C. T. MASON AND W. J. HART.

IGNITION SYSTEM

APPLICATION FILED OCT. 16, 1917.

1,400,561.

Patented Dec. 20, 1921.

2 SHEETS—SHEET 1.

FIG-1

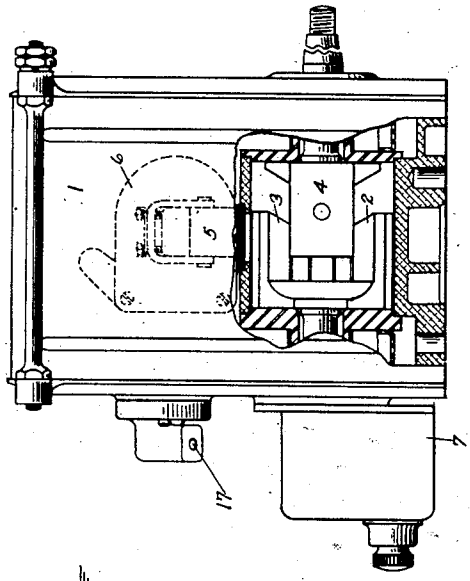
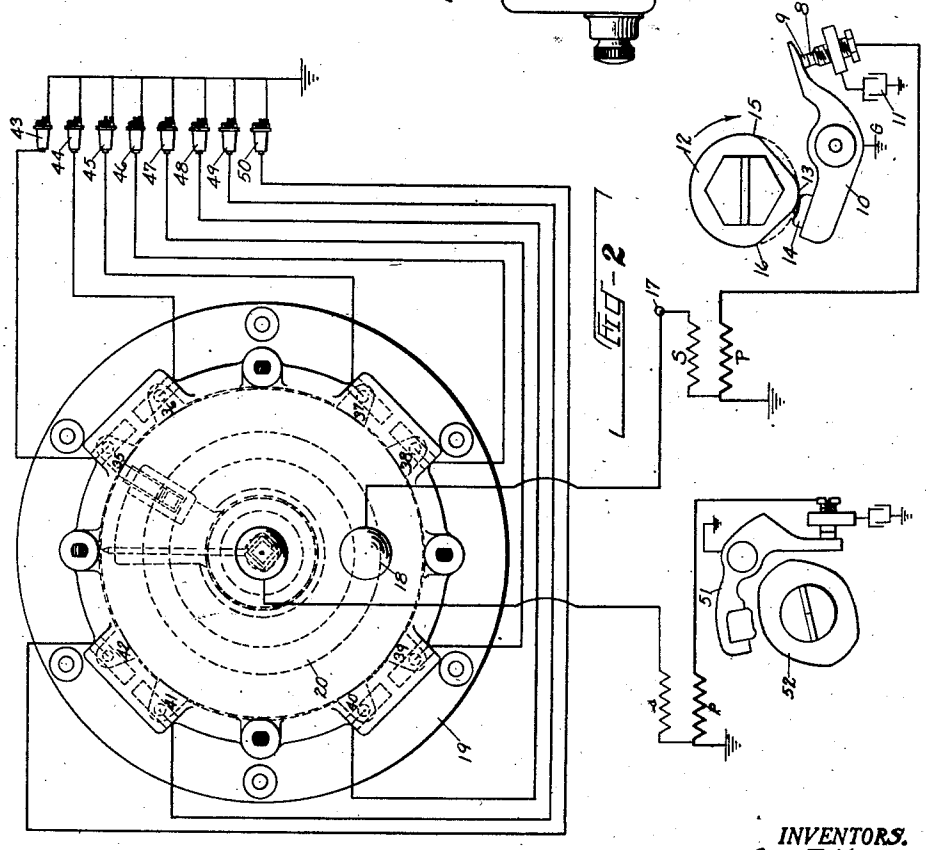


FIG-2



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2 SHEETS—SHEET 2.

