

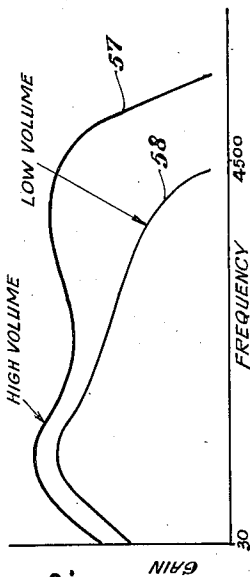
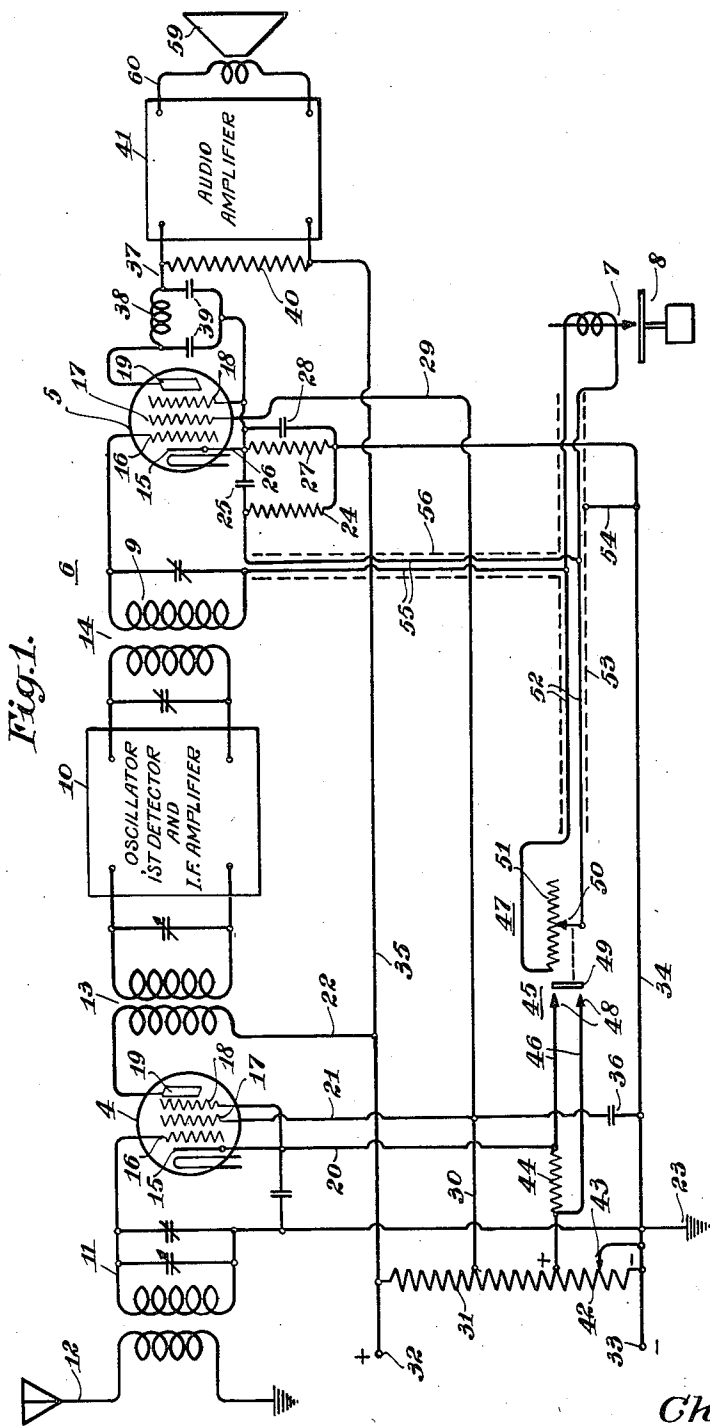
Oct. 15, 1935.

C. M. SINNETT

2,017,515

RADIO PHONOGRAPH SYSTEM

Filed June 24, 1933



INVENTOR:
Chester M. Sinnett,
BY *J. R. Goldborough*
HIS ATTORNEY.

