RECEIVER REMOTE CONTROL

Use of the Extension Loudspeaker Leads

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THE extension loudspeaker is a familiar sight in homes today, and in many instances it offers a cheap and satisfactory alternative to a second receiver. Some kind of volume control is often fitted to it, but it is very rare indeed to find that any provision is made for switching the set on or off from the remote point. This is a serious disadvantage but one which is not difficult to overcome. The facility is provided by the remote control system described in this article, and it does it without requiring any additional wires between the receiver and the extension loudspeaker. The writer has had the system in use since 1942, and it has needed negligible maintenance.

The basic circuit is shown in Fig. 1, and it will be seen that blocking capacitors are inserted in one extension loudspeaker lead; one at the receiver end and the other at the loudspeaker. The extension leads can then be used to carry a unidirectional control current as well as the speech currents. The insertion of the capacitors theoretically introduces some loss of bass which depends on their capacitance and on the output impedance of the receiver. In the writer's case, the set had a pentode output valve without negative feedback. The impedance in this case being high, two capacitors of 100 μF each were found to be adequate, the loss of bass being barely perceptible.

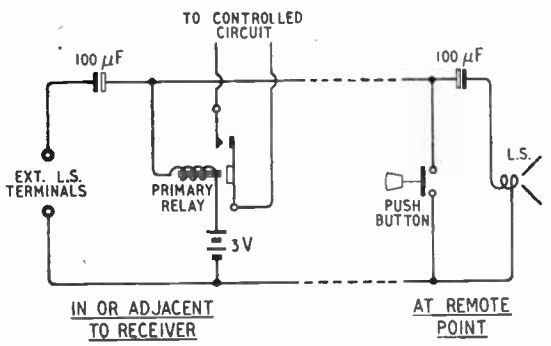


Fig. 1.—The basic remote-control circuit. Closing the push-button switch energizes the primary relay and so closes its contacts.

In the case of an output stage with negative voltage feedback, or one employing triodes, the circuit impedance is low, and in the limit when the set impedance is zero, an effective capacitance of 50 μF causes a loss of 18 db at 100 cycles. In such cases the value of the capacitors will have to be greatly increased. It is suggested, however, that the aural test should be the deciding factor.

Referring to Fig. 1, in normal use the push-button contacts are open, the battery merely maintains a polarizing voltage across the two capacitors, and the audio signal from the radio set passes through them to the loudspeaker.

The relay is of the type which requires not more than, say, 60 mA to operate it, at 3 volts, and is therefore of sufficiently high impedance, with the usual 1½ to 3 ohms extension loudspeaker, not appreciably to bypass the audio signals. The writer has tried inserting a low-resistance choke in series with the relay, and by-passing the latter with an electrolytic capacitor. This helps, but is not necessary unless a very high audio output is required from the extension loudspeaker. The trouble then is not the attenuation caused by the relay but the fact that low signal frequencies rattle the relay, which may consequently send false signals to the controlled circuits. For normal levels, such a refinement is not needed.

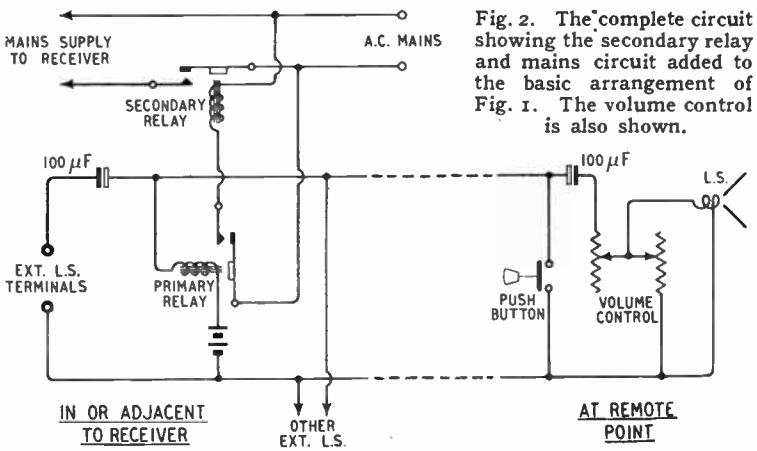


Fig. 2. The complete circuit showing the secondary relay and mains circuit added to the basic arrangement of Fig. 1. The volume control is also shown.

