

Sept. 2, 1947.

C. MESSERSCHMIDT

2,426,784

IGNITION APPARATUS

Filed June 2, 1945

3 Sheets-Sheet 1

Fig. 1.

Fig. 7.

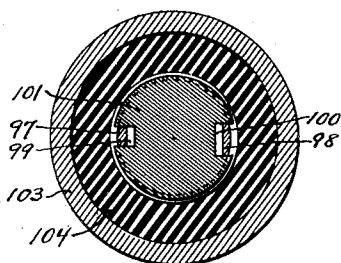
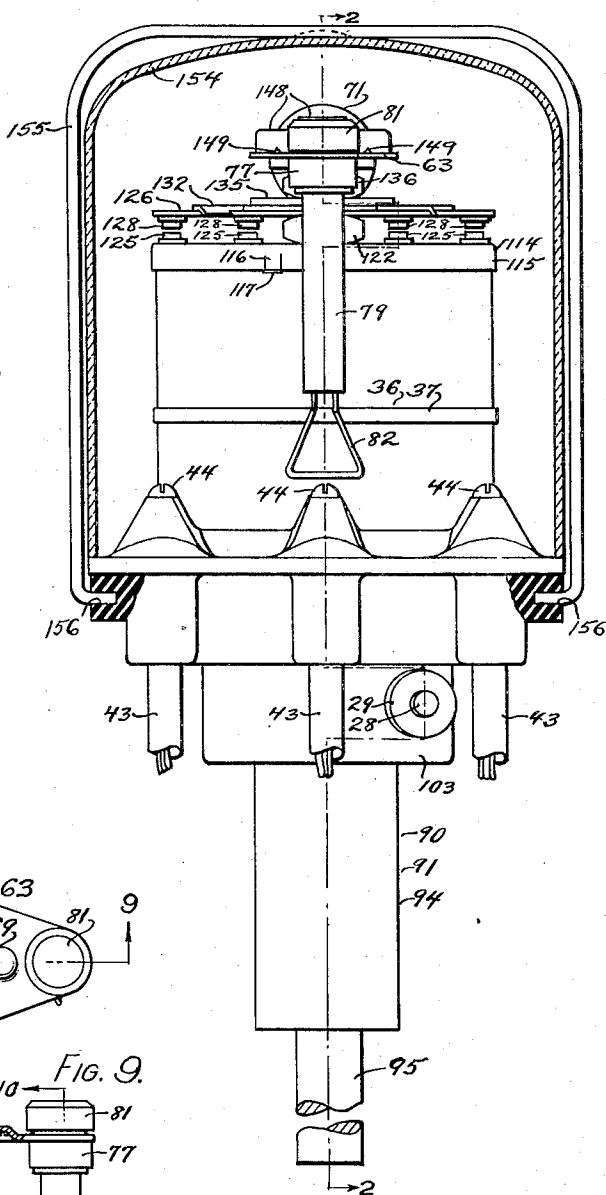
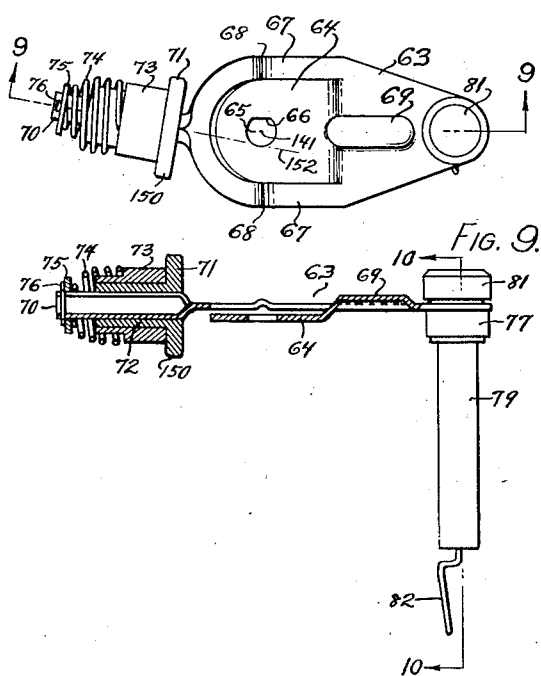


FIG. 8.

