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BUILT-IN CABINET ANTENNA FOR TELEVISION RECEIVERS

Filed April 1, 1952

3 Sheets-Sheet 1

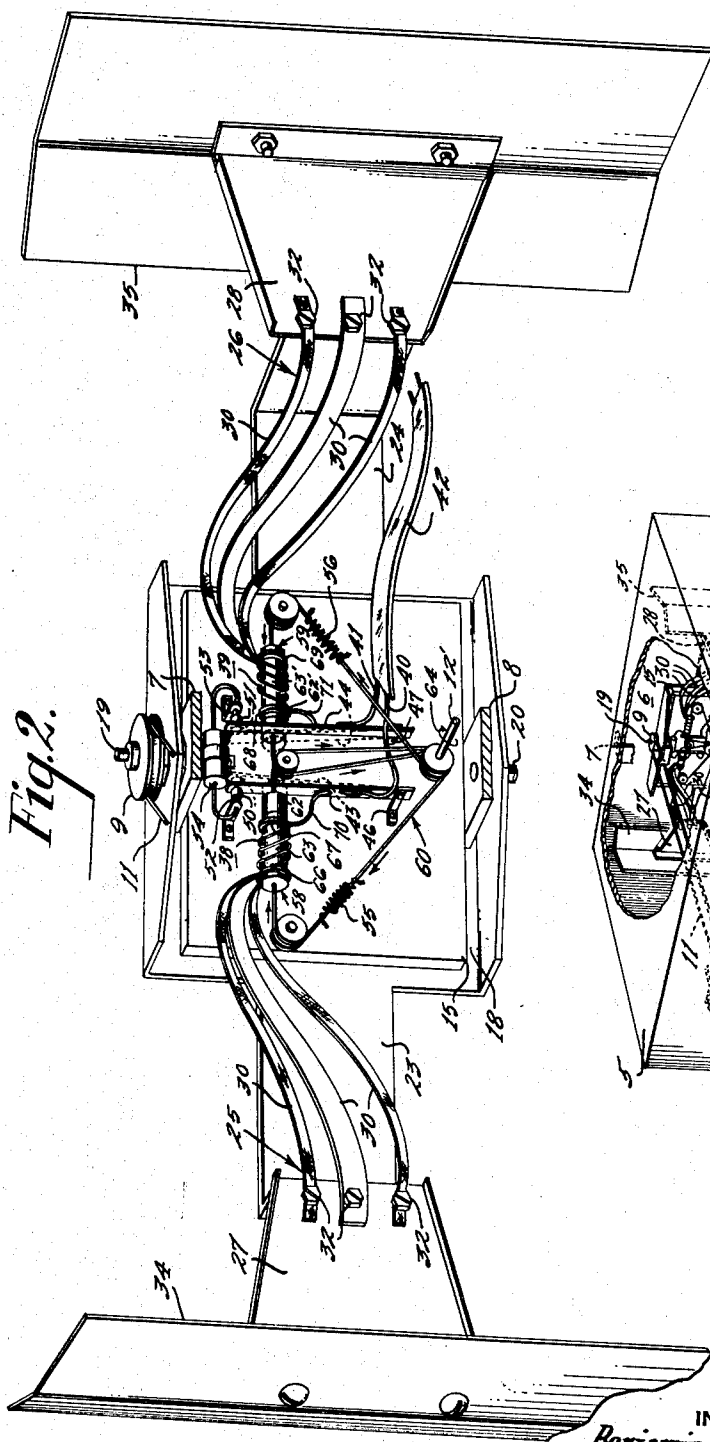


Fig. 2.

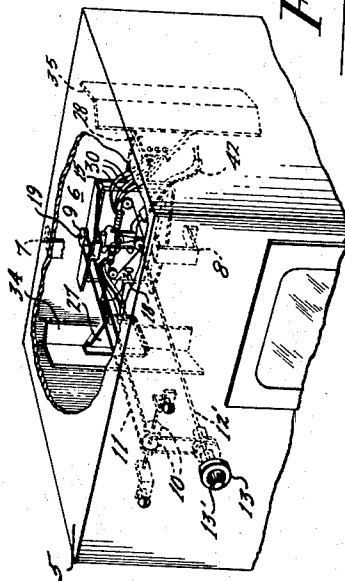


Fig. 1.

