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E. A. TERPENING

1,744,592

VARIABLE ELECTRIC CIRCUIT CONTROL DEVICE

Filed Sept. 17, 1923

Fig. 1

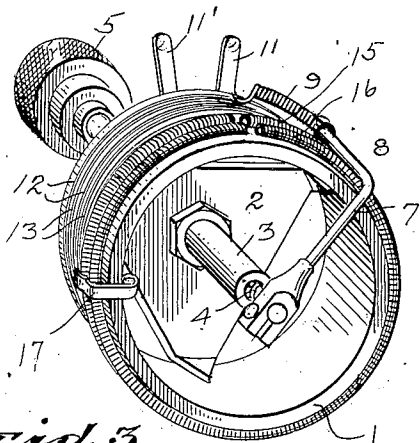


Fig. 2

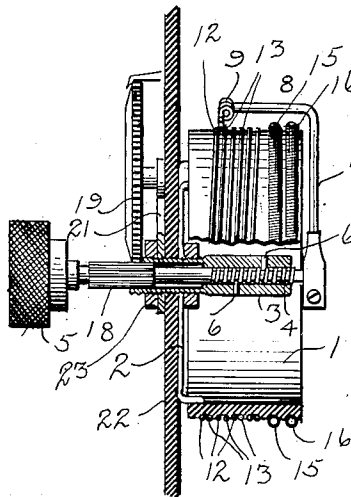


Fig. 3

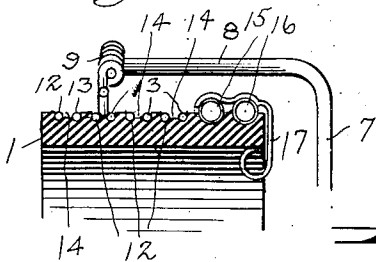


Fig. 4

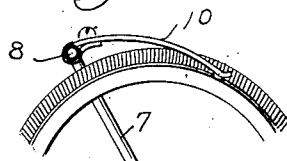
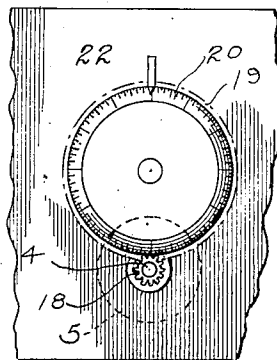
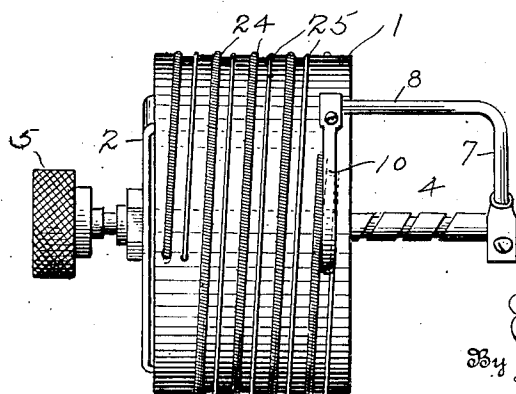


Fig. 5



Fig. 7

Fig. 6



Inventor

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UNITED STATES PATENT OFFICE

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VARIABLE ELECTRIC-CIRCUIT-CONTROL DEVICE

Application filed September 17, 1923. Serial No. 663,274.

My invention relates to variable control devices for electric circuits, particularly applicable to wireless apparatus but which may be advantageously embodied in wired circuits or electrical installations other than wireless.

For illustrative purposes the invention has been shown herein as embodied in a rheostat and in a potentiometer, but it is to be understood that it may be applied to various apparatus wherein a variable contact member is adjusted to and fro to include in or exclude from an electric circuit a greater or less length of electrical conductors which may be of high or low resistance according to the purpose and function of the instrument.

