United States Patent

French

[15] **3,671,973**

[45] **June 20, 1972**

[54] SELECTIVELY POLARIZED ANTENNA EMPLOYING IMPEDANCE MATCHED CROSSED DIPOLES

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[22] Filed: **Oct. 24, 1969**

[21] Appl. No.: **869,159**

[52] **U.S. Cl.**.....**343/751**, 343/797, 343/819, 343/822, 343/876

[51] **Int. Cl.**.....**H01q 21/26**

[58] **Field of Search**.....343/797, 727, 730, 876, 893, 343/908

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[57] **ABSTRACT**

A selectively polarized antenna has an antenna element parallel to one axis, has a second antenna element parallel to an angularly displaced second axis, has a selector switch connected to the down lead, has a transmission line extending from the selector switch to a position adjacent the first antenna element, has an impedance-matching means connecting said transmission line to the first antenna element at points on opposite sides of the mid-point of that antenna element, has a second transmission line extending from the selector switch to a position adjacent the second antenna element, and has an impedance-matching means connecting the second transmission line to the second antenna element at points on opposite sides of the mid-point of that antenna element.

9 Claims, 3 Drawing Figures

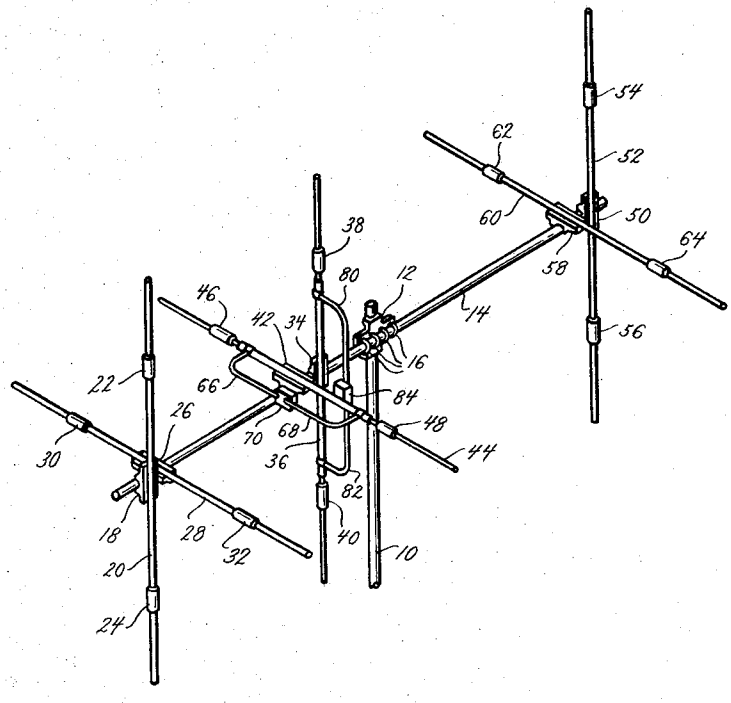


FIG. 1.

