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(71) Applicant: **NIPPON SHEET GLASS CO., LTD.**
5-11, 3-Chome Doshomachi
Chuo-ku Osaka (JP)

(72) Inventor: **Sakurai, Kaoru, c/o Nippon Sheet Glass Co., Ltd.**
5-11, 3-chome, Doshomachi
Chuo-ku, Osaka (JP)
Inventor: **Iijima, Hiroshi, c/o Nippon Sheet Glass Co., Ltd.**
5-11, 3-chome, Doshomachi
Chuo-ku, Osaka (JP)
Inventor: **Fujita, Kazuhisa, c/o Nippon Sheet Glass Co., Ltd.**
5-11, 3-chome, Doshomachi
Chuo-ku, Osaka (JP)

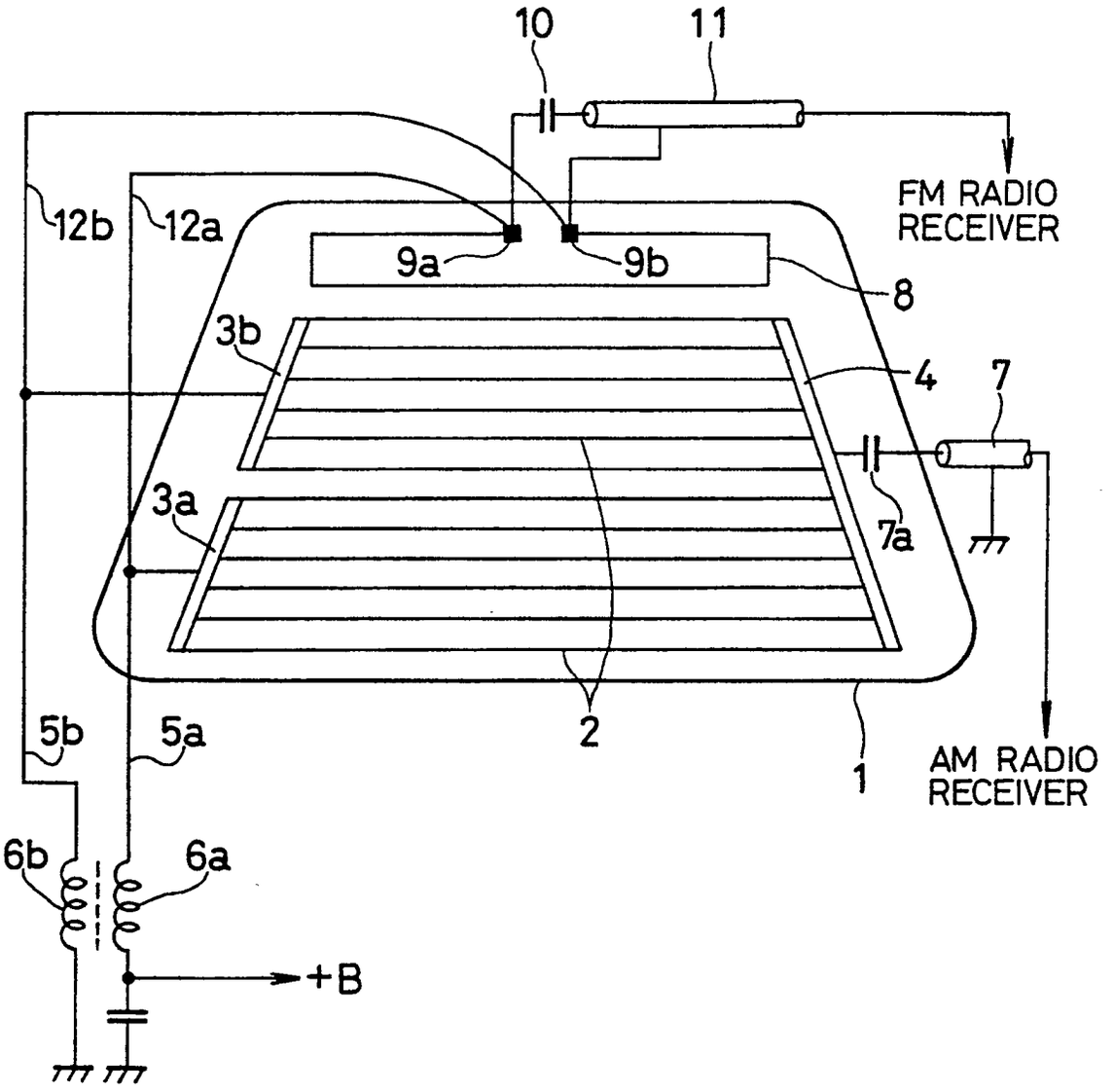
(74) Representative: **Jackson, David Spence et al**
REDDIE & GROSE 16, Theobalds Road
London, WC1X 8PL (GB)

