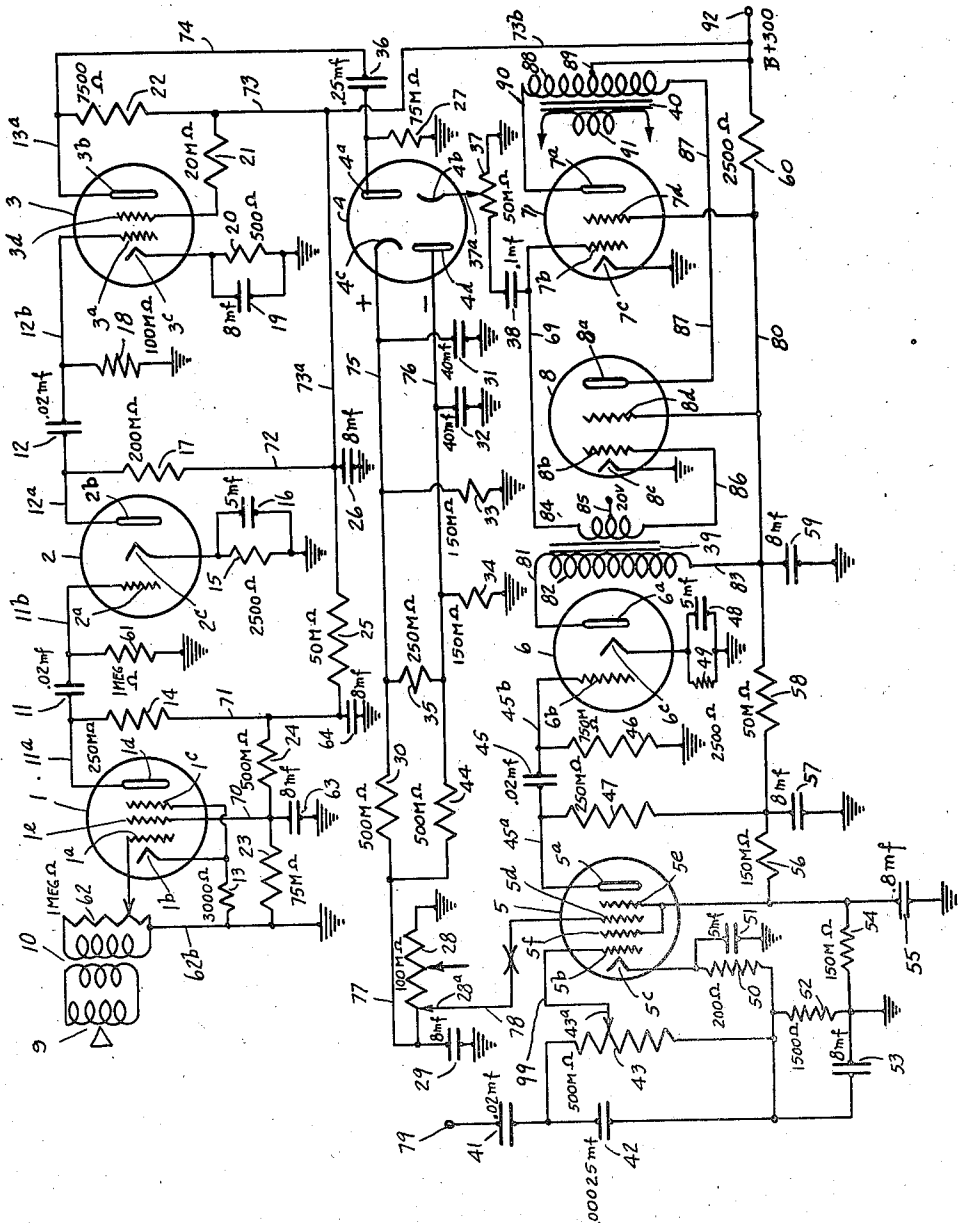


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AUTOMATIC VOLUME CONTROL

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This invention relates to an automatic volume control for a program amplifying circuit such as employed in phonographs, and particularly those of the coin operated type, radio receiving sets, public address systems and the like.

The chief object of the invention is to automatically control the normal amplification of a program amplifier in accordance with the noise intensity in the surroundings, room, etc., into which the amplifying loud speaker discharges the program.

The invention eliminates loud volume nuisance which is generally recognized as a serious objection under varying conditions and in many locations. With the present invention the program amplifier circuit is initially set for proper volume to be heard in that location when the surroundings are quiet. As noise varies, increases or decreases, the automatic volume control causes the amplified volume to imperceptibly increase and decrease with the increase and decrease in surface noise volume.

