July 1, 1958 E. D. O'BRIAN 2,841,676

ADJUSTABLE ELECTRICAL INSTRUMENTS

Filed June 20, 1955

FIG. 1.

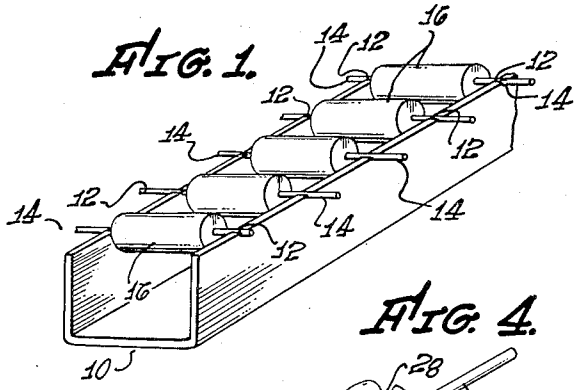


FIG. 4.

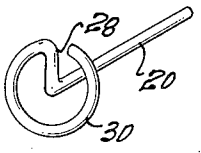


FIG. 5.

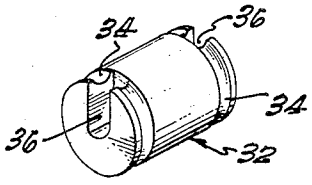


FIG. 2.

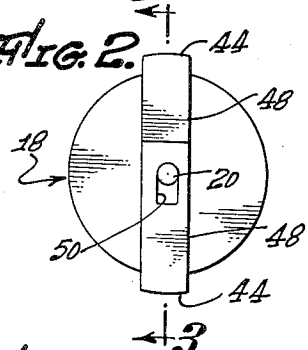


FIG. 3.

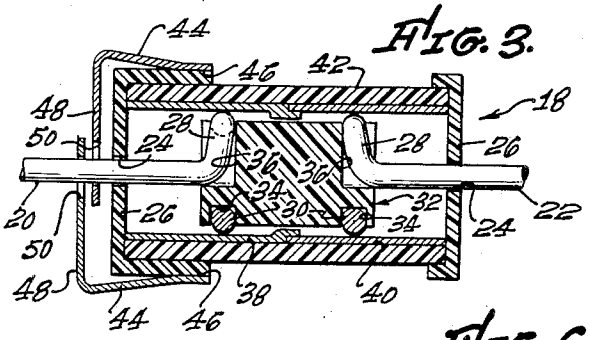


FIG. 7.

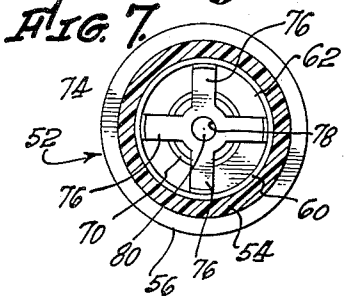


FIG. 6.

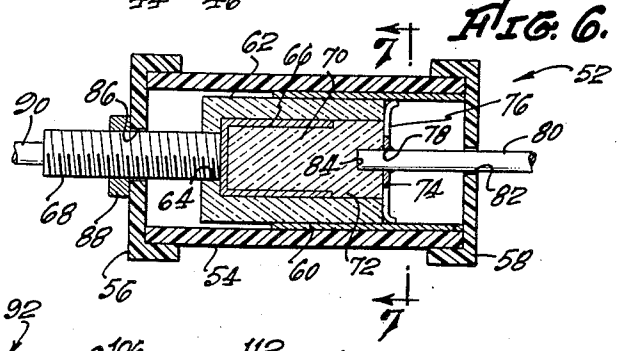
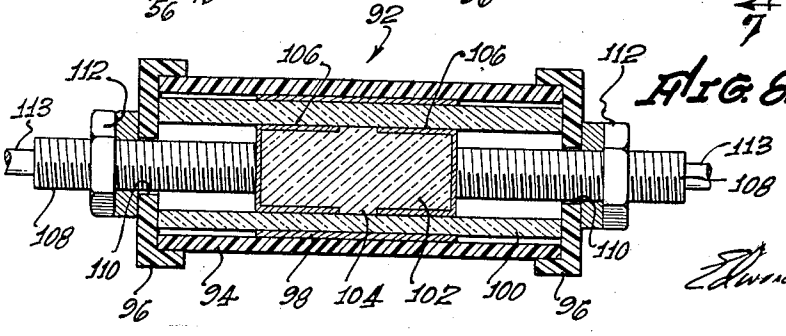


FIG. 8.



