

Feb. 12, 1952

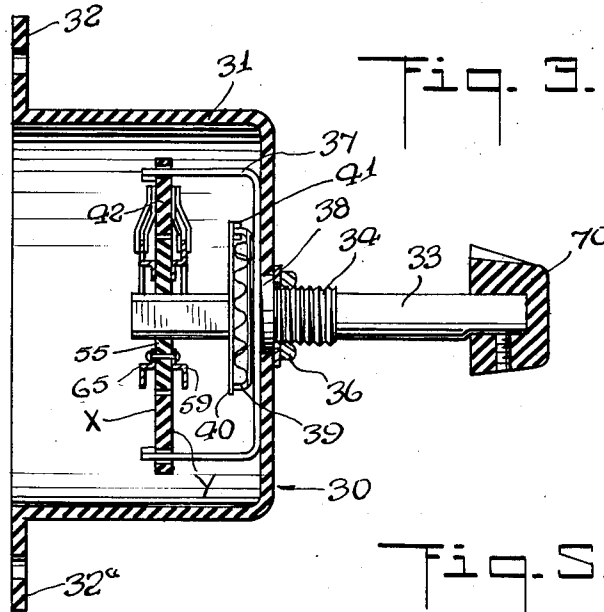
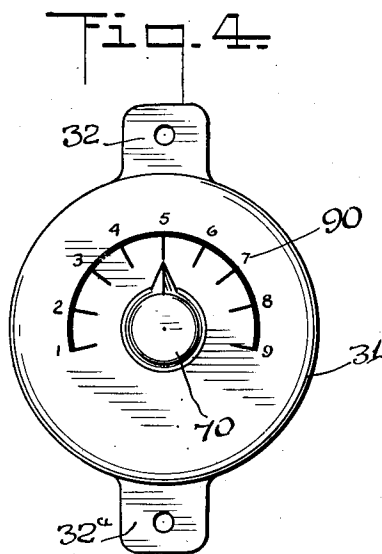
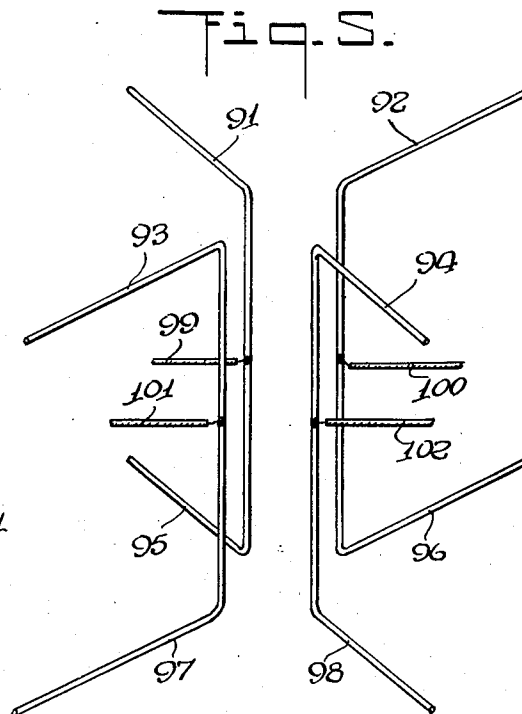
M. P. MIDDLEMARK

