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RADIO ANTENNA SYSTEM

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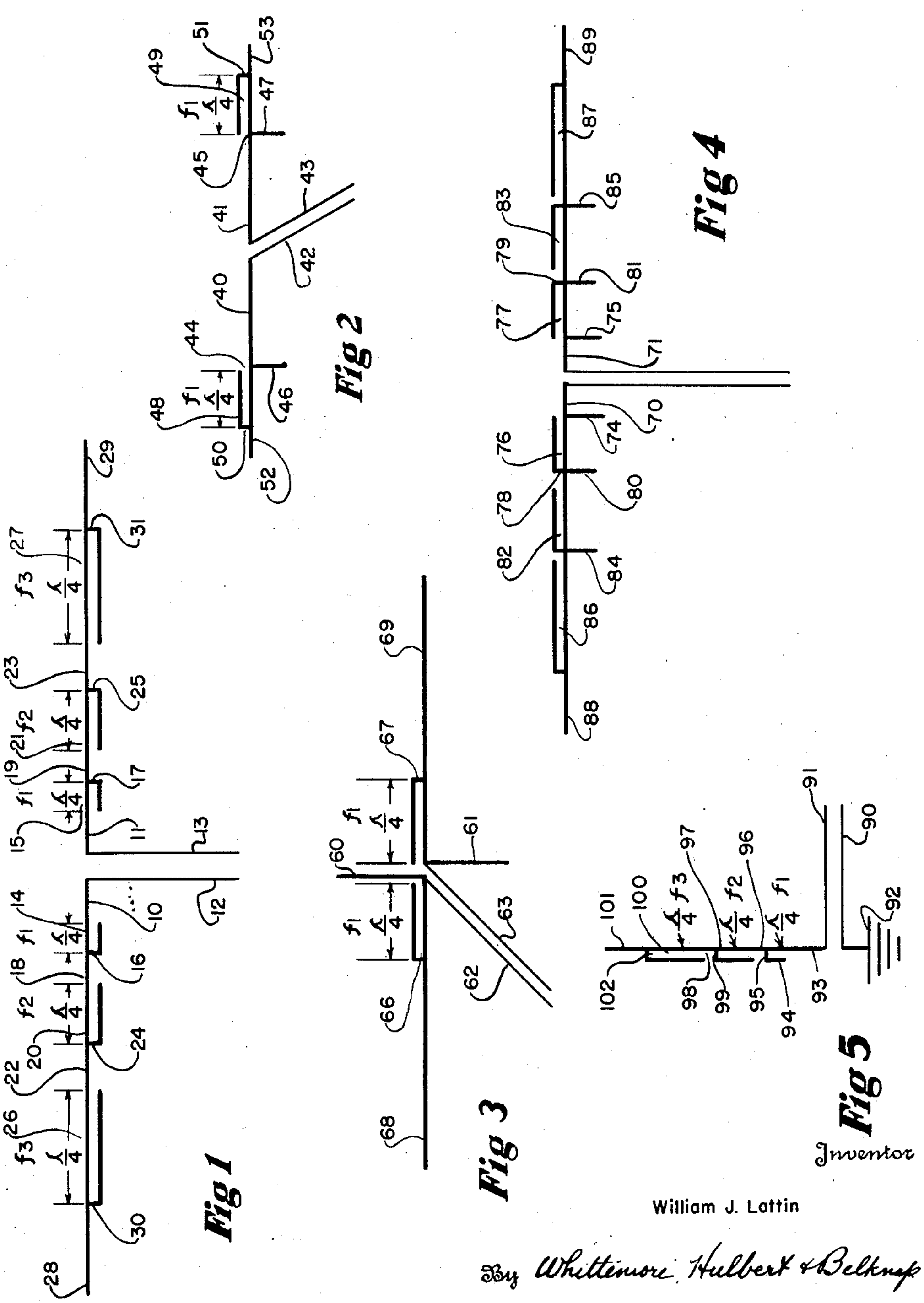

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RADIO ANTENNA SYSTEM

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5 Claims. (Cl. 250—33)

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This invention relates to radio antenna systems in general. More particularly, this invention relates to radio antenna systems that are responsive to currents of different predetermined frequencies.

An object of this invention is to provide a radio antenna system that may be operated at a multiplicity of frequencies without switching arrangements.

Another object of the invention is to provide an antenna that may be employed in radio transmission, said antenna being adapted to resonate in a multiplicity of transmission channels, for example, the 80, 40, 20 and 10 meter amateur bands, without switching arrangements or separate antennae for each band.

A further object of the invention is to provide a radio antenna arrangement whereby a single antenna can be made to resonate at a number of frequencies and function similarly to a half wave doublet at each frequency of operation.

