is usually associated with a timer or distributor and formed as a unit therewith. This application is a continuation in part of my prior application Serial No. 229,891, filed October 31, 1927.

The usual igniters, if satisfactory at low speed of engine operation are unsatisfactory at high speeds due to the fact that the dwell of the contacts of the circut breaker, i. e., the period that they are in contact at the higher engine speeds is not sufficiently long to enable the current to build up in the primary of the ignition coil with which the igniter is employed. The result is that while the ignition apparatus as a whole will produce a hot spark at relatively low engine speeds it produces a lean spark at the higher speeds, the current drawn from the battery at the higher speeds being a great deal less than at the lower speeds. In consequence, full power of the engine is not obtained at high speeds due to incomplete combustion of the fuel in the engine cylinders.

Speed responsive means in the form of governors are commonly employed to automatically advance the spark generally by turning the cam which operates the circuit breaker, but devices of this kind do not solve the problem here involved due to the fact that the dwell or the closed period of the contacts relative to the open period of each cycle of operation is not increased, but, on the other hand, it is actually decreased due to the inertia of the breaker lever and to the so-called circuit breaker "bounce" which is the tendency for the breaker lever to be thrown outward by the cam a greater distance at high speeds of rotation of the cam than at relatively low speeds. While attempts have been made to overcome these difficulties, the means employed for accomplishing the result have proven to be unsatisfactory commercially.

The principal object of the present invention is to provide a timer wherein satisfactory ignition is obtained at high engine speeds as well as at low engine speeds and wherein the current drawn from the battery or other source of current is substantially uniform at all speeds.

I accomplish this result with my improved igniter by a number of improvements, among which is the mounting of the breaker on a support preferably in the form of a slide which is moved laterally by a governor as the speed increases, the effect being to move the rubbing block or portion of the breaker lever which the cam engages laterally or substantially tangentially of the cam so that the time of ignition will be advanced and the angular movement of the cam effective to separate the contacts or to open the breaker is reduced relative to the angular movement during which they are closed.

As another improved feature, the circuit breaker spring is so arranged that its tension and, therefore, its tendency to close the contacts after they have been opened by the cam is increased as the engine speed increases, thereby overcoming the tendency for reduced dwell, due to the circuit breaker bounce and to the inertia of the breaker lever.

Additionally, I may increase the spark advance over that which is obtained by the lateral movement of the slide carrying the breaker by connecting the governor which shifts the slide also to the cam so that at the same time that it moves the slide laterally outward it turns or advances the cam on the shaft so that the full range of spark advance is obtained automatically in addition to the increased contact dwell.

Still another feature is employed by me to great advantage and that is the arrangement of the parts so that the circuit breaker spring is utilized to yieldingly and lightly

resist the outward movement of the governor weights at the relatively low engine speeds so that a spark advance is obtained even at relatively low speeds from zero speed before the main governor spring, which of necessity has considerable stiffness, takes effect.

All these parts and features are so associated and arranged as to provide an igniter of very practical and durable construction and one which results in a substantially uniform consumption of current at all speeds and, therefore, one which operates as efficiently at high speeds as at low speeds.

The invention may be further 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 wherein the preferred embodiment is illustrated,

Figure 1 is a vertical sectional view through the igniter;

Fig. 2 is another vertical sectional view taken at right angles to the section of Fig. 1;

Fig. 3 is a top plan view with the distributor cap and the distributor arm removed;

Fig. 4 is a transverse sectional view taken substantially along the line 4—4 of Fig. 1; and

Fig. 5 is a detached plan view of the slide which carries the circuit breaker.

In the drawing, 10 represents the igniter shaft which is usually vertically supported and is adapted to be driven by the engine in the usual manner. The shaft extends into a cup-shaped housing 11, preferably stamped from sheet metal, and secured at the bottom to a bearing sleeve 12 in which the shaft 10 is rotatably supported.

At the top of the housing 11 is the usual distributor cap 13 which can be removed but, in this instance, is held in place by pivoted clips or fingers 14. As usual, this distributor cap is provided around its periphery with equally spaced terminals 15, the number of which will depend upon the number of cylinders of the engine and which are adapted to be connected to the spark plugs thereof, and it is provided with a central terminal 16 which is usually connected to the secondary of the ignition coil, this terminal having at the bottom a contact 17 which engages, at a point in line with the axis of shaft 10, a rotary distributor contact strip 18 carried by a distributor arm 19 which is rotated by the shaft 10 and is supported in a manner to be explained.

