

Sept. 18, 1945.

C. W. LYTTLE

2,385,012

ANTENNA SYSTEM

Filed Feb. 10, 1942

3 Sheets-Sheet 1

Fig. 1

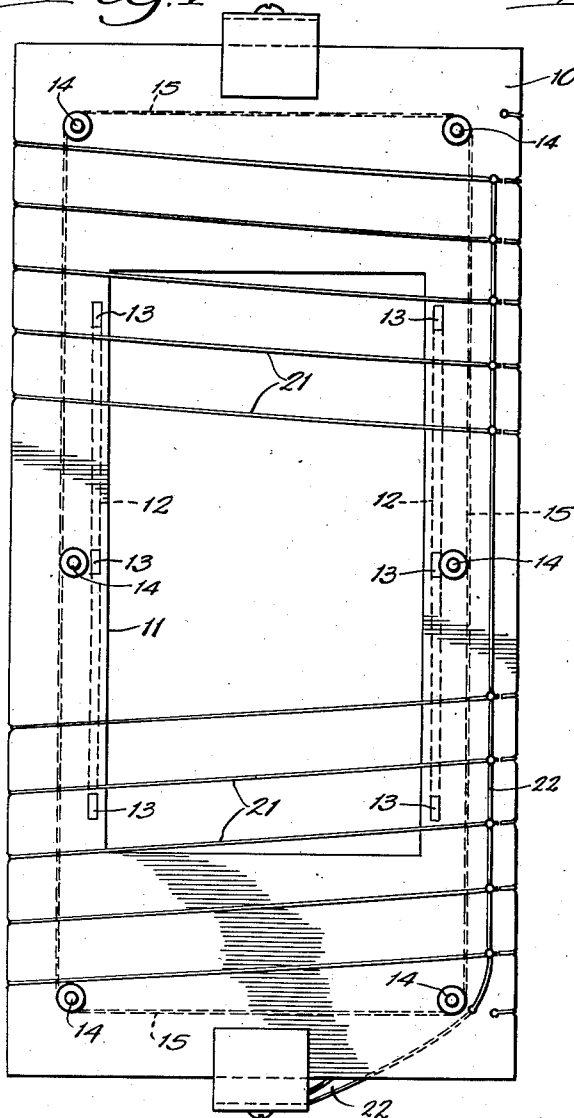
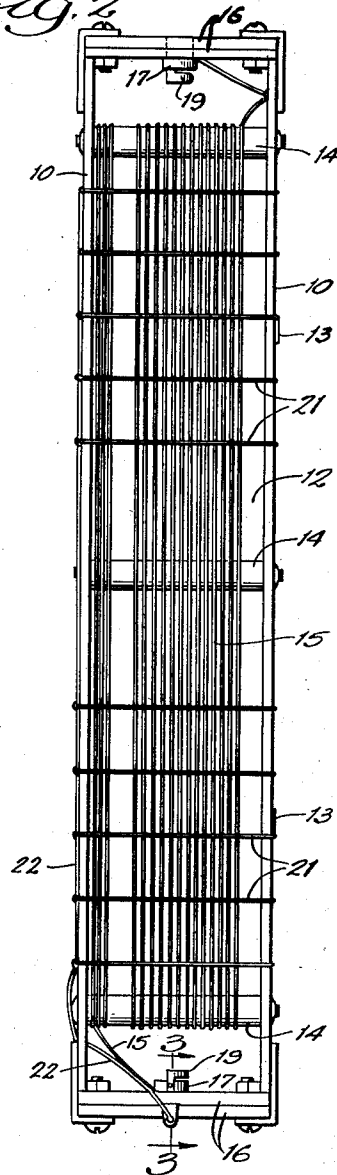


