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OPERATING MECHANISMS FOR ELECTRIC CIRCUIT CONTROL DEVICES

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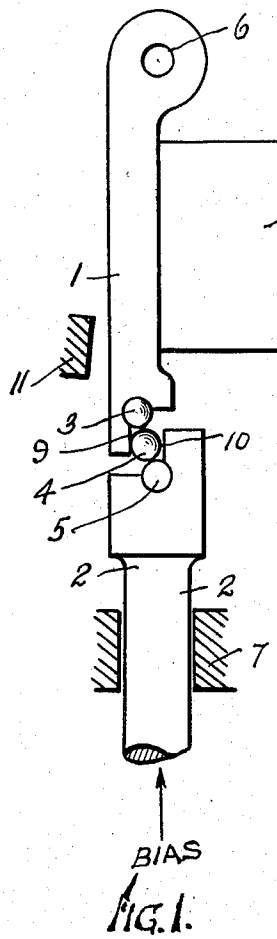



FIG. 1.

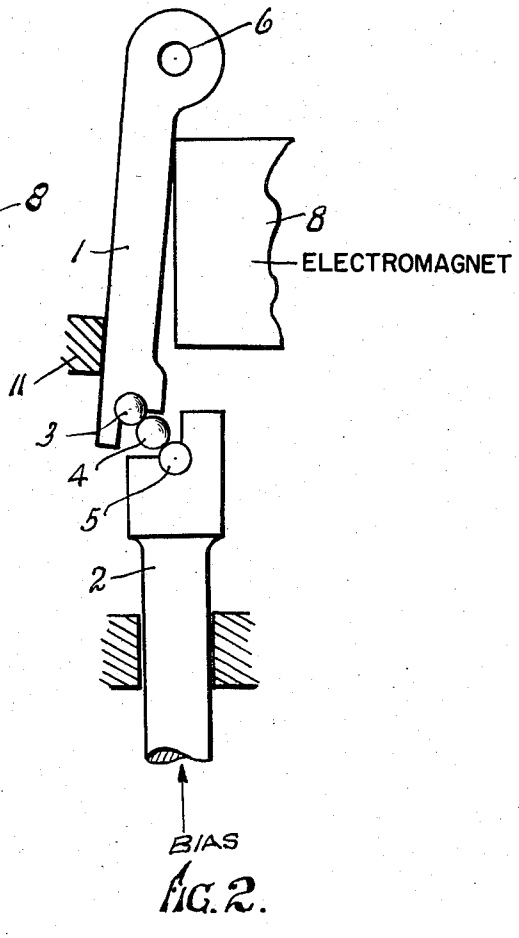



FIG. 2.

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# OPERATING MECHANISMS FOR ELECTRIC CIRCUIT CONTROL DEVICES

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12 Claims. (Cl. 74—520)

This invention relates to toggle mechanisms used in electric circuit controllers, such as circuit makers and breakers.

In such mechanisms it is sought to obtain rapid movement of a contact member between open and closed positions in response to a movement of a control lever initiated either manually or automatically by virtue of a magnetic effect produced by a change in current or voltage, frequently that of the circuit through the contact member. Usually a toggle is utilised to hold the contact member in a predetermined position against the bias of a spring, the toggle being released to allow the spring to move the contact member by the manual or automatic action above referred to. When rapid action is desired, the spring necessary to hold the contact member in the predetermined position may need to be strong with the result that the force necessary to restrain the toggle is considerable and friction losses may prove a determining factor in the speed of operation.

The object of the invention is to provide a toggle mechanism in which friction is reduced, enabling rapid operation of the contact members to be achieved.

The invention consists in a compression toggle comprising at least three members providing cylindrical surfaces in line contact with one another, the axes of the cylindrical surfaces being located substantially in a single plane and the central member being freely movable so that its axis is adapted to move transversely of said plane and being restrained from said movement by an armature of an electro-magnet, one of the outer members being adapted (on transverse movement of the central member when the restraint imposed by the armature is removed) to operate a circuit opening or closing member.