FIG. 9.



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3 Sheets-Sheet 2

FIG. 5.

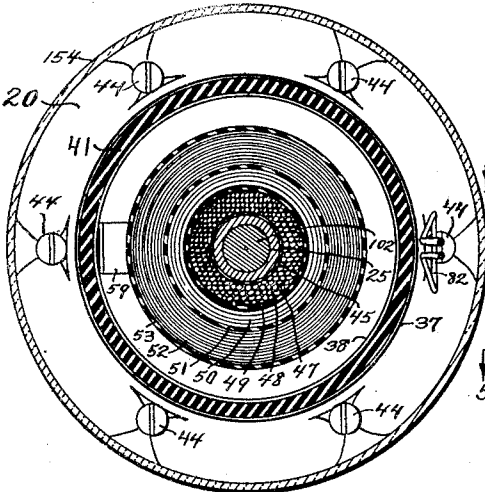


FIG. 4.

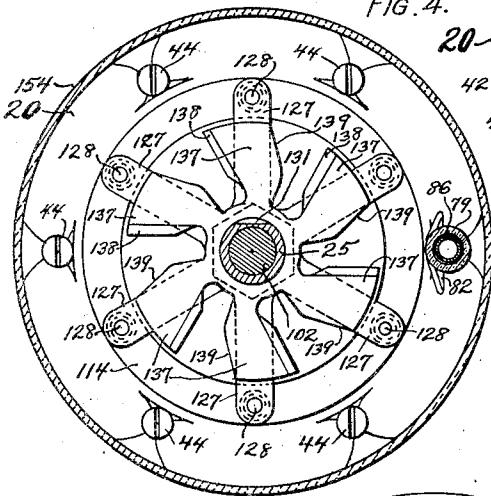


FIG. 3.

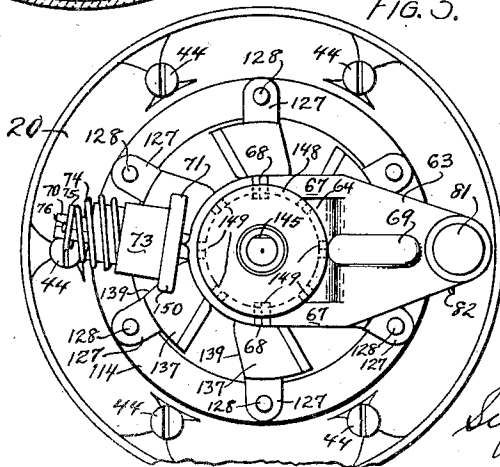


FIG. 2.

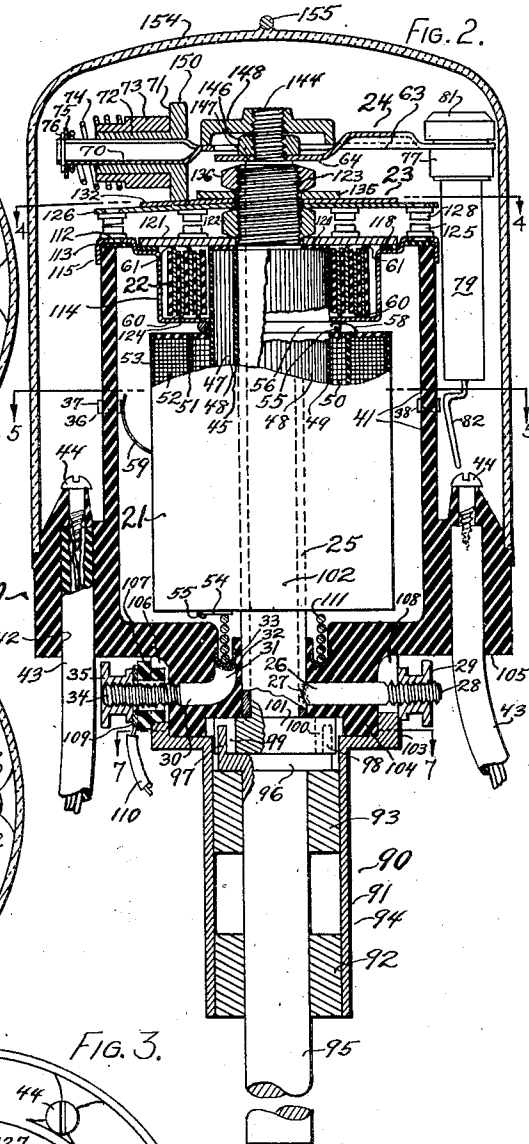
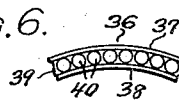


FIG. 6.



