

July 2, 1946.

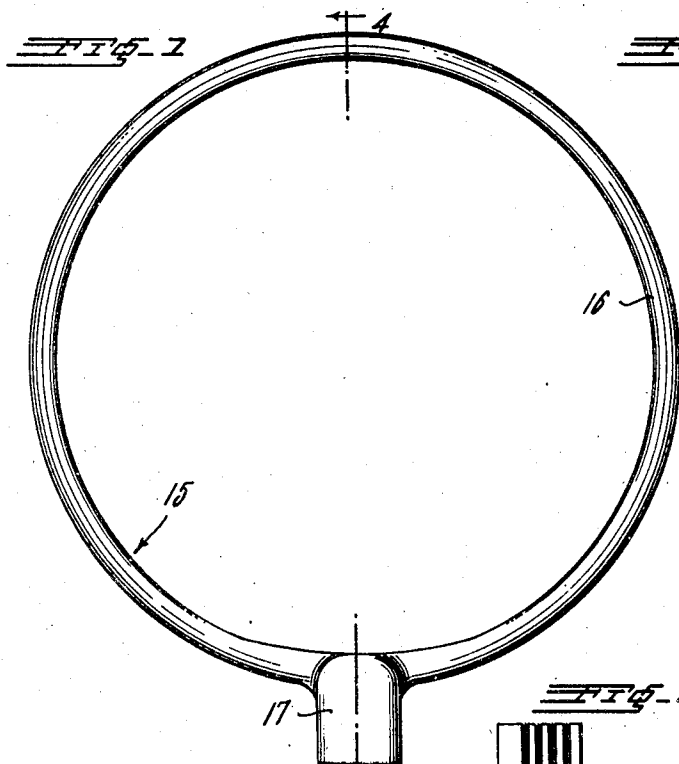
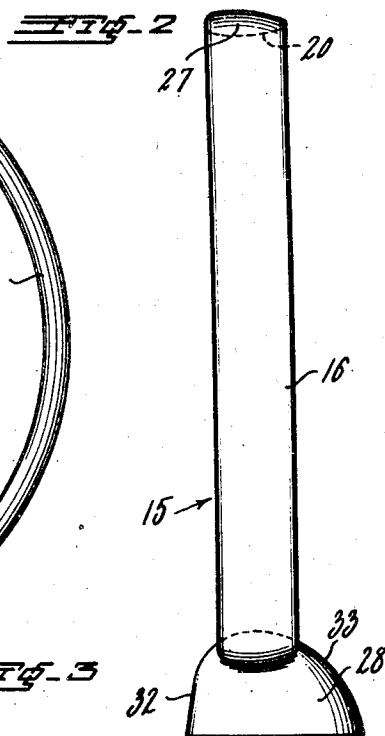
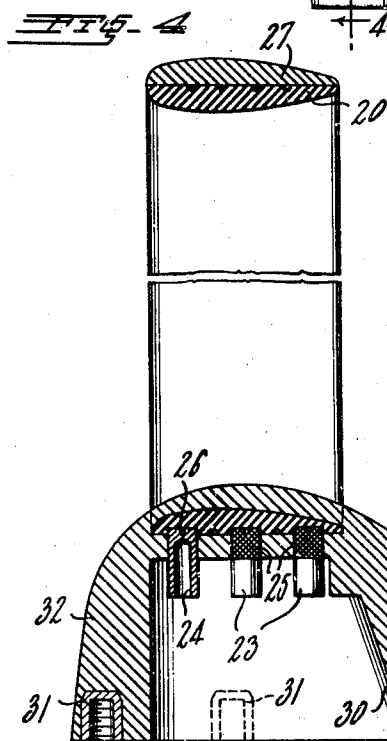
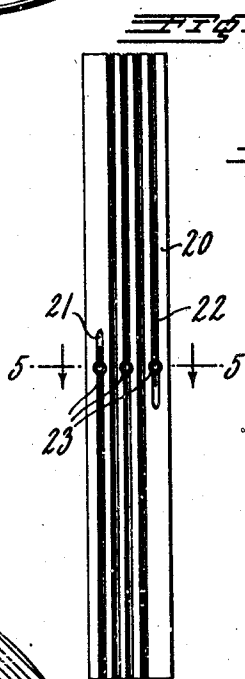
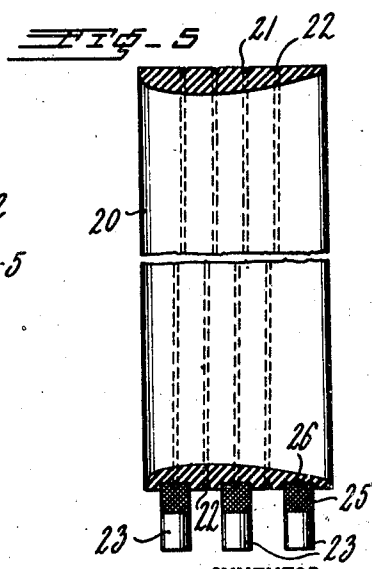
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2,403,093

