June 20, 1933. K. M. LEDERER ET AL 1,915,232

MULTIRANGE VOLTMETER AMMETER

Filed Oct. 30, 1930 2 Sheets-Sheet 1

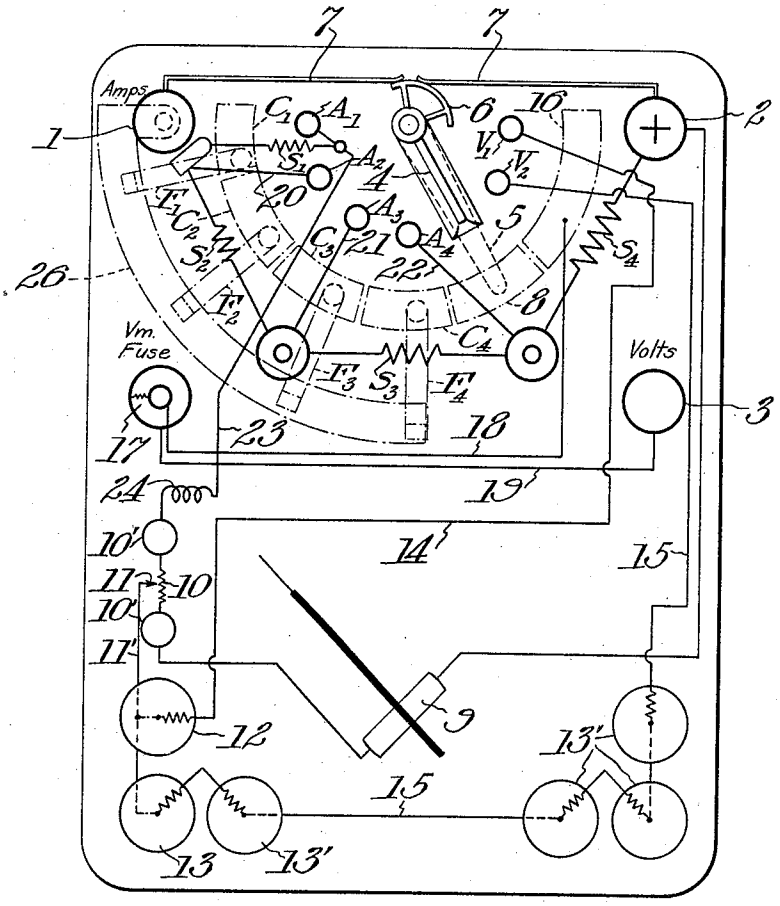

Fig. 1.

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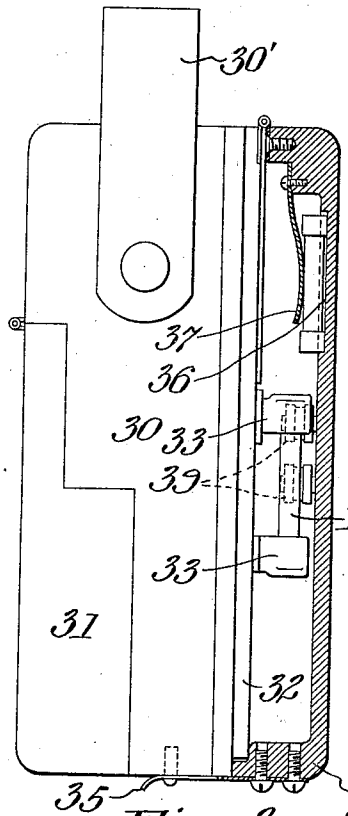

Fig. 2.

