April 11, 1944. E. F. McDONALD, JR 2,346,177

RADIO CONTROL SYSTEM AND MULTIPLE CIRCUIT SWITCH

Filed April 25, 1941 2 Sheets-Sheet 1

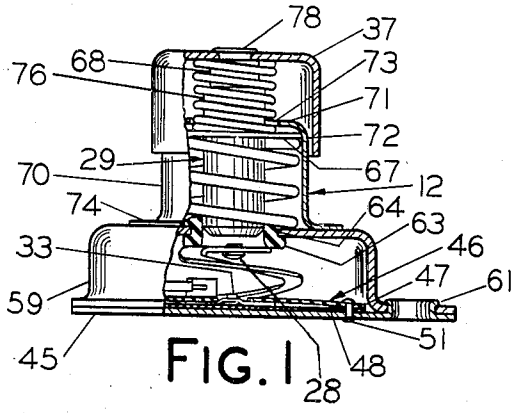


FIG. 1

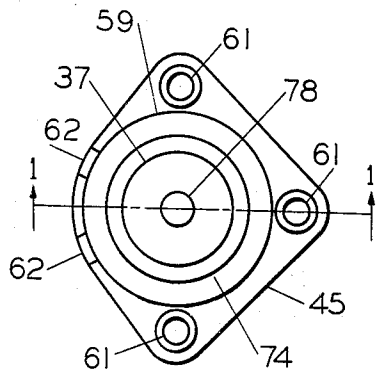


FIG. 2

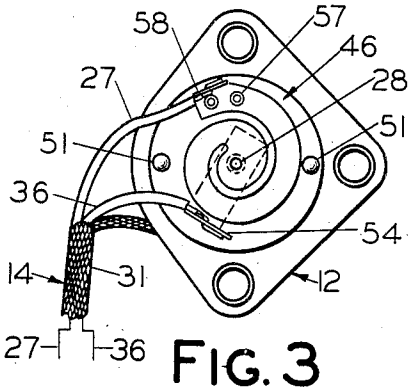


FIG. 3

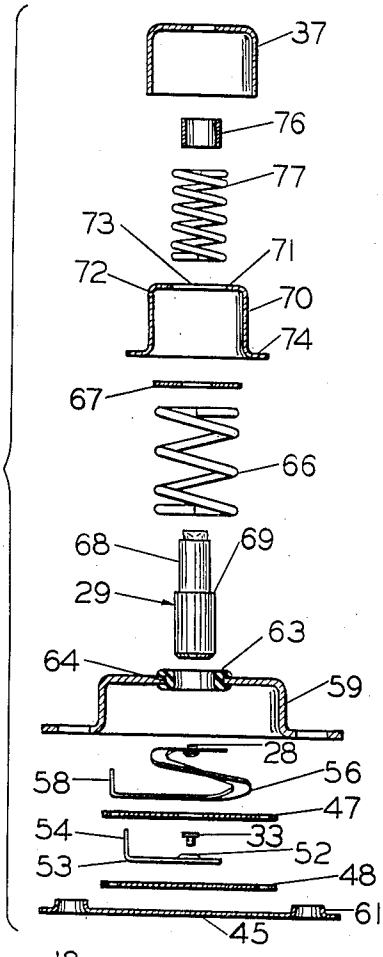


FIG. 5

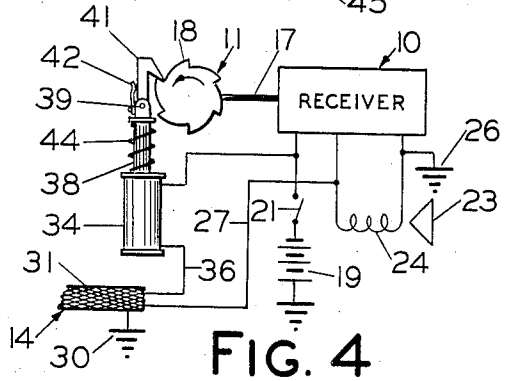


FIG. 4

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RADIO CONTROL SYSTEM AND MULTIPLE CIRCUIT SWITCH

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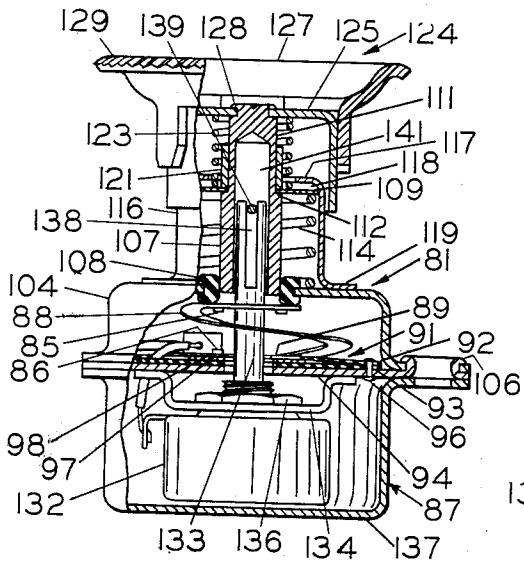