In carrying out the invention we prefer to employ an arrangement in which there are three rollers in contact at their peripheries and having their axes normally located in the single plane, the normal position of the rollers being maintained by mounting them between two substantially parallel abutments, one of which may form an extension of an operating member connected to a contact member, while the other is constituted by the electro-magnetic armature above referred to. These three rollers form in effect one arm of a toggle whilst the other arm is constituted by the electro-magnetic armature, this member being suitably pivoted at the end remote from the rollers. There is imparted to the operating member a bias produced by a spring acting in a direction to effect collapse of the toggle, and the resultant movement of the operating member following such collapse causes the contact member to engage with, or disengage from, stationary contacts which are adapted to be bridged by the contact member according to whether operation in a circuit closing or opening direction, respectively, is required. As soon as the restraint imparted to the toggle by the movable abutment furnished by the armature of the electro-magnet is removed, the toggle collapses, the rollers being caused to move relatively to one another as



a result of the spring bias so that their axes no longer lie in the common plane. We prefer to employ rollers of as small a diameter as is consistent with their mechanical strength, the diameters of the rollers thus being small in comparison with the length of the electro-magnetic armature. It follows from this that a very small movement of the electro-magnetic armature from its restrained position will allow a considerable movement of the contact operating member. Since the time of operation is proportional to the square root of the distance travelled and inversely proportional to the square root of the mass; and since the greater proportion of mass in the system is formed by the electro-magnetic armature, it follows that the small movement of the electro-magnetic armature achieved above will allow a more rapid operation of the contact operating member than would normally be obtained with a more conventional form of toggle. Furthermore, since the rollers are free to rotate with respect to one another, this relative movement involves only rolling line contact at their peripheries, thus reducing the friction of the toggle mechanism to a minimum.

In order that the invention may be readily understood, a construction of toggle mechanism embodying the same will now be described with reference to the accompanying drawings, in which Fig. 1 shows the toggle in the normal set position; and Fig. 2 the position adopted by the toggle when the restraint is released and the toggle collapses.

Referring to the drawings, we have shown our toggle mechanism as comprising a pivotally mounted control member or armature **1**, an operating member or rod **2** and rollers **3**, **4** and **5** mounted intermediately between them. The armature is pivotally mounted on a pin **6**, while the operating member **2** which may be connected to, or form part of a circuit breaker, is slidably mounted, for example by means of a guide **7**, for vertical reciprocal movement. It is biased upwardly in the direction indicated by the arrows by springs (not shown). The electro-magnet with which the armature **1** is associated is indicated at **8**.

With the electro-magnet **8** energised and the armature **1** attracted to it in the position shown in Fig. 1 the axes of the rollers **3**, **4** and **5** lie substantially in a single plane. They are restrained in this position by parallel abutments **9** and **10** constituted by the opposed faces of shoulders formed on the armature **1** and contact operating rod **2**, respectively, the opposed faces engaging the intermediate roller **4** along diametrically opposite regions. The rollers **3** and **5** are shown as mounted in recesses formed at the corners of the shoulders so that, in the position indicated in Fig. 1, the toggle is in compression. The axis of the roller **5** is located on the axis of the contact actuating member **2**, this axis, in the preferred arrangement illustrated, passing through the axis of the pivot pin **6** on which the armature **1** is rotatable.

When the electro-magnet **8** is de-energised, the armature **1** immediately is released and, as a result of the inclination of the plane containing the axes of the rollers **3**, **4**, **5** with respect to the axis of movement of the contact operating member **2**, the armature is immediately forced out against a stop, such as that indicated at **11**, and the toggle moves to the position indicated in Fig. 2, allowing the contact operating member **2** to rise and open or close contacts associated with it. The rollers may remain in the position indicated in Fig. 2, but since the central roller is free to move, it will probably adopt a position such that its axis is no longer in line with the axes of the rollers **3** and **5**, its movement being limited by the faces of the shoulders provided on the ends of the armature **1** and contact operating member **2**. This additional movement of the central roller will permit a greater vertical movement of the contact operating member **2**.

