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(54) Mobile communication apparatus

(57) A portable telephone (10) includes a portable telephone body (14) made from plastic having a receiver (11), a transmitter (12) and dial keys (13), and a chip antenna (17) which is mounted on a circuit board (15) secured at the inside of the portable telephone body (14) and which is electrically connected to an RF section (16) provided on the circuit board (15) in the portable telephone (10). The chip antenna (17) is disposed near the transmitter (12) where a transmitted electric wave is unlikely to receive the effects of a person who is holding the portable telephone (10).

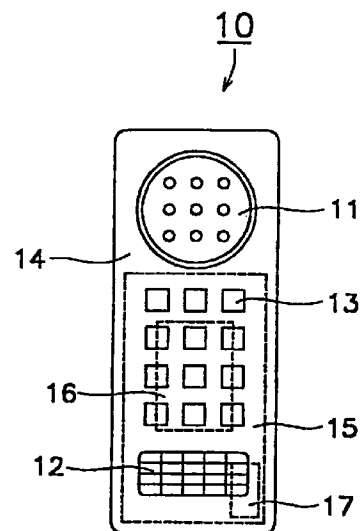


FIG. 1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to mobile communication apparatuses having a chip antenna in them for use in mobile communication and in a local area network (LAN).

2. Description of the Related Art

In a portable telephone 50, which is an example of a conventional mobile communication apparatus, as shown in Figs. 10 and 11, a nondirectional whip antenna 51 is protrusively mounted at the upper part of a portable telephone body 52 and an electric wave is transmitted and received with the use of this whip antenna 51.

In the portable telephone, which is one of conventional communication apparatuses, however, since the whip antenna is nondirectional, a transmitted electric wave is affected by the person who is holding the portable telephone during use and therefore antenna characteristics deteriorate. Especially in a high-power portable telephone, a person using it greatly affects its antenna characteristics.

To reduce the effects of the person who is holding the portable telephone, the whip antenna can be mounted, for example, at the lower part of the portable telephone body; however, since the whip antenna protrudes near the mouth of the person, the antenna may be an obstacle during communication.

SUMMARY OF THE INVENTION

The present invention is made to solve such problems. Accordingly, it is an object of the present invention to provide a mobile communication apparatus which prevents transmitted electric waves from receiving the effects of a person who is holding the apparatus and which is configured such that its antenna is not an obstacle during communication.

The object of the present invention is achieved through the provision of a mobile communication apparatus including a chip antenna provided with: a base member made from at least one of a dielectric material and a magnetic material, at least one conductor formed at at least one of the inside and a surface of the base member, and at least one electric power supply terminal provided on a surface of the base member in order to apply a voltage to the conductor; and a body for accommodating the chip antenna within its interior, wherein the chip antenna is disposed at a place in the body where an electric wave used for transmission and receiving is not significantly affected adversely.

According to the mobile communication apparatus

described above, an electric wave used for transmission and receiving is prevented from being adversely affected by disposing the chip antenna at a position in the portable telephone body where the electric wave is unlikely to receive the effects of a person who is using the mobile communication apparatus. Therefore, the deterioration of the antenna characteristics during transmission and receiving caused by the effects of the person who is using the telephone can be reduced.

Since the chip antenna is disposed inside the portable telephone body, the antenna is not an obstacle during communication.

In the mobile communication apparatus, the chip antenna may be disposed at a place which is positioned at the lower part of the body during use.

According to the mobile communication apparatus described above, since the chip antenna is disposed at a portion located at the lower part of the body during use, the deterioration of the antenna characteristics during transmission and receiving caused by the effects of the person who is using the telephone can be further reduced.

According to a mobile communication apparatus of the present invention, a transmitted electric wave can be prevented from being adversely affected by disposing the chip antenna at a place in the body where the transmitted electric wave is unlikely to receive the effects of a person who is holding the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partially transparent elevation of a portable telephone, which is an example of a mobile communication apparatus according to a first embodiment of the present invention.

Fig. 2 is a partially transparent side view of the mobile communication apparatus shown in Fig. 1.

Fig. 3 is a transparent perspective view of a chip antenna which can be used in a mobile communication apparatus of the present invention.

Fig. 4 is an exploded perspective view of the chip antenna shown in Fig. 3.

