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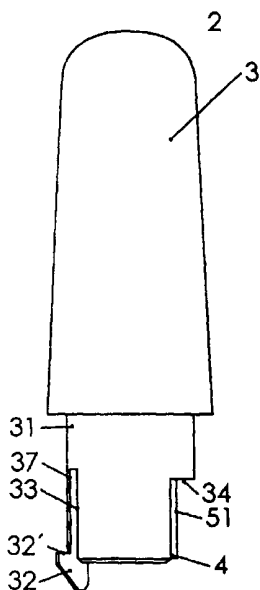
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(54) Title: ANTENNA DEVICE, A METHOD FOR ITS MANUFACTURE AND A CONTACT CLIP FOR SUCH ANTENNA DEVICE



(57) Abstract: Antenna device (2) for transmitting and/or receiving RF signals, a contact clip and a method for manufacturing such an antenna device. The antenna (2) device comprises an inner support structure (4) having a central first longitudinal axis and supporting a radiating element (5), and an outer support structure (3) having an elongated cavity with an entry aperture, and covering at least a main portion of the radiating element (5), and the inner support (4). The inner support (4) has a slit spring action means exerting force adjacent to the entry aperture in at least directions essentially perpendicular to said longitudinal axis. A retainer being designed such that the force of the slit spring action means must be overcome to remove the inner support structure from elongated aperture is also provided in the antenna device. A contact clip having slit spring action features can be used to contact the radiating element of the antenna device.

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**ANTENNA DEVICE, A METHOD FOR ITS MANUFACTURE AND A CONTACT CLIP
FOR SUCH ANTENNA DEVICE**

FIELD AND BACKGROUND OF THE INVENTION

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The present invention relates to an antenna device according to the introductory portion of the appended independent claim 1. Specifically, the invention concerns an antenna device for a hand-portable mobile telephone, which requires a compact and efficient antenna. Further it relates to a contact clip for such antenna device according to the introductory portion of the appended independent claim 22, to a contact clip for such antenna device according to the introductory portion of the appended independent claim 25 and to a method for manufacturing an antenna device according to the introductory portion of the appended independent claim 26.

Antennas in general and antennas for hand-portable radio communication devices in particular are going through a rapid evolution towards smaller sizes and lighter weights. The demands in the mobile radio business for smaller and lighter devices forwards requirements also on the antennas for such devices.

25 The current market volume of hand-portable radio communication devices and the expected increase in market volume also puts high requirements on the manufacturing processes for all components in such devices. Even relatively small improvements can result, due to large quantities, in large cost savings.

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For these reasons it is extremely important to find improvements in the manufacturing process and to implement these to achieve technical and competitive advantages.

35 PRIOR ART

Presently, the applicants antenna devices of the kind mentioned above often include a radiating pattern applied on an adhesive

tape. The tape carrying the pattern is attached to the support, which is cylindrical or a part of a cone. A cover, which could be elastic, is then pushed over the radiating pattern and the support, possibly during expansion of the cover. An example of
5 an antenna device that can be manufactured in such a way is disclosed in WO-A1-97/49141 and WO-A1-99/50927, and described in the EP patent application no. 99850020.1.

In such a process great care must be taken in order not to
10 damage the radiating pattern and the tape, displace or deform the tape, i.e., tip or slide them out of position or partially roll them up. Further, high demands are raised on the tolerances on the different parts. Even if the cover is elastic, the elasticity is generally not high enough to
15 substantially ease the demands on the tolerances. Thus, such a process can be complicated and expensive, and can involve a high rejection rate.

SUMMARY OF THE INVENTION

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It is an object of the invention to provide an antenna device for transmitting and/or receiving RF signals with which at least some of the problems mentioned above are eliminated or reduced.

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This object is attained by an antenna device according to the appended claims 1-21.

By the features of the invention is also achieved an antenna
30 means which is simple in its design and is suited for manufacturing cost-effectively in large quantities. Through the arrangement of a resilient support the mechanical tolerances on the parts of the antenna device can be rather high. This results in lower rejection rate in manufacture, than for prior
35 art antenna devices.

In a further aspect of the invention a contact clip is provided, which is especially advantageous when providing an

antenna device with which at least some of the problems mentioned above are eliminated or reduced.

Such a contact clip is attained by the features of the appended
5 claims 22-25.

It is also an object of the invention to provide a method for manufacturing an antenna device for transmitting and/or receiving RF signals with which at least some of the problems
10 mentioned above are eliminated or reduced.

This object is attained by a method according to the appended claims 26-32.

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows one possible application of an antenna device according to the invention.

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Fig. 2 shows a side view of an antenna device according to the invention.

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Fig. 3 shows a front view of an antenna device according to the invention.

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Figs. 4-6 show different views of different variations of carriers comprised in an antenna device according to the invention.

Fig. 7 shows a cross section of a possible carrier comprised in an antenna device according to the invention.

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Fig. 8 shows a further variation of a carrier, which can be comprised in the antenna device according to the invention.

Fig. 9 shows a cross section taken at IX-IX in figure 3.

Fig. 10 shows a further embodiment of an antenna device according to the invention.

5 Figs. 11-14 show different radiating structures, which can be comprised in an antenna device according to the invention.

10 Figs. 15-18 show different ways of arranging contact devices for establishing electric contact with a feed means of the radiating structure of an antenna device according to the invention.

Fig. 19 shows a side view of an antenna device of a further embodiment according to the invention.

