

C. F. KETTERING.
IGNITION SYSTEM.

APPLICATION FILED AUG. 30, 1915. RENEWED DEC. 5, 1917.

1,272,056.

Patented July 9, 1918.

4 SHEETS—SHEET 1.

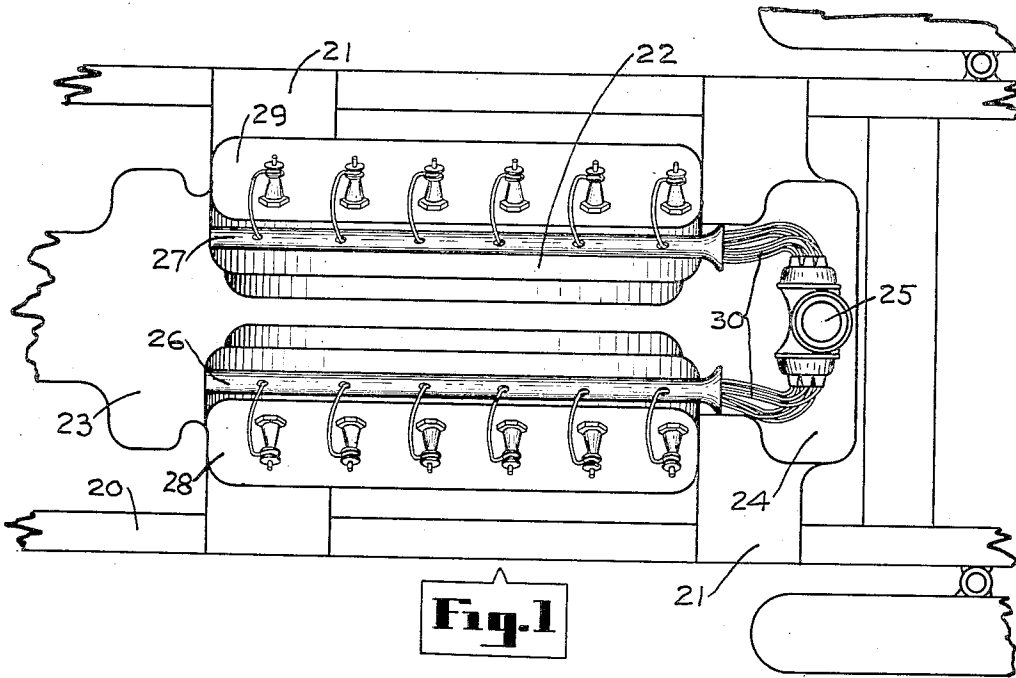


Fig. 1

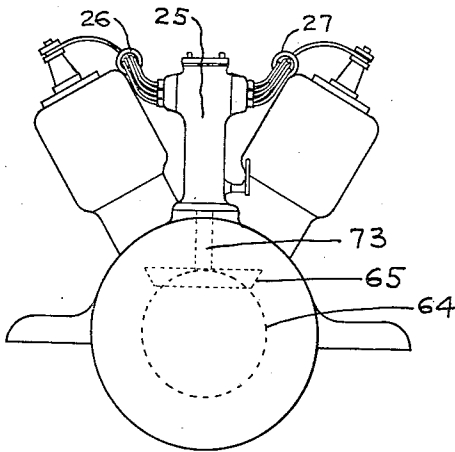


Fig. 2

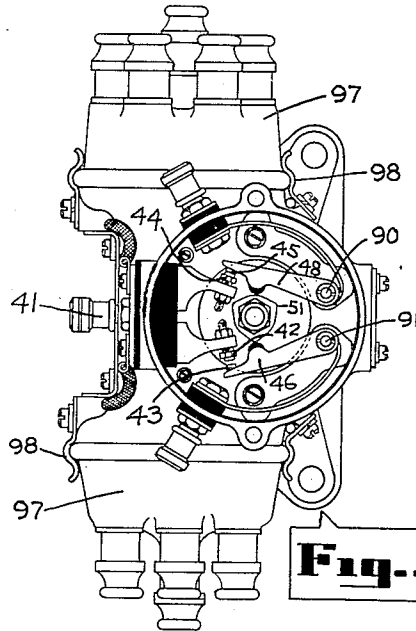


Fig. 3

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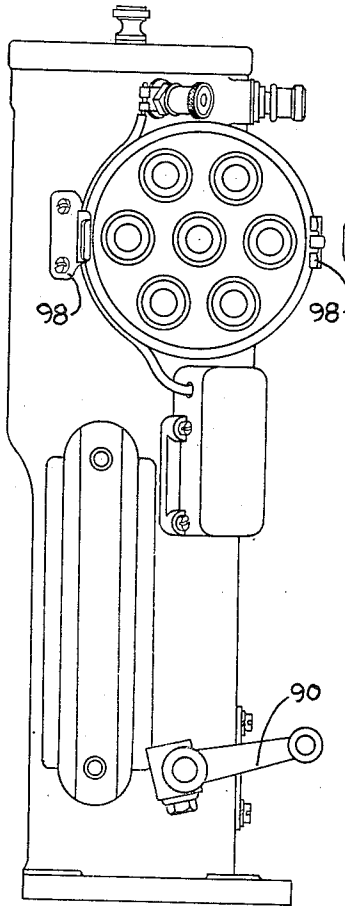


