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TUNER ANTENNA CONTROL

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3 Sheets-Sheet 2

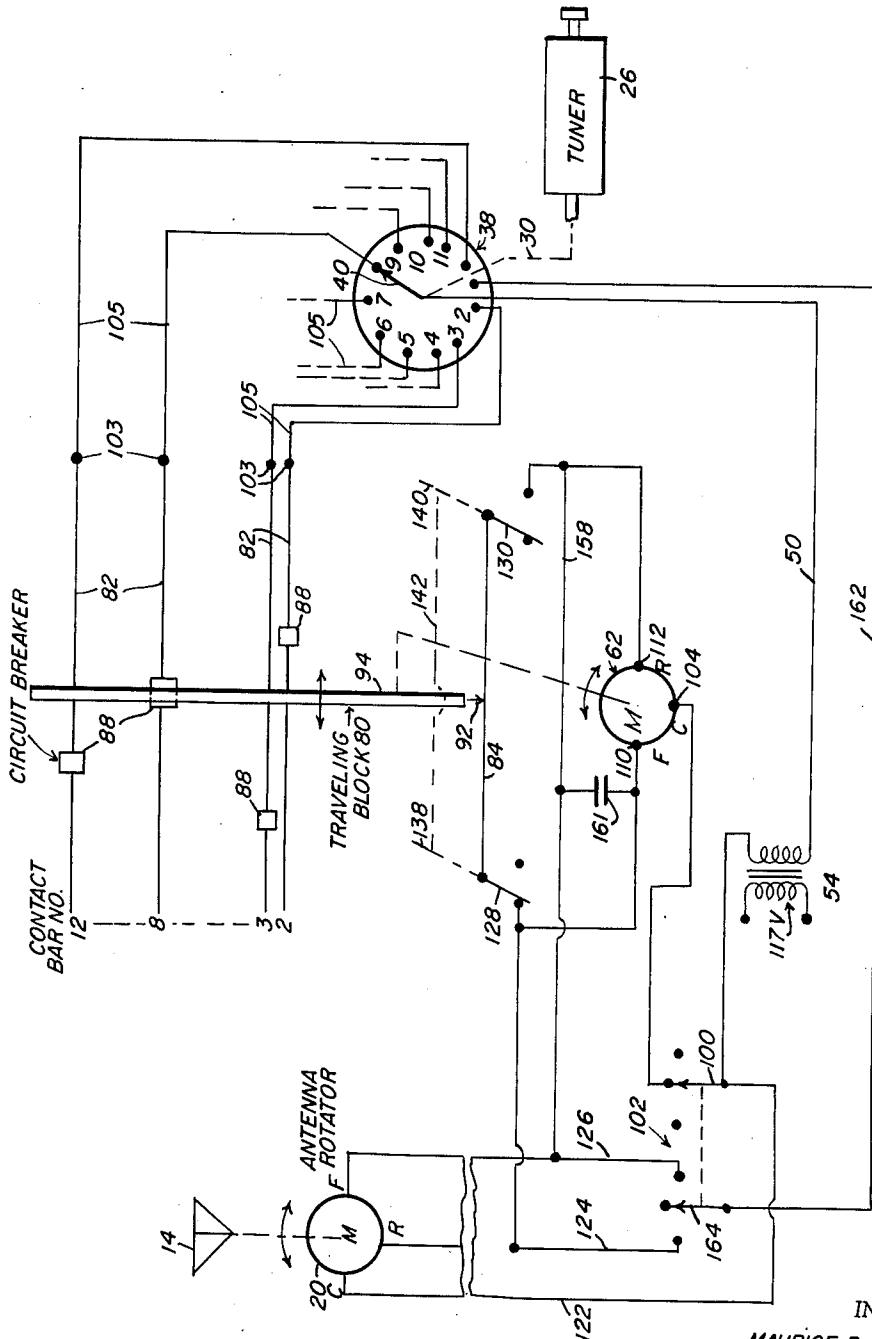


Fig. 3A.