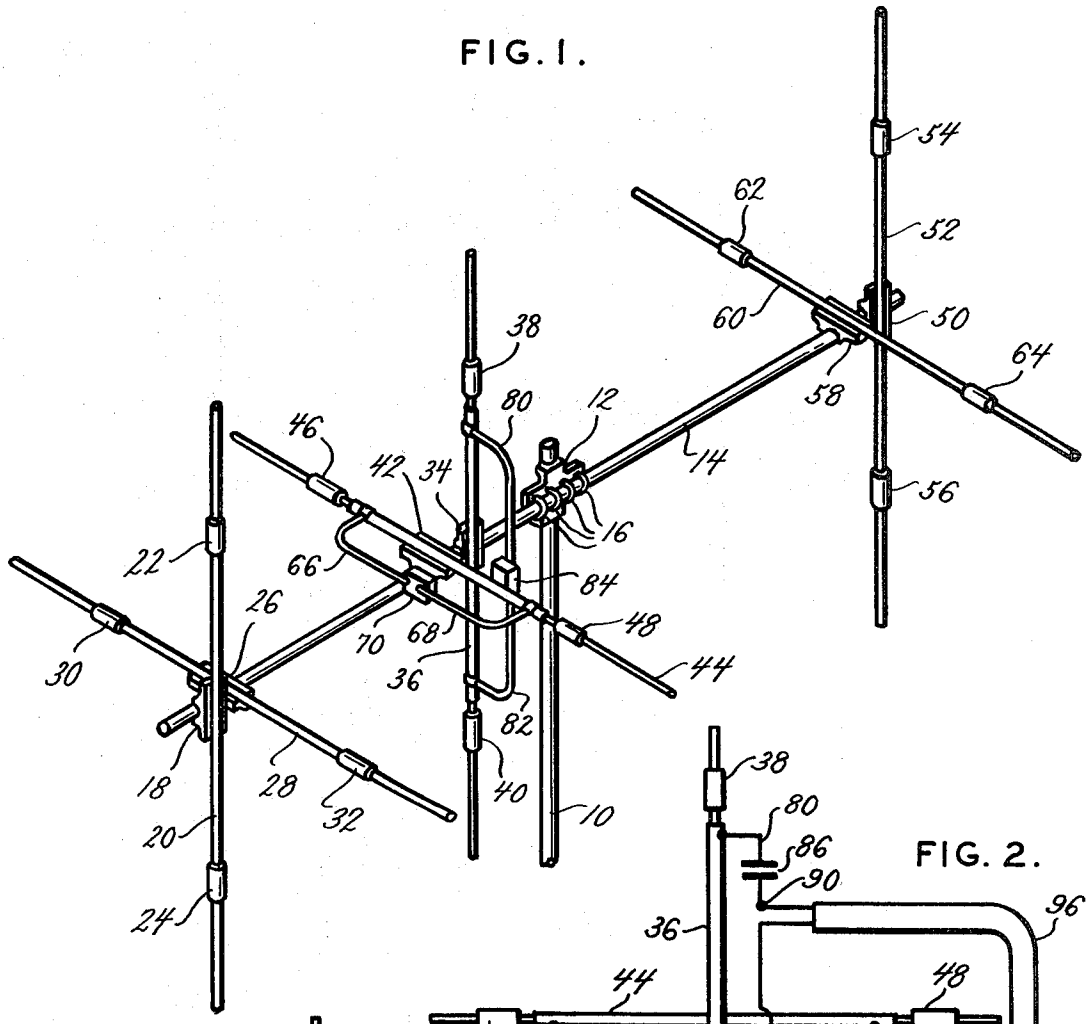


FIG. 2.

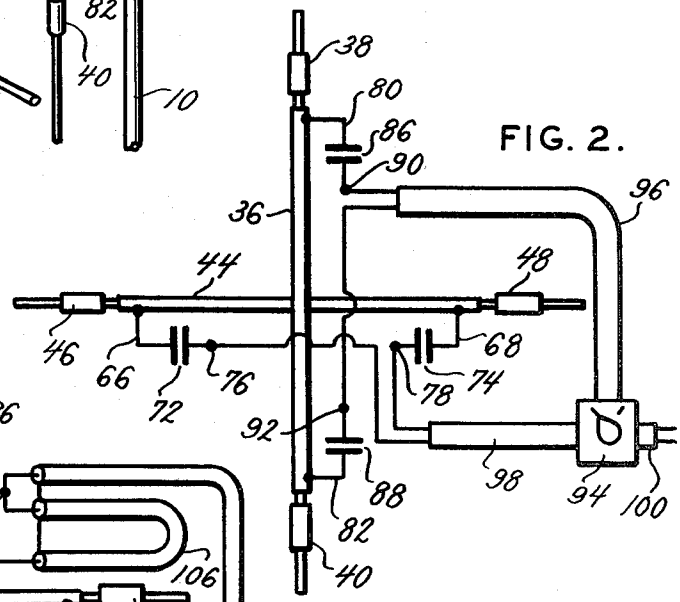
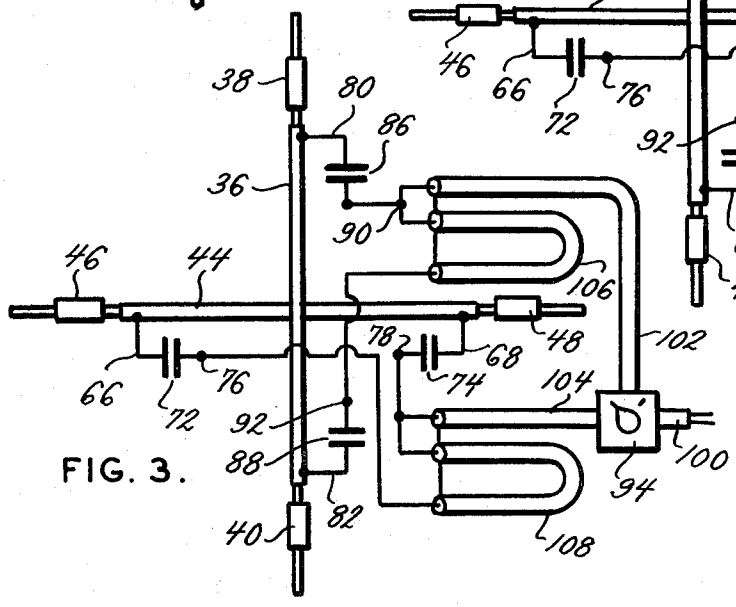


FIG. 3.



SELECTIVELY POLARIZED ANTENNA EMPLOYING IMPEDANCE MATCHED CROSSED DIPOLES

This invention relates to improvements in Selectively Polarized Antennae. More particularly, this invention relates to improvements in selectively polarized antennae which have angularly displaced antenna elements.

It is, therefore, an object of the present invention to provide a selectively polarized antenna which has angularly displaced antennae elements.

It frequency is desirable to provide an antenna which can be polarized to transmit vertically polarized waves or which can be polarized to transmit horizontally polarized waves. To be efficient, such an antenna should have a minimum amount of energy transference between the antenna elements thereof. However, because the antenna elements of a selectively polarized antenna are usually electrically connected adjacent the mid-points thereof, it is difficult to minimize the energy transference between those antenna elements. The present invention minimizes energy transference between the antenna elements of a selectively polarized antenna by selectively supplying energy to one of the antenna elements of that antenna at two points on opposite sides of the mid-point of that antenna element and by selectively supplying energy to the other of the antenna elements of that antenna at two points on opposite sides of the mid-point of that other antenna element. It is, therefore, an object of the present invention to selectively supply energy to the antenna elements of a selectively polarized antenna by connecting a transmission line to two points on opposite sides of the mid-point of one of the antenna elements of that antenna and by connecting a second transmission line to two points on opposite sides of the mid-point of a second antenna element of that antenna.

