

[72] Inventors **Joseph Vincent De Marinis**
Batavia;
Paul Esbelman Le Fevre, Pavillion; Joseph
Edward Thomas, Batavia, all of, N.Y.
 [21] Appl. No. 3,611
 [22] Filed Jan. 19, 1970
 [45] Patented Aug. 3, 1971
 [73] Assignee **Sylvania Electric Products Inc.,**

3,098,212 7/1963 Creamer, Jr. 325/392
 3,502,801 3/1970 Mayle 178/5.8

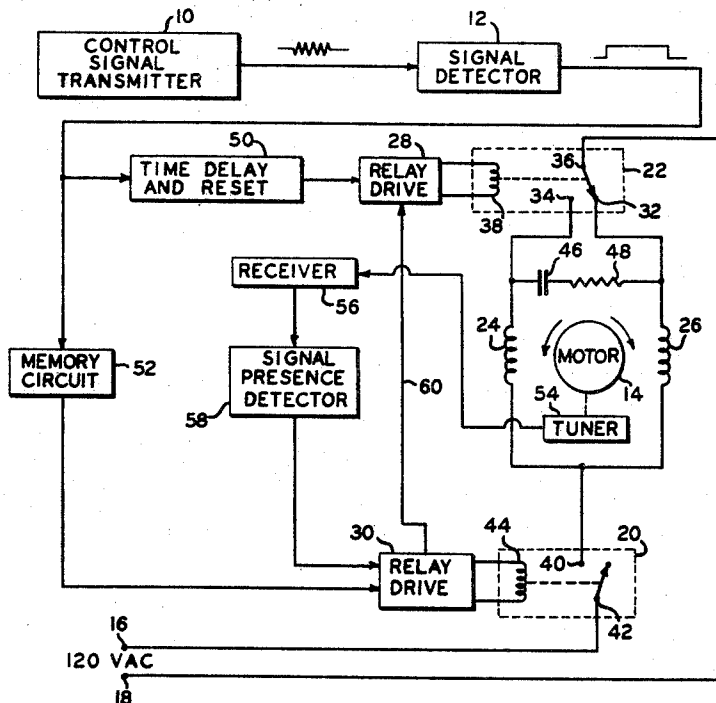
Primary Examiner—Robert L. Richardson
 Attorneys—Norman J. O'Malley, Robert E. Walrath and
 Edward J. Coleman

[54] **BIDIRECTIONAL SIGNAL SEEKING REMOTE CONTROL SYSTEM**
 18 Claims, 3 Drawing Figs.

[52] U.S. Cl. 178/5.8 R,
 325/392, 325/395, 325/471, 334/22
 [51] Int. Cl. H04n 5/44,
 H04b 1/16
 [50] Field of Search 178/5.8 R,
 5.8 F; 325/390, 391, 392, 393, 395, 470, 471;
 334/17—20, 22, 24, 25

[56] **References Cited**
UNITED STATES PATENTS
 2,875,329 2/1959 Paul et al. 325/471 X

ABSTRACT: A single frequency remote control system employing long and short pulses to effect bidirectional rotation of a motor driving a signal seeking UHF television tuner. The system includes an ultrasonic tone transmitter, a receiving transducer, and a signal detector for producing a pulse of duration corresponding to that of the transmitted and received tone. A time delay circuit is coupled to the detector output for actuating a direction control relay in response to a pulse of predetermined duration. Termination of the detector output pulse actuates a second relay to energize the motor windings and thereby cause rotation of the tuner drive shaft in the direction selected by pulse duration. This search mode is sustained by a logic circuit until the presence of both a sync signal and picture carrier indicate a new station has been tuned in. A memory circuit charged during the detector output pulse is operative upon pulse termination to assure the original station is vacated at the start of search.



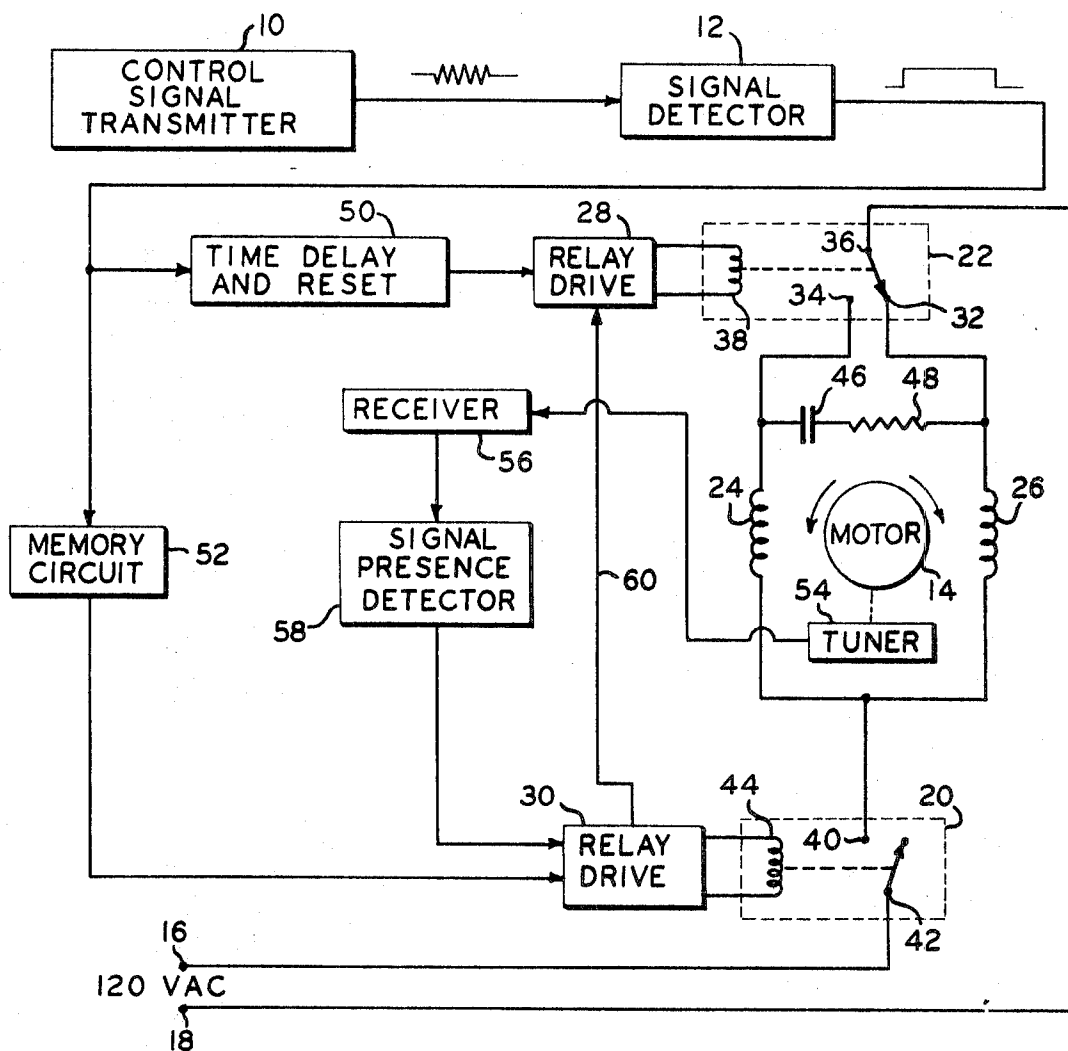
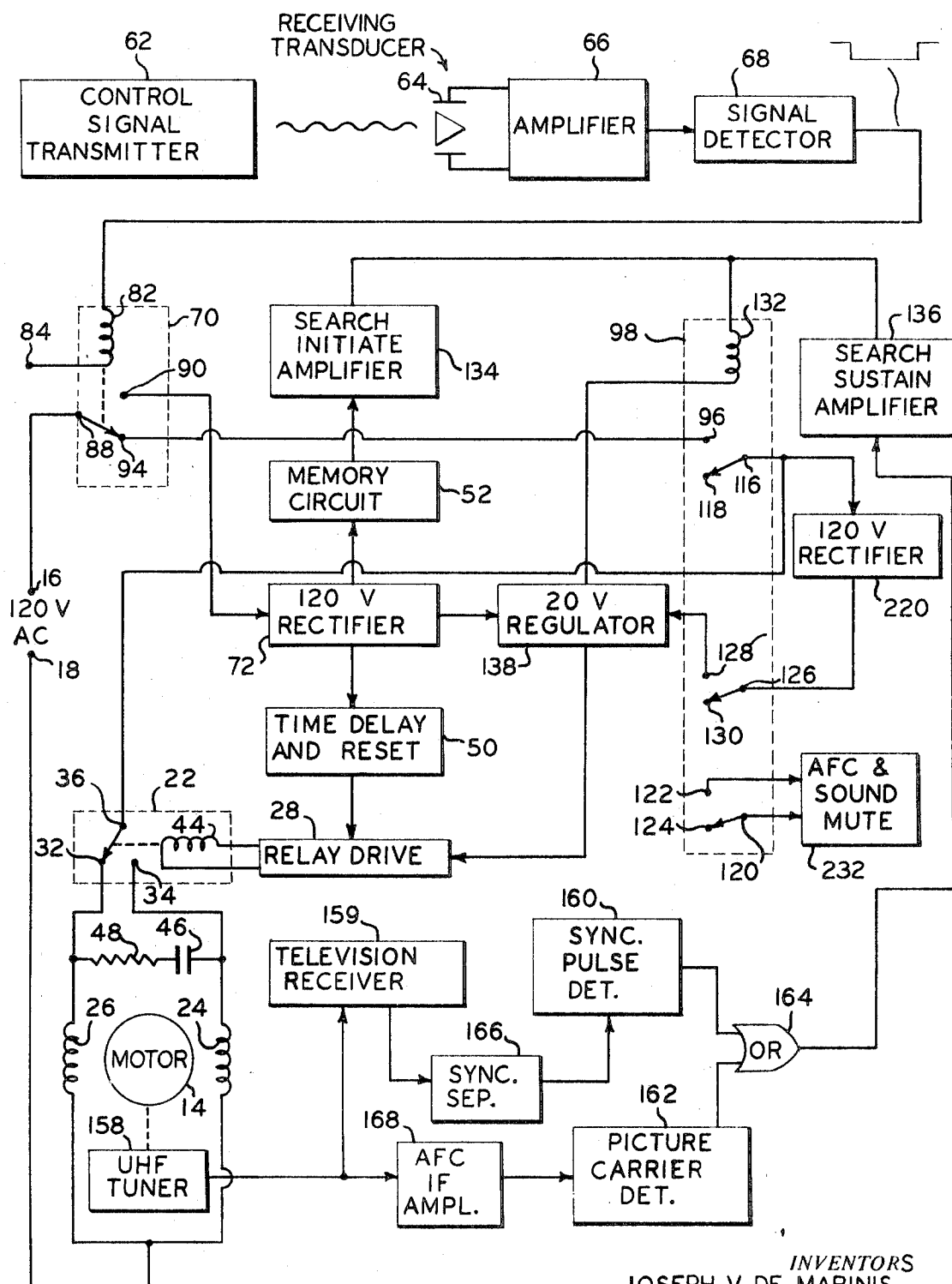


