May 30, 1944. D. GRIMES 2,350,277

VOLUME CONTROL FOR RADIO-PHONOGRAPHS

Filed Dec. 26, 1940 3 Sheets-Sheet 1

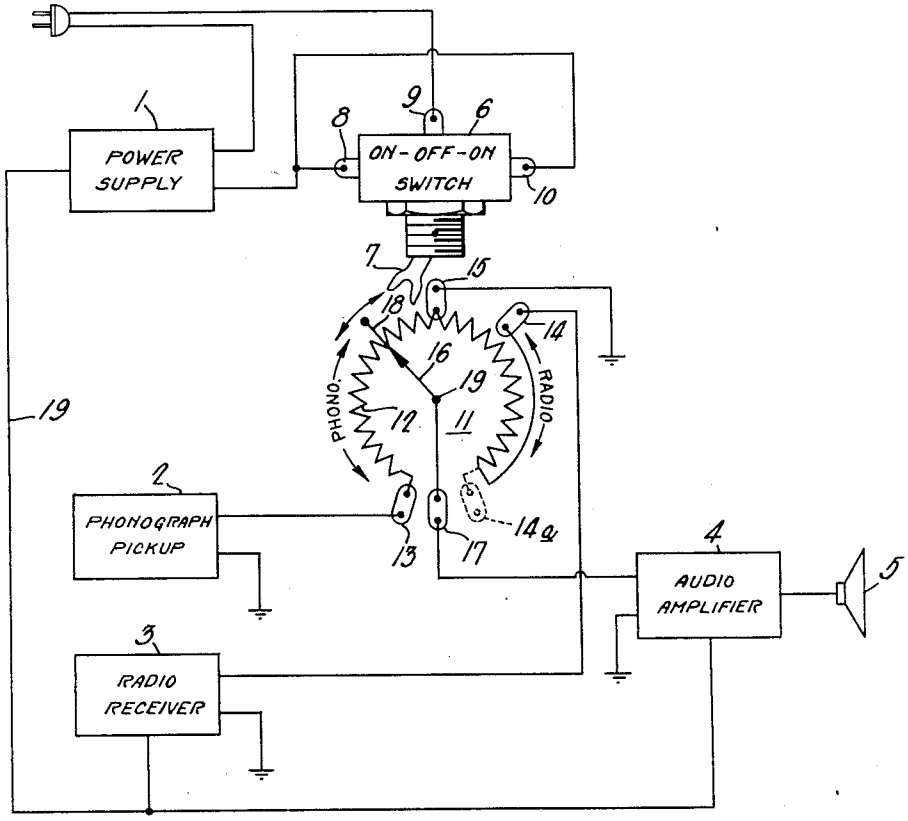


FIG. 1.

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VOLUME CONTROL FOR RADIO-PHONOGRAPHS

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Fig. 2.

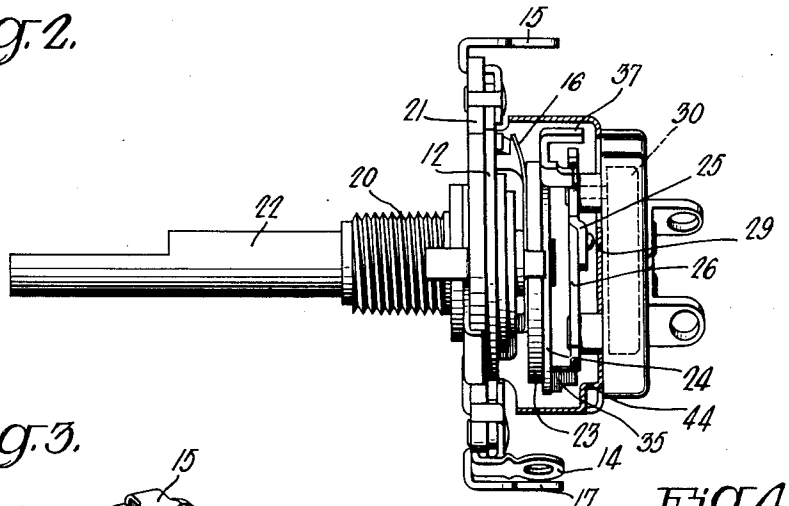


Fig. 3.

