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(54) Glass antenna device for an automobile

Scheibenantennenanordnung für ein Automobil

Dispositif d'antenne de vitre pour une voiture automobile

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(73) Proprietor: **ASAHI GLASS COMPANY LTD.**
Tokyo 100-8405 (JP)

(72) Inventors:
- **Terashima, Fumitaka**
Taketoyo-cho, Chita-gun, Aichi (JP)
- **Tabata, Kohji**
Taketoyo-cho, Chita-gun, Aichi (JP)

(74) Representative: **Müller-Boré & Partner**
Patentanwälte
Grafinger Strasse 2
81671 München (DE)

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Description

[0001] The present invention relates to a glass antenna device for an automobile suitable for receiving signals in, for example, a long wave broadcast band (LW band) (150-280 kHz), a middle wave broadcast band (MW band) (530-1630 kHz), an FM broadcast band of Japan (76-90 MHz), an FM broadcast band of U.S.A. (88-108 MHz) and so on, which is of high sensitivity, low noise and low cost.

[0002] As a glass antenna device for an automobile capable of improving the sensitivity by utilizing resonance, there has been proposed a glass antenna device for an automobile as shown in Figure 7 (JP-Y-4-53070).

[0003] In this conventional example, a defogger 90 comprising heater strips 2 and bus bars 15a, 15b, 15c is provided on a glass sheet 1 of a rear window of an automobile wherein there are provided the bus bar 15a in a lower portion and the bus bar 15b in an upper portion at a left side of the defogger 90. The lower bus bar 15a is connected to the automobile body as the earth and the upper bus bar 15b is connected to an anode of a d.c. power source 10. A supplied current flows from the upper bus bar 15b through the bus bar 15c provided at a right side to the lower bus bar 15a in a channel-like form. The defogger shown in Figure 7 is in a so-called channel-like form.

[0004] In the glass antenna device shown in Figure 7, a choke coil 9 is connected between the bus bars 15a, 15b and the d.c. power source 10 for the defogger 90, and by increasing the impedance of the choke coil 9 in a high frequency band region, a direct current is allowed to pass from the d.c. power source 10 to the defogger 90 but a current in the high frequency band region such as a broadcast band region or the like is blocked whereby the defogger 90 is utilized as an antenna.

[0005] Further, a parallel resonance is generated by the stray capacitance to ground (hereinbelow, referred to simply as the stray capacitance) of the defogger 90, a coil 71 and the choke coil 9 in a middle wave broadcast band, and a received signal in the middle wave broadcast band is passed in association with a coil 72, a capacitor 73 and a resistor 74. Reference numeral 11 designates a capacitor for cutting noises. In the conventional example having such construction as in Figure 7, an attempt has been made to improve the sensitivity and to reduce noises.

[0006] However, when such conventional glass antenna device was used to receive signals in a long wave broadcast band wherein a parallel resonance was to be generated in the long wave broadcast band, the inductance values of the coil 71 and the choke coil 9 were respectively high such as about 5-20 mH. Accordingly, the dimension of each of the coil 71 and the choke coil 9 was large, which did not meet a requirement of miniaturization. Further, it was necessary to use a thicker and longer conductive lines for the coil 71 and the choke coil 9, which invited a high manufacturing cost.

[0007] EP-A-0 856 904, which disclosed the preamble of claim 1 of the present invention, discloses a glass antenna device for an automobile comprising a first and a second antenna conductor. A first resonance is generated by the impedance of the first antenna conductor and the impedance of the first coil as resonance elements, and the second resonance is generated by the impedance of the second antenna conductor and the inductance of the second coil as resonance elements. The first antenna conductor is designed to be suitable for receiving signals of a high frequency band, and a second antenna conductor is designed to be suitable for receiving signals of a low frequency band.

[0008] It is an object of the present invention to eliminate the above-mentioned disadvantages of the conventional technique and to provide a glass antenna device for an automobile which can reduce the size and cost and which is of high sensitivity and low noise.

[0009] This object is fulfilled by a glass antenna device having the features disclosed in claim 1. Preferred embodiments are defined in the dependent claims.

[0010] In accordance with a preferred embodiment of the present invention, there is provided a glass antenna device for an automobile wherein an electric heating type defogger having heater strips and bus bars for supplying a current to the heater strips, and an antenna conductor are provided on a glass sheet fitted to a rear window of an automobile, and a choke coil is connected to at least one between a bus bar and a d.c. power source and between a bus bar and the automobile body as the earth, the glass antenna device being characterized in that a coil for first resonance is provided; a first resonance is generated by a resonance element which comprises the impedance of the antenna conductor and the inductance of the coil for first resonance; a second resonance is generated by a resonance element which comprises the impedance of the defogger and the inductance of the choke coil; a signal in at least a long wave broadcast band received by the defogger is supplied to a receiver; a signal in at least an FM broadcast band received by the antenna conductor is supplied to the receiver; the resonance frequency of the first resonance and the resonance frequency of the second resonance are determined so that the sensitivity of signals in the long wave broadcast band is increased, and a capacitor for second resonance is electrically connected between the defogger and the automobile body as the earth.

[0011] In accordance with a second embodiment of the present invention, there is provided a glass antenna device for an automobile wherein an electric heating type defogger having heater strips and bus bars for supplying a current to the heater strips, and an antenna conductor are provided on a glass sheet fitted to a rear window of an automobile, and a choke coil is connected to at least one between a bus bar and a d.c. power source and between a bus bar and the automobile body as the earth so that a signal in a long wave broadcast band and a signal in a frequency band which is higher in frequency than the long wave broadcast band are received, the glass antenna device being characterized in that a first resonance and a second resonance are generated; a capacitor for second resonance is provided; the inductance of the choke coil, the impedance of the defogger and the capacitance of the capacitor for second resonance are included as resonance elements for the second resonance; the resonance frequency of the first resonance and the resonance frequency of the second resonance are determined so that the sensitivity of signals in the long wave broadcast band is increased, and the capacitor for second resonance is electrically connected between the defogger and the automobile body as the earth.

[0012] Further, in accordance with a third embodiment of the present invention, there is provided a glass antenna device for an automobile wherein an electric heating type defogger having heater strips and bus bars for supplying a current to the heater strips, and an antenna conductor are provided on a glass sheet fitted to a rear window of an automobile, and a choke coil is connected to at least one between a bus bar and a d.c. power source and between a bus bar and the automobile body as the earth so that a signal receive by the antenna conductor is supplied to a receiver, the glass antenna device being characterized in that a coil for first resonance is electrically connected between the antenna conductor and the receiver by interposing a line and/or a circuit element; a capacitor for second resonance is electrically connected to at least one between the defogger and the automobile body as the earth and between the antenna conductor and the automobile body as the earth by interposing a line and/or a circuit element.

[0013] In drawings:

Figure 1 is a structural diagram of an embodiment of the glass antenna device for an automobile according to the present invention;
Figure 2 is a structural diagram of another embodiment of the glass antenna device for an automobile according to the present invention;
Figure 3 is an equivalent circuit diagram for explaining the function of an antenna conductor 3, a defogger 90 and a resonance circuit 6 in the glass antenna device shown in Figure 1;
Figure 4 is a circuit diagram showing a modified example of the resonance circuit 6;
Figure 5 is a characteristic diagram of frequency vs sensitivity in a long wave broadcast band in Examples 1, 2 and 3;
Figure 6 is a characteristic diagram of frequency vs sensitivity of signals in and around a long wave broadcast band and a middle wave broadcast band in Examples 1, 2 and 3;
Figure 7 is a structural diagram of a conventional glass antenna device for an automobile;
Figure 8 is a circuit diagram showing an embodiment of a resonance circuit 6 different from that shown in Figure 1;
Figure 9 is a characteristic diagram of frequency-sensitivity of signals in and around a long wave broadcast band and a middle wave broadcast band in Example 4;
Figure 10 is a characteristic diagram of frequency vs sensitivity of signals in and around a long wave broadcast band and a middle wave broadcast band in Example 5;
Figure 11 is a characteristic diagram of frequency vs sensitivity of signals in and around a long wave broadcast band and a middle wave broadcast band in Example 6;
Figure 12 is a characteristic diagram of frequency vs sensitivity of signals in and around a long wave broadcast band and a middle wave broadcast band in Example 7;
Figure 13 is a characteristic diagram of frequency vs sensitivity of signals in and around a long wave broadcast band and a middle wave broadcast band in Example 8; and
Figure 14 is a characteristic diagram of frequency vs sensitivity of signals in and around a long wave broadcast band and a middle wave broadcast band in Example 9.

[0014] Detailed description of preferred embodiments of the present invention will be described with reference to the drawings.

[0015] Figure 1 is a diagram showing the basic structure of an embodiment of the glass antenna device for an automobile of the present invention wherein a glass sheet 1 is used for a rear window of an automobile. In Figure 1, reference numeral 2 designates heater strips, numeral 3 an antenna conductor, numeral 4 a power feeding point for the antenna conductor 3, numerals 5a, 5b designate bus bars, numeral 6 designates a resonance circuit, numeral 7 a receiver, numeral 7a a cable, numeral 31 a coil for first resonance, numeral 32 a capacitor for second resonance, numeral 42 a bypass capacitor, numerals 45, 48 designate damping resistors, numeral 47 a resistor for reducing noises in the automobile, such as engine noises, numeral 50 a capacitor for cutting a direct current, numeral 52 a high frequency choking coil, numeral 90 a defogger, and numeral 91 a power feeding point provided at an end of an outgoing line connected to the defogger 90. In the explanation described below, directions are indicated as directions on the drawings unless particularly specified.

[0016] In Figure 1, the electric heating type defogger 90 having the heater strips 2 and bus bars 5a, 5b for supplying a current to the heater strips 2 and the antenna conductor 3 are provided on the glass sheet 1 fitted to a rear window of an automobile. A choke coil 9 connected between the bus bar 5b and a d.c. power source 10 and between the bus bar 5a and the automobile body as the earth from the viewpoints of improving the sensitivity and reducing noises. However, the choke coil 9 may be connected either between the bus bar 5b and the d.c. power source 10 or between the bus bar 5a and the automobile body as the earth.

[0017] Received signals in the antenna conductor 3 and the defogger 90 are supplied to the receiver 7. The coil for first resonance 31 is electrically connected between the antenna conductor 3 and the receiver 7 by interposing a line and the capacitor 50. The way of connecting the coil for first resonance 31 is not in particular limited to the embodiment as shown in Figure 1, and instead, the coil for first resonance 31 may be electrically connected between the antenna conductor 3 and the receiver 7 by interposing at least one of a line and a circuit element.

[0018] In this specification, the circuit element includes any element suitable for a semiconductor device and a circuit such as a capacitor, a coil, a resistor, a diode, a transistor or the like. Further, the line means an electrical connection with a wire or an electrical connection with a conductor pattern or a connector provided on a circuit substrate. In Figure 1, "the antenna conductor 3 and the defogger 90 being electrically connected" which is obtainable from capacitive coupling of the antenna conductor 3 and the defogger 90 excludes the line as defined above. The definition is applicable to the other embodiments.

