June 26, 1951 R. L. TRIPLETT 2,558,282

ELECTRICAL INSTRUMENT CONSTRUCTION

Filed Jan. 27, 1949 4 Sheets-Sheet 1

Fig. 1

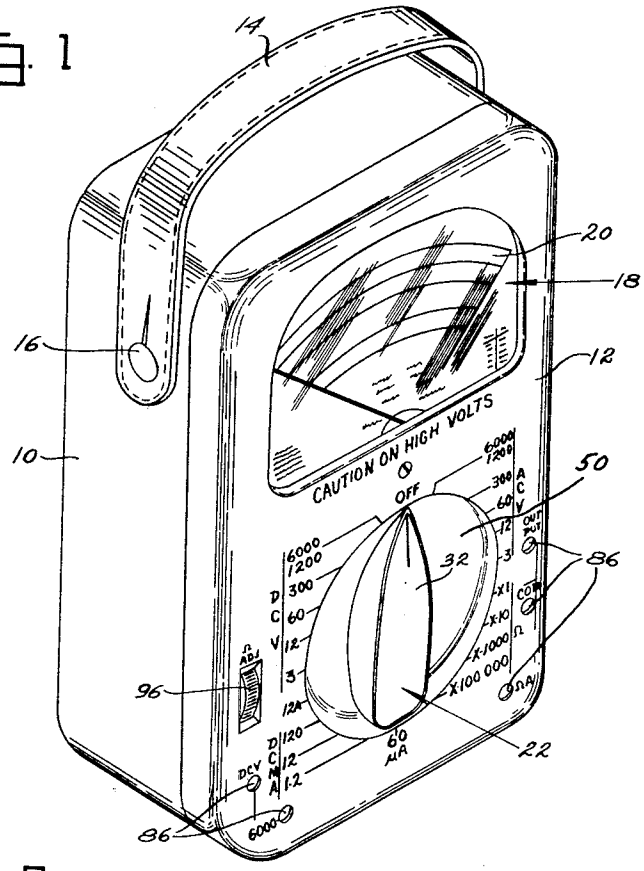
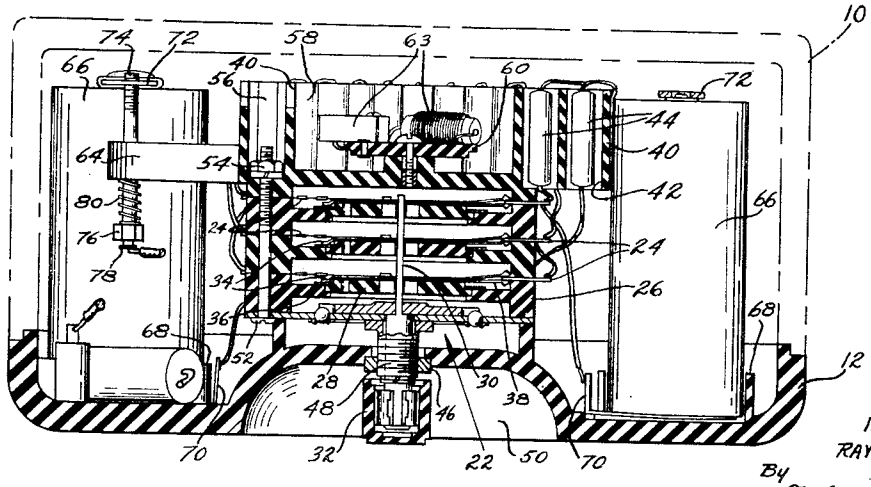


Fig. 3



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ELECTRICAL INSTRUMENT CONSTRUCTION

