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

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**EP-A- 0 065 263**  
**EP-A- 0 382 895**  
**FR-A- 2 258 015**

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## Description

### Description of the Prior Art

Generally, defogging heater wires are provided on a rear glass window of a motor car. It is well-known for an antenna conductor for radio or TV reception to be provided above or below the defogging area for the heater wires. The antenna conductor has an advantage in that tuning in directivity and bandwidth or the like can be achieved by forming the conductor pattern freely on the glass window. It is well-known too to use the heater wires as an antenna conductor. Document EP-A-65 263 discloses such a window antenna.

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

Document EP-A- 382 895, which belongs to the prior art according to Article 54 (3) EPC, i.e. which has been filed before the date of priority of the present application and published after said priority date, discloses an 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 the upper area of the heating area and constituting a closed circuit for passing a heating current therethrough;

In this document, the upper antenna conductor is tuned up to have a natural frequency which is lower than that of central heating wires.

It is an object of this invention to provide an antenna apparatus in which the problems of enlarging the fogging area and ensuring sufficient space are solved.

An antenna apparatus according to this invention 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; characterised in that said antenna element is tuned to have a natural frequency which is higher than that of said heater wires and constitutes 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 to a reception band located at sufficiently higher frequency than that of the heater wires. Recep-

tion 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 an arrangement of conductors on a motor vehicle window in an electric system embodying this invention.

A plurality of heater wires 2 provided on a rear glass window 1 are divided into upper and lower groups. Power is supplied to bus bars 3a and 3b at respective ends of the groups which are connected at their other ends 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 source terminal +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 the demagnetization direction to each other so that a core does not saturates with a large heating current. The impedances of the choke coils 6a and 6b are very large in a radio broadcast band. The impedance to the ground of the heater wires is enhanced so that it can be used as an antenna. A reception signal in the heater wires 2 is transmitted to an AM 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 is arranged as a 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-blocking 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 sensitivity. 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 as a branch from the power feed line 5b. A power feed line 12b as grounded side is connected to the feed terminal 9b as a branch 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 the power supply without passing through the choke coils 6a and 6b. In this power supply circuit, the choke coils 6a and 6b are set exclusively for an FM band. For an AM band, the inductance of the choke coils must be large, resulting in increase of stray capacitance along with increase in windings. Leaking of signal through the choke coil can not be ignored in an FM band. This problem can be settled when a choke coil exclusively for the FM band is employed. In Fig. 2, additional choke coils for the 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 at 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 8b, 8c, 8d, 8e is provided in the antenna conductor 8. The number of horizontal conductors may be adjusted to tune the antenna. A closed circuit for heating is formed by parallel connection of the conductors.

In the embodiments 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 is tuned to have a natural frequency that is higher than that of the heating wires in the defogging area.

Consequently, the defogging area can be enlarged to ensure a rear view without degrading the antenna characteristic in the high frequency range.

## Claims

1. Antenna apparatus for a motor vehicle comprising;
  - 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; characterised in that said antenna element is tuned to have a natural frequency which is higher than that of said heater wires and constitutes a closed circuit for passing a heating current therethrough.

## Patentansprüche

1. Antenne für ein Kraftfahrzeug, mit Entnebelungs-Heizdrähten in einem zentralen Heizbereich eines Kraftfahrzeugfensters, sowie mit einem Antennenelement wenigstens in einem oberen oder unteren Bereich des Heizbereichs, **dadurch gekennzeichnet**, daß das Antennenelement so abgestimmt ist, daß seine Eigenfrequenz höher liegt als die der Heizdrähte, und ferner als geschlossene und den Durchfluß eines Heizstroms erlaubende Schaltung ausgebildet ist.

## Revendications

1. Dispositif d'antenne pour un véhicule automobile comprenant :
  - des fils chauffants de dégivrage disposés sur une zone centrale de chauffage sur une vitre de véhicule automobile ; et
  - un élément antenne agencé dans au moins l'une des zones supérieure et inférieure de la zone chauffante ;
  - caractérisé en ce que ledit élément antenne est accordé pour avoir une fréquence propre qui est plus élevée que celle desdits fils chauffants et constitue un circuit fermé pour y faire passer un courant de chauffage.