It is recognized that heretofore electrical regulating or control devices have been disclosed which employ a helically wound conductor engaged by a traveling contact which follows the helical windings of the conductor under the control of a feed screw having a like pitch. Such a construction is shown and described in prior patent to Douglas, 1,438,753, dated December 12, 1922, and prior thereto in patent to Weston, No. 446,490, dated February 7, 1891. In such prior construction, the rotating arm and feed screw formed a part of the electrical circuit involving more or less difficulties due to imperfect contact through the adjusting stem or feed screw and current leakage.

In the present invention there is contemplated an improvement of the prior construction by providing a double helical winding upon a suitable core or insulating ring or tube, such double winding consisting of a pair of independent wires, one of which is a negative conductor and the other a positive conductor or connected with the negative and positive sides respectively, the traveling contact being such as to simultaneously engage both of these wires or windings to electrically connect or bridge the same and so complete the circuit without passing current through the rotary arm nor its adjusting stem. The invention further contemplates an indicator having reduced motion connection with the traveling contact by which the travel of the contact over successive turns of the double winding will be pro-

gressively indicated. The rheostat herein disclosed embodies in addition to the features before mentioned a pair of resistance elements interconnected or bridged by an adjustable contact member independent of the traveling contact by the adjustment of which the range of the instrument can be varied at will to approximate limit, the finer adjustment being affected by the movement of the traveling contact.

The object of the invention is to simplify the structure as well as the means and mode of operation of such variable contact electrical regulating and control instruments whereby they will not only be cheapened in construction, but will be more efficient in use, positive in operation, uniform in action, easily controlled and unlikely to get out of repair.

A further object of the invention is to provide such an instrument having a wide variation of range and in addition thereto means for affording vernier adjustment of the instrument within any predetermined range.

A further object of the invention is to provide a variable contact regulating or control instrument wherein the contact mounting and actuating means is excluded from the circuit.

A further object of the invention is to provide an improved winding for the coils of such regulating and control instruments by providing a double winding wherein the wires alternate, that is, each turn of the winding being composed of parallel wires in spaced relation in conjunction with the traveling contact simultaneously engaging and bridging the parallel conductors.

A further object of the invention is to provide rotary indicating means operating through reduced motion transmitting mechanism to indicate the progressive movement of the traveling contact over successive turns of the double or duplex coil.

With the above primary and other incidental objects in view as will more fully appear in the specification, the invention consists of the features of construction, the parts and combinations thereof, and the mode of operation, or their equivalents, as hereinafter described and set forth in the claims.

Referring to the accompanying drawings wherein is shown the preferred but obviously not necessarily the only forms of the embodiment of the invention, Fig. 1 is a perspective view of a rheostat embodying the present invention. Fig. 2 is a sectional view of the rheostat shown in Fig. 1 illustrating the inter-connection of the reduced motion indicator with the traveling contact control devices. Fig. 3 is an enlarged detail sectional view and Fig. 4 a detail side elevation illustrating the engagement of the traveling contact with the conductor. Fig. 5 is a diagrammatic view of the winding or conductor elements of the rheostat shown in the preceding figures. Fig. 6 is a side elevation showing the application of the present invention to a potentiometer. Fig. 7 is a front elevation illustrating the relation of the adjustment knob and the indicator.

Like parts are indicated by similar characters of reference throughout the several views.

One of the purposes of the present construction is to enable precise control of the flow of current through a circuit such as the filament circuit of a wireless apparatus by which extremely fine adjustment of resistance or variation of current may be effected by considerable movement of the adjusting element. Whereas, with the ordinary rheostat or other regulating or control instrument the slightest movement of the adjusting elements will produce a considerable variation of resistance or of current flow, the present construction is designed to materially decrease the degree of variation of the resistance or current flow in proportion to the degree of adjustment of the control device thereby enabling much finer adjustment or tuning to be effected by very appreciable degree of adjustment of the apparatus.