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Fig. 2

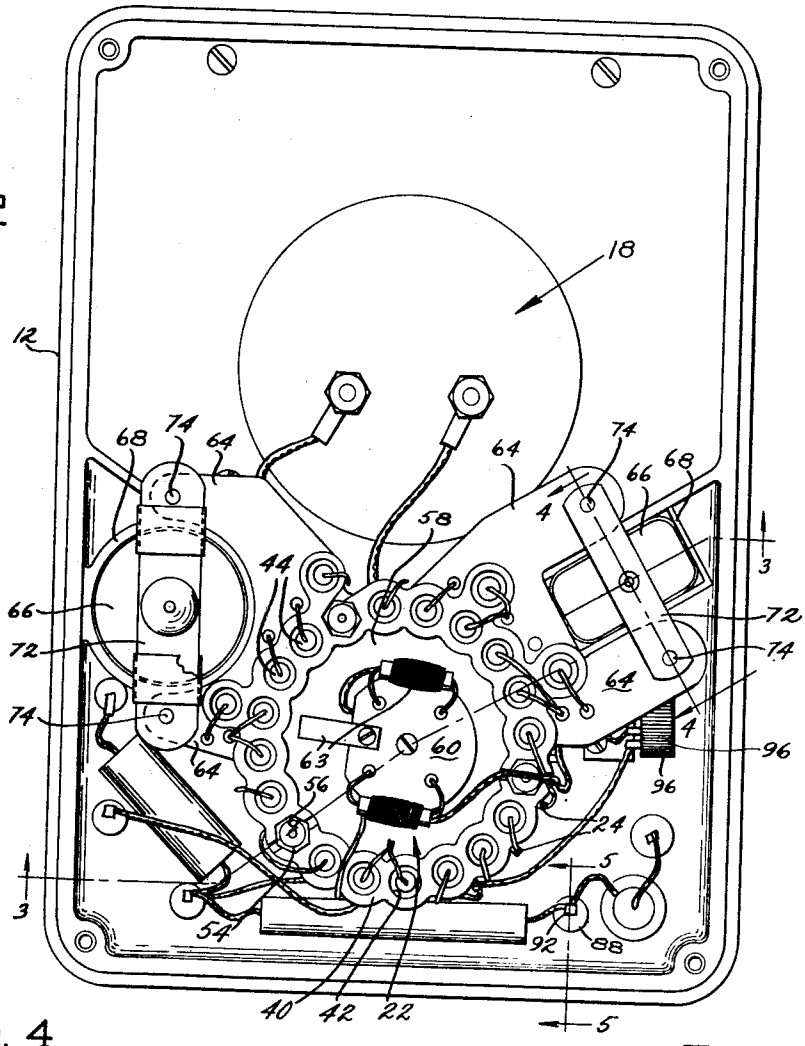
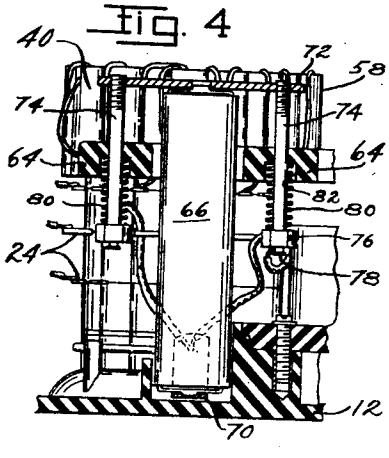


Fig. 4



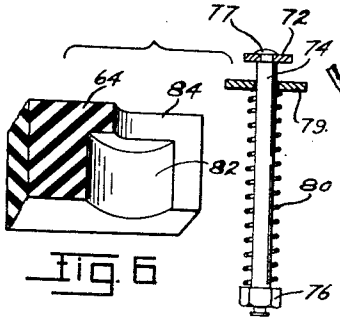
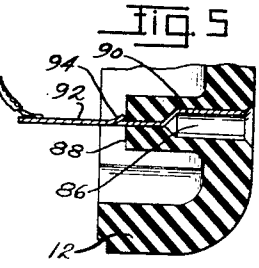


Fig. 6

Fig. 5



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ELECTRICAL INSTRUMENT CONSTRUCTION

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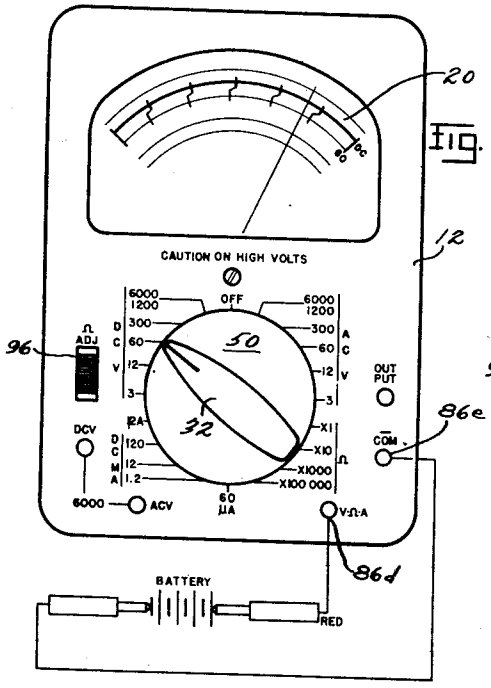

