

Sept. 19, 1961

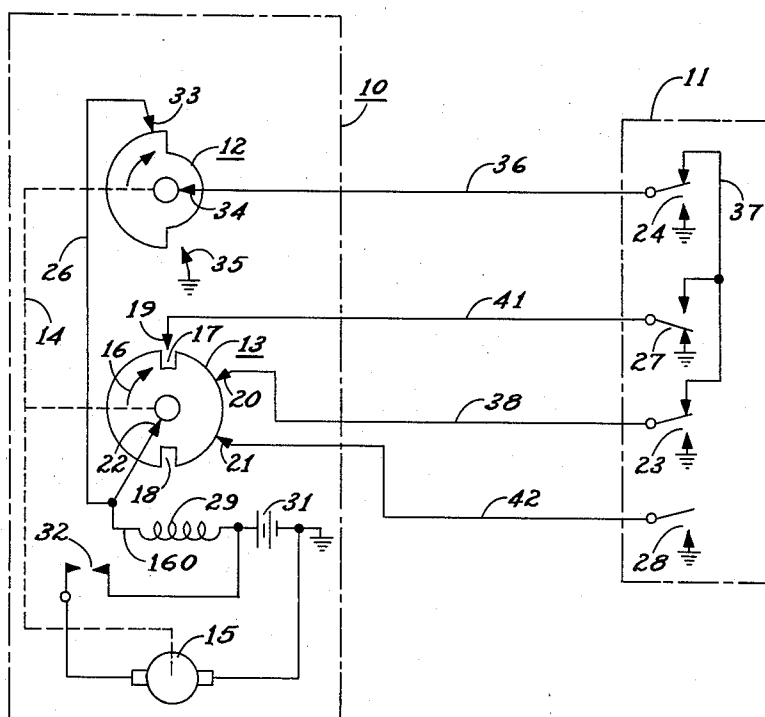
J. L. GOETZ

3,001,118

SEEKING SWITCH SYSTEM

Filed May 25, 1960

5 Sheets-Sheet 1



PRIOR ART

FIG 1

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Sept. 19, 1961

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SEEKING SWITCH SYSTEM

3,001,118

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5 Sheets-Sheet 2