[0019] In Figure 1, the capacitor for second resonance 32 is electrically connected between the defogger 90 and the automobile body as the earth by interposing a line and the resistor 48. The way of connection of the capacitor for second resonance 32 is not in particular limited to the embodiment as shown in Figure 1, and instead, the capacitor for second resonance 32 may be electrically connected between the defogger 90 and the automobile body as the earth by interposing at least one of a line and a circuit element.

[0020] Figure 3 shows an equivalent circuit diagram for explaining the principle of the glass antenna device shown in Figure 1 wherein the resistors 45, 47 and 48 are omitted for simplifying the explanation; the portion of the resistor 45 is opened, and the portions of the resistors 47 and 48 are short-circuited.

[0021] In Figure 3, E1 designates a voltage power source for the antenna conductor 3, E2 designates a voltage power source for the defogger 90, numeral 33 designates the stray capacitance of the antenna conductor 3, numeral 34 designates the stray capacitance of the defogger 90 and numeral 35 designates the stray capacitance of the cable. When the antenna conductor 3 is disposed close to the defogger 90 to have a capacitive coupling relation, the close capacitance due to the capacitive coupling is connected in parallel to the high frequency choking coil 52.

[0022] The antenna conductor 3 is preferably used for mainly receiving signals in an FM broadcast band. In this case, it is preferable to determine the length of conductor and the shape of conductor so that good signal reception performance can be obtained in the FM broadcast band. Further, the antenna conductor 3 may be utilized for receiving signals in a middle wave broadcast band, a short wave broadcast band, a long wave broadcast band, a TV-VHF band, a TV-UHF band and telephone.

[0023] The defogger 90 is used for receiving mainly signals in a long wave broadcast band. Since frequencies in the long wave broadcast band are close to frequencies in the middle wave broadcast band, the defogger 90 may be used for receiving signals in the long wave broadcast band and the middle wave broadcast band. Although the defogger 90 has function to receive signals in a short wave broadcast band, an FM broadcast band, a TV-VHF band, a TV-UHF band and telephone, the glass antenna device for an automobile shown in Figure 1 does not utilize such function.

[0024] The sensitivity of signals is improved by generating resonance in two portions. For the first resonance, the impedance of the antenna conductor (3) and the inductance of the coil for first resonance 31 are included as resonance elements.

[0025] The impedance of the antenna conductor 3 is the impedance of the side of the antenna conductor 3 viewed from the power feeding point 4. The impedance of the antenna conductor 3 is mainly the stray capacitance 33, which is generally 10-100 pF.

[0026] The resonance frequency of the fist resonance may be adjusted by connecting a capacitance element in parallel between the stray capacitance 33 and the automobile body as the earth. This capacitance element can be a resonance element for the first resonance. The automobile body as the earth means an electric conductive portion of the automobile body, which is usually made of metal.

[0027] Since the antenna conductor 3 and the defogger 90 are electrically connected, the impedance of the defogger 90 influences the first resonance, and it can be a resonance element for the first resonance.

[0028] The impedance of the defogger 90 is the impedance of the side of the defogger 90 viewed from the power feeding point 91. The impedance of the defogger 90 is mainly the stray capacitance 34, which is usually 50-300 pF.

[0029] The stray capacitance of a line extended in the vicinity of the coil for first resonance 31 and the stray capacitance of the cable 7a connected between the glass antenna and the receiver influence also the first resonance, and they can be resonance elements for the first resonance.

[0030] When the resonance circuit 6 is provided on the glass sheet 1 for a rear window of automobile, or the resonance circuit 6 is provided in the vicinity of the glass sheet 1 for a rear window of automobile, the length of the cable 7a is usually several meters because the receiver 7 is usually provided at a front portion of the automobile, and the capacitance value of the stray capacitance 35 is usually 50-300 pF.

[0031] Impedance matching may be conducted between the antenna conductor 3 and the receiver side by providing a new circuit element in the resonance circuit 6. The coil for first resonance 31 is generally of about 10 μH-1 mH to improve the sensitivity in a long wave broadcast band. In that range, 50-500 μH is preferable, and 65-350 μH is more preferable.

[0032] In the present invention, the sensitivity of signals in a long wave broadcast band is improved by generating the second resonance. When the resonance frequency for the second resonance is determined to improve the sensitivity in the long wave broadcast band and if the capacitance which constitutes the resonance element for the second resonance is only the stray capacitance 34, it is necessary to increase the inductance of the choke coil 9. In view of this, the capacitor for second resonance 32 is added to be a resonance element for the second resonance whereby the inductance of the choke coil 9 can be made relatively small.

[0033] The inductance of the choke coil 9 is preferably in a range of from 0.5 to 5.0 mH. In this range, the resonance frequency of the second resonance can be the resonance frequency for improving the sensitivity in the long wave broadcast band, and the choke coil 9 can be minimized. A range of 1.0-3.0 mH is more preferable, and a range of 1.5-3.0 mH is in particular preferable.

[0034] In Figure 1, the inductance of the choke coil 9, the impedance of the defogger 90 and the capacitance of the capacitor for second resonance 32 are included as main resonance elements for the second resonance, and they can be the main resonance elements. The capacitor for second resonance 32 generally used is of about 10-5,000 pF.

[0035] However, in consideration that the stray capacitance 34 is generally about 50-200 pF, a preferred range of the capacitance value of the capacitor for second resonance 32 is from 50 to 1,200 pF. In this range, the inductance of the choke coil 9 can generally be 5.0 mH or less and the resonance frequency of the second resonance can be the frequency for improving the sensitivity in the long wave broadcast band. A more preferable range is 100-500 pF.

[0036] The resistor 48 is for the adjustment of damping in the second resonance and a preferable range of resistance value of the resistor 48 is 200 Ω - 25 kΩ. In this range, the difference between the highest sensitivity and the lowest sensitivity in the long wave broadcast band can generally be 10 dB or less. The resistor 48 also has function for adjusting the coupling between the antenna conductor 3 and the defogger 90, and accordingly, it is preferable to provide the resistor 48. The presence of the resistor 48 can improve the sensitivity in the long wave broadcast band in comparison with the absence of the resistor 48.

[0037] In order to adjust the damping of the second resonance, a resistor may be connected in parallel to the capacitor for second resonance 32, or a resistor may be connected to the choke coil 9 although such elements are not shown in Figures 1 and 2.

[0038] Further, since the antenna conductor 3 and the defogger 90 are electrically connected, the impedance of the antenna conductor 3 influences also the second resonance, and it can be a resonance element for the second resonance. Further, the stray capacitance of a line around the antenna conductor 3, the stray capacitance of a line around the defogger 90, the stray capacitance of a line around the capacitor for second resonance 32 and so on influence also the second resonance, and they can be resonance elements for the second resonance. Further, the stray capacitance of the cable 7a connected between the output terminal of the resonance circuit 6 and the receiver influence also the second resonance.

[0039] In Figure 1, the first resonance is a series resonance and the second resonance is a parallel resonance, which are preferably generated from the viewpoint of improving the sensitivity. In the present invention, however, the first resonance is not limited to a series resonance and the second resonance is not limited to a parallel resonance. Accordingly, the first resonance may be a parallel resonance and the second resonance may be a series resonance.

[0040] In Figure 1, the resonance frequency of the first resonance and the resonance frequency of the second resonance are determined to be such ones to improve the sensitivity of signals in the long wave broadcast band. Namely, the frequency for a parallel resonance as the second resonance is preferably 100-180 kHz, more preferably, 120-150 kHz.

[0041] Further, in Figure 1, the high frequency choking coil 52 as an inductance element generally separates in terms of high frequency the antenna conductor 3 from the defogger 90 in an FM broadcast band, and functions to improve the sensitivity in the FM broadcast band without changing the effective length of conductor of the antenna conductor 3.

[0042] Further, in a case that the high frequency choking coil 52 is not provided and the location of the high frequency choking coil 52 is short-circuited, the self-resonance frequency of the choke coil 9 is low and generally exhibits a capacitive property in the FM broadcast band. Accordingly, received signals in the FM broadcast band excited in the antenna conductor 3 leak to the automobile body as the earth. Therefore, the high frequency choking coil 52 is to be provided to prevent the leakage. In other words, the high frequency choking coil 52 passes signals having frequencies in the long wave broadcast band and functions as a filter circuit which blocks or attenuates signals having frequencies in the FM broadcast band. Further, the high frequency choking coil 52 also passes frequencies in a middle wave broadcast band.

[0043] It is preferable to form a filter circuit by using the high frequency choking coil 52 shown in Figure 1 because the circuit structure is simple and inexpensive. However, the filter circuit is not limited to use such coil and may be composed of another circuit structure. The way of connecting the filter circuit is not limited to that shown in Figure 1, and the filter circuit may be electrically connected between the antenna conductor 3 and the defogger 90 by interposing at least one of a line and a circuit element.

[0044] Further, in a case that signals in a long wave broadcast band and an FM broadcast band are included as signals in a broadcast band to be received, the inductance value of the high frequency choking coil 52 is preferably in a range of 0.1-100 μH. When the inductance value of the high frequency choking coil 52 is within the range of 0.1-100 μH, the sensitivity in the FM broadcast band is improved 0.2 dB or more in comparison with a case out of the range of 0.1-100 μH. From the viewpoint of improving the sensitivity in the FM broadcast band, the high frequency choking coil 52 has preferably an inductance value of a range of 0.3-20 μH, more preferably a range of 0.8-4.8 μH.

[0045] With respect to the self-resonance frequency f_R of the high frequency choking coil 52 used for improving the sensitivity in the FM broadcast band, a relation of $f_H/15 \leqq f_R \leqq 3f_L$ should be satisfied between the highest frequency f_H of the FM broadcast band and the lowest frequency f_L of the FM broadcast band. The satisfaction of a relation of $f_H/9 \leqq f_R \leqq 2f_L$ is more preferable, and $f_H/3.6 \leqq f_R \leqq 1.85f_L$ is in particular preferable.

[0046] In Figure 1, it is preferable for the antenna conductor 3 and the defogger 90 to have no capacitive relation. When they have a capacitive coupling relation, received signals in the FM broadcast band excited in the antenna conductor 3 are apt to leak to the automobile body as the earth through the defogger 90 and the choke coil 9. In order to prevent the antenna conductor 3 and the defogger 90 from having a capacitive coupling relation, the shortest distance between the antenna conductor 3 and the defogger 90 should generally be 10 mm or more. When the shortest distance is 10 mm or more, the sensitivity in the FM broadcast band is improved 0.5 dB or more in comparison with a case that the shortest distance is less than 10 mm. More preferably, the shortest distance should be 20 mm or more. When the shortest distance is 20 mm or more, the sensitivity in the FM broadcast band is improved 0.5 dB or more in comparison with a case that the shortest distance is less than 20 mm.

[0047] The above-mentioned condition of the shortest distance between the antenna conductor 3 and the defogger 90 is generally applied to a case that the length of portions extending in substantially parallel in the antenna conductor 3 and the defogger 90 is 100 mm or more.

