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REMOTE CONTROL SYSTEM

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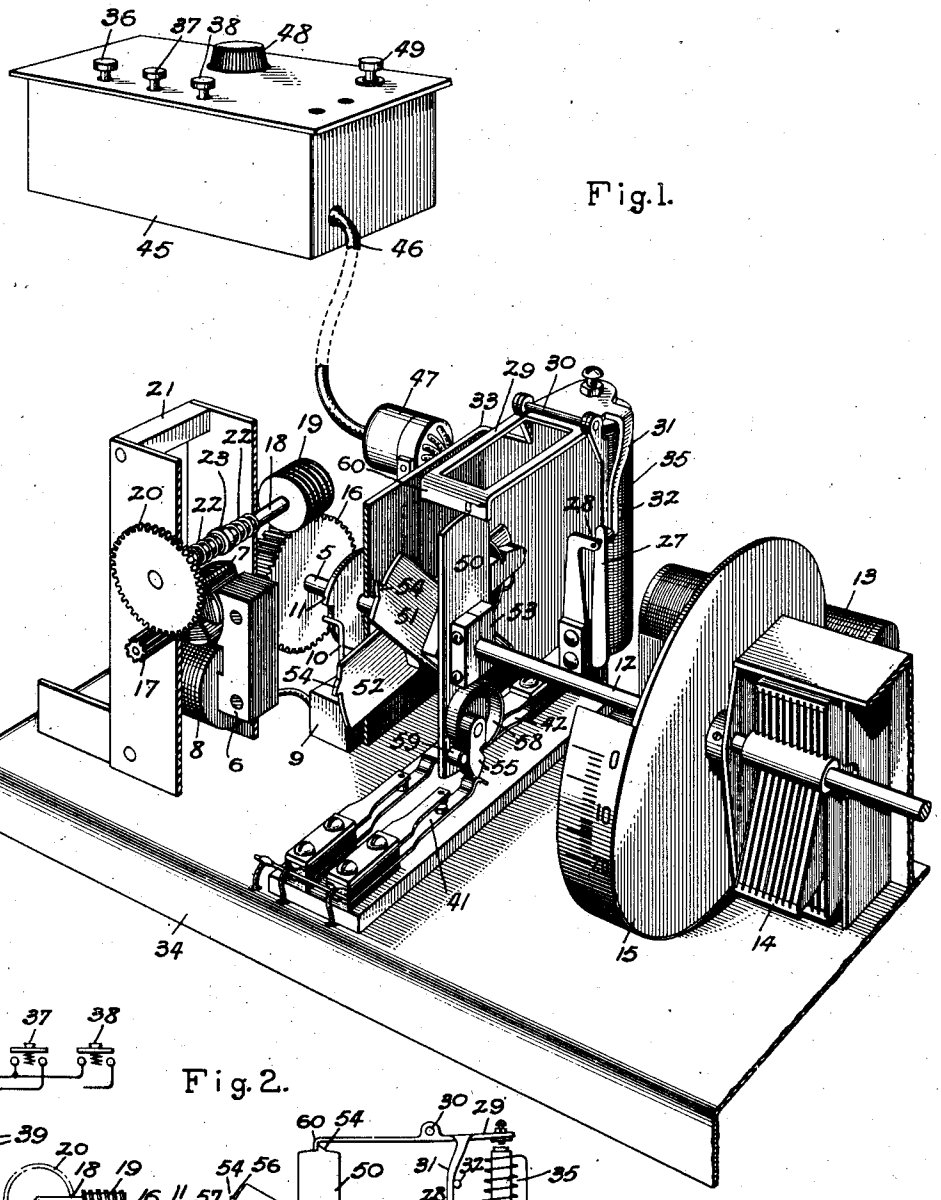


Fig. 1.

