Jan. 2, 1934. R. G. PIETY 1,942,385

RADIO RECEIVING CIRCUIT

Original Filed April 12, 1928

Fig. 1

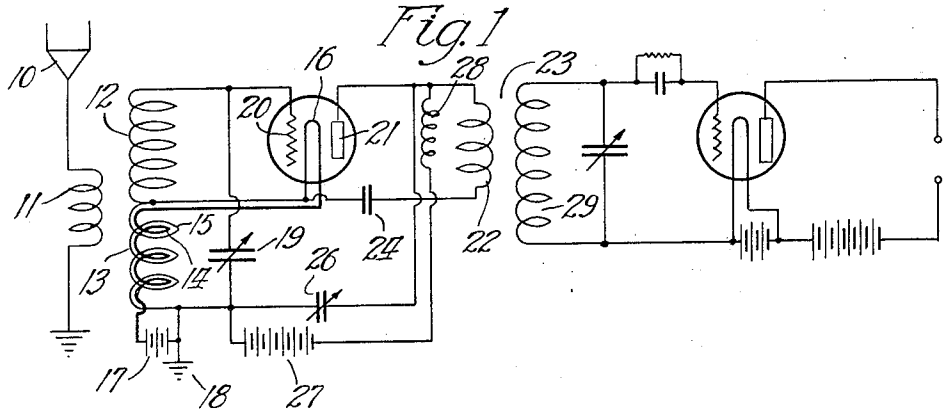


Fig. 2

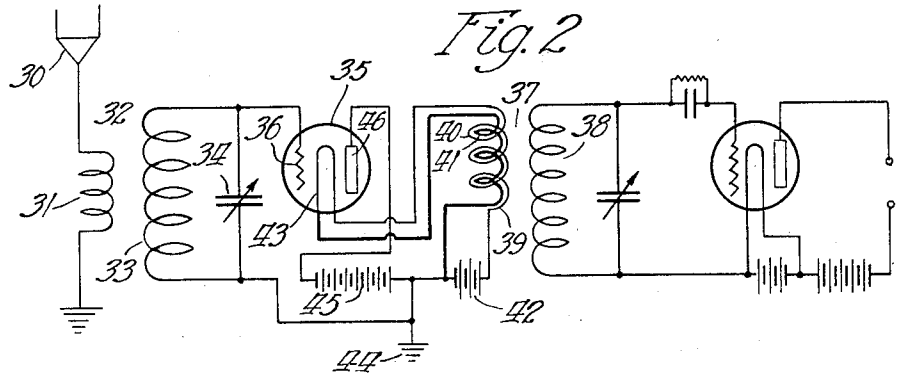
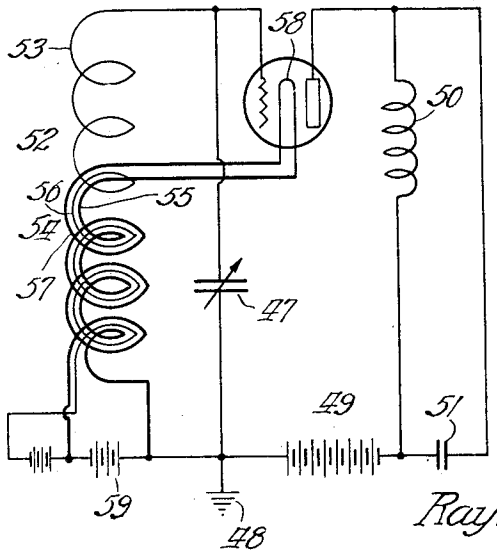


Fig. 3



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RADIO RECEIVING CIRCUIT

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6 Claims. (Cl. 179—171)

My invention relates to radio receiving circuits, and has for its object the provision of an improved circuit of this type in which the filament is so associated in circuit that it is maintained at a different radio frequency potential than the battery or other source of current supply for said filament.

There are many desirable applications for an arrangement of this type. It has heretofore been necessary to maintain the filament and a battery both at ground potential in order that a single current supply unit might be utilized to supply the filaments of several tubes and avoid the high distributed capacity which the large mass of the filament current supply unit would necessarily place across the input or output coupling impedances of the tubes. In certain types of circuits it is highly desirable to maintain the filament at a different radio frequency potential than the battery. It has heretofore been necessary to supply the filament current thru a high impedance choke coil if this result was to be accomplished.

In accordance with the preferred form of my invention, I connect the filament current supply unit to the filament through the interposition of a multiple wound inductive element forming part of the inductive coupling between circuits or stages. In this manner I am enabled to maintain the battery, that is, one pole thereof, at ground potential and to maintain the filament at a higher or different radio frequency potential than the battery.