[0048] In a case that the shortest distance between the antenna conductor 3 and the defogger 90 has to be less than 10 mm because the dimension in a vertical direction of the glass sheet 1 for a rear window of automobile is small, it is preferable to insert and connect high frequency choking coils 12a, 12b between the bus bar 5a and the automobile body as the earth and between the bus bar 5b and the automobile body as the earth respectively, as shown in Figure 2. It is because received signals in the FM broadcast band excited in the antenna conductor 3 are blocked by such high frequency choking coils to prevent the signals from leaking to the automobile body as the earth.

[0049] Figure 2 shows an another embodiment of the glass antenna device for an automobile shown in Figure 1 wherein the glass antenna device is suitable for diversity signal reception. In Figure 2, reference numeral 53 designates a capacitor, numeral 60 a high frequency choking coil, symbol t_1 a first input terminal of the receiver 7 and symbol t_2 a second input terminal of the receiver 7. The receiver 7 is adapted to select a stronger receiving signal in an FM broadcast band at either the first input terminal t_1 or the second input terminal t_2.

[0050] The capacitor 53 is provided according to requirement, which functions to block or attenuate received signals in a long wave broadcast band. The capacitance value of the capacitor 53 is preferably in a range of 10-500 pF, more preferably, 30-150 pF. When the capacitance value of the capacitor 53 is 10 pF or more, the sensitivity in the FM broadcast band at the second input terminal t_2 is improved 1 dB or more in a case that the capacitance value is less than 10 pF. When the capacitance value of the capacitor 53 is 500 pF or less, the sensitivity in the long wave broadcast band at the first input terminal t_1 is improved 1 dB or more in a case that the capacitance value exceeds 500 pF.

[0051] Received signals in the FM broadcast band may leak through the capacitor for second resonance 32 to the automobile body as the earth so that the sensitivity in the FM broadcast band reduces. In order to prevent such disadvantage, the high frequency choking coil 60 may be connected in series to the capacitor for second resonance 32. The high frequency choking coil 60 having about 0.1-100 μH is generally used.

[0052] In the glass antenna device for an automobile shown in Figure 2, it is preferable to connect the high frequency choking coils 12a, 12b between bus bars and the choke coil 9. The reason is as follows. In the glass antenna device shown in Figure 1, received signals in the FM broadcast band excited in the defogger 90 are not used. On the other hand, in the glass antenna device shown in Figure 2, received signals in the FM broadcast band excited in the defogger are used at the second input terminal t_2. Accordingly, the choke coils 12a, 12b are to prevent received signals in the FM broadcast band excited in the defogger 90 from leaking to the automobile body as the earth.

[0053] In Figure 2, the second input terminal t_2 of the receiver 7 is drawn from the inside of the resonance circuit 6 (a left end of the capacitor 53 is connected to a point in the resonance circuit 6). However, the drawing point of the second input terminal t_2 is not limited to the inside of the resonance circuit 6 but it may be drawn from any point of the defogger 90. Further, an antenna conductor which is separate from the antenna conductors 3 may be provided in a space which is lower in position than the defogger 90 to conduct diversity signal reception between the first input terminal t_1 and the other antenna conductor.

[0054] The reason why resonance is generated in the two portions in the present invention is because a broader received signal frequency band region can not be covered by only a single resonance. In the present invention, accordingly, a long wave broadcast band region is divided into two portions, and the divided portions are shared by the two portions of resonance whereby the sensitivity of received signals is flattened. When signals in a middle wave broadcast band are to be received in addition to the long wave broadcast band, a frequency band region which covers the long wave broadcast band and the middle wave broadcast band is shared by two portions of resonance whereby the sensitivity of signals in such frequency band region is flattened. The flattening of the sensitivity means that the difference between the highest sensitivity and the lowest sensitivity in the long wave broadcast band region is made small.

[0055] Figure 4 is a circuit diagram showing a modified embodiment of the resonance circuit 6. In Figure 4, numerals 41, 44 and 50 designate capacitors for cutting a direct current, numeral 42 designates a bypass capacitor, numeral 43 designates a capacitor for cutting a direct current or coupling, numerals 45, 48 and 49 designate damping resistors, numeral 55 designates a resistor for adjusting coupling and numeral 56 designates a capacitor for adjusting coupling.

[0056] In the resonance circuit in Figure 4, received signals in the defogger 90 are transmitted to a side of the receiver through the resistor 47, the high frequency choking coil 52 and the capacitor 43. When the antenna conductor 3 and the defogger 90 have a capacitive coupling relation, however, received signals in the defogger 90 are transmitted to the receiver side through the close capacitance.

[0057] The bypass capacitor 42 is provided according to requirements. When received signals in the FM broadcast band are blocked by means of the first coil, the bypass capacitor 42 allows signals in the FM broadcast band to pass through toward the receiver side. The capacitors 43, 56 are to adjust the coupling between the antenna conductor 3 and the defogger 90, and they are provided according to requirement. The resistors 45, 48, 49 and 55, which adjust flattening of the sensitivity, are provided according to requirement. In addition, a capacitor for resonance adjustment may be provided.

[0058] The capacitors 41, 44, 50 and 54 are provided according to requirement. When they are used, a capacitance of 100 pF-50 μF is generally used. The bypass capacitor 42 used is generally of 1-1,000 pF. The capacitor 43 used is generally of 5-500 pF. The resistors 45, 49 and 55 used are generally of 50 Ω - 100 kΩ.

[0059] Further, there is a possibility that a lead wire for supplying a direct current from the d.c. power source 10 to the defogger 90 takes noises of automobile such as engine noises to invite deterioration of the S/N ratio. The resistor 47 is provided according to requirement, which prevents the deterioration of the S/N ratio. In particular, it functions to prevent the deterioration of the S/N ratio in a low frequency region in a long wave broadcast band. Namely, the resistor 47 has function to reduce noises of automobile such as engine noises.

[0060] The resistance value of the resistor 47 is preferably 10 Ω - 1 kΩ, more preferably, 50-500 Ω. When the resistance value of the resistor 47 is 10 Ω - 1 kΩ, the S/N ratio of signals in the long wave broadcast band is improved 1 dB or more in comparison with a case out of that range. When the resistance value of the resister 47 is 50-500 Ω, the S/N ratio in the long wave broadcast band is improved 1 dB or more in comparison with a case out of that range.

[0061] As described above, the capacitors 41, 42, 43, 44, 50 and 54 and resistors 45, 47, 48, 49 and 55 in Figure 4 are provided according to requirement, or they may be omitted. Here, the omission of the capacitors 42, 56 and 44 and the omission of the resistors 45, 49 and 55 imply opening, and the omission of the capacitors 41, 43, 50 and 54 and the omission of the resistors 47 and 48 imply short-circuiting.

[0062] Figure 8 is a circuit diagram of a modified example of the resonance circuit 6 shown in Figure 1. In Figure 8, the antenna conductor 3 and the defogger 90 are omitted. In Figure 8, symbols A, B, C and D indicate points on lines. In Figure 1, an end (point C) of the capacitor for second resonance 32, which is opposite to the automobile body as the earth, is electrically connected to the power feeding point 91 by means of a line. In Figure 8, on the other hand, the point C is electrically connected to an end (point B) of the capacitor 50, which is opposite to the antenna conductor 3, by means of a line. In other words, the capacitor for second resonance 32 is electrically connected between the antenna conductor 3 and the automobile body as the earth by means of a line in which the capacitor 50 and the resistor 48 are interposed. Connecting the capacitor for second resonance 32 is not limited to the embodiment as shown in Figure 8, and instead, the capacitor for second resonance 32 may be electrically connected between the antenna conductor 3 and the automobile body as the earth by interposing at least one of a line and a circuit element. Further, the point C may be electrically connected to the point D by interposing at least one of a line and a circuit element.

[0063] With respect to the connection as shown in Figure 8, when the resistance value of the resistor 47 is very small such as several tens Ω or less, the function of the first resonance and the function of the second resonance are the same manner as those of the resonance circuit 6 in Figure 1, and all the conditions described with reference to Figure 1 are applicable to the resonance circuit 6 in Figure 8. However, the resonance circuit 6 in Figure 1 is easy in reducing noises because the resistance value of the resistor 47 can be increased, and therefore, the resonance circuit 6 in Figure 1 is preferable rather than the resonance circuit 6 in Figure 8.

[0064] In Figure 2, the choke coil 9 and the high frequency choking coils 12a, 12b are inserted between the bus bars 5a, 5b and the d.c. power source 10 for the defogger 90 to thereby increase the impedance of the choke coil 9 and the impedance of the high frequency choking coils 12a, 12b in the broadcast band region, whereby a direct current from the d.c. power source 10 to the defogger 90 is allowed to flow and a current in the broadcast band region is blocked.

[0065] Thus, the heater strips 2 of the defogger 90 and the bus bars 5a, 5b are isolated from the automobile body as the earth with respect to high frequency signals by means of the choke coil 9 and the high frequency choking coils 12a, 12b, whereby a current of received signal in the broadcast band excited in the defogger 90 is prevented from flowing to the automobile body as the earth, and a current of received signal is supplied to the receiver without any leakage. The choke coil 9 used is generally of about 0.1-10 mH.

[0066] The high frequency choking coils 12a, 12b and the high frequency choking coil 60 provide a high impedance in a high frequency band such as an FM broadcast band in a broadcast frequency band. Accordingly, a solenoid or magnetic core is generally used. Such element exhibits an inductive type inductance in a high frequency band such as an FM broadcast band or in the vicinity of such frequency band.

[0067] In a high frequency band such as an FM broadcast band, the self-resonance frequency of the choke coil 9 is low and the impedance of the choke coil 9 exhibits a capacitive property thereby become a low impedance. In this case, the high frequency choking coils 12a, 12b functions for the choke coil 9. The high frequency choking coils 12a, 12b generally used are of 0.1-100 μH.

[0068] When the impedance of the choke coil 9 does not exhibit a capacitive property in a high frequency band such as an FM broadcast band and it shows a high impedance, the high frequency choking coils 12a, 12b are unnecessary. Further, if any coil or coils which perform both functions of the choke coil 10 and the high frequency choking coils 12a, 12b can be provided, such coil or coils may be used.

[0069] The defogger 90 shown in Figure 1 or Figure 2 is substantially in a trapezoidal form. However, the defogger 90 used in the present invention is not limited to have such form, and any form, e.g., a substantially channel-like form as show in Figure 7 may be used for the defogger 90 of the present invention.

[0070] The antenna conductor 3 may be provided in a space of upper, lower, left or right portion with respect to the defogger 90 in the glass sheet 1 of automobile window and the portion is not limited to that shown in Figure 1. Further, the number of antenna conductors provided in the glass sheet 1 is not in particular limited.

[0071] The number of antenna conductors to be provided on an automobile, other than the antenna conductor 3, is not limited. Further, the glass antenna device of the present invention have the function of diversity signal reception in association with an antenna device such as a pole antenna or another type of glass antenna device.

EXAMPLE

EXAMPLE 1

[0072] A glass sheet for a rear window of automobile was used and the glass antenna device as shown in Figure 1 was prepared. The resistor 47 and the capacitor 50 were not provided, and the portions corresponding to the resistor 47 and the capacitor 50 were short-circuited. The capacitor 43 in Figure 4 was provided. The circuit constants of elements used are as shown in Table 1.