Fig. 7

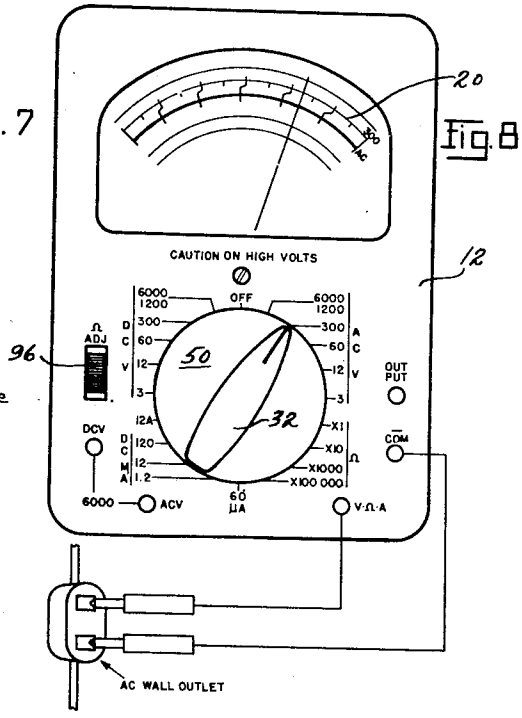

Fig. 8

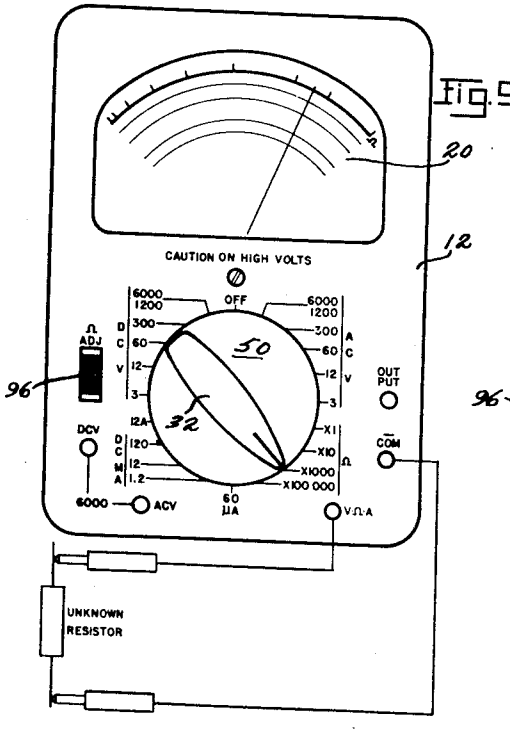

Fig. 9

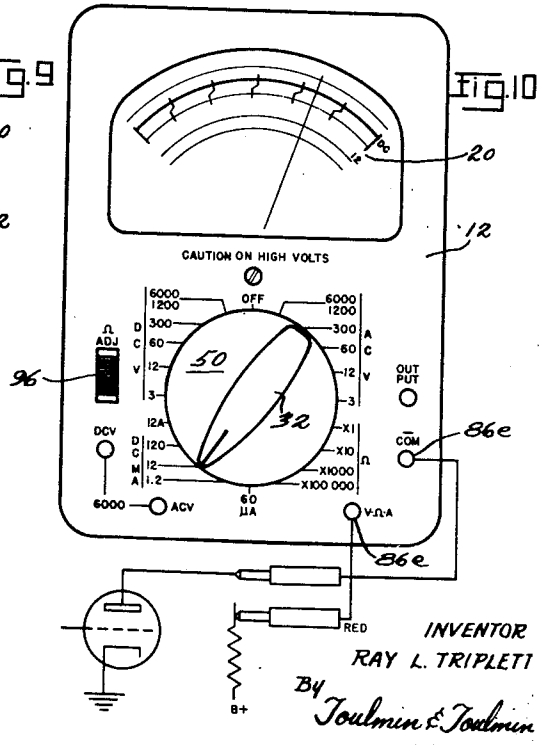

Fig. 10

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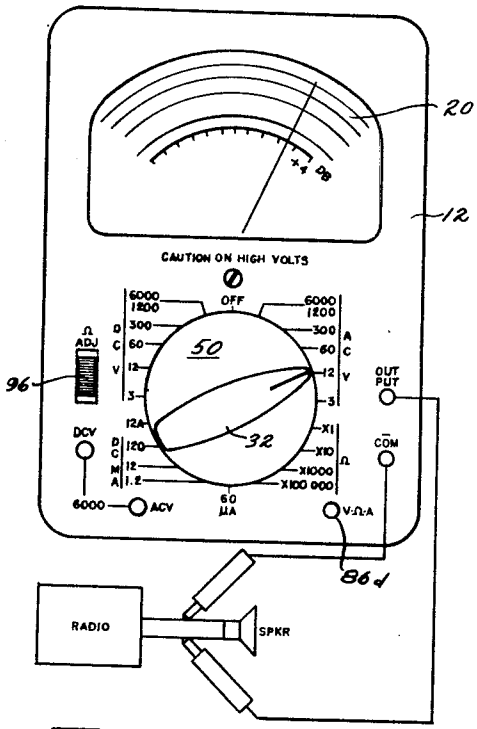

