United States Patent [19]

LeFevre

[11] **3,801,897**

[45] **Apr. 2, 1974**

[54] **CONTROL CIRCUITRY FOR REMOTE TUNING SYSTEM**

[75] Inventor: **Paul Eshelman LeFevre**, Pavilion, N.Y.

[73] Assignee: **GTE Sylvannia Incorporated**, Seneca Falls, N.Y.

[22] Filed: **Jan. 26, 1973**

[21] Appl. No.: **326,828**

[52] **U.S. Cl.** **334/8**, 334/10, 334/15, 325/392, 325/466

[51] **Int. Cl.** **H03j 1/00**

[58] **Field of Search** 334/8, 9, 10, 15; 325/392, 325/393, 466

[56] **References Cited**

UNITED STATES PATENTS

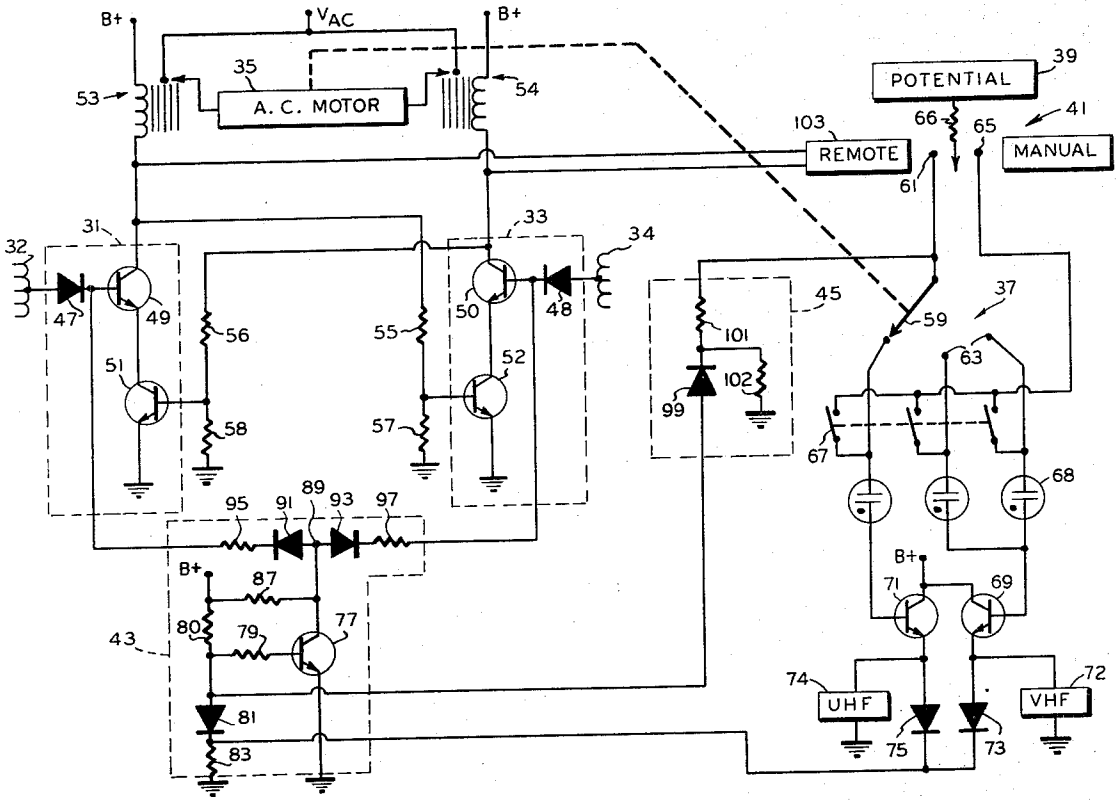
2,888,625	5/1959	Farrell et al.	334/9 X
3,116,454	12/1963	Morris	334/9 X
2,905,014	9/1959	Travis et al.	334/9 X
3,325,593	6/1967	Platt et al.	334/8 X
3,044,016	7/1962	Frihart et al.	334/10 X
3,266,021	8/1966	Druz et al.	334/8 X
3,573,684	4/1971	Dickinson	334/8

Primary Examiner—Archie R. Borchelt
Assistant Examiner—Saxfield Chatmon, Jr.
Attorney, Agent, or Firm—Norman J. O'Malley; Thomas H. Buffton; Cyril A. Krenzer

[57] **ABSTRACT**

In a signal receiver having pushbuttons for tuning individual signal channels, a control circuit for a remote tuning system includes a bi-directional motor coupled to first and second potential development means each responsive to opposite directional rotation signals and to a rotary switching means for selectively coupling a potential source to a selected channel contact in accordance with the selected rotational direction signal. A potential sustaining means couples the rotary switching means to the first and second potential development means and insures continued rotation of the rotary switching means intermediate the signal channel contacts.