Other and further objects and advantages of the present invention should become apparent from an examination of the drawing and accompanying description.

In the drawing and accompanying description some preferred embodiments of the present invention are shown and described but it is to be understood that the drawing and accompanying description are for the purpose of illustration only and do not limit the invention and that the invention will be defined by the appended claims.

In the drawing,

FIG. 1 is a perspective view of a selectively polarized antenna and of the means which is provided by the present invention for supplying energy to the antenna elements of that antenna,

FIG. 2 is a diagrammatic showing of the antenna of FIG. 1 and of the means which supplies energy to the antenna elements of that antenna, and

FIG. 3 is a schematic showing of another means for supplying energy to the antenna elements of the antenna of FIG. 1.

Referring to the drawing in detail, the numeral **10** denotes a mast which can be suitably secured to a tower, to a chimney, or to another support — either directly or by use of an antenna rotator. That mast is intended to serve as the support for the selectively polarized antenna shown in FIG. 1. The numeral **12** denotes a bracket which is secured to the mast **10** adjacent the upper end of that mast; and that bracket supports a boom **14** by means of U-shaped bolts **16** and of nuts, not shown. As shown by FIG. 1, the boom **14** is horizontally directed.

The numeral **18** denotes a bracket which is disposed adjacent the forward end of the boom **14**; and a tubular metal antenna element **20** is suitably secured to that bracket and to that boom by a bolt, not shown, which extends through that antenna element that bracket, and that boom. A nut, not shown, is threaded onto the shank of that bolt. An electrical loading coil **22** is secured to the antenna element **20** a short distance below the upper end of that antenna element; and an electrical loading coil **24** is secured to that antenna element a short distance above the lower end of that antenna element. As shown particularly by FIG. 1, the antenna element **20** is vertically directed. The numeral **26** denotes a bracket which is disposed adjacent the bracket **18**; and a tubular metal antenna element **28** is suitably secured to that bracket and to the boom

14 by a bolt, not shown, which extends through that antenna element, that bracket, and that boom. A nut, not shown, is threaded onto the shank of that bolt. An electrical loading coil **30** is secured to the antenna element **28** a short distance inwardly of the left-hand end of that antenna element; and an electrical loading coil **32** is secured to that antenna element a short distance inwardly of the right-hand end of that antenna element. As shown particularly by FIG. 1, the antenna element **28** is horizontally erected. The antenna elements **20** and **28** constitute a director element for the selectively polarized antenna shown in FIG. 1; and the electrical loading coils **22**, **24**, **30** and **32** on those antenna elements enable that director element to have the electrical characteristics of a director element which has vertically directed and horizontally directed antenna elements that are materially longer than the antenna elements **20** and **28** but which do not have electrical loading coils secured thereto. The bolt, which secures the antenna element **20** and the bracket **18** to the boom **14**, coacts with the bolt, which secured the antenna element **28** and the bracket **26** to the boom **14**, to electrically connect those antenna elements to each other adjacent the mid-points thereof.

The numeral **34** denotes a bracket which is located between the bracket **26** and the bracket **12**. A tubular metal antenna element **36** is suitably secured to that bracket and to the boom **14** by a bolt, not shown, which extends through that antenna element, that bracket, and that boom. A nut, not shown, is threaded onto the shank of that bolt. An electrical loading coil **38** is secured to the antenna element **36** a short distance below the upper end of that antenna element; and an electrical loading coil **40** is secured to that antenna element a short distance above the lower end of that antenna element. As shown particularly by FIG. 1, the antenna element **36** is parallel to the antenna element **20** of the director element. The numeral **42** denotes a bracket which is disposed adjacent the bracket **34**; and a tubular metal antenna element **44** is suitably secured to that bracket and to the boom **14** by a bolt, not shown, which extends through that antenna element, that bracket, and that boom. A nut, not shown, is threaded onto the shank of that bolt. An electrical loading coil **46** is secured to the antenna element **44** a short distance inwardly on the left-hand end of that antenna element; and an electrical loading coil **48** is secured to the antenna element a short distance inwardly of the right-hand end of that antenna element. As shown particularly by FIG. 1, the antenna element **44** is parallel to the antenna element **28** of the director element. The antenna elements **36** and **44** constitute the driven element of the selectively polarized antenna shown in FIG. 1; and the electrical loading coils **38**, **40**, **46** and **48** on those antenna elements enable that driven element to have the electrical characteristics of a driven element which has vertically directed and horizontally directed antenna elements that are materially longer than the antenna elements **36** and **44** but which do not have electrical loading coils secured thereto. The bolt, which secures the antenna element **36** and the bracket **34** to the boom **14**, coacts with the bolt, which secures the antenna element **44** and the bracket **42** to the boom **14**, to electrically connect those antenna elements to each other adjacent the mid-points thereof.

