R. F. HALL.

MAGNETO MACHINE FOR USE IN CONNECTION WITH THE IGNITION SYSTEMS OF INTERNAL COMBUSTION ENGINES.

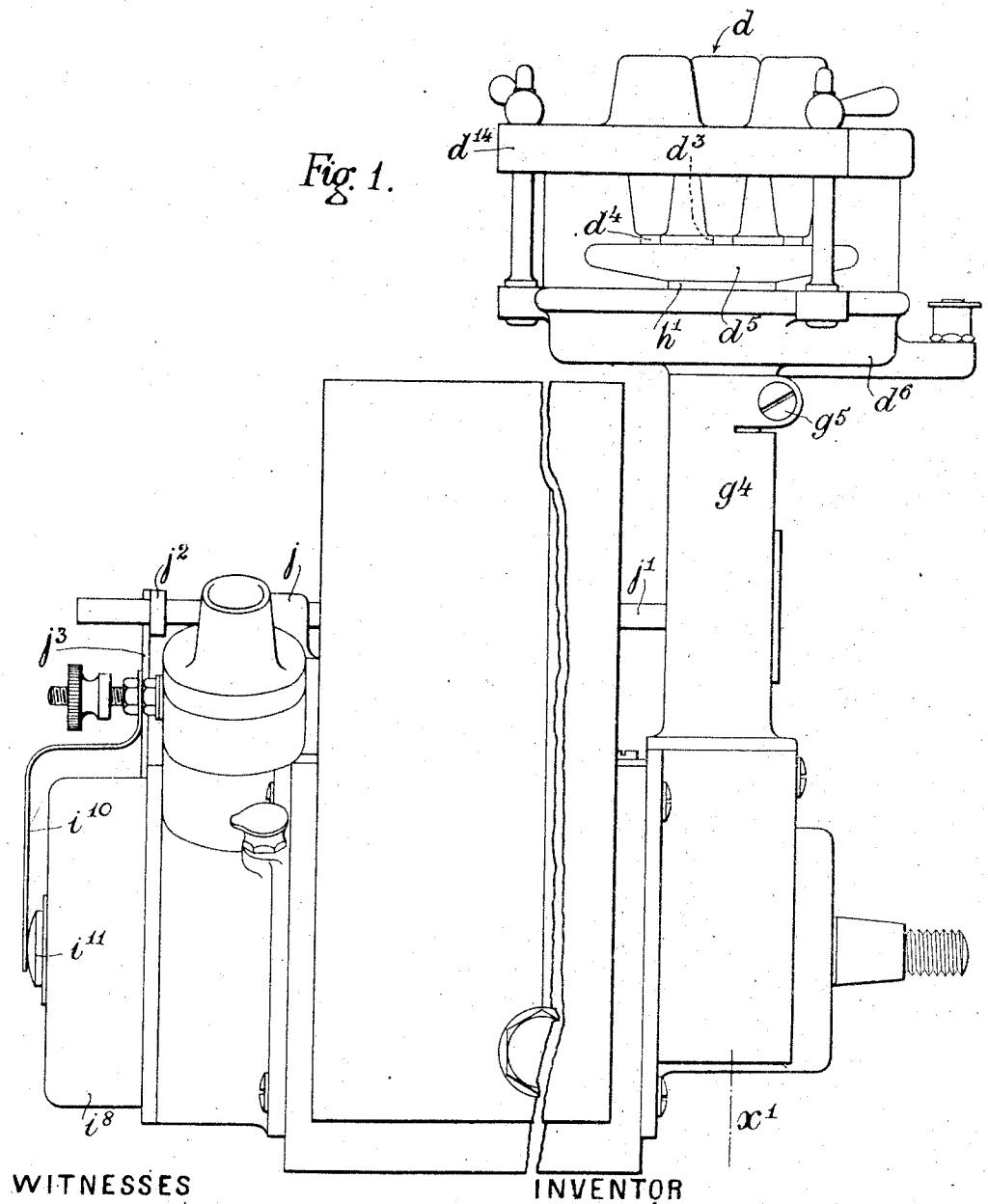
APPLICATION FILED AUG. 22, 1908.

984,368.

Patented Feb. 14, 1911.

8 SHEETS—SHEET 1.

Fig. 1.



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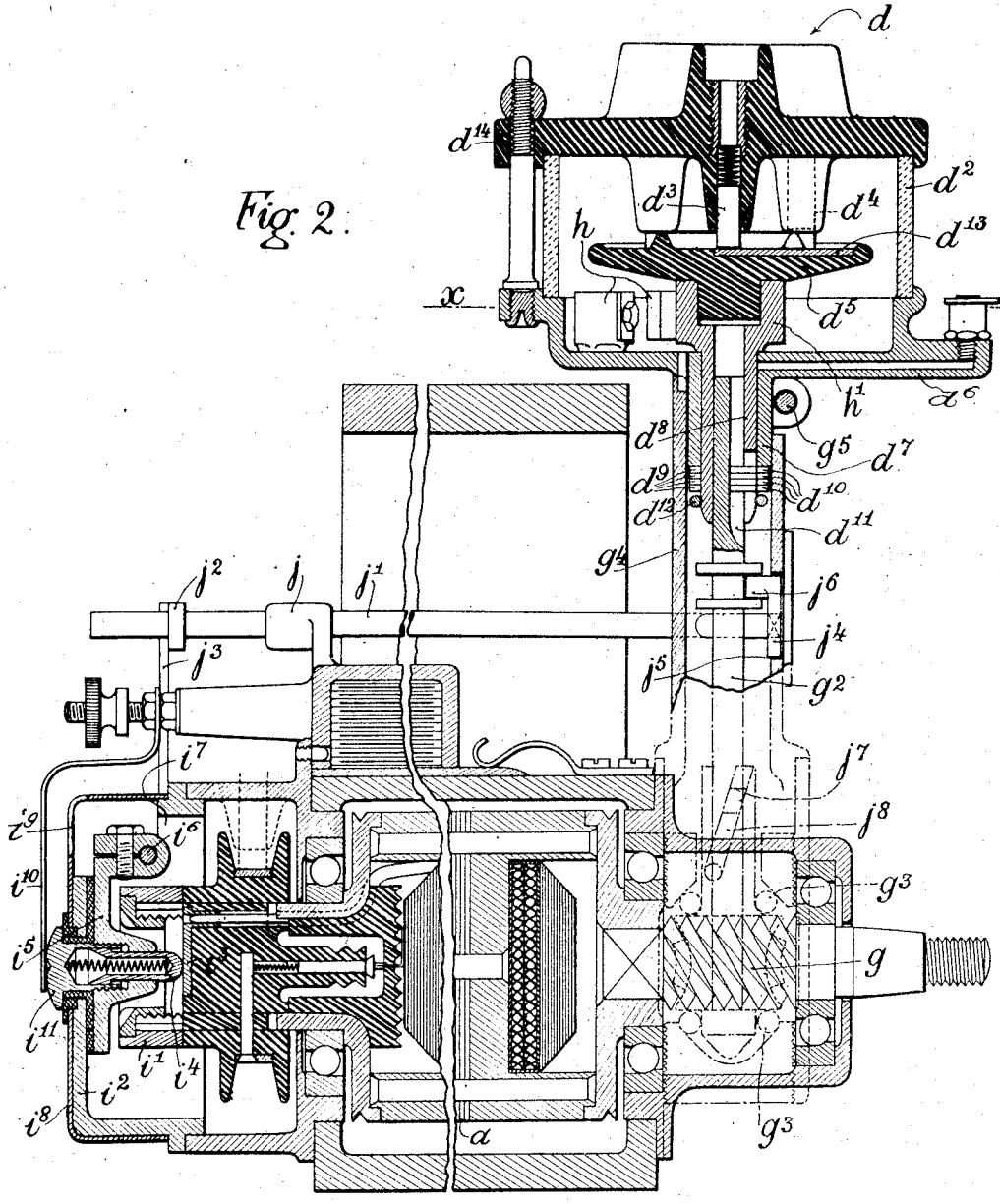
8 SHEETS—SHEET 2.

