Feb. 1, 1944. A. M. COHEN 2,340,579

ELECTRIC CONTROLLING APPARATUS

Filed June 25, 1942

Fig. 1.

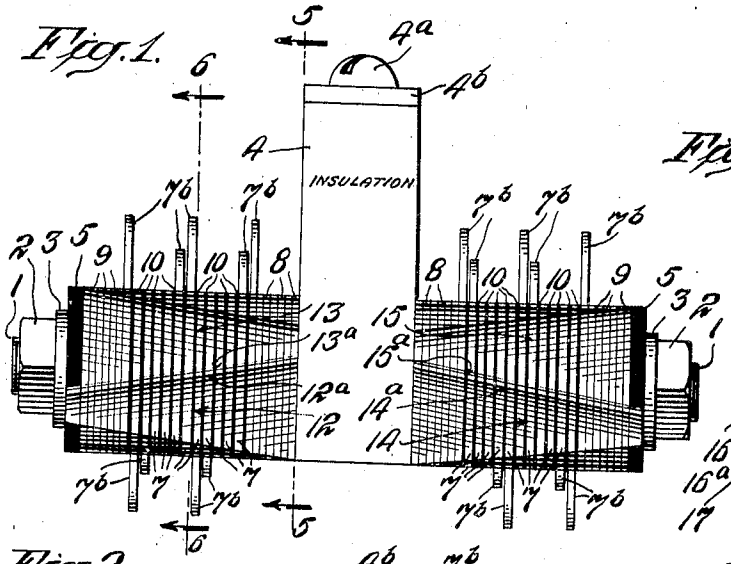


Fig. 4.

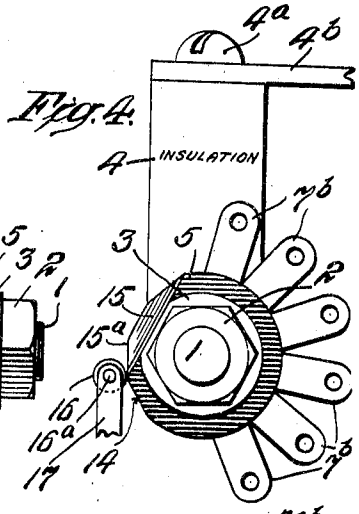


Fig. 2.

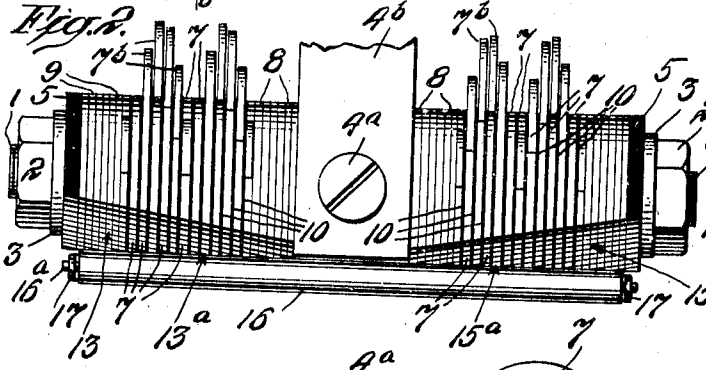


Fig. 5.

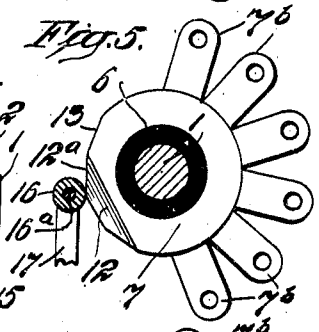


Fig. 6.

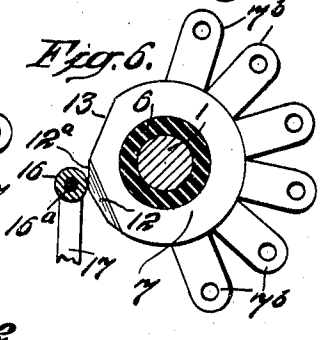


Fig. 7.