(54) **Antenna apparatus for a motor vehicle.**

(57) An antenna element (8) is arranged in one of the areas above or below a heating area on a motor vehicle window (1). The antenna element (8) is tuned to have a natural frequency which is higher than that of heater wires (2) on the heating area and forms a closed circuit through which a heating current flows. The heated area of the window is thus increased without using additional heating wires which are naturally not suited for an antenna for high frequency wave reception. A common power source (B) supplies heating current through leads (5a, 5b) to the heating wires (2) and the antenna element (8). Radio frequency chokes (6a, 6b) protect the source (B) from at least FM frequency current.

EP 0 438 247 A1

FIG. 1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ANTENNA APPARATUS FOR A MOTOR VEHICLE

This invention relates to an antenna apparatus for a motor vehicle having a glass window on which a conductor is provided by pointing or the like.

Description of the Prior Art

Generally, defogging heater wires are provided on a rear glass window of a motor car. It is well-known that an antenna conductor for radio or TV reception is provided on an upper or lower area of defogging area for the heater wires. The antenna conductor has an advantage that tuning in directivity and bandwidth or the like can be achieved by wiring conductor pattern freely on the glass window. It is well-known too to use the heater wires as an antenna conductor.

The heater wires have a fixed conductor length and an interval of the conductors. It is difficult to change wiring of the conductors for adjusting effective length which determines bandwidth or for improving directivity. Therefore, broadcast band which the heater wires can not receive is assigned to the antenna conductor located on upper or lower area of the heater wires.

A space is required for wiring the antenna conductor. In this space, however, fog can not be removed. On the contrary, when defogging area of the heater wires is enlarged, the space for the antenna conductor is reduced resulting in poor tuning.

OBJECTS AND SUMMARY OF THE INVENTION

In accordance with the problems, it is an object of this devise to provide an antenna apparatus which solves both problems to enlarge defogging area and to ensure space for arranging the antenna conductor.

An antenna apparatus according to this devise comprises defogging heater wires provided on a central heating area on a motor vehicle window ; and an antenna element arranged in at least one of upper and lower areas of the heating area ; said antenna element being tuned up to have a natural frequency which is higher than that of heating wires and constituting a closed circuit for passing a heating current therethrough.

The antenna conductor is used as a heater conductor which forms a closed circuit for passing a heating current therethrough. The antenna conductor is assigned for a reception band located at sufficiently higher frequency than that of the heater wires. Reception characteristics can be improved by tuning the arrangement of the antenna conductor.

The above, and other, objects, features and advantages of the present invention, will become readily apparent from the following detailed description thereof which is to be read in connection with the accompanying drawings in which the same or corresponding parts are identified by the same reference numerals in the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a front view of a rear window glass of a motor car and an electric system thereof according to an embodiment of this invention ;
Figs. 2 - 4 show modifications to Fig. 1 ; and Fig. 5 is another modification of antenna conductor.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Fig. 1 shows an example of arrangement of conductor on a motor vehicle window and an electric system according to this invention.

A plurality of heater wires 2 are provided on a rear glass window 1 with divided into upper and lower groups. Power is supplied to bus bars 3a and 3b at respective ends of the groups through an intermediate bus bar 4 so as to form a return path. Power feed lines 5a and 5b are connected to the bus bars 3a and 3b. A heating current passes from a main power +B to the power feed line 5a through an RF choke coil 6a. The power feed line 5b connected to the bus bar 3b is grounded through a choke coil 6b.