15 Fig. 20 shows a cross section taken at XX-XX in figure 19.

Fig. 21 shows a contact clip according to the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

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With reference to fig. 1, one possible application of an antenna device according to the invention is shown. A hand portable mobile telephone 1 is provided with an antenna device 2, according to the invention.

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Referring to fig.2, the antenna device 2 according to the invention includes an outer dielectric cover 3 whereof a top portion is seen when mounted on a telephone (as in fig. 1). Portion 31 is an interface portion and is to be inserted into a
30 hole or receiving device of a housing of a radio communication device, such as a telephone. It is therefore preferable that portion 31 has smaller outer dimensions than the top portion. To secure the antenna device to the housing, the cover is provided with a snap-in device 37, 32, whereof a shoulder 32'
35 of the snap-in device is adapted to co-act with a corresponding part on the housing or its receiving device, in order to achieve mechanical locking of the antenna device 2. Portion 37 of the snap-in device is formed of a portion of a wall of the

housing by means of slits 33, 33', and acts as a leaf spring. The lower portion of the cover 3 is also provided with an opening 34. This opening can provide access to a feed portion 51 of a radiating structure accommodated in the housing 3.

5 Opening 34 could also be provided for the purpose of reducing the size of the interface. In such a case a second opening can be provided in order to give access to the feed portion 51.

10 It is especially advantageous to provide the fastener or interface portion 31 on the cover 3. By this arrangement the inner parts of the antenna are prevented from unnecessary mechanical stresses, which could cause a displacement of the inner parts. Further a simple mounting of the antenna device is obtained, as well as simple access to the fastener or mounting
15 means.

In fig. 3 the antenna device is seen in a front view. Here a member 4, carrying the feed portion 51, is seen through the opening 34. Member 4 is a dielectric support or carrier for the
20 radiating structure or radiating element(s).

Different shapes and features of the support 4 are shown in figs. 4-7. It is common for all cases that the support 4 is provided with a slit 41, preferably open in both ends. The
25 support 4 also has a generally cylindrical outer shape, although it preferably is open inside by means of a channel. It can also be seen to have a generally tubular shape. The outer shape of the support 4 should essentially correspond to the shape of cavity 38 of the cover 3 into which it is to be
30 inserted (fig. 9). In its free state, as seen in figs. 4-7, the support has circumferential dimensions (perpendicular to the slit) being greater than the corresponding circumferential dimensions of the cavity 38 of the cover 3. To insert the support 4 into the cavity 38, the support 4 is forced to reduce
35 the outer dimensions thereof. This is achieved by applying a pressure on the support essentially perpendicular to the slit 41 or its longitudinal axis, so that the width of the slit decreases. The pressure can be applied from the outside or the

inside of the support 4. The support is made of an elastic or resilient dielectric material, so that when a pressure is applied said dimensions decrease when overcoming a spring force working against said applied pressure. Preferably no
5 compression or deformation takes place in the walls of the support 4, other than those necessary for achieving spring action. When the applied pressure ceases and the support is inserted, the support will exert a pressure on the
10 corresponding portions of the cavity 38 due to spring action force. The so described support thus includes a slit spring action means. The support 4 could also be said to be a spring pin. The cross sections of the generally cylindrical support 4 could be circular, elliptical or of any other suitable shape, e.g. of a polygon. The support 4 is preferably more resilient
15 or elastic than the cover 3, at least in the directions mentioned.

In fig. 4 the support is provided with a cut-in portion 42, which corresponds to the opening 34 of the cover 3.

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Fig. 5 shows the support 4 provided with walls forming a channel 43, in the interior cavity of the support 4. The wall portion 45 of the support is provided with a cut-in portion 42' on the outside, opposing the channel 43. The feed portion 51 of
25 the radiating structure is to be located on the cut-out portion 42'. The purpose of channel 43 is to accommodate a portion of, or guide a contact device, which is connected the feed portion 51 and further will connect to circuits of the radio communication device, preferably to a PCB.

30

The spring force of the snap-in device 37, 32 can be increased by the support, which is resilient and partially in contact with the snap-in device 37, 32. In order to control the spring force, the support can carry one or more slits 46 to form a
35 tongue to be in contact with the snap-in device 37, 32, as illustrated in fig. 6. The tongue portion could alternatively be removed.

In fig. 7, the support 4 is shown in a cross section. In the cavity of the support 4, the walls are provided with walls forming channels 44, 44'. When compressing the support, pins can be inserted in the channels 44, 44' and be forced towards each other. Alternative possible locations of the channels 44, 44' are shown with broken lines.

Fig. 8 shows a further variation of the support. The support 4 has a shape of a frustum of a cone, and the slit 41 only extends along a part of the support. The support could alternatively be a combination of a cylinder and a cone or a frustum of a cone. In all those cases, the cover is preferably given a corresponding shape, at least in the interior. The features of this variation is otherwise similar to those of the examples above.