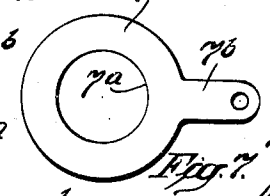
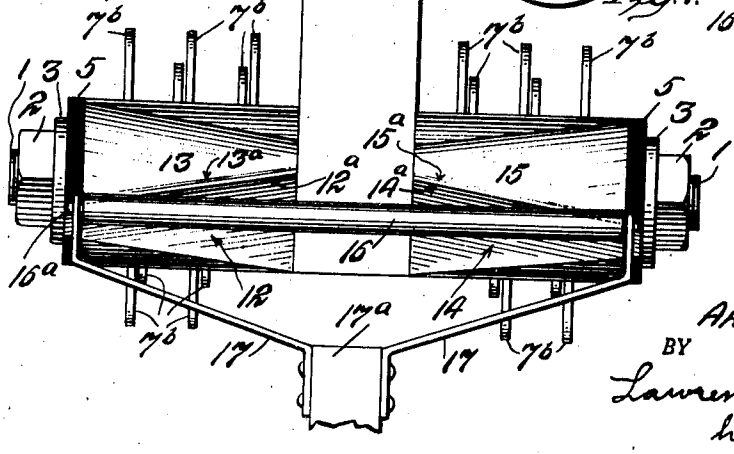


Fig. 3.



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UNITED STATES PATENT OFFICE

2,340,579

ELECTRIC CONTROLLING APPARATUS

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Application June 25, 1942, Serial No. 448,352

7 Claims. (Cl. 200—6)

This invention relates to a multiple contact device wherein a movable contact element variably engages a number of fixed contacts for the control of circuit connections and is applicable particularly to rheostats for changing the connections of the resistive conductors.

The method of making the apparatus disclosed herein is covered in a divisional application Serial No. 480,629, filed March 26, 1943.

In the United States patent of Frank G. Logan granted December 19, 1941, No. 2,266,222, an improved rheostat and contact structure for varying the resistance is disclosed and in which a straight row of contacts is controlled by a movable contact bar of wide open V form with an obtuse angle between two arms of the movable contact. The patent also discloses a form where a straight movable contact bar is utilized and wherein the row of contacts engaged thereby forms a wide open V with an obtuse angle between the two arms of the row of contacts. This latter relationship of contacts has particular advantages in certain uses but the making of a row of contacts in the form of a wide open V introduces difficulties in the cost of manufacture, the support and union of the two arms and the securing of sufficient strength and rigidity of the parts and accuracy of workmanship.

One of the main objects of the prevent invention is to provide a structure which may be readily and conveniently made. Another object is to provide a structure which may be made with a high degree of accuracy and be rigid and of a compact form and durable and dependable under long continued use. Another object is to provide a structure in which comparatively small movement of the movable element will secure a pronounced change of the contacts engaged thereby, giving pronounced control with comparatively small relative movement of the parts. Another object is to permit the use of a straight movable contact bar of light weight with resulting low inertia and with low friction of the parts. These objects and advantages of this improvement render it particularly advantageous for use in regulators wherein it is desired that the movable contact element be responsive to slight changes of the controlling influence and wherein a pronounced change is desired under comparatively small variations of control factor. The invention is particularly well adapted for control by an electromagnet in which the current, or change of current, in the winding of the magnet imposes the desired control and corrective effect. Other objects and advantages will be understood from the following description and accompanying drawing illustrating one embodiment of the invention.

Fig. 1 is a plan view of the fixed element, the movable element not being shown for clearness; Fig. 2 is a rear elevation showing the movable contact element in position; Fig. 3 is a plan view with the movable element in position, the showing of the individual fixed contacts and intervening insulation being omitted for the purpose of more clearly showing the different planes of the fixed contact device; Fig. 4 is an end view of the apparatus; Fig. 5 is a sectional view on the line 5—5 of Fig. 1 and also showing the movable contact; Fig. 6 is a sectional view on the line 6—6 of Fig. 1 also showing the movable contact; and Fig. 7 is a face view of one of the fixed contacts in its original form before assembly and completion of the structure.