The choke coils 6a and 6b are coupled in demagnetization direction to each other so that a core does not saturates with a large heating current. Impedance of the choke coils 6a and 6b are very large in a radio broadcast band. Impedance to the ground of the heater wires is enhanced so that it can be used as an antenna. A reception signal of the heater wires 2 is transmitted to an AM/FM radio receiver through a coupling capacitor 7a connected to a terminal of the intermediate bus bar 4 and a coaxial cable 7.

An upper blank area above the defogging area with the heater wires 2 is provided with an antenna conductor 8 tuned to receive an FM broadcast wave. The antenna conductor has an wiring arrangement with laterally extending oblong rectangle. A pair of feed terminals 9a and 9b is provided at the center of longitudinal (horizontal) side along the upper side of the window glass 1. The feed terminal 9a is coupled to a core wire of a coaxial cable 11 through a DC-cut capacitor 10. The feed terminal 9b is coupled to an outer conductor of the coaxial cable 11. The antenna conductor 8 operates as an unbalanced antenna with one side grounded. An FM reception signal received by the antenna conductor 8 is fed to an FM radio receiver through the coaxial cable 11.

The antenna conductor 8 is tuned to have a longer side and shorter side respectively 1600 mm

and 30 mm for receiving an FM broadcast wave with high sensibility. The antenna conductor 8 forms a closed circuit when viewed from the feed terminals 9a and 9b so as to be operated as a defogging heater conductor. A positive power feed line 12b is connected to the feed terminal 9a with branched from the power feed line 5b. A power feed line 12b as grounded side is connected to the feed terminal 9b with branched from the power feed line 5b. A heating current passes from the feed terminal 9a to the feed terminal 9b to heat the glass in an area enclosed by the conductor 8 as well as the vicinity thereof for defogging.

Fig. 2 shows a modification of a circuit for supplying heating current. In this example a heating current is supplied to the antenna conductor 8 via the choke coils 6a and 6b. On the other hand, a heating current is directly supplied to the heater wires 2 from a power supply without passing through the choke coils 6a and 6b. In this power supply circuit, the choke coils 6a and 6b is set exclusively for FM band. For AM band inductance of the choke coils must be set large, resulting in increase of stray capacitance along with increase of windings. Leaking signal through the choke coil can not be ignored in FM band. This problem can be settled when an exclusive choke coil for FM band is employed. In Fig. 2, additional choke coils for AM band can be inserted in the power feed lines 5a and 5b.

Fig. 3 shows another example in which the antenna conductor 8 is fed with power at the lateral side (shorter side). Terminals 9a and 9b are provided to supply power thereto and collect reception signal therefrom. Additionally, an auxiliary element 8a is attached to an end opposed to the terminals 9a and 9b to improve reception characteristics of the conductor 8.

A further modification is shown,in Fig. 4 in which the bus bar 3b in the grounded side is extended upward to connect to the feed terminal 9b of the antenna conductor 8 seen in Fig. 3. In this embodiment, the power feed line 12b in Fig. 3 is not employed.

Fig. 5 shows another modification in which a plurality of horizontal parallel conductors is provided to the antenna conductor 8. The number of the horizontal conductor may be adjusted to tune the antenna. A closed circuit for heating is formed by parallel connection of the conductors.

In the embodiment of Figs. 1 - 4, the antenna conductor 8 may be located in the lower blank area below the defogging area with heater wires 2.

According to this antenna apparatus of this invention, the antenna conductor located outside the defogging area is used as a heating conductor which constitutes a closed circuit for a heating current and tuned to have a natural frequency being higher than that of the heating wires in the defogging area.

Therefore, according to this devise, defogging area can be enlarged to secure rear view without degrading antenna characteristic in high frequency range.

Claims

1. Antenna apparatus for motor vehicle comprising;
   defogging heater wires provided on a central heating area on a motor vehicle window ; and
   antenna element arranged in at least one of upper and lower areas of the heating area ;
   said antenna element being tuned up to have a natural frequency which is higher than that of heating wires and constituting a closed circuit for passing a heating current therethrough.

