

Aug. 1, 1944.

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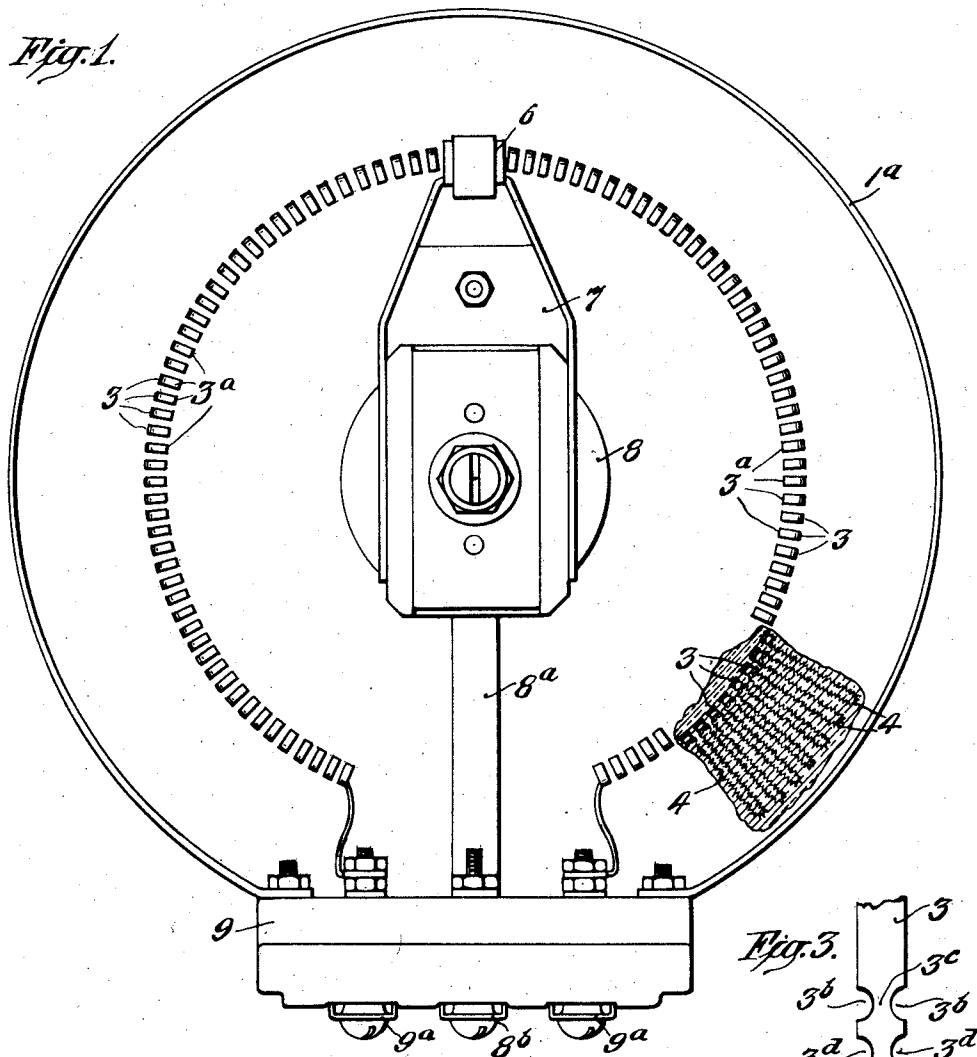
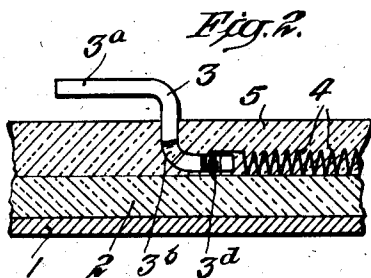
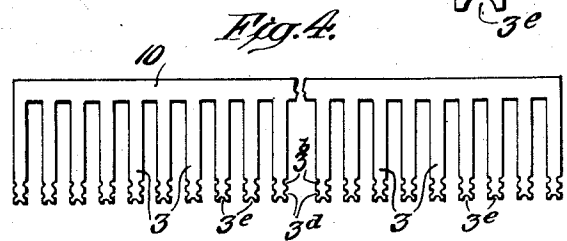
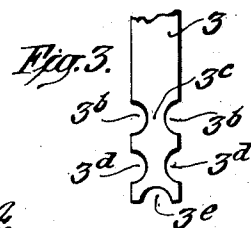
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RHEOSTAT

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2 Sheets-Sheet 1

Fig. 1.



