

Feb. 28, 1967

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3,307,133

PARALLEL GANGED MULTIPLE POTENTIOMETER

Filed Aug. 16, 1963

2 Sheets-Sheet 1

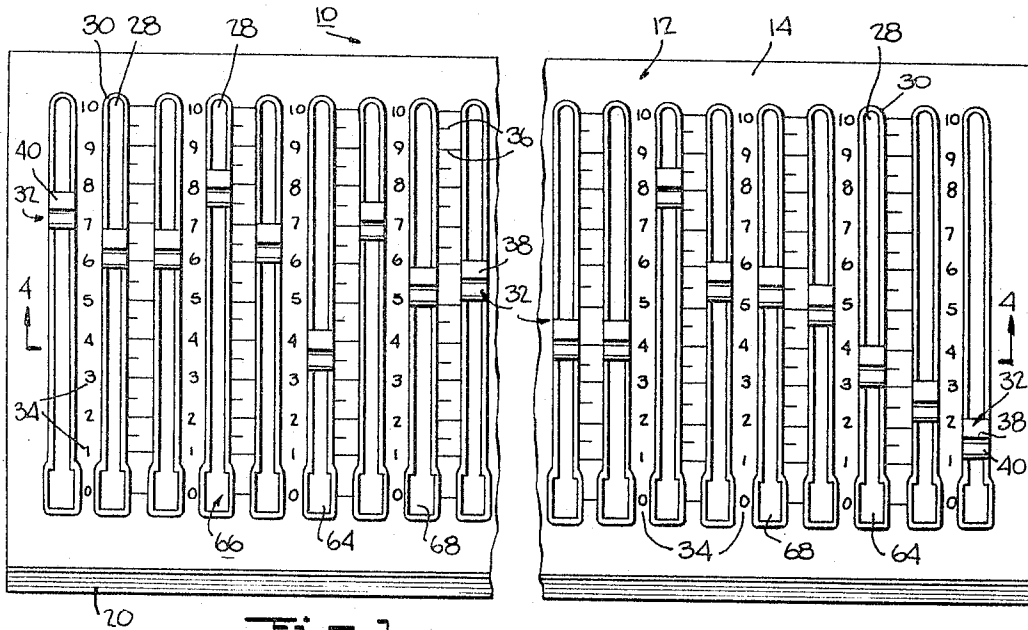


Fig. 1.

