

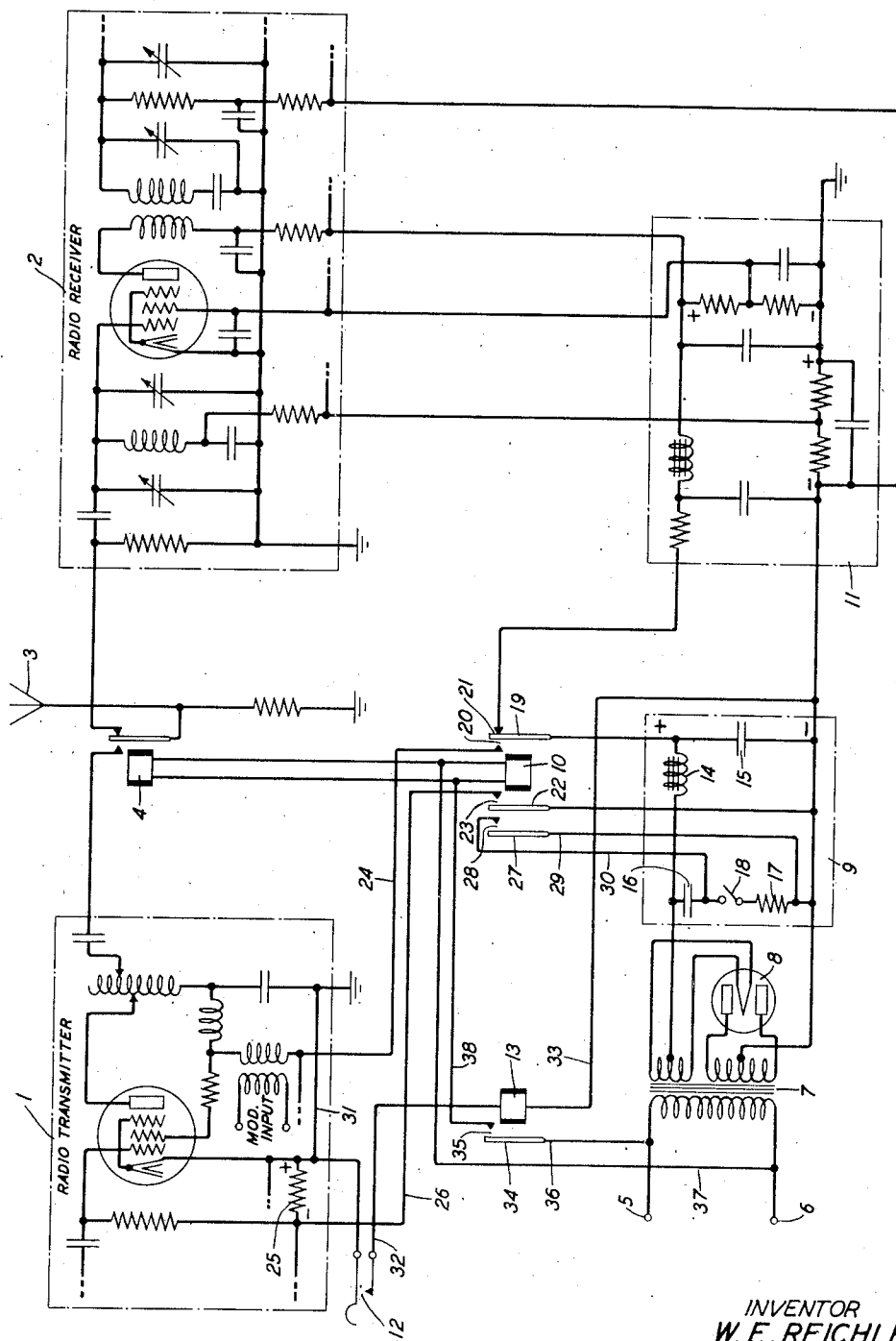
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DUPLEX RADIO SYSTEM

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DUPLEX RADIO SYSTEM

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The invention relates to power supply arrangements for vacuum tube apparatus, radio communication systems and the like and more particularly to arrangements in which alternating current is converted into pulsating current which is then filtered and supplied to a load circuit.

