Sept. 24, 1946. H. L. COYNE ET AL 2,408,046

ELECTRICAL RESISTANCE UNIT

Filed Oct. 21, 1943 3 Sheets-Sheet 1

FIG. 1

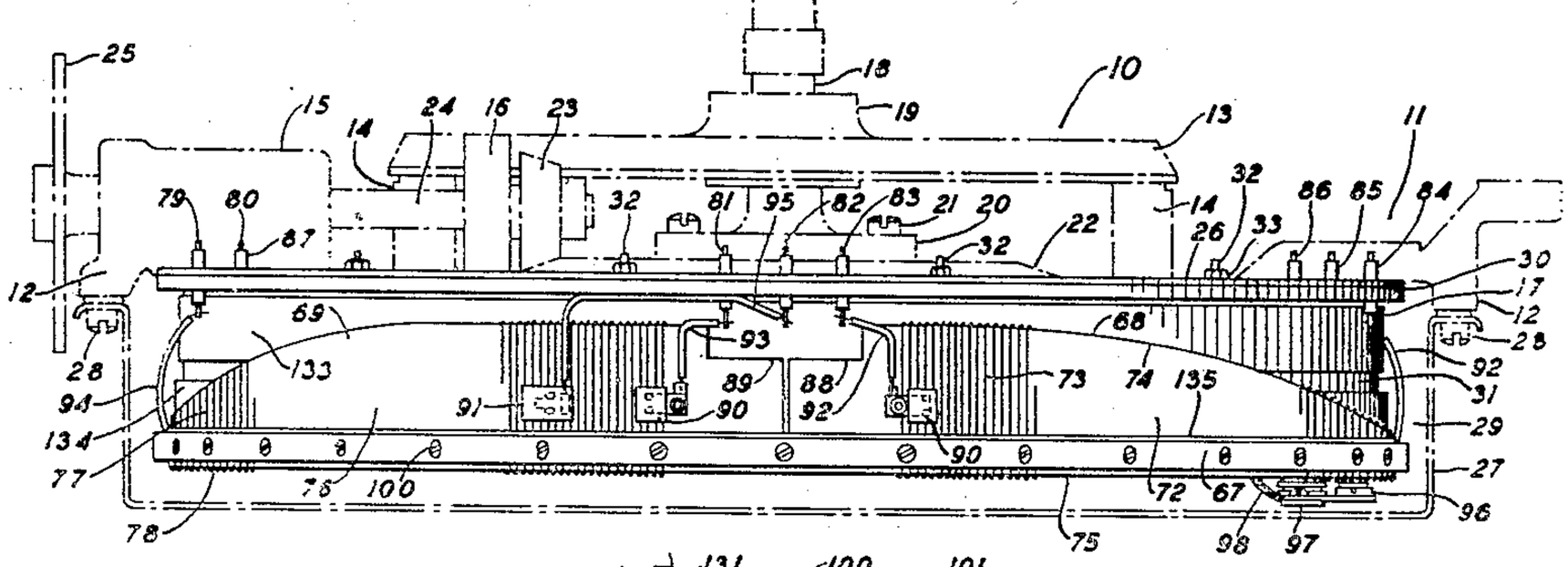

FIG. 2

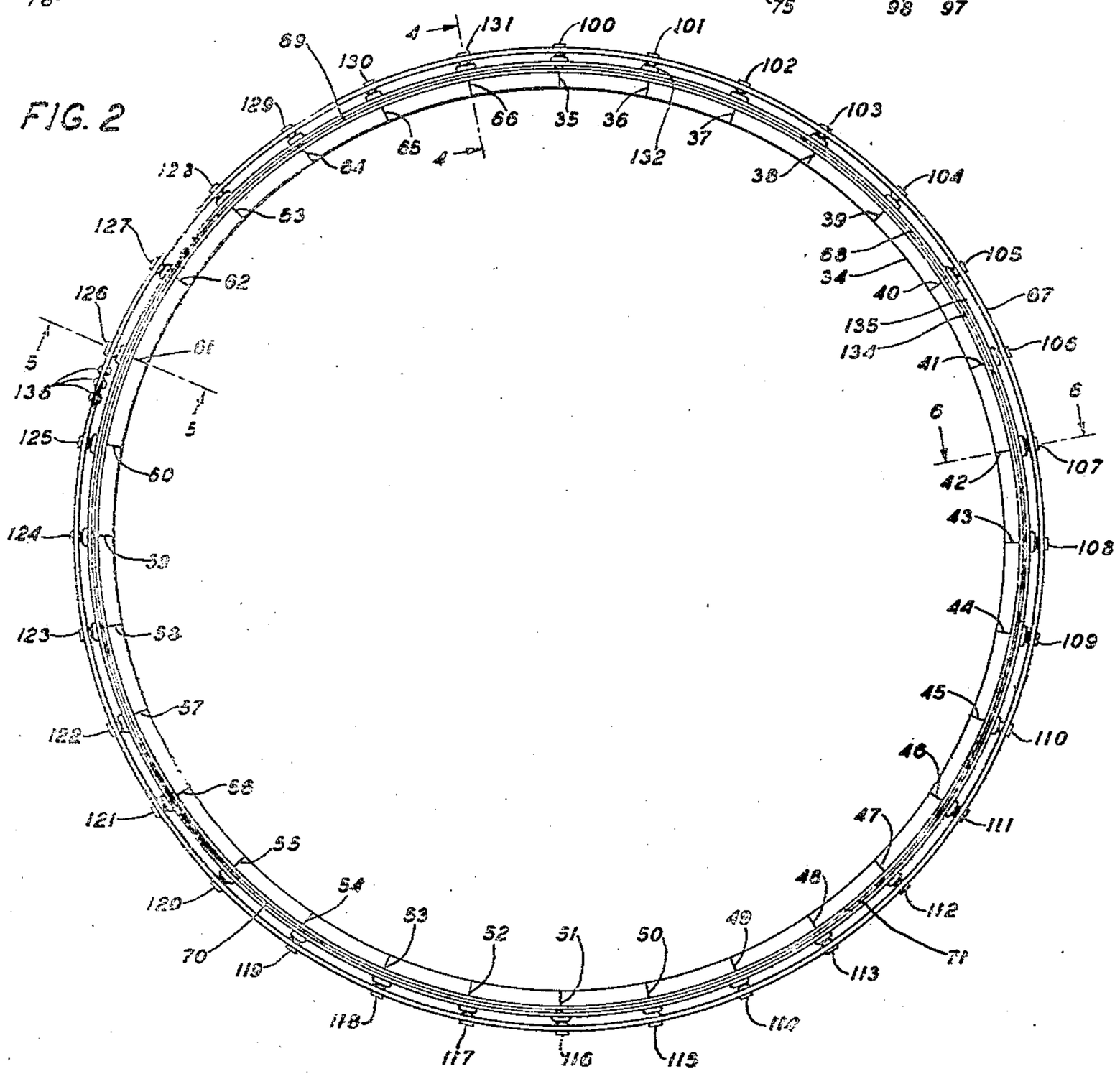

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FIG. 3

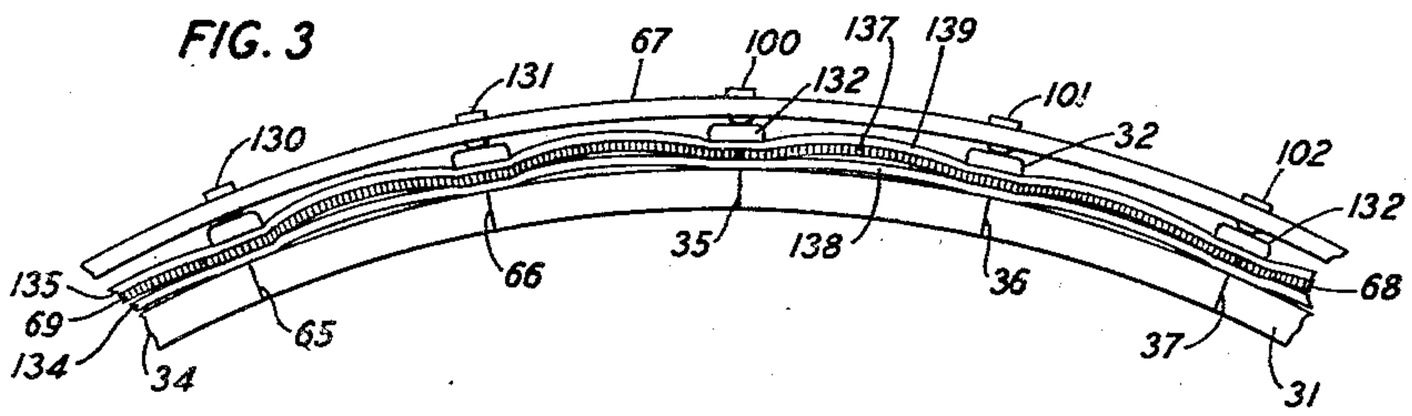

FIG. 5

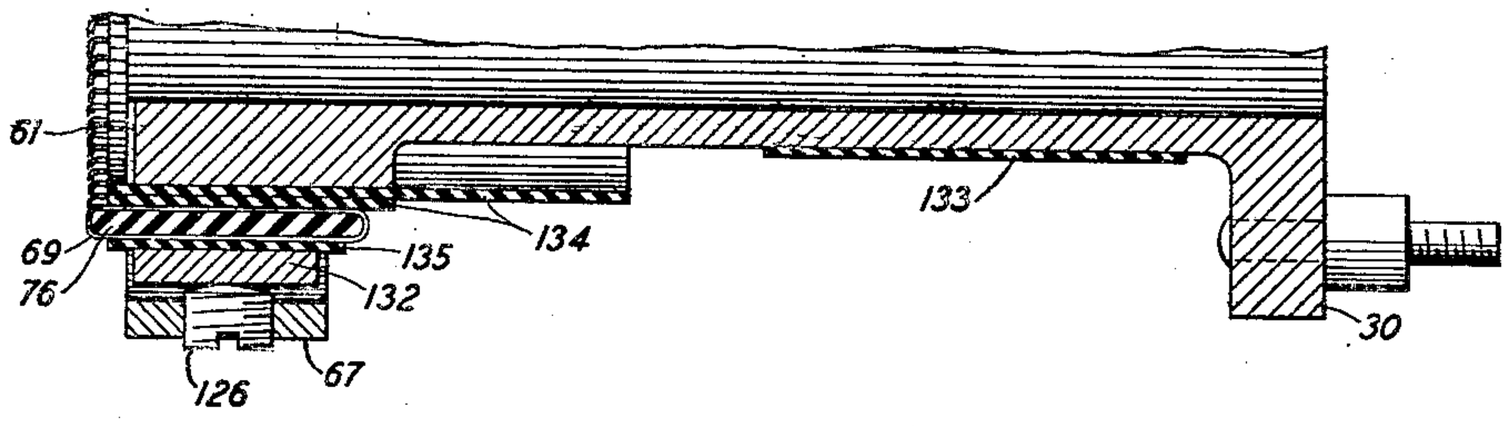

FIG. 6

FIG. 4

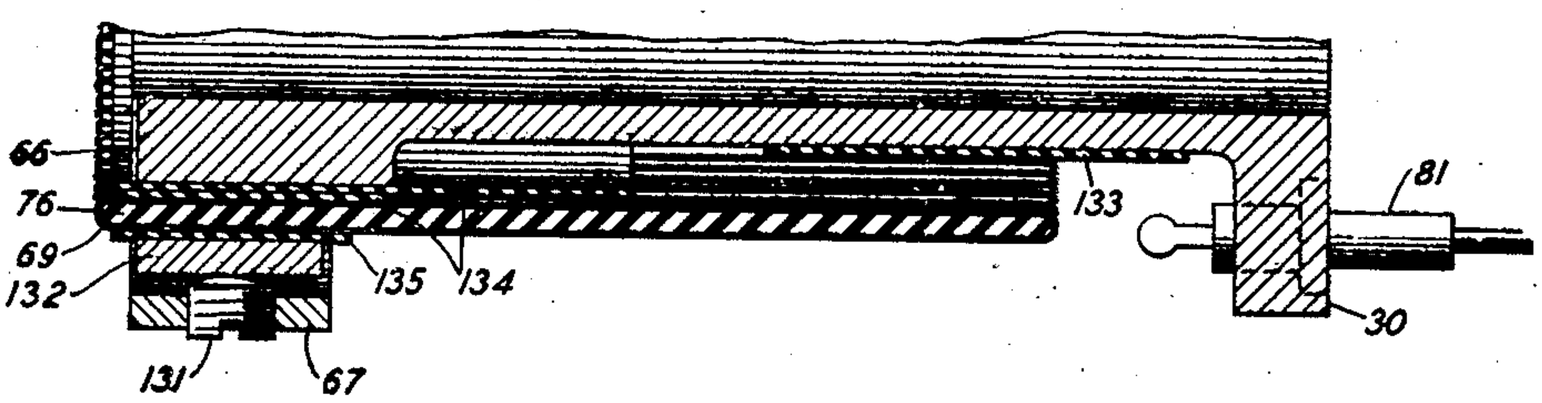

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FIG. 7

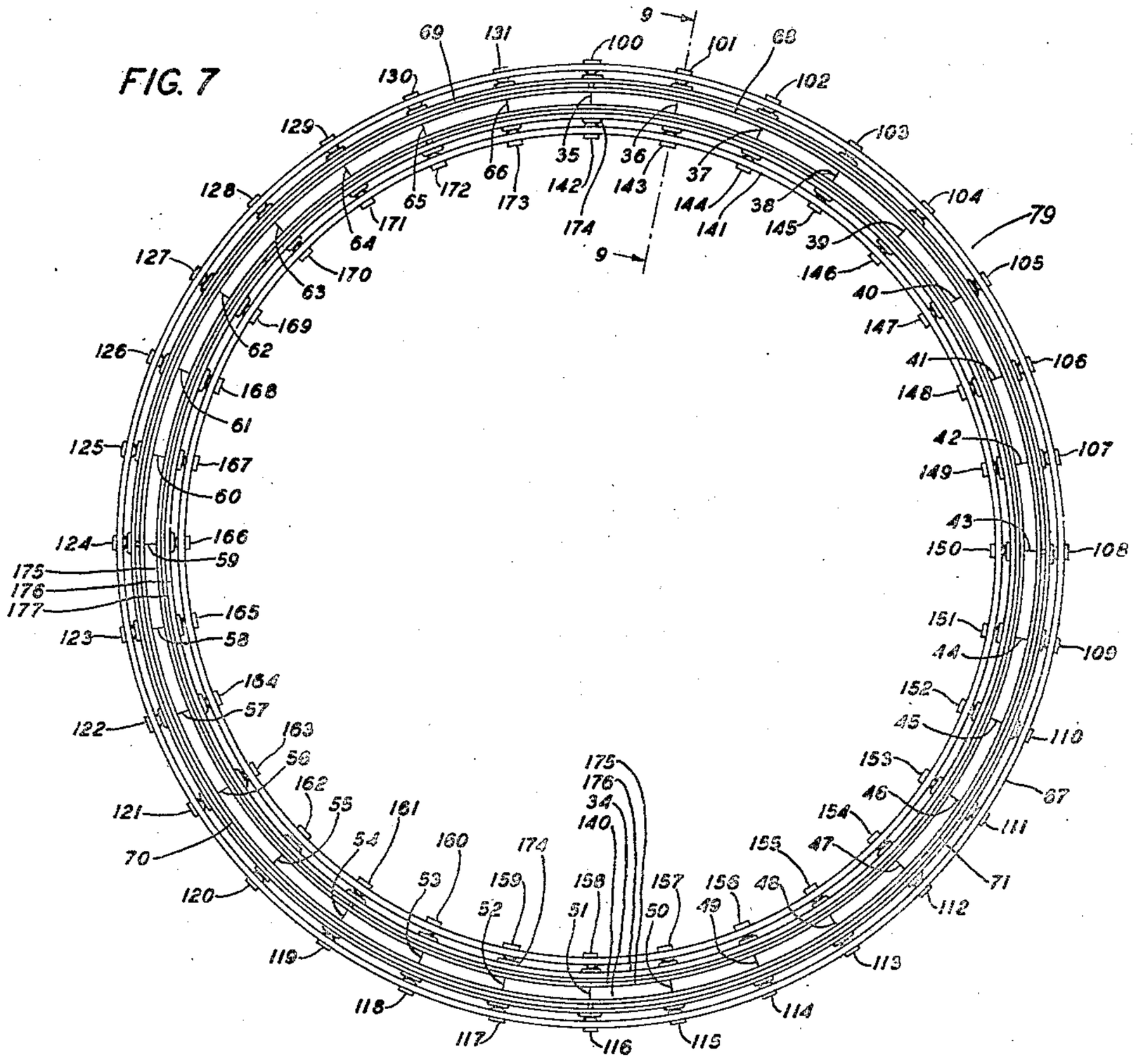


FIG. 8

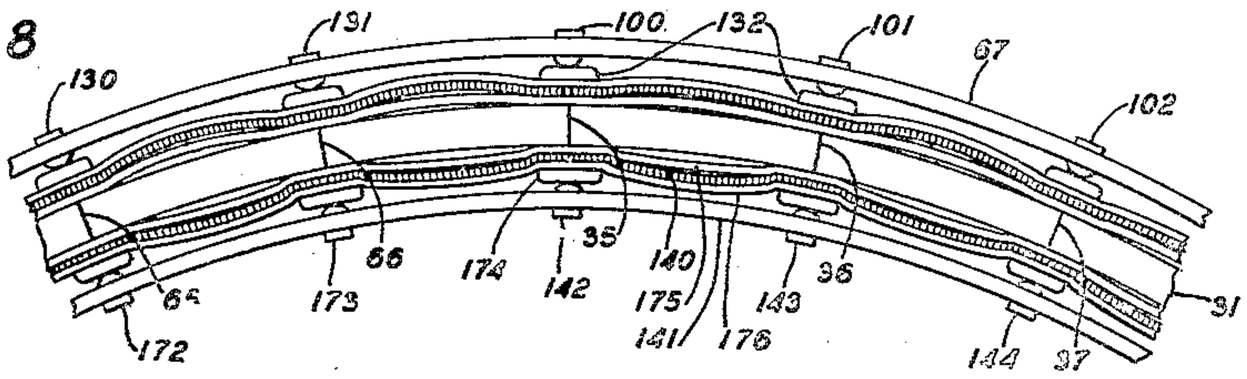
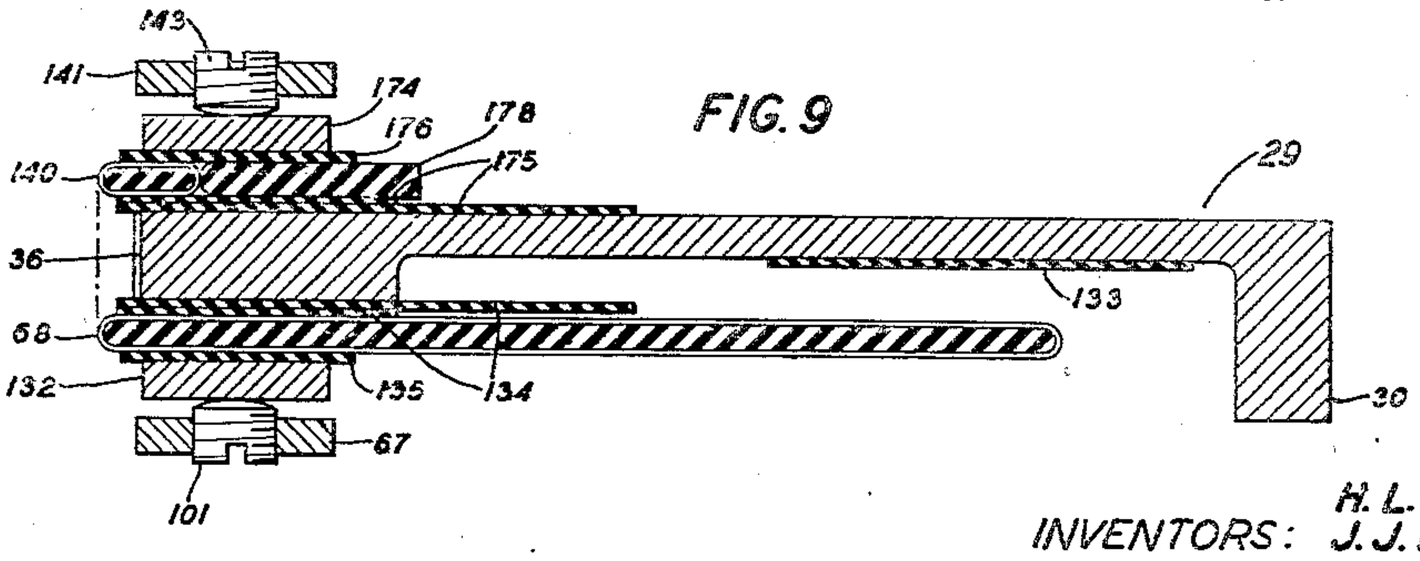


FIG. 9



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Patented Sept. 24, 1946 2,408,046

UNITED STATES PATENT OFFICE

2,408,046

ELECTRICAL RESISTANCE UNIT

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Application October 21, 1943, Serial No. 507,146

11 Claims. (Cl. 201—63)

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This invention relates to electrical resistance units and more particularly to resistance units suitable for use in rheostats or potentiometers in which a resistance element is arranged to be traversed by a wiper contact to obtain required changes in an electrical system in which the rheostat or potentiometer is employed.