The use of a battery is open to criticism, but the alternatives are complicated and wasteful of power. An ordinary twin-cell cycle-lamp battery usually lasts more than twelve months, and is cheap and easy to replace. The contacts at the loudspeaker are only closed when the actual operation of switching on or off is being performed; no power is taken from the battery at other times.

The relay shown in Fig. 1 is not used to carry out the actual switching operation itself, but to control another relay which performs this function. This secondary relay must alternately make and break a circuit at successive

operations. The photographs below show the construction. The core is built up of U-shaped laminations ½ in wide, and outside dimensions 1¾ in by 1¾ in, stacked

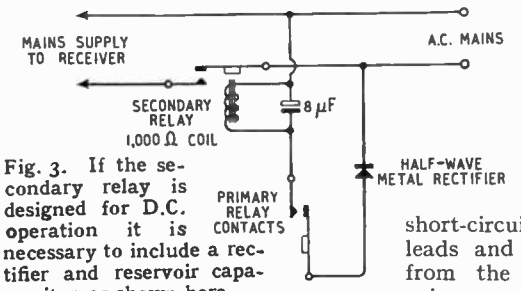


Fig. 3. If the secondary relay is designed for D.C. operation it is necessary to include a rectifier and reservoir capacitor as shown here.

to a depth of $\frac{11}{32}$ in. The coil, which is intended to operate on 230 V 50 c/s, consists of 7,000 turns of 38 S.W.G. enamelled-copper wire, and is placed over one limb of the core. It has a resistance of 750 Ω and an inductance, with the armature attracted, of 2 henrys. This value depends, of course, on the air-gap, which has been taken as $\frac{1}{32}$ in. The armature is also laminated, and has the same cross-section as the core. It is hinged to the latter by means of a bracket fixed to its outside limb.

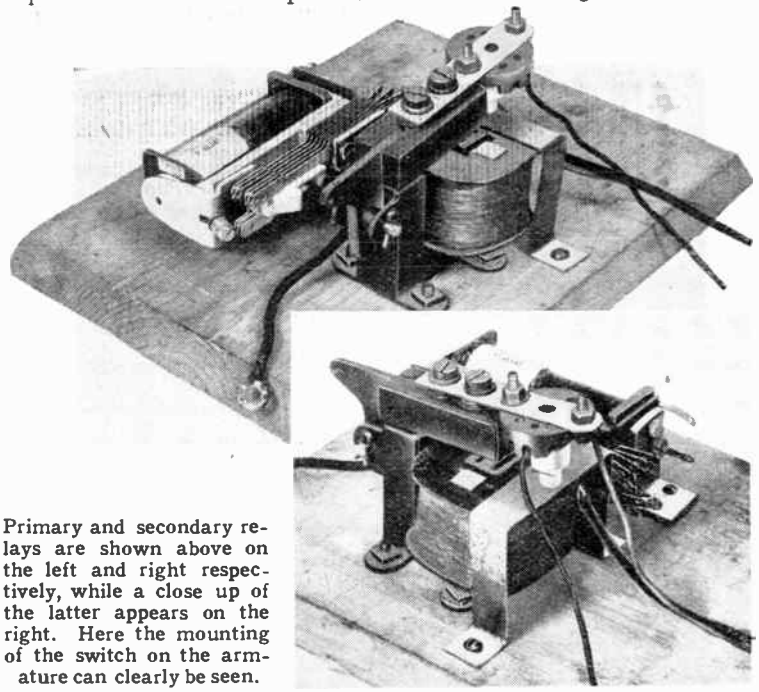
An extension on the armature carries a switch, the plunger of which is arranged to bear against a bridge mounted over the coil. This switch, of the type found on reading lamps, closes a circuit at one operation and opens it at the next. It is wired in one of the mains leads to the receiver, the mains switch on the set being left on, the set tuned to the required station, and its volume control set to the required level. Fig. 2 shows the complete circuit.