The numeral **50** denotes a bracket which is disposed adjacent the rear end of the boom **14**; and a tubular metal antenna element **52** is suitably secured to that bracket and to that boom by a bolt, not shown, which extends through the antenna element, that bracket, and that boom. A nut, not shown, is threaded onto the shank of that bolt. An electrical loading coil **54** is secured to the antenna element **52** a short distance below the upper end of that antenna; and an electrical loading coil **56** is secured to that antenna element a short distance above the lower end of that antenna element. As shown particularly by FIG. 1, the antenna element **52** is parallel to the antenna elements **20** and **36**. The numeral **58** denotes a bracket which is disposed adjacent the bracket **50**; and a tubular metal antenna element is suitably secured to that bracket and to the boom **14** by a bolt, not shown, which extends through that antenna element, that bracket, and that boom. A nut, not shown, is

threaded onto the shank of that bolt. An electrical loading coil **62** is secured to the antenna element **60** a short distance inwardly of the left-hand end of that antenna element; and an electrical loading coil **64** is secured to that antenna element a short distance inwardly of the right-hand end of that antenna element. As shown particularly by FIG. **1**, the antenna element **60** is parallel to the antenna elements **28** and **44**. The antenna elements **52** and **60** constitute the reflector element of the selectively polarized antenna shown in FIG. **1**; and the electrical loading coils **54, 56, 62** and **64** on those antenna elements enable that reflector element to have the electrical characteristics of a reflector element which has vertically directed and horizontally directed antenna elements that are materially longer than the antenna elements **52** and **60** but which do not have electrical loading coils secured thereto. The bolt; which secures the antenna element **52** and the bracket **50** to the boom **14**, coacts with the bolt, which secures the antenna element **60** and the bracket **58** to boom **14**, to electrically connect those antenna elements to each other adjacent the mid-points thereof.

The mast **10**, and the boom **14**, the director element, the reflector element, the driven element, the mounting brackets, and the hardware of the selectively polarized antenna of FIG. **1** are of standard and usual design. That mast, that boom, that director element, that driven element, and that reflector element can be made in various sizes and configurations. Further, if desired, that director element, that driven element, and that reflector element can be made with longer antenna elements — so the electrical loading coils thereon can be eliminated.

Referring to FIG. **2**, the numeral **66** denotes an L-shaped conductor which has one end thereof connected to the antenna element **44** at a point intermediate the left-hand end and the mid-point of that antenna element. The other end of that L-shaped conductor extends to a housing **70** and is connected to one terminal of a capacitor **72** within that housing. The numeral **68** denotes an L-shaped conductor which has one end thereof connected to the antenna element **44** at a point intermediate the right-hand end and the mid-point of that antenna element. The other end of the L-shaped conductor **66** extends to the housing **70** and is connected to one terminal of a capacitor **74** within that housing. A terminal **76** is connected to the other terminal of the capacitor **72**, and a terminal **78** is connected to the other terminal of the capacitor **74**; and portions of the terminals **76** and **78** are exposed at the exterior of the housing **70**.

A section **98** of balanced transmission line has one end of one of the conductors thereof connected to the terminal **76**, and has the other end of that conductor connected to a contact of a selector switch **94**. One end of the other conductor of the section **98** of balanced transmission line is connected to the terminal **78**, and the other end of that other conductor is connected to a second contact of the selector switch **94**. The capacitor **72** and the L-shaped conductor **66** thus connect one conductor of section **98** of the balanced transmission line to a point on one side of the mid-point of the antenna element **44**; and the capacitor **74** and the L-shaped conductor **68** connect the other conductor of that section of balanced transmission line to a point on the other side of the mid-point of that antenna element.

The numeral **80** denotes an L-shaped conductor which has one end thereof connected to the antenna element **36** at a point intermediate the upper end and the mid-point of that antenna element. The other end of that L-shaped conductor extends to a housing **84** and is connected to one terminal of a capacitor **86** within that housing. The numeral **82** denotes an L-shaped conductor which has one end thereof connected to the antenna element **36** at a point intermediate the lower end and the mid-point of that antenna element. The other end of the L-shaped conductor **82** extends to the housing **84** and is connected to one terminal of a capacitor **88**. The other terminal of the capacitor **86** is connected to a terminal **90**, and the other terminal of the capacitor **88** is connected to a terminal **92**; and the terminals **90** and **92** are exposed at the exterior of the housing **84**.

A section **96** of balanced transmission line has one end of one of the conductors thereof connected to the terminal **90**, and has the other end of that conductor connected to a third contact of the selector switch **94**. One end of the other conductor of the section **96** of balanced transmission line **96** is connected to the terminal **92**; and the other end of that other conductor is connected to a fourth contact of the selector switch **94**. The capacitor **86** and the L-shaped conductor **80** thus connect one conductor of the section **96** of the balanced transmission line to a point on one side of the mid-point of the antenna element **36**; and the capacitor **38** and the L-shaped conductor **82** connect the other conductor of that section of balanced transmission line to a point on the opposite side of the mid-point of that antenna element.

The numeral **100** denotes the down lead for the selectively polarized antenna shown in FIG. **1**; and the upper ends of the conductors of that down lead are connected to the movable contacts of the selector switch **94**. The down lead **100** is shown as a balanced transmission line.

