June 28, 1949. C. K. GIERINGER 2,474,242

ADJUSTABLE ANTENNA

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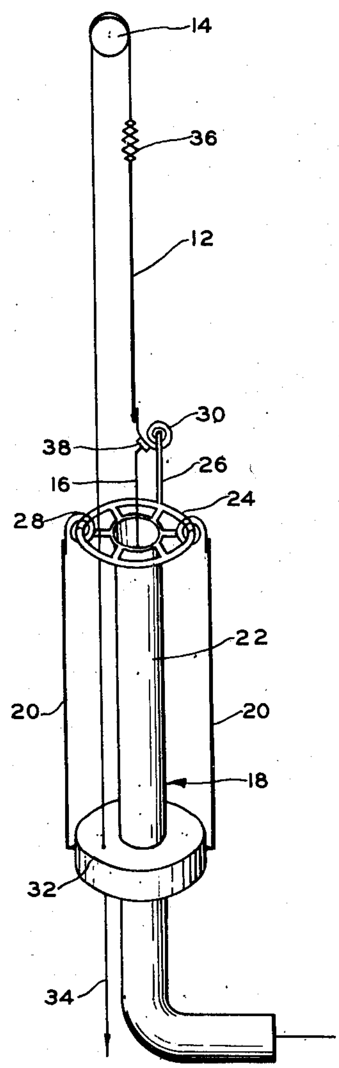

FIG. 1.

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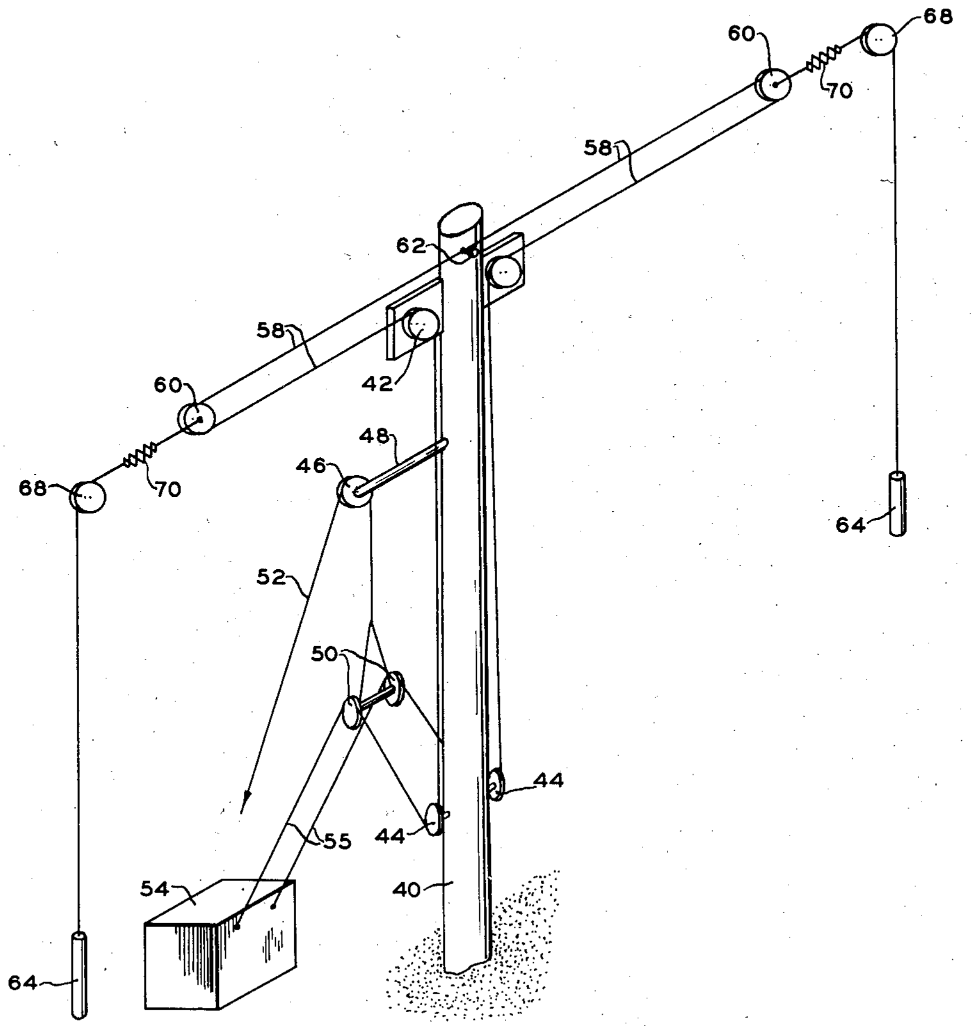

FIG. 2.

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ADJUSTABLE ANTENNA

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1 Claim. (Cl. 250—33)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to antennas and more particularly to dipole antennas adjustable over a wide frequency range.