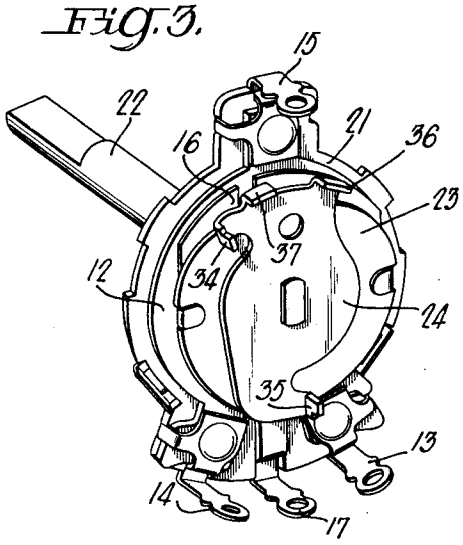


Fig. 4.

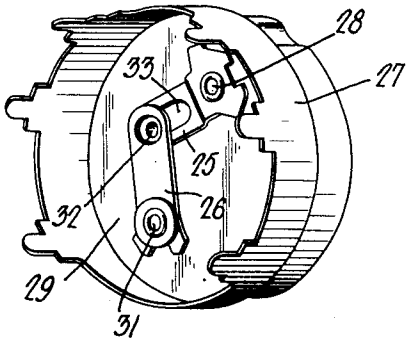


Fig. 5.

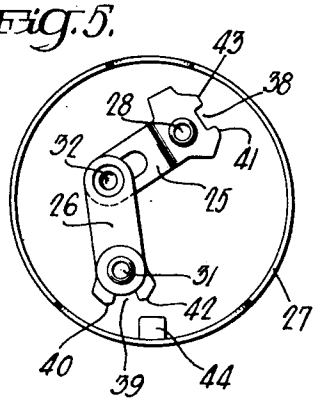


Fig. 6.

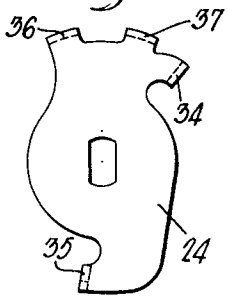
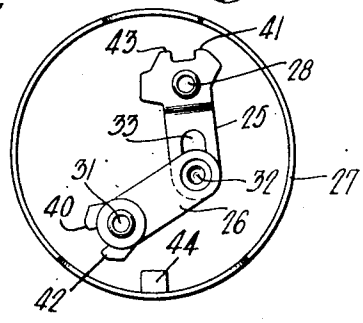


Fig. 7.



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VOLUME CONTROL FOR RADIO-PHONOGRAPHS

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Fig. 8.

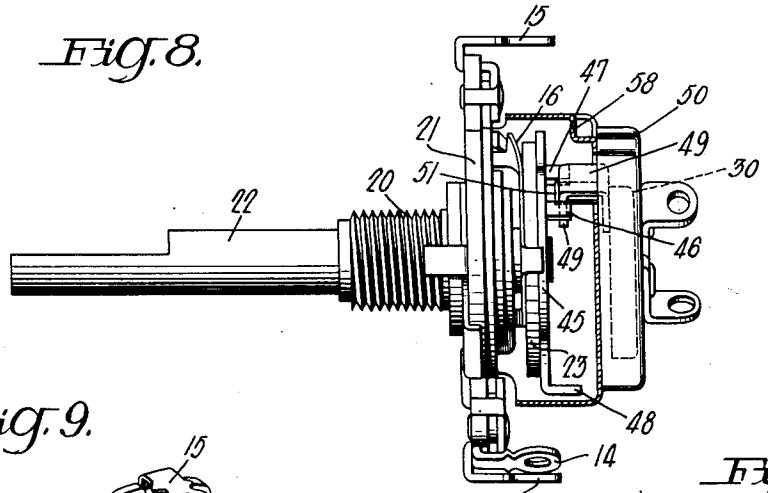


Fig. 9.

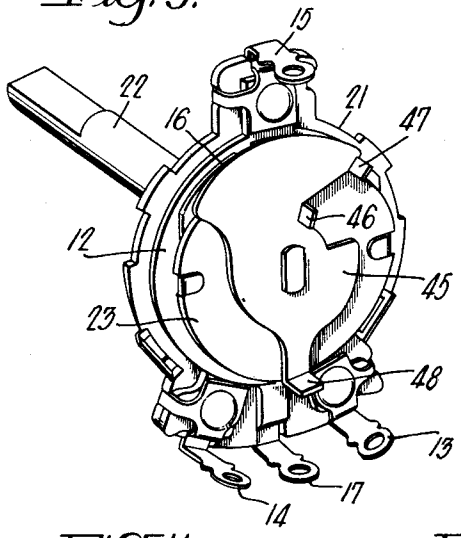


Fig. 10.

