Sept. 20, 1927. 1,643,270

M. GREINER

MAGNETO ELECTRIC AUTOMATIC INTERRUPTER

Filed May 17, 1926

Fig. 1.

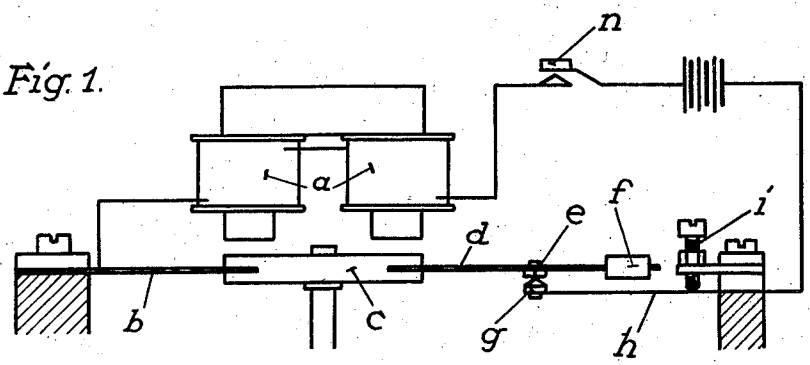


Fig. 2.

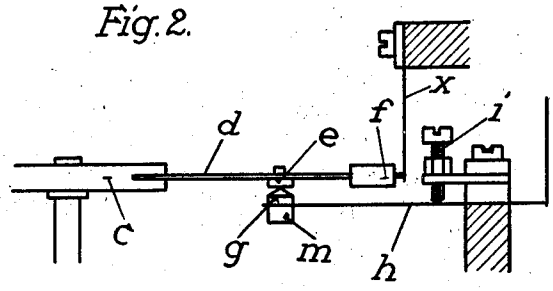
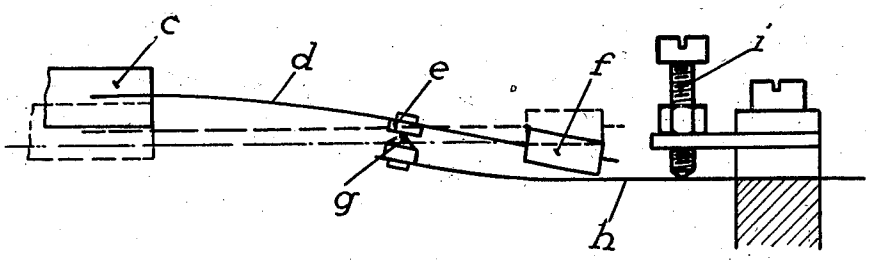


Fig. 3.



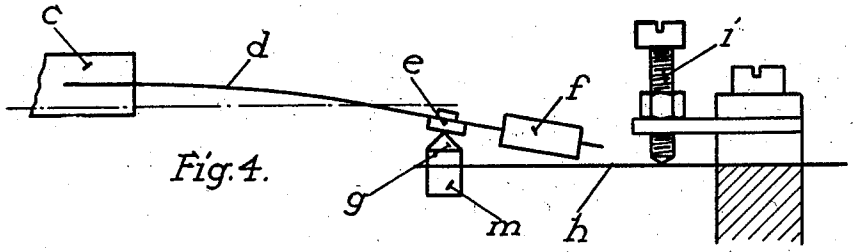


Fig. 4.

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UNITED STATES PATENT OFFICE.

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MAGNETO-ELECTRIC AUTOMATIC INTERRUPTER.

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Magneto-electric automatic interrupters serving for the delivery of mechanical oscillations and constructed partly like a magnetic hammer break and partly like a sliding contact, require for a high efficiency, in respect of the oscillations delivered, that the current be interrupted at the end of the working stroke of the armature only, while it can be switched-on either at the beginning of the working stroke or already during the return stroke of the armature, as the influence on the efficiency is rather small. As the contact break is positively operated by the oscillating armature, at the first switching-on the attraction force of the electromagnet up to the attainment of the cut-out position at each deflection of the armature from its zero position must be greater than the counteracting spring power of the armature elasticity. This requires a comparatively high magneto-electric excitation that highly exceeds the want for the armature oscillating with full amplitude. This results in an undue current consumption and in a noxious action upon the contacts which, as known, become the less reliable the stronger is the current flowing therethrough.