The control is of such sensitiveness that if the surface noise suddenly ceases, there is substantially no interim during which the program amplified volume is of blaring character, in other words, the element of time lag between control registration and actuation is substantially negligible. It has been found that the change is so imperceptible to an audience that until the actual change is called to its attention, no recognition of program volume variation is noted.

The principal object of the invention, therefore, consists in providing an amplifying circuit, such as in an electric phonograph, radio receiver or public address system and the like with an automatic volume control such as to maintain a constant relation between the volume of amplified sound and surface noises.

One feature of the invention resides in the manual adjustment of a surface noise microphone, the program microphone, the lag and the balancing potentiometers.

Another feature of the invention consists in interposing a filter and delay circuit between the surface noise pick-up and amplification circuit, and the program amplification circuit.

A further feature of the invention resides in the inclusion of a balancing arrangement in series with one portion of the noise volume transfer tube so that the program change will not affect the automatic volume control.

Preferably the invention also contemplates the inclusion of a simple, automatic stop volume control, adjustable for any given maximum volume desired and beyond which the program volume will not increase automatically regardless of any further increase in noise volume.

Other objects and features of the invention will be set forth more fully hereinafter.

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The full nature of the invention will be understood from the accompanying drawings and the following description and claims.

In the drawing, the figure is a schematic wiring diagram of one embodiment of the automatic volume control.

In the drawing, the upper portion represents generally the surface noise pick-up and amplification circuits, the lower portion represents the program pick-up and amplification circuits, while the intermediate portion comprises the connecting circuits which connect the aforesaid circuits together for the purpose described, the said connecting circuits including a filter and delay circuit.

The schematic diagram, by way of example only, has included therein conventional designations for certain tubes as illustrated, the capacity and resistance values, and voltage values thereof. It is also to be understood that certain portions of the circuit illustrated may be modified as desired or required, such as for example that immediately associated with a phonograph amplifier.

In the diagram 9 indicates a noise microphone of the permanent magnet type which is associated with an input transformer 10 bridged by a noise volume control potentiometer 62 having a manually adjustable tap 62^a connected to a grid 1^a of the input tube 1. The potentiometer is grounded by line 62^b. Cathode 1^b is connected to resistor 13 which is grounded by the line 62^b. Grid 1^c is also connected to said resistor as shown. The plate 1^d of said tube is connected to capacity 11 by line 11^a. Line 11^b from said capacity connects to grid 2^a of the second stage microphone amplifying tube 2. Resistor 61 is grounded at one end, and its other end is connected to line 11^b. Condenser 11 is of a coupling character between the first and second stages of the noise amplification system.

Tube 2 in addition to grid 2^a includes the plate 2^b and cathode 2^c. The coupling condenser 12 is connected by lines 12^a and 12^b to the plate 2^b of tube 2 and grid 3^a of the third, and herein the final stage amplifying tube 3. Resistor 18 has one end grounded and the other end connected to line 12^b. Tube 3 also includes the plate 3^b, cathode 3^c and a second grid 3^d. Cathode 3^c is connected to its resistor 20 and in multiple therewith is capacity 19, both being grounded remote from the cathode connection.

In like manner, cathode 2^c of tube 2 is connected to resistor 15 and in multiple therewith is capacity 16, both being grounded remote from the cathode connection.

Tube 1 also includes a grid 1^e connected by line 70 to the junction of resistors 23 and 24, the other terminal of the former being grounded and 60 the other terminal of the latter connecting to

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line 71. The aforesaid junction is connected to a grounded capacity 63.

Line 71 connects to a resistor 14 which is connected to line 11^a, and its other end is connected to a grounded capacity 64. The line 71 capacity 64 connection is connected to one terminal of resistor 25, the other terminal being connected to line 72. Line 72 connects to one terminal of resistor 17, the other terminal being connected to line 12^a. The junction of line 72 and resistor 25 is connected to a grounded capacity 26.

Tube 3 includes the second grid 3^d connected to resistor 21. Plate 3^b of said tube is connected to resistor 22 by line 13^a. Line 73 from this resistor has one branch 73^a connected to line 72 as illustrated, and has a second branch 73^b leading to the push-pull arrangement, to which reference will be had later.

Another line 74 connects to line 13^a and capacity 36, and the latter is connected to one plate 4^a of diode tube 4. Resistor 27 has one terminal grounded and the other connected to the connection between the capacity 36 and plate 4^a. The aforesaid noise amplifier arrangement is a high gain amplifier of fair fidelity and the output from tube 3 is about one watt for the specific example illustrated herein.

The cathode 4^b of diode tube 4 is fed into a filter and delay circuit and from that into a tertiary grid of a multi-grid tube 5, which may be a phonograph microphone input tube.