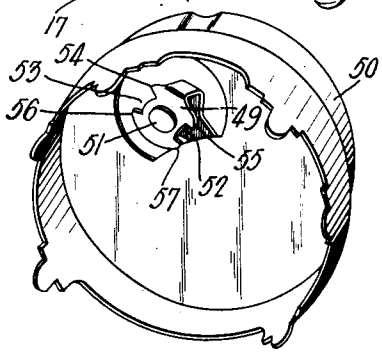


Fig. 11.

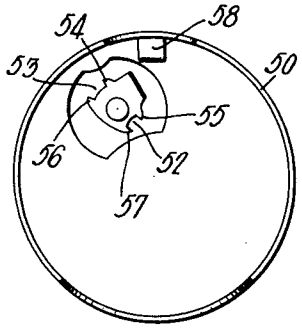


Fig. 12.

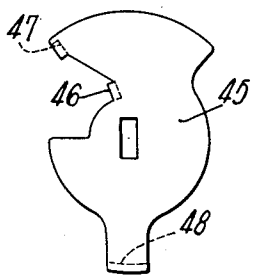
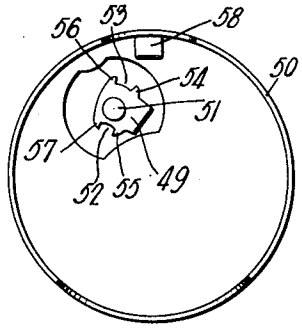


Fig. 13.



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Patented May 30, 1944 2,350,277

UNITED STATES PATENT OFFICE

2,350,277

VOLUME CONTROL FOR RADIO-PHONOGRAPHS

David Grimes, Meadowbrook, Pa., assignor to Philco Radio and Television Corporation, Philadelphia, Pa., a corporation of Delaware

Application December 26, 1940, Serial No. 371,748

15 Claims. (Cl. 179—100.11)

This invention relates to volume control devices for radio-phonograph combinations and the like, and has for its object the provision of a novel combination of a dual volume control and a power switch, the use of which makes unnecesary the provision of the usual "phono-radio" switch normally required for switching from radio to phonograph operation or vice versa.

According to the invention there is provided a volume control device having a line or power supply switch linked thereto. This linkage is constructed and arranged in such a way that the said switch is turned "off" whenever the volume control device is adjusted to the center or neutral position of its overall control range, but is turned "on" whenever the volume control is turned to either side of this neutral or center position. The volume control is, moreover, connected in the radio-phonograph circuit in such a manner that when it is varied over its range on one side of the neutral position the device acts to connect the phonograph pickup to the input of the audio frequency amplifier and to control the output volume thereof, while when varied over the range on the other side of the neutral position the device acts to connect the radio receiver to the input of the audio frequency amplifier and to control the volume of received radio programs.

The invention may best be understood by reference to the accompanying drawings in which

Fig. 1 is a diagrammatic illustration of a radio-phonograph combination embodying the device of the invention;

Fig. 2 is a side elevational view of a preferred form of the composite volume control and switch device, with a portion of the casing shown in section for the sake of illustration;

Figs. 3 and 4 are perspective views respectively of the principal parts of the device;

Figs. 5 to 7 are explanatory views of the switch operating parts;

Fig. 8 is a side elevational view of an alternative embodiment of the composite volume control and switch device, with a portion of the casing shown in section;

Figs. 9 and 10 are perspective views respectively of the principal parts thereof; and

Figs. 11 to 13 are explanatory views of the switch operating parts of this device.

Referring now particularly to Fig. 1, there is represented a complete radio-phonograph combination comprising a power supply system 1, a phonograph pickup device 2, a radio receiver 3, an audio frequency amplifier 4, and a loudspeaker 5. The power supply system 1 may derive its input power from any commercial source of electrical power, and its operation, and that of the entire radio-phonograph combination is controlled by means of a three-position toggle switch 6. When the switch arm 7 is in its neutral (vertical) position, the switch is open and the power supply is deenergized, but when the switch arm is moved either to its left-hand position (shown) or to its right-hand position, the switch closes the power supply circuit either through terminals 8 and 9 or through 9 and 10. The three-position toggle switch per se is well known and requires no detailed illustration, particularly since the present invention is not concerned with the specific structure of the switch.