Fig. 2



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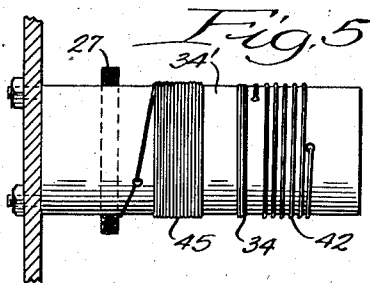
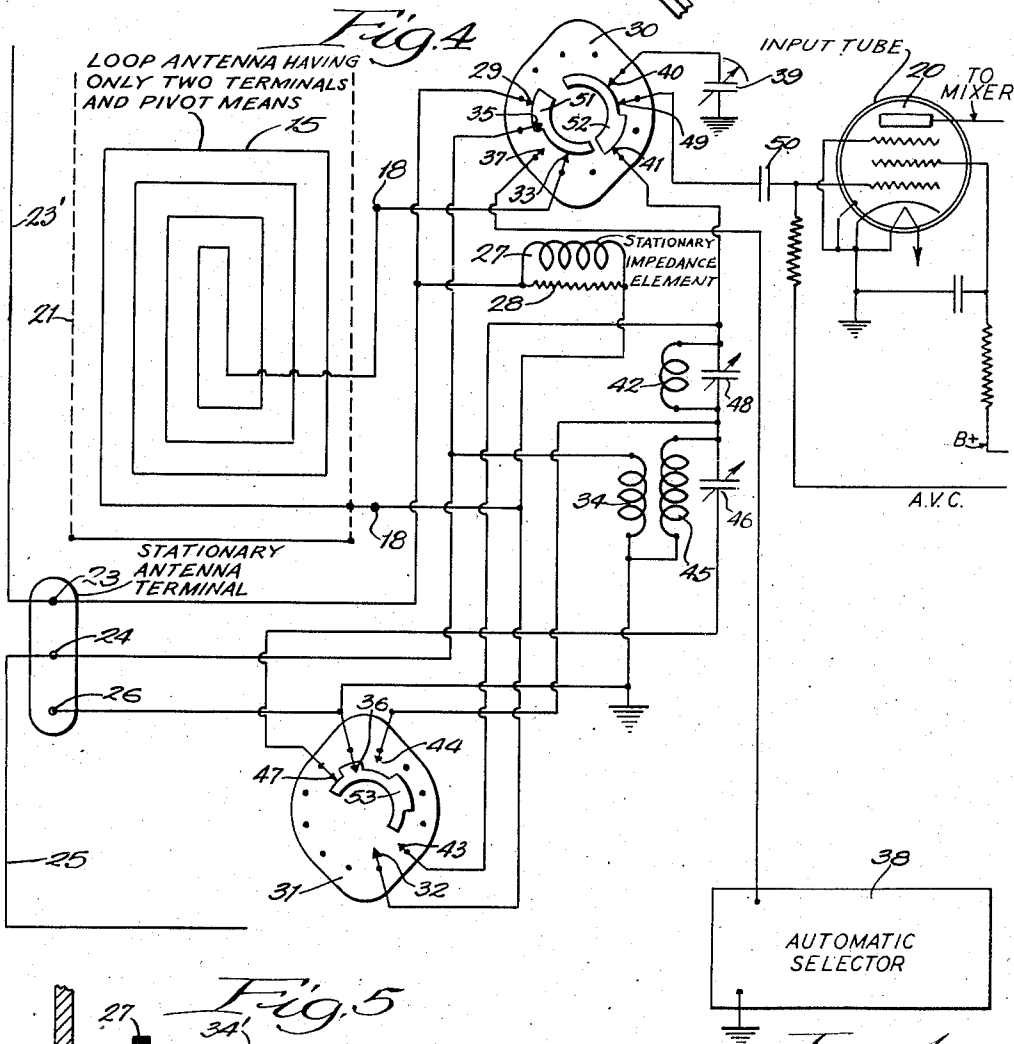
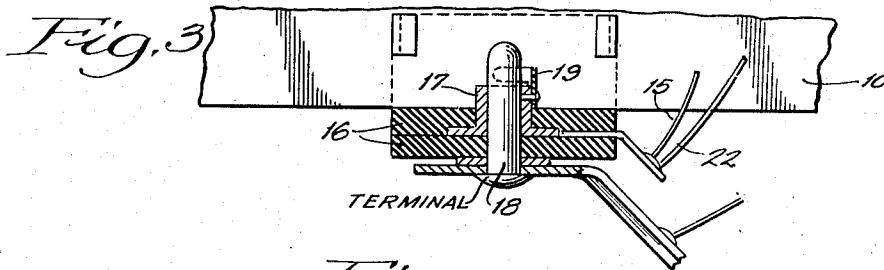
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ANTENNA SYSTEM

