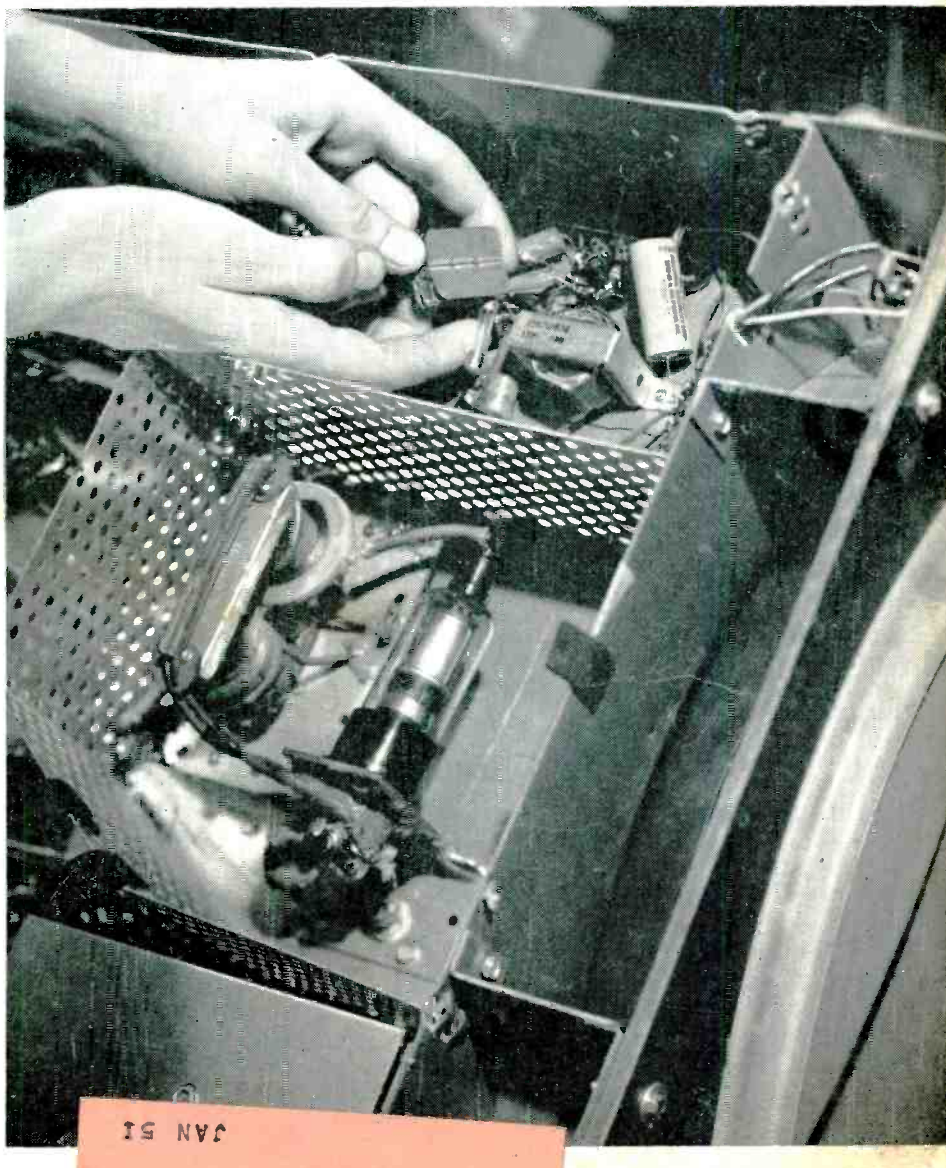
RADIO and TELEVISION maintenance



DEFLECTION SYSTEMS ISSUE

APRIL 1951


215
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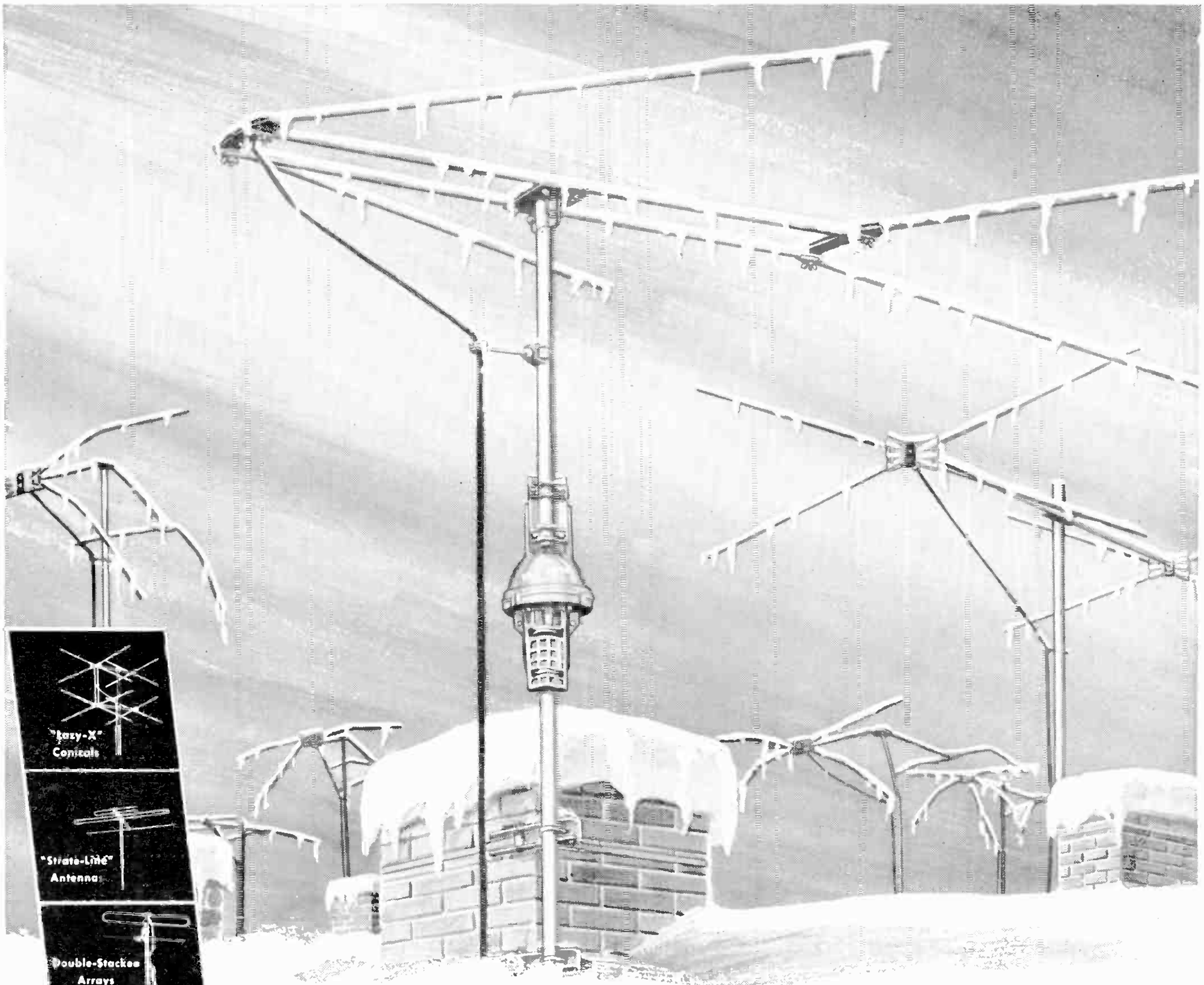

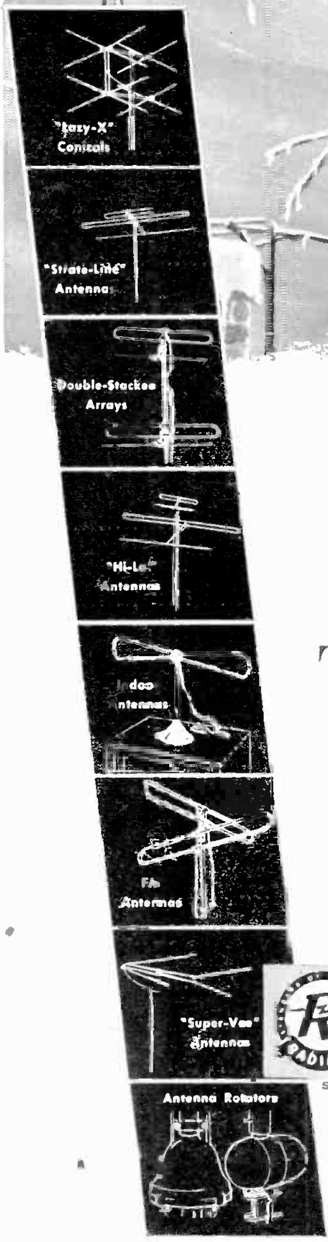

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"Strate-Line" Antennas
Double-Stacked Arrays
"Hi-Lo" Antennas
Indoor Antennas
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"Super-Vee" Antennas
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VOLUME VII NUMBER 4

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RADIO and TELEVISION maintenance

APRIL 1951

FEATURES

DEPARTMENTS

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DEVOTED TO SERVICE OF RADIO-AUDIO-VIDEO

RADIO INDUSTRY NEWSLETTER

SLUMP OVER IN TV TRANSMITTERS

The long slump in TV transmitter equipment business is apparently ending, according to the statement of one leading manufacturer, which says that the equipment is being bought by station operators who want to be ready to begin broadcasting as soon as the freeze is lifted. One explanation of the comparatively sudden boom in transmitter equipment is that the broadcasters don't want war shortages to prevent their getting on the air when they get licenses, since they expect a shortage of equipment to arise in the fairly near future.

FCC ISSUES NEW UHF ALLOCATION