16 Claims, 3 Drawing Figures



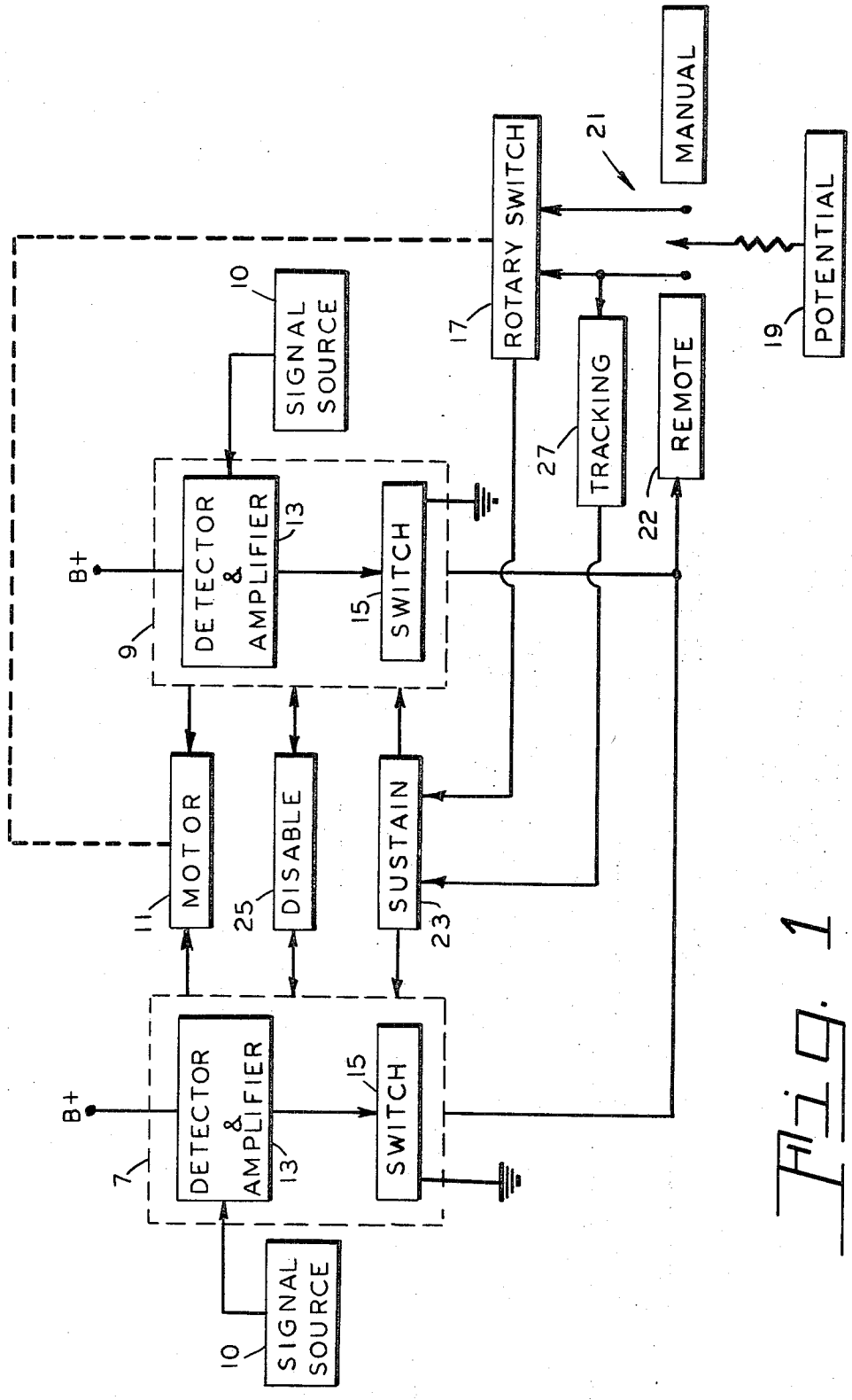

MANUAL
21
ROTARY SWITCH
17
POTENTIAL
19
10
SIGNAL SOURCE
TRACKING
27
REMOTE
22
B+
9
DETECTOR & AMPLIFIER
13
15
SWITCH
MOTOR
11
DISABLE
25
SUSTAIN
23
B+
7
DETECTOR & AMPLIFIER
13
15
SWITCH
10
SIGNAL SOURCE