Fig.9 is a section taken at IX-IX in fig. 2. Here it is seen how the support 4 is placed in the cover 3, and how a radiating structure 5, 5' is located between the support 4 and the cover 3. The pressure exerted by the support presses the radiating structure 5, 5' against the inner wall of the cover 3. For guiding the support during insertion and to prevent rotation of the support when inserted, the inner wall of the cover 3 is provided with a guiding device 35. This is a knob or protrusion, which can be boss-like. The guiding device co-acts with a slit in the support, e.g. slit 41. It can thus be secured that the radiating structure 5, 5' has the desired orientation in the antenna device. The support 4 is locked in its inserted position and prevented from sliding out from the cover, by means of stopping devices 36, 36', co-acting with the lower edge(s) of the support. A stopping device 36, 36' is a protrusion in the form of a rib 36 or a knob, which can be boss-like. In the figure the stopping device 36' is located at the snap-in device 37, 32. Although two stopping devices 36, 36' are shown it is sufficient with one stopping device. Although it is preferred that the structure comprising the support 4 and the radiating structure 5, 5' is in contact with the cover 3 over the whole circumferential surface, it can be

sufficient if only portions thereof are in contact. Reference numeral 7 denotes a longitudinal axis of the support 4 and cover 3.

5 Fig. 10 shows a further embodiment of an antenna device according to the invention. Here an extendable/retractable whip antenna 9 is arranged to be slidable through the support 4 and the cover 3 to provide a dual mode antenna combination with the radiating structure 5, 5'. At the top of the whip antenna 9, a knob 91 is provided. The bottom portion of the whip antenna 9 is not shown since the antenna is shown broken. However, the bottom portion is provided with a stopping and feed device, co-acting with stopping and feeding devices arranged in the bottom part of the antenna device.

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Figs. 11-14 show examples of different radiating patterns 5, 5' or structures which can be used in the antenna device according to the invention. Portion 5' is adapted for operation in a higher frequency band than portion 5. Hereby multi-band function is obtained. The patterns are carried on a dielectric carrier 6, which is to be attached to the support 4 by means of an adhesive or other suitable means. The carrier is attached on the carrier so that the edges 61, 62 are preferably located on each side of the slit 41. Alternatively the carrier can be attached in the cover, or the adhesive can be provided on the support or in the cover. In a further alternative, the different radiating patterns 5, 5' or structures are printed or etched directly on the carrier or the cover. The radiating structure could also be formed as a single structure (without carrier) attached on the carrier or cover in any other suitable way, e.g. pressed between the carrier and the cover.

The feed portion 51 of the radiating structure 5, 5' is to be conductively connected with circuits of the radio communication device. This can be made by suitable contact members in the radio communication device, e.g. located on a PCB, or on a feed line, which contact the feed portion 51. This can be facilitated by means of a conductive spring clip 8 (fig. 15)

pressing the feed portion 51 and a portion of the wall (e.g. portion 45) of the support 3 together. The spring clip 8 can then act as a contact surface to contact members connected to the radio communication device.

5

An alternative contact member to be attached to the support is shown in figure 16. The feed portion 51 is folded around the wall portion 45 and extends into channel 43. A spring clip 8' is introduced in the channel 43 and presses a portion of the feed portion against the wall portion 45 by means of spring force in the curved spring clip 8' when being pressed into channel 43. The spring clip 8' is provided with a contact surface 81 having a defined contact portion for establishing contact with mating contact members.

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A further alternative contact member to be attached to the support is shown in figure 17. It is similar to that shown in figure 15, but provided with a curved portion in order to provide a resilient contact portion.

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A yet further alternative contact member to be attached to the support is shown in figure 18. It is similar to that shown in figure 17, but adapted to be partly inserted into channel 43.

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In figures 19-21 a further embodiment of the invention is shown. Parts being the same or corresponding to those in previous embodiments are given the same reference numerals.

Figure 19 is a view similar to that of figure 2. The antenna device 2 shown in figure 19 is provided with a contact clip 85 for connection to circuits of the radio communication device, as described above. Even if no opening like opening 34 in figure 2 is shown, the antenna device in this further embodiment could be provided with a such.

25

Figure 20 shows the antenna device in a cross section taken at XX-XX in figure 19. Here the carrier 4 is constituted of a thin or flexible dielectric substrate e.g. a flex film, and the

radiating element(s) or pattern(s) is (are) arranged on the substrate, preferably arranged on the side facing the center of the antenna device (inwards). The substrate will be like a sheet formed like a tube with a slit, and will thus act as a slit spring. Slit spring action will also be obtained if the substrate is arranged with overlap. The substrate 4 and the radiating element(s) or pattern(s) can be of the kinds shown in figures 11-14.

10 The substrate can be retained or kept in position by means of ribs or protrusions coacting with a lower edge 47 of the substrate 4. Contact clips or devices as shown above can be used for contacting the antenna device to circuits of the radio communication device. However, in figure 20 a further contact clip 85 is shown. This contact clip 85 also has a retaining or supporting function on the substrate 4, and is shown in a different view in figure 21. The contact clip 85 includes a vertical section 82, whereof a portion 82' is arranged to galvanically contact a feed portion 51 of a radiating element.

20 The contact clip 85 is so formed that portion 82' exerts a spring force on the feed portion 51. Portion 82'' is arranged for contacting a PCB or other contact devices for establishing contact to circuits of the radio communication device.

25 The contact clip 85 also includes a section 83 connected to section 82. Section 83 has the shape of a short tube with a slit. The shape and material of section 83 is selected so that a slit spring action is obtained when the contact clip is introduced into the cover 3. Sections 82 and 83 can be made in one piece or two pieces that are fixed to each other. For positioning and retaining the contact clip 85, protrusions or knobs 84, 84' are arranged on section 83. Those protrusions are received in corresponding recesses in the cover 3. When placed in its location, the contact clip will support the substrate 4 at its lower edge 47 and act as a retainer. Alternatively, the substrate 4 could extend further down and extend between the portion 83 of the contact clip 85 and the cover. Hereby the substrate will be held in position by the spring action of the

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contact clip 85. The contact clip 85 can also be said to include a curved elongated portion 82 and a portion 83 comprising two arms 83', 83'' extending essentially perpendicular to the elongated portion 82.