**FIG. 1**

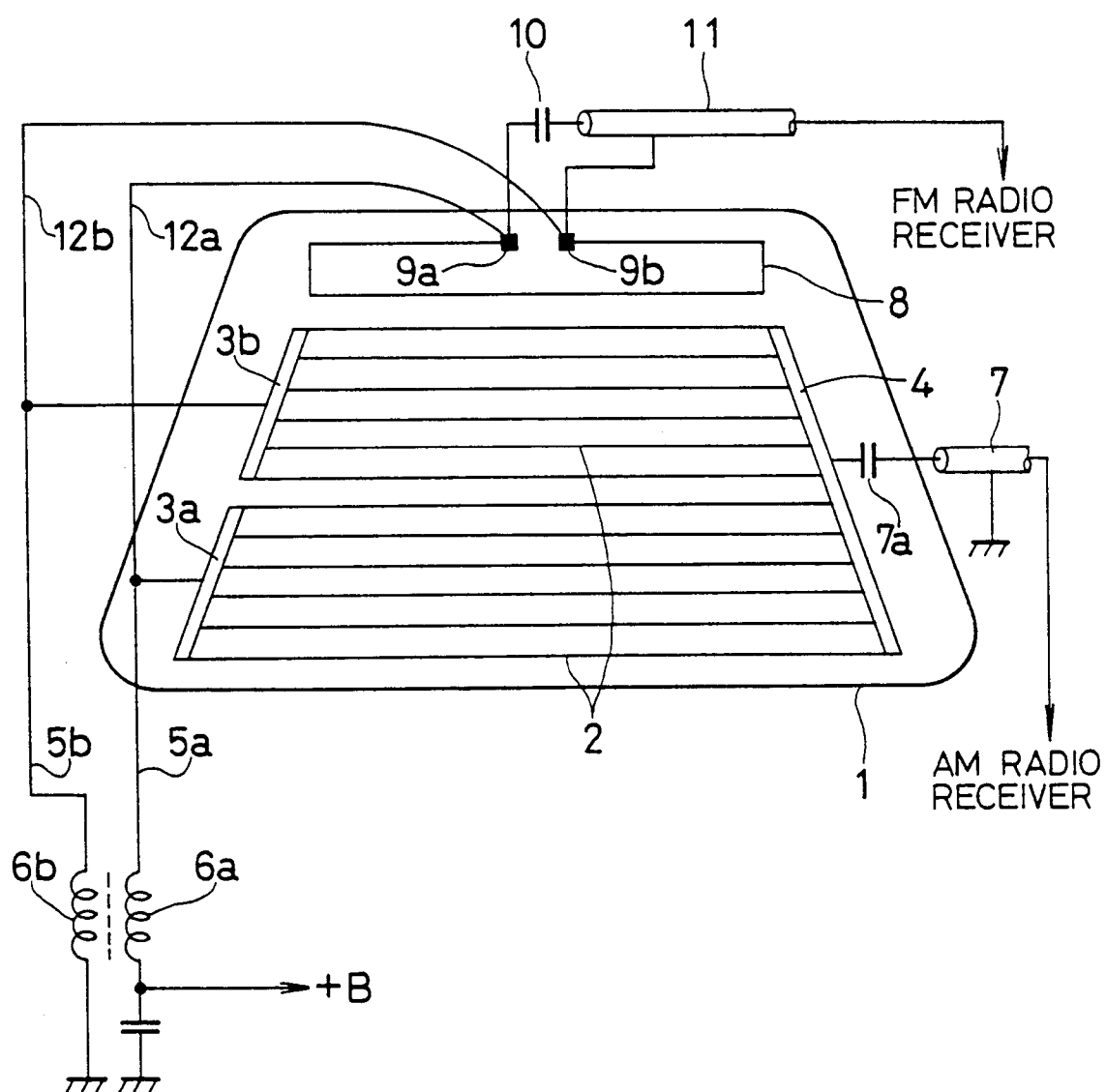