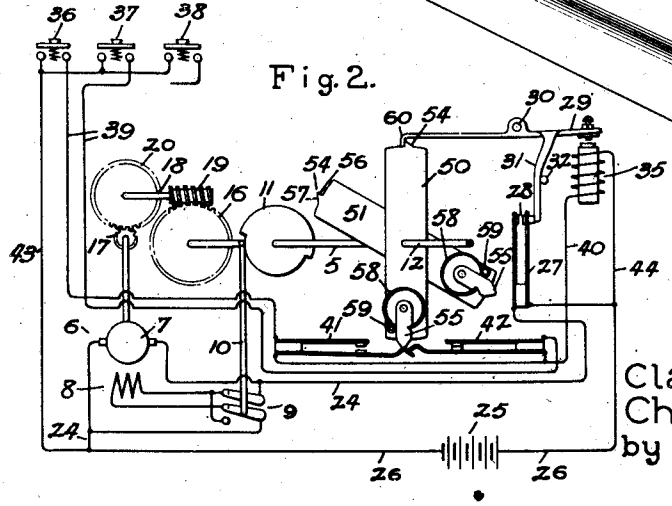


Fig. 2.

Inventor:
Clarence A. Gunther;
Charles A. Brokaw,
by Charles V. Mulla
His Attorney.

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UNITED STATES PATENT OFFICE

CLARENCE A. GUNTHER, OF SCHENECTADY, AND CHARLES A. BROKAW, OF SCOTIA, NEW YORK, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

REMOTE CONTROL SYSTEM

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The present invention relates to a remote control system for apparatus involving a control element, the operation or movement of which serves to regulate a characteristic of the apparatus. More particularly the present invention relates to means for remotely and automatically controlling or adjusting the tuning or control element of radio receiving apparatus and the like.

In automatically tuning a radio receiving apparatus by remote control means, the control element of the apparatus must be accurately positioned whereby a desired wave length or signal channel may be exactly selected, that is, it must be made to stop exactly at any one of a series of predetermined positions corresponding to a series of preselected wave lengths or signal channels. Such signal channels may be closely adjacent to one another as is the case with certain of the short wave signal bands used in aeroplane intercommunication, for example. This increases the difficulty of selecting a desired signal channel, and apparatus heretofore provided for the purpose of remotely controlling radio receiving apparatus such as short-wave receivers, for example, have not found a wide field of usefulness because, among other things, of difficulties in the way of properly selecting closely adjacent signal channels.

It is, therefore, the primary object of the present invention to provide an improved means for remotely and automatically moving and positioning a control element of a radio receiver and like apparatus and to exactly select any one of a series of predetermined positions, such positions in a radio receiving apparatus corresponding to predetermined wave lengths or signal channels.

It is a further object of the present invention to provide a means of the above character which may be electrically operated through the medium of a simple control unit adapted to be located in any suitable position remote from and connected with a control means for radio receiving apparatus and the like.

The means of the present invention is particularly adapted for control of aeroplane receivers and the like, the remote control feature permitting such apparatus to be located remotely from the cockpit or other control station at a point where suitable space is available for the complete receiving apparatus, and the automatic preselected channel feature permitting easy selection of any one of a group of channels available to the aeroplane for communication and signal purposes.

The invention will be better understood from the following description when considered in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing, Fig. 1 is a view in perspective and partly in section, of a remote control system embodying the invention and applied to the control element of a radio receiver, and Fig. 2 is a wiring diagram of the apparatus shown in Fig. 1.

Referring to the drawing, 5 is a control shaft to which is connected a driving motor 6. This motor may be of any suitable type adapted to be reversed, and in the present example is a shunt wound motor having an armature 7 and a shunt field 8. The field is provided with a suitable reversing switch 9 which is adapted to be actuated by a rod 10 in connection with a cam 11 carried by control shaft 5.

The control shaft 5 is connected with an instrument control shaft 12 and in the present example is integral with said shaft. The instrument control shaft is a tuning shaft for a radio receiving apparatus 13 on which shaft is mounted a tuning control element 14 and a tuning dial 15. The cam 11 is arranged to reverse the motor by striking rod 10 when the tuning control shaft 12 carries the tuning element 14 and dial 15 to one extreme or the other on its tuning movement. In the present example this is substantially a 180° movement when used in connection with a standard tuning condenser as indicated at 14.

