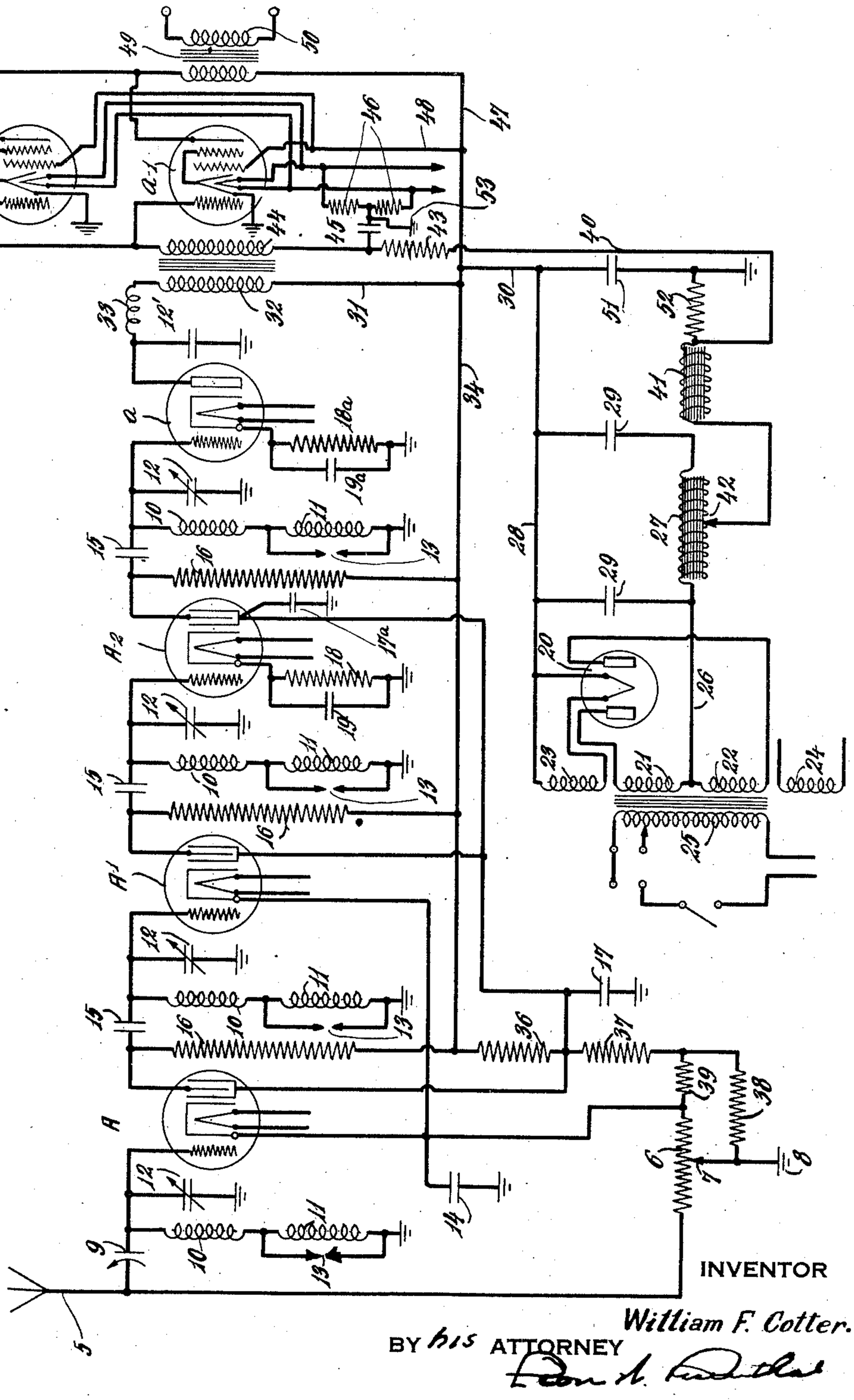
May 9, 1933. W. F. COTTER 1,908,119

RADIORECEIVER

Filed May 24, 1932



Patented May 9, 1933 1,908,119

UNITED STATES PATENT OFFICE

WILLIAM F. COTTER, OF SPRINGFIELD, MASSACHUSETTS, ASSIGNOR TO UNITED AMERICAN BOSCH CORPORATION, OF SPRINGFIELD, MASSACHUSETTS, A CORPORATION OF NEW YORK

RADIORECEIVER

Application filed May 24, 1932. Serial No. 613,215.

