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DEVICE FOR CONTROLLING POWER CIRCUITS

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Fig. 1

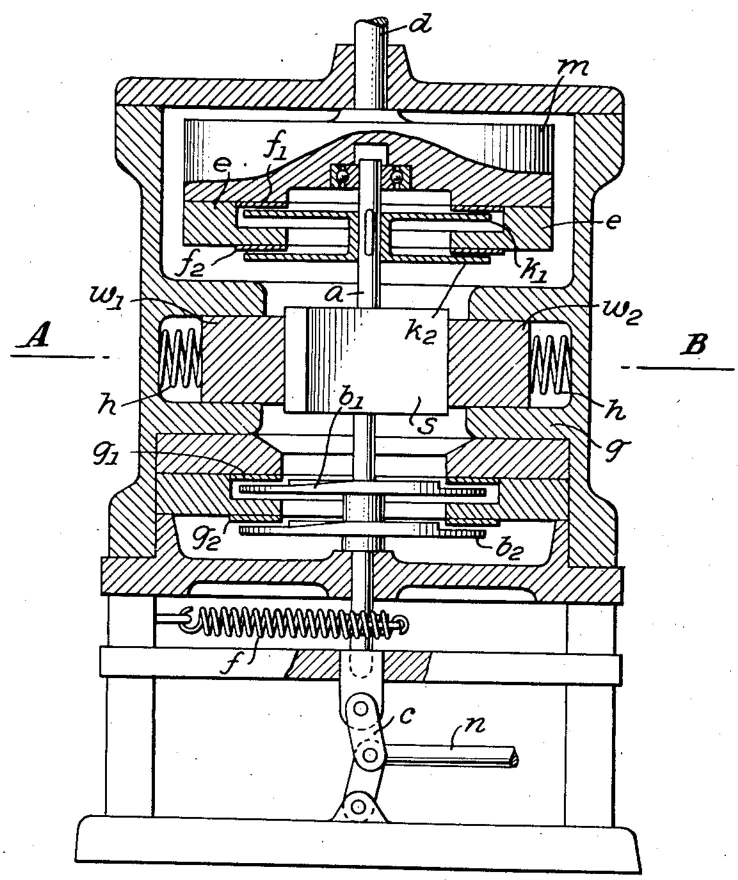


Fig. 2

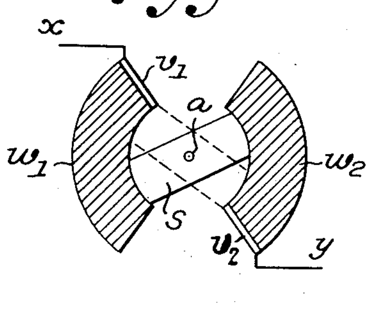
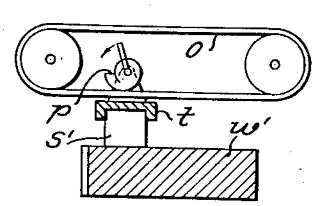


Fig. 3



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DEVICE FOR CONTROLLING POWER CIRCUITS

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4 Claims. (Cl. 201—55)

This invention relates to a device for controlling power circuits in which instead of the usual power circuit breaker a rapidly varying resistance device is connected in the circuit to be interrupted and controlled so as to increase the effective resistance from an initial low value continuously yet quickly up to a high resistance magnitude. It has been found that it is necessary to displace the movable control member of the resistance device with a very high speed, particularly when interrupting overloads, and it is a main object of the present invention to provide an apparatus which effects such a control operation with an extremely high speed and with sturdy and reliable means so as to render this type of resistance switch suitable for exacting high power and overload operations.

