F. KRATZ.

ELECTRIC IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES.

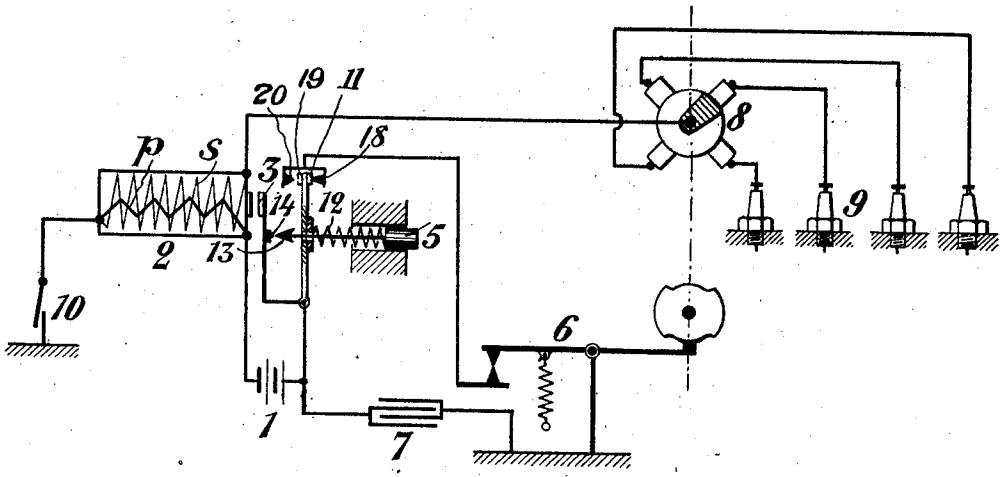
APPLICATION FILED SEPT. 19, 1911.

1,063,555.

Patented June 3, 1913.

2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

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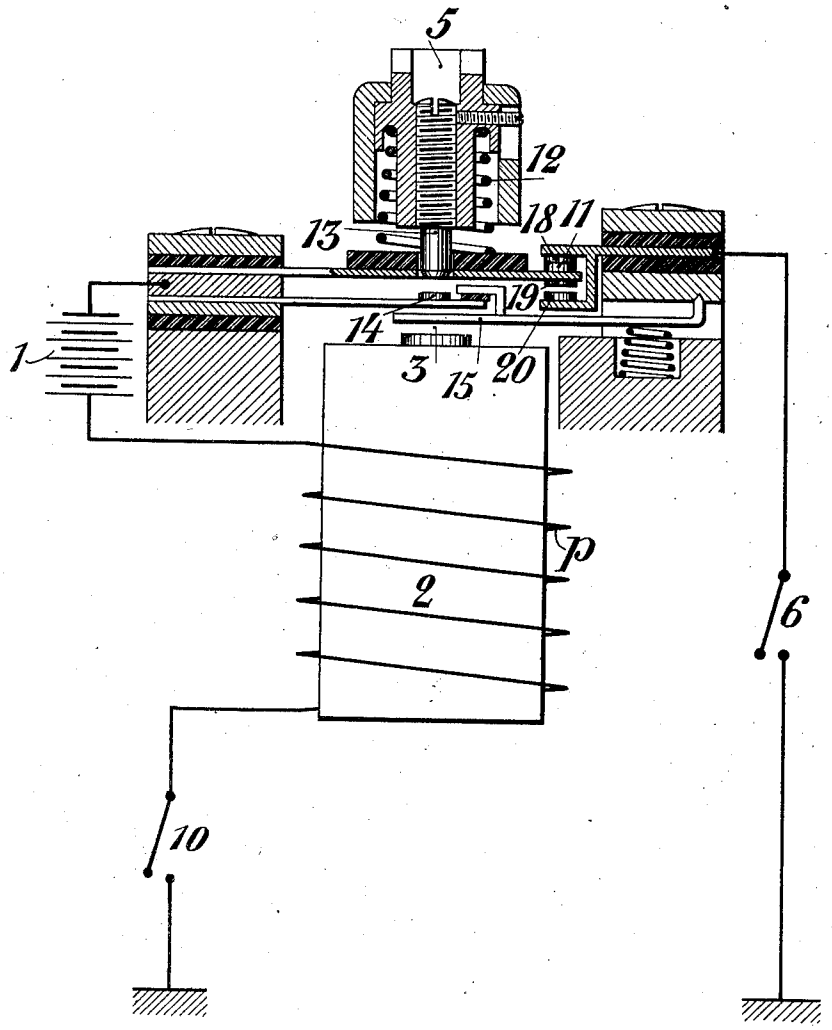
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2 SHEETS—SHEET 2.

