July 14, 1936. F. B. STONE 2,047,653

DETECTOR OSCILLATOR CIRCUIT

Filed March 31, 1934 2 Sheets-Sheet 1

Fig. 2.

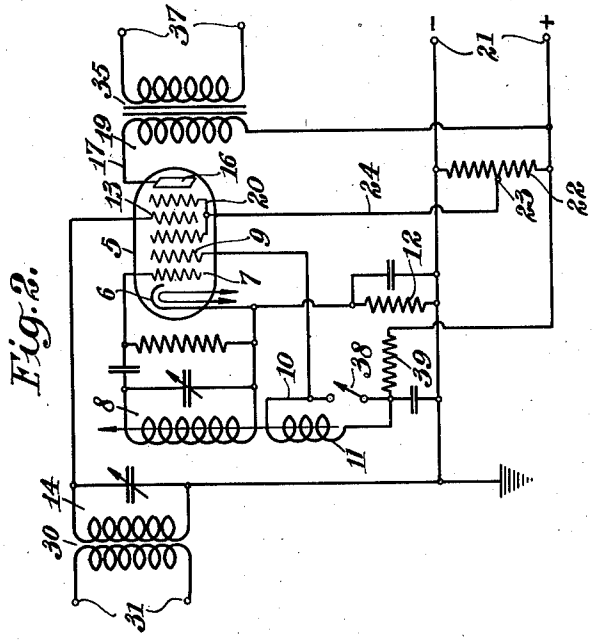
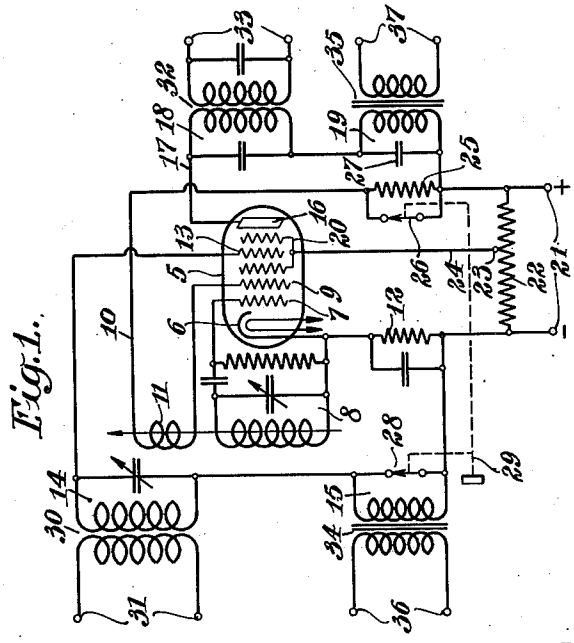


Fig. 1.



INVENTOR:
Fred B. Stone,
BY D. B. Goldsborough
ATTORNEY.