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3 Sheets-Sheet 2

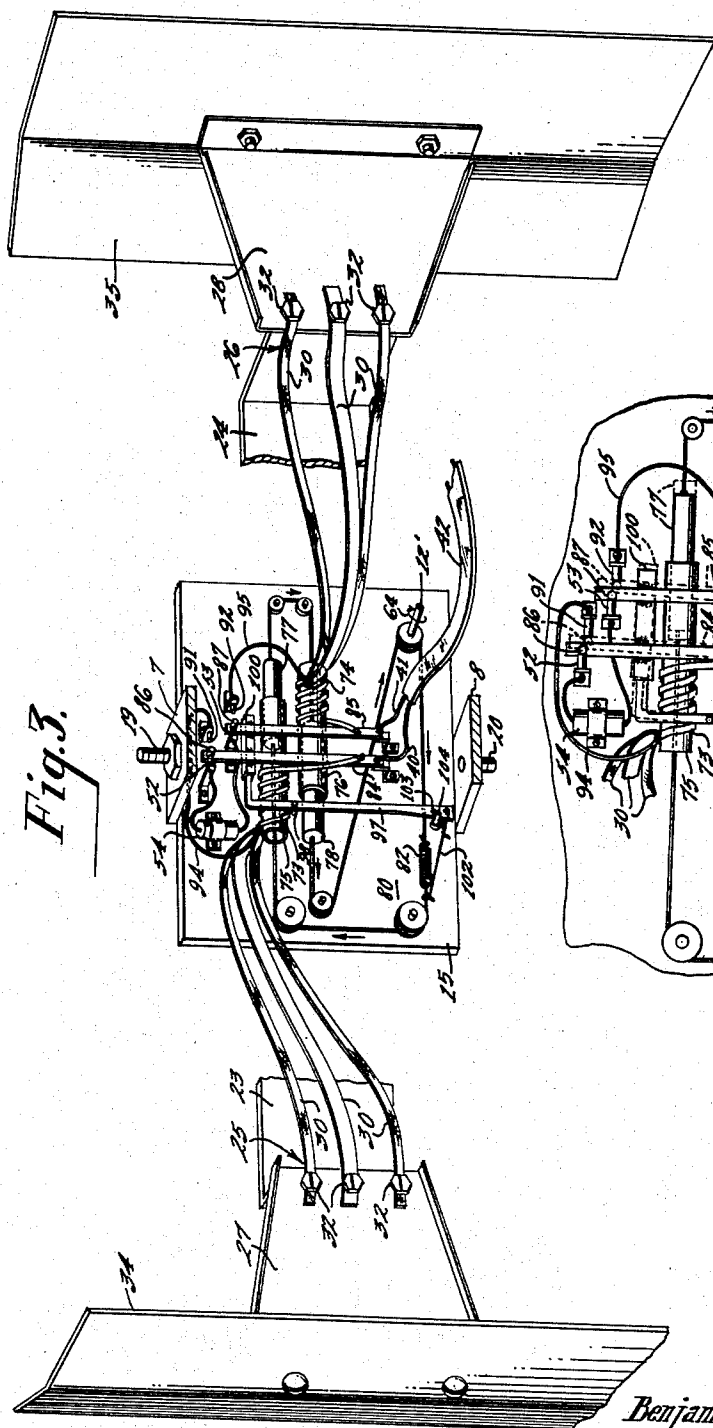


Fig. 3.

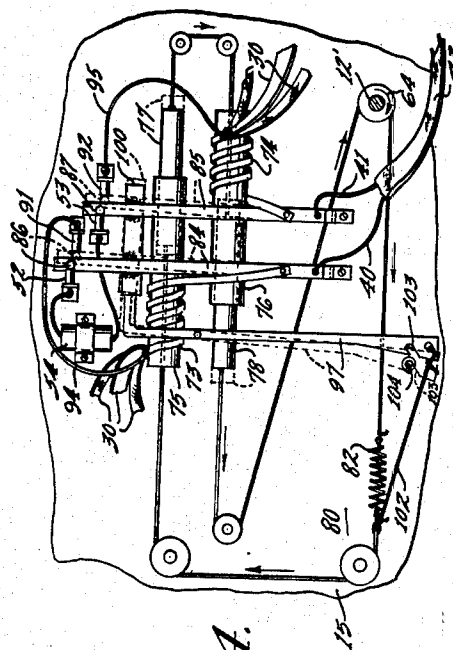


Fig. 4.

