All Channel TV Tuner

A TV front end can be constructed without any of the usual specially made coil or bandswitch assemblies

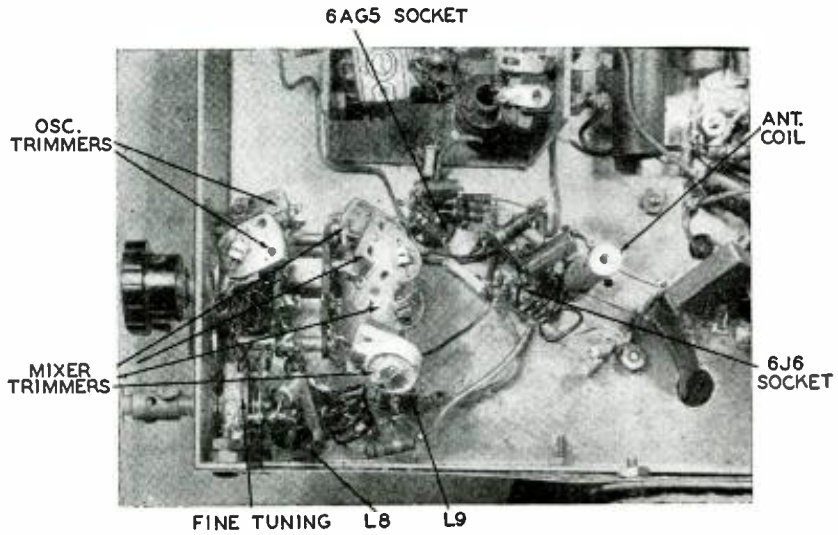
By E. J. SCHULTZ

ALTHOUGH there are a number of good television receiver kits and components available on the market, there are numerous constructors who, like the author, take pride in constructing their equipment without using manufactured assemblies. The average constructor will find that design and construction data on video i.f. amplifiers, detectors, sweep circuits, and video amplifiers have been published in a number of technical magazines and papers. Unfortunately, for us, little or no material is available on constructing or designing a TV front end for all channels. A number of commercial tuners have been described, but all these rely on special switches, turrets, or other components not readily available to the ordinary radio constructor.

Tuners usually present two problems: one is to make the oscillator work over the entire range, and the other is to track the mixer and antenna stages once the oscillator is working properly. The tuner described here was developed after weeks of experimenting with all types of circuits. Simple, it can be duplicated by almost anyone experienced with high-frequency circuits. It uses a channel-switching tuning system that can be made to work into almost any existing video i.f. circuit. It will work nicely with the video i.f. amplfier described on page 110 of the March, 1949, issue.

The circuit consists of a 6J6 broadband, grounded-grid amplifier with a cathode coil that is broadly resonant over the entire TV band. Its input circuit has an impedance of approximately 300 ohms on all TV channels. The plate circuit of the 6J6 is tuned and capacitance-coupled to the grid of the 6AG5 mixer. The oscillator is a 6C4 with its grid circuit tuned *above* the signal frequency and its cathode circuit loaded with an inductance. The plate is at ground potential for r.f. The oscillator and mixer grids are coupled to each other through stray capacitance and inductance.

The channels are selected with a 2-circuit, wafer-type rotary switch. One wafer switches small preset trimmer capacitors across the coil in the plate circuit of the 6J6, and the other shunts the oscillator coil with preset trimmers or small inductors. The capacitors lower the resonant frequency of L4 and the inductors raise it. Switch-tuning is advantageous in that it permits each channel to be aligned without disturbing the settings for other channels. A 2-plate midget and a 10-μμf capacitor are in series across the oscillator coil for fine tuning.



The parts are assembled in a compact mass under the chassis to eliminate long-lead trouble.

Construction

The channel-selector switch should be well constructed with good high-frequency insulation and good, clean, low-resistance contacts. A 7-position switch was selected for channel-switching since this is the maximum number of channels that will be assigned in any one area. If a builder is midway between the primary service areas of stations in two cities, a switch with more positions can be used. The position of the components is shown in the photographs. The oscillator grid and 6J6 plate circuits should be as close to the switch as components permit. In cases where leads must be long, make them out of heavy wire, as is usual in v.h.f. work.