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2,426,784

IGNITION APPARATUS

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4 Claims. (Cl. 200—31)

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This invention relates to improvements in ignition apparatus and more particularly to ignition apparatus for internal combustion engines.

One object of this invention is to provide an improved ignition apparatus of the general type set forth in my Patent No. 2,377,353 of June 5, 1945.

Another object of this invention is to provide an improved ignition apparatus provided with improved means which visibly indicates each time a spark passes to a spark plug of the engine.

Another object of this invention is to provide an improved ignition apparatus of improved simplicity and reliability of operation.

With the above and other objects in view, as will appear to those skilled in the art from the present disclosure, this invention includes all features in the said disclosure which are novel over the prior art.

In the description and claims, the various parts and steps are identified by specific terms for convenience, but they are intended to be as generic in their application as the prior art will permit.

In the accompanying drawings forming part of the present disclosure in which certain ways of carrying out the invention are shown for illustrative purposes:

Fig. 1 is a front view, mostly in elevation, illustrating one embodiment of ignition apparatus made in accordance with the present invention;

Fig. 2 is a sectional view along line 2—2 of Fig. 1;

Fig. 3 is a top plan view of Fig. 2, with the cover removed;

Fig. 4 is a sectional view on line 4—4 of Fig. 2;

Fig. 5 is a sectional view on line 5—5 of Fig. 2;

Fig. 6 is a fragmental top plan view of the conductor-ring;

Fig. 7 is a sectional view on line 7—7 of Fig. 2;

Fig. 8 is a top plan view of the rotatable distributor-means or member;

Fig. 9 is a sectional view on line 9—9 of Fig. 8, with certain parts in elevation;

Fig. 10 is an enlarged sectional view on line 10—10 of Fig. 9;

Fig. 11 is a top plan view of the flexible spring-disk circuit-breaker actuating-means;

Fig. 12 is a front elevation of Fig. 11;

Fig. 13 is a top plan view of the flexible spring-member carrying the movable contacts of the circuit-breaker;

Fig. 14 is a perspective view of the cup-member which carries the fixed contacts and which also receives the condenser within its cup-portion;

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Fig. 15 is a perspective view of the induction-coil unit; and

Fig. 16 is a modified construction adapted to perform the functions of both of the parts illustrated in Figs. 11 and 13.

Referring to Figs. 1 to 15 of the drawings inclusive, showing the particular form of the invention chosen for illustration therein, the ignition device or apparatus includes a hollow support 20 in which is mounted an induction-coil or induction-coil unit 21 and a condenser 22. A circuit-breaker 23 and a distributor 24 are also carried by the hollow support 20. As will presently appear, the particular ignition device illustrated in the drawings is adapted for a six-cylinder engine.

The hollow support 20 is preferably made of molded plastic insulating material such, for example, as Bakelite, with a number of inserts molded therein as will presently be described. A tube 25, which may be of self-lubricating bronze, may be provided with a knurled outer surface-portion at its lower end-portion to make firm engagement with the plastic material molded therearound. A stud 26 is welded or otherwise secured at 27 to the tube 25, the inner portion of the stud 26 being embedded in the molded plastic material, and the outer end 28 being screw-threaded to receive a nut 29. Another stud 30 has an angular inner end 31 welded or otherwise secured at 32 to an annular U-shape trough-like terminal 33, the inner portion of the stud 30 and the U-shape terminal 33 being embedded in the molded plastic material, and the outer end 34 of the stud 30 being screw-threaded to receive a nut 35. Also formed as a molded-in part of the molded hollow support 20, is a conductor-ring 36 which has an outer annular ring-member 37 and an inner annular ring-member 38, with the two ring-members 37 and 38 connected by a bottom web 39 provided with holes 40 therethrough to provide passageways for the plastic material to extend through to interconnect the molded plastic portions of the wall 41 of the hollow support 20, which are located above and below the web 39. The hollow support 20 is also provided with six molded passageways 42, each of which at the lower end is large enough to receive one of the six high-tension cables 43, and at its upper end-portion is of a size or diameter to permit free sliding entrance of one of the six screws 44, which are screwed among the wires of the ends of the cables 43 to secure the cables firmly in place, and which serve as terminals to receive

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high-tension current at their heads and pass it into the wires of the cables 43.

