United States Patent

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[54] **STEREO BALANCE AND FADER POTENTIOMETER**
20 Claims, 14 Drawing Figs.

[52] U.S. Cl. ..... 338/128, 323/80, 323/94 R
[51] Int. Cl. H01c 5/00
[50] Field of Search 323/73, 74, 80, 94; 338/115, 125, 128, 129, 131, 133, 134; 74/471

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Primary Examiner—Gerald Goldberg
Attorney—Amster & Rothstein

ABSTRACT: A voltage and/or impedance control for simultaneously adjusting a number of circuits or electrical components finding useful application in a number of environments, including the provision of a stereophonic balance and fader potentiometer for a four-speaker stereo system, including a common joystick control for individually and concurrently adjusting two pairs of wiper contacts associated with the circuits or electrical components.

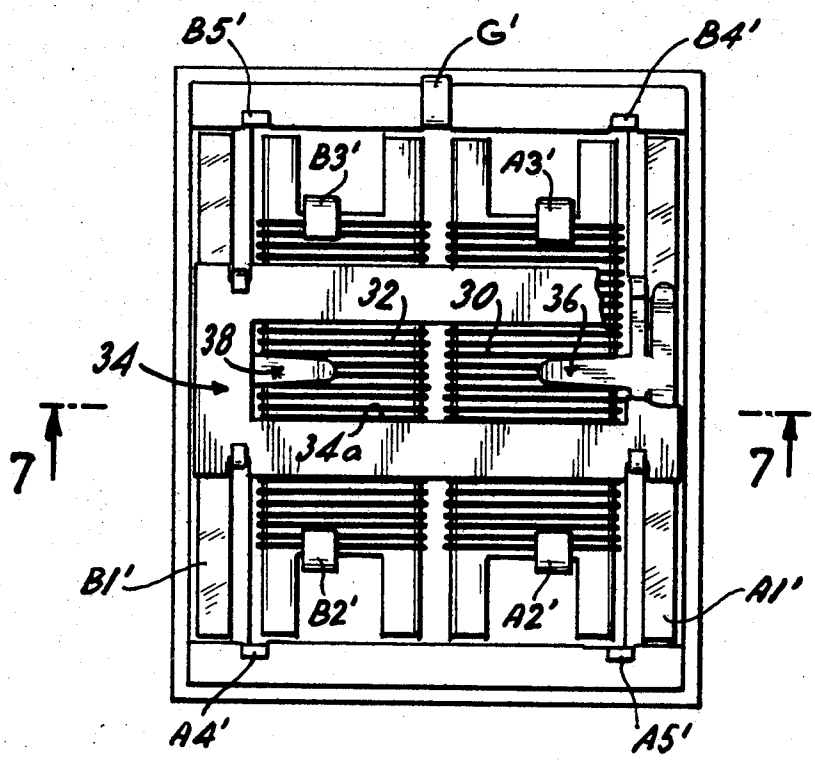


FIG. 4.

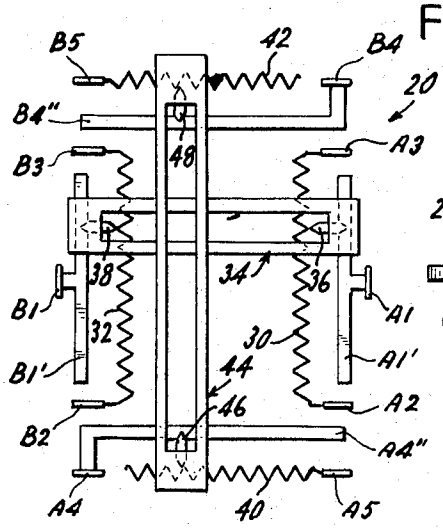


FIG. 2.

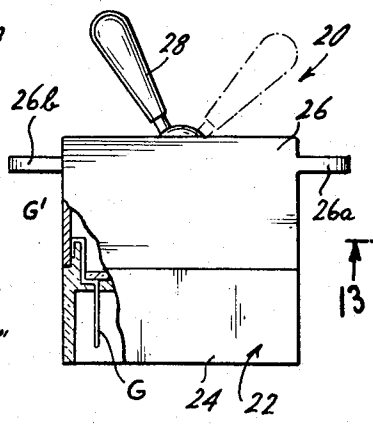


FIG. 1.

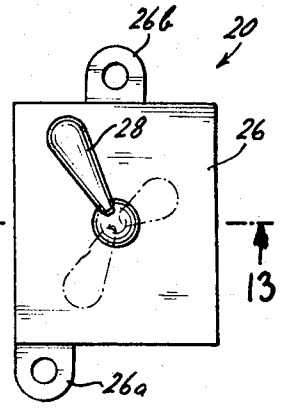


FIG. 7.

