Nov. 5, 1957 R. A. JARBOE 2,812,471

MULTIPLE RESISTOR UNIT

Filed Oct. 14, 1955 2 Sheets-Sheet 1

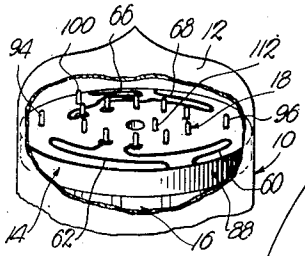


Fig. 1.

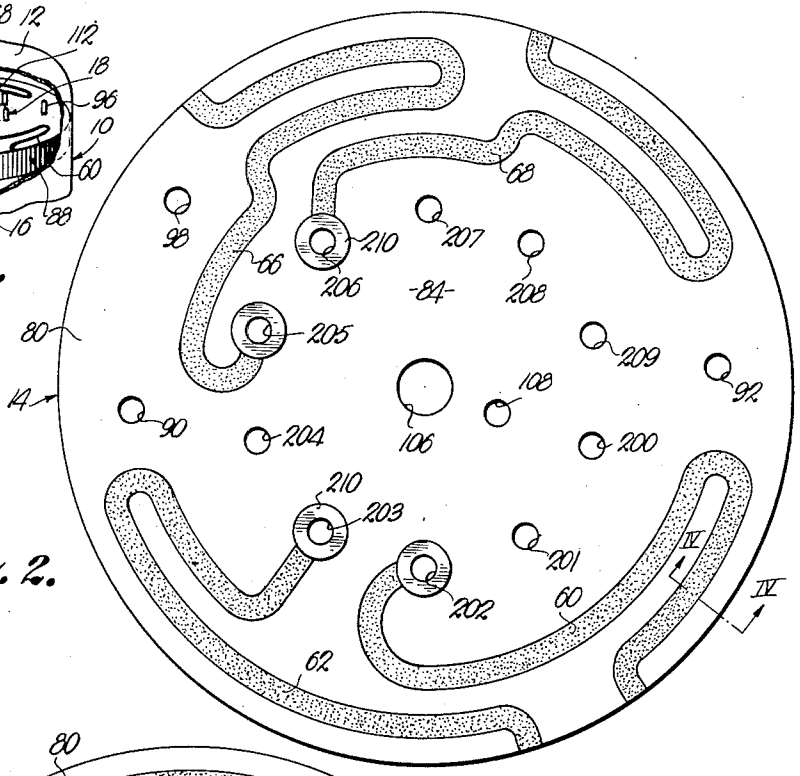


Fig. 2.

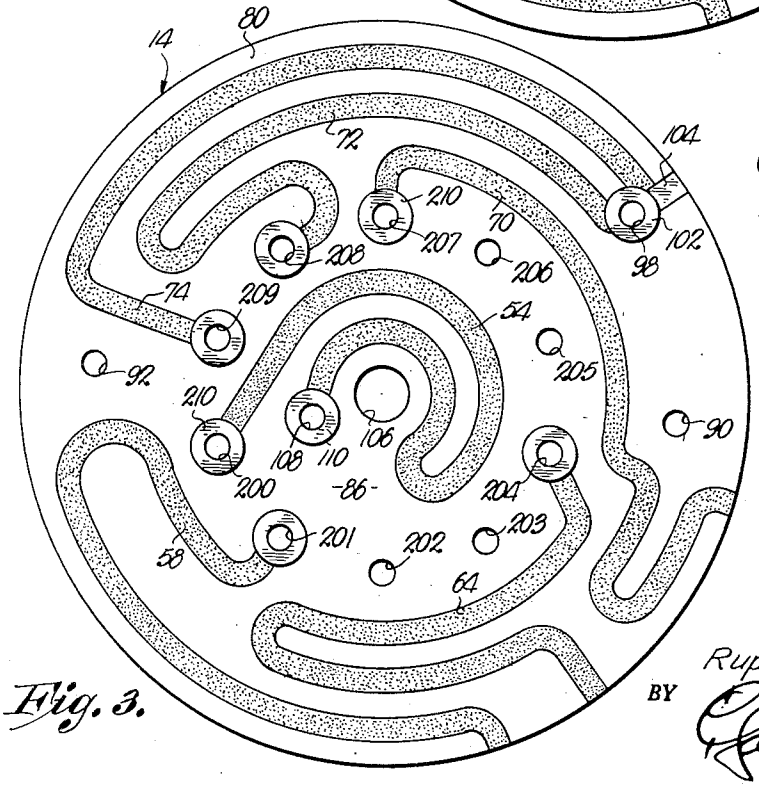


Fig. 3.

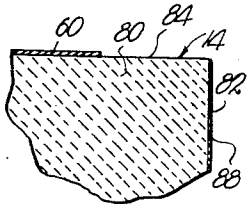


Fig. 4.