It will be evident that the armature **1** may be shaped

and located to act on the intermediate roller 4 instead of the upper roller 3 as shown in the illustrated embodiment. In this case the roller 3 may remain stationary, being formed as part of a control member, while the armature in its movement effects the motion of the roller 4 between positions in which its axis lies on one side or the other of the plane containing the axes of the cylindrical surfaces formed by the rollers 3 and 5. The motion of the roller 4 is then limited by the parallel abutments formed by the face 9 of the armature and the shoulder 10 on the operating member.

Although the mechanism is shown as being arranged with the axis of the contact operating member 2 in a vertical position, this is not to be taken as implying any limitation since the mechanism will operate equally well in the other positions.

If desired, however, the roller forming the abutment for the end of the contact operating member may be formed integrally therewith by constituting the end of the actuating member of cylindrical shape. Some sliding contact at the cylindrical surfaces may then take place without, however, involving material additional friction which will result in slowing down the movement of the operating member.

The toggle mechanism is suitable for use in connection with the circuit controller described and claimed in copending application Serial No. 391,350 of John A. Watson, now Patent No. 2,785,241, assigned to the same assignee as the present application.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A toggle operating mechanism comprising, in combination: a reciprocable operating member, a pivoted control member positioned in substantial axial alignment with said operating member, a convex surface formed on the end of said control member nearest said operating member, a second convex surface formed on the end of said operating member nearest said control member, a cylindrical roller positioned in free rolling contact with each of said surfaces, and means to restrain the limit of travel of said roller transversely to the axis of said members and positioned adjacent said roller.

2. A toggle operating mechanism comprising, in combination: a reciprocable operating member, a pivoted control member positioned in substantial axial alignment with said operating member, a convex surface formed on the end of said control member nearest said operating member, a second convex surface formed on the end of said operating member nearest said control member, a cylindrical roller positioned in free rolling contact with each of said surfaces, and a separate axially extending projection on each of said members adjacent said roller and defining therebetween a chamber within which said roller can move.

3. A toggle operating mechanism, comprising, in combination: a reciprocable operating member, a pivoted control member positioned in substantial axial alignment with said operating member, a convex surface formed on the end of said control member nearest said operating member, a second convex surface formed on the end of said operating member nearest said control member, a cylindrical roller positioned in free rolling contact with each of said surfaces, means to restrain the limit of travel of said roller transversely to the axis of said members and positioned adjacent said roller, and means to restrain said control member from pivotal movement.

4. A toggle operating mechanism comprising, in combination: a reciprocable operating member, a pivoted control member positioned in substantial axial alignment with said operating member, a convex surface formed on the end of said control member nearest said operating member, a second convex surface formed on the end of said operating member nearest said control member, a cylindrical roller positioned in free rolling contact with each of said surfaces, a separate axially extending projection on each of said members adjacent said roller and defining therebetween a chamber within which said roller can move, and means urging said operating member toward said control member whereby said roller is maintained in contact with said surfaces.

5. A toggle operating mechanism comprising, in combination: a reciprocable operating member, a pivoted control member positioned in substantial axial alignment with said operating member, a convex surface formed on the end of said control member nearest said operating member, a second convex surface formed on the end of said operating member nearest said control member, a cylindrical roller positioned in free rolling contact with each of said surfaces, a separate axially extending projection on each of said members adjacent said roller and defining therebetween a chamber within which said roller can move, means urging said operating member toward said control member whereby said roller is maintained in contact with said surfaces, and means to restrain said control member from pivotal movement.