Fig. 4

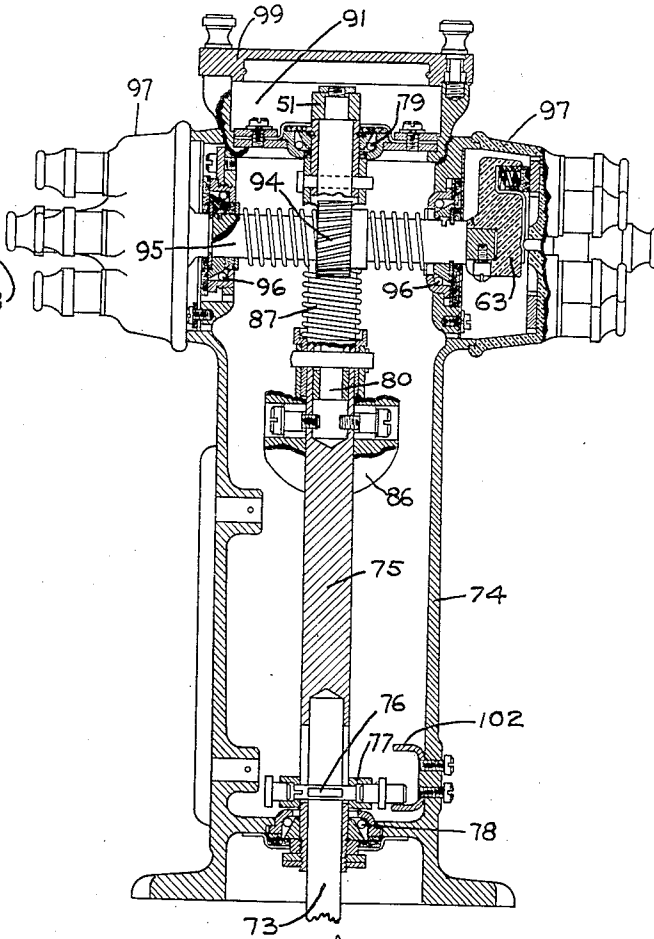


Fig. 5

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IGNITION SYSTEM.

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4 SHEETS--SHEET 3.



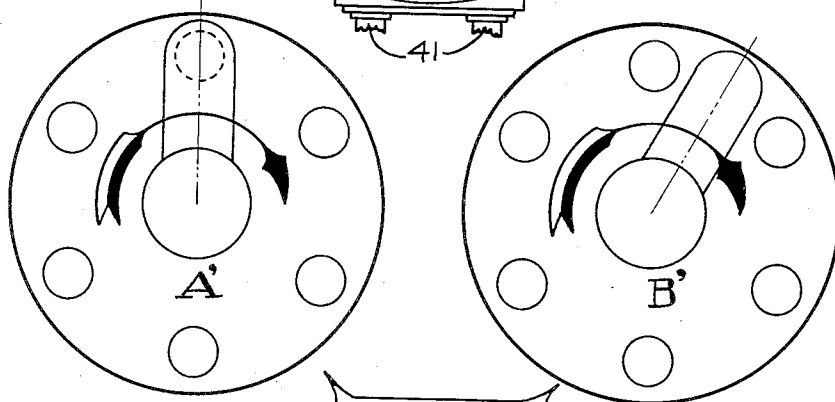
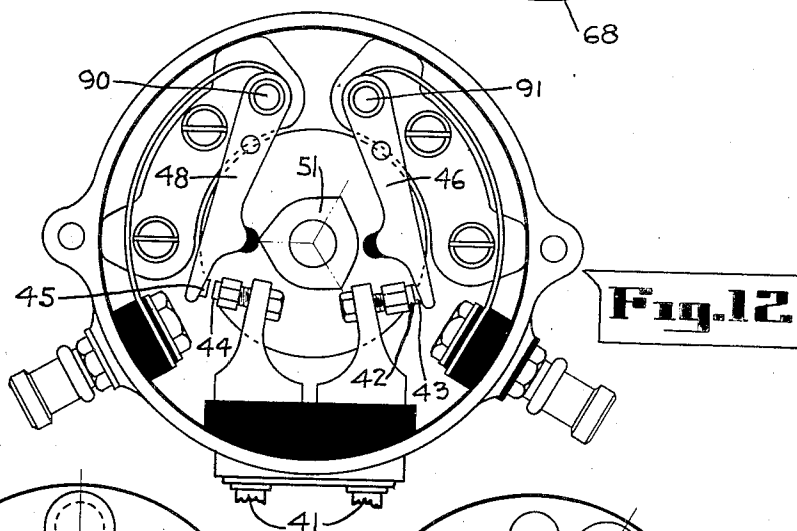
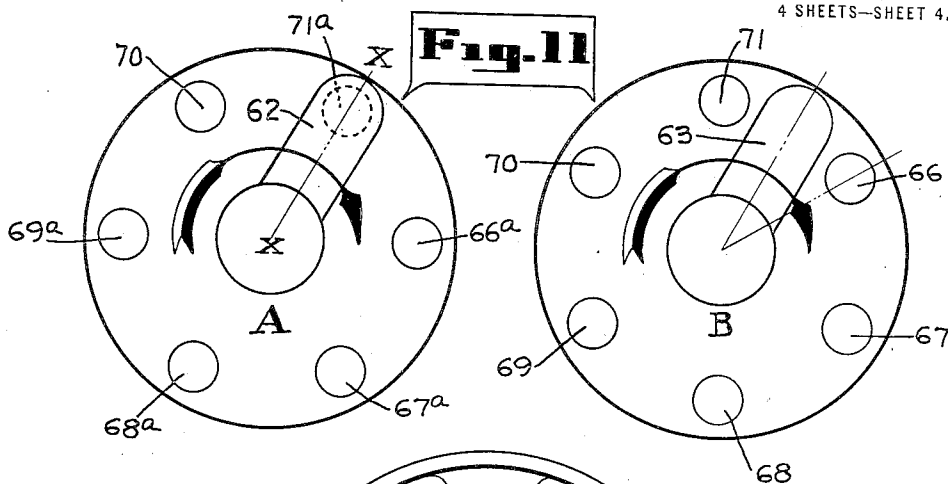
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4 SHEETS—SHEET 4.