Fig. 1

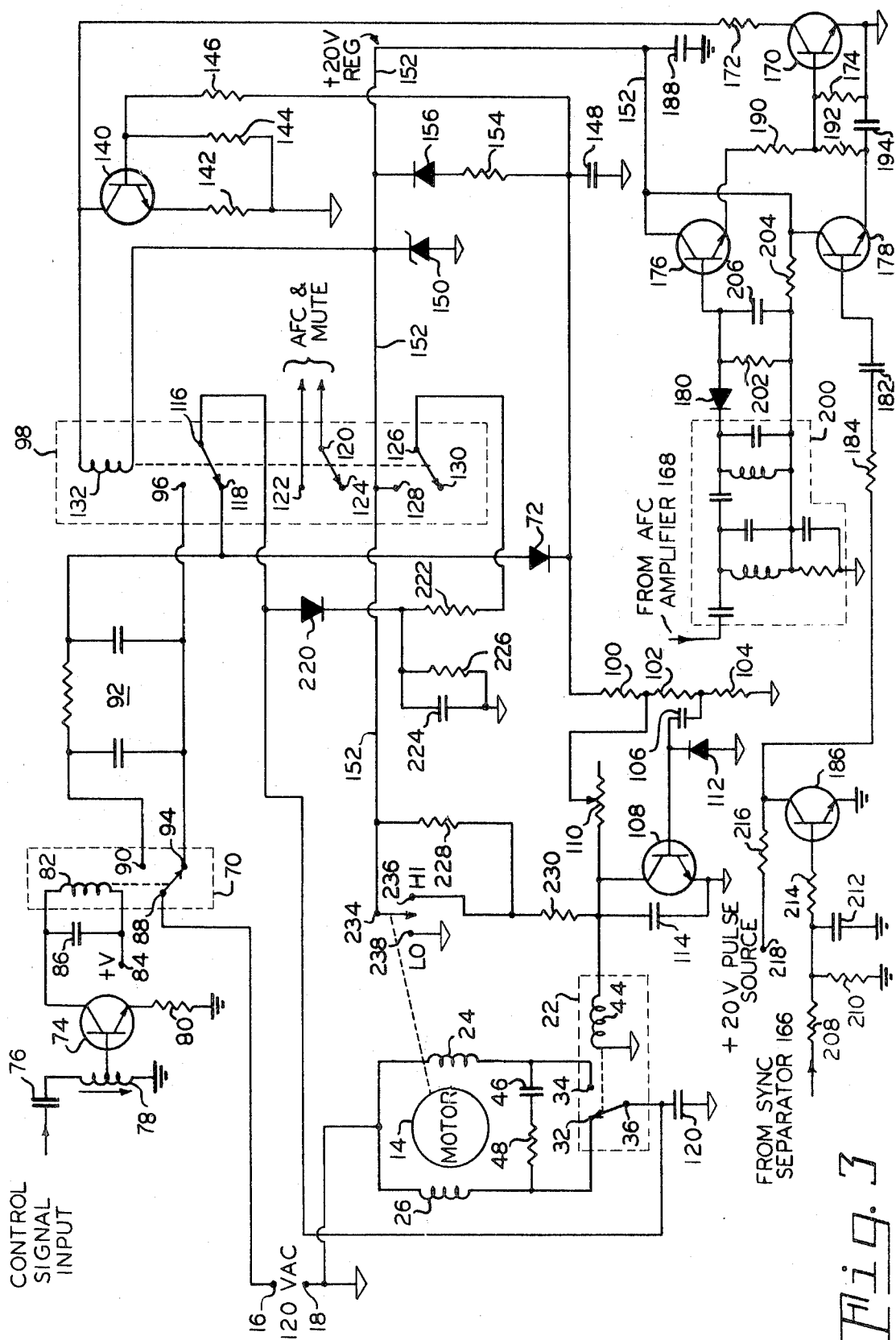
INVENTORS
 JOSEPH V. DEMARINIS,
 PAUL E. LE FEVRE, &
 JOSEPH E. THOMAS
 BY
 Robert E. Walrath
 ATTORNEY



INVENTORS

JOSEPH V. DE MARINIS,
PAUL E. LE FEVRE, &
JOSEPH E. THOMAS

BY *Robert E. Walrath*
ATTORNEY



BIDIRECTIONAL SIGNAL SEEKING REMOTE CONTROL SYSTEM

BACKGROUND OF THE INVENTION

This invention relates generally to motor control systems and, more particularly, to a signal seeking remote control system for a radio frequency receiver employing a bidirectional tuner drive motor.