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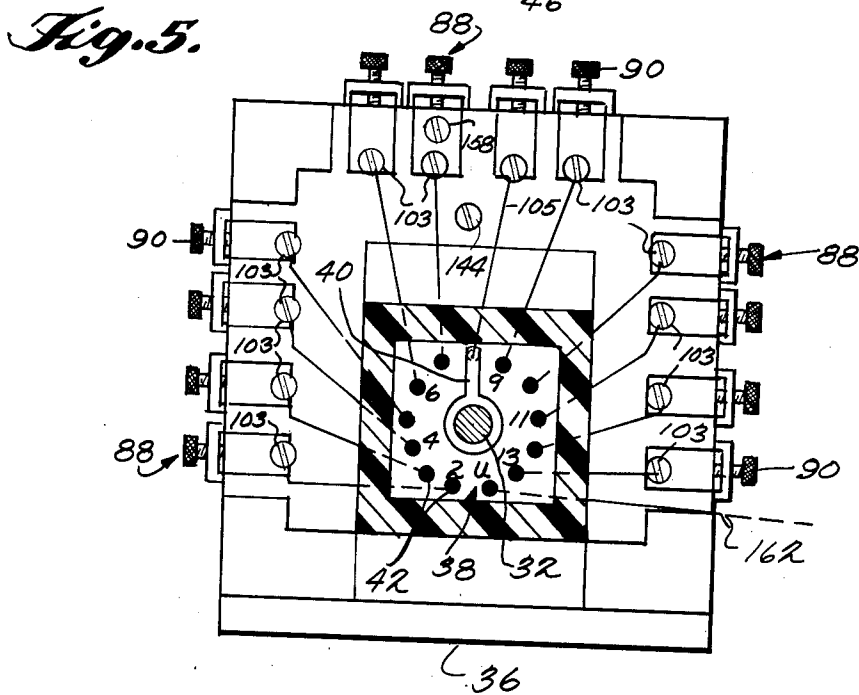
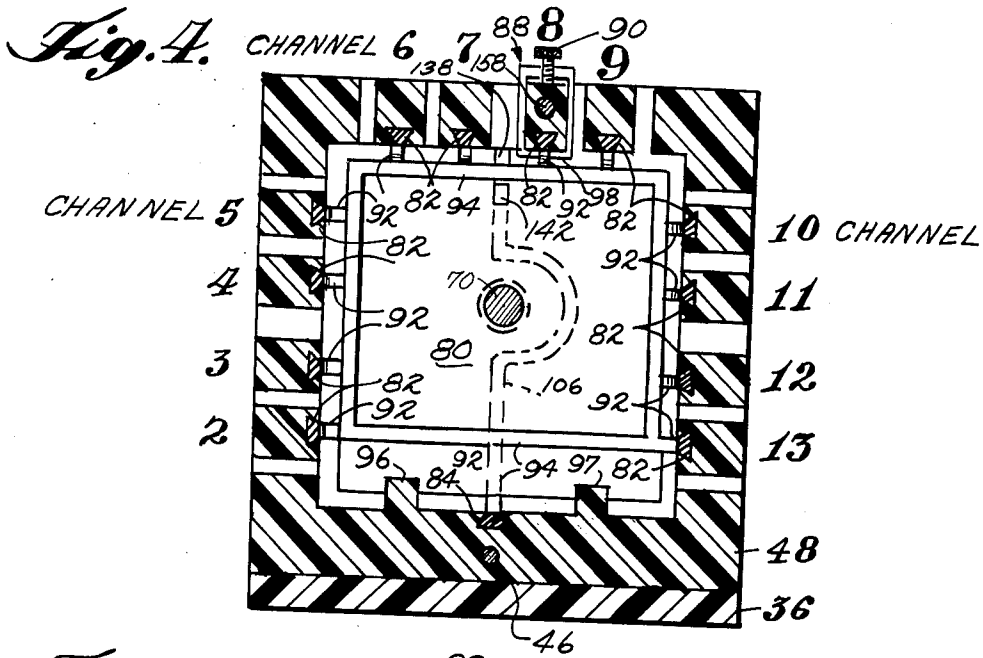
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TUNER ANTENNA CONTROL
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11 Claims. (Cl. 318-33)

This application is a continuation-in-part of my application Serial No. 81,664, filed January 3, 1961, under the same title, now abandoned, and contains all the subject matter therein and more. The invention herein, as therein, relates to the automatic control of the azimuthal or rotational position of a receiver's antenna in accordance with the station or channel selected.