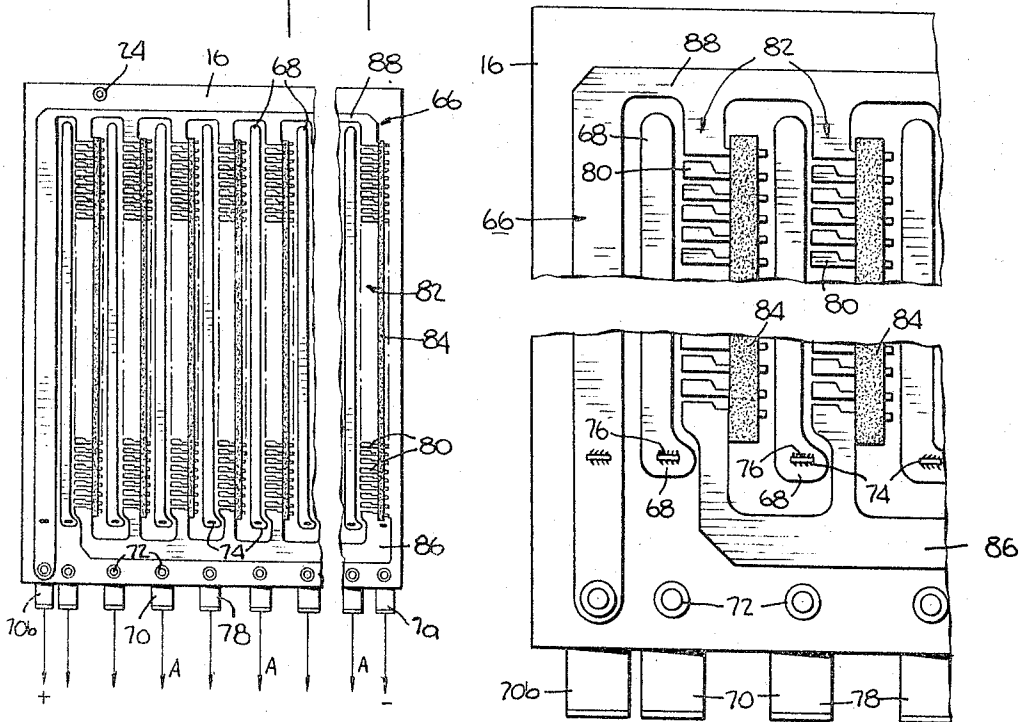


Fig. 2.

Fig. 3.

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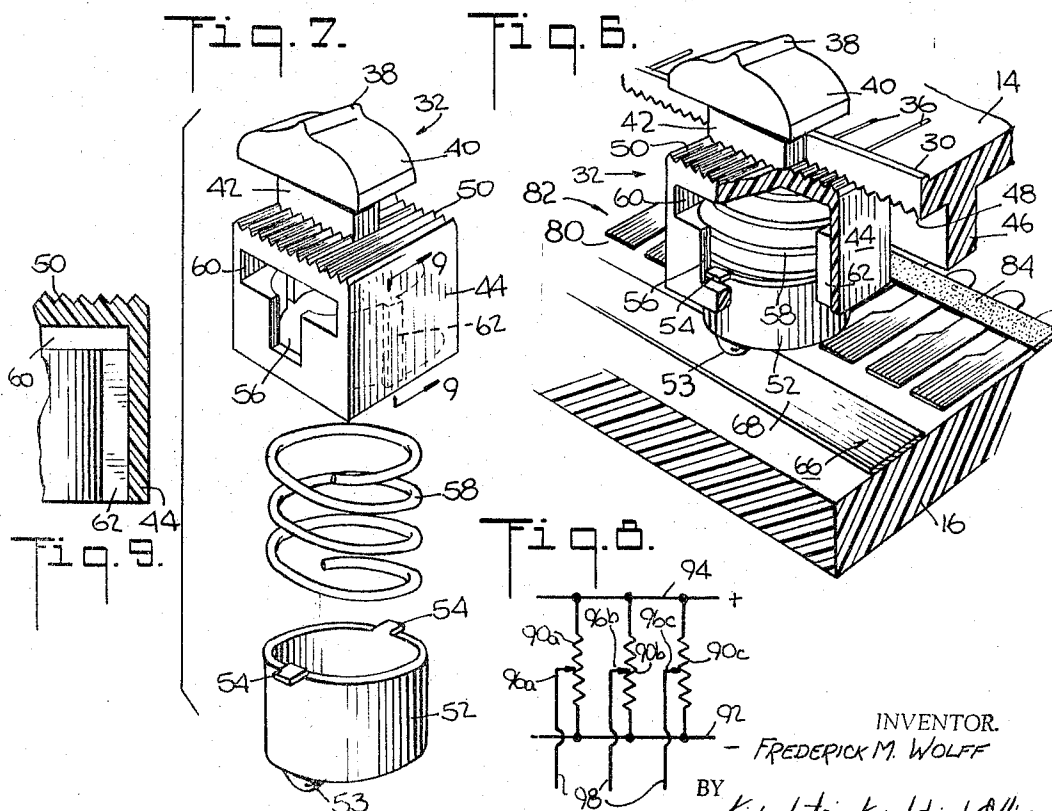
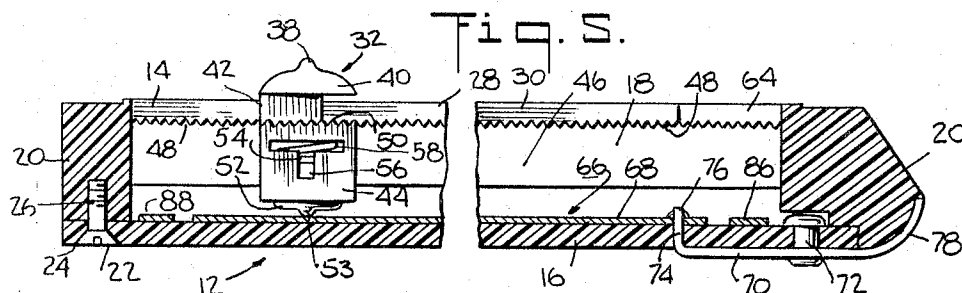
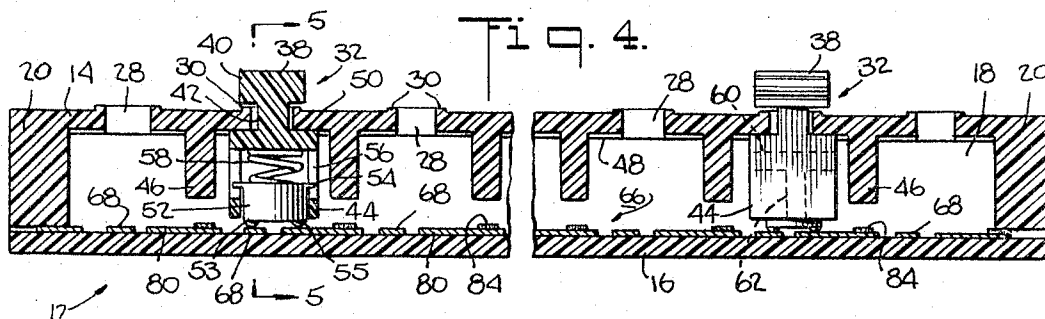
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PARALLEL GANGED MULTIPLE POTENTIOMETER