[0073] The length of conductor and the shape of conductor of the antenna conductor 3 were adjusted so that signals in an FM broadcast band could be received. The distance between a lower portion of the antenna conductor 3 and the highest line of the heater strips 2 was determined to be 21 mm. In this case, there was found substantially no capacitive coupling between the antenna conductor 3 and the defogger 90.

[0074] A thick solid line in Figure 5 exhibits a frequency-sensitivity characteristic of a signal in the vicinity of a long wave broadcast band. A thick solid line in Figure 6 exhibits a frequency-sensitivity characteristic of a signal in the vicinity of a long wave broadcast band or a middle wave broadcast band. The sensitivity of a pole antenna of 870 mm long was about 67 dB at 100-2,100 kHz.

EXAMPLE 2

[0075] A glass antenna device was prepared in the same manner as that of Example 1 except that the resistance value of the resistor 48 is changed to 220 Ω. The frequency-sensitivity characteristics are indicated by thin solid lines in Figures 5 and 6.

EXAMPLE 3

[0076] A glass antenna device was prepared in the same manner as that of Example 1 except that the resistance value of the resistor 48 was changed to 22 kΩ. The frequency-sensitivity characteristics are indicated by broken lines in Figures 5 and 6.

Table 1

Capacitor for second resonance 32	220 pF
Coil for first resonance 31	120 μH
High frequency choking coil 52	2.2 μH
Bypass capacitor 42	22 pF
Capacitor 43	1,000 pF
Resistor 45	4.7 kΩ
Resistor 48	2.2 kΩ
Choke coil 9	2.0 mH
Stray capacitance of defogger 90	100 pF

EXAMPLE 4

[0077] A glass antenna device was prepared in the same manner as that of Example 1 except that the circuit constants were determined as shown in Table 2. The frequency-sensitivity characteristic of a signal in the vicinity of a long wave broadcast band or a middle wave broadcast band is shown in Figure 9.

Table 2

Capacitor for second resonance 32	75 pF
Coil for first resonance 31	180 μH
High frequency choking coil 52	2.2 μH
Self-resonance frequency of high frequency choking coil 52	90 MHz
Bypass capacitor 42	22 pF
Capacitor 43	1,000 pF
Resistor 45	2.2 kΩ
Resistor 48	2.2 kΩ
Choke coil 9	3.0 mH
Self-resonance frequency of choking coil 9	0.38 MHz
Stray capacitance 34 of defogger 90	200 pF
Stray capacitance 33 of antenna conductor 3	20 pF
Stray capacitance of cable 7a	45 pF

EXAMPLE 5

[0078] A glass antenna device was prepared in the same manner as that of Example 1 except that the circuit constants were determined as shown in Table 3. The frequency-sensitivity characteristic of a signal in the vicinity of a long wave broadcast band or a middle wave broadcast band is shown in Figure 10.

Table 3

Capacitor for second resonance 32	560 pF
Coil for first resonance 31	80 μH
High frequency choking coil 52	10 μH
Self-resonance frequency of high frequency choking coil 52	50 MHz
Bypass capacitor 42	10 pF
Capacitor 43	500 pF
Resistor 45	2.7 kΩ
Resistor 48	1.0 kΩ
Choke coil 9	1.0 mH
Self-resonance frequency of choking coil 9	0.50 MHz
Stray capacitance 34 of defogger 90	300 pF
Stray capacitance 33 of antenna conductor 3	10 pF
Stray capacitance of cable 7a	150 pF

EXAMPLE 6

[0079] A glass antenna device was prepared in the same manner as that of Example 1 except that the circuit constants were determined as shown in Table 4. The frequency-sensitivity characteristic of a signal in the vicinity of a long wave broadcast or a middle wave broadcast band is shown in Figure 11.

Table 4

Capacitor for second resonance 32	330 pF
Coil for first resonance 31	100 μH
High frequency choking coil 52	1.0 μH
Self-resonance frequency of high frequency choking coil 52	160 MHz
Bypass capacitor 42	50 pF
Capacitor 43	2,200 pF
Resistor 45	3.3 kΩ
Resistor 48	5.0 kΩ
Choke coil 9	4.0 mH
Self-resonance frequency of choking coil 9	0.35 MHz
Stray capacitance 34 of defogger 90	50 pF
Stray capacitance 33 of antenna conductor 3	50 pF
Stray capacitance of cable 7a	50 pF

EXAMPLE 7

[0080] A glass antenna device was prepared in the same manner as that of Example 1 except that the circuit constants were determined as shown in Table 5. The frequency-sensitivity characteristic of a signal in the vicinity of a long wave broadcast band or a middle wave broadcast band is shown in Figure 12.

Table 5

Capacitor for second resonance 32	1,400 pF
Coil for first resonance 31	100 μH
High frequency choking coil 52	15 μH
Self-resonance frequency of high frequency choking coil 52	41 MHz
Bypass capacitor 42	30 pF
Capacitor 43	2,000 pF
Resistor 45	2.2 kΩ
Resistor 48	3.0 kΩ
Choke coil 9	3.0 mH
Self-resonance frequency of choking coil 9	0.41 MHz
Stray capacitance 34 of defogger 90	50 pF
Stray capacitance 33 of antenna conductor 3	80 pF
Stray capacitance of cable 7a	120 pF

EXAMPLE 8

[0081] A glass antenna device was prepared in the same manner as that of Example 1 except that the circuit constants were determined as shown in Table 6. The frequency-sensitivity characteristic of a signal in the vicinity of a long wave broadcast band or a middle wave broadcast band is shown in Figure 13.

Table 6

Capacitor for second resonance 32	1,100 pF
Coil for first resonance 31	100 μH
High frequency choking coil 52	1.5 μH
Self-resonance frequency of high frequency choking coil 52	70 MHz

Table 6 (continued)

Bypass capacitor 42	15 pF
Capacitor 43	10,000 pF
Resistor 45	2.2 kΩ
Resistor 48	3.9 kΩ
Choke coil 9	1.7 mH
Self-resonance frequency of choking coil 9	0.31 MHz
Stray capacitance 34 of defogger 90	100 pF
Stray capacitance 33 of antenna conductor 3	80 pF
Stray capacitance of cable 7a	120 pF

EXAMPLE 9

[0082] A glass antenna device was prepared in the same manner as that of Example 1 except that the circuit constants were determined as shown in Table 7. The frequency-sensitivity characteristic of a signal in the vicinity of a long wave broadcast band or a middle wave broadcast band is shown in Figure 14.

Table 7

Capacitor for second resonance 32	120 pF
Coil for first resonance 31	150 µH
High frequency choking coil 52	15 µH
Self-resonance frequency of high frequency choking coil 52	41 MHz
Bypass capacitor 42	15 pF
Capacitor 43	220 pF
Resistor 45	4.7 kΩ
Resistor 48	3.0 kΩ
Choke coil 9	3.0 mH
Self-resonance frequency of choking coil 9	0.29 MHz
Stray capacitance 34 of defogger 90	150 pF
Stray capacitance 33 of antenna conductor 3	30 pF
Stray capacitance of cable 7a	60 pF

[0083] According to the present invention, the first resonance is generated by the impedance of the antenna conductor and the inductance of the coil for first resonance as resonance elements, and the second resonance is generated by the impedance of the defogger and the inductance of the capacitor for second resonance as resonance elements. Accordingly, the sensitivity of signals a long wave broadcast band is excellent because two resonance portions are utilized. Further, the size of the choke coil 9 can be reduced, and manufacturing cost can be reduced.

[0084] When a filter circuit is electrically connected between the antenna conductor and the defogger to block or attenuate received signals in an FM broadcast band, received signals in the FM broadcast band excited in the antenna conductor are prevented from leaking to the automobile body as the earth, and reduction in the sensitivity of signals in the FM broadcast band is small.

[0085] When signals in a long wave broadcast band are received, both the antenna conductor and the defogger can be utilized whereby the sensitivity in the long wave broadcast band is excellent. On the other hand, in receiving signals in an FM broadcast band, an effective length of only the antenna conductor can be utilized whereby the sensitivity in the FM broadcast band is excellent.

Claims

1. Glass antenna device for an automobile comprising:

a window glasssheet (1) which fits to a rear window opening of an automobile;
an antenna conductor (3) having an antenna impedance, provided on the window glass sheet (1);
an electric heating type defogger (90) having a defogger impedance, provided on the window glass sheet (1)

having heater strips (2) and bus bars (5a, 5b) for supplying a current to the heater strips (2);
a choke coil (9) having an inductance, connected to at least one between a bus bar (5a, 5b) and a d.c. power source and between a bus bar (5a, 5b) and the automobile body as the earth,
a coil (31) having an inductance;
a receiver (7);
a first resonance circuit comprising a first group of resonance elements which cause the glass antenna device to resonate at a first resonance frequency, the first group of resonance elements comprising the impedance of the antenna conductor (3) and the inductance of the coil (31),
a capacitor (32) having a capacitance;
a second resonance circuit comprising a second group of resonance elements which cause the glass antenna to resonate at a second resonance frequency different from the first resonance frequency, the second group of resonance elements comprising mainly the inductance of the choke coil (9), the impedance of the defogger (90), and the capacitance of the capacitor (32) for second resonance;
the inductance of the choke coil (9) is from 0.5 to 5.0 mH, the impedance of the defogger (90) comprises mainly a stray capacitance of from 50 to 300 pF;
a signal in at least an FM broadcast band received by the antenna conductor (3) is supplied to the receiver (7), and
the impedance of the antenna conductor (3) comprises mainly a stray capacitance of 10 to 100 pF and the inductance of the coil (31) for the first resonance is from 10 μH to 10 mH,
the coil (31) for first resonance is electrically connected between the antenna conductor (3) and the receiver (7) by interposing a line and/or a circuit element;
a high frequency choke coil (52) configured to attenuate a signal in an FM broadcast band is electrically connected between the antenna conductor (3) and the defogger (90);

characterized in that

a signal in at least a long wave broadcast band received by the defogger (90) is supplied to the receiver (7);
the capacitor (32) is electrically connected to at least one between the defogger (90) and the automobile body as the earth and between the antenna conductor (3) and the automobile body as the earth by interposing a line and/or a circuit element;
the capacitance of the capacitor (32) ranges from 50 to 1200 pF;
the frequency of the second resonance is from 120 to 150 kHz.

2. The glass antenna device for an automobile according to claim 1, wherein a high frequency choke coil (60) is connected in series to the capacitor (32) for second resonance.

3. The glass antenna device for an automobile according to Claim 1 or 2, wherein the second resonance is a parallel resonance.

4. The glass antenna device according to any one of claims 1 to 5, wherein a resistor having a resistance value of 200 Ω - 25 kΩ is connected between the capacitor (32) for second resonance and the automobile body as the earth.

5. The glass antenna device according to one or more of the claims 1 to 4, wherein there is a relation of $f_H /15 \leq f_R \leq 3f_L$, where f_R represents the self-resonance frequency of the high frequency choke coil (52), f_H represents the highest frequency of the FM broadcast band and f_L represents the lowest frequency of the FM broadcast band.