In constructing a rheostat such as illustrated in the drawings, there is employed an annular core or ring 1 of insulating material having secured at one end thereof a head 2. In the present instance this head has been shown triangular in form for illustrative purposes and for economy of manufacture. The angles of the triangular head are turned and attached to the interior of the insulating ring or core 1. Obviously other forms of heads or supporting spider may be employed. The head 2 supports concentrically within annular core or ring 1 an extended sleeve or hub 3 through which extends a screw threaded stem having at its outer end an adjusting knob 5. The sleeve or hub 3 may be interiorly screw threaded to receive the feed screw or stem 4, but for economy of manufacture it is preferably provided with one or more inwardly projecting studs or lugs 6 which engage in the feed screw 4 in lieu of internal threads within the hub or sleeve. At its inner end the feed screw or adjusting stem

4 carries a rotating arm 7, the extremity of which is bent laterally at 8 over the periphery of the insulating core or ring 1. The overhanging portion 8 of the rotating or carrier arm 7 carries a flexible or yielding insulated contact member which may be a coiled spring wire or "pig-tail" as shown at 9 or it may be a spring finger as shown at 10. Surrounding the core or ring 1 is a duplex winding consisting of two wires wound helically about the core or ring in parallelism and spaced one from the other thus affording two independent helical windings, the turns of which alternate with each other. These windings are preferably of low conductive material. One winding or conductor is connected to the negative terminal or conductor 11 while the other winding or conductor is connected to the positive terminal 11'. In order to retain the proper spacing and facilitate the manufacture of the instrument, the respective windings or conductors 12 and 13 are seated or partially embedded in the peripheral face of the core or ring 1 and in spaced relation within a helical groove 14. The preferable construction is to make the groove 14 shallow but of sufficient width to contain the spaced wires or conductors which are embedded in the bottom of the shallow groove and at the opposite margins of such groove. Such construction, however, is not essential and the duplex windings may be mounted upon the peripheral face of the ring or core without being embedded or seated in grooves but in lieu thereof may be secured by cementing or otherwise attaching them fixedly in predetermined spaced relation. The pitch of the helical windings 12 and 13 about the periphery of the core 1 substantially agrees with the pitch of the feed screw or adjusting stem 4. The contact member 9 or 10 as the case may be rides within the peripheral groove 14 in wiping contact with the parallel windings 12 and 13 as the carrier arm 7 is oscillated to and fro. Upon rotation of the adjusting knob 5 to effect such oscillation of the carrier arm, the feed screw 4 causes the arm to be carried transversely of the windings or axially in relation with the core so that the contact member 9 or 10 will maintain constant relation to the windings regardless of the particular turns of the winding engaged or the number of rotations of the feed screw and carrier arm. The shallow groove 14 thus affords a track or guide within which the contact member travels about the ring or core 1 in constant engagement with the parallel electrical conductors in the bottom of such groove track. The current passes directly from one wire or winding to the other through the contacting portion of the member 9 or 10. With the exception of the bearing end of such member which simultaneously engages and bridges the respective windings, the contact member forms no part of the electric circuit,