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2 Sheets-Sheet 2



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PARALLEL GANGED MULTIPLE
POTENTIOMETER

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Filed Aug. 16, 1963, Ser. No. 302,595
3 Claims. (Cl. 338—194)

This invention relates to a parallel ganged multiple potentiometer.

It is an object of my invention to provide an improved parallel ganged multiple potentiometer which is light weight, rugged and compact and has its voltage pickoffs adapted for convenient connection into a control circuit.

It is a further object of my invention to provide a parallel ganged multiple potentiometer of the character described wherein the potentiometer voltage pickoffs are automatically locked in position after they have been brought to any selected point and wherein the pickoffs may be readily unlocked by quick manual manipulation and moved to another point after which they are again automatically locked in position, whereby to prevent accidental or unintended movement of the voltage pickoffs.

It is yet another object of my invention to provide a parallel ganged multiple potentiometer of the character described whose construction is particularly adapted to incorporate a printed circuit, resulting in a compact unit and affording economy of manufacture and ease in assembly.

It is another important object of my invention to provide a parallel ganged multiple potentiometer of the character described which has an electrical circuit that uses parallel printed carbon resistance bands to furnish voltage gradients and which is so constructed that no abrasive wear is applied to these bands so as to promote constant resistance and long life for the unit.

These and various other objects and advantages of my invention will become apparent to the reader in the following description.

My invention accordingly consists in the features of construction, combinations of elements and arrangements of parts which will be exemplified in the device herein-after described and of which the scope of application will be indicated in the appended claims.

