Aug. 16, 1960 C. W. LAMB 2,949,607

MULTIPLE-BAND GAMMA MATCHED ANTENNA

Filed Sept. 5, 1958

Fig.1

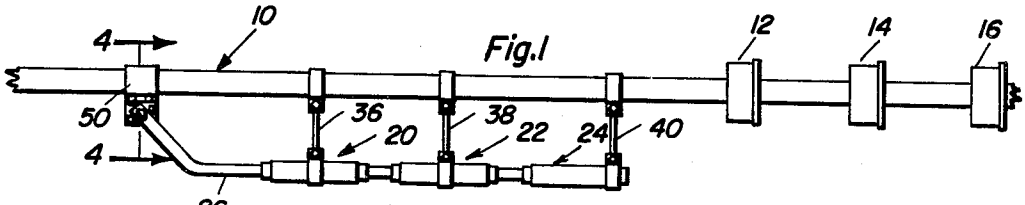


Fig.6

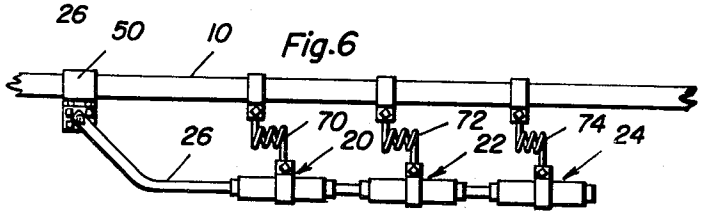


Fig.2

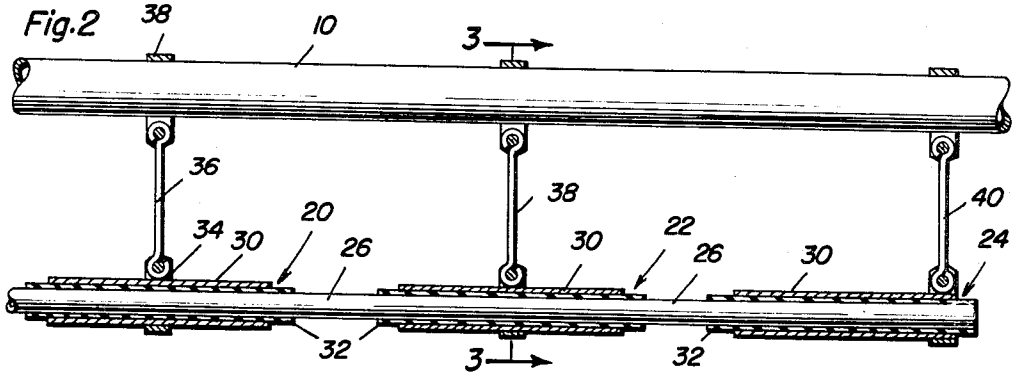


Fig.5

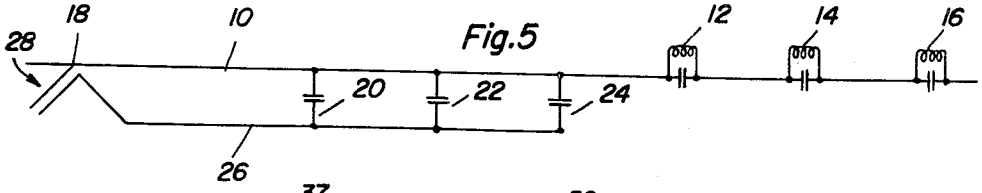


Fig.3

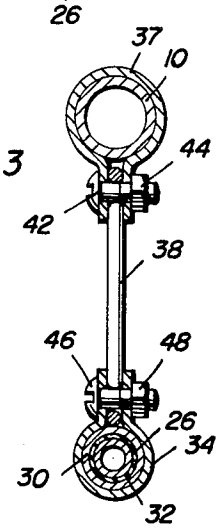
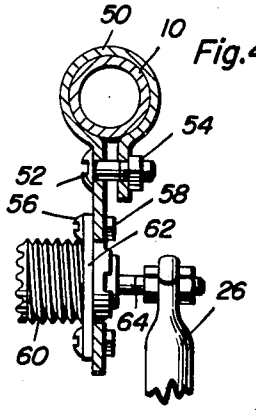


Fig.4



Carl W. Lamb

INVENTOR.

BY Thomas A. O'Brien and Harvey B. Jackson

Attorneys

United States Patent Office 2,949,607 Patented Aug. 16, 1960

2,949,607

MULTIPLE-BAND GAMMA MATCHED ANTENNA

Carl W. Lamb, 4301 Coster Road, Knoxville 18, Tenn.

Filed Sept. 5, 1958, Ser. No. 759,327

4 Claims. (Cl. 343—722)

This invention relates generally to antennas and more particularly to an improved match to be utilized particularly in multi-band antennas.

