June 25, 1968 G. C. IZENOUR 3,390,366

GANG OF VARIABLE RESISTANCE DEVICES WITH REMOVABLE BOARD CARRYING SETTABLE TAPS

Filed Aug. 12, 1966 3 Sheets-Sheet 1

FIG. 1

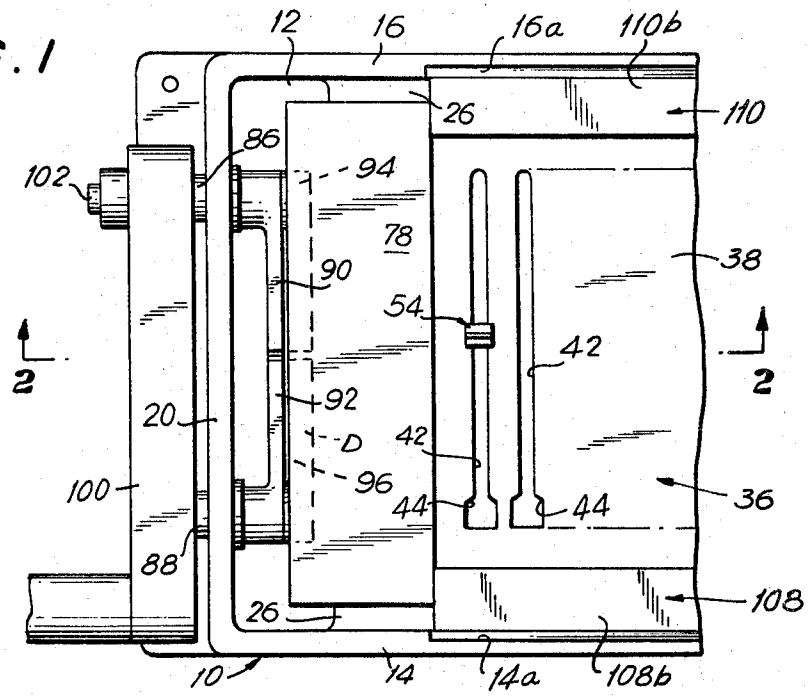
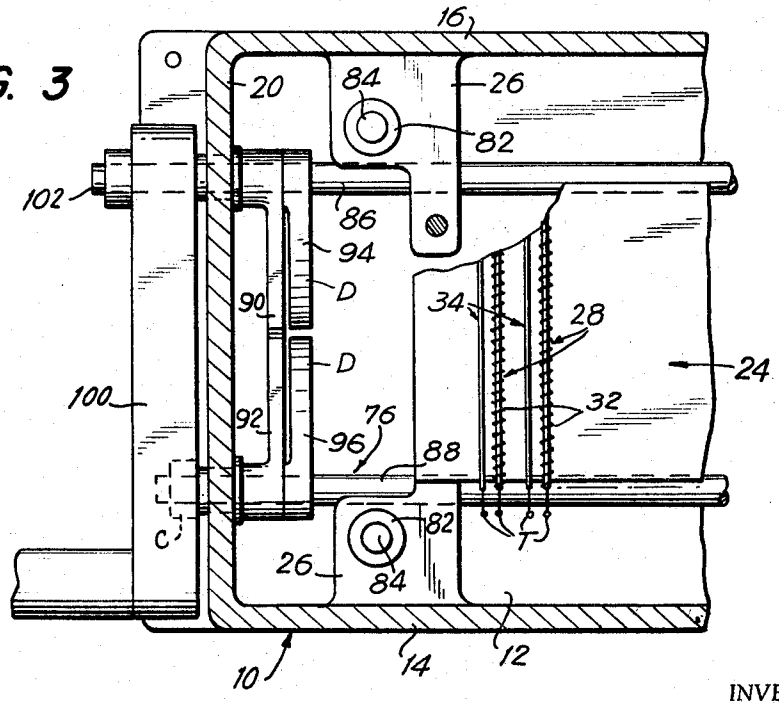


FIG. 3



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Filed Aug. 12, 1966 3 Sheets-Sheet 2