The under-chassis photograph shows placement of the parts in the tuner circuit. The oscillator socket is hidden by components mounted on its terminals. It is mounted just back of the 2-plate midget capacitor used for fine tuning. The oscillator grid coil, L4, is the large one between L8 and L9. The shunt inductors L5, L6, and L7 are mounted directly on the channel-selector switch. L3, the tuned coil between the amplifier plate and mixer grid, is the heavy winding close to the antenna coil. Circuit operation may possibly be improved by locating this coil at the socket of the 6AG5.

L1 has 6 turns interwound with L2, which has 12 turns on a ⅜-inch form. Both coils are closewound with No. 32 s.s.e. wire. L3 has 3½ turns of No. 14 enamel wound with an inside diameter of ½ inch and spaced to 1 inch long. The oscillator coil L4 consists of 2½ turns of No. 14 enamel wire spaced to ½ inch with a ½-inch inside diameter. L5, L6, and L7, the shunting inductors, are for channels 7, 11, and 13, respectively. They are self-supporting coils wound with No. 20 enamel wire to a ¼-inch inside diameter. L5 has 5 turns spaced to ½ inch, L6 has 3 turns spaced to ⅜ inch, and L7 has 2 turns spaced to ½ inch. L8 is a self-supporting coil made from 25 turns of No. 20 enamel wire close-wound on a ¼-inch form. L9

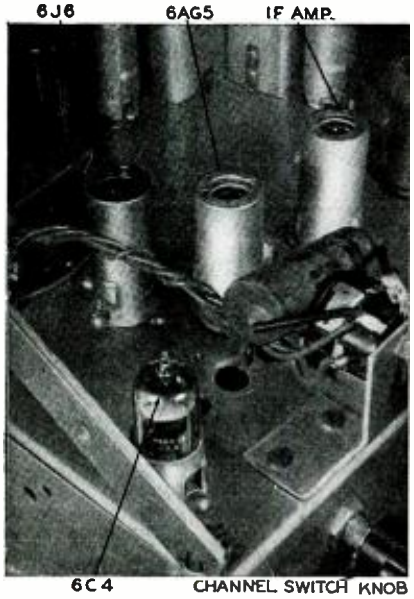
is 30 turns of No. 30 enamel wire close-wound on a $\frac{3}{16}$-inch form. The specifications for L5, L6, and L7 are approximate. The exact number of turns and spacing will have to be determined for each individual layout. Coils can be wound for other channels by using cut-and-try procedure based on the data which has been given for channels near them.

Aligning the tuner

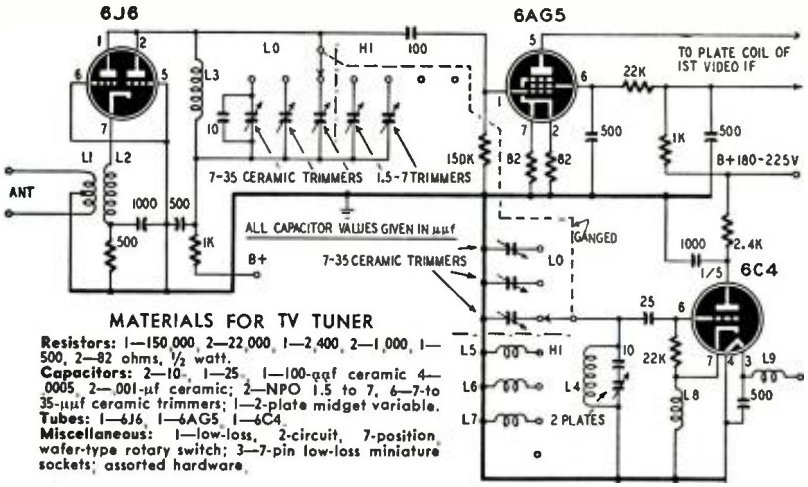
The tuner should be completed and connected to the i.f. system of a receiver before beginning the alignment procedure. Cut-and-try adjustments can be minimized by calculating the lowest oscillator frequency and adjusting L4 to approximately this frequency with an absorption frequency meter. The oscillator operates *above* the signal frequency, so its frequency can be found by adding the sound i.f. to the sound carrier frequency or by adding the video i.f. to the video carrier frequency.

