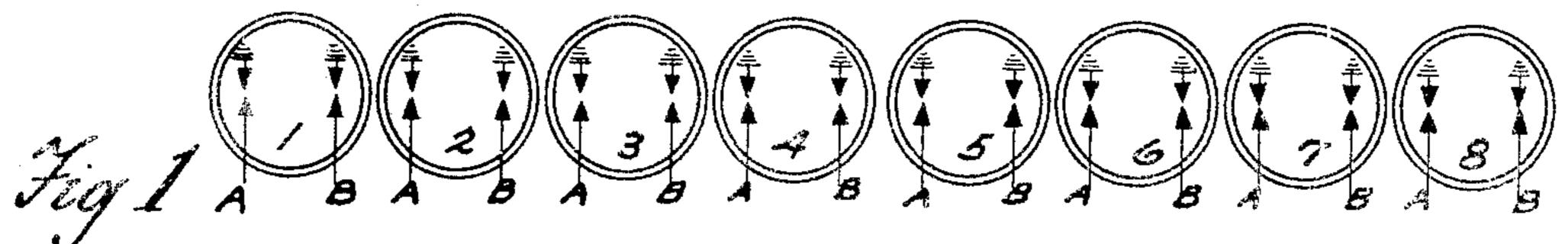
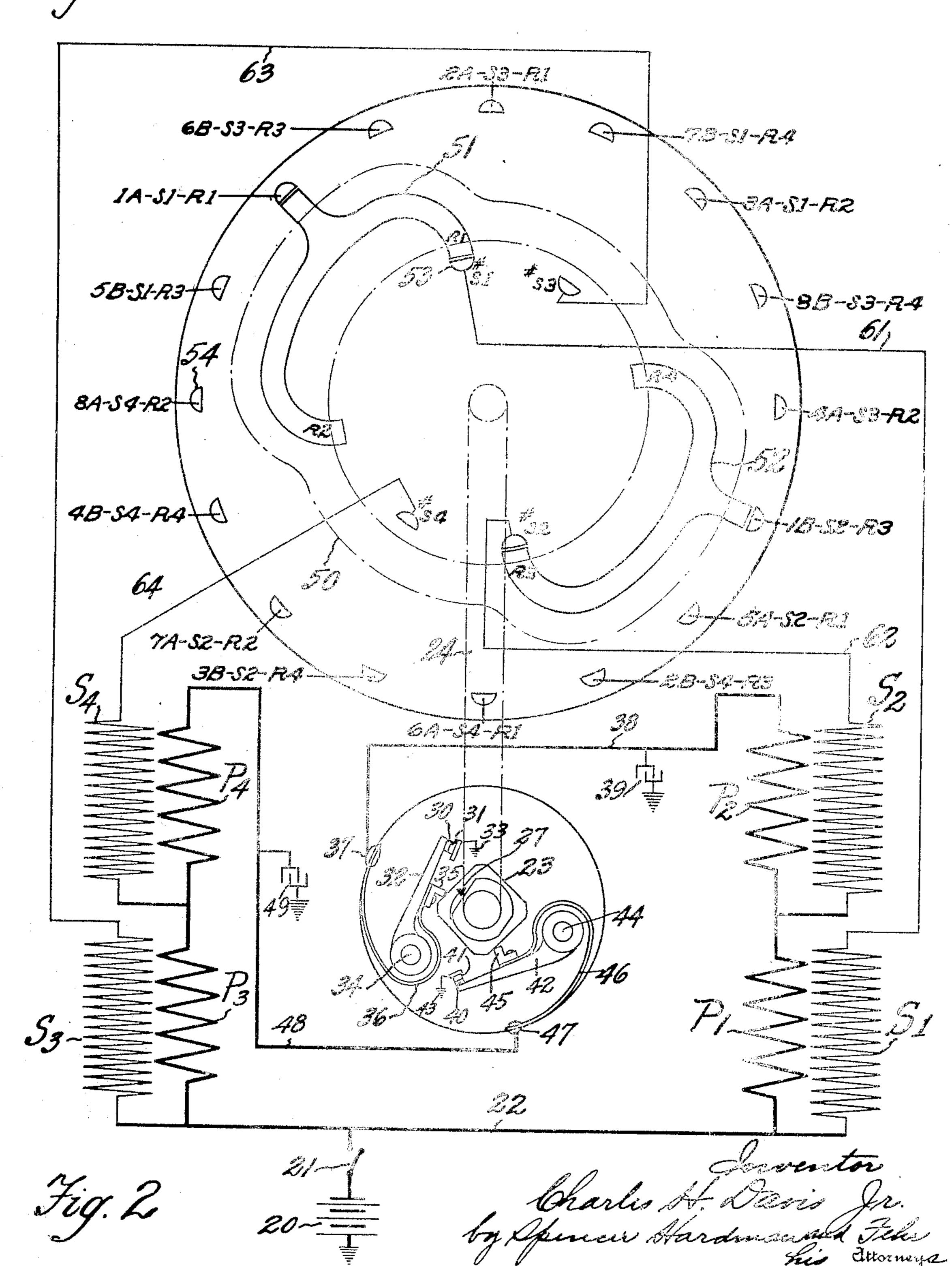
IGNITION APPARATUS

