

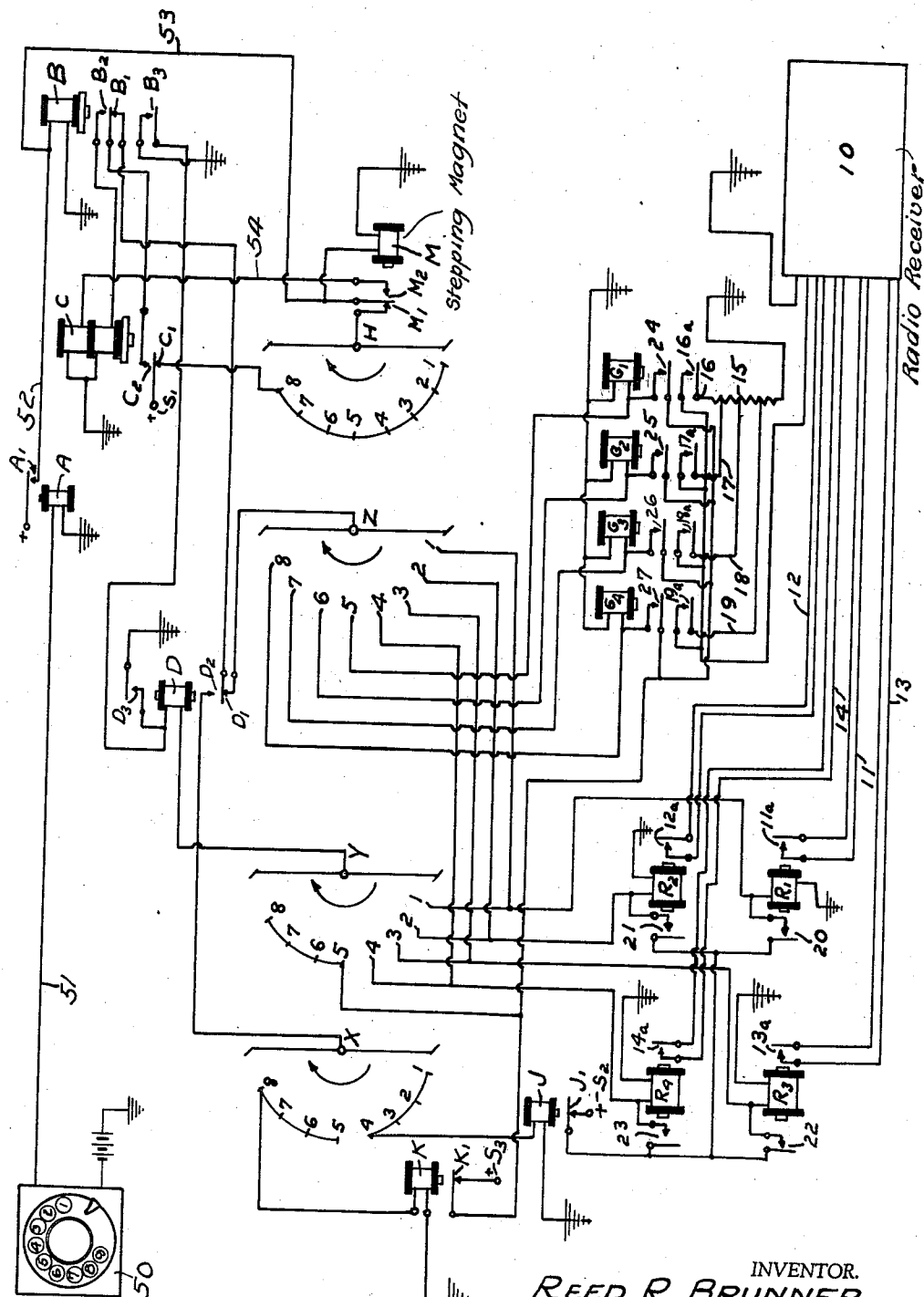
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CONTROL SYSTEM

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CONTROL SYSTEM

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This invention relates to an electrical control system and more particularly to a remote control system whereby some device such as a radio receiver may be controlled from a distance. The invention is well adapted for the control of a multi-channel radio receiver, but may be utilized in effecting various types of control of almost any kind of mechanism.