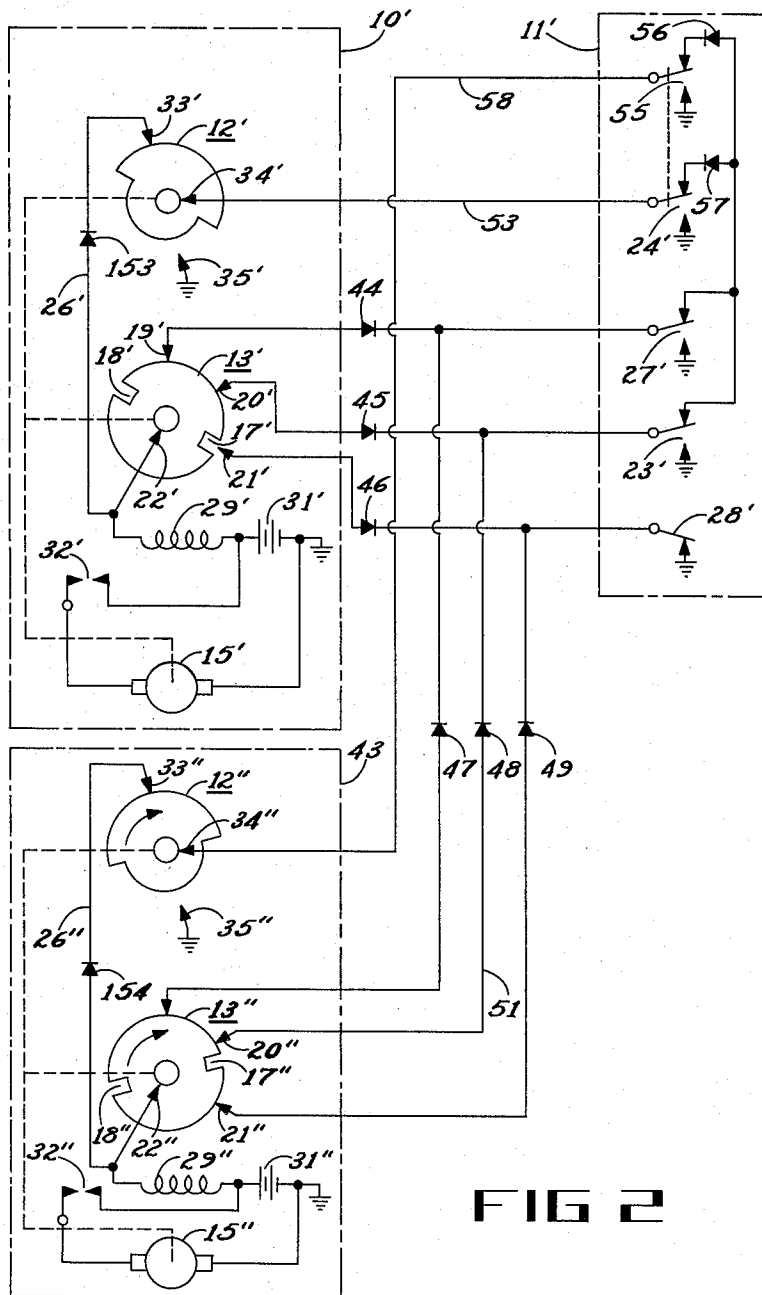


FIG 2

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SEEKING SWITCH SYSTEM

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5 Sheets-Sheet 3

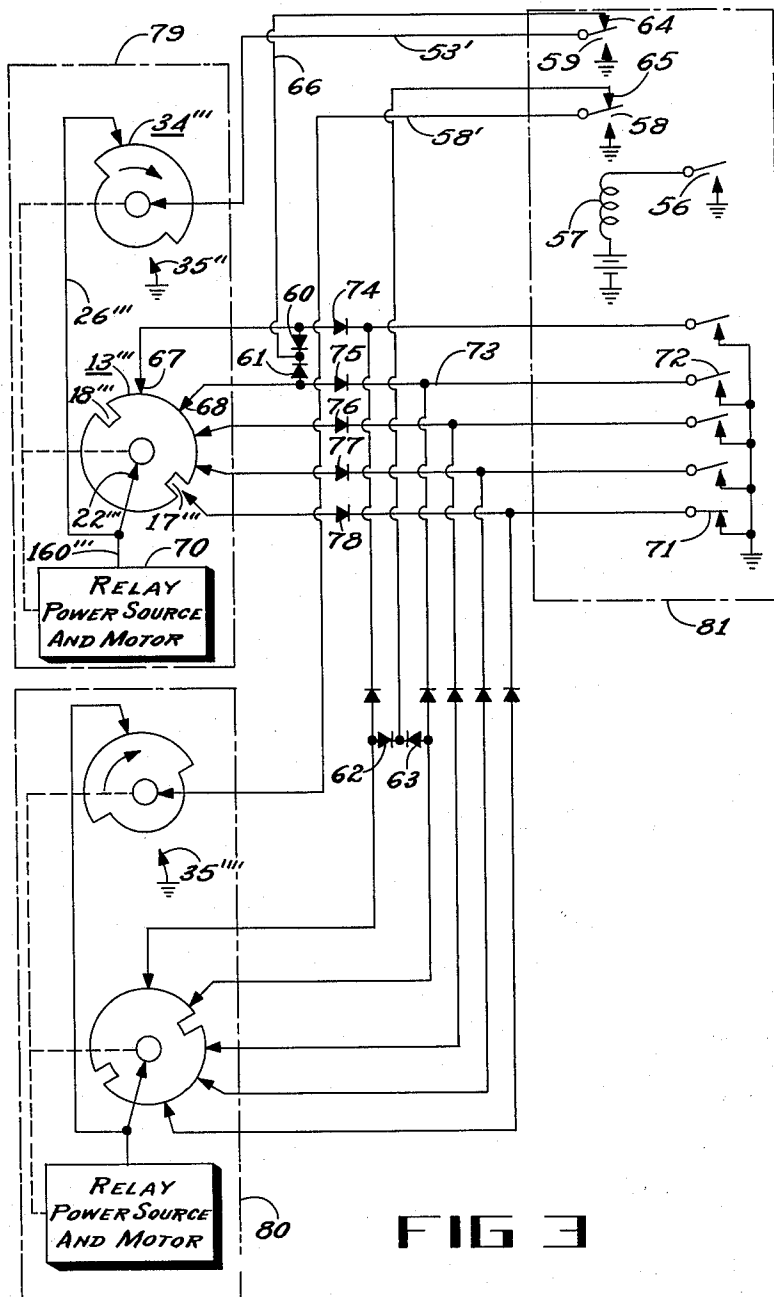


FIG 3

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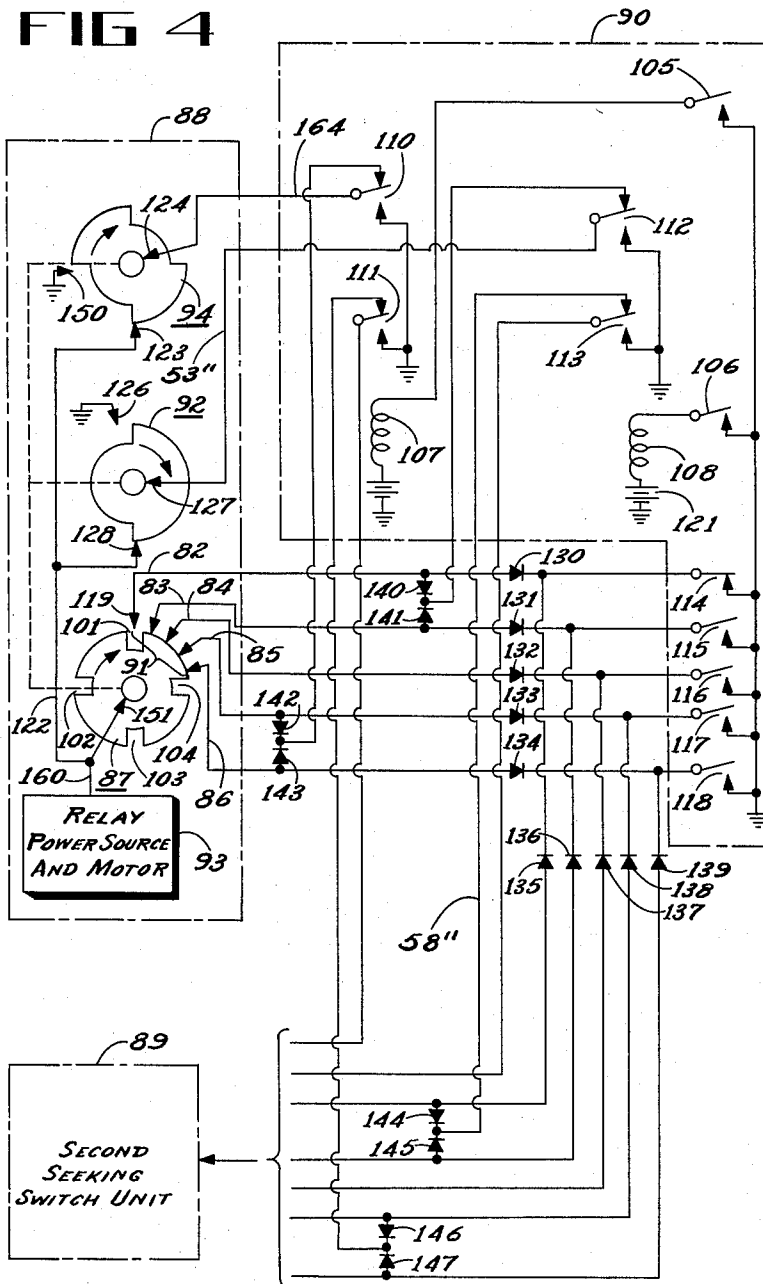
3,001,118