FIG. 6

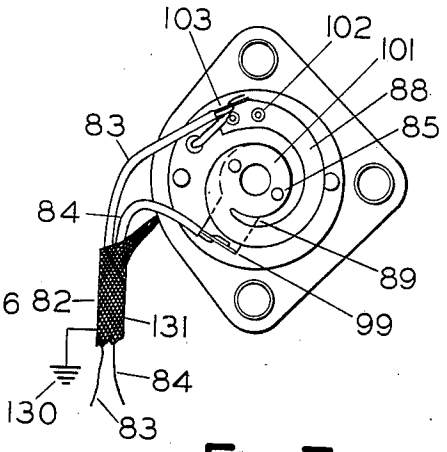


FIG. 7

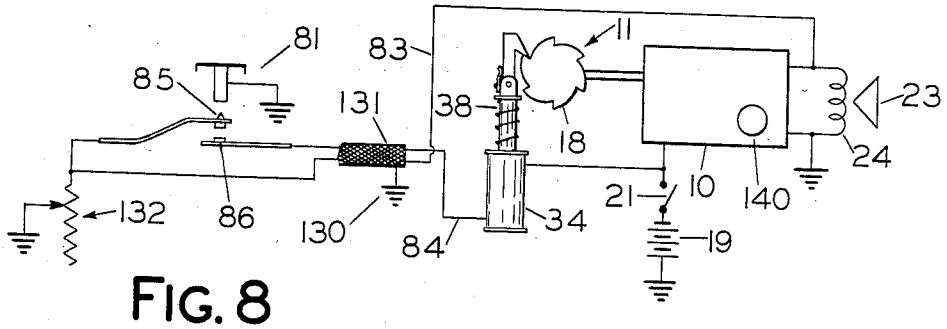


FIG. 8

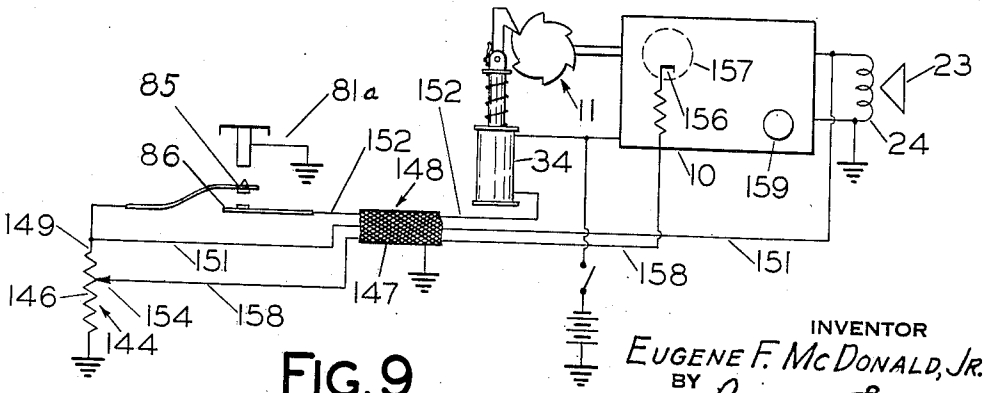


FIG. 9

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Patented Apr. 11, 1944

2,346,177

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2,346,177

RADIO CONTROL SYSTEM AND MULTIPLE CIRCUIT SWITCH

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Application April 25, 1941, Serial No. 390,406

12 Claims. (Cl. 250—20)

The present invention relates to a control system for a radio set, and more particularly to an improved system by which certain functions of a radio receiving set, such as muting, tuning and control of the volume of sound emitted from the loud speaker of the set, may be controlled in a simpler and more expeditious manner.

The present invention is particularly useful in connection with radio receivers mounted in motor vehicles, although it has general application wherever it is desired to control a plurality of functions of a radio receiver. The conventional hand tuning or actuation by hand of station selectors with conventional automobile radio receiver installation constitutes a serious hazard, as the driver's attention is distracted and serious accidents have frequently resulted. Furthermore, it is many times important to mute the radio receiver for short periods of time in order to be able to listen for warning bells at railroad crossings or for the sounds of approaching vehicles or trains. In addition, it is many times desired to change the volume of sound emitted from the loud speaker of the radio receiver, and in accordance with the present invention this function may be controlled by means in combination with the muting and tuning means without distracting the driver's attention.

In accordance with the present invention, muting of the radio receiver, the selection of the desired signal to be received, and control of sound volume from the receiver can be accomplished through a single member actuated, for example, by foot control with a special type of switch mounted on the floor board of an automobile. This enables the control operations of the radio receiver, which ordinarily require close attention by the driver, to be carried out without requiring the driver to look at the radio set or remove either hand from the steering wheel.

Another aspect of the invention also provides a multiple circuit switch for controlling a plurality of circuits which embodies novel features of construction which permit manufacture of its parts from low cost readily formed materials, and which also facilitate assembly of the parts.

The embodiment of the switch selected for illustrating this aspect of the invention is designed so it may control two electrical circuits by interrupting both circuits in its normal position and sequentially closing these circuits in a predetermined order as the switch operator is moved from its normal to its fully operated position. The point at which the first circuit has been closed and the second circuit is about to be closed is indicated to the sense of touch of a person operating the switch. As the switch operator returns from its fully operated position to its normal position, the circuit last to be closed is opened first, the point where the second circuit has opened and the first circuit is about to be opened again being indicated to the sense of touch. Upon completion of movement of the switch operator to the normal position, both circuits are opened. This design also makes it possible for the first circuit to be closed and thereafter opened without disturbing the second circuit which remains open under such circumstances. This design also embodies a contact spring of great durability and a contact arrangement which is not affected by excessive operating pressures. And, moreover, this design readily lends itself to use in combination with a volume control or other type of rheostat operable by the operating member of the switch. It will be understood that a switch having the novel structural features to be disclosed herein may be designed to accommodate a variety of circuit controlling contact arrangements.