Other objects of the invention will be apparent to those skilled in the art to which it relates from the following specification, claims, and drawing.

In accordance with this invention there is provided a multiple frequency radio antenna that may be used both for reception and transmission of radio signals. This antenna may be employed in the field of amateur radio as well as in the field of commercial radio, or any other field in which it may be desirable to transmit different frequency radio signals from the same antenna without employing various switching arrangements or other devices for changing the frequency of the antenna each time it is desired to transmit or receive different frequency signals.

Basically this invention consists of a doublet antenna or a half wave antenna to which are connected quarter wave sections that function to cause the antenna to resonate at different predetermined frequencies. The central section of the doublet is caused to resonate at the highest frequency of the antenna and quarter wave sections, measured at this highest frequency, are connected to the ends of this central section. The next highest frequency is determined by the central section of the doublet and the quarter wave sections plus two additional sections, one on the outside of each of the aforesaid quarter wave sections, and, if the antenna is to be adjusted to function at still another frequency, that is, a third frequency, then two additional quarter wave sections, measured at the aforesaid second frequency, are connected to the ends of the antenna adjusted for the second frequency, so that additional sections may be connected to the ends of the latter quarter wave sections to adjust the anenna for the third frequency.

These and other features of the invention are

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described in detail in the following specification and illustrated in the drawing.

In the drawing:

Figure 1 illustrates an antenna constructed in accordance with this invention and adapted to resonate in four different frequency bands;

Fig. 2 is a view showing a modified form of the invention;

Fig. 3 is a view showing a still further modified form of the invention;

Fig. 4 illustrates another form of the invention; and

Fig. 5 is a view showing the application of this invention to a quarter wave type of antenna.

In Figure 1 of the drawing there is illustrated a doublet type of antenna having a central section consisting of the elements 10 and 11 having the lengths thereof adjusted so that the doublet antenna consisting of these two elements 10 and 11 resonates at a frequency f'. The adjacent ends of the elements 10 and 11 are connected to ends of the transmission lines 12 and 13 respectively. The lines 12 and 13 may be of any conventional design such as a coaxial high frequency cable, or parallel open wire transmission lines, or dielectric insulated cable. The opposite ends of the doublet sections 10 and 11 are connected to one of the conductors 14 and 15 respectively of the quarter wave transmission line sections. These transmission line sections consist of suitable lengths of coaxial, parallel or twisted conductors having the open ends connected to the opposite ends of the doublet elements 10 and 11 and having the far ends shorted as indicated by reference numerals 16 and 17. Additional antenna sections 18 and 19 are connected to the shorted ends 16 and 17 respectively of the quarter wave sections 14 and 15 respectively. These additional antenna sections 18 and 19 are of suitable length to adjust the antenna to resonate at a second frequency f^2, which is lower than the frequency f'. If the quarter wave sections 14 and 15 are each made up of a pair of open wire transmission lines, then the value of the frequency f^2 must be less than half the frequency f'. However, by using wires separated by rubber or similar dielectric, as the quarter wave sections 14 and 15, the frequencies f' and f^2 may be closer together inasmuch as the velocity with which the electric waves travel through the dielectric insulated line is less than the velocity with which they travel in open wire transmission lines.

The doublet antenna may be adjusted for a third frequency f^3 and also for a fourth frequency f^4 by providing additional quarter wave sections 20 and 21 connected to the ends of the antenna sections 18 and 19 respectively and additional antenna sections 22 and 23 connected to the shorted ends 24 and 25 of the quarter wave sections 20 and 21 respectively, so as to adjust the antenna to a frequency f^3. Additional quarter wave sections 26 and 27 are connected to the antenna elements 22 and 23 respectively and additional antenna elements 28 and 29 are connected to the shorted ends 30 and 31 of the quarter wave sections 26 and 27 respectively to adjust the antenna to a fourth frequency f^4. More frequencies of resonance may be provided, as desired, by adding further quarter wave isolating sections and antenna elements.

As pointed out previously, the different quarter wave sections are adjusted at different frequencies, that is, the sections 14 and 15 are adjusted to be a quarter wave length long at the frequency f', the sections 20 and 21 are adjusted to be a quarter wave length long at the frequency f^2, and the sections 26 and 27 are adjusted to be a quarter wave length long at the frequency f^3. The lengths of the antenna elements are adjusted in a conventional manner, that is, the elements 10 and 11 together are one-half wave length; the elements 18 and 19 plus the quarter wave sections 14 and 15 plus the elements 10 and 11 equal in length approximately one-half the wave length of the frequency f^2, and the same is true of the antenna elements plus the quarter wave sections for the frequencies f^3 and f^4.