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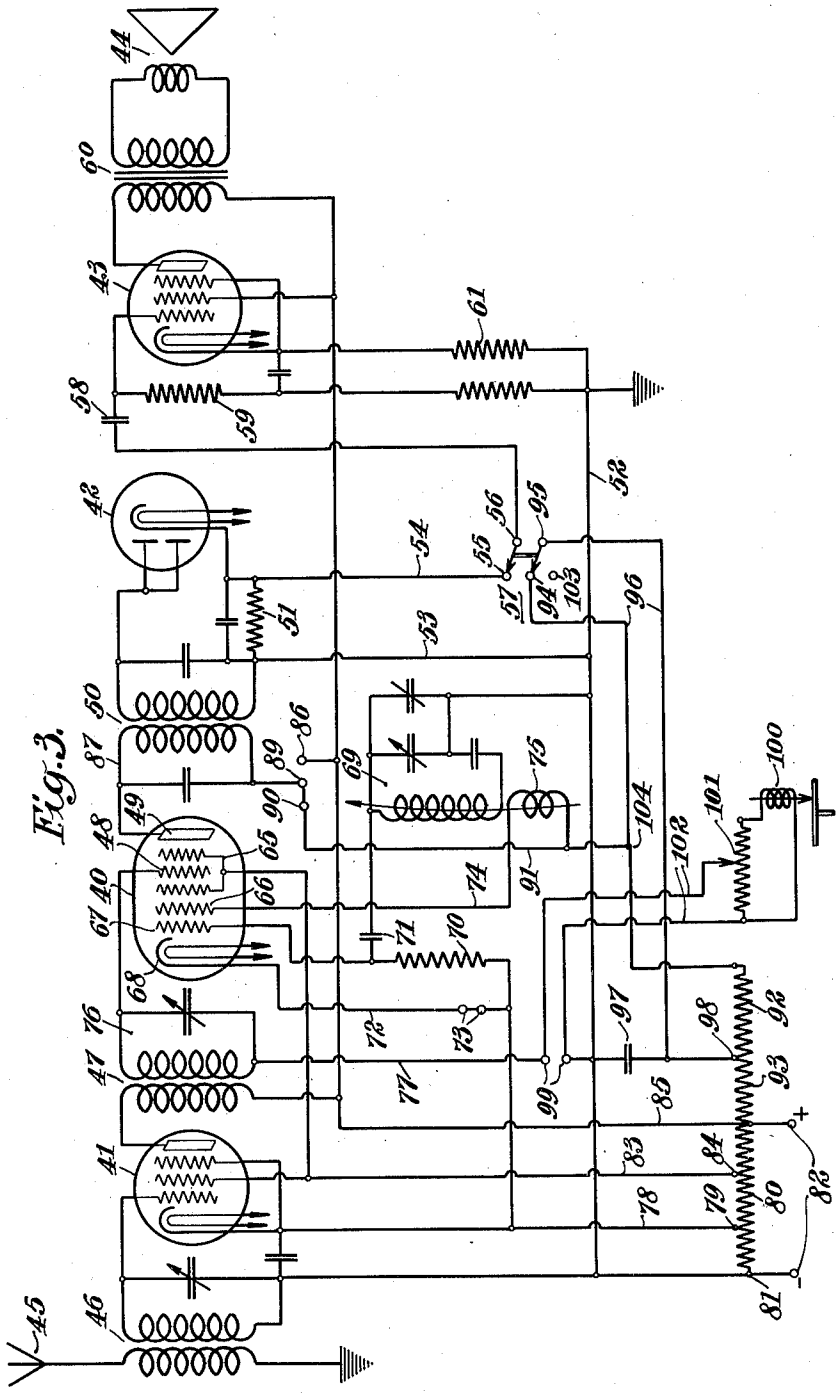

Fig. 3.

INVENTOR:
Fred B. Stone,
BY J. P. Goldsborough
ATTORNEY.

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UNITED STATES PATENT OFFICE

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DETECTOR-OSCILLATOR CIRCUIT

Fred B. Stone, Haddon Heights, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application March 31, 1934, Serial No. 718,383

14 Claims. (Cl. 179—100.11)

The present invention relates to combined detector-oscillator circuits for radio receiving apparatus and the like, wherein a single electric discharge device contains, in a common envelope, electrodes adapted for connection with an oscillator circuit and other electrodes adapted for connection with a detector or an amplifier circuit, the arrangement of the electrodes being such that the two circuits are coupled through the common electronic stream of the device.

A combined detector and oscillator system of the type to which the invention relates is shown and described in a co-pending application of J. C. Smith, Serial No. 654,421, filed January 31, 1933, entitled "Signaling systems" and assigned to the same assignee as this application.

In said co-pending application a multi-electrode electric discharge device, as a combined detector and oscillator, is provided with a cathode, an inner control grid as an oscillator grid, a second grid or electrode adjacent thereto as an oscillator plate, an outer control grid to which signals are applied, a screen electrode for said outer control grid, and an output anode to which is connected an intermediate frequency amplifier. Oscillations applied to the inner control grid and signals applied to the outer control grid are mixed by electronic coupling and appear in the output anode circuit as intermediate frequency signals.

With the advent of multi-electrode, dual-function electric discharge devices such as oscillator-detectors of the above type, known commercially as pentagrid converters of the general type represented by the RCA 6A7 tube, the desirability of utilizing such devices in other circuits of radio or amplifier apparatus for a different purpose, or in the same circuit for a different purpose has become evident.

In a superheterodyne radio receiver, for example, it may often be advantageous to provide a circuit and means for utilizing a detector-oscillator, converter or frequency changer type of combination electric discharge device, first normally as a radio signal detector and oscillator and then as an amplifier, such as an audio frequency amplifier, for the amplification of signals derived from a phonograph pickup device. By employing the same electric discharge device as a combined signal detector and oscillator or converter and as an amplifier for phonograph signals, it has been found that radio-phonograph combination apparatus of the superheterodyne type may be considerably simplified and reduced in cost.