Said drawbacks are overcome by the present invention in that the operative oscillating member (armature) is coupled with the control contact by a freely oscillating member of lower natural frequency than the operative member. Said coupling member may, in its simplest form of construction, consist of a blade spring carrying the control contact and loaded by an additional mass. Such a spring oscillates in different oscillation forms according to the ratio between the driving frequency and its natural frequency. If the former is lower than the latter, the whole spring with the additional mass oscillates practically in phase coincidence with the drive. If the frequency of the drive is increased beyond the resonance, the amplitude of the additional mass is quickly decreased to a fraction of the amplitude of the drive; the additional mass oscillating then in phase difference to the drive. Intermediary points of the spring oscillate thus partly in phase coincidence with, and partly in phase difference to, the drive.

Said oscillation forms known per se are utilized for the arrangement according to the present invention in such a way that at the first attraction of the armature, which due to the inertia of its mass and directed against the spring power of the armature takes place in a comparatively slow way, a point of the spring oscillating in phase coincidence opens the contact already after a trifling deflection of the armature. The following oscillations of the armature occur, however, with its natural frequency, that is higher than that of the coupling member. As the additional mass then oscillates in phase difference to the armature, the armature operating the coupling member must first attain a larger deflection in order that the contact point oscillating with smaller amplitude opens the contact. Except for the first time, the current interruption thus takes place almost independently from the attained amplitude of the armature always near the end of the stroke. The thereby required early re-switching-on of the current at the beginning of the return stroke is practically without noxious influence.

In order not to disturb the coupling spring in its oscillation forms by the counter-contact, the latter is, according to the invention, also elastic, for instance arranged on a spring, so that at the return oscillation of the coupling spring it can yield beyond the zero position. Furthermore, the oscillation energy of the coupling member, with reference to that of the operative armature, must be small only, in order to influence the natural frequency of the armature as little as possible by the coupling member.

Heretofore, the arrangement of an automatic interrupter for buzzer purposes has been known, in which the armature carries a contact pendulum that at its free end is loaded by an additional mass. Said pendulum strikes, however, against a fixed abutment forming a counter-contact. It comes thus again at rest after each stroke and must be accelerated afresh by the armature. Therefore, it cannot assume the different oscillation forms essential for the operation of the arrangement according to the present invention.

If, in the improved arrangement, for the operation of the contact a point of the coupling spring is chosen that, as afore stated, oscillates first in phase coincidence with and then in phase difference to the armature, and the counter-contact spring is loaded by such a large additional mass that its natural frequency is lower than that of the armature,

a sliding contact is produced which induces the first oscillation like a magnetic hammer break and automatically changes to the interrupting sequence of a sliding contact.

The accompanying drawing illustrates diagrammatically two appropriate constructional forms of the subject matter of the present invention:

Fig. 1 shows an automatic interrupter constructed like a magnetic hammer break;

Fig. 2 shows part of an interrupter with a sliding contact;

Figs. 3 and 4 indicate, on a larger scale, the action of the coupling member with a magnetic hammer break and with a sliding contact respectively, the dot-and-dash lines in the two latter figures indicating the normal position of rest of the parts.

Referring to Fig. 1: The electromagnet *a* has its oscillating armature *c* suspended from a blade spring *b*, while on said armature a second blade spring *d* is fixed and fitted with a control contact *e* and at its free end with an additional mass *f*. The counter-contact *g* for said control contact *e* is mounted on a blade spring *h* which can be adjusted by means of a set-screw *i* in such a way that in the position of rest of the armature *c* and of the spring *d* the two contacts *e* and *g* touch one another with slight contact pressure. The mass *f* is so determined that the natural frequency of the spring *d* is considerably lower than that of the armature *c*. The connection of the arrangement is that conventional with interrupters of similar kind.