2,585,670

TELEVISION AND HIGH-FREQUENCY ANTENNA SYSTEMS

Filed Oct. 19, 1951

2 SHEETS—SHEET 1



INVENTOR.
Herwin P. Middlemark
BY *A. Stepler Baker*
ATTORNEY

Feb. 12, 1952

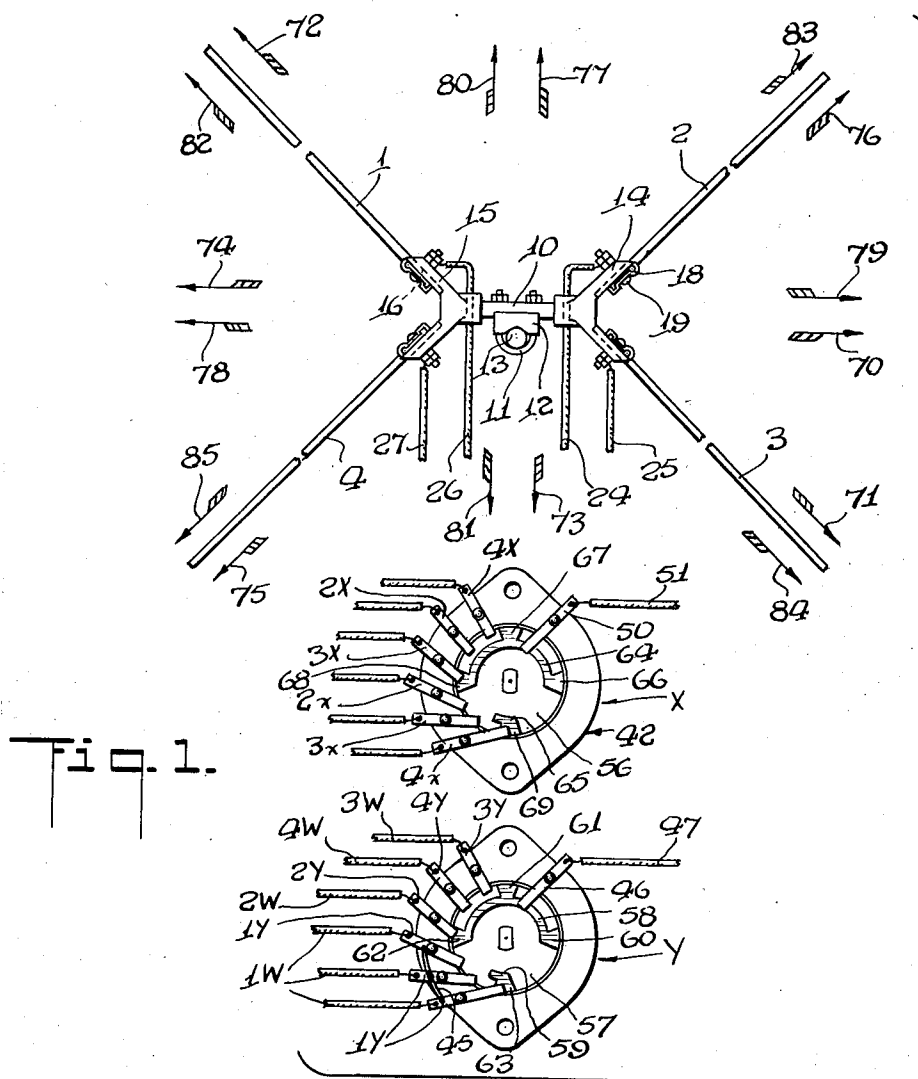
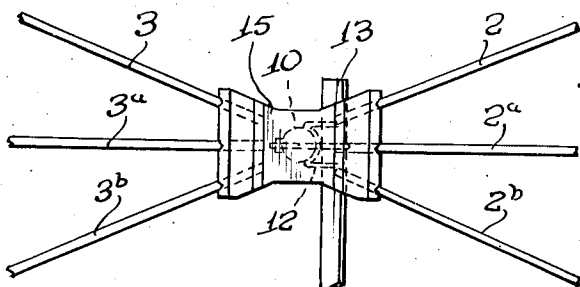
M. P. MIDDLEMARK

2,585,670

TELEVISION AND HIGH-FREQUENCY ANTENNA SYSTEMS

Filed Oct. 19, 1951

2 SHEETS—SHEET 2



INVENTOR.
Merwin P. Middlemark
 BY
D. Phelps Baker
 ATTORNEY

UNITED STATES PATENT OFFICE

2,585,670

TELEVISION AND HIGH-FREQUENCY
ANTENNA SYSTEMS

Marvin P. Middlemark, Woodside, N. Y.

