Test Scope Checks

Special design features of a new broad-band oscilloscope include sweep-delay circuit, sweep magnifier, time markers for sync pulses and vertical-amplifier calibrator. Individual lines or sync pulses of standard tv signal can be examined and identified

TELEVISION BROADCAST equipment frequently needs maintenance or adjustment that can best be accomplished with a cathode-ray oscilloscope. Station equipment to be tested includes synchronizing generators and video amplifiers as well as camera, monitor and switching equipment. Since any portion of the transmitted video signal must be presented accurately and in good detail, the test oscilloscope must have high input resistance, low input capacitance, good transient response and broad bandwidth. The instrument to be described contains a number of features designed for the purpose of tv testing, including a 10-megacycle bandwidth, an input impedance of one megohm shunted by 40 μμf, and a test probe (with ten times attenuation) that provides 10 megohms and by 14 μμf.

The sweep circuit of the oscilloscope has a range from 0.01 sec per cm to 0.1 μsec per cm and is a hard-tube, triggered type. Composite fields or complete frames may be observed by triggering the sweep from vertical sync pulses and selecting a slow-sweep rate that presents the desired amount of information during each sweep.

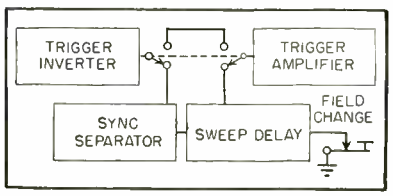

FIG. 1—Block diagram of the sweep-delay circuit

When individual lines or sync pulses are to be observed throughout the picture, the sweep must be set fast enough to spread out the desired information. It becomes necessary to delay the start of the sweep until the picture has progressed to the desired portion and then trigger the sweep with one of the horizontal-sync pulses.

The sweep delay introduced is adjustable through about 1.5 fields by means of a sweep-delay control. The sweep-delay circuit operates at the frame rate of 30 cps, so that individual lines are observed from only one of the interlaced fields at any time. A field-shift switch allows the operator to change to the other interlaced field. A block diagram of the sweep-delay circuit is shown in Fig. 1.

Sweep Delay

A trigger delay phantastron V_4 with 25-millisecond rundown time will accept alternate vertical-sync pulses from the sync separator. The field-shift switch, normally closed