A specific application of the invention is to a duplex radio system in which a single power supply is connected alternately to a radio transmitter and a radio receiver. To permit of this common use of the power supply and for other practical reasons the radio transmitter and radio receiver are conveniently designed to operate with nearly the same maximum voltage from the power supply. Commonly, however, the transmitter draws a considerably larger load current than the receiver, in order that the power output of the transmitter may be sufficient for communication to the desired distance. The power supply is required to possess sufficiently good regulation to permit it to supply either of these diverse loads in a satisfactory manner or else some compensation must be made each time the load is changed. In power supply devices now in use the filter serves as a voltage regulating device to a greater or less degree in addition to its function of smoothing out the pulsations or power ripples. The filter is usually of the low pass type comprising one or more series inductances and one or more shunt capacitances, the degree of regulation being greater if the filter terminates in a series inductance at the input side than it is if a shunt capacity termination is employed. The shunt termination, however, is known to provide higher terminal voltages at all current loads and accordingly to give a somewhat larger power output than can be obtained with the series termination. In commercial apparatus where it is desired to operate the vacuum tubes at maximum power output the advantage of the shunt termination will be evident, but the terminal voltage developed by the shunt terminated filter when supplying the relatively small current drawn by the radio receiver is in most cases very likely to be excessive.

In accordance with the invention auxiliary contacts are provided on the switch or relay used to transfer the power supply from the transmitter to the receiver and vice versa. The auxiliary contacts serve to alter the termination of the filter simultaneously with the change from one load condition to the other. In a specific embodiment of the invention the filter is normally terminated in a series inductance or choke coil and is so employed when connected with the radio receiver.

When the output of the filter is switched over to connect with the radio transmitter a shunt condenser is simultaneously switched into operation ahead of the series inductance, thereby converting the filter into one having a shunt capacity termination. With this arrangement, the voltage impressed upon the radio receiver by the power supply is held to a safe value and when the radio transmitter is in operation the power output radiated is considerably greater than would be the case if the filter termination were left unchanged when the power supply is shifted from the receiver to the transmitter.

To reduce or eliminate sparking at the contacts through which the shunt condenser is connected across the power supply circuit, the condenser may be permanently connected in place with a high resistance in series therewith. The resistance may be sufficiently large to prevent the condenser from raising the terminal voltage appreciably while the filter is connected to the radio receiver and the relay contacts may be employed to short-circuit the resistance when the filter is connected to the radio transmitter.

The single figure of the accompanying drawing shows an embodiment of the invention in a duplex radio communication system.

In the drawing, 1 is a radio transmitter and 2 is a radio receiver, either of which may be connected to a common antenna 3 by means of contacts operated by a relay winding 4 of an ordinary antenna transfer relay. Terminals 5 and 6 are for connection to an alternating current source such as commercial 60-cycle supply mains. The terminals 5 and 6 are connected to the primary winding of a conventional power supply transformer 7 having secondary windings for impressing voltages upon a full wave rectifier 8 and for supplying heating current to the filaments of the rectifier. A power supply filter 9 which embodies certain features of the invention is connected to the output of the rectifier. A relay winding 10 controls various contacts including main contacts for transferring the output connection of the filter 9 from the radio receiver to the radio transmitter and vice versa and also an auxiliary contact for carrying out purposes of the invention. The rectangle 11 encloses additional filtering elements and potential dividing arrangements of a conventional nature which are used in connection with the radio receiver. A manually operated key 12 controls the relays 4 and 10, through an intermediary relay 13, to place and maintain the system in the transmit-

ting condition as will be more fully described hereinafter.

The filter 9 normally terminates at its input side in a series inductance or choke coil 14. The filter illustrated is of very simple design, including in addition to the coil 14 a shunt condenser 15. Another shunt condenser 16 is for use only in the transmitting condition. In series with the condenser 16 across the input side of the filter 9 is a high resistance 17 and a switch 18.