Application October 19, 1951, Serial No. 252,031

8 Claims. (Cl. 250—33.51)

1

This invention relates to high frequency antennas as particularly used with television receivers or other high frequency systems employing selective directive radiation.

The present application is a continuation in part of my application Serial No. 241,959, filed August 15, 1951. In that prior application I disclosed an antenna having a plurality of variously directed dipole elements, combinations of which were selectable by a selector switch to achieve directivity of reception. The instant application has the same general objectives as set forth in my prior application but specifically it discloses a system which is more versatile in that it actually provides for the selection of 16 directions. Eight of these directions may broadly duplicate the other eight but the lobe patterns vary as will be hereinafter set forth. The desired directivity is accomplished by the operation of a selector switch which has nine different positions in achieving the different directions as above set forth. 360° of selected directivity are provided. In television practice the switch will be manually operated but other systems may employ a motor drive.

The invention discloses broadly a pair of dipoles which are crossed perpendicularly or at other angles so that four dipole rods are provided as will be shown hereinafter. Any two of these dipole rods or pairs thereof may be selected in achieving a desired orientation of the antenna and the remaining two will generally be shorted or connected together, this feature having been found to be very desirable. The selected combinations may comprise either straight or conical dipoles and may include reflector elements as will be hereinafter made clear. The entire arrangement is accomplished by a switch which is notable in regards to its simplicity of construction and use.

The invention will be further understood in the following description and drawings in which:

Figure 1 is a top view of an antenna system constructed according to the instant invention, the switch elements being shown schematically;

Figure 2 is a front fragmentary view of a preferred form of antenna elements;

Figure 3 is a cross-sectional view of the selector switch;

Figure 4 is a front view thereof; and

Figure 5 illustrates a modified embodiment of the antenna arrangement.

Figure 5 illustrates a modified embodiment of the antenna arrangement.

Referring to Figure 1, the antenna elements

2

are shown as being disposed in a horizontal plane as is customary although the disposition of the elements for the reception of vertically polarized waves will be evident to those skilled in the art. The supporting member comprises a rod 10 through which extends a U-shaped holder 11. Holder 11 in cooperation with clamp 12 grips the vertical mast 13 as will be evident. Such structure serves to support the antenna elements and insulator brackets on a roof or other side.

To the ends of rod 10 are connected a pair of insulator brackets 14 and 15. These are of electrically insulating material such as Bakelite or the like. Insulator 14 is angular in form, having two arms, each of which support the antenna elements in a predetermined angular relationship. Thus, each arm is formed with one or more grooves 16 into which the antenna elements, in this case dipole rods, fit. The illustrated system employs crossed dipoles, each comprising two dipole rods which are designated in the drawing as 1 and 4, and 2 and 3. Referring to Figure 1, the dipole rod 2 fits into a groove 13 wherein it is retained by a metal clamp 18 which is tightened by a bolt 19. This arrangement is more or less conventional and it serves to maintain the dipole rod 2 firmly in the groove.

It will be understood that whereas a complete antenna system, as will be hereinafter described, includes only four dipole rods such as might be deduced from the view of Figure 1, actually each insulator bracket 14 may have three diverging grooves as illustrated in Figure 2, these grooves holding the dipole rods 2, 2a and 2b. Inasmuch as the bracket 18 clamps all three of these dipole rods simultaneously, it will be evident that they function as a unit so that the same principles of operation apply to either a two or three element dipole rod arrangement or a single one, as the case may be.

Dipole rod 3 is similarly disposed in the opposing insulator arm as illustrated in Figure 2, while the other dipole rods 3a and 3b may also be included in the arrangement.

The other end of the antenna employs the insulator 15 and the dipole rods 1 and 4 each of which may be one of the group of three as above described. Viewing the antenna from above as in Figure 1, the structure may be described as comprising two crossed or perpendicularly related dipoles, each consisting of two dipole rods and all the rods being disposed in stellate form relative to each other.

