WIRELESS CONTROL SYSTEM

Wireless Remote Control Device.—By utilizing a device recently developed by the Philco Radio & Television Corp., it is possible to operate a radio receiver by means of remote control.

The control box popularly known as the "Mystery Control" is portable, and the desired station may be dialed in a manner similar to that of a dial-type telephone, except that no connected wires are necessary.

With reference to fig. 11, showing the control box, the tube and coils form an oscillator which can be preset to 355, 367, 375, 383, or 395 kilocycles.

The dial mechanism is technically called the "Pulser unit" since it keys or pulses the output of the oscillator.

Since the control box is battery operated, the device is easily turned on while selecting a station or changing the volume. This means that the battery drain is practically nil.

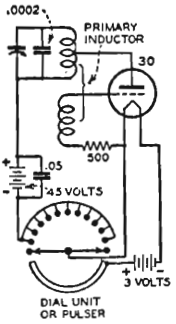
When the dial is operated, the filament circuit to the tube is closed by means of the lower switch arm and the continuous contact bar.

According to *Radio Today*, the device works principally as follows:

The Pulses Tune Radio.—The pulses are caused by making and breaking the plate battery circuit. As the dial mechanism turns, the plate circuit is opened and closed as the switch-arm touches the equally spaced contacts. Each station has a certain definite number of contacts that must be made. Corresponding to the station to be dialed, from 4 to 11 pulses are transmitted by the device. Two pulses increase the volume of the set, while 3 pulses decrease the volume. During the volume changes, a thumb-lever is held down which causes a continuous signal to

be emitted. This lever is released when the volume reaches the proper value.

The signal from the control box is transmitted to a loop or secondary coil in the radio set by induction. The remote control



FIGS. 10 and 11—Fig. 10 shows circuit diagram of the portable control box. Impulses sent out from the box are picked up by the five tube unit (fig. 12) and amplified to the proper degree to actuate the tuning mechanism shown in fig. 13. All control boxes are adjusted to use one of the five frequencies specified above.

box fig. 11 has a tuned coil (oscillator coil) which acts as a primary to induce a signal in the secondary. The coil in the control box can be likened to the primary of an induction coil. When a current flows in the primary, a current is induced in the secondary. The dimensions of both coils are made as large as possible so as to effect a maximum transfer of energy.

In the mystery control it is desired to transfer energy over a distance approaching 75 feet while avoiding any form of wire connection. It is also desired to limit the maximum operating range of the device as sharply as possible. For numerous reasons, electro-magnetic induction (rather than radiation) seems to be the most suitable means for the purpose.

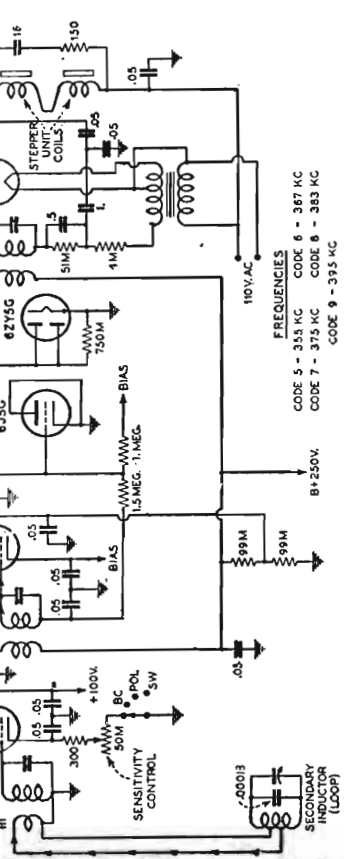


FIG. 12—Five tube stepper unit inter-connected with the high frequency part of the receiver shown in fig. 13. As previously described the receivers are equipped for five different control frequencies with range from 350 to 400 *k.c.* The purpose of the different control frequencies is to prevent interaction between two similarly equipped receivers which may be located on the same floor or are exceptionally close together. When several such receivers are to be located close together it will be necessary to utilize different control frequencies to avoid interaction between the receivers. In order to prevent interaction between receivers, there should be a difference of 20 *k.c.* between their control frequencies. If three receivers are to be operated at the same time and are closely situated, it will be advisable to adjust the control frequency of the first to 355 *k.c.*, the second set to 375 *k.c.* and the third to 395 *k.c.*, etc.

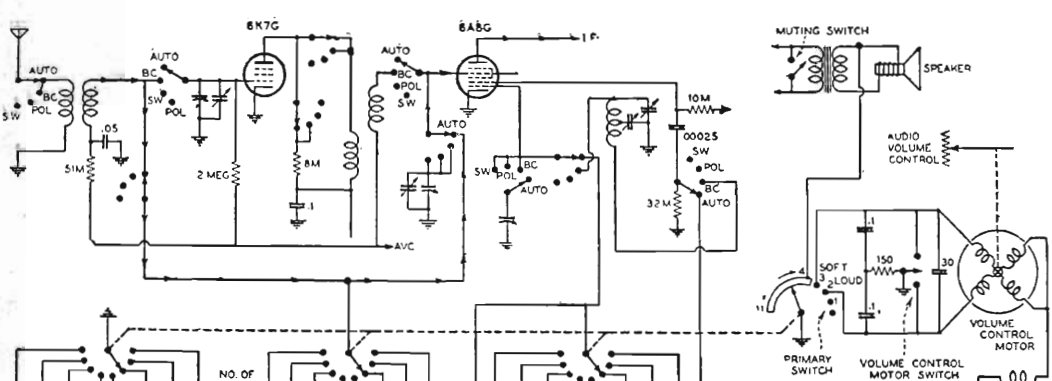


FIG. 13—Circuit diagram of high frequency part of broadcast receiver which is manipulated from a remote point by the control box. The stepper unit, fig. 12, energized by the thyratron tube switches to the desired station. Volume is also controlled remotely by means of a small motor attached to the volume control.