Associated with the relay winding 10 is a main armature 19 cooperating with a front contact 20 and a back contact 21, armature 19 and contact 21 normally completing a circuit from the positive terminal of the output side of filter 9 to one of the input terminals of device 11. The relay winding 10 has another main armature 22 and associated contact 23 which are connected together only in the transmitting condition. Contact 20 is permanently connected to the plate and screen grid supply circuits of the radio transmitter through a lead 24. Contact 23 is connected to the negative end of a self-biasing resistor 25 in the radio transmitter by means of a lead 26. There is also associated with the relay winding 10 an auxiliary armature 27 and a contact 28 which are also connected together only in the transmitting condition. The armature 27 is connected through a lead 29 to one end of the resistance 17. The contact 28 is connected through a lead 30 and the switch 18 to the opposite end of the resistance 17.

In the normal or receiving condition the positive terminal of the filter 9 is connected through armature 19, contact 21 and the inner connections of device 11 to ground and thence through a lead 31 in the radio transmitter to the positive terminal of resistance 25 and to one side of key 12. The other side of key 12 is connected through a lead 32 to a relay winding 13 and thence by a lead 33 to the negative side of filter 9. The relay winding 13 is associated with an armature 34 and a contact 35, the armature being connected to one side of the alternating current supply by means of a lead 36 and the other side of the alternating current supply being connected through a lead 37 to the relay windings 4 and 10 in parallel and thence through a lead 38 to contact 35.

The radio transmitter 1 and radio receiver 2, being conventional and forming no part of this invention, are only partially illustrated, such details being shown as are considered necessary to a full explanation of the invention.

In the operation of the system, let it be assumed that the terminals 5 and 6 are connected to a suitable source of alternating current and that the radio system is in the receiving or stand-by condition. The relay windings 4, 10 and 13 are all deenergized and their contacts are in the position shown in the figure. The alternating current passes through the transformer 7 and is converted into a pulsating unidirectional current by the rectifier 8 in well-known manner, the pulsating current being impressed upon the input side of the filter 9. The filtered output current passes through armature 19 and contact 21 to the auxiliary filter and potential divider 11, returning to the negative side of the filter. Various potentials from the potential divider are applied to the anodes, screen grids and control grids in the radio receiver in the usual manner, some of the connections being indicated in the figure. The antenna 3 is connected to the input of the radio receiver through the back contact of the antenna

transfer relay 4, the radio transmitter is disconnected from the antenna at the front contact of relay 4 and the power supply to the transmitter is cut off at contacts 20 and 23. In this condition the filter 9 is effectively terminated on the input side in the coil 14, the condenser 16 being ineffective and prevented from collecting any considerable electrical charge due to the series connection of the resistance 17. Alternatively, the switch 18 may be open or the resistance 17 may be omitted entirely, in either case the connection of the condenser 16 to the negative side of the filter 9 is broken at the contact 28.

To convert the system into the transmitting condition it is only necessary to depress the key 12 and thereafter the system will remain in the transmitting condition until the key is released. By means of the key, telegraph signals may be sent out in well-known manner or the system may be held in the active condition while the transmitter is being modulated with telephone signals, also in well-known manner. For the latter use, the key 12 is ordinarily mounted on the telephone transmitter or microphone in a position to be operated conveniently by the talker. A key thus used when talking is commonly called a "press to talk" button.

When the key 12 is closed it completes a circuit from the positive terminal of filter 9 through armature 19, contact 21 and device 11 to ground, thence through lead 31 through the key contacts to relay winding 13 and to the negative side of filter 9. A current from the filter passes through this circuit, energizing relay winding 13 and closing the circuit between armature 34 and contact 35 associated with relay winding 13. This relay is preferably a relatively sensitive one so as to be capable of operation on a small current obtainable from the power supply in the receiving condition. Relay 13 closes an obvious alternating current path from terminals 5 and 6 through the relay windings 4 and 10 in parallel to effect the final switching operations. The relay 4 transfers the antenna from the radio receiver to the radio transmitter in well-known manner. The relay 10 transfers the connection from the positive terminal of the filter 9 from the auxiliary filter 11 to the lead 24 and the vacuum tube supply circuits of the radio transmitter, by transferring the armature 19 from contact 21 to contact 20. The relay also connects the negative side of the filter through the lead 26 to the negative side of the grid biasing resistor 25 in the radio transmitter. The latter connection, made by armature 22 and contact 23, completes the power supply circuit of the radio transmitter and at the same time provides a new direct current supply circuit for the winding of relay 13 to take the place of the circuit previously described which is now broken at contact 21. This substitute circuit is readily traced from the positive terminal of the filter 9 through armature 19, contact 20, the plate and screen grid circuits of the radio transmitters to the cathodes of the vacuum tubes which are connected to ground, and thence, as before, through the key 12 and winding 13 to the negative side of the filter.

