Dec. 2, 1930. H. BURKAS 1,783,495

CIRCUIT BREAKER FOR IGNITION INSTALLATIONS OF INTERNAL COMBUSTION ENGINES

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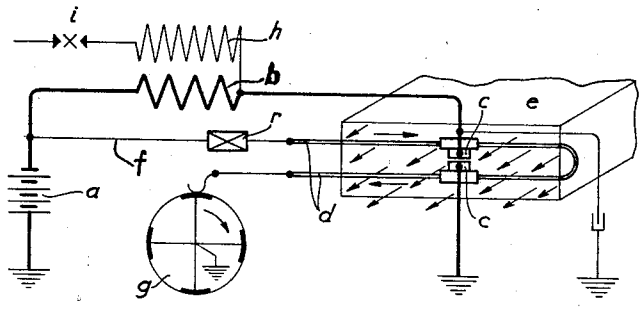

Fig. 1

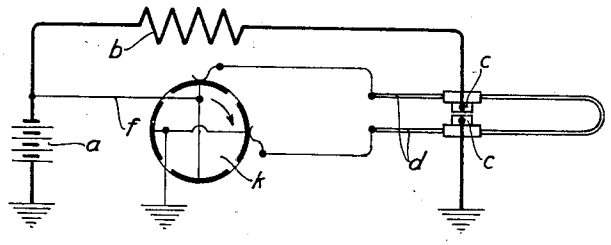

Fig. 2

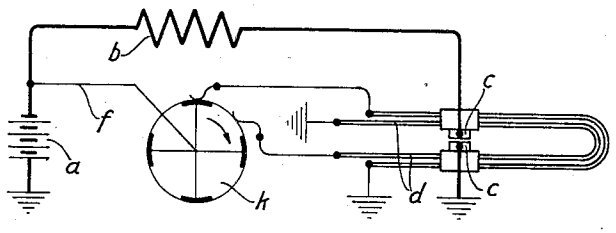

Fig. 3

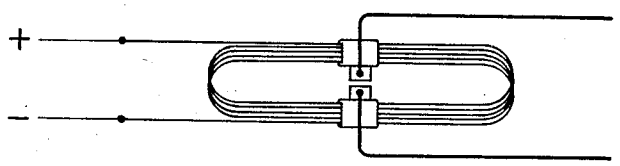

Fig. 4

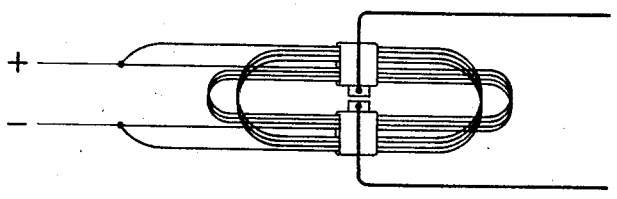

Fig. 5

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UNITED STATES PATENT OFFICE

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CIRCUIT BREAKER FOR IGNITION INSTALLATIONS OF INTERNAL-COMBUSTION ENGINES

Application filed March 9, 1927, Serial No. 174,080, and in Germany April 19, 1926.

This invention relates to an electrically operated circuit-breaker for the ignition installation of internal combustion engines, this circuit-breaker being distinguished by the features of having only slight oscillating masses and of being electromagnetically controllable by a weak current.

In electromagnetically actuated circuit-breakers, as designed hitherto, the electromagnets have been caused to act upon an armature adapted to serve as a carrier for the movable contact of the circuit-breaker. Owing to the high self-induction of the coil of the electromagnet, and especially in consequence of the comparatively large mass of the armature, together with that of the circuit-breaker contact, the number of the interruptions of the known electromagnet circuit breakers is restricted and often times not sufficient. Moreover the interruptions in known devices of this character may be inaccurately timed, by reason of the fact that the interruptions commence with a high number of interruptions which are initially irregular as a result of variations in the distance between the armature and the electromagnet; such variations resulting from undesired oscillations of the armature sufficient to bring it within the range of the attractive force of the electromagnet.

These drawbacks are done away with, according to the present invention, by a diminution of the oscillating masses of the circuit breaker, provided the latter be of that type in which the contacts are moved by the action of a magnet field upon the current-carrying conductor or conductors.

The invention is illustrated diagrammatically and by way of example in the accompanying drawing, in which

Figs. 1, 2 and 3 show three different embodiments of the circuit breaker, whereas

Figs. 4 and 5 show two modifications solely of the current-carrying conductors which are closed loops in these examples.

Referring to Fig. 1 *a* denotes a battery and *b* a primary coil receiving current from said battery. The coil *b* is a part of a high-voltage ignition coil, and the current flowing through it passes also over contacts *c c* secured to a conductor *d* and being insulated therefrom. This conductor has the form of an open loop and is located in the field of an electromagnet *e*. The conductor or loop *d* is connected up at one end to the battery *a* over a protective resistance *r* and over a wire *f*, and its other end can be connected up to a rotary switch *g* driven positively by the internal combustion engine.

If the circuit composed of the mass and the members *a—f—r—d* and *g* is closed by the switch *g*, the magnet field *e* deflects one leg of the U-shaped and current-carrying conductor or open loop upwards and the other leg downwards because the controlling current passes into the two legs of the open loop in opposite directions through the magnet field. The two contacts *c* move, therefore away from each other in time with the revolutions of the engine shaft and interrupt the primary circuit, so that there is produced in the secondary coil *h* in known manner a high-voltage current that passes over in the form of a spark at the sparking plug *i*. When the controlling current has been interrupted by the switch *g* the magnet field *e* no longer acts upon the conductor *d*, so that the contacts are again moved against each other either by reason of the inherent elasticity of the conductors or by means of a separately provided spring (not shown in Fig. 1) whereby the primary circuit is again closed.