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3 Sheets-Sheet 2



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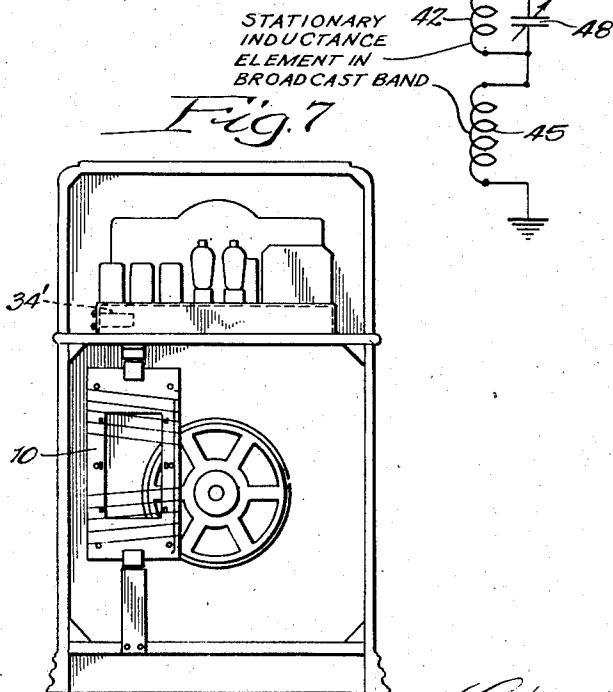
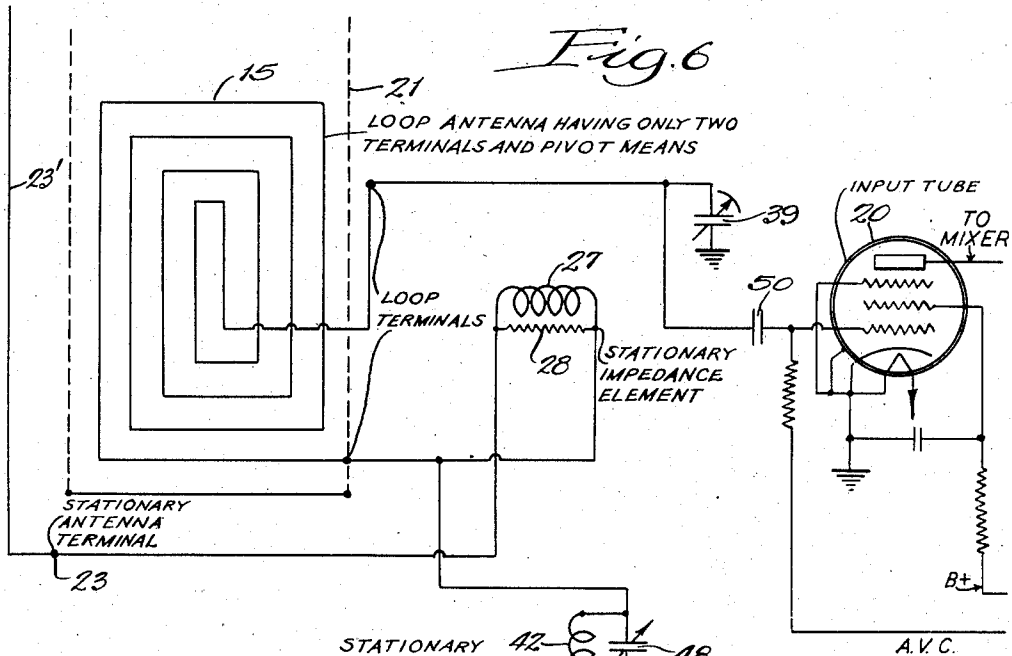
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ANTENNA SYSTEM

Filed Feb. 10, 1942

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,385,012

ANTENNA SYSTEM

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Application February 10, 1942, Serial No. 430,230

21 Claims. (Cl. 250—20)

This invention relates to antenna systems for radio receivers.

Heretofore radio receivers have been provided with a loop antenna. In many cases the loop has been mounted so as to be rotatable about a vertical axis to permit orientation for best reception. However, in certain locations the loop may fail to provide an adequate signal, and for this reason it is desirable to adapt such receivers for optional operation from a more conventional outside aerial such as, for example, an elevated wire system. When it is desired to install an outside aerial for a receiver provided with conventional loop antennas, such installation is usually complicated and ordinarily necessitates circuit changes such as removal of jumpers, etc.

One objectionable complexity of some of the previous systems is that they necessitate a high impedance coil coupled to the loop and thus a number of leads greater than two must be employed which introduces complexities in assembly, testing, and adjustment. With such a system, the loop cannot be rotated more than one revolution without fouling one or more of said leads.

One of the objects of the invention is to provide an improved antenna system comprising a loop antenna and which permits the attachment of an outside aerial without further circuit change.

A further object of the invention is to provide an improved antenna system of this type in which only two wires are required for loop connections which facilitates and simplifies pivotal mounting of the loop.

A further object of the invention is to provide an improved antenna system of this type in which the loop may be electrostatically shielded and thereby protected to a considerable extent from man-made static.

A further object of the invention is to provide an improved antenna system of this type in which high frequency image rejection is improved.

A further object of the invention is to provide an antenna system of this type in which the loop pickup is greatly increased.

Other objects, advantages and capabilities of the invention will appear from the following description of a preferred embodiment thereof taken in conjunction with the accompanying drawings, in which:

Figure 1 is a side elevation of the loop antenna;

Fig. 2 is an end elevation thereof;

Fig. 3 is a sectional detail view taken on the line 3—3 of Fig. 2;

Fig. 4 is a wiring diagram;

Fig. 5 is in elevational view of the coil assembly associated with the antenna system and mounted on the chassis in suitable location;

Fig. 6 is a schematic circuit diagram showing

that portion of the circuit of Fig. 4 which is active when the last-mentioned circuit is adjusted for reception of broadcast frequencies; and

Fig. 7 is a rear elevational view of a radio receiver embodying the invention.

Referring to the drawings, the loop assembly shown in Fig. 1 comprises two side plates 10 which may have a central opening 11. The plates 10 are maintained in spaced relation by two vertical walls 12 which are provided with lugs 13 which extend into openings in the walls 10.

Spacer rods 14 are provided which engage the two walls 10 and are supported thereby in suitable manner so as to serve as supports for the loop 15 which is wrapped around the rods 14 between the two plates 10.

At the top and bottom the two plates 10 are connected by bridge members 16 which carry bearing members 17 whereby the loop assembly is supported upon upwardly and downwardly directed pins 18. The lower pin 18 is shown in Fig. 3. The upper pin is quite similar. The bearing bushing 17, which is of metal, carries a resilient member 19 which is adapted to engage the pin 18.

Opposite ends of the loop 15 are connected to the bearing members 17 at the top and bottom of the loop assembly and consequently the opposite ends of the loop are connected to the pins 18. The supports of the pins 18 are connected in the circuit as shown in Fig. 4, serving as the conductors from the loop to the receiver.

