

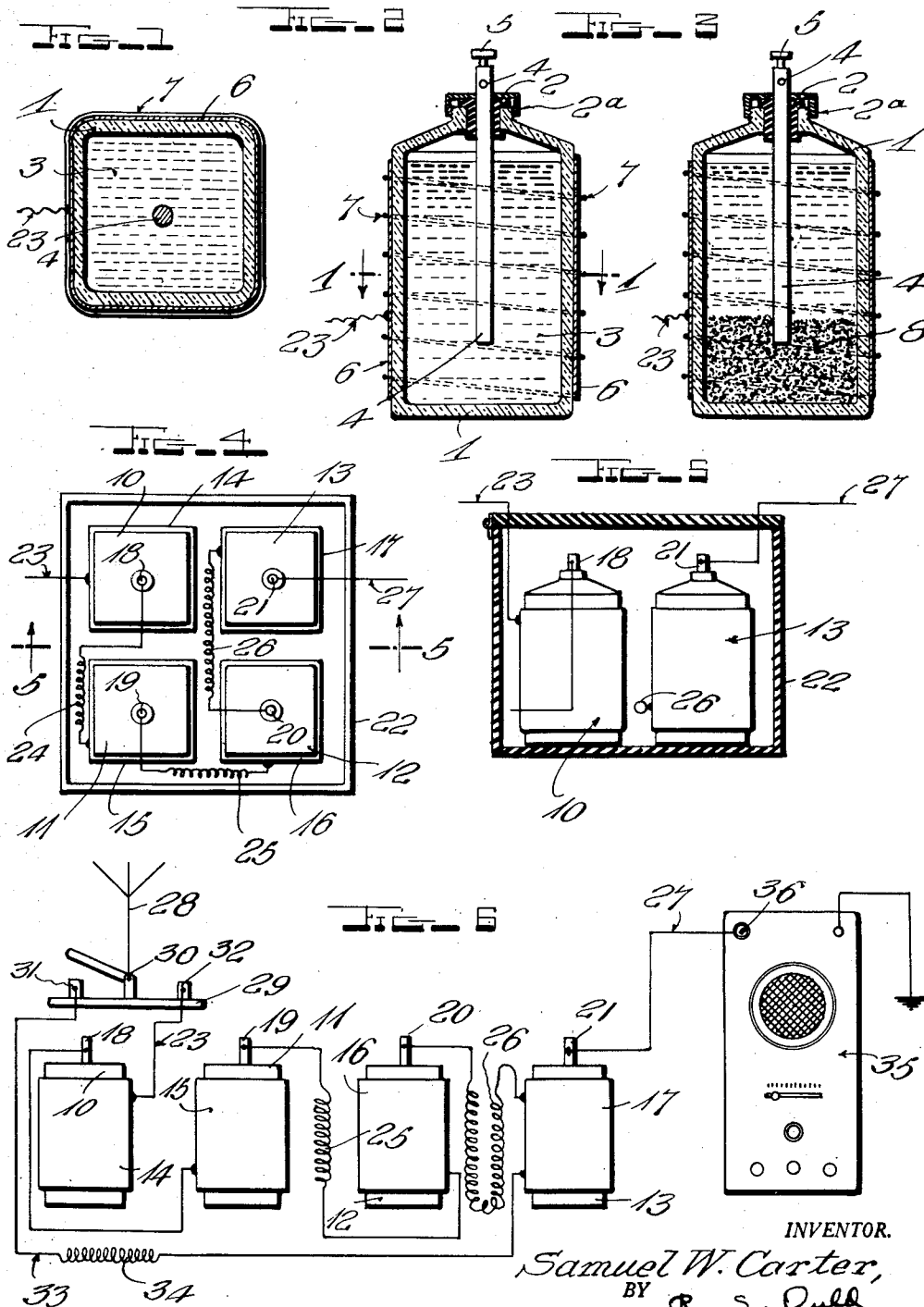
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S. W. CARTER

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ANTENNA UNIT

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## UNITED STATES PATENT OFFICE

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## ANTENNA UNIT

Samuel W. Carter, Washington, D. C.