The phonograph pickup 2 may be any suitable known device, and may include any satisfactory known type of reproducer unit such as magnetic, crystal, photo-electric, electrostatic, etc.

The radio receiver 3 may be of any conventional type. If it is of the superheterodyne type it may comprise a radio frequency amplifier, converter stage, intermediate frequency amplifier, and second detector. The audio frequency amplifier 4 is arranged to be selectively connected, by way of the dual volume control 11, to the output of either the phonograph pickup 2 or the radio receiver 3, as described more fully hereinafter.

The volume control device 11 may comprise the usual resistance strip 12 disposed in a circular or semicircular configuration betwen the terminal lugs 13 and 14. A predetermined point substantially midway between the extremities of the resistance strip 12 may be connected, by way of an intermediate lug 15, to a point which is common to the phonograph pickup 2, radio receiver 3, and audio amplifier 4. This common point is preferably a chassis or ground connection as illustrated. An adjustable contact arm 16 is arranged to be moved over the resistance strip 12 and to make contact with any point thereon. The contact arm may be connected, by way of the lug 17, to the high potential (ungrounded) input terminal of the audio amplifier 4. The terminal lug 13 may be connected to the high potential terminal of the phonograph pickup device, while the other terminal lug 14 is connected to the high potential terminal of the radio receiver 3. The dual nature of the volume control will be understood when it is observed that the phonograph pickup 2 is connected to the input of the amplifier 4 only when the volume control contact arm 16 is varied over that part

of the resistance strip 12 which extends between the lugs 13 and 15; similarly the radio receiver 3 is connected to the input of amplifier 4 only when the contact arm 16 is moved over that part of the resistance strip 12 which extends between the lugs 14 and 15. Accordingly it is evident that the dual volume control device 11 functions simultaneously to control volume and to select programs from either the phonograph or radio components of the combination, thereby eliminating the need for the usual "phono-radio" switch.

In cooperative arrangement with this dual volume control is the power supply switch 6 whose operation is controlled by a suitable extension 18 on the contact arm 16. The extension 18 may of course be physically separate from the arm 16 and may be suitably coupled or linked to the shaft 19 on which the arm 16 is mounted. As the arm 16 and extension 18 are rotated clockwise from the illustrated positions the extension 18 will engage the bifurcated end of the switch arm 7 and move it into its neutral or "off" position. During this movement of the volume control contact arm 16, phonograph volume will have been reduced to its minimum level and the contact arm may be brought to rest in a vertical and neutral position. If the rotation of the contact arm and extension are continued in the clockwise direction, the switch arm 7 will be snapped to the right in the first few degrees of continued rotation, and the output of the radio receiver 3 will be connected to the amplifier 4, and the volume level of radio reproduction will be gradually increased as the contact arm 16 is rotated toward that end of the resistance strip 12 which is connected to the terminal lug 14.

Volume control potentiometers heretofore available for use in a volume control system of the type described are provided with three closely adjacent terminal lugs 13, 17, and 14*a* (the latter shown in dotted lines). Such potentiometers have been found not altogether adapted to the most satisfactory operation of the invention. The disadvantage of the conventional potentiometer resides in the fact that, due to the close spacing of the lugs, there is sufficient capacity between the lug 14*a* (which would be connected to the high potential terminal of the radio receiver 3) and the lugs 13 and 17 to permit the capacitive transfer of a substantial audio or radio frequency signal to the audio amplifier 4 during phonograph operation of the system This objectionable signal transfer may be effectively avoided by omitting the lug 14*a* and by substituting the lug 14 which is physically removed from the lugs 13 and 17. Preferably the lug 14 is located near the grounded lug 15 so that the grounded lug and its associated wiring may act to shield the lugs 13 and 17 from any electrostatic effect of the radio lug 14. The disposition of the terminal lugs illustrated diagrammatically in Fig. 1 has been found to eliminate the leak-through of radio signals during phonograph operation so completely that it is unnecessary to include the switching means usually provided for muting or otherwise making inoperative the radio receiver portions of the system during phonograph operation.

In Figs. 2 to 7, there is illustrated a preferred mechanical form of a composite device embodying a toggle switch and dual volume control potentiometer. This composite device differs from the device of Fig. 1 in that it employs a simple two-position toggle switch which is closed in one position and open in its other position. The employment of such a switch is made possible by the specific construction of the device, as described hereinafter.

