May 26, 1942. N. P. CASE 2,284,131

ANTENNA SYSTEM FOR MODULATED-CARRIER SIGNAL RECEIVERS

Filed March 23, 1940

FIG. 1.

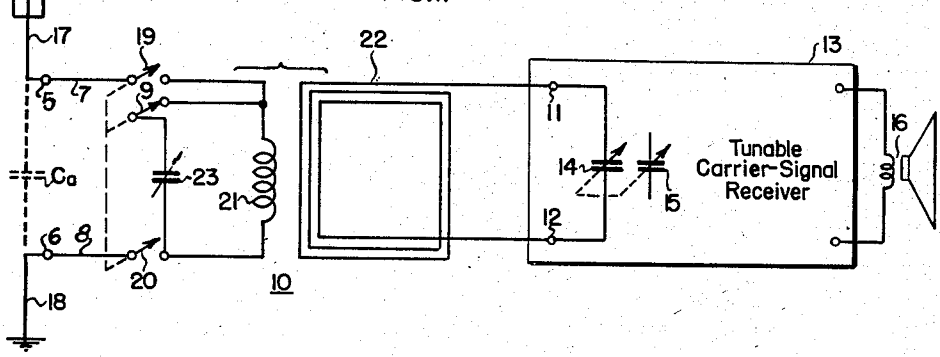


FIG. 2a.

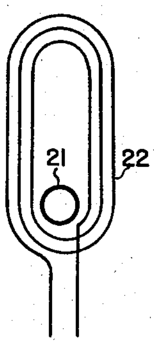


FIG. 2b.

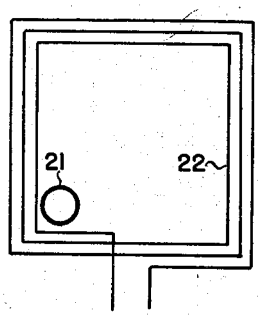


FIG. 3.

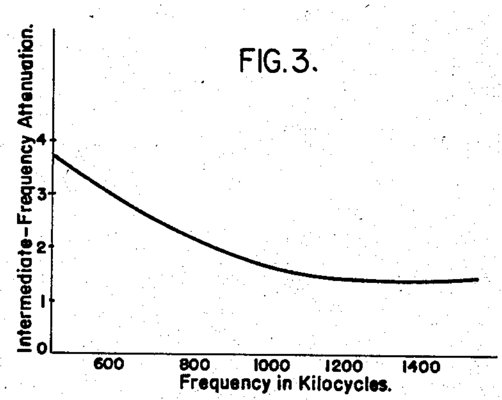


FIG. 4.

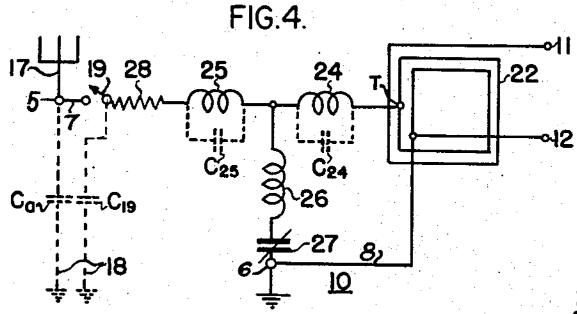


FIG. 5.

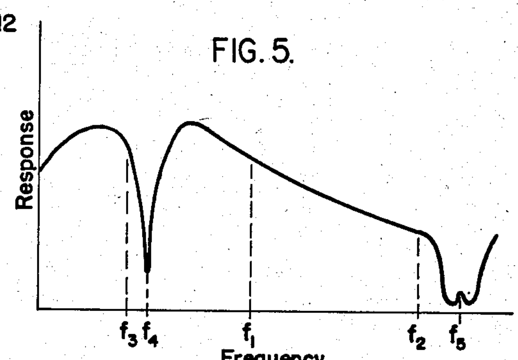
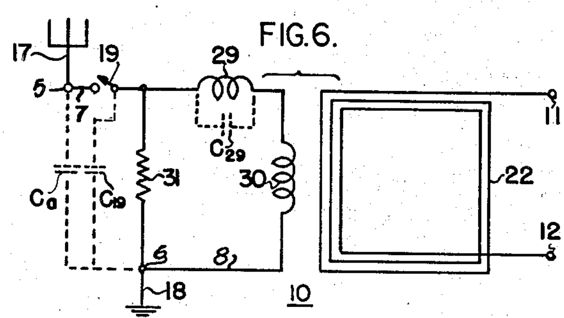


FIG. 6.