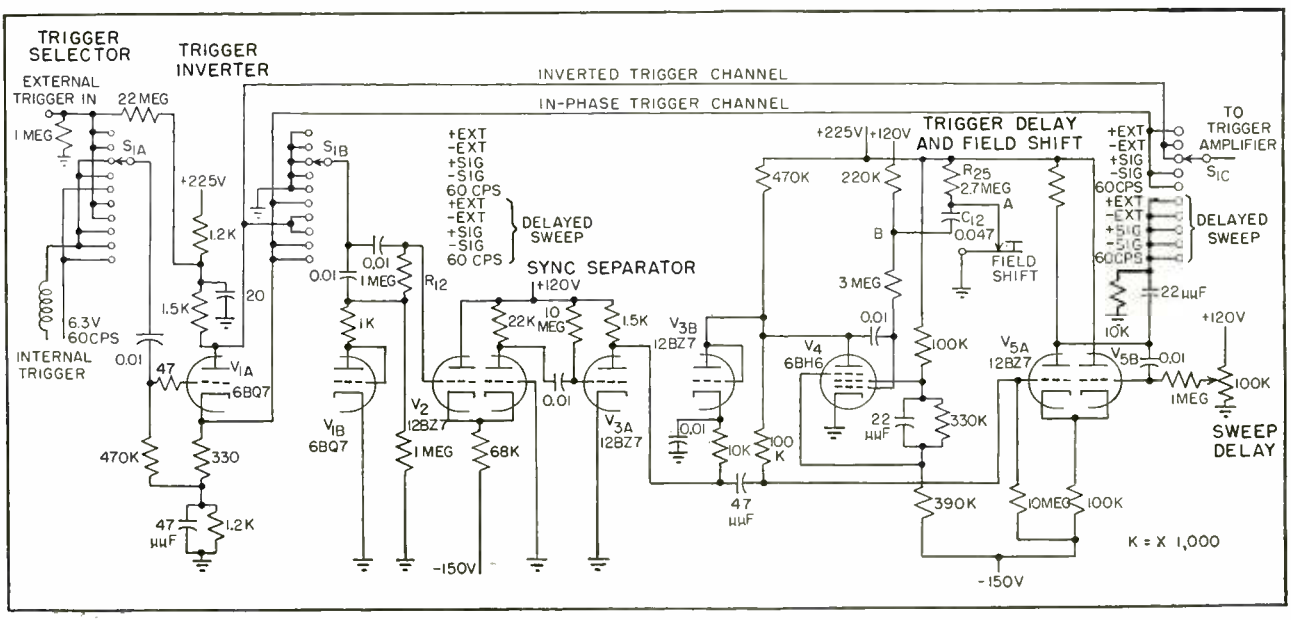

FIG. 2—Circuit of the trigger-delay and field-shift elements of the oscilloscope

TV Broadcasts

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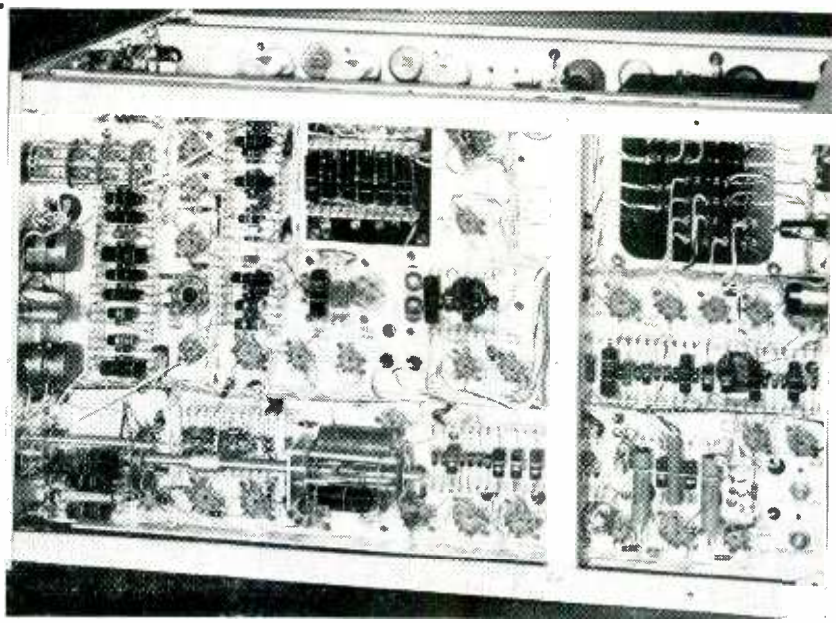
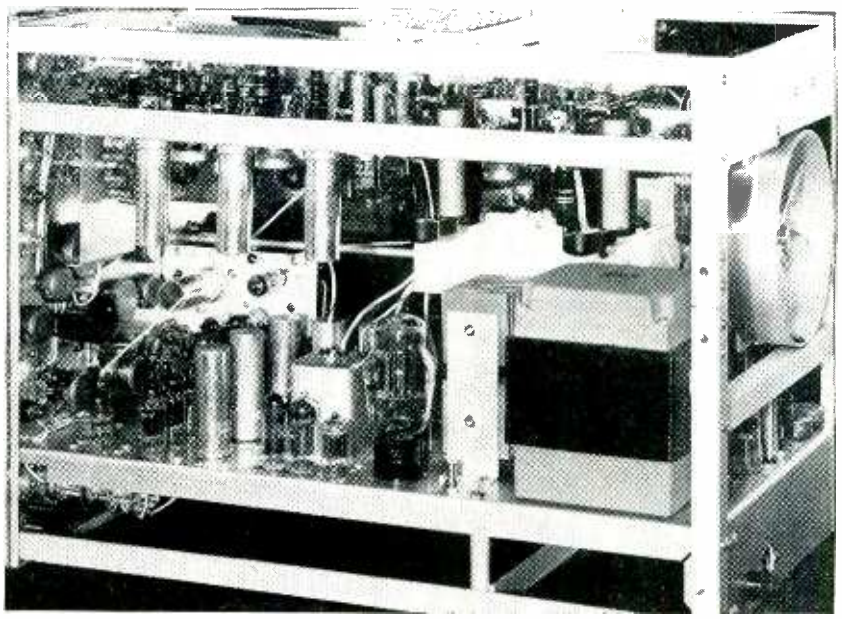


Underchassis view of the television oscilloscope looking towards front panel (left)



Blower (right) provides cooling for greater stability and longer component life

(Fig. 2), provides a unique means of forcing the phantastron to skip one extra trigger and hence change to the other field.

