April 21, 1931. J. T. FITZSIMMONS 1,801,600

IGNITION APPARATUS

Filed June 6, 1929 4 Sheets-Sheet 1

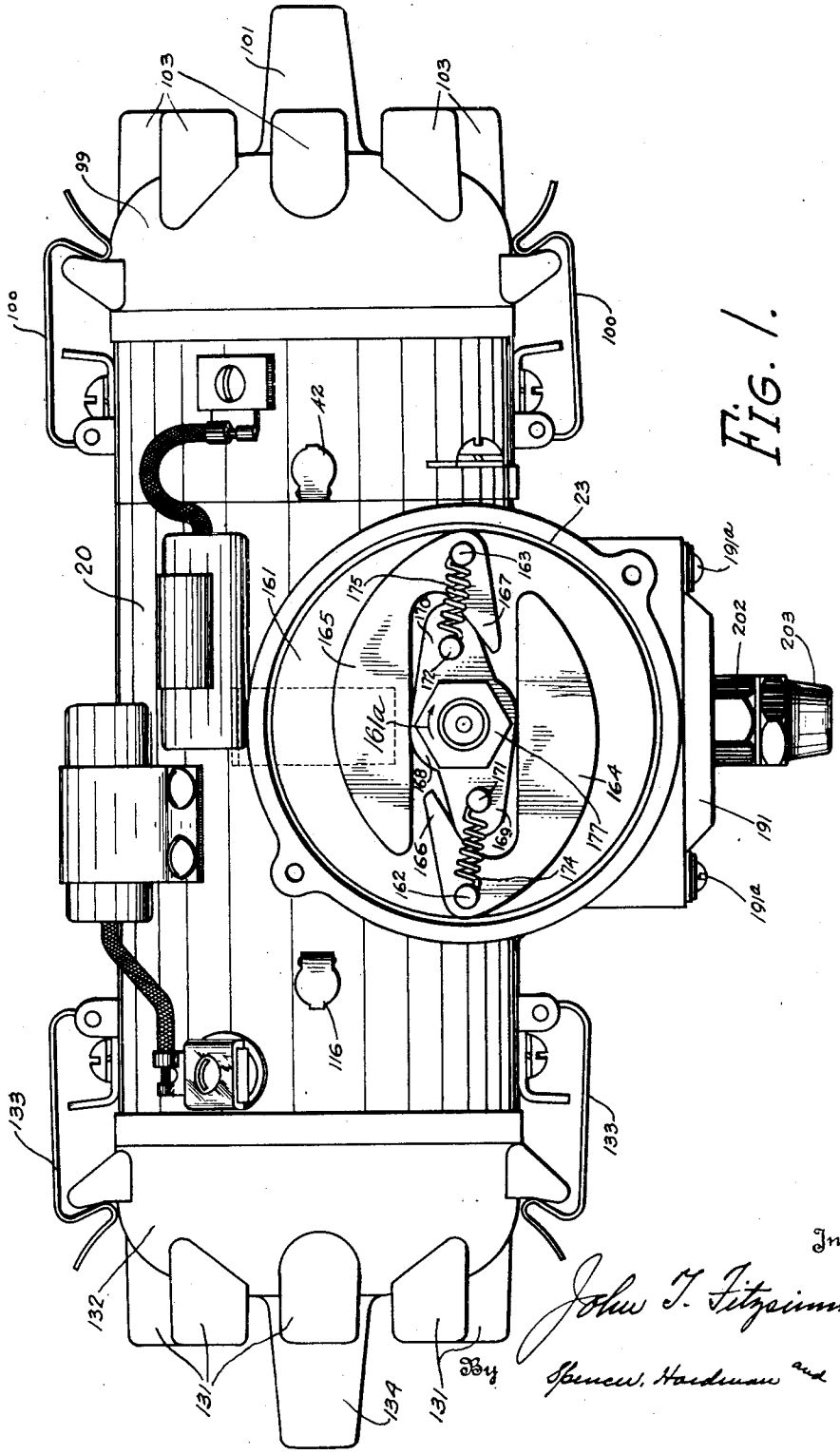


FIG. 1.

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IGNITION APPARATUS

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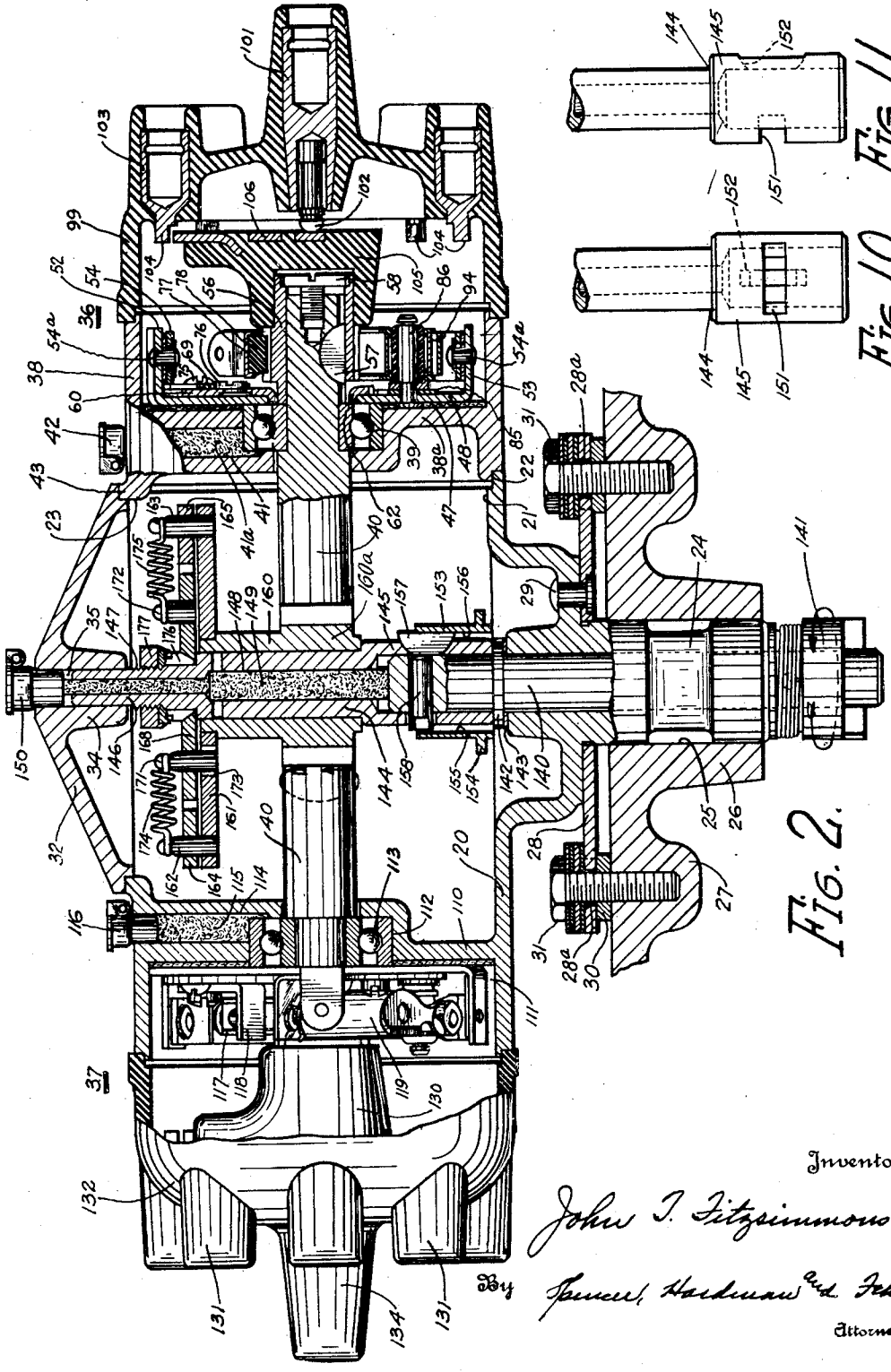


FIG. 2.