Fig. 2.



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8 SHEETS—SHEET 3.

Fig. 3.

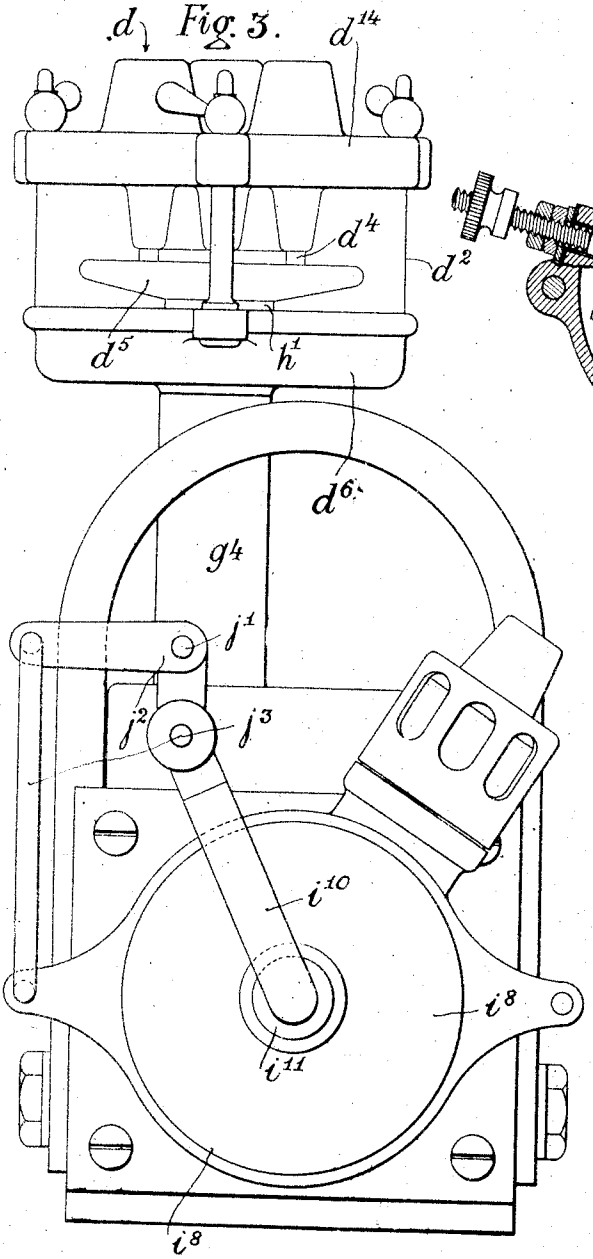


Fig. 5.

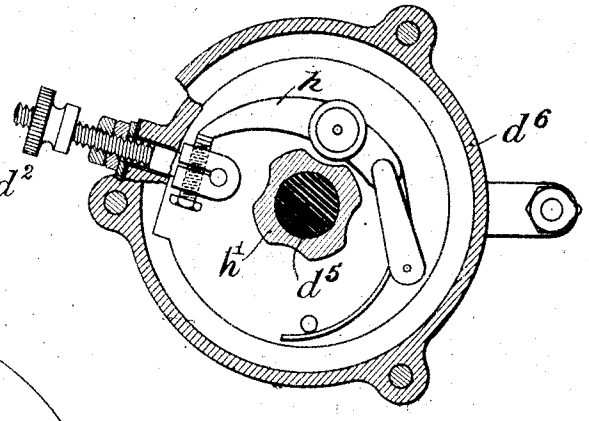
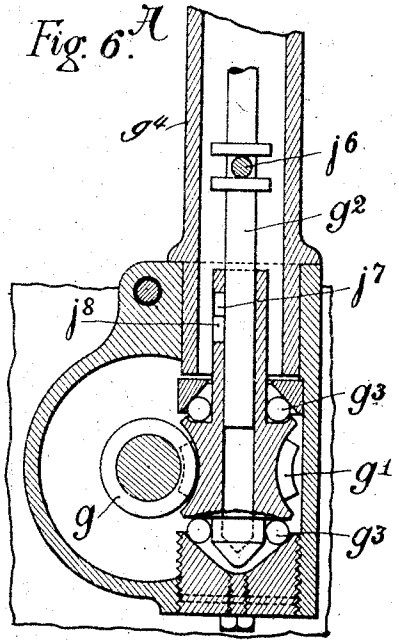


Fig. 6.



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8 SHEETS—SHEET 4.

Fig. 4.

