Aug. 19, 1941. T. P. KINN 2,253,379

ULTRA HIGH FREQUENCY ADJUSTABLE ANTENNA

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Fig. 3.

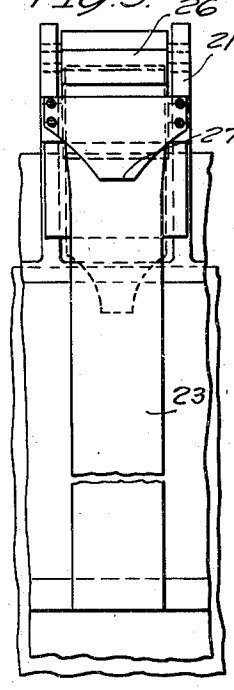


Fig. 2.

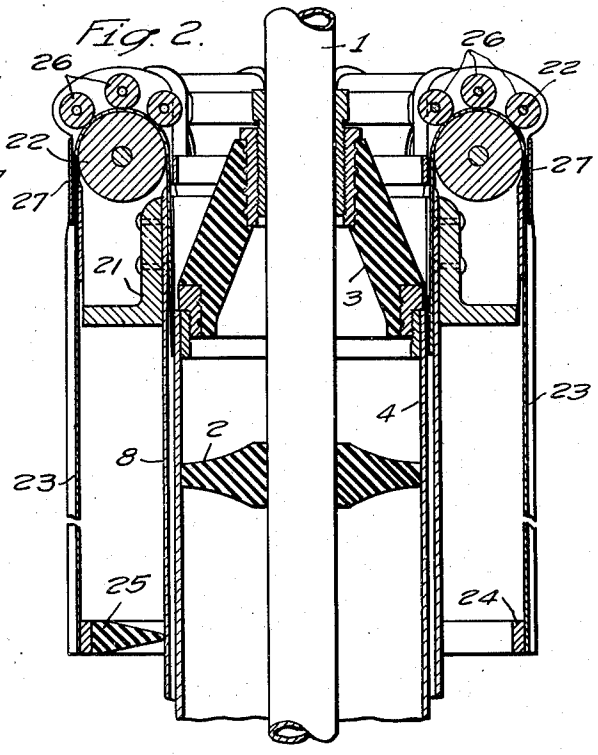


Fig. 1.

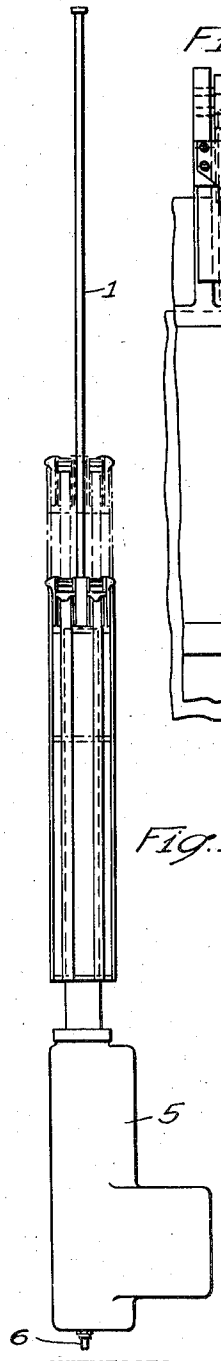
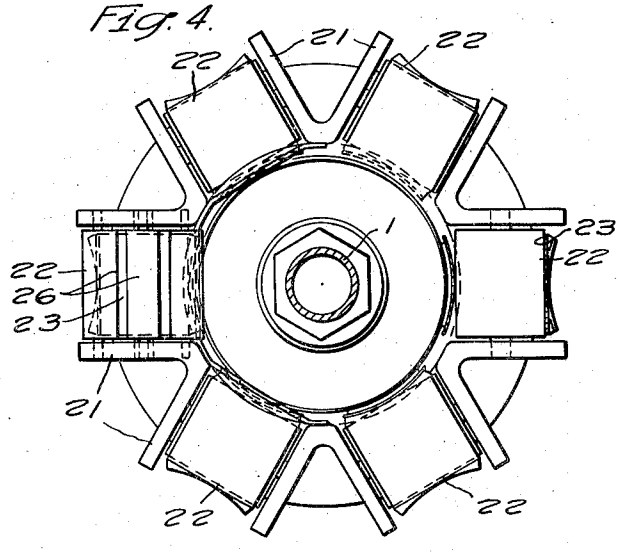


Fig. 4.