Fig. 5 is a transparent perspective view of a modification of the chip antenna shown in Fig. 3.

Fig. 6 is a transparent perspective view of another modification of the chip antenna shown in Fig. 3.

Fig. 7 is a chart indicating the antenna gain of the mobile communication apparatus shown in Fig. 1.

Fig. 8 is a partially transparent elevation of a portable telephone, which is an example of a mobile communication apparatus according to a second embodiment of the present invention.

Fig. 9 is a partially transparent side view of the mobile communication apparatus shown in Fig. 8.

Fig. 10 is an elevation of a conventional mobile communication apparatus.

Fig. 11 is a side view of the mobile communication apparatus shown in Fig. 10.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As examples of a mobile communication apparatus of the present invention, portable telephones according to embodiments will be described below by referring to the drawings.

Fig. 1 and Fig. 2 are a partially transparent elevation and a partially transparent side view of a mobile communication apparatus according to a first embodiment of the present invention. In Figs. 1 and 2, a portable telephone 10 includes a portable telephone body 14 made from, for example, plastic having a receiver 11, a transmitter 12, and dial keys 13, and a chip antenna 17 which is mounted on a circuit board 15 secured at the inside of the portable telephone body 14 and which is electrically connected to an RF section 16 provided on the circuit board 15 in the portable telephone 10 with a transmission line (not shown) on the circuit board 15. The chip antenna 17 is disposed at a place where a transmitted electric wave is unlikely to receive the effects of a person who is holding the portable telephone 10, for example, near the transmitter 12.

Even when the chip antenna 17 of a nondirectional type is used in the portable telephone 10 configured as described above, since the emission path of an electric wave transmitted from the chip antenna 17 is away from a person who is holding the portable telephone 10, the transmitted electric wave is unlikely to receive the effects of the person and the antenna characteristics of the chip antenna 17 are prevented from deteriorating.

The chip antenna 17 is formed, for example, by a conductor 19 helically wound in the longitudinal direction of a rectangular-parallelepiped base member 18 and disposed in the inside of the member 18, as shown in Fig. 3 and Fig. 4. The base member 18 is made from laminated rectangular sheet layers 18a to 18c which are made from a dielectric material having barium oxide, aluminum oxide, and silica as main components. Among these layers, on surfaces of the sheet layers 18b and 18c, straight or almost L-shaped electrically conductive patterns 19a to 19h made from copper or a copper alloy are formed by printing, deposition, bonding, or plating. Via holes 20 are also provided for the sheet layer 18b in the thickness direction. By laminating the sheet layers 18a to 18c and connecting the electrically conductive patterns 19a to 19h with the via holes 20, winding cross sections perpendicular to a winding axis C become rectangles and the helically wound conductor 19 is formed.

One end of the conductor 19 (one end of the electrically conductive pattern 19a) is led to a surface of the base member 18 to form an electric power supply section 21 and is connected to an electric power supply terminal 22 provided on a surface of the base member 18 in order to apply a voltage to the conductor 19. The other end of the conductor 19 (one end of the electrically conductive pattern 19h) forms a free end 23 at the

inside of the base member 18.

Fig. 5 and Fig. 6 are transparent perspective views of a modification of the chip antenna 17 shown in Fig. 3. A chip antenna 171 shown in Fig. 5 includes a rectangular-parallelepiped base member 181, a conductor 191 helically wound in the longitudinal direction of the base member 181 along surfaces of the base member 181, and an electric power supply terminal 221 used for applying a voltage to the conductor 191 and provided on surfaces of the base member 181. One end of the conductor 191 is connected to the electric power supply terminal 221 on a surface of the base member 181. The other end of the conductor 191 forms a free end 231 on a surface of the base member 181. In this case, since the conductor can be easily formed helically on surfaces of the base member by printing or other methods, the manufacturing process of the antenna can be simplified.

A chip antenna 172 shown in Fig. 6 includes a rectangular-parallelepiped base member 182, a conductor 192 formed in a meander shape on a surface of the base member 182, and an electric power supply terminal 222 used for applying a voltage to the conductor 192. One end of the conductor 192 is connected to the electric power supply terminal 222 on a surface of the base member 182. The other end of the conductor 192 forms a free end 232 on a surface of the base member 182. In this case, since the meander-shaped conductor is formed only on one main surface of the base member, the base member can be made to a low profile, and thereby the chip antenna can also be made to a low profile. The meander-shaped conductor may be formed inside the base member.