Though this invention is described with particular relation to a television receiver, it is also applicable to other types of receivers which require their respective antennas to be positioned or directed in different directions to best receive the signals transmitted from respective stations.

In the past, it has been necessary for home television receiver operators, for example, to utilize a double throw switch for remotely controlling the rotational movement of a roof antenna for their television receiver, after selecting a given station to be viewed. This, of course is bothersome, inconvenient and not always is the antenna positioned accurately in that manner.

It is the principal object of this invention to overcome the disadvantages of manual control of a receiver's remotely rotatable antenna by automatic positioning of the antenna in a rotational position at least approximately corresponding to the station selected.

Another object of this invention, in conjunction with the foregoing object, is the provision of automatic antenna positioning equipment which does not require a selsyn or other type of expensive follow-up systems but yet the antenna rotator and control motor according to this invention are resynchronized now and then and in-between times keep sufficiently synchronized to position an antenna tolerably accurate, for example within $\pm 10^\circ$ or so.

The specific apparatus for accomplishing this includes a unit which is integral with or connectable to the shaft of a tuner in the receiver. As is well known in television receiver art, an external knob is employed to manually change the tuner circuits and select any one of a plurality of stations or channels, numbered 2 through 13 for VHF operation. Rotation of the selection knob is such that the knob and the tuner shaft to which it is connected are detented at each one of the different channel indicators. The unit of this invention which may be attached to such a tuner shaft has a multiposition switch the arm of which rotates with the tuner shaft. The number of positions of this switch is at least equal to the number of usable channels on the TV set, and each position of the switch is electrically connected to a different channel contact bar which co-extends insulatively relative to each of the other contact bars. These bars are positioned around a block or the like which is movable as by an auger lengthwise of each of the bars simultaneously. Attached to the block at respective positions are a plurality of spring contact means for making respective electrical contact with the channel bars and to a further common bar. Positioned on each of the bars is a respective circuit breaker or disconnet means which is adjustable in position lengthwise of the bar for breaking electrical contact between the particular bar and the spring contact on the block. All of the spring contacts are connected together and thereby to the common bar. A reversible motor is employed to rotate the auger and move the block in opposite directions along the bars, and the motor is energized as soon as the station selecting knob is rotated to a particular channel. The block therefore begins to

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move and as soon as it encounters the circuit breaker associated with the selected channel, the motor circuit is broken and the block stops its movement. The circuit which operates the reversible motor that moves the block longitudinally of the bars, is also connected to the remote antenna motor to reversibly rotate the antenna. Therefore the antenna is rotated only the angular distance corresponding to the longitudinal movement of the block along the contact bars. There is also provision for reversing the direction of block movement, and consequently of the antenna motor direction, when the block approaches either end of its travel.

It is therefore another object of this invention to provide apparatus which has the features described above.

Other objects and advantages of this invention will become apparent to those of ordinary skill in the art after reading the appended claims and the following detailed description of the invention in conjunction with the drawings, in which:

FIGURE 1 is a diagrammatic representation of the application of this invention to a television receiver and its remote rotatable antenna.

FIGURE 2 is a partial diagrammatic representation indicating a variation in the invention,

FIGURE 3 is a schematic and diagrammatic illustration, partly in structural cross section, showing the details of the automatic control apparatus of this invention,

FIGURE 3A is a complete electrical schematic diagram corresponding to FIGURE 3.

FIGURE 4 is a cross sectional view taken approximately along the line 4-4 of FIGURE 3, and

FIGURE 5 is a view taken approximately along the line 5-5 of FIGURE 3.

In FIGURE 1 a conventional television receiver 10 is connected by a common type transmission line 12 to a remote antenna 14 positioned, for example, atop a roof 16 of the home containing the television receiver. The antenna may be held upstanding on a conventional mast 18 and may be angularly rotated in any azimuthal direction by a conventional reversible rotator or motor 20, which has the usual down gearing and a stop (not shown) to prevent rotation substantially beyond 360° so that its leads cannot become twisted around the mast. As previously indicated, normally a television receiver operator must first turn the station or channel selection knob 22 so as to make the proper frequency selection by tuner 24 in the receiver, and then he has had to operate a single pole double pole switch (not shown) for purposes of sending a forward or reverse signal to motor 20 to rotate antenna 14 until the picture on the screen of the television screen appeared the best. Sometimes other factors enter in and such manual control of the rotational position of antenna 14 leaves much to be desired in the way of its accurate resulting direction to ward the transmitting station selected.