The low voltage side of the loop 15, that is, the side other than that which is connected to the grid of the first radio frequency amplifying or input tube 20, is connected to the electrostatic shield 21. Thus, to the lower bearing member 17 is connected a conductor 22 which may suitably extend up one side of the exterior of one of the walls 10. This conductor 22 is soldered to all of a plurality of loops which constitute the shield 21.

In manufacture, the loops of the shield 21 may simply be wrapped in the generally horizontal direction around the exterior of the two walls 10. The conductor 22 may be soldered to each loop and then the loops may be cut quite close to the wire 22 as shown in Fig. 1, thus constituting an electrostatic shield having no closed loops. The shield 21 is, of course, held in position in any suitable manner upon the loop assembly. This may very readily be done with the aid of suitable cement.

It will of course be understood that the walls 10 and 12 and the spacer rods 14 may be of any suitable dielectric material. The elements 17, 18 and 19 are of course metallic.

Upon the receiver I provide a stationary terminal 23 for the optional attachment of an out-

side aerial, shown in Fig. 4 as 23'. To a terminal 24 I secure a short wave antenna 25. This antenna may suitably consist of a short piece of wire arranged at a desired position within the cabinet. The ground terminal is indicated at 26. This terminal may, if desired, be connected to a water pipe or any other grounded structure.

The outside aerial terminal 23 is connected to one terminal of a high impedance coil 27 which is in parallel with a high resistance 28. This terminal is also connected to a contact 29 which is part of a band switch 30. This band switch, like the band switch 31, is one of a gang of switches used for adapting the receiver for the reception of any one of a plurality of bands.

The other terminal of coil 27 and resistor 28 is connected to the lower, or shielded, end of the loop 15 and also to a contact 32 on the band switch 31. The upper end of the loop 15 is connected to a contact 33 on the band switch 30.

The terminal 24 is connected to one terminal of a primary coil 34 and to a contact 35 on the band switch 30. The other terminal of the coil 34 is grounded to the chassis and to the terminal 26 as is likewise contact 36 on band switch 31.

Contact 37 on the band switch 30 is connected to automatic control mechanism 38 which is not shown in detail and which may be described briefly as automatic means for bringing into circuit any one of a plurality of condensers set to definite capacity instead of condenser 39 which is one of the gang of tuning condensers.

One terminal of the condenser 39 is grounded, the other being connected to contact 40 of the band switch 30. Condenser 39 and, in the broadcast position of switches 30 and 31, the circuit including loop 15 and coils 42 and 45 as described hereinafter, are thereby connected between the input terminals of tube 20 including the previously mentioned grid of that tube and its grounded cathode.

Contact 41 of band switch 30 is connected to one terminal of the secondary winding 42 and to contact 43 of the band switch 31. The other terminal of the winding 42 is connected to contact 44 of band switch 31, to one terminal of winding 45 and to one terminal of tuning condenser 46. The other terminal of the tuning condenser 46 is connected to contact 47 of the band switch 31. The other terminal of the coil 45 is grounded. The coil 42 is paralleled by a tuning condenser 48.

The contact 49 of band switch 30 is connected through condenser 50, which may suitably have a capacity of .0005 microfarad, to the grid of the radio frequency amplifying tube 20. The cathode of the tube, or electron discharge device, 20 is suitably grounded and the cathode and abovementioned grid form its two right terminals.

The band switch 30 comprises two movable contacts 51 and 52 while the band switch 31 has a movable contact 53.

In Fig. 4 the band switches are shown in the "police position." The signal is picked up by the short wave antenna 25 which is connected to ground through primary winding 34. The lower end of the winding 45 is grounded. The signal appears across the secondary coils 42 and 45, the upper end of the coil 42 being connected to the grid of the tube 20 through the condenser 50 and to the condenser 39 which tunes the signal on the police band.

The loop 15 and coil 27 are connected in shunt with each other and the outside aerial 23', if any

such is connected to the terminal 23, is connected to one junction point of loop 15 and coil 27. The loop 15, outside aerial 23', if any, and the coil 27, are all connected to the terminal 24 and are also effective to transfer received energy to the input circuit, the terminals of loop antenna 15 being connected together through impedance 27 and resistance 28 so that loop 15 serves as a capacity antenna not only in the "police position" but also in the "short wave position" as will be described later.

For the reception of short wave signals, the movable elements of the band switches 30 and 31 are moved one step in the clockwise direction. The electrical connections effected by the band switch 30 are unchanged. The band switch 31 now connects both ends of the coil 45 to ground so that the short wave signal is transferred from coil 34 to coil 42 which is now the effective secondary. Here again the terminals of loop 15 are connected together through impedance element 27 and resistance 28 and one terminal of the loop 15 is connected to the ungrounded terminal of winding 34, the loop 15 thus serving as a capacity antenna.

In the "police position" and "short wave position" the short wave capacity type antenna 25 and loop antenna 15 serving as a capacity antenna are effective to transfer received energy to the control grid of input tube 20, and the antenna 23' when connected to terminal 23 serves to supplement the action of loop antenna 15 and short wave antenna 25.