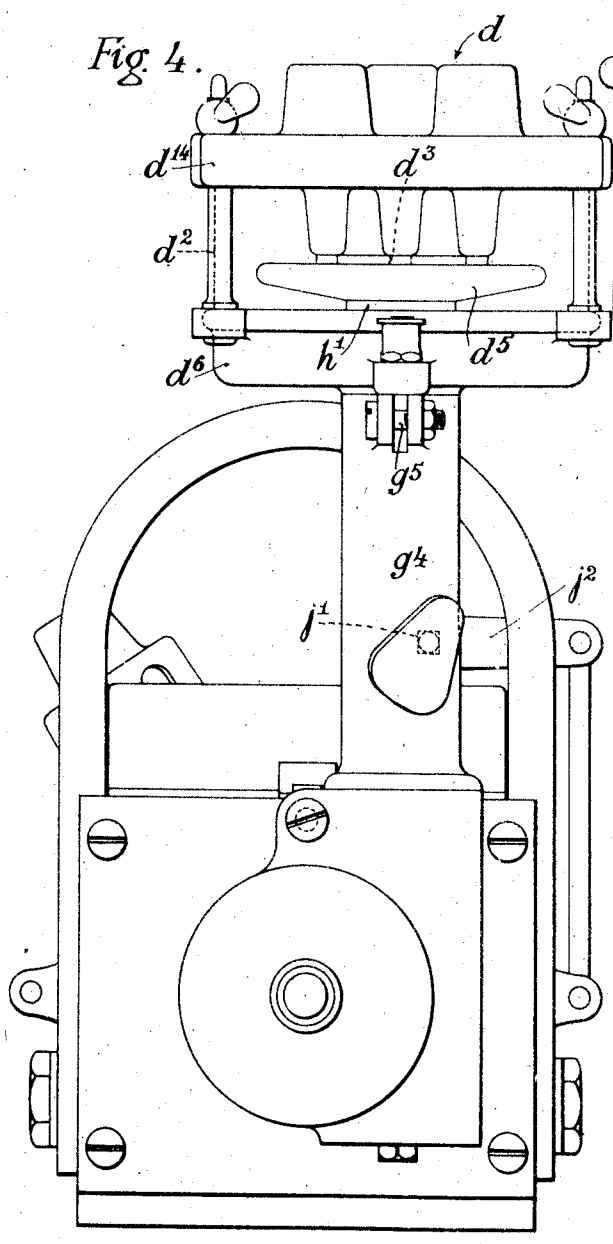
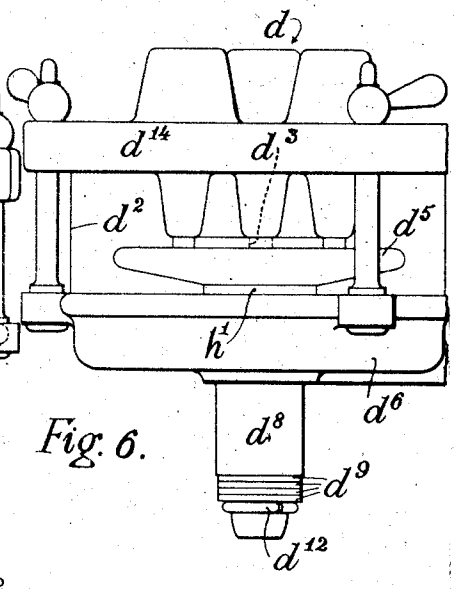
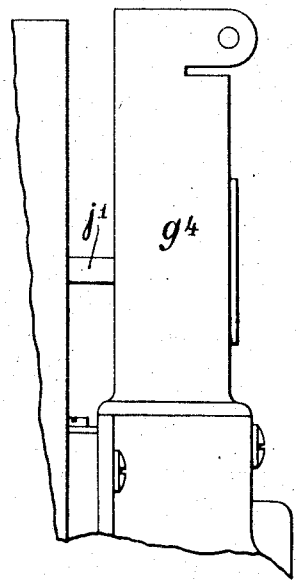


Fig. 6.





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8 SHEETS—SHEET 5.

Fig. 7.

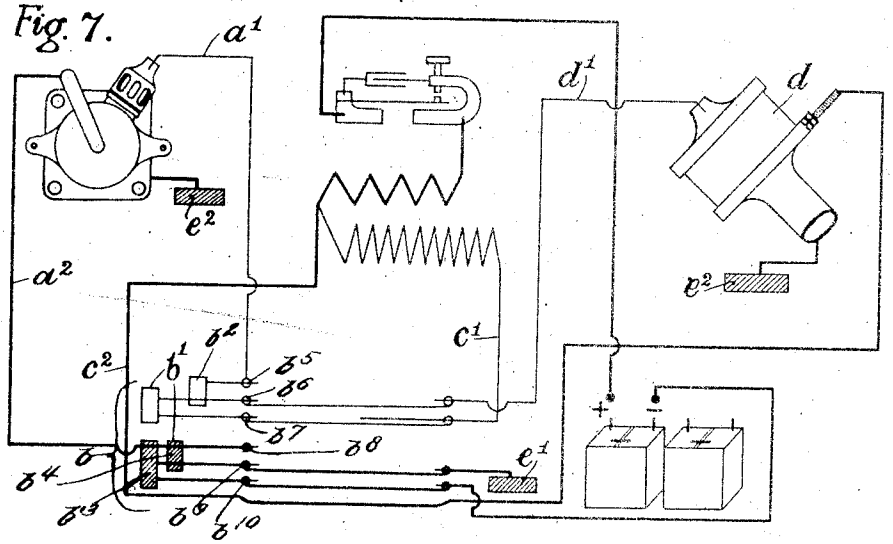
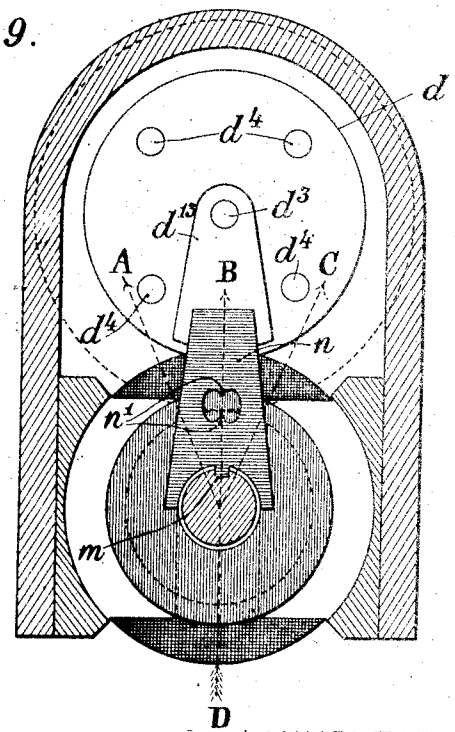


Fig. 9.



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984,368. Patented Feb. 14, 1911.

8 SHEETS—SHEET 6.

Fig. 10.

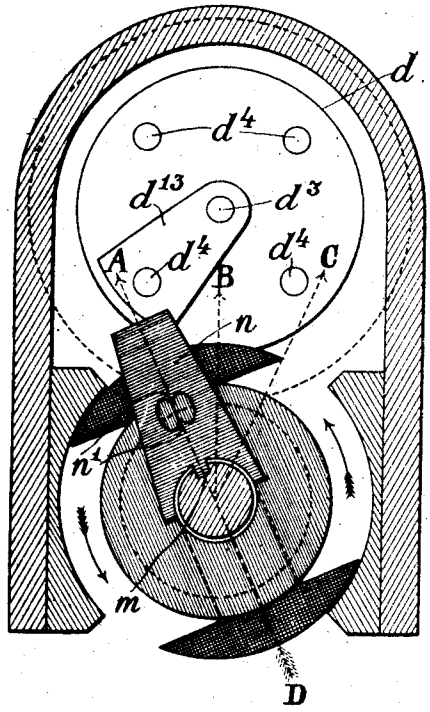
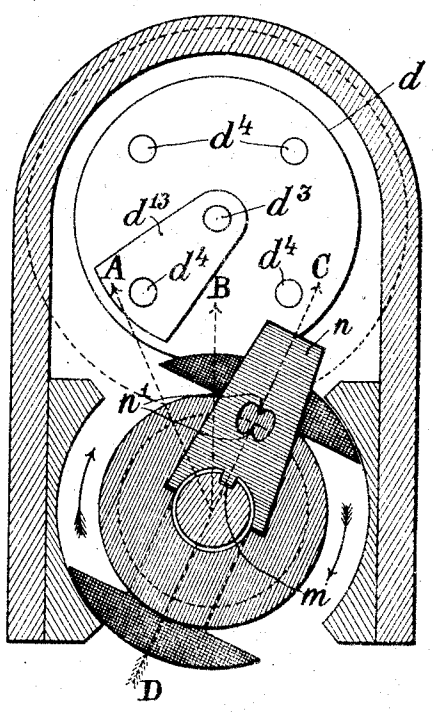