In the accompanying drawings in which is shown one of the various possible embodiments of my invention,

FIG. 1 is a fragmentary plan view of a parallel ganged multiple potentiometer constructed in accordance with my invention;

FIG. 2 is a fragmentary top view of the upper face of the bottom wall of my potentiometer on which are imprinted collector, tap and resistance components;

FIG. 3 is an enlarged fragmentary view of an end portion of the wall shown in FIG. 2;

FIG. 4 is an enlarged fragmentary cross-sectional view taken substantially along the line 4—4 of FIG. 1;

FIG. 5 is an enlarged fragmentary cross-sectional side view taken substantially along the line 5—5 of FIG. 4;

FIG. 6 is an enlarged fragmentary partially broken away perspective view of a sliding bridge contact and the cooperating printed components of the potentiometer;

Fig. 7 is an enlarged exploded perspective view of the several parts of the sliding bridge contact;

FIG. 8 is a partial schematic diagram of the electric circuit provided by my potentiometer; and

FIG. 9 is a fragmentary cross-sectional view taken substantially along the line 9—9 of FIG. 7.

Referring now in detail to the drawings, the reference numeral 10 denotes a parallel ganged multiple potentiometer constructed in accordance with my invention. A hollow flat elongated casing 12 houses and supports the

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several other components of the potentiometer and is composed of light weight electrically non-conductive tough material. The casing 12 comprises a shell 14 and a flat bottom wall 16, both of these parts being elongated and generally planar, and substantially of the same plan contour and dimensions. The shell is preferably formed from a high impact thermo-plastic resin such as an acrylonitrile-butadiene-styrene polymer. A plastic material sold as "Cyclocac" by the Marbon Chemical Division of the Borg-Warner Corporation has been found suitable. The bottom wall is preferably formed from fabric plies impregnated with a phenol formaldehyde condensation resin. The shell 14 and the bottom wall 16 define therebetween an elongated rectangular enclosed operating space 18 and to this end, short side walls 20, unitary with the shell 14, depend downwardly therefrom so as to space the top wall of the shell from the wall 16, said side walls being joined at their bottom edges to the top surface of the bottom wall 16 as by screws 22. The screws 22 pass through countersunk apertures 24 in the bottom wall 16 and are threaded into aligned tapped bores 26 in the side walls 20.

The top wall of the shell 14 includes numerous elongated parallel spaced slots 28 of uniform width over their major portions which slots extend through the shell and are transversely disposed to the length of the casing 12. Each slot is narrow as compared to its length and each lies along parallel axes. Preferably, these axes are linear and are mutually transverse to the length of the casing 12. Every slot 28 is outlined by an adjacent narrow low ridge 30 on the top surface of the shell 14. There may be as many slots as desired for a particular installation, and, as will shortly be described, each slot is associated with a different single potentiometer voltage pickoff. I utilize 30 slots (and therefore 30 potentiometer voltage pickoffs) in a typical embodiment of my invention.

A sliding bridge contact 32 rides in each of these slots 28 and is mounted for parallel movement, i.e. is adapted to be selectively moved, as by the hand of a user, to any desired position along its affiliated slot. Raised numerical indicia 34 and raised index lines 36 are disposed alongside each slot with which a raised index bar 38 on the top of each sliding bridge contact 32 may be aligned to indicate the relative position of the bridge contact 32 along its associated slot 28.

As each bridge contact 32 is similarly constructed, only one will be described in detail. The bridge contact 32 has an enlarged flat-bottomed head 40 whose top surface is slopingly contoured for convenient pushing or gripping by a hand of a user. The width of the head 40 is greater than the width of the slot 28 so that the bridge contact 32 cannot fall through the slot. The planar bottom surface of the head 40 slides along its affiliated slot on the raised low ridges 30 adjacent each top side edge of the slot.

A constricted neck 42 depends from the head 40 of the sliding bridge contact 32 and unitarily joins the head to a cubical hollow dielectric body 44 of the bridge contact. The neck 42 is slightly narrower than the width of the slot 28 to permit it to slide within the slot and yet is wide enough to prevent excessive movement therein. The neck is elongated in a direction parallel to the length of the slot and is formed with parallel side walls whereby to prevent twisting movement of the neck in the slot.