The induction-coil 21 has a central insulation-tube 45, the hole 46 of which is large enough to permit the insulation-tube 45 to freely slide on and off of the pipe or tube 25. Surrounding the insulation-tube 45 is arranged a magnetic core 47 formed of soft iron wires 48, the soft iron core 47 being surrounded by a tubular insulation-covering 49. Around the insulation-covering 49 is wound a primary wire coil 50, around which is a tubular insulation-covering 51, and around the latter is the secondary wire coil 52 which, in turn, is surrounded by a tubular insulation-covering 53. The induction-coil 21 has a metal terminal-plate 54 on its lower end surface which has one end of the wire 55 of the primary coil 50 soldered or otherwise connected to it. The other end of the wire 55 of the primary coil 50 is soldered or otherwise connected to a metal terminal-ring 56 which does not form a complete circle but has a gap such as 57 (Fig. 15). One end of the wire 53 of the secondary-coil 52 is connected to the ring-terminal 56, and the other end of the secondary wire 53 is connected to the resilient sheet-metal terminal 59 which is suitably secured at the side of the induction-coil 21.

The condenser 22 is of hollow ring-like form and may be made of usual construction with one set of tinfoil strips or strip-edges 60 projecting downwardly, and another set of alternate tinfoil strips or strip-edges 61 projecting upwardly, with layers of insulation separating the strips or layers of tinfoil.

The distributor or distributor-means 24 includes the main supporting- or carrying-member 63 made of spring sheet metal. The carrying-member 63 has a depressed spring-tongue 64 provided with a hole 65 having a flat edge 66 for a purpose to be later described. Each of the opposite spring side-portions 67 of the member 63 is provided with a pressed-up locking-lug 68. The member 63 is also provided with a pressed-out stiffening-rib 69. One end of the member 63 is formed up into a cylinder or stud-shaft portion 70 on which is mounted a roller 71 which is freely rotatable on the stud-shaft 70 and has a projecting hub-portion 72. A satisfactory embodiment of the member 63 has been made of tempered sheet tool steel of about .022" thickness. The roller 71 may conveniently be made of hard fiber or plastic. A cylindrical sleeve-member 73 preferably of metal to provide ample weight, has a press-fit or the like with the hub 72 of the roller 71. A coil-spring 74 is held under compression with one end against the metal sleeve 73 and the other end against a washer 75 held in place by a cotter pin 76. The other end of the member 63 is provided with a downwardly-extending annular flange 77 which has a press-fit around the outside of an annular sleeve 78 which may be of heavy metal such as brass or steel to aid in counterbalancing the weight of the metal sleeve-member 73 when the member 73 is in its normal operation of rotation. The sleeve 78 has a press-fit or is otherwise tightly secured on a transparent or translucent plastic tube-member 79 as, for example, by being in molded-on relation therewith. The upper end of the sleeve 78 is screw-threaded at 80 to screw-threadedly receive a closure-nut 81 which may, if desired, be made of heavy metal to give additional counterbalancing effect. A conductor 82 may be made of spring-wire such, for example, as piano wire, and have its two ends connected to a metal cup-member

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83 by riveting, welding, brazing or otherwise, and the cup-member 83 and the ends of the wire-conductor 82 are molded in place as part of the molded transparent plastic tube-member 79. A metallic wire spring 84 rests upon the metal cup 83 and has its upper portion in contact with the lower metal end or terminal 85 of a neon tube 86 of well-known and usual form, which tube has a transparent tubular glass-portion 87, and which tube also has an upper metal end or terminal 88 in engagement with which is the lower end of a metal wire spring 89. Both springs 84 and 89 are held under compression by engagement of the upper spring 89 against the under side of the metal closure-nut 81. Thus it will be seen that there is a continuous electric circuit for high tension electric current from the wire-conductor 82 of the distributor 24 through the parts 83, 84, 85, 89, 81, 73, 77 and 63 to ground.

