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Clavin et al.

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[54] **OMNI-DIRECTIONAL ANTENNA MOUNTED IN CIRCULAR RADOME**

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[52] **U.S. Cl.** **343/742,** 343/872

[51] **Int. Cl.** **H01q 11/12**

[58] **Field of Search** 343/741, 742, 872, 343/908

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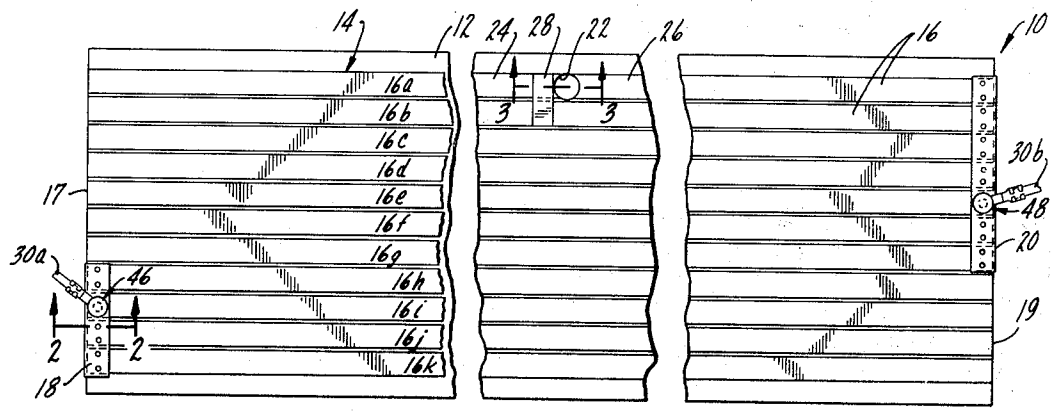
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[57] **ABSTRACT**

There is disclosed a method for manufacturing a television antenna, as well as a television antenna which is manufactured according to the preferred method. The television antenna of the preferred embodiment comprises a layer of flexible non-conductive material, such as mylar, on top of which is affixed a plurality of strips of flexible conductive material. Electrical leads are connected to the flexible strips of conductive material and the entire flexible structure is then placed on a rigid housing. In the preferred embodiment, the rigid housing comprises a circular non-conductive shell. The flexible layer of laminated conductive and non-conductive material is placed circumferentially around the interior of the circular shell, thereby forming an omni-directional antenna which is completely impervious to corrosive elements.