The invention although not limited to such use is found of particular value in rheostats or potentiometers used in target detecting and range finding apparatus in which information relating to the location of a target and obtained at a target observing station is transmitted in the form of elecrical signals to a receiving station.

In the resistance unit of the present invention a resistance wire is wound on a card of insulating material to provide a resistance element in the unit.

The object of the invention is to provide a resistance unit in which precise resistance values will be obtainable at predetermined points when a wiper contact engages turns of the resistance wire at these points.

A feature of the invention resides in means provided for supporting the resistance element.

Another feature resides in means provided to hold predetermined portions of the resistance element in required positions.

In the drawings:

Fig. 1 is a side elevational view of a potentiometer including the invention, the resistance unit being shown in full lines and other parts of the potentiometer being shown in dot-dash lines; also shown in dot-dash lines in this figure is a device for detecting and observing a target or other object. The parts shown in dot-dash lines are not parts of the present invention;

Fig. 2 is a plan view of the lower end of the resistance unit and taken from a point below the resistance unit shown in full lines in Fig. 1;

Fig. 3 is an enlarged view of a portion of Fig. 2;

Fig. 4 is an enlarged view in cross-section of a portion of the resistance unit and taken on the line 4—4 in Fig. 2;

Figs. 5 and 6 correspond to Fig. 4 but are taken on the lines 5—5 and 6—6 respectively in Fig. 2;

Fig. 7 is a view corresponding to Fig. 2 but showing a modification of the invention;

Fig. 8 is an enlarged view of a portion of Fig. 7; and

Fig. 9 is an enlarged view in cross-section of a portion of the unit shown in Fig. 7 and taken on the line 9—9 in Fig. 7.

In apparatus used in determining the presence

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of an object in an area and the location of the object under observance from a fixed point, electrical apparatus involving potentiometers is sometimes used, the electrical apparatus in such cases operating to produce in electrical values indications of the location of the object. The potentiometers used in such apparatus must be accurate and precise in their functions and in certain cases must be stable under changes in temperature or other climatic conditions.

The potentiometer 10 shown in Fig. 1 may well be used as part of an electrical apparatus for determining in electrical values the location of an object under observance relative to some fixed point such as an observer's station. The potentiometer includes one or more resistance elements supported in curved form, turns of resistance wire in the resistance elements and a wiper contact to successively engage the turns of resistance wire. The number of turns of wire from point to point in the resistance element, the length of the turns and the electrical resistance value of the wire may be such that a predetermined movement of the wiper contact from point to point will result in the obtaining of an electrical potential corresponding to some predetermined unit of measurement.