FIG. 1

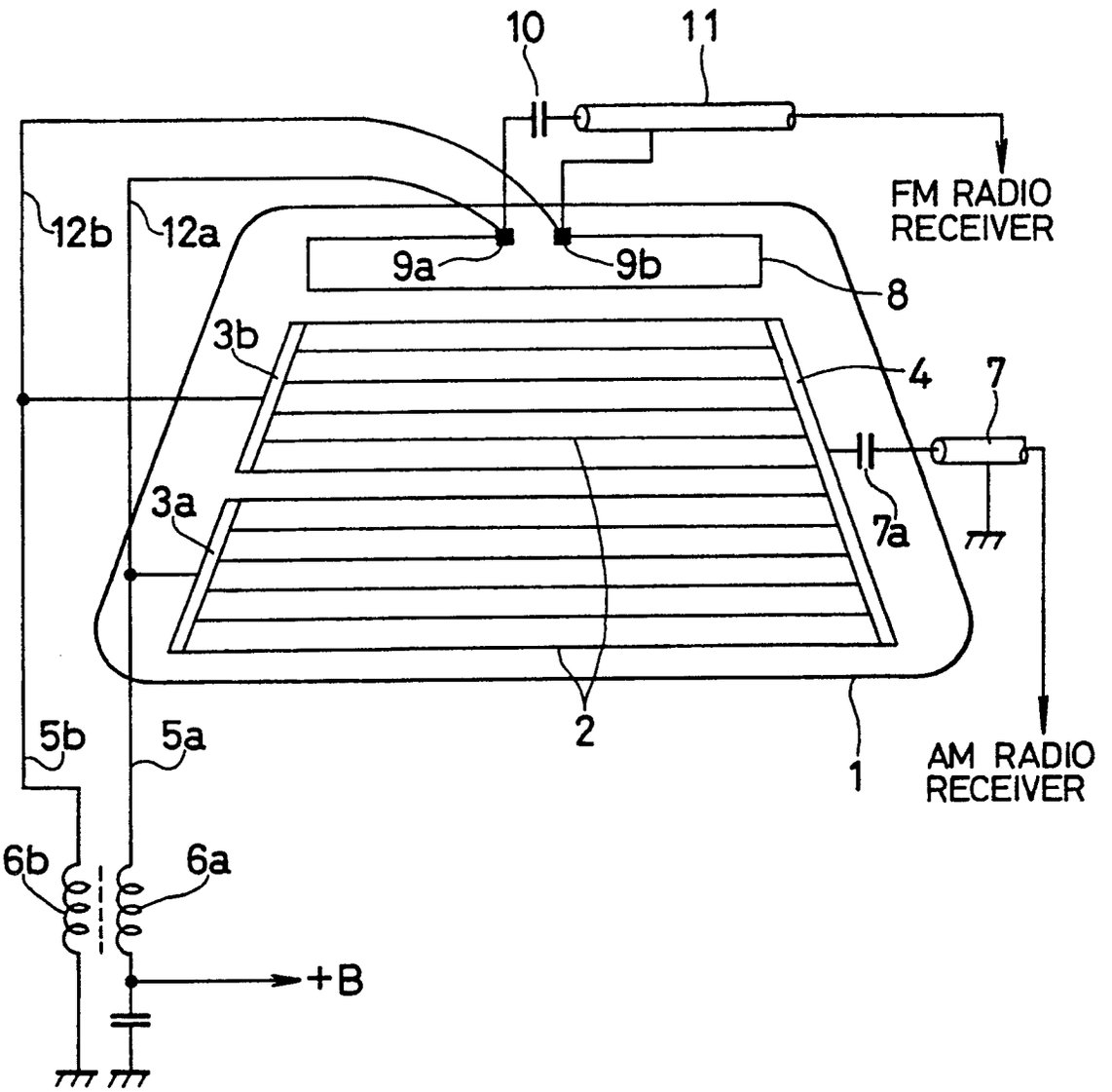
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FIG.2