The potentiometer section of the device (see Figs. 2 and 3) comprises a support bushing 20 carrying an insulating backplate 21 to which is affixed the circular resistance strip 12. Terminal lugs 13 and 14 are connected to the extremities of the resistance strip 12, while the lug 15 is connected to an intermediate point on the resistance strip 12. The lug 17 is conductively connected to the potentiometer contact arm or shoe 16 by means of a suitable sliding contact or the like. This contact requires no detailed illustration since the portion of the device so far described is in accordance with common practice and well known to those skilled in the art. See, for example, U. S. Patent No. 2,151,625 issued to E. O. Thompson March 21, 1939. The terminal lugs above mentioned correspond to the like numbered lugs of Fig. 1, and it is to be understood that the connections thereto may be substantially as shown in Fig. 1. Similarly if desired the lug 14 may be physically removed from lugs 13 and 17 substantially as illustrated in Fig. 1.

The control shaft 22, which extends through bushing 20, carries an insulating disc 23 to which the contact shoe 16 is attached. The insulating disc 23 also carries a suitable toggle actuating element 24 described more fully hereinafter. It will be understood that the contact shoe 16, insulating disc 23, and toggle actuating element 24 are all firmly secured to the shaft 22, and rotate therewith.

The switch actuating toggle 25—26 and the switch itself are mounted on the housing structure 27. The switch may be actuated by the rotation of toggle element 25 about its pivot 28. The switch itself is not visible, being disposed behind wall 29, but it is represented by the broken line outline 30 in Fig. 2. There is no need to illustrate or describe the switch structure, since it may be of any single-pole single-throw type adapted for rotational actuation. Such switches are well known in the radio and electrical arts. The switch may be arranged to be closed or "on" when the toggle 25—26 is in the position shown in Fig. 7, and open or "off" when the toggle is in the position shown in Fig. 5. The "off" position of the switch should obtain, as was the case with Fig. 1, whenever the contact portion of shoe 16 is over that part of the resistance strip 12 which is directly adjacent to the intermediate lug 15. Whenever the contact shoe 16 is moved to either side of this point it is desired that the switch be turned "on." This desired operation of the switch is obtained by means of the toggle elements 25—26 and the cooperating toggle actuating element 24 now to be described.

The toggle elements 25 and 26 are mounted to rotate about their respective pivots 28 and 31. Fixed to the toggle element 26 is a pin 32 arranged to ride in a longitudinal slot 33 in the toggle element 25. Thus as either toggle element is caused to rotate about its pivot 28 or 31 the pin 32 will slide toward the upper end of the slot 33, and then slide back again toward the lower end thereof. The two extremes of the toggle movement are illustrated in Figs. 5 and 7. In the embodiment, illustrated the toggle element 25 is directly linked to the switch, but it will be seen that the switch may be actuated by applying a rotational force to either of the toggle elements 25 or 26.

The toggle actuating element 24 shown in Figs. 3 and 6 comprises a flat plate on which a pair of projections 34 and 35 are turned up (down as viewed in Fig. 6) to form toggle actuating lugs. Similarly turned stop lugs 36 and 37 are employed for a purpose explained hereinafter. The purpose of Figs. 5 to 7 is to enable one to visualize the operation of the toggle switch by the actuating element 24. To this end the element 24 is shown in Fig. 6 in such position that it may be mentally transposed upon Fig. 5 as it is in the assembled device of Fig. 2. If now the toggle actuating element 24 of Fig. 6 be placed over the toggle device of Fig. 5 without altering the relative positions of either it will be seen that the toggle actuating lugs 34 and 35 will just enter the recesses 38 and 39, respectively, at the bifurcated extremities of the toggle elements 25 and 26. This is the "off" position of the switch and occurs at the minimum position of the dual volume control. Now if the volume control shaft be rotated in either direction, clockwise or counter-clockwise, the switch controlled by the toggle element 25 will be turned "on."

For example, assume that the shaft is rotated clockwise, thus turning the toggle actuating element 24 clockwise from the position shown in Fig. 6. In this case, the toggle actuating lug 35 will engage the shoulder 40 of toggle element 26 causing that element to rotate in a clockwise direction about its pivot 31. At the same time lug 34 will simply move past shoulder 41 on toggle element 25 without striking the same. Clockwise rotation of element 26 produces a counter-clockwise rotation of toggle element 25, motion being transmitted through the pin and slot arrangement 32—33. As a result the device is actuated to its "on" position shown in Fig. 7. If now it is desired to turn the switch off it is only necessary to turn the shaft in a counter-clockwise direction until the toggle actuating lug 35 engages the shoulder 42 of toggle element 26 and returns the device to the position of Fig. 5.