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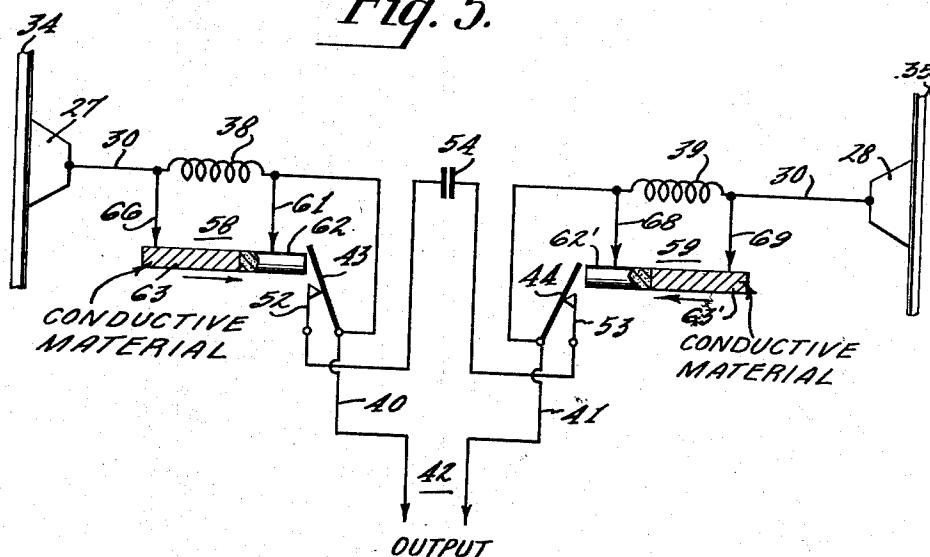
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Fig. 5.



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UNITED STATES PATENT OFFICE

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BUILT-IN CABINET ANTENNA FOR
TELEVISION RECEIVERSBenjamin S. Vilkomerson, Camden, N. J., assignor
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6 Claims. (Cl. 250—33)

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This invention relates generally to antenna systems for high frequency signal selective apparatus and particularly relates to tunable antenna systems of fixed physical dimensions suitable for mounting in a limited space, for example, in a television or frequency modulation receiver cabinet.

Lack of space in most receivers requires that an associated built-in antenna be made smaller than the most desirable electrical length. This is particularly true with reference to frequencies generally encountered in broadcast or television receivers. A half wave length dipole antenna is generally used for the higher broadcast and television frequencies. Since the wave length over a frequency band changes, the midband wave length is generally selected at the expense of the signal strength available in the antenna over other portions of the band.

In order to solve this problem, it has heretofore been proposed to utilize dipole antennas comprising extensible antenna arms which may be adjusted to the appropriate length in accordance with the frequency of the wave being translated. However, the extensible dipole antenna is plagued with hand capacity effects so that the optimum adjustment is often passed through without being recognized during manipulation of the arms. In addition it is difficult to physically adjust a dipole antenna housed in a receiver cabinet, which imposes a limit on the physical dimensions of the antenna.

It is, accordingly, a principal object of the present invention to provide a built-in high frequency dipole type antenna which will give optimum performance over a relatively wide frequency range in the space available in a radio receiver cabinet.

A further object of the invention is to provide an improved half-wave dipole type antenna of fixed physical length, the effective electrical length of which may be adjusted for optimum performance at any selected one of a plurality of frequencies within a wide frequency range.

Another object of the invention, is to provide a simple and effective high frequency half-way dipole type antenna and apparatus for tuning said antenna over a selected relatively low frequency range by center-loading and effectively unloading the antenna for operation within a relatively high frequency range.

The tunable high frequency dipole antenna of the present invention is selectively operable as a fixed tuned antenna in one frequency range and as a variably tuned antenna in a relatively

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lower frequency range. The antenna is therefore particularly adapted to be employed as a television cabinet antenna which is variably tunable over the frequency range covering the presently assigned channels 2 to 6 (54 to 88 megacycles) and which is fixed tuned for operation over the channels 7 to 13 (174 to 216 megacycles).