Interposed between the motor 6 and the control shaft 5 is a suitable reduction gearing, including in the present example, a worm wheel 16 mounted on the control shaft, a pinion 17 carried by the motor shaft, and an

intermediate shaft 18 on one end of which is mounted a worm 19 which meshes with worm wheel 16 and on the opposite end of which is mounted a gear 20 which meshes with motor pinion 17. Shaft 18 is journaled in suitable bearings provided by a frame 21 and is axially movable in said frame against the action of two buffer springs 22 which bear against the frame and against a collar 23 carried by the shaft. Pinion 17 is of such length that it permits movement of intermediate shaft 18 and gear wheel 20 while the latter is maintained in mesh with it.

This arrangement provides an elastic coupling means in the reduction gearing between the motor and the control shaft so that if and when the control shaft 5 is stopped, the inertia of the motor is absorbed by the worm wheel rotating in the then fixed worm gear 16 until the one or the other of the springs 22 is compressed sufficiently to stop the motor.

The motor leads, indicated as 24, are connected with a source of operating current such as a battery 25 through a pair of supply leads 26 and a normally open switch 27 the contacts 28 of which are arranged to be closed by a lever 29 pivoted at 30 and provided with an arm 31 which engages one of the switch contacts. In the present example the switch contacts 28 are arranged to be self-opening and hold the lever arm 31 against a stop 32 carried by a frame 33 which supports the pivot 30 for the lever and supports the control shaft 5. Frames 33 and 21 are mounted upon a common base as indicated at 34, this being in the present example the instrument base for the receiving apparatus indicated at 13, 14 and 15.

The motor control switch 27 is arranged to be closed magnetically through the medium of an electro-magnet 35 associated with the lever 29 and is controlled through the electromagnet by a series of remotely located buttons or switches 36, 37 and 38. Circuit connections between the electromagnet 35 and control switches 36, 37, 38 are indicated by leads 39 and 40. Interposed between leads 39 and 40, that is, between the control switches and the electromagnet are a number of normally closed contacts or switches 41 and 42, one for and in series with each control button or switch, a switch corresponding to switch 38 and its connecting lead being omitted from the drawing for purpose of simplicity. One of the supply leads 26 is connected with the control switches 36, 37 and 38 through a lead 43, while the other supply lead 26 is connected with the electromagnet through a lead 44, thereby completing the electromagnet control circuit.

In the arrangement thus far described, the motor is operated by closure of switch 27 by electromagnet 35 whenever any one of the control switches 36, 37 and 38 is closed and continues to operate while said switches are held in a closed position. Reversal of the motor is effected automatically at the end of the movement of the control shaft 5 and the tuning or instrument control shaft 12 in either direction, through the medium of the reversing switch 9, rod 10, and cam 11 as will be readily understood from the drawing.

The control switches or buttons, as indicated in Fig. 1 in particular, are grouped for ready operation in a tuning control unit or panel box 45 having connection with the control apparatus on base 34 by a suitable electric multi-wire cable 46 provided with a plug connection 47 as indicated in Fig. 1. The remote control unit is also provided with a suitable volume control means indicated at 48 and a switch 49 which may serve as the control switch for the apparatus. As these features do not concern the present invention further description thereof is believed to be unnecessary.

Since the control unit 45 contains merely the switches, volume control and main switch for the receiver, it may be relatively small in size whereby it is adapted for mounting in any suitable location, such as in the cockpit of an aeroplane, for example. It may be connected with the receiving apparatus and control means associated therewith by extending the cable 46 to any desired length. By depressing any one of the control buttons 36, 37 or 38, the control shaft 5 and shaft 12 of the apparatus connected therewith may be carried to any desired position corresponding to any desired wave length or signal channel whereat the apparatus may be stopped by releasing the button. However, with this arrangement alone the motor drive is liable to cause the tuning control to coast or travel past a desired position or point of tuning.