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ADJUSTABLE ELECTRICAL INSTRUMENTS

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7 Claims. (Cl. 201—62)

The present invention relates to new and improved electrical instruments which may be readily adjusted when mounted in operative positions.

This invention may be briefly summarized as required by Rule 78 of the Rules of Practice of the United States Patent Office in Patent Cases as being concerned with adjustable electrical instruments which include: a non-conductive connector; first and second aligned terminals attached to said connector so as to project therefrom, said terminals being insulated from one another; first and second electrical means attached to said first and second terminals respectively, said first and second electrical means being insulated from one another; an elongated housing having ends with openings formed thereon positioned around said connector and said first and second electrical means and part of said first and said second terminals with said terminals projecting out of said housing through said openings, said housing being movable along said first and second terminals with respect to said first and second electrical means and said connector; and an electrical element positioned within said housing adjacent to said first and second electrical means, whereby when said housing is moved along said terminals, said electrical element is moved with respect to said first and second electrical means.

Electrical instruments of the invention as indicated in the preceding paragraph are primarily designed to be used so as to overcome a problem with respect to the mounting of adjustable instruments within a non-conductive channel. There exists at the present time a trend toward small cylindrical electrical capacitors, resistors, and the like having terminal leads projecting therefrom in such a manner that these leads may be held within notches in a non-conductive channel. The various instruments of this category are, when so hold, connected into a circuit by various wires leading to and away from the channel. Unfortunately, with this type of construction it is exceedingly difficult to mount adjustable electrical units of a conventional category so that they lie within the same general plane as the various other components utilized.

It is an objective of the present invention to provide adjustable electrical instruments which have the same general appearance as common cylindrical capacitors or other cylindrical electrical components and which may be readily handled and mounted in various channel-like structures in the same manner as these other cylindrical components. A further objective of this disclosure is to provide new and improved electrical components or instruments as hereinafter set forth which are of very simple construction, which are exceedingly rugged, which may be easily manufactured and assembled, and which are very reliable in use. Another related object of the invention is to provide electrical instruments of the class described which are exceedingly acceptable at the present time inasmuch as they possess the same general appearance as common cylindrical capacitors and resistors so as to present a neat appearance when installed in an electrical assembly along with other components. A further related object of the invention is to provide generally cylindrical adjustable electrical instruments or components which by virtue of their size and shape can be easily assembled into an electrical assembly utilizing the same type of automatic equipment in assembling other cylindrical electrical components.

Further objects of this invention as well as many advantages of it will be more fully apparent from the remainder of this specification including the appended claims and the accompanying drawings, in which:

Fig. 1 is an isometric view indicating the type of assembly with which the unit of the present invention is designed to be employed;

Fig. 2 is an end view of adjustable electrical resistor constructed in accordance with this disclosure;

Fig. 3 is a cross sectional view taken at line 3—3 of Fig. 2;

Fig. 4 is an isometric view indicating an electrical contact employed in the adjustable resistor shown in Fig. 2;

Fig. 5 is an isometric view indicating a nonconductive connector employed in the adjustable resistor shown in Fig. 2;

Fig. 6 is a view similar to Fig. 3 of a modified electrical instrument of the invention;

Fig. 7 is a cross sectional view taken at line 7—7 of Fig. 6; and

Fig. 8 is a cross sectional view similar to Figs. 3 and 6 of a second modified electrical instrument of the invention.