In one preferred embodiment of the present invention, the antenna element **44** is a series of aluminum tubes which are coaxial and which are essentially contiguous. The centermost of those tubes has an outer diameter of one-half of an inch, has a wall thickness of fifty-eight thousandths of an inch, has an overall length of 54 inches, and extends 27 inches outwardly on each side of the mid-point of that antenna element. Connecting tubes extend outwardly from the ends of the centermost tube; and each of those connecting tubes has an outer diameter of three-eighths of an inch, has a wall thickness of fifty-eight thousandths of an inch, has a length of eleven and one-half inches, and has its inner end telescoped into the adjacent end of the centermost tube a distance of two inches. Coil forms of high impact plastic material are provided for the electrical loading coils **46** and **48**; and those coil forms telescope over the outer ends of the connecting tubes. Each of those coil forms is about eighty-seven hundredths of an inch in diameter and about 3 6/10 inches long. Recesses in the inner ends of those coil forms telescope over about 1 inch of the outer ends of the connecting tubes. Further tubes telescope into recesses in the outer ends of the coil forms; and each of those further tubes has an outer diameter of three-eighths of an inch, has a wall thickness of forty-two thousandths of an inch, has an overall length of 29 inches, and has its inner end telescoped about 1 inch into the recess in the outer end of the adjacent coil form. As a result, the overall length of the antenna element **44** is approximately 134⅛ inches. The electrical loading coils **46** and **48** of the antenna element **44** electrically interconnect the connecting tubes and the further tubes of that antenna element. The antenna element **36** is very similar to the antenna element **44** — the centermost tubes of both antenna elements being identical, the connecting tubes of both antenna elements being identical the coil forms of both antenna elements being identical, and the upper further tube of the antenna element **36** being identical to the further tubes of the antenna element **44** while the lower further tube of the antenna element **36** telescopes about 5 6/10 inches into the centermost tube of that antenna element. As a result, the length of the antenna element **136** is only approximately 130½ inches.

In the said one preferred embodiment of the present invention, each of the L-shaped conductors **66, 68, 80** and **82** is made from a rod blank that is about 25 ¾ of an inch long; and the radius of the bend in each of those L-shaped conductors is one and eleven-sixteenth inches. As a result, the long arm of each of those L-shaped conductors is about 23¾ inches long. The outer ends of the L-shaped conductors **66** and **68** are secured to the centermost tube of the antenna element **44** at points spaced 3 inches inwardly of the ends of that centermost tube; and the outer ends of the L-shaped conductors **80** and **82** are secured to the centermost tube of the antenna element **36** at points spaced 3 inches inwardly of the ends of that centermost tube. As a result, the inner ends of the L-shaped conductors **66** and **68** are spaced apart along the length of the antenna element **44** a distance of approximately 48 inches; and the inner ends of the L-shaped conductors **80** and **82** are

spaced apart along the length of the antenna element **36** approximately 48 inches. Each of the capacitors **72**, **74**, **86** and **88** is a 300 picofarad capacitor.

The said one preferred embodiment of the present invention is designed and dimensioned to operate efficiently in the 27 megahertz citizens band; and that citizens band includes radio frequencies in the range from 26 960/1,000 megahertz to 27 230/1,000 megahertz. If desired, of course, that one preferred embodiment of the present invention can be designed and dimensioned to operate efficiently in other bands.

The dimensions of the L-shaped conductors **66** and **68**, the length of the portion of the antenna element **44** between the outer ends of those L-shaped conductors, and the values of the capacitors **72** and **74** coact to provide a good impedance match between the transmission line **98** and that antenna element. Similarly, the dimensions of the L-shaped conductors **80** and **82**, the length of the portion of the antenna element **36** between the outer ends of those L-shaped conductors, and the values of the capacitors **86** and **88** coact to provide a good impedance match between the transmission line **96** and that antenna element. In connecting the conductors of the transmission line **98** to two points spaced on opposite sides of the mid-point of the antenna element **44**, the L-shaped conductors **66** and **68** and the capacitors **72** and **74** tend to keep the radio frequency energy, which that transmission line supplies to that antenna element, active along the axis of that antenna element, and thus to keep any appreciable amounts of that radio frequency energy from becoming active along the axes of the antenna element **36**. Similarly, in connecting the conductors of the transmission line **96** to two points spaced on opposite sides of the mid-point of the antenna element **36**, the L-shaped conductors **80** and **82** and the capacitors **86** and **88** tend to keep the radio frequency energy, which that transmission line supplies to that antenna element, active along the axes of that antenna element, and thus to keep any appreciable amount of that radio frequency energy from becoming active along the axes of the antenna element **44**.

Whenever it is desirable to radiate vertically polarized waves from the selectively polarized antenna shown in FIGS. **1** and **2**, the movable contacts of the selector switch **94** will be set to disconnect the conductors of the down lead **100** from the conductors of the section **98** of transmission line and to interconnect the conductors of that down lead with the conductors of the section **96** of transmission line. At such time, radio frequency energy that is supplied to the down lead **100** will be applied by the selector switch **94** and the section **96** of transmission line and the series-connected capacitors **86** and **88** and L-shaped conductors **80** and **82** to spaced points on opposite sides of the mid-point of the antenna element **36**. The movable contacts of the selector switch **94** will be spaced away from the right-hand ends of the conductors of the section **98** of transmission line; and hence substantially no radio frequency energy will be transferred from the down lead **100** to the antenna element **44** via selector switch **94**, the section **98** of transmission line, and the series-connected capacitors **72** and **74** and L-shaped conductors **66** and **68**. Tests and measurements show that no significant amounts of radio frequency energy are transferred from the the antenna element **36** to the antenna element **44** —even though the mid-points of those antenna elements are electrically connected. As a result, the selectively polarized antenna of FIGS. **1** and **2** can efficiently radiate vertically polarized waves.

