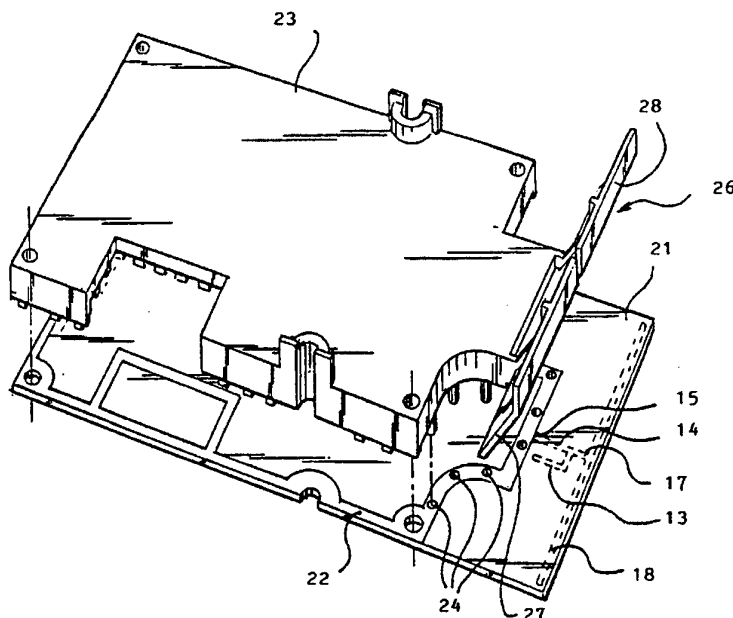




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(21) International Application Number: PCT/NL94/00158 (22) International Filing Date: 11 July 1994 (11.07.94) (30) Priority Data: 93202040.7 9 July 1993 (09.07.93) EP (34) Countries for which the regional or international application was filed: AT et al. 9302192 15 December 1993 (15.12.93) NL (71) Applicant (for all designated States except US): ERICSSON BUSINESS MOBILE NETWORKS B.V. [NL/NL]; Strawinsky laan 1257, NL-1077 XX Amsterdam (NL). (72) Inventors; and (75) Inventors/Applicants (for US only): VAN ZEIJL, Paulus, Thomas, Maria [NL/NL]; Dasstraat 52, NL-7559 AD Hengelo (NL). VAN BRUGGEN, Johannis [NL/NL]; Hooiraamhoek 106, NL-7546 MB Enschede (NL). (74) Agent: SCHUMANN, Bernard, Herman, Johan; Arnold & Siedsma, Sweelinckplein 1, NL-2517 GK The Hague (NL).	(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LT, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD). Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments. In English translation (filed in Dutch).	

(54) Title: DEVICE AND ANTENNA FOR CORDLESS RADIO COMMUNICATION



(57) Abstract

The invention relates to a device for cordless radio communication, such as a portable cordless telephone (1), provided with antenna means with an antenna directional pattern which has an attenuation in the direction toward the means for information exchange (4-7) of the telephone (1). The invention provides antenna means which comprise at least one electrically conducting element (14, 18; 30; 31; 32; 35) for receiving and/or transmitting radio signals and an electrically conducting surface (16; 26; 29) which interacts therewith and is connected to common electrical mass means (20). The desired antenna directional pattern is herein obtained by a suitable form and position of the electrically conducting surface (16; 26; 29).

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Title

DEVICE AND ANTENNA FOR CORDLESS RADIO COMMUNICATION

Technical Field of the Invention

The invention relates to devices for cordless radio communication, in particular portable cordless telephones, in addition to an antenna structure suitable for use in these devices.

Background of the Invention

10 Cordless telephones, walkie-talkies, personal paging equipment (called "radio pagers" in English language professional literature) and combinations thereof are examples of devices for cordless radio communication with antennas which have to have a preferably omnidirectional
15 receiving or radiating pattern in order to realize the best possible, direction-independent reception and/or transmission of radio signals. During use, however, a part of the electromagnetic energy generated by the antenna means will also be emitted in the direction of the user.

20

In a device for cordless radio communication embodied for instance as portable telephone which comprises information exchanging means for picking up and reproducing audio signals, which means are accessible to a user from one
25 side of the housing in the manner of a telephone receiver, the user will hold the telephone with said side against or close to his head. However, the electromagnetic shielding caused by the head results in an effective decrease of the electromagnetic energy generated by the antenna in the

direction of the head as well as a reduced sensitivity to radio reception in this direction.

European patent application 0,532,960 discloses a
5 portable cordless telephone provided with an extending rod antenna having an active part for receiving and transmitting radio-frequent radiation which extends mutually in line with a non-active part. During use the active part protrudes above the head of the user. In this manner an undesired influencing
10 of the antenna properties by the body of the user is prevented as far as possible. The amount of electromagnetic energy striking against the body of the user or a part thereof is also reduced in this manner.

15 The Japanese patent application 4,220,851 discloses the use of electromagnetic shielding means on the side of a portable cordless telephone directed toward the user during use, this to limit as far as possible the amount of electromagnetic energy radiated in the direction of the head
20 of the user.

Summary of the Invention

The basic objective of the invention is to provide a
25 device for cordless radio communication, wherein steps are taken aimed at reducing the influence of the body of a user, or a part of the body, on the electromagnetic energy effectively transmitted and/or received by the antenna means.

30 The invention also has for its object to reduce the amount of electromagnetic radiation to which the body of the user is exposed during use of a device for cordless radio communication suitable for transmitting radio signals.