It is, therefore, an object of the invention to provide a circuit and means for utilizing an electric discharge device of the combination type of a normal function as a signal converter and effectively for different functions in the same or another circuit of radio apparatus and the like.

Since a device of the character described embodies oscillator electrodes and is connected normally with an oscillator circuit having electronic coupling with the amplifier or detector portion, the provision of circuits and switching operations for effectively utilizing the device and in controlling the device for providing the additional functions as above described has been found to present new problems and difficulties in the way of stable operation.

It is, therefore, a further object of the invention to provide an improved selector circuit for controlling an electric discharge device of the combined detector-oscillator type whereby the same may be employed in other circuits of an apparatus and/or in another manner without appreciably affecting the efficiency of operation of the device under any selected condition of operation.

It is a further object of the present invention to provide an improved switching circuit for a combined detector-oscillator electric discharge tube whereby the same may be employed normally as a detector-oscillator and alternatively as an amplifier.

It is a still further object of the invention to provide an improved audio frequency or phonograph input circuit and switching means therefor, whereby the detector elements of a combined detector-oscillator electric discharge device may provide an audio frequency amplifier without being affected by operation of the oscillator portion thereof.

It is another object of the invention to provide, in connection with an electric discharge device of the pentagrid converter type, an improved signal receiving circuit and means therein for selectively operating said device as a combined detector-oscillator for continuous wave signals and as a detector for modulated signals.

It is also a further object of the invention to provide an improved and simplified radio phonograph combination system embodying substantially a minimum number of electric discharge devices and a combined detector oscillator device having an improved and simplified input coupling circuit for radio and phonograph signals and an improved output coupling circuit therefor.

The invention will be better understood, and other objects and advantages of the invention will appear from the following description when con-

sidered in connection with the accompanying drawings, and the scope of the invention will be pointed out in the appended claims.

In the drawings, Figure 1 is a circuit diagram of a combined detector-oscillator system embodying the invention and arranged for utilizing a portion of the detector-oscillator device as an amplifier; Fig. 2 is a similar circuit diagram of a detector-oscillator system showing a modification of the invention as adapted to provide a detector for continuous and modulated wave signals; and Fig. 3 is a circuit diagram of a radio receiving system and phonograph combination provided with an improved detector-oscillator circuit embodying a further modification of the invention.

Referring to Fig. 1, 5 is a combined detector-oscillator electric discharge device having a cathode 6 of the heater type, an inner control grid 7 connected with a tuned oscillator circuit 8, and an oscillator anode electrode 9, coupled to the oscillator circuit 8 through an oscillator plate circuit 10 and a feed-back winding 11, the latter being inductively coupled to the tuned circuit 8.

The cathode 6 is provided with a self-bias resistor 12 inserted in circuit therewith to the negative end of which resistor an outer control, or signal grid, 13 is returned through signal input circuits 14 and 15. In the present example the signal input circuits are arranged in series with each other with the circuit 15 more adjacent to the cathode.

The device 5 is provided with an output or main anode 16, in the output circuit 17 of which are connected output circuits 18 and 19, corresponding to the input circuits 14 and 15. The device is also provided with a screen electrode 20 between the signal grid 13 and the adjacent electrodes 9 and 16.

Suitable operating potentials for the anode and screen electrodes are obtained from supply terminals 21 providing a source of direct current having a polarity as indicated. An intermediate potential is provided for the screen electrode 20 through a voltage divider resistor 22 connected between the terminals 21 and provided with a tap 23 for the screen grid supply lead 24.

In the ordinary course of operation radio frequency signals are supplied through the input circuit 14 to the signal control grid 13, while oscillations are applied to the grid 7 to provide the desired intermediate frequency signal, which is taken through the output anode circuit 17 and the output circuit 18.

In circuit with the oscillator anode 9 is a resistor 25 which is normally short-circuited by a switch indicated at 26, in the closed position. With the switch 26 closed, a normal operating potential is applied to the oscillator anode 9, which is relatively higher than that applied to the screen grid 20 from the tap 23. The value of the resistor 25 is such that with the switch 26 open, the voltage applied to the oscillator anode is then reduced to a value preferably below that of the screen grid 20.