Fig. 11

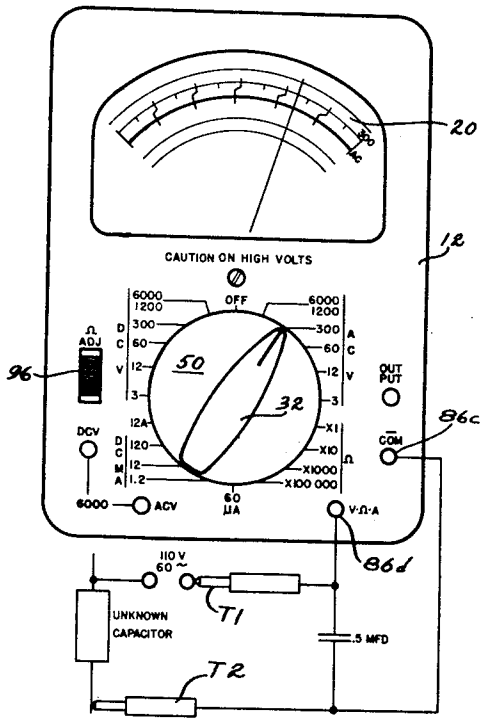

Fig. 12

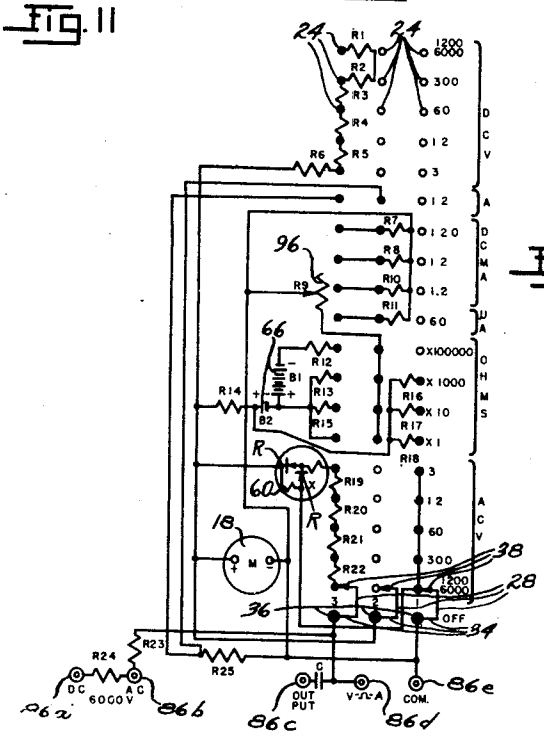

Fig. 13

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2,558,282

UNITED STATES PATENT OFFICE

2,558,282

ELECTRICAL INSTRUMENT CONSTRUCTION

Ray L. Triplett, Bluffton, Ohio, assignor to The Triplett Electrical Instrument Co., Bluffton, Ohio, a corporation of Ohio

Application January 27, 1949, Serial No. 73,171

3 Claims. (Cl. 136—173)

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This invention relates to electrical instruments, especially multipurpose electrical instruments, and is particularly concerned with improvements in the construction thereof which lead to a more economical and compact arrangement of parts.

In the construction of electrical instruments, particularly multi-purpose testing instruments, there are required a plurality of circuit elements including resistors, condensers, and batteries which are integrally associated with the electrical instrument and the connections to which are governed by operation of a suitable selector switch. Instruments of this type include the testing instruments employed by radio mechanics, by electric service men, by laboratory technicians, and by field personnel, in industrial plants and in garages. An instrument of this type is shown in this application, and it comprises a voltmeter, an ohmmeter and an ammeter in combination and is adapted for use on both D. C. and A. C. circuits.

In the instrument illustrated in this application there is a selector switch having nineteen positions in addition to an off position, and in each of the said nineteen positions there is a different arrangement of circuit elements obtained and by means of which the function and the range of operation of the instrument is modified.

Heretofore, in the construction of an instrument of this type, it was customary to support the resistors, condensers and the like within the instrument case by means of stiff lead wires or by placing special mounting brackets within the instrument case for supporting the resistors. The result of an arrangement of this nature was a very complex-appearing device and one which was difficult to assemble and in which there was always a possibility that the various circuit elements might come in contact with each other and thus destroy the usefulness of the instrument. Furthermore, in this type of arrangement and other circuit elements directly in the meter it is almost necessary to assemble the resistors case, and thus there is no opportunity to take advantage of economical sub-assembly processes and have this portion of the device assembled elsewhere and then brought together with the instrument case for final assembly.

Whenever a multi-purpose instrument is to be used as a ohmmeter it is necessary to include a source of electric power with it, and to this end most ohmmeters have batteries mounted within the case. Ordinarily, the mounting of batteries within an instrument case requires special clips and other arrangements to be secured to the

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instrument case for retaining the battery in position and in an accessible place where it can readily be exchanged when it becomes worn out. The provision of such special clips results in additional cost and in additional labor at the time of assembling the instrument. Battery connection is better secured by a double spiral spring action as an integral part of the resistor and component parts section, selector switch combination, thus simplifying all these attachments into a one-piece molded construction. Soldering battery wires direct to battery terminals as done when such provision for connecting is not provided often destroys the battery in the process.

In addition to this, most instrument casings are formed of an electrical insulating material which is easily broken, and the riveting of such clips in the casing often leads to the breaking of the casing.