Patentansprüche

1. Scheibenantennenvorrichtung bzw. -anordnung für ein Automobil, umfassend:

eine Fensterglasscheibe (1), welche in eine rückwärtige Fensteröffnung eines Automobils paßt;
einen Antennenleiter (3), der eine Antennenimpedanz aufweist, der auf der Fensterglasscheibe (1) zur Verfügung gestellt ist;
eine Antibeschlagseinheit (90) einer elektrischen Heizart, die eine Antibeschlagsimpedanz aufweist, die auf der Fensterglasscheibe (1) vorgesehen ist, die Heizstreifen (2) und Leiterbahnen bzw. Sammelschienen (5a, 5b) zum Zuführen eines Stroms zu den Heizstreifen (2) aufweist;
eine Drosselspule (9), die eine Induktivität besitzt, die mit wenigstens einem zwischen einer Leiterbahn (5a,

5b) und einer Gleichstromquelle und zwischen einer Leiterbahn (5a, 5b) und dem Automobilkörper als der Erde verbunden ist;
eine Spule (31) mit einer Induktivität;
einen Empfänger (7);
eine erste Resonanzschaltung, umfassend eine erste Gruppe von Resonanzelementen, welche die Scheibenantennenvorrichtung veranlassen, bei einer ersten Resonanzfrequenz zu schwingen, wobei die erste Gruppe von Resonanzelementen die Impedanz des Antennenleiters (3) und die Induktivität der Spule (31) umfaßt;
einen Kondensator (32), der eine Kapazität aufweist;
eine zweite Resonanzschaltung, umfassend eine zweite Gruppe von Resonanzelementen, welche die Scheibenantenne veranlassen, bei einer zweiten Resonanzfrequenz zu schwingen, die von der ersten Resonanzfrequenz unterschiedlich ist, wobei die zweite Gruppe von Resonanzelementen hauptsächlich die Induktivität der Drosselspule (9), die Impedanz der Antibeschlagseinheit (90) und die Kapazität des Kondensators (32) für die zweite Resonanz umfaßt;
die Induktivität der Drosselspule (9) von 0,5 bis 5,0 mH ist, die Impedanz der Antibeschlagseinheit (90) hauptsächlich eine Streukapazität von 50 bis 300 pF umfaßt;
ein Signal in wenigstens einem FM Rundfunkband, das durch den Antennenleiter (3) empfangen ist, dem Empfänger (7) zugeleitet wird, und
die Impedanz des Antennenleiters (3) hauptsächlich eine Streukapazität von 10 bis 100 pF umfaßt und die Induktivität der Spule (31) für die erste Resonanz von 10 μH bis 10 mH ist,
die Spule (31) für die erste Resonanz elektrisch zwischen dem Antennenleiter (3) und dem Empfänger (7) durch Zwischenlagern bzw. -schalten einer Leitung und/oder eines Schaltungselements angeschlossen ist;
eine Hochfrequenz-Drosselspule (52), die konfiguriert ist, um ein Signal in einem FM Rundfunkband zu schwächen bzw. zu dämpfen, elektrisch zwischen dem Antennenleiter (3) und der Antibeschlagseinheit (90) angeschlossen ist,

dadurch gekennzeichnet, daß

ein Signal in wenigstens einem langwelligen Rundfunkband, das durch die Antibeschlagseinheit (90) empfangen ist, dem Empfänger (7) zugeleitet ist;
der Kondensator (32) elektrisch zwischen der Antibeschlagseinheit (90) und dem Automobilkörper als der Erde und/oder zwischen dem Antennenleiter (3) und dem Automobilkörper als der Erde durch Zwischenlagern bzw. -schalten einer Leitung und/oder eines Schaltungselements verbunden ist;
die Kapazität des Kondensators (32) von 50 bis 1200 pF reicht;
die Frequenz der zweiten Resonanz von 120 bis 150 kHz beträgt.

2. Scheibenantennenvorrichtung für ein Automobil nach Anspruch 1, wobei eine Hochfrequenz-Drosselspule (60) in Serie mit dem Kondensator (32) für eine zweite Resonanz angeschlossen ist.

3. Scheibenantennenvorrichtung für ein Automobil nach Anspruch 1 oder 2, wobei die zweite Resonanz eine parallele bzw. Parallelresonanz ist.

4. Scheibenantennenvorrichtung für ein Automobil nach einem der Ansprüche 1 bis 5, wobei ein Widerstand, der einen Widerstandswert von 200 Ω - 25 kΩ aufweist, zwischen dem Kondensator (32) für die zweite Resonanz und dem Automobilkörper als der Erde angeschlossen ist.

5. Scheibenantennenvorrichtung für ein Automobil nach einem oder mehreren der Ansprüche 1 bis 4, wobei eine Relation von $f_H/15 \leq f_R \leq 3f_L$ besteht, wo f_R die Selbstresonanzfrequenz der Hochdruckfrequenzdrosselspule (52) repräsentiert, f_H die höchste Frequenz des FM Rundfunkbands repräsentiert und f_L die niedrigste Frequenz des FM Rundfunkbands repräsentiert.

Revendications

1. Dispositif d'antenne de vitre pour un véhicule automobile, comprenant :

un panneau de vitrage (1) qui s'adapte sur une ouverture de lunette arrière d'un véhicule automobile ;
un conducteur d'antenne (3) ayant une impédance d'antenne, placé sur le panneau de vitrage (1) ;

un dégivreur de type à chauffage électrique (90) ayant une impédance de dégivreur, placé sur le panneau de vitrage (1), ayant des bandes chauffantes (2) et des barres bus (5a, 5b) pour amener un courant aux bandes chauffantes (2) ;
une bobine d'arrêt (9) ayant une inductance, connectée entre une barre bus (5a, 5b) et une source de courant continu et/ou entre une barre bus (5a, 5b) et la carrosserie du véhicule d'automobile servant de masse ;
une bobine (31) ayant une inductance ;
un récepteur (7) ;
un premier circuit résonant comprenant un premier groupe d'éléments de résonance qui font résonner le dispositif d'antenne de vitre à une première fréquence de résonance, le premier groupe d'éléments de résonance comprenant l'impédance du conducteur d'antenne (3) et l'inductance de la bobine (31) ;
un condensateur (32) ayant une capacité ;
un second circuit résonant comprenant un second groupe d'éléments de résonance qui font résonner l'antenne de vitre à une seconde fréquence de résonance différente de la première fréquence de résonance, le second groupe d'éléments de résonance comprenant principalement l'inductance de la bobine d'arrêt (9), l'impédance du dégivreur (90) et la capacité du condensateur (32) pour la seconde résonance ;
l'inductance de la bobine d'arrêt (9) étant de 0,5 à 5,0 mH. et l'impédance du dégivreur (90) comprenant principalement une capacité parasite de 50 à 300 pF ;
un signal dans au moins une bande d'émission FM reçu par le conducteur d'antenne (3) étant délivré au récepteur (7), et
l'impédance du conducteur d'antenne (3) comprenant principalement une capacité parasite de 10 à 100 pF et l'inductance de la bobine (31) pour la première résonance étant de 10 μH à 10 mH,
la bobine (31) pour la première résonance étant électriquement connectée entre le conducteur d'antenne (3) et le récepteur (7) en interposant une ligne et/ou un élément de circuit ;
une bobine d'arrêt de hautes fréquences (52) configurée pour atténuer un signal dans une bande d'émission FM étant électriquement connectée entre le conducteur d'antenne (3) et le dégivreur (90) ;

caractérisé en ce que

un signal dans au moins une bande d'émission à grandes ondes reçu par le dégivreur (90) est délivré au récepteur (7) ;
le condensateur (32) est électriquement connecté et/ou entre le dégivreur (90) et la carrosserie du véhicule automobile servant de masse et/ou entre le conducteur d'antenne (3) et la carrosserie du véhicule automobile servant de masse en interposant une ligne et/ou un élément de circuit ;
la capacité du condensateur (32) est- dans la plage de 50 à 1200 pF ;
la fréquence de la seconde résonance est de 120 à 150 kHz.

2. Dispositif d'antenne de vitre pour un véhicule automobile selon la revendication 1, dans lequel une bobine d'arrêt de hautes fréquences (60) est connectée en série au condensateur (32) pour la seconde résonance.

3. Dispositif d'antenne de vitre pour un véhicule automobile selon la revendication 1 ou 2, dans lequel la seconde résonance est une résonance parallèle.

4. Dispositif d'antenne de vitre selon l'une quelconque des revendications 1 à 3, dans laquelle une résistance ayant une valeur de résistance de 200 Ω - 25 kΩ est connectée entre le condensateur (32) pour la seconde résonance et la carrosserie du véhicule automobile servant de masse.

5. Dispositif d'antenne de vitre selon une ou plusieurs des revendications 1 à 4, dans lequel il existe une relation $f_H/15 \leq f_R \leq 3f_L$, où f_R représente la fréquence d'auto-résonance de la bobine d'arrêt de hautes fréquences (52), f_H représente la fréquence la plus élevée de la bande d'émission FM et f_L représente la fréquence la plus basse de la bande d'émission FM.