The typical wireless remote control system for a bidirectional tuning motor includes an ultrasonic tone transmitter, a receiving transducer, signal detection circuits and motor control relays. According to prior art, two tone frequencies are required to provide bidirectional control of the motor. More specifically, each of the two windings of a phase shift synchronous motor are coupled across an alternating current (AC) voltage source through a separate single throw relay, whereby actuation of one relay provides clockwise rotation of the motor, while actuation of the other relay energizes the motor to rotate counterclockwise. The coils of each relay are controlled by respective signal detectors responsive to different control frequencies. Thus, in order to drive the remotely controlled tuner in the upward direction, a first tone frequency is generated from the ultrasonic transmitter to activate a first one of the signal detectors and its corresponding relay to energize the motor in a first direction of rotation. In order to tune in the downward direction, the second tone frequency is transmitted to activate the second one of the signal detectors and its corresponding relay whereby the motor is caused to rotate in the reverse direction. Hence, motor rotation is initiated by generation of the control tone, continues for the duration of the control tone and is terminated at the end of the control tone transmission, the direction of rotation being determined by the frequency of the control tone. Of course, in the case of a signal seeking system, the duration and termination of the control tone is of no effect. That is, the control tone initiates the search process by rotating the motor, but some type of memory circuit maintains energization of the motor until the next station is acquired by the tuner.

Although the above-described two tone remote control system may be suitable for a number of uses, it is somewhat disadvantageous for applications having control frequency limitations. For example, consider an ultrasonic remote control system for a television receiver, wherein the control signal frequencies typically are selected from a range between the second and third harmonics of the 15,750 kHz. horizontal oscillator frequency. Frequencies lower than this range require an undesirably high transmitter power, while frequencies above this range cause transducer problems. To avoid signal ambiguity, a frequency separation of approximately 1.5 kHz. is required. In view of these frequency range and separation requirements, television remote control systems are limited to eight frequencies between approximately 34 and 45 kHz.

Before the advent of remote UHF tuning, color television remote control systems utilized seven frequencies to control three bidirectional motors and a single unidirectional motor to provide the seven functions of volume up or down, color increase or decrease, tint red or green, and unidirectional VHF channel switching. As there are 72 UHF channels, a bidirectional signal seeking system provides the most desirable approach for remote control of the UHF tuner. Consequently, by employing prior art techniques, the remote control of a UHF bidirectional signal seeking system requires two control frequencies. Adding the two UHF tuning functions to the above-described seven color television remote control functions would require nine control frequencies whereas only eight are available. A prior art solution to this problem has been to employ a unidirectional step type volume control to free one of the eight available frequencies for bidirectional control of the UHF tuner. Control of volume by three or four steps, however, forces the user to go through the off position

whenever a reduction, or increase in volume is desired. The temporary increase in volume during this stepping process is also annoying.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an improved motor control system.

It is another object of the invention to provide an improved signal seeking remote control system for a radio frequency receiver having a bidirectional tuning means.

It is a further object of the invention to provide a remote control system employing a single frequency to control bidirectional rotation of a motor driving a signal seeking tuner in a radio frequency receiver.

Briefly, these objects are attained in one aspect of the invention by a bidirectional motor control system including means for generating a pulse of selected duration, a first switching means coupled to the motor for selecting direction of rotation, and means for actuating the first switching means in response to a pulse of predetermined duration from the pulse generating means. A second switching means actuated in response to termination of a pulse from the pulse generating means is provided for selectively connecting and disconnecting an AC or DC voltage source to the motor.

In another aspect of the invention the above objects are provided by a signal seeking system for a radio frequency receiver having bidirectional tuning means. The system includes means for generating a pulse of selected duration, and means for reversing the quiescent direction setting of the tuning means in response to a pulse of predetermined duration from the pulse generating means. Termination of a pulse from the generating means actuates means for applying voltage to the tuning means to cause a first station to be vacated and, thus, initiate search for a second station. A signal presence detection means is coupled to the receiver and operative upon the vacating of the first station to maintain the application of voltage to the tuning means until the second station is acquired.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention will be more fully described hereinafter in conjunction with the accompanying drawings, in which:

FIG. 1 is a simplified functional block diagram of a bidirectional signal seeking remote control system in accordance with the invention;

FIG. 2 is a block diagram of a system for remotely controlling a signal seeking UHF television tuner in accordance with the invention; and

FIG. 3 is a schematic diagram of a portion of the block diagram of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

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 connection with the above-described drawings.

In FIG. 1 there is shown a control signal transmitter 10 and a signal detector 12 for generating and applying a pulse of selected duration to the control circuitry of a bidirectional phase shift synchronous motor 14. Although AC and DC voltage sources are equally applicable, the motor is shown connected across a source of alternating current (AC) line voltage, represented by terminals 16 and 18, via relays 20 and 22. Motor 14 rotates clockwise or counterclockwise depending upon the manner in which AC voltage is applied to the motor windings 24 and 26. Relay 22 in combination with a relay drive circuit 28 comprises a switching means for selecting the direction of motor rotation, while the relay 20 and its corresponding drive circuit 30 comprise a switching means for selectively connecting and disconnecting the AC voltage source to the motor. Accordingly, relay 22 has a set of single pole-double throw contacts comprising a normally closed con-

tact 32 connected to one end of winding 26, a normally open contact 34 connected to one end of winding 24, and a common terminal 36 connected to one side of the AC voltage source, represented by terminal 18. Relay 22 is actuated in response to energization of its coil 38 by the relay drive circuit 28.

Relay 20 is a single pole-single throw device including a normally open contact 40 connected to the common junction of windings 24 and 26 and a common terminal 42 connected to the other side of the AC line, represented by terminal 16. Energization of coil 44 by drive circuit 30 actuates the contacts of relay 20.

A capacitor 46 and resistor 48 are serially connected across the relay terminals 34 and 32. In this manner, with relay 20 actuated and relay 22 in the quiescent state, i.e. terminal 36 being connected to contact 32, capacitor 46 is connected in series with winding 24 to thereby form an LC network with that winding and thus provide a phase shifted AC current therethrough. If relay 22 is actuated so as to connect common terminal 36 to contact 34, then, of course, capacitor 46 will be connected in series with winding 26 to provide a phase shifted AC current through that winding. Resistor 48 is selected to reduce any arcing across the relay contacts resulting from the inductive "kick" of the motor windings. Hence, energization of only relay coil 44 causes a closure of contacts 40 and 42 to thereby permit a main AC current flow through motor winding 26 and a phase shifted current flow through winding 24 and capacitor 46. As a result, motor 14 is caused to rotate in a clockwise direction. To rotate the motor counterclockwise, relay 22 must also be energized so as to close contacts 34 and 36. In this event, the main AC current will flow through motor winding 24 and a phase shifted AC current will flow through winding 26 and capacitor 46.

The actuation of the direction control relay 22 is controlled by a time delay and reset circuit 50 which is coupled between the output of signal detector 12 and the relay drive circuit 28. The line voltage switching relay 20, on the other hand, is controlled by a memory circuit 52 coupled between detector 12 and drive circuit 30. If this motor control system is employed in a signal seeking application, as illustrated, motor 14 is coupled to drive bidirectional tuner 54 of a radio frequency receiver 56. A signal presence detector 58 is then coupled between receiver 56 and drive circuit 30 to provide a second source for controlling the dropout of relay 20.

Transmitter 10, which is the unit remotely located from the motor, is adapted to generate a control signal of predetermined frequency for a selected duration, for example, by use of a pushbutton controlled oscillator output. The control link between transmitter 10 and detector 12 may be provided by wire, radio transmission, or ultrasonic radiation. Detector 12 responds to transmission of the single frequency control signal to produce a pulse having a duration corresponding to that of the transmission. Time delay circuit 50 is then operative to measure the duration of the detected pulse and actuate relay 22 in response to a pulse of predetermined duration from detector 12. Memory circuit 52 on the other hand is charged in response to pulse generation and operative upon initiation of the detected pulse to temporarily actuate relay 20. This initial actuation of relay 20 initiates the search process by connecting the AC source to the motor windings and thus activating the motor to drive tuner 54 away from its original station setting. To prevent ambiguous operation in response to a rapid succession of control pulses, time delay circuit 50 is adapted to be rapidly reset in response to initiation of a pulse from detector 12. Accordingly, a connection 60 is provided between relay drive circuits 30 and 28 for holding relay 22 in the actuated state, if it had been initially actuated in response to a control pulse of sufficient duration, during the period that relay 20 is in the actuated state connecting the voltage source to the motor.