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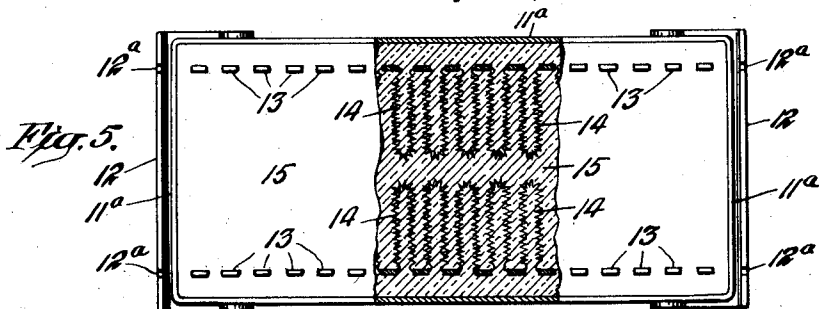
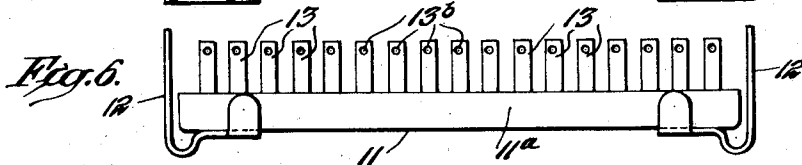
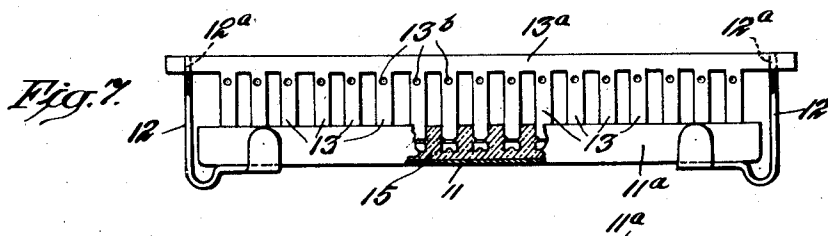
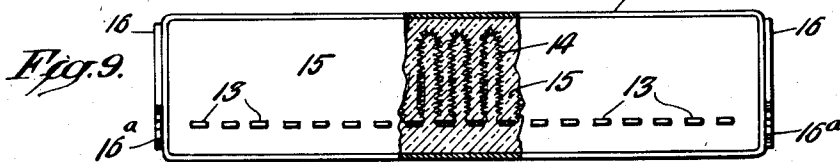
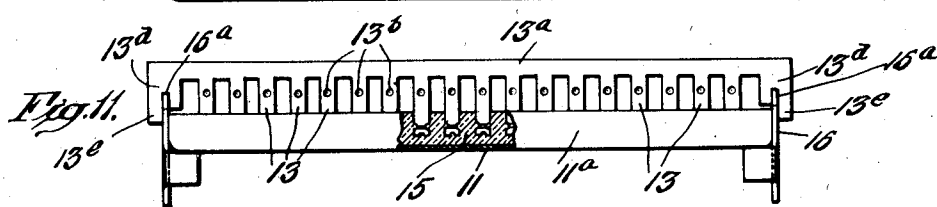
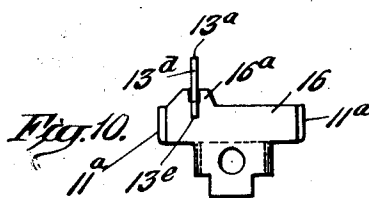
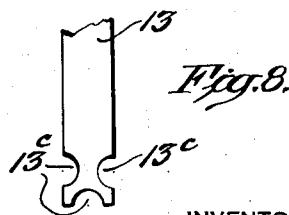
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2 Sheets-Sheet 2



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RHEOSTAT

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7 Claims. (Cl. 201—53)

This invention relates to improvements in rheostats and in the method of making them. It is applicable to rheostats wherein the resistive conductors and their connections to contacts of the rheostat are embedded in insulating material, such as plate rheostats having a movable contact arm which successively engages the exposed portions of the contacts and to rheostats wherein the terminals of the embedded resistive conductors are connected by leads to other contacts of the controlling apparatus.