11 Claims, 6 Drawing Figures



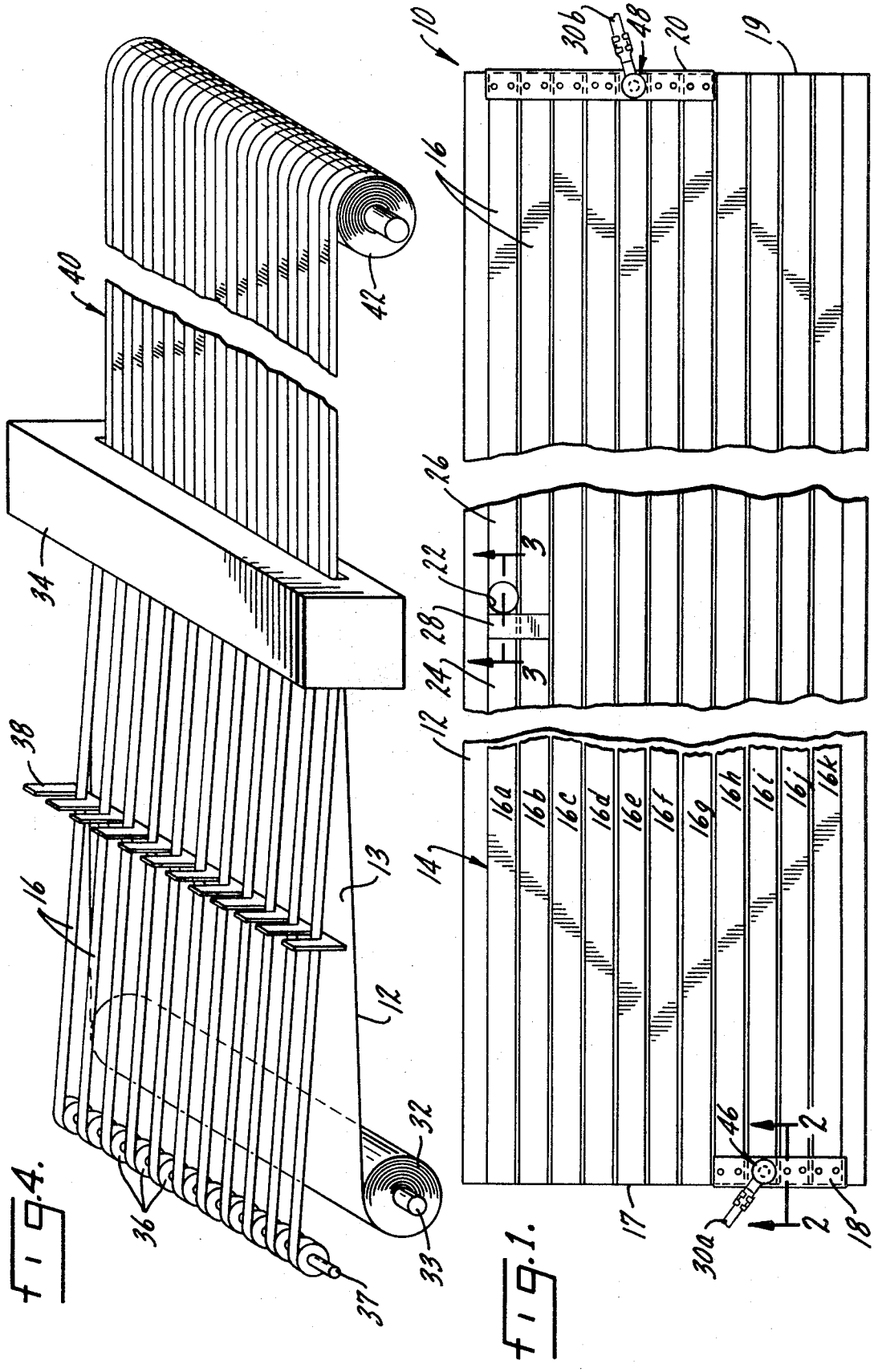

10
30b
48
20
19
16
26
22
3
28
24
12
14
16a
16b
16c
16d
16e
16f
16g
16h
16i
16j
16k
46
2
17
30a
18
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42
34
38
16
13
12
32
36
33
37

FIG. 1.

FIG. 4.

fig. 2.

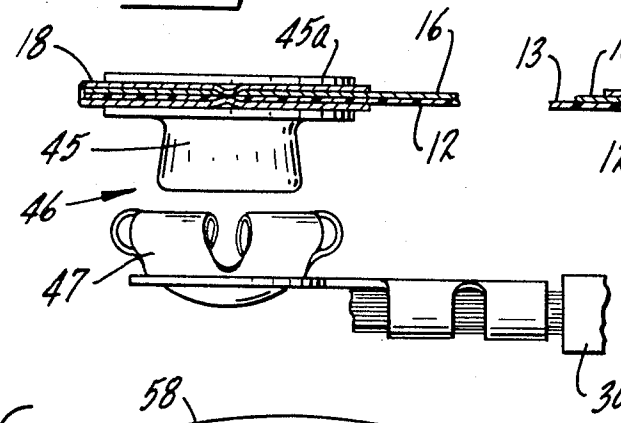
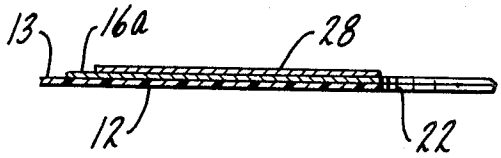
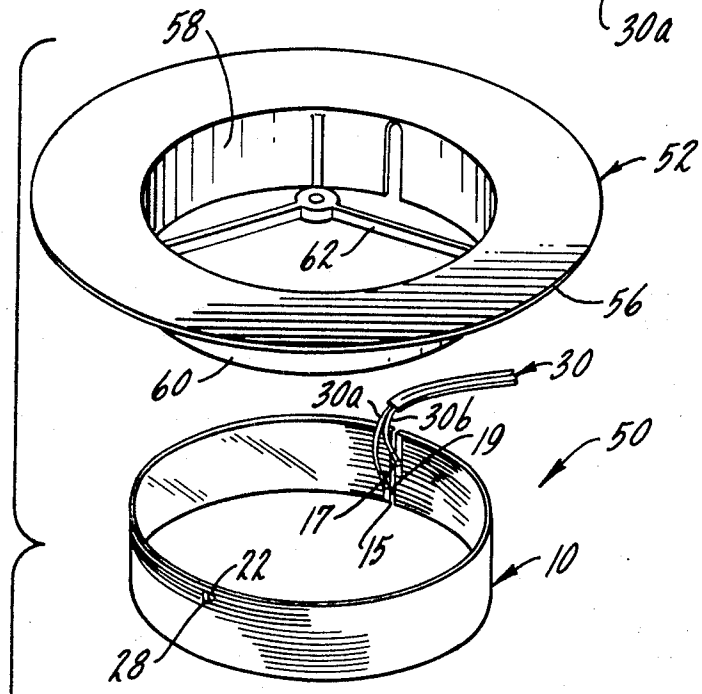