The circuit-breaker which consists of the contacts *c* and the conductor *d* need move only small masses over short paths, and the controlling current of the circuit-breaker can, therefore, be very small. Besides, the contacts can be moved very quickly, as the entire system has a very slight inertia electrically (low self-induction), as well as mechanically, owing to the slight mass. The fact that the contacts are moved in opposite directions also makes for a high rate of separation.

In the modifications Figs. 2 and 3, in which the carrier of the magnet field has been omitted for the sake of clearness, the basic idea is this, that the contacts shall be controlled positively not only as regards opening, but also as regards closing the circuit. For this pur-

pose the controlling current can, as in Fig. 2, be sent by means of a rotary switch *k* through the contact carrier *d* alternately in opposite direction, so that the magnet field acts alternately to open and close the contacts. The length of the periods of the opening time and the closing time is determined by a suitable construction of the switch *k*. In Fig. 3 the control current is sent alternately by means of the rotary switch *k* through one and the other of two different loops *d d*, the legs of which are connected with each other by the contact holders. In this way the number of the interruptions is rendered more independent of the number of the undesired oscillations of the system bearing the contacts, and the elasticity of the oscillating system can be kept very small so that only a weak current is required for the deflection.

Partly for this reason and partly in order to be able to use the smallest possible control current as the force for moving the contacts, a wire can be made to pass several times through the magnet fields, as shown in Fig. 4. The contacts are then fastened to a plurality of conductors through all of which the current flows in the same direction. Furthermore, in order to render it possible to subject the wire loops to a higher load, two parallel sets of wires may be disposed in a magnet field, the current passing also in this case through all wires of a set in the same direction, as is the case in the further modification shown in Fig. 5.

It is a matter of course that the control current loop can be designed and arranged in such a manner that its shape is not altered when the device is used but forms and remains a rigid structure which is deflected as a whole in the magnet field. The two longitudinal sides of the loop must then be subjected, of course, to fields of opposite sense, and only one movable contact should be fastened to the loop. Also in this constructional form the control currents can be sent through the loop alternately in opposite directions, so that the contact is moved in both directions by a controlled electrical force.

With loops operating with change of their form the magnet field can be produced by that current which flows through the circuit breaker loop. The current-carrying conductors are then deflected by their mutual attraction and repulsion.

I claim:

1. An electrically operated circuit-breaker for ignition installations of internal combustion engines, comprising, in combination, a current-carrying conductor, two contacts attached thereto, and a magnet-field, the arrangement of said magnet-field and said contacts relative to each other being such that the different contacts can be deflected by the said magnet-field in opposite directions relative thereto, substantially as set forth whereby the rate of relative movement between the contacts is enhanced.

2. An electrically operated circuit-breaker for ignition installations of internal combustion engines, comprising in combination, a current-carrying conductor consisting of a wire forming a plurality of loops, two contacts attached mechanically to the two sides of said loops, and magnet fields, the arrangement of said magnet-fields and the said loops relative to each other being such that the loops can be moved by the said fields, substantially as set forth.

3. An electrically operated circuit-breaker for ignition installations of internal combustion engines, comprising, in combination, a current-carrying conductor consisting of a plurality of wires forming a plurality of loops, two contacts attached mechanically to the two sides of said loops, and magnet fields, the arrangement of said magnet-fields and the said loops relative to each other being such, that the loops can be moved by the said fields, substantially as set forth.

4. An electrically operated circuit-breaker for ignition installations of internal combustion engines, comprising, in combination, a current-carrying conductor, two contacts attached thereto, and magnet-fields, the arrangement of said magnet-fields and said contacts relative to each other being such that the contacts can be deflected by the said magnet-fields in opposite directions, and means for moving the contacts back into their position of rest after the deflection, substantially as set forth.

5. An electrically operated circuit-breaker for ignition installations of internal combustion engines, comprising, in combination, a current-carrying conductor, two contacts attached thereto and magnet-fields, the arrangement of said magnet-fields and said contacts relative to each other being such that the contacts can be deflected by the said magnet-fields in opposite directions, and means for moving the contacts back into their position of rest after every deflection, said means being constituted partly by a current flowing through the said conductor in a direction opposite to the deflecting current, substantially as set forth.

6. A circuit breaker for internal combustion engines comprising, in combination, means for creating an electric field, a current carrying conductor disposed in said field, a contact secured to said conductor, and means for intermittently creating a magnetic field about said conductor, said last mentioned means being adapted and arranged to create an oscillatory movement of said contact.

7. A circuit breaker for internal combustion engines comprising, in combination, an electromagnet, a movable current carrying conductor disposed in the field of said elec-

tromagnet and having opposed branches, contacts secured to said branches, and means for intermittently passing current through said conductor to create magnetic fields about the branches thereof, the current flowing in reverse directions through said branches whereby said fields coact with the field of said electromagnet to move said contacts when the circuit through said conductor is made.

8. An electrically operated circuit-breaker comprising a magnetic field, a movable conductor situated in said magnetic field, a contact carried by said conductor, the arrangement of said conductor, contact and magnetic field, relative to each other being such that the conductor and contact carried thereby can be moved by the magnetic field in response to flow of current through the conductor, and means for controlling the flow of current through said conductor independently of said contact.

In testimony whereof I have hereunto affixed my signature.

HANS BURKAS.