The main objects of the invention are to reduce the cost of making, simplify the assembly of parts, reduce the cost of material required and to insure the proper fixed position of the contacts and of the resistive conductors. By this improvement the contacts may be stamped out of sheet metal such as copper and made of any desired shape and thickness which eliminates the cost of turning and forming the usual contact buttons and greatly reduces the amount of material required for the contacts. Likewise, it enables the contacts to be made of rectangular form which reduces the amount of space occupied by them, permitting more contacts to be assembled within a given space and thereby reducing the size of the rheostat, giving additional economy in cost in that respect. It likewise permits the bending of the contacts to any desired form according to particular requirements and also by determining the length of the contacts any desired amount of contact surfaces may be obtained for engagement by the movable contact.

An important feature of the invention is in the method of making whereby the contacts of the rheostat are formed and grouped as a unitary structure and positioned in the making of the rheostat as a unit. In this manner the proper positioning and spacing of the contacts is insured and the contacts are maintained in a fixed position during the process of manufacture which avoids the displacement or the so-called swimming of the individual contacts during the firing or maturing of the embedding insulating material. The common support or portion of the unitary contact structure of the contacts is removed after the contacts have assumed their fixed position in the matured insulating material and the individual contacts are then bent to the desired shape for forming the contact surfaces or utilized in a desired manner according to the required form of the apparatus. Another advantage is the adaptability of the unitary contact structure during the process of man-

ufacture to any desired shape, such as the circular arrangement of the contacts, placing them in a straight row, or forming them in rectangular, zig-zag, parallel or any other desired form. Other advantages and objects of the invention will be understood from the following description and accompanying drawings which illustrate various embodiments of the invention.

Fig. 1 is a plan view of a plate rheostat of circular form, partly in section, for showing the resistive conductors and their connections to the contacts; Fig. 2 is an enlarged sectional side view of one of the contacts; Fig. 3 is an enlarged face view of the inner end of one of the contacts before bending or connecting of the resistive conductor thereto; Fig. 4 is a face view of the unitary contact structure as stamped from sheet metal, showing the contacts and their common support during the process of manufacture; Fig. 5 is a plan view, partly in section, of a form of resistive device with the contacts arranged in parallel rows; Fig. 6 is a side view of the structure shown in Fig. 5; Fig. 7 is a side view of the structure of Fig. 5 showing an intermediate stage in the process of manufacture and showing the common support of the contacts and the support of the unitary contact unit; Fig. 8 is an enlarged face view of the inner end of one of the contacts of the structure of Fig. 5 before the connection of the resistive conductor thereto; Fig. 9 is a plan view, partly in section, of another form of resistance device having a single row of fixed contacts; Fig. 10 is an end view thereof looking from the right; and Fig. 11 is a side view of the structure of Fig. 7, partly in section, showing an intermediate stage during the process of manufacture.

Referring to Figs. 1 to 4, the rheostat is shown as mounted upon a circular metal base plate 1 having an upturned edge 1a. A coating 2, as shown in Fig. 2, of insulating material is applied to the metal base plate and after being matured by firing or otherwise, the contacts 3 are applied to the insulating base coat together with the resistive conductors 4 connected between the contacts. Another coating 5 of insulating material is then applied over the resistive conductor and the inner ends of the contacts which is afterwards matured for holding the contacts and resistive conductor in place and for protecting them from deterioration. The coating 5 is preferably a vitreous enamel coating. This embedding of the inner ends of the contacts and of the resistive conductor has been common practice for many years. A movable contact 6 is adapted to

engage the exposed contact surfaces of the contacts successively, thereby cutting in or out of the controlled circuit the desired amount of resistance. The movable contact is shown carried by a contact arm 7 pivoted on a central axis and forms connection between the contact 6 and a circular fixed contact plate 8 from which a conducting strip 8a extends to a contact 8b mounted upon an insulating terminal block 9. The end contacts 3 are connected respectively to contacts 9a mounted upon the terminal block for connection to the controlled circuit. The rheostat may be of any type, the circular form shown being conventional.