The dipole antenna of the invention comprises a narrow double V or "bow tie" type antenna having metallic plates on the outer ends of the antenna elements or vanes to provide end capacity loading. To tune the antenna there is connected in series with each antenna vane and its respective transmission line conductor, a continuously tunable inductor providing variable center-loading for the antenna and thereby modifying the effective electrical length of the antenna for optimum response to a carrier wave of desired frequency. An impedance-matching capacitor is connected in circuit across the transmission line conductors to match the impedance of the antenna to the impedance of the transmission line and thereby obtain maximum power transfer from the antenna to the transmission line.

A cord or belt drive is provided to adjust the inductance of the continually variable inductors which are preferably of the variable permeability type. The respective tuning elements or cores of the inductors are linked by the cord drive so as to be movable with respect to their associated inductors, whereby the reactances of the inductors are simultaneously increased or decreased by movement of the cord drive.

There is further provided, in accordance with the invention, a switching arrangement which selectively shorts out the variable inductors and thereby directly connects the antenna vanes to the transmission line conductors. At the same time the matching capacitor is disconnected from the conductors. The antenna is therefore adapted to be tunable over a predetermined frequency range such, for example, as the lower television frequency range which includes the presently assigned channels 2 to 6 (54 to 88 megacycles), and to be fixed tuned for operation over the higher television frequency range which includes the presently assigned channels 7 to 13 (174 to 216 megacycles).

To obtain maximum induced high frequency voltage in the antenna it is often necessary to orient the antenna in a direction parallel to the plane of polarization. In accordance with the invention the center-tuning mechanism is fixed in relation to the receiver cabinet and the an-

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tenna vanes are mounted on a support which is rotatable with respect to the cabinet. By connecting the tuning mechanism to the antenna vanes by means of flexible conductor or conductors, such for example, as copper braid bands or straps, a considerable degree of rotation of the antenna about its tuning mechanism is permitted.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings in which:

Figure 1 is a perspective view, with a portion broken away of a high frequency built-in dipole antenna system embodying the invention as applied to a television or like receiver;

Figure 2 is a perspective view on an enlarged scale of the antenna system of Figure 1 in accordance with the invention;

Figure 3 is a perspective view of another embodiment of a high frequency dipole antenna system in accordance with the invention; and

Figure 4 is an enlarged plan view of the tuning and switching system in accordance with the invention of the antenna system of Figure 3.

Figure 5 is a schematic circuit diagram of the antenna system which is shown in perspective view in Figure 2.

Referring now to the Figure 1, a television receiver cabinet 5 is provided with a built-in multi-band, high frequency dipole antenna system 6 which, as will hereinafter be explained, is tunable over a selected high frequency range and is fixed tuned for operation over another relatively higher selected frequency range.

The antenna system 6 is mounted in the receiver cabinet by means of brackets 7 and 8. Bracket 7 is partly broken away to more clearly show the pulley 9 which in cooperation with pulleys 10, cord drive 11, shaft 12 and knob 13, orients the antenna with respect to the incoming carrier waves whereby a maximum high frequency voltage is induced in the antenna system.

A shaft 12' concentrically positioned with respect to shaft 12 transmits motion from the knob 13' to the antenna variable tuning or loading means as will hereinafter be more fully explained.

Therefore, in addition to the conventional control knobs provided for picture and sound selection adjustment there is provided the concentric knobs 13 and 13' for antenna orientation and tuning. Although the antenna system is shown mounted within a television receiver cabinet, it is apparent that the antenna may be mounted outside of the receiver cabinet and may be employed for intercepting modulated carrier waves in frequency bands other than those bands allocated for the transmission of television carriers.