Now assume that the shaft and toggle actuating element 24 be turned counter-clockwise from the position shown in Fig. 6. In this case, the toggle actuating lug 34 will engage the shoulder 43 of toggle element 25 causing that element to rotate in a counter-clockwise direction about its pivot 28. At the same time lug 35 simply moves past shoulder 42 without striking the same. As a result the switch is again thrown to its "on" position of Fig. 7. Obviously, rotation of element 24 in the opposite direction will again throw the switch to "off" position.

Thus the switch may be turned "on" by turning the control shaft in either direction from its neutral position, as in the case of Fig. 1. Once the switch is turned on the volume control may be adjusted to any point over the selected half of its range, substantially as described with respect to the illustration of Fig. 1.

In order to limit the rotation of the volume control in either direction the stop lugs 36 and 37, projecting from the toggle actuating element 24, are arranged to engage the stop member 44 located on the inner surface of the toggle housing 27. This engagement preferably takes place at the maximum volume position of the control for both phonograph and radio operation.

In Figs. 8 to 13, there is illustrated another form of the composite dual volume control and switch device, which also employs a simple on-off toggle switch. The potentiometer section of the device, shown in Fig. 9, is generally similar to that shown in Fig. 3 except for the design of the snap-switch actuating element 45. The parts which are similar to those of the above-described device are similarly designated. The element 45 resembles the equivalent element 24 of Fig. 3 in that it comprises a pair of switch actuating lugs 46 and 47, and a stop lug 48.

The snap-switch actuating cam 49 and the snap-switch itself is housed in the housing structure 50. The switch may be actuated by the rotation of the actuating cam 49 about its pivot 51. The snap-switch itself is not shown in detail since it may conveniently be of any single-pole single-throw type adapted for rotational actuation. Specifically the switch may be arranged to be closed or "on" when the cam 49 is in the position shown in Fig. 13, and open or "off" when the cam 49 is in the position shown in Fig. 11. The "off" position of the switch is normally desired whenever the contact shoe 16 is over that part of the resistance strip 12 which is directly adjacent to the intermediate lug 15. Whenever the contact shoe is moved to either side of this position it is desired that the switch be turned "on." The snap-switch actuating element 45 is designed to effect this desired operation.

The snap-switch actuating element 45, shown in Figs. 9 and 12 comprises a flat plate fixed to the end of the control shaft 22 and has the projections 46 and 47 turned up (down as viewed in Fig. 12) to form the switch actuating lugs. If now the snap-switch actuating element 45 of Fig. 12 be placed over the device of Fig. 11, without altering the relative orientation of either, it will be seen that the switch actuating lugs 46 and 47 just enter the recesses 52 and 53, respectively, on either side of the switch actuating cam 49. This is the "off" position of the switch and occurs at the minimum volume position of the dual volume control. Now if the volume control shaft be rotated in either direction, clockwise or counter-clockwise, the switch controlled by the actuating cam 49 will be turned "on."

For example, assume that the actuating element 45 be turned clockwise from the position shown in Fig. 12. In this case the switch actuating lug 47 will engage the shoulder 54 of cam 49 causing the cam to snap into the position shown in Fig. 13, which is the "on" position of the switch. At the same time the lug 46 simply rides past the shoulder 55 without striking the same. If later it be desired to turn the switch off it is only necessary to turn the volume control shaft, and hence the element 45, in a counter-clockwise direction until the actuating lug 47 engages the shoulder 56 of cam 49, and then continue to turn until the cam is snapped into the 'off" position illustrated in Fig. 11.

Now assume that the shaft and snap-switch actuating element 45 be turned counter-clockwise from the "off" position shown in Figs. 11 and 12. In this case the actuating lug 46 will engage the shoulder 57 of the cam 49 causing the cam to rotate in a clockwise direction about its pivot 51 and to snap into the "on" position shown in Fig. 13. At the same time the lug 47 will simply ride past the shoulder 56 without striking the same. The switch may again be turned off by rotating the element 45 in a clockwise direction until the actuating lug 46 engages the shoulder 55 of cam 49 and forces the cam back into the "off" position of Fig. 11.