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MULTIPLE RESISTOR UNIT

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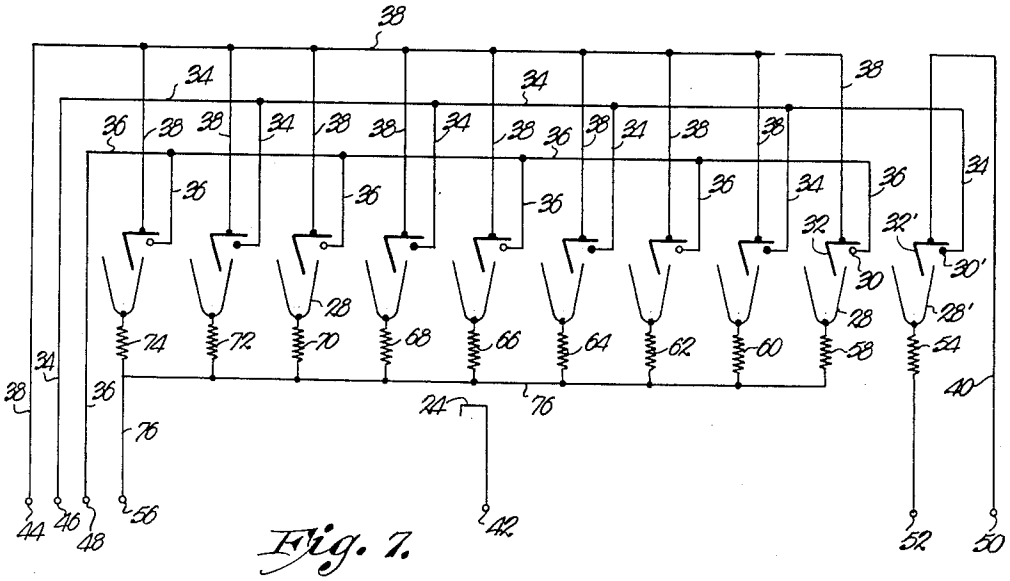


Fig. 7.

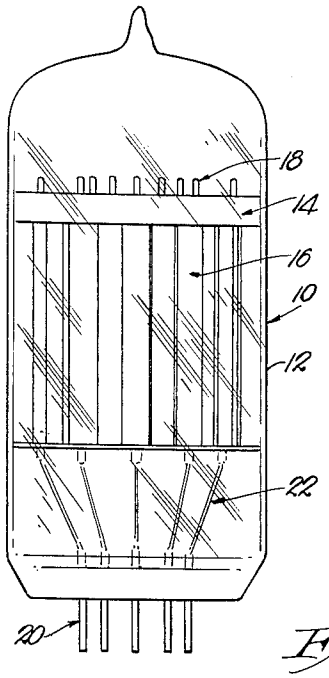


Fig. 5.

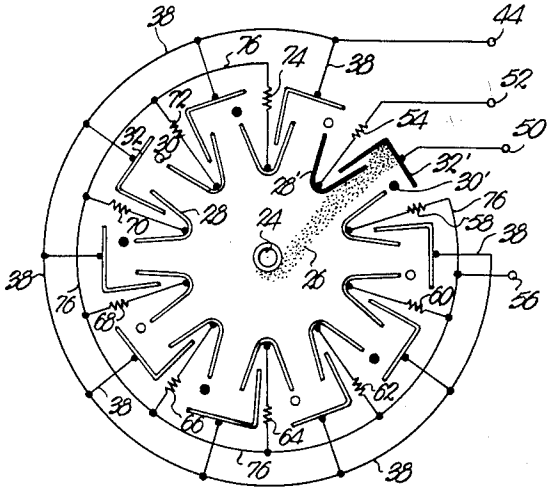


Fig. 6.

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MULTIPLE RESISTOR UNIT

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Application October 14, 1955, Serial No. 540,566

2 Claims. (Cl. 315—8.5)

This invention relates to the fields of multiple resistance electrical components and electronic tubes. More particularly, the invention is concerned with the provision of an improved multiple resistance unit ideally adapted for incorporation within vacuum tubes so that a part of the electrical circuitry normally associated with such tubes may be embodied in the tubes themselves with resultant improvement in the operating characteristics of the tubes and the circuitry in which they are employed.

Prior to this invention, it has been necessary for resistance units connected with the internal elements of an electronic tube to be either disposed externally of the tube, which results in the necessity for relatively long connecting conductors or leads between the tube elements and the resistance units detrimental to the operation of the circuitry in which the tube and resistance units are employed by virtue of stray capacitance or the like, or to provide individual resistors within the envelope of the electronic tube, which necessitates the miniaturization of the resistors to a point affecting their accuracy or stability.