The interrupter illustrated in Fig. 2 is distinguished from that afore described by having the counter-contact *g* loaded by an additional mass *m* thereby forming a sliding contact.

If, in the interrupter shown in Fig. 1, the circuit is closed by a switch *n*, the electromagnet *a* slowly attracts the armature *c* against the action of spring *b*. At this first slow attraction of the armature *c*, the coupling spring *d* with its control contact *e* follows the movement of the armature in phase coincidence, in that the contact *e* participates in the full amplitude of the movement of the armature, so that after a trifling deflection of the armature from its zero position the first interruption between the contacts *e* and *g* takes place. This is indicated in Fig. 3 by dotted lines. Thereupon, the armature returns at a speed that corresponds to its natural frequency. Consequently, the mass *f* then oscillates in phase difference to the armature, as indicated in Fig. 3 by full lines. Thus, in spite of increasing amplitude of the armature, the opening of the contacts *e*, *g* takes place at a large deflection of the armature only, about near the end of its stroke.

In the arrangement shown in Fig. 2, the additional mass *f* of the coupling spring *d* is also so determined that it oscillates initially in phase coincidence with and then in phase difference to the armature *c*. The contact *e* of the spring *d* is located nearer to the additional mass *f*. The additional mass *m* on the counter-contact *g* is so determined that the natural frequency of the spring *h* is lower than that of the armature *c*. The position of rest of the spring *h* is so adjusted by means of the set-screw *i* that the two contacts *e* and *g* touch one another with weak pressure. At a closing of the circuit, the contacts *e*, *g* are interrupted after a trifling movement of the armature *c*, as at the slow speed of the first attraction of the armature the springs *d* and *h* participate in the movement of the armature in phase coincidence therewith until the zero position of the spring *h* is exceeded. At the further oscillations of the armature, the additional mass *f* and the contact *e* oscillate in phase difference to the armature, as shown in Fig. 4. The contact *e* causes the contact *g* with the additional mass *m* to participate in its movement until the end of the stroke. The then occurring retardation of the contact *e* is, however, not followed by the counter-contact *g*, but the latter oscillates further due to its inertia increased by the additional mass *m* and thereby effects the interruption.

To avoid undesirable resonances at the change of the spring *d* from one oscillation form to another one, it is recommendable to provide the spring *d* with a weak damping consisting, for instance, of a weak blade spring *x* (Fig. 2) fixed at one end and bearing with slight friction pressure against the free end of the spring *d*, or of an oil brake, or of any other suitable contrivance. Said damping results further in a phase lagging, favourable for an extension of the current closing time, of the spring *d* behind the driving armature.

The improved arrangement is particularly adapted for use in connection with apparatus working with automatic interruption and serving for the delivery of mechanical oscillations of high periodicity, for instance for driving the main contact of spark coils, for shaking apparatus, automatic oscillation producers, and the like.

What I claim, is:

1. In a magneto-electric automatic interrupter for the delivery of mechanical oscillations, the combination with an operative oscillating part, of an oscillatory coupling member fixed to said part and having a lower natural frequency than the latter, a control contact on said coupling member, a resiliently mounted counter-contact for said control contact, and an additional mass on said counter-contact.

2. In a magneto-electric automatic interrupter for the delivery of mechanical oscil-

lations, the combination with a spring-suspended armature of an electromagnet, of an oscillatory coupling spring fixed to said armature and having a lower natural frequency than the latter, an additional mass on the free end of said coupling spring, a control contact on said coupling spring, a resiliently mounted counter-contact, an additional mass on said counter-contact, and a weak damping for said coupling spring for said control contact.

In testimony whereof I have hereunto set my hand.

MAX GREINER.