The Federal Communications Commission recently made a big step in the direction of ending the freeze, by issuing a new frequency assignment plan for the UHF, which would permit TV broadcasting in more than 1,200 communities. The 12 present channels would continue in use under the new plan, and 52 UHF channels would be put into use. About 30 stations now operating would be shifted to other assignments. Most of the metropolitan centers would have some VHF and some UHF stations.

'MOST POWERFUL' TV TRANSMITTER BUILT

A new, 200-pound TV transmitting tube, similar to the klystron, is expected to aid in the development of UHF television. Produced for the General Electric Co. by Varian Associates, a California firm, the new tube, a velocity-modulation, 5 Kw. unit, is said to be more powerful than any other transmitting tube now in use. No material increase in area covered by a station using the new tube is expected, but it is thought that signals will be greatly strengthened within the reception area, and that picture quality will be improved.

ADVERTISERS USE DEFENSE SLOGAN

CONSERVE CRITICAL MATERIALS

Many advertisers in the electronics industry are now using a slogan-logotype, "Conserve Critical Materials," in their paid ad space, to aid the defense effort. The symbol, which was designed by Burton Browne, president of a Chicago advertising agency specializing in electronics accounts, can be used by any advertiser. The current slogan will be changed periodically, in order to tie in with drives to promote mobilization work. The shield shape of the design will be maintained throughout the various campaigns.