The primary object of the present invention is to provide a novel control system for a radio receiving set.

Another object of the present invention is to provide a novel safety control system for an automobile radio receiving set.

Another object of the invention is to provide a novel device for muting or changing the volume of sound emitted by a radio receiver or selecting a desired signal, or performing these functions simultaneously.

Another object of the invention is to provide a novel device for muting a radio receiver, selecting a desired signal, or changing the volume of sound emitted by the loud speaker.

The features of my invention which I believe to be novel are set forth with particularity in the appended claims. My invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawings in which:

Figure 1 is an elevational view partly in section of a switch useful in connection with the invention, the section being taken on line 1—1 of Fig. 2.

Figure 2 is a view in plan of the switch of Figure 1.

Figure 3 is a view in plan of a portion of the switch of Figure 1.

Figure 4 is a diagrammatic representation of a

system in which such a switch may be used in accordance with the invention.

Figure 5 is an exploded view showing the parts partially sectioned on line 1—1 of Figure 2.

Figure 6 is an elevational view, partly in section, of a modification of the switch of Figure 1.

Figure 7 is a view in plan of a portion of the switch of Figure 6.

Figure 8 is a diagrammatic representation of a system in which the switch of Figure 6 may be used.

Figure 9 is a diagrammatic representation similar to Figure 8 of a modified system.

The operation of the switch of this invention, shown in Figures 1 to 3 and 5 of the drawings, will be described in connection with the control circuits of a muting and tuning device for a radio receiver. It will be understood, however, that the switch of this invention may be used for general circuit control purposes.

Referring to the drawings in detail and for the present to Figures 3 and 4 thereof, reference numeral 10 indicates tunable radio apparatus such as a radio receiver having a solenoid operated station selecting device indicated generally by reference character 11. This device is shown diagrammatically as being located exteriorly of the receiver 10 for the sake of convenience of illustration. The switch of this invention, to be described in detail hereinafter, is indicated by reference character 12 and is operatively connected to the device 11 by a shielded cable 14. The device 11 comprises a shaft 17 operatively connected to a ratchet gear 18. The shaft 17 carries or is otherwise connected to a plurality of switches (not shown) which connect previously tuned sets of cooperating circuit elements in the tunable circuits of the receiver so as to obtain automatic tuning of a plurality of preset stations. The operative connection to the tuning switches within the receiver 10 is indicated by the shaft 17 and may be obtained by mounting the switches on this shaft as suggested above, or in any other suitable manner, such as by means of gears, belt drives, etc. It will be understood that any type of electrically operated tuning device may be operated by the switch 12. One type of such device is shown in Patent 2,216,671, granted to Eugene F. McDonald, Jr., and dated October 1, 1940. This patent may be referred to for further details of a system of radio control in which a switch of this invention may be used to obtain the advantages pointed out herein.

The electrical connections of the tuning and muting system will now be described briefly before proceeding to a detailed description of the switch 12. The power supply may comprise a vehicle battery 19 which is connected to the receiver by way of a receiver power switch 21. The receiver is provided with a speaker 23 operated by a voice coil 24 supplied by the output of the receiver and having one terminal connected to ground at 26. Conductor 27 of the cable 14 connects the other terminal of the voice coil 24 to a contact 28 of the switch 12. The switch 12 is preferably mounted on the floor board of the vehicle in which the system is installed or upon some part of the vehicle easily reached by the occupant thereof. The movable contact 29 of the switch is electrically connected to the grounded base plate 45 through members 59, 66, 67, 77 and 37. The base plate 45 and hence the switch casing is connected to ground at 30 by way of the metallic sheath 31 of the cable 14. The point of connection to ground 30 is preferably some metallic part of the device the circuits of which are operated by the switch 12 and to which the cable 14 is connected. In Figure 4, the ground may be made directly to the external casing of the receiver 10.

The switch 12 has another contact 33 connected to a solenoid 34 by way of a conductor 36. This solenoid is connected to one terminal of the battery 19 through the receiver power switch 21. The operating button 37 serves as a switch operator to move the movable contact 29. Depressing the operating button 37 of the switch 12 causes contact 29 to engage contact 28 grounding conductor 27 to short circuit the voice coil of the speaker through ground. This serves to mute the speaker. A further depression of the operating button 37 of the switch completes the circuit through the solenoid from ground at 30 by way of the cable sheath 31, the contacts 29, 28 and 33, the conductor 36 and the battery 19.

The solenoid 34 has a core 38 to which is pivotally connected, as at 39, a pawl 41. A pawl spring 42 biases the pawl into engagement with the teeth on the ratchet wheel 18. When the circuit through the solenoid is completed, the core is retracted to rotate the ratchet 18 in the direction indicated. After the solenoid has rotated the ratchet to tune in a transmitting station, which occurs almost immediately, the switch button may be released and the solenoid core will be returned to its original position by means of a spring 44.