An adapter-unit 90 includes the main outer tubular member 91 in which is press-fitted or otherwise secured two bearing-bushings 92 and 93 which may be self-lubricating bronze or other suitable bearing material. The lower portion 94 of the tubular member 91 may be of any suitable size and shape to be readily gripped in any suitable way in a given particular make or model of automobile, with a shaft-member 95 suitably connected in driving engagement with the engine of the automobile. The shaft 95 is rotatably mounted in the bearing-bushings 92 and 93 and has an annular flange 96 at its upper end provided with two upstanding driving-lugs 97 and 98 which respectively are in driving engagement in the slots 99 and 100 of the annular flange 101 at the lower end of the shaft 102 which extends up through the tube 25. The upper flange-portion 103 of the tubular member 91 is of enlarged diameter to suitably fit up over the lower annular portion 104 of the support 21, and extends up to near, or in engagement with, the under surface 105 of the part 104 of the support 20. The annular enlarged flange-portion 103 has an upwardly-opening slot 106, within which is received the stud 30 and the smaller-diametered portion of the insulation-bushing 107, and at the opposite side the flange-portion 103 has a second upwardly-opening slot 108 which receives the stud 26. The nut 35 in screw-threaded engagement upon the stud 30 serves to clamp the metal terminal 109 of the battery lead-in wire 110 against the insulation-bushing 107 to cause the latter, in turn, to clamp against the annular flange 103 of the tubular member 91 of the adapter-unit 90. The other nut 29 screw-threaded upon the stud 26, serves to clamp the opposite side of the annular flange 103 of the adapter in position. Thus, it will be seen that by applying different adapters or adapter-units respectively suited to different makes and models of cars, a single type of ignition device can be employed on a wide variety of makes and models of cars.

In assembling together, the parts of the ignition device, a metal coil-spring contact 111, which normally is much more extended or open than illustrated in Fig. 2, when it is free of compression, is placed down within the hollow support 20 and in engagement with the annular U-shape metal terminal 33. Thereupon the induction-coil unit 21 is slid down over the tube 25 until the lower metal terminal-plate 54 thereof, rests upon and compresses the spring 111 as illustrated in Fig. 2, and when the induction-coil unit moves downward to its position illustrated in Fig. 2, the spring sheet metal side-

terminal 59 of the secondary coil engages against the inner annular ring-portion 38. It will be observed that the terminals 54 and 59 of the induction-coil unit will properly engage respectively with the spring 111 and the annular ring-portion 38, regardless of the rotative position in which the induction-coil unit 21 is inserted.

A soft annular gasket 112 is placed upon the annular top edge 113 of the annular wall 41 of the support 20, and a metal cup-member 114 having a depending annular skirt 115 provided with a pressed-in keying-portion 116 is placed in proper rotative position to cause its keying-portion 116 to slide down the shallow key-notch 117 (Fig. 1) in the outer face of the wall 41, which extends down through the top edge 113 of the wall 41 to the position shown in Fig. 1, with the cup-member 114 resting on the gasket 112. The condenser 22 is inserted within the cup-member 114. Another soft annular gasket 118 is placed on the annular surface 119 of the cup-member 114, and another soft annular gasket 120 is placed on the upper end of the magnetic core 47. An annular washer or plate 121 is slid down over the upper end of the tube 25 to rest on the two gaskets 118 and 120. A nut 122 is screwed down on the screw-threaded upper end 123 of the tube 25, to clamp the plate 121 against the gaskets 118 and 120 and, in turn, to cause the cup-member 114 to be clamped against the gasket 112. This clamping action also causes the downwardly-projecting tinfoil-edges 60 to be in engagement with the prongs 124 of the cup-member 114, and the upwardly-projecting tinfoil-edges 61 to be in engagement with the metal plate or washer 121 which is grounded through the nut 122, tube 25, stud 26, nut 29, adapter-member 91 and the metal part of the automobile (not shown) in which the member 91 is clamped. The clamping action of the nut 122 also causes at least all except one of the prongs 124 of the cup-member 114 to be pressed in firm metal-to-metal contact with the terminal-ring 56. If one prong 124 happened to come over the gap 57 (Fig. 15) in the terminal-ring 56, it would not contact the ring, but this does not matter as it is necessary for only a single prong 124 to contact the terminal-ring 56 to complete the electric circuit. The cup-member 114 has secured thereto by riveting or otherwise, six fixed contacts 125.