In accordance with this invention, however, an automatic controller 26 is interposed between the antenna motor 20 and the receiver tuner 24, to cause automatic positioning of the antenna in accordance with the station or channel manually selected by knob 22. This automatic controller may be coupled to the tuner shaft 28 by a flexible cable 30 whereby the controller 26 may be disposed externally of the television receiver. On the other hand, the input shaft 32 of the controller may be an integral extension of, or directly rigidly connected to, tuner shaft 28 as shown in FIGURE 2, whereby the controller 26 may be positioned within the television receiver cabinet. Either embodiment is equally satisfactory from the operational standpoint, and the interconnection between the tuner and controller, as well as the location of the latter, may be as desired.

The controller 26 of FIGURES 1 and 2 is shown in detail in FIGURE 3. Therein, a plastic housing 34 for the controller sits on a base 35. The housing may be made of plastic parts molded or otherwise formed to the shape desired. In any event, the input shaft 32, which may be coupled as previously indicated by a flexible shaft 30 to a television tuner, is also the shaft of a multiposition housed switch 38, which has an arm 40 that sweeps a plurality of terminals 42. At its inward end, shaft 32 is connected by a contact spring 44 to a length of conductor 46, such as copper bar which is molded or otherwise disposed in the lower side 48 of the housing. This bar 46 extends the full length of the housing and makes an electrical connection through the rear side by wire 50 to one output terminal 52 of a step-down transformer 54. This transformer may be connected internally of the television receiver, or it may be connected by a conventional male plug to a regular house outlet of approximately 117 volts. The turns ratio of the primary and secondary windings 56 and 58 is such that the output voltage across terminals 52 and 60 is approximately 30 volts, or according to the voltage required for the reversible antenna motor 20 (FIGURE 1) and a second reversible motor 62 which is utilized in operating the controller itself as below explained.

As indicated, the output shaft 64 of the reversible motor 62 is coupled by gears 66 and 68 to cause rotation of a threaded shaft or auger 70 which has its opposite ends disposed in respective blocks or bearings 72 and 74, which in turn are suitably held stationary in the rear housing side 76 and the front housing side 78. Disposed in threaded engagement with auger 70 is an insulative block 80, made of plastic for example, which may be caused to move leftwardly and rightwardly within the housing 34, according to the direction of rotation of reversible motor 62, the operation of which is fully explained below.

As is apparent in the cross sectional view of FIGURE 4, there are a plurality of longitudinally extending contact bars 82, one for each different one of the television channels 2 through 13, and there is a further and common contact bar 84. Each of the N station contact bars 82 is embedded or otherwise secured in a respective plastic insulator bar 86, each such insulator bar being spaced from another. In this manner, each insulator bar can carry a respective insulative circuit breaker 88 without interference from any other adjacent such circuit breaker in the longitudinal movement of either along the respective length of insulator 86. Each circuit breaker is of hollow rectangular cross section so as to closely surround the respective plastic bar 86 and be movable along the length thereof manually. On the other hand, the circuit breaker, which may be made of plastic for example, is securable at a desired lengthwise position along its respective plastic bar by means of a set screw 90.

The central block 80, which as previously indicated is movable longitudinally of the contact bars 82, has a configuration similar to the configuration outlined by the contact bars 82 and 84. As shown, that configuration is substantially square, though it may be rectangular, circular, etc., as desired. In addition, the block carries a plurality of spring contacts 92, one for each one of the contact bars 82 and 84. These spring contacts extend longitudinally of the contact bars 82 and 84 and ride respectively therealong as the block is moved longitudinally by auger 70. Further, as indicated particularly in FIGURE 4, all of the springs 92 are electrically interconnected by a copper or other type conductor 94.

Spring contacts 92 are disconnected from their respective station contact bars 82 whenever block 80, which slides on guides 96 and 97 in the lower side 48 of the housing, is moved so that the lower portion 98 of a respective circuit breaker 88 comes in-between the spring and contact bar. This breaks an electrical circuit which

stops the reversible antenna motor 20 and controller 62, as now explained in more detail.