SEEKING SWITCH SYSTEM

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5 Sheets-Sheet 4

FIG 4



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SEEKING SWITCH SYSTEM

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5 Sheets-Sheet 5

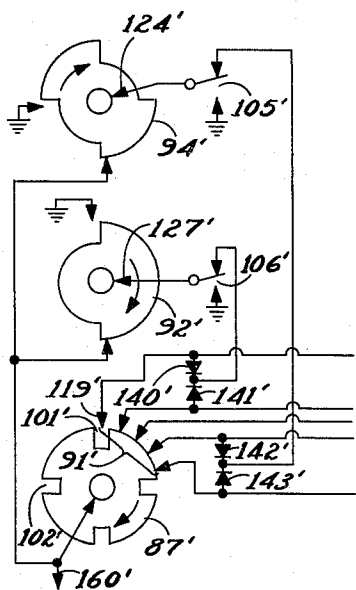


FIG 5

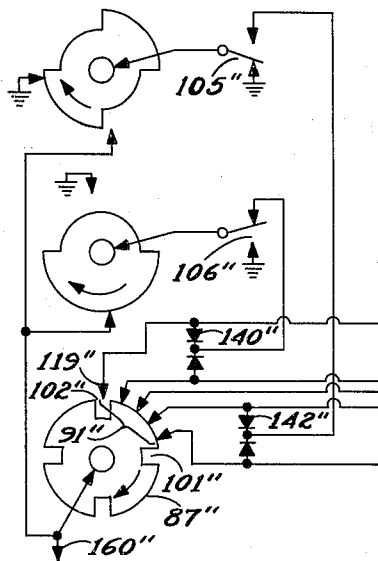


FIG 5A

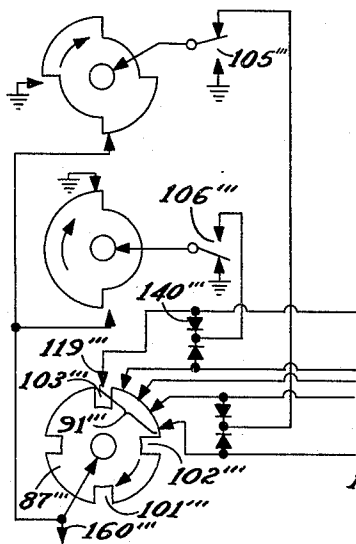


FIG 5B

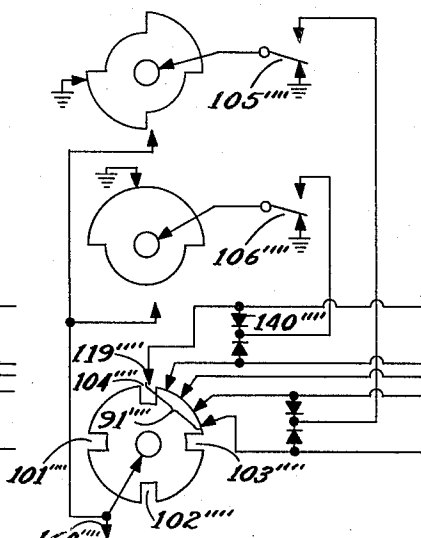


FIG 5C

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1

3,001,118

SEEKING SWITCH SYSTEM

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Filed May 25, 1960, Ser. No. 31,667
8 Claims. (Cl. 318-467)

This invention relates generally to a seeking switch system of the shaft positioning type and, more particularly, it relates to a seeking switch system having a motor which rotates a seeking switch until the seeking switch finds a null position (open circuit position) which in turn causes the motor to become de-energized and cease rotating. The aforementioned null position can be preset remotely by a control switch. Such seeking switch systems are described in U.S. Patents 2,476,673 issued on July 19, 1949, to May and Schweighofer and entitled "Shaft Positioning Control System," and U.S. Patent 2,676,289 issued on April 20, 1954, to Wulfsberg and Schweighofer and entitled "Shaft Positioning Mechanism for Binary Code Operation." Both of these aforementioned patents describe systems of the wire saving type, wherein a single additional lead will double the number of switch positions.

In prior art structures an individual control switch has been employed for each seeking switch. Thus, if it were desired to control (i.e., tune to a desired operating frequency) both a transmitter and a receiver by prior art structures it would be necessary to have separate seeking switches to tune the transmitter and receiver and it also would be necessary to have separate control switches for the two seeking switches associated with the transmitter and the receiver. It is apparent that in order to tune the transmitter and the receiver, the operator would first have to adjust manually the control switch for the transmitter by means of a knob, or set of knobs, and then would have to manipulate a similar knob, or set of knobs, to adjust the control switch associated with the receiver. It would mark a definite improvement in the art to provide structure whereby a plurality of seeking switches could be controlled by one control switch so that the operator could simultaneously tune both the transmitter and the receiver to the proper frequency.

It is an object of this invention to provide a seeking switch system in which two or more seeking switches connected in parallel arrangement can be controlled by means of one control switch.

A further object of the invention is to provide structure whereby a plurality of seeking switches of the wire saving type may be controlled with a single remotely located control switch.

A third purpose of the invention is to provide structure whereby a plurality of "plural system" seeking switch systems may be controlled from a common control switch system. The "plural system" seeking switch system is described in United States Patent 2,800,618, issued July 23, 1957, to John P. Giacoletto entitled "Seeking Switch System."

A fourth aim of the invention is the improvement of seeking switches generally.

The above-mentioned and other objects and features of the invention will be more fully understood from the following detailed description thereof when read in conjunction with the drawings in which:

FIG. 1 is a schematic sketch of a prior art structure to facilitate the reader's understanding of the invention;

FIG. 2 is a schematic diagram of a form of the invention;

FIG. 3 is a schematic diagram of another form of the invention somewhat more sophisticated than the structure shown in FIG. 2;

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FIG. 4 is a schematic diagram of an even more elaborate form of the invention; and

FIGS. 5, 5a, 5b, and 5c show the relationship of the three rotary switches of each seeking switch of the structure of FIG. 4 for various angular positions of said seeking switch and for various control switch settings.

Referring now to the prior art structure shown in FIG. 1, there is shown a seeking switch within the rectangular block 10 and a control switch therefor within the block 11. Within the block 10 are shown rotary elements 12 and 13 which are fastened securely and in a fixed position with respect to each other upon a common rotatable shaft 14 which is driven by the motor 15 in a manner to be described later.

