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IGNITION APPARATUS

Filed Sept. 16, 1931

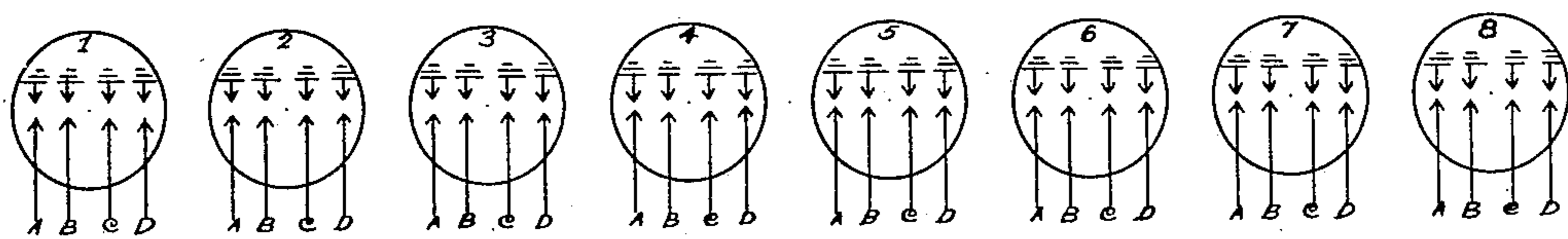
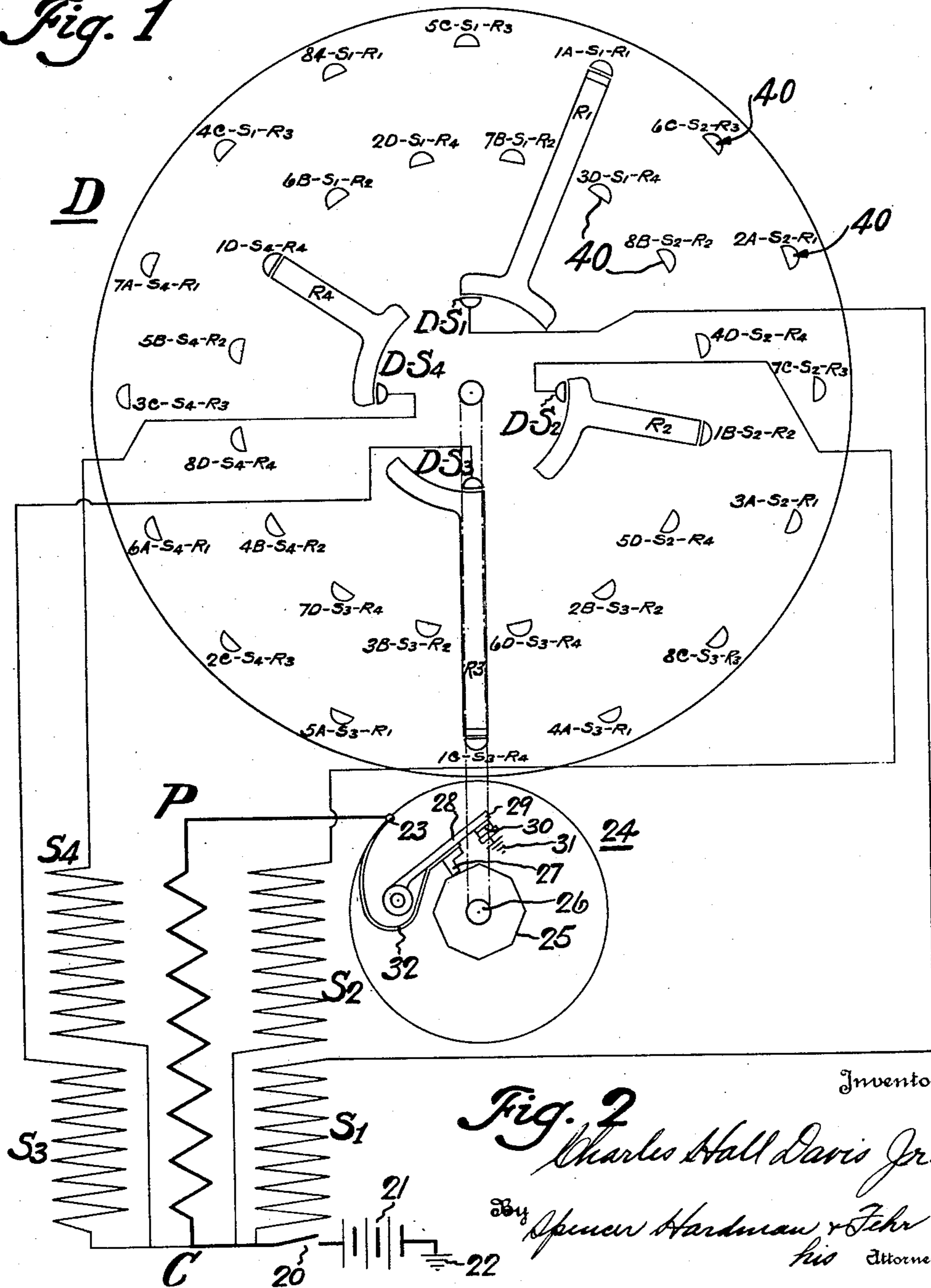


