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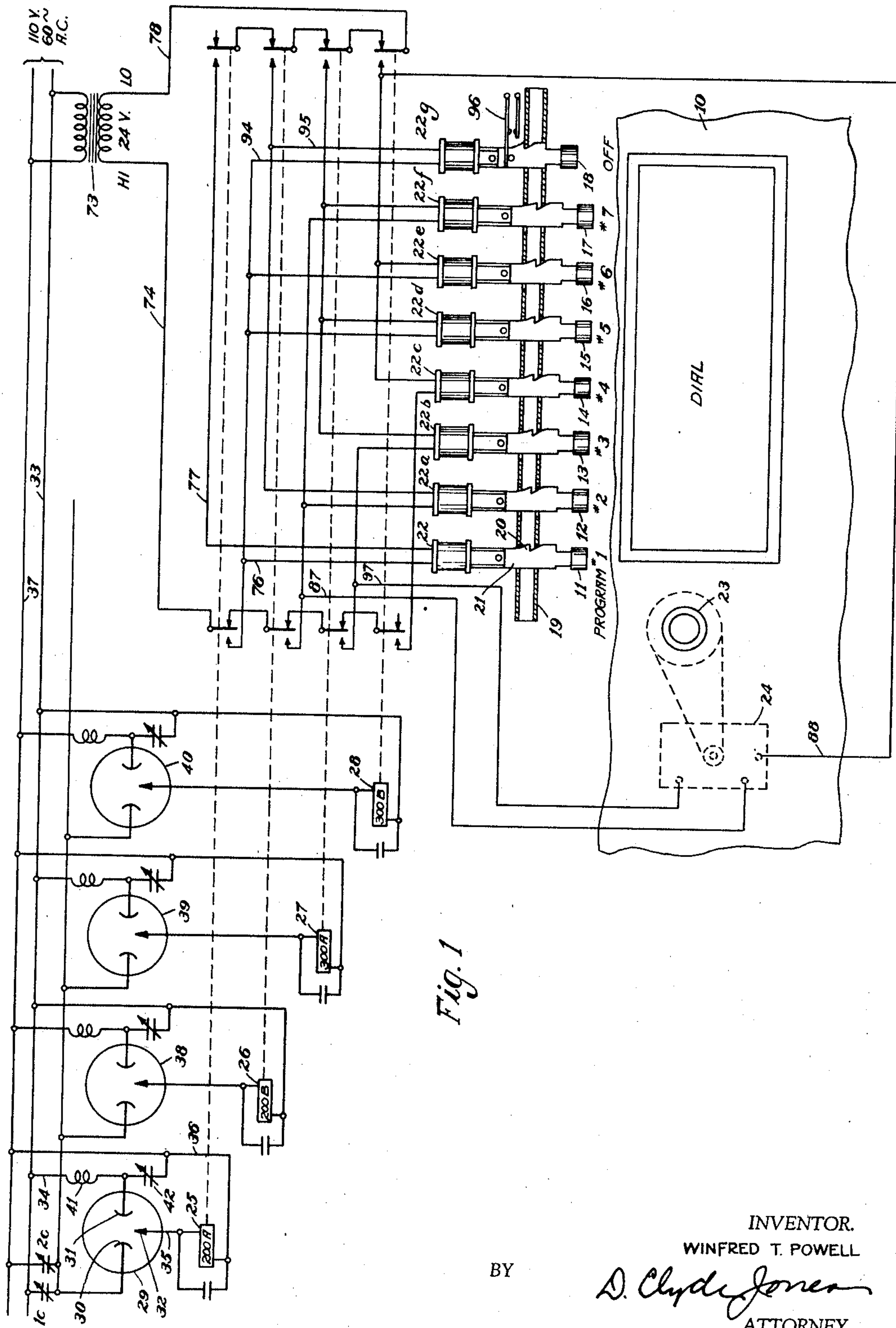
W. T. POWELL

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REMOTELY CONTROLLED RADIO RECEIVING SYSTEM

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2 Sheets-Sheet 1



BY

INVENTOR.
WINFRED T. POWELL

D. Clyde Jones
ATTORNEY.

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BY

INVENTOR.
WINFRED T. POWELL
D. Clyde Jones
ATTORNEY.