The present invention has as its primary object the provision of means which will circumvent the foregoing difficulties.

A still further object of this invention is the provision of an arrangement in a multi-purpose electrical instrument for retaining resistors, batteries and similar circuit elements in such a manner that there is little, if any, likelihood that they can come into contact with one another and thus destroy the calibration of the instrument or even result in the destruction of the instrument itself.

It is also an object of this invention to provide an arrangement for a multi-purpose electrical instrument including a plurality of circuit elements such that the manufacture and assembly of the instrument is considerably simplified, thereby resulting in a reduced cost of the instrument.

A still further object is the provision of an arrangement for multi-purpose electrical instrument which results in a more compact construction than has heretofore been possible.

It is also an object of this invention to provide in combination with a selector switch, a member forming a part thereof for retaining resistors and other circuit elements and by means of which the connection of the resistors and other circuit elements with the terminals of the switch can readily be accomplished and in a minimum amount of time, reducing the usual number of soldered connections employed with cabling in previous methods and shortening the length of direct wires from resistors, etc., to the switch terminals.

It is also an object of this invention to provide for an improved arrangement of a selector

switch having resistors and other circuit elements mounted on the switch itself, forming a cover for the switch and retaining switch parts in position when so attached.

These and other objects and advantages of this invention will become more apparent on reference to the following specifications taken in connection with the accompanying drawings in which:

Figure 1 is a perspective view of a typical electrical instrument adapted for being constructed according to this invention.

Figure 2 is a view looking in at the rear of the front panel of the instrument shown in Figure 1 and showing the arrangement of the indicating meter, the selector switch, the circuit elements associated with the instrument and the batteries therefor.

Figure 3 is a section indicated by line 3—3 on Figure 2 and showing more in detail the construction of the selector switch and the resistor mounting means associated therewith.

Figure 4 is a sectional view indicated by the line 4—4 on Figure 2 and showing the arrangement for supporting a battery within the instrument casing.

Figure 5 is a fragmentary sectional view indicated by the line 5—5 on Figure 2 and shows one of the jacks for making electrical connection with the electrical instrument;

Figure 6 is a view showing a modified arrangement for retaining the spring pressed battery clip in the arms which embrace the batteries;

Figures 7 through 12 are diagrammatic views showing the instrument of this invention being used in several of its capacities; and

Figure 13 is a view showing the diagram of one circuit of an instrument of the type of this invention.

Referring to the drawings more in detail, Figure 1 illustrates a multi-purpose electrical instrument which may comprise a casing consisting of a box-like part 10 on which is mounted a front panel part 12, the said front panel part being retained on the part 10 by any suitable means such as screws extending in through the back of the part 10. There is preferably provided a carrying handle 14 which supports the instrument by means of the studs or pins 16 at the ends of the handle.

As mentioned, the instrument is a multi-purpose instrument, and to this end, it may be provided with a plurality of scales for reading either A. C. or D. C. volts, D. C. milliamperes or for measuring ohms. For giving the instrument wide utility, each of the aforementioned classifications is divided into a plurality of ranges. For example, the voltmeter scales may read up to 3 volts, 12 volts, 60 volts, 300 volts and to 6,000 volts respectively for both A. C. and D. C. The current scales of the instrument may provide for ranges of from 0 to 60 microamperes, to 1.2 milliamperes, to 12 milliamperes, to 120 milliamperes, and to 12 amperes.

The instrument may also include an ohmmeter, and for this purpose there is provided a scale for indicating ohms, and the instrument includes means providing for multipliers of 1, 10, 1000 and 100,000 to extend the range of the scale.

To provide for accuracy and ease of reading, there is for each of the aforementioned uses and ranges, a different set of circuit elements in order to give the meter movement substantially full-scale deflection for the maximum reading to be taken within that range. The indicating meter in the instrument shown in the drawings is generally indicated at 18 in Figures 1 and 2, and the dial therefor having the plurality of scales associated with the aforementioned ranges is indicated at 20 in Figure 1.

The switch mechanism for switching from one set of circuit elements to another is indicated at 22 in Figures 1, 2 and 3 and comprises a construction which is more fully illustrated and described in the co-pending applications Serial No. 5,217 filed January 30, 1948, and Serial No. 57,553 filed October 30, 1948, now U. S. Patent 2,511,349 in the name of George H. Clay, and assigned to the same assignee as the instant application.

In general, this switch comprises a plurality of banks of terminals or contact members as indicated by the reference numeral 24 in Figure 3, and these terminals or contact members are retained between the substantially cylindrical blocks of electrical insulating material 26. Within the blocks 26 there are the rotors 28 and these are adapted for rotation by means of the blade 30 of the indexing mechanism which includes the handle 32. The rotors 28 have contact fingers 34 that ride on the contact rings 36 and are thus always in contact with the said rings. The rotors also include the contact fingers 38 which move from one to the other of the associated terminals 24 as the switch is indexed from position to position. It will be apparent that the switch mechanism provides for the selective connection of the contact rings 36 with a plurality of the terminals 24. The terminals 24, in turn, are connected externally of the switch mechanism with the aforementioned circuit elements comprising resistors, condensers and batteries.