Fig. 1



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Fig. 2

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IGNITION APPARATUS

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This invention relates to ignition apparatus for internal combustion engines and more particularly to engines having a plurality of explosion periods during each engine cycle and requiring the firing of a plurality of spark gaps at each explosion period. One example of such engine might be a heavy duty internal combustion engine such as used to furnish the power for gasoline-electric trains of the type wherein an internal combustion engine operates a generator which in turn operates electric motor mechanically connected with the wheels of the car.

It is one of the objects of the present invention to provide ignition apparatus for supplying concurrently a plurality of sparking impulses to the groups of spark gaps to be fired at each explosion period. In the disclosed embodiment of the present invention this object is carried out by providing an induction apparatus having as many secondary terminals as there are spark plugs in each engine cylinder, or spark plugs to be fired at each explosion period by providing an ignition interrupter which will cause sparking impulses to be generated simultaneously in the secondary coils of the induction apparatus to which the secondary terminals are connected, and by providing an ignition distributor having a head carrying a circular row of posts to which the secondary terminals are respectively connected, said head also carrying concentrically with respect to the secondary terminal posts, a row or rows of distributor posts to which the spark plugs are respectively connected, and by providing a distributor rotor having a plurality of distributing arms each so constructed and arranged so as to pass between the secondary terminal posts and the spark plug posts of the head while remaining out of contact therewith in order that it may cooperate with any of the secondary coil terminal posts of the distributor head to conduct sparking impulses from the secondary coils to certain ones of the spark plug terminal posts of the distributor head.

Further objects and advantages of the present invention will be apparent from the

following description, reference being had to the accompanying drawing wherein a preferred embodiment of one form of the present invention is clearly shown.

In the drawing:

Figs. 1 and 2 taken together constitute a wiring diagram illustrating the present invention.

Referring to the drawing an induction coil C is provided with a primary coil P and with four secondary coils S1, S2, S3 and S4 which are connected respectively with secondary terminal posts D—S1, D—S2, D—S3, D—S4 carried by a distributor head D. The secondary coils S1, S2, S3 and S4 and the primary P are connected by switch 20 with a battery 21 grounded at 22. Primary P is connected with terminal 23 of an ignition timer 24 comprising a cam 25 driven by shaft 26 and cooperating with the rubbing block 27 attached to a circuit breaker lever 28 carrying a contact 29 cooperating with a stationary contact 30 and grounded at 31. The rubbing block 27 is urged toward the cam 25 and the contact 29 toward contact 30 by a leaf spring conductor 32 having one end attached to the terminal 23 and the other to the lever 28. It is, therefore, apparent that each time the pair of contacts 29, 30 are separated by the action of the cam 25 upon the rubbing block 27, four sparking impulses will be generated simultaneously in the secondary coils S1, S2, S3 and S4. The four sparking impulses generated in the ignition coil C each time the terminal contacts are separated are conducted to the various spark plugs of the engine cylinders in a manner to be described.

