M. B. CRIST & M. R. WELLS.

IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES.

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1,040,518. Patented Oct. 8, 1912.

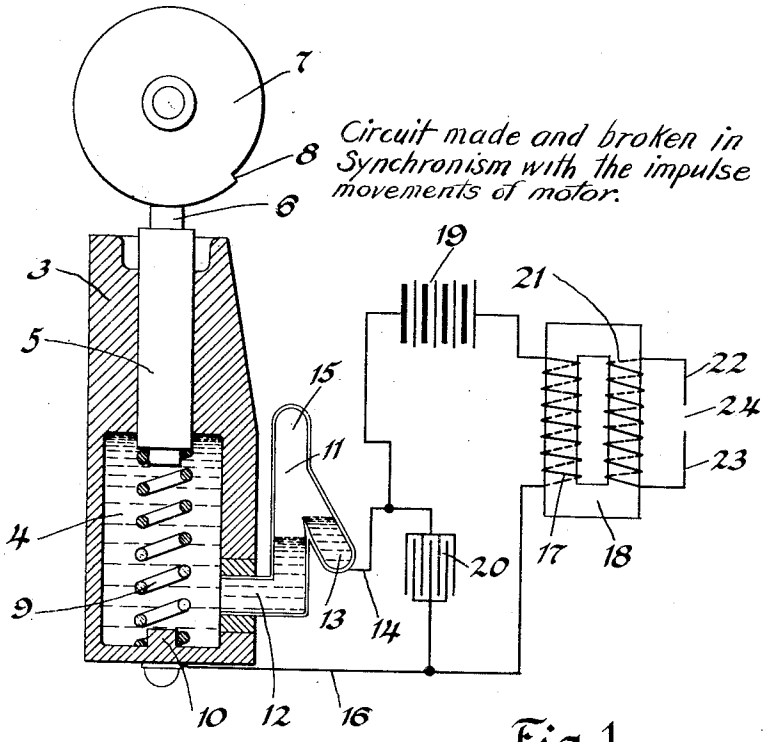

Fig. 1.

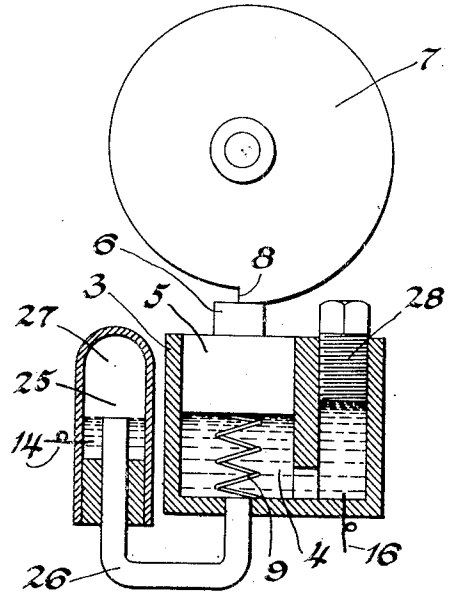

Fig. 2

WITNESSES:

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MARK B. CRIST, OF PITTSBURGH, AND MERRITT R. WELLS, OF WILKINSBURG, PENNSYLVANIA, ASSIGNORS, BY MESNE ASSIGNMENTS, TO THE COLONIAL TRUST COMPANY, TRUSTEE, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES.

1,040,518. Specification of Letters Patent. Patented Oct. 8, 1912.

Application filed February 15, 1906. Serial No. 301,224.

To all whom it may concern:

Be it known that we, MARK B. CRIST and MERRITT R. WELLS, citizens of the United States, and residents, respectively, of Pittsburgh and Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Ignition Apparatus for Internal-Combustion Engines, of which the following is a specification.

This invention relates to non-vibrator ignition apparatus for internal combustion engines.

In non-vibrator ignition systems for internal combustion engines the spark plug is connected to the terminal of the secondary coil of an induction coil, the primary coil of which is connected to a battery, or some other source of direct current; and the primary circuit of the system is provided with a circuit breaker across the terminals of which a condenser is connected. The high voltage spark across the terminals of the secondary coil, that is, in the spark plug of the engine, jumps at the time of breaking the primary circuit and is rendered more effective by the condenser which at the time of breaking the circuit sends an accumulated charge through the primary circuit. Considerable difficulty has been encountered with the circuit breakers of such apparatus because of the oxidation and burning away of the contact points which thereby render the circuit breaker ineffective in operation.

The object of this invention has been the production of a simple and effective circuit breaker in which effective means are utilized for overcoming the tendency of the contact points to oxidize. This and other objects we attain in an apparatus described and illustrated in the accompanying drawings, throughout the several views of which like parts are denoted by corresponding numerals.

Figure 1 is a sectional elevation of a circuit breaker embodying this invention in combination with a wiring diagram in which the electrical connections and apparatus utilized are diagrammatically illustrated. Fig. 2 is a sectional view of a modified form of circuit breaker embodying this invention.