A flexible plate-like spring-member 126 formed of spring sheet metal having six spring-arms 127, each having a movable contact 128 riveted or otherwise secured thereto, is slid down over the tube 25 and onto the top of the nut 122 with the flat edge 129 (Fig. 13) of its hole 130 in keying engagement with the flat surface 131 (Fig. 4) of the tube 25, thus locating each of the six movable contacts 128 above and spaced from a corresponding one of the fixed contacts 125, to thus form six pairs of contacts, of which the upper contact of each pair is movable.

A flexible contact-actuating-and-spark-advance plate-like spring-member 132 formed of spring sheet metal over the tube 25 and down on top of the spring sheet-metal member 126, with the flat edge 133 (Fig. 11) of the hole 134 in keying engagement with the flat surface 131 of the tube 25. A stiff metal washer 135 is slid down the tube 25 onto the top of the spring-member 132, and a nut 136 is screwed down upon the threaded end 123 of the tube 25 to clamp the parts 135, 132 and 126 against the nut 122. A satisfactory embodiment of each of the members 126 and 132 has been made of tempered sheet

tool steel of about .010" thickness. Each of the six actuation-surfaces 137 of the member 132 forms a contact-actuating-and-spark-advance means. A guide-portion 138 is arranged at an angle to each surface 137 to serve to guide the roller 71 up onto the surface 137 as the roller 71 rotates clockwise, as seen in Fig. 3. The rear edge or release edge 139 of each surface 137 is at a substantial angle to the radial plane 140 which passes through the longitudinal axis 141 (Fig. 11) of the shaft 102 and intersects said rear edge at the point 142 at the radially outermost edge 143 of the surface 137.

The spring-tongue 64 of the carrying-member 63 of the distributor-means 24 is placed down over the threaded end 144 of the shaft 102 with its flat edge 66 in keying engagement with the flat side 145 (Fig. 3) of the threaded end 144, and a nut 146 is screwed onto the threaded end 144 to clamp the tongue 64 against the annular shoulder 147 of the shaft 102. An adjusting-nut 148 which has a plurality of spaced-apart locking-notches 149 on its under edge, any two diametrically-opposite notches of which are adapted to have locking engagement with the locking-lugs 68, is screwed onto the threaded end 144 of the shaft 102 until the stud-shaft portion 70 carrying the roller 71 is sprung down sufficiently to cause the annular edge-face 150 of the rotating roller 71 to successively make proper engagement with the actuation-surfaces 137 of the member 132 to properly bend down the spring-arms 151 of the spring-member 132, on which the actuation-surfaces 137 are located, to cause the spring-arms 151 to bend the spring-arms 127 of the spring-member 126 carrying the movable contacts 128, to cause each movable contact 128 to engage and have a rubbing action upon its complementary fixed contact 125 to thereby constantly perfect the contact surfaces of the pairs of contacts and maintain them in proper operating condition. As the roller 71 passes off the rear edge or release edge 139 of each actuation-surface 137, the spring-arms 151 and 127 spring back to their original unstressed position, thus resulting in the movable contacts breaking the circuit in the primary circuit and causing a high tension current to be induced in the secondary circuit. The stiff washer 135 stops or damps any whipping action which might otherwise occur in the spring-arms 127.

Each time the roller 71 passes off the rear or release edge 139 of an actuation-surface 137, the roller 71 and the wire-conductor 82 will be in positions similar to those illustrated in Figs. 1, 2 and 3, and therefore the high tension current induced at this time will leap from the outer conductor-ring 37 to the wire-conductor 82, and will then leap to the terminal-screw 44 adjacent the conductor 82, and will then travel along the high-tension cable 43 connected to such screw 44, to the corresponding spark plug of the engine.