I have shown in the drawing two forms of application for such a connection. In one form, I have applied this style of connection to a balanced radio frequency circuit which might be of the type disclosed in the patent issued to Rice, No. 1,334,118, dated March 16, 1920. It will be apparent that, in thus connecting the filament current supply unit to the filament, both legs of this multiple winding are substantially at the same radio frequency potential, while the current flow of the filament current is in opposite directions in the two legs of the said winding. In a radio frequency circuit as shown in the said Rice patent, it has been found that, when the filament is at ground potential, with the condensers and shielding generally used in this type of receiver, it is almost impossible to avoid varying the capacity of the respective elements of the condensers to the grounded filament circuit, and such variation upsets the balance of this bridge circuit. Such unbalancing would, of course, not occur if the variations were the same in each arm of the bridge, but to bring this about is an extremely difficult undertaking if the expense is to be kept within reasonable bounds. If, however, the batteries, shields and one terminal of the tuning condenser are maintained at ground potential, then variations in the stray capacity of this condenser will have no tendency to destroy the balance of the bridge circuit.

In another form of my invention as disclosed herein, I accomplish a different result in that I am enabled to arrange the tube and the input and output circuits in such a way that the tube will not oscillate even though there be an inductive load in the plate circuit, but that such oscillation takes place only with a capacitative load.

I will explain my invention more in detail by referring to the accompanying drawing illustrating various embodiments thereof, in which,—

Fig. 1 shows a balanced bridge circuit arranged in accordance with my invention;

Fig. 2 shows a radio frequency circuit arranged to prevent oscillation with an inductive load in the plate circuit; and

Fig. 3 illustrates a circuit of the type of the Hartley oscillator, in which one side of the tuning condenser is maintained at ground potential.

Referring more particularly to Fig. 1, I show a tuned radio frequency circuit of the Rice type having the aerial 10 and the primary winding 11 in series therewith. This primary winding is associated with a balanced secondary winding having the legs 12 and 13, the leg 13 consisting of a multiple winding having two strands, respectively, the strand 14 and the strand 15. The central point of this balanced winding 12, 13, is connected to the filament 16 in such manner that one terminal of the filament is connected to the strand 15 and to the leg 12, and the other terminal of the filament is connected to the strand 14. The free terminals of the strands 14 and 15 are then connected to the unit which is utilized to supply the filament 16 with current, being herein illustrated as the A battery 17. One terminal of this A battery is grounded, as at 18. The balanced coil 12, 13 is then bridged by means of the tuning condenser 19, one terminal of which is connected to ground, as is readily apparent. The free terminal of the leg 12 is connected to the grid 20, as shown. The plate 21 is connected to one terminal of the primary winding 22 of the transformer 23, the remaining terminal of this winding 22 being connected through the condenser 24 to one terminal of the filament 16. An adjustable condenser 26 is then connected from

the grounded terminal of the battery 17 to the plate 21, this condenser 26 being adjustable for the requirements of each particular set, but remaining in permanent adjustment after having once been set to establish a capacity balance in accordance with the tube and other capacities which are to be compensated for. A current supply unit for the plate circuit, here shown as the B battery 27, is connected from the grounded terminal of the battery 17 through an impedance coil 28 to the plate, as shown. This impedance coil 28 prevents the flow of radio frequency currents through the circuit including the battery 27. The primary winding 22 of the coupling transformer is inductively associated with the secondary winding 29 forming the input element of the second stage, which is here shown as the detector stage. The circuit arrangements of this detector stage are standard, and are therefore not described further.

From the above description, it will be apparent that the current which is supplied to the filament passes through the two strands 14 and 15 of one leg of the secondary winding 12, 13. As the radio frequency potential is, of course, measured from the ground connection of the circuit as a starting point, it will be seen that the battery 17 is at ground potential, whereas the filament 16, having a relative position at the central point of the winding 12, 13, is at a radio frequency potential above that of the battery 17. It will likewise be apparent that the condenser 19 with one of its terminals grounded is so arranged that its stray capacity will not serve to unbalance this bridge receiving circuit in view of the fact that the heavy masses of parts, as exemplified by the batteries 17 and 27 and the shielding elements which may be used, but are here not shown, are all at ground potential. It is these parts of heavy mass which ordinarily have a high capacitative effect such that if they are not at ground potential the balance of this bridge circuit is destroyed as the plates of the condenser 19 are moved for purposes of tuning from one position to another. Although not so shown, it is obvious that the elements 17 and 27, being grounded and arranged in circuit as illustrated, can serve for not only one stage, but all of the stages of a multiple stage receiving set. The advantages of this type of connection and arrangement will thus be apparent in that the bridge circuit will at no time have its balance disturbed after this balance has once been established through the agency of the condenser 26.

In Fig. 2, I show a different application of my invention. In this figure I show the receiving aerial 30 with the primary winding 31 of the transformer 32 having also the secondary winding 33. The customary tuning condenser 34 is shown bridged across the winding 33. A thermionic tube 35 is illustrated having the customary grid 36 connected to one terminal of the winding 33. Between the first stage and the detector stage I have shown a transformer 37 having the secondary winding 38 and having a multiple primary winding 39 consisting of the strands 40 and 41. A power supply unit for the filament, here shown as a battery 42, is connected to two of the terminals of the winding 39, the remaining two terminals being directly connected to the filament 43. One terminal of the battery 42 is grounded, as at 44, and a B battery or other source of current supply 45 is connected between the plate 46 and the ground 44. One terminal of the winding 33 is then also connected to the ground 44, as shown. The detector stage connected to the secondary winding 38, being of the customary type, is herein not further described in detail.