As will be noted in FIGURE 3 the output terminal 60 of transformer 54 is connected to the movable arm 100 of a double-pole triple-position UHF antenna control switch 102. This switch is illustrated in its normal position, i.e., in the position for automatic operation of the controller during selection of VHF channels. Therefore, transformer terminal 60 is connected by switch arm 100 to the common terminal 104 of reversible motor 62. The other transformer output terminal 52, as previously explained, is connected by line 50 and bar 46 through spring contact 54 to the selector switch arm 40. Each of the stationary switch contacts 42, which correspond to a respective one of the VHF television channels 2 through 13 that can be selected, is electrically connected, as shown in FIGURES 3 and 5, to a respective one of the station contact bars 82, as via the external screw 103 thereof. Therefore, the station selected causes current from transformer terminal 52 to be directed through the corresponding one of the contact bars 82 and thence through the respective spring 92 and by the common spring connection 94 to the lower spring 92 and the common contact bar 84. In a manner explained in detail below, this contact bar via its upward extensions 106 and 108 causes electrical contact to be made to effect completion of the circuit to reversible motor 62 at either its forward or reverse terminals 110 and 112. Consequently, motor 62 operates as soon as this circuit is completed. Furthermore, the antenna motor 20 also operates at this time by virtue of transformer terminal 60 being connected also to terminal 114 of a terminal block 116, and motor terminals 110 and 112 being connected in parallel to terminals 118 and 120. The common-line terminal 114, and the opposite-direction-voltage terminals 118 and 120 are respectively connected to motor 20 by lines 122, 124 and 126, causing the antenna to rotate while the reversible motors 20 and 62 continue to rotate.

As soon as the disconnecter or circuit breaker 88, which is associated with the selected station contact bar 82, is interposed between that contact bar and the respective spring contact 92 by the movement of block 80, the circuit to reversible motors 20 and 62 is broken and consequently the antenna stops rotating. According to this invention, each of the circuit breakers 88 which are to be used are positioned longitudinally of the respective contact bar at the position which will effect a breaking of the circuit to the reversible motors so as to stop rotation of the antenna at the approximate position which directs it substantially toward the station selected by rotation of the selecting knob 22 of FIGURE 1. Since the different stations to be received at any given location will generally be located in different azimuthal directions, the position of disconnectors 88 for those respective stations will be at different longitudinal positions along their respective contact bars 82.

It is a feature of this invention that the overall effective length of travel of block 80 corresponds to approximately 360° of antenna rotation, but nevertheless when reversible motor 62 is energized initially during the change of stations, it may not necessarily first move in the direction by which the contact between the respective contact bar 82 and spring 92 may be broken by the respective circuit breaker 88. Therefore, this invention provides for a means to reverse the direction of rotation of motor 62, which at the same time reverses the direction of rotation of the antenna. Of course, when the direction of rotation of motor 62 is reversed the direction of movement of block 80 is also reversed. This reversal is accomplished by selectively connecting terminals 110 and 112 of reversible motor 62 to the common contact bar 84. As previously indicated, this contact bar has at its opposite ends upward extensions 106 and 108. These extensions turn inwardly at their upper end and make electrical contact respectively with switch arms 128 and 130 which are snap