FIG. 2

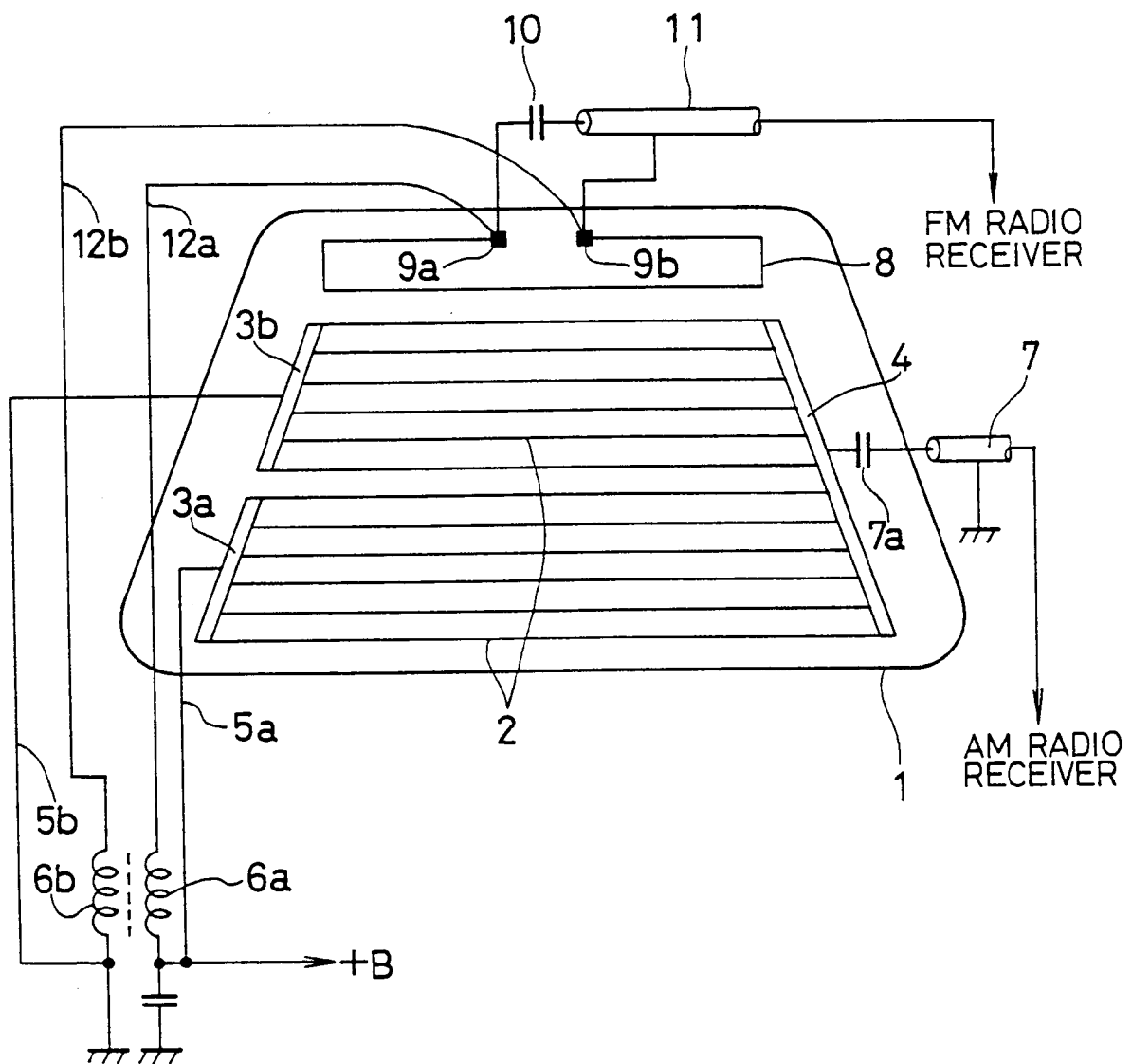


