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(54) **An antenna for a mobile communications device, and a mobile communications device with such an antenna**

(57) An antenna for use with a mobile telephone or other mobile communications devices. The electrically conductive part of the antenna is supported by a flexible moulded structure, which includes a cavity therein for receiving an electro-acoustic transducer in a substan-

tially tight fit. Preferably, the antenna also has a substantially rigid portion secured to the antenna with an opening dimensioned for receiving a screw or a rivet for securing the antenna to eg a printed circuit board of a mobile telephone.

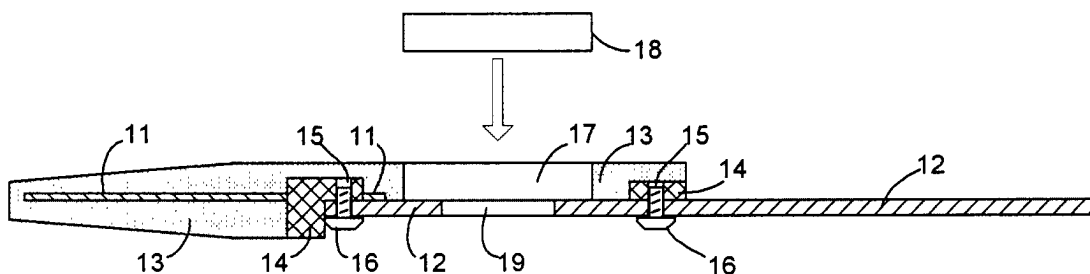


Fig. 1

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Description

Field of the invention

[0001] The invention relates to radio frequency antennas used in portable communications devices such as mobile telephones.

Related art

[0002] Many of today's mobile telephones and other portable communications devices have an antenna projecting from the main body of the telephone. Mobile telephones exist, which have a projecting antenna that is flexible, whereby the antenna is more robust and can better withstand rough handling without breaking or being otherwise damaged.

[0003] Today's mobile telephones are assembled from a large number of individual components including in particular an antenna with antenna connectors, and microphone and speaker or receiver transducer. These transducers are important components, which convert sound signals to corresponding electric signals or vice versa. These transducers require a well-defined acoustic environment in order to operate in accordance with the specifications for the transducers and for the telephone. For such and other reasons, the transducers are most often sealed against a housing wall of the telephone, eg by means of glue or a gasket ring of double-sided adhesive tape. Such adhesive gasket rings require careful handling and can give problems in the assembly line. It is desirable to reduce the number of individual components to be handled when assembling the communications device.

[0004] EP 702 478 discloses a telephone handset, in which a rubber keypad has an extension with a cavity for receiving a display of the telephone, and a further cavity for mounting a speaker or receiver transducer and providing an acoustic sealing of the transducer. This construction extends over substantially the entire length of the telephone handset, and it has the disadvantage of being inherently unstable, since rubber cannot easily be manufactured to tight tolerances over large dimensions such as the length of a telephone handset. The display is situated between the keypad and the transducer, and the relatively long and narrow rubber bands along the sides of the display are inherently unstable and provide no precise and stable mounting for the display.

Summary of the invention

[0005] The invention provides an antenna with a flexible structure supporting the electrically conductive portion of the antenna, where the flexible structure includes a cavity or nest for receiving an electro-acoustic transducer in a substantially tight fit. Such an antenna is particularly suited for use in mobile telephones and other

portable communications devices, where the speaker transducer is traditionally situated near the antenna.

[0006] The antenna can advantageously have a substantially rigid portion secured to the antenna, where the substantially rigid portion has means for securing the antenna to another structure of the communications device, eg to a printed circuit board (PCB). The securing means are preferably an opening or a hole in the substantially rigid portion, where a screw can be received in the hole for securing the antenna to the PCB by screwing.

[0007] Assembly of a communications device having an antenna of the invention is simplified due to a reduced number of individual parts to be assembled. In particular the mounting of the transducer is simplified, since no adhesive is needed, and the transducer will be mounted in a tight fit in a cavity of the flexible or soft part, which is also part of the antenna. The tight fit provides an acoustic seal for the transducer, and no separate gasket is thus needed, since the flexible material adapts itself to the transducer and also acts as a shock absorber for the transducer. An advantage over the construction in the above-identified EP 702 478 is that, in a mobile telephone, the speaker or receiver transducer is most often situated near the antenna, ie at one and the same end of the telephone (the "upper" end), and the flexible material can therefore be made very compact without long elastic bands or straps interconnecting two otherwise separate and separated portions of the flexible material. The entire antenna can easily be secured or fixed to a printed circuit board (PCB) of the mobile telephone by means of one or more screws or rivets cooperating with the substantially rigid portion, or by means of an adhesive. The substantially rigid portion can have flexible tongues with snap ridges for snapping around eg the edges of the PCB or other suitable structure in the telephone, whereby the antenna can be mounted using a simple snap-on action.