Witnesses
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UNITED STATES PATENT OFFICE.

CHARLES F. KETTERING, OF DAYTON, OHIO, ASSIGNOR TO THE DAYTON ENGINEERING LABORATORIES COMPANY, A CORPORATION OF OHIO.

IGNITION SYSTEM.

1,272,056.

Specification of Letters Patent.

Patented July 9, 1918.

Application filed August 30, 1915, Serial No. 47,962. Renewed December 5, 1917. Serial No. 205,666.

To all whom it may concern:

Be it known that I, CHARLES F. KETTERING, a citizen of the United States of America, residing at Dayton, county of Montgomery, and State of Ohio, have invented certain new and useful Improvements in Ignition Systems, of which the following is a full, clear, and exact description.

This invention relates to improvements in ignition systems for internal combustion or explosion engines, and more particularly to ignition systems adapted to be used with engines of the high speed type.

One of the objects of the present invention is to provide an ignition system which will furnish efficient ignition for the engine, regardless of whether the engine is running at substantially low speed or at its maximum speed.

Another object of the present invention is to provide an ignition system, wherein the operable parts of the ignition unit are so combined that a sufficient time interval will elapse between each of the successive operations of the various parts, to permit the same to resume their normal condition and thereby operate efficiently when brought into effect.

One manner of bringing about the aim of the above object is to provide an ignition system having distributing devices combined with certain arrangements, which give the requisite number of sparking impulses to supply the engine with efficient ignition, and then having mechanism for so operating these distributing devices that the sparking impulses are selected by the alternate effective operation of these devices, so as to select and distribute the sparking impulses in a recurrent sequence.

More specifically, the aim of the above object may be brought about by providing an ignition system having a plurality of distributing devices, which include elements through which the selection or distribution of the sparking impulses are effected, the respective elements of the different distributors being set different degrees apart, that is, the stationary contacts of one distributor being set ahead of the stationary contacts of the other distributor, so that the contacts of said distributors may be said to be in staggered relation, and then actuating the movable contacts of the respective distributors concurrently, it being understood that

the movable contacts of the respective distributors are positioned in alinement and operate together.

Or, another manner of attaining the above mentioned object of the invention may be to position the stationary contacts of the respective distributors directly in alinement and then setting the movable elements of each of the distributors a certain number of degrees apart, so that they will be in staggered relation relative to each other.

From the above, it will be seen that in each cycle of operation of the engine, first one of the distributing devices will be effective to select the proper cylinder in which the sparking impulse is to occur, and then another of the distributing devices will be brought into effect to select the next cylinder in which the sparking is to occur.

Under certain conditions, it may be desirable to make sure of securing the requisite number of sparking impulses.

In multiple cylinder engines of the high speed type, it is sometimes difficult to secure a single induction coil which will, when the engine is operating at high speed, operate fast enough to efficiently provide the sparking impulses. That is, the primary winding of the induction coil will not be able to build up and break down quick enough to supply the necessary number of impulses per minute.

The present invention also has for another of its objects to combine a plurality of induction coils and circuit break and make devices, in combination with a plurality of distributing devices, whereby when one of said induction coils and one of said circuit break and make devices, together with one of the distributing devices are in operation, the other set of devices, including the induction coil, make and break device and distributor, will be ineffective, in so far as effective operation is concerned, and therefore the respective parts particularly the induction coil will have sufficient time to resume its normal condition between each of its active operations.

Another object of the present invention is to provide timing and distributing devices including moving parts in combination with driving connections whereby the moving parts of the timing devices will be driven at a different ratio of speed than the moving parts of the distributing devices.

A further object of the present invention resides in providing an ignition system of compact construction and one wherein the various parts are readily accessible for repairs or adjustments.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

Figure 1 is a top plan view of a part of an automobile chassis, showing the present invention as combined with the engine of an automobile.

Fig. 2 is a view in end elevation of an engine with the ignition system installed thereon, the engine in the present view being shown as removed from the automobile chassis for the sake of clearness.

Fig. 3 is a top plan view of the ignition unit removed from the engine, with certain of the parts removed to disclose the arrangement of the timing mechanism.

Fig. 4 is a view in side elevation of the distributor unit shown in Fig. 3.

Fig. 5 is a vertical sectional view of the unit shown in Fig. 4, certain of the operative parts being shown in elevation to more clearly show the relative arrangement of certain of the parts.

Fig. 6 is a vertical sectional view of the ignition unit shown in Fig. 4, the outer casing being cut away to disclose certain of the operative parts of the system.

Figs. 7, 8 and 9 are detail views of some of the elements shown in Fig. 6.

Fig. 10 is a diagrammatic view of the electrical circuits and connections included in the present invention.

Fig. 11 is a detail view, partly diagrammatic, of the distributor device included in the present invention, showing the stationary contacts of one of the distributing units set ahead of the other in staggered relation relative to the stationary contacts of the other distributor.

Fig. 12 is a plan view of the circuit breaking and making devices, which cooperate with the distributing device shown in Fig. 11.

Fig. 13 discloses a modification of the distributing unit shown in Fig. 11, wherein the stationary contacts, or terminals of the distributing devices, are set directly in alignment, while the movable contacts of the respective distributing units are set one ahead of the other, or in staggered relation.

Referring to the drawings, and more particularly to Figs. 1, 2 and 3 thereof, there is shown a part of a chassis of an automobile, the side frames of which are designated by the numeral 20, having transverse arms 21, which support an engine 22. This

engine is of a type similar to that embodied in the automobile which is known to the trade as the Packard, and is of the high speed, multiple cylinder type.

This engine is shown as having twelve cylinders, which are disposed in groups of six on each side of the crank case, and at a certain angle thereto (see Fig. 2), so that there is provided an intermediate space between the respective sets of cylinders.