According to this invention, the end of the switch mechanism lying within the instrument case is closed by a specially formed member 40 which is constructed of insulating material and which includes a plurality of circumferentially spaced axial bores or sockets 42. These bores are open at both ends, and it will be noted that the ends of the bores adjacent the switch mechanism proper are located substantially at the periphery of the said switch mechanism so that it is but a short distance to the terminals of the said switch. This arrangement permits tubular resistors as at 44 to be mounted in the bores of the member 40 and to have electrical connection made thereto to their opposite ends through the open ends of the said bores. Each bore thus provides an individual compartment for one of the resistors. Since the material of the member 40 is electrical insulating material, it will be apparent that the resistors are well isolated from each other and that there is no possibility that they can come into electrical contact or physical engagement by jarring or dropping of the instrument in use. It will also be apparent that in constructing the electrical instrument, the switch and resistors therefor can be assembled separately from the instrument proper and later brought together with the front panel 12 of the instrument casing in a final assembly operation.

It is to be noted that the switch mechanism is retained in position on the front panel member 12 by means of a nut 46 which threads on the sleeve 48 extending outwardly from the panel side of the switch and through the adjacent wall of the panel. Preferably, the front panel is recessed as indicated at 50 for receiving the knob 32 of the

switch so that the front of the instrument is substantially flush.

It will be noted in Figures 2 and 3 that the member **40** is retained in assembled position with the other parts of the switch of which it forms a part by means of the through bolts **52** which have thereon the nuts **54** that are received in the pockets **56** formed in the member **40** and of such a shape that they will prevent the nuts from turning when the bolts are threaded thereon.

The member **40** may be recessed at its rear side as at **58** if desired, and there can be mounted therein a member **60** which in turn supports the circuit elements **63** such as resistors, condensers or rectifiers and which can readily be connected with other circuit elements carried by the member **40** or with terminals of the switch mechanism as required by the instrument being constructed.

As mentioned before, when the instrument is to be used as an ohmmeter, it is necessary to supply one or more batteries within the instrument casing. To this end, the member **40** includes the arms **64** extending outwardly therefrom and aranged in pairs, each pair having spaced fingers adapted for embracing one of the batteries **66**. The arms **64** embrace the batteries partway down the sides thereof as will best be seen in Figures 3 and 4 and are arranged directly over pockets **68** formed in the rear side of the front panel member **12** and of a size and shape to receive the lower end of the battery between the corresponding arms **64**. For making connection with the lower end of the battery there is a strap or bar as at **70** extending across the bottom wall of the pocket **68**. The upper end of the battery is adapted for being contacted by a terminal plate **72** and this plate extends over the arms **64** as will be seen in Figures 2 and 4. Each end of the terminal plate **72** has threaded therein a stud or elongated rod **74** and each of these studs extends downwardly through a shouldered bore in the arms **64** therebeneath. The lower end of each stud **74** has a head **76** formed thereon and a projection **78** to which a wire can be soldered if desired. A spring **80** surrounds each stud **74** and bears between the head **76** of the stud and the bottom of the counterbored part **82** of the bores in the arms **64**. These springs urge the studs and the terminal plate **72** downwardly and into firm physical and electrical contact with the upper terminal of the battery, thereby providing at one time good electrical connection and physical support for the said battery. As shown in Figure 4, the studs **74** are threaded into the ends of the plate **72**, but the arrangement shown in Figure 6 may be utilized if so desired.

In this construction the ends of the arms **64** are slotted as at **84** and the studs **74** are riveted to the terminal plate **72** as at **77** thus making a permanent and inexpensive assembly. A washer **79** of a size to be received within the enlarged part **82** of the bore is mounted between the terminal plate **72** and the upper end of the spring **80**. The washer **79** can be moved toward the head end of the stud **74** and this will permit the said stud to be slipped into the slot. Thereafter, releasing of the washer **79** will permit the spring **80** to push it into the enlarged part **82** of the aperture through the arm and this will retain the terminal plate, studs and springs in assembled position with the said arms until it is desired to remove them.

It will be seen in Figure 1 that there are a plurality of apertures **86** opening from the front side of the panel **12**, and these apertures are jack openings for receiving the jack ends of leads which are to be connected with the circuit to be measured. The construction of these jack terminals will be seen in Figure 5 where it will be noted that there is a boss **88** standing up from the back side of the front panel **12** in alignment with the said aperture **86**, and that the connection to the jack is accomplished by means of a metallic sleeve **90** having the part within the aperture **86** formed to a cylindrical shape and with its other part in the form of a flat blade **92** which is received in a flat slot in the boss **88**. There may be provided an upturned tab **94** which retains the metallic member in position after it has been inserted if so desired.