Fig. 1

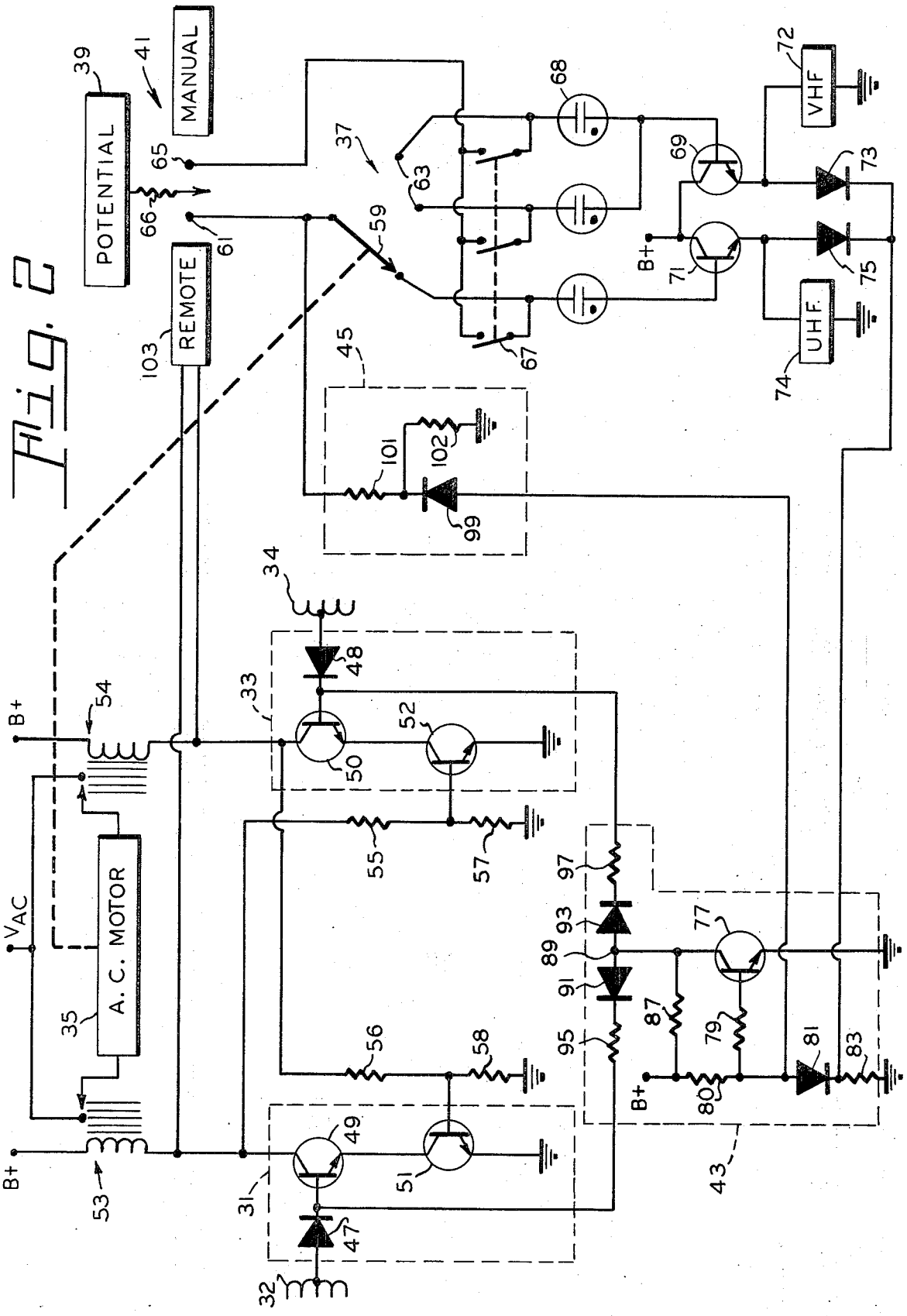


Fig. 2

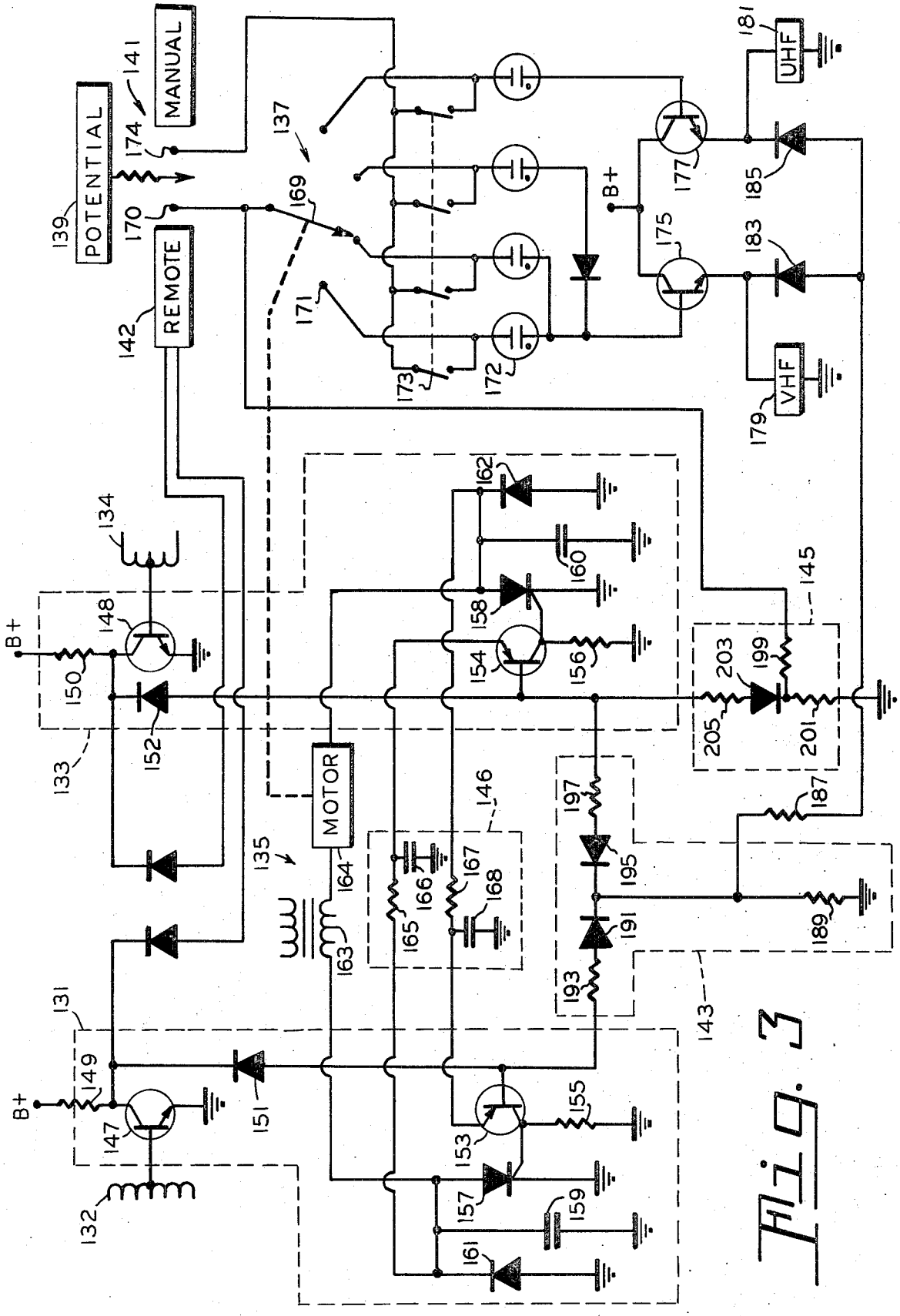

POTENTIAL
MANUAL
REMOTE
MOTOR
UHF
VHF
B+
139
141
142
170
174
137
169
171
172
173
175
177
179
181
183
185
131
133
134
135
143
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
187
189
191
193
195
197
199
201
203
205

Fig. 3

CONTROL CIRCUITRY FOR REMOTE TUNING SYSTEM

CROSS-REFERENCE TO OTHER APPLICATIONS

An application entitled "Pushbutton Tuning System" filed concurrently herewith in the names of William Lee Arrington and Lee Irving Merz, application Ser. No. 326,759, relates to a pushbutton type signal channel selector. An application entitled "Varactor Tuner Band Switching Circuitry" filed concurrently herewith in the name of the inventor of the present application and application Ser. No. 326,758 relates to band-switching apparatus suitable for use with the apparatus of the present application. Also, an application entitled "Varactor Tuner Band Switching and Signal Indicating Circuitry" filed concurrently herewith in the name of the inventor of the present application and application Ser. No. 326,829 relates to a combined band switching and signal indicating circuit suitable for use with the present apparatus.

BACKGROUND OF THE INVENTION

The invention relates to control circuitry for a remote tuning system in a signal receiver. A bi-directional motor responds to first and second transmitted signals to effect directional rotation of a rotary switching means and selection of a desired signal channel.

Generally, remote control systems of the wireless type include an ultrasonic tone transmitter which provides a pair of signals at differing signal frequencies. A receiver includes detection apparatus for providing a pair of signals which control a bi-directional motor. Thus, one signal from the tone transmitter causes advancement of the remotely driven tuner in one rotational direction while the other signal causes an opposite rotation of the remotely driven tuner.