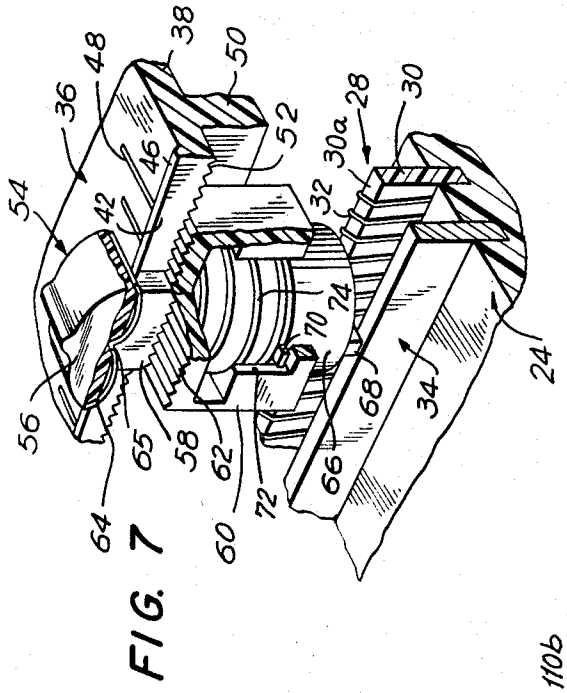


FIG. 7

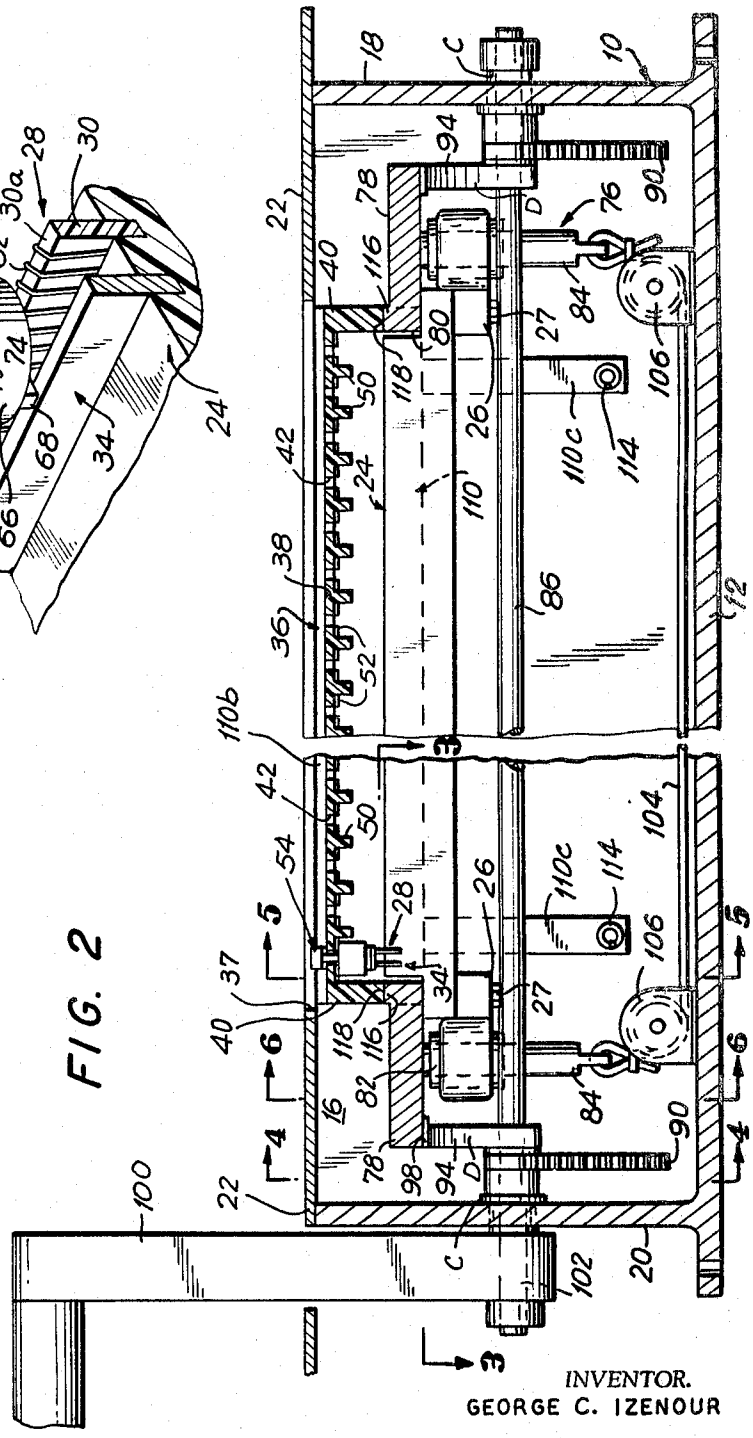


FIG. 2

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GANG OF VARIABLE RESISTANCE DEVICES WITH REMOVABLE BOARD CARRYING SETTABLE TAPS