35 A further objective of the invention is to provide a suitable antenna construction for use in a device for cordless radio communication, particularly in combination with the said steps for reducing the influence of the body of the user on the transmitting and/or receiving properties of

the device.

The invention is based on the insight that it is of no practical value to design the antenna means such that during
5 use they generate electromagnetic energy in a direction shielded by the body of the user or a part thereof and/or are sensitive to reception of radio-frequent radiation from this direction. In its most general form the invention involves providing a device for cordless radio communication provided
10 with antenna means having an asymmetrical directional pattern which has an attenuation in the direction of the side from which the means for information exchange are accessible to the user.

15 In a practical realization the invention provides a device for cordless radio communication provided with a housing, means for information exchange accommodated in the housing and accessible to the user from one side thereof, signal processing means coupled to the means for information
20 exchange and radio transmission means coupled to the signal processing means and provided with antenna means. The antenna means comprise at least one electrically conducting element for receiving and/or transmitting radio signals and an electrically conducting surface which is disposed in the
25 vicinity of the conducting element and interacts therewith and which is connected to common electrical mass means of the device, wherein the conducting surface has a position and form suitably chosen in relation to the conducting element in order to provide an antenna directional pattern with an
30 attenuation in the direction of the said side of the housing.

In order to realize a desired antenna directional pattern use is advantageously made in this embodiment of the invention of the electrically conducting surface which
35 interacts with the conductor for receiving and/or transmitting and which is essential to the operation of the antenna. The required attenuation in the antenna directional pattern is obtained by a suitably chosen position and/or design of the conducting surface in relation to the relevant

conductor and an amplification of the transmitted electromagnetic energy and an increase in the sensitivity of the antenna for radio reception in a desired direction can also be achieved.

5

It is noted that the non-prepublished European patent application 0,588,271 likewise describes the use of an antenna construction with an asymmetrical directional pattern in a portable device for cordless radio communication.

10 Different from the present invention this is realized by the use of additional elements such as shielding means or reflectors disposed adjacently of the antenna or the use of per se known antenna structures with directional properties which are comparatively bulky in size.

15

Specifically in the case of equipment of hand dimensions the use of such antenna structures is not always possible or desirable, particularly not when the antenna must be accommodated in the housing of the apparatus in question.

20 In general in such situations there is also insufficient space available for additional shielding means for the antenna.

In an antenna construction particularly suitable for
25 use in the device according to the invention the said conducting element comprises a first electrical conductor with an end provided with a terminal for connection to electrical mass means of the device and with another end connected to a second electrical conductor, which second
30 conductor extends substantially transversely of the first conductor, wherein the first conductor is provided in the region between the said ends with a terminal for connection to radio transmission means of the device.

35 This antenna construction, in particular the embodiment according to the invention wherein the first and second conductor form part of a printed circuit board, is advantageously suitable for fixed mounting in a device for cordless radio communication. Such an antenna construction

enables mass production in simple and relatively inexpensive manner.

The conductors can be formed in a manner suitable to
5 realize a desired antenna directional pattern and/or
resonance frequency. Embodiments which have been found
particularly suitable are those wherein the second conductor
has an elongate form with ends running for instance at an
angle of 45° or 90° relative to its lengthwise direction, so
10 that in combination with the first conductor a generally T-
shape results. The second conductor can also have a wholly or
partially closed contour with for instance an O- or C-form.
Yet another arrangement of both conductors consists of a
generally L-shape.

15

It is noted that the electrically conducting surface
referred to in the foregoing and interacting with the
conducting element of the antenna does not necessarily have
to be a surface in the form of a plate or the like. Component
20 shielding means present in the device, such as for instance
electrically conducting housings of coils and the like
connected to the mass means of the device, can also function
as conducting surface in the sense of the present invention.
Positioning of the conducting surface substantially on one
25 side of the conducting element, for example on one side
transversely of a printed circuit board on which the said
conducting element is formed, already results in certain
antenna directional properties.

30 In a preferred embodiment of the device according to
the invention the conducting surface has a substantially flat
form and an inclining position relative to the said side of
the housing of the device corresponding with the desired
antenna directivity pattern. Such a surface can with
35 advantage integrally form part of an electrically conducting
shielding wholly or partially enclosing at least the radio
transmission means.

The invention is illustrated hereinbelow with reference

to an application in a cordless portable telephone as illustrated in the annexed drawings.

Brief Description of the Drawings

5

Fig. 1 shows a schematic view of a portable cordless telephone provided with an antenna according to the invention.

10

Fig. 2 shows highly schematically and in perspective an exploded view of parts of a cordless telephone with an antenna construction according to the invention.

15

Fig. 3 shows schematically and in perspective an exploded view of an antenna construction with directional properties according to a preferred embodiment of the invention.

20

Fig. 4 shows schematically and in perspective another view of a part of the antenna construction used in fig. 3.

25

Fig. 5 shows schematically a desired antenna directional pattern for a portable cordless telephone according to the invention.

Fig. 6 shows schematically a measured antenna directional pattern for the antenna construction according to the invention as shown in fig. 3.

30

Fig. 7-11 show schematic views of embodiments of antenna elements according to the invention.