operated to a leftward or rightward position by virtue of respective springs 132. These springs are secured to a respective collar 134 which surrounds auger 70 and is held in position by a fixing arm 136. Switch arms 128 and 130 respectively operate in squared and inverted U-shaped sections 138 and 140 of a longitudinally movable plastic rod 142. This rod has opposite end positions 143 and 144 which extend through respective apertures in the rear and front sides of the housing for slidable movement therein. The rod also slidably extends through block 80. As the block moves, say rightwardly in FIGURE 3, its front side will come into physical engagement with the rear edge of the U-shaped portion 140 and will then push rod 142 leftward. This will cause switch arms 128 and 130 to flip or snap to their opposite (rightward) positions whereby the common contact bar 84 becomes disconnected from the terminal 146 which is on the inner end of a metal rod 148 disposed within the end portion 143 of the plastic rod 142. This metal rod is connected by line 150 to terminal 112 of reversible motor 62. Therefore, this motor as well as the antenna motor 20 stops running in its current direction, and due to connection of switch arm 130 to terminal 152, they begin operating in the opposite direction. As indicated in FIGURE 3, switch terminal 152 is connected by a metal rod 154 within the end portion 144 of the plastic rod 142, and by line 156 and another metal bar 158, which extends the full length of the housing in one of the insulator bars 86, and by line 160 to the other terminal 110 of reversible motor 62. This causes this motor, as well as the antenna motor, to change direction of operation, and therefore block 80 begins moving leftward in FIGURE 3, and continues to so move until one of its springs is disconnected from an electrically excited contact bar 82, at which time both motors stop. Then, if stations are again changed, block 80 will resume its leftward travel, and if it is not stopped by being intercepted by a proper circuit breaker 88, its rear edge will physically engage the front edge of the U-shaped portion 138 of the plastic rod 142. While motor 62 then continues to drive block 80 and rod 142 leftwardly, switch arms 128 and 130 will snap back to their opposite positions, i.e., back to the positions in which they are illustrated, disconnecting current from switch terminal 152 and connecting it to switch terminal 146, whereby the reversible motors both stop and change operational direction again. To prevent or reduce arcing or the like due to operation of switch arms 128 and 130, a condenser 161 is preferably connected across lines 150 and 160.

If the antenna rotator motor 20 and control motor 62 get out of or are not initially in synchronization for any reason, sooner or later they will be resynchronized at the time one or the other of reversing switches 128 and 130 operates, for at one of the switching times motor 20 has then prematurely reached its 360° limit and obviously stalls for a moment until both motors are reversed together.

Since the effective length of travel of block 80 from one reversing switch to the other corresponds to approximately 360° of antenna rotation, the relative speed of motor 62, ratio of gears 66 and 63, and pitch and length of auger 70 are obviously so related to the speed and gearing in the conventional antenna rotator 20 to effect the desired full length relationship for a full revolution of the antenna that change of the antenna to any angular position will at least approximate a corresponding or proportional change in the travel of block 80.

Instead of block 80 pushing on the U-shaped portions 138 and 140, the reversing switches may be snapped to their opposite positions by block 80 hitting against a respective extended portion (not shown) of the switch arms 128 and 130 which is straight therewith and extends in the opposite direction from the switch arm pivot points into the pathway of block 80. The springs 132 would then be exerting a snapping force on the lower end of such switch arm extensions.

Another feature of this invention is the inclusion of the UHF antenna control switch 102 previously mentioned. It is the purpose of this switch to allow the operator to control the rotational position of the antenna manually rather than automatically controlling same, when the tuner shaft selects the UHF circuits. In FIGURE 5, the switch contacts 42 are numbered 2 through 13, with the twelfth contact being designated by the letter "U" for self operation. This terminal, in FIGURE 3, is connected by line 162 to the switch arm 164 of the UHF control switch 102. Switch arms 100 and 164 are illustrated in the position in which they are maintained during VHF operation, whereby switch arm 164 completes no circuit but switch arm 100 provides current to reversible motor 62. However, during UHF operation, it is unnecessary to operate reversible motor 62, though it can be if desired in which case switch 100 would not be necessary and the transformer output terminal 60 would connect directly to motor terminal 104 (as well as block terminal 114). Preferably, however, when switch 102 is thrown to either of its other two positions to cause the antenna motor 20 to rotate the antenna in one direction or another, the input to terminal motor 104 of reversible motor 62 is broken, thereby energizing only the antenna motor 20 via the transformer output terminal 60 and its connection then only to the appropriate terminal of the antenna motor.

It is to be understood that any number N of contact bars 82 and corresponding spring contacts 92 and circuit breakers 88 may be employed in any given situation according to the requirements thereof regardless of the total number of channels to which the receiving set is tunable. If some of those channels are not useable in a particular locale, of course it is unnecessary to provide equipment in the controller for the unuseable channels, though it might be provided in a universally useable controller.

Thus, it is apparent that this invention has provided for all of the objects and advantages herein mentioned. Other objects and advantages, and even modifications of this invention, will become apparent to those of ordinary skill in the art upon reading this disclosure, but it is to be appreciated that this disclosure is intended to be illustrative and not limitative, the scope of the invention being defined by the appended claims.