Filed Aug. 12, 1966 3 Sheets-Sheet 3

FIG. 4

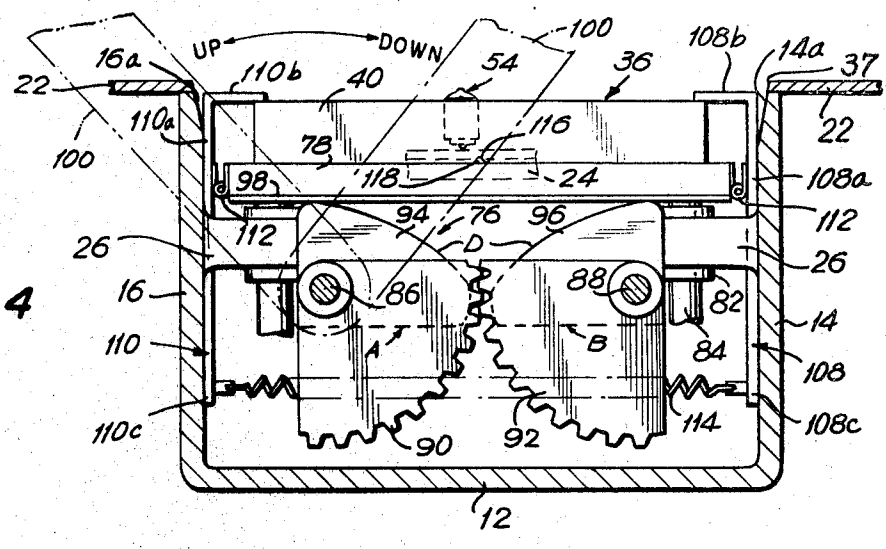
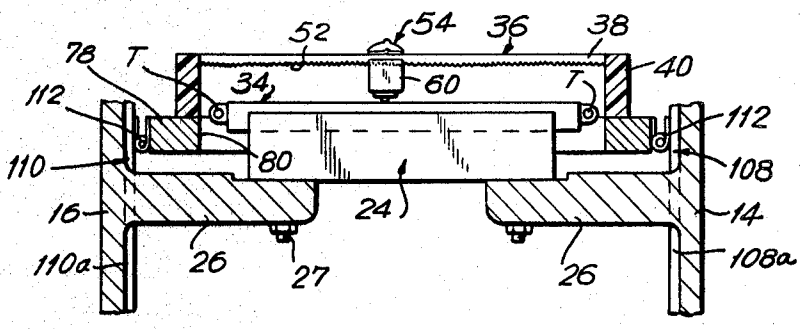


FIG. 5



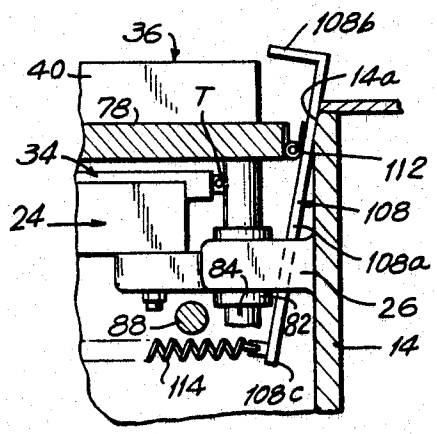


FIG. 6

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United States Patent Office 3,390,366
Patented June 25, 1968

3,390,366

GANG OF VARIABLE RESISTANCE DEVICES WITH REMOVABLE BOARD CARRYING SETTABLE TAPS

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Filed Aug. 12, 1966, Ser. No. 572,133
9 Claims. (Cl. 338—130)

ABSTRACT OF THE DISCLOSURE

An electrical unit composed of a stationary member on which there are fixed several resistance strips each with an affiliated collector alongside the same and spaced therefrom, a panel, voltage taps carried by the panel, the taps being settable along slots in the panel, an elevator carriage on which the panel is removably rested, means to move the elevator carriage and with it the panel from an elevated position in which the taps are spaced from the resistance strips and collectors to a lowered position in which each tap connects an associated collector to a point along the affiliated resistance strip, the tape being releasably retained on the panel in any position to which the taps are set, the taps holding such settings when the panel is either removed from the elevator carriage or when resting thereon in elevated position or when the elevator carriage and panel are in lowered position, the panel being locked against the elevator carriage when the carriage is in lowered position.

The present invention relates to an electrical unit comprising a gang of variable resistance devices as embodied in a parallel ganged multiple potentiometer.

It is the primary object of my invention to provide an electrical unit wherein a large number of different variable presettable voltage values can be substituted as a group for another large number of different variable presettable voltage values.

It is another object of my invention to provide a parallel ganged multiple potentiometer including resistors and slidable voltage taps wherein the resistors are permanently mounted on a fixed member and wherein different groups of voltage taps are carried by different panels each of which is quickly and easily attachable to and removable from the fixed member.

It is still another object of my invention to provide a parallel ganged multiple potentiometer of the character described wherein the different groups of voltage taps are presettable on their associated panels so that when the panel is attached to the fixed member and the potentiometer circuit is energized, predetermined voltages will be picked from the circuit by the taps.

It is still another object of my invention to provide a parallel ganged multiple potentiometer of the character described further including an elevator which is manually operable to aid in lifting the tap-carrying panel from the physically fixed resistors and lowering the panel to couple with the resistors.

It is still another object of my invention to provide a parallel ganged multiple potentiometer of the character described further including a locking mechanism for retaining the panel with its voltage taps in proper location relative to the fixed member, the locking mechanism being coordinated with the elevator so that the panel is locked in position immediately after the elevator lowers the panel to couple with the fixed member.

It is still another object of my invention to provide a parallel ganged multiple potentiometer of the character described wherein the slidable taps on each panel remain

in the positions to which they are set on the panel until the taps are relocated by the user of the potentiometer.

Other objects of my invention in part will be obvious and in part will be pointed out hereinafter.

My invention accordingly consists in the features of the construction, combination of elements and arrangements of parts which will be exemplified in the parallel ganged multiple potentiometer hereinafter described and of which the scope of application will be indicated in the appended claims.