The tuner can be aligned on a television signal or with an accurate signal generator. Set the channel-selector switch to the channel to be tuned in. Adjust the appropriate oscillator trimmer so the sound and picture come in together. Adjust the mixer trimmer for the best compromise between picture quality and maximum volume. If a high-band channel is being aligned, resonate the oscillator by varying the spacing between the turns of the shunt inductors. A tuning wand is useful in this operation because it indicates whether the turns should be squeezed together or spread apart. The vernier tuning control should be set at its mid-point when aligning each channel.

If it is impossible to peak the mixer coil on the highest channel, its trimmer may be replaced by a parallel inductor similar to the ones in the oscillator circuit.



Top-chassis photo shows how tubes are placed.



MATERIALS FOR TV TUNER

Resistors: 1—150,000, 2—22,000, 1—2,400, 2—1,000, 1—500, 2—82 ohms, ½ watt.
Capacitors: 2—10-, 1—25-, 1—100-μμf ceramic 4—.0005, 2—.001-μf ceramic; 2—NPO 1.5 to 7, 6—7-to 35-μμf ceramic trimmers; 1—2-plate midget variable.
Tubes: 1—6J6, 1—6AG5, 1—6C4.
Miscellaneous: 1—low-loss, 2-circuit, 7-position wafer-type rotary switch; 3—7-pin low-loss miniature sockets; assorted hardware.

The tuner precedes a 3-stage video i.f. amplifier followed by a detector and video amplifier driving a 7-inch picture tube. The set receives all New York City channels with satisfactory signal strength and picture quality when using an indoor antenna at Bayside, Long Island, approximately 15 miles from the stations.

Although not the ultimate in design, this tuner gives good results and will serve as a foundation for those constructors who design and build their own television receivers.

TELEVISION NOTES OF THE MONTH

Channels for TV may number 50 to 70 if a u.h.f. band is adopted, FCC chairman Wayne Coy told a group of radio and advertising executives recently. "I hold the need [for additional channels] to be self-evident," Mr. Coy said in a speech in Boston. "How many channels it takes to satisfy that need I do not know. My present thinking is that 50 to 70 channels may be required." Adding his own predictions to those current recently about the fight for audiences between radio and television, Mr. Coy said, "As I see it, broadcasters who own television stations will gradually dispose of their radio stations and concentrate on television." This, he added, will be because advertisers do not like to spend their money with an organization which operates another simultaneous service competing for the same audience. He foresees, however, that aural broadcasting will remain important for specialized programs and that networks will soon be sending one type of program schedule to areas served by television and a different service to those where there are no television stations.

Six rules for visual comfort in viewing television were issued recently by the American Optometric Association. They are:

1. Make sure that your set is properly installed, with particular attention to the antenna, for clearest possible reception.

2. In tuning, adjust audio tone setting before turning the picture up to desired brilliance. Strike a comfortable balance between steadiness of image and brilliance. Either an unsteady image or too much light will result in visual discomfort.

3. Avoid both intense darkness and bright light in the room in which television is viewed. If the room is totally dark there will be too much contrast between the bright screen and its surroundings. If there are bright lights they will distract you from the screen. Mild, indirect light in the room is preferable.

4. Sun glasses should not be worn for televiewing because they adapt vision to unnatural conditions.

5. Avoid excessively long periods of close concentration on the television screen.

6. In case of discomfort, have your vision examined by a competent vision specialist and follow his advice. Many older persons who wear bifocal glasses may find neither segment suited to television viewing. They may be helped by special lenses prescribed for the proper distance.

Color television's usefulness in teaching medicine and surgery will be demonstrated at the annual meeting of the American Medical Association in Atlantic City in June, under a plan of Smith, Kline and French, Philadelphia pharmaceutical firm, and the University of Pennsylvania. Pickups will be made by CBS in cooperation with Zenith and Webster-Chicago. For four days, surgery and other procedures at the Atlantic City Hospital will be scanned and transmitted in color to 20 receivers in Convention Hall. The system used will be the CBS color-disc.