The theory of operation is briefly that, as the volume of the surface noise increases, the microphone circuit (see top portion of the diagram) will introduce higher impulses into the circuit of tube 4, and accordingly more positive voltage will be available for the said tertiary grid of the input tube 5 which will raise the volume of the program amplifier proportionately.

Since the noise microphone 9 will pick up the program sounds, and the foregoing circuit will amplify same as well as the surface noises and thus try to control the phonograph input tube 5, provision is made to balance out the music component, for if this were not done, the phonograph amplification would progressively increase to the maximum possible volume and thus defeat the primary object of the invention.

Such compensation or balancing is attained as follows: Cathode 4^b of volume control tube 4 is connected to the balancing potentiometer 37 by a tap 37^a. This potentiometer is grounded at one end and its other terminal is connected to the capacity 38, which is in turn connected to line 69, included in the push-pull portion of the program amplification system. Specifically herein plate 6^a of tube 6 is inductively connected to the aforesaid line 69.

The filter and delay circuit aforesaid includes cathode 4^c and plate 4^d of tube 4. Line 75 from cathode 4^c has positive potential while line 76 from plate 4^d has negative potential. Each line is connected to a grounded capacity, 31 and 32 indicating such condensers for lines 75 and 76 respectively. Each line similarly is connected to a resistor having one terminal grounded, 33 and 34 indicating such resistors for lines 75 and 76 respectively. Each line connects to another resistor, such as resistor 30 for line 75 and resistor 44 for line 76. The other ends of such resistors connect to line 77. Bridging lines 75 and 76 is resistor 35. Preferably the values of resistors 30 and 44, capacities 31 and 32 and resistors 33 and 34 are equal.

Line 77 connects to one terminal of a potenti-

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ometer 28 having adjustable tap 28^a. In multiple therewith is grounded capacity 29. The other terminal of resistance 28 also is grounded. Tap 28^a connects by line 78 to the aforesaid tertiary grid 5^d of input tube 5 and thus the volume control is here imposed upon the program amplification system.

Whenever it is desired to change the lag value of such control the tap 28^a is shifted. When line 78 applies positive voltage to grid 5^d, there is a gain or increase in volume. When no voltage is applied, there is no change and when the voltage is negative, there is a decrease in volume. A voltmeter may be included from line 78 to ground when desired, as for initial adjustment purposes.

Reference will now be had more particularly to the program microphone amplification system illustrated in the lower third portion of the diagram. Herein 79 indicates one terminal connected to capacity 41 in turn connected to capacity 42 in multiple with the program volume potentiometer 43 having adjustable tap 43^a connected by line 99 to grid 5^b of input tube 5 aforesaid. Cathode 5^c of this tube is connected to resistor 50 and grounded capacity 51. The other terminal of resistor 50 is herein connected to one terminal of resistor 52, the other terminal of which is grounded. A capacity 53 is in multiple with resistor 52. Potentiometer 43, capacities 42 and 53 and resistors 50 and 52 have a common connection as illustrated.

Interposed between plate 5^a and tertiary grid 5^d of tube 5 is a grid 5^e and interposed between grids 5^b and 5^d thereof is grid 5^f. There grids 5^e and 5^f have common connection to resistor 54, the other terminal thereof being grounded and in multiple with said resistor in capacity 55.

The plate 5^a of input tube 5 is capacity connected to grid 6^b of tube 6 by lines 45^a and 45^b and capacity 45. Tube 6 is a second stage amplification tube having grid 6^b, plate 6^a and cathode 6^c. This cathode is connected to its resistor 49, the other terminal of which is grounded. In multiple with resistor 49 is capacity 48. A resistor 47 is connected at one end to line 45^a and its opposite end is connected to the junction between resistors 56 and 58. The other terminal of resistor 56 is connected to the connection between resistor 54 and grids 5^e and 5^f before mentioned. The junction of resistors 47, 56 and 58 connects to grounded capacity 57.

The plate 6^a aforesaid, of second stage tube 6 is connected by line 81 to the input side 82 of the input push-pull transformer 39. This winding is connected by line 83 to the other terminal of resistor 58 and the junction is connected to grounded capacity 59. The output side 84 of the input transformer 39 includes a median tap 85 having, in the example illustrated, a negative voltage of 20 volts.

Line 86 connects one end of winding 84 to grid 8^b of the tube 8 having cathode 8^c, plate 8^a and another grid 8^d. Line 69 before mentioned connects to the other end of winding 84, capacity 38 aforesaid and grid 7^b of the tube 7 having cathode 7^c, plate 7^a and another grid 7^d. Plate 8^a is connected by line 87 to one end of winding 83 of the output push-pull transformer 40 having median tap 89. Line 90 connects the other end of winding 83 to plate 7^a of tube 7. This output transformer has winding 91 as shown.