and is insulated from the carrier arm 7. By its travel to and fro about the periphery of the ring or core, the contact member moves to and from the terminals or connections 11 and 11' with which the respective windings or conductors are connected thereby introducing into the circuit between such terminals 11 and 11' greater or less length of the conductors 12 and 13 which, if of high resistance material, will introduce more or less resistance into the circuit, the degree of resistance however being comparatively small in relation with the extent of travel of the contact member or degree of rotation of the adjusting knob 5. This, in effect, affords a vernier adjustment and enables noiseless adjustment and permits of infinitesimal refinement in tuning. Moreover, the variable contact is constantly in engagement with the conductors 12 and 13 throughout its entire range of movement thereby obviating any momentary interruption. To increase the range of the rheostat while retaining the vernier adjustment there are provided about the periphery of the ring or core 1 two independent lengths of coiled resistance wire 15 and 16. These lengths of resistance material 15 and 16 are connected in series with the conductors 12 and 13 and intermediate the terminals 11 and 11'. The connection of the respective conductors is diagrammatically illustrated in Fig. 5. The conductors 12 and 13 are connected in series by the contact finger 9 which by its to and fro adjustment brings into the circuit greater or less length of the respective conductors. The conductor 12 is shown connected directly to the terminal 11. The other conductor 13 is shown in the diagram connected to one of the coils 15 of resistance material. The other coil of resistance material 16 is connected direct to the second terminal 11' while the coils 15 and 16 are themselves variably interconnected by an adjustable bridge member 17. It is obvious that by adjusting the bridge member manually to and fro upon the coils 15 and 16, greater or less length of such coils may be included in the circuit. Thus by shifting the bridge member 17 in close proximity to the connected ends of the resistance coils 15 and 16, such coils are excluded from the circuit and the resistance of the rheostat is limited to that afforded by the duplex helical winding consisting of the wires or conductors 12 and 13. By shifting the bridge piece 17 away from the connected ends, increasing resistance is introduced into the circuit. This bridge piece 17 is adjusted to approximate the desired range point or to afford approximately the desired resistance and the further and finer adjustment or tuning of the instrument is effected by the to and fro adjustment of the contact member 9 upon the duplex winding. The construction affords a safety feature. It enables the bridge piece 17 which is not readily accessible from

the front of the instrument or cabinet in which the instrument is mounted to be set at such point as to insure a safe amount of resistance in the line to protect a detector or amplifying bulb of a wireless set while allowing ample tuning within a suitable range by the to and fro adjustment of the contact member by rotation of the knob 5. The bridge piece 17 has been shown as a single spring clip which bears simultaneously upon the two resistance coils 15 and 16 and is provided with a resilient bight or eye which extends within the supporting ring 1 and engages the inner circumference thereof to exert yielding pressure upon the resistance coils 15 and 16. This bridging member, to vary the range of the instrument to different extent, is adjusted manually wholly independent of the vernier adjustment by means of the traveling contact bearing. The range of vernier adjustment is constant for all adjusted maximum range of the instrument.

Since the traveling contact may make several complete revolutions during the tuning or vernier adjustment, the angular adjustment of the control knob 5 or a dial connected therewith is not sufficient to indicate the range of movement of the traveling contact. For this reason special indicating means have been provided operated throughout successive turns of the traveling contact. To this end the stem 4 is provided with an elongated spur gear pinion 18 which extends within the outer end of the hub or sleeve 3. This hub or sleeve 3 is preferably counter-bored to accommodate the gear pinion enlargement of the stem. The gear pinion 18 may be formed from a length of pinion wire bored and adjusted upon the shank of the adjusting stem 4 or it may be formed integral therewith and adjacent to the screw threaded portion of such stem. The portion of the hub or sleeve 3 projecting beyond the head 2 is notched or recessed at one side to expose such elongated pinion 18 for engagement of a spur gear 19 which carries either an indicating dial 20 or a suitable pointer co-operating with a stationary dial. As a convenient method of mounting the dial gear 19 there is shown an arm 21 to one end of which the gear 19 is pivotally connected, the other end of the arm being perforated and surrounding the threaded protruding end of the hub or sleeve 3 which extends through the panel or mounting board 22 to receive the clamp nut 23 between which and the face of the panel 22 the supporting arm 21 is securely clamped. It is obvious that each complete rotation of the pinion 18 upon adjusting the stem will effect a partial rotation of the indicator gear 19 to adjust the dial 20 through a proportionately reduced angular movement. The gear pinion 18 is elongated in order that it may maintain its intermeshing engagement with the indicator gear 19 throughout the full range of axial

or longitudinal adjustment of the adjusting stem 4 due to the feed screw movement. It is obvious that in lieu of the elongated gear pinion, a suitable pinion of reduced face may be splined upon the adjusting stem 4 to permit the relative longitudinal adjustment of the stem to compensate for the feed screw movement.