It will be apparent that this invention provides for a very ready means of constructing electrical instruments employing a multiplicity of circuit elements and permits taking full advantage of sub-assembly processes. For example, in the instrument illustrated in the drawings, the entire switch mechanism together with the resistors mounted in the member **40** and the battery holding terminals plates can be preassembled and thereafter brought together with the front panel. At that time it is only necessary to effect connections with the instrument with the indicating meter **18** and with some of the jack openings in the front panel of the instrument in order to complete the assembly. The adjusting resistor indicated at **96** and the function of which is to adjust the zero position when the instrument is used as an ohmmeter, can either be assembled with the switch before it is placed in the front panel or assembled in the front panel and thereafter connected with the switch. In any event, the construction and assembly of the instrument can take place with much less trouble and much less time than by prior art practices.

Circuit diagram of Figure 13

The diagram shown in Figure 13 is typical of those associated with multi-purpose instruments of this type. The elements of the circuit which are numbered in Figures 1 through 6 carry corresponding numbers in Figure 13, and, additionally, there are certain explanatory legends appended. It will be noted that in Figure 13, there are resistors numbered from R1 through R25 and these are the resistors which are shown in the other figures of the drawings and indicated by the reference numeral **44**. The diagram also shows the location of the batteries **66**, the indicating instrument **18** and the member **60** which supports the two rectifiers marked R and a pair of resistors.

Also indicated in the diagram is the location of the jacks **86** which are indicated in Figure 13 by reference numerals **86***a*, **86***b*, **86***c*, **86***d* and **86***e*. The contact fingers **24** of the several switch banks are indicated in Figure 13, and the active ones for any switch position are indicated by black dots, while the inactive ones are indicated by circles. At the bottom of Figure 13 in alignment with the position marked "Off" the black dots and surrounding circles represent the annular contact members **36** of the several switch tiers. Contacting these members are the contact fingers **34** of the rotors **28**, the rotors being indicated by the short vertical lines extending upwardly from the contact fingers. At the up-

per ends of the lines indicating the rotors are the contact fingers 38 which index along the banks of contact elements 26.

The circuit shown is substantially conventional, and it need only be pointed out that the negative terminal of the indicating instrument 18 is directly connected with the jack 86e which is known as the "common" jack. The negative terminal of the indicating instrument is also connected through the zero adjusting resistor 96 or R9 with a bank of interconnected terminals which lie in the portion of the selector switch which is utilized when resistances are being measured.

The negative side of the instrument is also connected with the ends of a plurality of resistors R7 to R11 which are also connected with the terminals in the portion of the snap switch which is used when D. C. microamperes and milliamperes are to be measured.

The negative terminal of the instrument is also connected through the resistor R25 with two contacts of the selector switch which are effective when the selector switch is set to measure D. C. amperes.

The positive side of the instrument 18 is connected with the annular contact member 36 of the intermediate bank of the selector switch, with opposite sides of the two rectifiers R carried by the member 60, with one end of the resistor R14 which has its other end connected with the positive terminal of one of the batteries 66 and with the end of a group of serially connected resistors R1 through R6 which are connected with terminals in that portion of the snap switch which is utilized when D. C. volts are being measured.

The battery end of resistor R14 is connected with the terminals of resistors R16, R17 and R18 which are connected with terminals in the portion of the selector switch used when ohms are being measured, and the negative side of the one battery 66 is also connected with another group of resistors in the same portion of the selector switch but in a different bank thereof.

To provide for the multiplying factor of 100,000 in the ohms range of the selector switch there is an additional battery 66 or B1 which is connected through a resistor R12 with one terminal of one of the banks of the selector switch within that range.

The other side of the rectifiers R are connected with the serially arranged resistors R19, R20, R21 and R22 which are connected between the terminals of the selector switch which are active when A. C. volts are being measured.

The use of the instrument of this invention is illustrated in Figures 7 through 12. Each of these figures shows a different application of the instrument of this invention, and these applications of the instrument are described as follows:

Measuring D. C. volts

To measure direct current volts the selector switch is rotated to the appropriate range for the D. C. volts to be measured as indicated in Figure 7 wherein the selector switch is indexed to the 60 volt range.

The voltage to be measured, which in this case is shown as a battery, is then connected with its negative terminal in the common jack and its positive terminal in the jack marked 86d. In order to read the value of the voltage to be measured reference is made to the pointer of the instrument and the proper scale associated therewith.

Measuring A. C. volts

In measuring A. C. volts, as indicated in Figure 8, the selector switch is rotated to the proper A. C. volts range. The voltage to be measured is then connected with the jacks 86e and 86d. With A. C. volts there is no question of polarity, so it is not necessary to connect the load between the jacks 86e and 86d in any particular manner. In either case as shown in Figure 7 or Figure 8, if the value of the voltage being measured falls on the lower or left end of the scale the snap switch may be indexed to the next lower range and the reading brought up toward the upper end of the scale.