The contacts are in the form of strips of sheet metal, such as copper or brass. As shown in Fig. 2, the outer end 3a of each of the fixed contacts extends inwardly toward the center of the rheostat parallel to the base plate and its outer face forms the contact surface which is engaged by the movable contact 6. The contact strip is bent at an angle of about 90° for forming the inwardly extending contact surfaces and the mid-portion of the strip extends within the insulating material 5. The embedded end of the contact strip is again bent to extend outwardly in a flat portion parallel to the base, the resistive conductor being connected to the embedded flat end portion. The embedded end of the contact strip as first formed is shown in Fig. 3 with oppositely positioned arc-shaped notches 3b forming a neck 3c for permitting the convenient bending of the embedded end portion. The flat end of the contact is also provided with arc-shaped oppositely positioned notches 3d and a similar arc-shaped notch 3e at the end. These arc-shaped notches 3d and 3e are for the purpose of permitting convenient wrapping around of the resistive conductor and the soldering of the conductor to the contact.

In the process of manufacture, the contacts are rigidly supported in proper spaced fixed relationship from a common support and this is accomplished by stamping the contacts and their common support from sheet metal. Fig. 4 shows such a stamping wherein the contacts 3 are all joined together by a common portion 10 at the end of each contact which is to form the exposed end of the contact. This permits the whole series of contacts to be formed in one stamping operation and likewise provides for their proper support in their desired fixed relationship by the common portion 10 of the sheet metal. Any number of these contacts may be formed in such a unit giving the full number required for any particular device. The sheet metal may be of any desired thickness for securing proper rigidity of the contact and the contacts may be formed of any desired shape or width with any desired spacing between the contacts. The forming of the notches permits the use of circular pins in the die for stamping out the unit and in case of the breaking of any pin it may be replaced by a similar pin without rebuilding the die.

The resistive conductor is connected at intermediate points to the notched ends of the contacts and may be formed of straight portions or of zig-zag form, or of coiled wire as indicated in Figs. 1 and 2. One end of the resistive conductor is connected to the first contact and then the contact is formed in a loop and then an intermediate portion is connected to the notched end of the next contact and so on. The connections of the resistive conductor to the contacts

is then preferably soldered and the ends of the contacts are bent at the neck 3c giving a unitary structure like shown in Fig. 4 with the lower ends of the contacts bent and with the resistive conductor properly connected to the ends of the contacts and extending outwardly therefrom in a plane at approximately right-angles to the plane of the main portion of the contacts and of the common support 10. The structure is then bent in circular form of the desired radius by bending the support 10. The unit is then placed in proper position on the ground coat 2 of the plate. In this stage the contacts are all held in fixed, properly spaced position by the common supporting portion 10; and if desired the unit may be supported from the outer edge of the rim 1a of the plate, such as by one or more metal strips or rods resting upon the rim of the plate and passing under and in engagement with the inner portion of the common support 10 between the downwardly extending contacts. The insulating material for forming the coating 5 is then applied over the resistive conductor and over the end portions of the contacts to which the resistive conductor is connected after which the coating is matured as by firing in a furnace, baking, drying or otherwise. During the maturing operation the contacts are maintained in their proper fixed position because the common support during this operation serves to prevent any creeping, shifting or swimming of the contacts or change of their position relatively to each other. Also, by supporting the contact unit from the edge 1a of the face plate by cross rods or strips passing through the spaces between the contacts and under the common portion 10, the resistive conductor and base portion of the contacts may be held in fixed position relatively to the metal plate 1 which aids in overcoming the possibility of contact engagement with the metal plate during the maturing operation. Also, by thus supporting the unit contact structure from the upturned edge of the metal plate, the preliminary formation of the insulating ground coat 2 may sometimes be avoided if the parts including the resistive conductor are sufficiently rigid and the insulation of the resistive conductor and base of the contacts accomplished by the application of one coating of insulating material which will pass under and above the suspended contacts and resistive conductor. This further simplifies and reduces the cost of manufacture.

After the maturing of the insulating coating, the resistive conductor and base of the contacts are thereby firmly held in their fixed positions; and the portion 10 of the unit is cut or ground away from the outer ends of the contacts resulting in a series of individual contacts insulated from each other. The outer ends of the contacts are then bent inwardly at an angle of about 90° giving the final form of contact as shown in Fig. 2. This bending of the contacts may be readily accomplished in various ways in sections at a time or simultaneously and by use of a sectional spacing flat ring under the contacts if necessary for insuring proper bending. After bending, the faces of the contacts may be ground lightly for giving them a smooth finish for engagement by the movable contact of the rheostat.