It has been found that such reduction of the voltage on the oscillator anode is sufficient to stop the oscillations, and that with the oscillations stopped in this manner, the device 5 may be used for other purpose than its normal function as a combined detector and oscillator.

It will be noted that the device comprises the oscillator portion including the electrodes 6, 7 and 9, and a screen grid amplifier portion including the electrodes 6, 13, 16 and 20. It has been found that by stopping the oscillations, either the oscillator portion or the detector portion of the device may separately be used as a radio frequency, intermediate frequency or audio frequency amplifier and as a separate detector, depending upon the type of circuit employed in conjunction with it.

In the present example, audio frequency input and output circuits are indicated respectively at 15 and 19, and in the circuits shown, are provided for the purpose of utilizing the detector portion as an audio frequency amplifier. It will be noted that the circuits 15 and 19 are located at the low frequency ends of the control grid and anode circuits, and when signals are applied to the device 5 through the input circuit 15, the circuit 14 in series therewith offers no appreciable impedance to the low frequency signals. Likewise, the high frequency output circuit 18 offers no appreciable impedance to the audio or low frequency signals received through the output circuit 19 in series therewith.

In order, however, that the low frequency input and output circuits may not interfere with the transfer of high frequency signals, the circuits 15 and 19 are by-passed by any suitable means, such as a condenser of suitable value or short circuited by a switch. In the output circuit, a condenser 27, having a low impedance to high frequency signals is employed in the present example and the low frequency input circuit 15 may likewise be by-passed, a suitable switch 28, which is normally closed along with the switch 26, being shown by way of example instead of a condenser.

When the detector-oscillator device is to be used as an amplifier for low frequency or audio frequency signals, the switch 26 is opened, causing the oscillations to stop and the switch 28 is opened to admit audio frequency signals to the control grid 13. The amplified audio frequency signals are received through the output circuit 19. Normal operation is restored by closing the switch 26 and the switch 28. The switches may be arranged for simultaneous operation through a common operating means indicated at 29.

While any suitable coupling means may be employed in the input and output circuits, in the present example, the input circuit 14 is provided with a radio frequency tuned input transformer 30 provided with signal input terminals 31 and the output anode circuit is similarly provided with a suitable intermediate frequency tuned output transformer 32 having output terminals indicated at 33.

The audio frequency input and output circuits are provided with suitable audio frequency coupling transformers indicated at 34 and 35, to which are connected audio frequency input and output terminals 36 and 37 respectively.

For use in connection with a detector-oscillator or pentagrid converter tube of the type represented by the RCA 6A7, it has been found that with normal operating potentials, a resistance of substantially 300,000 ohms is suitable for the resistor 25 to effectively stop the oscillations. In any case, however, the oscillations are effectively stopped by the use of a series resistor in the oscillator plate circuit sufficient to reduce the plate voltage well below that of the screen grid. At the same time, the resistor, being inserted in series with the anode circuit, serves to reduce the energy transfer from the plate to the grid circuit of the oscillator, and thereby functions in a dual capacity.

It will be noted that, by this method of stopping oscillations, the oscillator plate circuit is not opened but merely the plate voltage is reduced.

It has been found that if the plate circuit is entirely opened, leaving the oscillator plate free, an undesirable effect may be produced in the other associated circuits because of unstable current and voltage conditions on the other elements of the tube.

Accordingly, the preferred method of stopping the oscillations is by increasing the resistance of, but not opening, the oscillator plate circuit, the resistance being increased, preferably, by the insertion of a resistor sufficient to simultaneously reduce the oscillator plate voltage below the screen grid voltage and to reduce the energy transfer from the oscillator plate circuit to the oscillator grid circuit.

It will therefore, be seen that, in the system described, means are provided to maintain the oscillator section energized but not functioning to produce oscillations, thereby making it possible to utilize one of the sections of the device for other purposes such as signal amplification. Stated generally, this is done by stopping the oscillations in such a manner and by such means that both sections, and particularly that one to be used for such other purpose, is maintained under stable voltage and current conditions. As above described, this is accomplished by the insertion of a suitable resistance in series with the oscillator plate. The lowered oscillator plate voltage together with the reduced energy transfer to the grid circuit stops the oscillation. The resistor at the same time limits the current to the oscillator plate thereby preventing objectionable increase in this current.