The volume control on the extension loudspeaker is of the constant-impedance type, so that its operation does not affect the volume at the set speaker, or at any other extension loudspeakers which may be in circuit. These latter, of course, must be fitted with blocking capacitors, but the volume control and push-button will not necessarily be fitted to them all.

The "local" unit, consisting of the two relays, the battery and 100-μF capacitor can be a separate small unit near the receiver. Sockets can be provided into which to plug the set's mains leads, and flexible leads can be arranged to plug into the "External L.S." terminals on the set and into the power point and "External L.S." sockets in the skirting.

Assuming everything to be off to start with, the sequence of operation is as follows. The act of pressing the push-button short-circuits the loudspeaker leads and completes the circuit from the battery through the primary relay, the contacts of which close and cause the secondary rely to be energized from the mains. The switch on the secondary relay closes, and remains closed even after the push-button has been released, and the relays de-energized. The set is thus switched on, and the volume can be controlled at the remote loudspeaker. To switch the set off, the button is pressed again, the sequence of events is repeated, and the switch operated by the secondary relay is moved to the off position.

If the device which is used as the secondary relay happens to be D.C. operated, it can be powered by the battery, but as the force required to operate the push-on push-off type switch is considerable, it cannot merely replace the primary relay. To obtain say six watts from a three-volt battery (which is possible under pulse conditions) the circuit resistance must be kept down to about 1½ ohms. This means a very low impedance relay which would noticeably attenuate the audio signals. Also the resistance of the loudspeaker extension wires would be important. Even if the primary relay is retained, however, if D.C. is required, a better plan is to supply the secondary relay from the mains through a half-wave rectifier and limiting resistance, as otherwise the battery life will be very much reduced. The coil should then be designed for high-voltage working. The rectifier and resistance, however, need not be designed to carry the required operating current continuously, as the duty cycle is very short; something like one second in an hour or more. The rectifier must, however, be designed to stand the peak inverse voltage; i.e., the peak mains voltage plus the unidirectional voltage developed across the relay coil. This coil should be shunted by an electrolytic capacitor of 8 μF or more to



Primary and secondary relays are shown above on the left and right respectively, while a close up of the latter appears on the right. Here the mounting of the switch on the armature can clearly be seen.

prevent rattle. The arrangement is shown in Fig. 3.

The resistance of the extension leads is in series with the primary relay, but with normal wiring this is small in comparison with the resistance of the relay coil and has little effect on the available current.

Care must be taken to ensure that the voltage across the electrolytic capacitor in the remote loudspeaker is of the correct polarity. Some loudspeaker extension systems employ non-reversible plugs and sockets. This will prevent accidental reversal of polarity in the event of the loudspeaker's being temporarily disconnected. Non-reversible plugs and sockets are not foolproof, however, as the connections between one room and another may be crossed. It is, therefore, necessary to check the polarity at all the sockets and make them uniform. This can easily be done by connecting a battery across one socket, and testing at the others with a voltmeter. If the plugs are reversible, and the chance of wrong connection cannot be avoided, reversible electrolytics can be used, but are not so readily obtainable as the polarized type.

The secondary relay current is about 0.3 A and so the contacts of the primary relay are required to make and break 230 volts A.C. at this current. The telegraph type of relay, which is the natural choice for this purpose, is usually fitted with rather light contacts, but the writer has found that perfectly reliable operation can be obtained if a relay with two pairs of "make" contacts is used, and the contacts wired in series so as to present a double gap when the contacts open. The G.P.O. "3000" type is suitable (see photo), and is available now in many radio shops as Government surplus. One with the required contact arrangement, and a coil resistance of 50 ohms should be selected.

In order to get the full benefit from the remote volume control, it is preferable to arrange for the audio output from the set to be just too loud for normal listening. It is particularly irritating to find that the control on the extension speaker is "flat out," but that the sound level is still not high enough.

For this reason it is desirable to fit a similar volume control to the built-in loudspeaker on the set, so that listeners at both points may adjust the volume to the required level, without affecting each other.