Longitudinal ribs 46 run along the underside of the top wall of the shell 14 and are unitary therewith. Each rib 46 runs midway between two adjacent slots 28 from the front to the rear side walls 20. The ribs 46 serve to strengthen the shell 14 and to physically isolate the various bridge contacts from one another in the event any particular bridge contact should break and no longer be confined by its affiliated slot.

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A section of the casing, e.g. the under surface of the top wall of the shell 14 is serrated to form a multitude of mutually parallel tiny teeth 48 which are elongated parallel to the length of the casing 12, i.e. transverse to the slots 28, and are interrupted by the slots. An abutting section of the bridge contact 32, e.g. the top surface of the sliding bridge contact body 44, also includes parallel teeth 50 of matching contour and dimensions for disengageable connection, i.e. engagement, with the teeth 48 on the shell undersurface.

Spring means 58 biases the bridge contact 32 upwardly so that the teeth 50 on the upper surface of the bridge contact body 44 are urged into engagement with the teeth 48 on the bottom surface of the shell 14 along the slots 28 whereby to lock the sliding bridge contact in any desired position along an associated slot. This engagement effectively restrains the bridge contact from undesired or accidental movement along the slot 28 that might be caused by vibration of the electrical unit in which my potentiometer 10 is installed, or by an unintended light touch by the hands or body of a user.

The neck 42, when the teeth 48, 50 are engaged, holds the under surface of the head 40 spaced from the low ridges 30 on which it rides. Downward force exerted by the hand of a user on the head 40 overcomes the spring means biasing force and moves the body 44 downwardly to clear the bridge contact teeth 50 from engagement with the shell teeth 48. This permits sliding movement of the bridge contact 32 along the slot 28 and hence movement of the bridge contact body 44 within the operating space 18.

The bridge contact body 44 houses within the downwardly opening hollow well defined by its sidewalls a conductive portion, e.g. an upwardly opening cup-shaped bridge button 52 formed from an electrically conductive material, such as brass. Two diametrically opposed nibs 53, 55 protrude downwardly from the bottom of the bridge button 52 and are integral therewith. Said nibs are spaced apart in the direction of the length of the casing 12. The button 52 projects downwardly from the body 44 and is slidably mounted for vertical movement relative to the bridge contact body 44. To this end, the interior of the body 44 defines in part a downwardly opening substantially cylindrical bore (well) of slightly larger diameter than the button 52. The button 52 slides in this bore. The top edge of the button 52 has two diametrically opposed tabs 54 extending radially outwardly therefrom which slide with the button 52 and which ride in opposed vertical through slots 56 in the side walls of the body 44. The tabs 54 limit downward movement of the button 52 beyond a point at which the tabs 54 abut the closed bottom ends of the slots 56. The tabs also restrict relative rotation between the button 52 and the body 44, when the tabs are within these slots.

A helical coil spring 58 disposed within the top portion of the cylindrical bore within the body 44 urges the bridge button 52 downwardly and into electrical contact with lines of the printed circuit 66. The biasing action by the coil spring 58 on the button 52 simultaneously causes an opposed upward force on the sliding bridge contact body 44 forcing the body teeth 50 into engagement with the teeth 48 on the shell bottom surface, as previously described.

A laterally disposed open-ended through slot 60 in the top portion of the body 44 and internal inwardly and downwardly opening vertical opposed entry grooves 62 in the body 44 are provided for assembly of the sliding bridge contact 32. The slot 60 passes through the pair of opposed body walls in which the slots 56 are contained and is connected therewith, the grooves 62 being formed within the other set of opposed body walls. The distance between the grooves 62 and their width is sufficient to allow entry of the button 52 and its tabs 54.

