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ELECTRICAL CONTROL DEVICE

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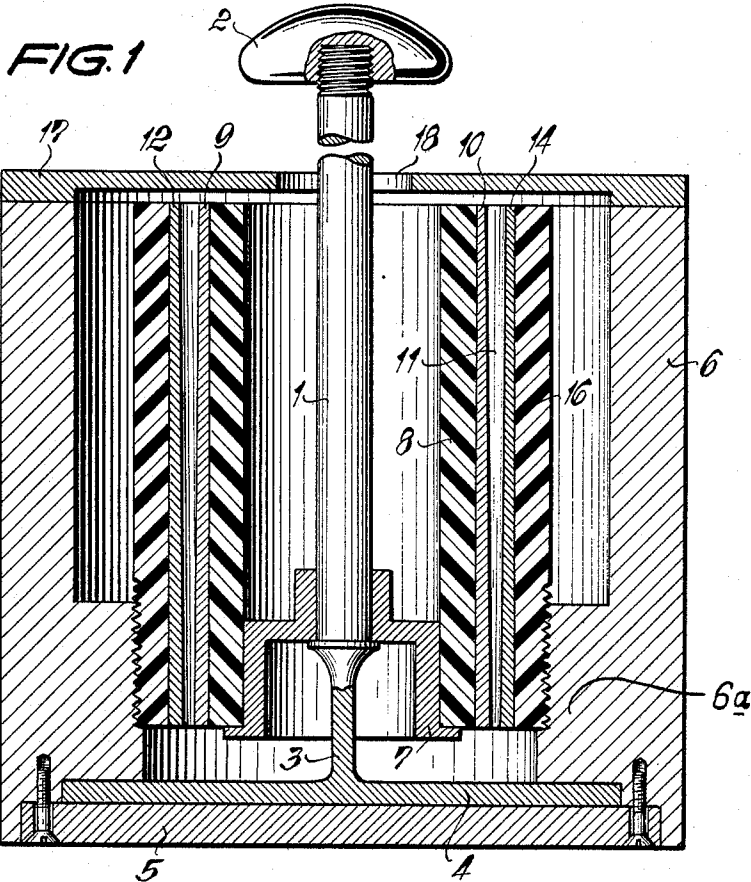
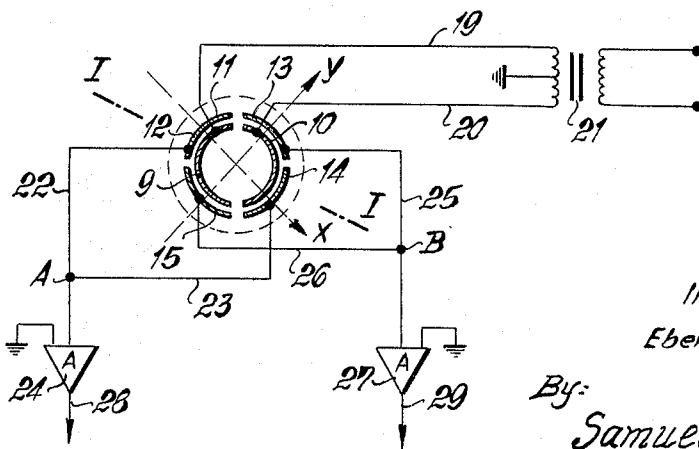


FIG. 2



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5 Claims. (Cl. 317-249)

The invention relates to improvements in a device for the speed control of electrically driven mechanisms and more particularly to a control device having a novel control handle or stick that is inherently elastic in part and readily manipulatable for moving electrical terminals into and out of various positions for variably controlling a control signal.

The device is designed in such a way that a very slight movement of the substantially firm control handle results in a considerable change in the respective control signal. Maximum displacement of the control handle amounts to but a few millimeters. The normal at rest position of the control handle holds the control signal at zero and it returns at all times to its original starting position when released after having been moved. Although the control handle is inherently flexible in part, it must be sufficiently firm so that there is no hysteresis because, otherwise, the handle would assume a different starting position after each operation and thus generate an unwanted control signal while in its zero position.

The control device includes a rod-shaped control handle or stick to which is secured for movement therewith a pair of diametrically opposed terminal electrodes that are spaced by an air gap from a plurality of encircling stationary terminal electrodes. The control handle and its mounting base are of one piece so as to eliminate any possibility of one becoming loosened from the other and thereby causing slight shifting with resulting changes in the zero position.