Detailed Description of Embodiments

35

Fig. 1 shows a schematic front view of a portable cordless telephone 1. Telephone 1 comprises a housing 2 having means for information exchange accessible to the user from one side 3 in the form of a microphone part 4 and a loudspeaker part 5 for picking up respectively reproducing

audio signals, in particular speech signals. The microphone and loudspeaker part 4, 5 are disposed on the side 3 in the manner of a telephone handset.

5 Situated between said parts 4, 5 is a keypad 6 and display means 7. Keypad 6 comprises the twelve number and control keys 8 typical for telephone handsets in addition to several supplementary function keys including a hook signaling key 9. On the display means 7 are shown inter alia the
10 chosen number and other data required for use of the telephone. The telephone, can be held in the hand, wherein during use the side 3 is directed toward the head of the user. The latter can thus speak into the microphone and listen with one ear to the sound reproduced by the
15 loudspeaker.

Fig. 2 shows a highly schematic perspective view of a part of a cordless telephone. Shown is an electronic unit 10 which comprises signal processing means 11 and radio
20 transmission means 12. A transmitter and receiver generally form part of the radio transmission means 12. Signal processing means 11 comprise means for processing the signals of the several keys 8, 9 and of the telephone system to which the telephone 1 connects, in addition to means such as
25 drivers for actuating the display means 7 and amplifiers and the like for the microphone and loudspeaker 4, 5 as shown in fig. 1.

The radio transmission means 12 are connected via an
30 antenna signal conductor 13 to an electrically conducting element of the antenna for receiving and/or transmitting radio signals. This element consists of an elongate first electrical conductor 14 and an elongate second electrical conductor 18 extending substantially transversely thereof.
35 The first conductor 14 is electrically connected to the second conductor 18 with an end 17. A further end 15 of the first conductor 14 is connected to an electrically conducting surface 16, which surface 16 forms with the first and second conductor 14, 18 the complete antenna.

The conducting surface 16, which is shown in the form of a plate, is connected to common electrical mass means 20 of the telephone 1, these being symbolically designated with three horizontal lines. The antenna signal conductor 13 is electrically connected to the first conductor 14 at a point 19 in the region between both ends 15, 17 of the first conductor 14. The location of the point 19 contributes toward determining the electrical impedance of the antenna, as seen from the antenna signal conductor 13.

10

Fig. 3 shows a further embodiment of the antenna according to the invention as applied in the cordless telephone 1 shown in fig. 1. The several conductors 13, 14, 18 are formed as electrically conducting tracks on a board 21 with printed circuitry. Such boards are generally called "Printed Circuit Boards (PCB)" in the English-language professional literature. The end 15 of the first conductor 14 is connected to an electrically conducting contour 22 arranged on the PCB 21, which contour 22 forms part of the common mass means 20 of telephone 1. Situated on PCB 21 inside this contour 22 is a printed circuit (not shown) for mounting electronic components including for instance the radio transmission means 12.

An electrically conducting shielding 23 in the form of a box open on one side is electrically connected, for example by soldering, to the conducting contour 22 which can extend on the other side of PCB 21 as a conducting surface. The shielding 23 thus electromagnetically shields from the outside world the thereby enclosed electronic components. Shielding 23 further carries an elongate electrically conducting plate 26 which is formed integrally with the shielding and which in the mounted situation is therefore connected to the mass means 20.

35

The conducting plate 26, which in the mounted situation of the shielding 23 extends in lengthwise direction of the second conductor 18 and on only one side of PCB 21, comprises a first part 27, which assumes an inclining position relative

to the surface of PCB 21, and a second part 28 which extends substantially transversely of PCB 21, as shown. In the assembled situation the shielding 23 adjoins the side 3 of telephone 1 shown in fig. 1. The conducting plate 26 forms
5 the conducting surface of the antenna and brings about an antenna operation with a directional pattern which has an effective attenuation in the direction of the said side 3 of telephone 1.

10 In this respect reference is now made to fig. 5. Shown herein is a desired antenna directional pattern, wherein the distance between the circles corresponds to a level difference of 1 dB. The side of telephone 1 which is directed toward the head of the user during use is situated at the
15 bottom of the diagram, as illustrated symbolically with the reference numeral 3. It will be apparent that the radiation intensity and the reception sensitivity is maximal in the main direction of the antenna remote from the side 3, while in the direction toward the side 3 an attenuation in the
20 order of magnitude of 6 dB has occurred.

Fig. 6 shows on the same scale as fig. 5 a measured antenna directional pattern for the configuration shown in fig. 3. Because both patterns are only intended to illustrate
25 intensity ratios no quantities and/or units are shown herein.

Fig. 4 shows the shielding 23 with the plate 26 from the open side thereof. It is apparent that the peripheral form of shielding 23 corresponds with the form of the contour
30 22. In order to connect the shielding 23 to the contour 22 on PCB 21 the former is provided with pins 25 which correspond in location with holes 24 in the contour 22. The pins can be joined to the contour by soldering. Other connecting techniques are of course also possible, such as for instance
35 the use of pins 25 with retention action in combination with plated-through holes 24.

In the embodiment shown the antenna signal conductor 13 extends through the PCB 21 from the one to the other side

thereof for connection to the radio transmission means 12. In the configuration wherein the contour 22 extends on both sides of PCB 21 the antenna signal conductor 13 must of course be free of conducting contact with the contour and the mass means. To this end use can be made of an additional separate conductor, while there is also the possibility of embodying the PCB 21 in per se known manner in multiple layers, wherein the antenna signal conductor 13 is coupled via an intermediate layer to the radio transmission means 12. The location of conductors 14 and 18 on the one or other side of the PCB has no fundamental effect on the antenna operation.