A casing 3 inclosed a chamber 4 into which a cam-actuated plunger 5 extends. The plunger 5 extends through the casing 3 and is provided with a finger 6 which contacts with a cam 7. The cam 7 is provided with an outwardly extending cam projection 8 which causes the plunger to reciprocate. A helical spring 9 is suitably mounted on a lug 10 in the chamber 4 and operating against the plunger 5 holds it against the cam 7. An insulating tube 11 connects with the chamber 4 through an opening 12 and extends upwardly, the top portion being hermetically sealed. A downwardly extending arm 13 connects with the tube and is provided with a terminal wire 14. The chamber 4 and the arm 13 of the tube 11 are filled with mercury and the tube 11 is partially filled with mercury and partially filled with an inert gas which is maintained over the mercury in the top portion 15 of the tube. The gas pressure in the portion 15 and consequently the pressure on the mercury in the tube 11 depends upon the pressure exerted on the column of mercury in the chamber 4. The mercury in the chamber 4 forms a terminal of a circuit make and break device and is in electrical contact with a wire 16 which connects with a primary coil 17 of transformer 18. The mercury in the arm 13 forms the other terminal of the circuit make and break device and is connected to a battery 19 by the wire 14. A condenser 20, in parallel with the battery 19, is connected between the wires 14 and 16 across the make and break device. The transformer is provided with a secondary coil 21 between the terminals 22 and 23 of which a spark gap 24 is maintained.

The reciprocations of the plunger 5, which are caused by the cam 7, causes the pressure in the chamber 4 to fluctuate and the mercury is periodically forced from the chamber into the tube 11 against the gas pressure in the top portion 15. When the lug 8 of the cam 7 forces the plunger 5 to its lowest position mercury from the chamber 4 rises to a sufficient height, in the tube 11, to contact with the mercury in the tube 13 and thereby completes the primary circuit. When the cam 7 permits the plunger 5 to be forced upward by the spring 9, the displaced mercury of the chamber 4 recedes from the tube 11 and breaks the primary circuit. At the time of breaking the primary

circuit an induced charge is generated in the secondary coil of the transformer 18, and a high voltage spark jumps the gap 24. The increased capacity of the primary circuit occasioned by the introduction of the condenser 20 causes a fatter spark at the gap 24 because the capacity of the condenser counteracts the inductance of the coil. Since the mercury terminals of the circuit breaker are surrounded by the inert gas contained in the top portion 15, no difficulty is encountered from oxidation since no oxygen is present. The heat occasioned by the spark is expended in vaporizing a portion of the mercury which will be rapidly condensed when the gas pressure in the portion 15 is increased by the pressure of the plunger 5 on the column of mercury in the chamber 4. The action of the circuit breaker is, therefore, effective and precise and the time of inducing the high voltage current can be definitely controlled.

In Fig. 2 a modification of the apparatus is shown. The chamber 4 is connected with a chamber 25 by an insulating tube 26. The tube 26 enters the bottom of the chamber 25 and extends partially into it. The chamber 25 is filled with mercury to the top of the tube 26 over which, in the top portion 27, an inert gas is maintained. The plunger 5 is reciprocated by the cam 7 against the spring 9, causing the mercury in the chamber 4 and the tube 26 to fluctuate. When the plunger 5 is at its lowest position, mercury is forced from the chamber 4 into the chamber 25 against the gas pressure in the top portion 27, thereby completing the metallic circuit between the mercury of the chamber 25 and the mercury of the chamber 4. When the plunger 5 recedes from the chamber 4 the gas pressure in the portion 27 forces the displaced mercury back through the tube 26 and metallic contact between the chambers is broken. The mercury in the chamber 25 is provided with a wire terminal 14 and the mercury in the chamber 4 is provided with a wire terminal 16 which forms a portion of a primary circuit as described above in connection with Fig. 1. The chamber 4 is provided with an adjusting screw 28 which is adapted to regulate the height to which the mercury will rise in the chamber 26 during the operation of the plunger 5. By this arrangement the time of closing the primary circuit can be accurately adjusted.

Since the mercury in the chamber 25 is covered by an inert gas, no difficulties will be encountered when the mercury recedes into the tube 26 and breaks the primary circuit.

Other forms and arrangements of this apparatus may be utilized without departing from the spirit or scope of this invention and

What we claim as new and useful is:

1. In an ignition apparatus, means for making and breaking an electric circuit in synchronism with the impulse movements of an explosion engine, said means comprising a sealed chamber containing mercury which constitutes a terminal for the circuit, an insulating tube separate from but communicating with said chamber and containing a body of mercury which constitutes a second terminal for the circuit, and a cam-reciprocated plunger operated within said chamber to bring the mercury in the chamber into and out of contact with the mercury in the tube and thereby make and break the circuit.

2. In an ignition apparatus, means for making and breaking an electric circuit in synchronism with the impulse movements of the engine, comprising a sealed chamber containing mercury constituting a terminal for the circuit, an insulating tube provided with an arm communicating with said chamber and containing mercury which comprises a second terminal in said circuit, and a cam-reciprocated plunger operating in said chamber to reciprocate the mercury contained therein and to thereby raise and lower the level of the mercury in said tube above and below the mercury in the arm to make and break the circuit.

In testimony whereof, we have hereunto subscribed our names this 13th day of February, 1906.

MARK B. CRIST.
MERRITT R. WELLS.

Witnesses:
CHARLES W. MCGHEE,
E. W. MCCALLISTER.

It is hereby certified that in Letters Patent No. 1,040,518, granted October 8, 1912, upon the application of Mark B. Crist, of Pittsburgh, and Merritt R. Wells, of Wilkinsburg, Pennsylvania, for an improvement in "Ignition Apparatus for Internal-Combustion Engines," errors appear in the printed specification requiring correction as follows: Page 1, line 52, for the word "inclosed" read *incloses;* same page, line 96, for the word "lug" read *cam projection;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of November, A. D., 1912.

[SEAL.] C. C. BILLINGS,

Acting Commissioner of Patents.