Wires 24, 25, 26 and 27 are respectively connected to each of the inner terminal ends of the

3

dipole rods 2, 3, 1 and 4. A suggested manner of connection is to connect the wires to the bolts 19 of the clamps 18 as illustrated in Figure 1, such connection being transmitted to the dipole rods themselves by the metal clamps. Wires 24 to 27 will be of the transmission line type. Thus, for example, wires 24 and 25 may be the two conductors of twin transmission line having the usual 300 ohm impedance. In the same way wires 26 and 27 may be the conductors of another twin transmission line. Of course, other conventional transmission lines may be employed. It is also proposed that a tubular form of transmission line having the conductors spaced 90° apart may be employed as may be a square transmission line, either solid or tubular, with the four conductors embedded longitudinally in each corner thereof.

In achieving the directivity accomplished by the apparatus of the instant invention, a switch 30 is employed. Switch 30 may be disposed within or adjacent to the television receiver cabinet probably depending upon whether it constitutes original equipment or is subsequently secured. It is also suggested that the switch may be disposed adjacent to the antenna and actuated by flexible cable instead of by the rigid shaft shown. As will be hereinafter described, switch 30 is manually operated by the user of the television receiver in order to select the proper effective direction and thus secure the best reception.

Switch 30 is of the type referred to as a flat, wafer switch of so-called staked construction. For example, switches of this type are manufactured by Centralab of Milwaukee, Wisconsin or Oak Mfg. Co. of Chicago, Ill., and are standard in the art. As illustrated in Figures 3, the switch includes a housing 31 having ears 32 and 32a which facilitate its connection to a support which may be the television receiver cabinet.

A shaft 33 operates the rotor contacts. A threaded bushing 34 surrounds the shaft and a nut 36 thereon serves to secure the shaft in respect to the housing 31. A frame 37 is mounted on a bushing 38 which is in turn secured to bushing 34. Bushings 34 and 38 are fixed relative to housing 31 and do not rotate with shaft 33. A toothed wheel 39 is secured to frame 37 so as to be immovable therewith. A spring disk 40 having a tooth 41 is employed to fix the position of the shaft at definite points, the tooth 41 mating with any one of the teeth of wheel 39 for this purpose.

Frame 37 includes a pair of arms which are riveted to the stationary insulator plate 42. Plate 42 carries a plurality of clips to which connections are made. In the instant embodiment, such clips are disposed on both faces of plate 42. It is to be understood that no claim is made to the construction of the switch as above described since such construction is broadly known and conventional in the trade.

In the preferred embodiment disclosed herein, plate 42 carries a series of 7 clips or contacts on each face thereof, so that in all, 14 clips are provided. In order that the clip arrangement may be more readily understood, the respective faces of plate 42 are illustrated in Figure 1 as being side by side and are respectively designated as X and Y. It will be understood however, that X and Y are the opposite faces of the same plate 42.

Referring to face Y, 6 of the clips are numbered in the drawing to correspond to the antenna elements to which they are connected.

4

Thus, clip 3Y is connected by wire 3W to dipole rod 3. Clip 4Y is connected by wire 4W to dipole rod 4. Clip 2Y is connected by wire 2W to dipole rod 2. The remaining three clips are interconnected as by wire 45 and are each labeled 1Y, they being connected by wires 1W to dipole rod 1. Clip 46 is the output element and is connected by wire 47 to one of the input terminals of the television receiver.

Face X of plate 42 has the same arrangement of clips. Thus clip 4X is connected by the wire soldered thereto, to dipole rod 4. Clip 2X is likewise connected to dipole rod 2 and clip 3X is connected to dipole rod 3. The remaining three clips are connected respectively to dipole rods 2, 3 and 4 and are designated as 2x, 3x and 4x to distinguish them from the other three clips of face X. Clip 50 is the output terminal and is connected by wire 51 to the other input terminal of the television receiver so that wires 47 and 51 represent the signal input to the receiver.

Switch 30 includes a rotor insulating plate 55 which carries the rotor contacts. The opposite faces of the rotor plate 55 are designated as 56 and 57 respectively. Face 57 supports a long, arcuate rotor 58 and a short rotor 59. Rotor 58 has three contacts designated as 60, 61 and 62 respectively. Rotor 59 has one contact designated as 63.