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

FIG. 1 is a top plan view of one end of my parallel ganged multiple potentiometer shown with the cover plate removed;

FIG. 2 is a fragmentary vertical cross-sectional view taken substantially along the line **2—2** of FIG. 1;

FIG. 3 is a fragmentary partially cross-sectional and partially broken away view of my potentiometer taken substantially along the line **3—3** of FIG. 2;

FIGS. 4, 5 and 6 are cross-sectional views taken substantially along the lines, respectively, **4—4**, **5—5** and **6—6** of FIG. 2, said last two views being fragmentary and the last view showing the elevator raised; and

FIG. 7 is a fragmentary partially broken away perspective view of a sliding voltage tap riding on the panel and bridging a resistance strip and a collector strip.

In general, and in accordance with the teaching of my invention, I provide a parallel ganged multiple potentiometer, that is, an electrical unit, comprised of a group of individual slide potentiometers. Each individual potentiometer includes, as is conventional, a resistor, a collector and a moveable tap bridging the resistor and collector and slidable along the resistor to pick off any desired voltage. The primary novelty of the present invention is that the voltage taps as a group can be selectively separated from or rejoined to the resistors and collectors and can be replaced by a similarly physically structured group in which at least some of the taps are at different settings. The taps can be individually prepositioned (preset) as desired, on a panel which carries them, and when the panel is connected to a stationary member which carries the resistors and collectors, the taps as preset are automatically connected into the potentiometer circuit. An extremely simple and rapid change from one set of voltage values to another set of voltage values thus can be accomplished by substituting one panel for another, with the values of each set having been predetermined and preset.

Referring now in detail to the drawings, the reference numeral **10** denotes a mounting member in the form of a box-like oblong casing which is a stationary, i.e. fixed, part of a control console for a light regulating system, such as for the lights of a television studio or of a theater. The casing **10** is hollow and includes a floor **12**, parallel side walls **14**, **16** and parallel end walls **18**, **20**. The casing is open at its top except for a cover plate **22**, which partially overlays the top of the casing along its side border and over its ends, said plate only being shown in FIGS. 2 and 4.

A horizontal resistance block **24** is permanently mounted in the casing. Said block is rectangular in plan, rigid and is formed from a nonconductive material, e.g. phenol-formaldehyde, and carries, as will be more fully described, numerous parallel pairs of exposed resistance strips and exposed collector strips. The resistance block **24** is held at its corners by four inwardly protruding horizontal coplanar brackets **26**, which extend from the walls of the casing **10**. The block is attached to the brackets as by bolts **27** and said brackets form a support to secure the block within the casing.

As has been mentioned, the resistance block carries

numerous resistance strips **28** and numerous collector strips **34**, all of said strips being parallel and each resistance strip being closely spaced to and affiliated with a different collector strip. One such pair of strips is illustrated in FIG. 7. Of each pair, a resistance strip **28** comprises an elongated thin bar **30** of rectangular cross-section formed from insulating material, e.g. a phenol-formaldehyde. A high-resistance wire **32**, e.g. Nichrome wire, is helically wound about the bar **30** along its entire length, the convolutions being juxtaposed. The surface of the wire is insulated, as by a lacquer coating, except that it is bare along the top face **30***a* of the resistance bar **30**. Thus, in effect the resistance strip is a conventional wire wound straight resistor. Terminals T are attached to the wire **32** on each end of the bar **30**.

The collector strip of each pair comprises an elongated thin bar **34**, the bar **34** being closely spaced to, e.g. ⅜ of an inch, parallel to and substantially coextensive with the bar **30**. The bar **34** is formed from a material of high conductivity, e.g., copper, and constitutes a collector strip for its affiliated resistance strip. The collector **34** has a terminal T on one end thereof. Both the resistance strip and the collector strip of each pair extend transversely across the resistance block **24** and preferably extend slightly beyond the side edges of the block. The resistance block carries the various strips and preferably the strips are partially embedded in the top surface of the block. For this purpose the block is formed of a synthetic plastic resin and the strips are either molded therein or set into transverse slots. A large number of pairs of strips are uniformly spaced on the resistor block between the ends thereof. The pairs may be approximately 25 in number. For the purpose of clarity, only one or two pairs of collectors and resistance strips are illustrated in the various views of the drawings. It will be observed that the pairs of strips are arranged in definite permanent relative locations.

A horizontal tap-carrying panel **36** is an important component of my invention. The panel is rectangular in plan and is dimensioned so that it will fit through a rectangular opening **37** in the cover plate **22**.

Said panel includes a planar wall **38** and a continuous dependent flange **40** joined to the wall **38** along its border. The wall **38** has formed therein a number of parallel spaced similar slots **42** extending transversely of the panel and situated in the panel between the ends thereof. The slots extend through the panel. The number of slots **42** is the same as the number of pairs of collector strips and resistance strips and when the panel is mounted in a predetermined position on the casing **10**, the slots are parallel to the strips. Moreover, as best seen in FIGS. 2 and 7, each slot is at such time directly over and between a pair of associated strips. Each slot is of uniform transverse width and on one end thereof terminates in an entry port **44** of enlarged dimensions. Each slot on the upper face of the panel **36** is lined by a pair of ridges **46** (see FIG. 7) and transverse index markings **48** are located along the length of each slot.