Fitted onto the reduced upper end of shaft 10 is a circuit breaker cam 20, which, as well as the distributor arm 19, is rotated by the shaft. The cam has at the top a flat-sided or otherwise non-circular portion 20*a* on which is fitted a skirt-like portion 19*a* of the distributor arm 19 so that the distributor arm is supported by the cam in a manner such that the cam and distributor arm rotate together but at the same time the distributor arm can be slipped off of the cam when desired. The cam may, if desired, be pinned or otherwise fixed to the upper end of the shaft, as is the case when the automatic spark advance is obtained solely by the lateral movement of the slide carrying the circuit breaker, but in the preferred embodiment of the invention the automatic spark advance is obtained partly by moving the slide laterally and partly by turning the cam on the shaft, both movements being imparted simultaneously by the governor to be referred to. In the latter event, and as here illustrated, the cam does not have a fixed position on the shaft but is driven by the latter through a connection, to be explained, which will turn the cam slightly on the shaft as the speed of the engine and of the shaft 10 varies. It will be understood, of course, that the cam will have as many so-called points as there are cylinders of the engine, with which the igniter is used, an eight point cam being here shown.

In the plane of the cam and arranged to be operated thereby is my improved circuit breaker which includes a breaker lever 21, in this instance in the form of a bell crank, pivoted intermediate its ends on but insulated from a pin 22 and provided at one end with a so-called rubbing block 23 formed of durable insulating material, which block is periodically engaged and moved outward by the cam 20 so as to rock the lever. The lever 21 is provided at its other end with a contact 24 which is adapted to engage what is normally termed the stationary contact 25.

The breaker lever 21 is preferably formed from a stamping and is in channel shape and the two arms of the bell crank are preferably of 1 to 1 ratio in length so that the rubbing block at the end of one arm and the contact adjacent the end of the other arm are at substantially equal distances from the pivotal axis of the lever. This novel form of the lever is desirable since it has the advantage that the wear on one part, i. e., on the contact or rubbing block will have less effect on the other part than would be the case if these parts were materially different distances from the pivotal axis of the lever as in conventional designs wherein a straight lever pivoted at one end is employed.

The breaker lever 21 is engaged by a spring 26 which tends to keep the contacts in engagement and closes the breaker after each opening operation by the cam. This spring is preferably in the form of a flat leaf spring peculiarly formed and mounted, one end of the spring being attached to the lever at 27 by a rivet or otherwise.

As igniters are usually constructed, the circuit breaker is stationarily mounted in the

housing but in accordance with the present invention both the breaker lever 21 and the contact 25 are mounted on a movable support, in this instance in the form of a slide 28, which is mounted in a guideway for lateral sliding or linear movement at right angles to the cam axis so that the inner end or cam-engaging portion of the rubbing block 23 will be moved in a straight line substantially tangentially of the cam when the slide is moved laterally by the governor. Accordingly, the pin 22 which pivotally supports the breaker lever 21 is fixed to and extends up from the slide 28 and the contact 25 is, in this instance, mounted upon the inner end of a screw 29 extending through and adjustably mounted in a lip 30 which is struck up from the slide. The contact and screw can be held in any adjusted position by a lock nut, such as illustrated, or other suitable means.

The slide 28 is slidingly supported on a support, in this instance in the form of a partition 31 extending across the housing 11, and secured to this partition and extending over the slide is a top plate 32 having a pair of parallel shoulders 32*a* which form guides for the opposite parallel edges of the slide, this top plate being cut away so as to provide a clearance for the parts of the breaker which project therethrough as illustrated in Fig. 3. The slide itself has a cutaway portion 28*a* in the form of a U to provide a clearance between the slide and the cam and other parts so that the latter will not interfere with the movement of the slide.

