Sept. 30, 1952 W. H. TURNER 2,612,557

VARIABLE RESISTOR SIGNAL EQUALIZATION UNIT

Filed July 29, 1949 3 Sheets-Sheet 1

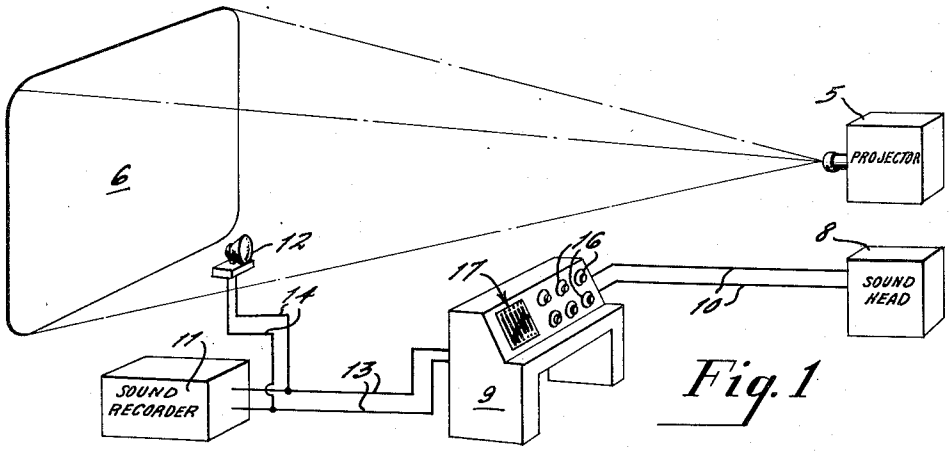


Fig. 1

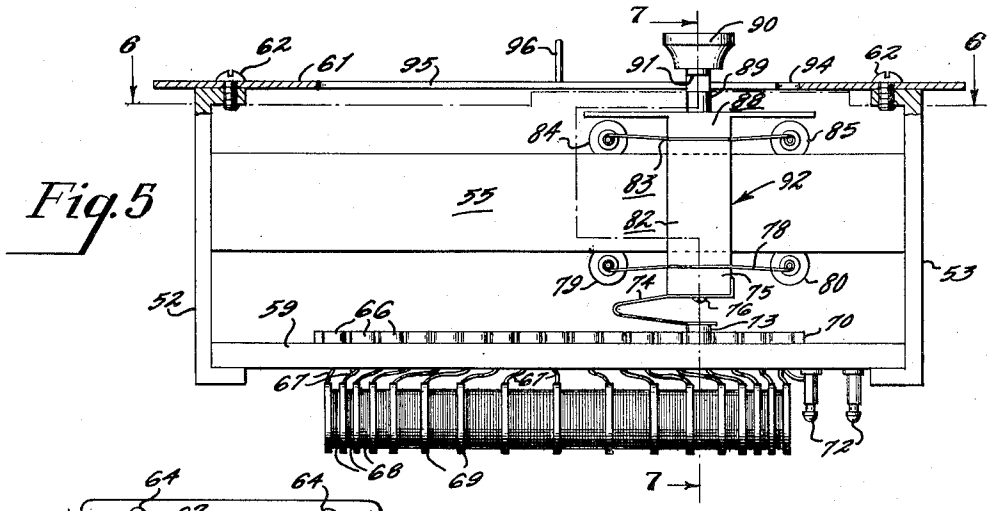


Fig. 5

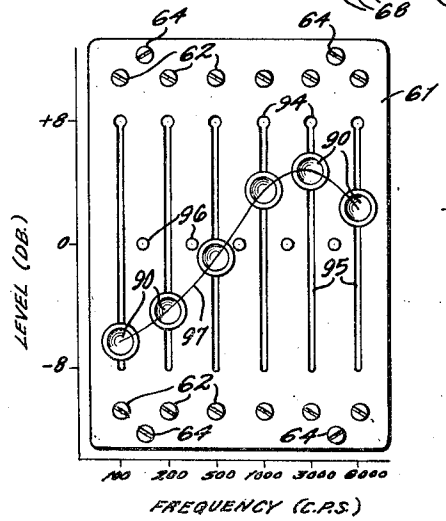


Fig. 4

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VARIABLE RESISTOR SIGNAL EQUALIZATION UNIT

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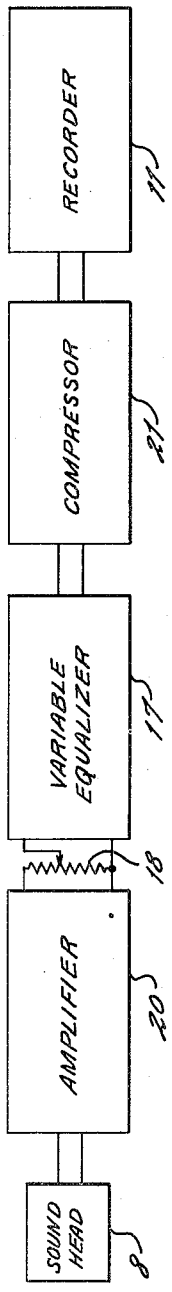