5

Alternatively, the radiating element(s) can be self-supporting and have slit spring action features, by making it in a suitable material with suitable dimensions. In such a case, the contact clip can act as support and/or retainer, and it is also possible to make the contact clip and the radiating element in one piece.

10

Although the invention has been described in conjunction with a number of preferred embodiments, it is to be understood that various modifications may still be made without departing from the spirit and scope of the invention as defined by the appended claims.

15

CLAIMS

1. Antenna device for transmitting and/or receiving RF signals, comprising:

- 5 - at least one feed means to be coupled to circuits of a radio communication device, for transferring RF signals between the antenna device and circuits of the radio communication device,
- a fastener to provide a secure mechanical interface of the antenna device to said radio communication device,
- 10 - a radiating first element fed via said at least one feed means,
- an inner support structure having a central first longitudinal axis and supporting the first element,
- 15 - an outer support structure having an elongated cavity with an entry aperture, and covering at least a main portion of the first element and the inner support, and
- a retainer keeping the inner support structure located in the elongated aperture,
- 20 c h a r a c t e r i s e d b y
- the inner support having a slit spring action means exerting a spring action force against the outer support in at least directions essentially perpendicular to said longitudinal axis,
- 25 - the retainer being designed such that the force of the slit spring action means must be overcome to remove the inner support structure from elongated aperture.

2. Antenna device of claim 1, wherein the inner support
30 includes a general shape included in the group consisting of a cylinder, a cone, a frustum of a cone, and combinations thereof.

3. Antenna device of claim 1 or 2, wherein the inner support
35 includes a cross section having a shape included in the group consisting of a circle, a polygon and an ellipse.

4. Antenna device according to any preceding claim, wherein the

inner support includes a generally cylindrical shape and a slit is provided between and through two end surfaces of the cylinder.

5 5. The antenna device according to any preceding claim, wherein the inner support includes a generally tubular shape and a slit is provided along the wall of the tube.

10 6. The antenna device according to any of claims 4-5, wherein the outer support is provided, on a surface facing the inner support, with a guiding device adapted for co-action with the slit.

15 7. The antenna device according to any preceding claim wherein the outer support is provided, on a surface facing the inner support, with a retainer adapted for co-action with the support.

20 8. The antenna device according to any preceding claim, wherein the radiating first element comprises a conductive element provided between the inner and outer supports.

25 9. The antenna device according to any of claims 1-8, wherein the radiating first element comprises a conductive pattern on a carrier attached to the one of the supports by means of an adhesive.

30 10. The antenna device according to any of claims 1-8, wherein the radiating first element comprises a conductive pattern printed on one of the supports.

35 11. The antenna device according to any preceding claim, wherein the outer support is provided with an opening, at which a feed portion of the first radiating structure is arranged.

12. The antenna device according to any preceding claim, wherein the feed means includes a contact clip exerting a spring force on a feed portion of the radiating first element

and at least one wall of the inner support.

13. The antenna device according to any preceding claim,
wherein an extendable/retractable radiating second element is
5 arranged to be slidable through the inner and outer supports to
provide a dual mode antenna combination with said first
element.

14. The antenna device according to claim 13 or any preceding
10 claim, wherein the first element is a compact element having a
geometry selected from a group consisting of a helix, a
meander, a spiral, a patch, fractals, and combinations thereof.

15. The antenna device according to any preceding claim,
15 wherein the fastener is provided on the outer support.

16. The antenna device according to any preceding claim,
wherein the slit spring action means exerts the force in
proximity of the entry aperture.

20 17. The antenna device according to any preceding claim,
wherein the inner support includes a flexible substrate.

18. The antenna device according to any preceding claim,
25 wherein the inner support includes a sheet-like dielectric
material.

19. The antenna device according to any preceding claim,
wherein the radiating first element is provided on the inner
30 support.

20. The antenna device according to any preceding claim,
wherein
- a contact clip is arranged to contact a feed portion of
35 the radiating first element and is provided with at
least one slit spring action portion extending along at
least one portion of the surface of said cavity on which
portion said slit spring action portion exerts a

pressure, and

- the contact clip is provided with a portion arranged to be connected to circuits of a radio communication device.

5

21. The antenna device according to claim 20, wherein

- the contact clip is arranged to support a carrier for the radiating first element.

10 22. A contact clip for an antenna device for transmitting and/or receiving RF signals, which antenna device comprises:

- at least one feed means to be coupled to circuits of a radio communication device, for transferring RF signals between the antenna device and circuits of the radio communication device,

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- a fastener to provide a secure mechanical interface of the antenna device to said radio communication device,
- a radiating first element fed via said at least one feed means,

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- an inner support structure having a central first longitudinal axis and supporting the first element,
- an outer support structure having an elongated cavity with an entry aperture, and covering at least a main portion of the first element and the inner support, and
- a retainer keeping the inner support structure located in the elongated aperture,

25

characterised by

- the contact clip having a slit spring action means exerting a spring action force against the outer support in at least directions essentially perpendicular to said longitudinal axis,
- the retainer being designed such that the force of the slit spring action means must be overcome to remove the inner support structure from elongated aperture.