Although the above-mentioned technique was satisfactory for years, the advent of compatible tuning for UHF and VHF signal bands has presented numerous problems, and particularly with respect to remote tuning systems. For example, UHF and VHF tuning must be substantially similar which would necessitate additional signals for controlling the UHF signal band in the same manner as the VHF signal band. Moreover, control signal frequencies are typically selected from a range between the second and third harmonics of the 15,750 kHz horizontal oscillator frequency and this range of frequencies is severely restricted.

As a result of the requirement for compatible UHF and VHF tuning and the limited range of available signals within a frequency range desirable for effecting remote control of signal channel selection, there has been a trend toward varactor or varicap tuners and a multiple pushbutton technique. Thus, a separate pushbutton is employed for each signal channel and each signal channel provides a distinct potential whereby the varactor tuner selects a given tuning frequency. Moreover, a remote control system must respond to external signals in a manner such that a result is obtained which duplicates or corresponds to the ordinary manual signal channel selection capability.

One known technique for remotely controlling a multiple pushbutton type tuning apparatus includes a printed circuit switching means having a multitude of diodes and transistors. Obviously, such an elaborate system is not only costly but also is most difficult to service. Moreover, the system leaves much to be desired with respect to manual response time as well as reliability and dependability of components.

OBJECTS AND SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide an enhanced control circuit for a remote control system of a signal receiver. Another object of the invention is to provide an improved control circuit for sustaining directional rotation of a remote control system intermediate signal channel selection. Still another object of the invention is to provide an enhanced bi-directional control circuit for improved operation of a remote control system utilized in a signal receiver having a plurality of signal channels. A further object of the invention is to provide improved control circuitry for a remote control system wherein tracking of manual tuning by the remote tuning apparatus is effected.

These and other objects, advantages and capabilities are achieved in one aspect of the invention by a control circuit for a remote control system wherein a bi-directional motor coupled to first and second potential development means responsive to opposing rotational direction signals is coupled to a rotary switching means for applying a potential to a signal channel and to a sustaining circuit for continuing the directional rotation of the bi-directional motor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a control circuit for a remote control system utilized in a signal receiver having a plurality of signal channels;

FIG. 2 is a schematic illustration of a specific bi-directional control circuit for a remote control system wherein an AC motor is utilized; and

FIG. 3 is a schematic illustration of a control circuit for a remote control system wherein a DC motor is employed to provide bi-directional rotation of a signal channel selector.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following disclosure and appended claims in conjunction with the accompanying drawings.

In the drawings, FIG. 1 is a schematic illustration, in block form, of a control circuit for a remote control system of a signal receiver having a plurality of pushbutton controlled signal channels. Herein, first and second potential development means 7 and 9 are each coupled to a signal source 10 of a different frequency and to a bi-directional motor 11. Also, each one of the first and second potential development means 7 and 9 is coupled to a potential source B+ and a potential reference level such as circuit ground. Moreover, each of the first and second potential development means 7 and 9 includes detector and amplifier circuitry 13 as well as switching means 15 for effecting development of a control potential in response to a received signal.

A rotary switching means 17 having a plurality of individual signal channel contacts and a rotatable arm member is mechanically coupled to the bi-directional motor 11. The rotary switching means 17 is selectively coupled to a potential source 19 by a remote-manual

switching means 21. Also, the rotary switching means 17 is coupled to a potential sustaining means 23 which is, in turn, coupled to the first and second potential development means 7 and 9. Moreover, the remote-manual switching means 21 includes a remote solenoid means 22 which is coupled and responsive to the first and second potential development means 7 and 9.

Additionally, a disablement circuit 25 interconnects the first and second potential development means 7 and 9 to effect inoperation of one during operation of the other. Also, a tracking means 27 couples the junction of the remote-manual switching means 21 and rotary switching means 17 to the potential sustaining means 23.

As to operation, a remote tone transmitter provides a signal of a given frequency at the signal source 10 and this signal is applied to and activates one of the first or second signal potential development means 7 or 9. Therein, a signal representative of a given direction of rotation causes development of a potential which is applied to the bi-directional motor means 11 to effect rotation in a desired direction. At the same time, a potential from one of the first and second signal potential development means 7 or 9 is applied to the remote-manual switching means 21 to effect coupling of the power source 19 to the rotary switching means 17 which includes a rotatable arm and a plurality of signal channel contacts.

As the bi-direction motor means 11 moves in a given rotational direction, the rotatable arm of the rotary switching means 17, which is mechanically coupled to the motor means 11, advances from one signal channel contact toward another.

During the period when the rotatable arm is advancing from one signal channel contact toward another, the signal applied to the potential development means 7 or 9 may cease leaving the rotatable arm between contacts whereupon the potential from the power source 19 is no longer available to the bi-directional motor means 11. Thereupon, the potential sustaining means 23 alters the operation of one of the potential developing means 7 or 9 in a manner such that the initiated directional rotation of the bi-directional motor means 11 is maintained. Thus, the rotational arm advances to a following signal channel contact. In this manner, a signal from a remote tone generator initiates rotational movement of the motor means 11 and the sustaining circuitry means 23 maintains the initiated rotational movement until a following signal channel contact is reached by the rotatable arm of the rotary switching means 17.

Also, the disablement circuitry 25 responds to activation of one of the first and second potential development means 7 or 9 to render the other one of the first and second potential development means 7 or 9 inoperative. In other words, activation of one potential development means 7 to effect rotation of the motor means 11 in one direction is accompanied by inactivation of the other potential development means 9 for effecting an opposite rotational direction of the motor means 11.

Further, tracking of manual tuning by a remote tuning circuit involves application of a potential from the potential source 19 via the remote-manual switching means 21 and rotary switching means 17 to the tracking circuitry 27. However, manual selection of another signal channel interrupts the above-mentioned potential from the potential source 19 whereupon the tracking circuitry 27 and sustaining circuitry 23 provides a potential which continues to energize one of the potential development means 7 or 9, which in turn, energizes the bi-directional motor means 11. Thereupon, the rotatable arm of the rotary switching means 17 is moved until contact with the manually selected signal channel contact by the rotatable arm is effected. Thus, manual signal channel selection is accompanied by automatic remote signal channel tracking and a remote system "tracks" or follows manual signal channel selection to eliminate undesired confusion when remote control is again utilized.