Fig. 2

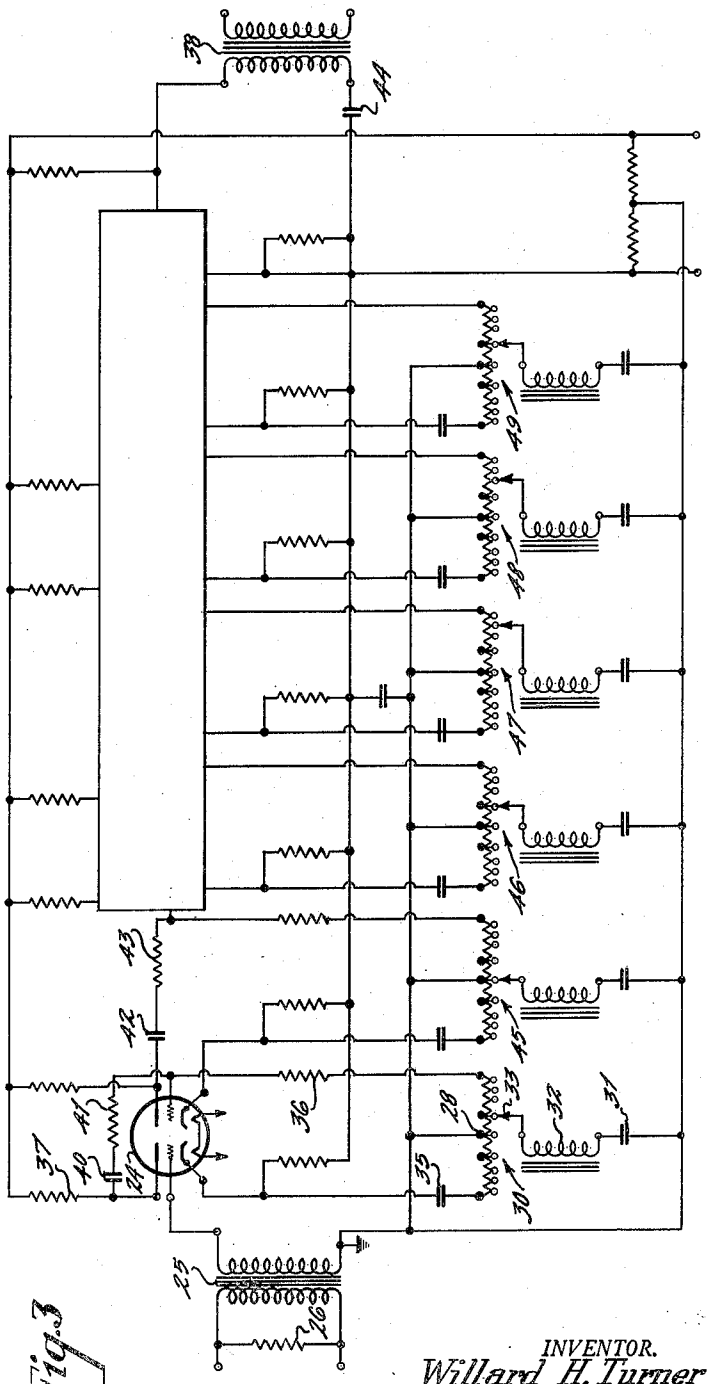


Fig. 3

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Fig. 6

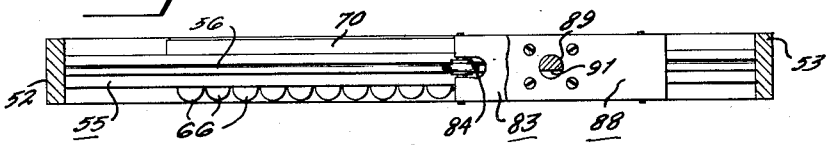


Fig. 7

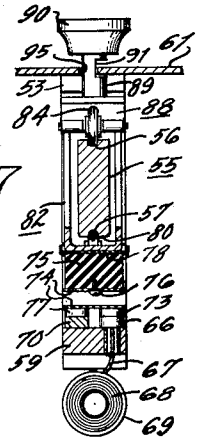


Fig. 8

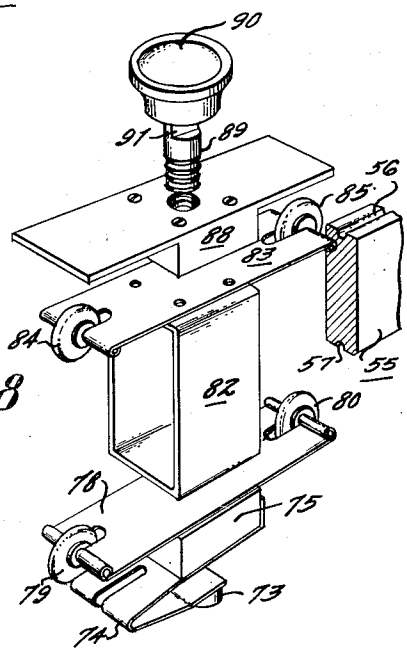
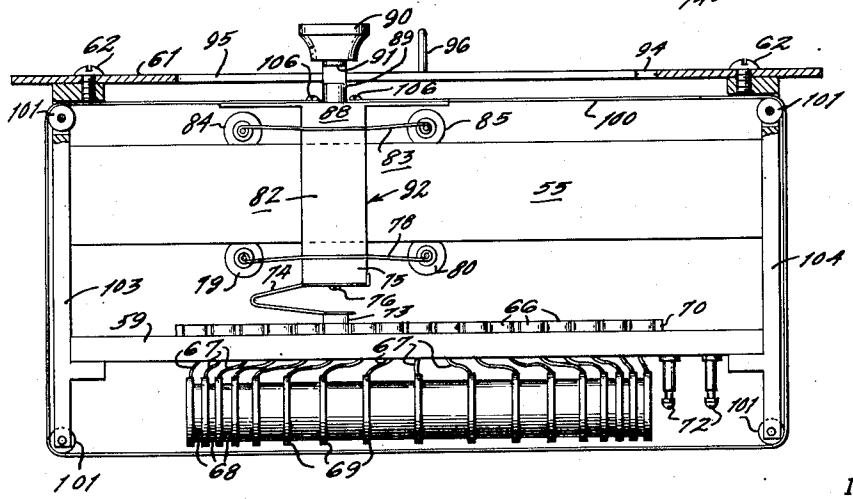


Fig. 9



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UNITED STATES PATENT OFFICE

2,612,557

VARIABLE RESISTOR SIGNAL EQUALIZATION UNIT

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Application July 29, 1949, Serial No. 107,584

8 Claims. (Cl. 178—44)

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This invention relates to motion picture producing apparatus, and particularly to a rerecording system and amplitude varying device, whereby changes in the frequency characteristic of a signal may be rapidly and accurately made during the transmission of the signal from a sound reproducer to a sound recorder or loudspeaker.

In the production of motion pictures, although concomitant picture and sound sequences are photographed and recorded simultaneously, various sequences are made at different times, and subsequently edited and joined together to form the complete film story. In many instances, the dialogue track, recorded at the time of photographing the scene, has background sounds, such as music or sound effects, added thereto in a rerecording process. This process, briefly, consists of projecting the picture sequences to a screen where they are observed by the operator, who controls the over-all volume of the various dialogue and background effects tracks to be combined into the final composite track. During this rerecording operation, the mixer, as he is called, also varies the frequency characteristic of the signal to enhance its quality or reduce objectionable frequencies, such as "hisses" or other distortion introduced by the actors or stages, as disclosed in U. S. Patent No. 2,458,641 of January 11, 1949. The mixer, therefore, has mounted on his console, volume controls and an equalizer mechanism.

The present invention is directed to an equalizing system and mechanism which permits the mixer to rapidly adjust the equalizer to provide the signal with any desired frequency characteristic solely by the sense of touch, since the rerecording operation is done in a dark or nearly dark room. Although it has been disclosed as a multiple unit device, whereby each unit controls the level of a portion of a freqeuncy band, a single unit could be employed for the entire frequency band of the signal.

The principal object of the invention, therefore, is to facilitate the recording or rerecording of a signal.

Another object of the invention is to provide an improved system for varying the frequency characteristic of a transmitted signal.