6. A compression toggle mechanism comprising, in combination: a reciprocable operating member, a pivoted armature control member positioned in substantial axial alignment with said operating member, and at least three rollers positioned between said members in free rolling peripheral contact and having all of their axes normally located substantially in a single plane, said plane having angular relation with the axis of said members, one of said rollers being positioned in rolling contact with said operating member, a second of said rollers being positioned in rolling contact with said control member, and means to restrain the limit of travel of said rollers transversely to the axis of said members and positioned adjacent to said rollers.

7. A compression toggle mechanism comprising, in combination: a reciprocable operating member, a pivoted armature control member positioned in substantial axial alignment with said operating member, and at least three rollers positioned between said members in free rolling peripheral contact and having all of their axes normally located substantially in a single plane, said plane having angular relation with the axis of said members, one of said rollers being positioned in rolling contact with said operating member, a second of said rollers being positioned in rolling contact with said control member, and a separate axially extending projection on each of said members adjacent said rollers and defining therebetween a chamber within which said rollers can move.

8. A compression toggle mechanism comprising, in combination: a reciprocable operating member, a pivoted armature control member positioned in substantial axial alignment with said operating member, and at least three rollers positioned between said members in free rolling peripheral contact and having all of their axes normally located substantially in a single plane, said plane having angular relation with the axis of said members, one of said rollers being positioned in rolling contact with said operating member, a second of said rollers being positioned in rolling contact with said control member, means to restrain the limit of travel of said rollers transversely to the axis of said members and positioned adjacent to said rollers, electromagnetic means positioned adjacent to said armature member in operable relation therewith, and means urging said operating member toward said control member.

9. A compression toggle mechanism comprising, in combination: a reciprocable operating member, a pivoted armature control member positioned in substantial axial alignment with said operating member, and at least three rollers positioned between said members in free rolling peripheral contact and having all of their axes normally located substantially in a single plane, said plane having angular relation with the axis of said members, one of said rollers being positioned in rolling contact with said operating member, a second of said rollers being posi-

tioned in rolling contact with said control member, a separate axially extending projection on each of said members adjacent said rollers and defining therebetween a chamber within which said rollers can move, electromagnetic means positioned adjacent to said armature member in operable relation therewith, and means urging said operating member toward said control member.

10. A compression toggle mechanism comprising, in combination: a reciprocable operating member, a pivoted armature control member positioned in substantial axial alignment with said operating member, and at least three rollers positioned between said members in free rolling peripheral contact and having all of their axes normally located substantially in a single plane, said plane having angular relation with the axis of said members, a separate axially extending projection on each of said members adjacent said rollers and defining therebetween a chamber within which said rollers can move, electromagnetic means positioned adjacent to said armature member in operable relation therewith, means urging said operating member toward said control member, a first recess formed in said operating member adjacent said operating member projection and having positioned therein one of said rollers, and a second recess formed in said armature member adjacent said armature member projection and having positioned therein a second of said rollers.

11. A compression toggle mechanism comprising, in combination: a reciprocable operating member, an armature control member, at least three rollers positioned in free rolling peripheral contact with each other and having all of their axes normally located substantially in a single plane, one of said rollers being positioned in rolling contact with said operating member, a second of said rollers being positioned in rolling contact with said control member, and means to restrain the limit of travel of said rollers transversely to the axis of reciprocation of said operating member.

12. A toggle operating mechanism comprising, in combination, a reciprocable operating member, a pivoted armature control member positioned in substantial axial alignment with said operating member, an electromagnet for operating said armature, cylindrical surfaces formed on said operating member and said control member, a cylindrical roller making line contact with said cylindrical surfaces, the axes of said roller and said cylindrical surfaces being normally located substantially in a single plane, said plane having an angular relation with the axis of said members and said roller being movable so that its axis moves transversely of said plane, a separate axially extending projection on each of said members defining therebetween abutments for restraining transverse movement of said roller, movement of said armature in response to a change in energization of said electromagnet effecting a movement of said roller whereby to alter the distance between the axes of said cylindrical surfaces and produce a movement of said operating member.



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