450 CLINICS LISTED BY DU MONT SERVICE

Television service clinics will be held in many TV centers across the country in the next several months, sponsored by the Teleset Service Control Department of Allen B. Du Mont Laboratories. Co-ordinated with programs of local service organizations, the 450 clinics will include lectures and discussions of general servicing techniques and specific maintenance problems.

RTMA INSTALLS NEW PRESIDENT

The new president of the Radio-Television Manufacturers Association, Glen McDaniel, assumed his responsibilities early this month. McDaniel, who is the first paid president of the association, succeeds Robert C. Sprague, who will remain in office as chairman of the group's board of directors. McDaniel was formerly a vice-president of RCA.

ARMY TELLS HOW TO GET RATINGS

The U. S. Army Signal Corps has just issued instructions to men with experience in electronics who are planning to enter the armed forces. Trained technicians, in order that their abilities be recognized and used in their service careers, are asked to bring statements from their employers, or other credentials, proving their experience and knowledge. Independent repairmen will be able to make their qualifications known to their commanding officers by means of radio amateur licenses, union cards, or similar certification.

Troubleshooting TV Deflection Systems

Critical Deflection Circuits Must Be In Perfect Working Condition For a Good Picture

By RICHARD L. BROWNE

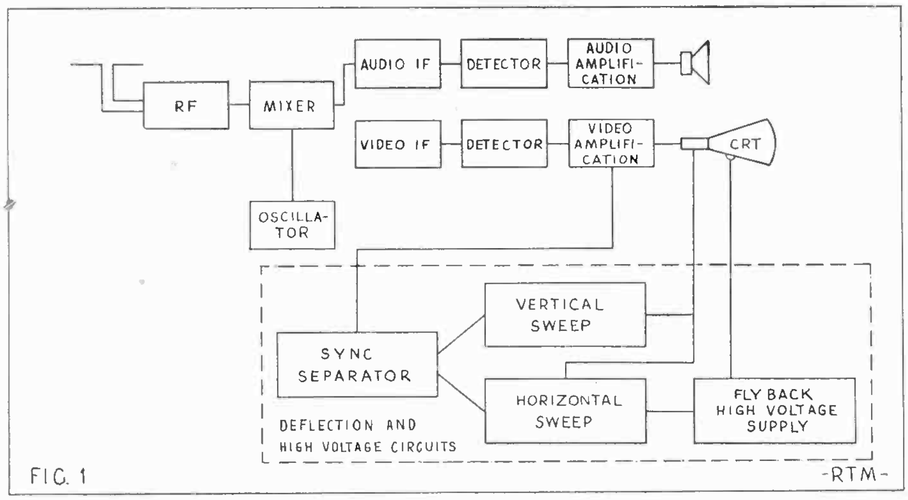
THE deflection system of the television receiver—including both horizontal and vertical sections—is probably the most important part of the entire set, if one section of the set could be singled out as being more important than others.

The reason why defective circuits might be said to be so essential, is that the functions they perform actually *make* television as we know it today. The IF strips, both video and audio, are analogous to those found in ordinary superhet radios; the TV set's front end is just an extension of the RF systems of radios, although far more complex and efficient; and there is not much in the audio circuits of television sets that is new to the radio technician. But in the deflection section, we see the real heart of the receiver. Its counterpart is not to be found anywhere except in oscillography, and only in the most involved extensions of that branch of electronics.

The complexity of deflection circuits which is necessary for their proper operation is, of course, a weak spot from the maintenance point of view. The slightest loss of efficiency in any part of the sweep sections, and the picture goes bad. And in many modern receivers, the high voltage for the picture tube's second anode depends on the horizontal sweep, thus complicating the requirements even further.

Short of complete failure of one or the other of the deflection sections, which would reveal itself in either a horizontal or vertical line in place of the desired raster, there are a great many faults which can be seen in a test pattern, and diagnosed immediately as deflection troubles. Non-rectangularity in the raster, lack of focus or centering, foldover, wrinkles, non-linearity (as revealed by the shape of circles in the pattern), small size of pattern—these are just a few of the many possible symptoms of trouble in the deflection circuits.

In sets utilizing flyback high-voltage supplies, the horizontal sweep section is first suspected when there is no raster at all, but the set's sound is all right. For a full procedure on servicing this receiver fault, see "Servicing Flyback High Voltage Supplies," in RADIO AND TELEVISION MAINTENANCE, December, 1950.



Block diagram of a typical TV receiver employing flyback for the second anode voltage. In this set, brightness of the picture depends on proper operation of the horizontal sweep circuit.

Keystone Effect

The "keystone effect," in which the test pattern or picture is wide at the top and narrow at the bottom, or vice versa, is one of the important symptoms demanding a check of the horizontal system. In magnetic-deflection sets, this is usually caused by poor positioning, or a fault in either the deflection yoke or the ion trap. For the quickest method of repairing the difficulty, the yoke or ion trap magnets should be replaced or moved around until the raster again becomes rectangular.

The trouble could also be that the leads to the yoke are not properly connected, or that an accidental short to ground is present. When these leads are shielded, a check to make sure that the shield is grounded is in order.

In electrostatically-deflected sets, which are likely to become more and more prominent in coming months, the defect is usually traceable to a resistor in the high voltage supply. Generally, there is a resistor of high value between each deflection plate and the supply. These components should be checked, as should all the bypass condensers in the supply. Another possibility is that the CR tube itself is bad, which can only be discovered through substitution of a picture tube known to be good.