One end of the spring 26, as clearly stated, is attached to the breaker lever carried by the laterally movable slide 28 but the opposite end of the spring is anchored on or attached to a stationary part by means of a screw 33. This stationary part to which the fixed end of the spring is attached is, in this instance, an extension 34 of an insulating case 35 for a condenser 36, which is preferably employed to bridge the contacts of the breaker, so as to minimize sparking at the contacts. This condenser and its housing are attached by a screw 37 to the bottom of a trough-like depression in the partition member 31, the condenser extending up freely through the U-shaped slot 28*a* in the slide shown in Fig. 5. It will be obvious that since one end of the spring is attached to the laterally movable breaker lever and the other to a fixed point, the tension of the spring and therefore the force which it exerts on the lever are increased as the slide moves laterally outward, the advantage of which will be explained more fully later. I prefer to provide between the ends of the spring a loop 26*a*, as I find that by the provision of such a loop there is little likelihood of the spring breaking by the constant changing of the tension between the fixed and movable ends of the spring as the slide 28 moves in and out with changes of engine speed. In fact I find that without an expedient of this kind, due to crystallization or other causes, the spring has a tendency to break in the curved part a short distance from the point of attachment with the breaker lever but with the loop provided in the straight portion of the spring, the life of the spring is indefinite, since the loop yields somewhat and allows the spring to lengthen slightly as the slide moves outward and prevents too great a stress being imposed on the curved part which extends part way around the breaker lever. The spring 26 is as before stated, a flat leaf spring which is cut to length from flat stock and before tempering the holes are punched in its ends and it is given the desired shape including the straight portion with the loop and with the curved portion or return bend where it passes around and is attached to the circuit breaker lever and it is then tempered while held in that shape. Before the spring is applied it is substantially of the shape shown in the drawing except that the curved part adjacent the end which is adapted to be attached to the lever is slightly more open.

Before passing to the automatic control of the slide or of both the slide and cam, it might be mentioned that a terminal strip 38 is preferably embedded in the condenser case 35 and its extension 34, one end of this strip extending outwardly from the igniter housing and having a terminal screw or binding post 39 for attachment to the primary of the ignition coil. This terminal strip extends over to and is electrically connected to the breaker spring 26, which carries the primary current to the insulated breaker lever, the stationary contact of the breaker being grounded. One side of the condenser 36 is connected also to the terminal strip 38, the other side of the condenser being connected to ground by a conductor 40.

Taking up now the automatic control, it will be observed that I provide in the lower compartment 41, formed between the base of the housing 11 and the partition 31 a centrifugal governor consisting of a governor body 42, pinned or otherwise secured to the shaft 10 and a pair of weighted arms 43 connected at their lower ends by pins 44 in bifurcations of the lower part of the governor body. The weights or weighted arms 43 have at their lower ends inwardly extending arms 45 which engage the lower ends of a pair of pins 46 slidable vertically in the governor body 42, which pins have reduced upper ends attached to a flange 47 of a sleeve 48 which surrounds the shaft and is slidable vertically thereon. It is to be understood that the governor, the pins 46 and the sleeve 48 rotate with the shaft and as the governor weights move outwardly, the pins 46 and the sleeve 48 move upwardly. This upward movement of sleeve 48 is transmitted by means of a series of balls 49 to a

non-rotating sleeve 50 which surrounds the sleeve 48 and extends up through the base of the trough-like depression 31*a* of the partition 31. As will be observed by reference to Fig. 4, the sleeve 50 is non-circular in shape and extends through a correspondingly shaped opening in the base of the trough in the partition so that this sleeve, while it will be elevated by the upward movement of the inner sleeve 48 and of the balls 49 it will be held from rotation. The flange of sleeve 48 and the end of sleeve 50 are provided with race-way grooves which receive the balls 50 the latter being spaced apart by a ball retainer or spacer such as commonly employed in annular ball bearings.

The upward movement of the sleeve 50 imparted by the governor weights is transmitted to the slide 38 by a bell-crank lever pivoted on a pin 51 extending between the sides of the trough 31*a*, this bell-crank having two arms 52 which straddle the shaft and engage the top of the sleeve 50 as best shown in Figs. 1 and 4, and having an upstanding arm 53 which extends up freely through the slide 28 and through the cover plate 32 and engages the inner end of an adjustable screw 54 mounted in an upturned lip 55 of the slide 28. This screw may be adjusted and by means of a lock nut secured in adjusted position.

The outward movement of the governor weights and the outward lateral movement of the slide 28 are yieldingly resisted primarily by one or more springs 56, a series of springs being here shown in the form of punchings, these springs being arc-shaped and at their free ends adapted to engage the head of the screw 54, as shown in Figs. 1 and 3, the opposite ends of the springs being secured to the partition 31 and cover plate 32 by one or more screws 57.

Fairly stiff springs are required to restrain the outward movement of the governor weights after a certain speed is reached and after the weights have moved outwardly some distance from their innermost position against the governor body illustrated in Fig. 1, but I find that springs of a stiffness suitable for high and moderately high speeds of operation are not suitable for comparatively low speeds. Therefore, I so mount the springs 56 that when the engine is stationary, the free ends of the springs do not engage the head of the screw 54 and for the low engine speeds, I rely upon the breaker springs 26 to restrain the outward movement of the weights, very little spring action then being required. Thus this spring 26 not only closes the breaker but inasmuch as one end of this spring is anchored on the stationary part while the other is connected to the laterally movable breaker lever, at the slower engine speeds and until the governor weights move outwardly a certain amount, this spring 26 serves as a governor spring, since the tendency of the spring is to yieldingly resist the outward lateral movement of the slide 28. A still further function of this spring is to eliminate all loose play between the slide 28 and the several parts which connect it to the governor weights.