In assembly of the bridge contact 32, first the helical spring 58 is placed in the cylindrical cavity within the

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body 44 and thereafter the bridge button 52, tab-end-first, is slid upward as by the assembler's finger against the force of this spring, the tabs 54 sliding in the internal grooves 62. When the tabs 54 have been slid to the ends of the grooves 62 and into the through slot 60, the button 54 is axially rotated 90°, the slot 60 preventing interference between the rotating tabs 54 and the body walls. After the 90° rotation, the tabs 54 will be above and in alignment with the vertical slots 56, into which, upon release, they are directed by the biasing force of the coil spring 58. This completes the assembly of the sliding bridge contact 32, the converse order of steps being taken for disassembly. The bridge contacts 32, after they are assembled, enter the slots 28 from beneath by means of enlarged openings 64 on the ends of the slots, these openings being dimensioned to allow entry only of the head 40 and not the body 44. The bottom wall 16, when subsequently joined to the shell 14, is spaced closely enough to the shell so as to prevent the sliding bridge contacts 32 from falling through openings 64, should any contact be slid to this area.

The bottom wall 16 of the casing 12 is flat, as has been mentioned, and carries thereon a printed circuit 66, on parts of which the bridge button nibs 53, 55 ride. The printed circuit is placed on the bottom wall 16 by standard processes, such as dipping, printing or plating, being formed with a copper base and a tin or rhodium cover layer or plate. A hard electrically conductive material such as rhodium is preferred to reduce wear due to continual sliding movement of the bridge button 52 over components of the printed circuit. The printed circuit 66 includes numerous parallel electrically conductive printed straight collector strips 68, each of which runs parallel to and approximately underneath an affiliated different slot 28 in the shell 14. The strips 68 are all of like uniform width and length. The collector strips 68 at one of their ends are each joined to a separate fixed contact 70, which is adapted to be electrically connected into the electrical circuit with which the potentiometer 10 will be used, as indicated by the arrows A in FIG. 2.

Each fixed contact 70 is mechanically joined to the bottom surface of the bottom wall 16 as by a rivet 72 which passes through the contact and the bottom wall, and each contact has one L-shaped end 74 which passes through the bottom wall and is joined to the end of an affiliated collector strip 68 as by solder at 76. The front end 78 of each fixed contact 70 is upwardly curved and lies in a matching groove in the front side wall 20 (see FIG. 5). As the bridge contact 32 slides along the slot 28, one nib 53 of the conductive button 52 rides along an affiliated collector strip 68.

The printed circuit 66 further includes a multitude of discrete elongated mutually parallel closely spaced electrically conductive tap segments 80. The tap segments 80 are disposed in parallel and preferably rectilinear rows 82, each row of segments being parallel to and between two adjoining collector strips 68. The rows of tap segments are parallel to one another as well as to the slots 28. Within each row, the tap segments have their long axes parallel to the longitudinal axis of the casing 12, i.e., perpendicular to the length of the row. One side of each row 82 of tap segments 80, i.e., the enlarged sides of all the segments in each row, underlies a portion of an associated slot 28. The other nib 55 of the button 52 rides along this side of an affiliated row.

The other (narrow) sides of the tap segments of each row 82 are electrically connected by a straight bare ablatable resistance band 84, e.g., of carbon in a matrix of a synthetic resin, one such resistance band being parallel to and electrically connecting the tap segments of each row 82. The resistance band 84 overlies the narrow segment ends, and the taps are thus electrically connected to an affiliated resistance band at equidistantly axially spaced points. The material from which the resistance band 84 is formed may be silk screened over the metallic narrow

ends of the printed tap segments. A suitable product for this purpose is Conductive Ink #EL-796, manufactured by the Advance Process Co. The Conductive Ink may be air dried or force dried, the latter method, under controlled temperature and humidity, reliably providing a uniform resistance. Such ink essentially comprises a thermoplastic binder dissolved in an organic solvent to form a liquid carrier throughout which there is a heavy dispersion of fine carbon powder.