The actual problem leading to the invention is best more fully explained with reference to Fig. 1 of the drawings. Here there is shown a non-conductive channel **10** having edge notches **12** which are designed to carry terminal leads **14** projecting from various electrical components **16**. These components are generally of cylindrical shape for a variety of reasons best known to those who purchase them. In order that the complete assembly within the channel **10** can have a neat, compact appearance it is desirable to have all of the components utilized to be of roughly the same configuration and general apperance. Thus, if various conventional irregularly shaped electrical resistors, capacitors, or the like of adjustable nature are to be mounted on the channel **10**, the essential appearance of the complete assembly is destroyed. Further, such mounting presents a very difficult practical problem inasmuch as these conventional units of an adjustable category are generally not designed to have projecting terminal leads aligned with one another so that these terminal leads can be mounted in a channel in such a manner as to support the entire component.

This difficulty is believed to be obviated with the present invention. In Figs. 2 and 3 of the drawings, there is shown an adjustable electrical resistor **18** of the invention which includes: first and second terminal leads **20** and **22** which are aligned with one another so as to project out through openings **24** in end caps **26** in such a manner that these leads are aligned with one another. Preferably the leads **20** and **22** are formed out of a comparatively stiff, yet resilient wire, so that they can serve to support the entire weight of the resistor **18** when it is mounted on a channel such as the channel **10**. Each of the leads **20** and **22** is constructed as indicated in Fig. 4 of the drawings so as to have formed on the end thereof an offset radial section **28** and a curved generally circular end **30**.

In the resistor **18** the terminal leads **20** and **22** are connected together by means of a non-conductive connector **32** formed out of an appropriate resinous material such as, for example, a phenolic composition, nylon, or the like. The construction of this connector is best seen in Fig. 5 of the drawings. Adjacent to both

ends of it there are provided circular grooves 34 and slots 36. These grooves and slots are located in such a manner that the curved ends 30 and the radial sections 28 on the terminal leads 20 and 22 fit within them so that the ends 30 project beyond the outer periphery of the connector. This construction provides a very efficient simple mechanism whereby the terminal leads 20 and 22 are rigidly connected to one another so that the distance between these two leads is fixed. With this construction the curved ends 30 of the terminal leads 20 and 22 extend as to be biased resiliently against an electrically conductive layer 38 and a resistance layer 40.

These two layers are generally cylindrical in shape and are located within a cylindrical non-conductive housing 42 formed of a phenolic composition, nylon, or the like. The end caps 26 may be also formed from such materials. It is considered obvious from Fig. 3 of the drawings that the end caps 26 are directly attached to the end of this housing. Appropriate means such as a conventional adhesive may be employed for this purpose. A small section of the conductive layer 38 overlies part of the resistance layer 40 in the construction shown so that an electrical contact is established between these two layers.

The manner in which resistor 18 operates is considered obvious from the foregoing description of the unit itself. When the terminal lead 20 is connected to an appropriate source of an electrical current, this current flows from this terminal lead through the radial section 28 and the curved end 30 formed on it to the conductive layer 38 and thence to the resistance layer 40 and to the curved end 32 formed on the terminal lead 22, and out through this terminal lead. Obviously the direction of the current flow can, of course, be reversed. The curved ends 30 specified may, if desired, be considered first and second electrical means, since, in the construction shown they serve as resilient contacts engaging the conductive layer 38 and the resistance layer 40.

These two layers are normally considered as a complete electrical element since they are both operatively connected together, and since they are both disposed essentially as a single element about the connector 32. Preferably the conductive layer 38 and the resistance layer 40 are formed in the housing by conventional printed circuit techniques, although obviously cylinders or strips or the like of other materials such as metals besides resistance inks and conductive inks of the type well known to the printed circuit art can be utilized.

In order to adjust the resistor 18, the housing 42 is moved with respect to the connector 32 and the curved ends 30 so that the effective distance between the junction of the conductive layer 38 and the resistance layer 40 and the curved end 30 formed on the terminal lead 22 is varied. If desired, the resistor 18 may be formed without any special means designed to hold the connector 32 in any given position with respect to the housing 42 although this is not preferred inasmuch as vibration or the like will tend to upset the adjustment of this resistor.