The oscillations may be stopped, however, by short-circuiting one of the oscillator circuits such as the plate or grid circuit. It has been found, however, that any system which stops the oscillations without removing or limiting the oscillator plate voltage results in excessive oscillator plate current unless the combined detector-oscillator device is provided with other means of limiting the plate current such as self bias means. In the case of self bias means, the increased current is utilized to provide increased bias on the control grid whereby the device may be utilized as a high biased detector. A system of this character is shown in Fig. 2, to which attention is now directed and wherein the same reference numerals are used to designate like parts as in Fig. 1.

In the circuit of Fig. 2, the combined detector-oscillator device 5 is arranged to receive either modulated or continuous wave signals through the input circuit 14 and to deliver resulting audio frequency signals through the output terminals 37.

The oscillator plate circuit is provided with a short circuiting means such as a switch 38, and a series resistor 39 is connected in series with the oscillator anode to provide the desired anode voltage. The supply voltage is sufficiently high and the value of the resistor 39 is sufficiently low to permit oscillations to continue as long as the switch 38 is open.

When the switch 38 is closed, the oscillations are stopped, and since the oscillations provide the grid bias, the plate current increases to a value determined by the self bias resistor and to a limited extent by the anode resistor 39. The increased anode current serves to increase the self-bias obtainable from the resistor 12 and the signal control grid 13 receives additional negative biasing potential.

The operation of the circuit shown in Fig. 2 is such that with continuous wave signals received through the input circuit 14, the oscillator is permitted to operate to heterodyne therewith and to provide an audible beat signal through the audio frequency circuit 19. When the device is to be utilized as a detector of modulated signals, receivable through the circuit 14, the oscillations are stopped by closing the switch 38, whereupon the detector receives a sufficiently increased bias to operate as a high biased detector and the audio frequency signal component is thereby delivered to the audio frequency output circuit as in the preceding example. Thus, by stopping the oscillations in the manner described, the combined detector-oscillator may function first as a detector of continuous wave signals, and then as a detector of modulated wave signals.

It will be noted that advantage is taken of the fact that by stopping the oscillations in the manner shown, the oscillator anode current increases, to automatically provide a high biased detector. Therefore, this type of control, whereby one of the oscillator circuits is short-circuited to stop oscillations, may be utilized whenever an increase in the anode current is desired to be automatically produced.

Referring now to Fig. 3, a combined detector-oscillator device 40 of the pentagrid converter type is shown in connection with a simplified combination radio and phonograph system. The device 40 is arranged to operate normally as a combined detector-oscillator in the radio receiving system, between a tuned high frequency input amplifier 41 and a detector 42, the latter being of the diode rectifier type. An audio frequency output amplifier indicated at 43 is provided for supplying audio frequency signals to an output sound producing device such as a loud speaker, indicated at 44.

The high frequency amplifier 41 is coupled to a suitable source of modulated signals such as an antenna 45 through a tuned input coupling transformer 46 and, in turn, is coupled through a second tuned high frequency coupling transformer 47 to the signal input or outer control grid 48 of the combined detector-oscillator 40. The output or main anode 49 of the device 40 is coupled to the detector 42 through a suitable tuned intermediate frequency transformer 50. Intermediate frequency signals supplied thereby to the detector 42 and are rectified and applied to an output coupling impedance device 51 in the rectifier circuit, one side of which impedance device is connected to the ground lead 52 through a lead 53 and the high potential side of which is connected through an output lead 54 and the contacts 55 and 56 of a selector switch 57, with the output amplifier device 43 through the usual coupling condenser and grid resistor 58 and 59 respectively. The amplifier 43 is connected to the loud speaker 44 through an output coupling transformer 60.

Any suitable audio frequency amplifier may be provided, however, except that it is preferable that it be provided with an input circuit adapted for impedance coupling. To provide high amplification, however, the amplifier device 43 may be of the screen grid pentode type as shown and may, preferably, be arranged for self-biased operation as indicated by the self-biased resistor 61.

The detector-oscillator device 40 is further provided with a screen grid 65 for the control grid 48, an oscillator anode electrode 66, and an inner or oscillator control grid 67 adjacent to the cathode 68. The oscillator grid is connected with a tuned grid circuit 69 through the usual grid

leak and condenser means 70—71, the grid leak being connected to the cathode lead indicated at 72. In the cathode leads a pair of closed input terminals 73 are provided for a purpose which will hereinafter be described.

