Feb. 26, 1946. J. J. ANTALEK 2,395,390

PHONOGRAPH

Filed March 9, 1942

FIG. 1.

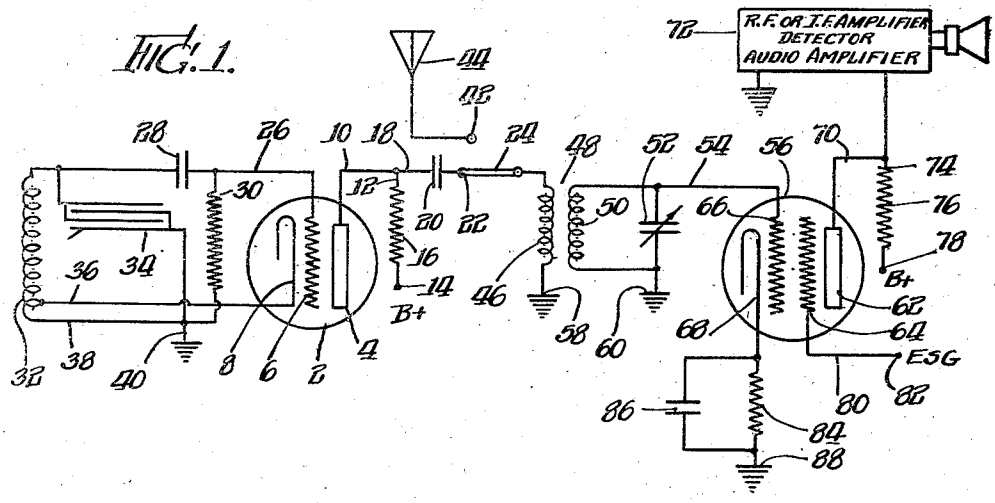
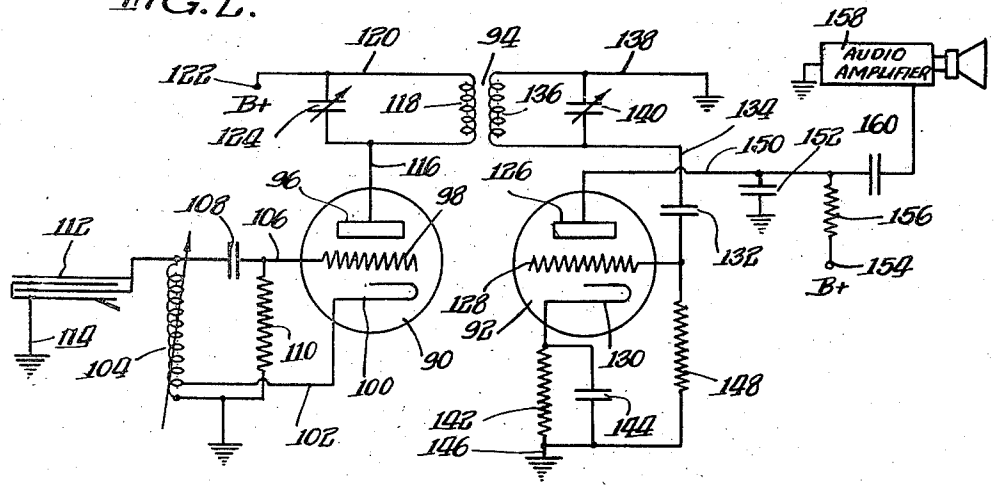



FIG. 2.




INVENTOR.

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# UNITED STATES PATENT OFFICE

2,395,390

## PHONOGRAPH

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2 Claims. (Cl. 179—100.11)

This invention relates to a phonograph or radio phonograph, and more particularly to the reproducing or amplifier circuits of a phonograph, radio phonograph, or public address system.

It is an object of my invention to provide improved circuits for the reproduction of sound from phonograph records or the like.

A further object of the invention is to provide phonograph record pick-up amplifying circuits having a high signal to noise ratio and improved frequency response.

A more specific object of the invention is to provide improved pick-up, reproducing, and amplifying circuits for phonograph record players which shall obtain greater fidelity and quality in the reproduction of the phonograph signals.

A further and important object of the invention is to provide phonographic and reproducing circuits wherein the phonographic pick-up circuit effects frequency modulation of high or radio frequency oscillations which are fed to a circuit resonant to a frequency within the band width or the side bands of the modulated oscillations so as to convert the frequency modulations into amplitude modulated oscillations which may be fed to a high or radio frequency amplifier or a radio frequency amplifier of a radio receiver or to a detector.

Other and further objects will be apparent from the following description when taken in connection with the accompanying drawing, wherein—

Figure 1 is a schematic diagram of a radio phonograph circuit embodying the invention; and

Figure 2 is a schematic diagram of another form of phonograph circuit embodying the invention.