The engine 22 is provided with the usual crank case 23, which forms, or is joined to, a casing for inclosing the timing gears of the engine, and designated by the numeral 24, as is shown in Fig. 1.

The housing 24 is utilized in the present invention as a mounting for the ignition unit 25, inasmuch as it permits the ignition unit to be mounted in the intermediate space between the two sets of diverging cylinders, and at the same time makes possible a convenient drive for this ignition unit from the timing gears of the engine.

In order to prevent confusion in the wiring of the engine, and also to provide protection for the ignition wires, a separate conduit is mounted adjacent to each set of cylinders, these conduits being designated by the numerals 26 and 27 respectively. It will be well understood that the said conduits are provided with openings through which the leads 30 extend to the spark plugs of the respective cylinders of the engine.

In providing ignition for engines of the high speed type, it is extremely advisable that the ignition system be as efficient at high speeds of the engine as at its low speeds. It will, of course, be understood that in an ignition system of this type, wherein engines of the multiple cylinder type are employed, a large number of sparks per minute are required. In this connection, the time interval between the successive sparking impulses is extremely limited, and of course becomes more and more limited as the speed of the engine increases.

The present invention tends to compensate for the increased speeds of the multiple cylinder engine, by providing a system of ignition wherein a sufficient time interval is provided between each successive sparking impulse, to permit the parts of the ignition system to efficiently perform their required functions.

One manner of securing the above result is disclosed in diagrammatic Fig. 10 of the drawings, which clearly sets forth the electrical circuits and connections.

By referring to this figure, it will be noted that the source of current may comprise a number of dry cells 33, or a storage battery, or other source 34. The source of current is controlled by the switch 35 which is operable to connect either of the above men-

tioned sources with the main circuit of the system.

If it is desired to use the storage battery source, the ignition switch 35 will be operated to close the contacts 37 and 38, whereby current will flow from the storage battery 34 through the conductor 36, across the contacts 37 and 38, conductor 39 to the common terminal 41, which forms a part of the timing and distributing unit of the ignition system, and which is carried by the unit 25 mentioned heretofore. From this terminal, the current will pass through one of the circuit interrupters which is associated with the primary circuits of the ignition system.

If the timer cam 51 is in the position shown in Fig. 10, the current will pass across the contacts 44 and 45, through contact arm 48 to the primary winding 49 of the induction coil 31, thence back to the battery, via the conductor 50. However, as soon as the cam 51 moves out of the position shown in Fig. 10, the contacts 43 and 42 will close, and the following circuit will be created:

From the terminal 41, through contacts 42 and 43, arm 46, primary winding 47 of the induction coil 32, back to the battery, via the conductor 50.

The next operation effected by the movement of the cam 51 will be to again open contacts 45 and 44, thereby inducing a sparking impulse in the secondary winding 53 of the induction coil 31. It will therefore be seen that for each alternate and successive opening of the contacts 44 and 45, and the contacts 42 and 43, by the timer cam 51, there will be a sparking impulse induced in the secondary windings 53 and 52 of the induction coils 31 and 32 respectively.

In this connection it will be noted that the secondary winding 53 is provided with a conductor 60, which is electrically connected with a main contact terminal 61. This terminal is in connection with a movable contact member 62, which is driven by the engine in a manner described hereinafter. As the member 62 rotates, it will successively engage the stationary contact elements 66, 67, 68, 69, 70 and 71 respectively. However, at the same time that the above operation is in effect, the other distributor will also be in operation.

This other distributing device includes the movable contact 63 and the stationary contacts 66^a, 67^a, 68^a, 69^a, 70^a and 71^a respectively, but, as will be explained hereinafter, these stationary contacts are preferably arranged in staggered relation, relative to the contacts of the other distributor.

Now, if the stationary contacts of each of these distributors were in alinement, and if each of the rotors or movable contacts of the distributors were also in alinement, it will be seen that there would be a tendency to create

sparking impulses in the respective secondary windings concomitantly.

However, in order to provide a suitable time interval between the successive sparking impulses induced in the respective secondary windings, the stationary contacts of the respective distributors are staggered; that is, the stationary contacts of the distributor "A" are moved ahead of the stationary contacts of the distributor "B", so that selecting a given line $x-x$ on distributor "A" as zero, it will be noted that the first contact of the distributor "B" is located thirty degrees ahead of the zero point of distributor "A", while the first contact of distributor "A" is located sixty degrees from the zero point on said distributor, and thirty degrees ahead of the first contact of distributor "B".

This arrangement is followed out in exactly the same way, in respect to the remaining contacts of the two distributors, so that it may be said that each of the movable contacts of the respective distributors must travel sixty degrees from one stationary contact to another, and inasmuch as these rotors are in direct alinement, as has been explained above, while the stationary contacts of each of the distributors are staggered with relation to each other, only one of the distributors will be effective to distribute sparking impulses to the cylinders of the engine at a given time.

As a modification of the arrangement and construction of the parts shown in Fig. 11, substantially the same results may be obtained by alining the stationary contacts of the respective distributors and staggering the movable contacts or rotors, so that the rotor of distributor "B" will be thirty degrees in advance of the rotor of distributor "A".

From the above description of the electrical circuits and connections, it will be noted that during the interval that one of the induction coils and one of the circuit break and make devices, and one of the distributing devices are in effective operation, to create the required sparking impulses, the other induction coil, break and make device, and distributing device, are inoperative so far as the creation of a sparking impulse is concerned.

Therefore, during the time interval that one of these sets of devices is in effective operation, the individual elements of the other set of devices are inoperative, so far as the creation of sparking impulses is concerned, and therefore a sufficient time is provided for these elements to regain their normal condition, before they are brought into operation to create the next successive sparking impulse.