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My invention relates to the art of radio communication, and in particular to a device particularly adapted to form a part of the wave collecting or pick-up system for collecting the incident radiant energy, and the leads therefrom to the receiving set, for controlling the characteristics of the received signal.

The ordinary type of pick-up device or antenna, picks up waves of all frequencies and characteristics without discrimination, and does not exclude those waves which have undesirable characteristics.

It is an object of my invention to provide a unit to be employed in the wave-pick-up apparatus of a radio receiving station which will select and pass to the receiving set proper, waves which have desired characteristics, and to exclude waves of other characteristics.

Another object of my invention is to provide a device which may be connected in series in the lead-in of an ordinary type of antenna, and will select desired waves.

A further object of my invention is to provide a device which is adapted to be used by itself as the wave collector, without a separate antenna of usual type.

A still further object of my invention is to provide a device in which collected radiant energy traverses in series a path through a liquid and through a solid vitreous medium.

Still a further object of my invention is to provide an antenna unit which comprises a plurality of individual elements having external plate electrodes and being connected in series in the antenna circuit by interconnections which are in capacity relation to said electrodes.

Another object of my invention is to provide a device which is simple in construction and easily installed, and is adapted for quantity production at a low price.

With these and other objects in view which will be apparent from the following, my invention consists in the apparatus and method as set forth in this specification and in the drawing which forms a part thereof. In the drawing:

Figure 1 shows a horizontal sectional view of an individual selecting element of my antenna unit, with its central rod and external peripheral electrode, and actuating liquid in place, taken on the line 1—1 of Figure 2,

Figure 2 is a vertical sectional view of the selecting element of Figure 1,

Figure 3 is a vertical sectional view of another form of individual selecting unit similar to that of Figures 1 and 2, but also containing finely

divided metal as an additional activating element,

Figure 4 shows in plan view a unit comprising four of my individual selecting elements arranged in relatively closely spaced relation and interconnected in series by leads in capacity relation to the external electrodes of the elements,

Figure 5 is a vertical view partly in section taken on the line 5—5 of Figure 4 and looking in the direction of the arrows; and

Figure 6 is a circuit diagram showing schematically the selecting elements and their interconnections, and their connection to an ordinary antenna and radio receiving set.

Incoming radio waves often have frequency components which are undesirable and which produce sounds of undesired characteristics in the loud speaker of the receiving set to which they are connected. One type of such component is the so-called strays or atmospherics which are electrical disturbances sometimes of high decrement and covering a wide frequency band, but which in some cases are limited to a comparatively narrow part of the frequency spectrum. This type of component is not present in the wave emitted by the transmitting broadcast station, but is picked up during the transmission of the wave through space, and is parasitical. My device is particularly adapted to reduce the effect of such disturbances which occupy a particular range of the frequency spectrum. Interfering electrical disturbances from nearby electrical apparatus also often occupy a particular part of the frequency spectrum and can be similarly controlled by my invention. Harmonics or other distortions of the wave form emitted by the transmitting radio broadcasting station may also introduce undesired characteristics in the received signal, and are controllable by my invention.

I have found that by causing the radio-frequency current picked up to traverse a selecting element comprising a bottle or vessel containing an acidulated or alkaline liquid, components of undesired characteristics are reduced.

The selecting element which I provide is conveniently a glass bottle having as one electrode a central metal rod immersed in the acidulated or alkaline liquid, and as the other electrode a piece of metal foil wrapped around the outside of the bottle.

A plurality of such selecting elements may be mounted in juxtaposition and connected in series by interconnecting leads which are in ca-

capacity relation to the several metal foil electrodes, thereby constituting an electrical system of selective frequency characteristics.