The switch 12 the parts of which are shown in section by Figure 1 of the drawings, and disassembled in Figure 5, includes a base plate 45 to which is secured by tubular rivets 51 a wafer-like contact assembly 46 comprising sheets of insulating material 47 and 48 secured together also by rivets 51. The previously described contact member 33 is secured on a protuberant portion 52 of a metallic strip 53 which is retained between the sheets 47 and 48. Ear 54 on the strip 53 provides a terminal to which the conductor 36 may be integrally secured in a permanently conductive manner by soldering or welding. The contact 28 is secured on a resilient member such as a spiral spring 56 which is secured to the insulating sheet 47 by eyelets 57. The contact spring 56 of spiral form has an inherently long life in use. Since the spring 56 is free of abrupt bends, and since its resilience does not depend on its being bent at any one point between its ends, it is not subject to crystallization and breakage. An upturned portion 58 provides a terminal connection for integrally receiving the conductor 27 in good electrical contact.

The cup-shaped contact enclosing member 59 is apertured for connection to the base plate 45 by eyelet connections 61 or other suitable means. The eyelet connections shown possess the advantage of receiving bolts, screws or other connecting means for securing the switch 12 to the floor board or other part of the vehicle, and also, the switch may lie closely in contact with the vehicle floor board or other part. Notches 62 (Figure 2) are formed in the contact enclosing member 59 to accommodate the insulated conductors 27 and 36. A guide bushing 63 of insulating material is crimped to an aperture 64 located substantially concentrically with respect to the contacts 28 and 33. The guide bushing 63 serves a threefold purpose in that it provides an insulating

abutment for the contact spring 56, serves as a guide for the contact 29 and positions a comparatively powerful contact biasing spring 66. The spring 66 presents two substantially flat ends, one of which rests on top of the member 59 and the other of which reacts against a washer 67 which surrounds the reduced portion 68 of the circular body of the contact 29. The washer 67 is seated in the shoulder 69 of the contact 29. The washer 67 preferably has an outside diameter such that it fits slidably in the cylindrical housing 70 which has an inwardly turned flange 71 providing a restricted portion indicated by the reference character 72 which serves to limit outward movement of the washer 67 and thereby holds the spring 66 partly compressed. It will be seen from this that the movable contact 29 is guided for longitudinal movement without assistance from the aperture 73 in the housing 70. At the end of the housing opposite the flange 71 is an outwardly turned flange 74 by means of which the housing is fastened by welding or other suitable means to the top of the contact enclosure member 59. Above the washer 67 is a cylindrical sleeve 76. This sleeve is surrounded by another spring 77, which is lighter than the spring 66, and the whole is enclosed by the operating button 37 which is riveted onto the top of the contact 29 at 78. The operating button 37 overlaps the housing 70 to prevent dirt and foreign matter from entering the switch body. In this manner the spring 77 is somewhat compressed under ordinary conditions. The aperture 73 in the housing 70 is large enough to accommodate the spring 77. Upon exertion of pressure on the operating button 37 to move the contact 29 toward circuit closing engagement with the contact 28, the spring 77 is compressed until the inner surface of the button 37 engages the top of the sleeve 76. At this time, the contact 29 is in full circuit closing engagement with the contact 28. This completes a circuit. In Figure 4, the circuit is completed from the speaker voice coil to ground in the manner explained above by grounding the conductor 27, thereby muting the speaker. At this point, the contact has not yet engaged the contact 33. Further movement of the operating button 37 must necessarily cause compression of the spring 66 since there is now a direct connection between the button 37, the sleeve 76 and the washer 67. The added resistance of the heavier spring 66 enables the operator to sense the point at which the circuit of conductor 27 has been closed and the closing of the circuit of conductor 36 is about to occur. Upon additional movement of the contact 29, the contact 28, which is now grounded by the contact 29, engages the contact 33 to complete the circuit to be controlled which includes conductor 36. In Figure 3, this circuit is completed through the solenoid 34 and serves to change stations.

In operation of the switch, it will be noted that the alignment of the contacts 29, 28 and 33 by reason of their concentric arrangement, prevents damage or misalignment thereof by excessively heavy pressures exerted on the operating button 37. With the button 37 fully depressed, the thrust of contact 29 is taken by the contact 28 which is solidly in contact with the fixed contact 33. The spiral spring 56, therefore, is not called upon to resist any of the excess pressure which may be exerted on the operating button, but it is fully effective to maintain the concentric location of the contact 28. Any force tending to displace the contact 28 laterally is prevented by the resistance to bending of the spring in the direction of its greatest dimension in cross section. In this respect, the spring may be regarded as a beam curved to spiral shape.

Figure 5 of the drawings serves to show the simple nature of the switch parts and the ease with which they may be assembled. While the manner of assembling the parts of the switch 12 is believed to be apparent from the foregoing, a suggested mode of assembly will be briefly described. The contact spring 56 is secured to insulating sheet 47, and this and insulating sheet 48 are assembled as a unit 46 together with the contact support 53 to which contact 33 has already been secured. This unit is fastened together and secured to the base 45 by means of the rivets 51.