FIG-3

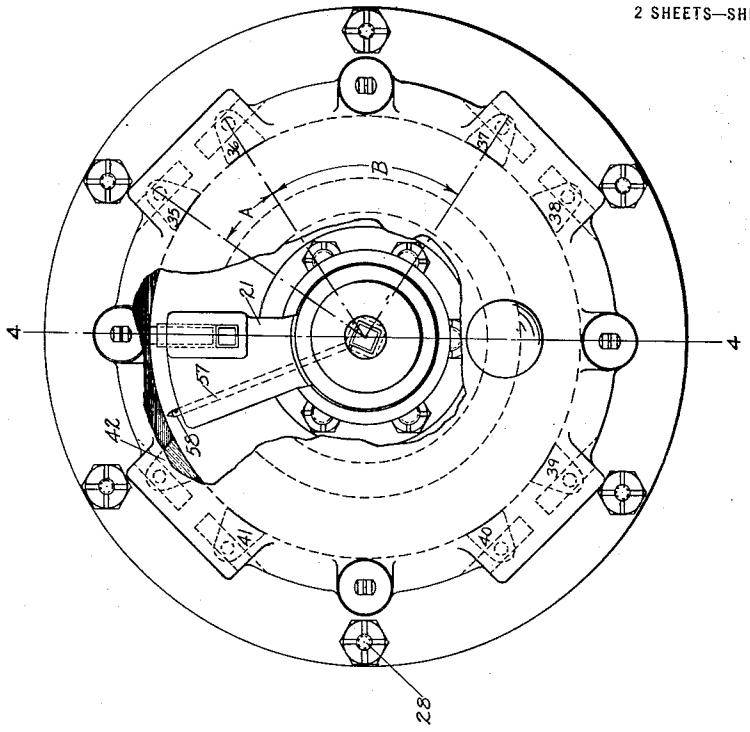
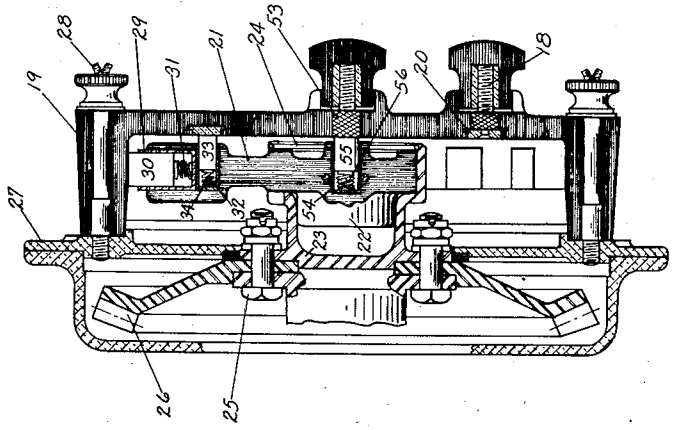


FIG-4



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UNITED STATES PATENT OFFICE.

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IGNITION SYSTEM.

1,400,561. Specification of Letters Patent. Patented Dec. 20, 1921.

Application filed October 16, 1917. Serial No. 196,804.

To all whom it may concern:

Be it known that we, CARL T. MASON and WILLIAM J. HART, citizens of the United States, residing, respectively, at East Orange, in the county of Essex and State of New Jersey, and Mount Vernon, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Ignition Systems, of which the following is a specification.

Our invention relates to a means for firing the fuel charges in an internal combustion engine, particularly of the multi-cylinder type. The system and mechanism which will be described herein relates to the method of firing an eight cylinder V-type in which the angle between the cylinders is 45 degrees. It will be apparent from what follows that special arrangements must be provided for firing an engine of this character. In an eight cylinder engine of the four cycle type four ignition sparks are required for each revolution of the crank shaft or one spark for every 90 degrees of rotation of the said shaft. The ordinary two pole type of magneto delivers two sparks substantially symmetrical for each revolution of the armature or rotor; hence to get four sparks the magneto would have to be driven at twice crank shaft speed. It is at once seen that these sparks occur for every 90 degrees of rotation of the crank shaft and in order to use a magneto for firing multi-cylinder engines, for example an eight cylinder one, it has been customary, in the past, to place the cylinders at an angle of 90 degrees. It has been proposed in some cases to place these cylinders at an agle of 45 degrees when it becomes evident that to fire such an engine the sparks must be delivered at intervals of 45 and 135 degrees of crank shaft rotation. It is at once clear that the ordinary magneto or ignition systems can not be utilized for the purpose at hand.