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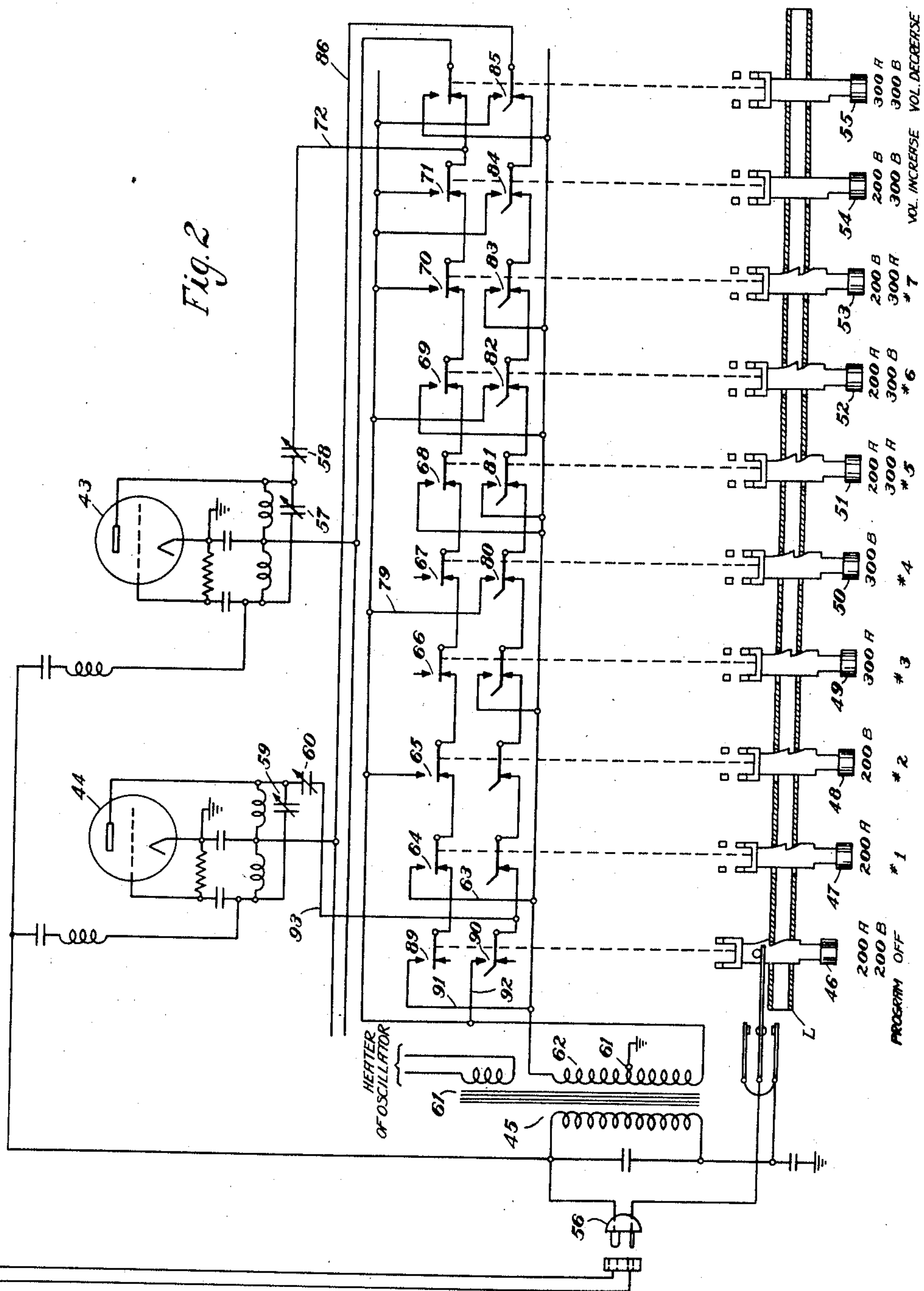


Fig. 2

UNITED STATES PATENT OFFICE

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REMOTELY CONTROLLED RADIO
RECEIVING SYSTEM

Winfred T. Powell, Rochester, N. Y., assignor to
The Stromberg-Carlson Telephone Manufac-
turing Company, Rochester, N. Y., a corpora-
tion of New York

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1 Claim. (Cl. 250—20)

This invention relates to remotely controlled radio receiving systems.