The two operational modes of a control system of FIG. 1 may be summarized as follows. Operation of an actuator, such as a pushbutton, on the remotely located transmitter 10 causes

the generation and transmission of a single tone frequency to signal detector 12. The resulting pulse output of the signal detector is then applied in parallel to both the time delay circuit 50 and memory circuit 52. If transmitter 10 is actuated for just a momentary period, a short tone burst will be transmitted to the signal detector to result in only a momentary output from detector 12. The short duration of the detector pulse is insufficient to overcome the time delay provided by circuit 50 and thus will not actuate relay 22. The pulse energy, however, will charge memory circuit 52, and upon initiation of the pulse, the resulting charge of the memory circuit activates relay drive circuit 30 to momentarily actuate closure of relay contacts 40 and 42. This actuation of relay 20 provides a closed circuit path from AC voltage terminal 16 through the motor windings and the direction control relay contacts 32 and 36 to AC voltage terminal 18. The resulting initial clockwise rotation of motor 14 drives tuner 54 off station so that receiver 56 is receiving little or no input signal strength. Detector 58 responds to this abrupt reduction of signal strength to continue the activation of drive circuit 30 and attendant continued actuation of relay 20 until tuner 54 acquires another station. When a station is tuned in, the resulting increase in input signal strength to receiver 56 is recognized by the signal presence detector 58, which thereupon terminates activation of relay drive circuit 30 to thereby disconnect relay contacts 40 and 42 and stop the motor 14.

In order to cause rotation of motor 14 in a counterclockwise direction, transmitter 10 is actuated for a much longer period. The resulting extended tone burst is detected by circuit 12 to produce a relatively long duration pulse which is applied to the time delay and memory circuits. The long pulse is of sufficient duration to overcome the time delay of circuit 50 and activate relay drive circuit 28. Consequently, coil 38 is energized to actuate relay 22 whereby contacts 34 and 36 are closed. Upon initiation of the pulse, memory circuit 52 activates relay drive 30 to close relay contacts 40 and 42 and continue activation of relay drive 28 via connection 60. Consequently, motor windings 24 and 26 will be connected in a closed circuit across the AC terminals 16 and 18 via relay contacts 42 and 40 and 34 and 36. Motor 14 will then initiate counterclockwise rotation to drive tuner 54 off station, whereupon signal presence detector 58 responds to continue the activation of drive circuit 30, which in turn continues the activation of drive circuit 28 via connection 60. When a station of sufficient strength is acquired by tuner 54, the signal presence detector deactivates relay drive circuit 30 to disconnect relay contacts 40 and 42. As a result of connection 60, the deactivation of drive circuit 30 also causes relay drive circuit 28 to be deactivated, thereupon returning relay 22 to its quiescent state with contacts 32 and 36 in the closed position. The tuner drive is thereby stopped on the newly acquired station, and the system is in condition to respond to any further control signal inputs.

FIG. 2 illustrates the preferred embodiment of a control system according to the invention as employed to provide ultrasonic remote control of the UHF tuner in a television receiver. The control signal transmitter 62 is adapted to generate a single control signal frequency of selected duration and to radiate that signal as an ultrasonic tone. Ultrasonic tone transmitters are well known in the art and typically comprise an oscillator, a pushbutton switching arrangement for selecting the duration of control signal generation, a transducer to radiate the signal and a battery or other source of power. The receiving means comprises a transducer 64, such as a capacitor type microphone, for converting the received ultrasonic tone into an electrical signal, and an amplifier 66 for amplifying the electrical signals from transducer 64 and providing an output to a signal detector 68. The output of detector 68 is then coupled to both time delay and reset circuit 50 and memory circuit 52 by means of a relay 70 and a rectifier 72.

More specifically, referring also to the schematic diagram of FIG. 3, signal detector 68 comprises a drive transistor 74 and a series resonant circuit, consisting of capacitor 76 and tunable coil 78, connected between the control signal input,

represented by the output of amplifier 66, and ground. The resonant circuit is coupled to the base electrode of transistor 74 by means of a tap on coil 78; the emitter of transistor 74 is connected to ground via resistor 80; and the collector electrode of transistor 74, which represents the output of signal detector 68, is connected directly to one end of the coil 82 of relay 70. The other end of coil 82 is connected to a source of positive direct current (DC) voltage, represented by terminal 84, and a capacitor 86 is connected across the relay coil. Relay 70 is of the single pole-double throw type having a common terminal 88 connected to one side of a source of AC line voltage represented by terminal 16, a normally open contact 90 connected through a high frequency RC pi filter 92 to the anode of rectifier 72, and a normally closed contact 94 connected to a normally open contact 96 of relay 98.

The schematically illustrated circuit performing the function of the time delay circuit 50 includes the following components. A string of three resistors identified by the numerals 100, 102 and 104, are serially connected between the cathode of rectifier diode 72 and the AC reference, or floating ground denoted by the hollow triangle. The AC reference refers to terminal 18 of the AC voltage source; the hollow triangle symbol represents this reference, which is typically coupled through a capacitor to the chassis ground. The junction of the voltage divider provided by resistors 102 and 104 is connected to an electrolytic capacitor 106 to the base electrode of a transistor 108. The collector of transistor 108 is connected through a variable resistor 110 to the junction of resistors 100 and 102, while the emitter electrode is connected to the AC reference. The rapid discharge resetting feature of the time delay circuit 50 is provided by a diode 112, which is connected between the base of transistor 108 and the AC reference. More specifically, the anode of diode 112 is connected to the AC reference, while its cathode is connected to the junction of transistor 108 and capacitor 106.

The function of relay drive circuit 28 is provided by an electrolytic capacitor 114 having a negative terminal connected to the AC reference and a positive terminal connected to the collector of transistor 108. The coil 44 of direction control relay 22, therefore, is connected between the positive side of capacitor 114 and the AC reference. In the implementation of FIGS. 2 and 3, the common junction of motor windings 24 and 26 is connected directly to the reference terminal 18 of the AC voltage source, and the function of the voltage disconnect relay 20 (FIG. 1) is provided by the relay 98, in cooperation with relay 70, both of these relays being connected between the common terminal 36 of direction control relay 22 and terminal 16 of the AC voltage source. More specifically, the common terminal 36 of the direction control relay is connected directly to a common terminal 116 of relay 98 which is normally closed to a contact 118 connected through filter 92 to the normally open contact 90 of relay 70. As previously noted, the normally open contact 96 associated with the common terminal 116 is connected via contacts 88 and 94 of relay 70 to AC terminal 16. A high frequency bypass capacitor 120 is coupled from the junction of relay terminals 36 and 116 to the AC reference. As previously described, the normally closed contact 32 of the direction control relay is connected to the clockwise drive terminal of the motor, represented by the junction of resistor 48 and coil 26, while the normally open contact 34 is connected to the counterclockwise drive terminal of the motor represented by the junction of capacitor 46 and coil 24.

In addition to the previously described set of contacts 96, 116 and 118, relay 98 includes two other sets of contacts comprising terminals 120, 122 and 124 for providing AFC override and sound muting functions, and contacts 126, 128 and 130 for providing an alternate energization connection. These three sets of relay 98 contacts are actuated by a coil 132. As shown in FIG. 2, the energization of coil 132 is controlled by a search initiate amplifier 134, a search sustain amplifier 136 and a 20 volt regulator circuit 138, all of which are analogous to the relay drive circuit 30 of FIG. 1.