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Fig. 5.

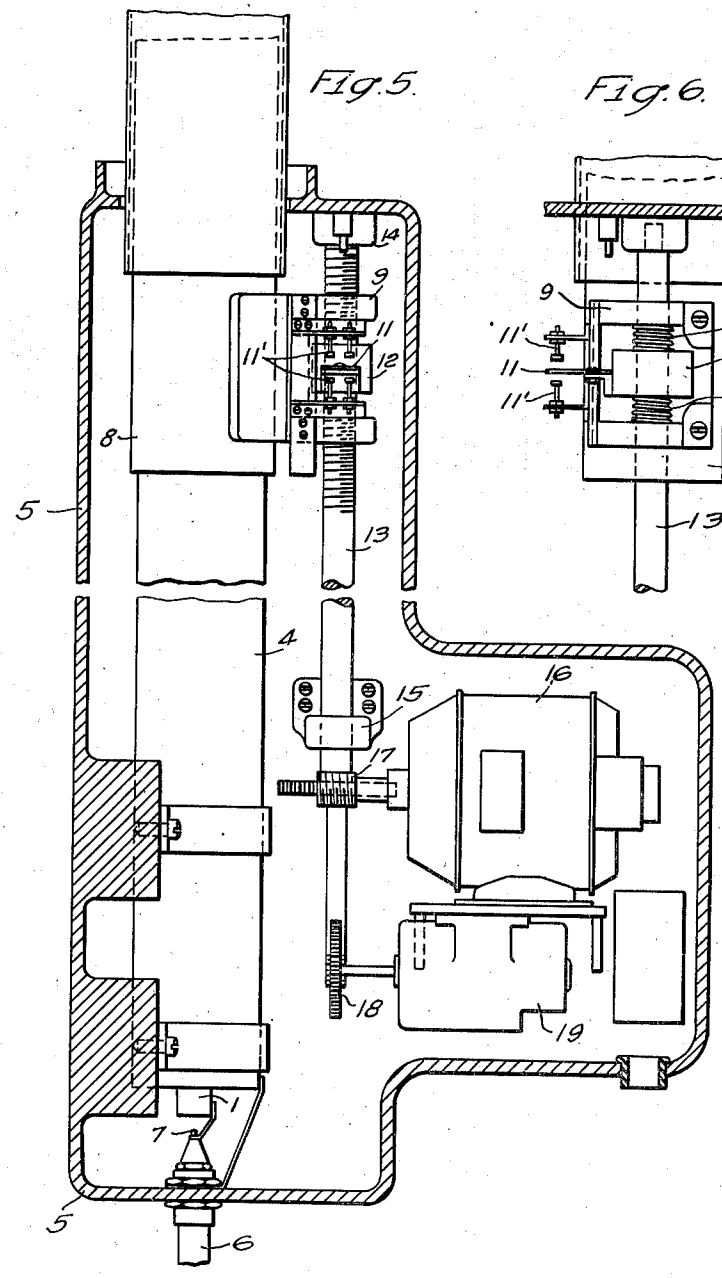


Fig. 6.

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UNITED STATES PATENT OFFICE

2,253,379

ULTRA HIGH FREQUENCY ADJUSTABLE ANTENNA

Theodore P. Kinn, Woodlawn, Md., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application November 13, 1940, Serial No. 365,494

9 Claims. (Cl. 250—33)

My invention relates to radio antennae and, in particular, to antennae of adjustable wave length for ultra high-frequency radiation.