A further object of the invention is to provide an improved system for adjusting an equalizer to any desired frequency characteristic by the sense of touch.

A still further object of the invention is to provide an improved equalizer construction which is simple and accurate to operate, and

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which permits the rapid adjustment thereof to provide any desired frequency characteristic to a signal being transmitted therethrough.

A still further object of the invention is to provide an improved construction for an amplitude control device.

Although the novel features which are believed to be characteristic of this invention will be pointed out with particularity in the appended claims, the manner of its organization and the mode of its operation will be better understood by referring to the following description, read in conjunction with the accompanying drawings, forming a part hereof, in which:

Fig. 1 is a diagrammatic view of a rerecording system in which the invention is used.

Fig. 2 is a block diagram of a rerecording system in which the invention is used.

Fig. 3 is a partial schematic drawing showing the equalizer circuit.

Fig. 4 is a plan view of the equalizer of the invention.

Fig. 5 is a cross-sectional view of one of the amplitude control units of the equalizer.

Fig. 6 is a cross-sectional view of the unit of Fig. 5 taken along the line 6—6 of Fig. 5.

Fig. 7 is a cross-sectional view of the unit of Fig. 5 taken along the line 7—7 of Fig. 5.

Fig. 8 is an exploded, perspective view of the slider mechanism of one of the units, and

Fig. 9 is an elevational view showing a modification of the unit shown in Fig. 5.

Referring now to the drawings, in which the same numerals identify like elements, a motion picture projector 5 is shown projecting a picture to an observation screen 6. Simultaneously, a sound head 8 is connected to a console 9 over conductors 10, and then to a sound recorder 11 and a loudspeaker 12 over conductors 13 and 14. Mounted on the console 9, are a plurality of potentiometer control knobs 16, any one of which may be used in the sound channel just traced, and an equalizer unit 17, the details of which will be disclosed hereinafter.

The operation of the apparatus shown in Fig. 1, is that the sound sequence, which accompanies a picture sequence projected by projector 5, is reproduced by sound head 8 and its over-all volume controlled by one of the knobs 16 and its frequency characteristic controlled by the equalizer unit 17. Other sound channels may be transmitted through the console and similarly controlled before they are mixed and recorded by recorder 11. Certain other units are generally included in a rerecording channel, and, as shown in Fig. 2, the sound head 8 is connected to an

amplifier 20, which, in turn, is connected to the variable equalizer 17 through a potentiometer 18. The output of the variable equalizer, in many instances, is impressed upon a compressor 21, and then on the sound recorder 11, with or without additional amplification. The variable equalizer circuit is shown partially in Fig. 3.

Referring now to Fig. 3, the complete equalizer unit shown uses six control sections and three double triode tubes, only one of which is shown at 24, for clarity, the other tubes being connected in the same manner. Although only three tubes and six units are being illustrated, it is to be understood that a greater or smaller number of tubes and units may be employed and that different frequency allocations may be used. The input of the first triode section of tube 24 is connected across the secondary of an input transformer 25, which has a terminating resistor 26 across the primary thereof. The grounded secondary terminal of transformer 25 is connected to the center tap 28 of the first equalizer unit 30, and also, to a condenser 31 in series with an inductance 32 connected to the slider 33 of the first equalizer unit. One terminal of the resistance portion 30 of the equalizer unit is connected over condenser 35 to the cathode of the first triode section of tube 24, and the other terminal of the unit 30 is connected over resistor 36 to the grid of the second triode section of tube 24. The output of the first triode section is connected over a load resistor 37 to the secondary of the output transformer 38 and also over condenser 40 and resistor 41 to the grid of the second triode unit. The output of the second triode unit is connected over a condenser 42 and a resistor 43 to the grid of the first triode section of the next tube, not shown, since the circuits for the other two tubes are substantially identical with the circuit shown for tube 24, except for the values of the component elements. A blocking condenser 44 isolates the plate potential from the cathodes.

The operation of equalizer unit 30 is to vary the attenuation of a band of frequencies in the neighborhood of 100 cycles per second. That is, if the band of frequencies around 100 cycles per second has a certain amplitude value when the slider 33 is at the mid-point 28, movement of the slider 33 to the end of the left-hand section of the unit 30 places this section in series with the condenser 31 and inductance 32, and this frequency range is attenuated. Movement of the slider toward the right-hand section of unit 30 reduces the attenuation, and thus, raises the amplitude of this frequency region above that obtained when the slider is connected at the mid-point. By varying the values of inductance 32 and capacitor 31, other frequency bands may be selected for control by the unit.