The potentiometer 10 illustrated in Fig. 1 comprises, as shown in dot-dash lines, a body 11 having a downwardly extending annular flange 12, a spider member 13 supported on posts 14, a block portion 15, an apertured upright wall 16 and a resistance unit 17, which is shown in full lines. A rotatable upright shaft 18 extending through a boss 19 on the spider member 13 has a flange 20 secured by means of screws 21 to a bevel gear 22 which is gear connected by means of a bevel pinion 23 to a shaft 24 rotatably supported in the block portion 15. The shaft 24 may be rotated by means of a disc 25 secured to the shaft 24. An apertured annular flange 26 is provided on the body 11 to support the resistance unit 17 and a flanged cup-like casing 27 is provided to form a lower cover for the resistance unit 17, the casing 27 being secured by means of screws 28 to the flange 12.

The resistance unit 17 comprises a drum type support 29 having a flange 30 on one end and a barrel portion 31 which is thickened on its lower end. Spaced studs 32 and nuts 33 are provided on the flange 30 to secure the resistance unit to a suitable support which may be as shown in Fig. 1 the flange 26 of the body 11. As shown in Fig. 2, the lower end 34 of the barrel portion 31 has a series of marks made thereon which are

generally equally spaced on the circle defined by the lower end 34. These marks may be made in any suitable manner such for instance as by scribing or otherwise indenting the lower end 34 of the barrel portion 31. For the purpose of identifying the marks in this description the marks are numbered on the drawings from 35 to 66, inclusive, and it is to be understood that the number and spacing of the marks may be changed to meet various requirements in construction of the resistance unit 17.

The drum type support 29 serves as a support for one or more resistance elements comprising in each case a card of insulating material and a winding of resistance wire supported on the card. The card with the winding of resistance wire thereon is bent to substantially conform to the curve of the barrel portion 31 of the drum type support 29 and is held in place by means of a hoop 67 and means cooperating with the hoop to clamp the card in required position, the card being clamped in such position that one edge of the card extends slightly beyond the lower end of the barrel portion 31 of the drum type support 29.

In the construction shown in Figs. 1 and 2, four resistance elements 68, 69, 70 and 71 are employed in the resistance unit 17. The construction of these resistance elements may be understood by a consideration of Fig. 1 which shows the resistance elements 68 and 69 and from the following description of elements 68 and 69. The resistance element 68 comprises a card 72 of insulating material on which is wound a resistance wire 73. The upper edge 74 of the card 72 is curved and all portions of the lower edge 75 are in a common plane so that the card 72 varies in width along the length of the card and the resistance element 68 is in effect what is commonly known as a tapered resistance. The resistance element 69 is constructed along the same general lines as the resistance element 68 and comprises a card 76 of insulating material and a resistance wire 77 wound on the card 76. The lower edge 78 of the resistance element 69 lies in the same horizontal plane as the lower edge of the resistance element 68. The resistance elements 70 and 71 may be duplicates of the resistance elements 68 and 69, respectively. The resistance elements 68 and 69 are arranged in end-to-end relation with the wide end of the card 72 near the wide end of the card 76 and the resistance elements are bent part way round the outside of the barrel portion 31 of the drum type support 29. The length of each resistance element will depend on the particular requirements of the case and the combined lengths of the resistance elements employed in the potentiometer unit may or may not be sufficient to completely encircle the barrel portion 31 of the drum type support 29. In the instant case, the combined lengths of the resistance elements 68, 69, 70 and 71 are about equal to the circumference of the barrel portion 31 of the drum type support 29. As shown in Fig. 2 the wide end of the card 72 of the resistance element 68 starts at 35 and the other end of the card 72 is at 43, the wide end of the card 76 of the resistance element 69 starts at 35 and the other end of the card 76 of the resistance element 69 is at 59. The wide ends of the cards of the resistance elements 70 and 71 start at 51, the narrow end of the resistance element 70 being at 59 and the narrow end of the resistance element 71 being at 43.

Conducting pins 79, 80, 81, 82, 83, 84, 85 and 86 are mounted in the flange 30 of the drum type support 29 to provide outside connection points for the potentiometer, each conducting pin being located in an aperture formed in the flange 30 and being insulated from the flange 30 by means of a sleeve 87 of insulating material. The wide ends of the cards are partly cut away as shown on the cards 72 and 76 at 88 and 89 to accommodate the lower ends of the conducting pins 81, 82 and 83. End tap terminals 90 are provided on the resistance elements and in some cases intermediate tap terminals 91 are provided on the resistance elements. The end tap terminals 90 and the intermediate tap terminals 91 may be located at predetermined points to form electrical connections between required points on the resistance wire windings and the conducting pins mounted on the flange 30. In Fig. 1 one end tap terminal 90 is electrically connected to the resistance wire 73 near one end of the resistance element 68 and an insulated wire 92 is provided to electrically connect this end tap terminal to the conducting pin 83. Another end tap terminal 90, not shown, is provided on the other end portion of the resistance element 68 and is electrically connected to the conducting pin 84 by means of an insulated wire 92. The resistance element 69 has an end tap terminal 90 electrically connected by means of an insulated wire 93 to the conducting pin 81 and another end tap terminal 90, not shown, but located near the other end of the resistance element 69 is electrically connected to the conducting pin 79 by means of an insulated wire 94. The intermediate tap terminal 91 is electrically connected to the resistance wire 77 at a required point and is electrically connected by means of the insulated wire 95 to the conducting pin 82. The resistance elements 70 and 71 are provided with end tap terminals 90 like those provided for the resistance elements 68 and 69 and the end tap terminals for the resistance elements 70 and 71 are electrically connected by means of insulated wires to conducting pins mounted on the flange 30. For instance, one end of the resistance element 70 may be electrically connected to the conducting pin 80 and one end of the resistance element 71 may be electrically connected to the conducting pin 85 and conducting pins, not shown, but corresponding to the conducting pins 81 and 83 would be provided for the other ends of the resistance elements 70 and 71.