As stated previously, it may be desirable to obtain the full range of spark advance automatically, that is to say a greater range than that which is attainable by movement of the circuit breaker laterally by means of the governor. In that event, the governor is utilized to cause additional spark advance by turning the cam on the shaft as well as moving the circuit breaker laterally. This is accomplished by providing in the upper part of the sleeve 48, which the governor elevates, spiral slots 58, which slots are engaged by the inner ends of pins 59 carried by a skirt or downwardly extending flange 60 formed on the bottom of the cam 20. In consequence, since the cam is held from moving upwardly on the shaft, the upward movement of the sleeve 48 causes through the instrumentality of the spiral slots 58 and pins 59, the cam to be turned on the shaft to an extent depending upon the speed of the engine. The increment of spark advance obtained in this fashion for a given increase in engine speed may be controlled by the degree of inclination of the slots 58.

If desired, provision may be made for retarding or advancing the spark manually in any of the usual ways as by turning the housing 11 relative to the shaft and to the cam and distributor arm which it carries. For this purpose, I show attached to the bearing sleeve just beneath the housing 41 an arm 62 by which the manual spark adjustment, if one is desired, may be made.

The operation of the igniter is as follows: When the engine is stationary the parts occupy the relative positions shown in the drawing with the weights inward against the governor body and the slide in its innermost position, the rubbing block then occupying the position with reference to the cam axis substantially as shown in Fig. 3. When the engine is started and its speed increases, the weights move outwardly and the slide 28 carrying the breaker begins to move outward, the first outward movement being opposed by the spring 26 and afterwards by both the spring 26 and the relatively stiff springs 56. This lateral movement of the slide moves the rubbing block of the breaker lever in a straight line substantially tangentially of the cam, the effect being to cause an earlier separation of the contacts, i. e., an advance in the time of ignition and also a quicker closing of the contacts since they are held separated by the cam for a smaller angular movement than is the case when the rubbing block occupies the position relative to the cam shown in Fig.

3; that is to say the effect in each cycle of operation is to increase the period of closure of the circuit breaker relative to the period that they are separated in degrees of angular movement of the cam. The result is that at the higher speeds of engine operation the dwell is long enough to enable the current to build up in the primary of the ignition coil and throughout the range of speed of the engine the ignition apparatus will draw about the same amount of current from the battery or other source, and as hot a spark is produced at high speeds as at low speeds of engine operation. Furthermore, the increase in the closure period relative to the open period in degrees of cam movement is enhanced by reason of the fact that at high speeds the rubbing block is moved outwardly a less distance than at low speeds, and also because of the fact that the breaker spring 26 is under greater tension at high speeds than at low speeds, thus successfully overcoming the tendency heretofore existing for the rubbing block to be thrown outwardly a greater distance at high speeds than at low speeds.

The spark advance obtained by the lateral movement of the slide may be used alone without any additional automatic spark-advancing means. The additional spark advance, if any is desired, may be obtained manually, but as pointed out above if it is desired that the full range of spark advance be obtained automatically this can be accomplished by having the governor, by the means such as herein illustrated or equivalent means, act on the cam to advance it on the shaft at the same time that the governor moves the slide and circuit breaker laterally to give a certain degree of spark advance as well as increased contact dwell.

It will be seen, therefore, that automatic spark advance may be obtained along with increased contact dwell solely by the lateral movement of the circuit breaker and of the slide supporting it or jointly by that method and by the rotation of the cam on the shaft, and I, therefore, do not wish to be confined in my claims to the use of both methods, although both are desirable in some instances.

Likewise, I do not wish to be confined to the specific means herein disclosed for transmitting movement from the governor to the slide carrying the breaker, although the mechanism herein illustrated is preferred since practice has demonstrated that it is very effective, in the way of accuracy, long life and general dependability.

Having thus described my invention, I claim:

1. An igniter comprising a rotary element having a cam, a circuit breaker composed of a pair of contact members one adapted to be operated by the cam and a common support for the two elements of the breaker movable bodily in a lateral direction.