Referring now to Figures 2 and 5, the high frequency multi-band antenna system is provided with a first mounting panel or support 15 adapted to be relatively fixed in position with respect to the receiver cabinet and to carry or support variably inductive tuning or center loading means for a dipole antenna. A second panel 18 is adapted to rotate with respect to the first panel and to carry or support a pair of dipole antenna vanes. Affixed to panel 18 is the pulley 9 which, by means of a suitable cord drive as

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shown in Figure 1, rotates panel 18 and orients the antenna vanes. The two panels are joined together by a pair of pins or studs 19 and 20 provided on panel 15 about which panel 18 may rotate. The panels 15 and 18 are composed of an insulating material such, for example, as Bakelite.

Extending from the rotatable panel 18 are a pair of rectilinear arms 23 and 24 which are also of an insulating material. Arms 23 and 24 support the V-shaped antenna vanes 25 and 26 which are adapted to intercept signal modulated carrier waves.

The opposed rectilinear antenna vanes 25 and 26 include a pair of tapered conductive elements 27 and 28 and a plurality of flexible conductive connectors or straps 30, such, for example as flexible copper braid bands. By means of the screws 32, a conductive connection is provided between the elements 27 and 28 and the straps 30. In addition, the screws 32 mount the conductive elements to the insulating arms 23 and 24.

One of a pair of conductive metallic end plates 34 and 35 is electrically affixed to each of the outer ends of the antenna vanes providing end capacity loading for the dipole antenna whereby the effective electrical length of the antenna is increased.

The inner adjacent ends of the antenna vanes provided by the joinder of the inner ends of the conductive straps 30, are individually connected to one of a pair of variable center-loading or tuning inductors 38 and 39. The inductors are interposed between the antenna vanes and the conductors 40 and 41 of an antenna transmission line 42. The inductor 38 is electrically connected to the conductor 40 through a leaf spring 43 and the inductor 39 is electrically connected to the conductor 41 through a leaf spring 44.

The leaf springs 43 and 44 are mounted at one end to panel 15 by means of brackets 46 and 47. The free ends of the leaf springs are each provided with a contact 50 and 51 which are normally spring biased against contacts 52 and 53 respectively. An impedance matching capacitor 54 is connected between the contacts 52 and 53 and is therefore normally connected across the transmission line conductors 40 and 41 to provide a proper impedance between the antenna system and the antenna transmission line.

With the leaf springs 43 and 44 in the position indicated by the solid lines in Figure 2, radio frequency energy induced in the antenna vanes by the intercepted signal modulated carrier waves is conducted to the antenna transmission line 42 through the inductors 38 and 39, and the leaf springs 43 and 44. The capacitor 54, connected across the transmission line conductors tends to provide a proper impedance match between the antenna vanes and the transmission line.

The transmission line 42 may feed the radio frequency energy into a radio frequency wave amplifier of a high frequency signal translating device such, for example, as a television receiver. The signal translating device circuits, not being a part of this invention are not shown.

To enable variable tuning or loading of the dipole antenna system a pair of composite tuning elements or cores 58 and 59 are provided. By means of the belt or cord drive mechanism 60 which is mechanically coupled to the cores, the tuning cores are simultaneously moved into or out of the magnetic field of their respective associated inductors 38 and 39. A pair of springs

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55 and 56 provide proper tension in the cord drive mechanism.

Each of the composite cores 58 and 59 include a permeable portion 62 and 62' of low electrical conductive material such, for example, as powdered iron, and a portion 63 and 63' of highly conductive material such, for example, as brass or copper. Thus, as the cord drive mechanism 60 is actuated by means of control knob 11 and drive shaft 12 by rotating shaft 12 to the right as indicated by the arrow 64, the permeable portions 62 and 62' move toward each other and out of the magnetic field of the inductors 38 and 39. The reactance of the inductors and the loading of the antenna system is thereby decreased. The dipole antenna being of an effectively shorter electrical length is thereby tuned or more responsive to a carrier wave of a relatively higher frequency. Continued rotation of shaft 12 moves the conductive portions 63 and 63' into the field of the inductors 38 and 39 and the conductive portions, acting as short circuited turns tend to minimize the reactance of the inductors, and further decrease the antenna loading.

In order to effectively remove the center loading inductors from the antenna system and connect the antenna vanes 25 and 26 directly to the transmission line 42, there is provided at the ends of each inductor one of a plurality of conductive end rings or contact springs 66, 67, 68 and 69. The end ring 67 is connected to the leaf spring 43 by a conductor 70, and the end ring 68 is connected to the leaf spring 44 by a conductor 71.