INVENTOR
NELSON P. CASE

BY Laurence B. Dodds

ATTORNEY

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ANTENNA SYSTEM FOR MODULATED-CARRIER SIGNAL RECEIVERS

Nelson P. Case, Great Neck, N. Y., assignor to Hazeltine Corporation, a corporation of Delaware

Application March 23, 1940, Serial No. 325,566

13 Claims. (Cl. 250—20)

The present invention relates to an improved antenna system for modulated-carrier signal receivers and, particularly, to an antenna system arranged and adapted to supply signal energy to a modulated-carrier signal receiver selectively from a loop antenna or from an antenna-ground system.

It is frequently desirable to be able to operate carrier-signal receivers either from a loop antenna or from an antenna-ground system. If the loop antenna is furnished as part of the carrier-signal receiving equipment, it is the customary practice to use the loop antenna itself as at least a portion of the tunable input circuit of the receiver. Where this is done, considerations of cost and design dictate that provisions be made for selectively coupling the antenna-ground system directly to the loop antenna rather than selectively to substitute for the loop an input transformer to which the antenna-ground system may be connected.

In accordance with prior art practices, the antenna-ground system has been inductively coupled to the loop antenna by the provision on the loop of a primary winding comprising one or two turns, generally closely coupled to the loop winding, or by tapping the loop winding one turn or so from its low-potential end. This arrangement has the merit of simplicity and economy, but has the important disadvantage that the gain tends to increase rapidly with frequency over the tuning range of the receiver. Thus, if sufficient coupling is provided between the primary winding and the loop winding to provide adequate gain at the low-frequency end of the tuning band, the gain over the middle and high-frequency portions of the tuning band is usually so excessive that "tweets," distortion, cross-modulation, and other over-load effects become readily apparent on strong signals. A second disadvantage of this type of coupling, when applied to superheterodyne receivers, resides in the fact that the slope of the gain-frequency characteristic is in the wrong direction to secure good image rejection, and the image rejection is consequently very poor. An additional disadvantage of this coupling arrangement results from the fact that the primary circuit usually resonates with the antenna capacitance at a frequency fairly close to the high-frequency end of the tuning band. This has the effect, due to the pronounced interaction between tightly coupled circuits tuned to nearly the same frequency, that the alignment of the tuned circuits of the receiver near the high-frequency end of the tuning range is seriously affected both by connecting or disconnecting the antenna-ground system and by variations of capacitance as between different antennas to which the receiver may be connected. Moreover, the necessarily tight coupling between the primary winding and the loop winding couples into the loop circuit the usually large antenna resistance with the result that the selectivity of the tuned loop circuit is greatly broadened and the already poor image-rejection characteristic is even further impaired.

The antenna-ground system has also been coupled to a loop antenna in accordance with another prior art arrangement by inserting a condenser in the low-potential side of the tuned loop circuit and by connecting the antenna-ground system across this condenser, either directly or through a low-inductance primary winding inductively coupled to the loop. This coupling circuit requires an additional radio-frequency choke or resistor and an additional blocking condenser in the antenna circuit when used with an A. C./D. C. receiver. In addition, the presence of the loop-circuit coupling condenser restricts the tuning range of the loop circuit and frequently makes it difficult to tune this circuit over the required tuning range of the receiver.

It is an object of the present invention, therefore, to provide a new and improved antenna system for modulated-carrier signal receivers which avoids one or more of the above-mentioned disadvantages of the prior art antenna systems.

It is a further object of the present invention to provide an improved antenna system by which a modulated-carrier signal receiver may be selectively operated either from a loop antenna with high attenuation for interfering low-frequency signals, or from an antenna-ground system of high impedance coupled through the loop to the input of the receiver.

It is an additional object of the invention to provide an antenna system by which a modulated-carrier signal receiver may be operated selectively from a loop antenna or an antenna-ground system and in which the selective connection or disconnection of the antenna-ground system has relatively little effect on the alignment of the tuned circuits of the receiver.