Fig. 8.



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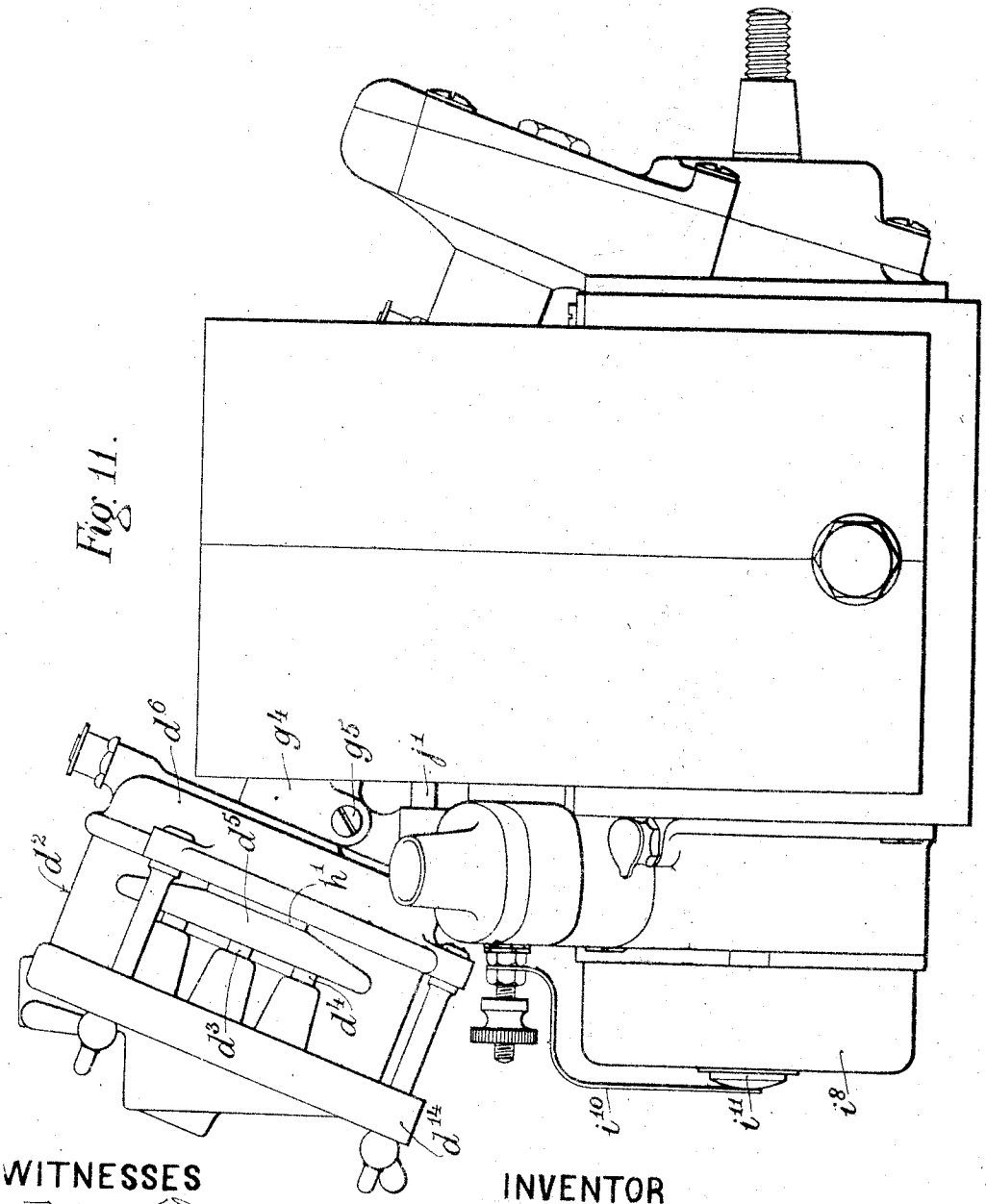
984,368. Patented Feb. 14, 1911.

8 SHEETS—SHEET 7.

Fig. 11.