An antenna gain in a case when the chip antenna 17 is disposed near the transmission section 12 in the portable telephone body 14 as shown in Fig. 1 is compared with an antenna gain in a case when the whip antenna 50 is protrusively mounted at the upper section of the portable telephone 51. Fig. 7 shows a comparison result. In Fig. 7, a solid line indicates an antenna gain in the present embodiment, and a dotted line indicates an antenna gain in the conventional case. Point A indicates the position of the portable telephones 10 and 50, and point B indicates the position of a person who is holding the telephones.

It is understood from the result that, in the portable telephone according to the present embodiment, the antenna gain is substantially constant in the range of 0 degrees to 360 degrees and the person who is holding the telephone does not affect the antenna gain.

In contrast, the antenna gain of the conventional portable telephone greatly decreases near a person who is holding the telephone. This indicates that a transmitted electric wave receives the effects of the person.

As described above, in the first embodiment, a transmitted electric wave is prevented from being adversely affected by disposing the chip antenna near the transmission section at the lower section of the port-

able telephone, which is a position in the portable telephone where a transmitted electric wave is unlikely to receive the effects of a person who is holding the telephone. Therefore, the deterioration of the antenna characteristics caused by the effects of a person who is holding the telephone during transmission and receiving can be reduced.

Since the chip antenna is disposed inside the portable telephone body, the antenna is not an obstacle during communication.

Fig. 8 and Fig. 9 are a partially transparent elevation and a partially transparent side view of a mobile communication apparatus according to a second embodiment of the present invention. In Figs. 8 and 9, a portable telephone 30 is equipped with a cover 32 rotatably connected to the lower part of a portable telephone body 14 through a hinge section 31. A chip antenna 17 mounted on a circuit board 33 is disposed at a tip of the cover 32. This chip antenna 17 is electrically connected with a lead (not shown) to the RF section 35 of the portable telephone 30 provided on a circuit board 34 secured to the inside of the portable telephone body 14. In this case, the tip of the cover 32 is used as a portion where a transmitted electric wave is unlikely to receive the effects of a person who is holding the telephone. With the cover 32 being opened, dial keys 13 are pressed to use the portable telephone 30.

As described above, in the second embodiment, by disposing the chip antenna at the tip of the cover in the portable telephone, where a transmitted electric wave is unlikely to receive the effects of a person who is holding the telephone, the distance between the person who is holding the telephone and the chip antenna can be extended during transmission and receiving. Therefore, in addition to the same advantages as in the first embodiment, the deterioration of the antenna characteristics during transmission and receiving caused by the effects of the person who is holding the telephone can be further reduced.

In the first and second embodiments, the base member of the chip antenna is made from a dielectric material. The material of the base member is not limited to a dielectric material and may be a magnetic material such as ferrite, or a combination of a dielectric material and a magnetic material.

In the above embodiments, a single conductor is used. A plurality of conductors disposed in parallel to each other may be used. In this case, a plurality of resonant frequencies can be provided according to the number of conductors, and one antenna can handle multiple bands.

In the above embodiments, the conductor is formed inside the base member of the chip antenna or on a surface of the base member. Conductive patterns may be wound on a surface and in the inside of the base member to form the conductor.

Claims

1. A mobile communication apparatus (10; 30) comprising:

an apparatus body (14) having a transmitter (12) and a receiver (11), and a chip antenna (17; 171; 172) in said apparatus body, said chip antenna (17; 171; 172) comprising:

a base member (18; 181; 182) made from at least one of a dielectric material and a magnetic material;

at least one conductor (19; 191; 192) formed at least at one of the inside and a surface of said base member (18; 181; 182); and at least one electromagnetic signal supply terminal (21; 221; 222) on a surface of said base member for applying an electromagnetic signal voltage to said conductor;

wherein said chip antenna (17; 171; 172) is disposed at a place in said apparatus body (14) such that a location of said chip antenna (17; 171; 172) is closer to a location of said transmitter (12) than to a location of said receiver (11).

2. A mobile communication apparatus (10) according to claim 1, wherein said chip antenna (17; 171; 172) is disposed at a lower part of said apparatus body (14) during use.