FIG. 1

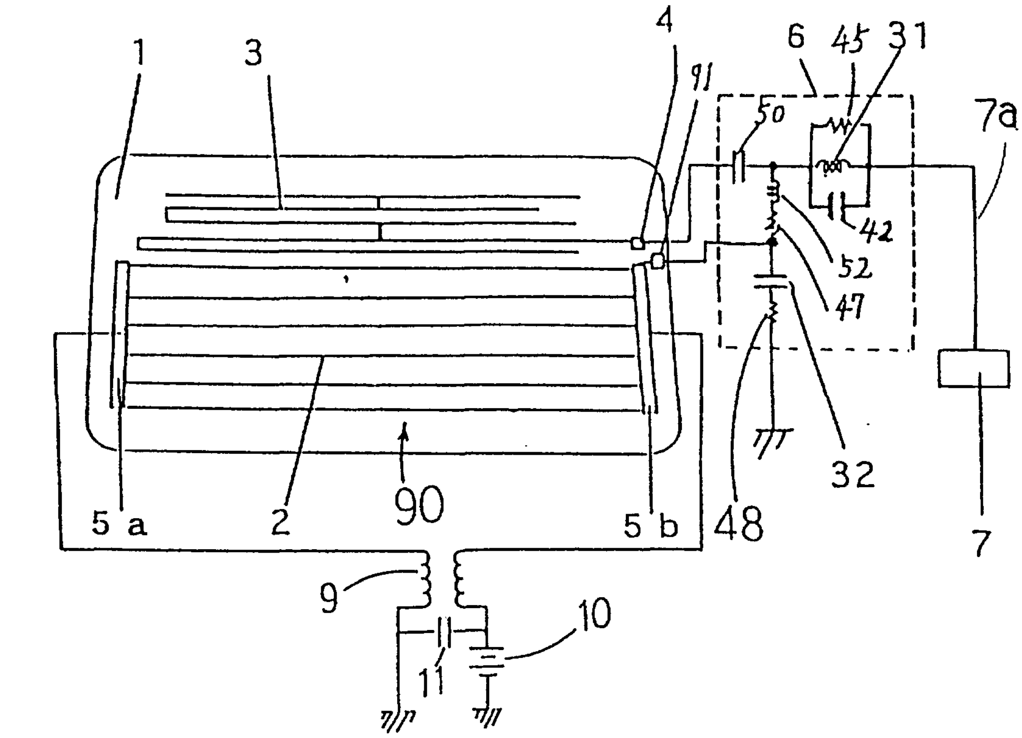
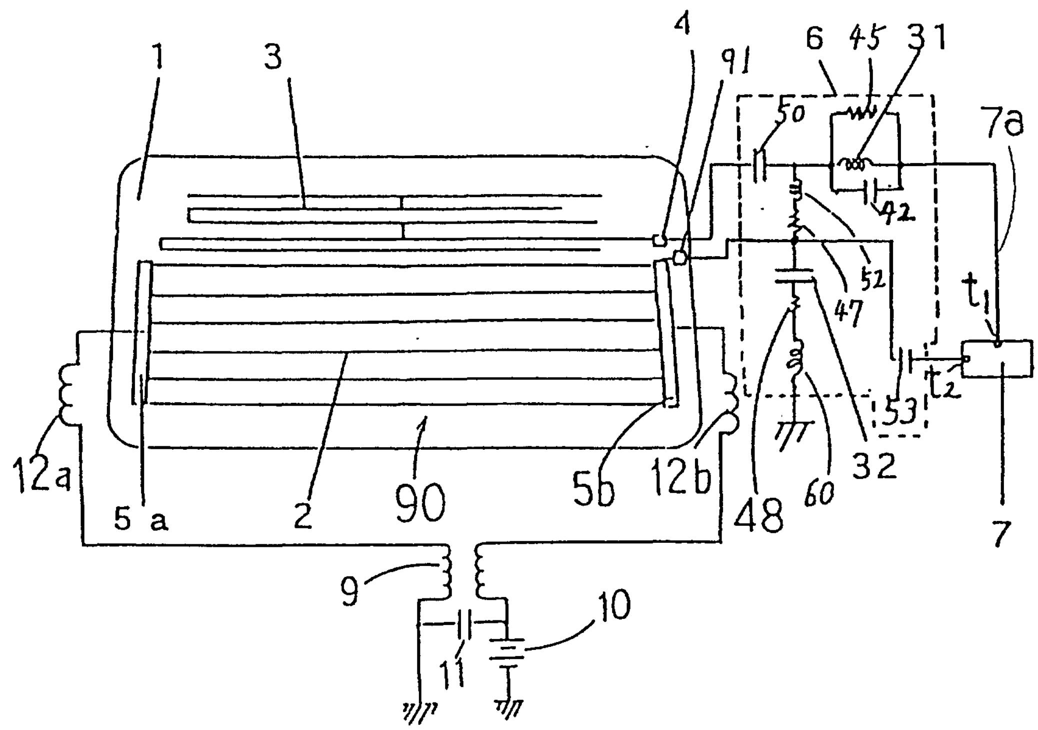
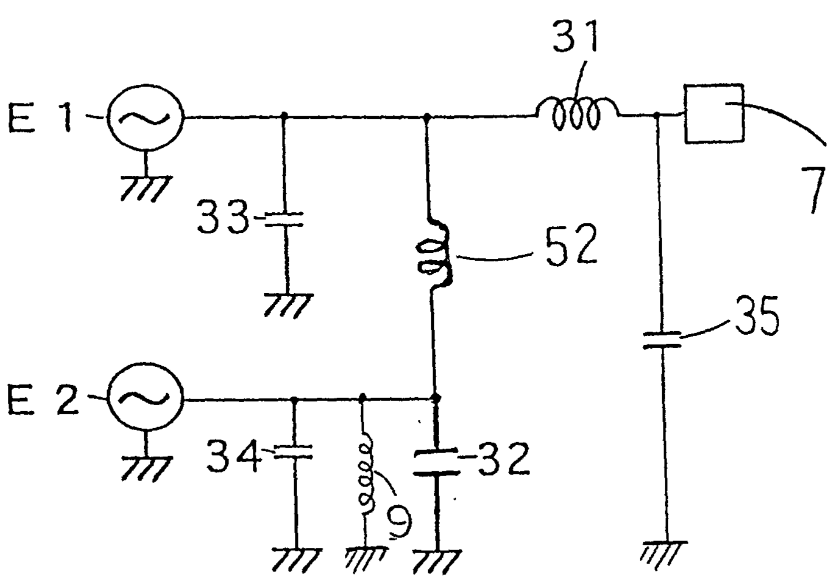