FIG. 10.

FIG. 11.

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IGNITION APPARATUS

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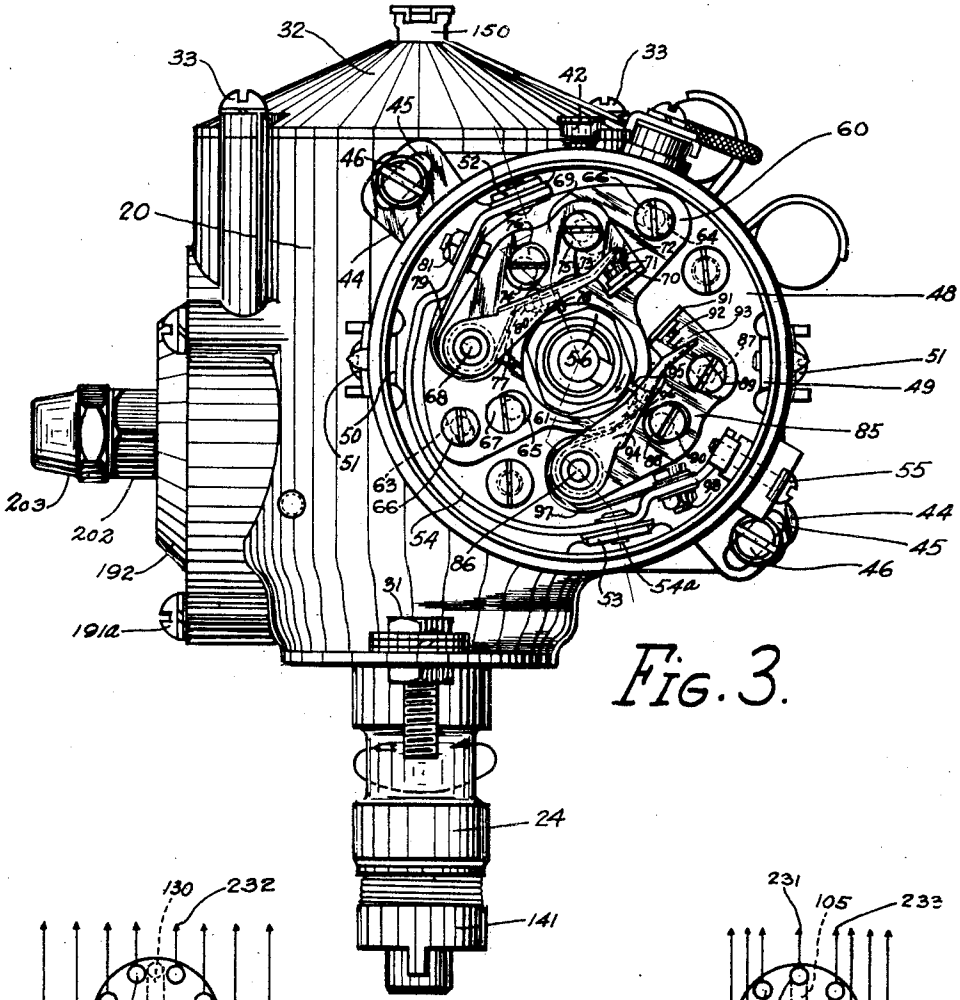


FIG. 3.

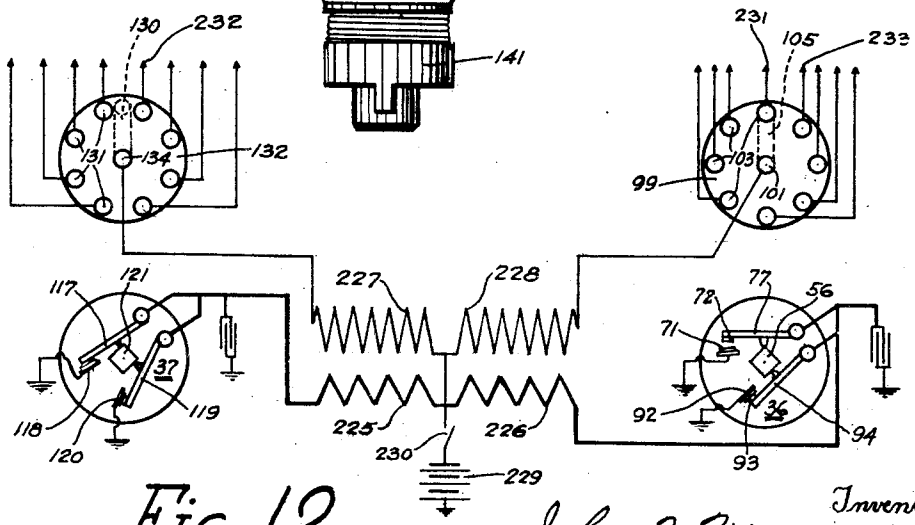


FIG. 12.

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IGNITION APPARATUS

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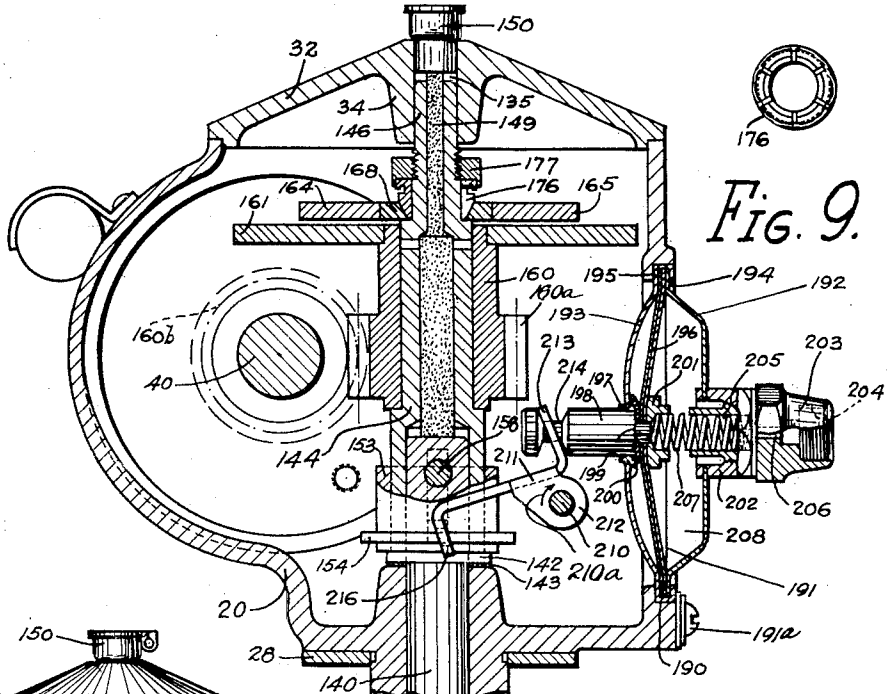


FIG. 9.

FIG. 4.

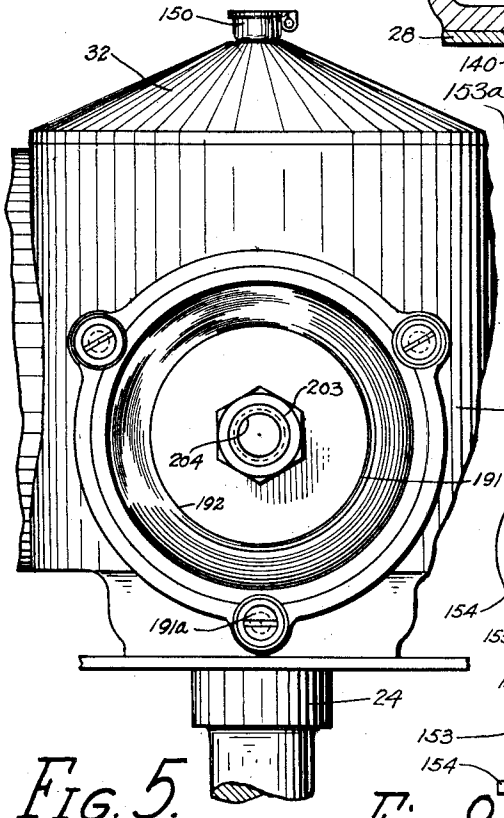


FIG. 5.