Fig. 2.



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ELECTRIC IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES.

1,063,555. Specification of Letters Patent. Patented June 3, 1913.

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To all whom it may concern:

Be it known that I, FRANZ KRATZ, a subject of the Emperor of Germany, and residing at Stuttgart, Germany, have invented certain new and useful Improvements in Electric Ignition Systems for Internal-Combustion Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to apparatus for starting multiple cylinder combustion engines of that kind wherein, after the engine is stopped, it may again be started by ignition if an ignitible gas is present in one of the cylinders.

To that end there is employed an ignition coil, a mechanical interrupter driven by the engine, and a switch for completing the circuit of the ignition coil when the mechanical interrupter assumes such a position that the ignition coil is otherwise rendered inoperative, these elements being constructed and connected together in the manner and for the purpose hereinafter described.

In one previous arrangement the vibratory armature of the ignition coil is used for the starting ignition, and also for running ignition, the winding and the vibratory armature of the ignition coil being connected in series with the mechanical interrupter. In such case it is only necessary to provide a switch to close the circuit of the ignition coil at will in the event that the engine stops with the circuit open at the mechanical interrupter.

In another previous arrangement the vibratory armature of the ignition coil is used only for starting, and during running the mechanical interrupter is relied upon to make and break the circuit of the winding of the ignition coil to produce the ignition sparks. In the latter case the vibratory armature of the ignition coil and the interrupter are connected in parallel while the winding of the ignition coil is in series with the interrupter, and if it happens that the engine stops with the mechanical interrupter closed, there is always a closed current path through the winding of the ignition coil, and the vibratory armature is consequently drawn at all times toward the magnet and cannot operate. This difficulty is overcome, in that case, by providing a switch adapted to close the buzzer circuit of the ignition coil independently of the mechanical interrupter, and further adapted, in the event that the engine stops with the mechanical interrupter closed, to open the circuit of the mechanical interrupter and thereby release the vibratory armature of the ignition coil. This expedient, however, while it attains the desired result, at the same time introduces the difficulty that the starting switch, if it is held closed, brings about a continuous operation of the vibratory armature, and as the rotating distributer, which distributes the sparking current to the several cylinders, establishes a connection with the spark plug of any particular cylinder, the spark due to the action of the vibratory armature will be immediately set up, causing premature ignition and back fire. This could not occur in the old arrangement, in which no provision was made for breaking the circuit through the mechanical interrupter, for the reason that the parts are so timed that the mechanical interrupter is closed at the period when the distributer starts to make connection with the spark plug of any particular cylinder, and remains closed until the closure of the circuit at the distributer contact is complete and the piston of that particular cylinder has reached the point of proper ignition, whereupon the mechanical interrupter is opened by its cam to cause the spark.

In accordance with the present invention, the above-mentioned difficulty is avoided by providing such an arrangement that there is a distinction between the mode of operation when the engine has stopped with the mechanical interrupter closed, and the mode of operation when the engine has stopped with the mechanical interrupter open. In the event that the engine stops with the mechanical interrupter open, ignition is brought about by closing the circuit of the ignition coil through the vibratory armature and the auxiliary switch but without having the interrupter circuit open at that time at a second point. The result is that as soon as the engine starts the mechanical interrupter has the above described effect to render the vibratory armature inoperative just before the proper sparking periods, thereby preventing premature ignition and back firing.

In the event that the engine stops with the mechanical interrupter closed, then the arrangement is such that the manipulation of the auxiliary switch first breaks the interrupter circuit, causing a single spark, and then immediately closes the interrupter circuit again, before the auxiliary switch has been moved far enough to bring the vibratory armature into circuit. The result is that the interrupter circuit is not opened at a second point at any time when the buzzer is in action and consequently the mechanical interrupter retains its effect to properly control the sparking periods. In this way the engine may be started by the initial spark referred to, or by setting up a number of sparks in succession by rapid repetition of the movement of the auxiliary switch. As soon as the engine starts the sparking is immediately controlled by the mechanical interrupter, and premature ignition and back firing are prevented.

In the accompanying drawings, illustrating the preferred arrangement of my invention, Figure 1 is a wiring diagram, and Fig. 2 shows the auxiliary switch and cooperating contacts in connection with the primary winding of the ignition coil.