The insulating guide bushing 63 may be formed into position over the aperture 64 in the contact enclosing member 59, following which the parts carried by the member 59 may be assembled to it by slipping the washer 67 over the reduced part 68 of the contact member 29 until it rests against the shoulder 69. The contact 29 with the washer 67 in place is inserted upwardly through the aperture 73 in the housing 70. The sleeve 76 and the spring 77 may then be slipped into place to surround the reduced contact portion 68. The operating button 37 is then riveted in place as indicated by the reference character 78. The spring 66 may now be placed on the member 59 in a position determined by the bushing 63. The housing 70 may now be secured to the contact enclosing member 59 by welding the flange 74 thereto. Assembly of the switch is completed by crimping the fastening means 61 on the base 45 to the contact enclosure 59 as shown in Figure 1.

Assembly of the switch 12 may be carried out in other ways to suit particular manufacturing methods and assembling machinery if used. The foregoing description of a suggested mode of assembly is illustrative only of the ease with which the switch of this invention may be assembled.

Figures 6 and 7 of the drawings disclose a modified and multiple circuit controlling switch in accordance with the present invention. In this case, a combined circuit controlling switch 81, which is a modification of the switch 12 of Figures 1 to 3 and 5, provides for reducing the volume of sound as well as for muting and tuning the receiver.

Figure 8 of the drawings discloses a modified system in which the switch of Figures 6 and 7 is useful, and similar reference characters are used to designate the same elements as in Figures 3 and 4. The receiver 10, the station selecting device 11 and the accessory equipment for the receiver are substantially like those illustrated in Figure 4 of the drawings. The combined multiple circuit controlling switch 81, the parts of which are shown in section by Figure 6 of the drawings, is similar in structure to the switch 12 of Figures 1 to 3 and 5 of the drawings, and is preferably mounted on the floor board of the vehicle in which the system is installed so as to be in a position for convenient operation by the foot of the driver of the vehicle, or it may be installed upon some part of the vehicle easily reached by another occupant thereof. The switch 81 is operatively connected to the device 11 by a shielded cable 82 which encloses the conductors 83 and 84. The conductors 83 and 84 correspond to the conductors 27 and 36 of Figures 3 and 4

of the drawings. The conductor 83 of the cable 82 connects the ungrounded terminal of the speaker voice coil 24 to the contact 85 of the switch 12. The conductor 84 is connected to one terminal of the solenoid 34 and to the contact 86 of the switch 81. The other terminal of the solenoid, which is the same as the solenoid 34 of Figure 4, is connected to one terminal of the battery 19 through the receiver power switch 21. The conductor 83 also provides a connection to the volume control section 87 of the circuit controlling switch 81 from the voice coil 24 of the speaker. The operating connection between the solenoid core 38 and the ratchet wheel 18, constituting parts of the device 11, is the same as that shown in Figure 4 of the drawings.

The switch contact 85 is carried by a spiral spring member 88 and the contact 86 is secured upon a contact supporting strip 89. A wafer-like contact assembly 91, comprising sheets of insulating material 92 and 93, is secured to the base plate 94 of the switch by tubular rivets or other suitable fastening means 96. The rivets 96 also serve to secure the sheets 92 and 93 together so as to retain the contact strip 89 in position between them. The contact strip 89 is provided with a protuberant portion 97, which is apertured as indicated by reference character 98. The previously mentioned contact 86 is secured on the protuberance 97. An ear 99 on the strip 89 provides a terminal to which the conductor 84 may be integrally secured in a permanently conductive manner as by soldering or welding. The contact 85 is secured on the apertured portion 101 of the spiral spring member 88. The spiral spring member 88 is fastened to the insulating sheet 92 by suitable fastening means such as the eyelets 102. An upturned portion 103 of the spring 88 provides a terminal connection for integrally receiving the conductor 83 in good electrical contact.

The cup-shaped contact enclosing member 104 is adapted for connection to the base plate 94 by eyelet connections 106 or other suitable securing means. A series of notches located in the same position as the notches 62 in Figure 2 of the drawings may be provided in the annular wall of the contact enclosing member 104 to accommodate the insulated conductors 83 and 84. The reciprocable and rotatable contact 107 is guided for longitudinal movement by a guide bushing 108 of insulating material which is crimped to an aperture located substantially concentrically with the apertures in the contact supporting members 88 and 89. The guide bushing 108 performs substantially the same functions as the bushing 63 shown in Figures 1 and 5 of the drawings. A disk or washer 109 surrounds the reduced portion 111 of the circular body of the contact 107 and is seated on the shoulder 112. A spring 114 presents two substantially flat ends, one of which rests on the member 104, and the other reacts against the washer 109. The washer 109 fits slidably in a cylindrical housing 116 which has an inwardly turned flange 117 providing a restricted portion indicated at 118. Outward movement of the washer 109 is limited by the restricted portion 118 to thereby hold the spring 114 partly compressed. The housing 116 may be secured to the top of the contact enclosure member 104 by welding its outwardly turned flange 119 to the enclosure member. A cylindrical sleeve 121 surrounds the reduced portion 111 of the contact 107 and rests on the washer 109. This sleeve is surrounded by another spring 123 which is lighter than the spring 114. The aperture provided at the top of the housing 116 is large enough to accommodate the spring 123. The combined operating knob and button 124, comprising the cap-shaped member 125 and the annular member 127, is riveted on to the top of the contact member 107 as indicated by reference character 128. The annular member 127 is knurled or otherwise formed to provide a roughened surface as indicated by reference character 129, so that it may be rotated by the foot of the person desiring to control the volume of sound emitted by the loud speaker of the radio receiver 10. The cap-shaped member 125 overlaps the housing 116 to prevent dirt and foreign matter from entering the switch. After the connection 128 is made the spring 123 is held in compression between the combined knob and button 124 and the washer 109. The portion of the contact 107 which provides the permanent connection 128 is preferably square in cross section to fit a square aperture in the cap member 125, thereby to insure rotation of the contact 107 when the combined operating knob and button is rotated. It will be understood that any irregular shape may be provided for the permanent connection 128 at the top of contact 107 where contact 107 is connected to the annular member 127 to insure that the contact 107 shall always rotate with the annular member 127, the combined operating member 124 thereby being essentially a single member. The switch casing is connected to ground at 130 (Figures 7 and 8) by way of the metallic sheath 131 of the cable 82. The point of connection to ground 130 is, like the point 30 of Figure 4, preferably some metallic portion of the device to which the cable 82 is connected. In Figure 8 the ground connection may be made directly to the external casing of the receiver 10. The movable contact 107 of the switch 81 is electrically connected to the grounded base plate 94 through the members 104, 114, 109, 123 and 125.