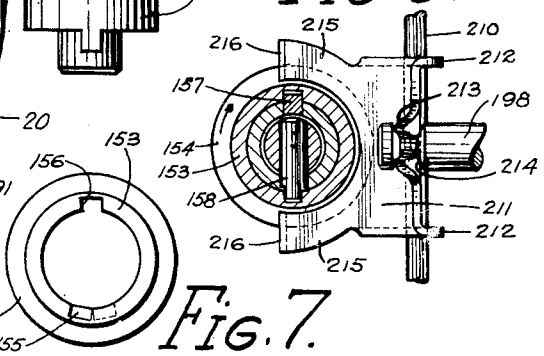


FIG. 6.

FIG. 7.

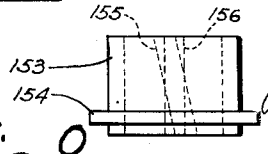


FIG. 8.

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UNITED STATES PATENT OFFICE

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IGNITION APPARATUS

Application filed June 6, 1929. Serial No. 368,890.

This invention relates to improvements in ignition devices for multi-cylinder internal combustion engines.

It is among the objects of the present invention to provide a device capable of effecting and distributing sparking impulses to a fast running multi-cylinder engine at proper intervals and in recurrent sequence.

This object is attained by providing an ignition system having a plurality of ignition circuits, each circuit being provided with a plurality of circuit interrupters.

Another object of the present invention is to control the time of sparking impulses in accordance with both engine speed and load conditions.

A still further object of the invention is to provide a device manually adjustable, initially to set the device in proper position to provide sparking impulses at the proper times during the cycles of engine operation, and to properly synchronize the circuit interrupters.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred embodiment of one form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a top plan view of the ignition device with the cover-cap removed.

Fig. 2 is a longitudinal sectional view taken through the ignition device, certain parts being shown in elevation for the sake of clearness.

Fig. 3 is an end elevation, with the distributor head removed to show the circuit interrupter mechanism of one timer-distributor unit.

Fig. 4 is a cross sectional view taken transversely through the center of the device, certain parts being shown in elevation for the sake of clearness.

Fig. 5 is a fragmentary view looking toward the suction control unit of the device.

Fig. 6 is a fragmentary, detail plan view of the mechanism connecting the suction control unit with the operating shafts of the device.

Fig. 7 is a plan view of the slidable collar, a part of the mechanism shown in Fig. 6.

Fig. 8 is a side elevation of the part shown in Fig. 7.

Fig. 9 is a detail view of the chuck used for connecting certain parts of the device.

Fig. 10 is a side view of the intermediate drive shaft.

Fig. 11 is another view of the part shown in Fig. 10.

Fig. 12 is a wiring diagram of an ignition system including the present ignition device.

Referring to the drawings, the ignition device is shown comprising a housing 20, substantially T-shaped, that is, the housing comprises a horizontal or cross arm portion and a vertical or upright portion. As shown in the Fig. 2, one end of the horizontal portion is closed while the other end is open as at 21, the inner peripheral edge of said open end being provided with a recess 22. At the top of the housing there is provided an opening 23, the center of which is offset from the axis of the horizontal portion of the housing as shown in Fig. 1. On the side of the housing directly opposite the opening 23 and substantially in coaxial alignment with said opening, the housing is provided with a shank 24, adapted to fit into an opening 25 provided in a lug 26 of the engine housing or crank case 27. The shank 24 of the housing 20 is hollow in order to provide a bearing for the drive shaft 140, which will be described detailedly hereinafter.

The shank 24 of housing 20 is rotatably supported within the opening 25 in the engine crank case for purposes of adjustment to be described hereinafter. The rotation of the housing 20 relative to the engine crank case 27 is limited by a plate 28 which is secured to housing 20 by rivets 29 and which rests upon a ring member 30 interposed between the plate 28 and the engine crank case 27. Plate 28 has arcuate slots 28*a* substantially concentric of the shank 24. Screws 31 have their shank portions extending through the arcuate slots 28*a* of the plate 28 and through openings in the ring member 30, and threadedly engage the engine crank case 27 so that tightening of said screws will

secure the plate 28 to the crank case 27 of the engine. Loosening of said screws 31 will permit the housing 20 to be rotated relative to the engine crank case 27, said rotation, however, being limited to the length of the arcuate slots 28*a*.

The opening 23 of the housing which, as has been stated, is substantially in coaxial alignment with the shank 24, has a cover plate 32 secured to the housing 20 by screws 33. Cover plate 32 has a central lug 34 provided with an aperture 35 substantially in coaxial alignment with the longitudinal channel of the shank 24.

The housing 20 supports two timer-distributor units, designated as a whole by the numerals 36 and 37. The timer-distributor unit 36 is mounted at the open end of the horizontal portion of the housing 20, while the timer-distributor unit 37 is secured to the housing 20 at the opposite end of its horizontal portion. The timer-distributor unit 36 comprises a cup-shaped casing 38 having a bottom wall 38*a* recessed centrally to receive the ball bearing 39 which rotatably supports one end of the cam shaft 40. The bottom wall 38*a* is provided with a passage 41 radially arranged relative to the casing 30, said passage 41 containing a fibrous wick 41*a* adapted to be charged with a lubricant through the oiler 42 which is secured to the outer end of passage 41. The inner end of said passage 41 communicates with the recess containing the ball bearing 39. The casing 38 has an outwardly extending annular flange 43 which fits into the annular recess 22 provided in the inner peripheral edge of the open end 21 of housing 20, said casing 38 being supported rotatably in said recess 22 for purposes of adjustment, which will be described detailedly hereinafter. The rotative movement of the casing 38 relative to the housing 20 is limited by ears 44 extending from the casing 38, said ears being provided with arcuate slots 45 substantially concentric with the cam shaft 40. Screws 46 have their shank portions extending through the slots 45 and threadedly engage the housing 20 so that when the screws are tightened, casing 38 is securely clamped upon the housing 20. Loosening of screws 46 permits the casing 38 to be rotated upon the housing 20, said rotation being limited to the length of the arcuate slots 45.

Each timer-distributor unit has two circuit interrupters, so positioned in relation to each other that when operated will successively interrupt an electrical circuit eight times during each complete revolution of the cam shaft 40, the intervals between the circuit interruptions being substantially equal.

Referring particularly to Figs. 2 and 3, the casing 38 is shown provided with an insulating lining 47 on the inner surface of its bottom or end wall 38*a*, the outer surface of said lining being substantially flush with the outer ends of the race members of ball bearing 39. In the casing 38 there is provided a supporting plate 48 which rests against the lining 47, said supporting plate 48 having a plurality of angular upstanding ears, two of which, 49 and 50, are secured to the annular wall of casing 38 by screws 51 so as to be in electrical connection with the casing 38. Two other ears 52 and 53 support a conducting strip 54 insulatingly, said conducting strip being secured to ears 52 and 53 of the plate 48 by rivets 54*a* which are insulated from both the ears 52 and 53 and the conducting strip 54. The one end of conducting strip 54 is electrically connected with a terminal screw 55 which extends to the outside of timer-distributor casing 38, but is insulated therefrom.