Dipole antennas are well known and understood in radio communication art and comprise a pair of metallic radiators whose length is in part determined by the wave length of the signals to be transmitted or received. To obtain maximum efficiency, the antenna length must be adjusted as different wave lengths are used. The design of presently used antennas renders it difficult to adjust the antenna length quickly and easily.

It is, therefor, an object of this invention to provide an antenna that may be quickly and easily varied in length as the wave-length of the radio energy transmitted or received thereby is varied.

It is also an object of this invention to provide an antenna that may be varied over a wide frequency range.

It is also an object of this invention to provide an antenna that will be electrically matched to its transmission line for all positions of the antenna.

It is a further object of this invention to provide an antenna that may be remotely adjusted while in its erected position.

These and other objects are accomplished by the use of radiating elements having one end fixed and the other end free to move, and means operative upon the free end of the said element whereby the lengths of the elements may be equally and simultaneously varied from a remote point.

The scope of the invention will be pointed out and defined in the attached claim. An understanding of the invention will best be obtained, however, from the following description of two antenna arrangements, the said description to be read in connection with the accompanying drawings, in which

Figure 1 is a perspective view of a preferred form of an antenna structure embodying the invention and connected to a transmission line.

Figure 2 is a perspective view of another form of an antenna structure connected to a transmission line.

Referring to Figure 1, the antenna comprises a flexible radiator **12**, vertically supported from a pulley **14** and constituting an extension of the

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inner conductor **16** of a coaxial transmission line **18**, and a plurality of flexible radiators **20**, constituting an extension of the outer conductor **22** of the line **18** folded back upon itself. An electrically conductive, spring supporting, wheel-like ring **24** is positioned coaxially about the upper periphery of the outer conductor **22**. A short, upwardly extending non-conductive spring mount **26** is positioned at one point on the circumference of the ring **24**, and is fixed thereto by any suitable means.

A plurality of flat coiled springs **28** are radially disposed equidistantly about the cricumference of the ring **24**, the inner ends of said springs being fixed thereto. Another spring **30**, identical to the springs **28**, is longitudinally positioned at the top of mount **26**, the inner end of the spring **30** being fixed thereto by any suitable means.

The springs **28, 30** are constructed of spring steel or any other suitable resilient conductive material. They may be fixed to the ring **24** and the mount **26** by any conventional means, such as bolts.

To the outer end of each spring **28** there is affixed one end of a radiator **20** of a plurality of radiators **20**. The radiators **20** may be affixed to the springs **28** by any conventional means, such as rivets.

The other ends of the radiators **20** are fastened to equally spaced points on the outer circumference of an insulator member **32**. The insulator member **32** comprises an insulating ring concentric with the outer conductor **22** and is slidably positionable thereabout. The insulator **32** is provided with suitable means whereby the ends of the radiators **20** may be fastened thereto, and is further provided with suitable means whereby a tension means, such as a rope **34**, may be attached thereto.

Referring now to the aforementioned spring **30**, one end of the radiator **12** is affixed by any suitable means to the outer end thereof. The other end of the radiator **12** is affixed to insulator **36**.

The radiators **12, 20** are formed of thin flexible metal strips of good radiating characteristics. As will be hereinafter pointed out, they are sufficiently flexible so as to be readily coilable about the springs **28, 30**. Electrical contact may be made between the conductor **16** and the radiator **12** by any well known means, a contact brush **38** positioned on the conductor **16** being shown here as illustrative of one method of making contact.

The rope **34** is fastened to the insulator **36** and passes upwardly over the pulley **14**, then downwardly to the insulator **32**, where it is fastened thereto, and thence to the hand of the operator. The pulley **14** and the line **18** may be supported by an antenna mast (not shown), or may be suspended from a tree limb or other suitable frame or support in the vicinity of the antenna.

The operation of the antenna system will now be described. Assume that the rope **34** is allowed to lie slack in the hand of the operator. The operation of the springs **28**, **30** will wind the radiators **20**, **12** to a predetermined minimum length. This minimum length determines the shortest wave length at which the antenna will operate most efficiently. It will be understood that radiator element **20**, since they are in common connection with ring **24**, in effect behave as a single radiator which in combination with radiator **12** completes the dipole.

As has been heretofore stated, an antenna transmits and receives most efficiently when its length is matched to the wave length used. Thus, if the wave length that is transmitted or received is increased, the antenna will be most efficient if its length is increased.

The length of the antenna may be increased by causing a downward movement of the rope **34**. A downward movement of the rope **34** will result in a downward movement of insulator **32** and in an upward movement of insulator **36**, thus increasing the effective length of the radiator elements **20** and **12** until the optimum operating length is obtained in accordance with the frequency. Similarly the antenna radiating length may be decreased by removing the downward force on the rope **34**, thus allowing the potential energy in the coiled springs **28**, **30** to wind a portion of the radiator lengths.