In Fig. 2 there is shown an antenna that may be made to respond to at least two frequencies f' and f^2 and the portion of this antenna responding to f' consists of the conductor elements 40 and 41, the adjacent ends of which are connected to the transmission line conductors 42 and 43 respectively, and the remote ends 44 and 45 of the antenna sections 40 and 41 respectively being connected to elements 46 and 47 respectively that are folded down. In this embodiment of the invention the antenna elements 40, 41, 46, and 47 therefore determine the frequency f' to which the antenna will respond or resonate. Quarter wave sections 48 and 49 are connected to the ends 44 and 45 respectively of the antenna conductors 40 and 41 respectively. Additional antenna elements 52 and 53 are connected to the shorted ends 50 and 51 respectively of the quarter wave sections 48 and 49 respectively, and these additional antenna sections 52 and 53 plus the quarter wave sections 48 and 49 are such as to cause the antenna to respond to a second frequency f^2 in cooperation with the antenna sections 40 and 41. Further antenna elements, folded-down sections, and quarter wave sections may be added to provide more resonant frequencies. By folding down the antenna sections the relation between adjacent frequencies may be less than two to one.

The modification of this invention shown in Fig. 3 employs quarter wave antenna sections 60 and 61 that together comprise a doublet. The adjacent ends of the elements 60 and 61 are connected to the transmission line conductors 62 and 63 respectively. These adjacent ends are also connected to the quarter wave sections respectively. Additional antenna elements 68 and 69 are connected to the shorted ends 66 and 67 respectively of the quarter wave sections and these additional elements 68 and 69 are of such length as to provide an antenna that will resonate at a frequency f^2 different from the frequency f'.

A further modified form of the invention incorporating the above principles is illustrated in Figure 4 in which the dipole sections 70 and 71 are each five feet five inches long and, together with the folded-down antenna elements 74 and 75, each of which is thirty-two inches long, resonate to a frequency f' of approximately twenty-nine megacycles. The adjacent ends of these sections 70 and 71 are connected to the ends of the transmission line feeder respectively. This transmission line feeder consists of a seventy-five ohm line and is employed for the purpose of connecting the antenna to a transmitter or a receiver. The remote ends of the antenna sections 70 and 71 that are connected to the folded-down sections 74 and 75 respectively are also connected to quarter wave sections 76 and 77 respectively, each of these quarter wave sections being seven feet three inches long and consisting of three hundred ohm polyethylene insulated twin lead or twisted conductors as described above.

To the shorted ends 78 and 79 of the quarter wave sections 76 and 77 respectively are connected folded down antenna elements 80 and 81 respectively, each of these folded-down elements being twenty-two inches long so that the antenna elements 70, 71, together with the quarter wave sections 76 and 77 and the antenna elements 80 and 81, resonate at a frequency f^2 of approximately 14.2 megacycles. The open ends of the quarter wave sections 82 and 83 are connected to the shorted ends of the quarter wave sections 76 and 77 respectively and folded-down sections 84 and 85 are connected to the shorted ends of 82 and 83, to provide an antenna that will respond to a frequency f^3 of approximately 7.2 megacycles. Additional quarter wave sections 86 and 87, each of a length of twenty-eight feet four inches, are connected with their open ends to the shorted ends of the sections 82 and 83 respectively, and additional antenna sections 88 and 89, each of a length of six feet, are connected to the shorted ends of the quarter wave sections 86 and 87 respectively. The frequency f^4 of the complete antenna is approximately 3.9 megacycles.

Antennae constructed in accordance with this invention may also take the form of the antenna illustrated in Fig. 5 in which the quarter wave section 93 of the antenna, responding to the frequency f', is connected to one side 91 of the transmission line going to the transmitter or receiver and the other side 90 of the transmission line is grounded at 92 instead of being connected to another antenna element corresponding to the antenna element 93. The remote end of the quarter wave antenna 93 is connected to the open end of the quarter wave section 94 and the shorted end 95 of this section 94 is connected to an additional antenna element 96. The antenna elements 93 and 96 and the quarter wave section 94 together form an antenna that resonates at the frequency f^2. An additional quarter wave section 97 is connected to the end of the antenna section 96 and an additional antenna section 98 is connected to the shorted end of the quarter wave section 99, so that the antenna employing the three sections 93, 96, and 98, and the quarter wave sections 94 and 97 resonate to a frequency f^3. An antenna resonating to a fourth frequency f^4 may be provided by connecting an additional quarter wave section 100 to the end of the element 98 and providing an additional antenna section 101 to the shorted end 102 of the section 100.