As has been mentioned before, the ball bearing 39 rotatably supports the one end of cam shaft 40, said end extending through the ball bearing 39 into the timer-distributor casing 38. A cam 56, shown in the present instance to have four equally spaced lobes, is secured to the portion of cam shaft 40 extending into the casing 38, by a key 57 whereby said cam 56 will rotate with the cam shaft 40. Relative endwise motion between cam 56 and the cam shaft 40 is substantially prevented by a screw having an enlarged head portion 58 which is seated within an annular recess provided in the end of the cam 56, the shank of said screw screw-threadedly engaging the cam shaft 40.

One of the circuit interrupters is supported upon a plate 60 which is adjustably secured to the supporting plate 48 in the following manner: Plate 60 has a central ring portion 61, the inner peripheral edge of which has an annular, depending flange 62 which fits into a central aperture provided in the mounting plate 48, said flange acting as a retainer and guide so that the plate 60 may be rotated about the axis of the cam 56. Plate 60 has three elongated slots 63, 64 and 65, the first two of which, 63 and 64, being arcuate and substantially concentric with the axis of the annular flange 62. Slot 65 is arranged radially of the cam 56. Slots 63 and 64 receive the shank portions of screws 66, which threadedly engage the mounting plate 48 whereby the tightening of screws 66 will securely clamp the plate 60 to the mounting plate 48. Slot 65 receives a member 67 provided with a screw driver slot, said member having an eccentric shank which is rotatably secured to the mounting plate 48. Rotation of the member 67, when screws 66 are loosed, will rotate the plate 60, the slots 63 and 64 and the annular flange 62 guiding said plate 60 in a path substantially concentric to the axis of the cam 56.

A pivot post 68 is supported upon the

plate 60. A contact supporting plate 69 is also supported upon plate 60, said contact supporting plate 69 being pivotally attached to the post 68. At the free end of plate 69 there is provided an angular member 70 supporting a contact 71 which is adapted to be engaged by a movable contact 72. Plate 69 has two elongated slots 73 and 74, the first being arcuate and substantially concentric with the axis of pivot post 68, the other slot 74 being arranged so that its longest dimension is substantially radial of the post 68. A screw 75 has its shank portion extending through arcuate slot 73 and threadedly engaging the plate 60 whereby tightening of said screw 75 will securely clamp the plate 69 to the plate 60. Slot 74 is adapted to receive a member 76 having a screw-driver slot, said member having also an eccentric shank which is rotatably secured to the plate 60 so that rotation of member 76 when screw 75 is loosed will rotate plate 69 about the pivot pin 68 whereby the plate 69 may be moved toward or away from the cam 56. The movable contact 72 mentioned heretofore is carried upon the free end of the contact lever 77, the one end of which is insulatingly, pivotally mounted upon the pin 68. A rubbing block 78 is secured to the lever 77 intermediate its ends. A spring conductor 79 has one end secured to the lever 77 by a rivet 80 which also secures rubbing block 78 to the lever 77, the opposite end of said spring conductor being electrically connected with the conductor strip 54 through the bolt and nut 81. Spring conductor 79 not only electrically connects the contact 72 with the conductor strip 54, but it also urges the arm 77 toward the cam 56 so that the rubbing block 78 of said lever may be engaged by the cam 56 to cause separation of contacts 72 and 71.

The other circuit interrupter of the timer distributor unit 36 comprises a plate 85 pivotally supported upon a pin 86 which is carried by the supporting plate 48. Like plate 69 of the other interrupter, plate 85 has two elongated slots 87 and 88, the former being arcuate and substantially concentric of the pin 86, the latter having its longer dimensions radially of said pin 86. A screw 89 has its shank extending through slot 87 and threadedly engaging plate 48 so that tightening of the screw will clamp plate 85 securely to the plate 48. Slot 88 receives member 90 provided with a screw driver slot, and with an eccentric shank portion rotatably attached to the plate 48. Rotation of member 90 when screw 89 is loosed will move plate 85 rotatably about pin 86 so as to move said plate radially of the cam. Plate 85 has, at its free end, an up-turned ear 91 carrying the stationary contact 92 which is adapted to be engaged by the movable contact 93. Movable contact 93 is supported at the free end of lever 94, the other end of which is insulatingly, pivotally supported upon the pivot pin 86. Like lever 77 of the other interrupter, this lever 94 has a rubbing block 95 secured to the lever by a rivet 96 which also secures one end of the spring conductor 97 to said lever. The other end of the spring conductor is electrically connected with the conductor strip 54 by bolt and nut 98. Spring conductor 97 electrically connects the movable contact 93 with the conductor strips 54 and also urges arm 94 toward the cam 56 so that the rubbing block 95 may be engaged by the cam.

From the aforegoing it may be seen that both interrupters of the timer-distributor unit 36 are adjustable so that their respective contact arms 77 and 94 may be adjusted radially of the cam 56 in order to provide proper contact separation. This adjustment is particularly adapted to compensate for wear of the rubbing blocks, which, if excessive, would result in insufficient or no contact separation. One of the circuit interrupters, particularly the interrupter including arm 77, is adjustable in a path substantially concentric with the axis of cam 56, said adjustment providing for the location of the rubbing block 78 of contact arm 77 in proper relation to the rubbing block 95 of contact arm 94 so that the proper interval between the operation of the two circuit interrupters is obtained.

The timer-distributor casing 38 is fitted with a distributor head 99 secured to the casing 38 by spring clips 100. The timer-distributor head 99 comprises a central terminal 101 having a spring pressed plunger 102. A plurality of terminals 103 are arranged in a circular formation about the central terminal 101, terminals 103 having posts 104 extending into the interior of the distributor head 99. A distributor rotor 105 is carried upon the end of the cam 56 so as to rotate therewith. Rotor 105 has a conductor strip 106, one end of said conductor strip being electrically engaged by the spring pressed plunger 102. The other end of said conductor strip 106, when the rotor 105 is rotated, is moved into close proximity to the posts 104.

The timer-distributor unit 37 is not adjustable relative to the housing 20 as is the aforedescribed timer-distributor unit 36. The left end of housing 20 as regards Figs. 1 and 2 has a partition 110 spaced somewhat from the extreme end of the housing so as to provide a cup-shaped chamber 111. Partition 110 provides a recess 112 in which the ball bearing 113 is supported, said ball bearing rotatably supporting the other end of the cam shaft 40. Like partition 38a of timer-distributor unit 36, partition 110 has a passage 114 containing a fibrous wick 115 adapted to be charged with a lubricant

through the oiler 116 so that lubricant may be directed to the ball bearing 113. The timer-distributor unit 37 is provided with two circuit interrupters similar to the circuit interrupters of the timer-distributor unit 36, so that a detailed description of these interrupters will not be necessary. Suffice to say that the one circuit interrupters of the timer-distributor unit 37 comprises a movable contact carrying arm 117 adapted to cooperate with the stationary contact 118, which interrupter is similar in construction to the interrupter of timer-distributor unit 36, including movable contact lever 77 carrying the movable contact 72 and cooperating with the stationary contact 71. The other interrupter of the timer-distributor unit 37 will be referred to as including movable contact carrying arm 119 adapted to cooperate with stationary contact 120, which interrupter is similar in construction to the one of timer-distributor unit 36, including a contact carrying lever 94 having contact 93 which cooperates with stationary contact 92. The cam of the timer-distributor unit 37 will be referred to by the numeral 121. Like timer-distributor unit 36, the interrupters of the timer-distributor unit 37 are adapted to break electrical circuits at eight equal intervals during one rotation of the cam so that it may be seen that the interruptions of each timer-distributor unit provide a circuit interruption for every 45 degrees rotation of the cam shaft 40. However the cam 121 of the timer-distributor unit 37 is so mounted upon the cam shaft 40 that the lobes of the cam 121 are angularly offset 22½° from the lobes of the cam 56 so that when cam 56 operates one of its circuit interrupters to break a circuit, the cam 121 of the timer-distributor unit 37 will operate after the cam shaft 40 has rotated through 22½° to move one of its circuit interrupters to break a circuit. From this it may be seen that the ignition device operates in recurrent sequence to provide a circuit interruption every 22½°, thus 16 circuit interruptions are provided for each complete revolution of the cam shaft 40.