Once the switch is turned on the volume control may be adjusted to any desired point on the selected half of its range substantially as de-

scribed with reference to the enbodiment of Fig. 1. In order to limit the rotation of the volume control in either direction the stop lug 48, projecting from the snap-switch actuating element 45, is arranged to engage the stop member 58 located on the liner surface of the cam housing 50.

The above-described embodiments of the invention have been shown only by way of example, and it will be understood that the invention is not limited thereto, but only by the scope of the appended claims.

I claim:

1. A radio-phonograph apparatus, comprising a radio receiver, a phonograph pickup, an audio amplifier for use with either said radio receiver or said pickup, a power supply circuit for said apparatus, a switch for controlling said power supply circuit, volume control means including a resistance element and a movable contact element engaging said resistance element, a terminal at one extremity of said resistance element connected to said pickup, a terminal at the other extremity of said resistance element connected to said receiver, a connection between said amplifier and said movable contact element, means connecting said receiver, said pickup and said amplifier to an intermediate point on said resistor element, whereby said receiver and said pickup may be selectively connected to said amplifier by moving said contact element to one or the other side of said intermediate point, and the volume may be controlled in either case by the extent of movement of said element, and means operable by the movement of said contact element to either side of said intermediate point for closing said switch, and for opening the switch whenever said contact element is returned to said intermediate point.

2. A radio-phonograph apparatus, comprising a radio receiver, a phonograph pickup, an audio amplifier for use with either said radio receiver or said pickup, a power supply circuit for said apparatus, a switch for controlling said power supply circuit, volume control means including a resistance element and a movable contact element engaging said resistance element, means connecting one end of said resistance element to said pickup, means connecting the other end of said resistance element to said receiver, a connection between said amplifier and said movable contact element, means connecting said receiver, said pickup and said amplifier to an intermediate point on said resistor element, whereby said receiver and said pickup may be selectively connected to said amplifier by moving said contact element to one or the other side of said intermediate point, and the volume may be controlled in either case by the extent of movement of said element, and means operable by the movement of said contact element to either side of said intermediate point for closing said switch, and for opening the switch whenever said contact element is returned to said intermediate point.

3. A radio-phonograph apparatus, comprising a radio receiver, a phonograph pickup, an audio amplifier for use with either said radio receiver or said pickup, a power supply circuit for said apparatus, a switch for controlling said power supply circuit, volume control means including a resistance element and a movable contact element engaging said resistance element, means connecting said pickup across one portion of said resistance element, means connecting said receiver across another portion of said resistance element, said portions having a common junction point, means connecting said amplifier between said movable contact element and said junction point, whereby said receiver and said pickup may be selectively connected to said amplifier by moving said contact element to one or the other side of said junction point, and the volume may be controlled in either case by the extent of movement of said element, and means operable by the movement of said contact element to either side of said junction point for closing said switch, and for opening the switch whenever said contact element is returned to said junction point.

4. A radio-phonograph apparatus, comprising radio reception means having high and low potential output leads, phonograph reproducing means having high and low potential output leads, audio amplifying means having high and low potential input leads, power supply means for said apparatus, a switch for controlling said power supply means, volume control means including a resistance element and a movable contact element engaging said resistance element, means connecting the high potential output leads of said radio reception means and said phonograph reproducing means to spaced points on said resistance element, means connecting the high potential input lead of said amplifier to said movable contact element, means connecting all of said low potential leads to a common intermediate point on said resistance element, and means for closing said switch in response to movement of said contact element to either side of said intermediate point, and for opening said switch in response to return movement of said contact element to said intermediate point.

5. A radio-phonograph apparatus, comprising a radio receiver, a phonograph pickup, an audio amplifier for use with either said radio receiver or said pickup, a power supply circuit for said apparatus, a switch for controlling said power supply circuit, a manual control element movable through a predetermined range, means operable by said element to open said switch when the element is at a certain intermediate point of said range and to close the switch when said element is moved to either side of said point, means controllable by said element to selectively supply the output of said receiver or said pickup to said amplifier depending on the direction of movement of said element from said intermediate point, and means for increasing the selected output in accordance with the movement of said element from said point.