The resistance elements are precision made to meet certain precise requirements of resistance values found necessary to be obtained when the potentiometer is used in an electrical system designed to translate into precise electrical potentials precise angular movements of devices used in determining the location of an object remote from the point from which the observation is made. The over-all resistance value of the resistance element must be precise and resistance values obtainable at predetermined points measured along the resistance element must be precise. To meet the particular requirements the resistance wire employed in the resistance element is of such character that a predetermined length of the resistance wire will have a certain required resistance value, the insulating card provided as a support for the resistance wire is made of such form and dimensions that it will meet certain requirements and the resistance wire is helically wound on the card in a predetermined number of equally spaced turns for a given unit of length of the card. The resistance elements as shown in Fig. 1 are mounted in the

potentiometer 10 in such position that a wiper contact 96 will engage turns of the resistance wire extending across the lower edge of the card, the wiper contact 96 being supported on an arm 97 which is mechanically connected to the shaft 18. When the shaft 18 is rotated, the wiper contact 96 will be moved along the lower edge of the resistance element and frictionally engage the turns of wire on the lower edge of the resistance element. A conductor wire 98 forms part of an electical connection between the wiper contact 96 and an outside connection point on the potentiometer which may be, for instance, the conducting pin 86.

When the wiper contact 96 is moved in accordance with the movement of some object detecting and observing apparatus and the potentials obtained through operation of the potentiometer 10 must be equivalent to the movements of the object detecting and observing apparatus, it is important that the potentials obtained will be exact electrical representations of the movements of the object detecting and observing apparatus.

The object detecting and observing apparatus may be any apparatus suitable for scanning an area to determine the presence and location of an object in the area. It may be, for instance, an apparatus suitable for sending electrical signals into the area and detecting reflections of the signals reflected back to the observing station from an object in the area or may be as shown in Fig. 1 a telescope 99 or other means suitable for scanning an area and detecting and observing a distant object therein. The object detecting and observing means shown in Fig. 1 is mechanically connected to the shaft 18 so that when the object observing means is moved to get it trained on the distant object the shaft 18 will be rotated and the wiper contact will be moved to some position on the resistance unit. The apparatus shown might be used in determining the azimuth position of a distant object and in translating into electrical values the information obtained. In order that certain predetermined potential values may be obtained at predetermined points along the resistance element, and when a wiper contact is brought into engagement with these points, the resistance element is made in some predetermind form and so that the pattern of resistance change obtainable when the potentiometer employing the resistance element is operated will substantially meet the requirements. Theoretically, if the resistance element is made to strictly conform to the required pattern the required resistance values should be obtainable at certain specific points measured along the resistance element. It has been found, however, extremely difficult to so accurately shape the insulating card and wind the resistance wire thereon with such precision that the precise values required will be obtainable at precise points in the resistance element. Manufacturing difficulties are also found in making a supporting drum for the resistance elements so precise in form and dimensions that resistance elements made in accordance with a required precise pattern and mounted on the drum type supports will give the same values at corresponding points in two or more potentiometers employing the resistance elements. Also, if the drum type supports for the resistance elements are made to exact dimensions and the resistance elements are precision made and are simply bent around the drum type support and secured at their ends to hold them in place, expansion or contraction of the drum type support and the resistance elements under changing temperatures encountered in service often result in changing the resistance values obtainable at required points.

To overcome the difficulties above mentioned, the resistance element is measured electrically from required point to point and notations are made as to where the required values of resistance are obtainable or the resistance element is marked at the points where the required values of resistance are obtainable. The barrel portion of the drum type support 29 is made slightly smaller in diameter than the circle defined by the resistance elements when the resistance elements are bent to follow the pattern of the barrel portion of the drum type support. The lower end 34 of the drum type support 29, as above mentioned, is usually marked at spaced points to provide the series of marks numbered 35 to 66, the number and spacing of the marks being determined by the precise requirements to be met by the potentiometer device. It is not essential in all cases to make the marks on the drum type support since it is only necessary to note where particular points of the resistance element must be positioned to be engaged by the wiper contact when the wiper contact is in predetermined positions and to insure that the particular points in the resistance element will be in engagement with the wiper contact when the wiper contact is in the predetermined positions. Wherever a precise value of resistance is required to be obtainable in the potentiometer device the point on the drum which should be in registry with the required point on the resistance element is noted and the exact point on the resistance element at which the required resistance value is obtainable is clamped in place on the drum type support at the required point on the drum type support. The means for clamping the resistance element in place at the required point on the drum type support comprises the hoop 67 and other means used in cooperation therewith.

As shown in Figs. 1 and 2 the hoop 67 encircles the lower end portion of the barrel portion 31 of the drum type support 29 and is spaced therefrom. The hoop 67 is drilled and tapped at spaced points to accommodate a plurality of set screws numbered 100 to 131, inclusive, which are supported in the hoop 67 and located substantially in registry with the marks 35 to 66, inclusive, on the barrel portion of the drum type support and so that they may be turned to extend more or less closer to the barrel portion of the drum type support. Between the inner end of each set screw and the resistance element bent around the barrel portion of the drum type support is a small plate 132 which serves as a pressure distributing member when the set screw associated therewith is turned to move closer to the barrel portion of the drum type support. Each set screw and the plate engaged by the inner end thereof is used to clamp a required portion of the resistance element in place. Bands 133 and 134 of insulating material are mounted on the barrel portion 31 of the drum type support 29 to provide insulating means between the inner surfaces of the resistance elements and the barrel portion of the drum type support 29. The band 134 is a two-ply band and the layers are arranged so that it is of double thickness where engaged by the resistance element. A band 135 of insulating material is disposed between the outer surfaces of the resistance elements and the blocks 132.