Although fig. 3 shows a slightly inclining plate 26 disposed on one side of PCB 21 in order to realize desired antenna directional properties, the invention is of course not limited thereto. The plate can for instance extend substantially transversely of the plane of PCB 21 or can have a shape curved in one or more directions. The plate can also extend on both sides of the PCB. The position and shape of the plate, as well as the construction of the radiating element of the antenna, contribute toward determining the eventual antenna directivity pattern.

Fig. 7-11 show five different embodiments of the electrically conducting element of the antenna for transmitting and receiving radio signals, in the form of printed wiring on a PCB. The conducting surface is formed by a box-like shielding 29 in elevated position relative to the PCB. All embodiments of the shown antennas can be dimensioned such that they are tuned for resonance at a frequency in the range of for instance 1.5 - 2.5 GHz, with optimum impedance matching of for instance 50 Ohm. These values are, however, only examples, wherein it is also quite possible to construct the antenna for higher and/or lower frequencies.

Fig. 7 shows the embodiment according to fig. 3 with an elongate first conductor 14 and an elongate second conductor 18 extending transversely thereof in the middle.

Fig. 8 shows an embodiment with an elongate second conductor 30 which extends transversely of the first conductor 14 only on one side, which results in a generally L-shape.

5

Fig. 9 and 10 shows variants of the general T-shape of fig. 7, wherein the extremities 33 and 34 of the second conductors 31 and 32 form respective angles of 45° and 90° with the longitudinal direction of the relevant conductors.

10 It will be apparent that the straight lengths of the second conductors 18, 31 and 32 are mutually differing while the elements can nevertheless be tuned to the same frequency.

Fig. 11 shows a variant wherein the second conductor 35
15 has a closed O-shaped contour. Instead of a closed contour the second conductor can also have an open, generally C-shaped contour.

It is noted that the conductors 14, 18, 30, 31, 32 and
20 35 are not microstrip lines but only several wiring tracks on a plate of electrically insulating material (dielectric). Microstrip lines are characterized by an assembly of wiring tracks and an earthing surface or earthing track located a determined distance therefrom and separated by a dielectric.

25

In addition to the shown antenna means fixedly mounted in the telephone 1, the former can also be mounted outside the housing 2, wherein instead of wiring tracks on a PCB, wire-like conductors and the like can also be applied.

30

Although the invention is illustrated in the foregoing on the basis of an application in a portable cordless telephone, for example a telephone operating in accordance with the DECT-standard (Digital European Cordless
35 Telecommunications), it is no sense limited thereto. The invention can be applied in a variety of cordless radio communication devices, irrespective of their function or the modulation technique etc. used.

CLAIMS

1. Device for cordless radio communication provided with a housing, means for information exchange accommodated in the housing and accessible to a user from one side thereof, signal processing means coupled to the means for
5 information exchange and radio transmission means coupled to the signal processing means and provided with antenna means, wherein the antenna means comprise at least one electrically conducting element for receiving and/or transmitting radio signals and an electrically conducting surface which is
10 disposed in the vicinity of the conducting element and interacts therewith and which is connected to common electrical mass means of the device,

characterized in that

the conducting surface has a position and form suitable
15 for providing an antenna directional pattern with an attenuation in the direction of the said side of the housing.

2. Device according to claim 1, wherein the conducting surface has a substantially flat form and takes an inclining
20 position relative to the said side of the housing corresponding with the desired antenna directional pattern.

3. Device according to claim 1 or 2, wherein the conducting element is of elongate shape and the conducting
25 surface extends substantially on one side of the conducting element in lengthwise direction thereof.

4. Device according to claim 3, wherein the conducting element forms part of a printed circuit board.
30

5. Device according to claim 1, 2, 3 or 4, wherein the conducting surface forms part of an electrically conducting shielding wholly or partially enclosing at least the radio transmission means.

6. Device according to claim 1, 2, 3 or 4, wherein the means for information exchange comprise means for picking up and reproducing audio signals, which means are accessible to a user from the said side of the housing in the manner of a telephone handset.

7. Antenna for use in a device for cordless radio communication, including a device as claimed in one or more of the claims 1-6, comprising at least one electrically conducting element for receiving and/or transmitting radio signals and an electrically conducting surface which is disposed in the vicinity of the conducting element and interacts therewith and which in the mounted situation is connected to common electrical mass means of the device, **characterized in that** the conducting element comprises a first electrical conductor with an end provided with a terminal for connection to electrical mass means of the device and with another end connected to a second electrical conductor, which second conductor extends substantially transversely of the first conductor, wherein the first conductor is provided in the region between the said ends with a terminal for connection to radio transmission means of the device.

8. Antenna according to claim 7, wherein the second conductor has an elongate form having at least one end running at an angle relative to its lengthwise direction.

9. Antenna according to claim 7, wherein the second conductor has an elongate form and forms a wholly or partially closed contour.