The oscillator anode electrode 66 is connected through the oscillator anode circuit indicated at 74 with a feedback winding 75 inductively coupled with the tuned circuit 69 as indicated, for setting up oscillations on the grid 67 in accordance with the tuning of the circuit 69.

The tuned high frequency single input circuit provided through the tuned secondary circuit 76 of the transformer 47 is connected through a grid circuit lead 77 with the ground or common lead 52. The cathode lead 72 is connected through a lead 78 with a tap 79 on a voltage supply resistor 80, to the negative end of which the ground lead 52 is connected, as indicated at 81.

The supply resistor 80 is provided with input terminals 82 for applying operating potentials thereto for the various anode and screen electrodes of the apparatus in the present example. The lead 83 is connected with an intermediate tap 84 to supply screen grid potentials to the screen grid 65 in common with the device 41, and a supply lead 85 provides a direct high potential for the anode circuits of the apparatus, including the device 41 and a terminal 86, the latter being provided for supplying the anode output circuit 87 through the transformer 50 for the output anode 49, as will hereinafter be described.

As shown in the present example, the output circuit 87 is connected through a terminal 89 and a supply terminal 90 with a supply lead 91 connected to the high potential terminal of the supply resistor 80 through a pair of series resistors 92 and 93. The resistor 92 is arranged to be short-circuited, normally, through the contacts 94 and 95 of the switch 57 and leads extending thereto as indicated at 96. A by-pass condenser 97 to ground is provided in conjunction with a tap point 98 between the resistors 92 and 93.

With the circuit arrangement shown, the anode 49 and the oscillator anode 66 receive operating current through the series resistors 92 and 93, the latter serving as a current limiting resistor when the resistor 92 is short-circuited by the switch 57, as shown. Full operating potential may, however, be applied to the main output anode 49 of the detector-oscillator tube, by removing the connection shown, between the terminals 89 and 96, and placing it between the terminals 86 and 89. The purpose in this connection will hereinafter be described.

A pair of signal input terminals indicated at 99 are provided in circuit with the control grid 48, preferably as shown in the grid circuit lead 77 and to these terminals is connected a source of audio frequency signals represented by an electric pickup device 100, the connection being completed through the usual volume control potentiometer device 101 and input leads 102. The leads 102 and the leads 77 are preferably shielded from electrical disturbances.

The operation of the system shown is as follows: With the potential supply circuits energized and the switch 57 in the position shown, the phonograph pickup or audio frequency input circuit is rendered ineffective by short-circuiting the terminals 99. In the present example, this is accomplished by moving the potentiometer device 101 to the zero volume position.

The detector-oscillator device 40 receives normal operating potential on the oscillator anode 66 through the resistor 93 from the supply terminals 82 and received modulated signals are rectified by the device 42 and supplied through the lead 54 to the audio frequency amplifier 43, as hereinbefore described.

When the system is desired to function as a phonograph amplifier, the switch 57 is moved to the alternative position in which the contacts 56 and 94 are connected together, leaving the contact 55 open and the contact 95 is connected to the blank contact indicated at 103.

This switching operation serves to remove the short circuit from the resistor 92, thereby reducing the operating anode potential on the oscillator anode 66 and, incidentally, from the main output anode 49. The resistance offered by the resistor 92 is sufficient to stop the oscillations. Since the resistor 92 is also inserted in the main output anode circuit, it serves as a load impedance for that circuit, and the junction point between the resistor 92 and the plate or main output anode 49, as indicated at 104, is then coupled through one of the leads 96 and the contacts 94 and 56 of the switch 57 to the audio frequency amplifier.

With this arrangement, when audio frequency signals are supplied to the terminals 99, as by operation of the electric pickup device 100, and with proper adjustment of the volume control potentiometer 101, the audio frequency signals are applied to the input signal grid 48 through the grid lead 77 and after amplification are conveyed to the output circuit 87 and to the audio frequency amplifier 43 in the same manner as radio signals rectified by the rectifier 42.

The switch 57 therefore serves alternatively to connect the audio frequency output system or amplifier with the signal detector and a coupling impedance inserted in the output anode circuit of the detector-oscillator device simultaneously therewith by operation of the switch. Stated in other words, the input circuit of the audio frequency amplifier comprising the impedance coupling elements 58 and 59, is arranged for alternative connection with either the coupling resistor 51, or the resistor 92 which serves both as a coupling impedance and as a limiting resistor for stopping oscillations of the combined detector-oscillator. By this arrangement, a simplified circuit and control means for stopping the oscillations of and utilizing a combined detector-oscillator device as an amplifier are provided.