A general object of the invention is to provide apparatus which will respond to the direction of an operator at a distant point and will effect the desired changes at the mechanism to be controlled. The invention is directed particularly toward versatility of control and simplicity of operation.

The invention contemplates the use by the operator at the remote point of some device such as the common telephone dial whereby the will of the operator may be transmitted in the form of electric stimuli to the control apparatus. It is desired to provide apparatus sensitive to such stimuli which will upon the simple manipulation of such device effect any desired type of control. The embodiment of the invention herein specifically set forth deals with a multi-channel radio receiver and the necessary control which is associated with such mechanism, but it is understood that the invention is applicable for controlling the operation of any kind of mechanism which can be made responsive to a condition of an electrical circuit.

Where the control apparatus is arranged for tuning in various channels at a radio receiver by dialing operations at the remote point, it is frequently desired to clear the receiver of all channels to which it may be tuned except one on which reception is to continue. That is, the operator may dial digit 1 causing channel No. 1 to be tuned in, then dial digit 2 causing channel No. 2 to be tuned in, the receiver then being receptive on both channels 1 and 2. Afterwards, when a call is received on channel No. 1 and communication is to take place on the No. 1 channel, the operator can not then leave the receiver tuned on both channels for reception on the No. 2 channel would ruin intelligibility on the No. 1 channel being used for communication. It is an important feature of this invention that the operator may re-dial for channel No. 1, in such a case, to effect the clearance of all channels except the No. 1 channel presently being used for communication.

Another feature of the invention is the provision of improved means for selecting the control circuits which are to be made effective either

alone or in conjunction with each other. One important factor of this feature is the provision of an automatically operative homing device for moving the switching mechanism back to "home" or neutral position after it has been moved for effecting a desired control, and it will also be found that the operation of this homing arrangement does not disturb or affect the conditioning then effective.

Other features and advantages of the invention will be apparent after the following detailed description and explanation. The described embodiment is illustrated by the drawing which accompanies this specification in which the figure shown is a schematic diagram of the circuits involved illustrating the arrangement of the elements and their electrical connections according to this invention.

As here illustrated, the invention is adapted to effect control of the multi-channel radio receiver with which are associated the circuits 11, 12, 13 and 14. These four circuits represent four channels to which the receiver may be tuned, and the arrangement is such that when one or more of these circuits are closed as by the closing of one or more of contacts 11a, 12a, 13a and 14a, the receiver will be receptive on channels corresponding with the closed circuits. As shown in the figure these contacts are controlled by the relays R₁, R₂, R₃ and R₄ respectively.

The resistance 15 is connected in the receiver sensitivity circuit, and the conductors 16, 17, 18 and 19 are provided for shorting out various amounts of this resistance thereby changing the sensitivity of the receiver. Each of these shorting conductors includes one of contacts 16a, 17a, 18a and 19a, which contacts are controlled respectively by the relays G₁, G₂, G₃ and G₄. From the above it is then clear that the channels on which the receiver remains tuned and also the sensitivity of the receiver depend upon which of relays R₁, R₂, R₃, R₄ and G₁, G₂, G₃ and G₄ are energized. It is understood that while only four channel-controlling relays and four sensitivity-controlling relays have been illustrated, any number of these may be provided as may be desired. I have found that all of these relays may be conveniently located within the casing of the receiver itself, and in fact all of the selecting mechanism may, if desired, be combined in the same casing with the device being controlled.

At the remote point is the device 50 which may be an ordinary telephone dial having digits 1 to 9 and connected to the transmission line 51 which extends from the remote point to the location of

the radio receiver. At the place of the receiver the transmission line 51 is connected through the winding of the relay A. The closing of contacts A₁ of relay A operates to place positive potential on the conductor 52. In the accompanying drawing, the character + is intended to designate the positive terminal of a suitable battery or source of electric energy, the other side of which is connected to ground.

The conductor 52 is connected through the winding of the delayed action relay B to ground. Energization of relay B operates to break contacts B₁ and close contacts B₂ and B₃. Conductor 53 which is attached to conductor 52 is connected through the winding of the motor magnet M to ground, and energization of magnet M operates to break contacts M₁ and make contacts M₂. Contacts M₂ are connected by conductor 54 with the winding of the delayed action relay C, and when contacts M₂ are closed, a circuit is completed from the energy source through the winding of relay C to ground.