In order to remedy this difficulty the end cap 26 adjacent to the terminal lead 20 is preferably provided with resilient spring clips 44. Each of these clips possesses a base 46 directly attached to the end cap by means of an adhesive, rivets, or the like. Each of these clips also possesses a terminal section 48 within which there is located an elongated opening 50. The spring tension of the clips themselves is generally sufficient so as to hold an edge of the wall defining each of the openings 50 against the terminal lead 20. When the clips 44 are compressed slightly by an individual the lead 20 is released in such a manner that the housing 42 may be moved as desired to adjust the effective resistance of the resistor 18.

In Fig. 6 of the drawings, a modified electrical instrument or component of the invention 52 is shown. This instrument is in the form of an adjustable capacitor and includes a housing 54 and end caps 56 and 58 of the same category as the housing 42 and the end caps 26. Within one part of the cylindrical housing 44 there is located a generally cylindrical electrode 60 which may be formed of a cylinder of aluminum or the like, secured to the housing 54 through the use of an adhesive. Within the housing 54 there is located a generally cup-shaped dielectric member 62 having a bottom opening 64 formed therein. Within the dielectric member 62 there is located a generally cup-shaped electrode 66 which is directly secured as by welding, soldering, or the like, to a threaded shaft 68 serving as a terminal with the instrument 52. The electrode 66 may be formed out of any conductive metal such as aluminum while the dielectric member 62 and a plug 70 located within the dielectric member 62 are both formed out of an appropriate non-conductive material having a comparatively high dielectric constant. Suitable materials are various dielectric ceramics such as are well known in the art. It is readily seen through an examination of Fig. 2 that a plug 70 positioned within the member 62 is provided with a flange portion 72 which fits quite closely against this dielectric member 62 beyond the end of the electrode 66 so as to form an effective dielectric "seal" against electrical shorting between the electrode 66 and the electrode 60 and between the electrode 66 and an electrical contact 74. This contact 74 has resilient arms 76 engaging the electrode 60 so as to be in electrical contact with this electrode.

The electrical contact 74 is provided with a central aperture 78 located around a terminal lead 80 which is attached within a short opening 82 in the plug 70 so as to project from the housing 54 out through an opening 84 in the end cap 58. This terminal lead 80 is preferably aligned with the shaft 68 so that both of these members project in opposite directions out of the instrument 52. The contact 74 is secured to terminal lead 80 by means of solder or the like. If the plug 70 is made out of a ceramic dielectric, the terminal lead 80 may be also directly secured to the ceramic by solder. Otherwise, it may be attached to it by various conventional means known to the art.

The shaft 68 projects out through the opening 86 in the other end cap 56 and through a threaded stud 88 secured as by an adhesive to this end cap 56. Preferably, a wire lead 90 is attached to the shaft 68 outside of the housing 54, instead of having the shaft project out from the instrument 52 to an inconvenient length.

The operation of the instrument 52 is essentially obvious. The shaft 68 and the terminal lead 80 serve as aligned terminals. The shaft 68 is directly attached to the electrode 66, which serves as a first electrical means within the instrument 52. The electrical contact 74 serves as a second electrical means, electrically connecting the electrode 60 to the terminal lead 80. When current is supplied to the shaft 68 and the terminal lead 80, these two electrodes act in the conventional manner of any electrodes within a capacitor. The portions of the two electrodes 66 and 68 overlying one another, and, hence the capacity of the instrument 52, may be readily regulated by turning the housing 54 causing this housing to move through the engagement of the shaft 68 and the stud 88. The plug 70 in this construction serves essentially as a non-conductive connector serving to connect the shaft 68 and the terminal lead 80. It is obvious that a certain amount of capacitance will result from the electrical contact 74 being positioned adjacent to the electrode 66 in this unit and that this is a fixed value for the instrument 52.

The instrument 52 may be adjusted as described above by moving the housing so as to move one electrode of a two-electrode capacitor with respect to another electrode. Frequently it is desired to utilize capacitors employing

the so-called "floating" electrode type of construction because of the voltage dividing action obtained with these units. A construction of this category is shown in Fig. 8 of the drawings. Here there is shown a capacitor **92** of the present invention which utilizes a cylindrical housing **94** of the same general category as the housing **42** previously described, and end caps **96** secured to this housing through various means such as adhesive. The end caps are conveniently formed of the same material as the housing **94**. Within the center portion of the cylindrical housing, there is located a cylindrical metal electrode **98** which, if desired, may be termed a "floating" electrode. Within this electrode there is located a dielectric cylinder **100** formed of an appropriate dielectric material such as, for example, known ceramic or resin dielectrics. Within the cylinder **100** there is mounted a connector **102** having a central flange **104** serving to separate two cut-shaped electrodes **106** attached to the ends of connector **102** by conventional means, such as, solder or adhesive.