For broadcast reception, the movable contacts of the band switches 30 and 31 are moved effectively two steps in the clockwise direction from their positions in Fig. 4, establishing the circuits shown in Fig. 6. In this condition the upper end of the loop 15 is connected through contact 33, contact 52, to the contacts 49 and 40. Thus, the upper end of the loop 15 is connected directly to the condenser 50 and to the tuning condenser 39.

The outside aerial 23', if such be connected to the terminal 23, is connected to one terminal of the coil 27. The other terminal of the coil 27 and the lower terminal of loop 15 are connected to the upper end of the coil 42 whose other terminal is connected to ground through coil 45, the junction of these two coils 42 and 45 being disconnected in this position of the band switches. Thus, the outside aerial 23', if any, is coupled to the loop 15 by the common impedance of the coils 42 and 45.

These specific circuit connections are best visible in Fig. 6 which illustrates an antenna input system having a first resonant circuit including the loop antenna 15 and the tuning condenser 39. The signals developed across that resonant circuit are applied to tube 20 by way of the coupling condenser 50. A second circuit is also provided which includes the terminal 23 adapted to receive the antenna 23' and an impedance element comprising the parallel combination of the inductance element 27 and the resistance element 28. A second inductance element comprising coils 42 and 45 is also provided, which is common to the first and second circuits for coupling the same.

If the band switches 30 and 31 are moved one step still further in the clockwise direction, the receiver is adapted for automatic tuning. The only change from the broadcast connections is that the condenser 39 is disconnected and a pre-adjusted condenser included in the automatic control mechanism is substituted therefor.

The tube 20 may suitably be a 7G7-1232 tube. The loop 15 may suitably have an inductance of 145 microhenries. The coil 27 may suitably have inductance of 225 microhenries and the damping resistance 28 may suitably be around 2200 ohms. The coil 42 may suitably have an inductance of about 1.5 microhenries, while the coil 45 may suitably have an inductance of about 18 microhenries.

The coil 34, which is the short wave primary coil, may comprise a few turns, for example four, on the same form 34' which carries the coils 42 and 45, the coil 34 being located between them as shown in Fig. 5. The coil 34 may suitably have an inductance around two microhenries.

It should be understood that, although condensers 46 and 48 have been called tuning condensers, tuning in all bands is effected by condenser 39, the condensers 46 and 48 being adjustable and in providing alignment of the tuned circuits of the receiver throughout the various bands, and when once adjusted, they are not thereafter used in normal tuning.

It is to be noted that without an outside aerial attached to the terminal 23, the receiver is complete in itself and the broadcast signal is received by the loop 15. The loop 15 being mounted for rotation on a vertical axis within the cabinet, as shown in Fig. 7, can be orientated for best reception. The electrostatic shield 21 reduces man-made static.

It is to be noted that for the loop 15 and the shield 21 only two connections are required and these may be provided through the pivot so that orientation of the loop 15 does not effect any change in distributed capacity or any change of inductance. Furthermore, the loop 15 may be rotated to any extent in either direction and no stops are necessary. When it is desired to install an outside aerial, it is merely attached to the terminal 23. No circuit changes are required.

When an outside aerial is used, the circuit including the coil 27 is resonant at approximately 700 kilocycles, providing the required gain at the low frequency end of the broadcast band.

It is evident, since coils 42 and 45 are arranged to resonate with condensers 48 and 46, respectively, together with condenser 39, in the short wave and the police bands, which bands are higher in frequency than the broadcast band, that the impedance presented by any combination of coils 42 and 45 and the associated condensers 48 and 46 is inductive throughout the broadcast band. This is an important feature of this invention, because coupling between antenna 23' and tube 20 for broadcast reception is provided by voltage across coils 42 and 45, and the coupling is greater at the high frequency end of the broadcast band than at the low frequency end by reason of the fact that that coupling impedance is predominantly inductive throughout the broadcast band. This makes for good rejection, or poor transmission, of waves having frequencies lower than the broadcast band, such as intermediate frequency waves generated locally or in nearby receivers.

The transmission characteristic of the input system of this invention is made substantially uniform over the broadcast band, while retaining this advantage of good rejection of waves of lower frequencies than the broadcast band, by making the circuit including antenna 23', coil 27, and coupling impedance 42, 45, 48 resonant at a frequency within the lower end of the broadcast band and by making that resonance broad by

damping the circuit by resistance 28 connected in shunt with coil 27. That damping should, of course, be only great enough to achieve this end, and the combination of coil 27 and resistance 28 is of high impedance.

By so making the common coupling impedance 42, 45, 48 predominantly inductive throughout the broadcast band, the described simple two-terminal loop 15 may be used, and all the advantages of good rejection below the broadcast band with uniform transmission within the broadcast band are retained, together with the advantages of mounting loop 15 to rotate on its two terminals, which provides a cheap and effective way of making the loop 15 rotatable, while retaining the advantages of having the two terminals separated by a substantial distance so that stray capacity and its attendant ill effects are minimized. This is particularly of advantage in that the upper pivoted terminal of the loop is the one connected to condenser 39 and tube 20, while the lower loop terminal, which requires longer leads, is at a lower high frequency potential at which stray capacity effects are not so intolerable.