In accordance with the invention, an antenna system for a superheterodyne modulated-carrier signal receiver having an intermediate-frequency signal channel therein and adapted to operate from a loop antenna or from an antenna-ground system comprises a loop antenna adapted to be tuned over a frequency band and means for coupling the loop antenna to the receiver. The antenna system includes an input circuit adapted to be connected to an antenna-ground system having capacitance, a resonant circuit tuned to the intermediate frequency of the receiver and including an inductor coupled to the loop, and means for selectively connecting the resonant circuit to the input circuit to couple the antenna-ground system through the loop antenna to the receiver.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Referring now to the drawing, Fig. 1 is a circuit diagram of an antenna system embodying the invention coupled to the input circuit of a modulated carrier signal receiver; Figs. 2*a* and 2*b* illustrate diagrammatically the arrangement of windings of two loop antennas of differing form, each provided with a primary winding suitably positioned to be effectively used in the Fig. 1 embodiment; Fig. 3 is a graph used in explaining the operation of the invention; Fig. 4 is a circuit diagram of an antenna system embodying a modified form of the invention; Fig. 5 graphically illustrates the frequency-response characteristic of the Fig. 4 modification; while Fig. 6 is a circuit diagram of an antenna system embodying another modified form of the invention.

Referring more particularly to Fig. 1, there is shown an antenna system for a modulated-carrier signal receiver of conventional design embodying the present invention in a preferred form. In general, an antenna system **10** is connected to an input circuit **11**, **12** of a modulated-carrier signal receiver **13** which may be of any suitable type, though preferably of the superheterodyne type, and which is adapted to operate from a loop antenna or from an antenna-ground system. The receiver has a plurality of aligned tunable circuits comprising an input circuit tuning condenser **14** mechanically connected or ganged for unicontrol operation with one or more other tuning condensers **15** for the radio-frequency or oscillator stages of the receiver, by which the receiver is tuned to a desired modulated-carrier signal. The output of the receiver is connected to a sound reproducer **16**. It will be understood that the modulated-carrier signal receiver, per se, may be of a conventional construction and operation, the details of which are well known in the art, rendering further description thereof unnecessary.

Referring now more particularly to the parts of the receiving system embodying the present invention, the antenna system **10** comprises an input circuit **7**, **8** adapted to be connected by input circuit terminals **5**, **6** to an antenna-ground system **17**, **18** which has a capacitance represented by the broken-line condenser C_a. The antenna-ground system may be selectively connected through the input circuit **7**, **8** and through a pair of switch elements **19**, **20** across an impedance means comprising an inductor or winding **21** coupled to a loop antenna **22** adapted to be tuned by the condenser **14** over a predetermined frequency band. Also connected across the winding **21** through a switch **9** is a small adjustable condenser **23**. The three switches **9**, **19**, and **20** are preferably mechanically connected for unicontrol operation. In practice, the antenna system **10** preferably is integrally housed with the carrier-signal receiver **13** in the receiver cabinet conventionally provided for the latter, the input circuit terminals **5**, **6** thus furnishing a convenient means by which the antenna system **10** may be connected to the external antenna-ground system **17**, **18**.

In considering the operation of the antenna system **10** just described it will be assumed that the system is initially adjusted for operation by closing the switch **9** to connect the condenser **23** across the winding **21** and by opening the switches **19**, **20** to disconnect the antenna-ground system **17**, **18** from the primary circuit comprising the primary winding **21** and the condenser **23**. If the receiver is of the superheterodyne type, condenser **23** is then adjusted to tune the primary winding **21** to the normal intermediate frequency of the receiver or to the frequency of any undesired low-frequency interfering signal. The adjustment of the condenser **23** thereafter remains fixed. Since the tuned circuit **21**, **23** is inductively coupled to the loop antenna **22**, it acts as a trap to absorb intermediate-frequency energy appearing in the loop circuit, such as might be induced by a nearby interfering station transmitting at the intermediate frequency. Thus, when the antenna-ground system is disconnected from the receiver, the loop antenna **22** alone receives modulated-carrier signals and supplies these signals to the receiver **13**, the tuned primary circuit **21**, **23** absorbing undesirable interfering signal energy of frequencies in the vicinity of the intermediate frequency.