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CHARLES HALL DAVIS, JR., OF ANDERSON, INDIANA, ASSIGNOR TO DELCO-REMY CORPORATION, OF ANDERSON, INDIANA, A CORPORATION OF DELAWARE

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This invention relates to an ignition apparatus for an internal combustion engine and more particularly engines which have a plurality of spark gaps to be fired simultaneously.

It is an object of the present invention to provide a timer-distributor unit the distributor head of which requires a relatively small number of terminal posts from which sparking impulses are distributed to the 10 posts which are connected with spark gaps.

In order to accomplish this object the present invention provides a distributor head having concentric inner and outer rows of posts, one row of posts being connected respectively with the spark gaps and the other row of posts being connected with the terminals of the means for generating sparking impulses. This distributor head cooperates with an engine driven rotor having as many distributing conductors as there are, spark gaps to be fired at the same instant. Each conductor has a main stem which moves in proximity to the posts in one row, and each conductor has a plurality of branches which move in proximity to the posts in the other row, there being but one branch of each conductor adjacent to a post of each conductor is adjacent a post in the first mentioned row at the firing period of the engine.

following description, reference being had engine. to the accompanying drawing wherein a preferred embodiment of one form of the battery constitute sparking impulse generpresent invention is clearly shown.

In the drawing:

Figs. 1 and 2 constitute a wiring diagram

illustrating the present invention.

trates the cylinders of an 8 cylinder en- driven cam 23. One of these generators gine in which these cylinders are numbered comprises the coils P1—S1 and P2—S2 and from 1 to 8 and each cylinder has two spark the circuit interrupter which connects them ⁴⁵ plugs A and B.

Referring to Fig. 2 a storage battery 20 is connectable by switch 21 with a wire 22 connected with pairs of ignition coil primaries P1 and P2 and pairs of ignition coil co primaries P3 and P4. The primaries P1,

P2, P3 and P4 cooperate respectively with ignition coil secondaries S1, S2, S3 and S4. The primaries P1 and P2 are connected together in series with a circuit interrupter comprising a pair of contacts 30 and 31 attached respectively to a circuit breaker lever 55 32 and a ground connection 33. The lever 32 is pivoted at 34 and carries a rubbing block 35 which cooperates with a timer cam 23. The lever 32 is connected to one end of a leaf spring conductor 36 the other end 60 of which is connected to the terminal 37 which is connected by wire 38 to primaries P2 and P1. The contacts 30 and 31 are shunted by condenser 39. Similarly, the primaries P3 and P4 are connected together 65 in series with a circuit interrupter comprising a pair of contracts 40 and 41 attached respectively with a circuit breaker lever 42 and a ground connection 43. The lever 42 is pivoted at 44 and carries a rubbing block 70 45 which cooperates with a timer cam 23. The lever 42 is connected to one end of a leaf spring conductor 46 the other end of which is connected to the terminal 47 which is connected by wire 48 to primaries P4 75 and P3. The contacts 40 and 41 are shunted by a condenser 49. The rubbing blocks of the last mentioned row while the stem 35 and 45 are located so that their circuit breaker levers will be operated alternately by the cam 23. The cam 23 is driven by a 80 shaft 24 which is operated at engine cycle Further objects and advantages of the speed, that is, engine speed for a 2 cycle present invention will be apparent from the engine, one-half engine speed for a 4 cycle