What is claimed is:

1. Apparatus for automatically controlling the rotational position of a receiver's antenna, which is rotatable by a reversible rotator, in accordance with which one of N predetermined selectable stations is selected by said receiver, comprising:

N contact bars insulatively extending lengthwise substantially coextensively,
means for selectively energizing said bars automatically in respective correspondence to the said N stations selectable by said receiver,
contact means movable in either direction along the length of said N bars for making disconnectable electrical contact therewith,
reversible moving means for moving said contact means as aforesaid,

reversing means electrically coupled to said contact means and operable when the contact means has reached either of two points separated a given distance corresponding to a predetermined angle of rotation of said antenna for reversing the moving direction of said contact moving means,

N disconnect means lengthwise positionable of said N bars respectively at predetermined points for the respective N stations for breaking electrical contact between said reversing means and any energized one of the said contact bars when the contact means moves adjacent the respective disconnect means,

means coupled to the output of said reversing means for reversibly rotating said antenna rotator within the limits of said angle in the corresponding direction and to the corresponding extent as the contact means

does until it is disconnected as aforesaid from the energized bar corresponding to a selected station, a receiver adapted for both VHF and UHF operation, switch means for manually controlling the direction of said reversible rotator, and

means in said selectively energizing means for selectively energizing said switch means only during UHF operation of said receiver, said N contact bars being selectively energized as aforesaid during VHF operation of said receiver.

2. Apparatus as in claim 1 including a tuner shaft in said receiver and a shaft in said selectively energizing means, which shafts are integral extensions of one another or rigidly connected directly together.

3. Apparatus for automatically controlling the rotational position of a receiver's antenna, which is rotatable by a reversible rotator, in accordance with which one of N predetermined selectable stations is selected by said receiver, comprising:

N contact bars insulatively extending lengthwise substantially coextensively,

means for selectively energizing said bars automatically in respective correspondence to the said N stations selectable by said receiver,

contact means movable in either direction along the length of said N bars respectively for making disconnectable electrical contact therewith,

reversible moving means for moving said contact means as aforesaid,

reversing means electrically coupled to said contact means and operable when the contact means has reached either of two end points separated a given distance corresponding to a predetermined angle of rotation of said antenna for reversing the moving direction of said contact moving means,

N disconnect means lengthwise positionable of said N bars respectively at predetermined points for the respective N stations for breaking electrical contact between said reversing means and any energized one of the said contact bars when the contact means moves adjacent the respective disconnect means,

and means coupled to the output of said reversing means for reversibly rotating said antenna rotator within the limits of said angle in the corresponding direction and to the corresponding extent as the contact means does until it is disconnected as aforesaid from the energized bar corresponding to a selected station.

4. Apparatus as in claim 3 wherein said reversing means includes two separate switches commonly coupled to said contact means and disposed at said two spaced points respectively so as to be actuated when said contact means moves adjacent either of said points,

said switches being mechanically interconnected so that actuation as aforesaid of either one of the switches automatically causes actuation of the other switch.

5. Apparatus as in claim 3 wherein said contact means comprises N contact springs electrically interconnected and spaced so as to be in contact respectively with said N contact bars,

each of said disconnect means being a circuit breaker adjustably secured along the length of a respective contact bar for depressing therefrom the respective one of said contact springs when the contact means moves adjacent that circuit breaker.

6. Apparatus as in claim 3 wherein said reversible moving means includes a reversible electric motor,

said contact means comprising a threaded block having a plurality of interconnected spring contactors for respectively engaging said contact bars,

said reversible moving means further including a threaded shaft coupled to said electric motor and to the said threads of said block for moving the block and its said spring contactors longitudinally of said contact bars.

7. Apparatus as in claim 6 wherein said reversing means includes two switches each of which has on and off conditions and is coupled to each of said spring contactors,

said switches being disposed in the path of travel of said block substantially at said two points for actuation by said block when the block travels to the respective one of said two points,

there being means for causing either of said two switches to change to a said condition opposite to that condition to which the other switch is actuated by said block.