In a preferred embodiment, FIG. 2 illustrates a control circuit for a remote control system wherein an AC motor is utilized. Herein, first and second potential development means 31 and 33 are each connected to a signal source 32 and 34, and to a potential source B+ (for bi-directional control of an AC bi-directional motor means 35.) The bi-directional motor means 35 is mechanically coupled to a rotary switching means 37 which is, in turn, electrically connected to a potential source 39 by a remote-manual switching means 41.

The rotary switching means 37 is coupled to a potential sustaining means 43 which is, in turn, coupled to the first and second potential development means 31 and 33. A tracking circuit 45 couples the junction of the rotary switching means 37 and the remote-manual switching means 41 to the potential sustaining means 43. Also, the remote-manual switching means 41 is coupled to the first and second potential development means 31 and 33.

More specifically, each of the first and second potential development means 31 and 33 includes a diode 47 and 48, amplifier stage 49 and 50, and switching stage 51 and 52. The diodes 47 and 48 are coupled to the signal source 32 and 34 and to the base of the amplifier stages 49 and 50 while the collectors of the amplifier stages 49 and 50 are coupled to a potential source B+ via the winding coils of relays 53 and 54 coupled to the AC motor means 35. The collector of each of the amplifier stages 49 and 50 is also coupled to the base of the opposite switching stage 52 and 51 of the potential development means 33 and 31 by first resistors 55 and 56 and to circuit ground respectively by series connected second resistors 57 and 58. Also, the emitter of the amplifier stages 49 and 50 of each of the first and second potential development means 31 and 33 is coupled to the collector of the switching stages 51 and 52 respectively which have an emitter coupled to circuit ground.

The bi-directional AC motor means 35 is mechanically coupled to a rotatable arm 59 of the rotary switching means 37. The rotatable arm 59 is coupled to a first terminal 61 of the remote-manual switching means 41 and selectively connectable to each one of a plurality of signal channel contacts 63. All of the signal channel contacts 63 are connected to a second terminal 65 of the remote-manual switching means 41 by manually operable switches 67 with the first and second terminals 61 and 65 of the remote manual switching means 41 selectively coupled by a resistor 66 to the potential source 39.

Each one of the signal channel contacts 63 is directly coupled to a neon lamp 68. The manually operable switches 67 are mechanically interconnected to render only a single switch operative at any one time as set

forth in the above-mentioned "Pushbutton Tuning System". The neon lamps **68** are collectively coupled in band switching groups by way of a pair of transistors, **69** and **71**, to VHF and UHF varistor or varicap tuners, **72** and **74**, and by way of a pair of diodes, **73** and **75**, to the potential sustaining means **43**.

The potential sustaining means **43** includes a transistor **77** having a base electrode coupled by series connected resistors **79** and **80** to a potential source B+ and by the series connected resistor **79**, diode **81**, and resistor **83** to circuit ground. The junction of the series connected diode **81** and resistor **83** is coupled to the diodes **73** and **75** of the rotary switching means **37**. The emitter electrode of the transistor **77** is coupled to circuit ground while the collector electrode is coupled to the potential source B+ by a resistor **87** and to the junction **89** of a pair of back-to-back diodes **91** and **93**. Each of the diodes **91** and **93** is connected by a resistor, **95** and **97** respectively, to the junction of the diodes **47** and **48** and base electrode of the amplifier transistors **49** and **50** in each of the first and second potential development means **31** and **33**.

Additionally, a tracking circuit **45** includes a series connected diode **99** and resistor **101** with a resistor **102** coupling the junction thereof to circuit ground. This tracking circuit **45** is coupled intermediate the junction of the rotatable arm **59** of the rotary switching means **37** and the first terminal **61** of the remote-manual switching means **41** and the junction of the series connected resistor **80** and diode **81** of the potential sustaining means **43**. Moreover, the remote-manual switching means **41** includes a relay means **103** coupled to the junction of the relays **53** and **54** which control the bi-directional motor means **35** and the first and second potential development means **31** and **33**.

As to an example of operation, the bi-directional AC motor **35** rotates clockwise upon energization of the first potential development means **31** and counter-clockwise upon energization of the second potential development means **33**. When neither of the potential development means **31** or **33** is energized, the motor **35** does not rotate.

An amplified remote signal of a given frequency applied to the signal source **32** causes current to flow through the diode **47** of the first potential development means **31**. Thereupon, current flows through the base-emitter junction of the amplifier stage **49**, and collector-emitter junction of the switching stage **51** to circuit ground. Current flowing through the base-emitter junction of the amplifier stage **49** causes current flow from the potential source B+, through the coil winding of the control relay **53**, through the collector-emitter junction of amplifier **49** and the collector-emitter junction of the switching means **51** to circuit ground. Therefore, the motor means **35** rotates in a clockwise direction.

When the motor means **35** rotates, the shaft thereof is mechanically coupled to the rotatable arm **59** of the rotary switching means **37** whereupon the rotatable arm **59** advances from one toward another of the signal channel contacts **63**. As the rotatable arm **59** leaves one of the signal channel contacts **63** to advance to another, base-emitter current to the transistors **69** and **71** supplied from the potential source **39** via the resistor **66**, remote-manual switch means **41**, rotatable arm **59**, and neon bulb **68** is interrupted. Moreover, the current for the VHF and UHF tuners **72** and **74**, which is supplied through the collector-emitter junctions of the transistors **69** and **71** from the source B+, is also interrupted whereupon the potential B+ does not appear at the VHF and UHF tuners **72** and **74** nor at the cathode of the diode **81** of the potential sustaining means **43**.

With the removal of the potential B+ from the cathode of the diode **81**, the diode **81** is no longer back biased and conducts current supplied by the potential source B+ via the resistors **80**, and **83** to circuit ground. Since the diode **81** is conducting, the current from the potential source B+ which would otherwise flow through the resistors **80** and **79** and the base-emitter junction of the transistor **77** flows through the diode **81** whereupon the transistor **77** is non-conducting. With the transistor **77** turned off, current from the potential source B+ will flow through the resistor **87**, diode **91**, resistor **95**, base-emitter junction of the amplifier transistor **49**, and collector-emitter junction of the switching transistor **51** to circuit ground. Thus, base-emitter current flow in the amplifier transistor stage **49** which was initiated by a remote signal by way of the signal source **32** and diode **47** is no longer dependent upon the initiating remote signal.