10. Antenna according to claim 7, 8 or 9, wherein the first and second conductors form part of a printed circuit board.

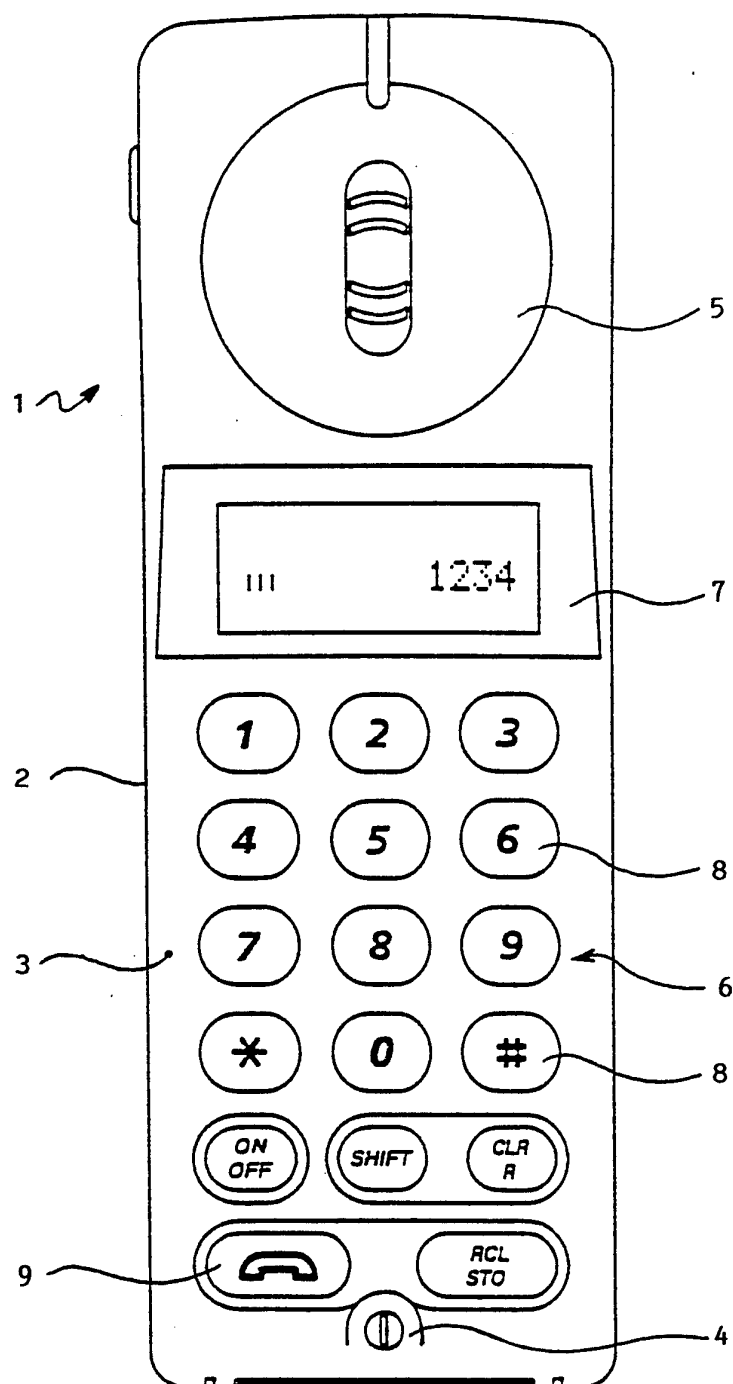
11. Antenna according to claim 7, 8, 9 or 10, wherein the conducting surface is formed by electrically conducting shielding means arranged in the device, including the

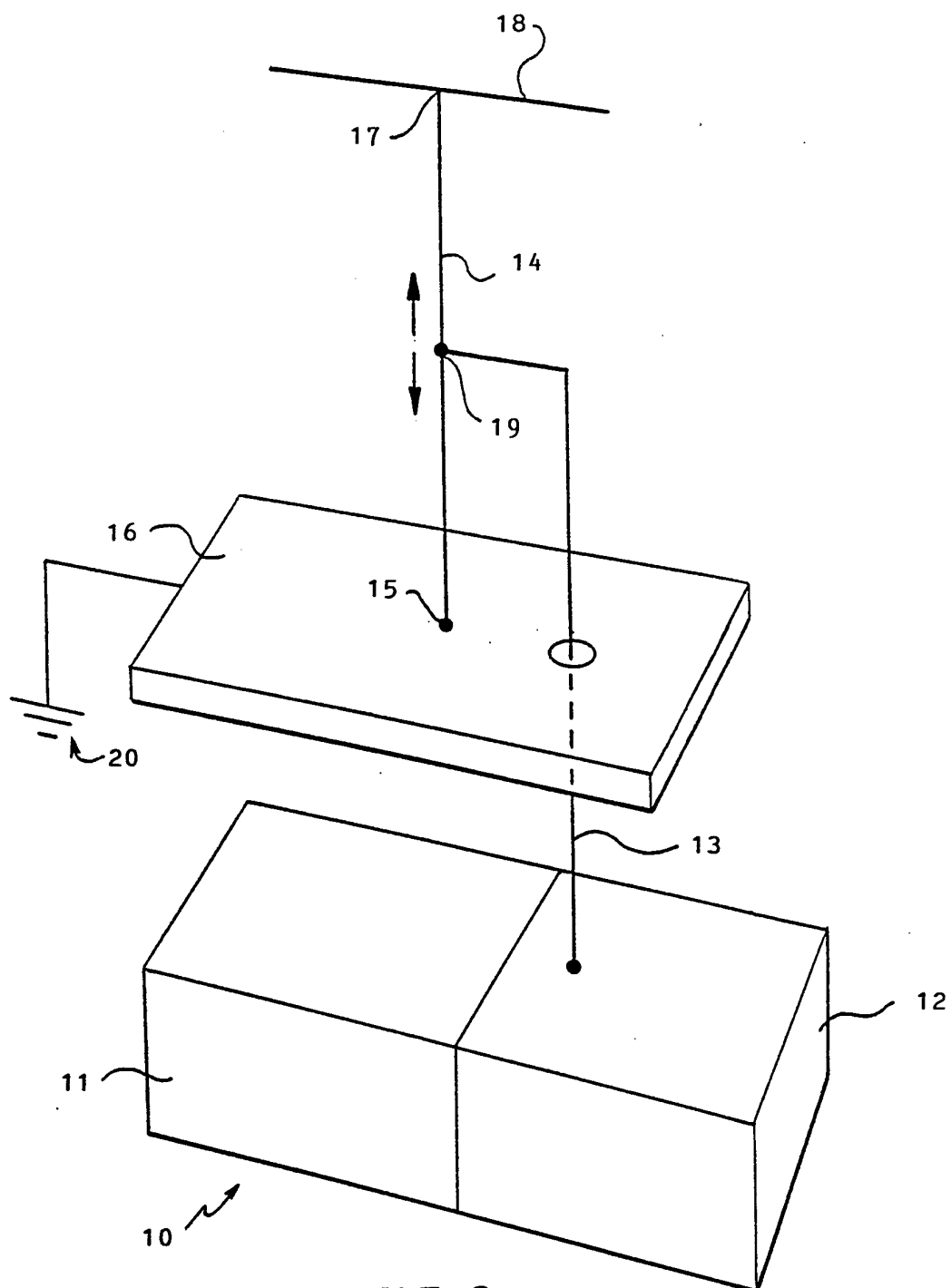
shielding means of individual components of the device.