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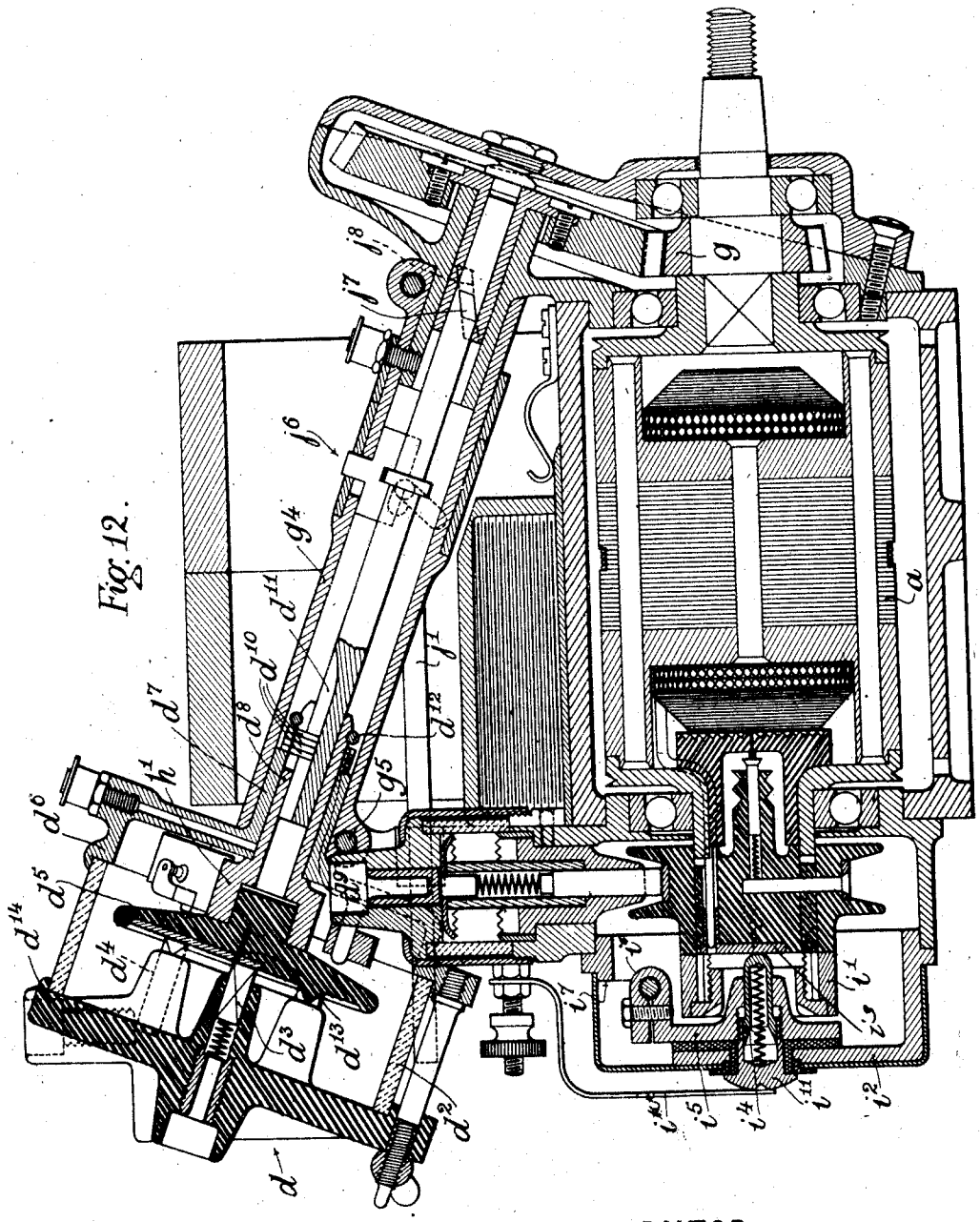
984,368. Patented Feb. 14, 1911.

8 SHEETS—SHEET 8.

Fig. 12.



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UNITED STATES PATENT OFFICE

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MAGNETO-MACHINE FOR USE IN CONNECTION WITH THE IGNITION SYSTEMS OF INTERNAL-COMBUSTION ENGINES.

984,368. Specification of Letters Patent. Patented Feb. 14, 1911.

Application filed August 22, 1908. Serial No. 449,854.

To all whom it may concern:

Be it known that I, ROBERT FREDERICK HALL, a subject of the King of Great Britain, residing at Ferndale, Church Road, Moseley, near Birmingham, England, have invented certain new and useful Improvements in Magneto-Machines for Use in Connection with the Ignition Systems of Internal-Combustion Engines, of which the following is a specification.

This invention has reference to magneto machines for use in connection with the high-tension ignition systems of internal combustion engines, and has for its principal object, to provide a self-contained magneto machine, or a self-contained and combined apparatus for generating and distributing high tension current, which is designed and adapted to greatly facilitate and simplify the application and use of what is commonly known as dual or mixed high-tension ignition systems in which provision is made for firing the charges in the cylinders of an engine through the medium of a single set of sparking plugs which are supplied in succession with high tension current that is generated either by the magneto or by a battery and induction coil which may be used in place of the said magneto under certain conditions. The advantages of this dual or mixed ignition system, as is well known, are that the battery and coil are available for starting up the engine, which cannot be conveniently done with the magneto, that by the use of a trembler coil and means for actuating same it is frequently possible to start up the engine from the switch without any manual effort whatever; and that the magneto is available when running at high speeds under which conditions it is much more effective than a coil. Further, with such mixed system the coil and battery are available as a stand-by for effective use in firing the engine in the event of any break-down of the magneto, although, on the other hand, the engines can always be run with the magneto alone should the battery and coil be thrown out of action. When the magneto is used as part of a dual or mixed ignition it is usually combined with a change-over switch whereby, when the coil and battery are placed in service, the magneto is cut out of circuit, and vice-versa, and further, in the known arrangements for working with the double system, the low-tension contact breaker in the battery and coil circuit is altogether separate from the magneto and distributer, and no effective provision is made for moving the said distributer in synchronism with the contact breaker of the low tension magneto circuit for advancing or retarding the ignition when firing with magneto ignition, or for moving said distributer in synchronism with the contact breaker of the battery circuit when coil ignition is being used.

The combined and self-contained magneto arrangement although capable of being used alone as the generator of a simple high-tension ignition system, is mainly adapted to facilitate the employment of the dual high-tension system, and its control by a single change-over switch, and comprises, in the said self-contained combination, a high-tension magneto generator whose armature carries both the primary and secondary windings of the magneto circuits, a high-tension current distributer which serves in common for both the magneto and the coil, a contact-breaker for the low-tension magneto circuit and a separate or electrically-distinct contact-breaker for the battery circuit; the said distributer and the two contact-breakers being, however, mechanically connected so as to admit of their synchronic movement for advancing and retarding the ignition irrespective of whether the high-tension current is being supplied by the magneto or by the coil and battery.

My invention also has several additional or secondary objects, one of which is to permanently and effectually combine all the above-mentioned essential parts of the dual magneto and battery ignition system in a single self-contained machine or apparatus which is capable of being readily applied to existing engines or cars, or may be adapted thereto without involving any material alteration in the dynamo, irrespective of the number of cylinders to be fired or whether the engine is suitable for driving the armature of the dynamo in the clock-wise or counter clock-wise directions.

Another object is to provide for the arrangement of a gear-driven high-tension distributer (a combined gear driven distributer and auxiliary contact breaker for a coil low-tension circuit) in either a vertical or an inclined position with respect to the magneto, and in such a manner that the

said distributer can be easily detached and replaced when required.

A further object is to provide improved means for advancing or retarding the ignition, such means being adapted to simultaneously act upon both the low-tension contact breaker of the magneto and upon the high tension distributer, in addition to which it is also operative with regard to the battery low-tension contact-breaker that is combined with the said distributer so that the same advance and retard mechanism is available for use when the engine is being fired from the coil and battery elements of the group, as when it is being fired from the magneto. And a still further object is to make provision for checking or adjusting the timing and setting of the magneto armature relative to the engine crank shaft without involving the dismantling of any of the parts of the said magneto, as is usually necessary.