3. A mobile communication apparatus (30) according to claim 2, wherein said apparatus body (14) comprises a cover (32) which is extendable away from a main part of the apparatus body (14) during use, said chip antenna (17; 171; 172) being disposed at said cover.

4. A mobile communication apparatus (10; 30) comprising:

an apparatus body (14) having a transmitter (12) and a receiver (11), and a chip antenna (17; 171; 172) in said apparatus body (14), said chip antenna comprising:

a base member (18; 181; 182) made from at least one of a dielectric material and a magnetic material;

at least one conductor (19; 191; 192) formed at least at one of the inside and a surface of said base member; and at least one electromagnetic signal supply terminal on a surface of said base member (18;

181; 182) for applying an electromagnetic
signal voltage to said conductor (19; 191;
192);
wherein said chip antenna (17; 171; 172) is
disposed at a lower part of said apparatus 5
body (14) during use.

5. A mobile communication apparatus (30) according
to claim 4, wherein said apparatus body (14) com- 10
prises a cover (32) which is extendable away from a
main part of the apparatus body during use, said
chip antenna being disposed at said cover.

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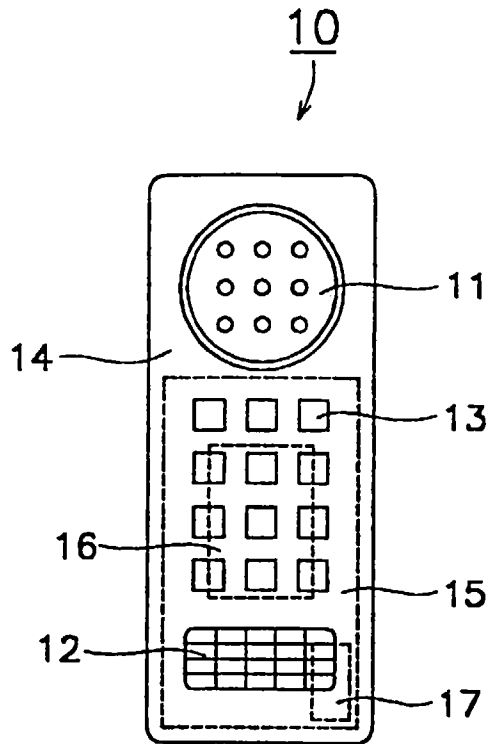