In mounting the resistance elements on the

drum type support 29 certain predetermined points in the resistance elements where predetermined resistance values are obtainable are clamped in place by means of the hoop 67, the set screws 100 to 131 and the plates 132 and the points of clamping are maintained at all times during the operation of the potentiometer and these points of clamping are not disturbed even under differential expanding or contracting movements of the parts of the potentiometer under changes in temperature. Between the points of clamping the resistance elements and the bands 134 and 135 of insulating material may bulge away from or move toward the barrel portion 31 of the drum type support 29 as shown in Fig. 3. In this figure it will be seen that spaced points on the resistance elements 68 and 69 are clamped in place on the barrel portion 31 of the drum type support by means of the hoop 67, the set screws 100, 101, 102, 130 and 131 and the plates 132 and that the portions of the resistance elements 68 and 69 and the portions of the bands 134 and 135 of insulating material extending between the points of clamping are permitted some freedom of movement. The hoop 67 is a band of metal bent into circular form as shown in Fig. 2 and having the ends fastened together by welding or other suitable means such as the rivets 136. When the set screws 100 to 131 are tightened the hoop 67 is slightly expanded and some spring pressure is developed therein. Expansion of the barrel portion 31 of the drum type support under changes in temperature will result in the development of more spring pressure in the hoop 67 and contraction of the barrel portion 31 will result in a following corresponding contraction of the hoop 67. It will be seen as shown in Fig. 3 that the portions of the resistance elements extending between the points of clamping are bulged somewhat relative to the contour of the barrel portion 31 of the drum type support 29 as shown for instance at 137, that the bands 134 and 135 of insulating material are also somewhat bulged relative to the barrel portion 31 as illustrated at 138 and 139 and that since these parts are only clamped against movement at spaced points more or less bulging of the parts between the points of clamping is permitted without disturbing the points of clamping. If the parts expand or contract under changes in temperature the only result will be more or less bulging of the parts between the points of clamping and no movement of the parts at the clamped positions. The clamping points will therefore not be loosened under changes in size of the parts resulting from changes in temperature to which the potentiometer is subjected in service. After initial setting and assembling of the parts the potentiometer may be used in most climates without any change in the relative position of the parts at the point of clamping.

When the resistance elements 68 and 69 are clamped on the barrel portion 31 of the drum type support as shown in Fig. 3 and the points of clamping are particular points at which desired potentials are obtainable, these potentials will be obtained when a wiper contact rests on turns of the resistance wire at these points and the potentiometer is properly energized. Assuming that the potentiometer is used in determining in electrical values the azimuth position of an object, that the mark 35 is pointing north and the telescope 99 is pointing north and the wiper contact 96 is on point 35, if the object is in direct line with the mark 36 and the telescope is pivotally swung to a position to view the object, the wiper contact 96 will engage the turn of resistance wire at mark 36 and the potential obtainable at mark 36 will be obtained in the system in which the potentiometer is being used. The marks 36 and 37 may represent certain numbers of degrees east of the north line at 35 and the marks 66 and 65 certain numbers of degrees west of the north line and the precise potentials obtainable when the wiper contact is on these points will be electrical values representing the number of degrees the observed object is east or west of the north line. The potentiometer might be used in determining in electrical values the number of degrees an observed object is east or west from a south pole by using the mark 51 as the south pole position and rotating the wiper contact 96 east or west of the south pole position simultaneously with the bringing of the object observing means 99 into line with the object and by using the potentials obtained at the various points as means for controlling the operation of a suitable recording device. The potentiometer of the present invention may be located for instance at a station from which a target is being observed and the potentials obtained may be used to control the operation of an electrical signal transmitting device located at or near the target observing station. The transmitting device may be used to control the operation of a signal receiving device located at a gun position and operating to record at the gun position the direction the target is from the target observing station.

In some cases we may provide two wiper contacts 96, one being located directly opposite from the other and so that one wiper contact will be swept over the resistance elements 68 and 69 and the other over the resistance elements 70 and 71. In other cases we may provide a separate wiper contact 96 for each resistance element.

The invention is not limited to use in apparatus designed to determine the azimuth position of an object but may be used in other apparatus in which exact predetermined points on a resistance element mounted on a drum type support must be maintained in exact positions.

In the modification of the invention shown in Figs. 7, 8 and 9 the structure in general is like the potentiometer unit above described and the corresponding parts are identified by the same numerals. In this modification, however, a resistance element 140 is added to the device and the resistance element 140 is supported inside the drum type support 29. The resistance element 140 may follow the same general structure of the resistance elements above described and is held in required position by means of a hoop 141, set screws 142 to 173 and plates 174, the set screws 142 to 173 being located in tapped holes formed in the hoop 141 and being adjustable relative to the inner surface of the barrel portion 31 of the drum type support 29. The resistance element 140 is bent to conform to the inner side of the barrel portion 31 of the drum type support 29 and is held in place at spaced points by the set screws 142 to 173 and the plates 174. A two-ply band 175 of insulating material, is disposed between the inner surface of the resistance element 140 and the inner surface of the barrel portion 31 of the drum type support. A band 176 of insulating material is interposed between the plates 174 and the outer surface of the resistance element 140 and predetermined points of the resistance element 140, where required resistance values are obtainable, are clamped in place by means of the hoop 141,

the set screws supported therein and the plates 174. In this case a wiper contact like the wiper contact 96 shown in Fig. 1 might be provided to sweep over and frictionally engage the turns of resistance wire on the resistance element 140. In other cases the resistance element 140 might be used simply as a resistance pad in the potentiometer and not be engaged by a wiper contact. The resistance element 140 may be of any desired length within the limits of the circumference of the inside of the barrel portion 31 of the drum type support 29. When the resistance element 140 is shorter than the circumference of the inside of the barrel portion 31 a band 177 of insulating material of sufficient length to substantially complete the circle is provided. This is shown in Fig. 7 in which the resistance element 140 begins at a point in line with the mark 54 and extends counter-clockwise to a point in line with the mark 65 and the band 177 extends counter-clockwise from this latter point to the beginning of the resistance element 140. The thickness of the band 177 should be about equal to the thickness of the resistance element 140 so that it will fill the space between the bands 175 and 176 where no portion of a resistance element is present.

In some cases in the structures above described there may be portions of the resistance elements too narrow for the clamping means provided to be fully effective without the addition of a suitable filler piece. The resistance element may be, for instance, narrower at some portions than the plates 132 or 174. In such cases as shown in Figs. 6 and 9 a filler piece 178 of insulating material is provided to fill the space not filled by the resistance element.