The fixed contact elements could be assembled so that the two rows of contacts form an obtuse angle with each other by mounting the contacts on two straight arms and then joining the two arms together at the apex; but this requires a considerable amount of handwork and involves difficulty of properly joining and supporting the parts and unless particular care is exercised, results in lack of uniformity and accuracy in the relationship of the parts. Another method is to utilize a straight central support and assemble the fixed contacts and intervening insulation on the support and manually adjust the individual contacts of proper form on the support so as to bring the contacting edge or surface of each contact in a line to form a wide open V or obtuse angle between the arms; but this greatly increases the handwork and time of assembly and if the contacting surfaces or edges of the fixed unit are to be positioned in the same plane which is the most desirable and practical arrangement, it requires that each of the fixed contacts in the two arms of the V must be different in shape from each of the others. Such a method results in lack of uniformity and inaccuracies in the final product. By the present invention these difficulties are overcome.

In this improvement each of the fixed contact elements are of the same form originally and are assembled on a straight supporting element with provision of proper insulation and then the parts are ground or machined to secure the desired wide open V form of contact surfaces and by reason of the fact that the contact surfaces of the fixed element are in the same plane, it permits the use of a straight movable contact bar mov-

able in one plane for engagement therewith. There is the further advantage of enabling the use of a movable straight bar contact in the form of a roller which avoids the friction of a sliding contact engagement. This reduction in friction is particularly advantageous where sensitiveness of response is required in regulators and other controlling apparatus.

Referring to Fig. 1, the contacts are supported by a straight metal rod 1 which extends through a series of fixed contacts. This rod is threaded at each end and the nuts 2 and washers 3 engage opposite ends of the rod for securely clamping the parts together. In the form shown, a block 4 of insulating material engages the central portion of the rod for supporting the fixed contact device and is shown of square cross section with a screw 4a at its outer end for clamping the device to any suitable support 4b. Instead of supporting the fixed contact device by this central support, it could, if desired, be supported at the ends of the rod 1. Adjoining the metal washers 3 at each end of the device is an insulating washer 5 and between each of these and the central support is a tube 6 of insulating material as shown in Figs. 5 and 6 which is mounted on the supporting rod 1. These tubes serve to insulate the fixed contacts from the supporting rod.

The original form of each of the fixed contacts 7 is shown in Fig. 7 and is in the shape of a round disk having a central opening 7a for permitting them to be slipped over the insulating tube 6. Each contact is provided with an extension 7b at one side, the outer end of which is perforated for convenient connection thereto of the lead wires which are connected to resistive controlling elements in proper order or to other devices for securing the desired controlling effect according to the particular use to be made of the apparatus.

At each side of the central support 4 is mounted a series of plain circular disks 8 of the same form as shown in Fig. 7 without any extension 7b; and adjoining each of the washers 5 is a series of rings 9 similar to the rings 8. The rings 8 and 9 have no insulation between them and serve to form the inner and outer terminals for engagement by the movable contact bar. Instead of building up these terminal contacts 8 and 9 of a series of rings, they could be formed of a single wide ring. The contacts 7 and the rings 8 and 9 are preferably made of good conducting material and in order to insure good contact with the movable contact element are preferably made of coin silver or a silver alloy.

The contacts 7 are mounted on the insulating tubes 6 between the contacts 8 and 9 respectively with an intervening washer 10 of insulating material separating each of the contacts from each other. In assembling the rings 7, their extensions 7b are positioned in staggered relation to each other as indicated in Figs. 1 to 3 and as well shown in Figs. 4 to 6. After the parts are assembled as described, the nuts 2 are tightened for securely clamping the assembled parts together. The staggered extensions from the contact rings are positioned below say the lower half of the assembled unit which leaves the upper half of the tubular assembly of cylindrical form. This arrangement is for exposing the upper portion of the unit to the machine or grinding operation by which the wide open V form of contact surfaces is provided.