This operation is, of course, continued throughout each cycle of operation of the

engine, so that it will be seen that the sets of devices will be brought into effective operation alternately and in a recurrent sequence.

By referring to Figs. 11 and 12, it will be noted that the make and break devices are actuated alternately and in a recurrent sequence, by means of the three point engine driven cam designated by the numeral 51. The lobes of this cam are spaced apart, substantially 120 degrees, but inasmuch as this cam is actuated by the engine at substantially the speed of the engine crank shaft, said cam will complete two revolutions during each cycle of operation of the engine. Therefore, the respective contact elements 48 and 46 will be actuated to break and make the primary circuits, which are respectively connected to these elements, six times, and inasmuch as the make and break operations occur at different times at each of said contacts, there will be twelve effective break and make operations for each engine cycle.

The distributing devices "A" and "B" include the movable conductors 62 and 63, which are actuated at the same ratio of speed relative to each other, but which are actuated only one half as fast as the timer cam 51, which is operated at substantially engine speed. The means for driving the cam 51 at one ratio of speed relative to the engine crank shaft, and the movable elements of the distributing devices at a different ratio of speed, will be explained more fully hereinafter.

In this connection, it should be understood that the embodiment shown in the accompanying drawings, and described in the specification, has simply been selected for purposes of illustration, and in this embodiment, a 12 cylinder 4 cycle engine is shown and described.

However, it will be understood that this is not intended as any limitation, but that an engine of a different number of cylinders, and of a different cycle of operation may be combined with the present system, without departing from the present invention.

It should also be understood that the mechanisms described as forming a part of the ignition system embodied in the present invention, have been selected simply for purposes of illustration. For instance, while the engine actuated timer cam has been described as including three lobes, each of which is effective relative to two sets of contacts during each engine cycle, a different arrangement of the cam and contacts may be readily employed.

That is, a timer cam, having six lobes may be readily substituted for the cam of three lobes and then actuating the said timer cam at a different speed ratio relative to the speed of the engine, the only requirement being that the cam actuate the contacts a

proper number of times to secure a sufficient number of sparking impulses.

It has been stated heretofore that the ignition unit 25 is mounted on the engine in such a position that the respective distributing devices will be adjacent to the set of cylinders with which they are electrically connected.

One preferred embodiment of the mechanical constructions embodied in the present invention will now be described, reference being had particularly to Figs. 1 to 9 inclusive. In this connection, the ignition unit 25 comprises a main casing 74, which may be of any suitable contour, but which is adapted to constitute a housing for the operative parts of the timing and distributing mechanisms.

By referring to Fig. 2, there is shown in dotted lines a driving connection between an engine actuated member 64 and the beveled pinion 65. This pinion 65 is secured to a shaft 73, see Figs. 2, 5 and 6, one end of which extends into the casing 74, and passes into a hollow end of a transmission shaft 75. This shaft 73 constitutes an intermediate drive between the engine and the timing mechanism, and is secured to the movable parts of the timing mechanism by means of a pin 76, which passes through a straight slot 100 in said shaft, and also through an angular slot 101 formed in the transmission shaft 75. This pin is connected to a sleeve 77, which in turn is connected to and adapted to be actuated by a suitable lever construction 90. The transmission shaft 75 is mounted at the opposite ends of the casing 74, on suitable bearings 78 and 79, which may be of the ball type, to facilitate the operation of said shaft.

It has already been explained that the lower end of said shaft is hollowed out to receive the shaft 73. The upper end of this shaft is also hollowed out and is adapted to receive the stub shaft 80, which carries the timer cam 51, and which when mounted in the upper end of the transmission shaft 75, is so positioned that this cam 51 projects into a compartment 91, wherein the contact arms 46 and 48, together with the contact points 44 and 45, and 42 and 43 respectively, are maintained in such a position as to be readily engaged by the lobes of the cam, when the parts are in operation.

The stub shaft 80 is provided with a curved slot 81, which lies in alinement with the straight slot 82, formed in the transmission shaft 75. A driving connection between the stub shaft 80 and the transmission shaft 75 is provided, by means of a pin which passes through the straight and curved slots of the stub shaft 80 and the transmission shaft 75 respectively. This pin has connection with one end of a link 84, while the other end of said link is pivotally secured to

a weight member 86, this weight member in turn being pivotally mounted on the transmission shaft 75, in any suitable manner, such as is shown in Fig. 5.

5 This weight member is normally held in a determined position by means of the coil spring 87, surrounding the shaft 75, one end abutting against the spiral pinion 88, while the other end abuts against a collar or sleeve 89, which is secured to and carried by the pin and link connection heretofore described.

The timing mechanism, which includes the circuit break and make devices referred to heretofore, comprises in the present instance, 15 two sets of contacts, one of said sets comprising the arm 48 and contacts 45 and 44, while the other set comprises the arm 46 and the contacts 43 and 42 respectively. The arms 48 and 46 are pivotally mounted as at 20 90 and 91 respectively, and are so positioned relative to each other that the parts of said arm which are engaged by the lobes of the cam 51, are substantially 180 degrees apart. The contacts 42 and 44 are shown in the present instance as being separate contacts, so far as the mechanical structure goes, but these contacts are secured to a common electrical connection, see for instance the common terminal 41 in Fig. 10.

However, it has been found by experiments that where the contacts 42 and 44 were mounted on a single supporting member, the concussion of the blow of either 35 of the arms 48 or 46 against their respective contacts, would cause a chattering or vibrating of the other arm, relative to its contact, so that at high speeds, a chattering effect which was extremely objectionable to efficient operation, was created. 40 However, by separating these contacts 42 and 44, this objectionable disadvantage has been substantially eliminated.