One object of my invention is to provide antennae which can be adjusted as to radiant wave length from a remote point.

Another object of my invention is to provide an adjustable wave length antenna particularly adapted for use in conjunction with a concentric carrier current transmission line.

Still another object of my invention is to provide an adjustable wave length antenna of the concentric line type particularly adapted for employment of ultra high-frequency carrier currents.

Still another object of my invention is to provide an antenna which is adjustable as to wave length, but which maintains a substantially constant surge impedance over a wide range of adjustment.

Other objects of my invention will become apparent upon reading the following description taken in connection with the drawings, in which:

Figure 1 is a side view in elevation of an antenna embodying the principles of my invention;

Fig. 2 is an enlarged view in cross-section illustrating a detail of the structure of my invention;

Fig. 3 is an elevational view, taken at right angles to the detailed view in cross-section of Fig. 2;

Fig. 4 is a top view looking down upon the portion of the structure shown in cross-section in Fig. 2;

Fig. 5 is a view, partly in elevation and partly in cross-section, illustrating in detail the mechanical arrangements for varying the wave length of my antenna; and

Fig. 6 is a view, partly in cross-section and partly in elevation, taken at right angles to a portion of Fig. 5.

For radio transmission operations at ultra high frequencies, that is to say, at frequencies of the order of 50 to 200 million cycles per second, it is desirable to transmit current between the radio frequency generating and modulating equipment to the radiating antennae by transmission lines of the concentric type; that is to say, by transmission lines in which a central core comprises one side of the line and a surrounding sheath constitutes the other side. For many purposes it is desirable to have a radiating antenna supplied by such a line which can be tuned to any frequency within a considerable range, for example, between 60 million cycles and 200 million cycles per second. One efficient form of such an antenna comprises a compound external sheath from the end of which a central rod extends. The compound external sheath consists of one conducting cylinder surrounded by a second conducting cylinder of slightly larger diameter and considerably shorter length, the two cylinders being connected together at the end of the smaller cylinder, and the internal rod extending outwardly from this interconnected end for a distance equal to the length of the outer cylinder. In other words, the structure is such a one as would be produced if the outer sheath of a concentric line could have its end slightly expanded in diameter and peeled or folded back for a limited distance upon itself, thereby leaving the central rod of the concentric line exposed for a distance equal to the folded-back portion of the sheath. Such an arrangement will be found to constitute an efficiently radiating antenna having a wave length equal to four times that of the exposed end of the central rod.

In order to tune such an antenna to different wave lengths, it is obviously necessary to be able to vary at will over a considerable range the length of folded-back portion of the outer sheath. In the arrangement about to be described, I describe means for effecting this result.

Referring particularly to Figs. 1 and 2 of the drawings, I provide an antenna having a central rod 1 which extends longitudinally of substantially the entire Fig. 1 and is supported by insulators 2, 3 in the axis of a metallic tube 4. As is shown in detail in Fig. 5, the tube 4 is supported from the walls of a casing 5 which is adapted to be grounded if desired. Through an aperture in the lower end of the casing 5 a concentric line having an outer sheath 6 and a central core 7 transmits high-frequency currents from a radio-frequency generator located at some distant point. The sheath 6 and the central core 7 are electrically connected, respectively, to the tube 4 and the rod 1. The tube 4 extends for only a portion of the length of the rod 1 and near its upper end is surrounded by a metallic tube 8 which telescopes over and slides easily upon it.

The lower end of the tube 8 is positioned at all times within the casing 5 and bears a bracket 9, shown in more detail in Figs. 5 and 6, which is adapted to elastically support on springs 10 a nut 12 carried by a threaded shaft 13 which is supported in suitable bearings 14, 15 affixed to the casing 5. A projection 11 on nut 12 is adapted to contact a pair of insulated contact-fingers 11' which control the circuit of the motor 16 about to be described and thereby stop rotation of shaft

13 when adjustment of the antenna is complete, or when any part of the mechanism becomes jammed. The motor 16, adapted to be set in rotation in either direction desired by remote control is likewise supported upon the casing 5 and rotates the shaft 13 through a worm gear 17. A second worm gear 18, engaging the shaft 13, drives a Selsyn indicator 19 to register the position of the nut 12, and, consequently, of the tube 8 at any desired point.