Face 56 of the rotor plate has similarly arranged rotors 64 and 65, the three contacts of rotor 64 being designated as 66, 67 and 68 respectively, and the contact of rotor 65 being designated as 69. As will be noted in Figure 3, the small rotors 59 and 65 are connected back to back, these rotors serving as the shorting elements as will be hereinafter made clear.

When knob 70 of the switch is rotated so as to rotate shaft 33, different switch positions are established because the rotor contacts meet different combinations of clips. It will be noted that output clips 46 and 50 are longer than the remaining clips so they effect electrical contact with the respective rotors 58 and 64 regardless of the position of the rotor contacts. Thus, the rotors effectively establish a connection with selected antenna elements which are in turn transmitted to the output clips 46 and 50.

In the position of the switch rotor plates illustrated in Figure 1, it will be noted that rotor contact 68, meets clip 3X so that dipole rod 3 is selected. Rotor contacts 66 and 67 are not used. Rotor contact 69 meets clip 4x. On the opposite side of the plate, rotor contact 62 meets clip 2Y so as to be effectively connected to dipole rod 2. Rotor contact 59 is in the same way connected to dipole rod 1. The result of this position, which we may call position 1, is to apply dipole rods 3 and 2 to the respective output wires 51 and 47 respectively, while the dipole rods 1 and 4 are shorted by the electrically connected small rotors 65 and 59. Examining the arrangement of the dipole rods in Figure 1, it will be evident at this time that the direction indicated by arrow 70 is accomplished. In other words, dipole rods 2 and 3 serve as forward elements of an inclined V-type antenna while dipole rods 1 and 4 are connected together at their terminal ends and jointly serve to some extent as a reflector. As is well understood, the direction achieved thereby is forward of the dipole rods 2 and 3 along a line substantially bisecting the angle between such rods.

In order that all nine switch positions may

be graphically set forth, the following table will indicate every position of the X and Y contacts and the directivity achieved thereby:

Pos.	X	X Rotor Contact	Y	Y Rotor Contact	Shorted	Direction
1.---	3X	68	2Y	62	1, 4	70
2.---	2X	68	4Y	62	3, 1	71, 72
3.---	4X	68	3Y	62	2, 1	73
4.---	4x	66	1Y	60	3, 2	74
5.---	3x	66	1Y	60	2, 4	75, 76
6.---	2x	66	1Y	60	4, 3	77
7.---	3X, 4x	66, 67	1Y, 2Y	60, 61	-----	78, 79
8.---	2X, 3x	66, 67	1Y, 4Y	60, 61	-----	80, 81
9.---	2x, 4	66, 67	1Y, 3Y	60, 61	-----	82, 83, 84, 85

Briefly summarizing the information in the foregoing table, it may be noted as follows:

When knob 70 is switched to position 2, the clips 2X and 4Y are connected through the rotor contacts 68 and 62 respectively to the dipole rods 2 and 4. At the same time, the shorting contacts 63 and 69 are connected to clips 3x and 1Y so as to connect the dipole rods 3 and 1. Thus, the output of dipole rods 2 and 4 is fed to the television receiver. It will be observed that dipole rods 2 and 4 constitute a substantially straight dipole. As is well-known, the lobe pattern of such a dipole is broadside to it. Accordingly, directivity is accomplished in the direction of arrows 71 and 72, a straight dipole being bi-directional as is well-known.