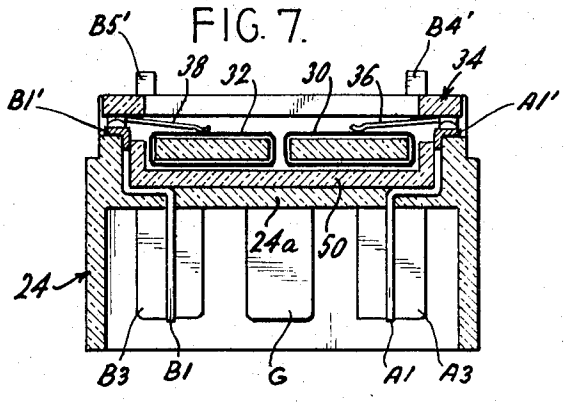
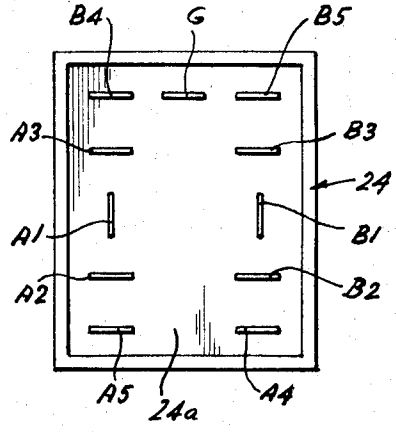


FIG. 3.



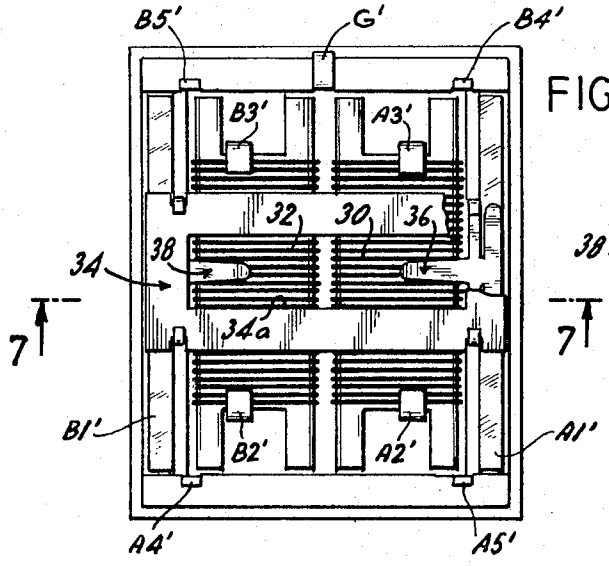
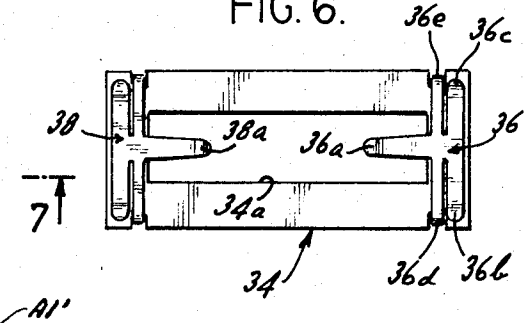


FIG. 5.

FIG. 6.



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FIG. 8.

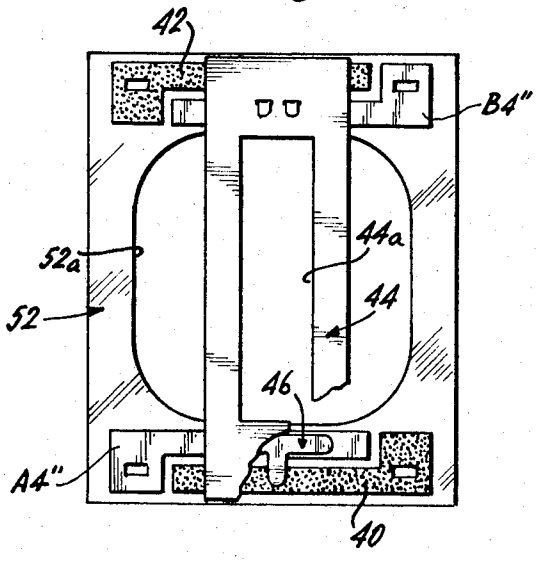


FIG. 10.

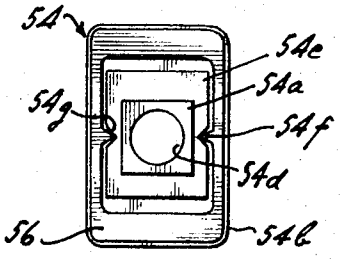


FIG. 9.

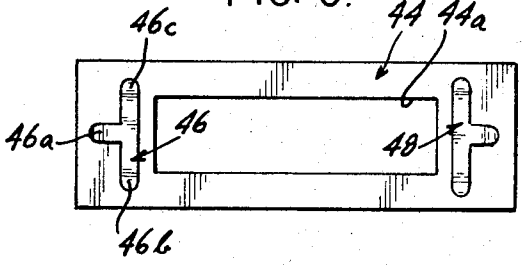
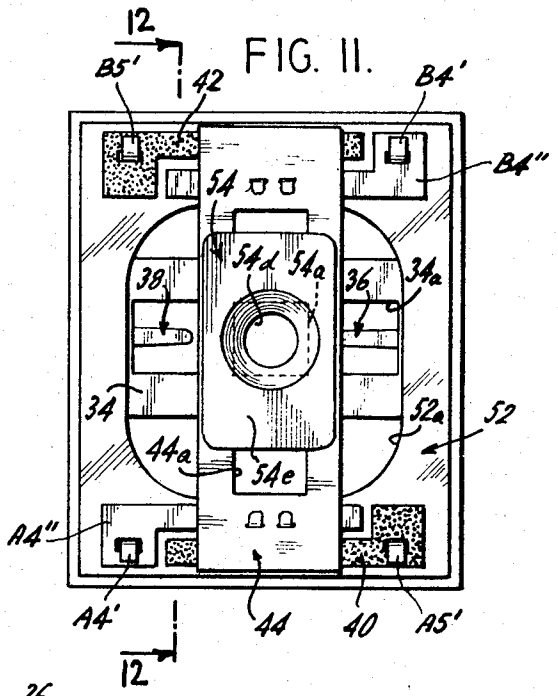


FIG. 11.