I find that the employment of the antenna unit which I describe will under the radio receiving conditions ordinarily met in practice, produce in the loud speaker of the radio receiving set connected, an improved and clarified tone output as compared with the sound produced under similar conditions without my device.

Referring to the drawing in detail, in Figures 1 and 2, 1 is a glass bottle or vial or vessel conveniently shaped as here shown substantially square. This bottle is of conventional form with a closed bottom and sloping top, and on its top surface provided with a shoulder or neck and an opening lipped to receive a tight-fitting cork 2 which is conveniently rubber. Bottles which are round or of other shape can also be used. I find that a one-ounce bottle is a convenient size for the purpose in view, but bottles as small as a quarter ounce, and as large as two-ounce and larger have also been found satisfactory. The bottle 1 is filled substantially full with an acidulated or alkaline liquid 3 hereafter described.

The rubber cork 2 is centrally pierced to receive a copper or other metal rod 4 part of which is outside of the bottle and cork, and which extends downwards through the cork well into the bottle and reaches into liquid 3. Metal rod 4 is provided with a binding post 5. Rubber cork 2 may be retained in position by a screw cap 2a fitting onto the neck of the bottle.

Wrapped around a substantial part of the vertical external surface of bottle 1 is a piece of metal foil 6 which is held in place by twine or other suitable material wrapped around. A connecting wire 23 is conductively attached to foil 6 by soldering or otherwise.

In Figure 3, the bottle and its electrodes are substantially the same as shown in Figure 2, but in the bottom of the bottle there is a layer 8 of fine copper or other metal filings, into which layer the lower end of rod 4 may project. I find that for some purposes the liquid is maintained in a condition to attain the desired result more satisfactorily by thus keeping a layer of such metal filings in the bottom of the bottle. Such layer of filings may be as thick as one-third of the height of the bottle, but layers of less thickness may also be employed satisfactorily.

The liquid 3 with which the bottle 1 is filled, is usually an acidulated liquid which may have different compositions which will produce the desired result. However, I find that for best results, the liquid advantageously is composed by mixing three parts of water and two parts alcohol, and to one pint of such mixture of water and alcohol adding one ounce of sulphuric acid. This makes a fluid composed approximately of ten parts water, six parts alcohol, and one part sulphuric acid. A liquid composed of only water and sulphuric acid in approximately the proportions of sixteen parts to one will also operate, but is not as satisfactory as the liquid containing the alcohol. The alcohol used is preferably a low primary alcohol such as ethyl or methyl alcohol. I have also found that the use in the bottle of certain alkaline liquids such as sodium hydroxide or aluminum hydroxide in water, produces good results. If these alkaline liquids are used it may be preferable to place a thin layer of a suitable oil on top of the alkaline liquid, and to pre-condition the copper rod to minimize its corrosion

by the liquid, as is known in the alkaline primary battery art.

The rubber cork 2 should be tightly fitted in the bottle lip and should tightly grip the metal rod 4 passing therethrough to form a substantially hermetic seal, but if necessary a sealing compound may be applied around the edges of cork 2 to insure a hermetic seal. Because of this tight seal, a space of about one-tenth the height of the bottle should be left above the liquid to allow for expansion. The copper rod 4 is advantageously about one-eighth inch in diameter but may be of other size such as one-fourth inch in diameter. While I have in most instances employed a copper rod, other metals may also be employed for this purpose.

The metal foil 6 wrapped around the bottle has been found to be advantageously aluminum foil, but I have also employed copper foil and other metal foils with good results. I have also employed a closely wound single-layer winding of copper wire around the outside of the bottle instead of the metal foil, which will operate, but which I do not consider produces as good results as the metal foil. One electrode, rod 4 or foil 6, is connected to the antenna, and the other electrode to the antenna post of an ordinary receiving set. I usually prefer to connect the antenna to the foil electrode.