8. Apparatus for controlling the rotational position of a receiver's antenna rotatable by a reversible electrical motor automatically in accordance with which one of N predetermined selectable stations is selected by the instant angular position of a tuner control of said receiver comprising:

N contact bars insulatively extending lengthwise substantially coextensively and corresponding respectively to said N stations,

means for coupling one side of a source of electrical energy selectively to any one of said N bars,

means for connecting said coupling means to said tuner control to cause any so energized bar to be the one which corresponds to the station then selected by the tuner control,

a common contact bar,

contact means connected with said common bar and respectively movable in either direction along the length of said N bars for making disconnectable electrical contact between the said common bar and each of the said N bars,

reversible moving means for moving said contact means as aforesaid,

N disconnect means positionable at respective predetermined points along the length of said N bars respectively for breaking electrical contact between the said common bar and the respective one of the N bars when said contact means moves to the position of the respective one of the N disconnect means,

a pair of reversing switches connected to said common contact bar and disposed at opposite ends of the travel of said contact means,

means, including means movable with said contact means, for actuating both of the said reversing switches to cause reversal of the said moving means and of said contact means at each end of its travel, and means coupled to the other side of said source and to the output of each of said reversing switches for reversibly rotating said electrical motor and antenna to the rotational position that corresponds to the predetermined longitudinal position of the disconnect means on the contact bar selectively energized in accordance with the station selected by the tuner control.

9. Apparatus as in claim 8 wherein the means for actuating both of said reversing switches causes those reversing switches to be actuated to opposite on-off conditions when the said means that is movable with the contact means actuates either one of the switches at the respective end of its travel.

10. Apparatus as in claim 9 wherein the reversing switch actuating means includes an internally threaded block which carries a plurality of electrically interconnected spring contactors for respectively contacting said N and common contact bars,

said reversible moving means including a reversible electric motor and a threaded shaft coupled thereto and to the said threads of said block,

the output of said reversing switches being coupled to opposite directional energizing inputs of said electrical motor,

said disconnect means being respective circuit breakers lengthwise adjustable of the respective N bars for

depressing said spring contactors respectively as said block moves adjacent the respective circuit breaker.

11. A system comprising a television receiver,
 a rotatable antenna therefor disposed at a remote location,
 a first reversible electric motor disposed adjacent said antenna for rotating the antenna in either of opposite directions,
 said receiver having a tuner control including a shaft rotatable to any one of a plurality of angular positions for tuning the receiver to a like number of frequency channels, and
 a control mechanism disposed adjacent said tuner control for controlling the said first motor and thereby the rotational position of said antenna automatically in accordance with which of the stations is selected by said tuner control shaft;
 said mechanism comprising a contact bar selector having an arm mechanically coupled to rotate with said tuner control shaft,
 a plurality of first contact bars insulatively extending lengthwise substantially coextensively and corresponding respectively to the channels selectable by said tuner control,
 means for coupling one side of a source of electrical energy to said selector arm for selectively energizing said first contact bars,
 a block having a predetermined peripheral configuration and having an axially extending threaded aperture,
 a second reversible electric motor,
 a threaded shaft engaging the threaded aperture of said block and being coupled to the output of said motor for causing said block to move longitudinally of said threaded shaft in either direction according to the direction of rotation of said second electrical motor,
 a plurality of first spring contactors electrically interconnected and disposed about the periphery of said block,

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said contact bars being also disposed about the periphery of said block so that said spring contactors respectively engage the contact bars during movement of the block along the path of said threaded shaft,
 a further contact bar,
 a further contactor on said block electrically connected with each of the aforesaid spring contactors for making continuous engagement with said further contact bar,
 a pair of electrical switches each having respective on and off conditions effected by a movable arm, said arms being commonly coupled to said further contact bar and said switches being disposed at opposite ends of the travel of said block so as to be actuatable thereby,
 means mechanically coupling the output contacts of said switches together to cause either switch to change to its opposite condition upon the other being actuated from that condition by said block, and
 means for electrically coupling the output contacts of said switches to both of the aforesaid motors to cause same to rotate in corresponding angular directions simultaneously and to be reversed or stopped at the same time, actuation of said switches by said block being effective to reverse the direction of rotation of said motors, and the respective circuit breaker on the energized one of the first contact bars corresponding to the channel selected by the tuner control effecting a stop of the motors by breaking engagement between that contact bar and the associated spring contactor.

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