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23. The contact clip according to claim 22, wherein the inner support is constituted of the contact clip.

24. The contact clip according to any of claims 22-23, wherein the contact clip includes

- an elongated section provided with a first portion arranged to be connected to a feed portion of a radiating element and a second portion arranged to be connected to circuits of a radio communication device, and a slit spring action section arranged to exert a slit spring action force in at least directions essentially perpendicular to the extension of said elongated section.

25. A contact clip for an antenna device for transmitting and/or receiving RF signals, comprising:

- an elongated section provided with a first portion arranged to be connected to a feed portion of a radiating element and a second portion arranged to be connected to circuits of a radio communication device, characterised by
- the contact clip further comprising a slit spring action section arranged to exert a slit spring action force in at least directions essentially perpendicular to the extension of said elongated section.

26. A method for manufacturing an antenna device for transmitting and/or receiving RF signals, having:

- a radiating first element fed via at least one feed means,
 - an inner support structure having a central first longitudinal axis and supporting the first element,
 - an outer support structure having an elongated cavity with an entry aperture, and covering at least a main portion of the first element and the inner support, and
 - a retainer keeping the inner support structure located in the elongated aperture,
- characterised by said method comprising the steps of:
- providing the inner support with a slit enabling

circumferential measures of the inner support to decrease when forces are applied to the inner support in directions essentially perpendicular to said longitudinal axis,

- 5 - applying a force decreasing circumferential measures of the inner support,
- introducing the inner support into the cavity,
- locating the first element at least partly between the inner and outer supports, and
- 10 - releasing said applied force.

27. The method according to claim 26, further including the step of providing the inner support with a slit between and through two end surfaces of the inner support.

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28. The method according to any of claims 26-27, further including the step of providing the outer support with a guiding device adapted for co-action with the slit on a surface facing the inner support.

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29. The method according to any of claims 26-28, further including the step of providing the outer support with a retainer adapted for co-action with the support, on a surface facing the inner support.

25

30. The method according to any of claims 26-29, further including the step of attaching the radiating first element, in the form of conductive pattern on a carrier, to one of the supports by means of an adhesive.

30

31. The method according to any of claims 26-29, further including the step of providing the radiating first element on one of the supports by printing a conductive pattern.

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32. The method according any of claims 26-31, further including the step of applying a contact clip exerting a spring force on a feed portion of the radiating first element and at least one wall of the inner support.

33. A radio communication device comprising a housing, a user interface and receiving and/or transmitting circuits connected to an antenna device,

5 c h a r a c t e r i s e d i n t h a t

- it includes an antenna device according to any of claims 1-21.

34. A radio communication device comprising a housing, a user interface and receiving and/or transmitting circuits connected to an antenna device,

10 c h a r a c t e r i s e d i n t h a t

- it includes a contact clip according to any of claims 22-25.

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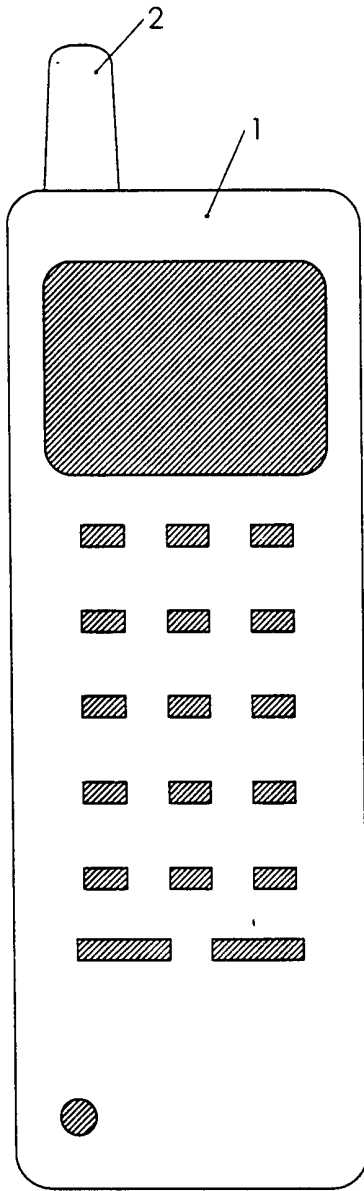