With the permeable portions 62 and 62' of the core most adjacent their respective inductors, there is a high impedance path interposed between the end rings of each inductor. The rings, therefore, have little effect on the antenna loading.

With the conductive portions 63 and 63' of the cores most adjacent their respective inductors a very low impedance path is interposed between the end rings of each of the inductors whereby the inductors are shorted out and the antenna vanes 25 and 26 are effectively directly connected to the transmission line conductors 40 and 41.

As indicated by the dotted lines in Figure 2, the permeable portions 62 and 62' of the tuning cores, as they approach the limit of their movement, press against the leaf springs 43 and 44 whereby the contacts 50 and 52 are opened as are the contacts 51 and 53. As a result the impedance matching capacitor 54 is disconnected from the transmission line conductors.

Accordingly, the cord drive mechanism 60, the tuning cores 58 and 59, and the leaf springs 43 and 44 provide a switching means which selectively shorts out the tunable loading inductors and at the same time disconnects the capacitor 54 from the dipole antenna circuit.

It is seen, therefore, that the effective electrical length of the antenna, which is determined in part by the variable center-loading inductors, is adjustable for optimum selection within a desired high frequency range and is fixed tuned for operation over a relatively higher frequency range.

In Figures 3 and 4 there is shown a further embodiment of the antenna system in accordance with the present invention. The variable inductors 73 and 74 are provided by conductive strap windings on coil forms 75 and 76, and the tuning elements or cores 77 and 78 movable with

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respect to the inductors are of a permeable material such as carbonyl iron.

The cores 77 and 78 are simultaneously movable into or out of the magnetic field of their respective associated inductors 73 and 74 by means of the belt or cord drive mechanism 80 which is mechanically attached to the cores. A spring 82 provides proper tension in the cord drive mechanism.

A pair of conductive contacts or leaf springs 84 and 85 are pivotally mounted with respect to panel 15 and are conductively connected to the inner ends of the inductors 73 and 74, and to the antenna transmission line conductors 40 and 41. The contacts 86 and 87 of the leaf springs are normally spring biased against the fixed contacts 52 and 53 respectively. The impedance matching capacitor 54 is connected between the contacts 52 and 53 and is therefore normally connected across the transmission line conductors 40 and 41.

A second pair of fixed contacts 91 and 92 are provided to be selectively engaged by the leaf spring contacts 86 and 87. Contact 91 is connected to the outer end of the inductor 73 by means of conductive lead 94 and contact 92 is connected to the outer end of the inductor 74 through the conductive lead 95. It is, therefore, apparent that upon actuating the leaf springs 84 and 85, the leaf spring contacts 86 and 87 are disconnected from the contacts 52 and 53 and engage the contacts 91 and 92. As a result, the impedance matching capacitor 54 is disconnected from the transmission line 42 and the inductors 73 and 74 are shorted out by means of the conductive leads 94 and 95 and the leaf springs 84 and 85. The center loading of the antenna vanes 25 and 26 is thereby effectively removed from the antenna circuit, and the antenna vanes are directly connected to the transmission line 42.

The conductive leaf springs 84 and 85 are selectively actuated by an L-shaped lever 97 which is pivotally mounted on panel 15 by means of a pivot pin 98. The leaf springs 84 and 85 are affixed to and insulated from the lever arm 97 by a sleeve 100 of electrical insulating material. A flexible linkage or cord 102 couples the free end of the lever 97 to the cord drive mechanism 80. A slot 103 is provided in the lever for engaging a pin 104 whereby movement of the lever is arrested.

As hereinbefore mentioned, the leaf springs are normally spring biased in contact with the fixed pair of contacts 52 and 53 as indicated by the solid lines in Figure 4. Variable center-loading is thereby provided for the antenna system and is adjusted by varying the position of the tuning cores 77 and 78 with respect to the inductors 73 and 74. In addition, the capacitor 54 is in circuit across the transmission line conductors 40 and 41 to provide a proper impedance match between the antenna system and the transmission line 42.