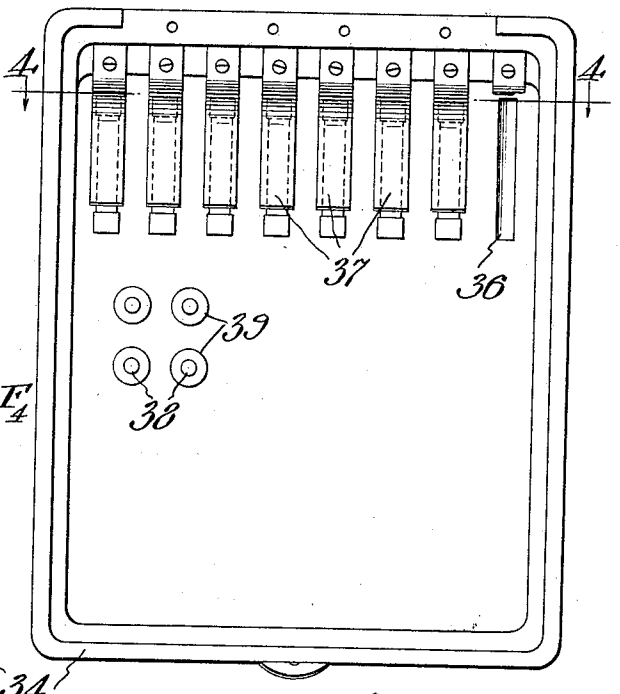

Fig. 3.

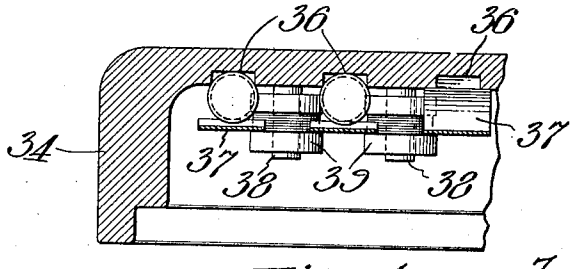

Fig. 4.

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UNITED STATES PATENT OFFICE

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MULTIRANGE VOLTMETER-AMMETER

Application filed October 30, 1930. Serial No. 492,315.

This invention relates to ammeters, and more particularly to a multi-range combination ammeter and voltmeter provided with fuses for each current range and with a convenient arrangement providing for spare fuses.

At present, it is common to have fuses in multi-range voltmeters. In this case no difficulty arises, due to the fact that the current is reduced to an appropriate value by series resistances, so that a single fuse may be used for all ranges. However, in multi-range ammeters, due to the wide variations in the current traversing the instrument, it is impossible to employ a single fuse for all ranges and, up to the present time, multiple range ammeters have not been protected by fuses. As a result, such an unprotected ammeter is likely to be burned out, if for instance, the low range is inadvertently connected for use when a heavy flow of current is to be measured.

An object of this invention is to provide a multiple range ammeter with an independent fuse for each range. Another object is to provide a combination ammeter and voltmeter which includes a resistance in the ammeter circuit, and a tapped conection to that resistance from the voltmeter circuit, whereby the voltmeter sensitivity may be adjusted without affecting the sensitivity of the ammeter. These and other objects will be apparent from the accompanying specification when taken with the drawings, in which:

Fig. 1 is a somewhat diagrammatic view of a combination voltmeter and ammeter, showing the circuit connections and the relative arrangements of the parts.

Fig. 2 is a side elevation of the assembled combination ammeter and voltmeter, with a portion of the rear cover cut away,

Fig. 3 is an inside view of the rear cover showing the spare ammeter fuses in position, and

Fig. 4 is a fragmentary cross-section on line 4—4 of Fig. 3.

The diagrammatic view, Fig. 1, illustrates the relative arrangement of the various circuit elements employed in one embodiment of the invention. The wiring is shown in solid lines, as viewed from the interior of the instrument casing, and those circuit elements which lie below the base panel of the instrument, i. e., the arcuate switch contacts and the ammeter fuses, are shown in broken line.