If an instrument of low range is desired or one having an increased range of vernier adjustment, the resistance coils 15 and 16 may be omitted and the duplex winding 12-13 may be continued to any extent desired, the screw threaded adjusting stem being proportionately extended to carry the contact member over the added turns. It is not necessary nor essential that the windings be high resistance windings nor that the construction be limited to a rheostat. The essential features of the invention and principle involved are equally applicable to other tuning coils or regulating devices as for instance, one involving variable inductance. There are various applications of the invention other than that shown herein for illustrative purposes. For instance, in Fig. 6 the construction is shown applied to a potentiometer wherein one of the windings or conductors is a coil in order to increase its effective length and resistance. This resistance coil 24 is wound parallel with a second conductor 26 preferably of low resistance. The contact finger simultaneously engages the coiled winding 24 and the low resistance winding 25. This construction enables quite fine adjustment and by introducing and excluding infinitesimal degrees of resistance the flow of current may be very accurately measured. To raise the range of such an instrument without necessarily increasing the movement, both of the windings 24 and 25 may be of the coiled type.

One of the several advantages resulting from the use of the double winding as herein described for various forms of electrical apparatus, and particularly radio apparatus is the elimination of inductance. The use of single wound coils for various purposes, such as rheostats, potentiometers and the like, influence unfavorably adjacent parts by induction and affords fields of magnetic or electrical influence which causes disturbances of associated sensitive apparatus. In the present instance, the induction resulting from the flow of current through one of the helical windings is neutralized or counter-acted by the return flow of the current in the opposite direction through the second winding. The flow of current in each direction and extent of the respective windings being equal, a neutral coil or winding is afforded which, while affording variable resistance and performing the functions of a rheostat, a potentiometer and serving other purposes for which it may be employed, exerts no external influence and causes

no undesirable disturbance of adjacent or associated parts.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute, the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific detail shown, but that the means and construction herein disclosed comprises the preferred form of several modes of putting the invention into effect and the invention is, therefore, claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described my invention, I claim:

1. In a variable electrical instrument, a pair of independent electrical conductors wound in parallel spaced relation into a helical coil, wherein the turns of the respective conductors alternate with each other, a single travelling finger projecting between adjacent turns of the respective conductor and having simultaneous wiping engagement with the respective conductors and electrically connecting substantially equalized portions of variable extent of said windings one to the other, and actuating means imparting to the travelling finger movement circumferentially of the coil and simultaneous movement in an axial direction thereof independent of the guiding influence of the engaged helical turns for causing the traveling contact to traverse successive turns of the parallel windings in either direction to vary the effective extent of such windings.

2. In a variable electrical device, a double helical winding of electro conductive material, a traveling contact wiper located coincident with the space between successive turns and bridging the double winding to interconnect in series equalized lengths thereof and movable through out successive turns of the double winding to vary the effective extent of the winding and actuating means therefor by which said wiper is guided through its path of travel independent of the guiding influence of the engaged helical winding.

3. In an electrical instrument, a pair of independent electrical conductors wound in parallel spaced relation into a helical coil wherein the turns of the conductors alternate with each other to form there between a guide space, and a single traveling contact member following the space between the turns and making simultaneous contact with both con-

ductors thereby interconnecting substantially equalized portions of variable extent of said conductors and means for manually actuating the traveling contact members through a helical path of travel coincident with the spaced double windings of said coil independent of the guiding influence of said winding.

4. In a variable electrical instrument, a pair of independent helically wound electrical conductors, a traveling contact extending into the space intermediate the conductors and having simultaneous wiping engagement with corresponding turns of the respective helices and interconnecting in series sections thereof of equal lengths and means for actuating the traveling contact to and fro throughout a helical path of travel in which it maintains its operative engagement with corresponding turns of the helices, independent of the guiding influence of the engaged turns of said conductor to vary the effective extent of said conductors.