Reversed Phantastron

When the pushbutton is depressed R_{35} charges C_{12} so that point A approaches +225 volts. When the switch is released, point A is again grounded and C_{12} instantaneously forces point B 225 volts negative with respect to its normal voltage. This actually reverses the phantastron and forces it to run up for a short time instead of down. Point B returns to normal voltage approximately according to the time constant $R_{35}C_{12}$, interrupting the phantastron only long enough to skip one trigger. The comparator V_5 will always be triggered by one of the differentiated horizontal-sync pulses from the sync separator that are superimposed on the phantastron waveform.

Sweep Magnifier

It is frequently desirable to look carefully at a small detail on the screen without upsetting the sweep-circuit settings. A magnifier principle has been incorporated in this oscilloscope that gives either three or ten times magnification of any detail that has been positioned to the center of the screen by a three-turn horizontal-position control. With magnification on, the operator may explore the entire trace by slowly turning this control. If a detail is located with the magnifier on, the position of the detail with respect to the entire sweep may be determined by turning off the magnifier and observing which part of the trace is centered on the screen.

The principle of operation of the magnifier can be explained with the block diagram of Fig. 3. Normally the high-gain amplifier is held to unity gain by feedback networks R_1C_1 and R_2C_2. Three and ten-times magnification are obtained by switching R_2 and C_2 to allow corresponding voltage gains.

Time markers are inserted as intensification pips in the crt beam at time intervals of 1 μsec, 0.1 μsec, 0.05 μsec or 200 pips per television line.

These markers provide a means of accurately timing the sync pulses of a composite signal. A horizontal-sync pulse with markers is

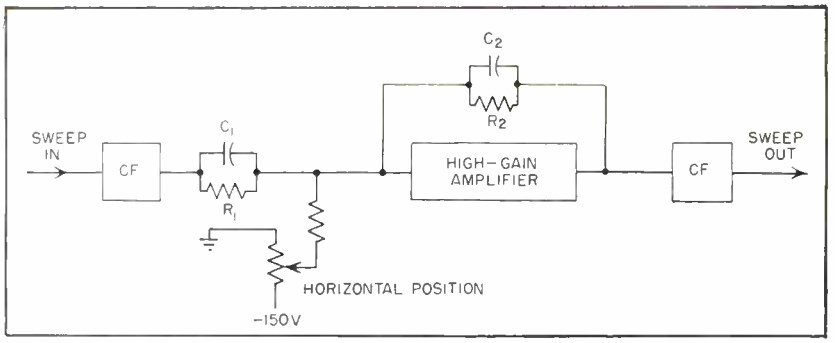


FIG. 3—Elements of the sweep-magnifier feature

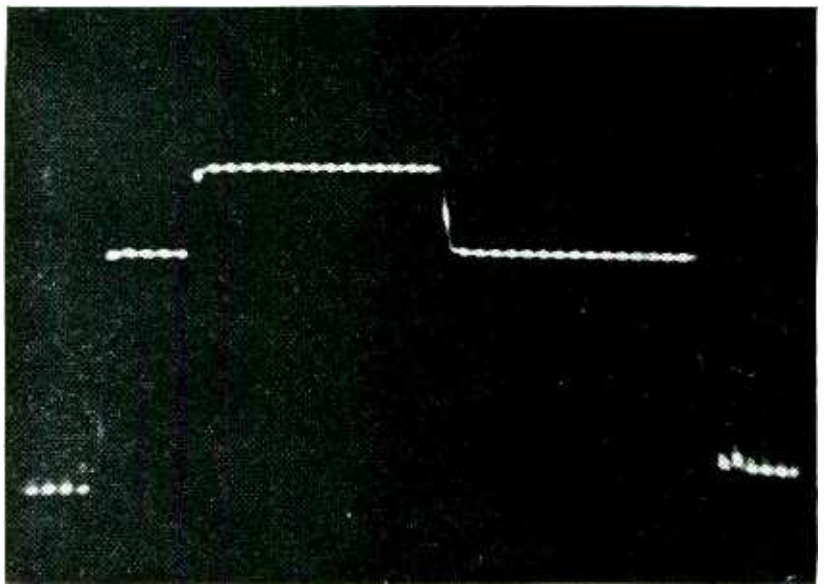


FIG. 4—Horizontal sync pulse with markers supplied from scope

shown in Fig. 4 above.