LOOP ANTENNA CONSTRUCTION

Filed May 24, 1943

2 Sheets-Sheet 1



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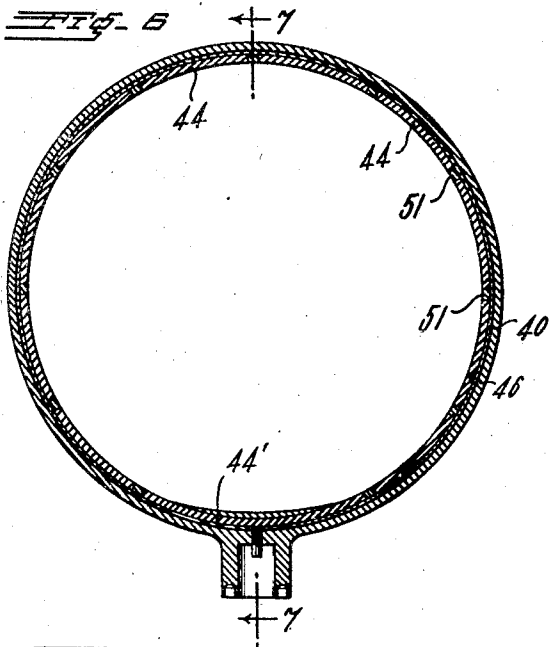
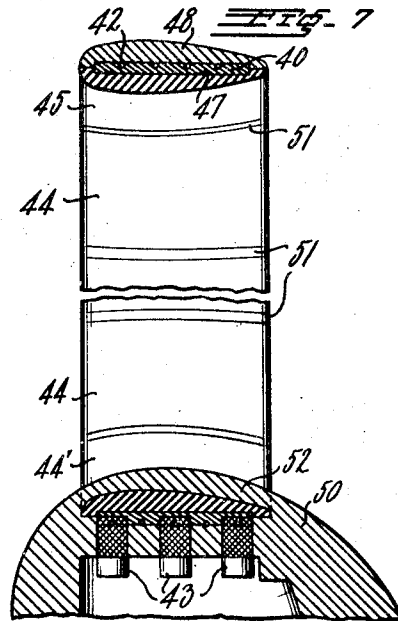
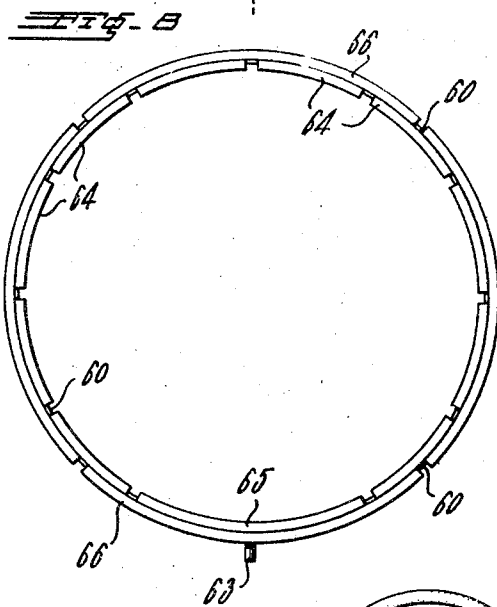
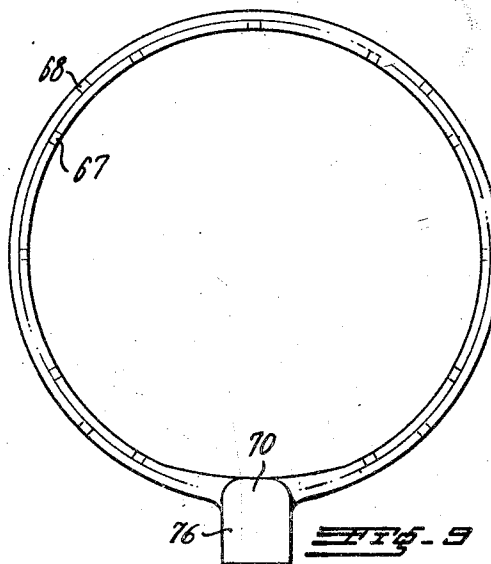
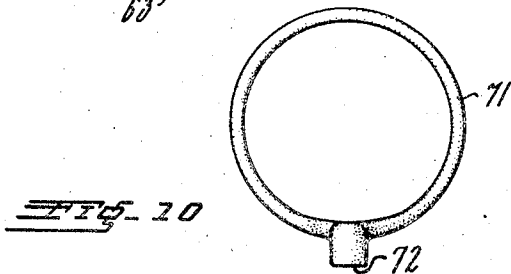
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LOOP ANTENNA CONSTRUCTION