fig. 3.





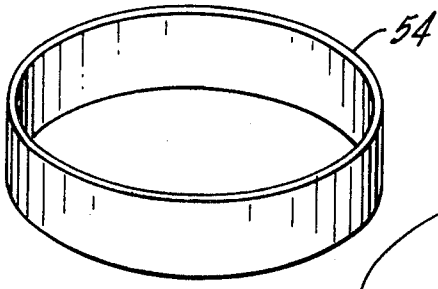
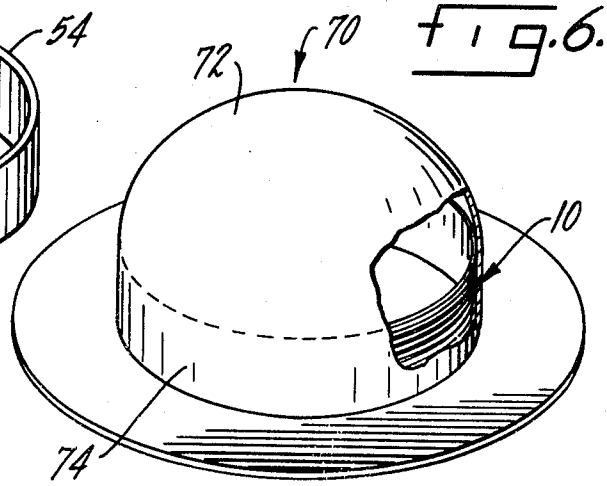


fig. 5.

fig. 6.



OMNI-DIRECTIONAL ANTENNA MOUNTED IN CIRCULAR RADOME

BACKGROUND OF THE INVENTION

The present invention relates to antennas and more particularly, to an improved omni-directional antenna for use with television receivers and/or FM receivers.

In the field of antennas, it has been the general practice to employ dipole antennas. These dipole antennas have not proved entirely satisfactory and subsequently, Yagi-type antenna arrays were developed. The Yagi-type array usually employed an active or radiator element, in combination with one or more directors and-/or reflectors. The use of these several elements widen the frequency response of the antenna when compared with a simple dipole antenna. Because these antennas were directional in nature, certain difficulties arose since they would only pick up signals from the direction in which the antenna was oriented. In an attempt to overcome these difficulties, omni-directional antennas have been developed.

SUMMARY OF THE INVENTION

The general purpose of this invention is to provide an improved, omni-directional antenna which provides a greater signal to noise ratio then previous omni-directional antennas and is less expensive to manufacture or fabricate. To attain this, the present invention contemplates a unique arrangement wherein all conductive elements of the antenna are constructed from a flexible conductive material which is laminated to a flexible strip of non-conductive material such as mylar. The conductive elements which are laminated to the mylar material are arranged in a preselected pattern and, in the preferred embodiment, comprise **11** uniform strips of flexible copper foil which are placed adjacent to each other in parallel arrangement and a preselected number of these strips are then electrically connected together by a suitable connecting means. The laminated structure is then attached to the interior of a rigid non-conductive housing in a circular arrangement, thereby forming the omni-directional antenna.