The marker oscillator is an electron-coupled Colpitts type with split capacitance from grid to cathode to ground. Cathode follower V_{1B} of Fig. 5 acts as a low resistance, damping the oscillator tuned circuit and preventing oscillations except during the sweep, at which time V_{1B} is gated off. Magnetic energy stored in the oscillator coil by cathode current from V_{1B} becomes oscillating energy when the tube is gated off at the start of a sweep.

Tube V_2 provides positive feedback that maintains the oscillations until V_{1B} is gated on again at the end of the sweep. The triode section V_{1A} amplifies the oscillator signal and provides sharp differentiated pulses to the grid of output amplifier V_3.

Pips spaced 200 per television line (0.005 H, where H is 62.5 μsec) are useful for adjusting both color and black-and-white equipment. Timing of sync pulses, specified by the FCC in terms of H, can be measured directly by counting the number of 0.005 H pips between specified points of the waveforms.

An improved circuit technique is employed in the crt unblanking circuit. With the new technique a given intensity control setting will result in the same crt beam current at any sweep speed or duty cycle. A separate floating high-voltage rectifier supplies a direct voltage coupling from the unblanking generator to the crt grid. The floating power supply is a radio-frequency type operating at about 25 kilocycles, and is part of the regular crt high-voltage supply.

A vertical-amplifier calibrator allows the operator to compare an observed signal amplitude to an internal square wave having an amplitude known accurately within 3 percent. The square wave has adjustable duty cycle from 1 percent to 99 percent allowing the duty cycle of the calibrator to be matched to the duty cycle of the observed signal. This adjustment minimizes error in amplitude comparison of an a-c coupled signal resulting from change in amplifier operating bias with the duty cycle of the signal.

A 60-cycle internal sweep with phasing through approximately 150 deg is provided to facilitate bandwidth measurements with a video sweep generator.

Positive and negative gate waveforms produced simultaneously with each sweep are provided so that if desired either intensification or blanking may be produced in a picture monitor to indicate the portion of the picture being observed by the oscilloscope.

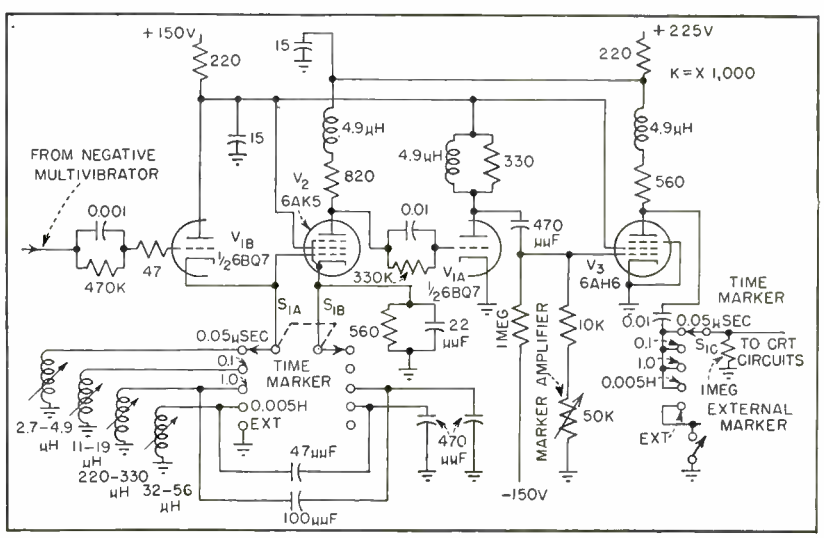


FIG. 5—Time-mark generator for providing pips shown in Fig. 4