With the switch **9** open and the switches **19**, **20** closed to connect the antenna-ground system **17**, **18** across the primary circuit **21**, **23**, the antenna capacitance C_a tunes the primary circuit to a frequency near the low-frequency end of the tuning band of the receiver to increase the low-frequency response of the tuning system. The primary circuit thereupon operates as a high-impedance input circuit to supply modulated-carrier signals through the loop antenna **22** to the input circuit **11**, **12** of the receiver **13** with approximately uniform response over the tuning range of the receiver. The signal energy picked up by the loop under these conditions is either in phase or 180 degrees out of phase with the signal energy picked up by the antenna-ground system and the loop, therefore, either aids or opposes the antenna-ground system depending upon the orientation of the loop with respect to the desired transmitting station. The energy picked up directly by the loop is generally so small in comparison to the energy picked up by the antenna-ground system, however, that for all practical purposes the effect of the loop may be ignored.

Thus, the switches **19** and **20** comprise means for selectively connecting the impedance means or winding **21** to the input circuit **7**, **8** to couple the antenna-ground system **17**, **18** through the loop antenna **22** to the receiver **13**.

The switch **9** may be omitted if desired. When this is done, the capacitance C_a of the antenna adds to the capacitance of condenser **23** when the switches **19** and **20** are closed and tunes the primary circuit comprising the inductor **21** and the condenser **23** well below the intermediate frequency and thereby well below the low-frequency end of the tuning band. Two possible physical arrangements of the loop and primary windings are diagrammatically shown in Figs. 2a and 2b. The primary winding 21 usually has a cross-sectional area, perpendicular to its axis, small in comparison to that of the loop antenna 22 for the reason that it is difficult in practice to construct a primary winding of the required inductance and yet of large cross-sectional area. Fig. 2a shows a loop antenna of oval form with the winding 21 disposed near the end of the loop winding. Fig. 2b illustrates a loop of rectangular shape, the winding 21 in this case being positioned near one of the corners of the loop to ensure that a substantial portion of the magnetic field of the winding 21 shall interlink the loop winding. It is evident that the inductive coupling between the winding 21 and the loop antenna 22 varies not only with the value of inductance of the former but additionally varies with the spacing between the axes of the windings.

The interfering-energy absorption characteristic of a primary circuit tuned to the intermediate frequency of the receiver for a typical loop having the construction shown in Fig. 2a or Fig. 2b is graphically illustrated in Fig. 3. In this figure, the intermediate-frequency attenuation by the tuned primary circuit is plotted against frequency over the tuning range of the receiver. It will be observed that this curve represents the sensitivity of the receiver to signals of intermediate frequency as the receiver is tuned over the tuning band.

A modification of the antenna system of the invention is represented in Fig. 4, which is essentially similar to that shown in Fig. 1, and similar circuit elements are designated by similar reference characters. The antenna-ground system 17, 18 is here connected to a tap T on the loop antenna 22 through a band-rejector filter comprising two series-inductance arms 24, 25, each tuned by its inherent capacitance as indicated by broken-line condensers C_{24}, C_{25}, respectively, and an interposed series-resonant shunt arm including an inductor 26 and an adjustable condenser 27. The input series arm may include a resistor 28 for a purpose presently to be considered. The switch 19 also has a distributed capacitance to ground, as indicated by broken-line condenser C_{19}.

In initially adjusting the antenna system for operation, the switch 19 is opened and the portion of the filter circuit comprising the adjustable condenser 27, inductor 26, series-arm inductor 24 and its capacitance C_{24}, and the lower portion of the loop between the tap T and ground is sharply tuned to the normal intermediate frequency of the receiver or to the frequency of any undesired low-frequency interfering signal. Since this portion of the filter circuit is coupled to the loop circuit, it absorbs from the loop energy of intermediate frequency, thereby to trap interfering intermediate-frequency signals which may appear in the loop when the latter is used alone to receive modulated-carrier signals. The inductor 25 with its distributed capacitance C_{25} is given a value such that the portion of the filter circuit comprising the distributed capacitance of the switch C_{19}, the inductors 24, 25 with their distributed capacitances, and the portion of the loop antenna 22 below the tap T, is tuned to a frequency lying above the tuning band of the receiver in order that the signal-response characteristics within the tuning band shall not be impaired by this portion of the filter circuit.

Upon closure of the switch 19, the antenna capacitance C_a tunes the portion of the circuit comprising the circuit elements 28, 25, 26, and 27 with the several distributed capacitances C_{25} and C_{19} to a frequency near the lower end of the tuning band, thus effectively increasing the gain of the antenna system in this region where it would otherwise be deficient. The resistor 28 not only broadens the tuning of this portion of the filter circuit to improve the uniformity of response or gain over the tuning range, but additionally reduces the misalignment of the receiver tuned circuits consequent upon the selective connection of the antenna-ground system. The circuit thus operates as a high-impedance circuit to supply modulated-carrier signals from the antenna-ground system 17, 18 through the band-rejector filter and through the loop antenna 22 to the input circuit 11, 12 of the receiver with approximately uniform response over the tuning range.