To this end, the movable part of the variable resistance device, preferably a slide contact, is provided, according to the invention, with a drive which displaces it under a sudden blow or impact. According to another feature of the invention, the drive mechanism of the apparatus contains a movable drive member or composite drive structure which is set in motion independently of the resistance device proper and is of relatively great mass in order to store kinetic driving energy before it is suddenly coupled with the movable contact member to be actuated. In this case, the material may be stressed by the impact approximately up to the limit of permanent deformation in order to attain as high an acceleration as possible of the part to be moved. The driving mass consists preferably of a revolving body which is brought into temporary engagement with the movable part of the variable resistor. However, the energy storing mass may also be associated with a revolving endless flexible member, such as a band or chain. The mass itself may be designed as a flexible member, or the flexible member may serve as a mere transmission or connection. If the stroke of the variable resistance device is short, its movable part may be driven by a mass whose motion is in the direction of displacement of the movable part or perpendicularly thereto and whose path is straight, at least in the region in which the mass acts upon the movable part of the resistor. In the case of a transverse motion of the driving mass, the control movement can be derived, for instance, by a wedge action.

To connect the resistor with the drive, a coupling with a short travel and a small mass of its driven part may be employed. This has the advantage of increasing the speed of response considerably.

In the accompanying drawing is shown an embodiment of the invention in diagrammatic form.

Fig. 1 shows an axial cross section through a control apparatus of rotary type containing a flywheel as an energy storing drive member.

Fig. 2 is a sectional view taken along the line A—B of Fig. 1.

Fig. 3 represents another embodiment with a rectilinear control movement, containing an endless flexible band for transmitting the drive movement to the resistance device proper.

The apparatus shown in Figs. 1 and 2 contains two arcuate resistance bodies w_1 and w_2 and a contact member *s* arranged between these bodies and mounted on a vertical shaft *a*. As apparent from Fig. 2, the resistors w_1 and w_2 have end contacts v_1 and v_2 respectively connected with the circuit *xy* to be interrupted. In the position of the contact member *s*, illustrated in Fig. 2 by broken lines, the two end contacts v_1 and v_2 are conductively connected with each other so that the total resistance of the device in circuit *xy* is negligible. When the contact member *s* is moved into the position shown in full lines, the current flows from *x* through v_1 and w_1 to *s*, and thence through w_2 and v_2 to *y*. Hence, the full resistance of the series-arranged resistors w_1 and w_2 is now effective in the circuit. This resistance is so high that the current is virtually interrupted or reduced to an easily interruptable residual value. For effecting the control operation, the contact member is rapidly moved from the broken line position to the full line position so that the total resistance is varied continuously from zero to the high end value.

The resistance bodies w_1 and w_2 are mounted in the housing *g* of the device and are under the influence of springs *h* which establish the contact pressure necessary between the resistance bodies and the contact *s*. The shaft *a* is provided at its upper end with two disks *k1*, *k2* which form one element of a friction coupling. A flywheel mass *m*, suspended from a rotatable shaft *d*, is disposed above these disks and is driven by a motor not shown. The friction surfaces or linings *f1* and *f2*, cooperating with the coupling disks *k1*, *k2*, are arranged beneath the mass *m* and beneath a ring *e* secured to the mass. The lower end of the shaft *a* is linked to a toggle joint mechanism *c* which in turn is connected with a control rod *n* to be operated by means of an electromagnet (not shown). Actuation of the control rod *n* causes the toggle joint mechanism *c* to raise the shaft *a* with the movable contact member *s* and the coupling disks *k1* and *k2* so that the latter engage the friction linings *f1* and *f2* and thereby couple the rotatable contact assembly with the flywheel *m*.

A braking device is provided to reduce the shock occurring when the rotatable assembly reaches its end position. The braking device contains disks *b*1 and *b*2, which are mounted on shaft *a*, and stationary linings *q*1 and *q*2 mounted on rings *i* and *l*. The disks *q*1 and *q*2 have helical surfaces designed in such a manner that at the beginning of the movement there is a clearance between the disks and the braking surfaces of the linings *q*1 and *q*2. At the end of the movement, the disks come into engagement with the linings *q*1 and *q*2 to effect braking. To return the movable contact assembly to its initial position, a spring *f* is connected between a crank arm on shaft *a* and the stationary casing *g*.