FIG. 3

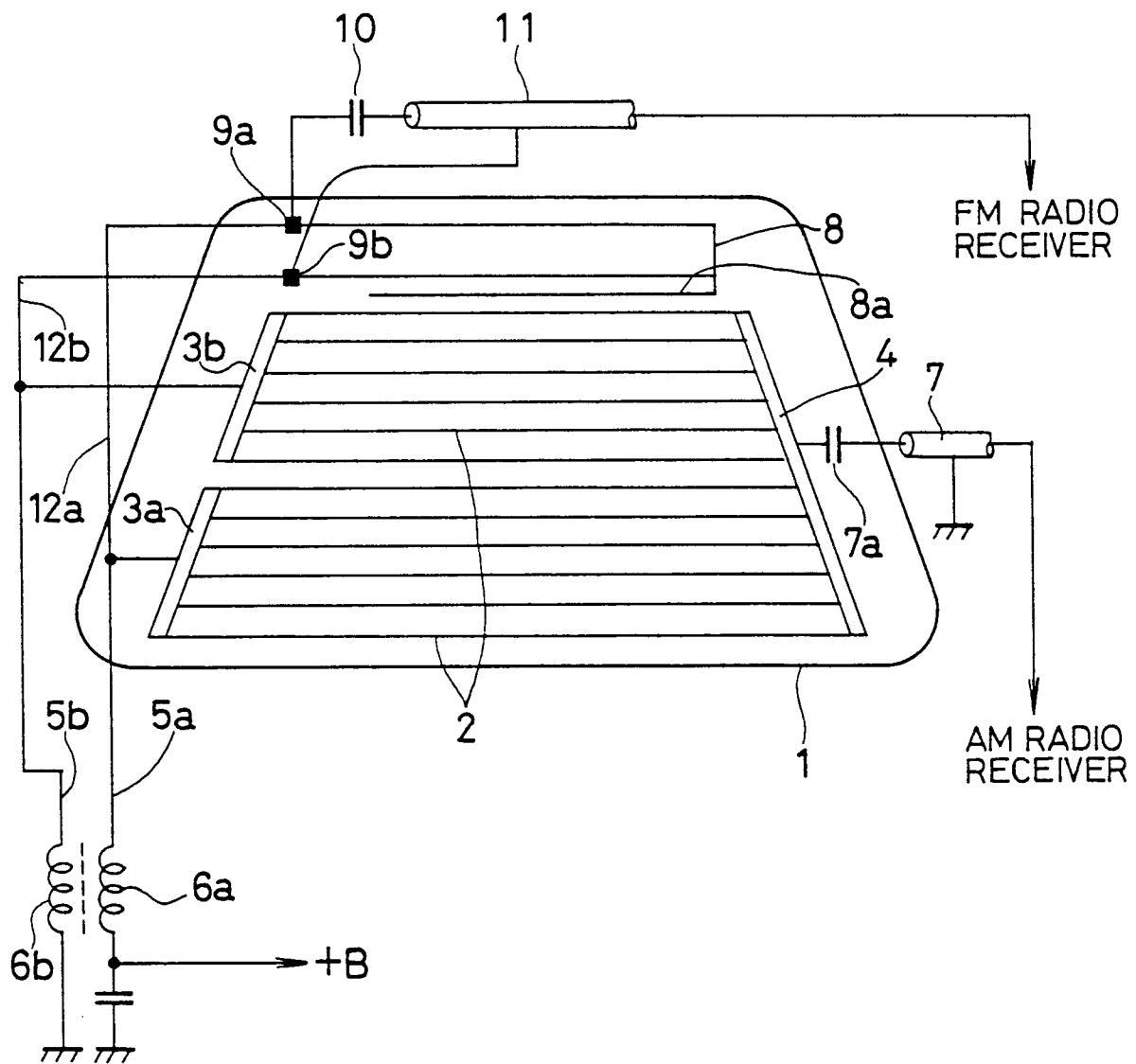