Lack of Focus

Lack of proper focus, when the control provided does not bring sharp definition to the picture, is, in electromag-

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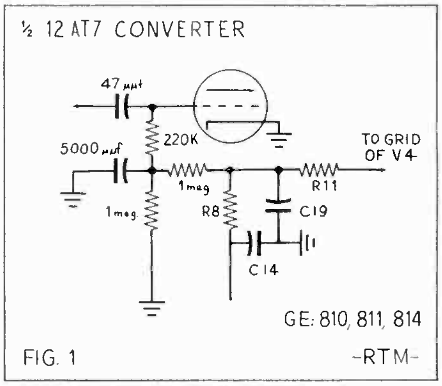
DESIGN AND SERVICE OF THE BASIC TYPES OF RF CIRCUITS IN MODERN TV RECEIVERS

By DAVID T. ARMSTRONG



Circuit change in the front end of a typical receiver design, to eliminate 60 cycle buzz (see text).

SERVICING THE TV FRONT END

IN TELEVISION front ends, which are always on separate subchassis, the function is to select the desired sound and picture carriers, amplify and convert them to provide picture and sound IF carriers of prescribed megacycle values, varying from 20 to 50 in modern receivers. At the RF unit, both picture and sound carriers are present, which is important from the servicing point of view.

Suppose a receiver provides excellent sound, but no picture. Obviously the defect is not in the front end, because, if it were there, both sound and picture would be similarly affected. Or, if there is picture but no sound, the defect likewise must be elsewhere than at the front end.

Some circuits use no separate RF stage, but feed the signal directly to the mixer stage. Other circuits have a separate RF stage and use a dual tube for oscillator-converter. The best circuits will have separate tubes for RF, mixer, and oscillator, because this generally provides the best signal with the least noise.

The function of the RF is to take a signal, which might be as low as 250 microvolts, and amplify it sufficiently so that the IF amplifiers will have a pretty husky signal which they may amplify to something like 0.5 to 2.0 volts at the input to the video detector. That is quite a bit of amplification.

Typical Design

Since the well-known 630TS is one of the best television circuits yet devised, and since many modern receivers are adaptations of the basic design principles employed therein, it is likely to be helpful to analyze this circuit. The front end is in reality a series of fixed tuned circuits for 13 channels. There are two sets of coils for each channel on the RF, on the mixer, and on the oscillator. Each stage is designed for push-pull amplification, so that a maximum signal output with minimum loss is provided at the plate of the converter.

The front end has a 300 ohm input impedance designed to match the impedance of common parallel wire flat transmission line. This calls for a folded dipole antenna, but excellent reception is possible with the double bay conical antenna which has an impedance of 150 ohms; the mismatch is not usually troublesome.

The transformer across the input terminals is a center tapped coil, included to eliminate low frequency signals. It is a high pass filter which permits TV carriers to reach the RF stage, but short circuits any lower carrier frequency to ground.

Resistors terminate the transmission line in a 300 ohm impedance and provide a DC path to the amplifier control grids. It might be desirable in some installations to change the values of these resistors where the 150 ohm impedance conical type antenna is used. The conical provides high Db gain and may be desirable in some installations where the folded dipole will not provide sufficient signal pickup for good reception.

Antenna isolating capacitors are included, as are neutralizing capacitors that counteract grid to plate feedback in each triode; this helps prevent spurious oscillation likely to occur in channels 11-13.

The tuning circuit is a series of inductances which represent artificial quarter wave lines. About one inch of line is in the circuit for channel 13 and about 40 inches of line is in the circuit for channel 2. The line is balanced against ground and a movable shorting bar grounds out the undesired channels; the length of line above ground thus constitutes the inductance tuned in the plate circuit of the RF amplifier. The mixer and oscillator stages are made up of similar tuning circuits.

Coupling between the RF stage and the mixer stage is attained by means of capacitors, plus a single turn of link coupling. A single link turn couples the oscillator and mixer. The signal and oscillator voltages combine in the mixer to form the picture and sound IF voltages which appear across the second transformer, from which point they are transferred to their respective systems.

Intercarrier Sound

When intercarrier sound is used, only the picture IF is taken off the mixer plate because the sound goes along with the video carrier and is taken out at the video detector by a 4.5 Mc trap. A fine tuning adjustment, by a variable condenser, provides approximately 300 Kc variation of oscillator frequency on channel 2 and about 750 Kc variation on channel 13.

A great many modern receivers use the intercarrier sound system, in which the sound modulation is taken from a 4.5 Mc beat between the sound and video carriers. Small amounts of local oscillator drift are not so noticeable with intercarrier sound, because the 4.5 Mc beat frequency containing the sound modulation is fixed at the transmitter. In such a front end system AFC, as well as local oscillator refinement, may be eliminated or simplified, because the stability and drift characteristics are not nearly so rigorous as they are when separate sound and picture systems are used.

Increasing RF Gain

Let us suppose you have done everything possible to the antenna to achieve the maximum amount of signal achieveable and there is still snow in the picture. The most obvious method of increasing RF gain is to add a stage of amplification. In general, this can't well be done within the set, because there isn't sufficient space on the chassis, the serviceman is not a design engineer, and it is quite difficult to build an RF stage capable of covering 6 Mc. In most instances, the first (and only) recommendation will be to add preamplifiers or boosters of one or two stages of RF.