UNITED STATES PATENT OFFICE

2,017,515

RADIO PHONOGRAPH SYSTEM

Chester M. Sinnett, Haddonfield, N. J., assignor
to Radio Corporation of America, a corporation
of Delaware

Application June 24, 1933, Serial No. 677,369

8 Claims. (Cl. 179—100.11)

The present invention relates to combination radio-phonograph systems and has for one object to provide a system of that character having an improved and simplified phonograph switching arrangement and volume control means.

While the phonograph output circuit may be connected with the signal channel of the receiver at any suitable point, it is more convenient, ordinarily, to provide the connection with the input circuit of one of the electric discharge devices or amplifier tubes of the receiving system in or adjacent to the audio frequency amplifier, such as the input circuit of the second or audio frequency detector tube, for example.

In providing a connection of the character referred to, it has heretofore been necessary to open the input circuit by switching means. It is, therefore, a further object of the present invention to provide a simplified radio-phonograph input circuit for an electric discharge amplifier device which obviates the necessity for opening the input or other associated circuits for switching purposes to effect a change to and from radio operation.

A still further object of the present invention is to provide an improved control circuit for a phonograph pickup device having unitary switching and phonograph volume control means. In a present preferred embodiment of the invention, the electric pickup device and volume control means are connected in parallel and have related impedance values such that the volume control means, in effect, is compensated for desired tonal effects at different sound levels.

The invention will, however, be better understood from the following description when taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing, Fig. 1 is a schematic wiring diagram of a radio-phonograph system embodying the invention; and

Fig. 2 is a curve diagram illustrating certain operating characteristics of the system shown in Fig. 1.

Referring to Fig. 1, 4 and 5 are electric discharge devices or vacuum tubes in the signal channel 6 of a radio apparatus, to which it is desired to connect an electric pickup device 7 to provide therewith a radio phonograph combination system. The pickup device is provided with the usual turntable and record drive means indicated generally at 8.

The electric pickup device is arranged to be connected in circuit with one of the electric dis-

charge devices such as the device 5, which is preferably associated with or located in the audio frequency amplifier system of the radio apparatus. In the present example, the device 5 is the second detector of a superheterodyne type of receiver. It is provided with a tuned intermediate frequency input circuit 9 and receives radio signals through intermediate circuits and apparatus indicated generally at 10, and in input amplifier device 4, which is located in the input or radio frequency amplifier portion of the receiver.

The amplifier device 4 is also provided with a tuned signal input circuit 11 which is associated with a suitable signal source such as an antenna circuit 12 from which signals are received. An output transformer 13 is provided as a coupling means in connection with the succeeding well known elements of the superheterodyne system, indicated generally at 10.

The detector device 5 is provided with an intermediate frequency input transformer 14 between the apparatus 10 and the detector tuned input circuit indicated at 9, the secondary of the transformer forming part of said tuned circuit.

The amplifier device 4 may be of any suitable type and in the present example is of the multiple grid type having a heated cathode 15, a control grid 16 connected with the input circuit 11, a screen grid 17, a suppressor grid 18 connected with the cathode as indicated, and an output anode 19 connected with the transformer 13. Cathode, screen grid, and anode circuits 20, 21 and 22, respectively, are provided in connection with the corresponding electrodes, and the input or control grid circuit 11 is grounded as indicated at 23.

The detector device 5 is of the same type as the device 4 and is provided with similar electrodes as indicated. The input circuit, in this case the tuned circuit 9, is connected with the control grid 16, and a suitable grid filter is provided by a series resistor 24 and a capacitor 25 connected with the cathode lead indicated at 26. Also connected in the cathode lead and between the cathode and ground is a self bias resistor 27 provided with a suitable bypass capacitor 28.

The detector screen grid lead indicated at 29 and the screen grid lead 21 for the amplifier device 4 are connected through a supply lead 30 with a usual potential supply source such as the direct current potential divider indicated at 31, to receive suitable operating potentials therefrom. The polarity of the terminals 32 and 33 is indicated adjacent thereto. In the present example

the negative terminal is grounded, as indicated, and is provided with a supply lead 34, while the positive plate supply lead is indicated at 35. The supply lead 30 for the screen grids is suitably bypassed to ground and the negative lead 34 by a condenser 36.

The output anode circuit for the device 5 is indicated at 37, and for the reason that the device is a detector in the present example, it is provided with a suitable intermediate frequency choke and condenser bypass means 38 and 39, respectively, forming a filter therein.