Brief description of the drawings

[0008]

Figure 1 schematically shows a cross-section through a printed circuit board with an antenna of the invention, seen from an edge,

Figure 2 shows the printed circuit board with the antenna in figure 1 seen from above, and

Figure 3 shows a mobile telephone using the antenna in figure 1, on a reduced scale.

Detailed description of the invention

[0009] Figures 1 and 2 show an antenna 10 with an electrically conductive portion 11 electrically connected to a printed circuit board (PCB) 12 for use in a mobile

telephone 50 shown in figure 3 or other mobile communications device. On the printed circuit board 12 there will normally be mounted a number of electronic and/or electro-mechanical components, which are necessary for the operation of the telephone. These and other components, which are not part of the invention, are not shown in the drawings. The electrically conductive portion 11 of the antenna can have any configuration in one, two or three dimensions as required and one or more frequency ranges in which the telephone is intended to operate. The conductive portion can thus have one or more straight and curved portions and portions of spiral or meander configurations, or combinations thereof, according to the intended use of the telephone. Such configuration is in itself not a part of the invention. The electrically conductive portion 11 of the antenna will preferably be operable both as a receiving antenna and as a transmitting antenna of the telephone.

[0010] A flexible sheet material, on which the conductive portion is materialised, preferably supports the electrically conductive portion 11 of the antenna. The conductive portion 11 of the antenna is embedded in a flexible material 13, such as rubber or soft plastics material, which thus completely encloses the conductive portion of the antenna. The flexible material 13 is preferably injection moulded and serves the purpose of protecting the conductive portion of the antenna against mechanical overload, and the flexible material has its physical dimensions and specific dielectric properties designed and selected for the proper functioning of the antenna.

[0011] The antenna also has portions 14 of a substantially rigid material such as a plastics material firmly secured to the flexible material 13, preferably by injection moulding. The portions 14 of a substantially rigid material has recesses or openings 15 therein, and the composite structure of the conductive portion 11, the flexible material 13 and the substantially rigid material 14 is secured to the printed circuit board 12 by means of screws 16 co-operating with the portions 14 of a substantially rigid material. The antenna with its flexible and rigid portions may be secured by other means than screws as shown here. Such alternatives may include rivets, adhesive such as hot melt glue or pressure sensitive adhesive, or flexible tongues with snap ridges for co-operating with edges on the printed circuit board or a housing wall of the telephone in a simple snap-on action.

[0012] The flexible material 13 has a nest or opening 17 therein. The opening 17 is shaped to receive an electro-acoustic transducer 18, preferably in a substantially tight fit. The printed circuit board 12 defines the bottom of the opening 17, and an opening 19 is provided in the printed circuit board. When the transducer 18 is received in the opening 17, the opening 19 serves to give the transducer access to a volume of air on its rear side, which for some transducers is necessary for the proper functioning of the transducer. The opening 19 at the rear side of the transducer can be tuned to have any desired acoustic impedance. For uses where a volume of air on

their rear side is not needed, the opening 19 can be omitted, whereby the nest or opening 17 can be a cavity closed at its bottom.

[0013] Figure 3 shows a mobile telephone 50 incorporating the antenna of figures 1 and 2. A portion of the flexible material 13 with the electrically conductive portion 11 embedded therein protrudes from the telephone. The shown shape of the flexible material is merely optional, and any shape that is technically and aesthetically acceptable can be used. The electro-acoustic speaker transducer 18 is situated within the housing of the telephone behind sound outlet openings 51 in the housing wall of the telephone.

Claims

1. An antenna with an electrically conductive portion, the electrically conductive portion being flexible, the antenna comprising a flexible structure supporting the electrically conductive portion, **characterized in that** the flexible supporting structure includes a cavity therein for receiving an electro-acoustic transducer.
2. An antenna according to claim 1, **characterized in that** the cavity is adapted to receive the transducer in a substantially tight fit.
3. An antenna according to claim 1, **characterized in that** the antenna further includes means for securing the antenna to another structure.
4. An antenna according to claim 3, **characterized in that** the securing means include an opening for receiving a screw or a rivet.
5. An antenna according to claim 4, **characterized in that** it includes a substantially rigid portion secured to the antenna with the opening dimensioned for receiving a screw or a rivet included in the substantially rigid portion.
6. An antenna according to claim 5, **characterized in that** each of the flexible supporting structure and the substantially rigid portion is a moulded structure.
7. An antenna according to claim 6, **characterized in that** the flexible supporting structure and the substantially rigid portion are moulded to each other.
8. A mobile communications device, **characterized in that** it comprises an antenna according to any one of claims 1-7 and an electro-acoustic transducer received in the cavity.