It has been proposed to selectively effect from a remote point, the tuning of a radio receiving system and also the regulation of the reproduced signal volume thereof, by utilizing governing carrier currents of low radio frequencies superimposed on the commercial power or lighting system in the building wherein the radio signal receiving system is operated.

The present invention has for its purpose a simplification of and a reduction in the amount of control equipment necessary in such a system.

For a clearer understanding of the invention, reference is made to the drawings in which:

Fig. 1 represents a portion of a radio receiver of the type in which push button keys selectively effect tuning of the radio receiver, as well as solenoids and related control equipment associated with the radio receiver whereby the push button keys may be selectively operated from a remote point;

Fig. 2 diagrammatically represents control equipment located at a remote point and includes two oscillators selectively controlled by push button keys at the remote point for transmitting impulses of current of different frequencies and different phases to selectively operate the control equipment associated with the radio receiver.

In the drawings the numeral 10 generally designates a cabinet enclosing a well known type of radio receiver (not shown). The circuits (also not shown) of this radio receiver are selectively tunable to the programs of any one of seven broadcast frequencies by means including a series of keys designated 11 to 17 inclusive. It will be understood that, by the operation of any one of these seven keys, any one of seven favorite programs may be selected. Although seven such keys have been illustrated, the invention is applicable to the selection of a lesser or greater number of programs depending on the number of keys used. These seven keys, as well as an "off" key 18, by which the radio receiver is turned off, are of the interlocking type, that is, a locking bar 19, which is normally urged toward the left, engages the latch such as 20 on each key when the key is depressed. However, the key last depressed releases any previously operated key. The key stem such as 21 of each key is connected to the movable core of a solenoid such as 22 so that when the solenoid is energized, it will operate its related key stem 21 in the same manner as when the push button of this key is

manually depressed. It will be understood that the key stems 21 are provided with switches effective to close circuits (not shown) which control the tuning of the radio receiver. This portion of the system has previously been disclosed in the application of R. H. Manson Serial No. 213,238 concurrently filed herewith, and need not be further described herein.

The radio receiver is also provided with a rotatably adjustable volume control knob 23 whereby the volume of the reproduced signal may be increased or diminished as desired by well known means (not shown). It will be noted that this knob can also be adjusted from a remote point by means of a reversible motor 24 which also actuates the knob 23 so that the program volume can be remotely controlled.

The operation of the eight solenoids 22 to 22g inclusive corresponding to the seven station keys and the "off" key, as well as the forward and reverse operation of the motor 24, are selectively controlled by four relays 25, 26, 27 and 28, when energized in various combinations. Each relay such as 25 has its operating circuit controlled by an arc discharge device such as 29. This device, which is of well-known construction, includes three electrodes 30, 31 and 32, surrounded by a gaseous atmosphere enclosed within a glass envelope. The electrodes 30 and 31 act as cathodes and the third electrode 32 serves as an anode, owing to their connection in the circuit network. Thus the anode 32 receives electrons from either of the electrodes 30 and 31. In this arrangement the gas in the space between the electrodes 30 and 31 breaks down or becomes ionized when the difference in potential thereacross reaches plus or minus 70 volts. With this space ionized, a discharge is maintained between electrode 32 and either electrode 30 and 31 as long as the difference in potential exceeds 60 volts. However, when the gas between the electrode 32 and either electrode 30 or electrode 31 is not ionized, the discharge potential of the device is approximately 200 volts and no discharge will take place in the absence of this voltage. Once the gas is ionized in the space between the electrodes 30 and 31, a discharge will be maintained if the electrode 32 is 60 volts positive with respect to either of the other two electrodes. With this discharge device connected as illustrated, the gap between the electrodes 32 and 30 is subjected alternately to positive and negative peaks of one and four tenths times the root mean square line voltage or a maximum of 180 volts. This is insufficient to cause ionization within the device.