Ribs **50** etxend transversely across the panel on the undersurface thereof midway between each pair of adjacent slots. The ribs strengthen the panel and physically isolate the taps from one another. Further, the undersurface of the panel between each pair of ribs **50** is serrated to form a multitude of parallel tiny elongated transverse teeth **52**, the teeth being disposed on each side of each slot and extending perpendicularly to the slots (see FIG. 7).

The panel carries a large number of adjustable voltage taps **54** with a different tap slidable along each slot **42**. Accordingly, the taps are mounted for linear sliding parallel movement through a number of positions along the slots. The number of taps is the same as the number of pairs of collector strips and resistance strips. The structural details and the function of a substantially similar tap is fully disclosed in pending application Ser. No. 302,595

for "Parallel Ganged Multiple Potentiometer," filed Aug. 16, 1963, the assignee of said pending application being the same as the assignee of the present application. The tap will be described herein for completeness and is best illustrated in FIG. 7.

The tap **54** has an enlarged flat-bottomed head **56** whose top surface is slopingly contoured like a bracket for convenient pushing or gripping by a user's fingers. The width of the head **56** is greater than the width of the slot **42** in which the tap slides so that the head cannot fall through the slot. A constricted neck **58** depends from the head **56** and unitarily joins the head to a cubical hollow dielectric body **60**. The neck is slightly narrower than the width of the slot to permit it to slide within the slot and yet is wide enough to prevent excessive lateral movement therein. The tap is introduced into the slot by passage of its head through the entry port **44** at the end of each slot, the same being dimensioned to nicely admit the head. 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. The top surface of the body **60** has numerous mutually parallel elongated tiny teeth **62** formed thereon, said teeth being parallel to the teeth **52** formed on the undersurface of the top wall **38** and being of complementary configuration. The teeth **62** disengageably mate with the teeth **52** when the tap **54** is urged upwardly, that is, when the body **60** of the tap is urged toward the undersurface of the wall **38**.

Spring means is provided to urge the teeth **62** toward the teeth **52** and into mating connectiong therewith, thereby to prevent accidental sliding of the tap along its slot. To this end, a leaf spring **64**, U-shaped in plan, is located between the head and the panel wall **38** and surrounds the neck **58** on three sides thereof. The center of the leaf spring **64** is raised along a line perpendicular to the slot **42**, and this raised line is received in a pair of notches **65** on the undersurface of the head **56** on each side of the neck. The ends of the springs are turned upwardly so that they will not catch on the panel. The legs of the spring ride on the wall **38** on opposite sides of the slot **42** and said legs are bowed upwardly so that they urge the teeth **62** towards the teeth **52** with sufficient force for the teeth to mate and not to become detached accidentally during handling of the panel, upon normal vibration of the console, and if a user should accidentally lightly touch a tap. However, said force is such that hand pressure on the head **56** can flex the spring downwardly so that the teeth can be uncoupled and the tap then slid in either direction to any desired position.

The body **60** houses within its hollow interior, an upwardly opening cup-shaped bridging button **66** formed from an electrically conductive material, such as brass. A transverse pendent ridge **68** is formed at the bottom of the button **66** and is in one piece therewith. The ridge is of sufficient length such that it at least bridges the distance between the outside surfaces of the collector strip **34** and the resistance strip **28**. Said ridge contacts the strips at transversely opposed points and electrically connects the strips at any location at which the tap is positioned.

The button **66** projects downwardly from the body **60** and is slidably mounted for vertical movement relative to said body. To this end, the interior of the housing **60** defines a cylindrical bore in which the button slides. The top edge of the button carries a pair of diametrically opposed outwardly protruding tabs **70** which ride in opposed vertical through slots **72** in diametrically opposite side walls of the body. Abutment of the tabs with the bottom of said slots limits protruding vertical movement of the button **66**. In addition the tabs cooperate with the slots to prevent the buttons from turning and to keep the ridge **68** perpendicular to the resistance and collector strips. A helical coil spring **74** is located within the top portion of the interior of the body and urges the bridging

button **66** downwardly and into electrical contact across an affiliated pair of collector and resistance strips **34**, **28**.

It will be appreciated at this point that the panel **36** carries a large number of slidable voltage taps. Each tap may be slid to any desired position along its slot and then released, this operation usually being effected when the panel is connected to this casing. Thereafter, when the panel is detached from the casing the spring **64** releasably retains the tap in its set position. When the panel is subsequently recoupled with the casing **10**, each voltage tap will have its bridging button **66** electrically connect a specific preset part of a resistance strip **28** to the associated collector **34**. Each tap and the resistance strip and collector strip which it bridges form a single potentiometer unit. As is conventional in circuitry for control of many lamps, the resistance strips are connected in parallel across an electrical source of voltage, and each of said resistances develops a voltage gradient, the voltage at any point along any resistance strip being a function of the position of that point on said strip. Thus, each sliding tap **54**, depending upon its preset position along its slot, picks off a voltage from the resistance strip **28** on which it rides and transmits this voltage to the associated collector **34** so that the voltage at the terminal of the collector is dependent upon the position of the tap **54**. Thereby, each terminal of each collector will have a voltage which has been preselected by the positioning of the slidable tap **54**.