To these electrodes **106** there are secured projecting shafts **108**, as by means of solder or the like. These shafts project outward in the instrument **52** through openings **110** formed within the caps **96**. Normally, the shafts **108** are threaded so that nuts **112** may be used on both of them in order to secure the housing **94** against movement with respect to the connector **104**. It is possible to relocate the housing **94** as desired through appropriate adjustment of these nuts. Conventional terminal wires **112** are attached to the ends of the shafts **108** by conventional means such as solder.

Those skilled in the art will realize that a wide number of modifications may be made in this invention without departing from the essential nature of it. As an example of such modifications, different types of connector structures can be employed in the instruments **52** and **92** so as to prevent any danger of shorting between the electrodes utilized. Thus, in the instrument **92** the electrodes themselves may be completely placed within a movable cylinder formed out of an appropriate dielectric material. Also with the invention, a wide variety of different types of contact means besides those specifically indicated can be employed. Also the various means utilized to secure the housing in a given position can be interchanged with one another. Any such modifications of this category insofar as they are within the skill of the art and are included within the scope of the appended claims are to be considered as part of the invention.

I claim:

1. A variable resistor comprising a housing having an elongated cavity formed therein, apertured end walls closing the ends of said cavity, a nonconductive connector movable linearly within said cavity, a resistance element and a conductor disposed parallel to the line of travel of said connector, said conductor being electrically connected to one end of said resistance element, a pair of spaced contacts on said connector wiping on said resistance element and said conductor, and a pair of terminals connected to said contacts, respectively, and extending axially therefrom, said terminals passing through and being slidable within said apertures in said end walls.

2. An electrical instrument as defined in claim 1 including: means for locking said housing against undesired movement.

3. An electrical instrument as defined in claim 1, including: spring clips attached to said housing, said spring clips engaging one of said terminals so as to prevent undesired movement of said housing.

4. An adjustable resistor which comprises: a cylindrical non-conductive connector having ends, grooves formed around the outside thereof adjacent to said ends, and slots formed in said ends leading to said grooves; terminal leads formed out of a comparatively stiff resilient wire so as to have offset radial sections and a curved generally circular end, each of said terminal means being carried at one end of said connector with the radial section thereof fitting within one of said slots and the curved generally circular end thereof fitting within one of said grooves; a non-conductive housing having a cylindrical interior positioned around said connector, the interior of said housing being longer than said connector, said terminal means extending through the ends of said housing; a cylindrical resistance layer located upon the interior of said housing; a cylindrical electrically conductive layer located upon the interior of said housing, said electrically conductive layer and said resistance layer being electrically connected to one another within said housing, each of said layers being engaged by one of said curved generally circular ends so as to establish electrical conduction therewith.

5. A variable resistor comprising a housing having an elongated cavity formed therein, a movable member movable linearly within said cavity, a resistance element and a conductor mounted within said cavity parallel to one another, said conductor being electrically connected to one end of said resistance element, and a pair of terminal wires attached at opposite ends of said movable member and extending therefrom parallel to the line of travel of the movable member in opposite directions, said movable member wiping on said resistance element and said conductor, respectively, said contact means being insulated from one another.

6. A variable resistor as defined in claim 5, wherein said resistance element and said conductor are mounted end to end within said cavity, the adjacent ends of said resistance element and said conductor being electrically connected and said contact means are spaced apart axially from one another.

7. A variable resistor as defined in claim 6, wherein said cavity is cylindrical in form, said resistance element and said conductor lining said cylindrical cavity, and said contact means being generally circular in form and disposed within a plane perpendicular to the axis of said cylindrical cavity, said contact means wiping on said resistance element and said conductor around substantially the entire circumference thereof.

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