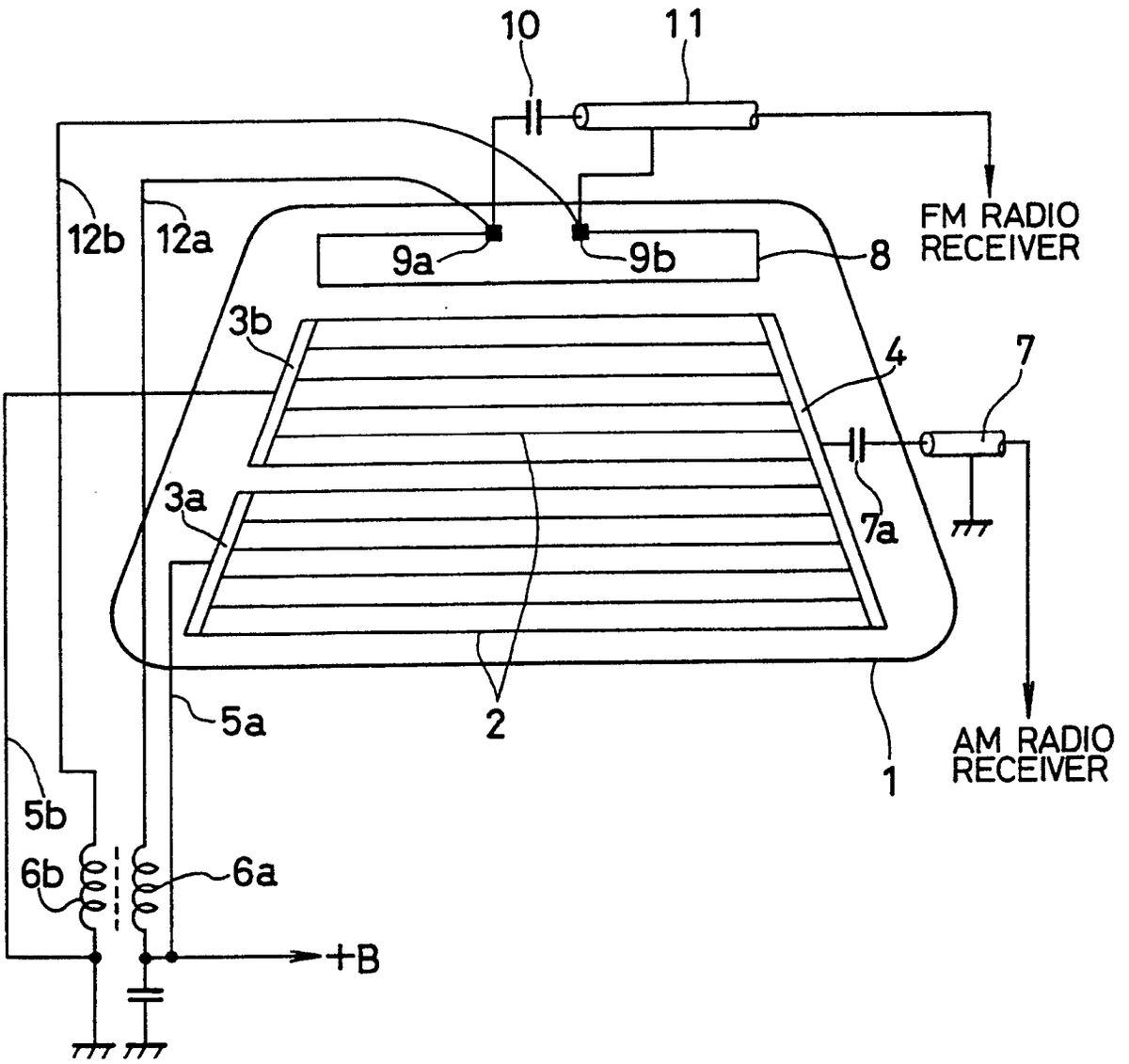
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FIG.3