2. An igniter comprising a rotary element having a cam and a circuit breaker adapted to be operated by the cam and a movable support for the breaker by which the cam engaging portion of the breaker may be moved laterally in a straight line.

3. In an igniter a rotary element having a cam, a circuit breaker adapted to be operated thereby and a laterally movable slide on which the circuit breaker is mounted.

4. In an igniter a rotary element having a cam, a circuit breaker including a breaker lever adapted to be shifted by the cam, and centrifugally operated means for moving the cam engaging portion of the lever in a straight line substantially tangentially of the cam.

5. In an igniter a rotary element having a cam, a circuit breaker adapted to be operated by the cam and having a movable support, and speed responsive means for automatically shifting the support so that the cam engaging portion of the breaker moves laterally in a straight line.

6. In an igniter a rotary element having a cam, a circuit breaker having a lever adapted to be rocked by the cam, a slide on which the lever is mounted and centrifugally operated means for moving the slide so that the cam engaging portion of the lever is given a lateral linear movement.

7. An igniter comprising a rotary element having a cam, a circuit breaker including a member adapted to be operated by the cam, a movable support for said breaker member mounted for straight line movement, and a spring serving to close the breaker and anchored on a stationary part.

8. An igniter comprising a rotary element having a cam, a circuit breaker adapted to be operated thereby, a slide carrying the breaker mounted for straight line movement, and a spring connected to the movable member of the breaker and anchored on a stationary part.

9. An igniter comprising a rotary element having a cam, a circuit breaker having a lever adapted to be operated by the cam, a movable support for the lever, and a flat spring connected at one end to the lever and at its other end to a stationary part and having two portions which are in substantial alignment and connected by a portion which will permit the spring to yield lengthwise.

10. An igniter comprising a rotary element having a cam, a circuit breaker adapted to be operated by the cam, a movable support for the breaker, and a leaf breaker spring connected at one end to the breaker lever and at its other end to a stationary part and provided with a substantially straight portion having between its ends a loop.

11. An igniter comprising a rotary element comprising a cam, a circuit breaker with a lever adapted to be operated by the cam, the

lever having a movable support and a flat breaker spring attached to one end to a stationary part and at its other end to the breaker lever and having a substantially straight portion and a curved portion and in the substantially straight portion having a loop whereby the spring may yield lengthwise as the breaker support is moved.

12. In an igniter a rotary element having a cam, a circuit breaker, a governor for obtaining automatic spark advance, and a spring which serves to close the contacts of the breaker and also as a governor spring.

13. An igniter comprising a rotary element having a cam, a circuit breaker adapted to be operated by the cam, a movable member carrying the breaker, centrifugal means connected to said member, and a spring which functions to both close the contacts of the breaker and to yieldingly resist the action of the centrifugal means on the said movable member.

14. In an igniter a rotary element having a cam, a circuit breaker adapted to be operated thereby, a governor rotated by the rotary element and serving to move the cam and breaker relatively to obtain an automatic spark advance, and a plurality of springs including a weak spring which resists the movement of the governor at relatively low engine speeds, and a relatively stiff spring which comes into action to oppose the movement of the governor when a predetermined speed is reached.

15. In an igniter a rotary element having a cam, a circuit breaker, a movable support carrying the circuit breaker, a governor for shifting the support so as to move the cam engaging portion of the breaker laterally, a spring for closing the contacts of the breaker and for opposing the outward movement of the support and the outward movement of the governor weight or weights, and a relatively stiff governor spring which comes into action when a certain speed is reached.

16. In an igniter a rotary element having a cam, a circuit breaker having a movable support adapted when shifted to move the cam engaging portion of the breaker laterally and speed responsive means connected both to said support and to the cam.

17. In an igniter a rotary shaft having a cam and a breaker with a laterally movable cam engaging portion, and a governor which serves to give automatic spark advance by moving both the cam and shaft relatively and the cam and cam engaging portion of the breaker relatively.

18. In an igniter a rotary shaft having a cam, a circuit breaker adapted to be operated thereby, a laterally movable slide carrying the circuit breaker, and a governor adapted to be rotated by the shaft and operatively connected to both the slide and the cam so as to move the slide laterally outward and to turn the cam on the shaft as the speed increases.

19. A circuit breaker spring comprising a flat resilient member consisting of a substantially straight shank portion with a return bend, the shank portion having a part which permits the spring to yield longitudinally.

20. A leaf spring for a circuit breaker having a substantially straight portion provided with a loop and a curved portion in the form of a return bend.

In testimony whereof, I hereunto affix my signature.

ALBERT G. KARKAU.