The biasing potential provided on the control grid 48 is adjusted to such a value, between the tap points 79 and 81 on the supply resistor 80, that the device 40 may function either as a detector-oscillator or as an amplifier. In the case, however, that it is desired to utilize the oscillator section of the combined detector oscillator device as an amplifier, the audio frequency supply leads 102 are connected to the input terminals 73 and the terminals 99 are short circuited in lieu of the terminals 73. With this arrangement audio frequency signals are applied between the cathode and oscillator grid, and the amplified signals appear in the output circuit 74 of the oscillator. Since the oscillator anode is connected through the coupling impedance 92, the signals delivered thereby may be transferred to the audio frequency amplifier by operation of the switch 57 in the same manner as hereinbefore described.

In case that the oscillator section is to be utilized continuously as an amplifier instead of the detector section, it is preferable to disconnect

the main output anode circuit from the coupling impedance 92. In the present example this is accomplished by disconnecting the terminal 89 from the terminal 90 and connecting it to the terminal 86 whereupon the main output anode circuit may receive a normal value of operating potential, from the positive side of the supply terminals 82 through the lead 85.

From the foregoing description it will be seen that by properly operating a combined detector-oscillator to stop the oscillations, either the detector or the oscillator section thereof may be utilized as an amplifier without interfering with the efficient operation of the device in either capacity, and that the same may be carried out by a simple switching operation.

Furthermore, it will be seen that in certain systems, the oscillations may preferably be stopped by inserting resistance in the oscillator anode circuit and that the inserted resistance in the form of a coupling resistor or impedance may be utilized as a plate or anode circuit load for transferring signals to succeeding circuits.

It will also further be seen that the oscillations are in any case preferably stopped by permitting the oscillator anode circuit to remain completed either by short-circuiting one of the oscillator circuits or by reducing the oscillator anode potential sufficiently to lower it below the screen grid potential and to introduce into the oscillator anode circuit sufficient impedance to lower the energy transferred from the oscillator anode circuit to the oscillator grid circuit.

I claim as my invention:

1. In a signal receiving system, combined detector-oscillator means including in combination, a single electric discharge device having an anode, a cathode, and a plurality of grid electrodes there between, an oscillator circuit connected with and coupling two of said electrodes more adjacent to the cathode, a signal input circuit connected with another of said electrodes, means for stopping oscillations in said oscillator circuit, and means for utilizing a portion of said detector-oscillator means as signal amplifying means.

2. In a signal receiving system, combined detector-oscillator means including in combination, a single electric discharge device having an anode, a cathode, and a plurality of grid electrodes there between, an oscillator circuit connected with and coupling two of said electrodes more adjacent to the cathode, a signal input circuit connected with another of said electrodes, means for inserting resistance in circuit with one of said oscillator electrodes to stop oscillations in said oscillator circuit, and means for utilizing said cathode, anode and signal input electrode as a signal amplifier.

3. The combination with an electric discharge device having a cathode, an output anode, a control grid adjacent to the cathode, a second control grid adjacent to the output anode, a screen grid for said last named control grid and a second anode electrode associated with said first named control grid, of a tuned oscillator circuit connected between the first named control grid and the cathode, means for coupling said last named anode to said oscillator circuit to supply oscillations thereto, means for supplying signals to the second named control grid, and means for stopping the oscillations in said oscillator circuit whereby said signals may be amplified.

4. The combination with an electric discharge device having a cathode, an output anode, a control grid adjacent to the cathode, a second control grid adjacent to the anode, a screen grid for said last named control grid and a second anode electrode associated with said first named control grid, of a tuned oscillator circuit connected between the first named control grid and the cathode, means for coupling said last named anode to said oscillator circuit to supply oscillations thereto, means for supplying signals to the second named control grid, means in circuit with said last named anode electrode for reducing operating potentials applied thereto below the screen grid potential whereby the oscillations in said oscillator circuit are stopped, and means for utilizing said cathode, second named control grid, screen grid and output anode to amplify signals while said oscillations are stopped.