This same action occurs for units 45, 46, 47, 48, and 49, the mid frequency of the frequency bands controlled by the other units being substantially 200 cycles per second, 500 cycles per second, 1000 cycles per second, 3000 cycles per second, and 6000 cycles per second, respectively. By positioning the sliders at the mid-points on their respective resistors, a flat frequency characteristic is obtained, and by positioning the sliders of the respective units at different relative positions, any desired shape of frequency characteristic may be given to the signal being transmitted between the transformers 25 and 38. By increasing the number of units and varying the mid frequency of each band, the detailed shape of the characteristic may be controlled.

Referring now to the remaining figures, which show the mechanical construction of the unit 17, each potentiometer unit is made up of a frame having end U-shaped members 52 and 53, a slider track center bar 55 having edge grooves 56 and 57, and a lower cross mounting bar 59. The upper ends of U members 52 and 53 are mounted on a cover mounting plate 61 by screws 62, a plurality of these screws 62 being shown in Fig. 4 for holding the other equalizer units to the plate 61, which, in turn, is mounted to the console frame by screws, such as shown at 64.

On the lower bar 59, are mounted a plurality of contact elements 66, which are connected by respective connectors 67 to wire-wound non-inductive resistor elements 68, separated by washers 69. It is observed that the units 68 are logarithmically tapered in size from the center tap 28 toward the ends, so that each division varies the attenuation in one decible step. Mounted parallel with the axis of bar 59 and adjacent the contact terminals 66, is a contact bar 70 for making connection of the elements 68 to terminals 72. Adapted to slide on the terminals 66 and bar 70, are a pair of terminals 73 and 77 mounted on the divided end of a U spring 74, connected to an insulating block 75, in any suitable manner, such as by a screw 76. The block 75 is mounted on a spring member 78 having wheels 79 and 80 at the ends thereof, then to a hollow tube member or slider body element 82, the upper end of the member 82 being connected to a second spring member 83 having wheels 84 and 85 at the ends thereof, to which is connected a T member 88, into which is threaded the stem 89 of a finger knob 90. The stem has a notch 91 cut therein to accommodate the cover plate 61. The wheels 84 and 85 roll in the groove 56, and the wheels 79 and 80 roll in the groove 57, when the slider unit generally indicated at 92 is moved by the finger knob 90.

To attach the finger knob to the T member 88, the unit 92 is moved under one of the holes 94, the stem 89 passing through the hole 94 and threaded into the T member 88 with the flat side of the notch 91 parallel with the sides of one of the narrow grooves 95 in the plate 61. This construction maintains a constant contact pressure between movable terminals 73 and 77 and fixed terminals 66 and 70, while providing the same "feel" of the slider at all times. That is, there is no variation in effort required to move the slider, regardless of its position, as frequently occurs with the usual rotary potentiometers.

Thus, when the unit 92 is positioned so that contact 73 is in contact with terminal 28, the slider 33 of Fig. 3 will then be at the center point, as shown in Fig. 3, and movement in either direction will raise or lower the amplitude of the frequency band controlled by any particular unit, as indicated at the bottom of Fig. 4. As also shown in Fig. 4, the movement of any slider from its mid-position, which is indicated by projections 96, from the plate 61, to its extreme upper position, will raise the amplitude of this frequency band eight decibels, and, by positioning the unit in its extreme lower position, this band will be attenuated eight decibels, thereby providing a sixteen decibel over-all variation.

A curve 97 has been shown joining the finger knobs 90 to illustrate the frequency characteristic given to the signal by the sliders when positioned as shown in Fig. 4. This characteristic

will vary with the positioning of the slider units, as indicated by the finger knobs **90**. Since the equalizer will be adjusted in a darkroom and the operator is observing the picture, the projections **96** indicate the mid points for the sliders **92**, and thus, the position of the units are easily determinable by the tips of the fingers. The sense of touch permits the desired characteristic to be obtained for any signal being transmitted. As shown in Fig. 4, the high frequency portion of a signal is being transmitted at less attenuation than the low frequency portion, while the reverse positioning of the finger knobs **90** would result in the reverse characteristic.

Contact elements **66** and **73** and bar **70** are made of coin silver, which is non-corrosive, and which provides better contacts than pure silver. The tension in the spring elements **78** and **83** and the use of rollers **79, 80, 84,** and **85** provide a very smooth and constant action for the slider **92** at all times along with perfect contacts. The transition from one resistive element to the next adjacent one is smooth, since the contact **73** will span the gaps between adjacent contactors when shifting from one to the other.