It is another important aspect of this arrangement, when switches 30 and 31 are set for the broadcast band, that not only is there good rejection of waves lower in frequency than the broadcast band and substantially uniform transmission of waves within the broadcast band, but also, when no antenna is connected to terminal 23, coil 27 is self-resonant at a frequency above the broadcast band, so that terminal 23, associated wiring and coil 27 do not pick up waves of frequency higher than the broadcast band to interfere with broadcast band signals, and reception is only by pickup of waves in loop 15.

When the outside aerial is removed, the circuit including the coil 27 is resonant at a frequency higher than the highest frequency on the broadcast band. At this frequency, the circuit is damped more than before by the resistor 28 because of the large reactance at this high frequency.

The distributed capacity of the coil 27 should be kept as small as possible for good high frequency image rejection which is obtained by the coil resonating at a frequency well above the high frequency end of the broadcast band. The large impedance of the coil 27 to frequencies near its natural frequency provides improved image rejection at the middle and low frequency end of the band. The low impedance common coupling ensures good low frequency image rejection and provides excellent rejection for the intermediate frequency which may be, for example, 455 kilocycles.

While in the present embodiment of the invention the inductance element common to the first resonant circuit including the loop antenna 15 and to the second resonant circuit including the coil 27 is composed of coils 42 and 45, as shown in Figs. 4 and 6, it will be understood that in other embodiments of the invention the common inductance element can be represented by a single coil having a relatively low inductance.

Although the invention has been described in connection with specific details of preferred embodiments thereof, it must be understood that I do not intend to be limited to the specific details of these embodiments except in so far as set forth in the accompanying claims.

Having thus described my invention, I declare that what I claim as new and desire to secure, by Letters Patent of the United States, is:

1. An antenna input system for a radio receiver having an amplifying tube having input terminals and arranged for the reception of a band of frequencies, comprising, in combination, a resonant circuit including a loop antenna and tuning means whereby said circuit may be tuned to a plurality of frequencies in said band, said circuit being coupled to the input terminals, said loop antenna having not more than two terminals, a second circuit including a terminal adapted for connection of a second antenna thereto and an impedance element, and means common to both said circuits for coupling the same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

2. An antenna input system for a radio receiver having an amplifying tube having input terminals and arranged for the reception of a band of frequencies, comprising, in combination, a resonant circuit including a loop antenna and a tuning condenser whereby said circuit may be tuned through said band of frequencies, said circuit being coupled to the input terminals, and said loop antenna having not more than two terminals, a second circuit including a terminal adapted for connection thereto of a second antenna and an impedance element, the impedance of said element being of such value that the second circuit with said second antenna connected thereto is resonant at a frequency below the center frequency of said band, and means common to both said circuits for coupling the same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

3. An antenna input system for a radio receiver having an amplifying tube having input terminals and arranged for the reception of a band of frequencies, comprising, in combination, a resonant circuit including a loop antenna and a tuning condenser whereby said circuit may be tuned through said band of frequencies, said circuit being coupled to the input terminals, and said loop antenna having not more than two terminals, a second circuit including a terminal adapted for connection thereto of a second antenna and an impedance element, the impedance of said element being of such value that the second circuit with said second antenna connected thereto is resonant at a frequency below the center frequency of said band and resonant, in the absence of said second antenna, at a frequency higher than the highest frequency of said band, and means common to both said circuits for coupling the same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

4. An antenna input system for a radio receiver having an amplifying tube having input terminals and arranged for the reception of a band of frequencies, comprising, in combination, a resonant circuit including a loop antenna and means whereby said circuit may be tuned to a plurality of frequencies in said band, said circuit being coupled to the input terminals, and said loop antenna having not more than two terminals, a second circuit including a terminal adapted for connection thereto of a second antenna and an inductance element, the inductance of said element being of such value that the second circuit with said second antenna connected thereto is resonant at a frequency below the center frequency of said band, and means common to both said circuits for coupling the

same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

5. An antenna input system for a radio receiver having an amplifying tube having input terminals, comprising, in combination, a resonant circuit including a loop antenna and a tuning condenser whereby said circuit may be tuned through a predetermined band of frequencies, said circuit being coupled to the input terminals, a second circuit including a terminal adapted for connection thereto of a second antenna and an impedance element, said impedance element comprising inductive and resistive components, said inductive component being of such value that said second circuit with said second antenna connected thereto is resonant at a frequency below the center frequency of said band, and means common to both said circuits for coupling the same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

6. An antenna input system for a radio receiver having an amplifying tube having input terminals and arranged for the reception of a band of frequencies, comprising, in combination, a resonant circuit including a loop antenna and tuning means whereby said circuit may be tuned to a plurality of frequencies in said band, said circuit being coupled to the input terminals, and said loop antenna having not more than two terminals, a second circuit including a terminal adapted for connection of a second antenna thereto and an impedance element, the impedance of said element being of such value that said second circuit with the second antenna connected thereto is resonant at a frequency below the center frequency of said band, and means common to both said circuits for coupling the same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