A suitable output circuit coupling impedance device, such as a resistor 40, is provided in the output circuit 37, as a coupling means for the following audio frequency amplifier indicated at 41. The anode circuit 37 is connected through the coupling resistor, to the supply source through the supply lead 35 as is also the supply lead 22 for the anode circuit of the device 4.

In the present example, for radio volume control purposes, the cathode lead 20 of the amplifier device 4 is returned to a variable section 42 of the potential supply source 31 adjacent to the negative end thereof as indicated, whereby the variable section 41 is connected in the cathode return lead and may be adjusted to apply to the device 4 a variable bias potential to control the gain and therefore the signal volume level of the system. To this end, the potential existing in the resistor section 42 by reason of current flow therethrough is varied by means of a manually movable contact indicated at 43, connected with the terminal 33, whereby it variably short circuits the section 42. Since the remaining portion of the section 42 is in series between the grid and cathode of the amplifier device 4, the potential existing across that remaining portion will then be applied to the grid of the tube as a bias potential.

Other suitable bias control means may be employed, although that shown is at present preferred, for the reason that one terminal and the variable contact of the volume control means comprising the resistor section 42 and the movable contact 43 is at ground potential, while the remaining terminal to which the cathode return lead is connected is substantially at ground potential for all radio frequency currents. Accordingly, the volume control means is readily adapted for extension to remote control points.

In addition to the manual volume control means, there is provided an additional volume or gain control means which is arranged to be effective when the phonograph pickup device 7 is in use. As a simplified and preferred means for reducing the radio volume or the sensitivity of the radio receiving apparatus, a self bias resistor 44 is inserted in the cathode lead 20 and arranged to be controlled by suitable means for controlling the phonograph pickup operation.

The resistor 44 is of such a value that when in circuit with the cathode, a relatively high negative bias is placed on the amplifier tube 4 in addition to the bias supplied by the volume control section 42 of the fixed potential source 31. The resistance value of the resistor is such that the negative bias is, in any case, sufficient to suppress or reduce the radio signal amplification so that no radio signals may be received through the signal channel of the receiver.

As a preferred means for controlling the additional bias source 44 for suppressing the radio signals, a switch 45 is connected, through a pair of extension leads 46, in parallel with the re-

sistor 44 and is so connected with a phonograph volume control device 47 that it is actuated when the volume control device is operated to reduce the phonograph output signal volume substantially to zero. In the present example, the switch 45 comprises two contacts 48 connected with the leads 46 and arranged to be shunted by a movable contact 49 which, in turn, is connected in any suitable manner with the movable element 50 of the phonograph volume control device 47 as indicated.

The volume control device is a simple variable resistor comprising a resistance element 51 along which the movable contact 50 is arranged to be moved, and is connected in parallel with the pickup device 7 through a pair of leads 52 which preferably are shielded, the shielding being indicated at 53 and being grounded by a lead 54 to the grounded supply lead 34.

A pair of phonograph pickup output leads 55 are connected in parallel with the leads 52, and are extended through a grounded shield 56 to the input or grid circuit of the device 5, although they may be connected into the signal channel 6 at any other suitable point. However, the circuit must be capable of transmitting the audio frequency signals delivered by the pickup device and, therefore, the second detector input circuit is preferable since it provides an additional amplifier and is directly connected with the audio frequency amplifier, in the usual radio receiving apparatus.

In the present example, the phonograph pickup output leads 55 are connected with the grid 16 of the detector device 5 between the high frequency input circuit 9 and the grid filter means 24-25. It will be noted that the phonograph pickup circuit comprises a single pair of shielded leads which may be extended to remote points of operation for the phonograph pickup device per se. The two-wire circuit is made possible by the use of a shunt variable resistor type of volume control device as distinguished from the usual potentiometer type requiring three terminals and three connection leads therefor, as is well known.

This circuit arrangement has the further advantage that, as the phonograph signal volume is reduced by reducing the volume of the resistor 51 through movement of the contact 50, the pickup device is gradually short circuited until finally when near the zero volume position corresponding to the left hand position as viewed in the drawing, the pickup device is entirely short circuited and entirely removed from the grid circuit.

Thus as the phonograph volume control device is moved toward the zero volume position, the series connection for the pickup device with the input circuit for the tube 5, is gradually short circuited whereby the signal output from the pickup device and its connection with the grid circuit are simultaneously controlled by a single device and a volume control operation.