At the same time that the spark thus passes through the wire-terminal 82 to one of the screws 44, a surge of current passes up through the neon tube 86 (Fig. 10) to thus cause it to light up and to be visible through the transparent plastic tube 79. And by running the engine at its slowest speed, it will be optically observable as to whether or not the spark is passing to every one of the high-tension cables 43 of the spark plugs. And if any one or more of the high-tension cables 43 are not receiving any sparking current, it will be optically visible as to which one or ones are not receiving it.

It will be noted from Figs. 2 and 1 that the pair of contacts at the extreme left of Fig. 2 is just about to separate to produce a spark and that the wire-conductor 82 is in position over one of the screws 44 to carry the spark to the latter. As the speed of rotation of the engine and, correspondingly, of the member 63 and the parts it carries, increases, the roller 71 and its heavy sleeve 73 are moved outward against the action of the coil-spring 74 to thereby cause the roller 71 to press upon successively further outward areas of the actuation-surfaces 137, and owing to the position of the rear or release edge 139 of each of these surfaces 137, the time of occurrence of the spark is advanced. In other words, the spark occurs at a time when the wire-terminal 82 is in a position somewhat to the right of that shown in Fig. 1. The advancing of the spark is also partly accomplished in consequence of the longitudinal axis 152 of the path of sliding movement of the roller 71 not passing through the longitudinal axis 141 of the shaft 102, but passing along a position substantially below the axis 141, as will be evident from viewing Fig. 8. It will be evident from a consideration of Figs. 8 and 11, which are in the same relative position that they occupy in Fig. 3 when the roller 71 is about to leave off contact with the rear or release edge 139 of the lower left surface 137 to thereby produce a spark, that the axis 152 of the roller 71 passes substantially below the longitudinal axis 141 of the main shaft 102, whereas, the prolongation of the rear or release edge 139 of the lower left surface 137 passes substantially above the longitudinal axis 141 of the main shaft 102, and therefore the lines 139 and 152 may be said to be on opposite sides of the longitudinal axis 141 of the main shaft 102 at the time of occurrence of the spark.

Instead of making the plate-like spring-members 126 and 132 as two separate members as illustrated in Figs. 11, 12 and 13, a single member 153 as illustrated in Fig. 16 may be made of a single plate of spring sheet metal carrying the movable contacts 128 and having actuation-surfaces 137a corresponding to the actuation-surfaces 137 shown in Fig. 11.

A cup-shape cover-member 154, preferably of transparent or translucent plastic, can be removably held in position by any suitable means, as, for example, by the spring-wire bail 155 snapped into the holes 156 in the plastic hollow support 20.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. An ignition apparatus including: a support; a shaft rotatably mounted on said support; ignition-current means including a circuit-breaker; said circuit-breaker including a pair of contacts relatively movable in opposite directions into and out of contact with one another; one circuit-breaker actuating-means adapted to relatively move said contacts into contact with one another, and other circuit-breaker actuating-means adapted to relatively move them out of contact with one another; contact-actuating-and-spark-advance means having an actuation-surface whose rear edge is transverse of the axis of said

shaft but at a substantial angle to the radial plane passing through said axis and intersecting said rear edge at the outermost edge of said surface; one of said circuit-breaker actuating-means being rotated by said shaft and having centrifugal-contact-actuating-and-spark-advance means actuatable by centrifugal force to yieldably move outward transversely of the axis of said shaft as the speed of rotation of said shaft increases, said centrifugal means as it successively moves further outward at successively higher speeds of rotation, successively engaging further-outward portions of said actuation-surface and leaving said rear edge and thereby relatively actuating one of said contacts at successively earlier times to thereby advance the time of occurrence of the spark.