An elevator, generally designated by the reference numeral **76**, is contained within the casing **10** and lifts the panel **36** away from the resistance block **24** and out of electrical contact therewith, or, alternatively, lowers the panel **36** toward the resistance block **24** and into electrical contact therewith. The lowering and coupling of the panel to the resistance block completes the circuit of my parallel ganged multiple potentiometer. When the panel is moved by the elevator toward or away from the resistance block, all of the taps, respectively, close with or break from the associated pairs of strips.

The elevator **76** includes a carriage **78** which is rectangular in its outside dimensions and which has an oblong opening **80** through which the resistance block **24** passes. The flange **40** of the panel **36** is adapted to stand on the carriage **78** adjacent the inner boundary of said carriage.

The carriage **78** is mounted for linear sliding reciprocating movement, said sliding movement being vertical when the casing **10** is situated on a horizontal surface. To this end, the brackets **26** carry bushings **82** through which guide shafts **84** slidably pass. The top ends of the shafts **84** are fixed to the undersurface of the carriage **78** adjacent the ends thereof and said shafts rise and fall in their respective bushings **82** as the carriage **78** rises and falls. Accordingly, as the carriage **78** rises and falls, the panel **36** then positioned thereon experiences the same movement.

Means is provided to selectively lift and lower the carriage **78**, and to this end, a pair of parallel elongated shafts **86**, **88** are journaled in the end walls **18**, **20** of the casing, below the fixed resistance block **24**. The shafts are rotatably mounted in bearings C in said end walls. Said shafts **86**, **88** are mechanically interconnected for simultaneous oppositely directed like rotative movement by two sets of meshing gear sectors, each gear sector being approximately a quadrant of a circle. Thus, the shaft **86** has fast thereto at each of its ends quadrant gear sectors **90** and the shaft **88** has at similar locations similar quadrant gear sectors **92**. Said gear sectors mesh so that when any one of the shafts is turned through an arc of not more than 90°, the other shaft is turned in an opposed direction through the same arc. It will be noted that when the panel **36** is in a position lowered to and electrically connected with the resistance block **24**, the gear sectors **90**, **92** occupy the segments, respectively, between 270° and 360° of a circle and between 180° and 270° of a circle (see FIG. 4).

Each shaft has fast thereto a pair of similar but oppositely disposed lifting cams, one cam being located at each end of each shaft. The shaft **86** mounts a pair of lifting cams **94** and the shaft **88** mounts a pair of lifting cams **96**. The lifting cams on the shaft **86** occupy the segment of a circle between 0° and 90° while the lifting cams **96** on the shaft **88** occupy the segment of a circle between 90° and 180° as viewed in FIG. 4. The cams of the shafts are in registry and are slightly spaced apart. The camming surfaces D (see FIGS. 2, 3 and 4) of the lifting cams bear against transversely elongated bosses **98** formed on the undersurface of the carriage **78**. Accordingly, when the shafts **86**, **88** are rotated in opposite directions by the gear sectors **90**, **92**, the lifting cams **94**, **96** also rotate in opposite directions so as to either force the carriage **70** upwardly, or if the carriage is elevated to permit the carriage **78** to drop. The direction of rotation through which the shafts **86**, **88** turn to lift the carriage is indicated by the arrows, respectively, A and B in FIG. 4 and conversely to permit the carriage in elevated position to drop, the shafts **86**, **88** rotate in directions opposed to the arrows A and B.

The elevator **76** is manually (hand) operated and for this purpose a handle **100** is fast to one of the shafts, and more specifically is fast to an extension **102** of the shaft **86** which protrudes through the end wall **20**. The handle in FIGS. 1, 2 and 3 is shown in a position in which the carriage **78** is lowered and the panel **36** is electrically coupled to the resistor block **78**; in FIG. 4 the handle **100** is illustrated in single dot and dash lines in a position to which it would be brought when the carriage **78** is lowered, and in the same figure the handle in double dot and dash lines is illustrated in a position to which it is brought when the carriage is elevated. The handle arm extends through the cover plate **22** to a position where the handle grip is readily accessible. The directions of movement are also indicated.

Resilient means urges the carriage **78** against the lifting cams and to its lower position. To this end, a different elastic cord **104** is fixed at its ends between each pair of longitudinally aligned guide shafts **84** (see FIG. 2). Each cord **104** passes through and is guided by a pair of pulleys **106** fastened to the floor **12** of the casing. When the handle **100** is rotated so that the lifting cams **94**, **96** elevate the carriage **78**, the elastic cords **104** are stretched and thereupon urge the shafts **84** downwardly. This in turn urges the carriage **78** downwardly so that when said lifting cams are returned to their initial position, the carriage follows said cams and will lower.

Locking means is provided to retain the panel **36** with its taps **54** firmly against the strips of the resistor block **24** when the elevator **76** is lowered. Said locking means comprises a pair of opposed locking arms **108**, **110**, each locking arm being generally parallel to and adjacent a different side wall of the casing **10**. The locking arms are similar and the arm **108** is adjacent the wall **14**, while the arm **110** is adjacent the wall **16**. Each arm is elongated in a direction parallel to the length of the casing and each arm has a length coextensive with the length of the panel **36**. Each locking arm includes an upright body portion, respectively **108*a***, **110*a***, an inwardly protruding top flange, respectively, **108*b***, **110*b***, disposed at a right angle to the body portion, and a pair of legs, respectively, **108*c***, **110*c***, depending from the body portion.