Simultaneously with the above-described switching of the power supply from the receiving to the transmitting condition, the relay 10 closes the contact between its armature 27 and contact 28. This completes the connection of the condenser 16 as a shunt termination across the input side of the filter 9. In case the switch 18 is open or the resistance 17 has been omitted, the

armature 27 simply connects the free end of the condenser 16 to the negative side of the filter. If the resistance 17 is provided and the switch 18 is closed, the armature short-circuits the resistance 17 with the same effect. The power is now supplied to the radio transmitter at a higher terminal voltage than would have been obtained had the condenser 16 not been connected.

To restore the system to the receiving or stand-by condition it is merely necessary to release key 12. This results in breaking the circuit of relay winding 13 causing that relay to release and in turn causing windings 4 and 10 to become de-energized. Thereupon the antenna transfer relay returns the antenna to contact with the input of the radio receiver and all the contacts of the relay 10 return to normal. If switch 18 is open or resistance 17 has been omitted, the separation of armature 27 and contact 28 may be attended by sparking due to a considerable charge on condenser 16. If, however, switch 18 is closed the condenser is discharged through the resistance 17, any such tendency to sparking at the relay contacts is reduced or entirely eliminated.

Numerous variations of the system illustrated, within the scope of the appended claims, will readily occur to those skilled in the art to which the invention appertains. For example, any two load circuits with unequal current requirements may be connected to the relay 10 instead of the radio transmitter and radio receiver. The relay 10 may be operated directly by arranging to have its circuit closed through the key 12 instead of through the action of an intermediary relay 13, or, if desired, the switching may be accomplished manually. It is also evident that the relay or relays may be operated from any convenient source of current and may, if desired, be independent of the main power supply. The filter 9 may, of course, consist of any configuration of elements suitable for the purpose and may contain additional sections as desired, provided only that one or more of the filter elements comprising part of the filter termination at the input side is arranged to have its connections changed simultaneously with the switching of the power supply from one load to the other.

What is claimed is:

1. In a power supply system, a source of pulsating current, a filter for smoothing out the pulsations of said current, a pair of load circuits with diverse load requirements, means for connecting the output side of the filter at will to either load, and means coupled to said connecting means for altering the circuit configuration of the input termination of the filter to provide one terminating configuration when the first load is connected and another terminating configuration when the second load is connected.

2. In a power supply system, a source of pulsating current, a filter for smoothing out the pulsations of said current, said filter being normally terminated at its input side in a series inductance, a pair of load circuits with diverse load requirements, transfer means for connecting the output side of the filter to either load circuit at will, a condenser, and means operating simultaneously with said transfer means for rendering said condenser effective as a shunt across the filter input terminals when the filter output terminals are connected to one load circuit and for substantially suppressing the shunting effect of the condenser when the filter output terminals are connected to the other load circuit.

3. In a power supply system, a source of pul-

sating current, a filter for smoothing out the pulsations of said current, said filter being terminated in a series inductance at its input side, a pair of load circuits with diverse load requirements, transfer means for connecting the output side of the filter to either load circuit at will, a condenser, and means operating simultaneously with said transfer means for connecting the condenser in shunt across the filter input terminals when the filter output terminals are connected to one load circuit and for disconnecting the condenser when the filter output terminals are connected to the other load circuit.