As shaft 12 is rotated to the right as indicated by the arrow 64, the linkage 102 exerts a pull on the lever 97 and the lever and attached leaf springs 84 and 85 assume the position indicated by the dotted lines in Figure 4. As a result the impedance matching capacitor 54 is disconnected from the antenna system, and the antenna vanes 25 and 26 are effectively directly connected to the transmission line 42.

In accordance with the invention, therefore, there is provided a high frequency multi-band

antenna which is suitable for mounting in a limited space, for example, in a television or frequency modulation receiver cabinet. The effective electrical length and the orientation of the antenna is adjustable for optimum performance at any selected one of a plurality of frequencies within a high frequency range. In addition there is provided a simple switching arrangement for effectively unloading the antenna for operation within a relatively higher frequency range.

What is claimed is:

1. A high frequency multi-band dipole antenna adapted to be mounted within a signal receiver cabinet comprising a pair of dipole antenna elements, inductive loading means comprising a pair of inductors individually coupled to the adjacent ends of each of said elements, a tuning core for each of said inductors, a drive means connected with each of said cores for moving each of said cores with respect to said inductors, and means including said cores for effectively short-circuiting said loading means in response to a predetermined movement of said core, whereby said antenna is fixed tuned for operation in one high frequency band and variably tunable over a relatively lower high frequency band.

2. A high frequency multi-band dipole antenna adapted to be mounted within a signal receiver cabinet comprising a pair of rotatable dipole type antenna elements, a pair of inductors individually coupled to the adjacent ends of said elements, and a composite tuning core for each of said inductors movable with respect to and along said inductors, means for moving said cores in unison, each of said cores including a highly conductive portion and contact means associated therewith for effectively short circuiting said inductors in response to minimum inductance adjustment thereof by said core movement, whereby said antenna is fixed tuned for operation in one high frequency band and is variably tunable over a relatively lower high frequency band.

3. A high frequency multi-band dipole antenna adapted to be mounted within a signal receiver cabinet comprising a pair of dipole type antenna elements, inductive loading means comprising a pair of inductors individually coupled to the adjacent ends of each of said elements, a tuning core for each of said inductors, a drive means connected with each of said cores for moving each of said cores with respect to said inductors, an impedance matching capacitor selectively connected between said adjacent ends, and means including said core for effectively shorting out said loading means and disconnecting said capacitor from said ends in response to movement of said core over a predetermined range whereby said antenna is fixed tuned for operation in one high frequency band and variably tunable over a relatively lower high frequency band.

4. A high frequency multi-band double-V type dipole antenna adapted to be mounted within a signal receiver cabinet comprising a pair of rotatable antenna elements, a pair of tunable in-

ductors individually coupled to the adjacent ends of said elements, a composite tuning core for each of said inductors including a permeable portion and a conductive portion, a drive means connected to each of said cores simultaneously moving said cores with respect to and along said inductors, an impedance matching capacitor selectively connected between said adjacent ends, and switch means actuated by said cores in response to minimum inductance adjustment of said inductors by said core movement for disconnecting said capacitor from said conductors.

5. A high frequency multi-band dipole antenna adapted to be mounted within a signal receiver cabinet comprising a pair of rotatable dipole type antenna elements, a pair of tunable inductors individually coupled to the adjacent ends of said elements, a tuning core for each of said inductors, a drive means connected to each of said cores simultaneously moving said cores with respect to and along said inductors, a capacitor selectively connected between said ends, and switch means actuated by said core for selectively shorting out said inductors and disconnecting said capacitor from said ends whereby said antenna is fixed tuned for operation in one high frequency band and tunable over a relatively lower high frequency band.

6. A high frequency tunable dipole antenna comprising a pair of antenna elements, end plates conductively affixed to said elements to provide end capacity loading for said antenna, a pair of output terminals for said antenna, a first inductive loading means serially connected between one of said elements and one of said terminals, a second inductive loading means serially connected between the other of said elements and the other of said terminals, a composite tuning core for each of said inductive loading means including a permeable portion and a conductive portion, drive means connected with said cores for moving said cores with respect to said inductive loading means, a capacitor selectively connected between said output terminals, means actuated by said cores in response to a predetermined movement thereof for selectively disconnecting said capacitor from said terminals and providing a connection across said loading means through said conductive portion of said core for effectively short-circuiting said loading means whereby said elements are directly connected to said output terminals.

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