The instrument is provided with three terminals, 1, 2 and 3, respectively for connecting the same in the circuit under investigation, and adjacent the respective terminals, the legends "Amps", "+" and "Volts" may be applied to indicate to the user the particular circuit connections which should be established. One side of the line is opened and the instrument is bridged across the gap thus formed by connections established to the terminals 1 and 2. The legends "Amps" and "+" adjacent these terminals indicate that the instrument will measure the flow of current through the line. Terminal 3 is then connected to the opposite side of the line.

The instrument as shown in Fig. 1 is adapted, by appropriate manipulation of the switch handle 4, to indicate voltages of two ranges and currents of four ranges.

The switch includes a contact arm 5 and a shunting contact 6 which engages the contacts 7, 7 to complete the series circuit between terminals 1 and 2 when voltages are to be indicated or when, as shown in Fig. 1, the contact arm 5 rests upon the "dead" contact 8.

The moving coil 9 is connected between the instrument terminal 2 and a slide wire resistance 10, the latter being secured to two studs 10′ and having an adjustable slider, indicated at 11, from which lead 11′ extends to one terminal of each of the resistance spools 12, 13. The other terminal of the resistance spool 12 is connected through a lead 14 to the low voltage range contact point V_1 of the switch system. Additional resistance spools 13′ are serially connected between the spool 13 and the high voltage range contact point V_2 by a lead 15. When the switch contact arm 5 is moved into engagement with either of these contact points, the arm 5 bridges across from that contact to the arcuate bar or contact 16 that is connected

through the voltmeter fuse 17 to the terminal 3 by leads 18, 19, respectively. The voltmeter fuse and its mounting are preferably of the type described in the patent to Carpenter, No. 1,699,046, but other forms of miniature fuses may be employed. The resistance 10 and sliding contact 11 provide a convenient means for adjusting the sensitivity in the voltmeter circuit.

When employed for measuring current flow, the switch handle 4 is turned clockwise from the position shown in Fig. 1, to open the shunt circuit established by the contacts 6 and 7, thereby diverting the current through the instrument.

A series of contact points A_1 to A_4 are positioned for engagement by the contact arm 4, and a corresponding series of arcuate contacts, C_1 to C_4, are in radial alinement with the respective contact points. The shunt resistances S_1 to S_4 are serially connected between the low current range contact point A_1 and the terminal 2; the junction of the resistances S_1 and S_2 being connected to contact point A_2 by a lead 20, and the succeeding junctions being connected to the point A_3 and A_4 by leads 21 and 22, respectively. The contact point A_1 is connected through lead 23, series resistance 24 and series resistance 10 to the moving coil 9.

In accordance with the invention, the several contact bars C_1, C_2 etc. are individually connected, by fuses F_1 to F_4, respectively, to the bus bar 26 which contacts with the terminal 1 of the instrument.

When the switch contact arm 4 is moved from the dead contact 8 to bridge the gap between contact point A_4 and contact C_4, the current flow from terminal 1 may be traced through the bus bar 26 and fuse F_4 to contact C_4, contact arm 5 to contact point A_4. The current then divides, a part passing directly to the terminal 2 through the relatively low resistance shunt S_4 while the remainder of the current passes, in series, through the progressively higher resistance shunts, S_3, S_2 and S_1 to the contact point A_1, and then through the moving coil 9 to the terminal 2. If the curent flow is of such small magnitude that a lower range is appropriate, the switch contact 5 is moved into engagement with one of the other contact points. When resting on the end contact point A_1, all of the resistance shunts are in parallel with the instrument coil, and when on point A_2 or A_3 a portion of the total resistance shunt is in parallel with the series circuit which includes the remaining resistance shunts and the moving coil 9. For any position of the contact arm 5 a current fuse of appropriate value is in series with the ammeter.