The cylinders of the engine are designated in Fig. 1 by the circles numbered 1 to 8 inclusive respectively. The four spark plugs of each cylinder are lettered A, B, C and D respectively.

Each of the engine spark plugs is connected by a wire, not shown, to one of a required number of distributor posts 40 carried by the head D. Obviously, there are as many distributor posts 40 as there are spark plugs. For example, in the disclosed

embodiment of the present invention the engine has 8 cylinders each provided with 4 spark plugs making a total of 32 spark plugs. The distributor head D has 32 distributor posts 40 to which the engine spark plugs are respectively connected. All of the distributor spark plug posts 40 may be arranged in a single row concentric with the row of secondary terminal posts D—S1, D—S2, D—S3 and D—S4, or these distributor spark plug posts 40 may be arranged in staggered relation in two or more concentric circular rows in order to provide for properly insulating the posts 40 from each other.

The distributor head D cooperates with four distributing arms R1, R2, R3, and R4 which are mounted upon a suitable rotor block, not shown, and driven by the shaft 26. It will be observed that each distributor rotor arm has a portion extending radially with respect to the axis of the shaft 26 and an arcuate portion which extends coaxial with the shaft 26 through an angle which is greater than one-half the angle between any two adjacent secondary terminal posts. The rotors R2 and R4 of shorter length distribute only to the inner row of posts 40, and the rotor arms R1 and R3 of greater length distribute only to the outer row of distributor posts 40. The rotors R1 and R3 during their rotation about the shaft 26 will not interfere with the inner row of distributor posts 40.

In order to avoid a complicated illustration of the present invention by a multiplicity of wires connecting the spark plugs of the engine respectively with the distributor posts 40, each distributor post has been labeled in such a way as to indicate the spark plug to which it is connected, and also to indicate the means whereby a distributor post receives a sparking impulse at the time an impulse is provided for the spark plug to which that post is connected. For example, the distributor spark plug post 40 nearest the top of the drawing has been numbered 5C—S1—R3. The indicia 5C means that distributor post 40 is connected with spark plug C of cylinder number 5; the indicia S1 means that secondary coil S1 serves to provide the sparking impulses for the spark plug 5C; and the indicia R3 means that rotor R3 is located so as to bridge the gap between secondary terminal post D—S1 and said distributor post 40 (marked 5C—S1—R3) at the time the sparking impulse is generated. It will be observed that each of the distributor spark plug posts 40 is similarly designated by three indicia. In each instance the first indicia indicates the cylinder and plug to which that post is connected, the middle indicia indicates the secondary coil and the secondary terminal post which is active to furnish

a sparking impulse, and the third indicia indicates which rotor serves to conduct the sparking impulse from the secondary terminal post to the distributor spark plug post.