Cathode 7^c and cathode 8^c of tubes 7 and 8 are each grounded as shown. Grids 7^d and 8^d of said tubes are connected together by line 89 which at one end connects to line 83 aforesaid

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and at its opposite end to resistor 60 having its other end connected to tap 39 and to line 74 through resistor 22 from the output side of the noise amplifying tube 3. Terminal 92 also connects to the last mentioned junction and has a potential of three hundred positive volts in the example illustrated.

Whenever it is desired to include between the input and output tubes of the microphone and program circuits, more than a single stage of amplification, same can readily be effected by inclusion of additional amplification tubes in the manner well known at this time.

The following is the procedure for adjusting the invention for use. The potentiometer tap 62^a (microphone control) is turned off. The tap 37^a of the balance control is turned to one extreme position. Then the tap 43^a of the program input potentiometer control is adjusted for program initial volume necessary for the minimum noise level present. The tap 62^a is then adjusted to about three-fourths of its available travel. With no noise present, tap 37^a is now adjusted to obtain the program volume previously obtained before the microphone control was shifted. Shifting of tap 37^a should be slow and cautious due to delay action. If different tapers of volume regulation are required, the microphone control is set differently than as last suggested and the above procedure repeated. Control 23^a is only utilized to adjust for different lags.

When properly adjusted, this invention balances out any program increase incident to noise increase, and insures that the program will increase and decrease only in accordance with surface noise increase and decrease respectively.

For ideal conditions of operations, it appears advisable to have two microphones 9 placed parallel at remote points of maximum surface noise. Since such parallel microphone connections are well known, illustration thereof is believed unnecessary.

It is to be noted that for tubes 2 and 6 the cathodes each may be grounded, or either grounded, or self-biased by the respective resistors and bypass condensers, 15-16 and 49-48 respectively. Each is correct and the circuit arrangement actually utilized is the one producing the best results.

Also relative to condenser 42, this is utilized to prevent stray radio frequency waves from being picked up and allowed to cause sounds to emanate from the loud speaker. Alternative to that illustrated herein, condenser 42 may be grounded directly instead of through condenser 53 and the latter would still be grounded and across resistor 52. Either variation is satisfactory for elimination of stray frequencies. When none are present, condenser 42 may be omitted.

The invention claimed is:

1. A sound volume control system including in combination a program amplifying circuit, a surface sound pick-up and amplifying circuit, and circuit means inter-connecting the input of the first mentioned circuit to the output of the second mentioned circuit for automatically varying the program output volume only in accordance with surface sound variation, and means for simultaneously balancing out of the effected control that increase in the surface sound volume due to program sound volume increase.

2. In combination with a surface sound pick-

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up and amplifying circuit including a microphone, an input transformer, a multi-grid tube, an amplifying tube and an output multi-grid tube, a program pick-up and amplifying circuit including a multi-grid input tube, an amplifying tube, a pair of multi-grid multiple connected tubes having their plates connected to an output push pull transformer and one grid connected to the input push pull transformer, and a control circuit comprising a diode tube connected to the output stages of the output tubes of the first two circuits and also connected to a grid of the multi-grids of the input tube of the program circuit.

3. A sound volume control system including in combination a program amplifying circuit, a surface sound pick-up and amplifying circuit, and circuit means inter-connecting the input of the first mentioned circuit to the output of the second mentioned circuit for automatically varying the program output volume only in accordance with surface sound variation, the inter-connecting circuit means including a filter and delay arrangement.

4. A sound volume control system including in combination a program amplifying circuit, a surface sound pick-up and amplifying circuit, and circuit means inter-connecting the input of the first mentioned circuit to the output of the second mentioned circuit for automatically varying the program output volume only in accordance with surface sound variation, the inter-connecting circuit means a filter and delay arrangement, and a manually adjustable means for adjusting said arrangement for predetermined lag.

5. A sound volume control system including in combination a program amplifying circuit, a surface sound pick-up and amplifying circuit, and circuit means inter-connecting the input of the first mentioned circuit to the output of the second mentioned circuit for automatically varying the program output volume only in accordance with surface sound variation, and means for simultaneously balancing out of the effected control that increase in surface sound volume due to program sound volume increase, said last mentioned means including an adjustable potentiometer capacity coupled to the output portion of the program amplifying circuit.

6. A system as defined by claim 2 wherein the surface sound pick-up circuit includes an adjustable potentiometer.

7. A system as defined by claim 2 wherein the program circuit includes an adjustable potentiometer.

8. A system as defined by claim 2 wherein each circuit includes an adjustable potentiometer.

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