Generally speaking, in operation the rotary element (or rotor) 13 will rotate in the direction of the arrow 16 until the proper one of the two notches 17 or 18 therein aligns itself under the proper stationary contact 19, 20, or 21 at which time the rotor 13 will cease rotating. More specifically, the reason why the rotary element 13 will continue rotating until the desired position of the rotary element is obtained is that for all other positions of the rotary element 13 an energizing circuit will be established which will cause the motor 15 to remain energized.

For example, in the particular structure shown in FIG. 1 the rotor 13 is shown in the only position in which the deenergizing circuit for motor 15 is obtained. It should be noted at this point that the motor 15 is connected across the battery 31 only when the relay winding 29 is energized to close contacts 32. Thus, energization or deenergization of motor 15 is dependent upon energization or deenergization of relay winding 29. In turn, energization of relay winding 29 is dependent upon ground potential being supplied to conductor 160. Such ground potential can only be supplied to relay winding 29 through conductor 160.

In the structure of FIG. 1 it can be seen that all circuits to ground from winding 29 are open. Specifically, contact 21 leads to an open circuit within the control switch 11, contact 20 can be traced through the switches 23 and 24 of control switch 11, the rotor 12, lead 26, and back to contact 20 through sliding contact 22 which maintains constant contact with the conductive rotor 13. Contact 19 is obviously open-circuited at the notch 17.

It is to be noted that the particular positioning of the rotor switch 13, shown in FIG. 1, is determined by two factors. The first factor is the connecting of the arm of one of the switches 27, 23, or 28 to its ground position. In the structure of FIG. 1 switch 27 is shown as being connected to its ground position. It can be seen then, that as long as contact 19 makes with rotor 13, a complete circuit will be established from ground through the contact 19, contact 22, relay winding 29, and through battery source 31 to energize the relay winding 29. Energization of relay winding 29 will close the contacts 32 and connect motor 15 directly across the battery 31, which motor will then function to rotate and drive the rotors 12 and 13 by means of the common rotatable shaft 14. However, when the contact 19 coincides with either the notch 17 or the notch 18 (ignoring any ground potential supplied through lead 26), it will be apparent that the circuit for energizing the relay winding 29 will be opened, thus causing the contacts 32 to be opened with consequent deenergization of motor 15. It will also be apparent that since there are two notches, 17 and 18, there will be ambiguity as to which notch the contact 19 is coincident. The means for resolving this ambiguity forms the second factor which determines the angular position of the rotors 12 and 13.

More specifically, the means for resolving the aforementioned ambiguity comprises the switch 24 located in

the control switch 11 and the rotor 12 which has sliding contacts 33, 34, and 35 thereon. The sliding contact 34 forms a continuous contact with the rotor 12 and is connected to the arm of the switch 24 through conductor 36. Generally speaking, the function of the rotor 12 is to provide a continuous ground return path for the relay winding 29 during a given continuous 180° of revolution of the rotors 13 and 12 when the switch 24 is in a given one of its two possible positions, and to provide a continuous ground return path for the relay winding 29 during the other 180° of revolution when the switch 24 is in its other position. Thus, the motor 15 will always be energized during a given 180° portion of a complete revolution of the rotor 18 so that one or the other of the notches 17 or 18 will pass under the grounded contact 19 without breaking the energizing circuit (ground return path) for relay winding 29. A specific example of the afore-mentioned operation is as follows. Assume that the arm of switch 24 is connected to its ground position (a position opposite to that shown in FIG. 1). A circuit will now be established from ground through switch 24, lead 36, contacts 34 and 33 of rotor 12, lead 26, and through the relay winding 29 to battery source 31. The contacts 32 will be closed and the motor 15 will be energized to rotate rotors 12 and 13 until the notch 18 falls under the ground contact 19. In this position the contact 33 will be open since rotor 12 has been rotated 180°. Thus, the ground connection cannot be transmitted from switch 24 through the rotor 12 to lead 26 and to relay winding 29. The sliding contact 35, which now will make contact with the conducting periphery of the rotor 12, will be simply connected to ground through switch 24 in the control switch 11 and will have no effect upon the relay winding 29. However, if in this new position of the rotors 12 and 13 the arm of the switch 24 is moved back to its upper position (i.e., to conductor 37), the relay winding 29 will become energized via a ground return path extending from the sliding contact 22 of rotor 13, contact 20, lead 38, switch 23, lead 37, lead 36, contact 34 of rotor 12 and then to ground potential through contact 35. The motor 15 will thereby become energized and rotate the rotors 12 and 13 until the notch 17 coincides with (passes under) the contact 19.

Although the foregoing discussion assumes that the arm of contact 19 is grounded by switch 27, it is to be understood that the arms of any one (but only one) of the three switches 27, 23, or 28 could be grounded; in which case the seeking rotor 13 would rotate until the proper notch of notches 17 or 18 coincides with the grounded contact of contacts 19, 20, or 21. The ambiguity produced by the fact that there are two notches is resolved by the setting of switch 24, as discussed above.

It is to be noted that current will travel in either direction through the lead 36, depending upon the setting of the switch 24. For example, if the arm of switch 24 is grounded, then conventional current can flow from battery source 31 through winding 29, lead 26, rotor 12, and then from left to right in the drawing through lead 36 to ground. On the other hand, if the arm of switch 24 is in its upper position (making contact with the lead 37) then, assuming rotor 12 to be making contact with contact 35, a circuit can be traced from battery 31 through winding 29, conductive rotor 13, contact 19 or 20, through one or the other of the switches 27 or 23 to the conductor 37, and then through switch 24 and lead 36 to ground potential through rotor 12 and contact 35. It is to be noted that switches 27 and 23 both have contacts leading to switch 37 inasmuch as one of the switch arms might be grounded. Thus, there will always be at least one switch (either switch 23 or 27), through which a closed circuit will be established between rotor switch 13 and lead 37.