Figure 1 of the accompanying drawing represents a combined machine constructed in accordance with my invention, and showing how the said invention is applied where the distributer and the coil contact-breaker are arranged in a vertical position or have their movable elements driven by a shaft which is disposed vertically with reference to the armature shaft. Fig. 2 is a section of the machine showing the arrangement of the magneto contact-breaker, the distributer and the coil contact-breaker; also the mechanical connections between these parts and the means which provide for the advance and retard of the ignition. Fig. 3 is a front elevation of the machine, showing how the angularly-adjustable casing of the magneto contact-breaker is linked up with the actuating mechanism of the ignition advance and retard system. Fig. 4 is a back elevation of the machine, partly in section, and showing how the distributer and the cam of the coil contact-breaker are driven by gear from the armature shaft. Fig. 5 is a horizontal section taken through the distributer upon the dotted line x of Fig. 2, and showing the arrangement of the coil-contact-breaker and its actuating cam. Fig. 6 is a view illustrating the complete detachability of the distributer and contact-breaker unit from the body of the machine and from the driving mechanism. Fig. 6^a is a section on the line x' of Fig. 1 showing the gear connections between the spindle of the armature and the distributing shaft for driving the latter from the former. Fig. 7 is a diagram of the connections, and Figs. 8, 9 and 10 are diagrammatic views illustrating the method and means provided for visually checking and adjusting (when necessary) the setting of the magneto armature. Figs. 11 and 12 show an elevation and a section of a modified or alternative form in which the distributer is arranged in an inclined position.

The improved machine or combined apparatus is, as already stated capable of being constructed in one or other of two different forms, differing only in the position and arrangement of the distributer relative to the magneto proper and in the nature of the gearing which is provided for driving the distributer shaft from the main or armature shaft. That is to say, the distributer may either be arranged in a vertical position at the rear or drive end of the magneto as shown in Figs. 1 to 6, and be driven by worm or skew gearing, or it may be arranged in an inclined position as shown in Figs. 11 and 12, in which case its shaft is driven from the armature shaft by bevel gears. The two different or alternative forms do not involve alterations other than in the gearing and its casing so that the same magneto and electrical arrangements may be used indifferently for either type of machine. I will, however, first describe the various features of the invention in their application to a machine with a vertical distributer as shown in Figs. 1 to 6, and deal subsequently with the slight changes which are incidental to the arrangement of the said distributer in the inclined position.

The armature a is constructed in the usual way, being provided with primary low-tension and secondary high-tension windings, so that when the machine is in use as part of a dual ignition system, it may be applied as indicated in the diagram of connections, Fig. 7, in which the high-tension winding a^1 of the magneto armature a and the high-tension winding c^1 of the coil c, terminate in a change-over switch b whereby either the magneto or the coil may be connected up with the high-tension feeder of the distributer d. In like manner, the low-tension or primary windings a^2, c^2 of the magneto and coil also terminate at the switch b, which is adapted when the engine is being fired off the magneto to cut out the coil and battery elements of the system altogether and to connect up the low-tension magneto winding a^2 with an "earth" return through the frame e^1, e^2, whereas when it is desired to fire the engine from the coil, the actuation of the said switch changes over the connections so as to connect up the coil high-tension circuit with the distributer, close the coil low-tension circuit and simultaneously to short-circuit the primary armature winding and thus render the magneto contact-breaker inoperative and prevent the induction of any high-tension current by the armature which is, of course, still driven by the engine. As will be seen from the said diagram, the high-tension feeder d^1 of the single distributer d

is connected up so that it serves in common for both the coil and the magneto. The foregoing operations will be readily understood in view of the following explanation. The switch b is of the three-position type, and includes two pairs of contact members, the first pair, b^1 and b^2 establishing the various conditions of the high tension circuits and the second pair b^3 and b^4 establishing the various conditions of the low tension circuits. The switch b is moved with relation to the following terminals, viz. a high tension magneto terminal b^5, a terminal b^6 of the high tension feed wire of the distributer, a high tension battery and coil terminal b^7, a magneto low tension terminal b^8, a low tension ground (frame) terminal b^9, and a battery terminal b^{10}. The "off" position of the switch is at the left hand limit of its movement as shown, when the drawings only are considered. In the central position of the switch the member b^2 connects the terminals b^5 and b^6 and the member b^4 connects the terminals b^8 and b^9. In this case the firing is effected from the high tension circuit of the magneto; the low tension magneto circuit is grounded through the frame parts e^1 and e^2 and the battery and coil high and low tension circuits are open. In the third position of the switch, the member b^1 connects the terminals b^6 and b^7 and the member b^3 connects the terminals b^8 and b^9, and b^9 and b^{10}. In this case, the engine is fired from the high tension circuit of the battery and coil system, the low tension circuit of the battery and coil system is closed, the high tension circuit of the magneto system is open and the low tension circuit of the magneto system remains as in the second position of the switch. The armature is entirely inclosed and is keyed to a spindle which is supported on ball bearings, as shown in Fig. 2 and is adapted to be connected with the engine at the rear or drive end while to provide for the driving of the distributer, the said drive end of the shaft is fitted with a skew or worm gear g that is arranged to mesh with a similar gear g^1 on the lower part of the distributer shaft, g^2, which is disposed in a vertical position at the drive end of the machine, so that its lower extremity may extend into and be inclosed by a gear and bearing box on the armature casing and be supported by foot step ball bearings g^3 which are also inclosed in the same box, as shown in detail in Fig. 6[a]. The skew gear is arranged to drive the distributer shaft at a reduced speed relative to the armature shaft, according to the number of cylinders to be fired, while one (or both) of the gears is made detachable and interchangeable with another gear or gears of different size so as to enable the machine to be readily adapted for use with an ignition system for four or six or other number of cylinders.

The distributer shaft (as well as certain parts of the spark-advance and retard mechanism hereinafter described) is inclosed in a stationary sleeve g^4 which is detachably mounted upon the gear and bearing box and serves as a support or pedestal for the distributer as well as for a second contact breaker h, which is inclosed within the glass-walled distributer casing d^2 and is adapted to be connected up in the primary or low-tension circuit of the coil part of a dual system, as shown in the diagram, and to be operated or controlled by a cam h^1 that is mounted on and rotates with the said distributer shaft. The parts that are inclosed within the glass cylinder and are consequently visible when in action, include the high-tension feed brush d^3 that brings in high-tension current either from magneto or the coil, as the case may be, the distributer brushes d^4 that are connected up respectively with the sparking plugs of the engine cylinders, the rotary contact plate d^5 of the distributer, the coil contact breaker h and its operating cam h^1. The whole of these inclosed parts are visible when in operation through the glass walls of the casing, and further, they may be bodily detached from the machine by providing the base d^6 of said casing with a tubular extension d^7 which sockets into the upper end of the stationary sleeve or support g^4 and is secured therein by a clip g^5 that is formed at the upper end of said support; also by constructing the distributer shaft in two feathered parts, or by providing the rotary distributer plate and contact-breaker cam with a sleeve-like extension d^8 which is adapted to socket over the upper end of the distributer shaft, preferably by means of a system of washers or rings d^9 whose inner edges are formed with tongues or key-pieces d^{10} that are adapted to extend through a suitable slot in the extension d^7 of the distributer plate and to engage with a groove or featherway d^{11} in the shaft. These keying washers are preferably secured on the extension by a split ring d^{12} or like device. Fig. 6 illustrates how the parts may be separated when the clip g^5 is unfastened.