A plurality of the individual selecting elements or bottles of Figures 1-3 may be employed together to produce a result which in general is better than that produced with a single bottle. The individual elements may be connected in series, or in some cases in parallel, or in series-parallel. Figure 4 shows such an arrangement of four selecting elements connected in series. Other numbers of elements may be connected in series, and as stated, types of connection other than the series connection may also be employed. I have, for instance, satisfactorily employed two and three elements in series.

In Figure 4, the individual elements 10, 11, 12, 13 are provided with external foil electrodes 14, 15, 16, 17, and with center rod electrodes 18, 19, 20, 21. The four bottle elements are placed in a box 22 of size suitable to hold the four bottles fairly snugly but with a relatively small space between adjacent bottles and between each bottle and the adjacent side of the box. The showing of Figure 4 is schematic, in practice the bottles will be fitted somewhat closer together and with relation to the sides of the box than is shown. The box confines the bottles relatively closely together. The bottles I usually employ are about 3½ inches high and are spaced about one-half inch apart. Any suitable type of frame surrounding the bottles will also serve. The outside foil electrode 14 of element 10 is preferably connected by lead 23 to the input lead of the ordinary type of antenna if one is employed. Center electrode 18 of element 10 is connected by interconnecting lead 24 to outside foil electrode 15 of element 11. Center electrode 19 of element 11 is connected by interconnecting lead 25 to outer foil electrode 16 of element 12. Center electrode 20 of element 12 is connected by interconnecting lead 26 to outer foil electrode 17 of element 13. Center electrode 21 of element 13 is connected by lead 27 to the antenna binding post of any usual type of radio receiving set. In general, in making the series connection, a center electrode of one element is connected to an outer foil electrode of the next element.

While I have found it preferable to connect the

ordinary antenna, if used, to the outer foil electrode of the first element, and to connect the center electrode of the last element to the antenna post of the receiving set, I also find that  
 5 it is possible to connect the antenna to the center electrode of the first element and to connect the outer foil electrode of the last element to the receiving set. In general it may be said that a tone of better quality will be delivered under  
 10 ordinary operating conditions by connecting the antenna to the outer foil electrode of the first element, and the receiving set to the center electrode of the last element. However, I also find that a sound of greater volume is usually produced if the antenna is connected to the center  
 15 electrode of the first element and the receiving set is connected to the outer foil electrode of the last element; while this latter arrangement does not produce as good a quality of sound if the receiving conditions are bad, with good receiving  
 20 conditions it may be quite satisfactory.

Figure 6 is a schematic circuit diagram of the arrangement of four elements of Figure 4, as connected to an antenna and receiving set. 28 is an ordinary type of antenna connected to the  
 25 blade 30 of a single-point double-throw switch. One point 32 of this switch is connected by lead 23 to outer foil electrode 14 of the first element 10, and the center electrode 21 of the last element 13 is connected by lead 27 to antenna binding  
 30 post 36 of receiving set 35, which constitutes substantially the arrangement shown in Figure 4 when the blade of switch 29 is in the right position and engages point 32.

I also find that in certain kinds of conditions of reception, it is desirable to be able to use only one element in the circuit for a time, and still  
 35 be able to throw all four elements into circuit on an instant's notice. The switch 29 makes this possible. By throwing the blade of switch 29 to its left position (Figure 6) so that it engages point 31, elements 10, 11, 12, are cut out of the circuit, and antenna 28 is connected directly  
 40 through lead 34 to outer foil electrode 17 of element 13, so that only element 13 is in the circuit.