We have solved the problem in a comparatively simple manner which renders the system but little more expensive than an ignition system used in connection with an engine having its cylinders placed at 90 degrees. In working out the solution we have used a magneto of the "Dixie" type as set forth in Patent 1,226,233, issued May 15, 1917, to Charles T. Mason, wherein there is an adjustable field structure carrying the high tension coil having the usual primary and secondary windings and a rotor operating in connection with the field structure which is capable of producing four current impulses in the ignition coil for each rotation of the rotor, all of which will be pointed out more specifically hereinafter.

We utilize a cam on the rotor of such a construction that it acts on the movable arm of the circuit breaker at intervals of 90 and 270 degrees of angular rotation of the magneto rotor. Since the rotor as above described is capable of producing four impulses per revolution it will be understood that the cam will act to suppress two of the current impulses which the rotor is capable of generating and will cause utilization of the other two at unequal intervals, that is 90 and 270 degrees, of rotation of the rotor. By driving the rotor at twice the speed of the engine crank shaft we produce the four sparks required asymmetrically spaced 90 and 270 degrees of angularity of the rotor but since this runs twice engine crank shaft speed the angularity referred thereto will be 45 and 135 degrees. We thus produce substantially equal sparks but in asymmetrical periods of time.

Having generated the sparks at the proper tension and at the proper time, these must be delivered to the various engine cylinders in the proper order. The distributer segments must therefore, be arranged in the same angular order as the means for producing the sparks, and in the form shown in the drawings accompanying this specification we have arranged the distributer segments in one plane so that the total number of sparks are delivered through the distributer for one revolution of the distributer finger but since only four sparks are required for one revolution of the crank shaft the distributer finger must be geared to run in synchronism with but at one half engine crank shaft speed or one quarter of the speed of the rotor of the magneto.

Our invention is particularly adapted for firing engines of the type described when used in connection with aircraft machines, but is just as adaptable for use on engines used on automobiles, boats or for other work. When used in connection with an aircraft engine, it is customary to provide an auxiliary means for starting these engines which are usually large and powerful. In starting aircraft engines it is usual to

prime the cylinders through priming cocks or to turn the engine over by taking hold of the propeller blades thereby drawing fuel into the cylinders. When carrying out the latter procedure the sparking machine must be put out of commission otherwise the engine is likely to start with probable dangerous results to the operator. To accomplish this starting, we have shown in connection with our system an auxiliary magneto which is not directly geared to the main magneto or the engine and which can, therefore, be operated by hand after the engine has been primed in the manner set forth above. The operation of this auxiliary or starting magneto provides a series of sparks which are delivered to the cylinders in an angular position a number of degrees later than the time of delivery of the main magneto, which is timed so the spark has some advance or can be advanced for best running conditions, so that the engine will start "on compression" in a forward direction. Since this starting feature forms no part of our present invention other than the method of introducing the same in our present type of distributer it will not be referred to at any length in the following description.

In the drawings, Figure 1 illustrates a magneto suitable for the purpose, having a portion broken away to show the rotor.

Fig. 2 is a diagrammatical view of our ignition system.

Fig. 3 is a plan view of our distributer, but having a portion broken away to show the distributer finger.

Fig. 4 is a sectional view on the line 4—4 of Fig. 3.