As shown in more detail in Figs. 2 and 3, the upper end of the tube 8 carries an annular bracket 21 which supports six rollers 22 freely rotatable upon axis. Six thin ribbons 23 of highly conductive material, such, for example, as beryllium-copper, pass over the rollers 22 and have one of their ends connected to the metallic tube 4 on which the tube 8 slides. The other ends of the ribbons 23 are interconnected by a metallic ring 24 which is supported in concentric relation with the tube 8 by insulators 25 which make sliding engagement with the outer surface of the tube 8. The arms of the bracket 21 likewise carry a set of three freely rotatable rollers 26 which engage and press downwardly upon the outer surface of the ribbon 23 to hold it in position in contact with the surface of the rollers 22. Flat shields 27 are attached to each of the brackets 21 to aid in keeping the ribbon 23 in close contact with the periphery of the rollers 22.

It will be seen that when the rotation of shaft 13 moves the nut 12 longitudinally, the bracket 9 will move the tube 8 and its attached rollers 22 upwardly or downwardly relative to the sheath 4. When the rollers 22 move upwardly from the position shown in Fig. 2, the lower ends of the ribbons 23, together with their supports 24, 25, will be moved upwardly along the surface of the tube 8 and so will move in an upward direction relative to the sheath 4. The ribbons 23 thus constitute in electrical effect an extension of the sheath 4, and the length of the central rod 1 which is exposed beyond the upper end of this extended sheath (i. e., is exposed beyond the position of the rollers 22) is correspondingly decreased. The length of the ribbons 23 is made substantially equal to the length of the rod 1 which projects above the end of the sheath 4.

Correspondingly, when the shaft 13 is rotated in the opposite direction to that just described, the nut 12 moves the tube 8 and its attached rollers 22 downwardly, exposing a greater and greater length of the center rod 1. The rollers 26, the shield 27 and the weight of the members 24 and 25 thus keep the portion of the ribbons 23 below the rollers 22 straight. Experiments have shown that the system of six ribbons 23, as just described, acts electrically as a satisfactory extension of the sheath 4 and constitutes an efficient radiating system.

I have found that when the above-described antenna is supplied with carrier current of such a frequency at any time that the exposed length of the center load 1 corresponds with a one-quarter wave length, the surge impedance of the antenna is approximately 73 ohms. In order to insure efficient transmission of the radio current to the antenna, the concentric line should have the relative diameters of its core 7 and sheath 6 adjusted in accordance with principles well known in the radio art, so that this line likewise has a surge impedance of 73 ohms.

In accordance with the patent statutes, I have described a particular embodiment of my invention, but the principles thereof are of broader application in ways that will be evident to those skilled in the art.

I claim as my invention:

1. A radiating antenna comprising a central rod of conducting material surrounded by a conducting sheath in stationary relationship thereto, means supported for longitudinal movement relative to said sheath and a flexible conducting body having one end attached to the end of said sheath passing over said means, and means for maintaining the portions of said body not in contact with said means in substantially parallel relationship to said sheath.

2. A radiating antenna comprising a central rod of conducting material surrounded by a conducting sheath in stationary relationship thereto, means supported for longitudinal movement relative to said sheath and a flexible conducting body having one end attached to the end of said sheath passing over said means, means for maintaining the portions of said body not in contact with said means in substantially parallel relationship to said sheath, and a concentric transmission line for radio-frequency current having its core electrically connected to said rod and its sheath electrically connected to the first-mentioned sheath.

