METHOD OF CONSTRUCTING LIGHTWEIGHT ANTENNA

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Figure 4

Figure 4A

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No. 490,643. 2 Claims. (Cl. 29—600)

This invention relates to an improved method of con-
structing an antenna and is a continuation in part of my
earlier filed application Ser. No. 160,451, entitled Light-
weight Spiral Antenna, filed Dec. 19, 1961, now aban-
doned. More specifically, it relates to a method of con-
structing an antenna having a strip-like radiating element
spaced from a reflecting surface that is formed on a
dielectric support. The support is cast of a foam material
and painted with a conducting paint to form the reflecting
surface. The construction is substantially simpler than
prior techniques and provides a light-weight antenna
readily fabricated at low cost.

Antennas often have conducting surfaces spaced behind
the radiating elements to reflect signals and thus form di-
rectional radiation patterns. Prior antenna constructions
of this type require rigid, self-supporting reflectors, fab-
ricated from sheet metal or castings, and, accordingly, they
are heavy and bulky. In addition, the prior constructions
are costly, since they require several fabricating opera-
tions. Furthermore, relatively bulky fastening devices
are required to secure the heavy reflector to the assembly.
Accordingly, it is a principal object of the present in-
vention to provide an improved method of constructing
an antenna having a reflecting surface spaced from the
radiating element.

A more specific object is to provide a method of con-
structing a directional antenna having a substantially
plane radiating element, that is substantially less costly
and lighter in weight than prior antennas of this type.

Other objects of the invention will be apparent and
will in part appear hereinafter.

The invention accordingly comprises the several steps
and the relation of one or more of such steps with respect
to each of the others to form the article possessing the
features, properties and the relation of elements, which
are exemplified in the following detailed disclosure, and
the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects
of the invention, reference should be had to the follow-
ing detailed description taken in connection with the
accompanying drawings, in which:

FIGURE 1 is a top plan view partly broken away of an
antenna constructed in accordance with the present inven-
tion.

FIGURE 2 is a sectional view taken on the line 2—2
of FIGURE 1.

FIGURE 3 is a sectional view similar to FIGURE 2,
of another embodiment of an antenna constructed in
accordance with the present invention.

FIGURE 4 is a sectional view of a mold utilized in the
construction of the antenna shown in FIGURES 1 and 2,
and

FIGURE 4A is an enlarged portion of a section of the
mold shown in FIGURE 4, illustrating the various
layers of materials utilized in the present invention.

In general, the present antenna construction features
a rigid, lightweight insulator that is painted with a con-
ducting film and mounted behind a radiating element.
The film reflects signals so that the antenna radiates a
directional pattern.

The insulator is preferably a foamed material, cast in
a mold which is coated with the conducting film and
secured to the radiating element. When the mold is
removed, the film adheres to the hardened insulator. In
this manner, the reflector is fabricated in the desired
shape and secured to the radiating element in a single
operation to provide a low-cost, light-weight antenna.

Referring to FIGS. 1 and 2, the antenna has a substan-
tially flat radiating element 10, such as a double Archi-
medean spiral, energized by means of a coaxial feed
cable 12 having a conductor connected to each of the
spirals 10a and 10b. A reflector 14 is supported by a
substantially rigid insulator 16 secured to a dielectric
board or sheet 18, to which the spirals 10a and 10b are
bonded. A conducting sleeve 20 ensures a good electrical
connection between the reflector 14 and the outer con-
derator 12a of the cable 12.

The insulator 16, preferably a cylinder made of light-
weight dielectric foam, effectively supports the reflector
14 at the desired distance from the radiating element 10,
so that the antenna radiates in a predetermined direc-
tional pattern.

The antenna is preferably constructed by forming the
Archimedean spirals 10a and 10b of thin high-conduc-
tivity metal on one or both sides of the dielectric board
18, using, for example, printed circuit techniques. The
radiating element can also be an equilateral element or
other type of broad band radiator of which log periodic
is a type.

The feed cable 12 is then connected to the radiating
element through a hole 18b (FIG. 2) formed in the
board 18. With the double Archimedean spiral shown,
the coaxial inner conductor 12b is connected to the spiral
10a, and the outer conductor 12c is connected to the spiral
10b. It is apparent that a waveguide or strip transmission
line feed system can be used instead of the coaxial line
shown.