The spiral pinion 88, referred to heretofore, is mounted in fixed relation relative to the transmission shaft 75, by means of any suitable connection, as at 93. This pinion is adapted to constantly enmesh with the spiral gear 94, which in turn is connected to a shaft 95 which extends transversely or at right angles relative to the shaft 75. This shaft 95 is suitably mounted adjacent to its opposite ends on bearings 96, which in turn are securely held in the casing 74. The extreme opposite ends of the shaft 95 project through the respective bearings and carry a rotor 63, which as has been explained heretofore in connection with diagrammatic Figs. 10 to 13 inclusive, forms the movable 50 part or contact of the distributing devices.

These rotors are each inclosed within a compartment formed by means of the distributor heads 97, which carry the stationary contacts referred to heretofore, of the 65 distributing mechanisms. Each of these

distributor heads 97 are of substantially the same construction, but, as has been explained heretofore, the stationary contacts of one of these distributor heads are in staggered relation relative to the stationary 70 contacts of the other distributor head, as is clearly shown and described in connection with Fig. 11.

This staggered relation of the stationary contacts of the distributor heads may be 75 readily maintained by securing the respective heads in determined position by means of clips 98 of any approved construction.

From the foregoing description, it will be seen that the break and make mechanisms, 80 that is, the sets of contact devices and the engine actuated timer cam, are mounted within the compartment 91, which has a suitable inclosure 99, readily removable so that any suitable repairs or adjustments of 85 the parts may be made. It will further be noted that the distributing units are mounted in compartments formed on the side of the casing 74, and have the moving parts thereof inclosed by the distributor 90 head itself, so that upon the removal of the distributor heads, any suitable repairs or adjustments may be effected.

From the description heretofore given, it will be seen that when the engine is in 95 operation, the shaft 73 will tend to drive the shaft 75, and this shaft in turn will tend to drive the timer cam 51.

The distributing mechanism, including the rotors 62 and 63, will also be driven at a 100 given speed ratio by the spiral gear connections shown in Figs. 5 and 6. It will, of course, be understood that by changing the diameters of the spiral pinions, this speed ratio may be changed to give any desired 105 ratio which may be proper for the efficient operation of the system, and it will also be understood that in the connection shown in Fig. 2, between the shaft 73 and the engine driven gear wheel 64, the speed ratio of the 110 drive from the engine to the timer cam may be changed likewise, to meet various conditions.

In connection with the operation of the ignition unit, it is generally desirable to 115 provide for adjusting the timing and distributing mechanism, so as to regulate the time of occurrence of the sparking impulses, in accordance with engine conditions.

It has already been described that the 120 shaft 75 has driving connection with the timing cam 51, through a pin which passes through the straight slot 82, formed in the shaft 75, and the curved or angular slot 81 in the stub shaft.

This pin is connected to the link 84, which is also secured to the weight 86. This weight is normally in unbalanced position, see Figs. 6 and 7, and is pivotally mounted on the shaft 75. Now, it will be seen that 130

as the speed of the shaft 75 increases, this weight will tend to assume a balanced position, and the movement of the weight toward balanced position, will tend to force
5 the pin upwardly and thereby effect a movement of the stub shaft 80, relative to the transmission shaft 75. Inasmuch as this stub shaft carries the timer cam 51, said cam will be moved relatively to the contact arms
10 48 and 46 respectively.

The above described operation will result in the advancing of the spark, as will be readily understood. However, in the present instance, the automatic control has a restricted range, so that it is possible to change
15 the timing of the spark by simply adjusting the cam 51, without adjusting any of the parts of the distributing mechanisms.

This is made possible in the present instance by making the stationary contacts of the distributors of such diameter that for any range of adjustment, which can be secured by the automatic arrangement heretofore described, a sufficient contact between
20 the movable and stationary contacts of the distributors, will insure the proper distribution of the sparking impulses.

As a result of the above, the operation of the automatic device will only have to overcome whatever frictional resistance there may be in the operation of the stub shaft 80,
30 relative to the shaft 75.

It has also been described heretofore that the driving connection between the engine driven shaft 73 and the transmission shaft 75, is secured by means of a suitable pin 76,
35 which passes through the straight slot in the shaft 73, and also through an angular slot formed in the transmission shaft 75. This pin is connected to a sleeve 77, which in turn is suitably secured to a lever construction 90. This lever construction is adapted to be so
40 positioned that it may be readily actuated by the operator, to control the time of occurrence of the sparking impulses manually.

The range of movement of the lever construction 90 is limited by means of suitable stops formed by the flanged member 102, which is secured to the casing 74. Upon
50 movement of the lever 90, the sleeve 77, together with the pin 76, will be moved upwardly, and inasmuch as the curved slot in this instance is formed in the transmission shaft 75, and the straight slot in the shaft
55 73, the transmission shaft 75, together with the stub shaft 80 and the pinion 88 will be moved ahead, relative to the movement of the shaft 73, so that this will result in the advancement of the timer cam 51, and also
60 in the advancement of the rotors 62 and 63 of the distributing devices.

This is made necessary in the present instance, because of the fact that the range of the manual advance is so great that there

should be an equal movement of the timer 65 cam 51 and the rotors of the distributors, so as to insure the proper operations.

While the form of mechanism herein shown and described constitutes a preferred form of embodiment of the invention, it is
70 to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What I claim is as follows:

1. In an ignition system, the combination 75 with a plurality of primary and secondary electric circuits including terminals and spark plugs; of means for breaking and making the primary circuit; and a plurality of distributing devices for selecting said secondary circuits in a predetermined and re-
80 current sequence.

2. In an ignition system, the combination with a primary electric circuit having a current interrupter and an operating member
85 for actuating said interrupter; of secondary electric circuits including terminals and spark plugs; and a plurality of distributing devices actuated to select the different secondary circuits.
90

3. In an ignition system the combination with a primary electric circuit; of means for making and breaking said circuit; a plurality of secondary circuits including terminals and spark plugs; a plurality of distributing devices for said secondary circuits,
95 operable alternately and in a recurrent sequence to select the different secondary circuits in a recurrent sequence.