Therefore, an object of the present invention is to provide an improved, omni-directional antenna which is capable of **360°** reception and which provides a high signal to low noise ratio.

Another object is to provide an omni-directional antenna which utilizes flexible active elements.

A further object of the invention is to provide an omni-directional antenna which is impervious to metallically corrosive elements.

Still another object is to provide an omni-directional antenna which is extremely simple and inexpensive to fabricate and at the same time easy to install and maintain.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood with reference to the following detailed description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top plan view of a flexible antenna segment which constitutes a preferred embodiment of the invention.

FIG. **2** is a section of the flexible antenna segment taken on the lines **2—2** of FIG. **1.**

FIG. **3** is a section of the flexible antenna segment taken on the lines **3—3** of FIG. **1.**

FIG. **4** is a diagram which schematically shows the method for manufacturing the flexible antenna segment shown in FIG. **1.**

FIG. **5** is an exploded view of a flexible antenna segment of FIG. **1** in combination with a rigid housing.

FIG. **6** is a perspective view, with a portion removed, of an alternative housing which may be used in combination with the flexible antenna segment of FIG. **1.**

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. **1** a flexible antenna segment **10.** Referring now to FIGS. **1, 2** and **3,** it can be seen that the flexible antenna segment **10** is a laminated structure comprising a flexible non-conductive layer **12** and a flexible layer of conductive material **14.** The layer of flexible conductive material **14** comprises a plurality of strips of flexible conductive material **16** which are arranged in a preselected pattern on the flexible non-conductive layer **12** and, as will be explained below, the strips of flexible conductive material **16** are permanently affixed to the flexible non-conductive layer **12.** In the preferred embodiment, eleven strips of flexible conductive material are arranged so as to be parallel to each other and spaced apart an equal distance from each other, thereby forming eleven parallel spaced apart strips of flexible conductive material **16***a* through **16**k.

The flexible antenna segment **10** is of preselected length having a first end **17** and a second end **19.** In the preferred embodiment, its length in inches is equal to one quarter wave length of channel **2** or 64 ½ inches.

As can be seen in FIG. **1,** a conductor **18** electrically connects to each other four of the strips of flexible conductive material, while the remaining seven strips of flexible conductive material **16** are electrically connected together by a conductor **20.** In addition, the strip of flexible conductive material **16**a is segmented at its center by an aperture **22,** thus forming two individual flexible conducted strips **24** and **26.** The flexible conductive strip **26** is electrically connected to the conductor **20** while the flexible conductive strip **24** is electrically connected to the strip of flexible conductive material **16b** by another conductor **28.** Lastly, as best shown in FIGS. **1** and **2,** a conventional antenna lead **30** is connected to the flexible antenna segment **10** by any suitable fastening means. In the preferred embodiment, a pair of snap fasteners **46** and **48** are employed. The antenna lead **30** may be conventional twin lead wire wherein the first lead wire **30***a* is electrically connected to the conductor **18** while the second lead wire **30***b* is electrically connected to the conductor **20.** In this manner, all eleven of the strips of flexible conductive material **16***a* through **16***k* are electrically connected to the antenna lead **30.** The antenna lead **30** may then be utilized to connect the flexible antenna segment **10** to a utilization device such as a television set or other similar device.

Referring now to FIG. **4,** the method of fabricating the flexible antenna segment **10** will be described. To manufacture the flexible antenna segment **10,** any conventional roll feeding machine that is adapted to feed rolls of continuous material to a receiving station may

be utilized. In this regard, a roll **32** of flexible non-conductive material **12** is mounted on a feed roller means **33** and is fed to a receiving station **34.** The flexible non-conductive material is treated with a heat resealable polyester adhesive. This heat resealable polyester adhesive may be applied to the flexible non-conductive material **12** as it is traveling to the receiving station **34** by any suitable means or the roll **32** of the flexible non-conductive material **12** may already have been treated by the manufacturer of the flexible non-conductive material with a heat resealable polyester adhesive. One such material which may be readily purchased and which contains the heat resealable polyester adhesive is Mylar and is manufactured by E. I. DuPont. In the preferred embodiment, the Mylar has a thickness of two mils and the adhesive contained on the surface of the Mylar has a thickness of 1 ½ mils. The width of the roll **32** is designed so as to be the same width as the desired width of the flexible antenna segment **10.** In the preferred embodiment, the roll **32** has a width of seven inches.

