COMBINATION OF TUBE ASSEMBLY AND CLIP FOR WIRELESS ANTENNA GROUNDING

TECHNICAL FIELD

The present invention relates to antenna grounding and mounting technology, and specifically to the mounting and grounding of an antenna in a mobile device.

BACKGROUND ART

In order to maximize signal reception and minimize noise, a good ground for an antenna is required. Unfortunately, in many mobile devices where the antenna is stored in a retracted state, proper grounding is not realized. This is generally the result of improper contact between the antenna contact block and a ground in the antenna tube assembly.

Further, even when an antenna does have a ground in a fully retracted position, in many cases this ground is ineffective when the antenna is not completely retracted. This can occur if a user fails to push the antenna completely into its mount, but rather leaves it partially extended.

Another problem with present grounding techniques occurs during assembly of the antenna, where the mounting tube can move axially. This axial movement shifts the fully retracted position of the antenna, resulting in ineffective grounding if the antenna requires a fully retracted position to be grounded properly.

A further problem with retractable antennae is that they can convey water into the antenna tube when they move from an extended state to a retracted state, especially when the mobile device is used in the rain.

DISCLOSURE OF THE INVENTION

The present invention overcomes the shortcomings of the prior art by providing a superior antenna tube and clip combination for an antenna. Specifically, the present invention includes a clip that is inserted into the end of an antenna tube. The clip includes at least one contact pin extending axially along the antenna tube, providing an extended surface for an antenna contact block to make contact when the contact block is in a retracted state. The length of the contact area allows contact even when the antenna is not fully retracted. Further resilient forces in the contact clip ensure that good contact is made with the antenna contact block.

The present invention further has a flange at one end of the mounting tube in order to significantly reduce the possibility of axial movement during manufacturing. This

flange fits into a groove that is located on a printed circuit board (PCB). The flange and groove can be created with high precision, thus providing a constant position for the fully retracted state of the antenna once the tube is mounted to the PCB. Without this groove and flange, slight axial movement of the tube could cause the contact point for a fully retracted antenna to shift towards or away from a mounting on the housing of the device within which the antenna is installed. By having a constant contact distance between the housing mount and the fully retracted position, grounding is facilitated.

The present invention further has an easy way to waterproof the antenna by providing a plastic tube that is mounted within an antenna tube assembly and captures any water conveyed into the tube assembly by a retracting antenna. The use of a cap at the other end of the tube ensures no water can enter from that end.

The present invention therefore provides an antenna grounding assembly for a hand-held device, said grounding assembly comprising: an antenna having an antenna shaft connected between a grounding block and a protective sheath; an antenna tube affixed within said hand-held device and holding said antenna, said antenna tube having an upper end through which said antenna shaft is extended or retracted, and an inner end opposite said upper end; and a grounding clip installed into said inner end of said antenna tube, said grounding clip having a base and at least one contact pin extending axially along said antenna tube for resilient contact with said grounding block.

The present invention further provides An antenna grounding assembly for a hand-held device, said grounding assembly comprising: an antenna having an antenna shaft connected between a grounding block and a protective sheath; an antenna tube affixed within said hand-held device and holding said antenna, said antenna tube having a flanged upper end through which said antenna shaft is extended or retracted, and an inner end opposite said upper end; a grounding clip installed into said inner end of said antenna tube; and a printed circuit board having a groove therein, said antenna tube being mounted to said printed circuit board using surface mount technology clips and said flanged end fitting into said groove to restrict axial movement of said antenna tube.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of the antenna tube and mount assembly of the present invention;

Figure 2 is a cross sectional view of the antenna tube and mount assembly;

Figure 3 is a cross sectional view of the contact end of the antenna tube and mount;

Figure 4 is a rear side elevational view of the grounding clip of the present invention;

Figure 5 is a top perspective view of the grounding clip of Figure 4;

Figure 6 is a bottom perspective view of the grounding clip;

Figure 7 is a top plan view of the grounding clip;

Figure 8 is a front side elevational view of the grounding clip;

Figure 9 is a left side elevational view of the grounding clip;

Figure 10 is a partial cross sectional view of the tube and grounding clip of the present invention;

Figure 11 is a partial cross sectional view of the tube and grounding clip of the present invention showing more of the tube;

Figure 12 is a partial cross sectional view of the tube and grounding clip of Figure 11 rotated to a different angle;

Figure 13 is an end view of the tube and grounding clip of Figure 11;

Figure 14 is a partial cross sectional view of the tube and grounding clip of the present invention;

Figure 15 is a schematical cross-sectional view of the tube and grounding clip of the present invention;

Figure 16 is a schematical plan view of an alternative contact pin for the grounding clip of the present invention;

Figure 17 is a schematical plan view of another alternative contact pin for the grounding clip of the present invention;

Figure 18 is a cross sectional view of the flange and groove assembly of the present invention; and

Figure 19 is a schematical cross-sectional view of the tube assembly of the present invention including waterproofing components.