Referring to the drawings, 1 is a battery, 2 an ignition coil having a vibratory armature 3, one terminal of the primary winding p being grounded through a switch 10 and the other terminal being connected to one side of a battery. The push button 5 is normally held out of contact with the vibratory armature by the spring 12, but is capable of contacting therewith at the cooperating contacts 13 and 14. The push button is permanently grounded as indicated. The mechanical interrupter 6 and the distributer 8 are driven by the engine in the well known manner. The spark plugs 9 in the cylinders of the engine are electrically connected through the distributer to the secondary winding of the ignition coil, and the condenser 7 is bridged across the cooperating contacts, in the usual manner.

The arrangement disclosed herein is distinguished from the previously mentioned arrangements by the auxiliary coöperating contacts 11 and 19, carried on the opposite side of a spring lever against which abuts the spring 12 of the push button 5. The stationary contacts 18 and 20 are electrically connected together and to the mechanical interrupter 6 and are disposed opposite the respective coöperating contacts 11 and 19, in such manner that one terminal of the mechanical interrupter 6 is normally connected to the battery through the coöperating contacts 11 and 18. The arrangement is such that upon pressing the push button 5, to put the ignition coil into operation to start the engine, the coöperating contacts 11 and 18 are first separated and then the coöperating contacts 19 and 20 are closed before the coöperating contacts 13 and 14 come together at the end of the movement.

The operation of the system will now be described.

If the engine comes to rest with the mechanical interrupter 6 in an open position, a slight movement of the push button 5 will not effect vibration of the ignition coil armature 3 since the coöperating contacts 13 and 14 are still separated. However, when the push button is depressed further, the cooperating contacts 13 and 14 are brought together and the armature 3 starts to vibrate. Practically at the same time, the cooperating contacts 19 and 20 are brought together so that the mechanical interrupter is then connected in series with the primary winding p of the ignition coil 2. As a result of the rapid interruption of the primary circuit p due to the vibration of armature 3, there are generated in the secondary coil s a number of ignition currents following each other in rapid succession and of sufficient intensity to produce a plurality of sparks at that spark plug 9 which is selected by the distributer 8. As soon as the engine starts, the push button is released and the ignition current is produced in the ignition coil as a result of the coöperating contacts 11 and 18 and the mechanical interrupter 6, whereby no premature ignitions and back firing can occur. If, on the other hand, the engine should come to rest with the mechanical interrupter 6 in a closed position, then as soon as the circuit of the mechanical interrupter is opened by depressing the push button 5 to a point where the cooperating contacts 11 and 18 are separated, a single spark is generated at the spark plug 9 due to the interruption of the primary circuit p. If suitable ignition occurs then the engine starts, but otherwise another spark is produced when the push button is further depressed to again close the cooperating contacts 19 and 20 in the circuit of the mechanical interrupter. If necessary, this operation may be repeated several times so that the circuit of the mechanical interrupter is alternately made and broken at the coöperating contacts 11 and 18 and 19 and 20, whereby a succession of single sparks are produced at the spark plug. In this way, combustible mixtures which have been confined in the cylinders for some time may be ignited. When the engine starts, the push button 5 is released and the ignition system operates through the mechanical interrupter in the well known manner.

It is obvious that the arrangement may be such that the push button 5 is held fast in its depressed position so that the primary circuit is continually complete at the coöperating contacts 19 and 20, in order that the engine may be started after a long stop by

cranking. Also, any other suitable device for closing and opening the coöperating contacts may be substituted for the push button, and an ignition coil with a single winding may replace the ignition coil with the primary and secondary windings, as herein shown. Also, the apparatus may be applied to a single cylinder engine.

Other modifications are obviously within the scope of my invention.

Having thus described my invention, what I claim is:

1. In combination with an electric ignition system for running internal combustion engines wherein there is employed a mechanical interrupter and the winding of an ignition coil connected in electrical series therewith, of apparatus for starting the engine by ignition comprising a plurality of coöperating contacts and connections therefor arranged to effect continued vibration of the vibratory armature when the mechanical interrupter is in open position, and to effect single movements of the vibratory armature when the mechanical interrupter is in a closed position.