The frequency-response characteristic of the band-rejector filter of Fig. 4 with the antenna system 17, 18 connected is shown in Fig. 5. The tuning band of the receiver covers the frequency range f_1 to f_2 and the normal intermediate frequency of the receiver is f_3. The series-tuned arm 26, 27 of the band-rejector filter closely couples the two portions of the filter which include the inductors 24 and 25 to produce a double-humped response with a valley at the frequency f_4 adjacent the intermediate frequency f_3 so that the filter is effective to trap out or attenuate spurious signals over a band in the vicinity of the normal intermediate frequency of the receiver. The circuit elements 24 and 25 are resonant near a frequency f_5 above the tuning band of the receiver and, therefore, not only do not impair the receiver characteristics within the tuning range, but materially aid in improving the image-rejection characteristic of the receiver.

An antenna system embodying another modification of the invention is represented by the circuit diagram of Fig. 6, which is essentially similar to the system of Fig. 4, except that the loop antenna 22 is provided with a separate primary winding 30 of relatively small inductance, which may simply be one or two turns of wire wound adjacent the turns of the loop winding; the series-tuned shunt arm 26, 27 of the Fig. 4 system is not used in this modification; and the series-inductance arms 24 and 25 of the Fig. 4 arrangement are merged into a single arm 29 having relatively large inductance having an inherent capacitance C_{29}. Circuit elements corresponding to like circuit elements of Fig. 4 are designated by like reference characters. A resistor 31 is connected across the primary circuit comprising the inductor 29 and the primary winding 30. The inductor 29 has sufficient distributed capacitance that the inductor is inherently resonant at a frequency above the tuning band of the receiver. The antenna capacitance C_a tunes the primary circuit to a frequency near the low-frequency end of the tuning band to increase the low-frequency response of the antenna system. The resistor 31 damps the primary circuit whether the switch 19 is open or closed and thereby improves the uniformity of response of the antenna system over the tuning band of the receiver while, at the same time, reducing the effect on the alignment of the tuned circuits of the receiver of the selective connection of the antenna-ground system 17, 18. The primary circuit operates as a high-impedance circuit to supply received carrier signals from the antenna-ground system 17, 18 through the loop antenna 22 to the receiver with approximately uniform response over the tuning range.

The modification of Fig. 6 is simpler and cheaper than that of the Fig. 4 arrangement, but has no circuit tuned to the intermediate frequency of the receiver and, therefore, does not provide a trap for interfering intermediate-frequency energy.

The resistor 31 of the Fig. 6 modification, while shown connected across the primary circuit, may be connected in series with the primary circuit by inserting it between the inductor 29 and the switch 19, in the manner of the resistor 28 of Fig. 4. This has the disadvantage, however, that the resistor has practically no effect on the frequency-response characteristic of the primary circuit while the switch 19 is open, its resistance being negligibly small in comparison to the reactance of the inherent switch capacitance C_{19} and the antenna system may, therefore, have a nonuniform response over the tuning range when using the loop antenna alone. Thus, the resistor 31, like the resistor 28 of Fig. 4, comprises resistive means for broadening the frequency response of the impedance means or winding 30 to minimize the effect on the alignment of the tunable circuits of the receiver consequent upon the selective connection by the switch 19 of the impedance means or winding 30 to the antenna-ground system 17, 18.

While the antenna-ground system has been shown and described as selectively connectable to the antenna system by switch members, it is evident that such switch members may take the form of binding posts or of link members manually connectable between binding posts by the user of the receiver when he desires to connect the antenna-ground system to the receiver.

While there have been described what are at present considered to be the preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. An antenna system for a modulated-carrier signal receiver including a plurality of aligned tunable circuits adapted to operate from a loop antenna or from an antenna-ground system comprising, a loop antenna adapted to be tuned over a frequency band, means for coupling said loop antenna to said receiver, an input circuit adapted to be connected to an antenna-ground system having capacitance, impedance means coupled to said loop and tunable by said antenna capacitance to resonance at a frequency near the lower end of said band, means for selectively connecting said last-named means to said input circuit to couple said antenna-ground system through said loop antenna to said receiver, and means for minimizing the effect on the alignment of said tunable circuits of the selective connection of said impedance means to said antenna-ground system.