Through conductors 41, 38, and 42, however, current will be caused to flow only in one direction, from left to

right. Now, since current will flow only in one direction through the conductors 41, 38, and 42 it is possible to construct a structure in which a single control switch, such as control switch 11, can be employed to control two or more seeking switches. Such a structure is shown in FIG. 2 in which control switch 11' is common to seeking switch 10' and to seeking switch 43, which is identical with seeking switch 10'. It is to be noted that the rotor switches of seeking switch 43 are not connected in the same shaft as the rotor switches of seeking switch 10', but operate independently thereof. However, they will both rotate to the same corresponding null position, as determined by the setting of control switch 11', where they will stop. Since seeking switches 10' and 43 rotate independently of each other, their instantaneous angular position during the seeking period will not necessarily be the same. In all likelihood such angular positions will be different. Consequently, unless some means, such as the diodes 44, 45, 46, 47, 48, 49, 56, 57, 153, and 154 are provided, sneak circuits to ground potential will exist which will short circuit the otherwise null position of either of the seeking switches 10' and thus cause the associated motor (15) to remain energized so that the associated rotor (13) will pass by the desired null position. A specific example will clarify the aforementioned statement.

Assume in FIG. 2 that the switch 28' is closed to ground potential so that a null position is obtained when the notch 17' coincides with the position of the sliding contact 21'. Under these conditions the relay 29' would normally be in a de-energized condition because there is no return path to ground potential. However, if the notch 17' of rotor 13' of seeking switch 43 has not yet rotated to a point coincidental with the contact 21', there will be, in the absence of the diodes 47, 48, and 49, a sneak path to ground for relay winding 29' of seeking switch 10'. Such sneak path would extend from ground potential, through switch 28', diode 49, contact 21' of switch 43, contact 20', lead 51 (and then assuming diode 48 to be non-existent) through the diode 45, sliding contact 20' of rotary switch 13', sliding contact 22', winding 29' to the battery source 31. However, since diode 48 does exist, such sneak circuit is effectively blocked. In a similar manner all the other diodes 47, 49, 44, 45, and 46 will prevent sneak circuits to ground potential for various other null positions of rotors 13' to 13''.

There still exists, however, the possibility of a sneak circuit through the fourth wires 53 and 58 which are connected respectively to the sliding contacts 34' and 34'' of rotors 12' and 12'' of switch 10' and 43, respectively. For example, such a sneak circuit could exist from ground potential in control switch 11' (assuming diode 154 to be non-existent), through switch 28, diode 49, sliding contacts 21'' and 22'', rotor 13'', conductor 26'', contacts 33'' and 34'', lead 58, the upper contact switch 55, diode 56, through either of switches 27' or 23', rotor 13', contact 22' to the winding 29. However, diode 154 is present and does block such sneak circuit. Alternatively a sneak circuit path might exist solely between the fourth wires 53 and 58. Assume, for example, that the grounded contact 35'' of seeking switch 43 makes with the rotor 12'. A circuit path will then be traceable from the grounded contact 35'' (of seeking switch 43) through the rotor 12'', conductor 58, the upper contact of switch 55, diode 56 and (then assuming diode 57 to be non-existent) through the upper contact of switch 24, conductor 53, contact 34', rotor 12', contact 33', diode 153 to the relay winding 29'. However, the diode 57 does exist and effectively blocks such incipient sneak circuit. It is to be specifically pointed out that the addition of the diodes 44 through 49, and diodes 56, 57, 153, and 154 constitute important features of the invention.

Referring now to FIG. 3, there is shown a form of the invention which is quite similar to that shown in FIG. 2 except that the form of seeking switch shown in FIG. 3

is a 5 wire system instead of a 3 wire system and has a sixth wire which will double the capacity of the seeking switch to provide 10 positions for each seeking switch. In the case of the structure shown in FIG. 2, a 3 wire system is used with a fourth wire which doubles the capacity to provide six positions. A further difference between the structures of FIG. 3 and FIG. 2, is that the function of the switches 55 and 24' and the diodes 56 and 57 of the control switch 11' of FIG. 2 are replaced with switch 56, relay winding 57, switches 58 and 59 which are operated by relay winding 57, and diodes 60, 61, 62, and 63 which are grouped in two pairs of diodes. An examination of the switches 59 and 58 and the activating relay winding 57 will show that ground potential is placed on leads 53' and 58' when the arm of switch 56 is connected to ground potential to energize relay winding 57. Such grounding of leads 53' and 58' corresponds to the grounding of the arms of the switches 55 and 24' of FIG. 2. When the switch 56 is open the relay winding 57 is de-energized and the arms of switches 58 and 59 make with the upper contacts 65 and 64, as shown in FIG. 3. The said upper contacts 65 and 64 connect to the common cathode junction of the diodes 62 and 63 and to the common cathode junction of diodes 60 and 61, respectively. One function of diodes 60 and 61 is to permit completion of a circuit from ground potential at the contact 35''' through the rotary switch 34''', the lead 53', contact 64, lead 66, and through diode 60 or 61 to either the contact 67 or 68 through the rotor 13''', and then to the relay winding contained within the block 70. It is to be noted that the block 70 contains a relay winding and associated contacts, a battery supply, and a motor similar to a relay winding 29, contacts 32, battery source 31 and the motor 15 shown in FIG. 1.

Another function of the diodes 60 and 61 is to prevent undesirable sneak circuits. For example, assume that the switch 71 was open instead of closed, as shown, and that the arm of switch 72, instead, was closed to ground potential. A sneak circuit would then exist from ground potential through switch 72, lead 73, diode 75 (and assuming diode 61 to be non-existent, i.e., short-circuited), through diode 60, contact 67 and through the rotary switch 13''' to the relay winding in the block 70. Another sneak circuit path might start from the same source (switch 72) and extend through conductor 73, conductor 66, switch 59, rotor 34'', lead 26''' to the relay winding in block 70. However, the presence of diodes 60, 61, 62, and 63 effectively block all such sneak circuit paths, thus completely isolating seeking switch system 79 from seeking switch system 80, although they both are controlled by the same control switch 81.