Printed bus strips 86, 88 electrically interconnect like ends of the resistance bands 84 in parallel, one bus strip 86 connecting the ends of all the bands adjacent the front of the casing 12 to one input fixed contact 70a and the other bus strip 88 connecting the ends of the bands adjacent the rear of the casing 12 to another input fixed contact 70b. For convenience, the input contacts 70a, 70b are placed at opposite ends of the line of contacts.

FIG. 8 is a schematic electrical diagram of the printed circuit 66, showing by way of example three potentiometer voltage pickoffs. Three resistance components 90a, 90b and 90c are connected in parallel between two input busses 92, 94 the latter being connected to a source of electrical potential. The busses 92, 94 of the schematic diagram represent, respectively, the busses 86, 88 of the printed circuit and the resistance components 90, the resistance bands 84 and associated tap segments 80 of the printed circuit. Movable contacts 96a, 96b and 96c pick off potential from their affiliated resistance components, respectively 90a, 90b and 90c, at any points along the potential drop between the input busses 92, 94. The contacts in the schematic diagram are embodied by the sliding bridge contacts 32. A lead 98 is provided to connect each of the schematic contacts 96 to a point external to the potentiometer and is adapted to be electrically joined to an affiliated control circuit, the collector strips 68 and the fixed contacts 70 of the potentiometer 10 serving the same function as the leads 98.

The operation of my parallel ganged multiple potentiometer 10 is, with the previous description in mind, quite simple. The endmost fixed contacts 70a and 70b are electrically connected to the output terminals of any suitable source of electrical potential. The busses 86 and 88 will thereby be differentially charged and a voltage drop will ensue across each resistance band 84. Since each individual band has a uniform unit resistance lengthwise the voltage gradients along the different bands will be the same even if the unit resistance of the different bands are not alike.

Each sliding bridge contact 32 rides along a slot 28. When in any selected position along the slot, the helical coil spring 58 urges the teeth 50 on the body 44 into engagement with the teeth 48 on the undersurface of the top wall of the shell and the button 52 into electrical contact with the printed circuit 66. When so engaged, the sliding bridge contact is locked against accidental and unintended movement as by unwanted vibration of the panel in which the potentiometer 10 is installed. When it is desired to move the sliding bridge contact 32, the contact is pushed downwardly, overcoming the coil spring's biasing force, so that the head 40 rides on the raised low ridges 30 and so that the teeth 48, 50 are clear of one another. The contact is then pushed along the slot 28 in either direction to another desired position, whereupon it is released, the coil spring again engaging the teeth 48, 50 and locking the contact 32 in place.

As has been mentioned, the conductive button 52 has two conductive nibs. One nib 53 rides on and is in electrical contact with an associated collector strip 68, the latter being connected to a contact 70 and the other nib 55 rides on the enlarged sides of tap segments 80 in a row 82 of such segments, each of the latter being connected at its narrow side to successive points of the associated resistive band 84. The nib 55 is of sufficient width and the tap segments 80 are closely enough spaced so that the nib always contacts at least one but never more

than two adjacent tap segments. The lines of the printed circuit on which the nibs 53, 55 ride are preferably of hard electrically conductive material as rhodium so that they do not wear out. The nibs 53, 55 through the bridge button 52 interconnect any one or two tap segments 80 to an associated collector strip 68 at any point along the resistance band 84, thereby picking off any desired potential drop between the busses 86, 88 and leading this voltage to the fixed contact 70. It will be noted that the nibs do not ride over the ablatable resistance bands 84 so that the resistance of the unit is not subject to variation due to abrasive wear.

The electrical device heretofore described houses and combines numerous individually adjustable potentiometer voltage pickoffs in convenient close proximity to one another and within a small and compact casing. The unit as a whole may be quickly mounted and easily manually manipulated by the hand of a user. The potentiometer 10 is particularly well suited for mounting in a console or control panel.