2. An antenna system for a modulated-carrier signal receiver including a plurality of aligned tunable circuits and adapted to operate from a loop antenna or from an antenna-ground system comprising, a loop antenna adapted to be tuned over a frequency band, means for coupling said loop antenna to said receiver, an input circuit adapted to be connected to an antenna-ground system having capacitance, impedance means coupled to said loop and tunable by said antenna capacitance to resonance at a frequency near the lower end of said band, means for selectively connecting said last-named means to said input circuit to couple said antenna-ground system through said loop antenna to said receiver, and resistive means for broadening the frequency response of said impedance means to minimize the effect on the alignment of said tunable circuits of the selective connection of said impedance means to said antenna-ground system.

3. An antenna system for a modulated-carrier signal receiver adapted to operate from a loop antenna or from an antenna-ground system comprising, an input circuit adapted to be connected to an antenna-ground system having capacitance, a loop antenna adapted to be tuned over a frequency band and constituting a secondary winding and a primary winding of relatively small inductance coupled to said secondary winding, an inductor having relatively large inductance serially arranged with said primary winding in a primary circuit and tunable at least by its inherent capacitance to resonance above said frequency band, said primary circuit being tunable by said antenna capacitance to resonance at a frequency near the lower end of said band, means for coupling said loop antenna to said receiver, and means for selectively connecting said primary circuit to said input circuit to couple said antenna-ground system through said loop antenna to said receiver.

4. An antenna system for a modulated-carrier signal receiver adapted to operate from a loop antenna or from an antenna-ground system and subject in operation to interfering relatively low-frequency signals comprising, a loop antenna adapted to be tuned over a frequency band, means for coupling said loop antenna to said receiver, an input circuit adapted to be connected to an antenna-ground system having capacitance, a band-rejector filter including two series-inductance arms and an interposed series-tuned shunt arm, one of said series arms and said series-tuned shunt arm providing a circuit tuned to resonance at the frequency of said interfering low-frequency signals and the other of said series arms and said series-tuned shunt arm providing a circuit tunable by said antenna capacitance to resonance at a frequency near the lower end of said frequency band, means for coupling said circuit resonant at said interfering signal frequency to said loop antenna, and means for selectively connecting said circuit resonant at said frequency near the lower end of said band to said input circuit to couple said antenna-ground system through said loop antenna to said receiver.

5. An antenna system for a superheterodyne modulated-carrier signal receiver having an intermediate-frequency signal channel therein and adapted to operate from a loop antenna or from an antenna-ground system comprising, a loop antenna adapted to be tuned over a frequency band, means for coupling said loop antenna to said receiver, an input circuit adapted to be connected to an antenna-ground system having capacitance, an impedance network coupled to said loop, at least a portion thereof being resonant at

said intermediate frequency for absorbing energy of intermediate frequency from said loop, and means for selectively connecting said last-named means to said input circuit to couple said antenna-ground system through said loop antenna to said receiver.

6. An antenna system for a superheterodyne modulated-carrier signal receiver having an intermediate-frequency signal channel therein and adapted to operate from a loop antenna or from an antenna-ground system comprising, a loop antenna adapted to be tuned over a frequency band, means for coupling said loop antenna to said receiver, an input circuit adapted to be connected to an antenna-ground system having capacitance, a resonant circuit tuned to said intermediate frequency and including an inductor coupled to said loop, and means for selectively connecting said resonant circuit to said input circuit to couple said antenna-ground system through said loop antenna to said receiver.

7. An antenna system for a superheterodyne modulated-carrier signal receiver having an intermediate-frequency signal channel therein and adapted to operate from a loop antenna or from an antenna-ground system comprising, a loop antenna adapted to be tuned over a frequency band, means for coupling said loop antenna to said receiver, an input circuit adapted to be connected to an antenna-ground system having capacitance, a condenser, an inductor coupled to said loop and tunable by said condenser to resonance at said intermediate frequency, said inductor being tunable by said antenna capacitance to resonance at a frequency near said intermediate frequency, and means for selectively connecting said inductor to said condenser or to said input circuit.