Continuous lengths of flexible conductive material **16** are also fed to the receiving station **34.** These continuous lengths of flexible conductive material **16** are fed from a plurality of rolls **36** of preselected width which are mounted on a feed roller means **37.** As can be seen in FIG. **2,** the roll **36** of flexible conductive material **16** are located directly above the roll **32** of flexible nonconductive material **12** and as the flexible conductive material **16** is fed towards the receiving station **34,** they are superposed above the flexible non-conductive material **12.** As mentioned previously with reference to FIG. **1,** the flexible antenna segment **10** comprises in the preferred embodiment, eleven strips of flexible conductive material **16***a* through **16***k*. Therefore, it is necessary to utilize 11 rolls **36** of flexible conductive material **16.** It will be recognized, however, that if it is desired to utilize fewer than eleven strips, then fewer rolls **36** will be required and, likewise, if a greater number of strips were desired, then a greater number of rolls **36** will be required.

Each of the rolls **36** are then fed through an alignment apparatus **38.** The alignment apparatus **38** insures that each of the flexible strips **16** are maintained at a preselected spaced distance from each other. The desired spacing may be determined empirically and, in the preferred embodiment, it is desired to maintain a spacing of 0.125 inches between the strips. Each of the strips of flexible conductive material **16** in the proposed embodiment are each one-half inch wide and the rolls **36** of this width may be obtained by slitting a larger roll of flexible conductive material into individual rolls one-half inch wide. In the preferred embodiment, the flexible conductive material **16** comprises a soft rolled copper foil which may be purchased commercially from many sources.

The plurality of strips of flexible conductive material **16** and the strip of flexible non-conductive material **12** are continuously fed to the receiving station **34.** At the receiving station **34,** each of the strips of flexible conductive material **16** are bonded or affixed to the upper surface **13** of the flexible non-conductive material **12.** As described above, the upper surface **13** of the flexible non-conductive layer **12** has been treated with the heat resealable polyester adhesive. At the receiving station **34,** a conventional set of hot rollers applies both pressure and heat to each of the strips of flexible conductive material **16,** thereby sealing or affixing each of the flexible conductive strips **16** to the upper surface **13** of the flexible non-conductive material **12,** thereby forming a continuous laminated flexible conductive material **40.** The continuous laminated flexible material **40** may then be formed into a roll **42.**

After obtaining the roll **42** of the continuous laminated flexible material **40,** the flexible antenna segment **10** may be manufactured by merely cutting the continuous laminated flexible material **40** into segments **10** of proper length. In the preferred embodiment, the flexible antenna segments **10** are cut to a length of 64 ½ inches. 64 ½ inches represents one quarter wave length, in inches, of television channel **2.** After obtaining this proper length, it is then necessary to electrically connect together a preselected plurality of the adjacent flexible conductors **16.** As mentioned previously in connection with FIGS. **1** through **3,** the strips of flexible conductive material **16***a*, *16b*, **16***c*, **16***d*, **16***e*, **16***f*, and **16***g* are electrically connected together by a conductor **20.** In the preferred embodiment, the conductor **20** may comprise a copper conductor which is welded to the layer of flexible non-conductive material **12** and to the strips of flexible conductive **16**a through **16***g*. Similarly, the strips of flexible conductive material **16***h* through **16***k* are also electrically connected in the similar manner by the conductor **18.** As also mentioned previously, the segment **24** of the flexible conductor **16***a* is electrically connected by a conductor **28** to the strip of flexible conductive material **16***b*. As can clearly be seen in FIG. **3,** this connection is only made on the upper surface **13** of the flexible non-conductive layer **12.** However, if it is desired, a two-sided connection may be utilized.