Referring now to FIG. 4, there is shown a more elaborate form of the invention. More specifically, there is shown in FIG. 4 two seeking switches, each of which has five wires plus a sixth wire and a seventh wire. The five wires of seeking switch system 88 are identified by reference characters 82, 83, 84, 85, and 86, each wire being connected to a separate sliding contact (91) which makes with the conductive periphery of the rotary switch 87. The sixth wire 163 functions to double the capacity of the five wires to provide ten angular positions of the rotary element 87 and the seventh wire 164 functions to double the aforementioned ten angular position capacity of the rotary element to provide a twenty discrete angular position capacity rotary switch 87.

The details of the seeking switch represented by the block 89 are not shown since they are identical with the seeking switch shown within the block 88. The control switch, which is that structure shown within dotted block 90, is common to both of the seeking switch systems 88 and 89.

Referring now to the seeking switch shown within the block 88, the rotary element 87 can be seen to have four notches, 101, 102, 103, and 104 spaced 90° apart around

the periphery thereof. The five sliding contacts 91 connected to the conductors 82 through 86, respectively, are spaced at equal distances along the periphery of rotary element 87 and span an angular distance somewhat less than 90°, so that the entire five contacts 91 can be located between two adjacent notches in the rotary element 87.

It is to be noted that the function of the rotary element 92 is the same as the rotary element 12 of FIG. 1, which function is to resolve a 180° ambiguity of the rotor 87. More specifically, the rotary element 92 will always complete the ground path for energization of the relay winding contained in block 93 during a continuous 180° segment of the cycle of the rotary element 87. However, since the element 87 has 20 discrete positions (five positions in each 90° sector thereof), there will be an ambiguity in the selected 180° portion of the cycle of the rotary element 87. The function of the rotary element 94 is to resolve the ambiguity of the two 90° sectors of the selected 180° sector. Thus, the rotary elements 94 and 92 will function in cooperation with associated control unit switching network, to be discussed later, to provide continuous ground potential to the relay winding of block 93 during the time intervals that three of the four 90° sectors of the rotary element 87 are passing under the five sliding contacts 91. Only during one 90° sector (with any given settings of the associated control unit circuitry to be discussed later) will the seeking switches 88 or 89 function to cooperate with the control switch 90 to produce a null or open circuit condition so that the motor in block 93 will be de-energized and stopped. The aforementioned statement can be seen to be true when it is considered that when the proper notch on the rotary switch 87 is passing under the sliding contacts 91 during the selected 90° segment of rotation of the rotary switch 87, that ground potential for the relay winding can be supplied only through the conductive rotary switch 87.

The particular switching circuitry which determines which of the 90° sectors of the rotary switch 87 will be the one during which a null can occur is found in the control switching unit 90 and, more specifically, comprises switches 105 and 106. Switches 105 and 106, respectively, energize relay winding 107 and 108. The relay winding 107 controls switches 110 and 111 which in turn control, respectively, the return-to-ground circuit for the relay winding of block 93 through rotary element 94, and a similar return-to-ground in the seeking switch 89. Relay winding 108 controls switches 112 and 113 which in turn control, respectively, the return-to-ground path for the relay in block 93 through the rotary element 92 and a similar return-to-ground path in the second seeking switch unit 89.

A specific example of the operation of the structure shown in FIG. 4 will now be described. First, however, it should be specifically noted that the combination of one seeking switch with one control unit is old in the art and the operation of such combination, as has been described in conjunction with the structures of FIGS. 1, 2, and 3, and as is about to be described in conjunction with the structure of FIG. 4, are described herein only because such description is considered necessary to facilitate an understanding of the invention. As indicated hereinbefore, the invention is essentially comprised of the circuitry required to control two or more seeking switches with a single control unit. Such required circuitry in the structure of FIG. 4 is comprised of the relays 107 and 108 and the associated switches 110 to 113. Such required circuitry also comprises diodes 130 to 147, inclusively.

With respect to the operation of the structure shown in FIG. 4, assume that in the control switch 10 the switch 114 is closed to ground potential as shown, and that switches 115, 116, 117, and 118 are all open. As indicated hereinbefore, this means that when the appropriate one of the notches 101 through 104 in rotary switch 87 coincides with the position of the grounded sliding contact 119, all possible return-to-ground circuits for the relay

winding in block 93 will be open so that said relay winding will be de-energized and the motor in block 93 will therefore also be de-energized. Now, as indicated hereinbefore, only one of the four notches, 101 through 104, will provide such a null position. When any of the other three notches pass under the contact 119, the relay winding in block 93 will be grounded either through the rotary switch 94 or the rotary switch 92 (referring only to seeking switch 88 and ignoring seeking switch 89). In the particular arrangement of contacts shown in FIG. 4, the proper notch of the notches 101 through 104 is notch 101, which is shown as passing under the contact 119. Thus, all return to ground for the relay winding of block 93 are open, which defines a null position and which will cause the motor and the rotary switches to stop rotating. Now, assume that switch 106 is closed by the operator. The relay winding 108 will be energized in a circuit extending from ground potential through switch 106, relay winding 108, to battery source 121. The arms of switches 112 and 113 will then be connected to ground potential (opposite to the connection shown in FIG. 4), establishing a return-to-ground path for the relay winding (in block 93) extending from the relay winding (in block 93), through conductor 122, sliding contact 128, sliding contact 127, switch 112 to ground. The motor in block 93 will be energized and will rotate the rotary switch consisting of rotary elements 87, 92, and 94 until the appropriate notch of notches 101 through 104 passes under contact 119. Such appropriate notch is notch 103, which means that the rotary switch must be rotated exactly 180° to find its new null position. Since the rotary elements 92 and 94 are rigidly secured on the same shaft 165 as rotary element 87, they also will be rotated 180°. From an examination of FIG. 4 it will be apparent that since rotary element 94 is symmetrical about its axis its new angular position is, for all purposes, the same as shown in FIG. 4. However, the rotary element 92 in its new position has a configuration reversed from that shown in FIG. 4 and thus will make contact with grounded sliding contact 126. There will be no ground return path for the relay winding in block 93, however, since the sliding contact 127 of rotary switch 92 is connected also to ground, and since the sliding contact 128 of rotary switch 92 no longer makes contact with the periphery of conductive rotary element 92.