The first operation in shaping the contacts is to grind a flat surface on the top of the assembled contacts. The depth of this grinding operation is of a sufficient amount to insure that each of the contact elements will have a surface positioned in the same plane as each of the other contacts on a line of wide open V form adapted to be engaged by the movable contact bar. The next operation is to form an inclined surface or plane generally indicated at 12 at one side of the central portion of the assembled elements. This plane is at an angle to and below the horizontal plane through the previously ground flat surface and is likewise at an angle to a vertical plane which plane is at right-angles to the axis of the assembled elements. The inclination of the plane 12 is well shown in Figs. 5 and 6. The plane 12 is formed by milling or preferably by surface grinding and owing to its inclination forms a line 12a in the previously ground flat surface which gives the inclination of one leg of the V contact engaging surfaces. The next surface to be formed may be considered as the surface 13 at the left of Fig. 1 and on the opposite side of the line 12a from the surface 12. The surface 13 is similarly inclined to a horizontal plane and to a vertical plane which latter is at right-angles to the axis of the assembled elements and extends in a downward direction from the horizontal plane. The inclination of the plane 13 is well shown in Figs. 5 and 6. This surface may be formed by milling or by surface grinding and extends to a line 13a which is quite close to the line 12a and thereby forms a flat narrow contact surface of one leg of the V.

Similarly the surface 14 at the right of the support 4 is ground down in a plane which extends below and at an angle to the horizontal surface and likewise at an angle to a vertical plane, the angle to the vertical plane being indicated by the line 14a to which the surface 14 is ground. The line 14a lies in the plane of the previously ground flat top surface. The inclination of the plane 14 is shown in Fig. 4. Likewise the surface 15 is ground down on the opposite side of the line 14 at an angle to vertical and horizontal planes, the inclination being shown in Fig. 4. The milling or grinding of this surface 15 is such that it extends to a line 15a quite close and parallel to the line 14a, thereby forming a flat narrow contact surface which is the other leg of the wide open V form of contacts. The edges of the rows 12a, 13a, 14a and 15a of the two contact legs may be polished and rounded slightly by hand and buffed.

The method of making the fixed unit as above described permits the parts to be readily and quickly assembled and the surface grinding for forming the inclined planes and the rows of contact surfaces in the wide open V relationship may be quickly and accurately accomplished. The result is a rigid, compact, permanent structure wherein the contacting surfaces are quite accurately formed and aligned. This structure and method of making also permits the use of thin contact rings, giving a considerable change of the contacting surfaces with comparatively small movement of the movable element. The angle of divergence of the inclined surfaces from the line of contacting surfaces may be comparatively small so that a relative small amount of material is ground away. Also this small angle of divergence requires less handwork in the polishing of the edges of the contact surfaces than would otherwise be required, or no handwork at all may be necessary.

The movable contact may be a straight bar of conducting material actuated by the controlling

influence and engages and moves over the two legs of the row of contacts; and by its variable movement will short-circuit more or less of the elements connected to the contact rings or secure other controlling effects according to the connections of the contact rings. The bar is preferably in the form of a straight roller 16 mounted on a supporting rod 16a and rotatably supported in the ends of a bail 17 actuated and controlled by its support 17a. This support is controllable by an electromagnet or other responsive device for variably adjusting the roller to give the desired control. Instead of providing a central supporting rod for the roller, it may be made a solid bar with reduced end portions for engagement with the bail 17. The roller is preferably made of an alloy of silver for insuring good electrical contact with the contacting surfaces of the fixed contacts. It is evident that when the roller is in the position shown in Fig. 3, it bridges the end contacts 9 and thereby short-circuits all of the devices connected to the various contact rings; and when the roller is advanced to its other extreme position it will engage only the contacts 8, thereby permitting all of the devices connected to the respective contact rings to be effective in the controlled circuit or circuits. But when the roller is in an intermediate position, it will affect the controlled circuit or circuits according to its adjustment in a manner well understood by those skilled in the art.