9. A mobile communications device according to claim 8, **characterized in that** the electro-acoustic transducer is a speaker transducer.
10. A mobile communications device according to claim 8, **characterized in that** the antenna is secured to a substantially rigid structure in the device. 5
11. A mobile communications device according to claim 10, **characterized in that** the rigid structure is a printed circuit board. 10
12. A mobile communications device according to claim 10, **characterized in that** the rigid structure is a housing wall of the device. 15

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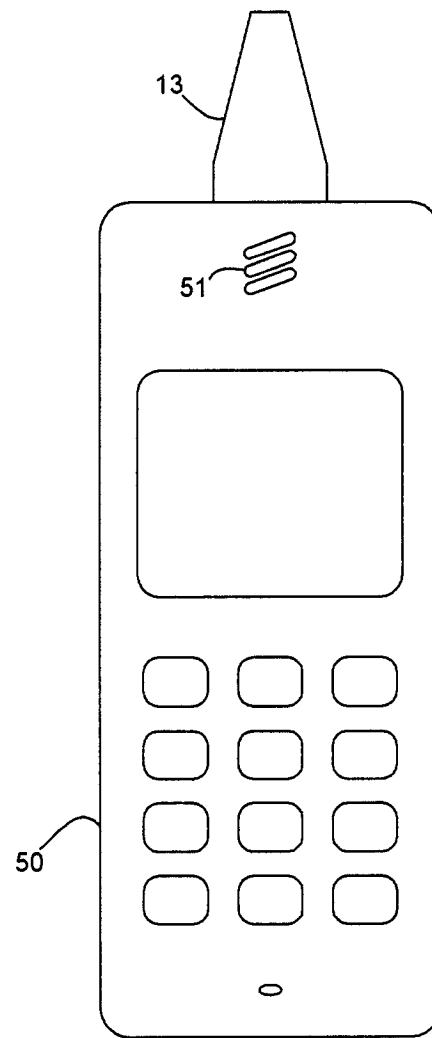
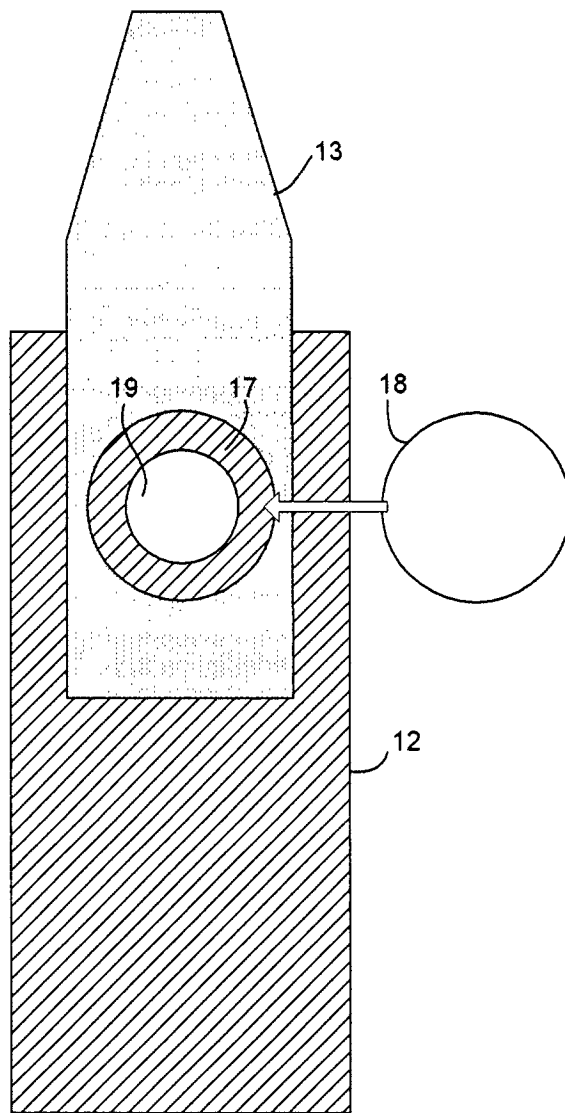
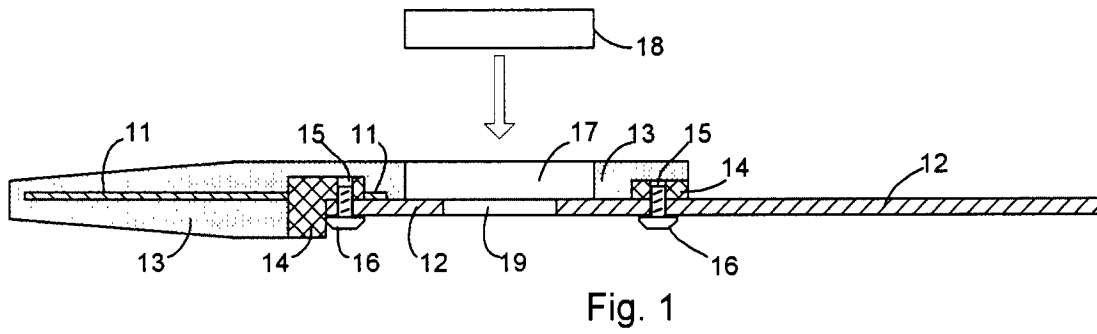
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EUROPEAN SEARCH REPORT

Application Number
EP 00 61 0121

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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 23 March 2001	Examiner Wattiaux, V
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 61 0121

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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