There is a possibility, however, of increasing RF gain by "pushing" the front end a little. Many tubes, like the 6AG5, 6AU6, 6AC7, 6AH6, 6BA6, and 6SG7, operate with about 125 to 150 volts of B+ on the plate and screen. By increasing this to 180 or 200, there will be a substantial improvement in signal strength gain. When this is done, remove the RF amplifier grid bias from the AGC bias bus and return it to ground. The noise characteristic will in general be best when the bias for these tubes is correct. For most of them about 0.5 to 1.0 volt is correct, but the 6CB6 should have about −1.5 volts bias.

If the poor signal strength manifests itself particularly on channels 7 to 12 try substituting a 6AK5 or 6CB6 for any of the above tubes. These are not generally used by manufacturers because the others are cheaper, but they are used widely in radar devices and make the finest RF and IF amplifiers available. The plate voltage may not exceed 180 volts for these tubes and it is desirable to ground the grid return lead.

Front-End Noise

Noise sometimes develops in the front end assembly because the contacts are becoming worn or dirty. This noise may often be eliminated by removing the head end and cleaning the contacts with a good grade of alcohol. Avoid carbon tetrachloride because it acts as a thinner for polystyrene. On GE models 810, 811, and 814 a piece of rubber band inserted between the oscillator wafer and the shaft materially helps eliminate noise and frequency drift or shift attributable to wobble or end-play. The rubber cushion effect thus obtained is more satisfactory than the application of cement.

In some areas and on some receivers, a low frequency buzzing sound accompanies the audio signal, particularly where a strong signal is received. The cause of this buzzing may be due to the vertical sync pulses operating on the converter grid in such a fashion as to draw grid current. This current frequency modulates the oscillator voltage at the vertical pulse rate of 60 cps. This buzzing may be eliminated by modifying the circuit somewhat as follows: see Fig. 1. This circuit applies the bias developed in the AVC circuit to the converter grid. Since this is an adjustment on the front end care must be exercised to avoid affecting alignment. The 5,000 mmf capacitor should be dressed as far away as possible from the oscillator trimmer.

Trouble Spots

The normal places where trouble is likely to be found include the tuning coils, resistors, and capacitors. In receivers using individual coils for each channel, an open coil will affect all channels in that band. For the 63OTS, an open coil would cut out all channels below the open coil, but all channels above the open coil would be in because the circuit operates on the amount of line in the circuit.

Similarly, for the Mallory Inductuner, the channels below a break in the coil would all be affected, but channels above the break would still be received because the tuning slider shorts out a portion of the line.

Resistance or voltage measurements will reveal either a short circuit or open coil in the front end. Servicing the front end is always a troublesome and time-consuming procedure, because of the difficulty of getting at the parts. Whenever it is necessary to remove or repair the front end, be very careful not to change lead dress or placement of parts; to change even slightly would seriously affect the distributed wiring capacitance.

Trouble Shooting

Difficulty at the front end may be recognized as a condition that affects both picture and sound signals. Power supply trouble will also affect video and audio signals, but there is generally no power supply difficulty if a raster is present.

Tubes may be at any time a source of trouble. One receiver, which defied the genius of an engineer, was finally found to have a 6CB6 at the front end which had a very slight almost invisible crack in it. The tube checked OK on a tube tester, but it would not perform in the circuit. When a tube was taken from another set that was working properly and placed in the receiver being serviced the problem was solved.

There is no good static test for a television tube. Check the tube in a receiver. Of course, there is always the rare instance in which two tubes in the front end are bad. Changing them one at a time will not locate the difficulty. For such an eventuality, the serviceman should substitute tubes from his kit that he knows are in good condition.

Oscillator tubes are critical in some receivers. Some of them work on the low band but not very well, or not at all, on the high band. It is sometimes desirable to try several different oscillator tubes until one is found with proper characteristics to perform satisfactorily on all channels. Whenever an RF tube is replaced, it is advisable to touch up the alignment.

Oscillator Checks

To discover whether the oscillator is functioning properly, the best test is to use a signal generator. Connect the signal generator across the input terminals and set the output frequency to a value a little above the video carrier frequency, not more than 1 Mc. If dark bands appear across the face of the tube a signal is getting through the RF stages. A signal generator will not produce any indication on the tube face if the oscillator is not working.

A quick check to determine whether the oscillator is inoperative, is to scrape the transmission line leads across the receiver input terminals. Flashes of

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Test Equipment

A Sensitive Meter For D C Millivolt Measurements

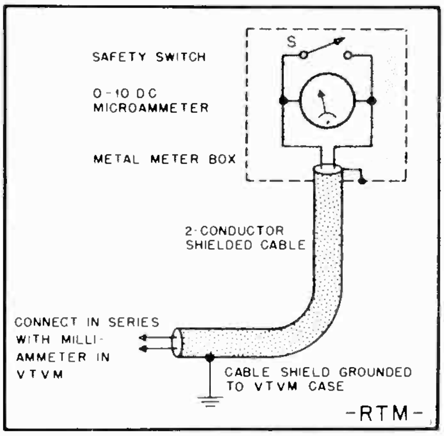
By ROY T. MATTHEWS

IN order to measure the feeble DC output of crystal detectors operating on weak signals, I recently needed a direct-reading DC millivoltmeter. I needed it also for tracing weak signals in a receiver, with a crystal probe. The instrument had to have high input resistance to minimize loading of the circuit under test. This called for a DC vacuum tube voltmeter. I tested several VTVM circuits of simple design, employing microammeters instead of the more common milliammeter, but they failed to provide the necessary stability and meter safety factor.