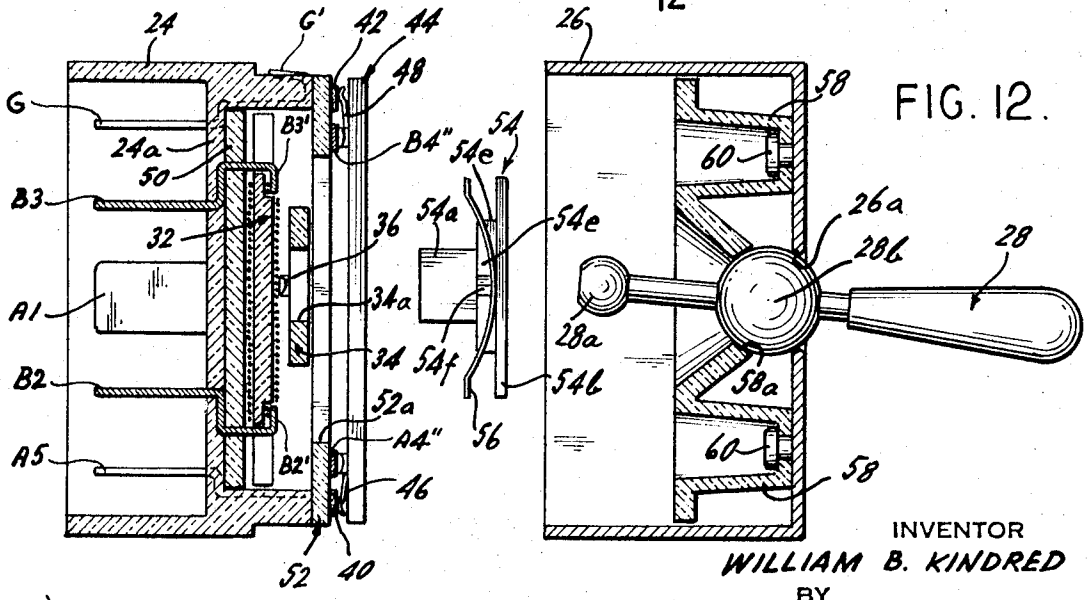
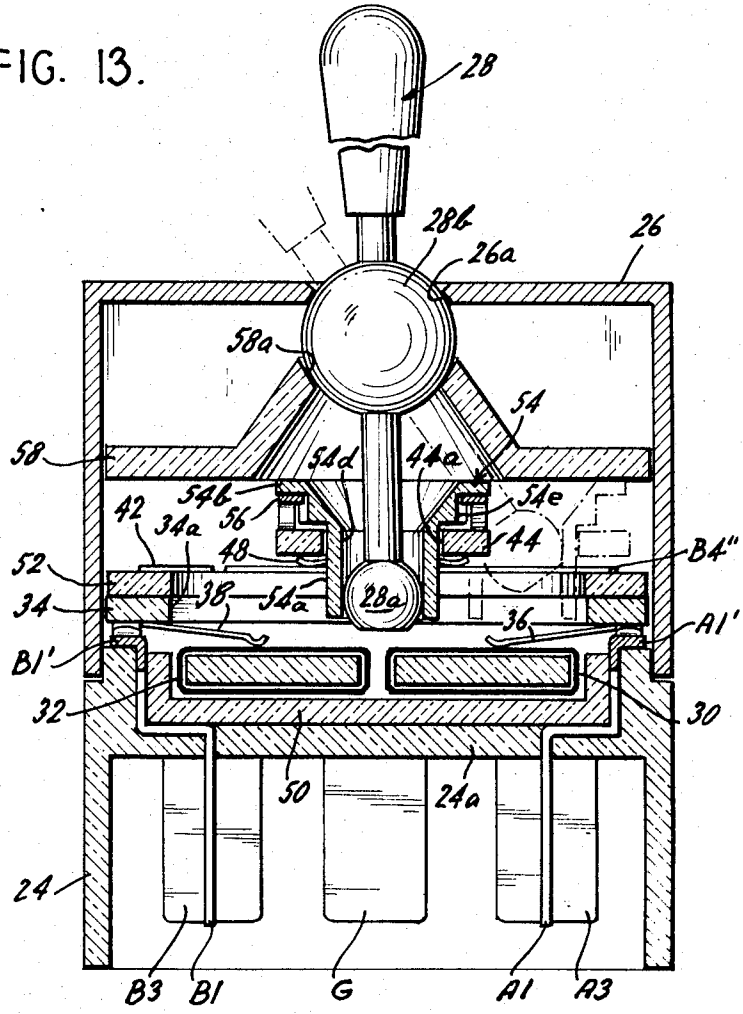


FIG. 12.