It is old and well known in the antenna art that a single antenna may be utilized for the transmission or reception of a multiple number of frequency bands by utilizing electrical traps along the length of the antenna rod. That is, by electrically serially connecting resonant circuits along the length of the antenna rod, effective antenna rod lengths of half-wave lengths may be established for desired frequencies. It is of course apparent that proper half-wave lengths utilized with corresponding wave frequencies result in minimum standing wave ratios and more efficient transmission and reception of radio waves. In recent years, the radio amateur or the "ham" has come to utilize a tri-band antenna having the traps noted above for the reception and transmission of the ten, fifteen and twenty meter bands. The traps utilized are merely resonant circuits which pass certain frequencies but refuse to pass other frequencies. Of course, the higher the frequency band, the shorter is the wave length and the shorter is the antenna length utilized in conjunction with this particular wave length. Therefore, in the construction of a multi-band antenna, traps closest to the antenna center or feed line are designed to pass the lower frequencies or longer wave lengths but to present an open circuit to the higher frequencies and, therefore, a shorter antenna rod length.

In the utilization of the above noted multi-band antennas, recent developments in the antenna field have included gamma matches for matching the antenna impedance to the antenna feed line impedance for the maximum efficient transfer of the energy between the antenna and the feed line. Of the gamma matches developed to date for utilization in conjunction with the multi-band antenna, capacitive elements are electrically connected to the antenna rod at proper points therealong and are further electrically connected to a gamma rod which electrically proceeds to one side of the antenna feed line. In the utilization of a tri-band antenna, three separate gamma matches must of course be utilized for the effective energy transfer of the three different bands for which the antenna was designed. The necessity of utilizing three separate gamma rods limits somewhat the electrical and mechanical efficiency of the antenna. More particularly, the utilization of three distinct gamma rods increases the expense, weight, and wind resistance of the antenna. Further, since generally the gamma rods are not designed to be reflecting parasitic elements, they distort the radiating pattern adjacent the antenna. In view of these deficiencies in the presently used conventional tri-band antennas, the following recites the particulars of an improved multi-band antenna match which obviates these deficiencies.

Accordingly, it is the principal object of this invention to provide a novel multi-band antenna match which while being electrically more efficient than hereto known

devices is less expensive, lighter, and presents less wind resistance.

It is a further object of this invention to provide a novel multi-band antenna match which decreases the distortion often generated in the radiating pattern adjacent the antenna.

It is a still further object of this invention to provide a more efficient gamma match for multi-band antennas which utilizes a series resonant circuit for more efficient discrimination between the bands.

In accordance with the above stated objects, below is particularly described the construction and utilization of the novel gamma match for a multi-band antenna. Whereas formerly a separate gamma rod was utilized with each capacitive element corresponding to a match for each of the bands, the applicant utilizes his capacitive elements on a single gamma rod supported below the antenna rod. Each capacitive element is formed by placing a conductive sleeve about the gamma rod at the desired matching point with a tubular insulator therebetween. The conductive sleeve is electrically connected to the antenna rod, while the gamma rod is terminally connected to one side of the antenna feed line. The capacitive elements are of such values that, of course, only one is electrically effective for each band. If desired, the electrical connection between the sleeve and the antenna rod may include a serially connected inductive element providing a series trap for aiding the conventional trap utilized on the antenna rod. This latter utilization provides better discrimination between the different bands.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

Figure 1 is an elevational view of the antenna construction showing the single gamma rod;

Figure 2 is an enlarged fragmentary sectional view of the gamma match portion of the antenna;

Figure 3 is a sectional view taken substantially along the plane 3—3 of Figure 2;

Figure 4 is a sectional view taken substantially along plane 4—4 of Figure 1;

Figure 5 is a schematic circuit diagram of the antenna and match illustrating the resonant trap circuits and capacitive matching elements; and

Figure 6 is a fragmentary elevational view of a modification of the gamma match.

With continuing reference to the drawings, numeral 10 represents a portion of an antenna rod having serially connected resonant trap circuits 12, 14 and 16 connected thereto for effectively limiting the antenna rod length to a half-wave length for desired frequency bands. Noting Figure 5, point 18 is the center of the antenna rod and the point of connection of one side of the feed line. Trap 12 presents an open circuit to the highest frequency for which the antenna is desired to be utilized. Therefore, the antenna rod length between point 18 and trap 12 should be equal to one quarter of a wave length of the wave which has a frequency limited by the trap 12. Likewise, the antenna rod distance between point 18 and trap 14 should be equal to one quarter of a wave length of a wave having the frequency to which trap 14 presents an open circuit.

Capacitive elements 20, 22 and 24 are electrically connected between the antenna rod 10 and gamma rod 26 for forming a gamma match for matching the impedance of the antenna rod 10 to the feed line 28. More particularly referring to Figure 2, the capacitive elements include

a conductive sleeve 30 concentrically placed about the gamma rod 26 with a tubular insulator 32 sandwiched therebetween. It of course should be apparent that electrical capacitance exists between sleeve 30 and gamma rod 26. Capacitive element 20 is electrically connected from the sleeve 30 to a collar 34 and thence to an aluminum wire 36 to a collar 38 electrically in contact with the antenna rod 10. Capacitive element 22 is electrically connected to the antenna rod through aluminum wire 38, while capacitive element 24 is electrically connected through aluminum wire 40.