1
3
4
91
6
45
31
50
7a
42
52
47
5 a
2
90
5 b
48
32
7
9
10
11

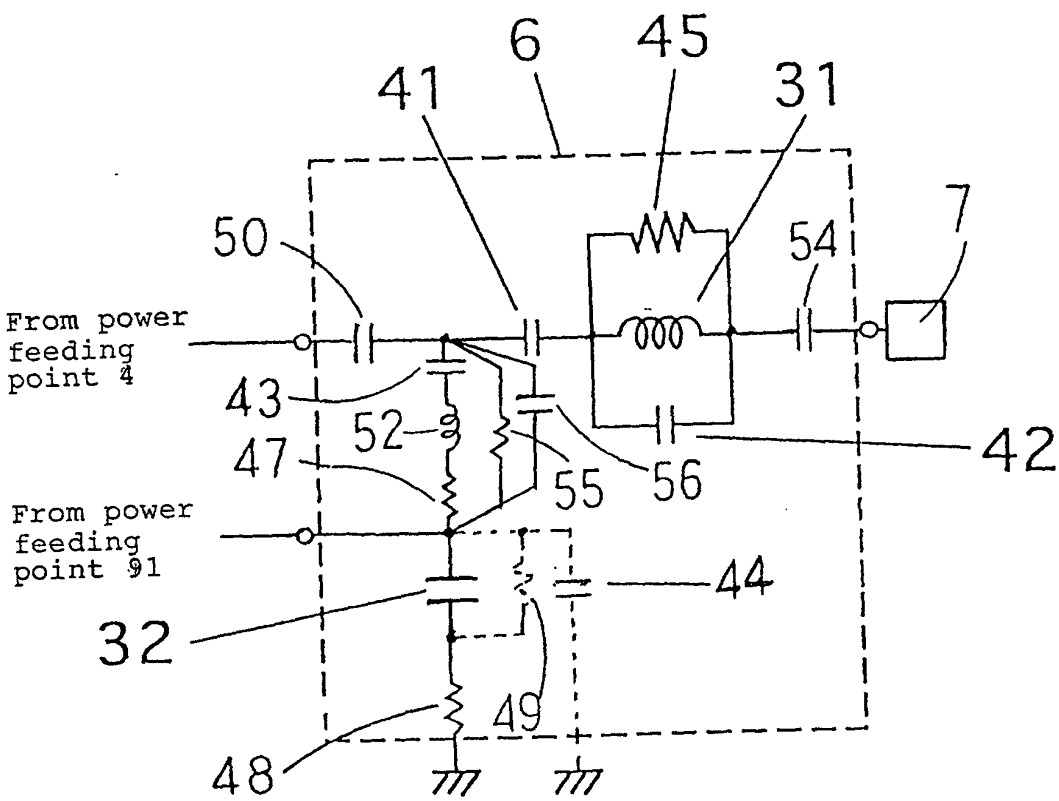
FIG. 2


1
3
4
91
6
45
31
50
7a
42
52
47
t1
t2
53
12a
5 a
2
90
5b
12b
48
60
32
7
9
10
11

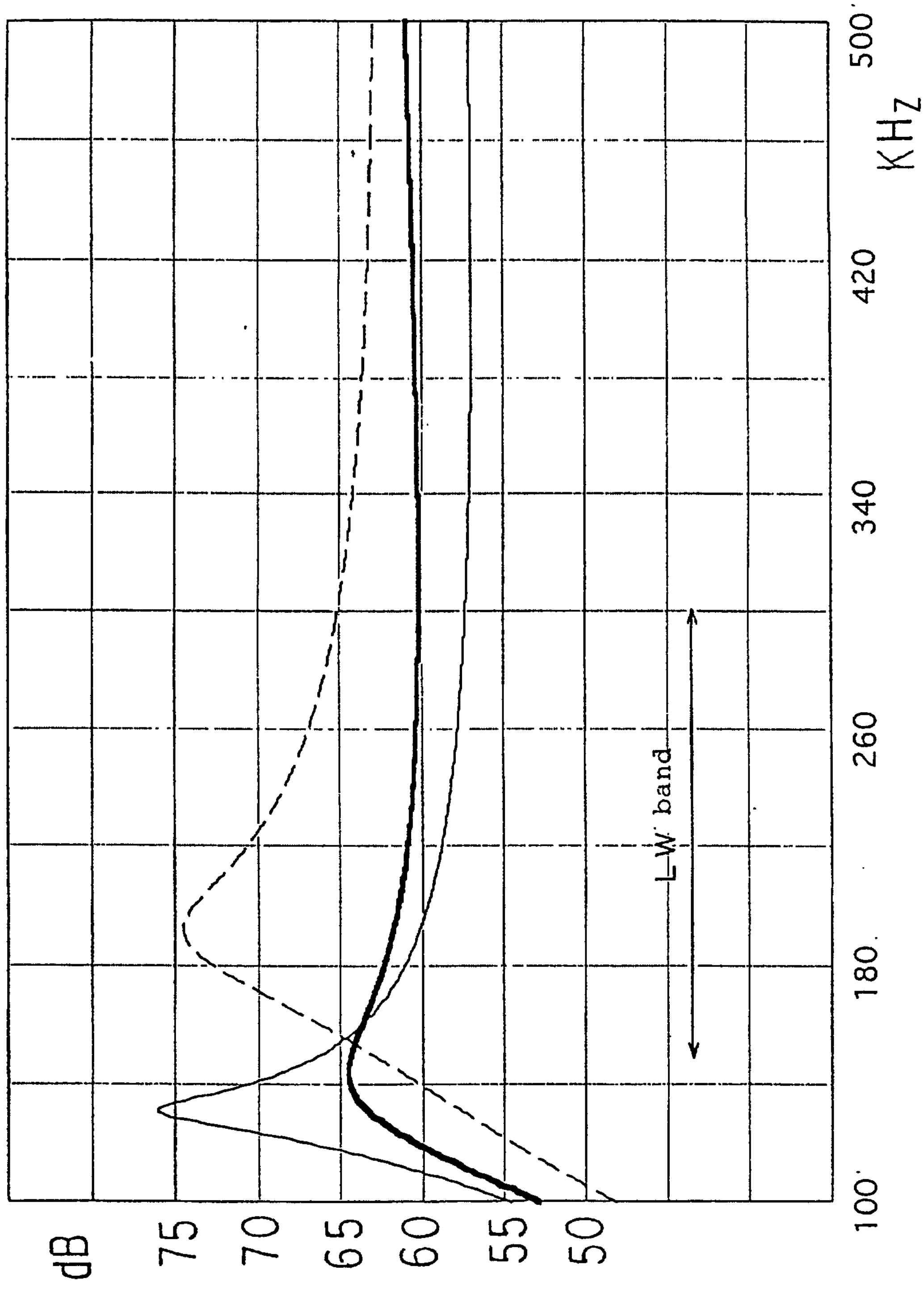
F I G. 3


31
E 1
7
33
52
35
E 2
34
32
9

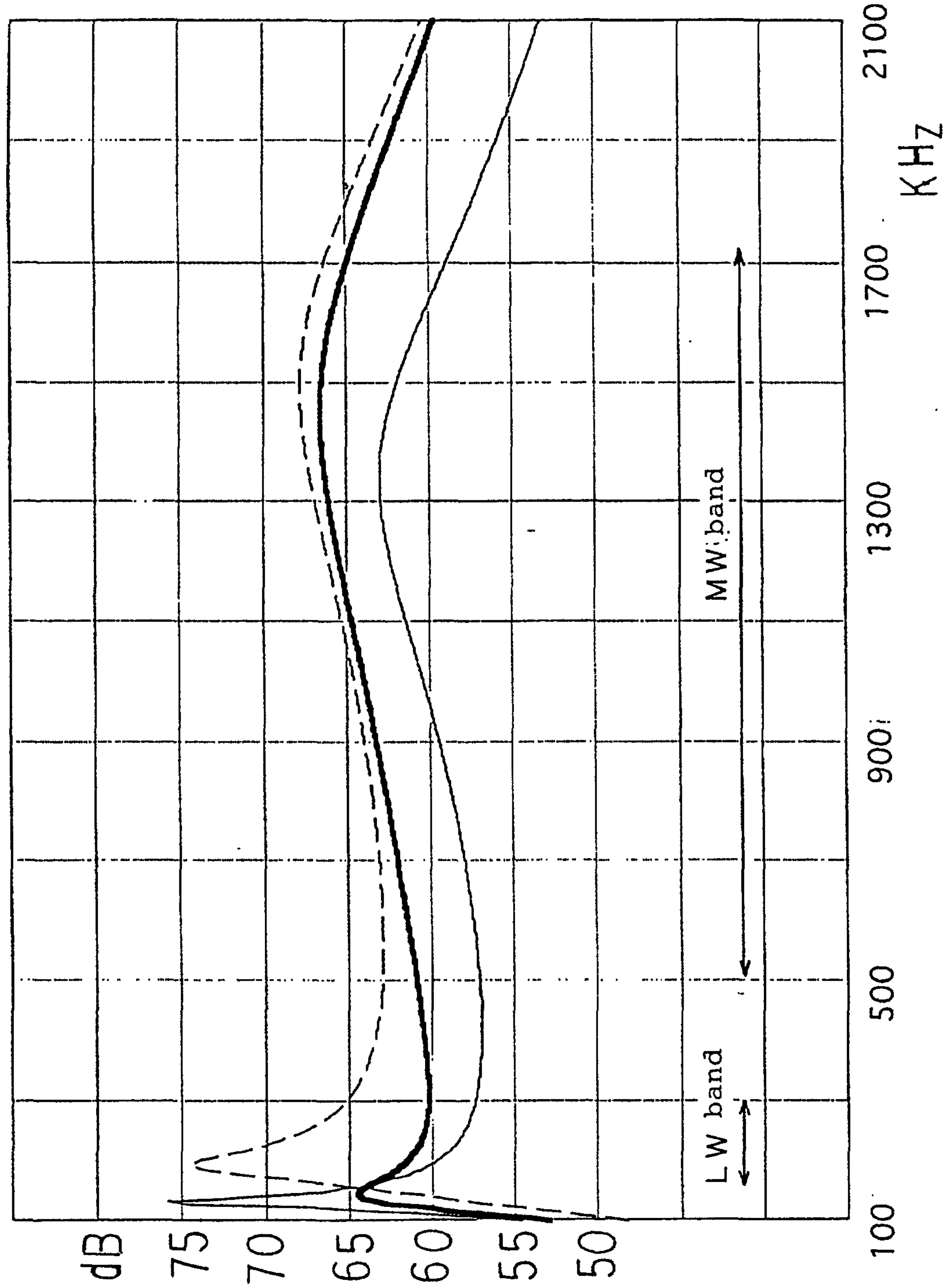
F I G. 4


6
45
41
31
50
54
7
From power feeding point 4
43
52
47
55
56
42
From power feeding point 91
44
32
49
48

