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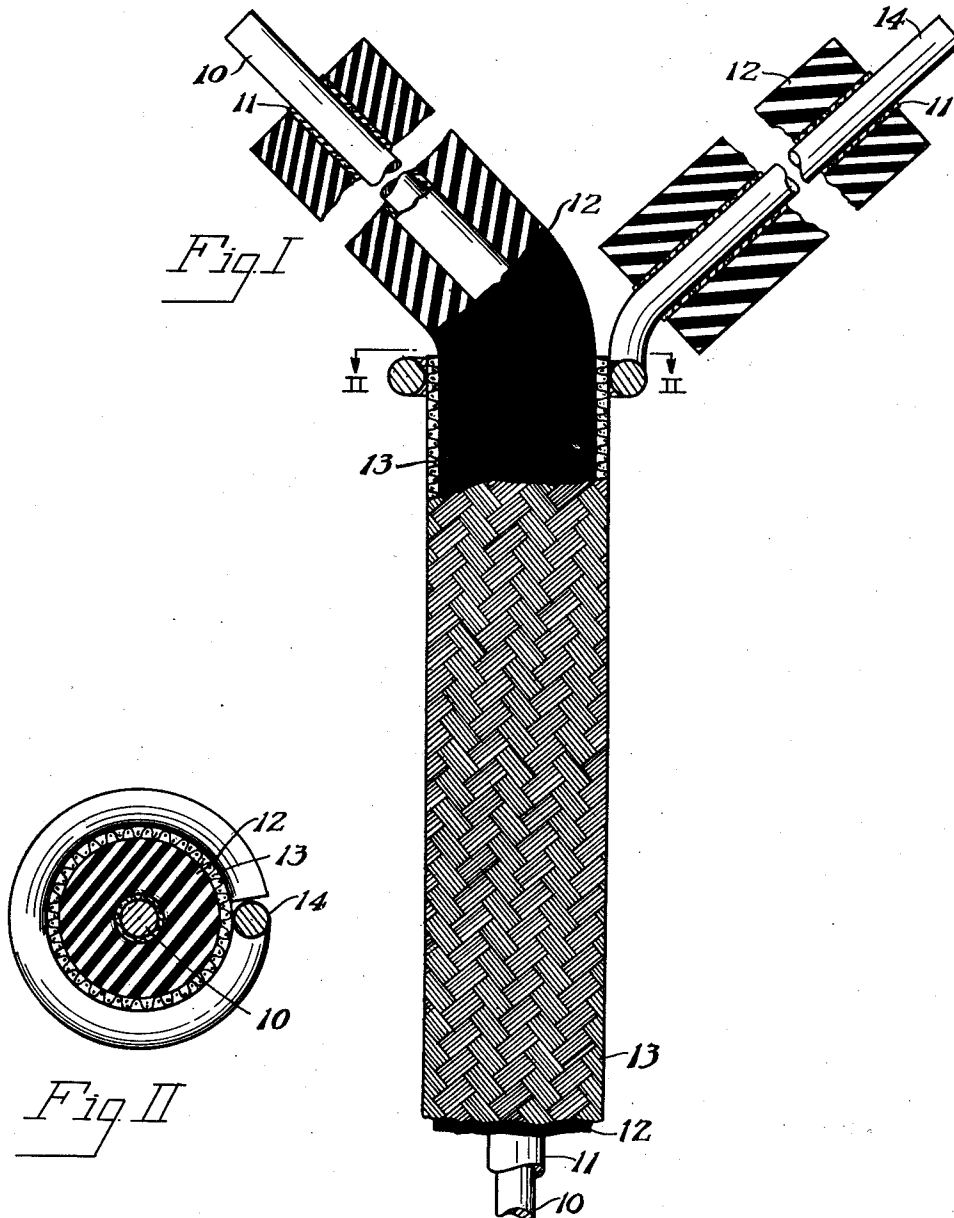
R. E. BASSETT, JR