7. An antenna input system for a radio receiver having an amplifying tube having input terminals, comprising, in combination, a resonant circuit including a loop antenna having a relatively high inductance and a tuning condenser whereby said circuit may be tuned through a predetermined band of frequencies, said circuit being coupled to the input terminals, and said loop antenna having not more than two terminals, a second circuit including a terminal adapted for the connection of a second antenna thereto and an impedance element, the impedance of said element being of such value that said second circuit with said second antenna connected thereto is resonant at a frequency below the center frequency of said band, and means common to both said circuits for coupling the same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

8. An antenna input system for a radio receiver having an amplifying tube having input terminals and arranged for reception of a band of frequencies, comprising, in combination, a resonant circuit including a loop antenna having a relatively high inductance and tuning means whereby said circuit may be tuned to a plurality of frequencies in said band, said circuit being coupled to the input terminals, and said loop antenna having not more than two terminals, a second circuit including a terminal adapted for the connection of a second antenna thereto and an impedance element comprising an inductance

element and a resistance element connected in parallel relation, the inductance of said inductance element being of such value that said second circuit with said second antenna connected thereto is resonant at a frequency below the center frequency of said band, and means common to both said circuits for coupling the same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

9. An antenna input system for a radio receiver having an amplifying tube having input terminals, comprising, in combination, a resonant circuit including a loop antenna having a relatively high inductance and a tuning condenser whereby said circuit may be tuned through a predetermined band of frequencies, said circuit being coupled to the input terminals, and said loop antenna having not more than two terminals, a second circuit including a terminal adapted for the connection of a second antenna thereto and an inductance element, the inductance of said element being of such value that said second circuit with said second antenna connected thereto is resonant at a frequency below the center frequency of said band and damping means for damping the natural oscillations of said inductance element, and means common to both said circuits for coupling the same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

10. An antenna input system for a radio receiver having an amplifying tube having input terminals, comprising, in combination, a loop antenna having not more than two terminals and pivot means for pivotally supporting said loop antenna, said two terminals being electrically connected to said pivot means, a tuning condenser, means for connecting said antenna and condenser through said pivot means to form a resonant circuit whereby said condenser is effective to tune said circuit through a predetermined band of frequencies, said circuit being coupled to the input terminals, a second circuit including a terminal adapted for the connection of a second antenna thereto and an impedance element, the impedance of said element being of such value that said second circuit with said second antenna connected thereto is resonant at a frequency below the center frequency of said band, and means common to both said circuits for coupling the same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

11. An antenna input system for a radio receiver having an amplifying tube having input terminals, comprising, in combination, a resonant circuit including a loop antenna and a tuning condenser for tuning said circuit through a predetermined band of frequencies, said circuit being coupled to the input terminals, said loop antenna being provided with a pair of pivot supports whereby it is pivotally mounted and having not more than two terminals, sliding contacts for electrically connecting said loop antenna in said circuit by way of said pivot supports permitting unlimited rotation of said loop antenna, a second circuit including a terminal adapted for the connection of a second antenna thereto and an inductance element, the inductance of said element being of such value that said second circuit with said second antenna connected thereto is resonant at a frequency below the cen-

ter frequency of said band, and means common to both said circuits for coupling the same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

12. An antenna input system for a radio receiver having an amplifying tube having input terminals, comprising, in combination, a resonant circuit including a loop antenna having a relatively high inductance and a tuning condenser whereby said circuit may be tuned through a predetermined range of frequencies, said circuit being coupled to the input terminals, a second circuit including a terminal adapted for the connection thereto of a second antenna for operation on broadcast frequencies and an impedance element, an inductance element having a relatively low inductance common to both said circuits for coupling the same, a short wave antenna for reception of relatively high frequency signals, switching means for disconnecting said inductance element from said second circuit, for disconnecting the loop antenna from said tuning condenser and for connecting said tuning condenser to said inductance element to form a resonant circuit tunable through a predetermined range of relatively high frequencies, and means for coupling said short wave antenna to said last-named resonant circuit.

13. An antenna input system for a radio receiver having an amplifying tube having input terminals, comprising, in combination, a resonant circuit including a rotatable loop antenna having not more than two terminals and a tuning condenser whereby said circuit may be tuned through a predetermined band of frequencies, said circuit being coupled to the input terminals, a second circuit including a stationary terminal adapted for connection of a second antenna thereto and a stationary impedance element, and means common to both said circuits for coupling the same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

14. An antenna input system for a radio receiver having an amplifying tube having input terminals, comprising, in combination, a resonant circuit including a rotatable loop antenna having not more than two terminals, and a tuning condenser whereby said circuit may be tuned through a predetermined band of frequencies, said circuit being coupled to the input terminals, a second circuit including a stationary terminal adapted for connection thereto of a second antenna and a stationary inductance element, the inductance of said element being of such value that the second circuit with the second antenna connected thereto is resonant at a frequency below the center frequency of said band, and means common to both said circuits for coupling the same, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies.