BEST MODE FOR CARRYING OUT THE INVENTION

Reference is now made to Figures 1 and 2. Figures 1 and 2 show a tube assembly 10 for a retractable antenna 25. Tube assembly 10 includes an outer metal wall 12 that is formed to a precise inner diameter ensuring very little deviation.

Tube assembly 10 is mounted to a printed circuit board (PCB) 14 using surface mount technology clips (SMT) 16. SMT clips provide an electrical contact between tube assembly 10 and PCB 14.

Antenna 25 includes an external protective sheath 30 at the antenna's outer tip, an antenna shaft 32, and a contact block 34 (seen more clearly in Figure 3). Antenna 25

is held at the shaft's upper end to the hand held device using a mount 36. Mount 36 provides some stability for antenna 25 and further provides some weather protection for tube assembly 10 to limit the ingress of water.

A user can extend antenna 25 by pulling external sheath 30 outwardly relative to the hand held device. This causes antenna shaft 32 to move through mount 36, pulling antenna contact block 34 with it. Contact block 34 moves from a position near the inner end 18 of tube assembly 10 to a position towards the outer end 20 of tube assembly 10.

Similarly, retraction is performed by pushing external protective sheath 30 towards the hand held device, causing antenna contact block 34 to move towards inner end 18 of tube assembly 10.

In order to facilitate grounding, the present invention is provided with a conductive and typically metal grounding clip 40. Grounding clip 40 is best seen in Figures 3 to 15.

Clip 40 consists of at least one, but preferably two resiliently flexible contact pins 42 connected to or formed integrally with a base ring 44.

In operation, grounding clip 40 is installed into the inner open end 18 of tube assembly 10. Tube assembly 10 is formed with a circumferentially extending groove 46 that is used to hold grounding clip 40 in place. Specifically, clip 40 can be inserted into tube 10 until base ring 44 snap fits securely into the space between groove 46 and the tube's inwardly curved lip 48 with both the insertion of the clip and, if necessary, its removal, being facilitated by the angled tabs 41 at the inner and outer ends of the base ring 44.

The end of tube assembly 10 is preferably formed into a tapered lip 48. Clip 40 is then installed into the space between groove 46 and lip 48 using some elastic deformation of the clip to fit it over lip 48. Preferably, a small jig is used to accomplish this insertion. Grounding clip 40 is thus locked in place between the tapered lip 48 of tube assembly 10 and groove 46.

Each contact pin 42 is essentially dog legged in shape which provides for clearance between each pin and groove 46 and allows the longer portion 43 of each pin to taper from the dog leg's apex 52 to tab 50 that is adapted to bear against the tube 10's inner surface. The surface 55 of each pin portion 43 between apex 52 and tab 50 is a flexible contact area for making electrical contact between clip 40 and contact block 34 at the inner end of the antenna's shaft as the antenna is fully or partially retracted.

Reference is now made to Figure 15. Figure 15 shows that if antenna contact block 34 is located between points 54 and 56 of contact area 55, contact pin 42 makes physical and electrical contact with the antenna contact block 34. Contact pin 42 is preferably gold plated within this area to ensure optimal contact and hence grounding.

Grounding clip 40 is preferably formed through a progressive stamping die. This ensures that the clip has very well controlled dimensions for consistent installation within each tube assembly 10. This ensures that pins 42 have very good repeatable positions when compared between one tube assembly 10 and another.

The slope between points 54 and 56 is designed to produce an optimal contact area. This is done by ensuring that the contact area 55 is as long as possible, and that contact pin 42 is resiliently flexible. This assembly creates a long contact area 55 that produces more chances for the grounding of antenna 25. Specifically, antenna 25 does not need to be fully retracted into the tube in order to achieve proper grounding.

In a preferred embodiment, clip 40 includes two contact pins 42. The use of two pins ensures that proper contact is maintained with antenna contact block 34 by providing a three contact grounding. The first two contact points are between block 34 and the two contact areas 55 on contact pins 42. Further, the spring forces produced by contact pins 42 on antenna contact block 34 will force antenna contact block 34 into contact with the inside of tube assembly 10, created a third grounding point as shown most clearly in Figure 15. The optimal configuration for contact pins 42 will not be diametrically opposed to one another, but rather at an angle of between 90 and 120 degrees from one another.

