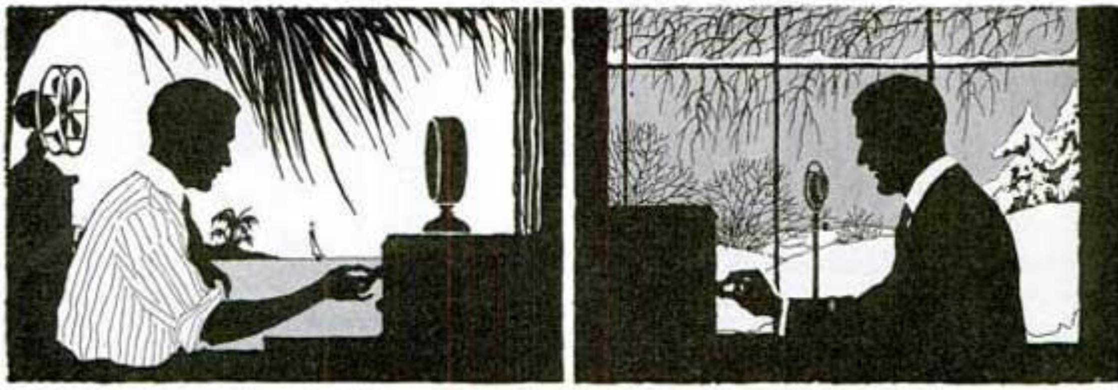
A SCREEN-GRID S·W· ADAPTER for YOUR SET



THE LAST few months have witnessed a renewal of interest in short waves, due to the overcrowded long-wave channels, coupled with the fact that television is a field which brings out the advantages of short-wave transmission and reception. A good television transmitter requires a band from 40 to 80 kilocycles wide, which represents from four to eight long-wave broadcasting channels. These cannot be afforded in the broadcast band, so the newer transmitters are working between 30 and 80 meters. The short waves are valuable, because "side-band cutting," with consequent loss of picture definition, is less severe. The width of the side bands is determined by the number of "dots" sent for each picture and the number of complete pictures per second. The definition of the picture will depend on the number of dots to each picture and the continuity or smoothness of motion on the number of complete pictures sent every second. High-quality transmitters have side bands 40 or more kilocycles wide, and future circuits especially designed for television reception must eventually tune uniformly to this wide frequency band.

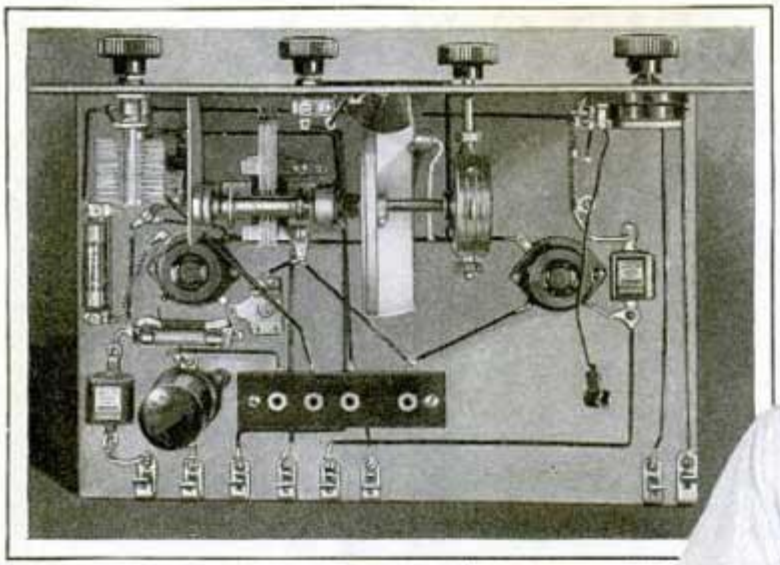
The best method of doing this will be in the use of r.f. circuits of the band-selector type, with regeneration used sparingly or not at all.