Use VTVM With Microammeter

It seemed probable that the Sylvania Type 221 Polymeter, switched to its lowest DC voltage range (0-3 v.) might serve the purpose if the 0-1 DC milliammeter in this instrument were replaced with a sensitive microammeter such as a 0-10 μa unit. The Polymeter has a constant input resistance on its DC ranges of 17 megohms (including the resistance of the DC test probe).

The accompanying circuit diagram shows how the VTVM was converted for low voltage measurements. The 0-10 DC microammeter is housed in an external meter box, together with the spst toggle switch, S, and is connected in series with the self-contained milliammeter in the Polymeter through a shielded 2-conductor cable. For convenience, the cable is connected to the Polymeter through Amphenol plug-in cable-and-chassis fittings. When high-sensitivity operation is not required, the meter cable and plug are withdrawn and are replaced by a short-circuiting plug which restores the Polymeter circuit for normal operation with the internal milliammeter. Switch S is closed to protect the sensitive microammeter while switching the Polymeter on and off and also during the initial zero-set adjustment. When the instrument is in use, the two meters are always in series with each other.



Circuit connections for adapting the VTVM for millivolt measurements. When warmed up, the DC microammeter used by the author drifted from calibration less than 1/50 of the full scale.

Calibration of Instrument

With the Polymeter range switch set to 3 volts, full-scale deflection of the microammeter is 30 millivolts. Each scale division of the microammeter is 0.6 millivolt. An individual scale calibration may be made, if desired, by means of a voltage divider and a known DC voltage supply. Each major scale division can be checked. In trial operation, I gave the instrument a preliminary warm-up period of half an hour and then set it to zero. The subsequent drift during a one-hour period did not exceed one meter scale division (one-fiftieth of full scale) on the microammeter. That is very little drift indeed for such a sensitive circuit.

Operation Procedure

The following steps should be followed in placing the circuit into operation:

1. Close switch S in the external meter circuit.
2. Set the Polymeter RANGE switch to the 3-volt range.
3. Set the SELECTOR switch to minus (—) volts.
4. Connect the DC test probes to the instrument.
5. Switch-on the power and allow at least half an hour for warmup.
6. Set the milliammeter in the Polymeter carefully to zero.
7. Open switch S and readjust the ZERO SET knob, if necessary, to set the external microammeter exactly to zero.
8. The instrument now is ready for use. Throw the SELECTOR switch to plus (+) or minus (—) volts, choosing the polarity to agree with that of the voltage source under test.

CAUTIONS: (a) Always keep switch S closed until the instrument has had ample time to come up to normal operating temperature, and until the main milliammeter has been set carefully to zero. (b) Close switch S *before* switching off the power to the instrument, and whenever the instrument is not actually being used to measure small voltages. This will protect the microammeter from surges. (c) When the instrument is being operated with the microammeter, grasp the test probes by their insulating sleeves or handles, with the fingers back as far as possible from the metal prod tips. This will prevent deflecting, and possibly pinning the meter by body capacitance effects. (d) Keep the DC test probes out of the vicinity of AC fields, since these will cause a spurious deflection of the meter.

Use in Signal Tracing

The 0-10 DC microammeter is not expensive. A voltmeter converted this

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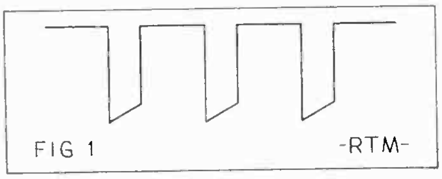
Service Technique

SERVICING DEFLECTION SYSTEMS WITH THE OSCILLOSCOPE

By RUFUS P. TURNER

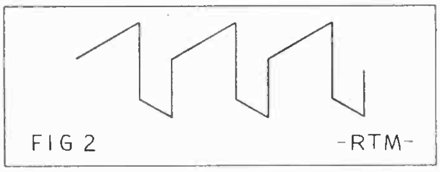


IN MAGNETIC deflection systems, such as are employed in most modern television receivers, linear deflection of the electron beam is produced by sawtooth waves of current flowing through the deflecting coils. This is somewhat different from electrostatic deflection systems, where linear deflection is produced by sawtooth voltage waves.

Since the deflecting coils possess a certain amount of inductance, in addition to inherent resistance, the simple relationship of voltage, current, and resistance $E = IR$, which holds for circuits containing resistance only, will not apply. Where the inductance (L) is large compared with the resistance of the coil, $E = L(dI/dt)$. When, on the other hand, the resistance is too large to be neglected, $E = IR + L(dI/dt)$.

The voltage applied to the high-inductance (low-resistance) deflecting coil must be spiked in waveform with flat tops (or, in other words of the "impulse" type) in order to set up a saw-tooth current waveform through the coil. Such a voltage waveform is shown in Figure 1. When the ratio of inductance to resistance is low, however, both the resistance and inductance influence the flow of current through the coil (see the second equation in the preceding paragraph) and a voltage is required having a waveform which is a combination of the sharp impulse and sawtooth, in order to force a sawtooth of current through the coil. Figure 2 shows an example of such a composite waveform.

The deflection voltages are set up by the horizontal and vertical oscillator-output circuits, respectively. "Striking" the deflecting coils with the non-sinusoidal deflecting voltage waves would result in oscillations at the frequency determined by the inductance and distributed capacitance of the coils. These self-oscillations are suppressed, however, by the damper tube and its associated resistance-capacitance network.