Referring now to the details, in which like numbers refer to corresponding parts in the various views, 1 illustrates a magneto of the "Dixie" type having a rotor with four lobes, 2, 3 and 4 of which are clearly seen. The other lobe being directly behind 4 is not visible. The field structure 5 carries a high tension coil 6 having primary winding P and secondary winding S. On the end of the rotor and inclosed within the breaker box cover 7 is a circuit breaker shown on an enlarged scale and somewhat diagrammatically in Fig. 2. One end of the primary winding P is connected to an adjustable contact 8 which coöperates with the movable contact 9 on breaker arm 10 which is grounded at G. The condenser 11 is connected across the breaker points 8 and 9. A cam 12 is attached to the breaker end of the rotor and as shown in Fig. 2 is about to open the contacts 8 and 9 at the point 13. After the bumper 14 has passed over the point 13, the breaker arm closes the contacts 8 and 9 and when the point 15 reaches the bumper 14 the contacts 8 and 9 are again opened and held until the point 16 is reached which is preferably about 180 degrees from the point 15, which in turn is 90 degrees from the point 13. The angular distance from 16 to 13 is made sufficient to allow the magnetic flux time to build up through the core of the coil so that the distance from 15 to 16 may be more or less than 180 degrees but preferably more. While the cam 12 has been acting on the breaker arm 10 in the manner described the rotor has made one complete revolution and on account of the four lobes would have produced four magnetic impulses through the coil 6 had the primary circuit P not been held open in the manner described. We have found that the holding open of the primary for this period of time is advantageous in that it gives the iron in the magnetic circuit an opportunity to rest, or recuperate, as it were, by removing the effects of the coil windings on the iron and even though the rotor is driven at twice engine crank shaft speed the two sparks delivered for one revolution of the rotor will "stay in" at speeds of the rotor greatly in access of that required. That is to say, the two sparks delivered as above described will "stay in" at a much higher speed of the rotor than they would if the rotor were producing the four sparks from the coil of which it is capable. We have thus turned an apparent disadvantage, that is, running the magneto at twice crank shaft speed, into a real advantage which will be specifically claimed.

Inasmuch as the principles of operation of the "Dixie" magneto have been described in numerous patents to Charles T. Mason, one of which is 1,226,233, issued May 15, 1917, further description of the magneto does not appear to be necessary to make this part of our invention clear to one skilled in the art.

We will now describe our method of distributing the sparking current produced by the magneto. The secondary S of the coil 6 is adapted to be brought out of the insulating terminal 17 and is then connected to the binding post 18 on the distributer block 19. Mounted on the interior of the block 19, preferably molded therein, is an annular ring 20 to which the binding post 18 is securely connected as shown in Fig. 4. 21 is a distributing finger having a hub 22 projecting into a holder 23 to which the finger 21 is securely fastened in any suitable manner such as by cap 24 attached to the end of the holder 23. Fastened to the rim of the holder 23 by any suitable means such as bolts 25 is a gear wheel 26 which is adapted to mesh with another gear driven by some portion of the engine. It will be understood that this gear ratio is such that the distributer finger is driven at one-fourth of the speed of the rotor of the magneto. The distributer block 19 is adapted to be fastened to some portion of the engine frame 27 by suitable studs and nuts 28. Finger 21 carries a brush

holder 29 in which a brush 30 is mounted adapted to be held in its working position by spring 31. Directly below the brush holder 29 and electrically connected thereto is a second brush holder 34 carrying a brush 33 which is held in contact with the annular ring 20 by spring 32. Circumferentially mounted within the inner part of the rim of the distributer 19 is a series of contacts 35 to 42 inclusive spaced so that the angle A is 22½ degrees and the angle B 67½ degrees which is respectively one half the firing angularity of the engine crank shaft since the distributer finger rotates at one half crank shaft speed. Wires run from the terminals 35 to 42 inclusive to spark plugs 43 to 50 inclusive which are located in the cylinders according to the proper firing order. In the diagrammatical view shown in Fig. 2 no attempt is made to show the firing order of the engine. It will be seen that the secondary or sparking current from the magneto coil 6 passes to the distributer finger and to all of the engine cylinders in one complete rotation of the distributing finger but in asynchronism or unequal intervals of time. That is to say, two sparks travel from the distributer 22½ degrees apart followed by another at 67½ degrees away succeeded by one 22½ degrees and so on. It will also be seen that the sparks are all full strength although unequally spaced. Attention is called to this as in some types of magnetos used heretofore for production of sparks at unequal intervals more or less distortion of the magnetic material of the magneto has been necessary to get the proper spacing of the current waves which has resulted in many cases in sparks not being of equal value. Our method as herewith described obviates this difficulty.