The five diodes 130, 131, 132, 133, 134, and the five diodes 135, 136, 137, 138, 139 function to prevent sneak circuits between seeking switch units 88 and 89 through the 10 leads to which they are connected. The four pairs of diodes consisting of diodes 140, 141, 142, 143, 144, 145, 146, and 147 function to prevent sneak circuits within either of the two seeking switch units 88 or 89. It is to be noted that in the structure of FIG. 4, as well as in the structure of FIG. 3, that the extra wire circuits, i.e., the sixth wires 58' and 53' of FIG. 3 and the sixth and seventh extra wires such as sixth and seventh wires 163 and 164 of FIG. 4 are isolated one from the other so that there is no danger of sneak circuits therebetween. Rather, as will be discussed later herein, the possibility of sneak circuits lies between pairs of the five basic tie leads, such as leads 82 through 86 which connect the control unit to a seeking switch unit.

It will be observed that the upper contacts of switches 110, 111, 112, and 113 each lead to a common cathode junction of an individual pair of diodes. Now, as discussed in connection with the structure of FIG. 3, this type connection functions to provide a ground return path from the relay windings (such as the relay winding in block 93) of seeking switches 88 and 89 to the grounded sliding contacts such as contacts 150 and 126 of rotary elements 94 and 92, and also functions to block sneak circuits. In both seeking switch units 88 and 89 such ground return path is connected to two leads of leads such as leads 82—86 since, at any given instant of time, one of the two leads might be open-circuited at the rotary

element 87 due to a notch passing under the sliding contact (91) connected to said lead. For example, in FIG. 4 it is apparent that a ground return path could not be established through the lead 82 since the contact 119 is open. However, a complete circuit can be traced from the junction between the diodes 140 and 141, through diode 141, lead 83, conductive rotary element 87, sliding contact 151, to the relay winding in block 93.

It is to be noted that if either the contact 114 or 115 were closed a sneak circuit would be established in the absence of diodes 140 and 141. For example, assuming as shown, that contact 114 is closed, a ground return sneak path could then be established from ground potential through switch 114, diode 130, and in the absence of diodes 140 and 141 (but assuming a solid connection thereacross), to the lead 83, and then to the sliding contact 151 of rotary element 87 to the relay in block 93. However, such a sneak circuit actually cannot exist due to presence of diodes 140 and 141, one of which is always poled in the proper polarity to prevent a sneak circuit path.

The three other pairs of diodes 142, 143, and 144, 145, and 146, 147 function in the same manner as diodes 140 and 141 but, of course, in connection with different pairs of connecting leads and in connection with different rotary elements.

In the discussion of the structure of FIG. 4 it was stated hereinbefore that only one 90° sector of the rotary elements 87, 92 and 94 was able to provide a null position for the seeking switch for any given setting of the switches 105 and 106. Since switches 105 and 106 are two in number, each having an open and a closed position, there are four combinations possible, which will selectively enable each of the four different 90° sectors of the rotary element 87 to provide a null position. These four combinations of the switch settings of switches 105 and 106 are shown in FIGS. 5, 5a, 5b, and 5c with the rotary elements being shown in the proper position so that the notch shown passing under the first of the five sliding contacts (91) is just entering the 90° portion of the cycle in which a null position is obtainable, i.e., will not be short-circuited through one of the other two rotary elements 92' or 94'. It is to be noted that switches 105' and 106' are shown as having their arms connected directly to the sliding contacts 124' and 127' of the rotary elements 94' and 92', respectively. For purposes of this portion of the discussion, the relays 107 and 108 of FIG. 4 and their associated switches may be eliminated from the circuit inasmuch as they provide means for simultaneously providing ground return paths for the seeking switch 88 and the seeking switch 89 of FIG. 4 while maintaining an electrical isolation therebetween. In the structure of FIG. 5 no isolation is needed since the operation of only one seeking switch is being described.

For purposes of convenience the notches 101, 102, 103 and 104 are labeled in each of the FIGS. 5, 5a, 5b, and 5c and it will be further observed that the notches are advanced 90° in each of the four FIGS. 5 through 5c.

In FIG. 5a the notch 102' is shown as passing under the contact 119''. An examination of the circuit will show that there are no return paths to ground from the conductor 106''. To effect this null condition the arm of switch 105 must be connected to ground potential and the arm of switch 106'' must be connected to its upper contact.

In FIG. 5b the arm of switch 105''' is shown as being connected to its upper contact and the arm of switch 106''' is shown as being connected to ground potential. The notch 103''' of rotary element 87''' is shown as passing under sliding contact 119'''. An examination of the circuit will show there is no sneak circuit path to ground potential under these conditions.

In FIG. 5c the fourth and last setting of switches 105''' and 106''' is shown; both switches having their arms connected to ground potential. Under these conditions

the null condition will exist when the notch 104"" passes under any grounded contact of the five sliding contacts 119"".

It is to be noted that the forms of the invention shown herein and described are but preferred embodiments thereof and that various changes may be made in circuit arrangements and configurations of rotary switches without departing from the spirit or scope of said invention.

I claim:

1. A seeking switch system comprising a common control unit and a plurality of seeking switch units connected in parallel with respect to said control unit and each controllable by said common control unit, each of said control units comprising a plurality of first switches, each of said first switches including an arm and a grounded contact, each seeking switch unit comprising a rotatable shaft and a first rotary element mounted on said rotatable shaft, said first rotary element having a plurality of notches in the periphery thereof spaced substantially equidistant apart around said periphery, a plurality of first sliding contacts arranged to make contact with the periphery of said first rotary element and spaced apart substantially equidistant in such a manner that the total angular distance spanned by said plurality of first sliding contacts is less than the angular distance between two adjacent ones of said notches, a plurality of diodes individually connecting each of said plurality of said first sliding contacts to an individual one of said arms of said first switches of said control unit, second sliding contact means constructed and arranged to make continuous contact with said first rotary element, motor means including a rotor coupled to said rotatable shaft, said motor means responsive to ground potential being supplied to said second sliding contact means to cause energization of said motor means, said first rotary element responsive to energization of said motor means to rotate until one of said notches passes underneath a grounded one of said plurality of first sliding contacts, individual ambiguity resolving means for each of said seeking switch units, each ambiguity resolving means constructed to supply ground potential to said second sliding contact means during a selectable one half cycle of the two half cycles forming a complete revolution of said first rotary element, thus maintaining energization of said motor means during said selected half cycle regardless of any notch passing under the grounded contact of said first plurality of sliding contacts, each of said ambiguity resolving means comprising a second rotary element, third sliding contact means connected to ground potential, fourth sliding contact means connected with said second sliding contact means, and fifth sliding contact means continuously in contact with said second rotary element, said rotary element being constructed to have a 180° sector of its periphery make contact with the third and fourth sliding contact means, and other switching means for selectively applying ground potential to the fifth sliding contact or to connect said fifth sliding contact to at least one of the contacts of said plurality of first sliding contact in contact with said first rotary element.