If however, a volt or two of low radio frequency energy exists across the line conductors 33 and 37, it may be increased by resonance in the capacitor 42 and the inductance 41 so that the electrode 31 is supplied with a peak radio frequency potential exceeding 70 volts. This causes ionization in the space between the electrodes 30 and 31 which lowers the "break down" potential of electrodes 32 and 33 so that large amounts of current are passed through the relay during positive alternating pulses. The sensitivity of the device may be increased by reducing the radio frequency peak voltage required between the electrodes 30 and 31 to initiate ionization. This is accomplished by supplying a polarizing 60 cycle potential to electrode 30. In this case the main anode current passes between the electrodes 32 and 31 through the inductance 41. A capacitance divider including capacitors 1c and 2c can be adjusted to apply, for example, 50 volts peak, 60 cycle potential between electrodes 30 and 31 and thus reduce the radio frequency peak potential required to initiate discharge to about 20 volts. It will be understood that the discharge in the device is intermittent in nature, and when the gap between the electrodes 30 and 31 is ionized the potential of electrode 30 has no effect but the main discharge is maintained only so long as the instantaneous potential of the electrode 32 is greater than 60 volts. The sinusoidal variation of the voltage on the electrode 32 causes the discharge to stop after the potential drops below this maintenance value. The potential between the electrodes 30 and 31 must rise again during the next cycle above ionizing potential if the discharge is to be reinitiated. This means that the radio frequency voltage added to the circuit including the electrodes 30 and 31 must be present to maintain the discharge. Let it be assumed that the device is inactive when radio frequency pulses are not on the line, due to the adjustment of the potential of the element 29 by means of the capacitance potential divider. The voltage across the inductance 41 due to the radio frequency in the line conductors will start a discharge in the tube if the phase of the radio frequency envelope is such that it adds to the potential of the element 30 and raises it above the "break down" potential. If the device is reversed in phase from the condition, the gap between the electrodes 30 and 31 is ionized but only during periods when the electrode 32 is negative with respect to the electrodes 30 and 31 and thus no current flows through the device. With the device 29 functioning, current flows therethru in series with the relay 25 and the power source. Thus the relay 25 will be energized. The circuits for the relays 26, 27 and 28 are respectively completed by the arc discharge devices 38, 39 and 40 in a similar manner. It will be noted that the arc discharge device 29 is tuned by means of the inductance 41 and capacitor 42 so that it is responsive only to current of 200 kilocycles in phase A. The arc discharge device 38 is responsive only to frequencies of 200 kilocycles in phase B, whereas, device 39 responds only to 300 kilocycles in phase A and device 40 to 300 kilocycles in phase B.

In order to selectively energize the arc discharge devices 29, 38, 39 and 40 and in turn the relays 25, 26, 27 and 28 to effect the various adjustments of the radio receiver, the control equipment illustrated in Fig. 2 is provided. This control equipment includes the oscillators 43 and 44 and the transformer 45, as well as the "off"

key 46 and control keys 47 to 55 inclusive, which are connectible to the power line conductors by means of a polarized connecting plug 56 of such construction that the transformer can be connected to the power supply conductors 33 and 37 in only one way. Thus current of the proper frequency and phase is applied to the power line conductors, on the actuation of the several control keys.

The oscillator 43 is normally tuned to generate a low radio frequency of 300 kilocycles, by the variable capacitor 57; however, when the capacitor 58 is connected in multiple therewith, the oscillator 43 generates a low radio frequency of 200 kilocycles. Similarly the oscillator 44 is normally tuned to generate a frequency of 300 kilocycles by the capacitor 59 but when the capacitor 60 is connected in multiple therewith, this oscillator likewise generates a frequency of 200 kilocycles. These oscillators have their respective plate circuits related to the power conductors 33 and 37 in such a manner as to transmit thereover carrier frequency impulses of selected frequency and phase, under the control of the series of locking keys including "off" key 46 and the seven station selecting keys respectively designated 47 to 53 inclusive. It will be understood that these keys are of such construction that when one of them is depressed it will be locked in its depressed condition by a locking bar L but any previously operated key will be released. There are also associated with these keys, two non-locking keys 54 and 55 which close their respective contacts only as long as their related keys are depressed.