Measuring D. C. resistance

Figure 9 shows the manner of measuring a resistance. In this figure the index switch is rotated until it is in the ohms range and the unknown resistor is then connected between the common jack 86e and the jack marked 86d. In taking a resistance reading, it is preferable that the test probes or test leads be first connected together, and at this time the pointer of the instrument should move to the extreme right end of the ohms scale on the dial. The exact position of the pointer can be adjusted by a variable resistor indicated at 96. If the resistor to be measured is already connected in circuit, it should be disconnected from at least one end before the instrument is connected with its terminals.

Measuring D. C. currents

Figure 10 illustrates the manner of measuring direct current by the instrument of this invention and shows that the selector switch has been indexed until it points to the D. C. ampere range. The positive side of the circuit to be measured is connected with the jack 86d while the negative side is connected with the common jack or the jack 86e. The current which is flowing in the circuit to be measured then passes through the instrument and through proper shunting resistors so that the pointer of the instrument gives substantially full-scale deflection for the maximum current indicated by the pointer, in the illustration shown in Figure 10, 12 milliamperes.

Measuring output volts or decibels

In Figure 11, it is illustrated how output volts or decibels, as, for example, in connection with a radio speaker or the like, can be measured. Output is generally measured in units called decibels, and this term indicates the voltage developed across a 500 ohm load when .006 watt is dissipated. This voltage is 1.73 volts and is taken as the zero point on the decibel scale.

In order to measure decibels, the selector switch is indexed to the appropriate A. C. voltage range. The circuit to be measured is then connected between the common jack 86e and either the jack 86d or the jack 86c, the latter being employed when there is a D. C. component in the voltage to be measured, and which is blocked out by the condenser C. Where there is no D. C. component in the output voltage it may be measured between the jacks 86e and 86d.

Measuring capacity

Figure 12 shows the instrument being employed for measuring an unknown capacitor. To accomplish this the selector switch is rotated to

the appropriate A. C. voltage range and the unknown capacitor is connected between the test probes T1 and T2 and in series with a source of alternating current of predetermined voltage. The test probes are connected together by means of a one-half microfarad condenser as indicated in Figure 12 and the terminals of this condenser are connected between the jacks 86*e* and 86*d*. The capacity in microfarads is measured on the A. C. voltage range and a suitable multiplying factor is employed to change the voltage reading into microfarads.

It will be understood that the foregoing examples of the use to which this instrument can be put are only exemplary of its many dozens of uses and are not intended to indicate any restriction in its scope of utility.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. In an electrical measuring instrument having a case, and a supporting unit in said case having a plurality of sockets adapted to receive electrical resistor means, the improvement which comprises an arm extending from said unit adapted to embrace a battery in said case, a pocket in a wall of the case for receiving and supporting one end of said battery and a conductor extending into said pocket engageable with a terminal of said battery, a terminal plate engageable with the other terminal of said battery, elongated means extending from said plate through said arm, and resilient means between said arm and the end of said elongated means opposite the connection of said elongated means with said plate for urging said plate against said other terminal, said plate, resilient means and elongated means being removable from said arm as a unit.

2. In an electrical measuring instrument having a case, an insulated supporting unit and battery in said case, said unit having an arm extending therefrom for supporting said battery, said arm having at one end thereof spaced fingers for embracing said battery therebetween, a pocket

in a wall of the case for receiving and supporting one end of said battery and a conductor extending into said pocket engageable with a terminal of the battery therein, a terminal plate engageable with the other terminal of said battery, rods extending from the ends of said plate through said fingers, and resilient means between said fingers and the ends of said rods opposite their connection with said plate for urging said plate against said other terminal of said battery, said plate, rods and resilient means being removable from said fingers as a unit.

3. In an electrical measuring instrument having a case, an insulated supporting unit and battery in said case, said unit having an arm extending therefrom, means including said arm for supporting said battery, said arm having at one end thereof spaced fingers for embracing said battery therebetween, a pocket in a wall of the case for receiving and supporting one end of said battery and a conductor extending into said pocket engageable with a terminal of the battery therein, a terminal plate engageable with the other terminal of said battery, rods extending from the ends of said plate through said fingers, and spring means between said fingers and the ends of said rods opposite their connection with said plate for urging said plate against said other terminal of said battery, said plate, rods and spring means being removable from said fingers as a unit, said fingers having slots therein to permit the assembly therewith and removal therefrom of said plate, rods and spring means as a unit.

RAY L. TRIPLETT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,593,024	Macadie	July 20, 1926
2,157,973	Wenger	May 9, 1939
2,439,408	Mitchell	Apr. 13, 1948
2,509,415	Bernreuter	May 30, 1950

FOREIGN PATENTS

Number	Country	Date
144,122	Switzerland	Dec. 15, 1930