To positively stop the control shaft 5 and connected apparatus at any desired position and to make the position correspond to a given control switch or button, a series of cams 50, 51 and 52 is provided and arranged to operate in conjunction with control switches or buttons 36, 37 and 38, respectively. Cam 52 has been omitted in Fig. 2 as it cooperates with button or switch 38, connection with which has also been omitted as previously mentioned. The cams are sheet metal plates through which the control shaft 5 passes substantially midway between the ends of the plates and to which the plates are secured in angular, spaced relation to each other, that is in any desired angular positions relative to each other and to the position of the control shaft by suitable mounting blocks indicated at 53.

Each cam is provided at its ends with projections 54 and 55, each of the former being fixed and provided with a radial face 56 and sloping face 57, and each of the latter being in the form of a short lever 55 pivoted as indi-

cated at the upper end of the lever to rotate in a plane parallel to the plane of the cam. Each of the movable projections or levers 55 is biased by a suitable spring 58 against a stop pin 59 in a direction of rotation toward the radial face 56 of the fixed projection at the oposite end of the cam.

The projections 54 and 55 serve to positively stop the rotating control shaft 12 in an exact desired position. This is effected by means of a detent 60 carried on one end of the lever 29 and arranged to engage the radial face 56 of any one of the fixed projections as the latter are carried past the detent when the control shaft 5 is rotated and the lever 29 is released by the electromagnet 35. In the present example cam 50 is shown in a stopped position with the detent 60 engaging the radial face of its fixed projection 54. The width of the detent 60 is such that it may engage any one of the cams. The latter are arranged along the shaft in close relation to each other in order that the detent 60 may be made as narrow as possible for mechanical reasons.

The movable projections 55 at the opposite ends of the cams are arranged to strike and open the contacts 41 or 42 depending upon the direction of rotation of the shaft. In the present example the cam 50 is arranged to rotate in a counter-clockwise direction and its projection 55 is arranged to open contact 41. When either of the contacts 41 or 42 is open it will be seen that electro-magnet 35 will be deenergized thereby opening motor control switch 27 and dropping the detent into position to engage the approaching radial face of the fixed projection 54 on the cam while the corresponding control switch 36 or 37 which was closed to initiate the movement of the tuner remains closed. When this radial face engages the detent, the rotataing shaft and cam are stopped positively in one position determined by the position of the cam relative to the shaft. The rotation of the motor and gear train continues for a short space in a manner which has been described hereinbefore but will then have no effect upon the position of shaft 12 as determined by the cam engaged by the detent 60.

In the present example, cam 50, as hereinbefore mentioned, is arranged to rotate in a counter-clockwise direction and cam 51 is arranged to rotate in a clockwise direction. By this is meant that the stopping operation of the cams is effected when rotating in the directions above specified. When rotating in an opposite direction in which they are not intended to be effective for stopping the shaft 5, the sloping portions of the fixed projections 54 if they engage the detent, merely serve to raise the detent, while the movable projections or levers 55 at the opposite ends acting against the spring 58, ride over the switch lever of either switch 41 or 42 which they engage and do not actuate the switch. The projections or levers 55 are effective to actuate switches 41 or 42 only when they are driven against their stop pins 59.

The operation is as follows: The tuning mechanism is adjusted for preselected or predetermined stopping positions or signal channels by setting the radial face of the fixed projection of a separate cam against the detent for each separate position or channel desired and then locking the cam on the shaft in this position.

When one of the selector or tuning switches 36, 37 or 38 is depressed, the electromagnet 35 is energized and through lever 29 causes the motor switch 27 to close, whereupon the motor 6 is energized and rotates in the direction determined by the last setting of the reversing switch 9 and continues to rotate in that direction until stopped by a cam projection 55 opening a switch 41 or 42 corresponding to and in circuit with that one of said switches, and by the resulting deenergization of the magnet 35 and opening of the contacts of the motor switch 27.