My invention relates to improvements in radio receivers; and especially radio receivers to operate on two or more bands of frequencies or wavelengths.

This invention has for one of its objects to provide means for increasing the sensitivity of radio receiving apparatus.

Another object of the invention is to provide a convenient arrangement by which the radio frequency output of the detector tube of the receiver can be more easily filtered. On account of the slope of the sensitivity curve on the high frequency end of the band of longer wavelengths, this filtering is apt to be more or less difficult to accomplish.

The advantages of the invention are fully set forth in the ensuing description, with the accompanying drawing; but the disclosure is illustrative only; and changes may be made without departing from the principle of the invention.

The figure shows a circuit for a receiver according to my invention.

The receiver comprises electric circuits containing vacuum tubes in parallel in the output of the audio frequency amplification stage, a suitable detector and several stages of radio frequency amplification disposed to operate on the resistance-repeater principle, with tuned circuits for selectivity; and a rectifier to enable ordinary lighting or power mains to serve as sources of electrical energy for the cathodes and anodes of the vacuum tubes.

I show an antenna 5 at one end of a resistance 6 having an adjustable contact 7 connected to ground. The antenna is also joined to one end of a variable electrical condenser 9, the other pole of which is connected to the grid of the first vacuum tube member or amplifier A. The other end of the resistance 6 is connected to the cathode in the tube A, this tube being of the screen-grid type, with a unipotential cathode grounded through a fixed condenser 14. The shield or screen in the tube A is grounded through a condenser 17. Attached to the lead between the grid of the tube A and condenser 9 is a coil including a pair of sections 10 and 11, these sections being in series and grounded. They are also associated with an adjustable condenser 12 connected to the grid of the tube A at one end and grounded at the other. The sections 10 and 11 and condenser 12 constitute a tuning circuit, and the tube A as shown is joined to the antenna by a resistance coupling because of the presence of the element 6. When the receiver is to be used for waves of the longer length, both sections 10 and 11 together with the condenser 12 are put into circuit. But when the band of shorter wave lengths is to be employed, the section 11 can be cut out by bridging the terminals 13 connected to the two ends of the section 11 by suitable switch mechanism. Of course, more than two sections may be utilized if operation is desired on more than two bands of wave lengths.

The second radio-frequency amplifier tube A—1 is of the same description as the first tube and is connected to the first tube by a conductor extending between the plate of the first tube and the grid of the second, with a fixed condenser 15 in the line thereof. The cathode of tube A—1 is also connected to resistance 6 and grounded by way of condenser 14; and the screen by way of condenser 17. Between the condenser 15 and the grid of the tube A—1 is a tuned circuit consisting again of a coil in two sections 10 and 11 in series and grounded, together with another adjustable grounded condenser 12 connected to the grid of tube A—1; the section 11 having contacts 13 joined to its extremities, so that this coil can be switched out at the same time as the first coil 11.

Between the condenser 15 and the plate of the first amplifier tube A is joined one end of the resistance 16 across which the plate circuit load is developed; this resistance 16 having capacity-coupling through the condenser 15 with the tuning circuit between the amplifiers A and A—1.

The same connections exist between the plate of the tube A—1 and the grid of the radio frequency amplifier tube A—2, except that the screen of the latter is grounded through an additional condenser 17*a*; and the cathode of this third tube is directly joined to one end of a resistance 18 and con-

denser 19 in parallel, the opposite terminals of these two elements being grounded on the framework of the receiver.

The condensers 14, 17 and 17*a* are by-pass condensers for high frequency oscillations; while the condenser 19 attached to the cathode of the tube A—2 constitutes a by-pass tor both radio and audio frequency oscillations. The resistance 18 of the cathode of tube A—2 is for grid bias purposes. The aforesaid coupling resistances 16 are connected to the condenser 17 through a suitable resistance element 36.

The last stage in the circuits of the receiver comprises a detector tube *a*, and two audio frequency amplifiers *a*—1 in parallel. The same coupling with tuning circuit as before is used to unite the tubes A—2 and *a*, and comprises the resistance 16. A resistance 18*a* and a condenser 19*a*, grounded in parallel, are connected with the cathode of the tube *a*. In the output of this tube *a* is a radio frequency choke coil 33, and the primary coil 32 of a transformer, together with a grounded fixed condenser 12′. A common lead 34 connects this coil 32 and all of the resistance coils 16. The tubes *a*—1 have each a suppressor grid connected to the filament therein.