12. Antenna according to claim 7, 8, 9, 10 or 11,
wherein the conducting surface and the said conducting
5 element are accommodated fixedly in a housing enclosing the
device.

13. Device according to any of the claims 1-6, wherein
the said conducting element is constructed as specified in
10 one or more of the claims 7-11.

14. Device according to any of the claims 1-6 or 13,
wherein the conducting surface and the conducting element are
accommodated fixedly in a housing enclosing the device.

FIG. 1

FIG. 2

3/5

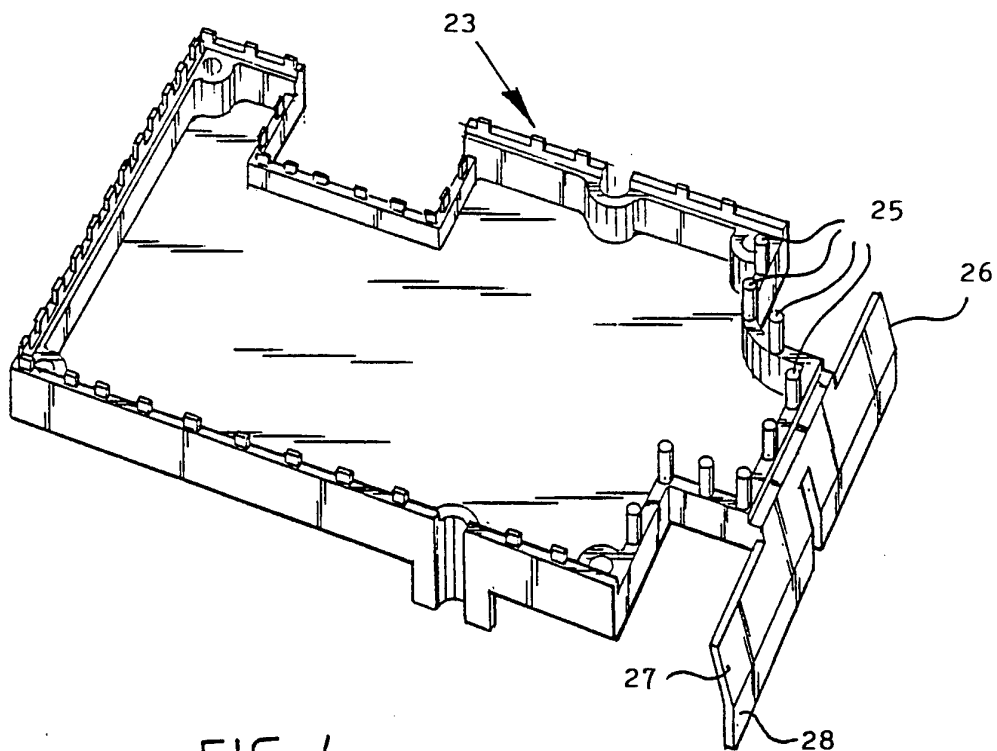


FIG. 4

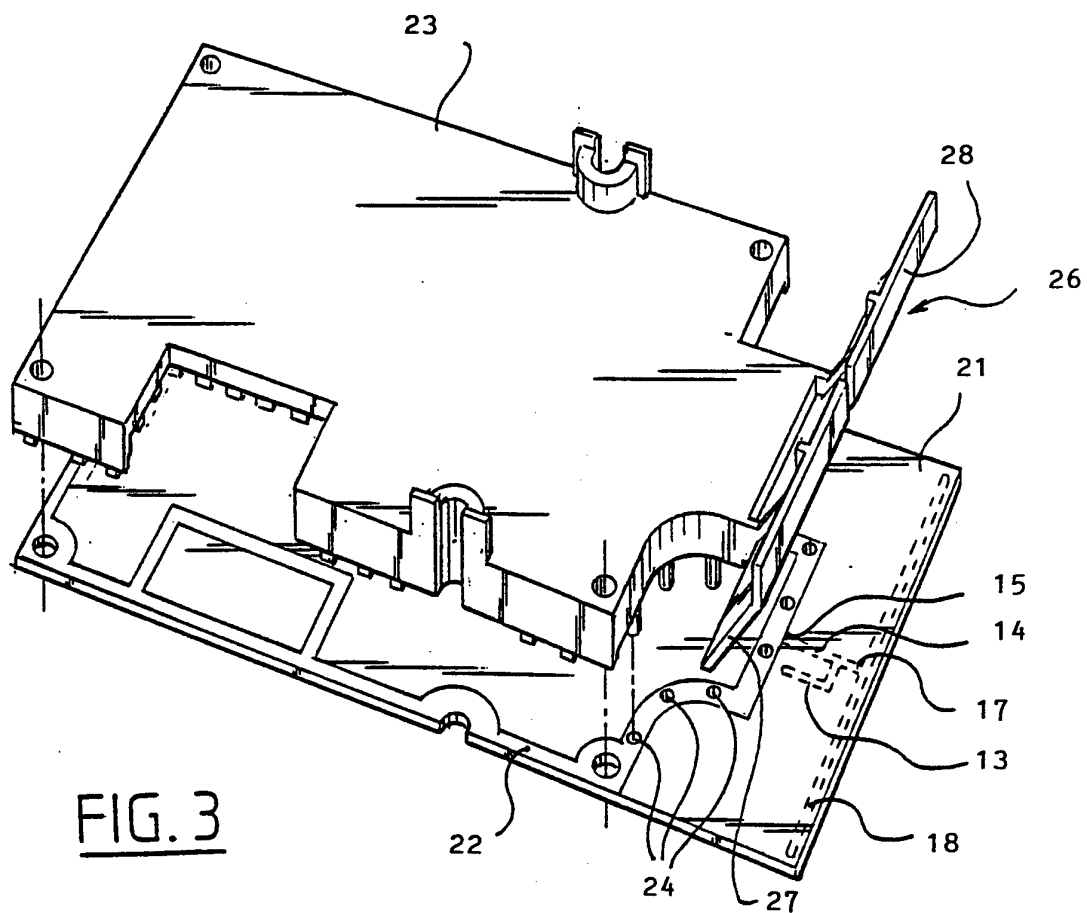


FIG. 3

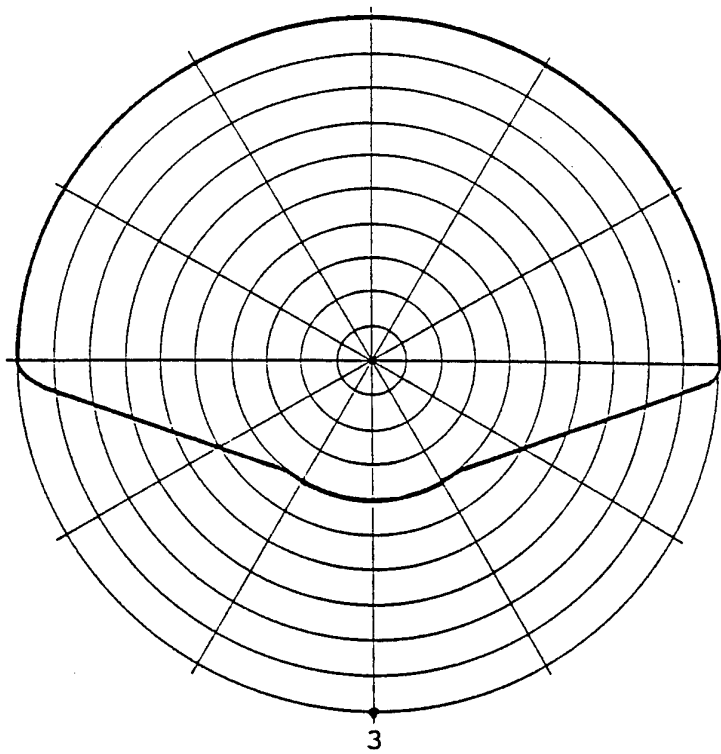


FIG.5