2. An electric ignition system for internal combustion engines comprising a mechanical interrupter driven by the engine and capable of coming to rest in either an open or a closed position, an ignition coil for generating ignition currents, a source of electric current, electrical connections for connecting the source to the ignition coil and the mechanical interrupter, and a switch adapted to complete a path in electrical parallel with the mechanical interrupter and also adapted to actuate a plurality of coacting contacts arranged in the path of the mechanical interrupter in such manner as, upon operation with the mechanical interrupter at rest to open the connection to the mechanical interrupter, to complete the circuit through the parallel path, and also to reëstablish the connection to the mechanical interrupter.

3. An electric ignition system for internal combustion engines, comprising a mechanical interrupter driven by the engine and capable of coming to rest in either an open or a closed position, an ignition coil for generating ignition currents, a source of electric current, electrical connections for connecting the source to the buzzer and the mechanical interrupter, and a switch adapted to complete a path in electrical parallel with the mechanical interrupter and also adapted to actuate a plurality of coacting contacts arranged in the path of the mechanical interrupter in such manner as, upon operation with the mechanical interrupter at rest in a closed position, to interrupt the circuit through the mechanical interrupter, and to complete the circuits through the switch and the interrupter.

4. An electric ignition system for internal combustion engines, comprising a mechanical interrupter driven by the engine and capable of coming to rest in either an open or a closed position, an ignition coil for generating ignition currents, a source of electric current, electrical connections for connecting the source to the buzzer and the mechanical interrupter, and a switch adapted to complete a path in electrical parallel with the mechanical interrupter and also adapted to actuate a plurality of coacting contacts arranged in the path of the mechanical interrupter in such manner as, upon operation with the mechanical interrupter in an open position, to open the connection to the mechanical interrupter, to complete the circuit through the parallel path, and also to reëstablish the connection to the mechanical interrupter.

5. An electric ignition system for multicylinder internal combustion engines provided with spark plugs, comprising a mechanical interrupter driven by the engine and capable of coming to rest in either an open or a closed position, an ignition coil having a primary and a secondary winding for generating sparks at the spark plugs, a distributer for distributing the currents induced in the secondary winding of the ignition coil to the spark plugs, a source of electric current, electric connections for connecting the source to the primary winding of the ignition coil and to the mech cal interrupter, and a switch adapted to complete a path in electrical parallel with the mechanical interrupter and also adapted to actuate a plurality of coöperating contacts arranged in the path of the mechanical interrupter in such manner, as upon operation, to first open the connection to the mechanical interrupter and then to complete the circuit through the parallel path and also to reëstablish the connection to the mechanical interrupter.

6. In an ignition system for starting internal combustion engines, an ignition coil having a winding and a vibratory armature, a mechanical interrupter connected in electrical series with the winding of the ignition coil, and a plurality of co-acting contacts for opening the connection to the mechanical interrupter, for completing the circuit of the vibratory armature independently of the mechanical interrupter, and for reëstablishing the connection to the mechanical interrupter.

7. In an ignition system for starting internal combustion engines, an ignition coil having a winding and a vibratory armature, a mechanical interrupter connected in electrical series with the winding of the ignition coil, and a plurality of co-acting contacts for first opening the connection to the mechanical interrupter, and for then completing the circuit of the vibratory armature independently of the mechanical interrupter and re-

establishing the connection to the mechanical interrupter.

8. In an ignition system for starting internal combustion engines, an ignition coil having a winding and a vibratory armature, a mechanical interrupter connected in electrical series with the winding of the ignition coil, a plurality of co-acting contacts for opening the connection to the mechanical interrupter, and for completing the circuit of the vibratory armature independently of the mechanical interrupter and reëstablishing the connection to the mechanical interrupter, and means for permanently closing the path which is independent of the mechanical interrupter.

9. In a system of electrical ignition for internal combustion engines, the combination with an ignition coil having a winding and a vibratory armature for starting ignition and a mechanical interrupter properly timed for ignition during periods of running, of auxiliary circuit-controlling mechanism and electrical connections therefor arranged to open the circuit of the mechanical interrupter, to reëstablish that circuit, and then to close the circuit of the vibratory armature, substantially as and for the purpose described.

10. A system of electrical ignition for internal combustion engines provided with a mechanical interrupter, and an ignition coil having a winding and a vibratory armature in combination with auxiliary circuit-controlling mechanism and electrical connections therefor arranged to open and close the circuit of said ignition coil and the circuit of said mechanical interrupter in such manner that when the circuit of the vibratory armature is closed by said auxiliary mechanism the circuit of the mechanical interrupter is also closed thereby, substantially as and for the purpose described.

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

FRANZ KRATZ.

Witnesses:
AUGUST RÜEGG,
DAVID KRIEGEL.