2,193,017

LEAD-IN CONDUCTOR

Original Filed Feb. 18, 1937

2 Sheets-Sheet 1



INVENTOR

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ATTORNEY

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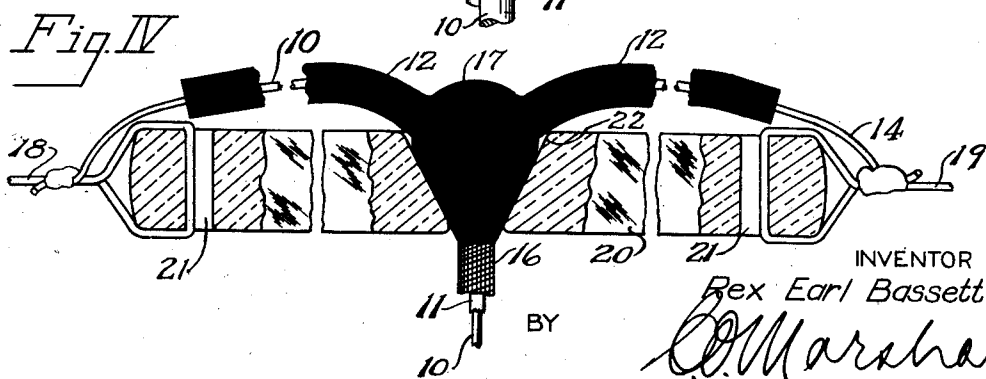
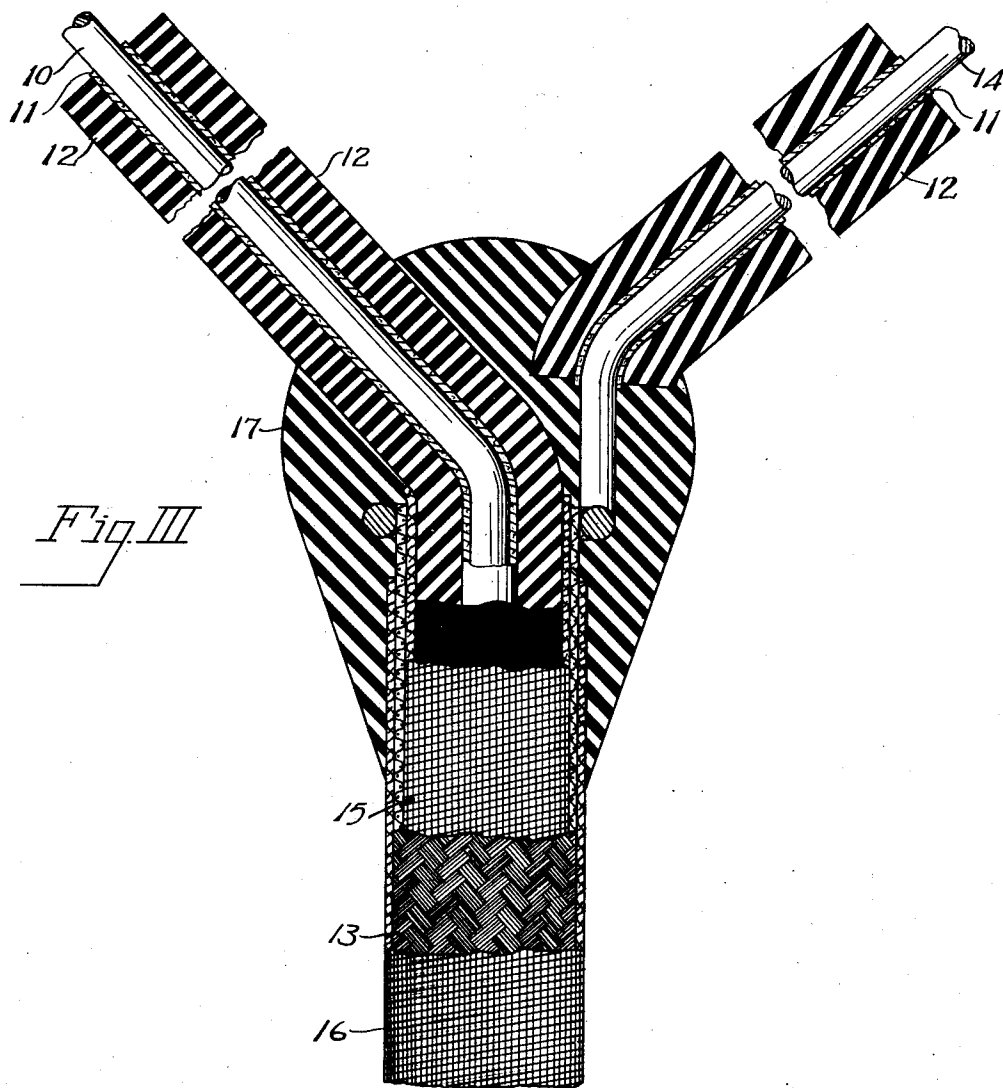
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UNITED STATES PATENT OFFICE

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LEAD-IN CONDUCTOR

Rex Earl Bassett, Jr., South Bend, Ind.