6. In a sound reproducing system, a first source of audio signal, a second source of audio signal, a common signal channel for receiving the output signal from either of said sources, power supply means for at least some of the aforesaid elements, a switch for controlling said power supply means, a manual control element movable through a predetermined range, means operable by said element to open said switch when the element is at a certain intermediate point of its operating range and to close the switch when said element is moved to either side of said point, electrical connections controllable by said element to selectively supply the output signal of either of said sources to said common channel depending on the direction of movement of said element from said point, and means included in said connections and controllable by said element to increase the selected output sig-

nal in accordance with the movement of said element from said point.

7. A combined switch and potentiometer, comprising a resistance element, a movable contact element engaging said resistance element, a two-position switch having a single open position and a single closed position, and means for opening said switch in response to positioning of said contact element at an intermediate point on said resistance element, and for closing said switch in response to movement of said contact element away from said point in either direction.

8. A combined switch and potentiometer, comprising a circular resistance element, a rotatable control shaft, a contact element carried by said shaft and engaging said resistance element, a two-position switch having a single open position and a single closed position, and means including an operating element on said shaft for opening said switch in response to positioning of said contact element at an intermediate point on said resistance element, and for closing said switch in response to movement of said contact element away from said point in either direction.

9. A combined switch and potentiometer, comprising a circular resistance element, a rotatable control shaft, a contact element carried by said shaft and engaging said resistance element, a two-position switch having a single open position and a single closed position, an operating toggle mechanism connected to said switch, an operating member on said shaft, and interengaging means on said toggle mechanism and said operating member for opening said switch in response to positioning of said contact element at an intermediate point on said resistance element, and for closing said switch in response to movement of said contact element away from said point in either direction.

10. A combined switch and potentiometer, comprising a circular resistance element, a rotatable control shaft, a contact element carried by said shaft and engaging said resistance element, a two-position switch having a single open position and a single closed position, an operating cam connected to said switch, an operating member on said shaft, an interengaging means on said cam and said operating member for opening said switch in response to positioning of said contact element at an intermediate point on said resistance element, and for closing said switch in response to movement of said contact element away from said point in either direction.

11. A combined switch and potentiometer, comprising a circular resistance element, a rotatable control shaft, a contact element carried by said shaft and engaging said resistance element, a two-position snap-switch adapted for rotational actuation, a cam device mechanically coupled to the rotatable element of said switch, a cam operating member on said control shaft, and interengaging means on said cam device and said cam operating member for opening said switch in response to positioning of said contact element at an intermediate point on said resistance element, and for closing said switch in response to movement of said contact element away from said point in either direction.

12. A combined switch and potentiometer, comprising an arcuate resistance element, a rotatable control shaft, a contact element carried by said shaft and movable thereby over said resistance element, a two-position snap-switch, and cooperative switch-actuating members attached to said shaft and said switch, said members being constructed and arranged to actuate said switch to its "off" position when said contact element is moved to an intermediate point on said resistance element, and to actuate said switch to its "on" position when said contact element is moved to either side of said intermediate point.

13. A combined switch and potentiometer, comprising a potentiometer unit and a switch unit adapted to be assembled as a composite device, said potentiometer unit including an arcuate resistance element, a rotatable shaft and a contact element carried by the shaft and movable thereby over said resistance element, said switch unit including a two-position snap-switch, and inter-engageable members on the respective units constructed and arranged to actuate said switch to its "off" position when said contact element is moved to an intermediate point on said resistance element, and to actuate said switch to its "on" position when said contact element is moved to either side of said intermediate point.

14. In an electrical system, a first voltage source, a second voltage source, a common transmission path for receiving the voltage from either of said sources, power supply means for at least some of the aforesaid elements, a switch for controlling said power supply means, a manual control element movable through a predetermined range, means operable by said element to open said switch when the element is at a certain intermediate point of its operating range and to close the switch when said element is moved to either side of said point, electrical connections controllable by said element to selectively supply the voltage of either of said sources to said common transmission path depending on the direction of movement of said element from said point, and means included in said connections and controllable by said element to increase the selected voltage in accordance with the movement of said element from said point.

15. A combined switch and potentiometer, comprising a manually-rotatable shaft, an arcuate resistance element arranged concentrically with respect to the axis of said shaft, a contact element on said shaft engaging said resistance element, a two-position single-throw switch spaced from said contact element in an axial direction, and cooperative inter-engaging elements attached to said shaft and said switch, respectively, for opening said switch in response to positioning of said contact element at an intermediate point on said resistance element, and for closing said switch in response to movement of said contact element away from said point in either direction.

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