The end of the cam shaft 40 extending into the timer-distributor unit 37 carries a distributor rotor 130 which is adapted to coact with a plurality of high tension terminals 131 in a manner similar to the cooperation between rotor 105 and terminal posts 104 of the timer-distributor unit 36. These terminal posts 131 are provided by the distributor head 132 which is supported upon housing 20 by spring clips 133. The distributor head 132 has a central high tension terminal 134 which is electrically connected with the rotor 130 through a plunger similar to the plunger 102 of the timer-distributor unit 36.

The mechanism for driving the cam shaft 40, which, as has been described, is rotatably supported by ball bearings 39 and 113, carried at opposite ends of the horizontal portion of the ignition housing 20, will now be described.

The shank 24 of the housing 20 has been described as having a longitudinal channel substantially coaxial of the aperture 35 in cover 32, said shank providing a journal in which the drive shaft 140 is rotatably supported. One end of the drive shaft 140 extends outside the shank 24 and has a coupling 141 secured thereto in any suitable manner, said coupling being adapted to be drivingly connected with a gear supported on a rotatable part of the engine, preferably the cam shaft of the engine, said gear not being shown in the present drawings. The drive shaft 140 has an annular flange 142 provided thereon which is adapted to engage a washer 143 interposed between the annular flange 142 and the inner end of the shank 24 whereby said washer 143 provides an end thrust bearing for the drive shaft 140. An intermediate drive shaft 144 has a tubular end 145 which telescopically fits over the end of the drive shaft 140 extending into the housing 20. The lower end of the intermediate drive shaft 144 rests upon the annular flange 142 of the drive shaft 140. The upper end portion of the intermediate drive shaft 144 is of reduced diameter, said portion being designated by the numeral 146. This end portion of the intermediate drive shaft is journalled in the aperture 35 of the cover 32, as illustrated in the Figs. 2 and 9. Screw threads 147 are provided on the portion 146 of the drive shaft for purposes to be described. A longitudinal passage 148 is provided in the intermediate drive shaft 144, said passage communicating with the interior of the tubular portion 145 of said intermediate drive shaft, the other end of the passage terminating at the upper end of said intermediate shaft. Passage 148 contains a fibrous wick 149, the lower end of which engages the upper end of the drive shaft 140, the upper end of said wick communicating with an oiler 150 through which lubricant is introduced to the wick 149.

The drive shaft 140 and the intermediate drive shaft 144 are connected operatively by a mechanism which causes the drive shaft 140 to rotate the intermediate drive shaft 144, said mechanism being operable also to rotate the intermediate drive shaft 144 relative to the drive shaft 140 for purposes of adjusting the time of sparking impulses for the engine, as will be described. This connecting mechanism between shafts 140 and 144 will now be described.

As shown in Figs. 10 and 11, the tubular portion 145 of the intermediate drive shaft 144 has two slots, the one designated by the numeral 151 being elongated circumferen-

tially of the tubular portion 145, the other 152 being elongated longitudinally of said tubular portion 145. A collar 153 illustrated detailedly in Figs. 7 and 8, is slidably supported upon the tubular portion 145, said collar having an annular flange 154. In the inside surface of said collar there are provided two longitudinal grooves, the one designated by the numeral 155 being oblique to the axis of the collar 153, the other designated by the numeral 156 being substantially in alignment with the axis of collar 153. A key 157 supported in the longitudinal slot 152 in the tubular portion 145 of the intermediate drive shaft 144 slidably fits into the groove 156 of the collar 153, thus providing for rotation of the collar 153 with the intermediate drive shaft 144, or vice versa A pin 158, radially supported by the drive shaft 140, extends through the slot 151 in the tubular portion 145 of the intermediate shaft 144 and into the oblique groove 155 of the collar 153 so that when collar 153 is slidably moved upon the tubular portion 145, said oblique groove 155 will have a camming action against the pin 158 and thus the collar 153 will be rotated relative to the drive shaft 140, and, due to the connection between collar 153 and portion 145 by the key 157, said tubular portion 145 of the intermediate drive shaft 144 must necessarily rotate with said collar 153 and consequently the intermediate shaft 144 is rotated relative to the drive shaft 140, the direction of rotation being dependent upon the direction in which the collar 153 is being moved slidably over the tubular portion 145.

The intermediate drive shaft 144 has an intermediate portion of lesser diameter than the tubular portion 145 and of greater diameter than the upper end portion 146, said intermediate portion rotatably supporting a hollow gear-shaft 160 providing a gear 160*a* which meshes with gear 160*b* on the cam shaft 40.

In order to transmit rotative motion from the intermediate drive shaft 144 to the gear 160*a*, driving connection between the two must necessarily be provided. In the present instance these driving connections comprise a speed controlled governor which not only causes the gear shaft 160 to be rotated with the intermediate drive shaft 144 under certain conditions, but said governor will also rotate said gear shaft 160 relative to the intermediate drive shaft 144 under other conditions, more specifically in response to variations in the speed of the engine which is drivingly connected with the drive shaft 140. In the Figs. 1, 2 and 4, the said speed controlled driving connection is clearly illustrated. A governor supporting plate 161 is attached to the gear shaft 160 in any suitable manner so that said plate will at all times be rotated with said gear shaft. Plate 161 supports two upright posts 162 and 163 substantially in diametrically opposite positions, said posts pivotally supporting centrifugal weight members 164 and 165 respectively. Said weight members having camming arms 166 and 167 respectively, both extending toward the axis of plate 161. Secured to the intermediate drive shaft 144, in a manner to be described, is a plate 168 having oppositely disposed arms 169 and 170 which respectively engage the camming arms 166 and 167 of the centrifugal weight members 164 and 165 respectively. The arms 169 and 170 of the plate 168 support posts 171 and 172 respectively, the post 171 extending through the plate 168 and into an elongated slot 173 in the plate 161, said slot limiting the rotative movement of the plate 168 relative to the plate 161. In order normally to maintain the plate 168 in proper position, tension springs 174 and 175 are interposed respectively between posts 162—171 and 163—172.

The device for connecting plate 168 to the portion 146 of the intermediate drive shaft 144 comprises a manually operable chuck which includes a split wedging portion 176 provided with a knurled head portion 177 screw-threadedly engaging the threaded portion 147 of the intermediate drive shaft 144. When the knurled portion 177 is turned on the threaded portion 147 toward the speed governor, the split wedged portion 176 will be forced into gripping engagement with a tapered aperture in the plate 168 whereby the split portion 176 will be wedged into said aperture to provide a gripping connection between said plate 168 and the intermediate drive shaft portion 146 about which said split wedge portion 176 fits. It may readily be seen that the member 177 may be loosed to disconnect the plate 168 from the intermediate drive shaft portion 146 whereby the speed governor including the plate 161 connected with gear shaft 160 may be adjusted rotatably relative to the intermediate drive shaft and consequently the angular relation between the gear shaft 160 and the intermediate drive shaft 144 and consequently the drive shaft 140 may be altered. Such alterations result in a change in the angular relation between the cam shaft 40 and the drive shaft 140 and thus the time of sparking impulses relative to the engine will be altered.

This ignition device includes also automatic means for adjusting the time of sparking impulses for the engine in accordance with variations in engine suction and engine load conditions. The mechanism for obtaining such an adjustment will now be described.