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FIG. 13.



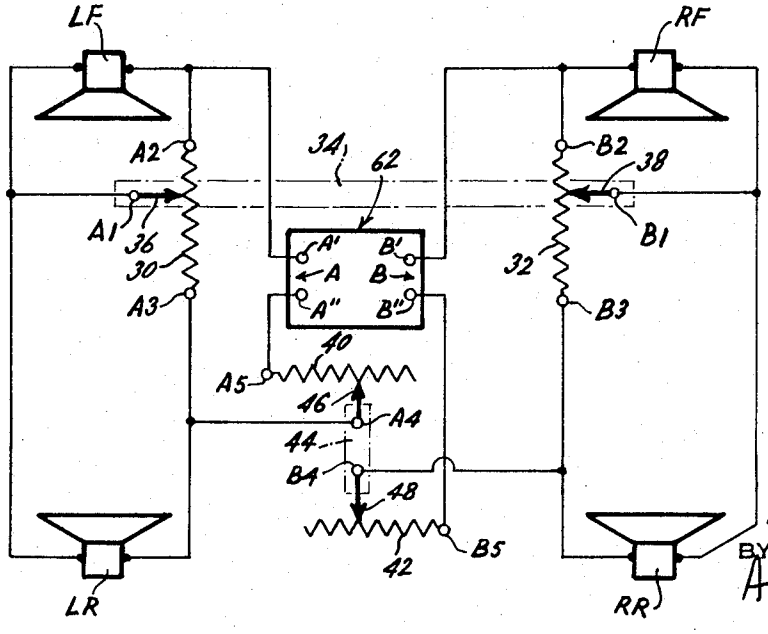


FIG. 14.

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STEREO BALANCE AND FADER POTENTIOMETER

The present invention relates generally to voltage and/or impedance controls and more particularly to a control for simultaneously adjusting a number of circuits or electrical components. Advantageously, the invention finds particular application in a construction of improved and simplified stereophonic balance and fader potentiometers.

There are many applications in electric and electronic devices wherein it would be highly desirable to provide a single manual control capable of simultaneously adjusting two pairs of circuit elements, separately and simultaneously. For example, in a multiple speaker stereophonic sound-reproducing system of the type used in automobiles, there is provided left and right front speakers and corresponding left and right rear speakers. A volume control is required to achieve balance between the left front and right front speakers on the one hand, and the left rear and right rear speakers on the other hand and also to establish desired sound levels as between the respective pairs of front and rear speakers. A volume control is required to achieve balance between the left front and right front speakers on the one hand, Although there have been multiple speaker potentiometer controls which have combined a two-channel balance control within a single unit operated by a single control lever, such previous controls were of constructions requiring exacting tolerances which were costly to maintain in production. Further, the constructions were such that mass production manufacture at relatively low unit cost was not particularly feasible. Still further, the construction was such that the impedance components employed were fragile and subject to distortion resulting in increased production shrinkage and cost. Still further, the impedance components (usually resistors) employed in such units were off minimal area and afforded little opportunity for reasonably wide ranges of adjustment in a relatively small control package. There exists a need for a relatively low-cost multiple speaker potentiometer control which may be manufactured by mass production techniques, employs rugged components and provides a final unit having the desired functionality including a reasonably wide range of adjustment in achieving balance between individual speakers of a pair and fading between two pairs of stereo speakers.

It is broadly an object of the present invention to provide an improved impedance control which realizes one or more of the aforesaid objectives. Specifically, it is within the contemplation of the present invention to provide an improved, simplified and rugged potentiometer control finding particularly useful application in balancing and controlling two pairs of stereophonic speakers in a multiple speaker system, for example of the type found in automobiles.

In accordance with an illustrative embodiment demonstrating objects and features of the present invention, there is provided a proportionate impedance control providing two pairs of proportionate impedances and/or corresponding voltages by a single manual manipulation. The control comprises a support having a first subassembly mounted thereon and including a first pair of impedance elements and a first movable wiper therefor having a contact for each impedance element. A second subassembly is mounted on the support and includes a second pair of impedance elements and a second movable wiper therefor having a contact for each impedance element. A common control is provided which includes a universally mounted control member and a shuttle control thereby and coupled to both the first and second wipers. The control member is movable in a first direction to adjust the first pair of impedance elements without affecting the second pair of impedance elements, for example to increase or decrease the volume of front and rear speaker pairs relative to each other. The control member is movable in a second direction to adjust the second pair of impedance elements without affecting the first pair of impedance elements, for example to change the balance between the left and right speakers of a speaker pair. Finally, the control member is movable in other directions to concurrently adjust the first and second pair of impedance elements to achieve combined control functions, such as balancing and fading pairs of speakers. Although the invention will be described with respect to its particular application to a multiple speaker potentiometer control, it will be appreciated that numerous other applications are intended, for example, the centering of a spot on oscilloscopes and indeed other applications wherein selective and proportional control is to be exerted over two pairs of circuit elements by pairs and together.