2. An ignition apparatus including: a support; a shaft rotatably mounted on said support; ignition-current means including a circuit-breaker; said circuit-breaker including a pair of contacts relatively movable in opposite directions into and out of contact with one another; one circuit-breaker actuating-means adapted to relatively move said contacts into contact with one another, and other circuit-breaker actuating-means adapted to relatively move them out of contact with one another; contact-actuating-and-spark-advance means having an actuation-surface whose rear edge is transverse of the axis of said shaft but at a substantial angle to the radial plane passing through said axis and intersecting said rear edge at the outermost edge of said surface; one of said circuit-breaker actuating-means being rotated by said shaft and having centrifugal-contact-actuating-and-spark-advance means actuatable by centrifugal force to yieldably move outward of said shaft along a line of movement transverse of the axis of said shaft but at a substantial angle to said radial plane, and on the opposite side thereof from said rear edge when said centrifugal-contact-actuating-and-spark-advance means is leaving said rear edge, as the speed of rotation of said shaft increases, said centrifugal means as it successively moves further outward at successively higher speeds of rotation, successively engaging further-outward portions of said actuation-surface and leaving said rear edge and thereby relatively actuating one of said contacts at successively earlier times to thereby advance the time of occurrence of the spark.

3. An ignition apparatus including: a support; a shaft rotatably mounted on said support; a plurality of spaced-apart conductor-terminals; ignition-current means including a circuit-breaker, and a distributor for delivering ignition-current to said conductor-terminals; said circuit-breaker including a plurality of pairs of contacts which include a pair for each said conductor-terminal, the contacts of each pair being relatively movable in opposite directions into and out of contact with one another; one circuit-breaker actuating-means adapted to relatively move the contacts of a pair into contact with one another, and other circuit-breaker actuating-means adapted to relatively move them out of contact with one another; said two circuit-breaker actuating-means being adapted to thus actuate each pair of contacts successively; one of said circuit-breaker actuating-means including a plurality of spring-arms, one spring-arm for each pair of contacts and adapted to relatively move one contact of each such pair of contacts in one of said directions; contact-ac-

tuating-and-spark-advance means having a plurality of actuation-surfaces, one actuation-surface for each said spring-arm; the rear edge of each actuation-surface being transverse of the axis of said shaft but at a substantial angle to the radial plane passing through said axis and intersecting said rear edge at the outermost edge of such surface; one of said circuit-breaker actuating-means being rotated by said shaft and having centrifugal-contact-actuating-and-spark-advance means actuatable by centrifugal force to yieldably move outward of said shaft as the speed of rotation of said shaft increases, said centrifugal means as it successively moves further outward at successively higher speeds of rotation, successively engaging further-outward portions of said actuation-surfaces and leaving said rear edges and thereby relatively actuating one of each of said pairs of contacts at successively earlier times to thereby advance the times of occurrence of the sparks.

4. An ignition apparatus including: a support; a shaft rotatably mounted on said support; a plurality of spaced-apart conductor-terminals; ignition-current means including a circuit-breaker, and a distributor for delivering ignition-current to said conductor-terminals; said circuit-breaker including a plurality of pairs of contacts which include a pair for each said conductor-terminal, the contacts of each pair being relatively movable in opposite directions into and out of contact with one another; one circuit-breaker actuating-means adapted to relatively move the contacts of a pair into contact with one another, and other circuit-breaker actuating-means adapted to relatively move them out of contact with one another; said two circuit-breaker actuating-means being adapted to thus actuate each pair of contacts successively; one of said circuit-breaker actuating-means including a plate-like spring-member having a plurality of spring-arms, one spring-arm for each pair of

contacts and adapted to relatively move one contact of each such pair of contacts in one of said directions; contact-actuating-and-spark-advance means including a plate-like spring-member having a plurality of actuation-arms, each actuation-arm having an actuation-surface, one actuation-surface for each said spring-arm; the rear edge of each actuation-surface being transverse of the axis of said shaft but at a substantial angle to the radial plane passing through said axis and intersecting said rear edge at the outermost edge of such surface; one of said circuit-breaker actuating-means being rotated by said shaft and having centrifugal-contact-actuating-and-spark-advance means actuatable by centrifugal force to yieldably move outward of said shaft as the speed of rotation of said shaft increases, said centrifugal means as it successively moves further outward at successively higher speeds of rotation, successively engaging further-outward portions of said actuation-surfaces and leaving said rear edges and thereby relatively actuating one of each of said pairs of contacts at successively earlier times to thereby advance the times of occurrence of the sparks.

CHARLES MESSERSCHMIDT.

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