As shown in Fig. 4, the slots **95** permit a small amount of dust to enter the unit, and deposit itself on the contacting elements. To prevent this, the modification shown in Fig. 9 is provided. This modification uses a belt **100**, which may be of belting material or steel, and which runs over corner rollers **101** on the ends of frames **103** and **104**. The ends of the belt **100** are connected to the T member **88** by screws **106**. The belts of the various units closely adjoin one another, so that all falling dust from above is deposited thereon, and thus, eliminated from the surface of the contact elements **66** and bar **70**. In other respects, the unit shown in Fig. 9 is the same as the unit shown in Fig. 5.

As mentioned above, a single unit could be used to vary the level of the entire frequency spectrum of a signal, and substituted for the potentiometers **18**; but, a plurality of such units constructed as described are particularly advantageous for an equalizer. Although the construction could be cylindrical so that the knobs would move in a circular path, the linear movement is preferred.

I claim:

1. A variable resistor device, comprising a hollow rectangular frame, an intermediate track element attached to the ends of said frame and spaced from the sides thereof, a plurality of resistor elements mounted on one side of said frame, a plurality of serially arranged contact elements connecting with said resistor elements, a slider body element, resilient wheeled means for mounting said slider body element on said track element, and resilient contact means intermediate said slider body element and said contact elements.

2. A variable resistor device in accordance with claim 1, in which said mounting means for said slider body element on said track element includes a member on each side of said track element, said slider body element being attached to both of said members, and a plurality of wheels mounted on said members and adapted to roll along said track element.

3. A variable resistor device in accordance with claim 1, in which a plurality of said resistor devices are mechanically arranged in parallel planes and electrically connected in parallel, the slider body element of each of said devices being linearly movable in parallel planes.

4. A variable resistor device in accordance with claim 1, in which belt means positioned above said contact elements to protect said contact elements are provided, the ends of said belt being connected to said slider body element, and means are provided for positioning said belt around the corners of said frame, said belt moving with movement of said slider to insure that a certain portion of said belt means is always above said contact elements.

5. An equalizer device for a system for equalizing a signal during the transmission thereof, comprising a plurality of resistor devices, said devices including hollow rectangular frames positioned in parallel planes, a plurality of resistor elements mounted on one side member of each of said frames, contact terminal means for said resistor elements arranged in a serial order on said side of each of said frame members, continuous contact bars having their surfaces in the same planes as the surfaces of said contact terminal means, track elements connected between the end members of each of said frames, means movable on each of said track elements, resilient contact elements between each of said movable means and said contact terminal means and each of said continuous contact bars, individual means for moving each of said movable means along said track elements and along said contact terminal means and said bars, and a plate to which all of said resistor devices are mounted.

6. An equalizer device in accordance with claim 5, in which a plurality of indicator means are provided on said mounting plate for indicating predetermined positions of each of said last mentioned means.

7. An equalizer device in accordance with claim 5, in which said resistor elements are mounted on one side of each side member of said frames, and, said contact terminal means and said bars are arranged in alignment on the other side of said side members, said track elements being bars having grooves in the edges thereof, said movable means having wheels in said grooves and supporting members for said wheels attached to said resilient contact elements, and said resilient contact elements are split U-shaped springs between said movable means and said contact terminal means and said contact bars.

8. An equalizer system for varying the frequency characteristic of a signal being transmitted therethrough, comprising a plurality of individual and separate resistors, a similar plurality of taps to which said resistors are connected, said taps being arranged in a row with the surface of each tap in the same plane as the surfaces of the other taps, said resistors and taps forming a unit, a movable slider having a contact thereon adapted to contact said taps in consecutive order when said slider is moved between its end positions, a plurality of similar individual and separate resistors, a similar plurality of taps having their surfaces in the same plane as the surfaces of said first mentioned taps, said groups of resistors and taps forming additional units, a plurality of sliders corresponding to said additional resistor and tap units, said sliders having portions movable in planes parallel to the plane of movement of a portion of said first mentioned slider, means for moving said sliders, and means for indicating the position of each one of said sliders with respect to the positions of said other sliders and with respect to the resistors connected thereto, each of said units including a hollow rectangular frame, a center track bar connect-

ing the ends of said frame, said resistors of each of said units being mounted on one side of each of said frames, a finger knob at the upper end of each slider, and a plurality of wheeled rolling members for moving said slider along said track bar to connect said resistors thereto.

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