If the electrical tapping means are especially of a capacitative nature it is well known to use differential condensers as tapping means with their terminal electrodes preferably arranged on two cylindrical surfaces which are concentrically located to the longitudinal axis of a control handle and to arrange the electrodes parallel to each other and spaced by an air gap, with the inner electrodes firmly connected with the handle and swingable with said handle toward and away from the outer stationary electrodes. The novel control handle improvement of zero-point constancy permits a greater deflection of the handle. In the present disclosure the electrodes are wedge-shaped, that is, in the form of segments of a truncated cone, to provide a larger air gap at the top and a smaller air gap at the bottom without changing their average distance from each other. In this manner a greater change in capacity and thus a stronger control signal is attainable with the same total capacity as in prior arrangements.

It is therefore an object of the invention to provide a novel construction and assembly of a control device of the character described.

Another object is to provide a control device of the character described which has a high degree of stability.

Another object is to provide a control device with novelly shaped electrodes establishing a wedge-shaped air gap between them.

Another object is to provide a control device of the character described which has a greater change in capacity and a stronger control signal than devices heretofore constructed.

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Another object is to provide a control device which is not expensive to manufacture, is simple to construct and assemble, easy to operate and extremely sensitive in its operation.

The structure by means of which the above noted and other advantages and objects of the invention are attained will be described in the following specification, taken in conjunction with the accompanying drawings showing a preferred illustrative embodiment of the invention, in which:

FIG. 1 is a diametrical sectional view of the control device, taken on line 1-1 of FIG. 2.

FIG. 2 is a schematic diagram illustrating the device and an associated electrical circuit.

Referring to the exemplary structure shown in the accompanying drawings, and particularly to FIG. 1, the device includes a hollow casing having a cylindrical wall 6, a bottom wall 5 and a cover 17. The cylindrical wall 6 has an internal circumferential flange 6a near its bottom which is suitably recessed annularly on its bottom face to receive seated therein a circular base plate 4 and the bottom wall 5, the latter being secured firmly therein so as to lock base plate 4 against any movement in any direction.

A cylindrical insulator 16, which preferably is plastic, is secured firmly within internal flange 6a and it extends upwardly therefrom to terminate short of top wall 17. This cylindrical insulator 16 carries on its inside surface a plurality (four) of mutually spaced metallic segments or electrodes 12, 13, 14 and 15 (FIG. 2) each of which preferably is tapered longitudinally (FIG. 1) so as to present a gradually thickened cross section with the thickest region at their lower edges.

The base plate 4 carries a control handle 1, integral therewith, which is axially concentric relative to the insulator 16. As shown, this handle extends upwardly through an opening 18 in top wall 17 and carries a knob 2 on its upper end. The base portion of said handle is of reduced diameter, as at 3, so as to permit the handle to be rocked or tilted slightly upon application of force in a radial direction on knob 2. However, the inherent firmness of the control handle, and particularly of the elastic reduced diameter 3 is such that, when pressure is relieved, the handle will always return to its precise initial position of axial alignment.

Mounted firmly on the control handle and above the reduced diameter 3, is an inverted cup-like fitting 7 over which is telescoped, and to which is firmly secured, a concentric cylindrical insulator 8 which is substantially coincidental in length with the length of the outer cylindrical insulator 16. This insulator 8 mounts on its outside surface a pair of diametrically opposed metallic segments or electrodes 9 and 10 which are also tapered lengthwise with their greatest thickness at their lower ends. These electrodes are spaced inwardly radially from the planes of segments 12 to 15 to define a wedge-shaped air gap 11 between their opposed surfaces.

Upon referring to FIG. 2 it will be observed that the electrodes 9 and 10 are each coincidental with a pair of the electrodes 12, 13, 14 or 15. Specifically, the electrode 9 is opposed to electrodes 12 and 15 whereas the electrode 10 is opposed to electrodes 13 and 14. It should be evident that when the control handle 1 is rocked or tilted in any direction radially, the air gap between the opposed electrodes on the side toward which the handle is tilted, is reduced while the diametrically opposed gap is increased.