As shown in Figures 4 and 6, one or more of the interconnecting leads 24, 25, 26, may be formed of insulated coiled wire, which may advantageously be helically coiled. In this way a  
 45 length of say five feet of wire may be coiled into a length of about nine inches, in one of these interconnecting leads. A box containing several elements interconnected by one or more such coiled interconnections contains its own effective  
 50 antenna, and it is not necessary to attach a conventional type of antenna as 28 to the first element, if it is not convenient to do so. My invention therefore constitutes a very convenient, compact and useful form of receiving antenna, entirely apart from its wave selective properties.  
 55 For four one-ounce bottles such as I have described which are about  $3\frac{1}{2}$  inches high, the box 22 need only be about four inches high, and about the same size in the other dimensions, forming a very compact unit. In Figure 6, if  
 60 only a single element is to be connected, the single lead 34 may also be formed of coiled wire.

Also, as shown in Figures 4 and 6, the interconnecting leads 24, 25, 26, are positioned between the several bottles or elements, or between  
 70 a bottle and the side of box 22, relatively close to the outer foil electrodes of the several elements, so as to be in electrical capacitative relation to the respective foil electrodes. A longer  
 75 one of such interconnecting leads, such as 26,

may be doubled reentrantly upon itself as shown in Figure 6, which materially increases its capacity effect with relation to the foil electrodes of both adjacent bottles.

In the arrangement of a number of elements  
 5 as shown in Figures 4 and 6, I have usually obtained best results by employing for the first element nearest the antenna the type of element shown in Figure 3 having a layer of copper filings in the bottom of the bottle, and using the form  
 10 of Figure 2 without such filings for the other elements. Also I have obtained good results by using the two elements nearest the antenna with such copper filings, and the other elements without filings. While the determination of whether  
 15 to use the type of bottle containing copper filings seems to depend on the particular reception conditions to be met, in general, the element with copper filings should be nearest the antenna.

My invention may be applied to receive both  
 20 long, short, and ultra-short waves. The determination of what particular form and size of my antenna unit is most suitable to meet a given condition depends on the particular receiving conditions which exist. In general, it may be  
 25 said that if the wave characteristics which it is desired to control correspond generally to long waves, an antenna unit of larger dimensions will be used than if the wave characteristics to be controlled correspond to short waves. A number of different boxes of my antenna units may  
 30 be provided for a given receiving set, such boxes being of different sizes and containing bottles of different sizes with outer electrodes of corresponding sizes, and having interconnecting leads  
 35 of different lengths. When a troublesome condition of reception is met, one of such boxes after another may be quickly connected in turn to the receiving set, and the one most suited to the existing condition selected.

In operation, with a single element, the antenna is connected to one electrode of element 1,  
 40 as to foil electrode 6 by lead 23, and the other electrode of element 1, as rod 4, is connected to the antenna post of the receiving set. A bottle without the copper filings may be first tried. A bottle with copper filings may then be substituted, and the bottle used which produces the best result. Preferably, however, I employ a  
 45 plurality of bottles connected in series, as has been described. With a plurality of bottles, as has been described, preferably the one nearest the antenna contains some copper filings. The coiled interconnecting leads between the adjacent bottles are positioned in capacitative  
 50 relation to the foil electrodes of the nearby bottles. The ordinary antenna, if used, is connected to one electrode of the first bottle as to foil electrode 14 of bottle 10, and the opposite electrode of the last bottle, as rod 21 of bottle 13, is connected to the antenna post of the receiving set. If a plurality of boxes is available containing several such bottles of different sizes and characteristics, one box after another may be tried  
 55 to get the box which gives best results. For some kinds of reception conditions, it may be found that bottles containing the alkaline liquids mentioned, give better results than bottles containing the acidulated liquids.