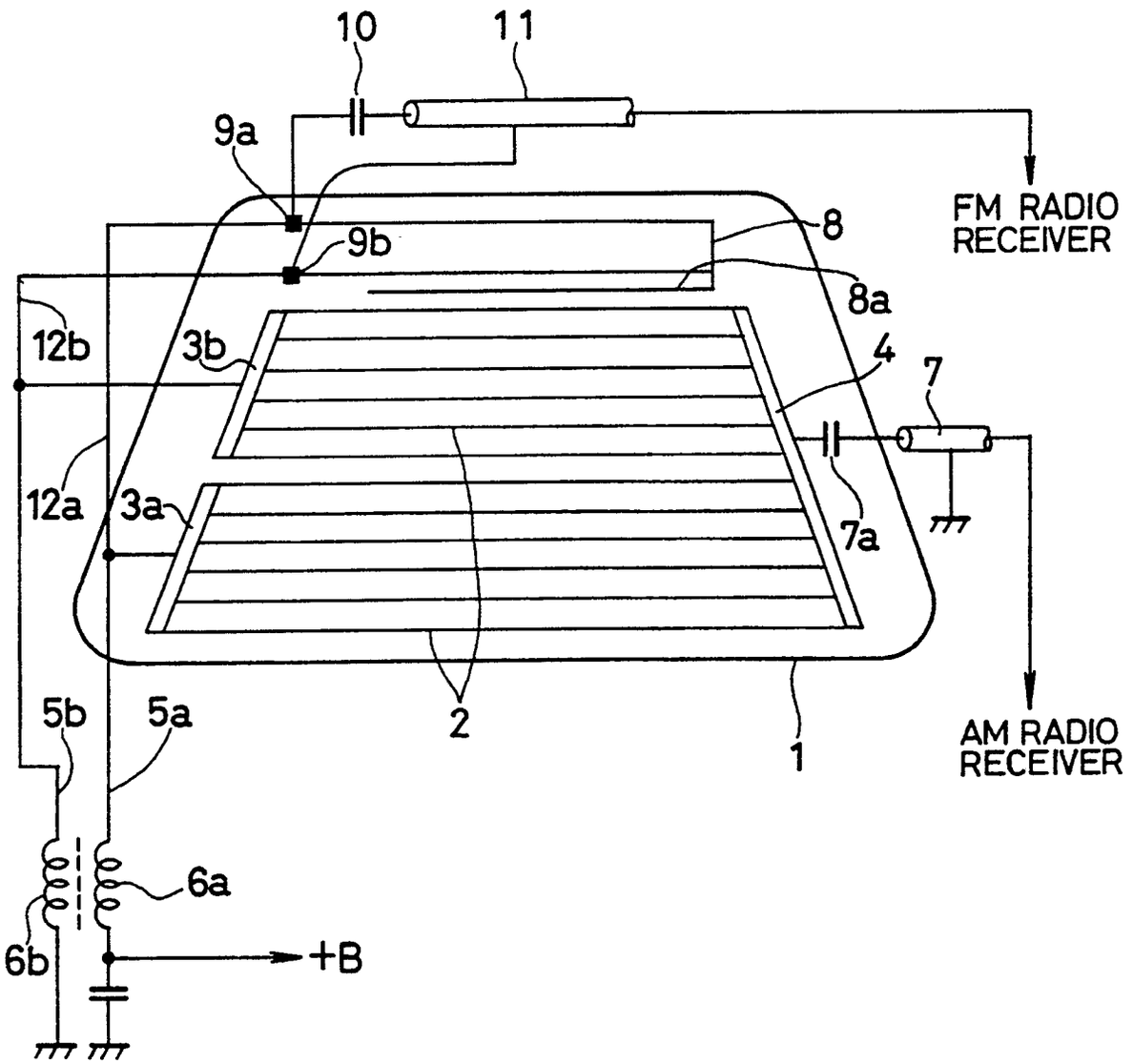
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FIG.4