The above brief description, as well as further objects, features and advantages of the present invention will be more fully appreciated by reference to the following detailed description of a presently preferred but nonetheless illustrative embodiment in accordance with the present invention, when taken in conjunction with the accompanying drawings, wherein:

FIG. **1** is a top plan view of an impedance control embodying features of the present invention, the control lever being shown in one adjusted position and further adjusted positions being shown by the dot-dash lines;

FIG. **2** is a side elevational view of the control taken from the left of FIG. **1**;

FIG. **3** is a bottom plan view of the control on an enlarged scale and showing the multiple terminals of the unit;

FIG. **4** is a simplified diagrammatic and schematic view showing the electrical functions of the improved control;

FIG. **5** is a plan view of the control showing a first stage of assembly which includes the subassembly in a housing of a first pair of wire wound resistors and its slider and contacts;

FIG. **6** is a bottom plan view of the slider for the first assembly, showing the details of the respective contacts for the pair of wire wound resistors and their corresponding terminal strips;

FIG. **7** is a sectional view taken substantially along the line **7—7** of FIG. **5** and looking in the direction of the arrows;

FIG. **8** is a plan view of the circuit board, slider and contacts of the second subassembly prior to mounting in stack relation to the first subassembly;

FIG. **9** is a bottom plan view of the second slider showing its corresponding contacts;

FIG. **10** is a bottom plan view of a common control shuttle for the control having mounted thereon a spring, the shuttle and spring shown prior to assembly;

FIG. **11** is a plan view of the control corresponding to FIG. **5** but showing the stacking thereon of the second subassembly of FIG. **8** and the control shuttle and spring of FIG. **10**;

FIG. **12** is an exploded sectional view taken substantially along the line **12—12** of FIG. **11**, showing in addition the metal housing cover carrying the universally mounted control lever to be assembled over the two subassembled stages;

FIG. **13** is a sectional view taken along the line **13—13** of FIG. **1**, on an enlarged scale and showing the completed control; and

FIG. **14** is a schematic and diagrammatic showing of a typical, but nonetheless illustrative application for the present control.

Referring now specifically to the drawings, and in particular to FIGS. **1** to **3**, the control **20** is seen to include a rectangular housing **22** including a plastic base **24** and a removable metal cover **26**. Projecting from opposite sides of cover **26** are integral mounting ears **26*a***, **26*b*** which facilitate the mounting of the unit in a particular working environment. The control **20** is entirely contained within housing **22** and is operated by a universally mounted control lever **28**. Preliminary to reference to FIGS. **5** to **13**, inclusive, for a detailed description of the entire control **20**, reference will be made to the schematic and diagrammatic showing in FIG. **4** for a description of the overall construction and function to facilitate an understanding of the details of the control.

As seen from FIG. **4**, control **20** includes a first pair of resistors **30**, **32** which are disposed substantially in a common first plane and in spaced and parallel relation to each other. Resistor **30** has terminals **A2**, **A3** at its opposite ends which are accessible at the underside of the control (see FIG. **3**). Similarly, resistor **32** has terminals **B2**, **B3** which are likewise

accessible at the underside of the unit. Disposed outwardly of resistors 30, 32 are respective terminal strips A1', B1' with the terminal strips having respective terminals A1, B1, likewise accessible at the underside of the unit. The unit also includes a ground terminal G. Extending at right angles to parallel resistors 30, 32 is a first wiper 34 which is movable in a path parallel to the longitudinal extent of the circuit elements 30, 32. Slider 34 carries a first pair of wiper contacts 36, 38 which are in contact respectively with resistors 30, 32. Contact 36 provides a variable tap from resistor 30 to terminal strip A1' and terminal A1; and, similarly, contact 38 provides a variable tap from resistor 32 to terminal strip B1' and terminal B1. Depending upon the position of slider 34, varying resistances will be provided between center tap terminals A1, B1 and the opposite ends of the respective resistors 30, 32 and their respective terminals A2, A3 and B2, B3. The control 20 includes a second pair of resistors 40, 42 disposed in a common plane spaced from and parallel to the first plane, with resistors 40, 42 being parallel to each other and at right angles to resistors 30, 32. A second wiper 44 is provided which is movable along a path at right angles to the first wiper 34 and parallel to resistors 40, 42. The second wiper 44 carries a pair of wiper contacts 46, 48 which are in contact respectively with the resistors 40, 42. Contact 46 provides a variable tap from resistor 42 to terminal strip A4'' while contact 48 provides a variable tap from resistor 42 to terminal strip B4'' As will be subsequently described, a common shuttle operated by control lever or handle 28 engages the first and second wipers 34, 44 for moving the wipers individually or concurrently to individually adjust the resistors by pairs and together. For example, and presuming that the points of the compass are assigned as directions, movement of slider 34 upwardly or toward the north will decrease the resistance between center tap terminal A1 and end terminal A3 and between center tap terminal B1 and end terminal B3. On the other hand, this movement will increase the resistance between center tap terminal A1 and end terminal A2 and between center tap terminal B1 and end terminal B2. Movement of the slider 34 downwardly or toward the south will produce the opposite changes in resistance. Movement of slider 44 toward the right or each will decrease the resistance between terminal A4 and terminal A5 and, at the same time, will proportionately increase the resistance between terminal B4 and terminal B5. Movement of slider 44 toward the left or west will increase the resistance between terminal A4 and terminal A5 and decrease the resistance between terminal B4 and terminal B5. As will be described, slides 34, 44 may be moved concurrently to achieve simultaneous adjustment of resistor pairs 30, 32 and 40, 42.