Fig. 1

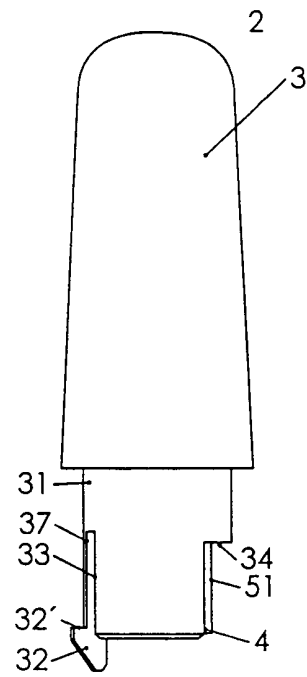


Fig. 2

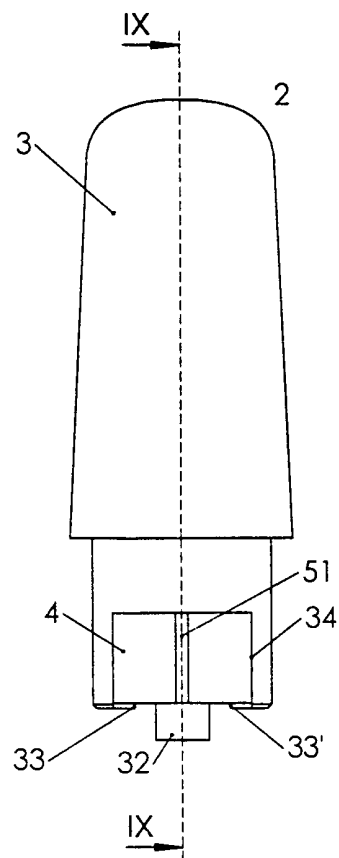
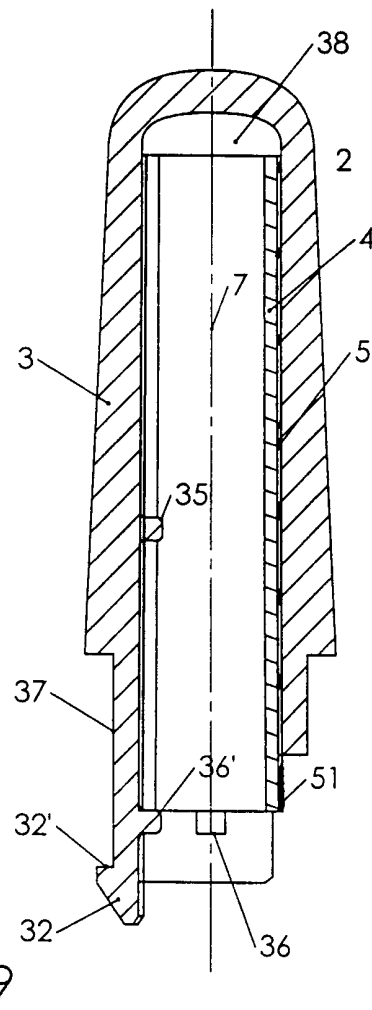
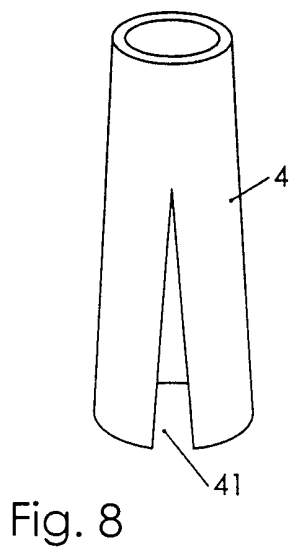
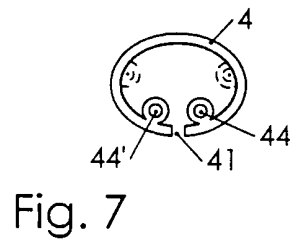
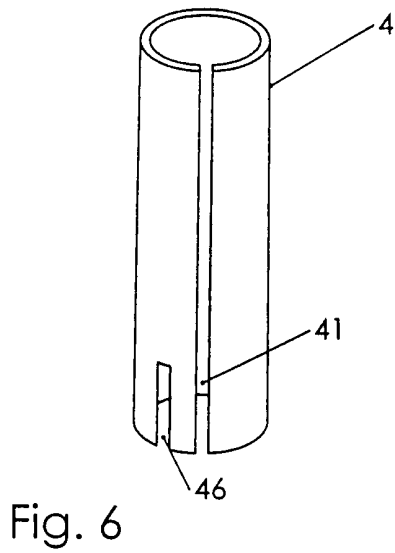
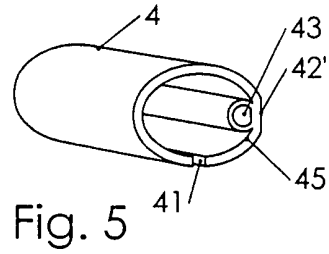
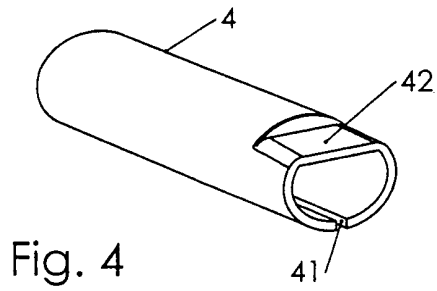