To supply current to the plates of all the tubes, the common conductor 34 is connected by leads 28 and 30 to the heated cathode of a rectifier 20. This rectifier also contains two anodes each united to the outer terminal of a pair of secondary coils 21 and 22 in series. The cathode of the rectifier is heated by current from a secondary 23, and a secondary coil 24 supplies current to the heaters of the cathodes of the tubes A, A—1, A—2 and *a*, and the filaments of the tubes *a*—1. All of these secondaries are mounted upon the same iron core to be energized from the primary 25 connected to a light or power circuit. From the junction point of the coils 21 and 22 is led a conductor 26 in series with an iron core inductance 27, having condensers 29 in shunt therewith and the conductor 28. A tap 42 leads from the coil 27 to a similar coil 41 connected by a lead 40 to a secondary 44 coupled to the coil 32. Coil 41 will be the field winding of a dynamic loud speaker. This coil 41 is also joined to a grounded resistance 52, with a condenser 51 between its grounded end and the supply lead 28. At 43 is a resistance in series with the secondary 44.

The grids of the audio amplifier tubes *a*′ are united to the tube "*a*" by transformer coupling by being joined to one terminal of the secondary 44, which is wound on an iron core with the coil 32. These tubes are both pentode tubes, with their screens joined to lead 34 by a lead 48. Between the resistance 43 and coil 44 is connected one pole of a condenser 45, the other pole of which is united to the midterminal of a resistor 46 bridged across the filaments of the tubes *a*—1. The common terminal of resistor 46 is grounded at 53.

The resistance 43 and coil 44 are in a circuit between grid and filament for audio frequency current, and are connected to the midpoint of the windings 46 to allow for alternating current fluctuations of the heating current. The plates of the tubes *a*—1 are connected to one terminal of the primary coil 49 of an iron core transformer, the secondary 50 of which is to have its terminals connected to the movable coil of the dynamic loud speaker. A lead 47 connects the other end of the primary 49 to the supply leads 26 and 30, hence the coils 32 and 49 and all the resistances 16 are in multiple.

This receiving set operates very similar to the set mentioned in the aforesaid application. For the shorter wavelength range the coils 11 are switched out, while for the band of longer wavelengths they are connected in. The arrangement of audio amplifying tubes *a*′ in parallel, connected through transformer coupling to the detector *a* increases the sensitivity of the set to a desirable level. The radio frequency currents in the output circuit of the detector tube are filtered out by the condenser 12′ and coil 33.

The numeral 37 indicates a resistance in series with a resistance 36 on the one hand and a grounded resistance 38 on the other; 39 being a similar resistance connected to the resistance 6 and the common terminal of resistances 37 and 38.

The current flowing in the resistance 52 is mainly direct current and a potential drop exists between the terminals of this resistance, which is in the return circuit to the rectifier 20. Hence the grids of the audio frequency amplifiers *a*—1 are negatively biased; and any alternating current in the resistance 52 is filtered and smoothed out by the resistance 43 and condenser 45. The resistance 43 is about 100,000 ohms, and condenser 45 has about 0.1 microfarad capacity. Thus a high capacity by-pass condenser is not needed.

The resistance-condenser coupling with tuned circuits described herein involves resistances such as resistors 16 of no greater value than of the order of 25,000 ohms; while the capacity of the condensers 15 is of the order of 25 micromicrofarads.

Having described the invention, what is claimed is:

A radio receiver having an audio amplifier tube, an electric circuit and a source of electrical energy for energizing the anode thereof, said circuit comprising filtering condensers and inductances and an ohmic resistor in circuit with said inductances and disposed in the return side of said circuit,

a connection at one end of said resistor for biasing the grid in said tube, a second resistor in said connection, a condenser connected to the second resistor, and to the filament circuit of said tube, and a ground connection between said second condenser and said filament circuit, said second condenser and last-named resistor forming a circuit to filter out alternating current oscillations from the connection between said resistors and the grid.

In testimony whereof I affix my signature.

WILLIAM F. COTTER.