In the schematic of FIG. 3, the search initiate amplifier comprises a transistor 140 having a collector electrode connected to one end of relay coil 132, and emitter connected through resistor 142 to the AC reference and a base electrode connected via resistor 144 to the AC reference and through resistor 146 to the output, or cathode terminal, of rectifier 172. Regulator 138 comprises a Zener diode 150 which is connected between the AC reference and the end of relay coil 132 opposite that connected to transistor 140. The 20 volt regulated voltage line 152 established by the Zener diode is powered in one mode of operation via a current limiting resistor 154 and diode 156 serially connected in that order between the cathode of rectifier 72 and the junction of the Zener diode 150 and relay coil 132.

The function of memory circuit 52 is provided by an electrolytic capacitor 148 coupled between the cathode of rectifier 72 and the AC reference. Capacitor 148 also functions as a filter for the rectifier circuit 72.

When relay 70 is actuated to close contacts 88 and 90, AC terminal 16 is connected via the high frequency filter 92 to rectifier 72. The rectifier converts the 120 volt AC line voltage to an approximately 150 volt DC potential which is applied via resistor 154 and diode 156 to energize the regulated voltage line 152 and via resistor 146 to bias transistor 140 into conduction. As a consequence, the terminal of relay coil 132 opposite that to which the 20 volt regulated potential is applied is connected to the AC reference via the transistor and resistor 142, thereby causing energization of coil 132 and actuation of the relay 98. During the period that relay 70 is actuated, capacitor 148 is charged via rectifier 72. When relay 70 is returned to its quiescent state and the source of energy via rectifier 72 is terminated, the energization of relay coil 132 will be maintained for a limited time by virtue of the discharge of capacitor 148 through resistors 146 and 154.

In the signal seeking system of FIG. 2, motor 14 drives the UHF tuner 158 of a television receiver 159. The function of signal presence detector 58 (FIG. 1) is provided by both a synchronizing pulse detector 160 and a picture carrier detector 162, which are coupled through an OR gate 164 to the search sustain amplifier 136. The input for sync pulse detector 160 is obtained from the output of the sync separator circuit 166 of television receiver 159, while the input for picture carrier detector 162 is obtained from the output of an IF amplifier 168 of the AFC loop in tuner 158 of receiver 159. The logic OR-circuit 164 is operative to provide a signal presence indication only in response to simultaneous detection of synchronizing pulses and a picture carrier. To prevent response to spurious carriers, gate 164 will not recognize signal presence for the following three conditions: the absence of both synchronizing pulse and picture carrier detector outputs; an output from sync pulse detector 160 with no detection of a picture carrier by circuit 162; and detection of a picture carrier by circuit 162 without a sync pulse detector output.

As tuner 158, sync separator 166 and AFC IF amplifier 168 are conventional television circuits of the type well known in the art, the details of these circuits are omitted from the schematic diagram of FIG. 3.

The search sustain amplifier 136 is illustrated as comprising a transistor 170 having a collector electrode connected via resistor 172 to the end of relay coil 132 opposite that connected to the regulated voltage line 152, an emitter connected to the AC reference, and a base electrode connected to the logical OR-circuit and via resistor 174 to the AC reference.

OR gate 164 comprises the pair of transistors 176 and 178. The base of transistor 176 is coupled to the picture carrier detection circuit which includes diode 180, while the base of transistor 178 is coupled via series connected capacitor 182 and resistor 184 to the synchronizing pulse detector, which includes transistor 186. The supply voltage for the OR-gate transistors is provided by the regulated voltage line 152, which is connected to the collectors of both transistors 176 and 178, with an AC bypass capacitor 188 being coupled between this

junction and ground. An output voltage summing network comprising series resistors 190 and 192 is connected between the emitters of transistors 176 and 178, with the center junction of the summing network being connected to the base electrode of transistor 170. A filter capacitor 194 is coupled between the emitter of transistor 178 and the AC reference.

Picture carrier detection circuit 162 includes the diode detector 180, a tuned circuit 200 coupled between the output of the AFC amplifier 168 and the cathode electrode of diode 180, bias resistors 202 and 204 serially connected between the cathode of diode 180 and the regulated voltage line 152 and a filter capacitor 206 connected across resistor 202. Cathode electrode of diode 180 is connected to the base of transistor 176. Circuit 200 is tuned to select the 45.75 MHz. picture carrier IF frequency from the tuner AFC loop. In the absence of a detectable picture carrier, the regulated supply voltage from line 152 and the selection of resistors 204, 202, 190 and 174 is operative to bias transistor 176 into conduction. On reception of a picture carrier of sufficient strength, the resulting negative output voltage of detector diode 180 is operative to reverse bias the base emitter junction of transistor 176 to cutoff.

The function of the synchronizing pulse detection circuit 160 is provided by a transistor 186 which is shunt connected across the output of a pulse source and base controlled by the output of the sync separator. In order to provide a DC control bias for transistor 186, the coupling circuitry from the sync separator to its base electrode comprises a voltage divider formed by the resistors 208 and 210 series connected between the sync separator output and ground, an electrolytic capacitor 212 connected between the junction of the voltage divider resistors and ground, and a series resistor 214. The emitter of transistor 186 is connected to ground while its collector electrode is connected to the junction of a pair of series resistors 216 and 184, which are connected between a 20 volt pulse source, represented by terminal 218, and the coupling capacitor 182. The input at terminal 218 may be provided by any convenient pulse source which, when not shunted by transistor 186, will be AC coupled via capacitor 182 to bias transistor 178 into the conducting state; e.g. the pulse source for terminal 218 may be provided by a tap on the horizontal flyback transformer of the television receiver.

In the absence of synchronizing pulses, the voltage divider comprising resistors 208 and 210, in conjunction with the supply voltage for the sync separator stage, establishes a base bias voltage whereby transistor 186 is rendered nonconducting. With transistor 186 thereby removed from the circuit coupling terminal 218 to the OR-gate, drive pulses are applied to the base of transistor 178 via capacitor 182 to render that transistor conducting. The AC input to transistor 178 is rectified at the emitter output by virtue of the rectification provided by the base emitter junction and the filtering provided by capacitor 194.

Upon the generation of sync pulses from sync separator 166, the DC bias level at the base of transistor 186, after filtering out the sync pulses by capacitor 212, is operative to "turn on" transistor 186 to shunt the terminal 218 pulse source to ground. This terminates the drive pulse input to the OR-gate and thereby renders transistor 178 nonconducting.

Accordingly, when the UHF tuner 158 has acquired a station, the resulting detection of both synchronizing pulses and a picture carrier will cause both of the transistors 176 and 178 to be rendered nonconducting. As a result, there will be no base bias for the search sustain amplifier transistor 170, thereby rendering that transistor nonconducting and, thus, inactive insofar as the signal seeking system is concerned. When there is an absence of either synchronizing pulses or picture carrier, or both, and the regulated voltage line 152 is energized, both or one of the transistors 176 and 178 will conduct to provide a base bias voltage for turning on the search sustain amplifier transistor 170. With transistor 170 conducting, the reference side of coil 132 will be connected to the AC reference via resistor 172 to thereby energize relay 98.

With relay 98 actuated and relay 70 in the quiescent state (upon pulse termination), the AC line voltage at terminal 16 is connected via closed relay contacts 88 and 94 and closed relay contacts 96 and 116. As relay contact 90 is open, there is no source of energy provided to rectifier 72. Consequently, in order to maintain energization of relay 98, a rectifier 220 is connected between the common relay terminal 116 and the voltage regulator 138 (FIG. 2). More specifically, the anode of diode rectifier 220 is connected to terminal 116, while its cathode electrode is connected via resistor 222 and closed relay contacts 126 and 128 to the regulated voltage line 152. An electrolytic capacitor 224 is connected between the cathode of diode 220 and the AC reference to provide output filtering, and a resistor 226 is connected across capacitor 224 to provide a rapid discharge path.