Reference will now be made to FIGS. 5 to 7, inclusive, for a description of the assembly of the first stage of the control which includes resistors 30, 32, slider 34 and contacts 36, 38 and to the structure of this stage or subassembly. In this illustrative embodiment, and as seen best in FIG. 5, resistors 30, 32 are in the form of helically wound wires on respective cores or mandrels. Wire wound resistors 30, 32 are disposed in side-by-side spaced relation, with the uppermost faces of the respective resistance wires being coplanar for contact along successive turns by sliding contacts 36, 38. Preliminary to the assembly of the wire wound resistors 30, 32 into plastic base 24, the plural terminals A1, A2, etc., which are individually bent and formed into the requisite configurations, are dropped into corresponding cutouts provided in the bottom wall 24*a* of the plastic base 24. The bottom wall 24*a* is spaced above the bottom of the unit 20 by depending pairs of end and side walls which define an open bottom receptacle into which the terminals A1, A2, etc. project for connection to the external associated circuitry. After the terminals are assembled through bottom wall 24*a*, a plastic base insert 50 (see FIG. 7) is dropped into place and over this and in the corresponding seat defined by base insert 50 and base 24 are placed the wire wound resistors 30, 32. When so assembled, the upper ends of terminals A2, A3 and B2, B3 may be bent over to provide corresponding holding tabs A2', A3' and B2' B3' to establish electrical connections between the opposite ends of wire wound resistors 30, 32 and their terminals. Once this subassembly is completed, the slider 34 is laid into position extending crosswise of resistors 30, 32. The slider 34 is of rectangular shape and is of a length such that the contiguous housing walls will confine the slider to move essentially in the north and south direction. The slider 34 is provided with a rectangular shuttle slot 34*a* which, upon completion of the assembly, will receive the control shuttle.

As seen in FIG. 6, contacts 36, 38 are T-shaped metal stampings. Contact 36 includes variable tap 36*a* making contact with the corresponding wire wound resistor and sliding contacts 36*b*, 36*c* riding along in spring contact against the corresponding terminals A1'. Conveniently, contact 36 is formed with holding ears 36*d*, 36*e* which may be bent into corresponding cutouts on the opposite sides of slider 34 for attaching contact 36 thereto. Contact 38 is of identical construction and requires no description. Reference will now be made to FIGS. 8 to 11, inclusive, for a description of the second stage or subassembly which includes resistors 40, 42, slider 44 and contacts 46, 48. In this illustrative embodiment, there is provided a nonconductive rectangular circuit board 52 which is provided with a central rounded corner cutout 52*a*. Circuit board 52 has formed thereon oppositely arranged and oppositely directed L-shaped carbon resistor strips 40, 42. Contiguous to strip 40 is a correspondingly shaped terminal strip A4'' and contiguous to carbon resistor 42 is a terminal strip B4''. At its four corners, the nonconductive circuit board 52 is formed with cutouts with the cutouts extending through the adjacent resistors and terminal strips. When circuit board 52 is dropped into position overlying the first stage as seen in FIG. 11, the upper ends of the associated terminals may be bent back to provide respective holding tabs A4', B4' A5', B5' which secure the circuit board 52 in position and establish the desired electrical connections to the resistor pair 40, 42 and their respective terminal strips A4'' B4'' In this embodiment, slider 44 is of rectangular shape and provided with a rectangular shuttle slot 44*a*. As seen in FIG. 9, contacts 46, 48 are of identical T-shaped construction and similar to contacts 36, 38. For example, contact 46 includes tap 46*a* for resistor 40 and opposite end contacts 46*b*, 46*c* for the corresponding terminal strip A4'' As seen in FIGS. 8 and 11, the metal stampings used to form contacts 46, 48 are also provided with appropriate ears which may be bent, as seen in FIG. 11 to mount the contacts on the slider 44. Once again slider 44 is dimensioned such that it will be confined by the opposite ends of the surrounding housing such it may slide from left to right or west to east and vice versa. Obviously, this stage is completed by mounting circuit board 52 in position and then dropping slider 44 into the housing, with slider 44 extending at right angles to slider 34. The next aspect of completing the unit 20 involves the assembly of a shuttle 54 and spring 56. Shuttle 54 includes a square shank 54*a* dimensioned to fit into crosswise shuttle slots 34*a*, 44*a* as seen in FIG. 13. Additionally, shuttle 54 includes an enlarged rectangular shuttle head 54*b* which is formed centrally thereof with a conical seat 54*c* which extends into a circular bore 54*d*. Bore 54*d* is of a cross section appropriate to receive an actuating ball 28*a* on control lever 28 (see FIG. 13). Beneath shuttle head 54*b*, the shuttle is formed with an intermediate shoulder 54*e* (see FIG. 10) which is notched at its opposite sides at 54*f*, 54*g* (see FIG. 10) to receive corresponding retaining prongs formed on spring 56 which frames the shuttle and underlies head 54*b* thereof. When square shuttle shank 54*a* is received within the shuttle slots or guideways 34*a*, 44*a*, spring 56 bears against slide 44 and will serve to impart a bias to the entire control unit when metal cover 26 is assembled over plastic base 24.