The segments **24** and **26** are shown to be of equal length in the preferred embodiment. To accomplish this, the aperture **22** is placed exactly in the center of the strip of flexible conductive material **16***a*. This positioning was determined empirically and it has been found that the best reception is obtained when the aperture **22** is positioned a good distance from each end of the strip of flexible conductive material **16***a*. However, other placements may be utilized.

As mentioned previously, the antenna lead **30** is electrically connected to the conductors **18** and **20** by any suitable fastening means. In the preferred embodiment, the snap fasteners **46** and **48** are inserted into the flexible, non-conductive layer **12** and the flexible conductive layer **14,** as well as contacting each of the conductors **20** and **18,** as shown in FIGS. **1** and **2.** The snap fasteners **46** and **48** are identical. The snap fastener **46** comprises a male portion **45** and a female portion **47.** The upper part **45a** male portion **45** is in electrical contact with the conductor **18** while the female portion **47** is in electrical contact with the antenna lead **30***a* or **30***b*. By utilizing snap fasteners **46** and **48,** a very secure, as well as inexpensive, fastening of the antenna lead **30** may be accomplished.

After fabricating the flexible antenna segment **10,** this antenna segment may then be coated with a protective non-conducting coating. Any suitable protective coating, such as plastic, may be utilized. If it is desired, rather than utilizing plastic coating, a secodn layer of Mylar can be placed over the layer of flexible conductive material **16,** thereby forming a three-layer flexible antenna segment having the layer of flexible conduc-

tive material **16** sandwiched in between two layers of flexible non-conductive Mylar **12.**

After fabricating the flexible antenna segment **10,** as described above, the flexible antenna segment **10** is then affixed or bonded to a rigid housing. In the preferred embodiment, it is desired to make the antenna omni-directional and, therefore, the housing must be circularly shaped. Referring now to FIG. **5,** a preferred housing **50** is shown. The housing **50** comprises an upper segment **52** and a lower segment **54.** The upper segment **52** is generally circularly shaped and has a circular rim **56** from which downwardly protrudes a cylindrically shaped extension **58.** The dimensions of the cylindrically shaped extension are such that the flexible antenna segment **10** is wrapped around the outer surface **60** of the cylindrically shaped extension **58.** When wrapped in this manner, and affixed or bonded to the housing, a space **15** is formed between the first end **17** and the second end **19** of the flexible antenna segment **10.** The flexible antenna segment **10** may be bonded to the rigid housing by any suitable means such as a cement or by heat. After the flexible antenna segment **10** has been affixed to the downwardly protruding cylindrically shaped extension **58,** the lower segment **54** of the housing **50** is again mated with the upper segment. As can be seen in FIG. **5,** the upper segment acts as a male member and the lower segment **54** acts as a female member thereby forming a compact circular donut-shaped housing wherein the flexible antenna segment **10** is completely protected from any corrosive elements. For mounting purposes, a support bar **62** may then be placed across the opening in the housing **50** and a shaft (not shown) may then be connected to the support **62** to mount the antenna in a conventional manner.

Referring now to FIG. **6,** an alternative housing **70** is disclosed. The housing **70** is generally shaped in the form of a hemisphere. The upper portion **72** of the hemisphere, however, comprises a vertically shaped segment **74** which is adapted to receive the flexible antenna segment **10.** The width of this vertically shaped segment **74** is made slightly greater than the width of the flexible antenna segment **19** and, in the preferred embodiment, is 7 ¼ inches tall. The circumference of the housing **70** is slightly larger than the length of the flexible antenna segment **10.** As can be seen in FIG. **6,** the flexible antenna segment **10** is bonded or attached to the interior surface of the vertical segment **74.** After the flexible antenna segment **10** has been affixed in this manner, a cover (not shown) may be affixed to the lower open end of the housing **70,** thereby closing the housing and thereby making the antenna completely impervious to corrosive elements.

It will be recognized by one skilled in the art that it is immaterial to the practice of this invention whether housing **50** is utilized or housing **70** is utilized and, furthermore, any otehr similar housing may be employed without departing from the spirit and the scope of the invention.