3. A radiating antenna comprising a central rod of conducting material surrounded by a conducting sheath in stationary relationship thereto, a plurality of rollers supported for longitudinal movement relative to said sheath and a plurality of conducting ribbons each having one end attached to the end of said sheath passing over said rollers, means for maintaining the portions of said ribbons not in contact with said rollers in substantially parallel relationship to said sheath, and a concentric transmission line for radio-frequency current having its core electrically connected to said rod and its sheath electrically connected to the first-mentioned sheath, the surge impedance of said concentric transmission line being substantially 73 ohms.

4. A radiating antenna comprising a central rod of conducting material surrounded by a conducting sheath in stationary relationship thereto, a plurality of rollers supported for longitudinal movement relative to said sheath and a plurality of conducting ribbons each having one end attached to the end of said sheath passing over said rollers, and means for maintaining the portions of said ribbons not in contact with said rollers in substantially concentric relationship with said sheath.

5. A radiating antenna comprising a central rod of conducting material surrounded by a conducting sheath in stationary relationship thereto, a plurality of rollers supported for longitudinal movement relative to said sheath and a plurality of conducting ribbons each having one end attached to the end of said sheath passing over said rollers, means for maintaining the portions of said ribbons not in contact with said rollers in substantially concentric relationship with said sheath, and a concentric transmission line for radio-frequency current having its core electrically connected to said load and its sheath electrically connected to said sheath.

6. A radiating antenna comprising a central rod of conducting material surrunded by a conducting sheath in stationary concentric relationship thereto, a tubular sleeve adapted for sliding engagement along said sheath and carrying a plurality of rollers at one end, a conducting

ribbon passing over each roller and having one end connected to said sheath, means for maintaining said ribbons in engagement with the surface of said rollers, a metallic conducting ring interconnecting the other ends of said ribbons and supported on insulators which make a sliding engagement with the surface of said sleeve, and a remote-controlled motor-means arranged to slide said sleeve longitudinally along the surface of said sheath.

.. A radiating antenna comprising a central rod of conducting material surrounded by a conducting sheath in stationary concentric relationship thereto, a tubular sleeve adapted for sliding engagement along said sheath and carrying a plurality of rollers at one end, a conducting ribbon passing over each roller and having one end connected to said sheath, means for maintaining said ribbons in engagement with the surface of said rollers, a metallic conducting ring interconnecting the other ends of said ribbons and supported on insulators which make a sliding engagement with the surface of said sleeve, a remote-controlled motor-means arranged to slide said sleeve longitudinally along the surface of said sheath, and means for indicating at a remote point the position of said sleeve relative to said sheath.

8. A radiating antenna comprising a central rod of conducting material surrounded by a conducting sheath in stationary concentric relationship thereto, a tubular sleeve adapted for sliding engagement along said sheath and carrying a plurality of rollers at one end, a conducting ribbon passing over each roller and having one end connected to said sheath, means for maintaining said ribbons in engagement with the surface of said rollers, a metallic conducting ring interconnecting the other ends of said ribbons and supported on insulators which make a sliding engagement with the surface of said sleeve, a remote-controlled motor-means arranged to slide said sleeve longitudinally along the surface of said sheath, and a concentric line transmitting current from a radio transmitter and having its core connected to said rod and its sheath connected to the first-mentioned sheath.

9. A radiating antenna comprising a central rod of conducting material surrounded by a conducting sheath in stationary concentric relationship thereto, a tubular sleeve adapted for sliding engagement along said sheath and carrying a plurality of rollers at one end, a conducting ribbon passing over each roller and having one end connected to said sheath, means for maintaining said ribbons in engagement with the surface of said rollers, a metallic conducting ring interconnecting the other ends of said ribbons and supported on insulators which make a sliding engagement with the surface of said sleeve, a remote-controlled motor-means arranged to slide said sleeve longitudinally along the surface of said sheath, and a concentric line transmitting current from a radio transmitter and having its core connected to said rod and its sheath connected to the first-mentioned sheath, said concentric line having a surge impedance of approximately 73 ohms.

THEODORE P. KINN.