In one side of the distributor housing there is provided an opening 190 adapted to receive the suction controlled unit 191, screws

191*a* maintaining said unit in proper position. This suction controlled unit comprises two cup-shaped discs 192 and 193, one having an annular flange 194, the other a peripheral flange 195 spun about said annular flange 194 to secure the two discs together. Interposed between the annular flange 194 and the peripheral flange 195 of the two cup-shaped discs so as to be tightly clamped therebetween, is a diaphragm 196, made up of any suitable flexible material, such as airplane linen or the like. Disc 193 has a central opening provided with an annular flange 197 which forms a slidable bearing for the plunger element 198. The inner end of said plunger element has a reduced portion forming a shoulder 199 upon which is mounted a washer 200 of larger diameter than the plunger 198 so that the peripheral edge thereof will engage the disc as plunger 198 is moved toward disc 193. The reduced portion of the inner end of the plunger 198 extends through an opening in the diaphragm 196 and has a recessed collar 201 secured thereto in any suitable manner so that the diaphragm is clamped tightly between the washer 200 and the recessed collar 201. Disc 192 is provided also with a central opening in which is secured a coupling 202 screw-threaded interiorly to receive the nipple 203. Nipple 203 is recessed on both sides as at 204 and 205, said recess being connected by a reduced intermediate portion 206 as shown in Fig. 9. Recess 204 is screw-threaded and adapted to receive a pipe which may be connected with the suction chamber of the engine, or with the intake manifold, said pipe, however, not being shown in the drawings. A spring 207 is interposed between the recessed collar 201 and nipple 203, one end of the spring fitting into the recess of collar 201, the other into the recess 205 of the nipple 203. Spring 207 normally urges the diaphragm 196 toward the disc 193, the space between the diaphragm and disc 192 designated by the numeral 208 being termed the suction chamber, which is in communication with the recess 204 through the passage 206, as has been described. A pin 210 extends from one side of the housing 20 to the other and supports a bell crank lever 211, said bell crank lever having ears 212 forming a saddle by which the lever is supported on the pin 210. One end of the lever 211 has a fork portion 213 fitting into a groove 214 provided in the plunger 198 adjacent the free end thereof. The other end of the lever 211 as shown in the Fig. 6 has yoke arms 215 each provided with an angular portion 216 notched to engage the annular flange 154 of the collar 153.

When the suction of the engine increases, the diaphragm 196 will be moved toward the right as regards Fig. 4, thus slidably moving plunger 198 to the right which will rotate bell crank lever 211 in the direction of the arrow 210*a* about the cam 210. This movement results in upward movement of the collar 153 along the tubular portion 145 of the intermediate drive shaft 144, thus the collar 153 will be rotated in the direction of arrow 153*a* (Fig. 4), and consequently collar 153 and intermediate shaft 144 will be rotated in the direction of arrow 153*a* additionally to the normal rotation thereof by the drive shaft 140.

In the Fig. 12 are shown the electrical connections between the various elements of the ignition device. The numerals 225 and 226 designate the primary windings of two ignition coils, while the numerals 227 and 228 respectively designate the high tension windings of said coils. Both coils, or more specifically, the primary windings 225 and 226, are connectible with a source of current 229 by the closing of a switch 230. The timer-distributor unit 36 cooperates with ignition coil including windings 226 and 228, while the timer-distributor unit 37 cooperates with the coil including windings 225 and 227. As has been mentioned before, cams 56 and 121 are secured to the same cam shaft 40, the lobes, however, of the cams being displaced angularly 22½°. Each cam is adapted to provide circuit interruptions at 45° intervals so that both cams being displaced angularly 22½° in cooperation will provide sparking impulses for every 22½° of cam shaft rotation. The rotors 105 and 130 of the timer-distributor unit will deliver the sparking impulses to the proper cylinder in proper sequence, said rotors being carried at the extreme outer ends of their respective cams.

In the wiring diagram Fig. 12, cam 56 is shown having operated arm 77 to separate contacts 72 and 71, causing a sparking impulse which is delivered by the rotor 105 to the spark plug 231. Upon 22½° rotation of the cam shaft 40, cam 121 will engage contact lever 119 to break the engagement with contact 120, thus an ignition impulse will be directed through the rotor 130 to the spark plug 232. The next circuit interruption will occur when the cam 56 moves the lever 94 to break contacts 93 and 92, at which time the rotor 105 will have reached the spark plug 233. Sparking impulses at intervals of 22½° cam shaft rotation will obtain in proper sequence so that during one revolution of the cam shaft 40, 16 sparking impulses will have been delivered.

When the ignition device is first applied to the engine, the engine is rotated into a proper position, for instance one cylinder is placed on upper dead center and the ignition device is then adjusted upon the engine so that the distributor rotor 130 is in proper position to deliver a sparking impulse to

said cylinder. It is desirable that the engine be set to a cylinder whose sparking impulse is to be delivered by the timer-distributor unit 37, for said timer distributor unit is not adjustable relative to the housing 20 and thus the ignition device should be initially adjusted relative to the engine in regards to the timer-distributor unit 37. When the housing 20 has been properly located upon the engine as regards timer-distributor unit 37, screws 31 are tightened, which, as has been described, securely fasten the housing to the engine crank case. The timer-distributor unit 36, and more specifically its interrupters, are then examined in order to ascertain whether said interrupters are properly located angularly relative to the interrupters of timer-distributor unit 37. If the interrupters of the timer-distributor unit 36 are not properly located relative to the cam 56, the cam shaft of course having been properly located for the timer-distributor unit 37, the timer-distributor unit 36 may be rotated relative to the housing 20, thereby rotating both interrupters relative to the cam 56 and consequently bringing the rubbing blocks 78 and 95 of their interrupters in proper angular relation to their cam 56. After proper adjustments are made, screws 46 are tightened and thus timer-distributor unit 36 is securely fastened to the housing 20 in proper angular relation to its mate, timer-distributor unit 37. If the degree of contact separation is not proper, any one of the interrupters may be adjusted to properly position the contacts for sufficient gap. If, in adjusting distributor unit 36 it is found that one interrupter is not properly located relative to the other, the one interrupter may be adjusted circumferentially of the cam 56 so as to provide proper intervals between the circuit interruption. These same adjustments may be made with the interrupters of timer-distributor unit 37.

If it is desired to change the angular relation between the gear shaft 160 and the intermediate drive shaft 144 to vary the time of sparking impulses, the manually operable member 177 of the chuck including the split member 176 must be released and the cam shaft 40 and gear shaft 160 may then be rotated relative to the intermediate shaft 144 through the desired degree, after which tightening of the manually operable member 177 will again securely attach the plate 168 of the speed governor to the intermediate shaft 144.

In operation, as the speed of the engine increases, the weights 164 and 165 will move outwardly away from the axis of the shaft 144, thus causing their camming arms 166 and 167 to push against the arms 169 and 170 of the plate 168, which is secured to the intermediate drive shaft 144, the reactionary force of said pressure upon said plate 168 causing the plate 161 to be moved clockwise in the direction of arrow 161*a* Fig. 1, in addition to the normal rotation thereof by the plate 168, consequently the gear 160*b* will be rotated additionally in a direction of its rotation and the same additional rotation be transmitted to the cam shaft 40, thus the cams 56 and 121 will be rotated additionally to advance the time of sparking impulses. The reduction in the speed of the engine will of course permit springs 174 and 175 to return the centrifugal weights 164 and 165 to their normal position, and as they approach the axis of shaft 144 the plate 161 will be rotated in a direction opposite the arrow 161*a*, Fig. 1, resulting in a moving back or retardation of the time of sparking impulses.

When the suction of the engine increases, the movement of the diaphragm 196 toward the right, as has been described heretofore, will cause plunger 198 to be moved to the right as regards Fig. 4, resulting in the movement of the collar 153 upwardly due to the counter-clockwise movement of the bell crank lever 211 in direction of arrow 210*a*. This, as has been described, results in a rotation of the intermediate shaft 144 in a direction of arrow 210*a* relative to the driving shaft 140 due to the provisions of the oblique groove 155 and a stationary groove 156 in the collar 153 which, coacting with pin 158 and key 157 respectively, will result in said added rotation of the shaft 144. This added rotation of shaft 144 is transmitted directly from said shaft through the split chuck 176, speed governor including plates 168, weights 164 and 165 and plate 161, which is secured to the gear shaft 160 and thus the added rotation of the intermediate shaft 144 will result in an advance in the time of sparking impulses for the engine. Reduction of suction acts inversely, causing a rotation of shaft 144 in a direction opposite arrow 210*a* relative to the shaft 140 due to the downward movement of collar 153, which results in retardation of sparking time.