One skilled in the art will realize that other configurations for contact pins 42 are possible. One contact pin could, for example, be used as long as the pin was sufficiently stable to provide a good contact area 55. Reference is now made to Figures 16 and 17, which show alternative configurations for contact pin 42. In Figure 16, a contact pin 42 is shown with a forked end 43. Forked end 43 provides sufficient stability to ensure contact pin 42 does not move when antenna contact block 34 is retracted.

Alternatively, contact pin 42 can be curved, as illustrated in Figure 17. Figure 17 shows contact pin 42 with a single contact point 55 at one end. However, contact area 55 is curved to fit around antenna contact block 34, ensuring contact pin 42 is not moved to the side of antenna contact block 34 when antenna 25 is retracted.

Grounding is further facilitated through the mounting of tube assembly 10 onto PCB 14. As indicated above, tube assembly 10 is mounted to PCB 14 using surface mount technology clips 16. Two SMT clips 16 are used, and these clips 16 connect to associated clips on PCB 14. Clips 16 will hold tube assembly 10 in the X and Y directions. The combination of two clips will restrict rotation in the X and Y axes.

Reference is now made to Figure 18. The present invention further includes a radially extending flange 60 at the front or upper end of tube assembly 10. Flange 60 fits into a groove 62 cut into PCB 14. The combination of flange 60 and groove 62 ensures that tube assembly 10 will not move in the tube's axial direction.

One advantage of the above mounting technique is that contact performance will be improved. If the tube were allowed to move axially, the retraction point of antenna contact block 34 would vary, thus making accurate grounding more difficult to achieve. The use of flange 60 and groove 62, which can both be manufactured for high precision, ensures that tube assembly 10 is always mounted correctly in the axial direction. This mounting technique only allows rotation about the axis of the tube assembly 10. This does not affect the contact of retracted antenna 25, and thus does not affect the grounding performance.

After the tube is completely assembled, one skilled in the art will appreciate that plastic components in the housing will also aid in holding the tube assembly 10 in the correct position.

The present invention further provides for improved waterproofing by providing a tube 70 within tube assembly 10. Water may enter tube assembly 10 from mount 36 when antenna 25 is retracted. This is overcome by plastic tube 70 and cap 72.

Reference is made to Figure 19. Tube 70 is preferably fabricated from plastic and is affixed to mount 36. Tube 70 extends from mount 36 to contact area 55. Preferably, a small gap exists between tube 70 and tube assembly 10 to facilitate insertion of plastic tube 70 into tube assembly 10. Further, even after the housing of the mobile device is closed, plastic tube 70 can be inserted into tube assembly 10 using the opening for mount 36.

In operation, water that may collect on shaft 30 because of rain can be pushed into mount 36 when antenna 25 is retracted. This water will stay in tube 70 rather than contact the side of tube assembly 10.

Further waterproofing is accomplished by adding a cap 72 at the end of tube assembly 10. Cap 72 can be comprised of metal or plastic, and fits snugly on the end of tube assembly 10, thus providing a seal.

The above-described embodiments of the present invention are meant to be illustrative of preferred embodiments and are not intended to limit the scope of the present invention. Also, various modifications, which would be readily apparent to one skilled in the art, are intended to be within the scope of the present invention. The only limitations to the scope of the present invention are set forth in the following claims appended hereto.

INDUSTRIAL APPLICABILITY

The present invention is directed at the mounting and grounding of an antenna in a mobile device.

Claims

1. An antenna grounding assembly for a hand-held device, said grounding assembly comprising:

an antenna having an antenna shaft connected between a grounding block and a protective sheath;

an antenna tube affixed within said hand-held device and holding said antenna, said antenna tube having an upper end through which said antenna shaft is extended or retracted, and an inner end opposite said upper end; and

a grounding clip installed into said inner end of said antenna tube, said grounding clip having a base and at least one contact pin extending axially along said antenna tube for resilient contact with said grounding block.

2. The antenna grounding assembly of claim 1, wherein said antenna tube further has a tapered lip at said inner end.

3. The antenna grounding assembly of claim 2, wherein said antenna tube further includes a groove between said inner end and said upper end.

4. The antenna grounding assembly of claim 3, wherein said base of said grounding clip is adapted to fit securely between said groove and said tapered lip of said antenna tube.

5. The antenna grounding assembly of claim 4, wherein said base of said grounding clip is resiliently deformable in a radial direction for installation of said grounding clip over said tapered lip.

6. The antenna grounding assembly of claim 5, wherein said grounding clip is held in place by said tapered lip and said groove.