4. In an ignition system, the combination 100 with a primary electric circuit; of means for breaking and making said circuit; a plurality of secondary circuits including terminals and spark plugs; a plurality of distributing devices for said secondary circuits; and
105 means for actuating said distributing devices in a recurrent sequence to select the different secondary circuits.

5. In an ignition system, the combination 110 with a primary electric circuit having a plurality of means for breaking and making said circuit; a plurality of secondary circuits including terminals and spark plugs; and a plurality of distributors; and means
115 for actuating the break and make devices alternately, and actuating the distributors to alternately select the different secondary circuits in a recurrent sequence.

6. In an ignition system, the combination 120 with a primary circuit having a plurality of means for breaking and making the same; said means being set a determined number of degrees apart; means for actuating said break and make devices alternately; a plurality of secondary circuits; a plurality of
125 distributors including stationary and movable contacts, the stationary contacts of one distributor being set a determined number

of degrees ahead of the respective stationary contacts of the other distributor; and means for bringing said distributor into effective operation alternately to select the secondary

whereby the said distributors will be brought into effective operation alternately to select the secondary circuits in a recurrent sequence.

5 circuits in a recurrent sequence.

7. In an ignition system, the combination with a primary circuit having a plurality of means for breaking and making the same; said being set a determined number of degrees apart; means for actuating said break and make devices alternately; a plurality of secondary circuits; a plurality of distributors including stationary and movable contacts, the stationary contacts of one distributor being set a determined number of degrees ahead of the respective stationary contacts of the other distributor; and means for bringing one of said means for breaking and making the primary circuit of one of the distributors into effective operation concomitantly, and then bringing the other means for breaking and making the primary circuit and another distributor into effective operation to select a different secondary circuit.

8. In an ignition system, the combination with a plurality of primary and secondary circuits; of means for making and breaking the primary circuit; a plurality of distributors each including stationary and movable contacts, the stationary contacts of one distributor being set in staggered relation relative to the stationary contacts of the other distributor; and means for actuating the break and make devices of the primary circuit and the movable contacts of the distributors concomitantly, whereby the said distributors will be brought into operation alternately, to select the secondary circuits in a recurrent sequence.

9. In an ignition system, the combination with a plurality of primary and secondary circuits; of means for making and breaking the primary circuit; a plurality of distributors, each including stationary and movable contacts, the stationary contacts of one distributor being set in alinement relative to the stationary contacts of the other distributor; the movable contacts of one of said distributors being set in staggered relation, whereby the respective distributors will be brought into effective operation alternately.

10. In an ignition system, the combination with a plurality of primary and secondary circuits; of means for making and breaking the primary circuit; a plurality of distributors, each including stationary and movable contacts, the stationary contacts of one distributor being set in alinement relative to the stationary contacts of the other distributor; the movable contacts of one of said distributors being set in staggered relation; and means for actuating the break and make devices of the primary circuit and the movable contacts of the distributors concomitantly,

11. In an ignition system, the combination with a plurality of primary electric circuits; an induction coil associated with each of said primary circuits, including a primary and a secondary winding; a plurality of secondary circuits associated therewith; of break and make devices for said primary circuits; distributors associated with said secondary circuits; and actuating mechanism for operating the make and break devices to open and close the respective primary circuits alternately and in a recurrent sequence, and to operate the distributors alternately to select the respective secondary circuits in a recurrent sequence.

12. In an ignition system, the combination with a plurality of primary electric circuits; an induction coil including a primary and secondary winding associated with each of said primary circuits; a plurality of secondary circuits associated with each of the induction coils; a make and break device for each of said primary circuits; a distributor associated with the respective sets of secondary circuits; of actuating mechanism for bringing one of said break and make devices, one induction coil and one of the distributors into effective operation to secure one sparking impulse and then bringing another of the primary circuits, another induction coil, and another distributor into operation to select another of the secondary circuits to generate the next successive sparking impulse.

13. In an ignition system, the combination with an electric circuit; of a plurality of circuit break and make devices included therein, disposed and spaced apart substantially 180 degrees; a plurality of sets of secondary circuits, each including stationary and movable contacts, the stationary contacts of one distributor being set a determined number of degrees ahead of the stationary contacts of the other distributor; a main operating member comprising a cam having contact points of equal angular spacing, adapted to operate the circuit break and make devices alternately; and driving mechanism adapted to operate the movable contacts of the respective distributors concomitantly, whereby said distributors will be brought into effective operation alternately to select the secondary circuits in a recurrent sequence.

14. In an ignition system for combustion engines, the combination with an engine having a plurality of cylinders; of an ignition system including a plurality of primary and secondary circuits; make and break devices for said primary circuit; and a plu-

ality of distributing devices for said secondary circuits; an engine driven member having provisions for actuating the make and break devices; and a drive shaft actuated by said engine driven shaft to effectively operate the distributing devices alternately, whereby the secondary circuits will be selected in a recurrent sequence.

15. In an ignition system for combustion engines, the combination with an engine having a plurality of cylinders; an ignition system therefor, including a plurality of primary and secondary circuits; make and break devices for said primary circuit; distributing devices associated with the secondary circuits; an engine driven member having provisions for actuating the make and break devices; and a drive shaft, each end of which is connected with one of the distributing devices and having driving connection intermediate the ends thereof with said engine driven member, whereby one of the break and make devices and one of the distributing devices will be actuated concomitantly to generate sparking impluses.