4. In a power supply system, a source of pulsating unidirectional current, a filter for smoothing out the pulsations of said current, two load circuits, one of which draws a relatively large current compared to the other, transfer means for establishing connections from the output side of the filter to either load at will, and means coupled to said transfer means for altering the circuit configuration of the input side of the filter simultaneously with the load transfer, in such manner as to provide a shunt input termination for the filter when connected to the load drawing the larger current and a series input termination when the filter is connected to the load drawing the smaller current.

5. In a power supply system, a source of pulsating current, a smoothing filter, said filter normally terminating at its input side in a series inductance, two load circuits, one of which draws a relatively large current compared to the other, transfer means for connecting the output side of the filter to either load circuit at will, a condenser, and means coupled to said transfer means for effectively connecting the condenser in shunt across the filter input terminals when the filter output terminals are connected to the load which draws the larger current and for rendering the condenser ineffective as a shunt termination to the filter input when the filter output terminals are connected to the load which draws the smaller current.

6. In a power supply system, a source of pulsating current, a smoothing filter, said filter normally terminating at its input side in a series inductance, two load circuits, one of which draws a relatively large current compared to the other, transfer means for connecting the output side of the filter to either load circuit at will, a condenser, and means coupled to said transfer means for connecting the condenser in shunt across the filter input terminals when the filter output terminals are connected to the load which draws the larger current and for disconnecting the condenser when the filter output terminals are connected to the load which draws the smaller current.

7. In a power supply system, a source of alternating current, a rectifier, a smoothing filter normally terminated at its input side in a choke coil, a condenser and a large resistance connected in series with each other and together shunted across the filter input terminals, the resistance being sufficiently large to substantially eliminate the condenser as an effective shunt element of the filter, a pair of load circuits requiring relatively large and small currents respectively, and a relay having main contacts and auxiliary contacts, said main contacts being arranged to connect the filter output to either load circuit under control of the relay, and the auxiliary contacts being arranged to short-circuit the said resistance when the load requiring relatively large current is con-

nected and to remove the short circuit when the other load is connected.

8. In a duplex radio system, a radio transmitter, a radio receiver, a source of pulsating current, a filter for smoothing out the pulsations, means for connecting the output side of the filter to the current utilizing circuits of either the radio transmitter or the radio receiver at will, and means coupled to said connecting means for altering the circuit configuration of the filter termination at the input side of the filter to provide different terminations according to whether the filter is connected to the radio transmitter or to the radio receiver.

9. In a duplex radio system, a radio transmitter, a radio receiver, a source of pulsating current, a filter for smoothing out the pulsations, said filter being terminated in a series inductance at its input side, transfer means for connecting the output side of the filter to the radio transmitter or to the radio receiver at will, a condenser, and means coupled to said transfer means for connecting the condenser in shunt across the filter input terminals when the filter output terminals are connected to the radio transmitter and for disconnecting the condenser when the filter output terminals are connected to the radio receiver.

10. In a duplex radio system, a radio transmitter, a radio receiver, a source of alternating current, a rectifier for converting alternating current from said source into a pulsating unidirectional current, a filter for smoothing out the pulsations, said filter being terminated in a series

inductance at its input side, transfer means for connecting the output side of the filter to the radio transmitter or to the radio receiver at will, a condenser, and means coupled to said transfer means for connecting the condenser in shunt across the filter input terminals when the filter output terminals are connected to the radio transmitter and for disconnecting the condenser when the filter output terminals are connected to the radio receiver.

11. In a duplex radio system, a radio transmitter, a radio receiver, a source of alternating current, a rectifier for converting alternating current from said source into pulsating direct current, a smoothing filter with input terminals connected to said rectifier, said filter normally terminating at its input side in a series inductance, a condenser and a large resistance connected in series with each other and in shunt to the filter input terminals, the value of the resistance being sufficiently great to substantially prevent the condenser from acting as a shunt termination for the filter, and a relay having a main set of transfer contacts and a pair of auxiliary contacts, the main contacts being arranged to transfer the output of the filter from the radio transmitter to the radio receiver and vice versa, and the auxiliary contacts being arranged to short-circuit the said large resistance simultaneously with transfer of the filter connection over to the radio transmitter and to remove the short circuit simultaneously with the transfer of the filter connection over to the radio receiver.

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