In some cases the embedded ends of the contacts need not be bent at the reduced neck previously described and in Figs. 5 to 10 forms of resistive devices are shown in which the inner flat ends of the contacts are left straight and project within the insulated coating. Likewise

in these figures the devices are not shown with a movable contact element and are adapted for connection at the exposed ends of the contacts to other contact controlling means, such as automatic regulators.

In Figs. 5 and 6 the resistive device is shown having a metal base plate 11 of rectangular form with an upturned edge 11a. Additional sheet metal end pieces 12 are secured to the sides of opposite end portions of the plate 11 as by welding or otherwise. These portions 12 extend upwardly a considerable distance above the rim of the plate 11. Two oppositely placed rows of contacts 13 are shown in Fig. 5 with a resistive conductor 14 connected between successive contacts of each row, the resistive conductors extending inwardly from the oppositely located contacts. In making this form of structure two separate unitary devices are stamped out from sheet metal of the form shown in Fig. 7 with a common side portion 13a joining the outer ends of the contacts. The portion 13a is extended at opposite ends so that after the resistive conductor is connected to the inner ends of the contacts in the manner already described and as indicated in Fig. 5, each contact unit is then placed in position over the plate 11 and supported at its ends by the extensions of the common portion 13a passing through slots 12a formed in the end plates 12, as shown in Fig. 7. This suspends the contacts and resistive conductors in a spaced position from the base plate 11. The insulating material 15 is then applied to the assembled structure so as to pass around the inner flat ends of the contacts and around the resistive conductor as shown in Fig. 7. The device is then ready for maturing the coating which is preferably accomplished by firing in an oven to form a vitreous enamel, although other insulating materials and other ways of maturing may be used. Thus one insulating coating may be applied and matured as previously referred to, or an insulating ground coat may first be applied.

After the maturing of the insulating coating, the common portion 13a is removed from the contacts giving a resultant resistive device, as shown in Figs. 5 and 6. The holes 13b near the outer ends of the contacts are punched in the initial stamping out of the contact unit and are for the purpose of inserting the ends of the lead wires which extend from the contacts to other controlling apparatus, the connections being soldered. The lower flat end of each of the contacts 13 is shown enlarged in Fig. 8 with arc-shaped notches 13c for facilitating the wrapping around of a portion of the resistive conductor and the making of a soldered connection. In this instance no neck for facilitating the bending of the inner end of the contact is provided.

In Figs. 9 to 11 parts corresponding to those of Figs. 5 to 7 are similarly numbered, but in this case only one row of contacts is shown. End pieces 16 are welded or otherwise secured to the ends of the plate 11 and are provided with downwardly extending perforated portions, as shown in Fig. 10, for mounting on a proper support, the end pieces 12 of Figs. 5 and 6 being utilized likewise for mounting on a support. At one end of each of the portions 16 is provided a notched upwardly extending lip 16a, as particularly shown in Fig. 10. In stamping out the contact unit for this structure, the common portion 13a is provided with downwardly extending end portions 13d from which extends a further downwardly extending portion 13e. When the contact unit

is placed in position on the plate 11, the extended portions 13d engage the slots in the lips 16a and the extended portions 13e engage the outer faces of the end pieces 16. Thus the contact unit is not only supported in fixed spaced relationship from the base plate 11 but is also prevented from longitudinal movement by the end portions 13e during the application of the insulating material and during the maturing operation. Similar means could be provided on the extended end portions of the contact unit as shown in Fig. 7, for preventing longitudinal movement if desired. After maturing of the insulating coating the common portion 13a and extensions 13d and 13e are removed from the upper ends of the contacts with a resulting structure as shown in Fig. 9.

Instead of connecting leads to the outer ends of the contacts in the structures of Figs. 5 to 11 and extending these leads to other controlling means, a movable contact may be utilized to slidably engage the exposed side portions of the contacts or their ends; and the projecting portions of the contacts may be bent for providing contact surfaces in a different plane for engagement by the slidable contact.

Although particular embodiments of the invention and method of making have been described, it will be understood that modifications may be made for adaptation to particular uses without departing from the scope of the invention.

