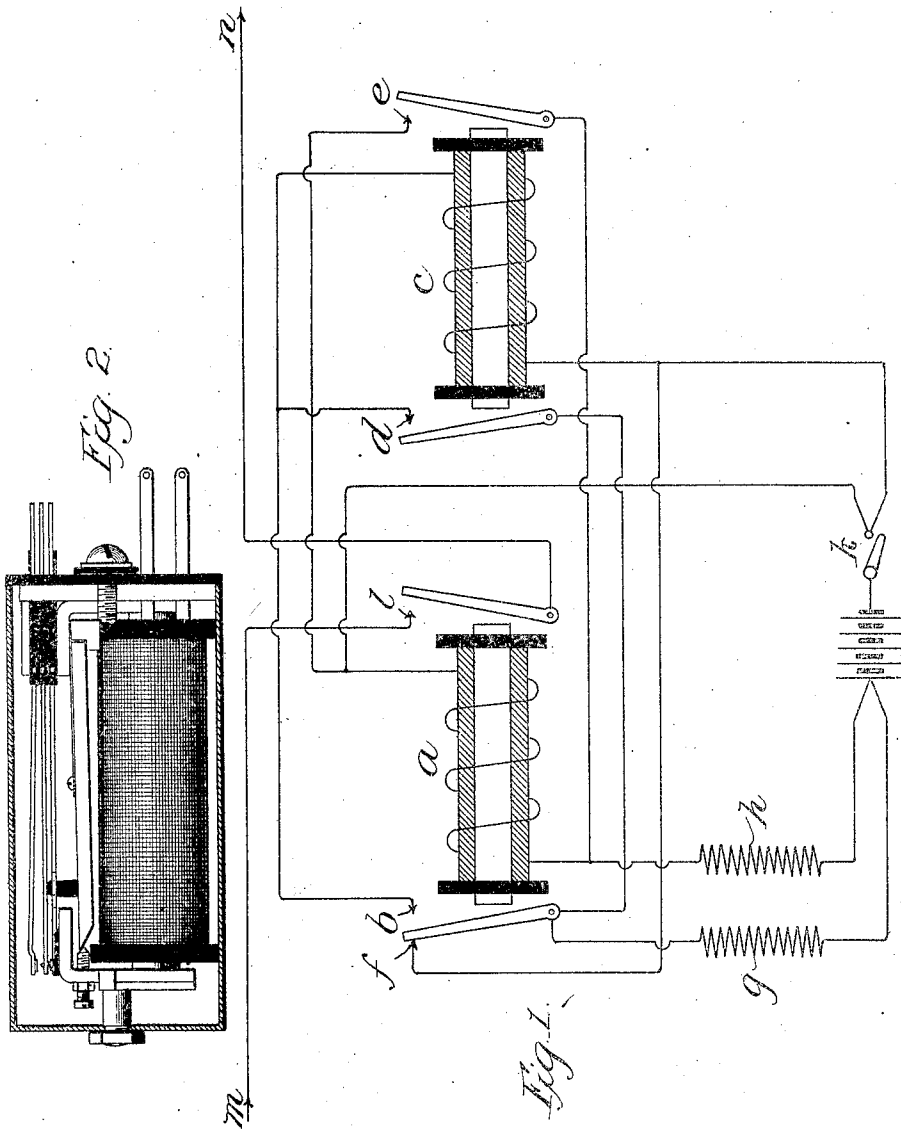


No. 838,005.

PATENTED DEC. 11, 1906.

A. M. BULLARD & W. H. MATTHIES.
ELECTRICAL CIRCUIT INTERRUPTER.
APPLICATION FILED SEPT. 9, 1905.



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UNITED STATES PATENT OFFICE.

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ELECTRICAL CIRCUIT-INTERRUPTER.

No. 838,005.

Specification of Letters Patent.

Patented Dec. 11, 1906.

Application filed September 9, 1905. Serial No. 277,713.

To all whom it may concern:

Be it known that we, ALBERT M. BULLARD and WILLIAM H. MATTHIES, citizens of the United States, residing at New York city, in the county of New York and State of New York, have invented a certain new and useful Improvement in Electrical Circuit-Interrupters, of which the following is a full, clear, concise, and exact description.

In telephone-exchange systems the busy tone is more readily distinguished if it is intermittent or throbbing in character rather than a continuous hum, for the latter is easily mistaken for the noise produced by induction from electric-light circuits where the telephone-lines are not properly protected by transposition.

Heretofore an interrupter has been used having a heavy weight on the arm to reduce its vibrations to a comparatively slow periodicity. While such an arrangement can be operated in a manual exchange, where attention can be given at any time to its adjustment, at small automatic exchanges, where there is no one in regular attendance, and, furthermore, where the interrupter is subject to low temperatures never encountered in manual exchanges, this type of interrupter has proven unreliable principally because the extreme variations in temperature cause changes in the structure supporting the back contact, through which the current for the operation of the device passes.

