Japanese Patent No. 4182229

Microstrip Antenna Embedded in Clothing

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Prototype cloth antenna (2.5 GHz)

Overview of the technology

This invention pertains to a power supply for microstrip antennas that are flexible enough to incorporated into clothing and similar materials. The microstrip antenna is made flexible by using conductive cloth as a radiating conductor or ground conductor. Conductive fiber is based mainly on synthetic resin cloth made of polyester fiber, aramid fiber or similar material coated with a layer of nickel on the copper covering.

Other applicable conductive fibers also include conductive layers in which carbon black, a metal compound or another conductive particulate is mixed in a high concentration and spun in a composite molten manner with ordinary layers of polymer for protection.

This technique provides flexibility for both radiating conductors and ground conductors, but the power supply poses a problem. Cloth antennas in the past needed a power supply capable of coping flexibly. Regardless of how flexible the periphery can be made by making it cloth-like, it makes no sense if the power supply is inflexible. Unless the power supply is flexible, any breaking or bending force applied to the power supply will change the antenna characteristics or, in a worst-case scenario, will break the antenna, thereby resulting in a loss of antenna functionality. This invention therefore offers sufficient flexibility even for the power supply by selecting flexible power supply materials and providing a conductive medium consisting of a metallic plate-like substance having conductive ad-

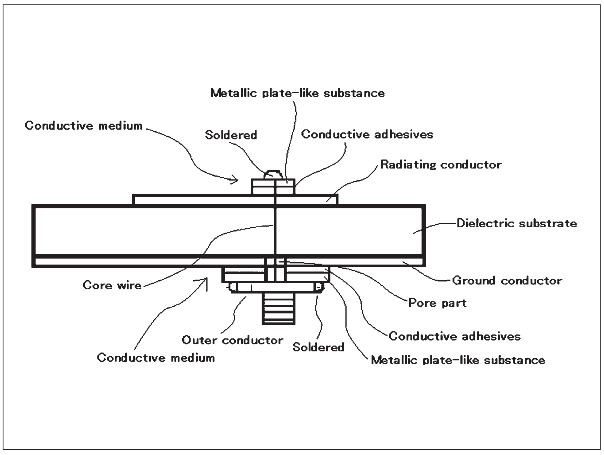

Fig.1 Cross section of cloth antenna

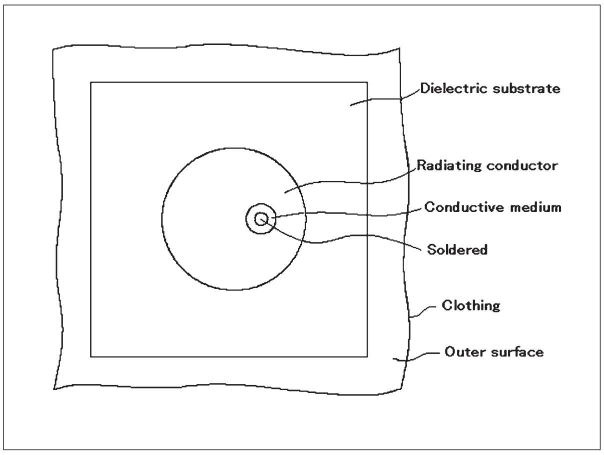

Fig. 2 Plan view of cloth antenna

hesives as a method of electrical connection between radiating conductors and ground conductors.

The dielectric substrate is conversely made of felt, blanket or other cloth-like material that is both flexible and insulated. However, the thickness of this cloth results in great variances in antenna characteristics. Moreover, the shape of the radiating conductor and the power supply's location are also closely related to the antenna's electrical characteristics. These parameters can be optimally configured to achieve a cloth antenna having the desired characteristics (see Figs. 1 and 2).

Applications of cloth antennas

Through cloth antenna technology, we have successfully softened previously hard antennas. This triggered the concept of various uses for such antennas, and we have actually manufactured prototypes and conducted experiments. In taking advantage of the characteristics of soft antennas, we first thought about applying such antennas to clothing. Figure 3 shows a GPS antenna or something similar mounted in the back of clothing for dogs. Even if a dog gets lost, the antenna can presumably send positional information from the GPS to the dog's owner, who can then locate the pet safe and sound. Figure 4 shows how a cloth antenna is incorporated into the shoulder area of a life jacket, with a GPS unit around the neck and a transmitter in the pocket, thereby allowing the person wearing the life jacket to be easily located. The antenna is built into the shoulder area, so that even if the wearer is thrown overboard into the sea, the shoulder area will not be constantly immersed in seawater, making it possible to catch signals securely from the GPS satellite. Last but not least, Fig. 5 shows a "wireless conductor's baton." This device is intended to allow visually impaired persons to play musical instruments in synchronization by feeling the conductor's instructions not with their eyes but with their hands. The baton held by the conductor features an acceleration sensor to send two-dimensional (vertical and horizontal) information from the conductor to each player. These radio waves are received via the cloth antenna and conveyed to the player's hand in the form of vibration information. The equipment is designed so that the cloth antenna can be housed in a folder hung on the player's neck together with the receiver, and thus lo-

Fig. 3 Example of pet clothing attached with an antenna

Fig. 4 Example of life jacket attached with an antenna

Receiver and cloth antenna

Folder containing the antenna

Fig. 5 Wireless conductor's baton

cated opposite the conductor and placed around the chest of the player as a suitable position for receiving radio waves from the conductor.

Conclusion

We have succeeded in softening previously hard antennas, thereby expanding the applications of such antennas, but have not managed to soften the entire set of equipment. Should technical advances in the future allow us to soften the entire set of equipment, we may see a wider range of enjoyable uses.

(Article written by SAWADA Fumitake, Expert, Research Results and Intellectual Property Management Office, Outcome Promotion Department)

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