FIG. 1

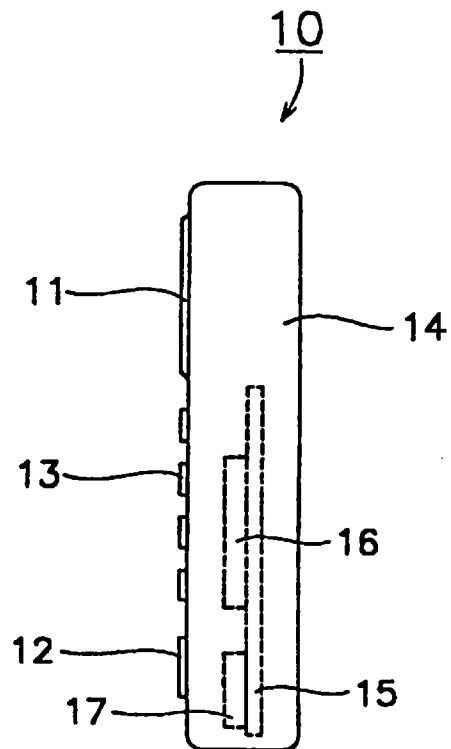


FIG. 2

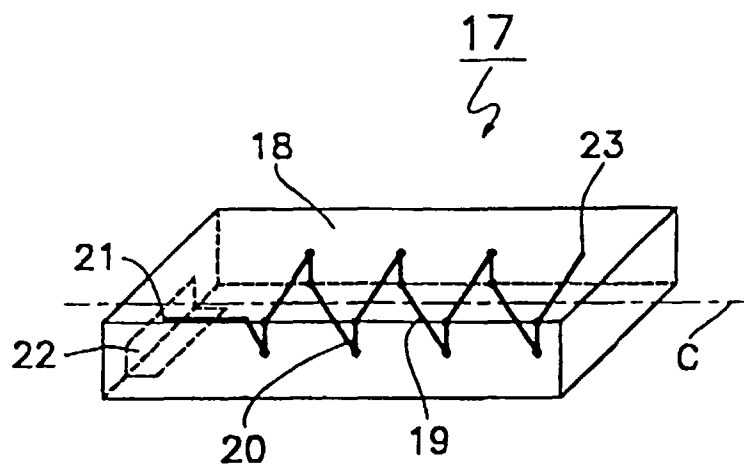


FIG. 3

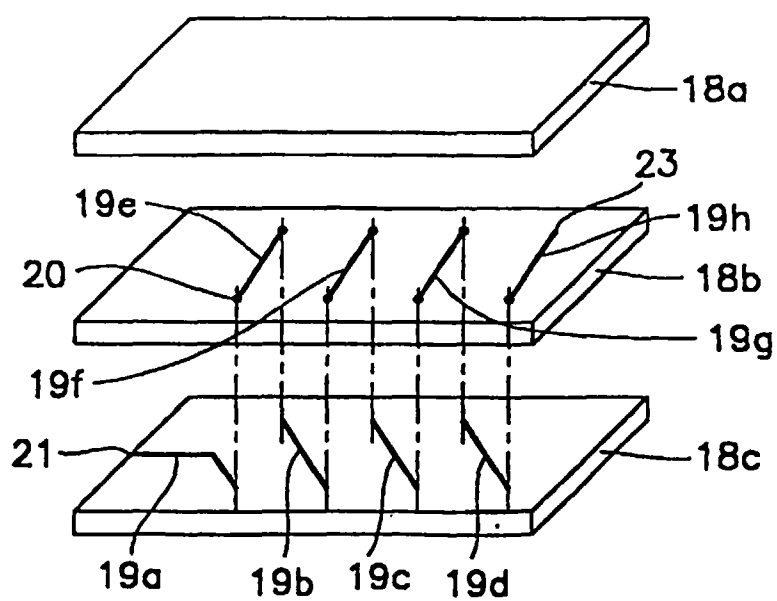


FIG. 4