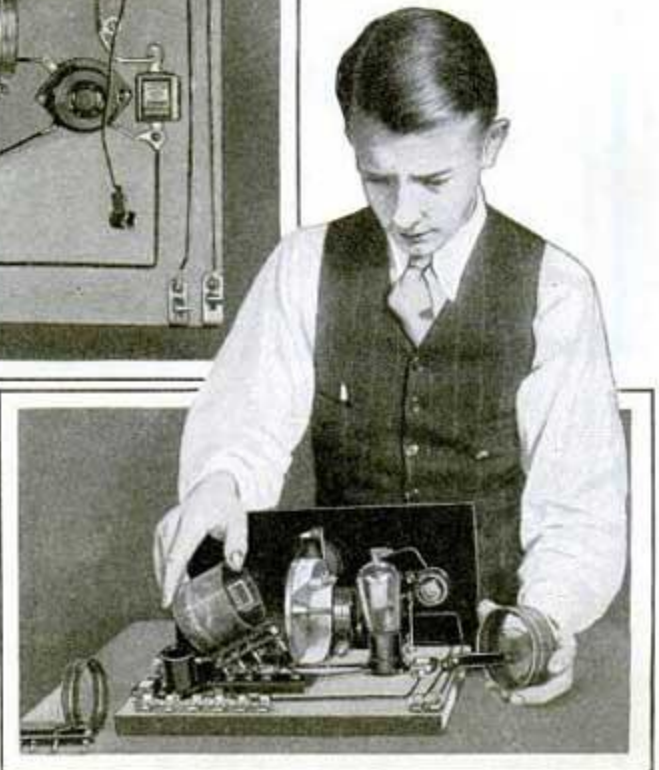
However, the widest interest in short waves at the present time is confined to the excellent programs transmitted by twenty or more stations in the United States and a much larger group employing code. The simple adapter described in this article is suitable for all three types of reception, but is not especially designed for television, as a compromise must be made in this case.

Byrd's expedition to the south pole; the flight of the "Southern Cross" to Australia, and similar instances, where short waves have enabled a transmission link with civilization, show the value of these short wavelengths.

Great progress has been made with short-wave apparatus. Further advancement in the ultra-short wave bands, below 5 meters, is limited, since the lower end of the ultra-short band merges with the upper end of the heat-wave band, although electrical oscillations have been produced which are near the border line. Short-wave transmitters costing only some thousand dollars have in many instances replaced long-wave transmitters costing hundreds of thousands of dollars. They are not only less expensive and much more compact, but they provide reliable communication over enormous distances and during daylight hours when consistent operation on long waves is ordinarily difficult.

The trend of short-wave receiver design follows closely that of broadcast receivers, and the development of satisfactory short-wave receivers and adapters has been greatly advanced by the new screen-grid tubes, which were used experimentally in short-wave transatlantic reception for over a year before they appeared on the market.





The two-tube adapter described and illustrated in this article employs the screen-grid tube, and greatly increases r.f. amplification without complicating the operation in any way. In fact, the operation is actually improved over that of the standard broadcast receiver, because the regenerative detector is not directly coupled to the antenna, and the antenna coupling does not have to be varied to prevent "dead spots." An adapter of this type does not re-radiate, as the screen-grid tube acts as a "blocking tube" and prevents direct radiation into the antenna. Some years ago, when oscillating receivers became numerous, there was a crusade against them. The necessity for a similar crusade can be eliminated by the use of circuits employing the screen-grid tube.

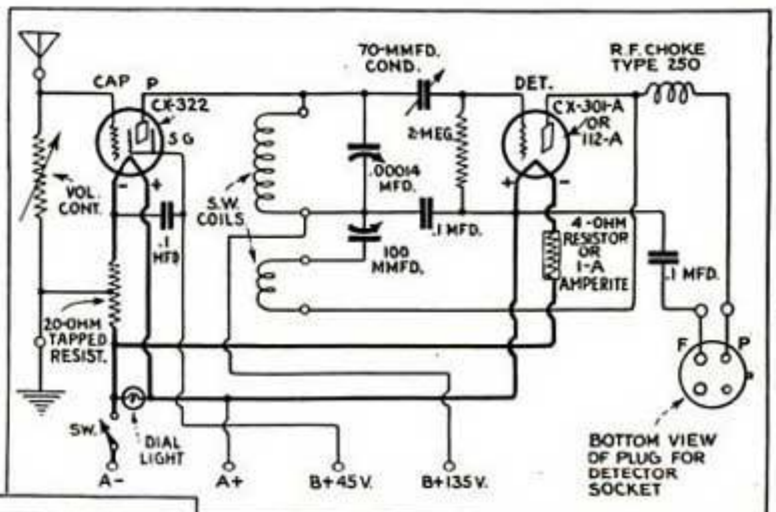
The model illustrated in this article was built and tested in Popular Mechanics radio laboratory and brought in eastern short-wave television and voice broadcasts with loud-speaker volume during the daylight hours. Reception at night included short-wave stations in all parts of the United States at good loud-speaker volume. These tests were made with the adapter plugged into a standard broadcast receiver. The detector tube in the receiver is transferred to the adapter, and the adapter plug is then plugged into the detector socket in the set. All tuning is done with the adapter-unit dial, as nothing but the audio amplifier in the broadcast set is in use. A schematic diagram for a two-stage audio-frequency amplifier is given for those who wish to include the amplifier with the tuner instead of using it in combination with the standard receiver. The terminal marked "plate lead" is connected to the binding post which goes to the r.f. choke, and the B-positive terminal is connected to the 45-volt tap of the B-battery. Any high quality a.f. transformers may be used. The first jack is for the use of headphones, and the output jack for the loud speaker.