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2 Sheets-Sheet 2



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## UNITED STATES PATENT OFFICE

2,403,093

## LOOP ANTENNA CONSTRUCTION

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Application May 24, 1943, Serial No. 488,150

5 Claims. (Cl. 250—33)

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This invention relates to directional radio antennae, and more particularly to improved streamline loop antenna constructions.

Loop antennae used on moving vehicles, such as airplanes, are generally provided with a shell having streamline contour to reduce wind resistance to flight. These antennae comprise a coil of several turns of wire, for connection to directional radio apparatus. The coil is enclosed in the shell which in turn is secured to a suitable base in which the terminal connections are made. There are two general types of enclosures for loop antennae used on aircraft. Where the loop is rotatable it is enclosed within a streamline shell of tear drop shape. Where the loop is fixed with respect to the aircraft, it is enclosed in a substantially annular shell. In such fixed type, the shell enclosing the loop coil is of streamline cross-section to reduce wind resistance. The present invention relates to fixed loop antennae.

The shell structure is conveniently made of suitable plastic material, such as the well-known synthetic resins. However, loop antennae mounted on an airplane are subject to vibrational stresses due to various causes. When the shell structures have been molded as a single member, it has been found that, under the influence of these vibrational stresses, the ordinarily annular shell structure tends to become distorted from a circular form to an ellipsoidal form. Such vibration is particularly pronounced as the frequency of vibration approaches the mechanical resonance frequency of the shell structure. Under severe conditions of vibration, the shell structures fail by cracking at one or more places, with portions of the shell breaking away to expose the loop coil to the atmosphere.

It is among the objects of the present invention to provide a novel shell structure for a loop antenna that is resistant to destruction by vibrational stresses; to provide a loop antenna structure comprising integrally united elements; to provide a loop antenna shell structure in which a loop winding support is provided and an outer shell and base are molded to the support; and to provide a loop antenna shell structure comprising a loop winding support or form and inner shell sections which are molded to the support by plastic molding material forming the outer shell and base sections.

These and other objects, advantages and features of the invention will be apparent from the following description and accompanying drawings. In the drawings:

Fig. 1 is a front elevation view of a loop an-

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tenna in accordance with the present invention.

Fig. 2 is a side elevation view of the loop shell structure shown in Fig. 1.

Fig. 3 is a side elevation view of a loop winding support or form used in the loop antenna of Fig. 1.

Fig. 4 is an enlarged, broken away section through the loop taken on the line 4—4 of Fig. 1.

Fig. 5 is an enlarged, broken away section through the coil form taken on the line 5—5 of Fig. 3.

Fig. 6 is a vertical sectional view of another embodiment of the invention.

Fig. 7 is an enlarged, broken away sectional view on the line 7—7 of Fig. 6.

Fig. 8 is a front elevation view illustrating a further embodiment of the invention in one stage of construction.

Fig. 9 is a front elevation view of a completed loop antenna shell structure embodying the construction shown in Fig. 8.