The combined operating knob and button 124 is operated in the same manner as the operating button 37 of the switch 12 of Figure 1 to mute and tune the receiver. Upon exertion of pressure on the combined operating knob and button 124 to reciprocate the contact 107 toward circuit closing engagement with the contact 85, the top of the sleeve 121 is engaged by the inner, or lower, surface of the combined knob and button following initial compression of the spring 123.

At this time the contact 107 is in full circuit closing engagement with the contact 85, completing a circuit from the speaker voice coil to ground by grounding the conductor 83 and thereby muting the speaker. At this point in its movement, the contact 107 has not brought the contact 85 into circuit closing engagement with the contact 86. Further movement of the combined knob and operating button 124 causes the spring 114 to be compressed since there is now a direct connection between the knob and operating button 124, the sleeve 121 and the washer 109. Because of the added resistance of the spring 114, the operator can sense the point at which the circuit of conductor 83 has been closed and the closing of the circuit of conductor 84 is about to occur. Additional movement of the contact 107 will cause the contact 85, which is now grounded by the contact 107, to engage the contact 86 to complete the circuit including the conductor 84.

The volume control section 87 of the combined switch 81 includes a volume control rheostat 132 which may be of any well known type, adjustable

by rotating its operating shaft 133. The rheostat 132 is shown as being secured to a bracket 134 by means of a nut 136. The supporting means for the rheostat just described is convenient since volume control rheostats are readily available which are of the panel mounted type shown, employing the nut 136. However, it will be understood that any type of rheostat may be mounted in any desired manner on the switch 81 with its operating shaft projecting upwardly into the body of the switch as shown in Figure 6 of the drawings, or the combination of a switch and volume control may be effected in other ways. To prevent ingress of foreign matter into the volume control section 87 and the contacts of the switch 81, a cover member 137 is provided which encloses the rheostat 132 and the lower end of the switch.

The operating shaft 133 of the rheostat is slotted or bifurcated as shown at 138 so as to provide an extensible driving connection with a pin at 139 projecting from side to side through a bore 141 in the end of the contact 107. The extensible connection provided between the bifurcated end of the shaft 133 and the pin 139 permits the contact 107 to be moved longitudinally in the manner explained above to control the circuits of the conductors 83 and 84. Rotating the combined knob and button, or single control member, 124 will adjust the amount of resistance included in the muting circuit, and hence will regulate the volume of sound emitted by the loud speaker. This is preferably to be accomplished by foot operation as explained above. The set may be muted at any time in the manner pointed out above irrespective of the angular position of the rheostat shaft 133.

The operation of the multiple circuit control system of Figure 8 will now be explained briefly. Muting and tuning is accomplished in the manner already pointed out in connection with the description of the structure of the combined switch 81. The volume of sound emitted by the loud speaker 23 is controlled by varying the amount of resistance placed in shunt with the loud speaker voice coil 24. That is, the single control member 124 may be moved in one direction from a normal position to a muting position to mute the loud speaker without operating the station changing mechanism and may be further moved in the same direction to operate the station changing mechanism while keeping the set muted, and the same single control member 124 may be moved in a different direction, that is, in rotation, to change the volume of sound coming from the loud speaker. The usual volume control arrangement, indicated by reference character 140, ordinarily forming a part of the receiver, is operated in the normal manner to select a desired volume level, and the volume control rheostat 132 serves to reduce the volume below this level when desired. The volume control arrangement of Figure 8 of the drawings does not interfere with the use of the ordinary volume control, nor does it interfere with the automatic volume control usually supplied with present day receivers. Special shielding or insulation need not be provided for the conductor 83. The arrangement illustrated by Figure 8 of the drawings has the advantage that it does not require any conductors between the combined switch 81 and the receiver 10 in addition to those shown in Figure 4 of the drawings. It will be understood that the volume control section 87 of the switch 81 may be used to replace the regular volume control of the receiver if suitable precautions are taken to shield the leads between the receiver and the volume control so as to substantially eliminate the possibility of leakage and of picking up stray noises or stray signals.