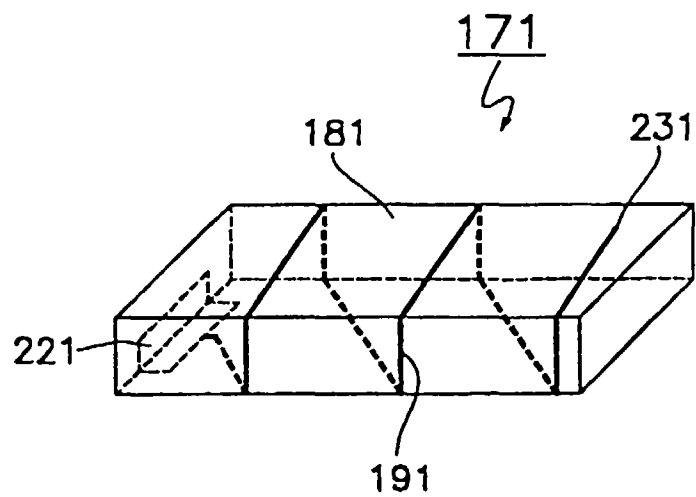


FIG. 5

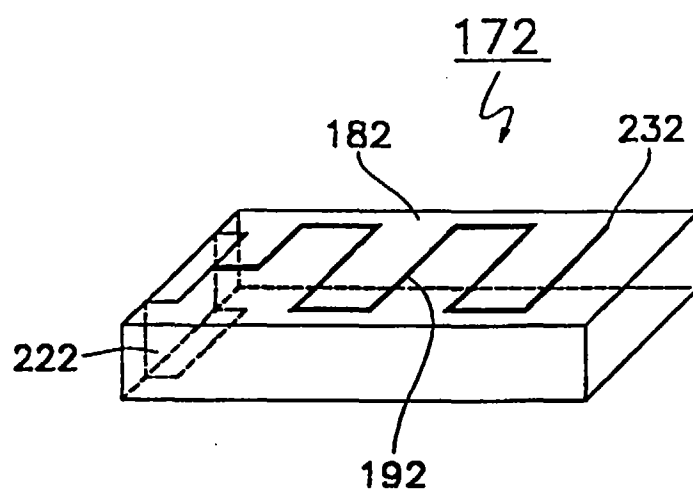


FIG. 6

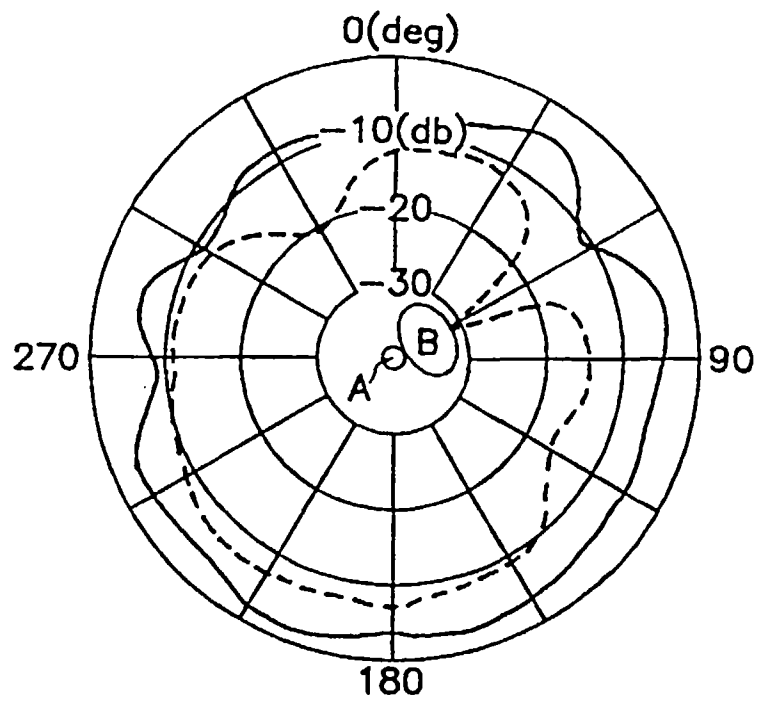


FIG. 7

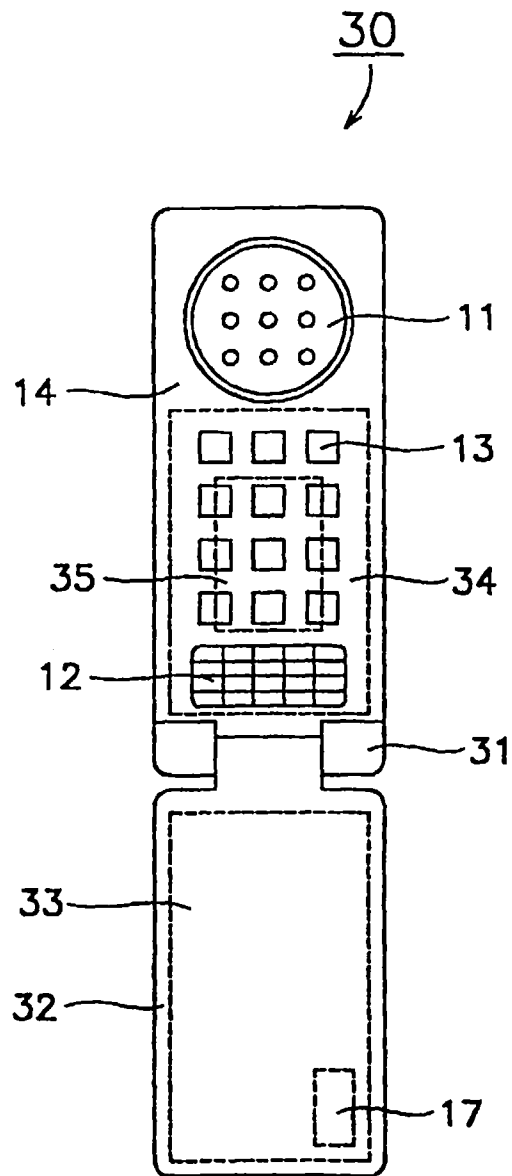