Energization of relay C operates to break contacts C₁ and make contacts C₂. Closing of contacts C₂ operates through contacts B₂ to complete a circuit from a source of energy through a winding of relay C to ground for locking up the armature of relay C until the armature of relay B is released.

An important part of the apparatus is the switching mechanism which comprises the switch banks designated X, Y, Z and H in the accompanying diagram. All of these banks are operated by a single shaft and move in unison. The shaft of the switching mechanism is mechanically connected and associated with the motor magnet M, so that when magnet M is actuated, the arms of each of switches X, Y, Z, and H are advanced one step. The arrangement whereby motor magnet M is adapted to advance the switching mechanism is well known in the communications field and will not be described in detail here. It is sufficient to say that a series of impulses impressed on motor magnet M will cause the arms of switches on each of the various banks to be advanced to some predetermined position in which each of these arms causes its respective bank to become conducting through some desired one of the electrical contacts of the bank.

As here shown each of the switch banks includes 8 electrical contacts, the ninth point being vacant or idle, but any number of contacts or points may be provided as may be necessary or desired. Taking first the Z bank, points 1, 2, 3 and 4 of this bank are connected through the windings of relays R₁, R₂, R₃ and R₄ respectively to ground, and points 5, 6, 7, and 8 of this bank are connected through the windings of relays G₁, G₂, G₃ and G₄ respectively to ground. The rotor or arm of this switch bank is connected through contacts D₁ of relay D, B₁ of relay B, and C₁ of relay C to a source of electrical energy.

The Y bank or level of the switching mechanism has its points 1 to 4 connected respectively through contacts 20, 21, 22 and 23 controlled by relays R₁, R₂, R₃ and R₄, and through contact J₁ of relay J to the source of electrical energy. It will be observed that this source of energy is also connected by circuits including contacts J₁ and contacts 20 to 23, through the windings of the relays to ground, thus providing lock-in circuits for these relays. Points 5 to 8 of the Y switch bank are joined and connected through contacts K₁ of relay K to a source of energy.

The contacts 24, 25, 26 and 27 controlled by relays G₁, G₂, G₃ and G₄ respectively operate, when closed, to connect this last-mentioned source of energy through the relay windings to ground, and so provides lock-in circuits for these relays.

The arm or rotor of the Y switch bank is connected through the winding of relay D, and through contacts B₃ of relay B to ground. Relay D is adapted when energized to break contacts D₁ and make contacts D₂ and D₃. The making of contacts D₃ operates to connect the arm of switch bank Y through the winding of relay D directly to ground and this provides a lock-in arrangement for relay D.

The X bank of the switching mechanism has its points 1 to 4 connected together and through the winding of relay J to ground, and has its points 5 to 8 connected together and through the winding of relay K to ground. The arm of this bank is connected through contacts D₂ of relay D, contacts B₁ of relay B, and contacts C₂ of relay C, to a source of potential.

The H switch bank, which performs the holding function for the mechanism has its points 1 to 8 connected together and through contacts C₁ of relay C to a source of energy. The arm of this switch bank is connected through contacts M₁ and the winding of magnet M to ground.

In explaining the operation of the above described system, let us assume that the operator at the distant point wishes to tune in channels 1 and 3 while using the greatest receiver sensitivity. The operator would then dial the digit 1. As soon as the dialing operation is begun current is placed on the transmission line 51 and the relay A is energized placing an electrical potential on conductor 52. Relay B and magnet M, then being in direct connection between potential and ground are energized and pull up their armatures. Pulling up of the armature at magnet M closes contacts M₂ and thereby places potential on the winding of relay C, causing it also to pull up its armature, and this operates to close contacts C₂ which completes a circuit from the source of energy designated S₁ through contacts B₂ of relay B (now closed), through the winding of relay C to ground, which circuit locks up relay C until such time as relay B releases to open contacts B₂.