In the present invention the cam shaft 26 rotates at cycle speed that is, one-half engine speed for a four cycle internal combustion engine or the engine speed for a two cycle internal combustion engine. The shaft 26 operates a circuit interrupter cooperating with induction coil C in such a manner that during each revolution of shaft 26 there will be generated as many sets of sparking impulses as there are engine cylinders. There will be as many sparking impulses in each set of impulses as there are spark plugs to be fired. In order to provide for the distribution of these sparking impulses the present invention contemplates the use of as many distributor rotor arms as there are spark plugs in each cylinder, each rotor arm cooperating with each of a number of secondary terminal posts arranged in a circular row on the distributor head, the number of posts being also equal to the number of spark plugs in each cylinder. The present invention contemplates that each of the distributor rotor arms is capable of occupying as many sparking-impulse-conducting positions as there are engine cylinders; and that in any sparking-impulse-conducting position of a rotor, said rotor is located in cooperative relation with respect to one of the secondary terminal posts of the distributor head; and that each one of said secondary terminal posts of the distributor head serves all of the distributor rotor arms during each rotation thereof of the distributor rotor arms. For example, in the disclosed embodiment of the invention there are eight cylinders each having four spark plugs, therefore, the cam 25 must be provided with eight lobes so that, during each rotation thereof, the cam will operate upon the rubbing block 27 eight times so that eight instances of sparking impulse generation will occur during one revolution of shaft 26. In each instance of sparking impulse generation four sparking impulses will be generated simultaneously by the four secondary coils S1, S2, S3 and S4. Since there are four sparking impulses generated simultaneously in each instance of sparking impulse generation four separate rotors are required to distribute the four sparking impulses to the four spark plugs of any one cylinder. Since each rotor has eight sparking-impulse-conducting-positions corresponding in number to the number of cam lobes of cam 25, and since there are but four secondary terminal posts to be placed in conductive relation with respect to the rotor in eight different positions thereof, it is apparent that each secondary terminal post must be in conductive relation with respect to each

rotor in two consecutive positions of that rotor during a complete rotation of the shaft 26. Therefore, since each rotor moves 45° between sparking-impulse-conducting positions, each rotor must be provided with an arcuate portion extending through an angular distance of at least 45° so that in two consecutive positions of any rotor one of the secondary terminal posts will be in conductive relation thereto. Obviously, in the disclosed embodiment of the present invention the length of the arcuate portion of each rotor is an arc subtended by an angle of greater than 45° .

The present invention may be applied to engines having other numbers of cylinders and numbers of spark plugs per cylinder. For example, an ignition apparatus for a six cylinder engine having three spark plugs per cylinder would require a six lobe cam and three secondary windings and terminals corresponding to the number of spark plugs. The three secondary terminal posts of the distributor head would be equidistant angularly namely at 120° in a circular row on the distributor head. The number of rotor arms would be three and each rotor arm would have an arcuate portion subtended by an angle at least equal to one-half the angle between the secondary terminal posts, namely an angle of at least 60° .

From the examples given, it is obvious that the invention may be applied to other combinations of numbers of cylinders and numbers of spark plugs in each cylinder.

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. Ignition apparatus for internal combustion engines having a plurality of spark gaps to be supplied with sparking impulses at each explosion period comprising, in combination, means for generating sparking impulses and having a plurality of terminals, engine operated circuit breaker means for controlling the sparking impulse generators, a distributor head carrying a circular row of posts connected respectively with spark gaps, a plurality of posts of substantially the same width as the spark gap posts of the head, and arranged concentrically therewith, and connected respectively with terminals of the spark generating means, a plurality of distributing arms arranged to pass between the first and second mentioned posts but out of contact therewith in order to distribute sparking impulses from the second mentioned posts to certain of the spark gap posts, and means for operating the circuit breaker means and for rotating the distributing arms,

2. Ignition apparatus for internal combustion engines having a plurality of spark gaps to be supplied with sparking impulses at each explosion period comprising, in combination, means for generating sparking impulses and having a plurality of terminals, engine operated circuit breaker means for controlling the sparking impulse generators, a distributor head carrying a circular row of posts connected respectively with spark gaps, a plurality of posts of substantially the same width as the spark gap posts of the head and arranged concentrically therewith, and connected respectively with terminals of the spark generating means, a plurality of distributing arms arranged to pass between the first and second mentioned posts but out of contact therewith in order to distribute sparking impulses from the second mentioned posts to certain of the spark gap posts, each arm having an arcuate end portion which moves past the second mentioned posts and which receives a plurality of sparking impulses from one of the second mentioned posts before passing into cooperative relation with another of the second mentioned posts, and means for operating the circuit breaker means and for rotating the distributing arms.