Whenever it is desirable to radiate horizontally polarized waves from the selectively polarized antenna shown in FIGS. **1** and **2**, the movable contacts of the selector switch **94** will be set to disconnect the conductors of the down lead **100** from the conductors of the section **96** of transmission line and to interconnect the conductors of that down lead with the conductors of the section **98** of transmission line. At such time, radio frequency energy that is supplied to the down lead **100** will be applied by the selector switch **94** and the section **98** of transmission line and the series-connected capacitors **72** and **74** and L-shaped conductors **66** and **68** to spaced points on opposite sides of the mid-point of the antenna element **44**. The movable contacts of the selector switch **94** will be spaced away from the lower ends of the conductors of the section **96** of transmission line; and hence substantially no radio frequency energy will be transferred from the down lead **100** to the antenna element **36** via selector switch **94**, the section **96** of transmission line, and the series-connected capacitors **86** and **88** and L-shaped conductors **80** and **82**. Tests and measurements show that no significant amounts of radio frequency energy are transferred from the antenna element **44** to the antenna element **36** — even though the mid-points of those antenna elements are electrically connected. As a result, the selectively polarized antenna of FIGS. **1** and **2** can efficiently radiate horizontally polarized waves.

Referring particularly to FIG. **3**, the numerals **102** and **104** denote sections of unbalanced transmission lines which extend from the selector switch **94** to positions adjacent the antenna elements **36** and **44**. The free end of the inner conductor of the section **102** of unbalanced transmission line is connected to one end of the inner conductor of a U-shaped section **106** of unbalanced transmission line; and then both of those ends are connected to the terminal **90**. The free end of the shielding conductor of the section **102** of unbalanced transmission line is connected to both ends of the shielding conductor of the U-shaped section **106** of unbalanced transmission line. The other end of the inner conductor of the U-shaped section **106** of unbalanced transmission line is connected to the terminal **92**. The U-shaped section **106** of unbalanced transmission line acts as a balun, and thus enables the unbalanced transmission line **102** to apply a balanced output to the terminals **90** and **92**.

The free end of the inner conductor of the section **104** of unbalanced transmission line is connected to one end of the inner conductor of a U-shaped section **108** of unbalanced transmission line; and then both of those ends are connected to the terminal **78**. The free end of the shielding conductor of the section **104** of unbalanced transmission line is connected to both ends of the shielding conductor of the U-shaped section **108** of unbalanced transmission line. The other end of the inner conductor of the U-shaped section **108** of unbalanced transmission line is connected to the terminal **76**. The U-shaped section **108** acts as a balun, and thus enables the unbalanced transmission line **104** to apply a balanced output to the terminals **76** and **78**.

Whenever it is desirable to radiate vertically polarized waves from the selectively polarized antenna shown in FIGS. **1** and **3**, the movable contacts of the selector switch **94** will be set to disconnect the conductors of the down lead **100** from the conductors of the section **104** of unbalanced transmission line and to interconnect the conductors of that down lead with the conductors of the section **102** of unbalanced transmission line. At such time, radio frequency energy that is supplied to the down lead **100** will be applied by the selector switch **94** and the sections **102** and **106** of unbalanced transmission line to the terminals **90** and **92**, and then via the series-connected capacitors **86** and **88** and L-shaped conductors **80** and **82** to spaced points on opposite sides of the mid-point of the antenna element **36**. The movable contacts of the selector switch **94** will be spaced away from the right-hand ends of the conductors of the section **104** of unbalanced transmission line; and hence substantially no radio frequency energy will be transferred from the down lead **100** to the antenna element **44** via selector switch **94**, the section **104** of unbalanced transmission line, and the series-connected capacitors **72** and **74** and L-shaped conductors **66** and **68**. Measurements and tests show that no significant amounts of radio frequency energy are transferred from the antenna element **36** to the antenna element **44** — even though the mid-points of those antenna elements are electrically connected. As a result, the selective-polarized antenna of FIGS. **1** and **3** can efficiently radiate vertically polarized waves.

Whenever it is desirable to radiate horizontally polarized waves from the selectively polarized antenna of FIGS. **1** and **3**,

the movable contacts of the selector switch **94** will be set to disconnect the conductors of the down lead **100** from the conductors of the section **102** of unbalanced transmission line and to interconnect the conductors of that down lead with the conductors of the section **104** of unbalanced transmission line. At such time, radio frequency energy that is supplied to the down lead **100** will be applied by the selector switch **94** and sections **104** and **108** of unbalanced transmission line to the terminals **76** and **78**, and then via the series-connected capacitors **72** and **74** and L-shaped conductors **66** and **68** to spaced points on opposite sides of the mid-point of the antenna element **44**. The movable contacts of the selector switch **94** will be spaced away from the lower ends of the conductors of the section **102** of unbalanced transmission line; and hence substantially no radio frequency energy will be transferred from the down lead **100** to the antenna element **36** via selector switch **94**, the section **102** of unbalanced transmission line, and the series-connected capacitors **86** and **88** and L-shaped conductors **80** and **82**. Measurements and tests show that no significant amounts of radio frequency energy are transferred from the antenna element **44** to the antenna element **36** — even though the mid-points of those antenna elements are electrically connected. As a result, the selectively polarized antenna of FIGS. **1** and **3** can efficiently radiate horizontally polarized waves.