Figure 9 of the drawings is a diagrammatic showing of a modified radio control system in accordance with this invention in which volume control as well as muting and tuning may be accomplished by the combined switch 81 of Figures 6 and 7 of the drawings. In this figure similar reference characters are used to designate the same elements as are illustrated by Figure 4. The receiver 10, the station selecting device 11 and the accessory equipment for the receiver may be of any conventional type such as is illustrated in Figure 4 of the drawings. Suitable output terminals on the receiver 10 serve to energize the voice coil 24 of the loud speaker 23. The combined switch 81*a*, which is similar to the switch 81 of Figures 6 and 8, is provided with a volume control potentiometer 144 which has one terminal of its resistor 146 connected to ground at any suitable point in or on the switch casing, or on the sheath 147 of the shielded cable 148. The remaining terminal of the resistor 146 is connected to the muting contact 85 of the switch 81*a* preferably by way of a conductor 149 connected to the conductor 151. The conductor 151 corresponds in function to the conductor 83 of Figure 8 and is connected to one terminal of the voice coil 24 of the loud speaker, the other voice coil terminal being grounded. The conductor 152 connects the station changing contact of switch 81*a* to the solenoid 34 which performs the same function as the solenoid 36 of Figure 4 of the drawings. A contact 154, slidable on the resistor 146, is connected to the cathode 156 of an amplifier tube 157 in the radio receiver 10 by way of a conductor 158. This tube 157 is preferably one of the audio amplifier tubes. The volume control arrangement just described does not interfere with the use of the regular volume control 159, nor does it interfere with the automatic volume control arrangement if one is provided in the receiver. The volume control arrangement just described operates by including some of the voltage appearing across the voice coil 24 in series with the cathode circuit of an audio amplifier tube. The phase relationship of the voltage applied to the amplifier tube cathode is such that a reduction in gain results. Since the signal voltage fed into the audio amplifier depends on the setting of the regular volume control 159 of the receiver, the auxiliary inverse feed back volume control of Figure 9 gives a variation in audio output below the level established by the main volume control. The value of the resistor 146 is not critical and may, for standard receivers of present day design, be in the neighborhood of 500 ohms. The system of Figure 9 has the advantage of not requiring high impedance circuits externally of the receiver which would pick up undesirable noises or be affected by insulation leakage. The relatively low impedance circuit, including the resistor 146 and the sliding contact 154, have substantially no tendency to pick up extraneous signals or noises generated by the vehicle engine.

A plurality of switches, such as those shown in Figures 1 and 6, may be employed so that the receiver may be controlled from more than one point. The system of the present invention

makes possible station changing, control of sound volume and muting of the radio set by a single foot-operated control device without the operator having to look at the set, or dial, or remove his hands from the automobile controls. The system of the present invention is particularly applicable to the control of automobile radio sets and has been described in detail with respect to operation from low voltage batteries. However, other types of radio sets, such as sets operated from alternating current or higher voltage direct current, may be operated from a remote point in accordance with the principles of the present invention. The invention has been illustrated in connection with an "electrical" type of automatic tuning wherein individual presettable condensers or inductances are employed, but is also applicable to other types of automatic tuning arrangement.

This application is a continuation in part of my co-pending application Serial No. 359,137, filed September 30, 1940, now Patent No. 2,307,329, granted January 5, 1943.

While there is shown and described here an illustrative embodiment of the invention, the invention may be embodied in other forms, and therefore, the invention is not limited except as indicated by the terms and scope of the appended claims.

What is claimed is:

1. An automobile radio receiving system comprising a receiving set having a plurality of presettable means for presetting said set to receive a signal from any one of a plurality of transmitting stations, selecting means for selecting a desired one of said presettable means, muting means for said set, volume control means for said set, and control means for said selecting means, said muting means and said volume control means including a foot control device positioned at the floor board of said automobile, to be actuated by the driver of said automobile, said control means providing independent operation of said volume control means and muting means, an electrical connection from said receiving set to said foot control device for operating said selecting means upon actuation of said device, and a single electrical connection from said receiving set to said device to provide for operation of said volume control and said muting means upon actuation of said device.

2. An automobile radio receiving system comprising a receiving set having a station changing mechanism, a muting means for said set, a volume controlling means for said set, and a single control member actuatable in one direction from a normal position to a muting position for operating said muting means to mute said set independently of said station changing mechanism and volume controlling means and further actuatable in the same direction to a station changing position for operating said station changing mechanism to change the station being received while maintaining said set muted, said volume controlling means being operable independently of said station changing mechanism and said muting means by movement of said member in another direction.

3. An automobile radio receiving system comprising a receiving set having a station changing mechanism, a muting means for said set, a volume controlling means for said set, and a single control member actuatable in one direction from a normal position to a muting position for operating said muting means to mute said set independently of said station changing mechanism and volume controlling means and further actuatable in the same direction to a station changing position for operating said station changing mechanism to change the station being received while maintaining said set muted, said volume controlling means being operable independently of said station changing mechanism and said muting means by movement of said member in another direction, one of said directions of movement of said member being a rotational movement.

4. An automobile radio receiving system comprising a receiving set having a step by step station changing mechanism, a muting means for said set, a volume controlling means for said set, and a single control member actuatable in one direction from a normal position to a muting position for operating said muting means to mute said set independently of said station changing mechanism and further actuatable in the same direction to operate said station changing mechanism while maintaining said set muted, said volume controlling means being operable independently of said station changing mechanism and said muting means by movement of said member in a plane at right angles to said direction of movement.