The starting magneto may be of any construction having a primary winding *p* and secondary winding *s* and circuit breaker 51 adapted to be acted on by cam 52. One end of the secondary is grounded in the usual manner and the other end is connected to terminal 53 at the distributer block 19. Finger 21 carries a brush holder 54 within which a brush 55 contacts with the inner end of terminal 53 being held in operative position by spring 56. Brush holder 54 has a contact rod 57 connected thereto and embedded in the insulating portion of the finger 21, preferably being molded therein. The outer end 58 of the rod 57 terminates in a point in close proximity to the contact terminals 35 to 42 inclusive so that when the engine is in a position to be started "on compression" the point 58 is opposite the terminal connected to the plug that is in position to fire the charge in the engine cylinder. On turning the crank of the auxiliary magneto rapidly a spark is generated which jumps across the point 58 to the terminal above mentioned. The spark thus produced in the engine cylinder starts the engine forward and immediately the main magneto picks it up and further cranking of the auxiliary magneto is not required. The starting spark is shown of the jump-spark type but a wipe spark contact as used in the secondary of the main magneto might be used, but we eliminate brush wear, etc., by using the jump spark in the starting circuit.

While we have shown and described one embodiment of our invention it will be understood by those skilled in the art, that numerous changes and alterations may be made in the various details of the parts entering into the system without departing from the spirit of our invention and the scope of the appended claims.

Having thus described our invention what we claim is:—

1. A distributer block for use in an ignition system for eight cylinder 45 degree four cycle internal combustion engines, and with a generator adapted to be driven at twice engine crank shaft speed and having a source of magnetic flux, a generating coil, a rotating element adapted to direct the flux through said coil in combination with means to produce two current impulses spaced 45 and 135 degrees apart when referred to said engine crank shaft, said distributer block being adapted to be attached to said engine and having terminals spaced 22½ and 67½ degrees with means for connection to sparking devices in said engine cylinders, a distributing finger inside said block geared to be driven by said engine at one half crank shaft speed, an annular ring in said distributer block with means for connecting a terminal of the generating coil thereto, a brush carried by said finger in running contact with said ring and a second brush in electrical contact with the first for contacting with said block terminals as the finger rotates, a terminal on said block adapted to be connected to an auxiliary generator, a third brush associated with the distributing finger in running contact with the last mentioned terminal, a distributing contact connected to said third brush and adapted to conduct sparking current to said distributer block terminals when said auxiliary generator is operated in the manner described.

2. A distributer block for use in an ignition system for eight cylinder 45 degree four cycle internal combustion engines, and with a generator adapted to be driven at twice engine crank shaft speed and having a source of magnetic flux, a generating coil, a rotating element adapted to direct the flux through said coil in combination with means to produce two current impulses spaced 45 and 135 degrees apart when referred to said engine crank shaft, said distributer black being adapted to be attached to said engine and

having terminals spaced 22½ and 67½ degrees with means for connection to sparking devices in said engine cylinders, a distributing finger associated with said block and having a hub projecting rearwardly from said block, a carrier to take said hub, a gear driven by said engine at half crank shaft speed and having said carrier fastened thereto, an annular ring set in the face of said distributer block with means for connecting a terminal of the generating coil thereto, a brush carried by said finger in running contact with said ring and a second brush carried in the end of said finger substantially at right angles to the first and electrically connected thereto for contacting with said block terminals as the finger rotates, a terminal on said block adapted to be connected to an auxiliary generator, a third brush associated with the distributing finger in running contact with the last mentioned terminal, a distributing contact connected to said third brush and adapted to conduct sparking current to said distributer block terminals when said auxiliary generator is operated in the manner described.

In witness whereof we affix our signatures.

CARL T. MASON.
WILLIAM J. HART.