The locking arms are pivotally connected for limited rocking movement to opposite parallel sides of the carriage **78** as by hinges **112** so as to rock about horizontal axes at said sides. Thus, as the carriage is raised or lowered, it will raise or lower the locking arms **108**, **110** therewith. The arms are arranged and the flanges **108*b***, **110*b*** are so located that the flanges overlay and

bear downwardly on opposite side marginal top portions of the panel, when the carriage is in its lowermost position (see FIG. 4). Further, the flanges of the locking arms are on one, the upper, sides of the hinges and the depending legs are on the other, the lower, sides of the hinges (see FIGS. 4 and 6). When the carriage **78** is lowered within the casing **10**, the hinges **112** position their respective locking arms so that the exterior surfaces of the locking arms are flat against the interior surfaces of the side walls **14**, **16** of the casing. In this position, the locking arms cannot rock and the flanges **108***b*, **110***b* are forced to overlay the upper face of the tap-carrying panel **36**. When the carriage is in its elevated position (see FIG. 6), the rocking arms are also elevated and the flange of each rocking arm is allowed to rock outwardly about the hinge **112**, this rocking movement being permitted by the outwardly flaring configuration of the interior upper portion of each of the side walls **14**, **16**, as at **14***a* and **16***a*. The locking arms are permitted to rock far enough apart by the flaring portions **14***a*, **16***a* so that the inward edges of the flanges are clear of the edges of the panel **36** (see FIG. 6). The locking arms are urged to this position by two elongated coil springs **114**, each coil spring running between one of the legs of one of the locking arms and a transversely aligned leg of a different locking arm. When the carriage **78** is lowered, the locking arms are forced to rock inwardly and the flanges moved toward one another by the side walls of the casing.

To insure that the tap-carrying panel **36** is properly located onto the carriage **78** when placed thereon by a user, guide nibs **116** of triangular cross-section protrude from the upper surface of the carriage and complementary detects **118** are provided in the bottom surface of the flange **40** of the panel. There are, desirably, four such guide nibs and matching detents, one on each side of the panel and one on each end of the panel, centered in the middle of each respective side and end (see FIG. 4).

Turning then to the operation of my parallel ganged multiple potentiometer, there are two or more panels **36** supplied for use with each casing **10**. If for example, my potentiometer is used to set the lighting for scenes of a play, during a lighting rehearsal a panel will have each of its taps appropriately set to conform with the desired intensities of the lamps illuminating a lighting scene and the tap readings noted. This is done for every scene. When it is desired to put a panel into use for the first scene, its taps are set to the noted readings while it is remote from the casing, the casing is readied to receive the panel by rotating the handle **100** so that the carriage **78** is in its elevated position. At this point, the locking arms will be in their outwardly rocked position, as shown in FIG. 6. Then the user places the panel **36** with its taps in preselected positions onto the carriage **78** so that the panel rests thereon, the panel being properly located by passage through the opening defined on the sides by the flanges **108***b*, **110***b* of the locking arms and on the ends by the overlapping portions of the cover plate **22**. The precise location of the panel with respect to the carriage is determined by the mating of the guide nibs **116** with the corresponding guide detents **118**.

Then the handle **100** is counterrotated, thereby lowering the carriage **78** which in turn lowers the panel **36**. The lowering of the carriage **78** simultaneously lowers the locking arms **108**, **110** and as the carriage reaches its lowermost position, the flanges **108***b*, **110***b* of the locking arms close over the panel and hold the panel in place. The flanges bear down so that the taps **54** of the panel have their conductive buttons **66** forced against, to electrically bridge, pairs of affiliated resistor stripes and collector strips. However, the springs on the taps are not fully compressed so that even when the panel is fully lowered, the taps may be slid thereon. Such sliding is necessary to initially (during rehearsal) set the taps on the panel for a lighting scene of a play.

The various terminals of the potentiometer are appropriately and conventionally wired so that when the circuit is energized, various voltages can be picked off of the various terminals, these voltages having been determined by the positions of the various taps in their slots on the panel. The panel is removed in a converse manner, that is, the handle **100** is rotated in an opposed direction, this raising the carriage, moving the locking arms apart and freeing the tap-carrying panel for removal off of the elevator carriage so that a different panel with different preset tap positions may be placed thereon, in its stead.

The multiple ganged parallel potentiometer with which a reader of the instant disclosure is now familiar can be easily incorporated into a lighting control circuit such as disclosed in my United States Letters Patent Re. 23,575.

It thus will be seen that I have provided a parallel ganged multiple potentiometer 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 illustrative and not in a limiting sense.