The release of the lever 29 causes the detent to fall in the path of the approaching face 56 of the fixed projection at the opposite end of the cam and positively stops control shaft 5 at a definite position. The inertia of the motor and gearing after the shaft is stopped by the falling detent 60 is sufficient to cause the radial face of the projection to snugly engage the detent, thereby assisting in accurately locating the position of the control shaft 12.

Through the medium of the elastic coupling means in the reduction gearing between the motor and the control shaft, the inertia of the rapidly rotating motor is absorbed and is prevented from reaching the control shaft and the cams with sufficient force to cause the projections on the cams to jam against the detent. At the same time, however, as above mentioned, the action is such that the radial face of the projection on the cam is biased to move in the direction of the detent since in stopping, the motor continues to rotate in a driving direction. The cam projection shows no tendency to rebound from the detent after engaging the latter. This is a desirable feature for the reason that any tendency to rebound would cause the positioning of the control shaft to be uncertain.

In certain instances the selector operation necessitates the operation of the apparatus to the limit of its control movement and return after operation of the reversing switch 9 to a point at which the radial face of the cam projection is engaged by the falling detent.

In the present example with a station already tuned in as indicated by the position of cam 50 in which switch contacts 41 are opened, closure of control button or switch

36 will effect no movement of the tuning control apparatus, as is obvious.

It is also obvious that any suitable number of control cams may be added to the shaft, together with their associated control switches corresponding to switches 41 and 42, each of said switches being separately connected with a control switch or button corresponding to buttons 36, 37 and 38 as hereinbefore described.

From the foregoing description it will be seen that the control system herein described includes essentially, a control shaft adapted to be rotated by a motor means, which in the present example is a reversible electric motor, the reversing mechanism for which is connected directly with the control shaft and which mechanism may be of any suitable type and permits the full rotation of the shaft through its operating movement. Interposed between the motor and the control shaft is a reduction gearing and means providing a take-up mechanism or elastic coupling means for absorbing the inertia of the motor when the control shaft is abruptly stopped.

The control shaft is arranged to be operated by the motor under control of a remote control circuit, including a desired number of control switches, one for each position in which it is desired to stop the control shaft, and a corresponding number of stop switches one in series with each of said control switches. In connection with the remote control circuit and under control of the switches therein is an electrically operated means for starting and stopping the motor and for simultaneously interlocking with and stopping the control shaft.

The mechanical means for interlocking with and stopping the control shaft includes a series of cams mounted on the control shaft in desired angular positions relative to each other in which positions it is desired to stop the control shaft, and provided with projections having radial faces adapted to be engaged by a falling detent, and electrical means in the remote control circuit for simultaneously causing the detent to fall and the motor circuit to be opened. The electrical means in the remote control circuit is under manual control through the medium of a series of selector switches, one corresponding to each cam on the control shaft and to each position of the control shaft, and a series of stop switches each of which is arranged to be opened by one of said cams to deenergize the electrical control means in the remote control circuit while any one of said selector switches is in a selecting, closed position.

The advantages of the above described remote control system are found in its simplicity, since it involves merely a remote control circuit and series connected manually operated and automatic stop switches and a simple detent means for stopping the control shaft, and its accuracy in positioning the control shaft in any preselected position through the medium of its radial faced stop means and motor driving means involving a suitable take-up mechanism which biases the radial face of the stop means against the detent without rebound.

What we claim as new and desire to secure by Letters Patent of the United States, is,—

1. A remote control system for radio receiving apparatus and the like, including a control shaft, a cam carried by said shaft and provided with a projection, means for driving said control shaft alternately in opposite directions between predetermined limits through not more than a predetermined fraction of one revolution in either direction, means to reverse automatically the direction of rotation of said shaft when it has moved to either of said limits, a detent arranged to cooperate with said projection to stop the motion of said shaft in only one direction of motion thereof, a control switch for said driving means, electrically operated means for simultaneously closing said control switch and withdrawing said detent from the path of said projection, a remote control circuit for said electrically operated means, a stop switch in series with said remote control means and means carried by said cam for opening said stop switch.