5. In a variable electrical instrument, a pair of independent helically wound electrical conductors, a single traveling contact engaging intermediate successive turns thereof having simultaneous wiping engagement with both conductors and electrically connecting equalized portions of the conductors in series, a mounting for the traveling contact including a feed screw having a pitch substantially equivalent to that of the helix formed by the conductors, said contact being advanced by the adjustment of the feed screw in constant relation with the successive turns of the conductors.

6. In a variable electrical instrument, a double wound coil the windings of which alternate, a single traveling contact engaging intermediate successive turns thereof and having simultaneous wiping engagement with both windings and means for advancing the contact through a helical path of travel having a pitch substantially equivalent to that of the winding.

7. In an electrical instrument, a pair of high resistance conductors and a pair of low resistance conductors and a pair of independently adjustable contact members, one interconnecting the high resistance conductors and the other interconnecting the low resistance conductors, said interconnected pairs of conductors being in turn interconnected in series, the adjustment of one contact serving to vary the resistance of the instrument in comparatively large amounts, and the adjustment of the other contact effecting lesser graduations of the maximum resistance determined by the first contact.

8. In an electrical instrument, a pair of high resistance elements, and a pair of relatively lower resistance elements, independently adjustable bridging members for variably connecting the members of the respective pairs in series, the said pairs of members be-

ing in turn connected in series, the adjustment of one of said bridging members being adapted to vary the maximum range of the instrument, the other bridging member being adapted to vary the capacity of the instrument within the determined maximum range.

9. In a rheostat or the like, a plurality of electrical conductors of relatively high and relatively low resistance arranged in pairs, variable contacts connecting the members of high resistance and low resistance pairs in series, said pairs being in turn interconnected in series, the adjustment of the variable contact connecting the high resistance members to vary their effective extent serving to limit the maximum range of the instrument the adjustment of the variable contact to vary the effective length of the low resistance conductors serving to vary the capacity of the instrument within the range determined by the other contact member.

10. In a rheostat or the like, a plurality of electrical conductors, a plurality of variable contact members connecting the conductors in pairs, said pairs of interconnected conductors being in turn connected in series, and variable contact members being independently adjustable whereby one of said contact members may vary the maximum range of the instrument and another of said contact may vary the capacity of the instrument within the predetermined range.

11. In a rheostat or the like, a helical wound resistance member, a traveling contact member having wiping contact with the resistance member and movable thereupon throughout successive turns of its helical winding, a pair of additional resistance elements, a variable contact member bridging said pair of resistance elements and by its adjustment varying their effective extent, said interconnected pair of resistance elements being connected in series with said helical winding, the contact members being adjustable independent of each other.

12. In a rheostat or the like, a pair of independent resistance wires helically wound in parallel spaced relation, a traveling contact interconnecting in series the independent wires of windings and movable to and fro throughout successive turns of the windings to vary the effective lengths of said wires, and a second pair of resistance elements, a movable bridge member interconnecting the members of said second pair of elements in series and by its adjustment varying their effective extent, said interconnected pair of wires and interconnected pair of additional resistance elements being in turn connected in series, said traveling contact and bridge member being independently adjustable.

13. In an electrical instrument, a helical winding, a traveling contact movable to and

fro over successive turns of the winding, an axially movable rotary stem by which the adjustment of the contact is controlled, an elongated gear pinion carried by the stem, a
5 gear member with which the pinion meshes, the elongation of the gear pinion compensating for the axial movement of the stem necessary to adjust the contact over successive turns of the winding, and indicator means
10 controlled by said gear member.

14. In a rheostat, a pair of conductors of relatively high resistance and a pair of conductors of relatively low resistance, said pairs of conductors being connected in series, and
15 variable bridging contacts operable independent of each other for each pair of conductors, by the adjustment of which the combined resistance of said conductors is varied by relatively large and small degrees respectively.
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In testimony whereof, I have hereunto set my hand this 7th day of September, A. D. 1923.

ELMER A. TERPENING.

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