It is believed that the operation of the system will best be understood by describing the operations which take place when the remote control keys are depressed. For example, if the key 47 corresponding to the #1 program is depressed, the "off" key 46 is automatically released to connect the transformer 45 to the power line conductors 33 and 37 and current of 200 kilocycles frequency in phase A will be superimposed on these conductors. This is effected in a circuit traceable from ground at the mid tap 61 of the secondary winding 62 of the transformer 45, upper portion of this winding, conductor 63, contacts 64 of the #1 program key 47, normally closed contacts 65 to 71 inclusive of the keys 48 to 54 inclusive, conductor 72 and thence through the capacitor 58 in multiple with the capacitor 57, to the anode of the oscillator 43. This oscillator now generates current at a frequency of 200 kilocycles in phase A which is superimposed on the power line conductors 33 and 37 to which the output of the oscillator is coupled. Since the arc discharge device 29 connected to the power conductors at the radio receiver, is tuned to 200 kilocycles in phase A, the ionizing atmosphere therein "breaks down" and current flows between the electrodes 31 and 32 to energize the relay 25. With the relay 25 energized, current flows from one terminal of the secondary winding of the step down transformer 73, conductor 74, inner front contact and armature of relay 25, conductor 76, winding of the solenoid 22, conductor 77, outer front contact and armature of relay 25, outer back contacts and armatures of relays 26, 27 and 28, and conductor 78, to the other terminal of the secondary winding of the transformer 73. The solenoid 22 is thus energized and depresses its related key to lock it in depressed condition. With this key depressed, the radio receiver is tuned to receive the #1 program.

Furthermore, locking bar 19 is operated by latch 20 to release the key 18, which connects power to the radio receiver by means of contacts 96.

In case the key 50, corresponding to the #4 program, is depressed, any previously depressed key is released and current at a frequency of 300 kilocycles in phase B is superimposed on the power line conductors 33 and 37. This is effected in a circuit extending from ground at the mid-tap 61 of the secondary winding 62 of the transformer 45, lower portion of this winding, conductor 79, contacts 80, now closed by key 50, normally closed contacts 81 to 85 inclusive of the remaining keys in the series, conductor 86 and thence to anode of the oscillator 44. It will be noted in this instance that the capacitor 60 is ineffective so that only the capacitor 59 tunes the oscillator and this results in the oscillator superimposing radio frequency current of three hundred kilocycles in phase B on the power line conductors, so that the arc discharge device 40 "breaks down" and permits current to flow therethrough to energize the relay 28. This relay when energized completes a circuit from one terminal of the secondary winding of the power transformer 73, conductor 74, inner armatures and back contacts of relays 25, 26 and 27, armature and front contact of relay 28, winding of the solenoid 22c, outer front contact and armature of relay 28, conductor 78 to the other terminal of the secondary winding of the power transformer 73. The solenoid 22c is energized in this circuit and depresses its key 14, which is thereupon locked in its depressed condition to effect the tuning of the radio receiver to the #4 program corresponding to this key.

It is unnecessary to describe the operations resulting from the depression of the remaining keys in the series numbered 47 to 55 inclusive, since this will be obvious from the foregoing description. It is only necessary to understand that a given frequency and phase of current or combinations of frequencies and phases, are individual to each of these keys, the particular frequency or frequencies as well as current phase being noted at the bottom of Fig. 2 in vertical alignment with the respective keys to which they are individual. It should be noted that the legends associated with each of the relays 25, 26, 27 and 28, indicate the frequency and phase of the current which controls the operation of a given relay under the control of its related arc discharge device.