Application February 18, 1937, Serial No. 126,352
Renewed August 8, 1939

3 Claims. (Cl. 250—33)

The present invention relates to radio aeri-
als and particularly to improvements in transmission
lines and couplings used in the construction
thereof. This application discloses an improve-
ment upon the apparatus described in application
Serial No. 99,571 filed in the name of Rex Earl
Bassett, Jr., on September 5, 1936, and is a con-
tinuation in part of application Serial No. 99,571.

In order to improve both the transmission and
reception of radio signals, it has been found de-
sirable to erect the antenna where it is as
free as possible from local interference. Accord-
ingly, transmission lines have been utilized
to transmit the signal energy to the antenna
from the transmitter and from the antenna to
the receiver. Transmission lines have been used
extensively with antennae of the doublet type,
which have been found very suitable for the
reception of both short wave and the regular
broadcast range frequencies.

Heretofore, a concentric transmission line has
usually consisted of a hollow tube of conducting
material with a conductor suspended axially
thereof by suitable insulators. Lines of this
type not only are expensive to manufacture, but
require a considerable outlay for upkeep. Usually
they are filled with dry nitrogen gas under pres-
sure, to prevent dielectric failure due to con-
densation of moisture inside the line.

Recently, transmission lines of the above type
have been largely displaced by the "twisted pair"
line, consisting merely of two insulated wires
twisted together. The insulation most often used
has been rubber, but because of the susceptibility
of rubber to atmospheric conditions the average
life of the line is not very great. Collection of
moisture between conductors causes it to func-
tion unsatisfactorily.

The principal object of the invention is to pro-
vide a new and improved flexible transmission
line that may be easily and efficiently secured to
antennae.

Further objects and advantages of the inven-
tion are apparent from the description, in which
reference is had to the accompanying drawings
illustrating preferred embodiments of the inven-
tion.

Fig. I of the drawings is a vertical section,
showing a preferred form of the invention;

Fig. II is a fragmentary enlarged horizontal
section taken on the line 2—2 of Fig. I;

Fig. III is a vertical section, showing a modi-
fied form of the invention; and

Fig. IV is an elevation, partly in section, show-
ing the manner in which the terminal end of the
device of Fig. III may be connected to the
antenna.

These specific drawings and the specific de-
scription that follows are to disclose and il-

lustrate the invention, and are not to impose
limitations upon the claims.

The preferred form of transmission line com-
prises a central conductor surrounded by a layer
of a flexible dielectric that is impervious to
water, which is in turn surrounded by a flexible
tubular conductor.

This construction enables the line to be con-
nected to the antenna in a simple yet secure
and highly effective fashion. The central con-
ductor may be extended and partly uncovered to
form a connecting portion for attachment to
one of the terminals of the antenna, and the
outer conductor may be suitably secured, as by
soldering, to another connecting portion for at-
tachment to the other terminal. It is not nec-
essary to cover the junction of these connecting
portions of the transmission line with moisture
proof material because of the layer of impervious
dielectric between the conductors, but a body of
rubber may be molded thereabout to add strength
to the connecting portions and to guard further
against any interference with the operation of
the line through deposition of moisture.

Even though moisture penetrates the outer
conductor so that the outer conductor becomes
thoroughly wet, the impervious dielectric sub-
stantially prevents the moisture from getting
into the dielectric field between the conductors,
and there is no interference with the operation
of the line. No expensive waterproof outer coat-
ing is necessary, and leaks in the outer coating
are not to be feared. In addition, the layer of
impervious dielectric is thick enough that it
obviates interference from deposition of mois-
ture in the crotch where the conductors lead
outward to opposite branches of the antenna.

In Fig. I, a length of untinned No. 12 B and S
gauge copper wire 10 is spirally or longitudinally
wrapped with a layer of paper 11 impregnated
with varnish or wax, to prevent the sulphat-
ion that is caused by sulphur present in the
rubber. Surrounding the paper is a relatively
thick coating of rubber insulation 12 which is
preferably good grade rubber having a low
dielectric constant.

The rubber is covered by a flexible tube or
sleeve 13 closely braided from No. 30 tinned
copper wire. This tube or sleeve constitutes the
outer conductor of the concentric transmission
line.

The tinning of the wire in the braided outer
conductor 13 does not increase appreciably the
resistance of this portion of the transmission line
because of the relatively large diameter of the
tube, but prevents sulphation, like the layer of
paper around the inner conductor, as well known
to those skilled in the art. The central con-
ductor 10 is untinned, because tinning makes

the radio frequency resistance of that conductor too high.

The thickness of the rubber layer 12 may be varied as desired in order to obtain a transmission line having a surge impedance matching that of the antenna. If rubber having a dielectric constant of 2.8, a central conductor of No. 12 solid soft-drawn wire, and a braid of No. 30 wire are used the thickness of the dielectric must be .21 inch for an impedance of 62.5 ohms. The amount of power to be transmitted through the line of course determines the diameter of the inner conductor.