Release of the dial by the operator allows the dialing mechanism to move back to its original position causing one interruption of current as it does so (the digit 1 was dialed in this instance). Since the relay B is of the slow release type, this one interruption will not affect it, and this relay will remain in operated position until after the operator's dial has come to rest. The motor magnet M, however, is affected by this one impulse and is caused to move the switching mechanism one step forward. The arms of each of the switch banks X, Y, Z, and H, are then moved to points 1 on the respective switches. It will be observed that during the operation of the motor magnet the circuit from the arm of switch bank Z to the source of energy is open because the contacts B₁ are held apart by relay B.

After the operator's dial has come to rest and the series of impulses delivered by it is terminated, the current through relay A ceases and this relay releases, taking potential off relay B. An instant later relay B is demagnetized sufficiently to allow its armature to drop, causing contacts B₂ to be broken and contacts B₁ and B₃ to be closed. Breaking of contacts B₂ takes potential off relay C, but because this also is

a slow release relay it does not drop its armature at this instant. The closing of contacts B₁ at this instant completes a circuit from energy source S₁ through contacts C₂ of relay C, contacts B₁ of relay B, point 1 of switch bank Z (the arm of this bank has now been moved to point 1), and through the winding of relay R₁ to ground. The consequent operation of relay R₁ closes the circuit 11 and effects reception of channel No. 1. The operation of relay R₁ also closes the lock-in circuit to the energy source designated S₂, so that this relay will remain energized after the arm of switch bank Z has moved beyond point 1.

In another instant of time the relay C will have had time to deenergize and will drop its armature thus cutting off the circuit from energy source S₁ to the arm of switch bank Z and placing potential on each of the points of switch bank H. Since the arm of bank H is at this time on point 1 there will be a circuit completed from source S₁ through switch bank H, contacts M₁, and the winding of magnet M, to ground. It will be clear that with this arrangement the motor magnet M will continue to operate and will move the switching mechanism step-by-step until the switch arm of the H bank is moved to an idle position in which the switch is non-conducting to any of circuits including any of its points of contacts. This position at which the switching mechanism is non-conducting to all circuits is known as the "home" position and movement of the mechanism to this position is known as "homing."

To make the receiver receptive also to channel No. 3, the operator has but to dial again, this time dialing the digit 3. The operation of the selecting mechanism is the same as before except that this time three current interruptions cause the switching mechanism to be moved by the motor magnet to points 3, and the relay R₃ is operated and locked in to hold the receiver receptive to channel No. 3 in addition to channel No. 1.

In the same way, the operator may dial digits 2 and 4 to make the receiver receptive to these channels also if he so desires. To cause the receiver to be most sensitive the operator may dial the digit 8 in the arrangement shown. This causes the switching mechanism to move to point 8 serving to energize relay G₄. Operation of relay G₄ closes circuit 19 which shunts out practically all of resistance 15, and also closes a circuit leading to the energy source designated S₃ so locking itself up. The homing operation takes place after the selection of sensitivities just the same as was explained in connection with the selection of channels.

If now, the operator should receive a call on channel No. 2, for example, and it is desired to clear the receiver of all channels except channel No. 2, so that communication can take place on this channel, the operator has but to dial the digit 2 again. Upon repeated dialing of the digit 2, the apparatus functions as before explained to move the switching mechanism to point 2. When the arm of switch bank Y comes into contact with a point which is associated with a locked relay, the relay D is energized through a circuit including energy source S₂ switch bank Y, the winding of relay D, and contacts B₃ of relay B to ground. This locks up the relay D closing contacts D₂. Then as soon as the switching mechanism has come to rest and the relay B has an opportunity to release, a circuit is completed from the energy source S₁, through contacts C₂ of relay C, con-

tacts B₁ of relay B, D₂ of relay D, the arm of switch bank X, point 2 of this bank, and the winding of relay J to ground. This causes the operation of relay J which breaks the lock-in circuits of all relays R₁, R₂, R₃ and R₄. Operation of relay J also serves to break the energizing circuit of relay D and this relay drops its armature. Release of relay D again completes the circuit from the energy source S₁ through the arm of switch bank Z and the winding of relay R₂ to ground, thus energizing the relay R₂ through this circuit and causing it to be locked in again. Though the means just described interrupts lock-in circuits for all channels and then sets up the channel corresponding with the redialed digit, its over-all function is to destroy the conditioning for reception on all channels except the one corresponding with the redialed digit, and this over-all function is accomplished automatically. The homing operation in the case of a re-dialed digit is accomplished upon the release of relay C in the same way as before explained.