When using the apparatus, the shaft *d* and the flywheel *m* are kept in continuous rotation so that a great kinetic drive energy stored in the rotating masses is available. When, now, the control rod *n* is moved towards the shaft *a*, a very short control movement suffices to place the coupling disks *k*1 and *k*2 against the linings *f*1 and *f*2 so that the flywheel *m* is instantaneously connected with the rotary contact assembly. As a result, the movable contact is thrown into the circuit-interrupting position under a forceful impact whose effect is braked only after the contact has almost reached its new position. During the short switching period, the current is gradually reduced without giving cause to arcs or sparks. When releasing the control rod *n*, the assembly is lowered by its own weight and then returned into its original position due to the action of the spring *f*.

In the embodiment shown in Fig. 3, the movable part *s'* of the variable resistance device is driven by a revolving flexible transmission member or band *o* whose mass is so chosen that it displaces the contact *s'* under a sudden blow after the latter has been connected therewith. This connection is brought about by means of a friction coupling containing a rotatable eccentric *p* which, when rotated in the direction of the arrow, presses the band *o* against the back of the contact *s'* or its support *t*. In this embodiment, the resistance body *w'* is of straight and elongated shape, and the control movement of the contact member *s'* is rectilinear. The movement of the band *o* is likewise rectilinear within the range of the control motion to be transmitted.

If a rigid coupling serves to connect the movable part with its drive, known devices are preferably provided to facilitate the engagement of the coupling in order that the latter does not break under a sudden blow. If a revolving chain is, for instance, employed for the drive, a rigid coupling member, for instance a hook or a pin, which establishes the connection with the movable part of the variable resistor, may be brought into a favorable position with respect to the links of the chain by means of a guide device, for instance by means of an auxiliary chain or the like, before the hook or pin engages the chain.

Also elastic members which damp the shocks occurring when coupling may be employed in the drive.

We claim:

1. Apparatus for controlling electric power circuits, comprising a variable resistance device connected in the circuit to be controlled and having a movable contact member for increasing, when in operation, the effective resistance of the device from a low initial value to a high value, a drive mechaniism for actuating said movable contact member, said mechanism having a movable drive member disposed to be in motion previous to and during the operation of said contact, controllable coupling means disposed between said drive member and said contact member for effecting a connection between said two members to displace said contact member, and a braking device for resisting said drive mechanism as said contact moves toward end position.

2. Apparatus for controlling electric power circuits, comprising a resistance device of continuously variable resistance characteristic connected in the circuit to be controlled and having a movable contact member displaceable between two end positions for varying the effective resistance of the device between a low and a high end value, a drive mechanism for high-speed actuation of said movable contact member, said mechanism including structure for actuating said contact member, said structure being movable independently of said contact member and having a greater movable mass than said member in order to store kinetic driving energy previous to the actuation of said contact member, controllable coupling means disposed between said contact member and said structure for establishing, when said structure is in motion, a driving connection whereby said contact member is thrown from one to the other end position, and a frictional braking device having a stationary element and a cooperating element, the latter being connected with said movable contact so as to be operative in the latter position of the contact movement in order to reduce the shock when the moving contact member reaches its end position.

3. Apparatus for controlling power circuits, comprising a resistance body connected in the circuit to be controlled, a contact member forming a part of said circuit and slidably engaging said body to vary the effective resistance of the body, an axially shiftable shaft for supporting said contact, a rotatable fly wheel coaxial with said shaft and independent of said contact members for storing kinetic energy previous to the actuation of said member, a friction coupling having a coupling element connected with said fly wheel and another coupling element connected to said shaft, and means for axially shifting said shaft to cause said coupling elements to become engaged and thereby rotate said sliding contact to a different position on said resistance body.

4. Apparatus for controlling power circuits, comprising a resistance body connected in the circuit to be controlled, a contact member forming a part of said circuit and slidably engaging said body to vary the effective resistance of the body, an axially shiftable shaft for supporting said contact, a rotatable fly wheel coaxial with said shaft and independent of said contact members for storing kinetic energy previous to the actuation of said member, a friction coupling having a coupling element connected with said fly wheel and another coupling element connected to said shaft, means for axially shifting said shaft to cause said coupling elements to become engaged and thereby rotate said sliding contact to a different position on said resistance body, and a braking device for resisting the rotational force imparted to the contact as the latter moves toward an end position on said resistance body.

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