In order to hold relay 22 in the actuated state (if previously actuated in response to a control signal input pulse of sufficient duration) during the period that relay 98 is actuated, a pair of resistors 228 and 230 are serially connected between the regulated voltage line 152 and the junction of relay coil 44 and capacitor 114. More specifically, resistors 228 and 230 are selected to provide a hold-in current only for relay coil 44; that is, in the unenergized state, the resistance of coil 44 is sufficiently high to preclude activation by the current provided via resistors 228 and 230. On the other hand, upon receiving a control signal input pulse of sufficient duration, the current provided via variable resistor 110 upon sufficient charge of capacitor 114 need only supply the difference between hold-in and pull-in current to activate relay coil 44. This connection between the regulated voltage line and the drive source for relay coil 44 provides the function of connection 60 in FIG. 1 and the connection between regulator 138 and relay drive circuit 28 in FIG. 2.

The overall operation of the signal seeking system shown in FIGS. 2 and 3 proceeds as follow. For purposes of illustration, it will be assumed that the selection of resistors 100, 102 and 104 and capacitors 106 and 114, and the time constant adjustment of variable resistor 110, are such as to provide a $\frac{1}{4}$ second delay before direction control relay 22 will be actuated in response to an incoming control signal. Further, it will be assumed that the television receiver is energized and tuned to a given channel. All relays are shown in the quiescent state, whereby relay contacts 96 and 116 are open thereby disconnecting the signal seeking system from the AC line voltage source; contacts 120 and 122 are open to permit normal operation of the AFC and sound circuits; contacts 126 and 128 are open; and the direction control relay contacts 32 and 36 are closed, thereby readying motor 14 for clockwise rotation.

To initiate search in a clockwise direction toward a higher channel, an operator depresses the actuating control button on the remote transmitter 62 for about $\frac{1}{2}$ second or less. The resulting half second burst of ultrasonic energy is received and converted to electrical energy by transducer 64, amplified by circuit 66 and applied to activate the resonant circuit 76-78 of the signal detector. The normally nonconducting transistor 74 is thereby turned on to energize coil 82 and thus actuate relay 70 for a period of $\frac{1}{2}$ second. Actuated relay 70 closes contacts 88 and 90 to connect the AC voltage at terminal 16 to rectifier 72 via the high frequency filter 92. As a consequence, rectifier 72 provides an approximately 150 volt direct current voltage source for energizing the time delay, memory, and regulator circuits.

Referring first to the time delay circuit, the DC voltage from rectifier 72 is applied via resistor 100 and variable resistor 110 to charge capacitor 114. Simultaneously, capacitor 106 at the base of transistor 108 is charged via resistor 102. Assuming there is initially no voltage at the base of transistor 108, that transistor will be in a nonconducting state prior to generation of the control signal. As capacitor 106 charges however, current will be caused to flow through the base emitter junction of transistor 108 and thereby bias the transistor into conduction. The conducting transistor 108 shorts out the charge path

to capacitor 114 and thereby delays the charging of capacitor 114 toward the pull-in current level necessary to energize relay coil 44.

The direct current from rectifier 72 is also connected through rectifier 156 to energize the regulated voltage line 152 and applied via resistor 146 to turn on the search initiate transistor 140. Coil 132 is thereby energized to actuate relay 98 and thus close the three sets of contacts 96—116, 120—122, and 126—128. In practice, the inertia of relay 98 will generally cause a delay in its actuation. In this event, it will be noted that the AC voltage path from terminal 16 will be connected via closed terminals 88 and 90 of actuated relay 70 and via closed terminals 116 and 118 of the quiescent relay 98 to the motor windings 26 and 24 via the closed direction control relay contacts 32 and 36. Consequently, the motor windings will be energized to induce a momentary clockwise rotation of motor 14 prior to the actuation of relay 98. Of course, the motor will stop rotating as soon as the actuated relay 98 closes contacts 96 and 116, as contact 94 of the actuated relay 70 is disconnected from the AC voltage source. This momentary rotation of motor 14 may be sufficient to drive the tuner 158 off station so as to substantially diminish or completely remove the picture carrier and synchronizing pulse outputs of circuits 168 and 166. Accordingly, the sync pulse and picture carrier detectors will function as previously described to cause transistors 176 and 178 to conduct and thereby "turn on" search sustain transistor 170. The conducting transistor 170 complements transistor 140 in maintaining the energization of relay coil 132 as long as DC voltage is applied to the regulated line 152.

Upon termination of the short $\frac{1}{2}$ second control signal pulse, resonant circuit 76—78 is deactivated to turn off transistor 74 and thereby deenergize coil 82. Relay 70 thereupon returns to its quiescence state with contact 90 disconnected from the AC voltage source. As a result, the DC output from rectifier 72 is terminated prior to the $\frac{1}{4}$ second time delay established by the circuit including variable resistor 110. As the charging of capacitor 114 is thereby terminated prior to reaching the pull-in current level direction control relay 22 remains in its quiescence state with the motor connected for clockwise rotation.

Transistor 108 and diode 112 are both included in the time delay circuit as a safeguard to prevent false operation. The transistor serves to compensate for fluctuations in line voltage, as the output of rectifier 72 is unregulated. If the DC voltage is higher than normal, capacitor 114 will charge at a faster rate. In the absence of compensation this could result in a shortening of the predetermined time delay and, thus, cause undesired actuation of direction control relay 22 in response to a short pulse. With the present circuit arrangement, however, the higher than normal DC voltage also increases the charge rate of capacitor 106 and thus increases the current flow through transistor 108. As a result, the tendency to charge capacitor 114 at a faster rate is counteracted by the increased current flow in the discharge path for this capacitor via transistor 108.

In the event the DC output of rectifier 72 is lower than normal, capacitor 114 will charge at a slower rate to lengthen the delay period. The danger in this event is that a sufficiently increased delay could undesirably preclude actuation of direction control relay 22 in response to a normal long pulse control signal. In the present circuit, however, the slowed charge rate is effectively increased by the reduced current flow through transistor 108 due to the corresponding reduced charge rate of capacitor 106.

Diode 112 is connected so that upon termination of the voltage source provided by rectifier 72, the negative terminal of electrolytic capacitor 106 will be shorted to the AC reference through the now forward biased diode 112 to enable a very rapid discharge path via resistor 104. Preferably, this automatic discharge circuit should be designed to reset the time delay circuit faster than the operator's normal reaction time. In this manner, the time delay circuit will be immediately

responsive to any new command signals transmitted during the tuning operation, and the transmission of two or more short pulses in succession will not have the undesired effect of a single long pulse.

The termination of DC voltage from rectifier 72 also results in discharge of filter capacitor 148 via resistors 154 and 146. This discharge provides a memory function by maintaining the energization of regulated voltage line 152 and the conducting state of transistor 140 for a limited time, determined by the RC time constant of the capacitor 148 discharge circuit. Preferably, resistors 154 and 146 are selected to provide a very slow discharge of capacitor 148. This capacitor will also, of course, be discharged via resistors 100, 102 and 104; however, these resistance values should also be selected to provide a long discharge period.

Referring again to relay 70, the quiescent state of this switching means upon termination of the control signal also results in the AC voltage source being connected via contacts 88 and 94 and the closed contacts 96 and 116 of the still actuated relay 98 to the common terminal 36 of the direction control relay. With direction control relay 22 in the quiescent state, this AC voltage will be applied via contacts 36 and 32 to energize windings 24 and 26 so as to cause a clockwise rotation of motor 14. The AC voltage connected via contacts 96 and 116 is also converted to DC by rectifier 220 and applied via closed contacts 126 and 128 to continue the energization of regulated voltage line 152, the discharge of memory capacitor 148 having precluded any interruption in the energization of relay coil 132 during transfer of the power source from rectifier 72 to rectifier 220. Conducting transistor 170 continues to hold relay 98 in the actuated state and thus sustain the clockwise rotation of the motor and corresponding upward drive of the UHF tuner until another station of sufficient strength to actuate the signal presence detection circuitry is acquired by the tuner.