Since the phonograph pickup output leads are connected between the high frequency input circuit and the high frequency filter means, the bias potential set up by the self bias resistor 27 for detector operation is not changed. It has been found that by the proper selection of the value of the self bias resistor 27, equally satisfactory detector and amplifier action may be obtained without changing the bias, thereby simplifying the change over from radio to phonograph operation.

It has also been found that this shunt volume control means has the further advantage that a compensated tone control feature simultaneous with volume control may be obtained by properly relating the impedance of the pickup device to that of the shunt volume control resistor.

By way of example, in one embodiment of the invention, a 1500 turn pickup winding is provided which has approximately 1200 ohms resistance at 1000 cycles and this resistance drops to approximately 100 ohms at 100 cycles. The shunt volume control resistor 51 has a maximum resistance of 5000 ohms. Assuming now that the volume setting of the volume control device 47 is reduced to a relatively low value such as 80 percent, and with the shunt volume control resistor then having a value of approximately 1000 ohms, it will be seen that the shunting effect of the volume control resistor across the pickup device and its output circuit will be appreciable at 1000 cycles and at higher frequencies, but at 100 cycles and below it may be considered to have substantially a relatively low shunting effect upon the signal potentials delivered by the pickup device. The low frequency signals will therefore be attenuated much less than the higher frequency signals.

The shunting effect or tone control feature may further be illustrated in connection with Fig. 2, in which two curves plotted against gain or signal potential delivered by the pickup, and frequency, are shown at 57 and 58, 57 being the response curve of the pickup circuit when the volume control device is adjusted for substantially maximum or high volume with the entire resistance of 5000 ohms across the pickup device output circuit, and the curve 58 is the response characteristic of the pickup circuit when the volume is reduced to a relatively low value as above described.

From an inspection of the curves, it will be seen that upon the listening ear, the compensation provides an improved effect, in that the signals in the low audio frequency range are not reduced to the same extent as are the signals in the higher audio frequency range, it being known that at low sound volume levels, the lower frequency signals must be materially increased in volume level over the higher mid frequency range in order to provide the same sound level effect upon the ear as provided by a sound output device connected with the system, such as a loud speaker device shown at 59 in connection with the output circuit 60 of the audio frequency amplifier 41. In the present example, the loud speaker device 59 forms the output device of the signal channel of the radio receiver and represents any suitable output device for the amplifier system.

From the foregoing description it will be seen that in accordance with the invention, a pickup device having a relatively high number of turns may be connected directly, without the usual transformer means, with the high frequency coupling means in the input or control grid circuit of an electric discharge device in a signal channel of a radio receiver or like apparatus. This connection is made, preferably, between the normal input circuit for said device and the cathode thereof, and preferably with a grid filter inserted adjacent to the cathode. The device is associated with or is located in the audio frequency amplifier and may, preferably, be the detector which precedes the audio frequency amplifier in the apparatus.

The pickup device is connected, therefore, in the low potential side of the normal control grid input circuit through the medium of a pair of leads which may be shielded and extended to any remote location for the pickup device.

The simple two-wire pickup device output circuit formed by said leads is shunted by a variable resistor requiring but two leads for connection with the pickup circuit, and the resistor has, preferably, a maximum resistance greater than the resistance of the pickup device at a certain higher audio frequency range and which may be reduced to a value lower than the resistance of the pickup device at a certain low audio frequency range.

Furthermore, it will be seen that as an independent means separate from the normal manual volume control means for the radio receiving channel, an additional gain control means is provided, and is arranged to be actuated simultaneously with and by the phonograph volume control means when the latter is moved to substantially the zero volume control position. A movement of the volume control means to the zero phonograph volume position, causing the auxiliary gain control means to permit the radio receiving channel to become operative to receive signals, and a movement of the phonograph volume control means from said zero position, causing the auxiliary gain control means to place the radio receiving channel out of operation to receive signals.

As hereinbefore noted, the grid bias of the electric discharge device 5 is not changed when the phonograph pickup device is connected in circuit therewith. With this arrangement, furthermore, the pickup device is permanently connected with the radio signal channel, and the shunt variable volume control resistor is the sole means for rendering the pickup device inoperative or effectively disconnected from the radio channel. The phonograph volume control means further operates in one position to control the sensitivity of the radio receiving system whereby it is rendered operative or inoperative simultaneously with movement of the volume control means to and from the substantially zero phonograph volume position.