8. An antenna system for a superheterodyne modulated-carrier signal receiver having an intermediate-frequency signal channel therein adapted to operate from a loop antenna or from an antenna-ground system comprising, a loop antenna adapted to be tuned over a frequency band, means for coupling said loop antenna to said receiver, an input circuit adapted to be connected to an antenna-ground system having capacitance, an impedance network coupled to said loop, at least a portion thereof being resonant at said intermediate frequency for absorbing energy of intermediate frequency from said loop, and at least a portion of said network being tunable by said antenna capacitance to resonance at a frequency near the lower end of said frequency band, and means for selectively connecting said impedance network to said input circuit to couple said antenna-ground system through said loop antenna to said receiver.

9. An antenna system for a superheterodyne modulated-carrier signal receiver having an intermediate-frequency channel therein adapted to operate from a loop antenna or from an antenna-ground system comprising, a loop antenna adapted to be tuned over a frequency band, means for coupling said loop antenna to said receiver, an input circuit adapted to be connected to an antenna-ground system having capacitance, a band-rejector filter including two series-inductance arms and an interposed series-tuned shunt arm, one of said series arms and said series-tuned shunt arm providing a circuit tuned to resonance at said intermediate frequency and the other of said series arms and said series-tuned shunt arm providing a circuit tunable by said antenna capacitance to resonance at a frequency near the lower end of said frequency band, means for coupling said circuit tuned to resonance at said intermediate frequency to said loop antenna, and means for selectively connecting said circuit resonant at said frequency near the lower end of said band to said input circuit to couple said antenna-ground system through said loop antenna to said receiver.

10. An antenna system for a superheterodyne modulated-carrier signal receiver having an intermediate-frequency signal channel therein adapted to operate from a loop antenna or from an antenna-ground system comprising, a loop antenna adapted to be tuned over a frequency band, means for coupling said loop antenna to said receiver, an input circuit adapted to be connected to an antenna-ground system having capacitance, a band-rejector filter including two series-inductance arms and an interposed series-tuned shunt arm, one of said series arms and said series-tuned shunt arm providing a circuit sharply tuned to resonance at said intermediate frequency and the other of said series arms and said series-tuned shunt arm providing a circuit broadly tunable by said capacitance to resonance at a frequency near the lower end of said frequency band, means for coupling said circuit tuned to resonance at said intermediate frequency to said loop antenna, and means for selectively connecting said circuit resonant at said frequency near the lower end of said band to said input circuit to couple said antenna-ground system through said loop antenna to said receiver.

11. An antenna system for a modulated-carrier signal receiver adapted to operate from a loop antenna or from an antenna-ground system comprising, a loop antenna adapted to be tuned over a frequency band, means for coupling said loop antenna to said receiver, an input circuit adapted to be connected to an antenna-ground system having capacitance, a primary circuit including an inductor coupled to said loop, said primary circuit being tunable by said antenna capacitance to resonance at a frequency near the lower end of said band, resistive means connected in shunt to said primary circuit for damping said primary circuit to improve the uniformity of gain of said antenna system over said frequency band, and means for selectively connecting said primary circuit to said input circuit to couple said antenna-ground system through said loop antenna to said receiver.

12. An antenna system for a modulated-carrier signal receiver adapted to operate from a loop antenna or from an antenna-ground system comprising, a loop antenna adapted to be tuned over a frequency band, means for coupling said loop antenna to said receiver, an input circuit adapted to be connected to an antenna-ground system having capacitance, a primary circuit coupled to said loop and including an inductor, said inductor with its distributed capacitance being resonant at a frequency above said frequency band, said primary circuit being tunable by said antenna capacitance to resonance at a frequency near the lower end of said band, and means for selectively connecting said primary circuit to said input circuit to couple said antenna-ground system through said loop antenna to said receiver.

13. An antenna system for a modulated carrier-signal receiver adapted to operate from a loop antenna or from an antenna-ground system but subject during operation to interference from an undesired relatively low-frequency carrier

signal comprising, a loop antenna adapted to be tuned over a frequency band, means for coupling said loop antenna to said receiver, an input circuit adapted to be connected to an antenna-ground system having capacitance, an impedance network coupled to said loop, at least a portion thereof being resonant at the frequency of said undesired carrier signal for absorbing energy of such carrier-signal frequency from said loop, and means for selectively connecting said impedance network to said input circuit to couple said antenna-ground system through said loop antenna to said receiver.

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