The assembly is completed by universally mounting control lever 28 on cover 26 and then assembling cover 26 to plastic base 24 to complete housing 22. As seen in FIG. 12, to cover 26 is provided internally thereof with a lever-retaining insert 58 which is secured within the cover in an appropriate fashion, as by rivets 60. Retainer 58 is provided with a circular seat 58*a*

which cooperates with central cutout 26*a* in cover 26 to seat the mounting ball 28*b* of control lever 28 on the cover. This subassembly is completed in a separate operation and involves placing control lever in position and then riveting insert 58 to cover 26. The final assembly merely involves slipping cover 26 into base which brings the actuating ball 28into bore 54*d* of shuttle 54. When this is accomplished, insert 58 bears against the stacked assembly which is retained under spring tension, with the shuttle 54 and slides 34, 44 moving in response to actuation of control lever 28.

A typical sequence of operation will now be described to facilitate a more thorough understanding of the present invention:

Assuming the previously described orientation of the control unit 20, when lever or joystick 28 is moved north and south, slider 34 will move without affecting slider 44. Thus, there will be a corresponding adjustment of the movable tap for wire wound potentiometers 30, 32. Typically, 40° of movement from an upstanding central position of lever 28 will cover the entire range of these wire wound resistors. Similarly, when the control lever or joystick 28 is moved east and west, there will be a corresponding movement of slider 44, with an increase in one of the resistors 40, 42, and a decrease in the other of the resistors. Here again, the east or west movement will not affect the adjusted position of slider 34. Once again, a 40° left-to-right movement will achieve the entire range of adjustment. Movement of the control lever or joystick in other directions subtended by a cone, the generatrix of which is at an angle of approximately 40°, will produce corresponding adjustments of both pairs of resistors 30, 32 and 40, 42, depending upon the angular and radial position of the control lever 28.

From the foregoing, it will be appreciated that the entire assembly is accomplished by the simple expedient of stacking the components in plastic base 24 and cover 26 and then joining the two together to complete the housing 22. None of the components is mounted to the side of, or requires close tolerances laterally within the housing and all electrical contacts are under controlled pressure established by the dimensioning of the stack and the presence of spring 56. The stacked construction is quite advantageous in the utilization of space, and accordingly relatively small units may be fabricated with adequate control ranges for most intended purposes.

Although numerous applications are intended for the instant control, there is illustrated in FIG. 14 one representative application which involves a multiple stereo speaker control which achieves both balancing and fading of the speaker pairs. As is generally understood, a stereo system usually has a left speaker and a right speaker and for an automotive installation, including front and rear speakers, there is a left front speaker LF, right front speaker RF, left rear speaker LR, and right rear speaker RR. It is necessary to establish balance between the left and right speakers, both front and rear, and also to increase and decrease the volume of the front speakers and rear speakers relative to each other, generally known as fading. The several speakers are connected to the present control and to the output of the radio, amplifier or the like, generally designated at 62. The connections and terminals bear the same notation as described in conjunction with FIG. 4 and it will be appreciated that when the control 20 is connected, as illustrated schematically in FIG. 14, the north-south movement of the lever 28 will control the fading of the front and rear speakers. Movement of the lever 28 to the south will cause the front speakers to fade and the rear speakers to increase in volume; and movement of the control lever 28 to the north will cause the front speakers to increase in volume and the rear speakers to fade. Similarly, movement of the control lever from east to west will provide balance between the two channels, proportionally increasing the volume in one channel as the other is decreased. Other useful applications for the present control will be obvious to those skilled in this art.

A latitude of modification, change and substitution is intended in the foregoing disclosure and, accordingly, it is appropriate that the appended claims be construed broadly and in the manner consistent with the spirit and scope of the present invention.

What I claim is:

1. An impedance control comprising a housing, a first pair of circuit elements disposed substantially in a common first plane and in spaced and parallel relation to each other, a first wiper movable in a first direction parallel to said first pair of circuit elements, a first pair of wiper contacts on said first pair of of circuit elements, a first pair of wiper contacts on said first wiper and in contact respectively with said first pair of circuit elements, a second pair of circuit elements disposed substantially in a second common plane spaced from and parallel to said first plane, said second pair of circuit elements being disposed in spaced and parallel relation to each other and at right angles to said first pair of circuits elements, a second wiper movable in a second direction at right angles to said first direction and parallel to said second pair of circuit elements a second pair of wiper contacts on said second wiper and in contact respectively with said second pair of circuit elements, a common shuttle engaging both said first and second wipers for moving same individually or concurrently and manually operable actuating means operatively connected to said common shuttle.

2. A control according to claim 1 wherein said actuating means includes a control lever and a swivel mount for said control lever on said housing.

3. A control according to claim 2 wherein said swivel mount includes a ball and socket.

4. A control according to claim 1 wherein said circuit elements and said wipers are disposed in stacked relation.

5. A control according to claim 1 including a spring for establishing a pressure contact between said second pair of wiper contacts and said second pair of circuit elements.

6. A control according to claim 5 wherein said second pair of circuit elements are carbon resistors.

7. A control according to claim 1 including a first pair of terminal strips for said first pair of circuit elements, one wiper contact of said first pair bridging one circuit element of said first pair and an adjacent terminal strip of said first pair, the other wiper contact of said first pair bridging the other circuit element of said first pair and the other terminal strip.