One essential difference between the arrangement shown in FIG. **2** and the arrangement shown in FIG. **3** is that the down lead in FIG. **2** will be a balanced transmission line whereas the down lead **100** in FIG. **3** will be an unbalanced transmission line. The other essential difference is that the sections **102** and **104** are sections of unbalanced transmission line whereas the sections **96** and **98** are sections of balanced transmission line. However, the basic theory and operation of the selectively polarized antennae of FIGS. **2** and **3** are the same.

Whereas the drawing and accompanying description have shown and described some preferred embodiments of the present invention it should be apparent to those skilled in the art that various changes may be made in the form of the invention without affecting the scope thereof.

What I claim is:

1. An antenna which can be polarized to transmit signals of a predetermined frequency along one axis or can be polarized to transmit signals of said predetermined frequency along a second axis that is angularly displaced from said one axis and which comprises an antenna element that can be mounted so it is parallel to said one axis, a second antenna element that is angularly displaced from the first said antenna element and that can be mounted so it is parallel to said second axis, connecting means electrically connecting said antenna elements to each other adjacent the mid-points of said antenna elements, a selector switch, a down lead connected to and extending from said selector switch, a transmission line connected to said selector switch and extending from said selector switch to a position adjacent said first said antenna element, impedance-matching means connected between said transmission line and two predetermined points on said first said antenna element which are located on opposite sides of said connecting means and which are displaced from said connecting means, a second transmission line connected to said selector switch and extending from said selector switch to a position adjacent said second antenna element, and a second impedance-matching means connected between said second transmission line and two predetermined points on said second antenna element which are located on opposite sides of said connecting means and which are displaced from said connecting means, said selector switch being selectively actuatable to disconnect said down lead from said second transmission line and to connect said down lead to the first said transmission line to polarize said antenna along said one axis, said selector switch being selectively actuatable to disconnect said down lead from said first said transmission line and to connect said down lead to said second transmission line to polarize said antenna along said second axis.

2. An antenna as claimed in claim **1** wherein said first said antenna element has an electrical loading coil spaced inwardly of one end thereof and has a second electrical loading coil spaced inwardly of the opposite end thereof, and wherein said second antenna element has an electrical loading coil spaced inwardly of one end thereof and has a second electrical loading coil spaced inwardly of the opposite end thereof.

3. An antenna as claimed in claim **1** wherein said transmission lines are balanced transmission lines.

4. An antenna as claimed in claim **1** wherein the first said antenna element is a dipole, and wherein said second antenna element is a dipole.

5. An antenna which can be polarized along one axis or can be polarized along a second axis that is angularly displaced from said one axis and which comprises an antenna element that can be mounted so it is parallel to said one axis, a second antenna element that is angularly displaced from the first said antenna element and that can be mounted so it is parallel to said second axis, a selector switch, a down lead connected to and extending from said selector switch, a transmission line connected to said selector switch and extending from said selector switch to a position adjacent said first said antenna element, impedance-matching means connected between said transmission line and two predetermined points on said first said antenna element on opposite sides to the mid-point of said first said antenna element, a second transmission line connected to said selector switch and extending from said selector switch to a position adjacent said second antenna element, a second impedance-matching means connected between said second transmission line and two predetermined points on said second antenna element on opposite sides of the mid-point of said second antenna element, said selector switch being selectively actuatable to disconnect said down lead from said second transmission line and to connect said down lead to the first said transmission line to polarize said antenna along said one axis, said selector switch being selectively actuatable to disconnect said down lead from said first said transmission line and to connect said down lead to said second transmission line to polarize said antenna along said second axis, the first said impedance-matching means including a capacitor and a conductor which connect one conductor of said first said transmission line to one of said predetermined points on said first said antenna element and also including a second capacitor and a second conductor which connect the other conductor of said first said transmission line to the other of said predetermined points on said first said antenna element, and said second impedance-matching means including a third capacitor and a third conductor which connect one conductor of said second transmission line to one of said predetermined points on said second antenna element and also including a fourth capacitor and a fourth conductor which connect the other conductor of said second transmission line to the other of said predetermined points on said second antenna element.

6. An antenna which can be polarized along one axis or can be polarized along a second axis that is angularly displaced from said one axis and which comprises an antenna element that can be mounted so it is parallel to said one axis, a second antenna element that is angularly displaced from the first said antenna element and that can be mounted so it is parallel to said second axis, a selector switch, a down lead connected to and extending from said selector switch, a transmission line connected to said selector switch and extending from said selector switch to a position adjacent said first said antenna element, impedance-matching means connected between said transmission line and two predetermined points on said first said antenna element on opposite sides to the mid-point of said first said antenna element, a second transmission line connected to said selector switch and extending from said selector switch to a position adjacent said second antenna element, a second impedance-matching means connected between said second transmission line and two predetermined points on said second antenna element on opposite sides of the mid-point of said second antenna element, said selector switch

being selectively actuatable to disconnect said down lead from said second transmission line and to connect said down lead to the first said transmission line to polarize said antenna along said one axis, said selector switch being selectively actuatable to disconnect said down lead from said first said transmission line and to connect said down lead to said second transmission line to polarize said antenna along said second axis, the first said impedance-matching means including a capacitor and a conductor which connect one conductor of said first said transmission line to one of said predetermined points on said first said antenna element and also including a second capacitor and a second conductor which connect the other conductor of said first said transmission line to the other of said predetermined points on said first said antenna element, said second impedance-matching means including a third capacitor and a third conductor which connect one conductor of said second transmission line to one of said predetermined points on said second antenna element and also including a fourth capacitor and a fourth conductor which connect the other conductor of said second transmission line to the other of said predetermined points on said second antenna element, the first said and said second and said third and said fourth conductors being L-shaped conductors, and said first said and said second and said third and said fourth conductors being connected, respectively, between the first said and said second and said third and said fourth capacitors and said antenna elements.