I claim:

1. A resistive device comprising a support, a plurality of contacts adjoining each other, a resistive conductor connected between said contacts, and a coating of insulating material embedding said conductor and the bases of said contacts and the connections of the resistive conductor thereto, said contacts being in the form of sheet metal strips and extending outwardly from said insulating material, said contacts having their embedded bases flat and having notches at their inner flat ends for facilitating connection of the resistive conductor thereto, said conductor being wound around said inner ends and within said notches and soldered to the inner ends.

2. A resistive device comprising a support, a plurality of contacts adjoining each other, a resistive conductor connected between said contacts, and a coating of insulating material embedding said conductor and the bases of said contacts and the connections of the resistive conductor thereto, said contacts being in the form of sheet metal strips and extending outwardly from said insulating material, said contacts being bent at right-angles within the insulating material and having end portions extending flat-wise parallel to said support and having notches opposite to each other at the bends to facilitate the bending and having notches at the flat end portions for facilitating connection of the resistive conductor thereto, said conductor being wound around said flat end portions and within said last named notches and soldered to said end portions.

3. The method of making a resistive device having a series of contacts connected to a resistive conductor comprising stamping a unitary contact from sheet metal, said contact having a common connecting portion at one side with a plurality of spaced portions projecting therefrom, connecting a resistive conductor between the ends of said projecting portions, said conductor extending substantially at right-angles to said projecting portions, placing said unitary contact

and resistive conductor in position on a support, embedding said conductor and the bases of said projecting portions and connections of the resistive conductor thereto with insulating material, maturing said material, and then removing said common connecting portion of the unitary contact to form a plurality of spaced individual contacts by said projecting portions.

4. The method of making a resistive device having a series of contacts connected to a resistive conductor comprising stamping a unitary contact from sheet metal, said contact having a common connecting portion at one side with a plurality of spaced portions projecting therefrom having arc-shaped notches at their ends, connecting a resistive conductor between the ends of said projecting portions, said conductor extending substantially at right-angles to said projecting portions, placing said unitary contact and resistive conductor in position on a support, embedding said conductor and the bases of said projecting portions and connections of the resistive conductor thereto with insulating material, maturing said material, and then removing said common connecting portion of the unitary contact to form a plurality of spaced individual contacts by said projecting portions.

5. The method of making a resistive device having a series of contacts connected to a resistive conductor comprising stamping a unitary contact from sheet metal, said contact having a common connecting portion at one side with a plurality of spaced portions projecting therefrom, connecting a resistive conductor between the ends of said projecting portions, said conductor extending substantially at right-angles to said projecting portions, placing said unitary contact and resistive conductor in position on a support and supporting said unitary contact by said common connecting portion from said support, embedding said conductor and the bases of said projecting portions and connections of the resistive conductor thereto with insulating material, maturing said material, and then removing said common connecting portion of the unitary

tary contact to form a plurality of spaced individual contacts by said projecting portions.

6. The method of making a resistive device having a series of contacts connected to a resistive conductor comprising stamping a unitary contact from sheet metal, said contact having a common connecting portion at one side with a plurality of spaced portions projecting therefrom, connecting a resistive conductor between the ends of said projecting portions, said conductor extending substantially at right-angles to said projecting portions, placing said unitary contact and resistive conductor in position on a support and supporting said unitary contact from said support by end portions extending from said common connecting portion, embedding said conductor and the bases of said projecting portions and connections of the resistive conductor thereto with insulating material, maturing said material, and then removing said common connecting portion of the unitary contact to form a plurality of spaced individual contacts by said projecting portions.

7. The method of making a resistive device having a series of contacts connected to a resistive conductor comprising stamping a unitary contact from sheet metal, said contact having a common connecting portion at one side with a plurality of spaced portions projecting therefrom, connecting a resistive conductor between the ends of said projecting portions, said conductor extending substantially at right-angles to said projecting portions, placing said unitary contact and resistive conductor in position on a support, embedding said conductor and the bases of said projecting portions and connections of the resistive conductor thereto with insulating material, maturing said material, then removing said common connecting portion of the unitary contact to form a plurality of spaced individual contacts by said projecting portions, and then bending said projecting portions at approximately right-angles to form a series of outer contact surfaces for engagement by a movable contact.

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