Trouble Shooting

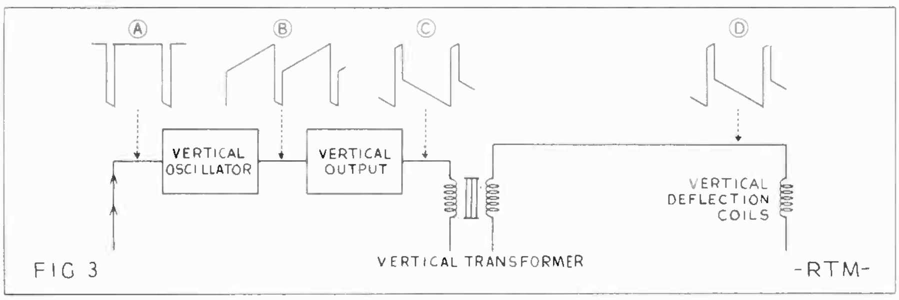
Successful trouble shooting in deflection systems demands an examination of deflection voltage magnitudes and waveforms at various points in the deflection circuits. A good oscilloscope is required for this purpose, since the complexity of the waveforms encountered necessitates an examination of waveshapes as well as peak-to-peak voltage values.

This article describes the procedure which is prescribed for a detailed study of the deflection circuits and their performance. The reader's attention is directed to the fact that waveforms shown in the accompanying illustrations are idealized; that is, the actual patterns obtained on the oscilloscope screen may not coincide exactly with these ideal patterns. However, they will not depart greatly from these shapes (or from similar ones given in the receiver manufacturer's service literature) unless trouble is present in the circuits.

Test Procedure

The best place to begin the trouble shooting operation is at the control grid of the horizontal and vertical deflection oscillators. Here, the synchronizing signal pulses are encountered. The waveforms are observed then in the oscillator output circuits, at the input and output of each output tube, and finally across the deflection coils themselves.

First, prepare the receiver in the following manner: (1) Tune in a test pattern sharply, if possible. If a pattern cannot be obtained, tune as care-



Test points and the proper waveforms to be found in the vertical deflection circuit.

fully as possible to a regular program. (It is assumed that the receiver is operating up to the deflection amplifier grids.) (2) Set the brightness and contrast controls of the receiver at about half maximum. (3) Set the focus, linearity, height, and hold controls to their normal positions. (4) Set the volume control at about one-fourth maximum.

Vertical Deflection

VERTICAL CIRCUIT: (1) Set the oscilloscope internal sweep to 30 cycles.

(2) Set the oscilloscope SYNC switch to its INTERNAL position.

(3) Set the HORIZONTAL and VERTICAL gain controls to about one-half maximum.

(4) Connect a shielded probe to the VERTICAL AMPLIFIER input terminals.

(5) Connect the ground terminal of the scope to the chassis of the TV receiver. *Caution:* If the receiver uses a transformerless power supply, an isolating transformer must be connected between the receiver and the power line to prevent electric shock and to minimize coupling of hum into the oscilloscope.

(6) Place the test probe in contact with the control grid of the vertical oscillator tube. The waveform corresponding to two vertical sync pulses, such as shown at A in Fig. 3, should be seen on the oscilloscope screen. Readjust the scope's gain, sync, intensity, focus, and fine frequency controls, if necessary, to obtain a clear, single-line image.

(7) If a sync pulse pattern of this type is not obtained, check the integrating network, sync amplifier, and sync separator circuits for improper operation or failure.

(8) Transfer the test probe to the vertical oscillator plate where a pattern resembling B in Fig. 3 should be obtained. Compare the peak-to-peak voltage value, as measured on the oscilloscope screen, with that given in the set manufacturer's service notes.

(9) Transfer the test probe to the plate of the vertical output tube and observe the oscilloscope screen for a pattern resembling C in Fig. 3. Here, also, compare the shape and peak-to-peak voltage value with the corresponding data given in the set manufacturer's service literature. Note that a complete phase reversal has occurred between B and C. Note also that the waveforms in B, C, and D in Fig. 3 show the combination of impulse and sawtooth which is necessary to produce a sawtooth wave of current in the vertical deflection coil.

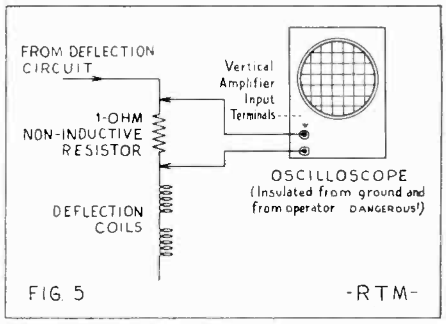
(10) Transfer the test probe to the vertical deflection coils and note that the reproduced image resembles the pattern at D in Fig. 3. Check the peak-to-peak voltage value and compare with the value given by the set manufacturer in the receiver service notes.

If the signal is lost at any test point in the circuit, check the preceding circuit for incorrect operating voltages, defective tubes, or other defective components.

Horizontal Deflection

HORIZONTAL CIRCUIT: Set up the oscilloscope in the same manner as explained in the preceding section, but set the internal sweep frequency to 7875 cycles. This value is one-half horizontal sweep frequency, and will cause two cycles of each phenomenon to be displayed on the screen.

(1) Place the oscilloscope test probe in contact with the control grid terminal of the horizontal oscillator tube. Here, two horizontal sync pulses resembling those shown at A in Fig. 4



Setup for display of current waveform in analysis of electromagnetically-deflected receiver. Current appears as IR drop across one-ohm resistor.

should be observed on the oscilloscope screen. Readjust the scope controls, if necessaary, to obtain a clear, sharp, single-line trace. If these pulses are not obtained, check the differentiating network, sync amplifier, and sync separator circuits for incorrect performance.

(2) Transfer the test probe to the plate of the horizontal oscillator tube, noting pattern on oscilloscope screen which should resemble B in Fig. 4. Check the peak-to-peak voltage and compare with the set manufacturer's specifications.