7. An antenna which can be polarized along a second axis that is angularly displaced from said one axis and which comprises an antenna element that can be mounted so it is parallel to said one axis, a second antenna element that is angularly displaced from the first said antenna element and that can be mounted so it is parallel to said second axis, a selector switch, a down lead connected to and extending from said selector switch, a transmission line connected to said selector switch and extending from said selector switch to a position adjacent said first said antenna element, impedance-matching means connected between said transmission line and two predetermined points on said first said antenna element on opposite sides to the mid-point of said first said antenna element, a second transmission line connected to said selector switch and extending from said selector switch to a position adjacent said second antenna element, a second impedance-matching means connected between said second transmission line and two predetermined points on said second antenna element on opposite sides of the mid-point of said second antenna element, said selector switch being selectively actuatable to disconnect said down lead from said second transmission line and to connect said down lead to the first said transmission line to polarize said antenna along said one axis, said selector switch being selectively actuatable to disconnect said down lead from said first said transmission line and to connect said down lead to said second transmission line to polarize said antenna along said second axis, the first said impedance-matching means including a capacitor and a conductor which connect one conductor of said first said transmission line to one of said predetermined points on said first said antenna element and also including a second capacitor and a second conductor which connect the other conductor of said first said transmission line to the other of said predetermined points on said first said antenna element, said second impedance-matching means including a third capacitor and a third conductor which connect one conductor of said second transmission line to one of said predetermined points on said second antenna element and also including a fourth capacitor and a fourth conductor which connect the other conductor of said second transmission line to the other of said predetermined points on said second antenna element, the first said capacitor and said second capacitor being enclosed within a housing adjacent said first said antenna element, and said third capacitor and said fourth capacitor being enclosed within a second housing adjacent said second antenna element.

8. An antenna which can be polarized to transmit signals of a predetermined frequency along one axis or can be polarized to transmit signals of said predetermined frequency along a second axis that is angularly displaced from said one axis and which comprises an antenna element that can be mounted so it is parallel to said one axis, a second antenna element that is angularly displaced from the first said antenna element and that can be mounted so it is parallel to said second axis, connecting means electrically connecting said antenna elements to each other adjacent the mid-points of said antenna elements, a selector switch a down lead connected to and extending from said selector switch, a transmission line connected to said selector switch and extending from said selector switch to a position adjacent said first said antenna element, impedance-matching means connected between said transmission line and two predetermined points on said first said antenna element which are located on opposite sides of said connecting means and which are displaced from said connecting means, a second transmission line connected to said selector switch and extending from said selector switch to a position adjacent said second antenna element, a second impedance-matching means connected between said second transmission line and two predetermined points on said second antenna element which are located on opposite sides of said connecting means and which are displaced from said connecting means, said selector switch being selectively actuatable to disconnect said down lead from said second transmission line and to connect said down lead to the first said transmission line to polarize said antenna along said one axis, said selector switch being selectively actuatable to disconnect said down lead from said first said transmission line and to connect said down lead to said second transmission line to polarize said antenna along said second axis, said first said antenna element having an electrical loading coil spaced inwardly of one end thereof and located intermediate said one end and one of said predetermined points on said first said antenna element, said first said antenna element having a second electrical loading coil spaced inwardly of the opposite end thereof and located intermediate said opposite end and the other of said predetermined points on said first said antenna element, said second antenna element having an electrical loading coil spaced inwardly of one end thereof and located intermediate said one end and one of said predetermined points on said second antenna element, and said second antenna element having a second electrical loading coil spaced inwardly of the opposite end thereof and located intermediate said opposite end and the other of said predetermined points on said second antenna element.

9. An antenna which can be polarized to transmit signals of a predetermined frequency along one axis or can be polarized to transmit signals of said predetermined frequency along a second axis that is angularly displaced from said one axis and which comprises an antenna element that can be mounted so it is parallel to said one axis, a second antenna element that is angularly displaced from the first said antenna element and that can be mounted so it is parallel to said second axis, connecting means electrically connecting said antenna elements to each other adjacent the mid-points of said antenna elements, a selector switch, a down lead connected to and extending from said selector switch, a transmission line connected to said selector switch and extending from said selector switch to a position adjacent said first said antenna element, impedance-matching means connected between said transmission line and two predetermined points on said first said antenna element which are located on opposite sides of said connecting means and which are displaced from said connecting means, a second transmission line connected to said selector switch and extending from said selector switch to a position adjacent said second antenna element, a second impedance-matching means connected between said second transmission line and two predetermined points on said second antenna element which are located on opposite sides of said connecting means and which are displaced from said connecting means, said selector switch being selectively actuatable to disconnect

said down lead from said second transmission line and to connect said down lead to the first said transmission line to polarize said antenna along said one axis, said selector switch being selectively actuable to disconnect said down lead from said first said transmission line and to connect said down lead to said second transmission line to polarize said antenna along said second axis, said transmission lines being unbalanced transmission lines, and baluns connected to said unbalanced transmission lines.

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