When the dielectric constant of the rubber is 2.8, the relationship of the surge impedance Z , the inside diameter D of the outer conductor, and the outside diameter d of the inner conductor is as follows:

$$Z = 79 \log_{10} \frac{D}{d}$$

At the antenna end of the cable a central rubber covered conductor, which may be formed by removing a length of the outer conductor 13, extends outward for several inches, and is bent at an angle of approximately 45° to the axis of the cable. Soldered to the end of the braided tube 13 is a piece of No. 12 copper wire 14, several inches long, which diverges from the axis of the cable in the opposite direction, likewise at an angle of about 45°. Conductor 14 may be covered with a layer of waxed paper 11 and a protecting sheath of rubber 12.

In the modified form of transmission line shown in Fig. III, the central conductor 10 is surrounded by the layers of wax impregnated paper 11 and rubber compound 12. The rubber layer is surrounded by an anti-sulphation sheath of soft waxed cotton braid 15. Then the outer conductor 13 may be braided over the cotton braid 15, and untinned copper wire may be used therefor.

To protect the copper braid, an outer covering 16 may be employed, which need not be waterproof, but may be composed of soft waxed cotton braid.

The terminal end of the line is made substantially weatherproof by extending conductor 10 as in the previous modification, and providing a diverging conductor 14, with a sheath 12 of rubber. A substantial length of the diverging portions of these conductors is surrounded by a body of rubber compound 17 that entirely prevents accumulation of water therebetween. The described construction provides an integral rubber body at the terminal end of the line that not only effectively prevents the aforesaid accumulation of moisture, but also acts to strengthen the coupling. Exposed portions of the copper conductors to which the rubber is to be applied may be tinned.

The types of apparatus described immediately above are chiefly used with the half wave doublet antenna, which consists of two oppositely extending conductors supported a predetermined distance above the ground and parallel thereto. A preferred mode of making the connection to the antenna is illustrated in Fig. IV, in which the transmission line of Fig. III is shown coupled to a doublet antenna comprising conductors 18 and 19 secured to a cylindrical ceramic insulator 20. Insulator 20 is provided with transverse holes 21

adjacent its ends to facilitate the securing of the conductors.

The transmission line is supported in the central cup-shaped depression 22 adapted to receive the molded portion 17 of the line, the cup-shaped depression 22 being provided with a central aperture through which the transmission line extends. The conductors 10 and 14 are secured to the antenna portions 18 and 19, as by soldering.

The concentric transmission line described above is quite flexible and may be handled roughly without fear of injury thereto. It may be shipped like other flexible cable and cut to desired lengths. It retains its concentricity and its electrical constants remain unchanged even after repeated flexure.

The line is very easily attached to antennae already in position or to antennae installed with the line. It may be submerged in water or buried in the earth, and its characteristics are not materially affected by the presence of moisture on its exterior, as the moisture cannot enter the dielectric field.

Changes in the illustrated embodiments may be made and other embodiments of the substance of the invention may be devised to meet various requirements.

Having described my invention, I claim:

1. In an apparatus of the class described, a lead-in connection comprising a support, flexible central conducting means for connection with one portion of an aerial, a layer of rubber surrounding the central conducting means, a tubular conductor enclosing the rubber layer, a branch conductor for connecting the tubular conductor with another portion of the aerial, and a body of rubber molded about the connection between the tubular conductor and the branch conductor for sealing the connection against moisture and retaining the central conductor on said support.

2. In an apparatus of the class described, a lead-in connection comprising an insulation support having a substantially cone-shaped transverse opening, flexible central conducting means for connection with one portion of an aerial extending upwardly and outwardly through said opening, a layer of moisture-impervious solid dielectric surrounding the central conducting means, a tubular conductor surrounding the dielectric layer, a branch conductor for connecting the tubular conductor with another portion of the aerial, said connection being substantially within the transverse opening and a body of dielectric of substantial size molded about the connection between the tubular conductor and the branch conductor.

3. In an apparatus of the class described, a support having a transverse opening, a central copper conductor passing through said opening for connection with one portion of an aerial, a layer of rubber of a thickness predetermined in accordance with its dielectric constant surrounding the central conductor, a braided tubular copper conductor enclosing the rubber layer, a branch conductor for connecting the tubular conductor with another portion of the aerial, a body of rubber of substantial size molded about the connection between the tubular conductor and the branch conductor and arranged to support said central conductor in said transverse opening, and anti-sulphation layers substantially separating the rubber from the copper surfaces.

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