The insulator 16 is preferably made of a dielectric
foam cast in a mold 11 (FIG. 4) having a cavity 13 with
the desired shape for the insulator and an aperture 15
for the cable 12. The mold is coated with a mold release
agent 17 and then with a conducting paint 19 such as a
silver-epoxy. The cable 12 is then secured to the board
18 and the latter is secured to the mold, e.g., by clamps,
and the insulator 16 foamed in place according to well-
known techniques, for example, by adding a suitable
catalyst to the dielectric material before closing the
mold. The material preferably has a low dielectric con-
stant and forms a uncellular foam. A suitable material
is phenolic or epoxy foam. As the foam hardens, it
adheres to the conducting paint, which serves as the
reflector 14. It also adheres to the board 18 to form a
unitary structure of the entire assembly. The feed cable
12 may be anchored within the insulator, as shown, prior
to foaming of the insulator 16.

The aperture that accommodates the conducting sleeve
20 may be molded in place or formed after the mold
has been removed. The assembly of the antenna is then
completed by securing the sleeve in place. Alternatively,
the sleeve 20 may be inserted into the mold after the
release agent is applied and before the application of
the conducting paint, as shown in FIGS. 4 and 4A. The
paint then adheres to the sleeve to form an efficient con-
nection thereto. A suitable coating, indicated by the
dashed line 21, may be applied to protect the reflector
14 after the unit is removed from the mold.

As shown in FIGS. 1 and 2, the insulator 16 is pref-
erably a solid right cylinder, and the electrical distance
between the element 10 and the reflector portion 14a par-
allel to the element, is preferably a quarter-wavelength at
the geometric mean of the design frequency. This spacing
generally provides the optimum combination of antenna radiation pattern and impedance. The connection between
the feed cable outer conductor 12a and the reflector 14 maintains the reflector at substantially ground potential.

Using the foregoing process, the antenna can be constructed with low-cost materials, and its size and weight
are substantially reduced as compared to similar antennas constructed according to prior techniques. For example,
an S-band antenna, operating between 2 and 4 kmc, is 80% lighter than a similar prior antenna having a cast
aluminum reflector.

In addition, the reflector 14 is fabricated and secured in place in substantially a single process, whereas the prior
construction required the machining of a casting and securing it to the dielectric board 18.

Referring now to FIG. 3, according to an alternative construction, the reflector 14 is formed on a cam-shaped
insulator 22 secured with suitable adhesive 23 to the dielectric board 18. A conducting fillet 24 of solder or the
like connects the reflector 14 to the feed cable outer conductor 12a.

More specifically, the insulator 22 is preferably cast in the desired shape using, for example, a phenolic material.
The reflector 14 may be formed on either the inside or the outside of the insulator by painting the insulator or a mold,
which is not shown but which is similar to mold 11, with a silver or other conducting epoxy. The feed
cable 12 is then fed through the insulator 22 and secured to the radiating elements 10a and 10b by soldering, for
example. The adhesive 23, a low-loss epoxy or other cement, fastens the dielectric board 18 to the support and
the conducting fillet 24 is then formed between the outer conductor 12a and the reflector 14. A protective film,
shown dotted at 26, is preferably sprayed over the reflector 14 on the outside of the insulator 22.

The antenna constructed with the hollow cylindrical insulator 22 is even lighter than the antenna described
above with reference to FIGS. 1 and 2, in addition to retaining its small size and low cost. It will be apparent
that the radiating element and associated surface of the dielectric board may have a surface shape other than
planar. For example, the surface may be conical with the apex of the cone pointing away from the reflector.

It will thus be seen that the objects set forth above,
among those made apparent from the preceding description,
are efficiently attained and, since certain changes
may be made in carrying out the above method and in
the constructions set forth without departing from the
scope of the invention, it is intended that all matter con-
tained in the above description or shown in the accom-
panying drawings shall be interpreted as illustrative and
not in a limiting sense.

Having described my invention, what I claim as new
and desire to secure by Letters Patent is:

What is claimed is:

1. A process for constructing an antenna having a
radiating element, said process comprising the steps of
securing said radiating element to a dielectric board, se-
curing to said dielectric board a dielectric support pro-
jecting substantially transverse to the plane thereof by
casting a dielectric foam in a mold having a cavity closed
by said dielectric board, and forming a thin conductor on
said dielectric support to reflect electromagnetic signals
radiated by said element.

2. A process for constructing an antenna comprising
the steps of fabricating a strip-like radiating element on a
dielectric sheet, electrically connecting a feed system to
said radiating element, coating a mold cavity having a
substantially cylindrical configuration with a release
agent and then with a conducting epoxy, closing said
cavity with said sheet, said feed system extending axial-
ly through said cavity, casting a solid cylinder of die-
lectric foam in said mold cavity and permitting the same
to harden therein, whereby said hardened foam adheres
to said dielectric sheet and said epoxy, removing said
cylinder from said mold cavity, and connecting said
epoxv to a conductor of said feed system.

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