15. An antenna input system for a radio receiver having an amplifying tube having input terminals, comprising, in combination, a resonant circuit including a loop antenna having two pivot means whereby it is rotatably mounted, said loop antenna having not more than two terminals connected through said pivots, and tuning means whereby said circuit may be tuned to a plurality of frequencies within a band, said circuit being coupled to the input terminals, a stationary terminal adapted for connection of a second antenna thereto, a stationary inductance element

separate from said loop antenna and connected to said stationary terminal, and coupling means connected to said inductance element for coupling said second antenna to said loop antenna, said coupling means being separated from the loop antenna and being predominantly inductive in said band of frequencies, said inductance and coupling means being arranged so that said second antenna, when connected to said stationary terminal, is tuned to a frequency below the center frequency of said band and in the absence of said antenna the circuit through said inductance and coupling means has a resonant frequency above the frequency of said band.

16. An antenna input system for a radio receiver having an amplifying tube having input terminals, comprising, in combination, a resonant circuit including a loop antenna having two pivot means whereby it is rotatably mounted, said loop antenna having not more than two terminals and connected through said pivots, and tuning means whereby said circuit may be tuned to a plurality of frequencies within a band, said circuit being coupled to the input terminals, a stationary terminal adapted for connection of a second antenna thereto, a stationary inductance element separate from said loop antenna and connected to said stationary terminal, a damping resistance in parallel with said inductance, and coupling means connected to said inductance element for coupling said second antenna to said loop antenna, said coupling means being separated from the loop antenna and being predominantly inductive in said frequency band, said inductance and coupling means being arranged so that said second antenna, when connected to said stationary terminal, is tuned to a frequency below the center frequency of said band and in the absence of said antenna the circuit through said inductances and coupling means has a resonant frequency above the frequency of said band.

17. An antenna input system for a radio receiver having an amplifying tube with input terminals, comprising, in combination, a stationary terminal arranged for connection of an antenna thereto, a circuit connected between said stationary terminal and one of said input terminals, said circuit including a stationary inductance element, a loop antenna having only two terminals, a second circuit including said loop antenna connected between said input terminals, means for coupling said stationary terminal to said second circuit, said coupling means being separated from said loop antenna, being connected through said stationary inductance element between said stationary terminal and the other one of said input terminals, and being predominantly inductive in a predetermined band of frequencies, and means for tuning said last circuit to a frequency within said band.

18. In a radio receiver, a fixedly mounted inductance, a terminal for a capacity antenna, an impedance connected between said antenna terminal and one terminal of said inductance, the other terminal of said inductance being grounded, the series circuit formed by said inductance and said impedance being arranged to resonate with said antenna in the low frequency end of a band of received frequencies, an amplifier having input terminals, one of said input terminals being grounded, and means for impressing signal voltages, which appear on said antenna and produce signal voltages across said inductance, between said amplifier input terminals, said means

comprising a loop antenna having only two terminals, one terminal of said loop antenna being connected to a point between said inductance and said impedance, and the other terminal of said loop antenna being coupled to the ungrounded input terminal, and a tuning condenser connected between said input terminals.

19. In a radio receiver, a fixedly mounted inductance, an antenna, an impedance connected between said antenna and one terminal of said inductance, the other terminal of said inductance being grounded, the series circuit formed by said inductance and said impedance being arranged to resonate with said antenna in the low frequency end of a band of received frequencies, an amplifier having input terminals, one of said input terminals being grounded, means for impressing signal voltages, which appear on said antenna and produce signal voltages across said inductance, between said amplifier input terminals, said means comprising a loop antenna having only two terminals, one terminal of said loop antenna being connected to a point between said inductance and said impedance, and the other terminal of said loop antenna being coupled to said ungrounded input terminal, and a tuning condenser connected between said input terminals, said inductance being small relative to the inductance of said loop antenna whereby good image rejection is achieved.

20. In a radio receiver, a fixedly mounted inductance, an antenna, an impedance connected between said antenna and one terminal of said inductance, the other terminal of said inductance being grounded, the series circuit formed by said inductance and said impedance being arranged to resonate with said antenna in the low frequency end of a band of received frequencies, an amplifier having input terminals, one of said input terminals being grounded, means for impressing signal voltages, which appear on said antenna and produce signal voltages across said inductance, between said amplifier input terminals, said means comprising a loop antenna having only two terminals, one terminal of said loop antenna being connected to a point between said inductance and said impedance, and the other terminal of said loop antenna being coupled to said ungrounded input terminal, and a tuning condenser connected between said input terminals, said loop antenna being rotatably supported on said two terminals.

21. In a radio receiver, a fixedly mounted inductance, a terminal for a capacity antenna, an impedance connected between said antenna terminal and one terminal of said inductance, the series circuit formed by said inductance and said impedance being arranged to resonate with an antenna connected with said antenna terminal in the low frequency end of a band of received frequencies, an amplifier having input terminals, a first amplifier input terminal being connected with the other terminal of said inductance and means for impressing signal voltages, which appear on said antenna and produce signal voltages across said inductances, between said amplifier input terminals, said means comprising a loop antenna having only two terminals, one terminal of said loop antenna being connected to a point between said inductance and said impedance, and the other terminal of said loop antenna being coupled to the second amplifier input terminal, and a tuning condenser coupled between said amplifier input terminals.

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