To illustrate a practical application of the control device, the FIG. 2 illustration is representative of the circuitry for an automatic remote control. In this illustration the electrodes 9 and 10 are connected by wires 19

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and 20 respectively, with the secondary winding of a push-pull transformer 21, the primary winding of which may be connected to a 50 cycles per second power supply. The electrodes 12 and 14 are connected with the inlet of an amplifier 24 by means of wires 22 and 23 respectively, and the electrodes 13 and 15 are connected to the inlet of the amplifier 27 by lines 25 and 26 respectively. The six electrodes form four condensers of which each two are located opposite from each other. Other electrical transmission equipment (not shown) and finally an electric motor is connected to the outlet side of each amplifier 24 and 27 by means of wires 28 and 29 respectively, and the number of revolutions and direction of rotation of said motors is controlled by the control device shown in FIG. 1. As a result of the described feed of the condenser-electrodes 9 and 10 the alternating current voltages occurring at the points A and B are practically zero in a completely symmetrical mechanical design. Any possible mechanical asymmetries can be compensated for by adjusting trimming condensers.

A deflection of the control rod 1, for instance in the direction indicated by the line x in FIG. 2, changes the air separation 11 between the electrodes, and thus the capacity of the respective opposite condensers, in such a way that the capacity of one condenser increases with the decrease of the air separation and the capacity of the opposite condenser decreases when its air separation increases. Thus, the potential at the point A is disturbed by the deflection of the control rod in x-direction and consequently the potential at point B is disturbed when the control rod is deflected in the direction of line y. Therefore, the alternating current voltages become effective at these points, the amplitude of which is approximately proportional to the capacity difference between the two opposed condensers for small deflections of the control rod from its normal position of rest. In a proper geometrical design of the control mechanism the amplitude of the effective alternating current voltages at the inlets of the amplifiers 24 and 27 changes as a function of the deflection of the control handle 1 linear with the deflection. Therefore, it is possible to control, with the control handle, a mechanism driven by the above mentioned electric motors. For example, such mechanism may be an optical target-tracking instrument similar to the well known motion picture theodolites, with its vertical and horizontal axes of rotation adjustable by a motor with controllable angular velocity, in both coordinate directions.

The design of the novel control mechanism is not limited to the application of capacitative tapping means. It can be used also in connection with other electrical means, for instance inductive, or photoelectric tapping means; with tapping means operating with adjustable ohmic resistors, or also in connection with pneumatic or hydraulic tapping means.

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Obviously the base plate 4 may be secured firmly by means other than shown and the control handle 1-3 may be other than the circular rod stock shown.

Although I have described a preferred embodiment of my invention, in considerable detail, it will be understood that the description thereof is intended to be illustrative, rather than restrictive, as many details of the structure may be modified or changed without departing from the spirit or scope of the invention. Accordingly, I do not desire to be restricted to the exact construction described.

I claim:

1. A control mechanism comprising an elongated shaft fixed at one end and having its other end free to be manually controlled, a cylindrical body of electric insulation material secured to said shaft, a set of electrodes circumferentially spaced about said cylindrical body, a tubular body of electric insulation material surrounding and spaced from said cylindrical body, a set of electrodes circumferentially spaced around the inside surface of said tubular body in capacitive relation to the first named set of electrodes, each of said electrodes comprising a segment of a truncated cone and being so arranged as to decrease the gap between related electrodes in the direction of the fixed end of said shaft, said shaft having a flexible portion adjacent to its mounted end whereby the gap may be varied when force is applied to the free end of said shaft.

2. The control mechanism recited in claim 1, in which the tubular body is mounted firmly in a casing.

3. The control mechanism recited in claim 1, in which the flexible portion of the shaft is of reduced cross section.

4. The control mechanism recited in claim 1, in which the cylindrical body is connected to the shaft closely adjacent to the flexible portion of said shaft.

5. A control mechanism comprising a fixed base plate, an elongated shaft integral with and projecting from said base plate at a normally fixed angle with respect thereto which defines its zero position, a body of electric insulation material carried firmly on said shaft for movement therewith, at least one electrode carried by said body, a fixed body of electric insulation material supported closely adjacent to the first named body, at least one electrode carried by the fixed body in opposed relation to and spaced from the first named electrode, and said shaft being inherently elastic whereby it is movable relative to the base plate and last named electrode from its zero position so as to vary the spacing between the two electrodes and it will thereafter return to said zero position.

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