Instead of making the two rows of contacts of wide open V form, they could be arc-shaped or of bow form, or be in a curved pane, or be of any other equivalent form to secure approximately the same results without departing from the scope of the appended claims. Also the inclined surfaces which diverge from the rows of contact surfaces instead of being flat surfaces may be somewhat curved, such as of concave or convex conical form, or made up of a series of flat surfaces combined to diverge in a general direction from the rows of contacts. Furthermore these surfaces need not necessarily be inclined or diverged from the contact rows, it being basically sufficient to cut away material from the body of the unit to form the projecting rows of contact surfaces at an angle to each other, such as by forming surfaces all in the same plane, or nearly so, below the plane of the rows of contacts.

Although a preferred embodiment of the invention has been described and a preferred method of making, it will be understood that various modifications may be made without departing from the scope of the invention.

I claim:

1. Electric controlling apparatus comprising a plurality of contact elements insulated from each other and mounted in a straight row, said contact elements each having a portion projecting therefrom to form two legs of contact surfaces at an obtuse angle to each other, and a contact element in engagement with said two legs of contact surfaces and movable in a direction at right-angles to said straight row to variably engage said contact surfaces.

2. Electric controlling apparatus comprising a straight supporting element, a plurality of contact elements insulated from each other and from said supporting element and mounted in a straight row thereon, said contact elements each having a portion projecting therefrom to form two legs of contact surfaces at an obtuse angle to each other, and a contact element in engagement with said two legs of contact surfaces and movable in a direction at right-angles to said straight row to variably engage said contact surfaces.

3. Electric controlling apparatus comprising a plurality of contact elements insulated from each other and mounted in a straight row, a straight support for said contact elements within and extending through said contact elements, said contact elements having inclined surfaces diverging from each other on the two sides of an intermediate portion of said row and forming two legs of contact surfaces at an obtuse angle to each other, and a contact element in engagement with said two legs of contact surfaces and movable in a direction at right-angles to said straight row to variably engage said contact surfaces.

4. Electric controlling apparatus comprising a plurality of contact elements insulated from each other and mounted in a straight row, a straight supporting rod within and passing through said contact elements, clamping means on the ends of said rod for holding said contact elements in position, said contact elements having inclined surfaces diverging from each other on the two sides of an intermediate portion of said row and forming two legs of contact surfaces at an obtuse angle to each other, and a contact element in engagement with said two legs of contact surfaces and movable in a direction at right-angles to said straight row to variably engage said contact surfaces.

5. Electric controlling apparatus comprising a plurality of contact rings insulated from each other and mounted in a row, said rings having projecting portions extending therefrom respectively for electrical connection to external means, a supporting rod for said rings passing within and extending through said rings, said contact rings having inclined surfaces diverging from each other on the two sides of an intermediate portion of said row and forming two legs of contact surfaces at an obtuse angle to each other, and a contact element in engagement with said two legs of contact surfaces and movable in a direction at right-angles to said straight row to variably engage said contact surfaces.

6. Electric controlling apparatus comprising a plurality of contact elements insulated from each other and mounted in a straight row, a supporting rod within and extending through said contact elements, an auxiliary support mounted on said rod at a mid-portion thereof and separating said contact elements in two sections, said contact elements of each section having inclined surfaces diverging from each other and forming a row of contact surfaces on each section, said contact surfaces of the two rows forming an obtuse angle between them, and a contact element in engagement with said two rows of contact surfaces and movable in a direction at right-angles to said straight row to variably engage said contact surfaces.

7. Electric controlling apparatus comprising a plurality of contact elements insulated from each other and mounted in a straight row, said contact elements each having a portion projecting therefrom to form two legs of contact surfaces at an obtuse angle to each other, and a contact roller in engagement with said two legs of contact surfaces and movable in a direction at right-angles to said straight row to variably engage said contact surfaces.

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