The ignition coils, circuit interrupter and 85 ating means which is controlled by the engine through the engine driven cam 23. This sparking impulse generating means comprises a plurality of generators which 90 Referring to the drawing, Fig. 1 illus- are operated alternately by the engine with the storage battery; and the other 95 sparking impulse generator comprises the ignition coils P3—S3 and P4—S4 and the circuit interrupter which connects these coils with the storage battery. The shaft 24 drives a distributor rotor 50 100

the outline of which is designated in dot 5 52 has branches R3 and R4 connected with would be completed through the circuit of 70 10 There are but four posts 58 connected re- used. For example, in place of using two 75 ample, post 53#s1 designates that it is con- pair of soils P3—S3 and P4—S4 one coil so with secondary S2; post 53#s3 is connected spectively to post 53#s3 and post 53#s4. by wire 63 with secondary S3; and post It will be apparent from the foregoing de-20 53#84 is connected by wire 64 with second-scription of the construction and mode of 85 ary S4. It will be noted that in the circular operation of the present invention that it is row of posts 53 there are two groups of applicable to engines whose cylinders numposts diametrically opposite. One group in- ber other than 8, such as 12, 16, 20, 24 etc. cludes posts at and as, the other includes Obviously the number of posts 54 in the posts \$\frac{1}{2}\$ and \$4. These posts are spaced outer row will be 2N where N is the number 90 apart an angular distance corresponding to of cylinders and the spacing of these posts the firing interval which is 45° for an 8 will be 360°/2N. Where double ignition is cylinder engine. It will be noted that the required the distributor posts 53 of the inner distributing conductor branches R1, R2, R3 row will be arranged in two groups, the and R4 are equiangularly distant and are number of posts in each group being G. 95 spaced twice the firing interval or 90° for Where the number G is two or more the an 8 cylinder engine. Diametrically op- spacing of the posts in each group of posts posite branches of the distributing conduc- of the inner row 53 will be 360°/N. The tors cooperates alternately with other dia- distributor rotor 50 will carry two segments metrically opposite branches of the distrib- 51 and 52 corresponding to the number of 100 uting conductors; and each branch operates spark gaps to be fired simultaneously. The two times in succession and then remains angular spacing of the main stems of the inoperative while the other branch of the segments 51 and 52 is $180^{\circ} \pm (180^{\circ}/N)$. same conductor is operative two times in The number of branches of each rotor con-40 succession. For example, assuming that the ductor will be equal to N/2G and the angu- 105 cam 23 rotates clockwise as indicated by ar- lar spacing between the segment branches row 27 in Fig. 2 it will be apparent that will be 360° G/N. The following tabulajust as contact 30 separates from contact 31 tions show the values for engines having 8, conductor 51 will be operative to conduct 12, 16, 20 and 24 cylinders. a sparking impulse between post 53#s1 and post 54#1A-S1-R1 and that concurrently therewith conductor 52 will be operative to conduct a sparking impulse between distributor post 53#s2 and post 54#1B—S2— R3. The indicia 1A-S1-R1 designates that spark plug A of cylinder #1 is furnished with a sparking impulse generated in secondary S1 and distributed through the branch R1 of conductor 51. Likewise the indicia 1B—S2—R3 indicates that spark plug B of cylinder #1 is supplied with a sparking impulse generated in secondary S2 and distributed through the branch R3 of conductor 52. With this explanation the means of the indicia applied to other distributor posts 54 will be entirely clear. The use of indicia serves the purpose of a multiplicity of wires connecting post 54 with spark plugs and is preferred in this case on account of its simplicity.