In Figure 1 the phonograph circuit comprises an oscillator tube 2 having a plate electrode 4, a control grid electrode 6, and a cathode 8. The plate is connected by the wires 10 and 12 to the positive plate supply terminal 14 through the resistor 16, the negative side of the plate supply source being grounded. The plate is also connected through the wire 10, the wire 18, and the blocking condenser 20 to the contact 22 of a selector switch 24. The control grid 6 is connected by the wire 26 to a grid condenser 28 and a grid resistor or leak 30, this condenser and resistor being connected in shunt to the oscillator tank circuit comprising an inductance coil 32 and a condenser 34, which may comprise a variable impedance phonographic pick-up. The cathode 8 is connected by wire 36 to an intermediate point of the oscillator coil 32. The wire 38 connecting the lower end of the oscillator coil to the tank circuit condenser 34 and the grid resistor 30 is grounded as at 40, and thereby connected to the plate circuit of the oscillator. The selector switch 24 cooperates with the switch contact 22 and a like contact 42 connected to the primary 46 of the usual antenna coupling-transformer 48, the secondary 50 of this transformer being tunable by the condenser 52, which is connected in shunt to the secondary and connected by a wire 54 to the first radio receiver tube 56, which may comprise a radio frequency amplifying tube, a convertor or mixer tube or a detector tube.

The primary 46 is grounded as at 58 and the corresponding end of the secondary is grounded as at 60. The tube 56 may comprise a plate electrode 62, a screen grid electrode 64, a control grid 66, and a cathode 68. The plate electrode 62 is connected with a wire 70 to the usual radio frequency or intermediate frequency output circuits 72 of the radio receiver, and in shunt thereto by a wire 74 through a resistor 76 to a positive plate supply terminal 78, the negative side of the plate supply being, of course, grounded. The screen grid electrode is connected by the wire 80 to the usual positive screen grid supply terminal 82. The control grid is connected to the wire 54. The cathode 68 is connected to the cathode resistor 84, shunted by the by-pass condenser 86 and grounded as at 88.

When the selector switch 24 is in position engaging contact 42, the radio receiver, of which the tube 56 constitutes the first tube, operates in the usual manner to receive and reproduce radio signals. With this switch 24 in position engaging contact 22, the radio receiver is disconnected from the antenna and thus made ineffective to receive or reproduce radio signals, but is connected to the phonographic circuit. With the switch in this position, the antenna transformer 48 is tuned by the condenser 52 to a frequency within approximately plus and minus eight kilocycles of the unmodulated signal carrier supplied by the oscillator, of which the tube 2 forms a part. Variations in the impedance of the pick-up, due to the lateral undulations of the record groove, effect a frequency modulation of the carrier or the signal supplied by the oscillator. This frequency modulated signal is transmitted as an amplitude modulated signal by the tuned antenna coupling to the input circuit of the tube 56, which amplifies or converts the signal and passes it to the R. F. or I. F. output circuit 72 of the receiver. It will be understood that the remaining usual circuits of the radio receiver amplifies the modulated signal supplied to the output circuit

72, and/or convert it into I. F. amplitude modulated signal which is then detected, amplified and supplied to the reproducer or loud speaker.

In the case of a tuned radio frequency receiver, the tube 56 may constitute a radio frequency amplifier feeding into the usual circuits, where the phonographically modulated signal is detected, amplified, and supplied to the reproducer or loud speaker. In the case of a superheterodyne receiver, the tube 56 or the electrodes thereof may also constitute a part of the convertor or mixer section, by which the modulated signal or radio frequency is converted into a modulated intermediate frequency signal, and thereafter amplified and converted into audio frequency voltages and supplied to the reproducer or loud speaker.

In the circuit of Figure 1 either a capacity, resistor or inductance type of phonographic pick-up may be employed. Where a resistor type pick-up is employed, it may be connected in shunt to the tank circuit condenser 34, an auxiliary condenser being connected in series with the resistor in this shunt circuit so as to vary the effective impedance and the resultant frequency of the oscillator circuit in accordance with the undulations of the record groove. Where an impedance pick-up is employed, it may be connected so as to form all, or a part, of the tank circuit inductance 32.