Fig. 3



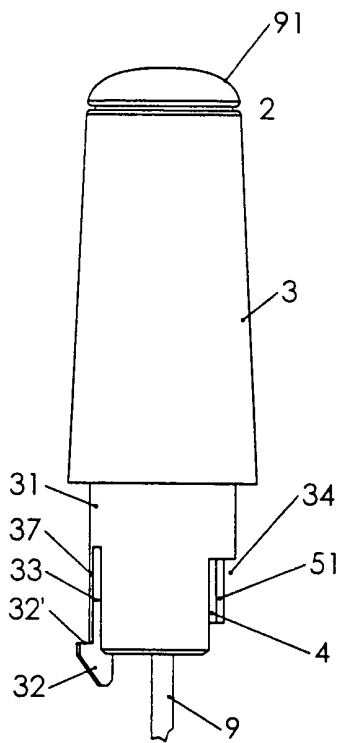


Fig. 10

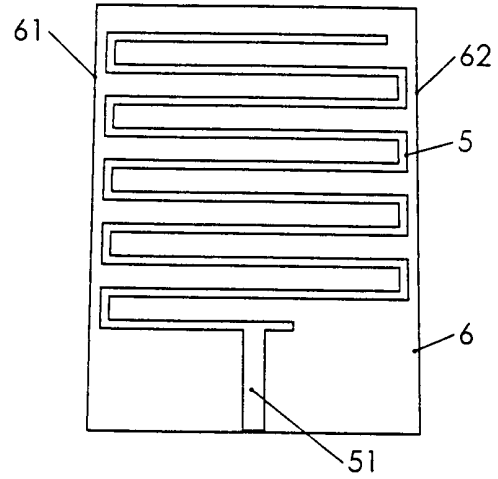


Fig. 11

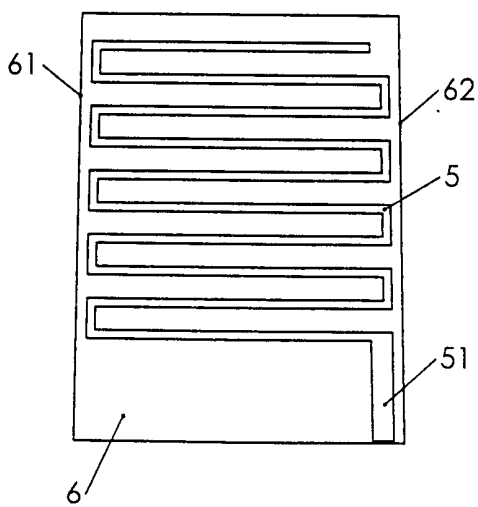


Fig. 12

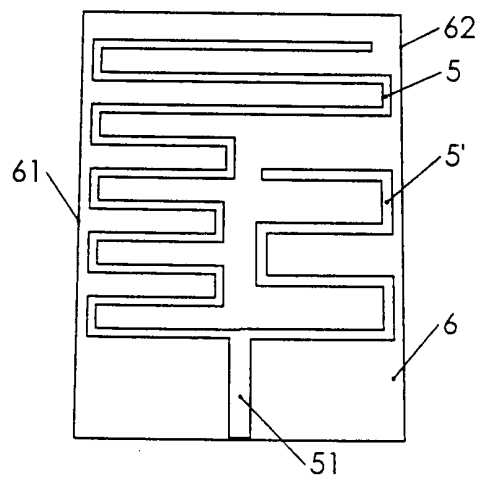


Fig. 13

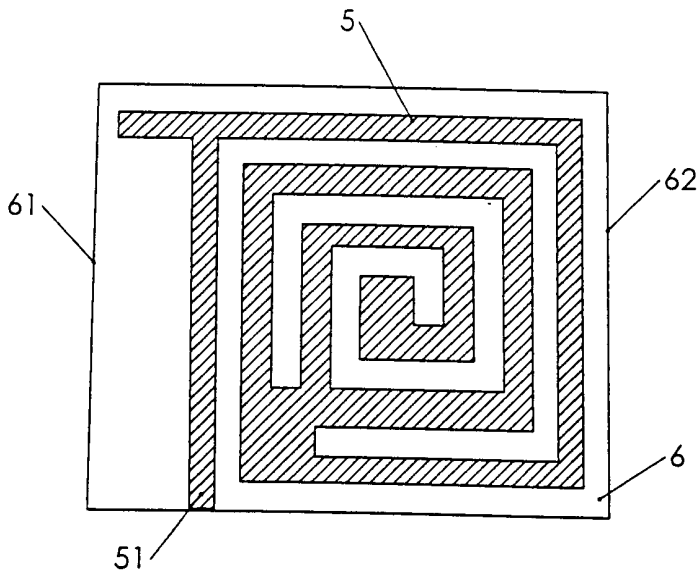


Fig. 14

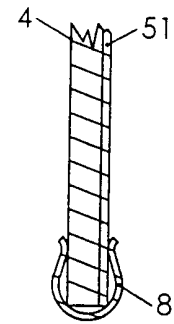


Fig. 15

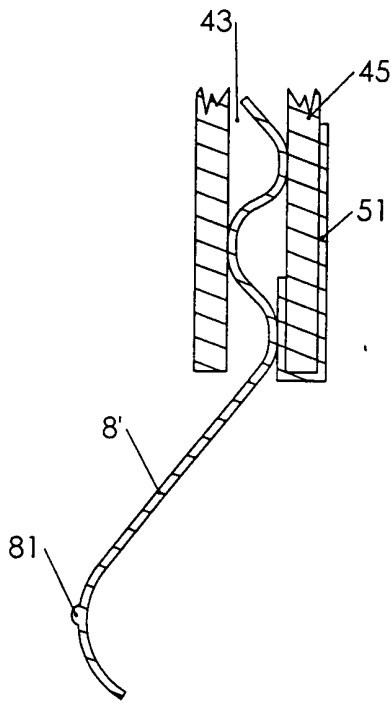


Fig. 16

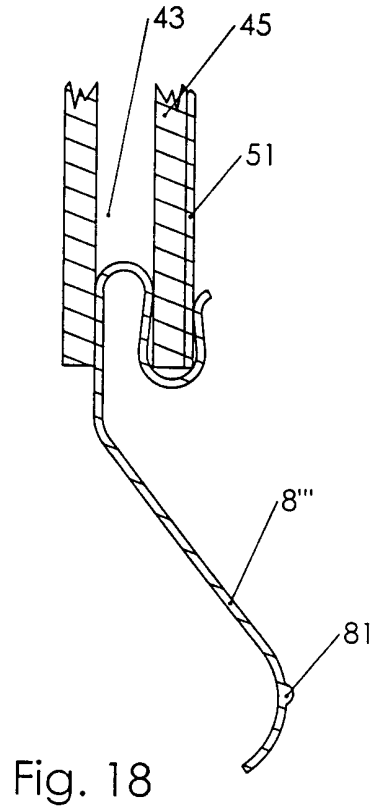


Fig. 18

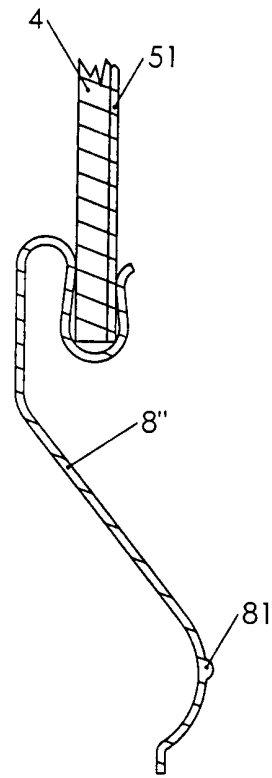


Fig. 17

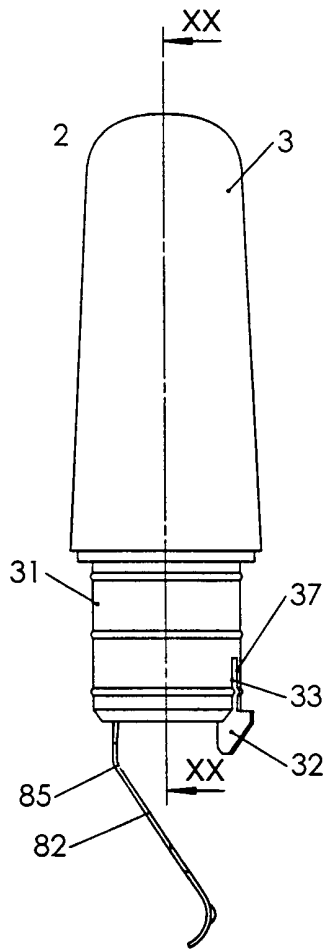


Fig. 19

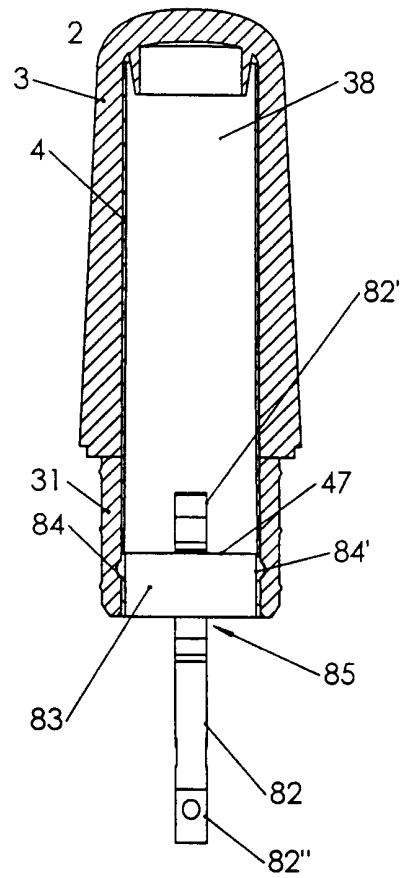


Fig. 20

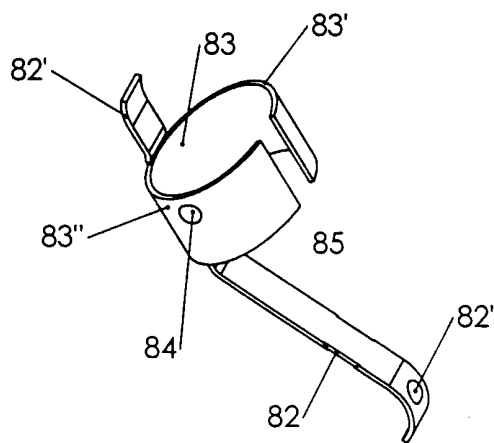


Fig. 21

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 00/02007

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H01Q 1/24

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)

IPC7: H01Q

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

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, 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.
A	WO 9950927 A1 (ALLGON AB), 7 October 1999 (07.10.99) --	1-34
A	WO 9749141 A1 (ALLGON AB), 24 December 1997 (24.12.97) --	1-34
P,A	WO 0005781 A1 (ALLGON AB), 3 February 2000 (03.02.00) -- -----	1-34

 Further documents are listed in the continuation of Box C. See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search

15 February 2001

Date of mailing of the international search report

19-02-2001

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SE 00/02007

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
WO	9950927	A1	07/10/99	AU	4175399 A	18/10/99
				AU	7948298 A	19/01/99
				BR	9909317 A	21/11/00
				EP	1016160 A	05/07/00
				SE	511900 C	13/12/99
				SE	9801155 A	02/10/99
				SE	9900412 D	00/00/00
				AU	3178799 A	18/10/99
WO	9749141	A1	24/12/97	AU	3280897 A	07/01/98
				EP	0904611 A	31/03/99
				SE	509638 C	15/02/99
				SE	9602387 A	16/12/97
				US	6069592 A	30/05/00
WO	0005781	A1	03/02/00	AU	5077799 A	14/02/00
				SE	513162 C	17/07/00
				SE	9802617 A	25/01/00