For dual ignition it is customary to use and dash lines. Rotor 50 carries two Y- two standard plugs in each engine cylinder. shaped conductors 51 and 52. Conductor One double end spark plug could be used in 51 has branches R1 and R2 and conductor which case the circuit of one secondary a terminal. The conductors 51 and 52 move the other secondary in which a sparking imin a path between two concentric circular pulse is concurrently generated. Instead of rows of distributor posts, the inner row be- using four ignition coils two coils each with ing numbered 53 and the outer row 54. two insulated secondary terminals could be spectively with the secondary coils S1 to coils P1—S1 and P2—S2 one coil could be S4. Hence each post 53 has been marked used and its secondary terminals would be with a special designation indicating to connected respectively with post 53#81 and which secondary it is connected. For ex- post 53#s2. Similarly instead of using a nected by wire 61 with secondary S1. Simi- could be used having a double terminal seclarly post 53#s2 is connected by wire 62 ondary, the ends of which are connected re-

Tabulation #1 [G. the number of posts 52 in each group squals 21

Number of cylinders—	Specing of posts 53 -	Specing of seg- ments 51 and 53-	Number of branches for each segment =	Specing of segment branches—	115
N	300°/N 45° 30° 221,6° 18° 15°	180°±(180°/N) 180°± 221/3° 180°± 15° 180°± 111/4° 180°± 9° 180°± 71/3°	N/20 2 3 4 5 6	360°G/N 90° 45° 36° 30°	120

110

Tabulation #2 [G, the number of posts 58 in each group, equals 1]

Number of cylinders-	Specing of seg- ments 51 and 52-	Number of branches for each segment =	Specing of segment branches—	125
N	180°±(180°/N) 180°± 2216° 180°± 15° 180°± 1116° 180°± 9° 180°± 716°	N/2G 4 6 8 9	360°G/N 45° 30° 23)4° 18°	130

This invention contemplates a distributor having circularly arranged posts connected respectively with engine spark gaps, other posts arranged consecutively with respect to 5 the spark gap posts and connected with sparking impulse generator terminals. This distributor includes rotating conductor arms moving between the spark gap posts and sparking impulse generator posts, each arm 10 having a plurality of branches which cooperate with the sparking impulse generator posts. At one explosion period, one branch of each arm is adjacent one of the spark means connected with the posts of the secgenerator posts and said posts are connect- ond mentioned row. 15 ed with a sparking impulse generator which 2. Ignition apparatus for an internal 80 operates at that explosion. The sparking combustion engine having N explosion peimpulse generating means comprises two de- riods during each engine cycle and having vices which operate alternately. Hence, at two spark gaps firing simultaneously, comthe next explosion period branches of the prising in combination, a distributor head 20 distributing arms will be adjacent two of having concentric rows of posts, the posts 85 the sparking impulse generator posts, said of one row numbering 2N and each being posts being connected with another of the connected with a spark gap, the posts of sparking impulse generating devices which is the other row being arranged in two groups operated at that explosion period. The con- arranged diametrically opposite, the number 25 ducting arm branches and the spark gener- of posts in each group being G, the spacing 90 ating posts are so arranged that a branch of the posts in each group being 360°/N if of each rotor cooperates a plurality of times G, the number of posts, is greater than one; in succession with spark generator posts and an engine driven distributor rotor carrying then another branch of each arm cooperates two conducting segments which rotate be-30 a plurality of times in succession with the tween said rows of posts; the segments each 95 spark generator posts. More particularly, having a main stem rotating in proximity the spark generator posts are arranged in to the posts of the first mentioned row, the groups, the posts in each group being rela-stems of the segments being spaced 180°± tively closely spaced, each group being re- (180° N), and each segment having a pluspectively connected with the alternately operating sparking impulse generating devices. rality of branches which rotate in proximity to the second mentioned row of posts, the It will be noted that each conducting arm number of branches of each segment being branch cooperates a plurality of times with N/2G and the spacing of the segment the spark generator posts of each group and 40 with those posts in succession and then another branch of the same rotor cooperates connected with the posts of the second menwith said group of posts in succession before that arm passes into cooperative relation with another group of spark generator combustion engine having N explosion pe-45 posts.

present invention as herein disclosed, con- each explosion period, comprising in comstitutes a preferred form, it is to be under- bination, a distributor head having constood that other forms might be adopted, centric rows of posts, the posts of one row

which follow.