Should the operator wish to change the sensitivity of the receiver, he might dial, for example, the digit 5. When the arm of the switch bank Y comes to rest on point 5 and before the relay B has dropped its armature the relay D will become energized and lock itself in. When relay B drops its armature a circuit will be completed through switch bank X, through the winding of relay K to ground. This causes operation of relay K which opens the lock-in circuits of relays G₁, G₂, G₃ and G₄ and also opens the energizing circuit through relay D. When relay D drops its armature it completes an energizing circuit which energizes and locks up the relay G₁. The armature of relay C subsequently drops and causes the switch mechanism to "home" as before explained. With this change effected, the receiver now has all the resistance 15 in its sensitivity circuit and so is less sensitive than before.

The feature by which the switching mechanism is caused to automatically move to home position after the respective control relays have been energized and locked in is deemed of great importance here, for with this apparatus, the operator is relieved of any thought of sending the apparatus to the neutral or home position.

With the apparatus as herein described, the thought and action necessary on the part of the operator has been reduced to a minimum, as it is here unnecessary for the operator to do anything but the simplest dialing operations.

It will be apparent that while in the described embodiment of the invention the circuits which are conditioned for control are associated with the channel and sensitivity circuits of a radio receiver, these circuits may be associated with any type of mechanism desired to be controlled. Also though these control circuits as here shown are conditioned for control when closed, it might easily be arranged to have the desired control effected when the circuits are opened, such changes being considered within the scope of the invention.

It is understood, also, that many other changes may be made in the construction and arrangement of the apparatus without departing from the spirit of the invention. The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, but the appended claims should be construed as broadly as permissible in view of the prior art.

I claim:

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1. In a system of the character set forth, a plurality of control circuits, switching mechanism having one set of contacts associated respectively with said circuits, said mechanism being of the step-by-step type and actuatable by current impulses to designate successively one and another of said set of contacts whereby at least two of said control circuits are successively conditioned for control, and means operative when one of said contacts is designated by said mechanism a second time for destroying the conditioning of all circuits except the circuit associated with the again designated contact, said means including a relay so connected as to be energized only when said mechanism is actuated to designate a contact associated with a control circuit previously conditioned.

2. In a system of the character set forth, at least two control circuits, a relay associated with each of said circuits and adapted when energized to condition its associated circuit for control said relays being of the lock-in type in which the lock-in circuit is closed by the action of the relay, dialing mechanism adapted to deliver electrical impulses, switching mechanism in connection with and responsive to impulses delivered by said dialing mechanism, said switching mechanism having at least two banks of switches, one of the banks having contacts connected respectively in circuits including the windings of said relays, circuit means associated with the contacts of said other bank for controlling the lock-in circuits of said relays, said means including a relay effective to open all said lock-in circuits when said switch-

ing mechanism is moved to designate a contact associated with a relay having its lock-in circuit previously closed.

3. In apparatus of the character described, a plurality of control circuits, a relay associated with each of said circuits and adapted when energized to condition said circuits for control, said relays being equipped with lock-in circuits, switching mechanism having at least two banks of contacts, the energizing circuits of said relays including contacts on one of said banks, switch-actuating mechanism for moving said mechanism to a position in which it is conducting to a predetermined one of said circuits whereby one of said relays may be energized and its lock-in circuit closed, a plurality of circuits each including a contact on a second bank of contacts on said switching mechanism and including also a source of electrical energy, each of said last-mentioned circuits including means for interrupting all of said lock-in circuits previously closed each time said last-mentioned circuits are closed, said lock-in circuits being so associated with said last-mentioned circuits as to prevent the closing of the last-mentioned circuits except when the switching mechanism is moved for the second time to a contact on said second bank while the corresponding relay is locked.

4. Apparatus as set forth in claim 3 which also includes relay means for enabling the completion of any of said first-mentioned circuits after said interrupting means has functioned but not during the operation of said interrupting means.

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