2. The combination with an instrument control shaft and a motor means for driving said shaft, of a magnetically operated switch for starting and stopping said motor, a plurality of cams carried by said shaft and provided with radial projections, means arranged to engage said radial projections and open said switch and to stop said shaft mechanically in a plurality of desired positions each corresponding to a different one of said cams, a remote control circuit for said magnetically operated switch, a plurality of remotely located selector switches through which said circuit is energized, a plurality of stop switches one in series with each of said selector switches, one of said last named switches being associated with each of said cams, and means carried by each of said cams for opening the stop switch associated therewith.

3. The combination with a control shaft for a radio receiver and the like, of electric motor means for moving said control shaft substantially less than one revolution between predetermined limits, switch means associated with said motor means for reversing the direction of rotation of said shaft when either of said limits is reached, adjustable mechanical means for stopping said shaft in any one of a plurality of predetermined positions, each of said means being ar-

ranged to stop said shaft during its motion in one direction only, a switch for controlling said motor means, a means for simultaneously operating said mechanical stop means and said motor switch, said means including an electromagnet, a remote control circuit in which said magnet is located, a plurality of remote control switches in said circuit, and a corresponding number of stop switches one in circuit with each of said control switches, and means for automatically opening each of said last named switches when said control shaft is in position to be stopped by said mechanical means.

4. The combination with an instrument control shaft, of electric motor means for driving said shaft between predetermined limits through less than one revolution, means for reversing the direction of rotation of said shaft when either of said limits is reached, a remote control unit for said motor means including a plurality of manually operable switches the closure of any one of which serves to energize said motor, a plurality of stop switches associated with said control shaft, means connected with said shaft for opening said stop switches to deenergize the motor, means operable only when said shaft is rotating in a predetermined direction for interlocking with and stopping said shaft in one of a plurality of predetermined positions when said motor is deenergized, and means operable only when said shaft is rotating in the opposite direction for interlocking with and stopping the shaft in another of said positions when the motor is deenergized.

5. The combination with an instrument control shaft, of motor means for operating said shaft between predetermined limits through substantially 180°, means to reverse the direction of rotation of said shaft when either of said limits is reached, mechanical interlocking means associated with said shaft and operable only when said shaft is rotating in a predetermined direction for stopping the same in one of a plurality of predetermined positions, mechanical interlocking means associated with said shaft and operable only when the shaft is rotating in the opposite direction for stopping the same in another of said plurality of positions, electrical means for operating said mechanical interlocking means including a plurality of remote control switches for selecting each of said predetermined positions, a plurality of stop switches each in series with a different one of said control switches, and means associated with said mechanical interlocking means and including said stop switches for stopping the motor means when said shaft is in one of said preselected positions.

6. In a remote control system, the combination of a control shaft, a reversible electric motor for driving said shaft between predetermined limits through less than one revolution of said shaft, means including a cam connected to said shaft and a switch connected to said motor for reversing the direction of rotating of said shaft when said shaft is rotated to either of said limits, a control switch for the motor, an electromagnet for operating said switch, a remote control circuit with which said electromagnet is connected, a plurality of control switches in said remote control circuit through which said circuit is energized, a stop switch in series with each of said control switches, means carried by said shaft for opening said last named switches to deenergize said control switches, mechanical interlocking means operable only when said shaft is rotating in a predetermined direction for positively stopping said shaft in one of a plurality of predetermined positions when said remote control circuit is deenergized and mechanical interlocking means operable only when said shaft is rotating in the opposite direction for positively stopping the shaft in another of said predetermined positions when said remote control circuit is deenergized.

In witness whereof, we have hereunto set our hands this 7th day of October, 1929.

CLARENCE A. GUNTHER.
CHARLES A. BROKAW.