Rather, the potential sustaining means **43** assures that the motor means **35** will continue to drive the rotatable arm **59** of the rotary switching means **37** until a succeeding signal channel contact **63** is attained.

Thereupon, base-current flow in the transistors **69** or **71** will be reinstated due to the potentials applied thereto from the potential source B+ and the potential source **39** via the resistor **66**, remote-manual switching means **41**, and rotatable arm **59**. Moreover, the above-mentioned potential available through the diodes **73** and **75** will once again back bias the diode **81** of the potential sustaining means **43** rendering the diode **81** non-conductive.

With the diode **81** non-conductive, current will now flow from the potential source B+ through the resistors **80** and **79** and and the base-emitter junction of the transistor **77** to circuit ground. The collector-emitter current of the transistor **77** will flow from the potential source B+ through the resistor **87** and transistor **77** to circuit ground. This current flow renders the collector electrode of the transistor **77** at a potential substantially at or near circuit ground potential whereupon current flow through the diode **91** will essentially cease. Since the remote signal has been removed and current flow through the diode **91** has ceased, the transistor amplifier **49** is turned off which, in turn, interrupts current flow through the winding of relay **53** whereupon the bi-directional motor **35** ceases to rotate.

Further, continued rotation of the rotatable arm **59** in the initiated direction is assured by a disablement circuit arrangement whereby energizing current for the winding of the relay **53** coupled to the first potential development means **31** must pass through the collector-emitter junction of the switch transistor **51**. Energizing current for the winding of the relay **54** coupled to the second potential development means **33** must pass through the collector-emitter junction of the switch transistor **52** of the second potential development means **33**.

The base-emitter current for the switch transistor **52** of the second potential development means **33** is supplied from the potential source B+ via the coil winding of the relay **53** coupled to the first potential development means **31** and the resistor **55** coupled to the base electrode of the switch transistor **52** of the second po-

tential development means 33. When the transistor amplifier 49 of the first potential development means 31 is turned on, the collector voltage drops to a value low enough to prevent current flow through the resistor 55 and the base-emitter junction of the switching transistor 52 of the second potential development means 33. Thus, the switching transistor 52 is turned off.

The potential appearing at the diode 91 which assures continued rotation of the motor means 35 in the initial direction also appears at the diode 93. However, the current path through the diode 93 and through the base-emitter junction of the amplifier 50 of the second potential development means 33 is broken at the collector-emitter junction of the switching transistor 52 which is in a non-conductive state. Thus, continued rotation in the desired direction is assured.

When the rotatable arm 59 of the rotary switching means 37 reaches another signal channel contact 63, the potential applied to the VHF or UHF tuners 72 and 74 from the potential source 39 is restored. Also, the amplifier stages 49 and 50 of each one of the first and second potential development means 31 and 33 are turned off while the switching transistors 51 and 52 of each of the potential development means 31 and 33 are turned on due to the current flow through the coil winding relays 53 and 54 and resistors 55 and 56. However, current flow through the coil windings of the relays 53 and 54 is insufficient to energize the relays 53 and 54 but renders the system receptive to initiation in either rotational direction.

Further, rotation in a counterclockwise direction of the motor means 35 and rotatable arm 59 to effect a signal channel selection is initiated and continued in a manner substantially as described above. However, the amplified remote signal is applied from the signal source 34 causing current flow through the diode 48 and the base-emitter junction of the amplifier transistor 50 of the second potential development means 33. The operation is similar to clockwise rotation except for the substitution of the coil winding relay 54 for the coil winding relay 53 of the motor means 35, transistor 50 for transistor 49, switch transistor 52 for switch transistor 51, resistor 56 for resistor 55 and diode 93 for diode 91.

Additionally, the tracking means 45 provides tracking of manual tuning by a remote tuning circuit. Herein, manual signal channel selection is effected by closure of one of the manually operable switches 67 of the rotary switching means 37 whereupon the remaining interconnected channel selecting switches are opened as set forth in the co-pending application entitled "Pushbutton Tuning System."

With one of the manual switches 67 closed, current flows from the potential source 39, through the second terminal 65 of the remote-manual switching means 41, through the closed manual switch 67, the rotatable arm 59 of the rotary switching means 37, the resistor 101 of the tracking means 45, and to the diode 99 to effect bias biasing or non-conduction of the diode 99. Also, current from the potential source B+ flows through resistors 80 and 79 and through the base-emitter junction of the transistor 77. Thereupon, the transistor 77 is rendered conductive from emitter to collector with the collector coupled to the junction 89 of the diodes 91 and 93 and the emitter coupled to circuit ground. Thus, the junction 89 of the diodes 91 and 93 is very near circuit ground potential preventing current flow through the diodes 91 and 93 to the amplifier stages 49 and 50. Moreover, without base-emitter current flow in either of the amplifier stages 49 and 50 nor in the windings 53 and 54 the motor means 35 will not run in either direction and the rotatable arm 59 remains fixed.

However, selection of a different one of the manually operable signal channel switches 67 opens the previously selected signal channel switch 67. Thereupon, continuity from the potential source 39 to the diode 99 is interrupted and the diode 99 is no longer back biased and current flows from the potential source B+ through the resistor 80, the diode 99, and resistor 102 to circuit ground. Thereupon, base-emitter current will no longer flow in the transistor 77 which, in turn, will no longer conduct a collector-emitter current. Thus, current will flow from the potential source B+ through resistor 87 to the diodes 91 and 93 and to the amplifier stages 49 and 50 to effect base-emitter current flow in one of the amplifier stages 49 or 50. By inherent imbalance due to parts tolerances in the amplifier stages 49 and 50, one of the coil windings of the relays 53 and 54 will have current flow therethrough in an amount sufficient to energize the motor means 35 which, in turn, will activate the rotatable arm 59 until the manually selected signal channel switch 67 is attained. Thus, the remote system "tracks" or follows the manual operation.