In summarizing, the present ignition device comprises a housing which comprises two timer-distributor units. One of said units is adjustable relative to the housing. Each timer-distributor unit has two circuit interrupters all operated by driving mechanism supported by the housing. The said driving mechanism is connectible with a moving part of the engine, usually the cam shaft. The housing is supported upon the engine so that it may be rotated relative thereto for purposes of initially, properly locating the one timer-distributor unit, preferably the non-adjustable one, relative to the engine cam shaft. The other timer-distributor unit is adjustably supported upon

the housing so that it may be moved into proper angular relation with the initially adjusted timer distributor unit. Proper intervals between circuit interruptions are thus provided between the two units.

Proper contact separation in all of the interrupters is provided by the adjustment of the separate interrupters radially of their cams.

Proper operation of the cooperating interrupters at the proper intervals is obtained by adjusting one of said interrupters relative to its cooperating interrupter.

The time of sparking impulse is adjusted automatically by a speed governor responsive to variations in engine speed and by a suction device responsive to variations in engine suction and load conditions.

The driving mechanism may be adjusted angularly by the operation of a manually adjustable chuck whereby the time of sparking impulses may be altered.

In short the present device provides for a plurality of adjustments in order to obtain proper setting of the ignition device so that it will function to provide sparking impulses at proper times in the cycle of engine operation and at proper intervals, automatic controls being provided to vary the time of sparking impulses for the engine in accordance with speed, suction and load conditions of said engine.

While the form of embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An ignition device for a multicylinder engine comprising, in combination, a housing; a plurality of timer-distributor units supported by the housing, a common driving means connecting the timer-distributor units with a rotating member of the engine; and a plate rigidly secured to the housing, said plate being adapted adjustably to secure the housing to the engine, the adjustment of the housing relative to the engine varying the angular positions of the timer-distributor units relative to the rotating member of the engine.

2. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing having a shank portion adapted to be received by the engine rotatably supporting the housing on the engine; a plurality of timer-distributor units supported by the housing; a common driving means connecting the said units with a rotatable member of the engine; a plate rigidly secured to the housing, having curved elongated slots concentric to the shank of the housing; and clamping screws extending through said slots and into the engine for securing the plate to the engine in properly adjusted position.

3. An ignition device for a multicylinder engine comprising in combination, a housing having a hollow shank adapted to be received by the engine rotatably supporting the housing on the engine; a drive shaft journalled in the hollow shank and operatively connected with a rotatable member of the engine; a driven shaft at right angles to the drive shaft and operatively connected with the drive shaft; timer-distributor units supported by the housing and operated by the driven shaft; and a plate rigidly secured to the housing and being adapted adjustably to secure the housing to the engine, the adjustment of said housing relative to the engine varying the angular relation between the driving and driven shafts.

4. An ignition device for a multicylinder internal combustion engine comprising, in combination, a housing; a hollow shank portion integral with the housing and adapted to be received by the engine rotatably supporting said housing on the engine; a drive shaft journalled in the hollow shank and operatively connected with a rotatable part of the engine; a driven shaft operatively connected with the drive shaft; a plurality of timer-distributor units supported by the housing and operated by the driven shaft; and a plate rigidly attached to the housing and adapted to secure the housing to the engine, said plate having provisions to permit adjustment of the housing relative to the engine, such adjustments changing the angular relation between the timer-distributor units and the rotatable part of the engine to which they are connected.

5. An ignition device for a multicylinder internal combustion engine comprising, in combination, a main housing; a plurality of timer casings carried by said housing; a timer unit in each of said casings; and means for adjustably securing one of said casings to the housing.

6. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; an integral casing on said housing; a timer in said casing; a separate casing rotatably secured to the housing; means on said casing, engaging the housing to limit the rotation thereof relative to said housing; a timer in said separate casing; and common means for driving both timers.

7. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a partition in said housing forming an immovable casing; a timer in said casing; another casing rotatably carried by the housing; a timer in said other casing; and a common driving element for both timers.

8. An ignition device for a multicylinder

internal combustion engine comprising in combination, a main housing; a plate rigidly attached to the main housing and adapted movably to secure said housing to the engine; a plurality of casings carried by the housing; means for adjustably securing one of said casings to the housing; a circuit interrupter in each casing; and a common driving means for all circuit interrupters.

9. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a drive shaft rotatably supported therein; a driven shaft at right angles to the drive shaft and operatively connected thereto; a timer casing integral with the housing; a timer in said casing, operated by one end of the driven shaft; another casing rotatably secured to the housing; a timer in said casing, operated by the other end of the driven shaft; and a plate rigidly secured to the housing and rotatably attached to the engine for adjustably securing the housing to the engine.

10. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing adjustably secured to the engine; a partition in said housing forming a casing at one end thereof; a timer unit in said casing; another casing rotatably supported at the other end of the housing; means for limiting the rotative movement of said timer casing upon the housing; a timer in said casing; and a common driving member for both timers.

11. An ignition device for a multicylinder internal combustion engine comprising in combination, a T-shaped housing having a main upright portion and a cross-arm portion, supported at a base of its upright portion rotatably upon the engine; a fixed casing at one end of the housing cross-arm portion; a timer in said casing; another casing rotatably attached at the other end of the housing cross-arm portion; a timer in said casing; a drive shaft substantially coaxial of the upright portion of the housing; and a driven shaft substantially coaxial of the cross-arm portion of the housing, operatively connected to the drive shaft and to the timers in the casings at the ends of the housing cross-arm portion.

12. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a drive shaft journalled in said housing; a counter-shaft rotatably supported in said housing and operatively connected with the drive shaft; timer-distributor units supported by the housing and operated by the counter-shaft; a plurality of circuit interrupters in each of said units, at least one of said interrupters of each unit being movably supported so as to be adjustable in a circular path coaxial of the cam shaft.

13. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a drive shaft journalled in said housing; a counter-shaft rotatably supported in said housing and operatively connected with the drive shaft; cams on the counter-shaft; timer-distributor units supported by the housing and operated by the counter-shaft; a plurality of circuit interrupters in each of said units, at least one of said interrupters of each unit having provisions for adjusting it in a circular path concentric to the axis of the housing to vary the angular relation between said interrupters and their respective cams of the counter-shaft.

14. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a drive shaft journalled in said housing; a counter-shaft rotatably supported in said housing and operatively connected with the drive shaft; cams provided by the counter-shaft; timer-distributor units supported by the housing and operated by the counter-shaft; a plurality of circuit interrupters in each of said units, one interrupter of each unit having provisions for adjusting it in a circular path concentric with the axis of the cam-shaft to vary the angular relation between said interrupter and the cams of the shaft; the other interrupter of each unit having provisions for adjusting it radially relative to said cam-shaft.

15. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a plurality of timer-distributor units supported on said housing; a drive shaft journalled in said housing; a counter-shaft for operating all of the timer-distributor units; and a clamping member for operatively connecting the two shafts, said member being releasable to permit adjustment of the one shaft relative to the other.

16. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a plurality of timer-distributor units supported on said housing; a drive shaft journalled in said housing; a counter-shaft provided with cams adapted to operate all of the timer-distributor units; an intermediate shaft rotatable with the drive-shaft; means including a gear operatively connected to the counter-shaft and supported upon the intermediate-shaft so as to be rotatable relative thereto; and means manually operable to be wedged between the intermediate-shaft and the aforementioned means for operatively connecting the two shafts.

17. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing, a plurality of timer-distributor units supported on said housing; a drive-shaft journalled in said housing; a

counter-shaft provided with cams adapted to operate all of the timer-distributor units; a gear supported by the drive-shaft so as to be rotatable relative thereto said gear being operatively connected to the counter-shaft; a centrifugal governor carried by the gear so as to be rotatable therewith; and a manually adjustable chuck carried by the drive-shaft and operable to secure the centrifugal governor to the drive-shaft whereby the gear is rotated at the speed of the drive-shaft at constant engine speeds and relative to said drive-shaft in response to variations in speeds of the engine.

18. An ignition device for a multicylinder internal combustion engine comprising in combination a housing adjustably supported on the engine; a driving shaft journalled in said housing; a cam-shaft rotatably supported in the housing and operatively connected to the driving shaft; timer-distributor units supported by the housing one of said units being bodily adjustable relative to said housing; circuit interrupters in each of said units operated by the cam-shaft, a plate movably supporting one of the circuit interrupters of each unit providing for its adjustment relative to the housing in a path concentric to the axis of the cam shaft, and a bracket supporting another one of said circuit interrupters of each unit to provide for adjusting it radially relative to the cam-shaft.

19. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing supported on the engine; a drive shaft journalled in said housing; a cam shaft rotatably supported in the housing and operatively connected with the drive shaft; timer-distributor units one rigidly, the other rotatably supported on the housing; a plurality of circuit interrupters in each of said units, operated by the cam-shaft; means rigidly secured to the housing securing the housing adjustably to the engine; means secured to the rotatably supported timer-distributor unit for adjusting said unit relative to the rigidly supported unit and for securing said unit to the housing in the adjusted position, said adjustment varying the angular relation between the cam-shaft and the interrupter in said unit; a plate supporting the one interrupter of each unit so as to be adjustable in a circular path substantially concentric to the axis of the cam-shaft to vary the angular relation between said interrupters and the cam-shaft; and a bracket supporting each of the other interrupters of the units said brackets being movable to adjust said interrupters radially relative to the cam-shaft.

20. An ignition device for a multicylinder internal combustion engine comprising, in combination, a housing adapted to be supported by the engine; timer-distributor units supported by the housing; a drive shaft journalled in the housing and adapted to be connected with a rotatable part of the engine; a cam-shaft rotatably supported by the housing and adapted to operate the timer-distributor units; a gear rotatably supported by the drive shaft and operatively engaging the cam-shaft; and means connecting the gear and drive shaft, said means being adapted, in response to varying speeds of said drive shaft to rotate the gear relative to said drive shaft to alter the angular relation therebetween.

21. An ignition device for a multicylinder internal combustion engine comprising in combination, a plurality of timer-distributor units; common means for operating all of said timer-distributor units, including a drive shaft, a cam-shaft and a gear supported by the drive-shaft so as to be rotatable relative thereto and operatively connected to the cam-shaft; and means connecting the gear and drive-shaft, said means including a governor adapted to vary the angular relation between said gear and drive-shaft in response to varying speeds of the drive-shaft.

22. An ignition device for a multicylinder internal combustion engine comprising, in combination, a housing supported upon the engine so as to be adjustable manually relative thereto; a plurality of timer-distributor units supported by the housing; means for operating said units, said means comprising a drive shaft adapted to be operatively connected to a rotatable part of the engine, a cam-shaft, a gear supported by the drive shaft so as to be rotatable relative thereto and operatively connected to the cam-shaft, and means connecting the gear and drive-shaft, said means being adapted to rotate the gear relative to the drive-shaft in response to variations in the speed of the drive-shaft rotation.

23. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a plurality of timer-distributor units, one of which is rigidly supported, the other adjustably supported by said housing; a drive-shaft in said housing adapted to be connected with a rotatable part of the engine; a cam-shaft in said housing adapted to operate the timer-distributor units; a gear supported by the drive-shaft so as to be rotatable relative thereto, said gear being operatively connected to the cam-shaft; means operatively connecting the gear and drive-shaft, said means being adapted to rotate the gear relative to the drive-shaft in response to variations in the rotating speed of the drive-shaft to vary the time of sparking impulses during engine operation, means for securing the housing to the engine in various positions rotatably about the axis of its drive shaft whereby to provide for set-

ting initially, the angular relation between the drive shaft and the rotatable part of the engine by which said shaft is driven.

24. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a plurality of timer-distributor units one of which is rotatably supported upon said housing; a drive-shaft journalled in said housing; a cam-shaft rotatably supported by said housing and operatively connected to all of the timer-distributor units; an intermediate shaft supported by and operatively connected to the drive-shaft; a cover for the housing providing a bearing in which one end of the intermediate shaft is journalled; a gear supported on said intermediate shaft so as to be rotatable relative thereto and operatively connected to the cam-shaft; and means operatively connecting the gear with said intermediate shaft, said means being adapted to rotate the gear relative to said shaft in response to varying speeds of said shaft.

25. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a plurality of timer-distributor units supported on said housing; a drive-shaft journalled in said housing; a cam-shaft rotatably supported by said housing and operatively connected to all of the timer-distributor units; an intermediate shaft supported by and operatively connected to the drive-shaft; a cover for the housing providing a bearing in which one end of the intermediate shaft is journalled; a gear supported on said intermediate shaft so as to be rotatable relative thereto and operatively connected to the cam-shaft; and a speed governor comprising a base plate and weights pivotally supported on said base plate, the base plate being secured to the gear and the weights in operating engagement with the intermediate shaft whereby the gear will be rotated with the said shaft, and in response to variations in speed will be rotated relative to said shaft.

26. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a plurality of timer-distributor units supported by said housing; a drive-shaft; an intermediate gear-shaft adapted to be driven by the drive shaft to operate all of the said units; and means adapted to adjust the angular relation between the drive-shaft and intermediate gear-shaft in response to variations in the engine load conditions whereby to vary the time of ignition impulses for the engine.

27. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a plurality of timer-distributor units supported by said housing; a drive shaft journalled in said housing; a cam-shaft rotatably supported by said housing and operatively connected to all of the timer-distributor units; an intermediate shaft supported by the drive-shaft so as to be rotatable relative thereto, said intermediate shaft being operatively connected to the cam-shaft; coupling means operatively connecting the drive and intermediate shafts so that both shafts rotate together, said means being operable to rotate the intermediate shaft relative to the drive-shaft; and means connected to the coupling means for operating said coupling means in response to variations in the suction of the engine.

28. An ignition device for a multicylinder internal combustion engine comprising in combination, a housing; a plurality of timer-distributor units supported by said housing; a drive-shaft journalled in said housing; a cam-shaft rotatably supported by said housing and operatively connected to all of the timer-distributor units; an intermediate shaft supported by the drive-shaft and a portion of the housing so as to be rotatable relative to said drive-shaft; a gear carried on the intermediate shaft so as to be rotatable relative thereto, said gear being operatively connected to the cam-shaft; a speed governor connecting the gear and intermediate shaft so that the said shaft will rotate the gear to drive the cam-shaft, said speed governor being adapted to rotate the gear relative to the intermediate shaft in response to variations in the speed of said shaft; coupling means connecting the drive and intermediate shafts so that the one will rotate with the other, said coupling means being operable to rotate the intermediate shaft relative to the drive-shaft; and means connected with the coupling means for operating said coupling means in response to variations in engine load conditions.

29. An ignition device for a multicylinder internal combustion engine, having a predetermined range of movement for varying the time of sparking impulses, comprising in combination, a housing; a plurality of timer-distributor units supported upon the housing; means for operating all of said units; speed controlled means for operating the ignition device through a portion of its range of movement to vary the time of sparking impulses; and engine suction controlled means operating through the speed controlled means for moving the ignition device through another portion of its range of movement to vary the time of sparking impulses.

In testimony whereof I hereto affix my signature.

JOHN T. FITZSIMMONS.