FIG. 8

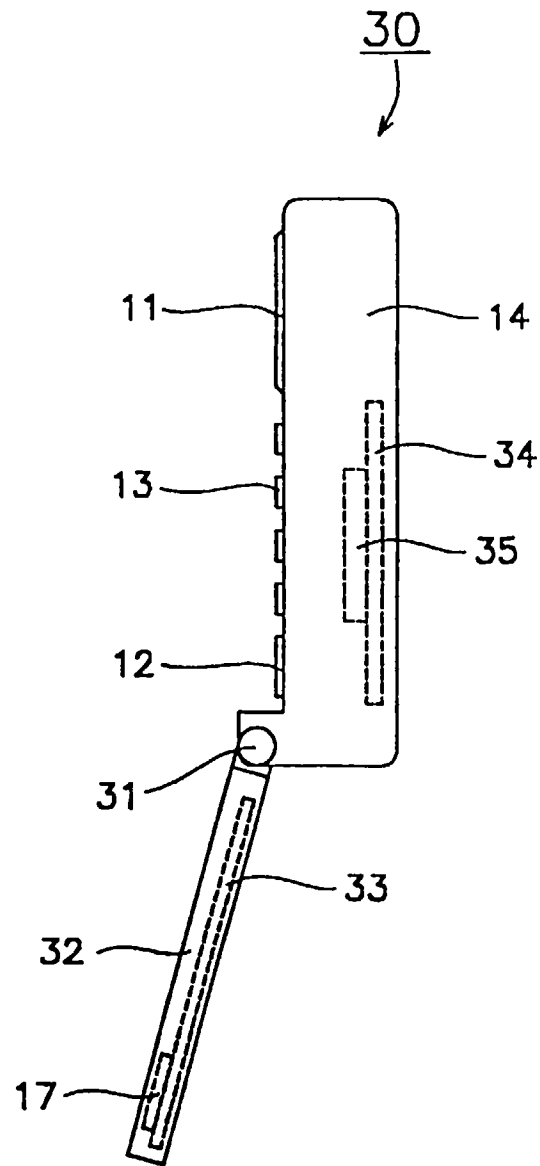


FIG. 9

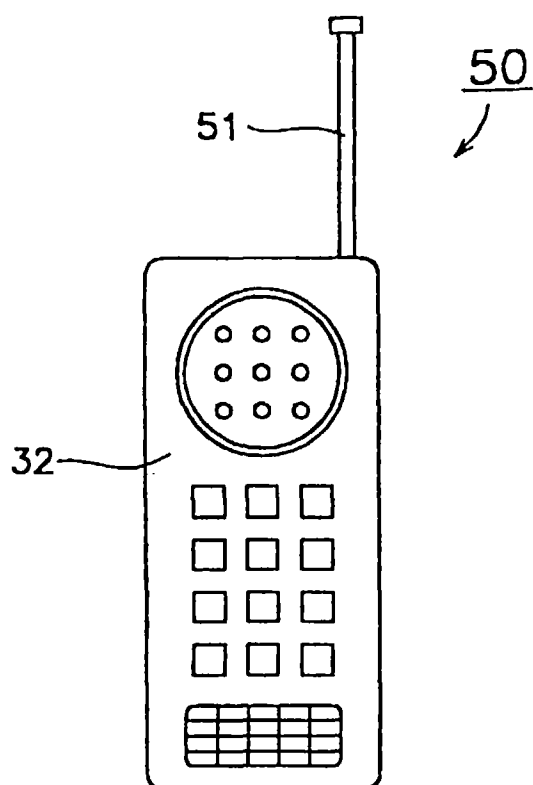


FIG. 10

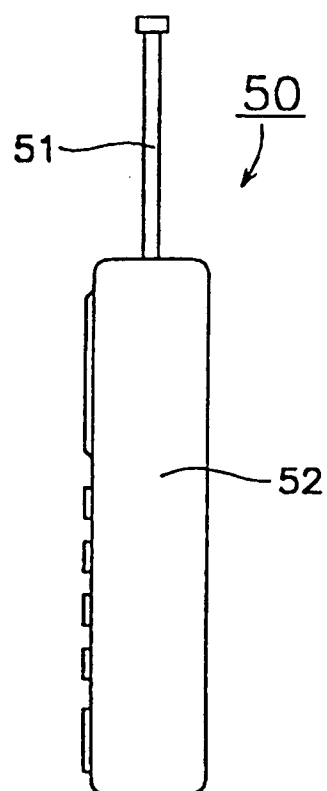


FIG. 11