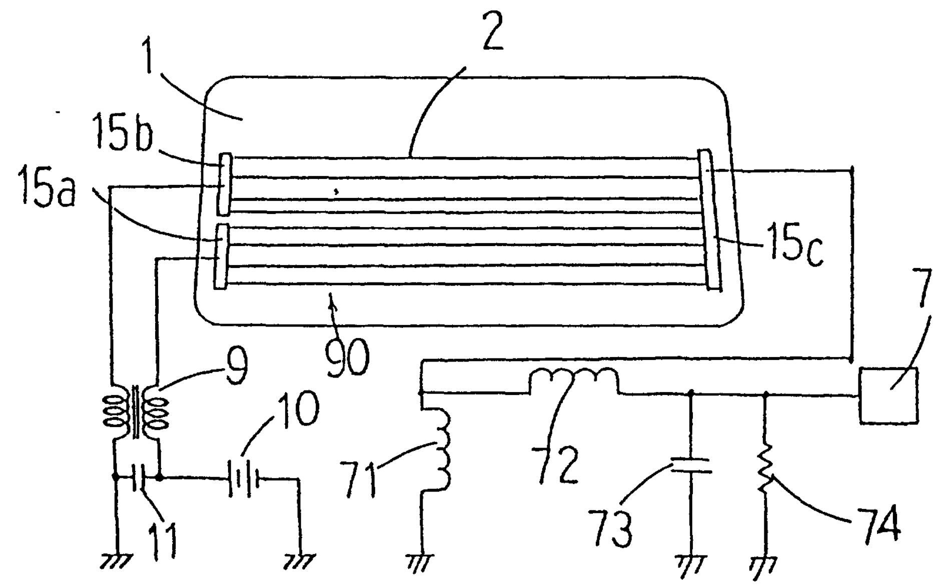
F I G. 5



F I G. 6


dB
75
70
65
60
55
50
100
500
900
1300
1700
2100
KHz
LW band
MW band

F I G. 7


2
1
15b
15a
15c
7
90
9
10
71
72
73
74
11

F I G. 8

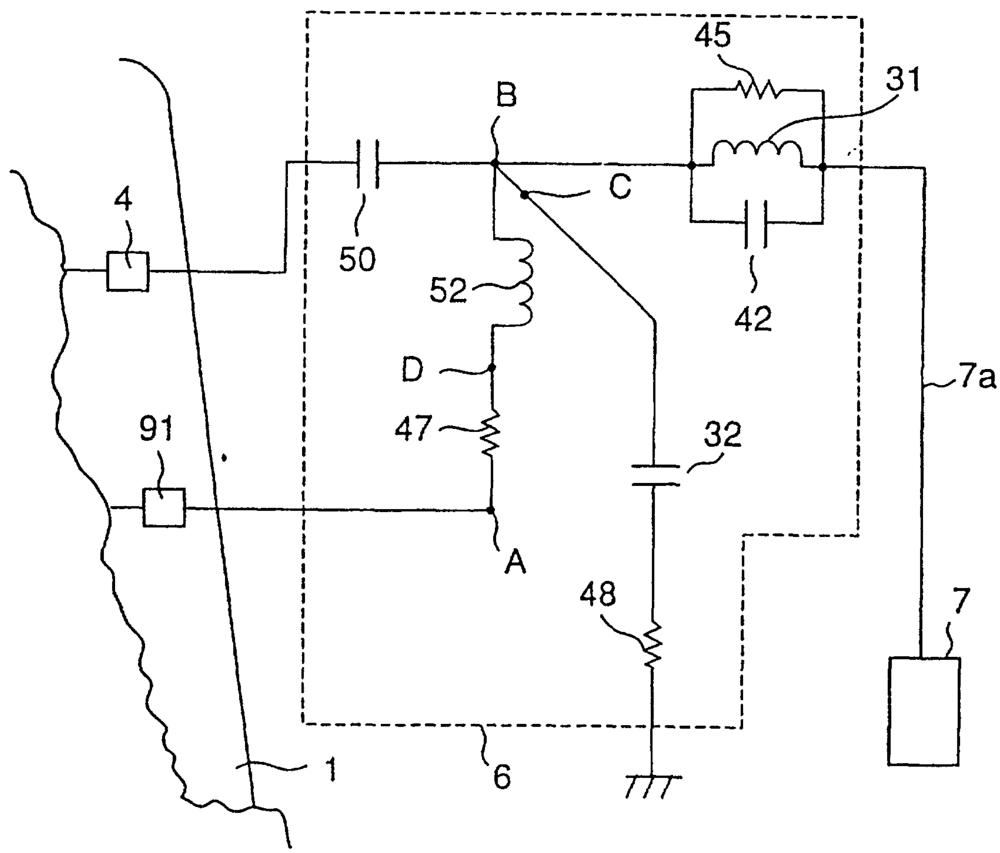

45
31
B
C
4
50
52
42
D
7a
91
47
32
A
48
7
1
6

FIG. 9

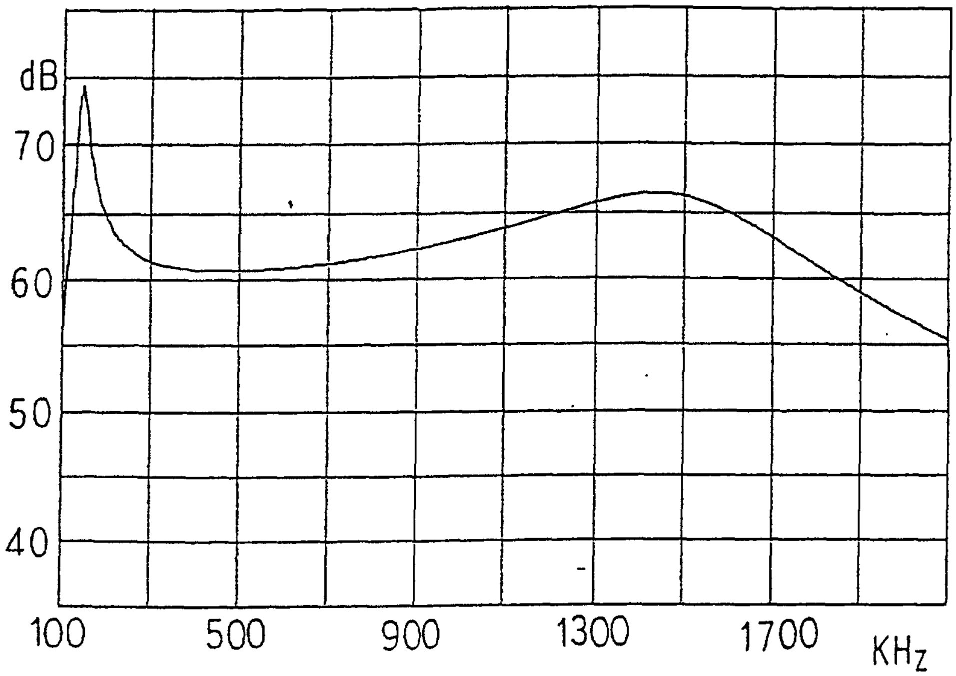
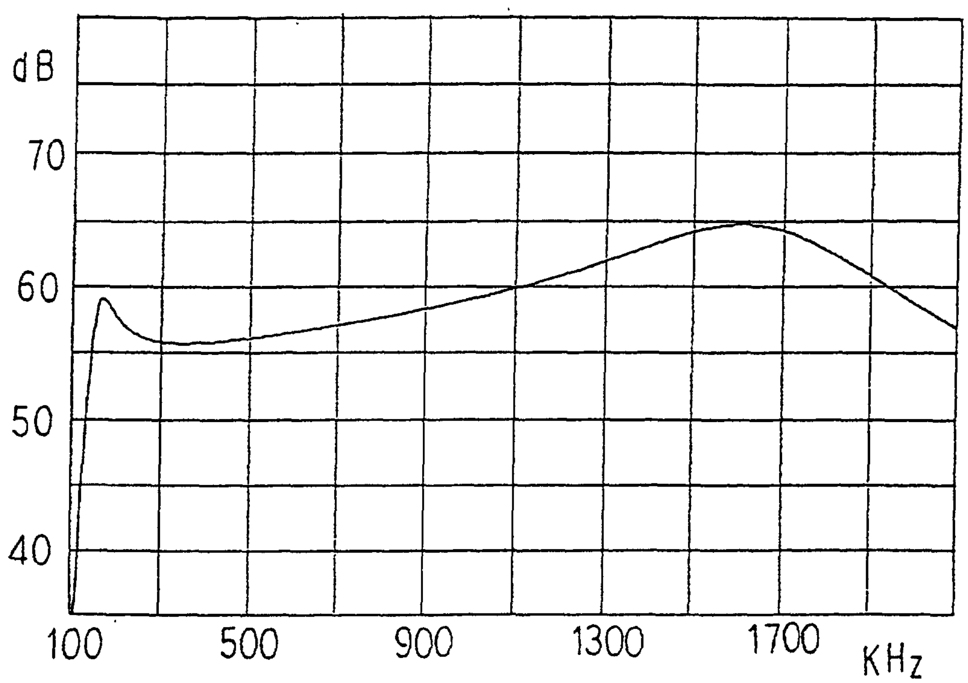
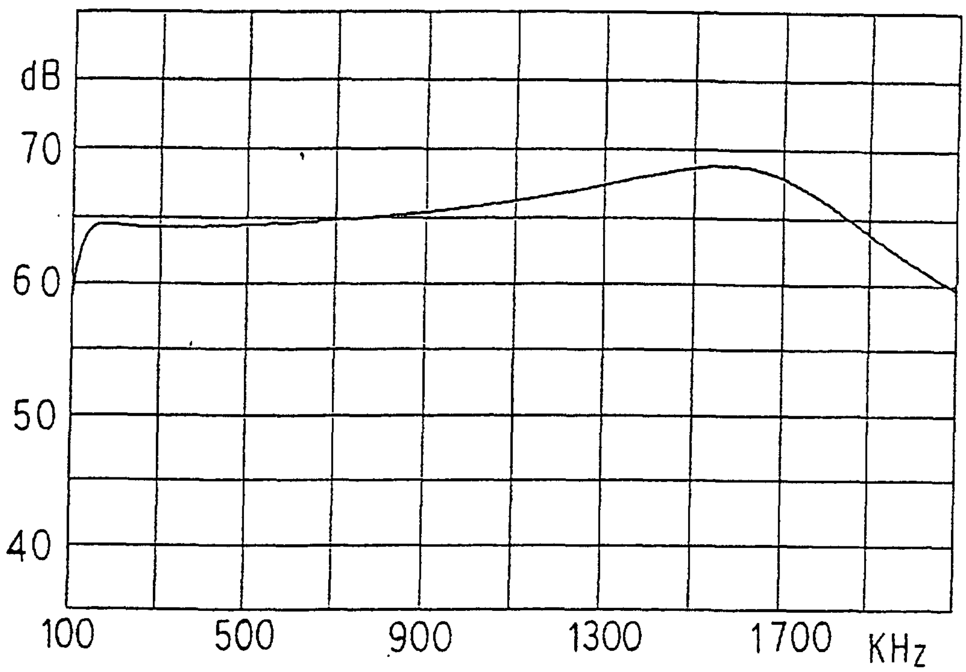

dB
70
60
50
40
100
500
900
1300
1700
KHz

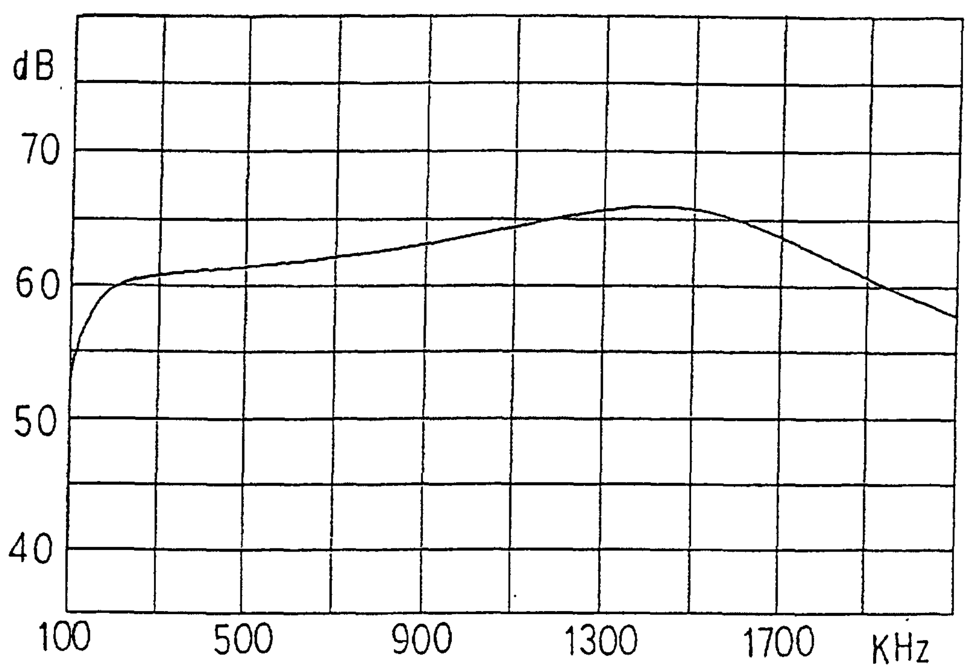
FIG. 10


dB
70
60
50
40
100
500
900
1300
1700
KHz

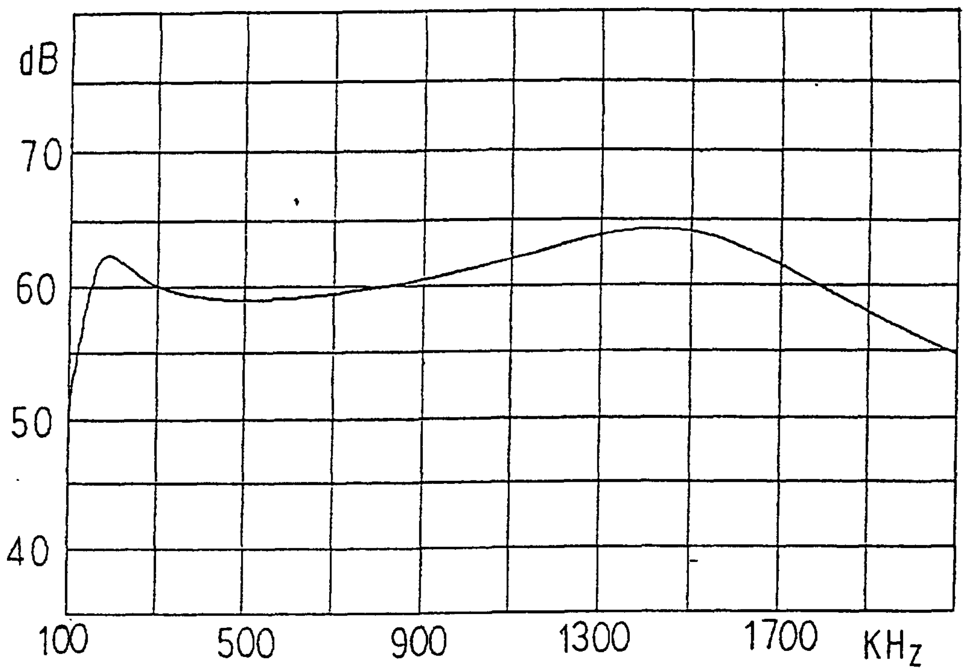
F I G. 11


dB
70
60
50
40
100
500
900
1300
1700
KHz

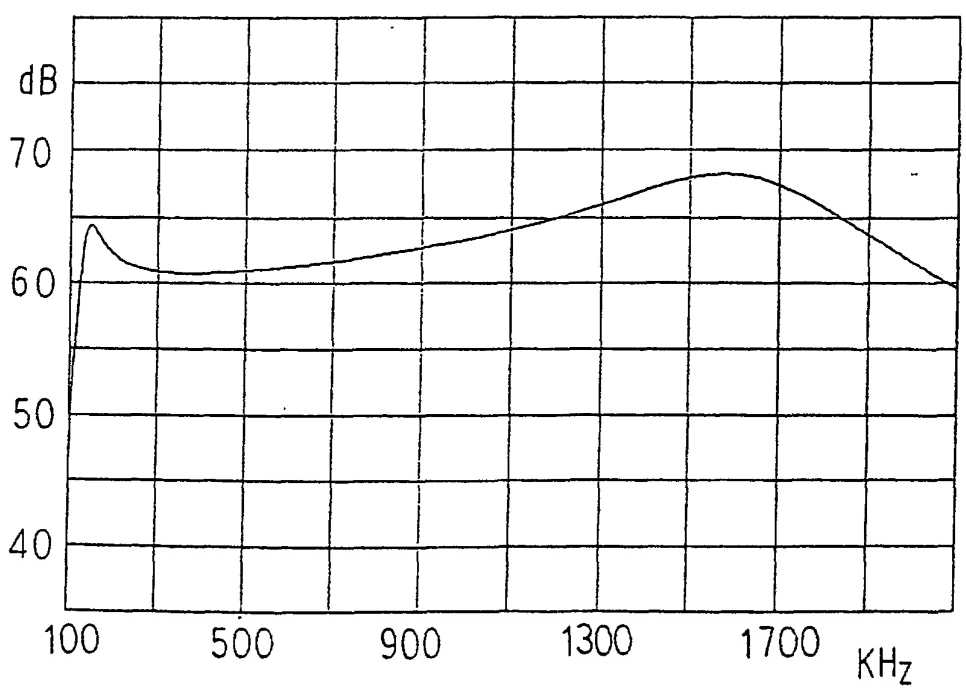
F I G. 12


dB
70
60
50
40
100
500
900
1300
1700
KHz

F I G. 13


dB
70
60
50
40
100
500
900
1300
1700
KHz

F I G. 14


dB
70
60
50
40
100
500
900
1300
1700
KHz