2. A seeking switch system in accordance with claim 1 in which each of said other switching means comprises a single pole double throw switch having a first contact connected to ground potential and a second contact, in which at least two switches of said plurality of first switches comprise a second contact, diode means connecting said second contact of each of said other switching means to the second contacts of said first switches, said last mentioned diode means being poled in the same polarity as the polarity of said first diode means with respect to said motor means in a circuit extending through the second contacts of said first switches.

3. A seeking switch system in accordance with claim 1 in which said first rotary element comprises four notches in the outer periphery thereof spaced apart at 90° intervals, and in which each of said seeking switch units com-

prises a second ambiguity resolving means including a third rotary element, a sixth sliding contact connected to ground potential, a seventh sliding contact connected to said second sliding contact, and an eighth sliding contact constructed to be in continuous contact with said third rotary element, said third rotary element constructed to provide a continuous ground return path to said second sliding contact means to cause energization of said motor means during a 90° sector of the operable 180° sector of said first rotary element to resolve the ambiguity of said operable 180° sector, said third rotary element comprising two 90° sectors which make contact with said sixth and seventh sliding contacts, said two 90° sectors being positioned so that they are each bisected by a diametrical line passing through the rotatable shaft upon which said third rotary element is mounted, and means for selectively applying ground potential to said eighth sliding contact or to connect said eighth sliding contact to at least two of said first sliding contacts.

4. A seeking switch system in accordance with claim 3 in which the last mentioned means comprises a pair of diodes connected back-to-back between a given pair of said first sliding contacts, relay winding means, means for selectively energizing or de-energizing said relay winding means, a relay arm connected to said eighth sliding contact and operable by said relay winding means, and front and back contacts connectable to said relay arm, one of said front and back contacts being connected to ground potential and the other of said contacts being connected to the junction between said back-to-back diode.

5. A seeking switch system comprising a common control unit and a plurality of seeking switch units operable by said common control unit, said common control unit comprising a plurality of first switches each including an arm and a first contact connected to a reference potential, each seeking switch unit comprising a rotary switch having a rotatable shaft and a first rotary element mounted thereon, said seeking switch system responsive to the connecting of the arm of a selectable one of said plurality of first switches to the first contact thereof, said first rotary element being of a conductive material and having notches in the periphery thereof, said rotary switch further comprising a plurality of first sliding contacts which make contact with said periphery of said first rotary element, first individual diode means connecting each of said first sliding contacts to an individual one of said arms of said first plurality of switches, second sliding contact means constructed and arranged to make continuous contact with said first rotary element, motor means comprising a rotor coupled to said rotatable shaft, actuating means constructed and arranged to respond to the supplying of said reference potential to said second sliding contact to energize said motor means and to cause said rotary switch to rotate until one of said notches in the periphery of said first rotary element passes underneath the particular one of said first sliding contacts which is connected to said reference potential through the arm of one of said plurality of first switches, a second rotary element of conductive material mounted on said rotatable shaft, third and fourth sliding contacts connected respectively to said reference potential and said second sliding contact and arranged substantially 180° apart with respect to said rotatable shaft, said second rotary element being constructed and arranged to make contact alternately with said third and fourth sliding contacts during substantially exclusive 180° continuous sectors of rotation of said second rotary element to cause said motor means to be energized continuously during a first of said exclusive 180° sectors, a fifth sliding contact constructed to make continuous contact with said second rotary element, and means including other switching means for selectively connecting said fifth sliding contact to said reference potential or to at least one of said first sliding contacts which is making contact with said first rotary element,

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said last means including diode means to block sneak circuit paths.

6. A seeking switch system in accordance with claim 5 in which each of said other switching means comprises a single pole double throw switch having a first contact connected to said reference potential and a second contact, in which at least two switches of said plurality of first switches comprise a second contact, diode means connecting said second contact of each of said other switching means to the second contact of said first switches, said last mentioned diode means being poled in the same polarity as the polarity of said first diode means with respect to said motor means in a circuit extending through the second contacts of said first switches.

7. A seeking switch system in accordance with claim 5 in which the first rotary element contains four notches in the outer periphery thereof spaced apart at 90° intervals, and comprising a third rotary element, a sixth sliding contact connected to said reference potential and a seventh sliding contact connected to said second sliding contact, and an eighth sliding contact constructed to be in continuous contact with said third rotary element, said third rotary element constructed to provide a circuit path for said reference potential to said second sliding contact means to cause energization of said motor means

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during a 90° sector of the second of said exclusive 180° sector of said second rotary element to resolve the ambiguity of the second exclusive 180° sector, said third rotary element having two 90° sectors which make contact with said sixth and seventh sliding contacts, said two 90° sectors being positioned so that they are bisected by a diametrical line passing through the rotatable shaft upon which said third rotary element is mounted, and means for selectively applying said reference potential to said eighth sliding contact or to connect said eighth sliding contact to at least two of said first sliding contacts.

8. A seeking switch system in accordance with claim 7 in which the last mentioned means comprises a pair of diodes connected back-to-back between a given pair of said first sliding contacts, relay winding means, means for selectively energizing or de-energizing said relay winding means, a relay arm operable by said relay winding means and connected to said eighth sliding contact, and front and back contacts connectable to said relay arm, one of said front and back contacts being connected to said reference potential and the other of said contacts being connected to the junction between said back-to-back diodes.

No references cited.