Alternatively, FIG. 3 illustrates a control circuit for a remote control system wherein a DC motor and circuitry are employed. Herein, first and second potential development means 131 and 133 are each connected to a signal source, 132 and 134 respectively, and to a potential source B+. A bi-directional DC motor means 135 is mechanically coupled to a rotary switching means 137. The rotary switching means 137 is coupled to a potential source 139 by way of a remote-manual switching means 141.

The rotary switching means 137 is coupled to a potential sustaining means 143 which is, in turn, coupled to the first and second potential development means 131 and 133. Also, the remote-manual switching means 141 includes a remote solenoid 142 which is coupled to the first and second potential development means 131 and 133.

Additionally, tracking means 145 couples the junction of the rotary switching means 137 and remote-manual switching means 141 to the junction of the potential sustaining means 143 and the second potential development means 133. A disablement circuit 146 interconnects the first and second potential development means 131 and 133 whereby inoperation of one of the potential development means 131 or 133 is effected upon operation of the other.

More specifically, each of the first and second potential development means 131 and 133 includes a detector transistor 147 and 148 having a base electrode coupled to a signal source 132 and 134, an emitter electrode coupled to circuit ground, and a collector electrode coupled to a potential source B+ by a resistor 149 and 150 and to a diode 151 and 152. The diodes 151 and 152 are connected to the base of amplifier transistors 153 and 154 which have a collector electrode connected by a resistor 155 and 156 to circuit ground and to the gate of a silicon control rectifier (SCR) 157 and 158.

Each one of the SCR's 157 and 158 has a cathode electrode directly connected to circuit ground and an anode electrode coupled to circuit ground by a parallel

connected capacitor 159 and 160 and diode 161 and 162. The anode electrodes of the SCR's 157 and 158 are interconnected by a series connected transformer winding 163 and DC motor means 164. Also, the disablement circuit 146 includes a resistor 165 coupled to circuit ground by a capacitor 166 and interconnecting the anode of the SCR 157 and the emitter electrode of the amplifier transistor 154 while a resistor 167 is coupled to circuit ground by a capacitor 168 and interconnects the anode of the SCR 158 and the emitter electrode of the amplifier transistor 153.

The bi-directional DC motor 164 is mechanically coupled to the rotary switching means 137 and more specifically to a rotatable arm 169. The rotatable arm 169 is electrically connected to a remote terminal 170 of the remote-manual switching means 141 and to the tracking means 145. Also, the rotatable arm 169 is selectively connected to one of a plurality of signal channel contacts 171 each of which is connected to a neon lamp 172. A manually operable switch 173 is coupled to the junction of each one of the signal channel contacts 171 and neon lamps 172 and connected in common to a manual terminal 174 of the remote-manual switching means 141. Moreover, the manually operable switches 173 are mechanically interconnected to provide non-conduction of all except a selected one of the switches 173.

The neon lamps 172 are connected in parallel coupled band switching groups to the base of a pair of transistors 175 and 177 which are connected to VHF and UHF varactor tuners 179 and 181 and by way of a pair of diodes 183 and 185 and a resistor 187 to the potential sustaining means 143. The potential sustaining means 143 includes a resistor 189 coupling the resistor 187 to circuit ground with a first series connected diode 191 and resistor 193 coupling the resistor 187 to the base electrode of the amplifier transistor 153 and a second series connected diode 195 and resistor 197 coupled to the first diode 191 and resistor 187 and to the base electrode of the amplifier transistor 154.

Further, the tracking means 145 includes a pair of resistors 199 and 201 series connected intermediate the remote terminal 170 of the remote-manual switching means 141 and circuit ground. A series connected diode 203 and resistor 205 connects the junction of the series connected resistors 199 and 201 to the junction of the potential sustaining means 143 and second potential development means 133.

As to operation, applying a signal from a remote transmitter to the signal source 132, for example, causes base-emitter current flow which renders the detector transistor 147 conductive and causes the collector electrode of the detector transistor 147 to assume a potential very close to circuit ground potential. Thereupon, the diode 151 coupled to the collector electrode of the detector transistor 147 lowers the base electrode of the amplifier transistor 153 below the potential of the emitter electrode. This emitter electrode potential is supplied from the transformer winding 163 and rectified by the diode 162 and filtered by the capacitors 160 and 168 whereupon conduction of the amplifier transistor 153 is effected.

When the amplifier transistor 153 conducts, current supplied by the transformer winding 163 flows through the DC motor 164, the amplifier transistor 153, the gate circuit of the SCR 157, and the diode 161 back to the transformer winding 163. As a result of the current flow through the gate electrode of the SCR 157, the SCR 157 is turned on which starts the DC motor 164 and causes it to run in a given direction. Moreover, conduction of the SCR 157 causes the anode electrode to approach ground potential whereupon the potential at the emitter of the amplifier transistor 154 is removed rendering the amplifier transistor 154 non-conductive. Moreover, as the rotatable arm 169 advances intermediate the signal channel contacts 171, the voltage from the potential source 139 which would cause B+ potential to be applied to the VHF or UHF tuner 179 or 181, is interrupted. Thereupon, the junction of the diodes 191 and 195 approaches circuit ground level by way of the inactivated VHF or UHF tuners 179 or 181. Thus, rotation is continued until a following signal channel contact 171 is attained by the rotatable arm 169.

Further, remote tracking of manual operation is effected in a manner similar to that previously explained with respect to the AC version of a remote control system. Briefly, a potential from the potential source 139 is applied via contact 174 via a closed manual switch 173, the rotatable arm 169 and resistor 199 to the cathode of diode 203 causing diode 203 to be non-conductive and amplifier transistor 154 turned off. Upon closure of another one of the manually operable switches 173, the above-mentioned potential path is interrupted causing diode 203 to be conductive through resistors 201 and 205 to ground which turns amplifier transistor 154 on until the above-mentioned potential path is re-established by rotation of arm 169 to the closed switch 173.