It will be apparent that any practical form of a fused multi-range ammeter should provide for the ready replacement of the fuses. A convenient assembly is illustrated in Figs. 2, 3 and 4. The instrument includes a main casing 30 which may be provided with a carrying strap 30'. The hinged front 31 of the case may be turned back to expose the terminals, the switch handle and the instrument scale. The switch contact points and arcuate contact bars are all mounted on the inner face of the rear panel or wall 32 of the casing and the current fuses F_1, F_2 etc. are mounted on the outer wall of the panel 32. The fuses are of the conventional cylindrical type and their ends are mounted in clips 33 that are connected, through the rear panel 32, to the bus bar 26 and their respective contact bars.

The casing 30 has a rear cover 34 which may be hinged at one end of the casing and provided with a spring clip 35 for normally retaining it in closed position. The rear cover is provided with a series of shallow depressions 36 in which spare current fuses may be held by the spring fingers 37. The rear cover is also provided with a series of expansible or spring pins 38 on which spare voltmeter fuses 39 of the type described in the Carpenter Patent No. 1,699,046 may be carried.

While one particular embodiment of the invention has been described, it will be apparent that other specific arrangements may be employed and that, so far as concerns the provision of fuses for each range of a multi-range ammeter is concerned, it is immaterial whether or not provision is made for measuring voltages.

We claim:

1. In a multi-range ammeter, the combination with a moving coil system, a plurality of pairs of switch contacts, a contact arm for bridging between the contacts of each pair, and a plurality of resistive shunts connected between one instrument terminal and one contact of each of said pairs, of fuses connected between the other instrument terminal and the other contact of each of said pairs.

2. In a multi-range ammeter, the combination of a pair of terminals, a set of contacts arranged along the arc of a circle, a resistance between one terminal and one end contact, resistances between each pair of adjacent contacts, a moving coil system connected between the other end contact and said first terminal, a second set of contacts arranged along the arc of a circle, the contacts of said sets being arranged in pairs in radial alinement, a contact arm adjustable to bridge the two contacts of any desired pair, and fuses of different capacity connected between the second terminal and the respective contacts of said second set.

3. In a volt-ammeter, a moving coil and pointer assembly, an instrument terminal connected to one side of said moving coil, a resistance connected to the opposite side of said moving coil, a contact adjustable

along said resistance, an ammeter terminal, a voltmeter terminal, and switch means operable when appropriate connections are simultaneously made to each of said three terminals for completing a current measuring circuit from said ammeter terminal to said first terminal through all of said resistance in series with said moving coil or alternatively for completing a voltage measuring circuit from said voltage terminal to said first terminal through said contact, a portion of said resistance, and said moving coil.

4. In a volt-ammeter, the combination with a moving coil system, a common terminal, a direct connection from said common terminal to one side of said moving coil system, an ammeter terminal, and means including a resistance in series with said moving coil system for completing a current measuring circuit betwen said terminals, said resistance having an adjustable contact thereon; of a voltmeter terminal, and a voltage measuring circuit between said voltmeter terminal and said common terminal; said voltage measuring circuit consisting of fixed resistance between said voltmeter terminal and the adjustable contact on said first resistance, the portion of said resistance between said contact and said moving coil system, the said moving coil system, and said direct connection, whereby said contact may be adjusted to vary the sensitivity of the voltmeter without altering the sensitivity of the ammeter.

5. In a multi-range volt-ammeter, the combination with a moving coil system in a closed series circuit including a plurality of fixed resistances and an additional resistance having an adjustable contact thereon, a common terminal at the junction of said moving coil system and one of said fixed resistances, said additional resistance being connected between the moving coil system and the said plurality of fixed resistances, an ammeter terminal, and adjustable means for connecting the ammeter terminal to the desired one of a plurality of points along said fixed resistances, thereby to vary the current-measuring range of said moving coil system; of a voltage terminal, a plurality of series resistances, a connection from an intermediate junction of said series resistances to the contact on said additional resistance, and switch means for alternatively completing a circuit from said voltmeter terminal to said intermediate junction through the section of said series resistances arranged at one or the other side of said intermediate junction.

In testimony whereof, we affix our signatures.

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