16. In an ignition system for combustion engines, the combination with an engine having a plurality of cylinders; of an ignition system therefor, including spark timing and distributing devices; and an engine driven member having driving connection with the timing and distributing devices, and having provisions for driving the timing devices at one speed ratio and the distributing devices at a different speed ratio, relative to the speed of the engine driven member.

17. In an ignition system for combustion engines, having a plurality of cylinders; the combination with an ignition system therefor, including a plurality of primary and secondary circuits; a make and break device for said primary circuit; a distributing device for said secondary circuits; and engine driven means for actuating the make and break device and the distributing device concomitantly, but at different speed ratios relative to the speed of the engine driven member.

18. In an ignition system, the combination with primary and secondary circuits; of a timing device including cooperating contacts in said primary circuit; a distributing device for the secondary circuits; an engine driven member having provisions for opening and closing the contacts in the primary circuit and for driving the distributing devices; and means operable relative to the engine driven member for changing the operation of said member relative to the timing contacts, without affecting the relation of the distributing device to the secondary circuits.

19. In an ignition system, the combination with primary and secondary circuits; of a

timing device including cooperating contacts in the primary circuit; a distributing device for the secondary circuits; an engine driven member operable to open and close the contacts in the primary circuit and to drive each of the distributing devices; and means for automatically actuating the engine driven member in accordance with the speed of the engine, to change the time of opening and closing the contacts in the primary circuit without affecting the relation of the distributing devices to the secondary circuits.

20. In an ignition system, the combination with primary and secondary circuits; a timing device for said primary circuit; and distributing devices for the secondary circuits; means for automatically changing the relation of the timing devices relative to the primary circuit, without affecting the relation of the distributing devices to the secondary circuits; and manual means for changing the relation of the make and break devices, relative to the primary circuit and concomitantly changing the relation of the distributing devices relative to the secondary circuits.

21. In an ignition system, the combination with a combustion or explosion engine having a plurality of cylinders arranged in parallel rows; of an ignition system for said engine, including a distributing device for each row of cylinders; secondary circuits connected with the cylinders of one row of cylinders to the respective distributors; and a common driving means for bringing the distributors into effective operation alternately to select the secondary circuits of the cylinders in a recurrent sequence.

22. In an ignition system, the combination with a combustion or explosion engine having a plurality of cylinders arranged in parallel rows; of an ignition system for said engine, including a timing and distributing device mounted between the adjacent rows of cylinders, one of the distributing devices being positioned on each side of the timing device, and each adjacent to one of the rows of cylinders; secondary circuits adapted to connect each distributor with the cylinders of the row adjacent to said distributor; and an engine driven means for bringing each distributor into effective operation alternately, whereby to select alternately the secondary circuits of the cylinders in a recurrent sequence.

23. In an ignition system, the combination with a combustion or explosion engine having a plurality of cylinders arranged in parallel rows; of an ignition system for said engine, including a timing and distributing device mounted intermediate said rows, said device having a removable distributor head connected on the opposite side thereof and in alinement with the respective rows of

cylinders; secondary terminals adapted to connect the respective cylinders of one row with one of the distributors; and a conduit adapted to carry the secondary terminals whereby the removable head will be supported by said conduits when it is removed from the distributor.

24. In an ignition system, the combination with primary and secondary circuits, including terminals and spark plugs; of timing means for breaking and making the primary circuit; and a plurality of distributing devices positioned on the opposite sides of the timing means.

25. In an ignition system for combustion engines, the combination with a plurality of primary and secondary circuits; a timing device for said primary circuit; a distributing device for said secondary circuits; and means for driving the timing device and distributing device at different speeds.

26. In an ignition system for internal combustion or explosion engines, the combination with a pair of movable contact elements; two stationary contacts mechanically mounted independent of each other and each coöperating with one of said movable contacts; electrical means connecting said stationary contacts; and an engine actuated element for operating the movable contacts alternately into and out of engagement with the respective stationary contacts.

27. In combination with a multi-cylinder internal combustion engine; an ignition system including primary and secondary electric circuits; an engine driven distributing means for recurrently establishing said secondary circuits; and a timing device including a plurality of pairs of movable and stationary contacts, means for maintaining said contacts in closed position; and engine driven means for recurrently opening said contacts in such relation to the distributing means that the opening of each one of said pairs of contacts by the engine driven means to produce one sparking impulse, is effected concurrently with the establishing of a secondary circuit by the distributing means to distribute the impulse to the correct cylinder.

28. The combination with a multi-cylinder internal combustion engine; of an ignition system comprising a plurality of induction coils; electrical connections including primary and secondary circuits; engine driven distributing means for recurrently closing said secondary circuits; and a timing device including a plurality of pairs of movable and stationary contacts connected in said primary circuits; means for maintaining said contacts in closed position; and engine driven means for recurrently opening said contacts.

29. A timing device for the ignition systems of internal combustion engines, comprising a plurality of primary make and break devices, each consisting of a stationary and a movable contact, and resilient means urging said movable contact against a stationary contact; an engine driven cam for successively separating said movable contacts from said stationary contacts; engine driven distributing means including a rotary contact member and a plurality of distributor terminals; and circuit connections and devices whereby upon separation of the contacts of each of the make and break devices, a sparking impulse is produced, and is distributed by said distributing means.

30. In combination with an internal combustion engine including a plurality of cylinders; an ignition system including primary and secondary electric circuits; distributing means for recurrently establishing said secondary circuits; and a timing device including a plurality of movable and stationary contacts; means for maintaining the said contacts in closed position; and an engine driven cam provided with a plurality of projecting lobes located at an equal distance from the center of the cam and bearing a predetermined relation to the number of engine cylinders for recurrently opening said contact members.

In testimony whereof I affix my signature in the presence of two subscribing witnesses.

CHARLES F. KETTERING.

Witnesses:

J. W. McDONALD,
O. D. MOWRY.