It will be seen from this illustration that the customary style of connection by virtue of which the arrangement of parts is such as to complete a circuit from the filament through the B battery, primary winding of the coupling transformer to the plate, and then through the tube back to the filament, is changed so that this circuit extends from the filament through the primary winding of the coupling transformer, through the B battery, then to the plate, and then through the tube back to the filament. In the first case the filament is grounded, and in the second case the connection between the B battery and the primary winding of the transformer is grounded. In this case the counter-electromotive force of the primary winding establishes upon the plate oscillations which are in phase with the oscillations impressed on the tube so that the tube may be caused to oscillate. In the second case, the counter-electromotive force caused in the said primary winding acts upon the plate in a direction which is displaced 180° from that in the first case, so that the tube has no tendency to oscillate with an inductive load.

While thus by the use of my invention I am enabled effectively to reverse the phase of the fictitious generator in the plate circuit by 180°, it is well understood, of course, that with the ordinary type of connection, that is, in the first case hereinbefore referred to, an inductive load in a plate circuit will cause the vacuum tube in this type of amplifier to oscillate, provided, of course, that the damping of the coils is sufficiently low and the plate grid capacity is sufficiently large. This reversal of the plate filament generator prevents the tube from oscillating with an inductive load, and makes it regenerative with a capacitative load only. It is true that this type of amplifier would probably be inefficient at exact resonance due to the fact that the drop across the primary circuit must be added vectorially to the originally applied electromotive force between the grid and the ground. This in general would reduce the effective amplification of this type of amplifier. However, by the operation of the transformer slightly off resonance on the secondary circuit, the primary may be made to have a capacitative reactance due to the counter electromotive force of the secondary, thus to make the tube highly regenerative and to thereupon increase its voltage step-up. This reactance can be made sufficiently high to cause oscillation.

Fig. 3 shows yet a third form of application of my invention as applied to a well known Hartley oscillator, the object to be accomplished being the arrangement of the circuit in such a way that one terminal of the tuning condenser 47 is grounded, as at 48. The B battery 49 is connected to the plate circuit through the impedance coil 50, the customary condenser 51 being employed to prevent battery flow through its circuit, and the balanced primary winding 52 has the leg 53 and a triple-stranded leg 54 consisting of the strands 55, 56 and 57. The filament 58 is connected between the strands 55 and 57, and from thence to the A battery 59; and the C battery is connected between the strands 55 and 56. By virtue of this arrangement it will be seen that the filament again is maintained at a radio frequency potential above that of the bat-

teries, and that I am enabled to connect one terminal of the condenser 47 to ground, as shown.

From what has thus been described, the nature of my invention will be clear, and it will also be clear that there are many forms in which it may be successfully applied in addition to those illustrated herein.

Having, however, thus described certain forms which my invention may take, what I claim as new, and desire to secure by Letters Patent of the United States, is:

1. A vacuum tube circuit including a thermionic tube having an input and an output circuit, an inductive element included in one of said circuits having a multiple winding of three strands, a source of filament current supply associated with the thermionic element of said tube through strands of said winding, and a source of C-battery supply associated with the grid element of said tube through strands of said winding.

2. In a radio system, a vacuum tube and a split input coil connected thereto comprising two portions, one portion being a single conductor connected between the cathode and grid, the other portion being a double strand conductor connected between both cathode heater leads, and the cathode current supply.

3. In a radio system, a vacuum tube member having a heated cathode, a source of heating power therefor, at ground potential, and means for conveying heating current therefrom to said cathode while bringing said cathode to a potential other than ground potential, comprising a coiled multi-strand conductor spiral connected between said power sources and said cathode, one of said strands forming a part of a larger coil.

4. In a radio system, a vacuum tube member having a heated cathode, a source, at ground potential, of current for heating said cathode, and means for conveying heating current therefrom to said cathode while bringing said cathode to a potential other than ground potential, comprising a multi-strand coil having one conductor of said multiple strand coil, continued as a single strand portion of said coil.

5. In a radio system, a vacuum tube amplifier member, a resonant input circuit therefor, comprising a coil and a condenser in parallel, one end of said coil being connected to a grid of said vacuum tube, the cathode of said vacuum tube being connected to a mid-point tap on said coil, said cathode being further connected to a second strand of conductor coiled parallel to a portion only of the coil of said resonant circuit.

6. In a radio system, a vacuum tube amplifier member, a resonant input circuit therefor, comprising a coil and a condenser in parallel, one end of said coil being connected to a grid of said vacuum tube, the cathode of said vacuum tube being connected to a mid-point tap on said coil, said cathode being further connected to a second strand of conductor coiled parallel to a portion only of the coil of said resonant circuit, and a bypass condenser and lead between the anode of said vacuum tube and a second end of said coil.

RAYMOND G. PIETY.