During this search mode of operation, the closure of contacts 120 and 122 of the actuated relay 98 activates the conventional AFC override and sound muting circuitry, represented by circuit block 232 in FIG. 2. For example, sound muting may be accomplished by increasing the impedance in the B+ source for the sound circuit to a point where the circuit becomes inoperative with an active dropping impedance. The override of the AFC loop control in the UHF tuner may be provided by switching on a pair of clamping transistors which establish a fixed manual bias for the tuner at low impedance and override the output from the AFC amplifier. These are conventional functions in any search system, the muting being provided to suppress the discordant audio noise attendant with the search process, and overriding of the AFC loop preventing the AFC from causing the search system to stop tuner drive too soon, whereby the fine tuning will not be as accurate as desired.

As a subsidiary feature of the system, limit switches are provided at each end of the UHF tuner dial. The switch at the high end of the band is represented in FIG. 3 by switch terminals 234 and 236, whereas the low end switch is represented by terminals 234 and 238. If a station is not acquired while the clockwise rotating motor is driving the UH tuner in the upward direction, the resultant closure of switch terminals 234 and 236 at the high end of the band shorts out resistor 228 and thereby increases the supply voltage applied to relay coil 44 from the regulated voltage line 152 sufficiently to energize coil 44 with pull-in current and thereby actuate relay 22. As a result, contacts 34 and 36 are closed to cause the motor to rotate in a counterclockwise direction and thus reverse the tuner to search in a downward direction. If the tuner is driven to the low end of the band, the resultant closure of switch terminals 234 and 238 shorts the regulated voltage line to the AC reference and thereby stops the search function by deenergizing relay coil 132.

In order to stop the search function in response to a newly acquired station, as previously described, there must be simultaneous detection of the reception of both synchronizing pul-

ses and a picture carrier by the television receiver. That is, the search sustain amplifier transistor 170 is switched off only when both of the OR-gate transistors 176 and 178 are switched off due to the simultaneous presence of both sync pulses and carrier. In this manner, the system ignores spurious carriers and sound carriers, stopping only when a picture carrier with its accompanying sync information is present.

When a true station is acquired by the tuner, the resultant turn off of transistor 170 deenergizes coil 132 to return relay 98 to its quiescent state. The attendant opening of contacts 96 and 116 disconnect the AC voltage source from the motor windings to promptly stop the search process on the newly acquired station.

Returning for a moment to the point in the clockwise operational cycle wherein the short pulse control signal is initially detected, if the switching means represented by relay 98 is actuated immediately, without delay, the motor may not be moved off station prior to pulse termination. This is of no consequence, however, as the discharge of memory capacitor 148 will maintain the actuated condition of the switching means represented by relay 98 for a sufficient period after pulse termination to permit the tuner to be driven off station pursuant to the motor winding connection to the AC line via closed contacts 32—36, 96—116, and 88—90. Once the original station is vacated, the resulting disappearance of sync pulse and picture carrier information causes transistor 170 to be turned on to continue the actuation of the switching means represented by relay 98.

Counterclockwise motor rotation, and hence the search toward lower stations on the UHF band, is initiated in the following manner. The operator depresses the actuating button on the remote transmitter 62 for approximately 1 second or longer, thereby generating a control signal comprising a relatively long burst ultrasonic tone. Transducer 64 receives the ultrasonic control tone and converts it to a single frequency electrical signal, which is processed by amplifier 66 and applied to activate the resonant circuit 76—78. The resulting conduction of transistor 74 thereupon actuates relay 70 for the duration of the control tone, i.e. 1 second or longer. AC voltage from terminal 16 is applied via closed contacts 88 and 90 of the actuated relay 70 to rectifier 72, thereby providing a DC voltage source for activating the time delay circuit, energizing regulated voltage line 152, and turning on the search initiate transistor 140.

As previously discussed with respect to the clockwise mode of operation, the DC voltage source provided by rectifier 72 is applied via resistors 100 and 110 to charge capacitor 114, and via resistor 102 to charge capacitor 106. The charging capacitor 106 causes base current to flow through transistor 108, thereby causing that transistor to conduct and thus counteract and retard the charging of capacitor 114 via variable resistor 110. In this instance, however, the duration of the DC source exceeds the $\frac{1}{4}$ second time delay established by the setting of variable resistor 110. As a consequence, capacitor 106 will become fully charged during the incoming control signal pulse period, whereupon the base current flow through transistor 108 will cease and the transistor will be cutoff. With transistor 108 nonconducting, capacitor 114 is permitted to charge to a sufficient level, which in cooperation with the regulated supply voltage provided via resistors 228 and 230 will provide the pull-in current necessary to energize relay coil 44. Hence, relay 22 will be actuated to close contacts 34 and 36 and thus provide for counterclockwise rotation of motor 14 during the search process.

Prior to the delayed actuation of direction control relay 22, however, the inertia of relay 98 may cause a delay in its actuation. As a result, the AC line voltage connected via contacts 88 and 90 of relay 70 may momentarily be applied via contacts 116 and 118 and the normally closed contacts 32 and 36 (relay 22 has not been actuated yet due to the time delay circuit) to cause a momentary clockwise rotation of motor 14. UHF tuner 158 is thereby driven off station whereupon OR-gate transistors 176 and 178 are turned on in response to the

disappearance of picture carrier and sync pulse information. Transistor 170 is thereby biased to conduct and thus complement transistor 140 in sustaining the energization of relay coil 132.

Upon termination of the incoming control signal pulse, the disappearance of DC voltage at the output of rectifier 72 permits the memory capacitor 148 to discharge via resistors 154 and 146 to thereby hold relay 98 in the actuated state for a limited time. Also, as with the clockwise mode of operation, the return of relay 70 to its normal state causes the AC line voltage to be connected via contacts 88 and 94 and the closed contacts 96 and 116 of actuated relay 98 to continue energization of the regulated voltage line via rectifier 220 and provide AC energy via the closed contacts 34 and 36 of the actuated direction control relay to produce counterclockwise rotation of the motor. Relay 22 is held in the actuated state during the period that relay 98 is actuated by virtue of the connection from the regulated voltage line 152 to coil 44 via resistors 228 and 230. That is, as long as relay 98 remains actuated AC energy will be applied via contacts 96 and 116 to rectifier 220; the resulting DC output of the rectifier will then be connected via the closed contacts 126 and 128, through the regulated voltage line, and via resistors 228 and 230 to provide sufficient hold in current for the relay coil 44. That is, although resistors 228 and 230 provide a supply voltage connection to coil 44 which is not sufficient to provide pull in current, the resistor values are chosen to supply the coil with hold-in current, whereupon relay 22 will be held in the actuated state, if it had been previously actuated.

Assuming motor 14 had been momentarily rotated in a clockwise direction as described, the subsequent counterclockwise drive will cause the tuner to pass over the channel that it had just vacated. Here again, the discharge function of the memory circuit maintains proper operation. More specifically, the time period of the discharge of memory capacitor 148 via resistors 154 and 146 is selected so as to maintain the energization of relay coil 132 during the period, shortly following control pulse termination, that transistor 170 is turned off in response to the momentary signal presence detection which occurs as the UHF tuner passes over the station to be vacated. The remainder of the search process proceeds as described with respect to the clockwise mode of operation, other than for the direction of travel, until a new station is acquired and the signal presence detection circuitry turns off transistor 170, thereby deactivating relay 98 and stopping the search process.

In the event the switching means represented by relay 98 is actuated without delay by the incoming control signal, the motor and tuner will not be driven away from the station to be vacated until pulse termination. In this instance, upon removal of the DC voltage from rectifier 72 at the end of the control pulse, the discharge of memory capacitor 148 via resistors 154 and 146 holds relay 98 in the actuated state until motor 14 is rotated counterclockwise pursuant to the return of relay 70 to its quiescent state and the resulting drive of the tuner away from its original station setting causes transistor 170 to be rendered conducting in response to the disappearance of picture carrier and sync pulse information.