I find that the signal received on a receiving  
 70 set when using one or more of my antenna selecting elements in the antenna circuit, is materially improved in quality and clarity as compared with the signal when my elements are not so used, particularly if bad receiving conditions exist. I  
 75

believe that the liquid which I employ probably forms a microscopically thin gas film at points around the center electrode, which gives a capacity effect at this point to a certain extent and a capacity path at this point, although the liquid may have conductive relation with the center electrode at other points. The waves also have a liquid path through the acidulated or alkaline liquid, and a glass path through the glass side of the bottle. My device constitutes a selective impedance element, delivering a wave of different character from that received. I believe that the helical windings forming the interconnecting leads, which are adjacent and in capacity relation to the outer foil electrodes, form with the bottle elements an electrical net work of inductances and capacities which is able to control the frequency and other characteristics of the waves transmitted to the receiving set. I believe that this is the most probable explanation of the way in which my invention produces the useful results which I obtain. However, I do not wish to rely upon this as the only possible explanation of the scientific principles of the operation of my invention, since further investigation may show that my results are obtained by virtue of some other scientific principle.

My invention has been found to produce very satisfactory results, is simple to construct and apply, and may be employed by persons having no technical familiarity with radio communication.

Having now particularly described my invention and in what manner the same is to be performed, what I claim as my invention for which I desire to secure Letters Patent of the United States is:

1. In a receiving antenna unit, a plurality of closed vessels formed of electrical insulating material and each containing an acidulated liquid, a plurality of conducting metallic sheets respectively wrapped peripherally around the exteriors of said vessels, a plurality of metallic rod members respectively extending into the interior of said vessels from the exterior thereof and being in contact with said liquid therein, a plurality of interconnecting leads respectively connected from said rod member of one of said vessels to said metallic sheet of another of said vessels for connecting said vessels in series, at least one of said interconnecting leads comprising a relatively long and relatively closely wound conductor positioned adjacent said metallic sheets of a plurality of said vessels, and frame retaining means surrounding said vessels and holding the same relatively closely adjacent each other and with said interconnecting lead adjacent said metallic sheets being in capacitative relation thereto.

2. The subject matter of claim 1, said acidulated liquid consisting approximately of ten parts water, six parts of a low primary alcohol, and one part sulphuric acid.

3. In a receiving antenna unit, a plurality of closed vessels formed of electrical insulating material and each containing an acidulated liquid, a plurality of conducting metallic sheets respectively wrapped peripherally around the exteriors of said vessels, a plurality of metallic rod members respectively extending into the interior of said vessels from the exterior thereof and being in contact with said liquid therein, a plurality of interconnecting leads respectively connected from said rod member of one of said vessels to said metallic sheet of another of said vessels for connecting said vessels in series, at least one of said

interconnecting leads comprising a relatively long and relatively closely wound conductor positioned adjacent at least one of said metallic sheets of one of said vessels, and frame retaining means surrounding said vessels and holding the same relatively closely adjacent each other and with said interconnecting lead adjacent said metallic sheet being in capacitative relation thereto.

4. In a receiving antenna unit, a plurality of closed vessels formed of electrical insulating material and each containing a liquid consisting of sodium hydroxide and water, a plurality of conducting metallic sheets respectively wrapped peripherally around the exteriors of said vessels, a plurality of metallic rod members respectively extending into the interior of said vessels from the exterior thereof and being in contact with said liquid therein, a plurality of interconnecting leads respectively connected from said rod member of one of said vessels to said metallic sheet of another of said vessels for connecting said vessels in series, at least one of said interconnecting leads comprising a relatively long and relatively closely wound conductor positioned adjacent said metallic sheets of a plurality of said vessels, and frame retaining means surrounding said vessels and holding the same relatively closely adjacent each other and with said interconnecting lead adjacent said metallic sheets being in capacitative relation thereto.

5. In a receiving antenna unit, a plurality of closed vessels formed of electrical insulating material and each containing a liquid consisting of aluminum hydroxide and water, a plurality of conducting metallic sheets respectively wrapped peripherally around the exteriors of said vessels, a plurality of metallic rod members respectively extending into the interior of said vessels from the exterior thereof and being in contact with said liquid therein, a plurality of interconnecting leads respectively connected from said rod member of one of said vessels to said metallic sheet of another of said vessels for connecting said vessels in series, at least one of said interconnecting leads comprising a relatively long and relatively closely wound conductor positioned adjacent said metallic sheets of a plurality of said vessels, and frame retaining means surrounding said vessels and holding the same relatively closely adjacent each other and with said interconnecting lead adjacent said metallic sheets being in capacitative relation thereto.