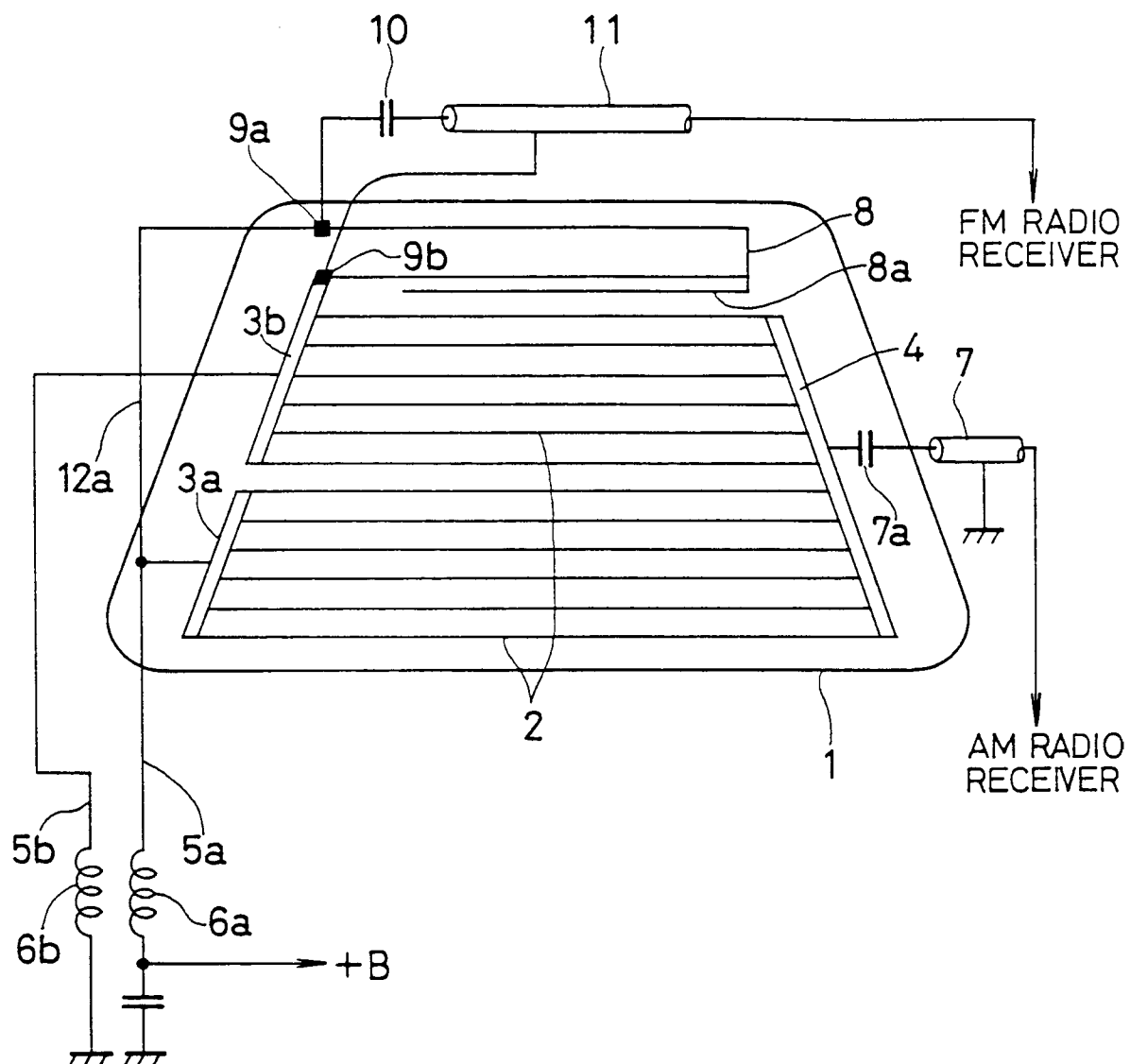


FIG. 4



**FIG.5**