The lower end of the rope **34** may be fixed to winding means such as a reel at the operator's station whereby vernier adjustments of the rope movement may be obtained.

Many modifications of this system are possible and within the spirit of the invention as defined by the claim. For instance, the coiled springs might well be replaced by a revolvable cylinder arrangement, whereby the radiators might be wound thereabout when it is necessary to shorten them for operation on shorter wave lengths. Further, I have shown a rope as being the most simple means to use to move the radiators. Any other suitable means might be used equally well, and the use of a more rigid means would be desirable if horizontally polarized waves were to be transmitted.

There has thus been disclosed a simple and efficient system whereby an antenna may be accurately controlled over a wide frequency range from a remote point. The advantages of such a system are obvious. The antenna may be adjusted to cover a wide frequency range. The adjustment may be easily effected without lowering the antenna, and may be accomplished from a remotely situated radio station. The antenna is light and may be compactly folded into a portable condition. It is easy to install and dissemble.

Referring now to Figure 2, the drawing shows another antenna arrangement. An antenna mast **40** is provided with a pair of coplanar pulleys **42**, disposed one on either side of the mast near the top thereof, and toward the bottom thereof with a pair of parallel pulleys **44**, coaxial with one another and disposed one on either side of the mast. The plane of the coplanar pulleys **42** lies generally normal to the planes of the parallel

pulleys **44**. Intermediate the said two pairs of pulleys **42**, **44** is disposed a single pulley **46**, positioned at the end of a short arm **48** that is fixed to the mast **40**. A pair of coaxial pulleys **50** are suspended from the single pulley **46** by a rope **52**, the free end thereof terminating near a radio set **54**.

Parallel conductors **55** extending from a radio set **54** pass in sequence over pulleys **50**, under pulleys **44**, over pulleys **42**, then under and over pulleys **60**, to connect at a binding post **62** on mast **40**, said post being located above the axis of coplanar pulleys **42** a distance equal to the diameter of spaced pulleys **60**. The length of parallel conductors **55** up to the point of pulleys **42** serves as a transmission line while the folded over portion of the inductors from this point functions as a dipole radiator **58**.

The spacing between the conductors in transmission line **56** is such as to provide optimum radiation cancellation at the mean frequency in the operating range of the antenna.

The antenna **58** is held in tension by weights **64**, one of said weights being connected to each spaced pulley **60** by flexible lines passing over pulleys **68**. The pulleys **68** may be supported from secondary arms or masts (not shown) or from a natural object of the terrain. The antenna **58** is electrically isolated from the lines **66** by insulators **70**, disposed in the lines **66** between the spaced pulleys **60** and the pulleys **68**.

The device thus described is capable of efficient operation over a wide frequency range. The antenna **58** is always matched electrically to the transmission line **56**. If it is necessary that the length of the antenna be shortened in accordance with a shorter wave length, this shortening may be done by moving the free end of the rope **52** downward. The antenna will at all times be held taut by virtue of the weights **64**. Similarly, if it is necessary to lengthen the antenna **58**, this lengthening may be accomplished by removing the force on the rope **52**, allowing the weights **64** to pull out the antenna to the desired length. The rope may be attached to a gear system (not shown) whereby accurate and delicate movements of the rope may be accomplished.

Many modifications and changes are possible and within the scope of the invention as defined in the attached claim. For example, the rope in each figure may be replaced by any suitable flexible means. Further, the pulleys might be supported by buttresses (not shown) positioned on the mast. The pulleys, of course, might be replaced by other direction mechanism, such as wire guides. Further, both of the devices here shown may readily be enclosed in dielectric shelters whereby the devices may be protected from the weather.

The device thus discloses a means whereby an antenna may be adjusted from a remote point. The device is simple in construction and may be readily assembled. Since the necessary fixtures are few in number and small in size, the device may be packed for shipment into a small kit. A wide frequency range is possible and may be easily achieved from a point remote from the antenna itself. For all positions of the antenna, the effective load impedance that is offered to the line is a resistance equal to the characteristic impedance of the line.

What is claimed is:

An adjustable doublet antenna system comprising a coaxial transmission line, a first coiled spring, an antenna radiator element connected at one end to the outer end of said first coiled spring, means electrically connecting said first named spring to the inner conductor of the coaxial transmission line, a second coiled spring, at least one antenna radiator element connected at one end to the outer end of said second coiled spring, means electrically connecting the inner end of said second named spring to the outer conductor of the coaxial transmission line, nonconductive mounting means positioned adjacent the said transmission line and mechanically connected to the inner end of said first coiled spring, an annular insulating member coaxial with the said outer conductor, the said member including means whereby the free ends of the said second named radiator element may be attached thereto, and means connected to the free end of the first named radiator and to the said insulating member whereby the effective length of the said radiators may be varied from a remote point.

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