Fig. 10 is a front elevation view of a loop antenna showing a means of electrically shielding it.

I have found that the tendency to destruction by vibrational stresses in plastic loop antenna shell structures may be reduced by forming the shell structures of a plurality of integrally united elements. By using a plurality of integrally united elements, rather than a single molded element, the continuity of the structure is interrupted to such an extent as to substantially raise the mechanical resonance frequency of vibration of the structure. Furthermore, by integrally uniting a plurality of relatively smaller elements into the shell structure, there is a substantial reduction in the "locked-up stresses" present in the elements due to the molding operation; as compared to a single piece molded construction. The resistance to destruction by vibration may be further increased by staggering the joints between the elements forming the shell structure. The combination of these several features produces a loop antenna shell structure that is highly resistant to destruction by vibrational stresses as compared to the one piece plastic shell structures generally used hitherto.

Referring more particularly to Figs. 1 through 5, a loop antenna shell structure 15 is shown as comprising an annular shell or winding enclosure 16 and a base 17 formed integral with the shell. In constructing the loop antenna, a loop winding support and inner winding enclosure member 20, of composition or any other suitable material, is provided, and is formed with a spiral groove 21 in its outer periphery. The loop winding 22 is

placed in groove 21 and its terminal ends and mid point are secured to suitable electric terminals 23. Winding 22 may be secured to terminals 23 in any preferred manner. As shown, terminals 23 are formed with conductor receiving recesses 24 and knurled sections 25 set into recesses in support 20 and provided with apertures 26. Wire 22 is passed through apertures 26. The support 20, as shown more particularly in Figs. 4 and 5, has a semi-streamline cross-section, so that, when united to a complementary similar shaped outer winding enclosure member 27, a shell or loop enclosure having a fully streamline cross-section of the conventional tear drop contour is produced.

When wire 22 has been placed on form 20 and terminals 23 have been secured to the winding, the assembled elements are placed in a mold having the requisite shape to produce the semi-streamline outer section 27 and a base 28. Molding material, such as molten plastic is poured into the mold and sets, producing the structure shown in Figs. 1 and 2. Outer shell 27 and base section 28 are thereby integrally united to loop winding form 20 to produce a sturdy unitary loop antenna shell structure.

Base 28 may be hollow and formed with a recess 30 which may receive wire connections for terminals 23 projecting into recess 29. Base 28 is provided with threaded mounting members 31 for receiving mounting elements. Members 31 may, of course, be secured in position in the mold, so that, when the plastic is placed in the mold, members 31 will be molded into base 28 as inserts.

As the resultant antenna shell structure comprises two parts, which parts are integrally united, it is more resistant to vibrational stresses than a one piece antenna structure. The semi-streamline loop winding form 20 and outer shell 27 are complementary and united to form a loop shell having a full streamline cross-section. It will be noted that base 28 likewise has a streamline cross-section, as it has a relatively blunt forward face 32 and a sloping rearward face 33.

Figs. 6 and 7 illustrate another method of constructing the antenna shell structure. In this method, a loop winding form 40 of substantially rectangular cross-section, is provided with a spiral groove receiving a loop winding 42 which is secured to terminals 43 in the same manner as described in connection with Figs. 1 through 5. The inner shell member comprises a plurality of arcuate sections 44 curved about a radius having the same center as the radius of loop form 40. Arcuate sections 44 are arranged in circumferentially spaced relation around the inner periphery of loop form 40. Sections 44 have a radially inner streamline surface 45 and a radially outer surface 46 formed with a rectangular recess 47 in which loop winding form 40 nests. The section 44' adjacent the base of the loop structure is made somewhat longer than the other sections 44 to strengthen the loop construction.

When sections 44 have been nested in circumferentially spaced relation around the inner periphery of loop winding form 40, the juxtaposed parts are placed in a mold having the requisite contour to produce outer shell 48 and base 50. Plastic molding material is then placed in the mold to form outer shell 48 and base 50, and to provide plastic joints 51 integrally uniting arcuate sections 44 to each other and to coil form 40, outer shell 48 and base 50. It will be noted that the material of base 50 completely encloses the long arcuate section 44', as shown at 52, and that

base 50 has a streamline form. This construction results in a multi-section antenna shell structure in which the sections are all integrally united. The multi-section structure increases the resistance of the antenna shell structure against damage by vibrational stresses.