If the volume of the reproduced program is to be increased or diminished, the keys 54 and 55 are respectively depressed. For example, if it is desired to increase the volume, the key 54 is depressed. As a result of this operation, current at a frequency of 200 kilocycles in phase B and 300 kilocycles in phase B is superimposed on the power conductors. As a result of these currents, the arc discharge devices 38 and 40 will respond and effect the operation of the relays 26 and 28. With these relays operated, the forward operating winding of the motor 24 will be energized to turn the volume control shaft in a direction to increase the volume. The circuit for the mentioned winding of the motor is traceable from one terminal of the power transformer 73, conductor 74, inner armature and back contact of relay 25, inner armature and front contact of relay 26, conductor 87, forward operating winding of the motor 24, common return conductor 88, outer armature and front contact of relay 28, conductor 78 to the other terminal of the power transformer 73. If it is desired to decrease the volume of the

reproduced program, the key 55 will be depressed and this is effective to operate the relays 27 and 28. This in turn completes a circuit by way of conductor 97, which it is unnecessary to describe, for the reverse winding of the motor 24.

It will be noted that the contacts of the "off" key 46 closes a circuit including the primary winding of the transformer 45 in series with the power line conductors 33 and 37, both when this "off" key is in its normal or retracted position and also when this key is manually depressed to its innermost position. However, when the "off" key is mechanically latched in its semi-depressed condition, the power circuit connection to the primary winding of the transformer is open. With the "off" key fully depressed to close contacts 89 and 90, a circuit is completed from ground at the mid-tap 61 of the secondary winding 62 of the transformer 45, upper portion of the secondary winding, conductor 91, contacts 89 of the "off" key and thence in series through the upper, normally closed, contacts of keys 47 to 54 inclusive, conductor 72 and to the plate or anode of the oscillator 43. It will be noted in this instance that the capacitors 57 and 58 are connected in multiple so that this oscillator will generate a frequency of 200 kilocycles. Also when this "off" key is depressed, a circuit is closed from ground at the mid-tap 61 of the secondary winding 62 of the transformer 45, lower portion of this winding, conductor 92, contacts 90 of the "off" key, conductor 93, thence to the anode or plate of the oscillator 44, through the capacitor 60. In this instance it will also be noted that capacitors 59 and 60 are connected in multiple so that the frequency generated by this oscillator will be of 200 kilocycles.

In this manner radio frequency currents of 200 kilocycles frequency in phase A and 200 kilocycles frequency in phase B are superimposed on the power line conductors 33 and 37. This will cause the arc discharge device 29 and 38 to "break down" and in turn effect the operation of the relays 25 and 26. With these relays operated, the solenoid 22g is operated to depress the "off" key 18 in which position it is latched to turn off the radio receiver. The operating circuit for the solenoid 22g is traceable from one terminal of the transformer 73, conductor 74, inner armature and front contact of relay 25, conductor 94, winding of the solenoid 22g, conductor 95, outer front contact and armature of relay 26, outer back contacts and armatures of relays 27 and 28, and conductor 78 to the other terminal of the transformer 73.

It will be noted from the foregoing, that merely by the use of various combinations of low radio frequency and phase, four arc discharge devices with their related four relays can selectively control ten different operations to effect the tuning of the radio receiver to any one of seven programs as well as to turn the receiver on and off and selectively adjust the volume thereof. It will be appreciated that this effects a substantial simplification over prior arrangements in which volume increase and volume decrease as well as the operation of the "off" key could only be effected at the radio receiver.

What I claim is:

In a remotely controlled radio receiving system, a radio receiver selectably tunable to a plurality of broadcast programs, a plurality of keys, means interlocking said keys whereby the operation of a given key latches it in operated condition and unlatches a previously operated key, one of said

keys serving to turn the radio receiver on and off and each of the remaining keys serving to tune said radio receiver, when turned on, to a particular program, a solenoid individual to each
5 key and having an armature connected to its key for operating the same, line conductors connecting said radio receiver to a remote point, means including an oscillator and interlocking keys at said remote point corresponding in number to the

keys at said radio receiver for selectively applying to said conductors, currents in different combinations of frequency and phase, one of said keys at said remote point serving to turn said oscillator on and off, and means including arc
5 discharge devices selectively responsive to said currents for selectively operating said solenoids.

WINFRED T. POWELL.