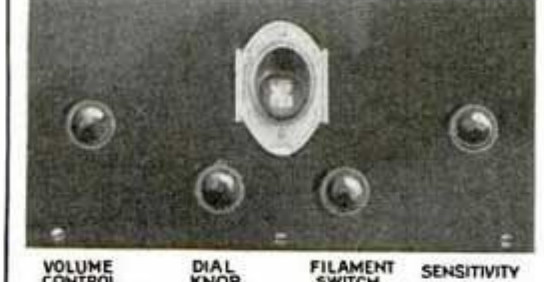
The construction of the adapter unit is very simple, as shown in the simplified wiring diagram. The front panel is 7 by 14 in. and the wood baseboard 3/4 by 8 3/4 by 13 in. Solder every connection carefully, as perfect electrical and mechanical connections are absolutely necessary in short-wave adapters and receivers. See that the small setscrew on the 100-mmfd. condenser is tightened so as to give a good wiping contact for the rotor. The wiring in short-wave receivers deserves more attention than is accorded it in broadcast receivers. All leads should be as short and direct as possible, that is, bee-line wiring should be used. Wires carrying r.f. current should cross at right angles and should clear each other as much as possible. A slight increase in lead length may be permitted to make this possible. Capacities between the grid and plate circuits are especially important and should be reduced to an absolute minimum.

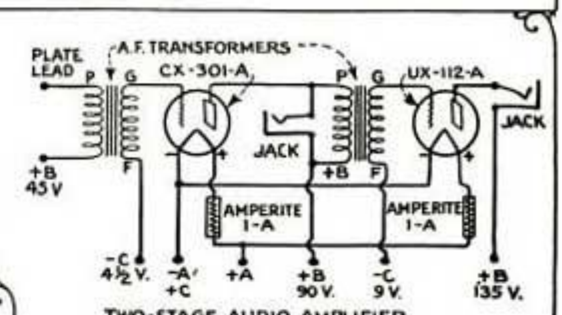
Batteries are recommended because of the high sensitivity of the adapter, although it may also be used with sets having an A and B-eliminator by disconnecting the detector-supply lead (positive 45 or 67) from the set and connecting a small 45-volt B-battery in its place. The B-battery 45-volt positive terminal should go to the receiving set and the negative terminal to the B-negative binding post on the set.

Complete a.c. operation of short-wave receivers and adapters has not been found altogether satisfactory, owing to the fact that the B-eliminator introduces extraneous noises on short waves. If the receiver employs a.c. tubes, four separate No. 6 dry cells, connected in series, with a 301-A or 112-A detector, are recommended for filament supply. Where a two-stage power-pack type of amplifier is available, it is a simple matter to arrange a switch to throw the input of the first transformer from the detector of the broadcast receiver to the detector of the short-wave receiver. If the adapter is to be used in connection with a superheterodyne, it should be plugged into the first-detector socket and the oscillator tube in the superheterodyne must be removed; the converter is then made to oscillate and is operated in this condition. Where the intermediate frequency is high, above 150 kilocycles, the adapter will work better when plugged into the second detector and operated in the usual manner.