What is claimed is:

1. An electrical resistance device comprising a drum type support, a resistance element bent to follow the curve of said support, a hoop concentric with said support and pressure developing means supported by said hoop and at spaced points on said hoop and cooperating with said hoop to exert pressure on said resistance element to hold said resistance element on said support at required spaced points on said support.

2. An electrical resistance device comprising a drum type support, a barrel portion on said support, a resistance element bent to follow the curve of said barrel portion, a hoop concentric with said barrel portion and pressure developing means adjustably supported at a plurality of spaced points in said hoop and cooperating with said hoop to clamp said resistance element on the barrel portion on said support at a plurality of spaced points.

3. An electrical resistance device comprising a drum type support, a barrel portion on said support, a resistance element bent to follow the curve of said barrel portion, a hoop concentric with said barrel portion and a plurality of set screws adjustably supported in said hoop and at spaced points thereof and cooperating with said hoop to hold said resistance element on said support at a plurality of spaced points.

4. An electrical resistance device comprising a drum type support, a barrel portion on said support, a series of spaced marks formed on said barrel portion, a hoop concentric with said barrel portion, a resistance element disposed between said barrel portion and said hoop and bent to follow the curve of said barrel portion, a plurality of set screws adjustably supported in said hoop and located in registry with said marks, plates disposed between said set screws and said resistance element, and said hoop, set screws and plates cooperating to clamp said resistance element on said support at points in registry with said marks.

5. An electrical resistance device comprising a drum type support, a barrel portion on said support, a band of insulating material on said barrel portion, a resistance element comprising a card of insulating material and a resistance wire wound in a plurality of turns on said card, a hoop concentric with said barrel portion, a plurality of set screws adjustably supported at spaced points in said hoop, said resistance element being disposed between said band of insulating material and said hoop, said set screws being adjustable relative to said resistance element, a series of plates disposed between said set screws and said resistance element, said hoop, set screws and plates cooperating to clamp said resistance element in place on said support and at spaced points on said support and the unclamped portions of said resistance element between the points of clamping being free to move relative to said barrel portion.

6. An electrical resistance device comprising a drum type support, a barrel portion on said support, a band of insulating material on said barrel portion, a series of spaced marks formed on said barrel portion, a resistance element comprising a card of insulating material and a resistance wire wound in a plurality of turns on said card, a hoop concentric with said barrel portion, a plurality of set screws adjustably supported at spaced points in said hoop, and in position in registry with said marks, said resistance element being disposed between said band of insulating material and said hoop, said set screws being adjustable relative to said resistance element, a series of plates disposed between said set screws and said resistance element, insulating means between said plates and said resistance element, said hoop, set screws and plates cooperating to clamp said resistance element in place on said support and at spaced points in registry with said marks and the unclamped portions of said resistance element between the points of clamping being free to move relative to said barrel portion.

7. An electrical resistance device comprising a drum type support, a barrel portion on said support, a hoop encircling said barrel portion, a second hoop spaced inwardly of said barrel portion, said hoops and said barrel portion being concentrically arranged, a resistance element located between the first hoop and said barrel portion, a second resistance element located between said second hoop and said barrel portion, a series of means supported at spaced points in the first hoop and cooperating therewith to hold the first resistance element in place on said barrel portion, and a second series of means supported at spaced points in said second hoop and cooperating with said second hoop to hold said second resistance element in place on said barrel portion.

8. An electrical resistance device comprising a drum type support, a barrel portion on said support, a hoop encircling said barrel portion and spaced therefrom, a series of set screws adjustably supported at spaced points in said hoop and projecting toward said barrel portion, a resistance element disposed between said hoop and said barrel portion, a plurality of plates located between said set screws and said resistance element, said hoop, set screws and plates cooperating to hold said resistance element on said barrel portion, a

second hoop, said second hoop being located inwardly of said barrel portion and in spaced relation therewith, a second series of set screws and a second plurality of plates, said second set of set screws being adjustably supported at spaced points in said second hoop and said second plurality of plates being disposed between said second series of set screws and said barrel portion, a second resistance element, said second resistance element being disposed between said barrel portion and said second plurality of plates, and said second hoop, series of set screws and plates cooperating to hold said second resistance element in place on said barrel portion.

9. In a potentiometer comprising a body, a shaft supported therein and a wiper contact mechanically connected to said shaft, a resistance unit, said wiper contact and said resistance unit being relatively movable and said resistance unit comprising, in combination, a flanged drum type support, a barrel portion on said support, a band of insulating material on said barrel portion, a resistance element having a card of insulating material and a resistance wire wound helically on the card, said resistance element being bent to follow the curve of said barrel portion and resting against said band, a hoop concentric with said barrel portion and spaced from said resistance element, a series of spaced marks formed on said barrel portion, a plurality of set screws adjustably supported in said hoop and extending in registry with said marks, a plurality of plates, one for each set screw, disposed between said set screws and said resistance element, insulating means located between said plates and said resistance element, and said hoop, set screws and plates cooperating to clamp said resistance element on said support and at points in registry with said marks.

10. In a range finder apparatus in which detecting means are provided to detect the presence of an object in an area and in which the detecting means is rotatable in an arc and from one predetermined point to another predetermined point in the arc and is mechanically connected to a movable conducting means in a potentiometer, a resistance unit in the potentiometer comprising, in combination, a drum type support, a barrel portion on said support, a resistance element bent to conform to the curve of said barrel portion, a hoop concentric with said barrel portion and a series of clamping means supported by said hoop and operating in cooperation with said hoop to clamp said resistance element on said barrel portion at a plurality of predetermined spaced points on said barrel portion corresponding to the point to point movement of the detecting means.

11. In a range finder apparatus in which means are provided to scan an area to determine the presence of an object in the area and in which the area scanning means is rotatable in an arc and is mechanically connected to a movable conducting means in a potentiometer, a resistance unit in the potentiometer comprising, in combination, a drum type support, a barrel portion on said support, a resistance element bent to conform to the curve of said barrel portion, a series of spaced marks formed on said barrel portion and representing point to point rotation of the area scanning means, a hoop concentric with said barrel portion and a series of clamping means supported by said hoop and in registry with said marks and operating in cooperation with said hoop to clamp said resistance element on said barrel portion and at points in registry with said marks.

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