3. Ignition apparatus for internal combustion engines having a plurality of spark gaps to be supplied with sparking impulses at each explosion period comprising, in combination, means for generating sparking impulses and having a plurality of terminals, engine operated circuit breaker means for controlling the sparking impulse generators, a distributor head carrying a circular row of posts connected respectively with spark gaps, a plurality of posts of substantially the same width as the spark gap posts of the head and arranged concentrically therewith and connected respectively with terminals of the spark generating means, a plurality of distributing arms arranged to pass between the first and second mentioned posts but out of contact therewith in order to distribute sparking impulses from the second mentioned posts to certain of the spark gap posts, each arm being so constructed that coincidentally with the discharge of a series of sparking impulses, it will present different portions thereof consecutively adjacent to one of the second mentioned posts before said arm passes into cooperative relation with another of the second mentioned posts, and means for operating the circuit breaker means and for rotating the distributing arms.

4. Ignition apparatus for internal combustion engines comprising, in combination, a distributor for distributing sparking impulses to a plurality of spark gaps to be fired in groups simultaneously at each explosion

sion period, said distributor comprising concentric rows of distributor posts, one row of posts being connected respectively with the spark gaps of the engine, said distributor
 5 comprising a rotor carrying distributing conductors which move between the rows of posts in order to provide a conducting path between certain pairs of posts, the number of conductors being equal to the number of
 10 spark gaps to be fired simultaneously; and sparking impulse generating means controlled by the engine and connected with the other row of distributor posts.

5. Ignition apparatus for internal combustion engines comprising, in combination, means for generating sparking impulses and a distributor carrying a circular row of posts connected respectively with spark gaps of the engine; terminal posts carried by the
 15 head and connected with the sparking impulse generating means, and a distributor conductor which moves between said terminal posts and said posts in said circular row in order to provide a conducting path, said
 20 distributor conductor having an arcuate end portion which moves adjacent to said terminal posts.

6. Ignition apparatus for internal combustion engines comprising, in combination, means for generating sparking impulses and a distributor carrying a circular row of posts connected respectively with spark gaps of the engine; terminal posts carried by the
 25 head and connected with the sparking impulse generating means, and a distributor conductor which moves between said terminal posts and said posts in said circular row in order to provide a conducting path, said
 30 conductor being so constructed that coincidentally with a discharge of a series of sparking impulses, it will present different portions thereof consecutively adjacent to said terminal posts.

7. Ignition apparatus for internal combustion engines comprising, in combination, a distributor for distributing sparking impulses to a plurality of spark gaps to be fired in groups simultaneously at each explosion period, said distributor comprising concentric rows of distributor posts, one row of posts being connected respectively with spark gaps of the engine, sparking impulse
 35 generating means having terminals connected with another row of distributor posts, and said distributor including distributing conductor arms, each arm cooperating with alternate posts of the row of posts connected with spark gaps and each arm cooperating with all of the posts connected with
 40 sparking impulse generator terminals.

8. Ignition apparatus for internal combustion engines, comprising in combination, a distributor for distributing sparking impulses to a plurality of spark gaps to be
 45 fired in groups simultaneously at each explosion period, said distributor comprising concentric rows of distributor posts, one row of posts being connected respectively with spark gaps of the engine, sparking impulse
 50 generating means having terminals connected with another row of distributor posts, and said distributor including distributing conductor arms, each arm cooperating with alternate posts of the row of posts connected with spark gaps and each arm cooperating with all of the posts connected with
 55 sparking impulse generator terminals.

sion period, said distributor comprising concentric rows of distributor posts, one row of posts being connected respectively with spark gaps of the engine, sparking impulse
 60 generating means having terminals connected with another row of distributor posts, said distributor including distributing conductor arms, each arm cooperating with alternate posts of the row of posts connected with spark gaps and each arm cooperating with all of the posts connected with sparking impulse generator terminals, and each arm being so constructed as to cooperate with a sparking impulse generator terminal post a plurality of times during each cycle
 65 of operation of the distributor.

In testimony whereof I hereto affix my signature.

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