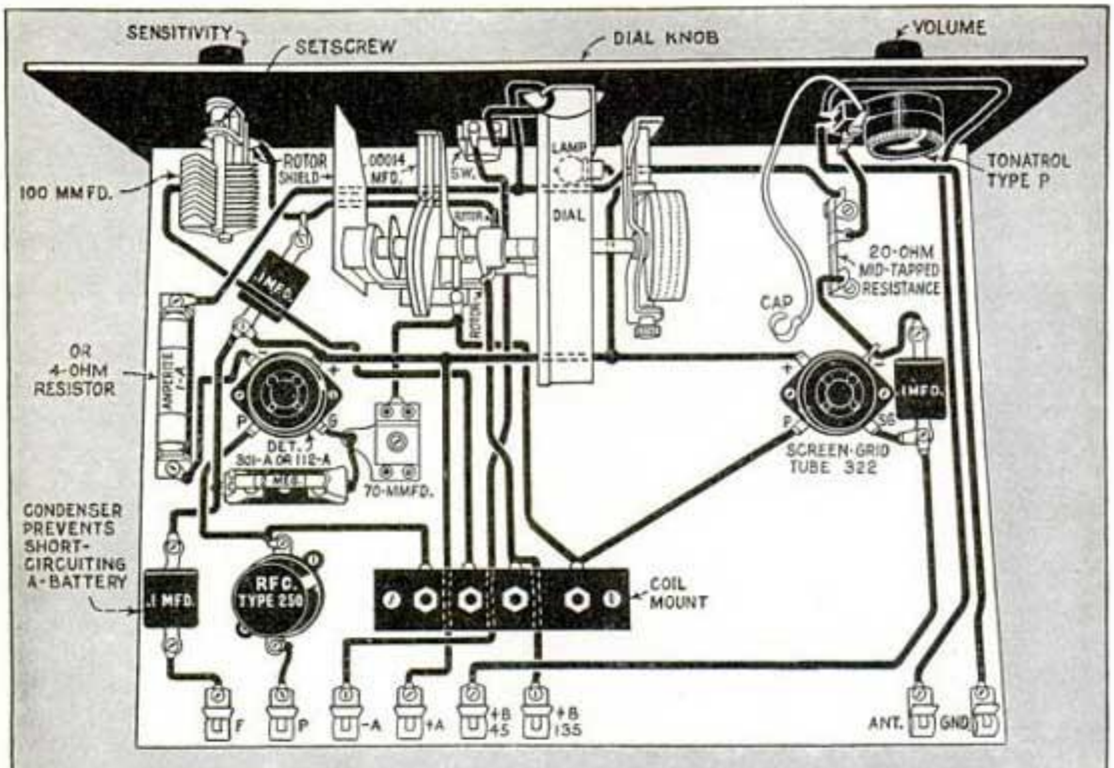
The A-battery leads should be permanently connected to the adapter unit; if the a.f. amplifier is combined with the adapter, making a complete receiver, the A-positive leads should be connected direct to the A-battery positive terminal and the set side of the battery switch so that this switch turns off all tubes. Ordinarily 112-A detector and screen-grid r.f. tubes are recommended for short-wave receivers. The 112-A is more sensitive and is a stable oscillator. The 301-A is almost as satisfactory as a detector and may be used when the effective input capacity must be low; for example, when working at the minimum wavelength of the circuit. The 200-A detector tube is very sensitive but noisy. A 199 tube may







TWO-STAGE AUDIO AMPLIFIER FOR COMPLETE RECEIVER



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POPULAR MECHANICS MAGAZINE
MARCH 1929

be used when filaments have to be dry-cell operated, but the regeneration may be poor, especially at very short wavelengths.

Anyone who has tuned a set of the type employing a stage of r.f. amplification and a regenerative detector will have little difficulty in tuning this short-wave unit, as the principle is exactly the same, although the settings are more critical. Distant stations may be heard by gradually increasing the capacity of the regeneration or "sensitivity" condenser, until a hissing noise is heard and the detector just begins to oscillate. This control should be kept as near as possible to the oscillating point throughout the tuning range. When properly adjusted, touching the stator plates of the detector condenser will result in a sharp click. If there is no click, readjust the sensitivity control. When the station is located, decrease the sensitivity slightly and readjust the tuning condenser until the whistle is very low in pitch. Both adjustments should be made simultaneously, so that the pitch is very low at the point where the receiver stops oscillating. A slight readjustment of the tuning condenser is necessary, because the sensitivity control affects the tuning adjustment slightly. The proper setting for the 70-mmfd. grid condenser will be at nearly maximum capacity; the best gridleak value will be found by test and will be between 2 and 5 megohms. The setting of the variable grid condenser, the resistance of the gridleak and the detector-plate voltage determine the suddenness with which the receiver goes into oscillation. It is not a good plan to let this happen abruptly, as it makes the instrument difficult to operate at the point of maximum sensitivity. The short-wave plug-in coils come in sets of three, covering the 20, 40 and 80-meter bands, and a mounting base is included in the coil set.

A large blueprint of the simplified and schematic diagrams may be obtained from Popular Mechanics radio department, 200 E. Ontario St., Chicago, for 25 cents to cover cost and packing. Specify blueprint No. 142. A copy of the material list will be mailed free to any address upon request.