While the invention has been described in connection with the second detector of a super-heterodyne receiver, it should be understood that it is not limited in its application to such apparatus, but may be applied to substantially any radio apparatus in connection with the audio frequency signal channel thereof.

I claim as my invention:

1. In a radio phonograph system, the combination of means for rendering said system inoperative to receive radio signals, a detector grid circuit forming part of the signal channel of said system, a phonograph pickup device connected permanently in series with said grid circuit, volume control means comprising a variable resistor connected in parallel with said pickup device, said resistor being variable between a maximum resistance value substantially higher than the resistance of said pickup device and a minimum resistance value, and means providing an operating connection between said volume control means and said first named means for actuating the latter when said volume control means is moved from the substantially zero volume position.

2. In a radio phonograph system, a phonograph pickup output circuit, a phonograph vol-

ume control variable resistor connected in shunt therewith, means for rendering said system inoperative to receive radio signals, said resistor having a maximum resistance value substantially greater than the impedance of the phonograph pickup circuit, and said first named means comprising a resistor for controlling the radio signal gain in said system and a switch connected in circuit with said resistor and arranged to be actuated by operation of said volume control resistor when passing through a predetermined position of adjustment.

3. In a radio receiving system, the combination with a detector having a signal input circuit, of a phonograph pickup device connected permanently in series with said input circuit in the low potential side thereof, a phonograph volume control means connected in parallel with said pickup device and being adjustable between a position of maximum impedance substantially greater than that of the pickup device and a position of minimum impedance whereat said pickup device is substantially short circuited, and additional means connected with said volume control means for simultaneously rendering said radio receiving system operative to receive radio signals when said volume control means is moved to said last named position.

4. In a radio receiving system, the combination with an electric discharge detector device having a control grid and a cathode, a signal input circuit connected with said control grid and an electrical filter means connected with the input circuit adjacent to the cathode thereof, of a phonograph pickup device connected permanently in series with said input circuit in the low potential side thereof adjacent to said filter means, a phonograph volume control means connected in parallel with said pickup device and being adjustable between a position of maximum impedance substantially greater than that of the pickup device and a position of minimum impedance whereat said pickup device is substantially short circuited, and means for simultaneously rendering said radio receiving system operative to receive radio signals when said volume control device is moved to said last named position.

5. In a radio receiving system comprising a high frequency amplifier and a detector of the electric discharge type, said detector and amplifier each having a control grid, a cathode and an anode, of a phonograph pickup device connected permanently in series with the grid circuit

of said detector device, a volume control resistor connected in parallel with said pickup device, and means for simultaneously varying said resistor and applying a biasing potential on said amplifier grid.

6. In a radio receiving system comprising a high frequency amplifier and a detector of the electric discharge type, said detector and amplifier each having a control grid, a cathode and an anode, of a phonograph pickup device connected permanently in series with the grid circuit of said detector device, a volume control resistor connected in parallel with said pickup device, and means for simultaneously varying said resistor and controlling the amplifier gain, said last named means comprising a movable contact on said resistor, and a switch connected therewith to be actuated thereby when moved to substantially the zero resistance position, said switch being connected with the amplifier to control the application of a biasing potential thereto.

7. In a radio receiving system comprising a high frequency amplifier and a detector of the electric discharge type, said detector and amplifier each having a control grid, a cathode and an anode, of a pair of phonograph pickup output leads connected permanently with the grid circuit of said detector device, a volume control resistor connected in parallel with said pickup device, means for simultaneously varying said resistor and controlling a biasing potential on said amplifier grid, said last named means comprising a movable contact for said resistor and a switch actuated thereby when moved to substantially the zero resistance position, a self bias resistor in the cathode lead of said amplifier, and leads connected between said switch and said resistor to connect the switch effectively in parallel therewith.

8. In a radio phonograph system, the combination of radio volume control means, phonograph volume control means, means providing a connection between said volume control means whereby the radio volume control means is actuated to permit radio signals to be received when the phonograph volume control means is adjusted to a zero volume position, a phonograph pickup circuit, and an electronic amplifier grid circuit, said phonograph volume control means comprising a variable resistor connected in series with said grid circuit and in parallel with said phonograph pickup circuit.

CHESTER M. SINNETT.