5. An automobile radio receiving system comprising a receiving set having a station changing mechanism, a muting means for said set, a volume controlling means for said set and a single control means reciprocable in one direction from a normal position to a muting position for operating said muting means to mute said set independently of said station changing mechanism and volume controlling means and further reciprocable in the same direction to a station changing position for operating said station changing mechanism to change the station being received while maintaining said set muted, said volume controlling means being operable independently of said station changing mechanism and said muting means by movement of said control means in a plane at right angles to the direction of said reciprocation.

6. An automobile radio receiving system comprising a receiving set having a station changing mechanism, a muting means for said set, a volume controlling means for said set and a single control means reciprocable in one direction from a normal position to a muting position for operating said muting means to mute said set independently of said station changing mechanism and volume controlling means and further reciprocable in the same direction to a station changing position for operating said station changing mechanism to change the station being received while maintaining said set muted, said volume controlling means being operable independently of said station changing mechanism and said muting means by rotational movement of said control means.

7. An automobile radio receiving system comprising a receiving set having a step by step station changing mechanism, a solenoid, a source of electric power and a circuit associated therewith having a normally open contact for energizing said solenoid to step said station changing mechanism upon closing of said contact, a muting means for said set including a muting circuit having a second normally open contact, a volume controlling means for said set, and a single control member actuatable in one direction from a

normal position to a muting position for closing said second contact to mute said set independently of said station changing mechanism and volume controlling means and further actuatable in the same direction to close said first mentioned contact to step said station changing mechanism while maintaining said second contact closed, said volume controlling means being operable independently of said station changing mechanism and said muting means by movement of said member in another direction.

8. An automobile radio receiving system comprising a receiving set having a station changing mechanism, a muting means for said set, a volume controlling means for said set, a single control member actuatable in one direction from a normal position to a muting position for operating said muting means to mute said set independently of said station changing mechanism and volume controlling means and further actuatable in the same direction to a station changing position for operating said station changing mechanism to change the station being received while maintaining said set muted, said volume controlling means being operable independently of said station changing mechanism and said muting means by movement of said member in another direction and resilient means for resisting movement of said control member from said normal position to said muting position and resisting movement of said control member from said muting position to said station changing position with abruptly increased force over the resisting force from said normal position to said muting position.

9. An automobile radio receiving system comprising a receiving set having a step by step station changing mechanism, a muting means for said set, a volume controlling means for said set, and a single control member actuatable in one direction from a normal position to a muting position for operating said muting means to mute said set independently of said station changing mechanism and further actuatable in the same direction to step said station changing mechanism while maintaining said set muted, said volume controlling means being operable independently of said station changing mechanism and said muting means by movement of said member in another direction, said control member being a foot control device positioned adjacent the floorboard of said automobile to be operated by the foot of the driver of said automobile.

10. An automobile radio receiving system comprising a receiving set having step-by-step station changing mechanism, a solenoid, a source of electric power and a circuit associated therewith having a normally open contact arranged when closed to energize said solenoid to step said station changing mechanism, a muting means for said set including a muting circuit having a second normally open contact, a volume controlling means for said set, and a foot controlled device positioned adjacent the floorboard of said automobile to be operated by the foot of the driver of said automobile, said foot control device comprising a single control member movable upon pressure by the foot of said driver to move from a normal position to a muting position for closing the second contact to mute said set independently of said station changing mechanism and volume controlling means and further movable in the same direction upon further pressure by the foot of said driver to close said first mentioned contact to step said station changing mechanism while maintaining said second contact closed, said volume controlling means being operable independently of said station changing mechanism and said muting means by rotation of said single control member by the foot of said driver.

11. An automobile radio receiving system comprising a receiving set having a step-by-step station changing mechanism, a solenoid, a source of electric power and a circuit associated therewith having a normally open contact arranged when closed to energize said solenoid to step said station changing mechanism, a muting means for said set including a muting circuit having a second normally open contact, a volume controlling means for said set, a single control member actuable in one direction from a normal position to a muting position for closing said second contact to mute said set independently of said station changing mechanism and volume controlling means and further actuable in the same direction to close said first mentioned contact to step said station changing mechanism while maintaining said second contact closed, said volume controlling means being operable independently of said station changing mechanism and said muting means by movement of said control member in another direction, and resilient means for resisting movement of said control member from said normal position to said muting position and for resisting movement of said control member from said muting position to said station changing position with abruptly increased force over the resisting force from said normal position to said muting position.

12. An automobile radio receiving system comprising a receiving set having step-by-step station changing mechanism, a solenoid, a source of electric power and a circuit associated therewith having a normally open contact arranged when closed to energize said solenoid to step said station changing mechanism, a muting means including a muting circuit having a second normally open contact, a volume controlling means for said set, a foot control device positioned adjacent the floorboard of said automobile to be operated by the foot of the driver of said automobile, said foot control device comprising a single control member movable upon pressure by the foot of said driver in one direction from a normal position to a muting position for closing said second contact to mute said set independently of said station changing mechanism and volume controlling means and further movable in the same direction upon further pressure of said driver to close said first mentioned contact to step said station changing mechanism while maintaining said second contact closed, said volume controlling means being operable independently of said station changing mechanism and said muting means by rotation of said control member by the foot of said driver, and resilient means for resisting movement of said control member by the foot of said driver from said normal position to said muting position and for resisting movement of said control member by the foot of said driver from said muting position to said station changing position with abruptly increased force sensible to said driver over the resisting force from said normal position to said muting position.

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