It should be apparent that when the antenna is excited with its highest frequency radio power, the traps 12 (only one shown) electrically show an open circuit and only the antenna portion on both sides of center point 18 to trap 12 utilizes power. Also at this frequency only the capacitive element 20 and the portion of the gamma rod between the element 20 and the feed line matches the antenna. The other traps, antenna lengths, capacitive elements and gamma rod lengths will have no electrical effect at all. Likewise, when the mid-frequency is utilized, traps 14 show an open circuit and the antenna becomes equal to twice the length between point 18 and trap 14 and then capacitive element 22 and the gamma rod length between capacitive element 22 and the feed line is utilized. Again the other traps, antenna lengths, capacitive elements and gamma rod lengths are not used. The apparent exclusive of the undesired capacitive elements and antenna lengths should be apparent upon the realization of the parallel electrical relationship between the capacitive elements.

More particularly referring to the mechanical or structural features of the invention, Figure 3 clearly shows the particulars of the connection between the antenna rod 10 and the gamma rod 26. The electrical circuit extends from the antenna rod 10 to the collar 37 held tightly by bolt and nut 42 and 44 to the aluminum wire 38, thence to the collar 34, to the sleeve 30, across the tubular insulator 32 to the gamma rod 26. A bolt 46 and nut 48 are utilized in conjunction with the collar 34.

Figure 4 shows the structural features of the coaxial panel connector. Intially, a collar 50 is utilized about the antenna rod 10 and is held by bolt 52 and nut 54 and electrically communicates with the bolt 56 and nut 58 which are electrically connected to the threaded sleeve 60 through member 62. The gamma rod 26 electrically extends through the pin 64 to a central contact within the sleeve 60 (not shown). Of course, insulation within the sleeve 60 insulates the central contact from the sleeve 60 whereby the coaxial connector may be threaded over the threaded sleeve 60 and extended to two sides of a feed line for connection to the gamma rod 26 and antenna 10.

A further modification of the invention is illustrated in Figure 6 wherein inductive elements 70, 72 and 74 are shown utilized with the capacitive elements 20, 22 and 24. The match established between the antenna and feed line should not be disturbed, but the series combination of the inductive and capacitive elements establishes a series trap at desired frequencies to aid the parallel trap coils 12, 14 and 16. The electrical features of Figure 6 have proven extremely satisfactory and discriminating. Aside from the addition of the inductive elements 70, 72 and 74, the features remain identical to those described above.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. An improved match for a multi-band antenna system having an antenna feed line, an antenna rod and a plurality of electrically resonant traps connected thereto comprising a single gamma rod terminally electrically connected to said antenna feed line and a plurality of capacitive elements electrically connecting said gamma rod to said antenna rod at varying points along said rods, said capacitive elements including a conductive sleeve concentrically carried around said gamma rod and a tubular insulator sandwiched between said sleeve and said gamma rod, said sleeve being electrically connected to said antenna rod.

2. The combination of claim 1 wherein said electrical connection between said sleeve and said antenna rod includes a serially connected inductive element.

3. A multi-band antenna comprising an antenna rod, resonant traps electrically connected to said antenna rod for establishing proper antenna half-wave lengths for desired frequency bands, an antenna feed line, a gamma match electrically connected between said antenna rod and said feed line for matching the respective impedances thereof, said gamma match including a single gamma rod terminally connected to said feed line, and a plurality of capacitive elements electrically connected between said gamma rod and said antenna rod, said capacitive elements including a conductive sleeve concentrically carried around said gamma rod and a tubular insulator sandwiched between said sleeve and said gamma rod, said sleeve being electrically connected to said antenna rod.

4. A multi-band antenna comprising an antenna rod, resonant traps electrically connected to said antenna rod for establishing proper antenna half-wave lengths for desired frequency bands, an antenna feed line, a gamma match electrically connected between said antenna rod and said feed line for matching the respective impedances thereof, said gamma match including a single gamma rod terminally connected to said feed line, and a plurality of capacitive elements electrically connected between said gamma rod and said antenna rod, said capacitive elements including a conductive sleeve concentrically carried around said gamma rod and a tubular insulator sandwiched between said sleeve and said gamma rod, a plurality of inductive elements, each of said inductive elements electrically connected between a sleeve and said antenna rod.

References Cited in the file of this patent

UNITED STATES PATENTS

2,578,973	Hills	Dec. 18, 1951
2,648,771	Cork	Aug. 11, 1953
2,719,920	Ellis	Oct. 4, 1955
2,861,267	Arrasmith	Nov. 18, 1958

OTHER REFERENCES

Pub. I: "Simple Gamma-Match Construction," Reynolds, QST, vol. 41, July 1957, page 30.

Pub. II: "A Matching System for a Three-Band Beam," McCoy, QST, vol. 41, November 1957, pages 40 and 41.