Antennae of this type have been found to have a somewhat higher radiation resistance than an ordinary half wave doublet. However, the field strength of this antenna is substantially the same as an ordinary doublet antenna in addition to permitting operation on a number of different frequencies. Furthermore, this antenna may be incorporated in antenna arrays where more than one antenna unit are employed and the antenna unit of this invention may be employed as a radiator, reflector, or director, as desired, so that the array or beam or directioal antenna system may be employed on several frequencies.

While I have described this invention and various modifications thereof in detail, I do not desire to limit the invention to the exact details shown and described except as those details may be defined by the appended claims.

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

1. An antenna adapted to resonate at a multiplicity of frequencies comprising a substantially centrally disposed doublet adapted to resonate at the highest fundamental frequency of the multiplicity of frequencies, a pair of quarter wave sections measured at the said highest fundamental frequency, said quarter wave sections each consisting of a pair of conductors positioned side by side and spaced from each other, one of the conductors of one of said quarter wave sections being connected to one of the remote ends of said substantially centrally disposed doublet and one of the conductors of the other of said quarter wave sections being connected to the other remote end of said substantially centrally disposed doublet, means for connecting the remote ends of the said pair of conductors together in each of said quarter wave sections and additional conductors connected to the remote ends of said quarter wave sections, said additional conductors, said quarter wave sections and said substantially centrally disposed doublet forming an antenna adapted to resonate at a lower fundamental frequency.

2. An antenna adapted to resonate at a multiplicity of frequencies comprising a doublet adapted to resonate at the highest fundamental frequency of the multiplicity of frequencies, a pair of quarter wave sections measured at the said highest fundamental frequency, said quarter wave sections each consisting of a pair of conductors positioned side by side and spaced from each other, one of the conductors of one of said quarter wave sections being connected to one of the remote ends of said doublet and substantially colinear therewith and one of the conductors of the other of said quarter wave sections being connected to the other remote end of said doublet and substantially colinear therewith, and means for connecting the remote ends of the said pair of conductors together in each of said quarter wave sections, said quarter wave sections and said doublet functioning as an antenna resonate at another frequency.

3. An antenna adapted to resonate at a multiplicity of frequencies comprising a doublet adapted to resonate at the highest fundamental frequency of the multiplicity of frequencies, a pair of quarter wave sections measured at the said highest fundamental frequency, said quarter wave sections each consisting of a pair of conductors, one of said conductors being folded over the other, one of the conductors of one of said quarter wave sections being connected to one of the remote ends of said doublet and one of the conductors of the other of said quarter wave sections being connected to the other remote end of said doublet, and additional conductors connected to the remote ends of said quarter wave sections to form an antenna with said doublet and said quarter wave sections resonating at a lower fundamental frequency and receiving or radiating energy at said lower fundamental frequency.

4. An antenna adapted to resonate at a multiplicity of frequencies comprising a first antenna element adapted to resonate at the highest fundamental frequency of the multiplicity of frequencies, a quarter wave section measured at the said highest fundamental frequency, said quarter wave section consisting of a pair of conductors positioned side by side and spaced from each other, one of the conductors of said quarter wave section being connected to the remote end of said first antenna element, means for connecting the remote ends of the said pair of conductors together in said quarter wave section and a second antenna element connected to the remote end of said quarter wave section, said first and said second antenna elements and said quarter wave section resonating at a second different fundamental frequency and receiving or radiating energy at said second different fundamental frequency.

5. An antenna adapted to resonate at a multiplicity of frequencies comprising a substantially centrally disposed doublet adapted to resonate at the highest fundamental frequency of the multiplicity of frequencies, a first pair of quarter wave sections measured at the said highest fundamental frequency, said quarter wave sections each consisting of a pair of conductors positioned side by side and spaced from each other, one of the conductors of one of said quarter wave sections being connected to one of the remote ends of said substantially centrally disposed doublet and one of the conductors of the other of said quarter wave sections being connected to the other remote end of said substantially centrally disposed doublet, means for connecting the remote ends of the said pair of conductors together in each of said quarter wave sections, additional conductors connected to the remote ends of said quarter wave sections, said additional conductors, said quarter wave sections and said substantially centrally disposed doublet forming an antenna adapted to resonate at a lower fundamental frequency, a second pair of quarter wave sections measured at said lower fundamental frequency connected to the remote ends of said additional conductors and further additional conductors connected to the remote ends of said first pair of quarter wave sections, said centrally disposed doublet, said first pair of quarter wave sections, said additional conductors, said second pair of quarter wave sections, and said further additional conductors all functioning as an antenna structure at a still lower fundamental frequency.

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