What is claimed is as follows:

bustion engine having N explosion periods of two posts each, the spacing of the posts 55 during each engine cycle and comprising, in in each group being 360°/N; an engine 120 combination, means for distributing spark- driven distributor rotor carrying two coning impulses to S (a plurality of) spark ducting segments which rotate between the gaps to be fired simultaneously at each ex- rows of posts, the segments each having a plosion period, said distributing means comprising a head having concentric rows of posts of the first mentioned row, the stems posts, one row of posts numbering N x S of the segments being spaced 180°± and each post in that row being connected (180°/N), and each segment having a pluwith a spark gap, the other row of posts rality of branches which rotate in proximity numbering S or a multiple thereof, said to the posts of the second mentioned row, distributing means comprising also an enter the number of branches of each segment 120

gine driven rotor having S distributing conductors each having a main stem which moves in proximity to the posts in the first mentioned row and each having a plurality of branches which move in proximity to 70 the posts in the second mentioned row, there being but one branch of each conductor adjacent to a post of the second mentioned row while the stem of each conductor is adjacent a post of the first mentioned row 75 at the firing period of the engine; and engine controlled sparking impulse generating

branches being 360°G/N; and engine controlling sparking impulse generating means 105 tioned row.

3. Ignition apparatus for an internal riods during each engine cycle and having 110 While the form of embodiment of the two spark gaps firing simultaneously at 50 all coming within the scope of the claims numbering 2N and each being connected 115 with a spark gap, the posts of the other row numbering four and being ar-1. Ignition apparatus for an internal com- ranged in two diametrically opposite groups

being N/4 and the spacing of the branches fired in groups simultaneously at each ex-5 tioned row.

10 explosion period, comprising in combinabering four and being arranged in two dia- with the spark generator posts. which rotate between the rows of posts, the pulses to a plurality of spark gaps to be 85 segments each having a main stem rotating fred in groups simultaneously at each exin proximity to the posts of the first men- plosion period, said distributor comprising tioned row, the stems of the segments being concentric rows of distributor posts, one spaced 180°± (180°/N), and each segment row of posts being connected respectively 25 having a plurality of branches which rotate in proximity to the posts of the second mentioned row, the number of branches of each segment being N/4 and the spacing of the branches being 720°/N; two sparking im-30 pulse generators each having two terminals connected respectively with diametrically opposite posts of the second mentioned row of posts; and engine operated means for causing said generators to function alter-35 nately.

comprising, in combination, means for gen- alternately with another branch of the same 40 erating sparking impulses and having a plu- conductor. rality of terminals, engine operated circuit 8. Ignition apparatus for internal comtributing arms.

a distributor for distributing sparking im- spark generator posts. pulses to a plurality of spark gaps to be 9. Ignition apparatus for internal com- 136

being 720°/N; and engine controlling plosion period, said distributor comprising sparking impulse generating means con- concentric rows of distributor posts, one nected with the posts of the second men- row of posts being connected respectively with the spark gaps of the engine and an-4. Ignition apparatus for an internal other row of posts being connected with the combustion engine having N explosion spark generating means, said distributor periods during each engine cycle and having comprising a rotor carrying distributing two spark gaps firing simultaneously at each conductors which move between the rows of posts in order to provide conducting paths 75 tion, a distributor head having concentric between them, the number of conductors berows of posts, the posts of one row number- ing equal to the number of spark gaps to ing 2N and each being connected with a be fired at the same time, and each conductor spark gap, the posts of the other row num- having a plurality of branches cooperating