The distributer plate consists of a disk d^5 of vulcanite or like non-conducting material which is fitted with a metallic sector or contact-piece d^{13} which is in permanent connection, through the spring-influenced carbon-feed brush d^3, with the high tension circuit, (either of the magneto or of the battery coil) and which is also adapted to pass in succession under, the other brushes d^4 which are respectively connected with the engine plugs. The whole of the carbon brushes are mounted in the ebonite top-plate or cover d^{14} of the casing, and the said top-plate is de-

tachable and interchangeable with another of the same dimensions but carrying a different number of brushes so as to admit of and facilitate the adaptation of the machine for any type of engine by the application of a cover carrying four, six or other number of brushes. The contact piece on the distributer plate d^5 is also detachable to admit of the substitution or application of a piece of greater or less width to suit the number of distributing brushes and to make it impossible for the said contact to be in simultaneous circuit with two brushes while providing the necessary range of relative movement that is required in order to advance or retard the ignition. This combination with the high tension distributer which is common to both magneto and coil ignitions of a separate or independent contact-breaker that forms part of the coil system, and is additional to the low tension contact-breaker i on the magneto, constitutes the principal feature of my invention, as it greatly facilitates and simplifies the application and use of the dual or mixed ignition system in connection with automobiles and the like, and in addition to reducing the number of parts and enabling all the mechanical elements of the system to be grouped in a practical and effective manner in a single machine, it enables the contact breaker and its cam to be effectively inclosed and protected while still being visible when in action, and further it admits of the two contact breakers, or either of them, and the distributer being moved in synchronism for advancing or retarding the ignition, although both contact breakers are nevertheless completely independent so that, as already stated, no failure or defect in the one can in any way influence the working of the other, while in advancing or retarding the ignition, the glass-walled casing and the whole of the high tension cables remain stationary so that the rotatory distributer or feeder plate d^5 and the cam h^1 are the only parts that are moved when the ignition time is altered.

The contact breaker i for mechanically making and breaking the primary or low-tension circuit of the magneto system, is operated by a cam i^1 on the armature spindle while all the other parts of the device are carried upon the inside of, and inclosed within, a circular casing i^2 that is rotatably mounted on the front end of the armature casing as shown in Fig. 2.

The primary winding from the armature terminates in a suitably-insulated contact plate i^3 from which the low-tension current is collected by an insulated brush i^4 that is mounted in the front of the contact-breaker case and is in electrical connection with the contact-breaker as well as with the condenser of the system.

A metallic arm i^5 having connection with the low-tension armature winding through the brush or contact i^4 is mounted on the inner face of the contact-breaker case so as to move with the latter when the ignition is being advanced or retarded, and is also arranged to carry a platinum tipped screw i^6 for adjusting the distance between the points of the cam-operated contact breaker. To provide for the adjustment of the contact screw or for the inspection of the device when the magneto is running, the upper part of the case is cut away at i^7 and a metallic cap or cover i^8, having a similar cutaway part or gap i^9 is arranged to inclose the contact-breaker case so as to be both rotatable thereon and detachable. Normally, the clearance i^7 in the case is closed by a solid part of the cap, but by turning the latter so as to bring both clearances into register, the interior of the said case is rendered accessible and the contact maker may be inspected or adjusted even when in action. Preferably the cap or cover is held in position by a spring arm i^{10} which can be turned aside when it is required to remove said cap and may also be used as a circuit connection between the contact breaker and the condenser, in which case one end of the said spring is arranged to bear on an external-metallic stud i^{11} having an electrical connection with the low-tension collector brush. The screw or fitting that connects the said spring arm with the condenser terminal may also be used for wiring the magneto low tension to the switch whereby said magneto may be short-circuited to earth when coil ignition is in use or when the engine is not running. It will be understood from the foregoing that, in the particular arrangement shown, the breaking of the magneto primary circuit is timed or advanced and retarded by turning the contact-breaker cover and parts mounted therein so as to alter the positions of the contact breaker arm relative to the cam i^1 on the armature spindle, whereas in the case of the coil contact breaker where the rocking arm is mounted on the stationary part of the distributer casing, the timing of the contact breaking action is effected by shifting the cam relative to the said arm. As the distributer plate d^5 and the cam h^1 of the coil contact breaker are connected with one another and are mounted on and driven by the distributer shaft, they must necessarily turn with one another on the cam being shifted for timing the ignition when the high tension current is being obtained by the use of the coil and accumulator, and the synchronizing of the distribution of the high-tension current is necessarily consequential to the altering of the timing, but in order to provide for a similar synchronism when the magneto is in use and the contact-breaker h is inoperative, the distrib-

ater must also be mechanically connected to the movable part of the magneto contact breaker so that any alteration in the timing of the action of the latter shall simultaneously set the distributer plate backward or forward, as the case may be. I may mechanically connect these parts in any suitable manner that will insure their movement in unison relative to the driving gear and the armature, but prefer to arrange for their simultaneous movement by providing the armature casing with suitable bearings j to support an actuating rod j^1 which extends under the magneto and is connected at its forward end, by means of a lever and link j^2, j^3, to the rotatable casing i^2 of the magneto contact breaker as well as to the hand lever or other device by which the advance-spark gear in controlled, while the other end carries another lever or arm j^4 which extends through an opening j^5 in the sleeve or pedestal that incloses the distributer shaft and is provided with a stud j^6 to engage with or act cam-wise upon a collar or groove that is formed upon or in the said shaft, as shown in Fig. 2.

The lower end of the distributer shaft is connected to the hub of the driven skew or worm gear by a stud j^7 engaging with an inclined or helical slot or groove j^8 of suitable pitch, while its upper end is, as has already been described, slidably feathered to the contact-breaker cam and rotary distributer plate, the whole arrangement being such as to insure that when the shaft is raised or lowered through the actuating rod and lever, both it and the cam and distributer plate are turned or rotated together through a corresponding angle relative to the gear wheel. This synchronizes the coil low-tension contact breaker and the high tension distributer, while by virtue of the linkage of the said actuating rod j^1 to the magneto contact-breaker as well as to the distributer plate, the said contact breaker is also moved in unison with the distributer when the ignition timing gear is operated. By reason of the fact that the coil and accumulator system demands a further range of advance and retard movement than the magneto as a consequence of the lag in the coil due to primary saturation and magnetic reluctance, it is necessary to provide for this increment being available when the coil is being used, and such provision can be made by modifying the length and pitch of the inclined slot j^8 in the sleeve that drives the cam and distributer shaft.