The object of the present invention is to provide a slow-acting circuit-breaker which can be operated at any temperature and which is self-starting, which starts promptly, and which operates on wide margins of adjustment. Instead of operating on the principle of mechanical inertia, as heretofore, it utilizes electromagnetic inertia produced by a heavy closed copper secondary encircling the iron core of the device.

The apparatus consists, preferably, of two magnets or relays, each having a heavy copper tube driven over its iron core and with the small wire winding wound upon the copper tube. The armature approaches and recedes from the pole-piece with a marked degree of sluggishness—a phenomenon well understood in the art.

Our invention will be more readily under-

stood by reference to the accompanying drawings, in which—

Figure 1 shows a diagram of two relays with circuits embodying our invention. Fig. 2 is a side elevation, with the casing in section, of a relay suitable for the work required.

It may be stated at the outset that the circuits of the relays are so designed that they alternately short-circuit each other's winding, thus producing a slow reciprocating movement of each armature, which is utilized to make and break at regular intervals the busy-tone circuit leading to the switch-board.

Referring to Fig. 1, when the battery-circuit is closed relay *a* operates its front contact *b*, and thus closes a circuit through relay *c*, which attracts its armatures, and in so doing closes contact *d*, which causes relay *c* to remain thereafter locked up independent of contact *b* of relay *a*. Contact *e* of relay *c* short-circuits relay *a*, which thereupon releases its armatures, and its back contact *f* short-circuits relay *c* and of course causes relay *c* to release its armatures regardless of the locking-circuit closed at contact *d*. Now the opening of contact *e* of relay *c* allows relay *a* to operate, thus beginning a second cycle identical with the first. Each cycle may occupy about one second of time. These cycles follow one another with great regularity and are kept from becoming too frequent by, first, the sluggishness of the copper-jacketed relays; second, by the short-circuiting method of deenergizing the respective relays, and, third, by the plan of causing the second relay *c* to lock up its armature, thereby permitting the armature of the first relay—that is, relay *a*—to fully recover before current is diverted from relay *c*. The resistance-coil *g* likewise tends to slow the reciprocative movement by reducing the amount of current used for the operation of the relay *c* and proportionately increasing the sluggishness of its armature movement. This resistance *g* also serves to prevent short-circuiting of the battery when contact *f* of relay *a* is closed. The resistance *h* is to prevent a short-circuit of the battery when contact *e* is closed by relay *c*. The switch *k* is for closing the battery-circuit to start the

interrupter. The contact *l* of the relay *a* is included in the circuit of conductors *m n*, which may lead to a busy-tone apparatus and to the switchboard or mechanism of the exchange, respectively, in a manner well understood. The purpose of the combination of the two relays is to cause a retardation in the closing and opening of the contact *l*, which is included in the tone-circuit.

The apparatus as thus described causes cycles of about a one-half second duration. The time can be varied by adjustment of the relays as may be thought most desirable. In Fig. 1 two armatures are shown simply for clearness of illustration. In practice we have employed relays of the general character shown in Fig. 2, in which the contacts are in the case of each relay controlled by a single armature.

This device works reliably at all temperatures found in practice. It is self-starting and assumes its normal frequency immediately. The changes in frequency due to variations of battery voltage within practical commercial limits are negligible.

We claim—

1. A circuit-interrupter comprising the combination with two relays and local circuits therefor, of contacts in said circuits controlled by said relays, whereby said relays reciprocally control each other's circuits and are alternately energized and deenergized, and an external busy-tone circuit having a contact controlled by one of said relays, substantially as described.

2. In a circuit-interrupter, the combination with a relay and a circuit therefor, of a second relay having a circuit with a contact adapted to be closed by the energization of said first relay, and a short circuit of said first relay having a contact adapted to be closed by the energization of said second relay, whereby said relays are alternately energized and deenergized.

3. In a circuit-interrupter, the combination with a relay and a circuit therefor, of a

second relay having a circuit controlled by said first relay, a locking-circuit through said second relay having a contact closed by its energization, and a short circuit for each of said relays having a normally open contact, that of the first being closed by the energization of said second relay and that of the second being closed by the deenergization of said first relay, whereby said relays reciprocally control each other's circuits, and are alternately energized and deenergized.

4. In a circuit-interrupter, the combination with two relays each having its winding included in a local circuit with a resistance, of contacts in said circuits controlled by said relays, whereby said relays reciprocally control each other's circuits and are alternately energized and deenergized, and an external busy-tone circuit having a contact controlled by one of said relays.

5. In a circuit-interrupter, the combination with two relays, *a* and *c*, and their circuits, of a switch *k* adapted to close the circuit of relay *a*, a contact *b* of relay *a*, a locking contact *d* of relay *c*, each of said contacts being adapted to close the circuit of the winding of relay *c*, contacts *f* and *e*, respectively, reciprocally controlling the circuit through each other's windings, and an external circuit having a contact controlled by one of said relays, whereby said relay is intermittently energized to operate the contact of said external circuit.

In witness whereof we hereunto subscribe our names.

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Witnesses to signature of William H. Matthies:

JASON G. CRANE.
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