5. In a radio receiving system, the combination with a combined detector oscillator device of the pentagrid converter type, of means for stopping the oscillations of said device, and means for utilizing said device to amplify signals while said oscillations are stopped.

6. In a signal receiving system, the combination with a combined detector-oscillator device of the pentagrid converter type having an oscillator anode, of means for stopping the oscillations of said device, including a current limiting impedance element, and means for selectively inserting said impedance in circuit with said anode to reduce the operating potential thereon to a subnormal value.

7. In a signal receiving system, the combination with a combined detector-oscillator device of the pentagrid converter type having an output anode and a separate oscillator anode, of means for stopping the oscillations of said device, including an impedance element, means for selectively inserting said impedance in circuit with said oscillator anode to reduce the operating potential thereon to a subnormal value, means for utilizing said impedance in circuit with said oscillator anode as signal output coupling means for external signals applied to said device, and means for applying said signals to the input circuit of said device.

8. In a signal receiving system, the combination with an electric discharge device having a cathode, an anode, a control grid adjacent to the anode, a second control grid adjacent to the cathode, a screen grid between said control grids, and an auxiliary anode electrode adjacent to the second control grid, of a signal input circuit connected between the first named control grid and the cathode, said circuit being adapted to receive continuous wave and modulated signals, a self bias resistor in circuit with the cathode for supplying a biasing potential to said first named grid, oscillator means for heterodyning continuous wave signals including a tuned grid circuit connected with said second control grid and an anode circuit coupled therewith and connected with the auxiliary anode electrode, said circuits being connected with the cathode, a signal output circuit connected with the first named anode, and means for shortcircuiting one of said oscillator circuits when receiving modulated signals.

9. In a superheterodyne receiver, the combination with an electric discharge device providing a combined detector-oscillator for said receiver and having oscillator grid and anode electrodes, detector grid and anode electrodes and a common cathode for said oscillator and detector elements, of means for applying audio frequency signals to one of said grid electrodes, means for insert-

ing an impedance device in circuit with at least one of said anode electrodes including the oscillator anode to stop oscillations therethrough, and means for utilizing said impedance device as a signal output coupling element for signals applied to said control grid.

10. In a superheterodyne receiver, the combination with an electric discharge device providing a combined detector-oscillator for said receiver and having oscillator grid and anode electrodes, detector grid and anode electrodes and a common cathode for said oscillator and detector elements, of means for applying audio frequency signals to one of said grid electrodes, a series impedance device for at least one of said anode electrodes including the oscillator anode to stop oscillations therethrough, means for utilizing said impedance device as a signal output coupling element for signals applied to said control grids, an audio frequency amplifier having a signal input coupling circuit, and means for simultaneously connecting said impedance device in said last named circuit and in the oscillator anode circuit.

11. In a radio receiving system, including a single electric discharge device having in a common envelope electrodes adapted for connection with an oscillator circuit and other electrodes adapted for connection with detector and output intermediate frequency amplifier circuits, the electrode arrangement therein being such that the detector and oscillator circuits are coupled through the common electronic stream of the device, the combination with said device and associated detector-oscillator circuits, of an audio frequency amplifier, and means for simultaneously stopping the oscillations in the oscillator circuit of said device and connecting the audio frequency amplifier with an output circuit of said detector-oscillator device.

12. In a radio receiving system, the combination with a combined detector-oscillator device having a common cathode, oscillator and detector portions, each comprising a control grid and a plate electrode, of means for limiting the oscillator plate voltage to stop the oscillations of said device, and means for utilizing a portion of said device as a phonograph signal amplifier while said oscillations are stopped.

13. In a radio receiving system, the combination with a combined detector-oscillator device having a common cathode, oscillator and detector portions, each comprising a control grid and a plate electrode, of a signal input grid circuit for said device, means for applying phonograph signals thereto, means associated with the oscillator circuit for maintaining said circuit continuous and reducing the oscillator plate voltage for simultaneously stopping the oscillations therein, and means for deriving amplified phonograph signals from an output circuit of said device.

14. The combination with a combined detector-oscillator device having a common cathode, oscillator and detector portions, each comprising a control grid and a plate electrode and having signal input and oscillator circuits connected therewith, of means for maintaining said oscillator circuit continuous at reduced plate voltage to stop the oscillations therein, and means for utilizing one of said circuits for the amplification and transmission of external signals through said device when the oscillations are stopped.

FRED B. STONE.