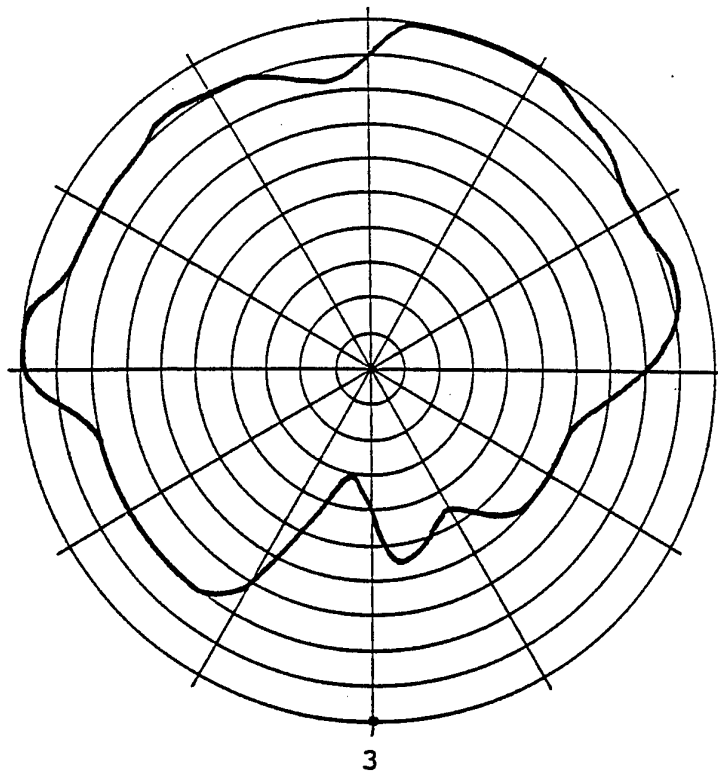


FIG.6

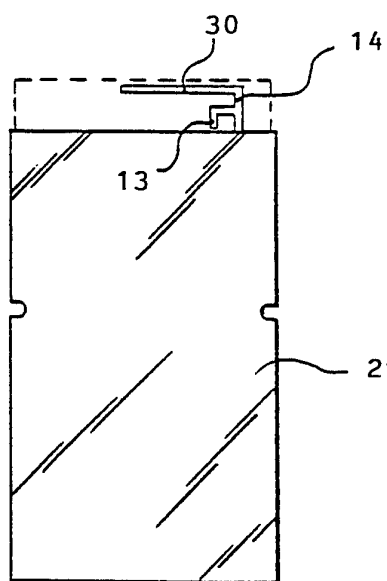


FIG. 8

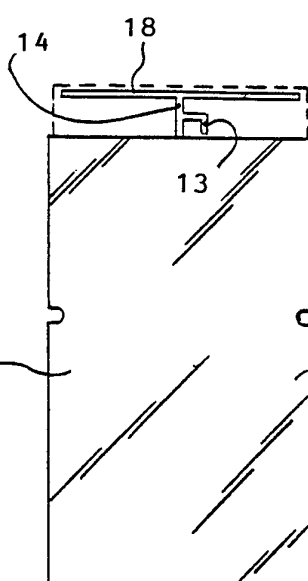


FIG. 7

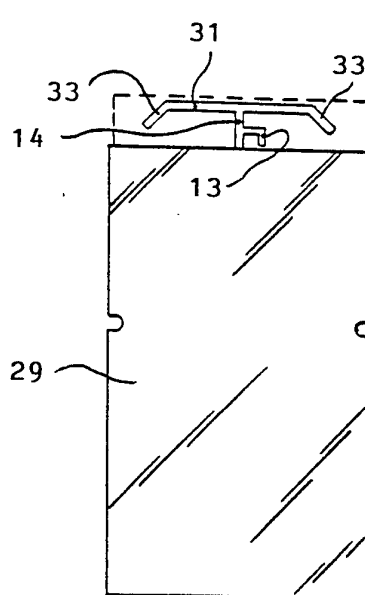


FIG. 9

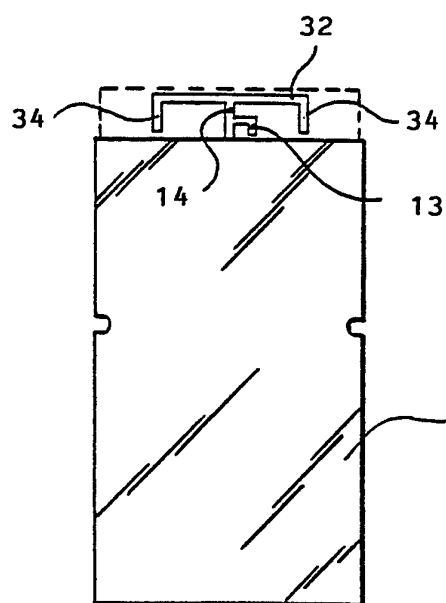


FIG. 10

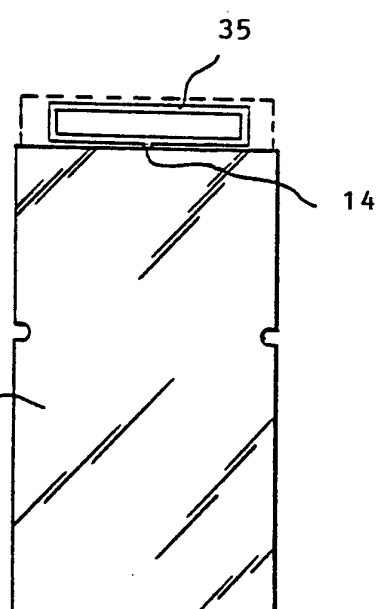


FIG. 11

INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 94/00158

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04B1/38 H01Q1/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04B H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	EP,A,0 588 271 (ALCATEL ITALIA) 23 March 1994 cited in the application see column 2, line 3 - line 47	1
A	---	3-6
A	PATENT ABSTRACTS OF JAPAN vol. 16, no. 570 (E-1297) 10 December 1992 & JP,A,90 405 141 (MISUBISHI) 11 August 1992 cited in the application see abstract	1-14
A	---	
A	EP,A,0 532 960 (SIEMENS) 24 March 1993 cited in the application see abstract; figure 2 -----	1,7



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

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Date of mailing of the international search report

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European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Andersen, J.G.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0588271	23-03-94	AU-B- 4607593	24-03-94
EP-A-0532960	24-03-93	NONE	