As shown in FIG. **1,** the preferred embodiment utilizes eleven strips of flexible conductive material connected together in several groups. The actual connections and dimensiosn of this antenna have been found empirically and provide the best television reception over channels **2** through **13** as well as the UHF channels. The dimensions of this antenna are provided below; however, it is to be recognized that these dimensions are merely illustrative of the invention, and various modifications may be made without departing from the spirit and the scope of the invention. The flexible non-conductive material utilized in the preferred embodiment is mylar an it two mills thick. An adhesive coating 1 ½ mills thick is applied to one surface of the mylar. The flexible conductive material utilized is rolled copper foil which is 0.0014 inches thick and is ½ inch wide. The purity of the copper is rolled 99.9 percent. The resistivity of one ounce of this copper is 0.15940 ohm-gram meter at 20° centigrade. The tensile strength is equal to 50. The connectors **18** and **20** are manufactured from a copper alloy and are one inch wide. The strips of flexible conductive material **16** are affixed to the mylar at the receiving station **34.** The receiving station **34** applies a pressure of 30 psi at 325° F. to each of the strips of flexible conductive material **16** thereby bonding the strips of flexible conductive material **16** to the flexible non-conductive layer **12.** The space between each adjacent strip of flexible conductive material **16** is approximately 0.125 inches.

While specific dimensions and components have been described, it will be recognized that these dimensions and components are only exemplary and that if the antenna were to be used with other frequencies than the television frequency, different lengths and different spacings may be utilized and obviously, many modifications and alterations may be made herein without departing from the spirit and the scope of the invention as set forth in the appended claims.

What is claimed is:

1. An omni-directional television receiving antenna comprising:

a layer of flexible non-conductive material;

a plurality of parallel strips of flexible conductive material having a preselected substantially equal length wherein each of said strips of flexible conductive material includes a first end and a second end and wherein each of said strips of flexible conductive material are affixed to said layer of flexible non-conductive material;

first means for electrically connecting said strips of flexible conductive material to a utilization device; and

a rigid non-conductive circular housing wherein said layer of flexible non-conductive material is affixed to the interior of said housing whereby said first end of each of said conductive strips is placed adjacent to its respective second end of said conductive strips thereby forming a plurality of substantially circularly shaped conductive elements.

2. The omni-directional antenna of claim **1** further comprising:

second means for electrically connecting a preselected number of said parallel conductive strips to each other.

3. The omni-directional antenna of claim **2** wherein said second means comprises a strip of conductive material affixed to said first ends of each of said preselected parallel conductive strips.

4. The omni-directional antenna of claim **1** wherein said antenna comprises 11 parallel strips of flexible conductive material affixed to said non-conductive material.

5. The omni-directional antenna of claim **4** further comprising:

second means for electrically connecting together the first ends of four of said conducting strips thereby forming a first group of conductive elements; and

third means for electrically connecting together the first ends of the remaining seven of said conducting strips thereby forming a second group of conductive elements.

6. The omni-directional antenna of claim **5** further comprising:

a means for electrically bisecting one of said strips of conductive material of said second group of conductive elements whereby one of said bisected segments remains electrically connected to said third means; and

fourth means for electrically connecting the other of said bisected segments to another of said strips of conductive material in said second group of conductive elements.

7. The omni-directional antenna of claim **6** wherein said flexible non-conductive material comprises mylar and wherein said flexible strips of conductive material each comprise copper foil.

8. The omni-directional antenna of claim **7** wherein said circular housing completely encloses said layer of flexible non-conductive material thereby making said antenna impervious to corrosive elements.

9. The omni-directional antenna of claim **8** wherein said first means comprises a twin lead wire and wherein one of said leads is electrically connected to said first group of conductive elements and wherein the other of said leads is electrically connected to said second group of conductive elements.

10. The omni-directional antenna of claim **9** wherein each of said leads are electrically connected to said conductive elements by a snap fastening means.

11. The omni-directional antenna of claim **3** wherein said first means is electrically connected to said strips of flexible conductive material by a snap fastening means.

* * * * *