Accordingly, it is the primary object of this invention to provide a novel and improved multiple resistance unit adapted for incorporation within an electronic tube as a component or element thereof which will overcome all of the above mentioned and other disadvantages inherent in previously known means for attempting to accomplish the shortening and minimization of the number of leads that is so desirable, if not necessary, in a number of types of electrical circuits. It will be understood that the multiple resistance units of this invention are also adapted for use in applications other than in electron tubes, and such uses thereof are within the contemplation of the invention.

It is another important object of this invention to provide an improved multiple resistance unit principally comprised of a disc of ceramic material having a peripheral edge on which a layer of conductive material has been deposited, a number of perforations in which a layer of conductive material has been deposited and which are adapted to receive in electrically contacting relationship a conductor or conductive part of a tube element, and a plurality of strip-like layers of resistance material deposited upon the faces of the disc and extending in predetermined arrangement between said perforations and said peripherally disposed conductive layer.

Although the multiple resistance unit of this invention may be used in various types of electron tubes, it is particularly adaptable for use in a beam switching type electron tube, and it is an important object of this invention to provide a multiple resistance unit especially suited for inclusion in a beam switching tube as an integral part thereof.

Other important objects of this invention, including many significant details of construction and the manner in which the invention minimizes manufacturing costs, improves tube and circuit performance and decreases

maintenance requirements, will be made clear or become apparent as the following description of the invention progresses.

In the accompanying drawing:

Figure 1 is a fragmentary perspective view of a portion of an electron tube having one of the multiple resistance units contemplated by this invention incorporated therein, parts being broken away for clarity of illustration;

Fig. 2 is a plan view of one face of an embodiment of multiple resistance unit made in accordance with the invention;

Fig. 3 is a plan view of the opposite face of the unit illustrated in Fig. 2;

Fig. 4 is an enlarged, fragmentary, cross-sectional view taken on line IV—IV of Fig. 2;

Fig. 5 is an elevational view of an electron tube showing one of the multiple resistance units of this invention incorporated therein, only such detail of the tube as is believed necessary to illustrate the relative disposition of the resistance unit within the tube envelope being shown;

Fig. 6 is a diagrammatic representation of a typical beam switching tube, together with certain portions of one type of circuitry conventionally employed therewith; and

Fig. 7 is a schematic representation of the electrical aspects of the tube and circuitry illustrated in Fig. 6.

For purposes of illustration, the invention may, and will, be explained with particular reference to its adaptability for application as a component part of a beam switching type electron tube. Those skilled in the art will readily understand how the invention may be employed in connection with tubes of other types and in other differing applications.

Referring now particularly to Figs. 1 and 5, the numeral **10** generally designates a beam switching type electron tube having an evacuated glass envelope **12** containing a multiple resistance unit generally designated **14** of the type contemplated by this invention and a number of internal electrodes or tube elements generally designated **16** having portions generally designated **18** in electrical contact with portions of the unit **14** housed therewithin. Tube **10** is also provided with a number of connecting pins generally designated **20**, which are respectively coupled electrically with various of tube elements **16** by leads generally designated **22**.

Referring now more particularly to Figs. 6 and 7, it will be seen that a typical type of pin positioned beam switching tube and the circuitry normally associated therewith include a tube cathode **24** for emitting an electron beam **26**, and ten positional sets of tube elements **16** each corresponding to a digit from zero to nine and including a beam forming and locking spade **28**, a switching grid **30** and a target output plate **32**. The spade, grid and plate associated with the zero position are designated respectively **28'**, **30'** and **32'** for purposes of identification, the positions or sets of tube element **16** corresponding to successively increasing digits being disposed in a clockwise direction from the zero position set in Fig. 6 and from right to left in Fig. 7. The grid **30'** and the grids **30** of alternate sets corresponding with each even numbered position are interconnected by conductive means **34** (illustrated only in Fig. 7), while the remaining grids **30** corresponding to the odd digital positions are interconnected by conductive means **36** (shown only in Fig. 7). In ordinary tube manufacturing practice, the interconnections **34** and **36** are effected within the tube by split, generally annular bands (not shown) contacting an extremity of the appropriate grids **30**. Similarly, all of the plates **32**, except plate **32'**, are electrically interconnected by conductive means **38** in the nature of a band or the like (not shown) within the tube **10**, the plate **32'**

being provided with an individual lead 40. Cathode 24 and conductive means 38, 34, 36 and 40 will normally be coupled respectively with pins 20 more particularly identified by the numerals 42, 44, 46, 48 and 50. It will now be observed, however, that the circuitry illustrated, which is typical, requires that the spade 28' be coupled with a pin 52 through an electrical resistance 54, while the remaining spades 28 must be connected in common to a pin 56 through individual series resistances 58, 60, 62, 64, 66, 68, 70, 72 and 74 and conductive means 76.