By virtue of the above described arrangement, no alteration has to be made in any part of the timing gear in changing over from magneto to coil or vice-versa as all the connections are permanently made for enabling the distributer to work efficiently with either method of ignition and for synchronizing the distributing action with the timing of the low-tension break of either the magneto or the coil, whichever may be in service.

Special provision is made to admit of the combined machine being readily adapted to any engines irrespective of whether the latter are designed to drive the magneto-armature in the clock-wise or counter clockwise direction, and also to facilitate the adjustment of the armature to suit either direction of running, as well as to enable such setting to be subsequently checked and adjusted (if necessary) without involving the opening up of the armature casing or the dismantling of any part of the appliance. So far as the coil contact breaker is concerned, this will operate effectively whichever way the cam and distributer shaft is run so that no alteration is required to be made in this part to adapt same to either direction of running, but the cams for actuating the magneto contact-breaker are set in certain definite relationship to the armature so as to insure that the low-tension circuit shall be broken when the armature is in the maximum" voltage postion. This relation, of course, varies with the direction in which the armature and cam are run, and the cam-ring i^1 is therefore made detachable and reversible, which enables the same to be set with its cam-lifts at the correct angle forward or rearward of a line taken through the center of the armature and shaft. The cam ring is detachably held in position by means of a shouldered retaining nut i^{12} which is threaded into the end of the armature spindle. The line above referred to, which is taken through the center of the armature and shaft and with respect to which the cam ring is set, is indicated by the letter D in the diagrams Figs. 8, 9 and 10 which respectively indicate the beginning of the "maximum" voltage position of the armature and its relation to the distributer plate when the machine is set for running in the clock-wise direction (Fig. 8;) when the armature is at the neutral or zero position (Fig. 9); and the beginning of the maximum voltage position when the machine is set for running in the anti-clockwise direction (Fig. 10). The setting of the reversible cam ring with the cams in the right relationship to the armature is the only alteration that is required in the contact breaker, but it is also necessarily essential to set the armature so that it shall be in one or other of the two maximum voltage positions shown in Figs. 8 and 10 and (according to the direction of running) when the piston of the first firing cylinder is at the top of its stroke. To enable this to be done when first applying or adapting the machine to any particular engine and also to enable the user to subsequently check or set

the timing of the armature in proper step with said engine, I propose to fix the armature rigidly to its shaft or to secure the said armature so that its vertical axis (indicated by the line D in the diagrams) has a fixed and definite relationship to the center line of the said shaft. I also form on that part of the shaft which extends outwardly beyond the drive end of the machine, a slot or recess m, which bears the same relationship to the center line as does the vertical axis of the inclosed or boxed-up armature and which is adapted to be engaged by a loose index piece or detachable pointer n that is applied to said shaft only when it is desired to set, alter or test the timing and which is, of course, held by the slot in the same position with respect to the engine crank shaft as the armature itself. Then I provide on the outside of the drive end of the armature casing, a set of permanent indicator markings (A, B and C in the diagram) which correspond respectively to the correct maximum position of armature for clockwise running, the zero position, and the maximum position of the armature for anti-clockwise running. The index piece has an aperture with points at n^1 which are alinable with the center of the shaft and armature, and when the said index piece is attached to the shaft, as shown in the diagrams, the position of the armature is at once indicated and by taking a "reading" from the relative positions of the center points n^1 and one or other of the markings A, B and C, it can be immediately ascertained whether the armature is in the correct in-step position that it should have when the working piston is at the top of its stroke. This "reading" or check can be taken without dismantling a single part of the machine or uncoupling it from the engine, but the making of any adjustment of the armature that may be necessary, and also the first adapting or setting the machine to run in the desired direction, can be readily effected by the aid of the indicator by merely disconnecting the driving shaft from the engine and without disturbing any part of the magneto itself.

In the application of the invention to a self-contained combination in which the distributer and coil contact-breaker casing is arranged in an inclined position above the front of the armature as shown in Figs. 11 and 12 only very slight modifications are necessary. The distributer shaft is inclined, as also is the casing or sleeve for inclosing same and it is preferably arranged above the armature casing and inside the magnets, in a plane parallel to that in which the actuating rod of the advance and retard mechanism is placed. The terminal sockets in the inclined cap or cover of the distributer casing are arranged vertically and stepped relative to the front of the said cover so as to facilitate the leading off of the cables to the respective cylinder plugs while instead of using skew or worm gear to drive the shaft, I use an arrangement of bevel toothed gears contained in a casing of sufficient size to admit of the interchangeable application of different sets of gears in adapting the machine for a four or six cylinder or other engine. In the said Figs. 11 and 12 the same letters are used to indicate the different parts as are employed for distinguishing the corresponding parts in Figs. 1 to 6. By the use of an inclined and inclosed distributer shaft, the whole arrangement is rendered more compact, as the distributer can be driven by smaller gears than would be possible if the shaft was arranged horizontally and it is furthermore impossible for any oil from the gear or bearings to work along the shaft or its casing and upset the operations of the parts that are inclosed in the distributer casing.

Having fully described my invention, what I desire to claim and secure by Letters Patent is:—

1. In an ignition system for internal combustion engines, the combination with a magneto machine and its high and low tension circuits and a battery and coil and their high and low tension circuits, of electrically distinct and structurally independent contact breakers in the two low tension circuits, means mechanically connecting the contact breakers to provide for synchronic differentiated adjustments thereof, and a high tension distributer for said high tension circuits also connected with the said means, for adjustment thereby synchronously with the adjustment of the low tension contact breakers.

2. In an ignition system, the combination with a magneto machine and its high and low tension circuits and a battery and coil and their high and low tension circuits, of a rotary high tension current distributer for the said high tension circuits, the distributer being driven from the armature of the machine, a contact breaker combined with the distributer and connected up in the low tension circuit of the coil, an electrically distinct magneto circuit breaker, operated directly from the armature shaft and including an adjusting part, and mechanical connections for effecting synchronic differentiated adjustments of the magneto contact breaker as one element and of the distributer and the battery and coil contact breaker combined therewith as another element.

3. The combination with the armature shaft of a magneto machine, a magneto low tension contact breaker including a cam mounted on said shaft and operable for either a clockwise or counter-clockwise rotation of the armature, and an armature casing having indications thereon of the

maximum voltage positions of the armature in clockwise or counter-clockwise running and of its neutral position, of an index piece for removable rigid assemblage upon the end portion of the shaft in a definite relation to the armature to indicate the position of the latter with respect to one of the indications on the armature casing.

4. In an ignition system for internal combustion engines, a magneto machine and its high and low tension circuits, a battery and coil and their high and low tension circuits, a high tension distributer for the high tension circuits, electrically distinct contact breakers in the two low tension circuits, one of the contact breakers being associated with the distributer and mechanical connections between the contact breakers for effecting synchronous differentiated adjustments thereof.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

ROBERT FREDERICK HALL.

Witnesses:
HENRY NORTON SKERRETT,
HY. SKERRETT.