The Pulse Amplifier.—Because the pulses sent out from the primary (remote box) unit are rather feeble at the radio set, it is necessary to tune the remote oscillator to the frequency of the secondary coil and amplifier. As the range of the remote control device may be 75 feet under normal conditions, a variable frequency in both the oscillator and amplifier is provided so that no interference will be produced on neighboring mystery control sets. A choice of 5 frequencies from 355 to 395 *k.c.* is provided to eliminate the possibility of two or more sets interfering with one another.

The signals picked up by the loop are coupled to a tuned grid coil by a low-impedance link circuit. From the grid coil, the signals go through two stages of amplification to the grid of a 2A4G thyratron tube. The output from the thyratron tube is fed into the relays which in turn control the stepper unit and station selecting switch.

The Sensitivity Control.—In the control (pulse) amplifier circuit there is a sensitivity control which is employed for the purpose of adapting the set to the particular location where it is used. This control is in the cathode of the type 78 first amplifier tube.

The setting of this sensitivity control is of tremendous importance to the mystery control operation. The normal range of mystery control is within a circle of the receiver with a radius of about 25 feet. It is important to remember that mystery control operates in a circle around the receiver cabinet. To get the most from mystery control it is therefore advisable to place the cabinet as close to the center of the "operating circle" as possible.

If the receiver be located against the front wall of a home only half of the effective operating area is within the house. The remainder is outside the walls. There is a distinct advantage

in operating the control amplifier sensitivity control at the lowest possible setting.

Extra sensitivity in the control frequency amplifier is provided so as to permit operation in the presence of inductive shields such as steel girders, metal lath construction and large bodies of metal, furnaces, boilers, stoves, refrigerators, chandeliers, or any similar metallic objects.

The sensitivity of the control frequency amplifier is variable to fit a large range of operating conditions. Normally, sufficient precautions are taken in the amplifier and remote control circuits to greatly reduce the possibility of electrical interference. The control amplifiers are very much less subject to interference than an ordinary radio receiving system. It requires an extreme and unusual type of interference to interfere with the operation of mystery control. There is no possibility of interference affecting mystery control receivers if the sensitivity control is kept down to the first half of its total movement. This illustrates the importance of setting the sensitivity control to the minimum position possible.

In some installations, however, owing to the presence of large metal objects around or near the receiver chasses of the mystery control cabinet, it will be necessary to increase the sensitivity of the control frequency amplifiers owing to the absorption of the metal surfaces.

When this occurs, it will very likely be found that the same metal objects are shielding the receiver from excess static which would normally interfere with the mystery control circuits in a high setting of the sensitivity control. Therefore, when it is necessary to increase the setting of the sensitivity control in order to get operation of mystery control, it will likely be found that interference is not present and that a higher setting of the control is possible.

In all installations be careful to set the sensitivity control at the lowest possible position and to locate the receiver away from metal objects which would absorb the induction field of mystery control.

The 6ZY5G and 6J5G tubes act as a noise gate to exclude unwanted interference which might control the stepper assembly. This noise gate makes the amplifier respond only to pulses having a time interval equal to that of the pulser mechanism. Thus pulses of random timing do not operate the set.

The operation of the thyratron tube is entirely different from any tube so far encountered by the radio serviceman. It is a gas-filled tube which can handle large plate currents—in other words, large amounts of power. Before getting into the operation of the stepper relay unit for station selection, the *r.f.* circuits of the receiver should be examined. The wave-switch selects any one of three wave-bands or automatic tuning (mystery control operation).

The Tuning Circuits.—To illustrate the automatic operation, the wave switch has been drawn in that position. The wave switch sections disconnect the *r.f.* amplifier from the circuit and transfer the antenna coil to the grid of the converter tube. Also, the antenna coil is connected to the station selector switch which selects the proper trimmer condenser for any one station. The gange condenser is cut out of the circuit for remote operation.

The oscillator coil system is completely cut out of the circuit and trimmer type inductances with iron-core tuning are connected by the station selector switch.

A third rotary switch turns on the proper station indicator lamp. The assembly for the station selecting circuits is located beneath the chassis and is driven by the stepper assembly.

There are three groups of contacts operated by the switch. One group switches in the oscillator coils, the second group switches in the antenna padding condensers and the third group of switches, lights the pilot lamps indicating the station dialed.

Excessive friction in this switch would cause improper action of the stepper assembly. It should be adjusted so that when the relays have selected the station dialed, the contact arm is squarely on the contact. The tension of the contact arm is regulated by the setting of the hub on the switch shaft. The long wiper contacts exert a firm pressure on the contacts which may be increased or decreased by adjusting the location of the hub.

The position of the contact arm is determined by the set screws which hold the driver arm on its shaft. This is located above the chassis but beneath the stepper assembly. If the contact arms do not come to rest on the contacts it may be necessary to loosen the set screws on the switch shaft and re-locate the position of the driver arm so that the contacts are made correctly.

Excessive tension in the switch would act as a load on the relays and might result in chattering on one of the stations, part way up, and then failing to reach the station dialed.

The Stepper Assembly.—The stepper assembly which operates the station selecting switch is operated by the thyratron tube referred to previously. The coils which operates this assembly as shown as the plate load of the thyratron in fig. 12.

When the thyratron tube lights, the holding relay closes and the stepping relay pushes a ratchet as many times as there are pulses sent out by the pulser in the mystery control box. There is a primary and a secondary ratchet. The stepper relay operates the primary ratchet which is connected to the primary switch. This switch controls the volume control motor and