8. A control according to claim 7 including a second pair of terminal strips for said second pair of circuit elements, one wiper contact of said second pair bridging one circuit element of said second pair and an adjacent terminal strip of said second pair, the other wiper contact of said second pair bridging the other circuit element of said second pair and the other terminal strip.

9. A proportionate impedance control for providing two pairs of proportional impedances and/or corresponding voltages by a single manual manipulation comprising a support, a first subassembly on said support including a first pair of impedance elements and a first movable wiper therefor having a contact for each impedance element, a second subassembly on said support stacked above said first subassembly including a second pair of impedance elements and a second movable wiper therefor having a contact for each impedance elements and contact for each impedance element and common control means including a universally mounted control member and a shuttle controlled thereby and coupled to both said first and second wipers, said control member being movable in a first direction to adjust said first pair of impedance elements without affecting said second pair of impedance elements, said control member being movable in a second direction at prescribed angles relative to said first direction to adjust said second pair of impedance elements without affecting said first pair of impedance elements, said control member being movable in other directions to concurrently adjust said first and second pairs of impedance elements.

10. A control according to claim 9 wherein said first and second wipers are disposed at right angles to each other.

11. A control according to claim 10 wherein said first and second wipers are formed with respective shuttle-receiving slots, said shuttle being engaged in both said shuttle-receiving slots.

12. An impedance control comprising a housing a first pair of circuit elements disposed substantially in a common first pair of circuit elements disposed substantially in a common first plane, a first wiper movable in a first direction, a first pair of wiper contacts on said first wiper and in contact respectively with said first pair of circuit elements, a second pair of circuit elements disposed substantially in a second common plane spaced from and parallel to said first plane, a second wiper movable in a second direction, a second pair of wiper contacts on said second wiper and in contact respectively with said second pair of circuit elements, said circuit elements and said wipers disposed in stacked relation, a common shuttle engaging said first and second wipers for moving same individually or concurrently and manually operable actuating means operatively connected to said common shuttle.

13. A control according to claim 12 wherein said actuating means includes a control lever and a swivel mount for said control lever on said housing.

14. A control according to claim 12 including a spring for establishing a pressure contact between said second pair of wiper contacts and said second pair of circuit elements.

15. A control according to claim 12 including a first pair of terminal strips for said first pair of circuit elements, one wiper contact of said first pair bridging one circuit element of said first pair and an adjacent terminal strip of said first pair, the other wiper contact of said first pair bridging the other circuit element of said first pair and the other terminal strip.

16. A control according to claim 15 including a second pair of terminal strips for said second pair of circuit elements, one wiper contact of said second pair bridging one circuit element of said second pair and an adjacent terminal strip of said second pair, the other wiper contact of said second pair bridging the other circuit element of said second pair and the other terminal strip.

17. A proportionate impedance control for providing proportional impedances and/or corresponding voltages by a single manual manipulation comprising a support, a first subassembly on said support including a first impedance and a first movable wiper therefor, a second subassembly on said support stacked above said first subassembly including a second impedance and a second movable wiper therefor and common control means including a universally mounted control member and a shuttle controlled thereby and coupled to both said first and second wipers, said control member being movable in a first direction to adjust said first impedance without affecting said second impedance, said control member being movable in a second direction at prescribed angles relative to said first direction to adjust and second impedance without affecting said first impedance, said control member being movable in other directions to concurrently adjust said first and second impedances.

18 A control according to claim 17 wherein said first and second wipers are disposed at right angles to each other.

19. An impedance control comprising a housing, a first pair of circuit elements disposed substantially in a first plane and in spaced and parallel relation to each other, a first wiper slidable in a first direction in a second plane parallel to and spaced from said first plane in which said first pair of circuit elements are disposed, a first pair of wiper contacts on said first wiper and in contact respectively with said first pair of circuit elements, a second pair of circuit elements disposed substantially in a third plane spaced from and parallel to said first and second planes, said second pair of circuit elements being disposed in spaced and parallel relation to each other and at right angles to said first pair of circuit elements, a second wiper slidable in a second direction at right angles to said first direction and in a fourth plane parallel to and spaced from said third plane in which said second pair of circuit elements are disposed, a second pair of wiper contacts on said second wiper and in contact respectively with said second pair of circuit elements, a common shuttle engaging both said first and second wipers for moving same individually or concurrently and manually operable actuating means operatively connected to said common shuttle.

20. An impedance control comprising a housing, a first pair of circuit elements disposed substantially in a first common plane, a first wiper slidable in a first direction in a plane parallel to and spaced from said first plane, a first pair of wiper contacts on said first wiper and in contact respectively with said first pair of circuit elements, a second pair of circuit elements disposed substantially in a second pair of circuit elements disposed substantially in a second common plane spaced from and parallel to said first plane, a second wiper slidable in a second direction in a plane parallel to and spaced from said second wiper and in contact respectively with said second pair of circuit elements, said circuit elements and said wipers being disposed in stacked relation, a common shuttle engaging both said first and second wipers for moving same individually or concurrently and manually operable actuating means operatively connected to said common shuttle.

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