The other combinations shown on the above table will achieve the direction illustrated by the arrows 73 to 85 pursuant to well-known radiation principles. In position No. 7, it will be noted that dipole rods 3 and 4 are connected to the X output terminal while rods 1 and 2 are connected to the Y dipole terminal. This is equivalent to fed, forward elements of a V-type antenna inclined in the direction of arrows 78 and 79 respectively, and accomplishing directivity in such directions. It will be noted that arrows 78 and 79 actually duplicate broadly the directions of arrows 74 and 76. However, in the directivity shown by arrow 70, the dipole rods 2 and 3 were used as the forward elements while rods 1 and 4 served as reflector elements. On the other hand, in regard to the directivity achieved by arrow 79, rod 3 is connected to rod 4 and rod 2 is connected to rod 1. It will be recognized that such a variation changes the lobe pattern to a considerable degree. In other words, while broadly speaking, arrows 78 and 79 point in the same direction, actually the patterns of reception vary. Therefore, a station which is somewhere in the sector defined by rods 2 and 3 may be better received in position 7 than in position 1. The user may try either one of the arrows 78 or 79 to receive a station in such sector.

Position 8 achieves directivity in the direction of arrows 80 and 81 which duplicate those of arrows 77 and 73 in the same general manner set forth above. Finally, in position 9, the dipole rods of each dipole are interconnected such as in a turnstile antenna and the pattern is substantially in four directions along each dipole rod. This completes the 16 directions, 8 of which are believed to generally duplicate the remaining 8 but with different lobe patterns. In the various directions around the 360° of a circle, the user is given the option of selecting different reception patterns so that he can choose the one giving the best results. The housing 31 of the switch may include indicia 90 wherein the 9 switch positions are indicated. Of course, other indicia

such as arrows or channel numbers may be employed.

It will be understood that the antenna elements may take various conventional forms and may be stacked as is customary. For example, in Figure 6 is illustrated a system of dipole rods 91-94 which are stacked in respect to rods 95-98. The upper dipoles are connected to the lower dipoles by rods from the center of which extend the output wires 99 to 102 as is customary. It will be further understood that such antenna systems may assume other conventional forms such as folded dipoles as set forth in my prior application or rods having conventional whiskers or stubs, these being well-known substitutes or variations of simple dipole elements. The dipoles may be crossed at 90° as illustrated or at anywhere from 60° to 120°. Whereas Figure 2 shows three dipole elements functioning as connected dipole rods, either one or two or more may be used as will be understood. Furthermore, the dipoles may take the form of conical or fan-like sheets which are also conventional substitutes for ordinary single dipoles.

It will be recognized that inasmuch as the antenna is used in a broad band system, the dipoles are necessarily cut to compromise lengths as is customary. Generally, they are cut as half wave dipoles near the low end of the band. This will vary the reception patterns at other frequencies but the general principles of maximum directivity as above set forth will still be applicable to a satisfactory degree as has been determined by modern practice.

What is claimed is:

1. A television antenna system comprising a pair of crossed dipoles each having two inner terminal ends and each comprising two dipole rods, wires extending from the four terminal ends, a switch to which said wires are connected, a manually operated selector member on said switch, a pair of output terminals on said selector member, and means controlled by operation of said selector member for electrically connecting any two of said dipole rods to said output terminals, and for simultaneously shorting the two remaining dipole rods when two adjacent dipole rods are electrically connected to said output terminals.

2. A television antenna system comprising four dipole rods extending in different directions, each of said dipole rods having an inner terminal end, a switch having two series of contacts, each contact of each series being electrically connected to one of said inner terminal ends, an output contact for each series, a selector member for simultaneously selecting one contact of each series and connecting it to its output contact so as to effectively connect any two of said dipole rods to said output contacts, and means on said switch for simultaneously shorting the remaining two of said four dipole rods when the other two thereof are connected to said output contacts.

3. A television antenna system comprising a pair of crossed dipoles each including two dipole rods so that said pair of dipoles comprises four dipole rods, each of the dipole rods having an inner terminal end, a switch comprising a stationary plate having two series of contacts on the respective sides thereof, each contact of each series being electrically connected to one of said inner terminal ends, an output contact for each series, a selector member for simultaneously selecting one contact of each series and connecting it to its output contact so as to effectively con-

7

nect any two of said dipole rods to said output contacts, a rotor plate on said selector member, a pair of selector rotors on the respective sides of said rotor plate, each of said selector rotors being adapted to make an electrical connection to one of the respective series of contact when said selector member is operated, and a pair of shorting rotors each mounted on the respective sides of said rotor plate, said shorting rotors being interconnected and being operative to short the remaining two of said four dipole rods.