In summary, a signal seeking remote control system has been provided wherein bidirectional tuning is accomplished by pulse duration modulation of a single control frequency. The primary function provided during transmission of the control tone is the selection of the direction of operation as determined by the time delay circuit. The actual search process commences at the end of the control tone transmission. In addition to the advantage of requiring only a single control frequency to accomplish bidirectional control, and thereby enabling more control functions to be provided within a limited frequency spectrum, the described system also includes a quick reset capability to avoid ambiguity, and, for television applications, reliable signal presence detection process which requires both picture carrier and sync pulse information to stop the search process.

It is contemplated that the present invention may be embodied in a control system employing switching means other than relays, such as silicon control rectifiers or transistors. The invention can also be embodied in a control system for controlling motors as well as the described AC motor control system. The invention is not restricted to a signal seeking system as the long and short pulse control function may readily be applied to other bidirectional motor control applications. Conversely, the described control system is not limited to bidirectional motor control applications, as it is equally applicable to a signal seeking system employing means other than switching relays and a motor to provide bidirectional tuning. For example, it is contemplated that the long and short control pulses may be applied to provide bidirectional control of an electronically controlled tuning means employing varactors. Hence, although the invention has been described with respect to certain specific embodiments, it will be appreciated that modifications and changes may be made by those skilled in the art without departing from the true spirit and scope of the invention.

I claim:

1. A control system for a bidirectional motor comprising, in combination, means for generating a pulse of selected duration, a first switching means coupled to said motor for selecting the direction of motor rotation, means for actuating said first switching means in response to a pulse of predetermined duration from said pulse generating means, a source of voltage, a second switching means for selectively connecting and disconnecting said voltage source to said motor, and means for actuating said second switching means in response to termination of a pulse from said pulse generating means.

2. A control system in accordance with claim 1 wherein said pulse generating means comprises means for generating a control signal of predetermined frequency for a selected duration, a signal detector coupled to said control signal generating means, and means coupling the output of said detector to said means for actuating said first switching means and to said means for actuating said second switching means.

3. A control system in accordance with claim 1 wherein said means for actuating said first switching means comprises a time delay circuit having an input coupled to said pulse generating means and an output coupled to said first switching means, and wherein said means for actuating said second switching means comprises a memory circuit which is charged during pulse generation, said memory circuit having a charge path coupled to said pulse generating means and a discharge path coupled to said second switching means.

4. A control system in accordance with claim 1 wherein each of said first and second switching means comprises a relay having contacts in circuit with said voltage source.

5. A control system in accordance with claim 1 wherein said control system is a signal seeking system for a radio frequency receiver having bidirectional tuning means, said motor is coupled to drive said bidirectional tuning means, and said means for actuating said second switching means is operative upon termination of a pulse from said pulse generating means to cause said second switching means to connect said voltage source to said motor, thereby activating said motor to drive said tuning means away from a first station to initiate search for a second station, and further including signal presence detection means coupled between said receiver and said second switching means and operative upon the vacating of said first station to maintain the connection of said voltage source to said motor until said second station is acquired by said tuning means.

6. A signal seeking system in accordance with claim 5 wherein said receiver is a television receiver, and said signal presence detection means comprises a logic circuit having two inputs and an output, means coupled to the first input of said logic circuit for detecting the reception of synchronizing pulses by said television receiver, means coupled to the second input of said logic circuit for detecting the reception of a picture carrier by said television receiver, and means coupling

the output of said logic circuit to said second switching means, said logic circuit being operative to cause said second switching means to maintain connection of said voltage to said motor in the absence of simultaneous detection of synchronizing pulses and a picture carrier.

7. A signal seeking system in accordance with claim 5 wherein said pulse generating means comprises a transmitter for radiating an ultrasonic control signal of predetermined frequency for a selected duration, a receiving transducer for converting said ultrasonic signal to an electrical signal, a signal detector coupled to said transducer, and means coupling the output of said detector to said means for actuating said first switching means and to said means for actuating said second switching means.

8. A signal seeking system in accordance with claim 5 further including means coupled between said first and second switching means for holding said first switching means in the actuated state, if actuated in response to a pulse of sufficient duration, during the period said second switching means is in the actuated state connecting said voltage source to said motor.

9. A signal seeking system in accordance with claim 8 wherein said means for actuating said first switching means comprises a time delay circuit having an input coupled to said pulse generating means, said motor has clockwise and counterclockwise drive terminals, and said first switching means comprises a first relay having a coil coupled to the output of said time delay circuit, first and second contacts respectively connected to the clockwise and counterclockwise terminals of said motor, and a common terminal coupled via circuit means to said voltage source.

10. A signal seeking system in accordance with claim 9 further including means for resetting said time delay circuit in response to termination of a pulse from said pulse generating means.

11. A signal seeking system in accordance with claim 9 wherein said means for actuating said first switching means comprises a memory circuit which is charged during pulse generation, said memory circuit having a charge path coupled to said pulse generating means and a discharge path coupled to said second switching means, and wherein said second switching means comprises a second relay having a contact and common terminal in circuit with said voltage source and a coil coupled to both the discharge path of said memory circuit and the output of said signal presence detection means.

12. A signal seeking system in accordance with claim 11 further including a third relay having a coil coupled to said pulse generating means, a first contact coupled to said contact of said second relay, a second contact coupled by means including a first rectifier to the input of said time delay circuit, and a common terminal connected to said source of voltage, and wherein said circuit means coupling the common terminal of said first relay to said voltage source comprises said second, and third relays, the common terminals of said first and second relays being interconnected, and said means coupled between said first and second switching means for holding said first switching means in the actuated state comprises circuit means including a rectifier connected between the common terminal of said second relay and the junction of said first relay coil and the output of said time delay circuit.

13. A signal seeking system for a radio frequency receiver having bidirectional tuning means comprising, in combination, means for generating a pulse of selected duration, means for reversing the quiescent direction setting of said tuning means in response to a pulse of predetermined duration from said pulse generating means, means for applying voltage to said tuning means in response to termination of a pulse from said pulse generating means to cause said tuning means to vacate a first station and initiate search for a second station, and signal presence detection means coupled to said receiver and operative upon the vacating of said first station to maintain the application of voltage to said tuning means until said second station is acquired.

15

14. A signal seeking system in accordance with claim 13 wherein said pulse generating means comprises means for generating a control signal of predetermined frequency for a selected duration, a signal detector coupled to said control signal generating means, and means coupling the output of said detector to said direction reversing means and said voltage applying means.

15. A signal seeking system in accordance with claim 13 wherein said receiver is a television receiver, and said signal presence detection means comprises a logic circuit having two inputs and an output, means coupled to the first input of said logic circuit for detecting the reception of synchronizing pulses by said television receiver, means coupled to the second input of said logic circuit for detecting the reception of a picture carrier by said television receiver, and means coupling the output of said logic circuit to said voltage applying means, said logic circuit being operative to maintain the application of voltage to said tuning means in the absence of simultaneous detection of synchronizing pulses and a picture carrier.

16. A signal seeking system in accordance with claim 13 wherein said direction reversing means comprises a first switching means coupled to said tuning means for selecting the direction of tuning, and a time delay circuit having an input coupled to said pulse generating means and an output coupled to said first switching means, said first switching

16

means being actuated by a predetermined voltage output level from said time delay circuit.

17. A signal seeking system in accordance with claim 16 wherein said voltage applying means comprises a source of voltage, a second switching means for selectively connecting and disconnecting said voltage source to said tuning means, and a memory circuit which is charged during pulse generation, said memory circuit having a charge path coupled to said pulse generating means and a discharge path coupled to said second switching means and being operative during discharge to cause said second switching means to connect said voltage source to said tuning means, and wherein said signal presence detection means is coupled between said receiver and said second switching means and operative upon the vacating of said first station to maintain the connection of said voltage source to said tuning means until said second station is acquired.

18. A signal seeking system in accordance with claim 13 further including means coupled between said voltage applying means and said direction reversing means for holding the reversed direction setting of said tuning means, if reversed in response to a pulse of sufficient duration, during the period that voltage is being applied to said tuning means.

30

35

40

45

50

55

60

65

70

75