I claim:

1. An electrical unit comprising a gang of variable resistance devices and including a stationary mounting member, electrical elements fixedly carried by the member, said elements including numerous resistance strips each having an affiliated collector alongside and spaced from the same, each resistance strip having a linear portion, a panel, numerous voltage taps carried by the panel, means mounting the taps for movement on the panel through a number of positions, means releasably retaining each tap on the panel in any position to which the tap is set, support means for the panel on which the panel removably rests, means to shift the support means with the panel bodily toward and away from the stationary member with its resistance strips and collectors between a first position in which the panel is spaced from the member and a second position in which the panel is adjacent to the member, the taps being arranged on the panel such that when the support member and panel are in their second position each tap in each of its positions electrically connects the collector associated therewith to a different point along the portion of the affiliated resistance strip, each tap separating from its associated collector and resistance strip when the support means and the panel move toward the first position, said tap retaining means holding the taps in their set positions against accidental displacement when the support means and panel are in their first and second positions and when the panel is removed from the mounting member.

2. An electrical unit as set forth in claim **1** wherein the means to shift the support means constitutes an elevator.

3. An electrical unit as set forth in claim **2** wherein the elevator includes a carriage, the panel resting on the carriage, means guiding the carriage for movement along a linear path toward and away from the electrical elements and means for selectively lowering and raising the carriage along its path.

4. An electrical unit comprising a gang of variable resistance devices and including a stationary mounting member, electrical elements fixedly carried by the member, said elements including numerous pairs of resistance strips and affiliated collectors, each resistance strip having a linear portion, numerous voltage taps carried by the panel, means mounting the taps for movement on

the panel through a number of positions, means releasably retaining each tap on the panel in any position to which the tap is set, an elevator including a carriage, the panel resting on the carriage, means guiding the carriage for movement along a linear path toward and away from the electrical elements to, respectively, couple the panel with the mounting member so that each tap simultaneously bridges a resistance strip and a collector and separate from the member so that all of the taps part from their strips and collectors, each tap in each of its positions on the panel when the panel is coupled with the mounting member electrically connecting the collector of a pair to a different point along the portion of the affiliated resistance strip of the pair, and means for selectively lowering and raising the carriage along its path, said carriage moving means being hand operable and including a shaft, a cam fast to the shaft, said cam bearing against and being operably engaged to the carriage, a handle fixed to the shaft so that rotation of the handle rotates the shaft and thus the cam reciprocates the carriage, and means to maintain the cam in engagement with the carriage.

5. An electrical unit as set forth in claim 4 wherein the carriage moving means includes an additional shaft with a cam thereon, wherein gears interengage the shafts for opposite rotation, and wherein the means to maintain the cam in engagement with the carriage is a spring, whereby rotation of the handle rotates both shafts and whereby both cams thereupon reciprocate the carriage.

6. An electrical unit comprising a gang of variable resistance devices and including a stationary mounting member, electrical elements fixedly carried by the member, said elements including numerous pairs of resistance strips and affiliated collectors, each resistance strip having a linear portion, numerous voltage taps carried by the panel, means mounting the taps for movement on the panel through a number of positions, means releasably retaining each tap on the panel in any position to which the tap is set, an elevator including a carriage, the panel resting on the carriage, means guiding the carriage for movement along a linear path toward and away from the electrical elements to, respectively, couple the panel with the mounting member so that each tap simultaneously bridges a resistance strip and a collector and separate from the member so that all of the taps part from their strips and collectors, each tap in each of its positions on the panel when the panel is coupled with the mounting member electrically connecting the collector of a pair to a different point along the portion of the affiliated resistance strip of the pair, and means for selectively lowering and raising the carriage along its path, interengageable guide members being carried by the panel and the carriage so that when a user places the panel on the carriage the panel will be properly oriented with respect to the carriage.

7. An electrical unit as set forth in claim 2 further including locking means firmly retaining the panel against the elevator when the elevator is in its lowermost position.

8. An electrical unit comprising a gang of variable resistance devices and including a stationary mounting member, electrical elements fixedly carried by the member, said elements including numerous pairs of resistance strips and affiliated collectors, each resistance strips having a linear portion, a panel, numerous voltage taps carried by the panel, means mounting the taps for movement on the panel through a number of positions, means releasably retaining each tap on the panel in any position to which the tap is set, an elevator including a carriage on which the panel rests, means guiding the carriage for movement along a linear path toward and away from the electrical elements for selectively lowering and raising the panel to, respectively, couple with the mounting member so that each tap simultaneously bridges a resistance strip and a collector and separate from the member so that all of the taps part from their strips and collectors, locking means for firmly retaining the panel against the carriage when the elevator is in its lowermost position, the locking means comprising a locking arm movable between a position engaging the panel and a position free from the panel, means moving the locking arm to the first named position only when the elevator is in its lowermost position and moving the locking arm to its second position when the elevator is in its uppermost position, and means for selectively lowering and raising the carriage along its path, the taps being arranged on the panel such that when the panel is coupled to the mounting member each tap in each of its positions electrically connects the collector of a pair to a different point along the portion of the affiliated resistance strip of the pair.

9. An electrical unit as set forth in claim 8 wherein the locking means includes a locking arm having a flange movable to a position overlapping the panel pivot means mounting the locking arm on the elevator for limited rocking movement and for common reciprocating movement, spring means fixed to the arm and urging the flange away from the panel and means stationary with respect to the elevator forcing the flanges to overlap the panel when the elevator is lowered and permitting the arms to move apart when the elevator is raised.

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