In the circuit shown in Figure 2, an oscillator tube or tube section 90 is connected to a detector tube or section 92 by a doubly tuned transformer coupling 94. The oscillator tube or section 90 comprises a plate 96, a control grid 98, and a cathode 100. The cathode 100 is connected by the wire 102 to an intermediate point of the adjustable tank circuit inductance coil 104. The control grid is connected by a wire 106 to one side of a grid condenser 108 and one end of a grid resistor or leak 110. The other side of the condenser 108 is connected to the ungrounded end of the coil 104, while the other end of the resistor 110 is connected to the grounded end of the coil 104. The coil 104 is shunted by the phonographic pick-up, which may comprise a capacity type pick-up 112 grounded as at 114. It will, of course, be evident that the phonographic pick-up may be of a resistance or inductance type so connected as to effect a frequency modulation of the carrier or unmodulated signal supplied by the oscillator. Where a resistor or inductance type of pick-up is employed, the capacity necessary for the tank circuit of the oscillator may be provided by a condenser connected in the same manner as the pick-up capacity 112; with this condenser, in the case of a resistor pick-up, being shunted by the pick-up and an auxiliary condenser connected in series with the pick-up resistor. In the case of the inductance type pick-up, the pick-up may form a part or all of the tank circuit coil 104.

The plate electrode 96 is connected by a wire 116 to one side of the primary winding 118 of the transformer coupling 94, the other side of the primary being connected by a wire 120 to the positive plate supply terminal 122. The primary 118 is tunable by a condenser 124 in shunt therewith.

The detector tube or section 92 may comprise a plate electrode 126, a control grid 128, and a cathode 130. The control grid is connected through grid condenser 132 and by wire 134 to one side of the secondary winding 136 of the transformer coupling 94. The other side of the secondary winding 136 is grounded by the wire 138. The secondary winding is shunted by tuning condenser 140. The cathode 130 is connected to the ungrounded end of the cathode biasing resistor 142 which is shunted by the usual by-pass condenser 144 and grounded as at 146. The control grid is connected to the grounded end of the biasing resistor through the grid resistor or leak 148.

The plate electrode 126 is connected by a wire 150 to the ungrounded side of an R. F. by-pass condenser 152; to the positive plate supply terminal 154 through a resistor 156; and to audio output circuit 158 through blocking condenser 160. The audio output circuit 158 may comprise any usual audio amplifier or audio amplifying section of a radio receiver or public address system, by which the audio signals in the output circuit of the detector tube or section 92 are amplified and supplied to the usual reproducer or loud speaker.

The oscillator and detector sections 90 and 92 may constitute parts of a single dual triode vacuum tube. It will also be evident that any number of desired additional radio frequency amplifying stages may be employed between the oscillator tube or section 90 and the detector tube or section 92.

Both the primary and secondary of the transformer coupling 94 are tuned to approximately plus or minus eight kilocycles of the oscillator frequency or approximately plus and minus eight kilocycles of any harmonic frequency of the oscillator. The oscillator is frequency modulated by the variations in impedance of the phonographic pick-up along the steep slope of the selectivity curve of the doubly tuned transformer coupling 94. Accordingly, this coupling impresses on the input circuit of the detector tube a radio frequency amplitude modulated signal, and this signal is detected by the detector tube or section and supplied to the audio output circuit.

It is thought that the invention and numerous of its attendant advantages will be understood from the foregoing description, and it is obvious that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of the invention or sacrificing any of its attendant advantages, the forms herein described being preferred embodiments for the purpose of illustrating the invention.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a radio phonograph, a radio receiver comprising a first radio frequency amplifier, and a tuned antenna coupling in the input of said amplifier, a phonographic circuit adapted to be connected to said antenna coupling circuit, said phonographic circuit comprising an impedance varying record pick-up, an oscillator having plate, grid, and cathode electrodes, means for connecting said antenna coupling circuit in the plate-to-cathode circuit of said tube, and a tank circuit connected to all of said electrodes for generating radio frequency oscillations, said tank circuit having inductive and capacitive branches, one of said branches including said pick-up to tune said oscillator and vary the frequency of oscillations in said antenna coupling circuit, said tuned antenna coupling circuit including a tuning element for tuning said circuit to a frequency within the side bands of the modulated oscillations supplied to

said antenna coupling circuit by said phonographic circuit.

2. In a radio phonograph, a radio receiver comprising a first radio frequency amplifier, and a tuned antenna coupling in the input of said amplifier, a phonographic circuit adapted to be connected to said antenna coupling circuit, said phonographic circuit comprising a capacitive varying record pick-up, an oscillator having plate, grid, and cathode electrodes, means for connecting said antenna coupling circuit in the plate-to-cathode circuit of said tube, and an inductance coil connected to all of said electrodes, said capacity varying pick-up being connected in shunt to said coil to tune said phonographic circuit and vary the frequency of the oscillations supplied to said antenna coupling circuit, said tuned antenna coupling circuit including a tuning element for tuning said circuit to a frequency within the side bands of the modulated oscillations supplied to said antenna coupling circuit by said phonographic circuit.

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