4. A television antenna system comprising a pair of crossed dipoles each including two dipole rods so that said pair of dipoles comprises four dipole rods, each of the dipole rods having an inner terminal end, a switch comprising a stationary plate having two series of contacts on the respective sides thereof, each contact of each series being electrically connected to one of said inner terminal ends, an output contact for each series, a selector member for simultaneously selecting one contact of each series and connecting it to its output contact so as to effectively connect any two of said dipole rods to said output contacts, said selector including a rotor plate, a pair of selector rotors on the respective sides of said rotor plate, each of said selector rotors having three contacts for effecting electrical connection with contacts of the respective series when said selector member is operated, and a shorting rotor for shorting the remaining two of said dipole rods mounted on each side of said rotor plate, said shorting rotors being insulated from said selector rotors.

5. For use with a television antenna system having a pair of crossed dipoles each consisting of two dipole rods so that said pair of dipoles comprises four dipole rods, a switch for selecting combinations of said dipole rods for connection to a television receiver, said switch comprising a stationary plate having two series of contacts on the respective sides thereof, an output contact for each series, a rotor plate, a pair of selector rotors on the respective sides of said rotor plate, each of said rotors being adapted to make an electrical connection to at least one of the respective series of contacts when said selector member is operated, a pair of shorting rotors each mounted on the respective sides of said rotor plate and being operative to short together two contacts on the respective sides of said rotor plate which are not electrically connected to said selector rotors when said selector member is operated to make the said electrical connections of said selector rotors, said shorting rotors being interconnected and being insulated from said selector rotors.

6. For use with a television antenna system having a pair of crossed dipoles each consisting of two dipole rods so that said pair of dipoles comprises four dipole rods, each of which has an inner terminal end, a switch for selecting combinations of said dipole rods for connection to a television receiver, said switch comprising a

8

stationary plate having two series of contacts on the respective sides thereof, each contact of each series being electrically connected to one of said inner terminal ends, each series comprising six contacts, one series of contacts having two different contacts thereof connected to each of three of said terminal ends, and the other series having three of its contacts respectively connected to the said three terminal ends and the remaining three contacts connected to the remaining terminal end, an output contact for each series, a selector member for simultaneously selecting one contact of each series and connecting it to its output contact so as to effectively connect any two of said dipole rods to said output contacts, said selector including a rotor plate, and a pair of selector rotors on the respective sides of said rotor plate.

7. A switch according to claim 6 and wherein each of said selector rotors has three integral contacts for effecting electrical connection with contacts of the respective series when said selector member is operated.

8. A television antenna system comprising a pair of crossed dipoles each including two dipole rods so that said pair of dipoles comprises four dipole rods, each of the dipole rods having an inner terminal end, a switch comprising a stationary plate having two series of contacts on the respective sides thereof, each contact of each series being electrically connected to one of said inner terminal ends, each series comprising six contacts, one series of contacts having two different contacts thereof connected to each of three of said terminal ends, and the other series having three of its contacts respectively connected to the said three terminal ends and the remaining three contacts connected to the remaining terminal end, an output contact for each series, and a selector member for simultaneously selecting one contact of each series and connecting it to its output contact so as to effectively connect any two of said dipole rods to said output contacts, said selector including a rotor plate, a pair of selector rotors on the respective sides of said rotor plate, each of said selector rotors having three integral contacts for effecting electrical connection with contacts of the respective series when said selector member is operated.

MARVIN P. MIDDLEMARK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,424,365	Loftin et al.	Aug. 1, 1922
2,186,949	Allison et al.	Jan. 16, 1940
2,368,286	Carlson	Jan. 30, 1945
2,427,940	Ayres	Sept. 23, 1947
2,435,978	Newkirk	Feb. 17, 1948
2,552,816	Root	May 15, 1951
2,563,243	Hills	Aug. 7, 1951