6. In a receiving antenna unit, a plurality of closed vessels formed of electrical insulating material and each containing a liquid selected from the group consisting of acidulated liquids and alkaline liquids, a plurality of conducting metallic sheets respectively wrapped peripherally around the exteriors of said vessels, a plurality of metallic rod members respectively extending into the interior of said vessels from the exterior thereof and being in contact with said liquid therein, a plurality of interconnecting leads respectively connected from said rod member of one of said vessels to said metallic sheet of another of said vessels for connecting said vessels in series, at least one of said interconnecting leads comprising a relatively long and relatively closely wound conductor positioned adjacent said metallic sheets of a plurality of said vessels, and frame retaining means surrounding said vessels and holding the same relatively closely adjacent each other and with said interconnecting lead adjacent said metallic sheets being in capacitative relation thereto.

7. In a receiving antenna unit, a plurality of closed vessels formed of electrical insulating material and each containing a liquid selected from the group consisting of acidulated liquids and alkaline liquids, a plurality of conducting metallic sheets respectively wrapped peripherally around the exteriors of said vessels, a plurality of metallic rod members respectively extending into the interior of said vessels from the exterior thereof and being in contact with said liquid therein, a plurality of interconnecting leads respectively connected from said rod member of one of said vessels to said metallic sheet of another of said vessels for connecting said vessels in series, at least one of said interconnecting leads comprising a relatively long and relatively closely wound conductor positioned adjacent at least one of said metallic sheets of one of said vessels, and frame retaining means surrounding said vessels and holding the same relatively closely adjacent each other and with said interconnecting lead adjacent said metallic sheet being in capacitative relation thereto.

8. In a receiving antenna unit, a plurality of closed vessels formed of vitreous electrical insulating material, each of said vessels containing a liquid selected from the group consisting of acidulated liquids and alkaline liquids, a plurality of conducting metallic sheets respectively wrapped peripherally around the exteriors of said vessels, a plurality of metallic rod members respectively extending into the interior of said vessels from the exterior thereof and being in contact with said liquid therein, a plurality of interconnecting leads respectively connected from said rod member of one of said vessels to said metallic sheet of another of said vessels for connecting said vessels in series, at least one of said interconnecting leads comprising a relatively

long and relatively closely wound conductor positioned adjacent at least one of said metallic sheets of one of said vessels, frame retaining means surrounding said vessels and holding the same relatively closely adjacent each other and with said interconnecting lead adjacent said metallic sheet being in capacitative relation thereto, an initial one of said vessels having no interconnecting lead connected to its metallic sheet, and a terminal one of said vessels having no interconnecting lead connected to its rod member, a receiving antenna connected to the metallic sheet of said initial vessel, and means for connecting the rod member of said terminal vessel to the antenna input post of a radio receiving set.

9. In a receiving antenna unit, a plurality of closed vessels formed of vitreous electrical insulating material, each of said vessels containing an acidulated liquid, a plurality of conducting metallic sheets respectively wrapped peripherally around the exteriors of said vessels, a plurality of metallic rod members respectively extending into the interior of said vessels from the exterior thereof and being in contact with said liquid therein, a plurality of interconnecting leads respectively connected from said rod member of one of said vessels to said metallic sheet of another of said vessels for connecting said vessels in series, at least one of said interconnecting leads comprising a relatively long and relatively closely wound conductor positioned adjacent at least one of said metallic sheets of one of said vessels, and frame retaining means surrounding said vessels and holding the same relatively closely adjacent each other and with said interconnecting lead adjacent said metallic sheet being in capacitative relation thereto.

SAMUEL W. CARTER.