7. The antenna grounding assembly of claim 6, wherein said base of said grounding clip includes angled tabs for removal of said grounding clip from said antenna tube.

8. The antenna grounding assembly of claim 1 having two contact pins.

9. The antenna grounding assembly of claim 1, wherein said at least one contact pin is dog legged in shape.

10. The antenna grounding assembly of claim 9, wherein said contact pin tapers from an apex to a tab at an end of said contact pin.

11. The antenna grounding assembly of claim 10, wherein said tab is adapted to bear against an inner surface of said antenna tube.

12. The antenna grounding assembly of claim 11, wherein said contact pin between said apex and said tab is resiliently flexible.

13. The antenna grounding assembly of claim 12, wherein said grounding clip is gold plated.

14. The antenna grounding assembly of claim 1, wherein said contact pin has a forked end.

15. The antenna grounding assembly of claim 1, wherein said contact pin is curved

16. The antenna grounding assembly of claim 1, wherein said antenna tube is mounted to a printed circuit board using surface mount technology clips.

17. The antenna grounding assembly of claim 16, wherein said antenna tube further includes a flange at its upper end and said printed circuit board includes a groove to accept said flange, thereby restricting movement in the axial direction of said antenna tube.

18. The antenna grounding assembly of claim 17, wherein movement of said antenna tube is further restricted by plastic components in said hand-held device.

19. The antenna grounding assembly of claim 1, further comprising a mount on said handheld device, said mount located above said upper end and having a hole through which said antenna shaft passes.

20. The antenna grounding assembly of claim 19, further comprising a tube connected to said mount and extending into said antenna tube, said tube providing waterproofing for said antenna grounding assembly.

21. The antenna grounding assembly of claim 20, further comprising a cap adapted to fit snugly over said inner end of said antenna tube, said cap providing a seal for said antenna tube.

22. An antenna grounding assembly for a hand-held device, said grounding assembly comprising:

an antenna having an antenna shaft connected between a grounding block and a protective sheath;

an antenna tube affixed within said hand-held device and holding said antenna, said antenna tube having a flanged upper end through which said antenna shaft is extended or retracted, and an inner end opposite said upper end;

a grounding clip installed into said inner end of said antenna tube; and

a printed circuit board having a groove therein, said antenna tube being mounted to said printed circuit board using surface mount technology clips and said flanged end fitting into said groove to restrict axial movement of said antenna tube.

23. The antenna grounding assembly of claim 22, wherein said grounding clip includes a base and at least one contact pin extending axially along said antenna tube for resilient contact with said grounding block.

24. The antenna grounding assembly of claim 23, wherein said antenna tube further has a tapered lip at said inner end.

25. The antenna grounding assembly of claim 24, wherein said antenna tube further includes a groove between said inner end and said upper end.

26. The antenna grounding assembly of claim 25, wherein said base of said grounding clip is adapted to fit securely between said groove and said tapered lip of said antenna tube.

27. The antenna grounding assembly of claim 26, wherein said base of said grounding clip is resiliently deformable in a radial direction for installation of said grounding clip over said tapered lip.

28. The antenna grounding assembly of claim 27, wherein said grounding clip is held in place by said tapered lip and said groove.

29. The antenna grounding assembly of claim 28, wherein said base of grounding clip includes angled tabs for removal of said grounding clip from said antenna tube.

30. The antenna grounding assembly of claim 23 having two contact pins.

31. The antenna grounding assembly of claim 23, wherein said at least one contact pin is dog legged in shape.

32. The antenna grounding assembly of claim 31, wherein said contact pin tapers from an apex to a tab at an end of said contact pin.

33. The antenna grounding assembly of claim 32, wherein said tab is adapted to bear against an inner surface of said antenna tube.

34. The antenna grounding assembly of claim 33, wherein said contact pin between said apex and said tab is resiliently flexible.

35. The antenna grounding assembly of claim 34, wherein said grounding clip is gold plated.

36. The antenna grounding assembly of claim 23, wherein said contact pin has a forked end.

37. The antenna grounding assembly of claim 23, wherein said contact pin is curved.

38. The antenna grounding assembly of claim 22, further comprising a mount on said handheld device, said mount located above said flanged upper end and having a hole through which said antenna shaft passes.

39. The antenna grounding assembly of claim 38, further comprising a tube connected to said mount and extending into said antenna tube, said tube providing waterproofing for said antenna grounding assembly.

40. The antenna grounding assembly of claim 39, further comprising a cap adapted to fit snugly over said inner end of said antenna tube, said cap providing a seal for said antenna tube.