metrically opposite groups of two posts 7. Ignition apparatus for internal comeach, the spacing of the posts in each group bustion engines comprising, in combination, being 360°/N; an engine driven distributor generating means controlled by the engine, rotor carrying two conducting segments a distributor for distributing sparking imwith the spark gaps of the engine, and an. 90 other row of posts being connected with the spark generating means, said distributor comprising a rotor carrying distributing conductors which move between the rows of posts in order to provide conducting paths 95 between them, the number of conductors being equal to the number of spark gaps to be fired at the same time and each conductor having a plurality of branches cooperating with the spark generator posts, said branches 100 5. Ignition apparatus for internal com- and said spark generator posts being arbustion engines having a plurality of spark ranged so that the one branch of a conductor gaps to be fired at each explosion period operates a plurality of times in succession

breaker means for controlling the sparking bustion engines comprising, in combination, impulse generators, a distributor head car- generating means controlled by the engine, a rying a circular row of posts connected re- distributor for distributing sparking im-45 spectively with spark gaps, a plurality of pulses to a plurality of spark gaps to be 110 posts of substantially the same width as the fired in groups simultaneously at each exspark gap posts of the head and arranged plosion period, said distributor comprising concentrically therewith and connected re- concentric rows of distributor posts one row spectively with terminals of the spark gen- of posts being connected respectively with erating means, a plurality of distributing the spark gaps of the engine and another 115 arms arranged to pass between the first and row of posts being connected with the spark second mentioned posts but out of contact generating means, the spark generator posts therewith in order to distribute sparking being arranged in groups, said distributor impulses from the second mentioned posts comprising a rotor carrying distributing to certain of the spark gap posts, each arm conductors which move between the rows of 120 having a plurality of branches which coop- posts in order to provide conducting paths erate with the spark generator terminal between them, the number of conductors beposts, and means for operating the circuit ing equal to the number of spark gaps to breaker means and for rotating the dis- be fired at the same time, each conductor being constructed so as to cooperate with 125 6. Ignition apparatus for internal com- a group of spark generator posts a plurality bustion engines comprising, in combination, of times in succession before passing into generating means controlled by the engine, cooperative relation with another group of

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bustion engines, comprising in combination, plurality of times in succession and then generating means controlled by the engine, another branch cooperates with consecutive a distributor for distributing sparking im- spark generator posts a plurality of times pulses to a plurality of spark gaps to be in succession. fired in groups simultaneously at each ex- 13. Ignition apparatus for internal com- 70 plosion period, said distributor comprising bustion engines having N explosion periods concentric rows of distributor posts one row during each engine cycle comprising, in comof posts being connected respectively with bination, spark generating means controlled the spark gaps of the engine and another by the engine, and a distributor having a 10 row of posts being connected with the spark circular row of posts connected with engine 75 generating means, the spark generator posts spark gaps, and other posts connected with being arranged in groups, said distributor the spark generating means, at least one comprising a rotor carrying distributing distributing conductor arm movable between conductors which move between the rows the spark gap posts and spark generator 15 of posts in order to provide conducting posts, the number of arms being equal to 80 paths between them, the number of conduc- the number of spark gaps to be fired at the tors being equal to the number of spark gaps same time, each arm having B branches and to be fired at the same time and each conductor having a plurality of branches coop-20 erating with the spark generator posts one conductor branch cooperating with the ber of times each branch operates during a spark generator posts of a group in suc-cycle of operation of its arm. cession and then another conductor branch 14. Ignition apparatus for internal comof the same conductor cooperating with bustion engines having a plurality of 25 the spark generator posts of a group in explosion periods and a plurality of spark 90 succession.

engine, a distributor having a circular row tributor having a circular row of posts conof posts connected with engine spark gaps nected respectively with spark gaps, and movable between the spark gap posts and ing devices, and a rotor carrying distribu- 100 rality of branches each of which cooperates with the spark generator posts.