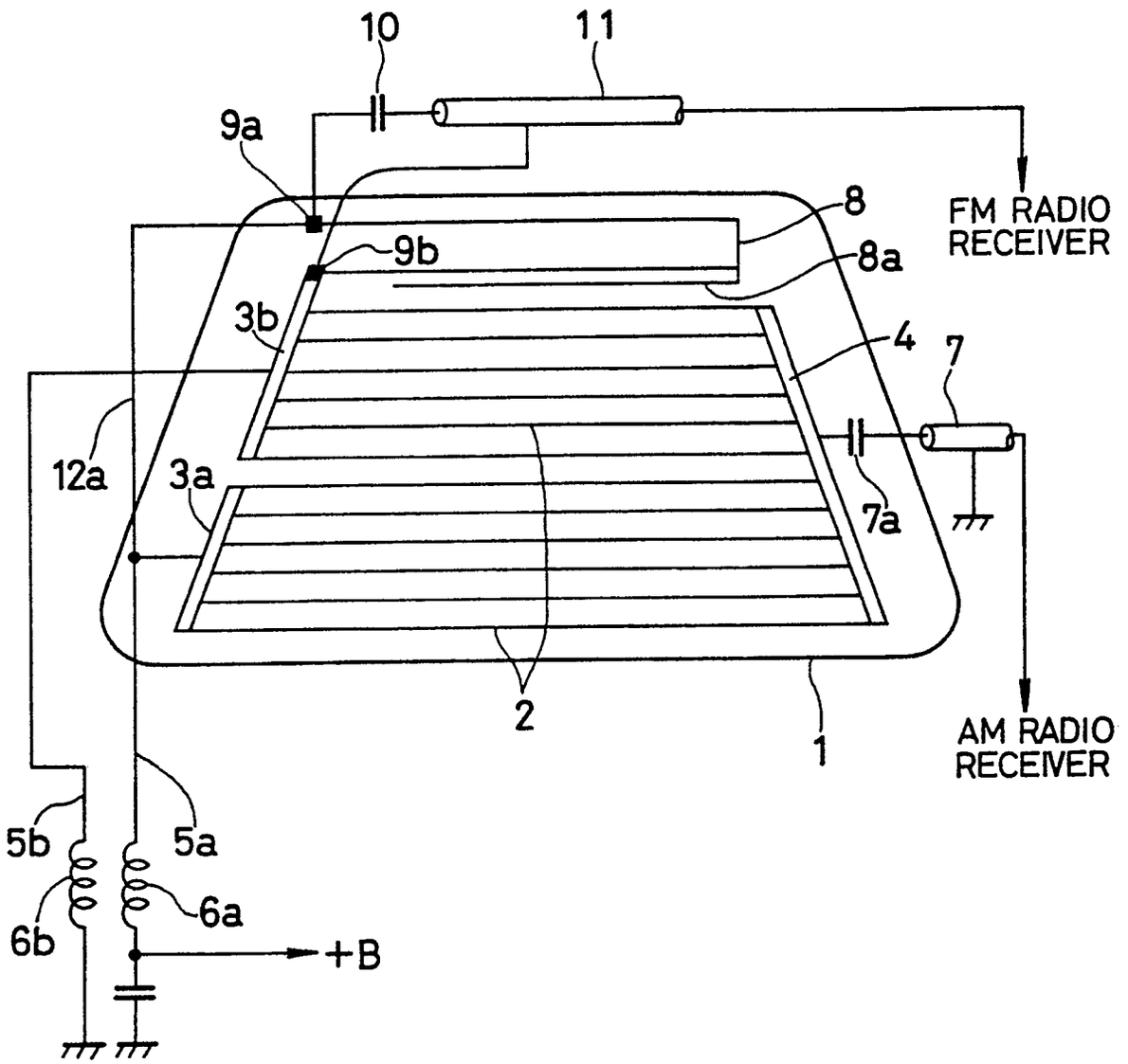
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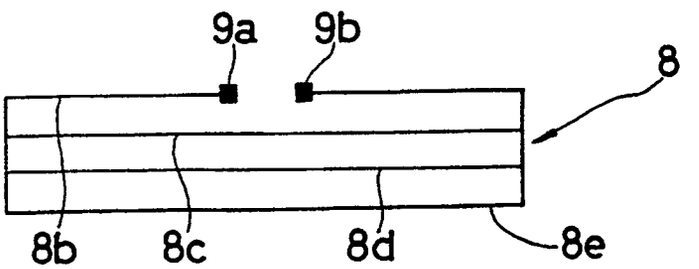
FIG.5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European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 30 0238

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	FR-A-2 258 015 (E.C.H. ORGAN) * figure 2; page 3, line 31 - page 4, line 5 *	1	H 01 Q 1/12
P,Y	EP-A-0 382 895 (ROBERT BOSCH) * figure 1; column 1, lines 8-30 *	1	
A	EP-A-0 065 263 (ASAHI GLASS) * figure 8; abstract *		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 01 Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	26-03-1991	BREUSING J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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