Figs. 8 and 9 illustrate a further modification of the loop antenna shell structure. In this modification, a loop winding support or form 60 is provided of the same construction as that shown in Fig. 7, and terminals 63 are secured to the loop winding in the manner previously described. In the construction of Figs. 8 and 9, a plurality of arcuate sections 64, including one relatively longer section 65, are disposed in circumferentially spaced relation around the inner periphery of loop winding form 60. A lesser number of longer arcuate outer shell sections 66 are then placed around the outer periphery of form 60, in circumferentially spaced relation. Sections 66 are so arranged that the spaces between the ends thereof do not coincide with the spaces between the ends of sections 64. The assembled elements are then placed in a mold having the requisite form to provide a streamline base 76 and to form a streamline surface on the loop structure. The form is then filled with plastic molding material which enters the spaces between the ends of sections 64 and of sections 66 to form joints 67 and 68, respectively uniting the circumferentially adjacent sections to each other and to form 60. Base 76 has a portion 70 enclosing the long inner arcuate section 65 as well as the outer section 66 radially adjacent thereto. In this instance likewise, as the loop construction is made of a number of integrally united sections with the joints between such sections staggered, the resultant loop is highly resistant to damage by vibrational stresses.

Fig. 10 illustrates a preferred way that the loop shell structure of the present invention may be electrically shielded. The shielding is performed by spraying the completed structure with one or more coats of aluminum paint 71. The paint is sprayed on so that it covers not only the shell structure, and the outer portion of the base, but also underside 72 of the base. The paint thus also makes contact with the inserts shown at 31 in Fig. 4 to form a ground terminal connection. The ground connection also may be provided by contact of aluminum paint 71 with the grounding ring customarily provided in loop antenna constructions. To protect the paint and the structure generally from weather effects, one or more coats of a clear lacquer may be sprayed on the entire structure after the sprayed aluminum paint is dried.

While specific embodiments of the invention have been shown and described, to illustrate the application of the principles of the invention, it will be obvious to those skilled in the art that the invention may be otherwise embodied without departing from the principles thereof.

What is claimed is:

1. A loop antenna comprising a combined annular loop winding support and inner winding enclosure having a partially streamline cross-section; a loop winding wrapped around the outer surface of said support; and plastic composition material molded to said combined inner enclosure and support to form an outer winding enclosure having a complementary partially streamline cross-section and a streamline base integral with said combined inner winding enclosure and support.

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2. A loop antenna comprising a combined annular loop winding support and inner winding enclosure having a partially streamline cross-section; a loop winding wrapped around the outer surface of said support; terminals secured to said loop winding; and plastic composition material molded to said combined inner enclosure and support to form an outer winding enclosure having a complementary partially streamline cross-section and streamline hollow base integral with said combined inner winding enclosure and support, said terminals projecting from said support into the interior of said base.

3. A loop antenna structure comprising a non-metallic member forming a combined annular loop winding support and inner enclosure for the loop winding; a loop winding comprising a non-insulated electrical conductor wrapped around the external periphery of said member; and plastic composition material bonded to said winding and the external periphery of said member support and forming with said member a solid enclosure for said conductor.

4. A loop antenna structure comprising a non-metallic member forming a combined annular loop winding support and inner enclosure for the

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loop winding; a loop winding comprising a non-insulated electrical conductor wrapped around the external periphery of said member; and plastic composition material bonded to said winding and the outer periphery of said member and forming with said member a solid streamline annular enclosure for said winding and a streamline hollow base of substantially larger cross-section than the cross-section of said enclosure.

5. A loop antenna structure comprising a non-metallic member forming a combined annular loop winding support and inner enclosure for the loop winding; a loop winding comprising a non-insulated electrical conductor wrapped around the external periphery of said member; metallic terminals engaging said loop winding; and plastic composition material bonded to said winding and the outer periphery of said member and forming with said member a solid enclosure for said winding and a hollow base therefor of substantially larger cross-sectional area than the cross-sectional area of said enclosure, said metallic terminals projecting from said member into the interior of said base.

WILLIAM P. LEAR.