11. Ignition apparatus for internal combustion engines comprising, in combination, spark generating means controlled by the engine, a distributor having a circular row and having other posts concentric with the bustion engines having a plurality of exspark gap posts and connected with the spark generating means, and a conductor movable between the spark gap posts and the spark generator posts and having a pluso rality of branches each of which cooperates with the spark generator posts a plurality of times in succession and alternately with another branch.

12. Ignition apparatus for internal com-55 bustion engines comprising, in combination, spark generating means controlled by the engine, a distributor having a circular row of posts connected with engine spark gaps and having other posts concentric with the spark gap posts and connected with the spark generating means, and a conductor movable between the spark gap posts and 65 with consecutive spark generator posts a of the spark generating devices and then 130

each arm operating $\frac{N}{BR}$ cycles of operation during each engine cycle, R being the num-

gaps to be fired at each explosion period 10. Ignition apparatus for internal com- comprising, in combination, a plurality of bustion engines comprising, in combination, spark generating devices controlled by the spark generating means controlled by the engine for alternate operation, and a disand having other posts concentric with the posts arranged concentrically with respect spark gap posts and connected with the to the spark gap posts and connected alterspark generating means, and a conductor nately respectively with the spark generatthe spark generator posts and having a plu-ting arms moving between the spark plug posts and the spark generator posts and each having branches, each branch cooperating first with a post connected with one of the spark generating devices and then with a 105 post connected with another of the spark generating devices.

of posts connected with engine spark gaps 15. Ignition apparatus for internal complosion periods and a plurality of spark 110 gaps to be fired at each explosion period, comprising, in combination, a plurality of spark generating devices controlled by the engine for alternate operation, and a distributor having a circular row of posts con- 115 nected respectively with spark gaps and posts arranged concentrically with respect to the spark gap posts and connected alternately respectively with the spark generating devices, and a rotor carrying dis- 120 tributing arms moving between the spark plug posts and the spark generator posts and each having branches, one branch of each conductor cooperating first with a post connected with one of the spark generating 125 devices and then with a post connected with another spark generating device, and then the spark generator posts and having a plu- another branch of each conductor cooperrality of branches each of which cooperates ating first with a post connected with one

generating device.

16. Ignition apparatus for internal combustion engines having a plurality of ex-5 plosion periods and requiring the firing of a plurality of spark gaps at each explosion period comprising, in combination, a plurality of sparking impulse generating devices operated alternately by the engine, a dis-10 tributor having circularly arranged posts connected respectively with spark gaps of the engine and having other posts arranged diametrically opposite in pairs, each pair being connected with a sparking impulse gen-15 erating device, and a plurality of distributing conductor arms each having a plurality of branches so arranged with respect to the spark generator posts that, at each explosion period, a branch of an arm is located adjacent each one of a pair of diametrically opposite spark generator posts. 17. Ignition apparatus for internal com-

bustion engines having a plurality of explosion periods and requiring the firing of a plurality of spark gaps at each explosion period comprising, in combination, a plurality of sparking impulses generating devices operated alternately by the engine, a distributor having circularly arranged posts connected respectively with spark gaps of the engine and having other posts arranged diametrically opposite in pairs each pair being connected with a sparking impulse generating device and a plurality of distributing conductor arms each having a a plurality of branches so arranged with respect to the spark generator posts that, at each explosion period, a branch of an arm is located adjacent each one of a pair of diametrically opposite spark generator posts and so that each branch of an arm operates

a plurality of times in succession alternately with another branch of the same arm. 18. Ignition apparatus for internal combustion engines comprising, in combination, generating means controlled by the engine, 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 the spark gaps of the engine and another row of posts being connected with the spark generating means, said distributor comprising a rotor carrying distributing conductors which move between the rows of posts in order to provide conducting paths between them, the number of conductors being equal to the number of spark gaps to be fired at the same time, and each conductor having a plurality of branches cooperating with the spark generator posts, the conductor branches being equi-angularly

spaced by an amount equal to 360° divided

with a post connected with another spark by the total number of branches of all the arms.

In testimony whereof I hereto affix my signature.

CHARLES HALL DAVIS, JR. 70

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