Thus, there has been provided a unique remote control system having an enhanced control circuit. The system features both AC and DC operational versions as well as circuitry for effecting tracking of manual tuning by remote tuning circuitry. Also, the improved control circuitry includes a sustaining circuit whereby a given direction of rotational movement is maintained until a desired signal channel is attained. Moreover, a disablement circuit insures disablement of circuitry for effecting opposite directional rotation until a desired amount of rotation in the given direction is attained.

While there has been shown and described what is at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention as defined by the appended claims.

What is claimed is:

1. In a signal receiver having a plurality of signal channels, a control circuit for a remote control system comprising:

a source of rotational direction signals and a potential source; bi-directional motor means;

first and second potential development means coupled to said signal source and said motor means;

disablement circuit means interconnecting said first and second potential development means for effecting disablement of one of said first and second potential development means upon enablement of the other of said potential development means;

rotary switching means having a rotatable arm and a plurality signal channel contacts each coupled by a channel indicating means to a varactor tuner means, said arm mechanically coupled to said motor means, electrically coupled to said potential

source, and selectively coupled to one of said plurality of signal channel contacts;

tracking means coupled to said rotary switching means and to said potential sustaining means to effect tracking of manual tunings by said remote control system;

potential sustaining means coupled to said rotary switching means and to said first and second potential development means for effecting continued rotation of said motor means intermediate coupling of said rotatable arm to one of said plurality of signal channel contacts; and

remote-manual switching means having first and second terminals coupled to said rotary switching means and a remote solenoid means coupled to said first and second potential development means for selectively coupling said first and second terminals to said potential source.

2. The control circuit of claim **1** wherein each one of said first and second potential development means includes signal detector means, amplifier means, and switching means coupled to said signal source and said bi-directional motor means.

3. The control circuit of claim **1** wherein said potential sustaining means includes a pair of unidirectional conduction devices coupled to one another and to said first and second potential development means with the junction therebetween coupled to said rotary switching means.

4. The control circuit of claim **1** wherein said rotary switching means includes a plurality of manually operable switches each coupled to a signal channel contact and in common to said remote-manual switching means, said switches being mechanically interconnected to provide closure of only one and opening of all remaining switches at any one time.

5. In a signal receiver having a plurality of signal channels, a control circuit for a remote control system comprising:

a source of rotational direction signals;

a potential source;

bi-directional motor means including an AC motor having a pair of windings;

first and second potential development means coupled to said source of rotational direction signals and to said motor means by way of said windings connected to a potential source;

disablement circuit means wherein each one of said first and second potential development means is coupled to the other by a first impedance with a second impedance coupling said first impedance and one of said first and second potential development means to a potential reference level;

rotary switching means having a rotatable arm and a plurality of signal channel contacts with said rotatable arm mechanically coupled to said AC motor and selectively coupled to one of said plurality of signal channel contacts;

remote-manual switching means coupled to said potential source and selectively connected to said rotary switching means;

potential sustaining means coupled to said rotary switching means and to said first and second potential development means for effecting application of a potential to one of said pair of windings and rotation of said AC motor in accordance with a signal from said source of sustaining signals; and

tracking means in the form of a series connected resistor and diode coupling said rotary switching means to said potential sustaining means.

6. The control circuit of claim **5** wherein each one of said first and second potential development means includes a detector means coupled to said source of rotational direction signals; an amplifier means coupled to said detector means and potential sustaining means, to said AC motor means, and to the opposite one of said first and second potential development means; and a switching means coupled intermediate said amplifier means and a potential reference level and to the opposite one of said first and second potential development means.

7. The control circuit of claim **5** wherein said remote-manual switching means includes a solenoid means coupled to said first and second potential development means for selectively coupling said potential source to said rotary switching means in accordance with a signal from said source of rotational direction signals.

8. The control circuit of claim **5** wherein said potential sustaining means includes an amplifier stage coupled to said rotary switching means for effecting amplification and inversion of a signal provided by said rotary switching means.

9. The control circuit of claim **5** wherein said potential sustaining means includes a diode coupled to said rotary switching means for effecting alteration in the potential applied to said first and second potential development means in accordance with the potential available from said rotary switching means.

10. The control circuit of claim **5** wherein said rotary switching means is coupled to VHF and UHF tuners of the varactor type.

11. The control circuit of claim **5** wherein said rotary switching means includes a plurality of signal channel contacts formed to provide band switching groups with each contact coupled to a channel indicating means, to a manually operable switch means, and selectively coupled to said rotatable arm.

12. In a signal receiver having a plurality of signal channels, a control circuit for a remote control system comprising:

rotational direction signal sources;

a potential source;

bi-directional motor means including a transformer coupled to a power source and having a winding in series connection with a DC motor;

first and second potential development means each coupled to a rotational direction signal source and to said bi-directional motor means;

disablement circuit means having a first capacitor coupled to circuit ground and to a first resistor interconnecting said first and second potential development means and a second capacitor coupled to circuit ground and to a second resistor interconnecting said first and second potential development means;

rotary switching means having a rotatable arm and a plurality of signal channel contacts, said rotatable arm mechanically coupled to said DC motor and selectively coupled to one of said signal channel contacts;

remote-manual switching means coupled to said potential source and selectively coupled to said rotary switching means;

potential sustaining means coupled to said rotary switching means and to said first and second potential development means for effecting continued directional rotation of said DC motor means intermediate contact of said rotatable arm with said signal channel contacts; and

tracking means coupling said rotary switching means to the junction of said potential sustaining means and said second potential development means whereby tracking of manual tuning by a remote tuning circuit is effected.

13. The control circuit of claim **12** wherein said first and second potential development means each include a detector stage coupled to a signal source, an amplifier stage coupled to said detector stage by a diode, and a switching means in the form of a silicon controlled rectifier coupled to said DC motor means.

14. The control circuit of claim **12** wherein each one of said first and second potential development means includes a silicon controlled rectifier coupled to said DC motor means and to a potential reference level and a parallel coupled diode and capacitor shunting said silicon controlled rectifier.

15. The control circuit of claim **12** wherein said remote-manual switching means includes a solenoid means coupled by diodes to said first and to said second potential development means.

16. The control circuit of claim **12** wherein said rotary switching means includes a plurality of parallel coupled and mechanically interconnected signal channel switches whereby closure of one of said switches insures non-closure of any other of the plurality of switches.

* * * * *