The multiple ganged parallel potentiometer 10 with which a reader of the instant disclosure is now familiar has particular value in use with stage and television lighting, and can be easily incorporated into a lighting control circuit as disclosed in Izenour, United States Letters Patent Re. 23,575.

It thus will be seen that I have provided a device which achieves the several objects of my invention and which is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiment set forth, it is to be understood that all matter herein described or shown in the accompanying drawings is to be interpreted as illustrated and not in a limiting sense.

Having thus described my invention, I claim as new and desire to secure by Letters Patent,

1. A parallel ganged multiple potentiometer comprising a casing including numerous elongated linear parallel narrow slots, numerous bridge contacts each mounted for parallel sliding movement in a different slot, a wall of said casing and a section of each bridge contact both having teeth of like contour, spring biasing means urging said teeth into disengageable interconnection so as to selectively lock any bridge contact along on its associated slot, and electrical printed circuit means carried by a wall of the casing, said printed circuit means comprising input busses, numerous ablatable resistance bands electrically connected in parallel between the busses so as to each induce a like voltage gradient, conductive abrasion-resistant tap segments disposed in rows parallel to the slots, each row being associated with a different resistance band and each tap segment being electrically joined to its affiliated resistance band at an axially spaced discrete point, numerous fixed contacts, and elongated linear collector strips each electrically connected to a different fixed contact, an electrically conductive portion of each bridge contact riding along and thereby electrically connecting a different collector strip and at least one tap segment of an associated row whereby to selectively variably pick off a desired voltage from along any single voltage gradient and to lead said voltage to its fixed contact, the electrically conductive portion of each bridge contact constituting a button mounted for sliding movement within the bridge contact, the spring biasing means urging the button into electrical contact with the printed circuit means.

2. A potentiometer comprising a casing including narrow elongated slots, a different bridge contact mounted for sliding movement along each slot, and electrical printed circuit means carried by a wall of the casing, said printed circuit means including input busses, an ablatable carbonaceous resistance film band electrically connected between the busses so as to induce a voltage gradient, conductive abrasion-resistant tap segments disposed in a row extending parallel to each slot, each tap segment

having a narrow end joined to and overlain by the resistance band at an axially spaced different discrete point and a collector strip parallel to said row, an electrically conductive portion of each bridge contact riding along and thereby electrically connecting the collector strip and at least one tap segment of the row whereby to selectively variably pick off a desired voltage from along the voltage gradient, said slot having an enlarged opening at one end, said bridge contact including an electrically non-conductive one-piece member constituting a head smaller in outline than the opening, a body carrying said electrically conductive portion and a constricted neck joining and spacing the head and the body, whereby the head and not the body can enter the opening and the neck can slide within the slot, said electrically conductive portion of each bridge contact being an electrically conductive button carried by the contact.

3. A potentiometer comprising a casing including narrow elongated slots, a different bridge contact mounted for sliding movement along each slot, and electrical printed circuit means carried by a wall of the casing, said printed circuit means including input busses, an ablatable carbonaceous resistance film band electrically connected between the busses so as to induce a voltage gradient, conductive abrasion-resistant tap segments disposed in a row extending parallel to each slot, each tap segment having a narrow end joined to and overlain by the resistance band at an axially spaced different discrete joint and a collector strip parallel to said row, an electrically conductive portion of each bridge contact riding along and there-

by electrically connecting the collector strip and at least one tap segment of the row whereby to selectively variably pick off a desired voltage from along the voltage gradient, the electrically conductive portion of each bridge contact being an electrically conductive button, the contact including means mounting the button for sliding movement towards and away from the wall of the casing on which the circuit means is carried, spring means urging the button towards the circuit means, and means restricting the button against rotation relative to the bridge contact, said button having a first integral portion riding along a collector strip associated with said bridge contact and another integral portion riding along a row of tap segments associated with the same bridge contact.

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