In the operation of the beam switching tube 10 and its associated circuitry just referred to, it is necessary for optimum performance and reliability that stray capacitance between the spades 28 and, more particularly, any leads from such spades 28 to the respective resistances 54, 58, 60, et seq., be minimized. This operating requirement is so stringent that the capacitance existing between leads running from the spades 28 to resistors disposed externally of the tube 10 is virtually prohibitive, and even that capacitance existing between miniaturized, conventional, cylindrical, deposited or wire wound resistances disposed within the tube envelope 12 is markedly deleterious on the operation of the circuitry.

Such problem is solved by the unit 14 of this invention which will be seen from Figs. 2–4 inclusive to be comprised of a thin, circular, ceramic disc or wafer 80 having an annular marginal edge 82 and a pair of opposed faces 84 and 86, together with conductive and resistive structure hereinafter to be described.

An annular layer 88 of conductive material such as silver, is deposited upon the edge 82 of disc 80 to provide a common line or terminal corresponding to the conductive means 76 illustrated in Figs. 6 and 7.

The disc 80 is provided with a pair of openings 90 and 92 used to receive structures 94 and 96 (see Fig. 1) upon which the disc 80 is mounted within the tube 10. A hole 98 is provided in disc 80 for receiving a conductive element 100 (see Fig. 1) within tube 10, which is used for coupling the conductive band 88 (corresponding to the conductive means 76 of Figs. 6 and 7) to the pin 56 of tube 10, such hole 98 being provided with an internally deposited layer 102 of conductive material such as silver for effecting electrical contact with the conductor 100. It may also be noted that the conductive layer 102 extends radially as at 104 into electrical contact with the conductive layer 88.

Disc 80 is also provided with a central opening 106 for accommodating the upper extremity of cathode 24 and with a hole 108 adjacent opening 106 for establishing electrical contact, by means of an internal conductive coating 110 with a conductor element 112 (see Fig. 1) provided within tube 10 and leading to the pin 52.

Arranged outwardly from opening 108 and inwardly from openings 90, 92 and 98 are an annular row of ten holes respectively designated 200, 201, 202, 203, 204, 205, 206, 207, 208 and 209, each of which is provided with an internal coating of conductive material designated 210 for effecting electrical contact with a portion of the corresponding spade 28, it being noted that hole 200 receives spade 28' corresponding to the zero position or condition of the tube, while holes 201, 202, et seq. respectively receive the spades 28 corresponding to the digits one through nine inclusive.

Between the conductive means 110 associated with hole 108 and the conductive means 210 associated with hole 200 is arranged an elongated, thin strip of carbon or other deposited resistance material comprising the resistance 54, such resistance 54 being on face 86 of disc 80 and, therefore, illustrated in Fig. 3. The resistances 58, 60, 62, 64, 66, 68, 70, 72 and 74 are formed in similar manner extending between the respective holes 201, 202, et seq. and the common terminal conductive band 88 or, in the case of resistances 72 and 74, the conductive means 102 associated with hole 98. The various resistances are identified in Figs. 2 and 3 by the same numerals appearing in Figs. 6 and 7.

It will now be apparent that the strip-like deposited resistances 54 and 58, 60, 62 et seq. may be conveniently divided between the faces 84 and 86 of disc 80 and thereon arranged in manner providing for the lengths necessary to effect the proper electrical resistance while still maintaining configurations and relative positioning which will minimize stray capacitance therebetween. As is well known to those skilled in the art, such capacitance is considerably minimized by virtue alone of the thin cross-sectional configuration of the strip-like resistances and their substantially coplanar relationship.

It will now be further apparent that the structure contemplated and provided by this invention is ideally suited for solving all of the problems and attaining all of the objectives hereinbefore referred to. Manifestly, however, certain minor modifications and changes could be made from the exact details disclosed for purposes of illustration without materially departing from the true spirit and intention of the invention. Accordingly, it is to be understood that the invention shall be deemed limited only by the scope of the appended claims.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. In an electron tube, an evacuated envelope; a number of tube elements within the envelope; a disc of insulating material within the envelope, said disc having a number of holes therethrough, a portion of a plurality of said elements extending into corresponding holes for physical support by the disc; a conductive structure secured to the disc within each of said holes in electrically contacting relationship with a corresponding tube element portion; a band of conductive material deposited upon the periphery of the disc; and a plurality of strips of resistance material deposited upon the disc and respectively extending from different ones of said structures to said band.

2. In an electron tube, an evacuated envelope; a number of tube elements within the envelope; a disc of insulating material within the envelope, said disc having a number of holes therethrough, a portion of a plurality of said elements extending into corresponding holes for physical support by the disc; a conductive structure secured to the disc within each of said holes in electrically contacting relationship with a corresponding tube element portion; a band of conductive material deposited upon the periphery of the disc; and a plurality of strips of resistance material deposited upon the disc and respectively extending from different ones of said structures to said band and between different pairs of said structures.

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