(3) Transfer the probe to the plate of the horizontal discharge tube. The pattern observed at this point should have the sawtooth shape shown at C in Fig. 4. Compare the peak-to-peak voltage with the value given in the service notes.

(4) Before proceeding to the next two steps, provide a capacitative voltage divider for the vertical amplifier input of the oscilloscope. This divider is necessary because the voltages encountered next will exceed the rated signal input voltage value of most service-type oscilloscopes. The actual capacitance values employed will depend upon the receiver voltage values and upon the rated input voltage of the oscilloscope and its input capacitance.

(5) Transfer the probe to the plate of the horizontal output tube (horizontal transformer primary). The pattern here should resemble D in Fig. 4. Compare the peak-to-peak voltage with the corresponding value found in the notes.

(6) Transfer the test probe to the plate of the damper tube (horizontal deflection coils). The deflection voltage voltage waveform at this point will resemble the pattern shown at E in Fig. 4. Note the peak-to-peak voltage and compare with the value given in the manufacturer's literature. In order to

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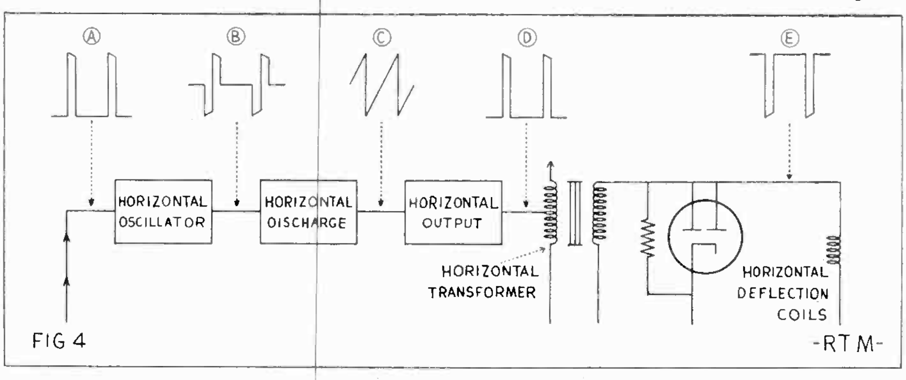


Test points and waveforms in signal tracing of horizontal circuit. Waves shown are "ideal," and may correspond only approximately to those found in actual practice. Settings on the scope are the same as for test of vertical circuit, except for sweep frequency adjustmnt.

R&TM Survey

ELECTROSTATIC FOCUSING AND DEFLECTION

By RUDOLF F. GRAF

THE MOST important and also the most expensive single item of any television receiver is the cathode-ray tube. Every single stage in the receiver, with the exception of the sound section, contributes ultimately to its operation and control. What the customer sees on the screen of the tube is not only the determining factor of his attitude toward any one particular set, but it will also contribute materially to the formation of his opinion of the field of television as a whole.

Before giving a detailed description of the electrostatic tube, let us briefly look at the functions of some of its component parts.

Tube Elements

The cathode is indirectly heated and serves as the source of electrons. The control grid has a function very similar to that of the control grid of an ordinary vacuum tube—it too controls the number of electrons making up the electron stream. This grid, however, is not a wire mesh, as in the conventional tube, but rather consists of a metallic cylinder with a small opening at one end to permit the passage of electrons.

The first anode is another metallic cylinder which further helps concentrate the electron beam. A DC potential which is positive with respect to the cathode is applied to the first anode so that the electrons from the cathode will be attracted forward. The second anode is the last cylinder. It is here that the electron beam receives its final acceleration. The potential on this anode determines to the greatest extent the final velocity of the electron beam. The second anode is connected within the tube to a black coating on the inside surface of the glass envelope. This coating extends upward toward the screen and is commercially known as an "aquadag coating." This extension of the second anode is sometimes called the collector, since it serves to collect secondary electrons which are released from the fluorescent screen due to the impact of the electron stream.

The electrons emitted from the cathode are formed into a narrow high velocity beam by all of the above elements which collectively make up the electron gun. Before striking the screen, the electron beam is subjected to the influence of deflection plates, which move the beam in a horizontal and vertical direction. When the electron stream is under the influence of both sets of deflection plates it will light up the entire screen of the tube and form a raster.

Beam Formation

In modern cathode ray tubes, the cathode is an indirectly heated electron emitter. It is a thin metal sleeve made of nickel or a nickel alloy and is about one-half inch long. Its diameter is about one-eighth inch. This little cylinder is open at one end and closed at the other. The closed end is coated with an oxide that has the property of emitting electrons in great quantities when it is heated. The cathode sleeve is heated by a double spiral non-inductive tungsten wire filament. The filament wire is wound in such fashion that any magnetic field arising from it, which would exert an undesirable influence on the electron stream, is cancelled. The filament is electrically insulated from the cathode as in any other tube. The main difference between the cathode used in a cathode-ray tube and that used in a conventional tube, is that the CRT cathode is coated only at the end cap of the cathode cylinder. The cathode is fixed in a ceramic support to insure mechanical rigidity when it is mounted in the gun assembly.

The control grid is a cylindrical element which surrounds the cathode. It has a small aperture at one end through which the electrons travel towards the screen. The potential difference between the cathode and the control grid, as well as the size of the opening in the control grid, determines the number of electrons which make up the electron stream. Due to the potential difference between the cathode and the control grid an electrostatic field is developed. This field causes the electron beam to converge in a manner similar to the way in which light rays are converged by a convex lens.

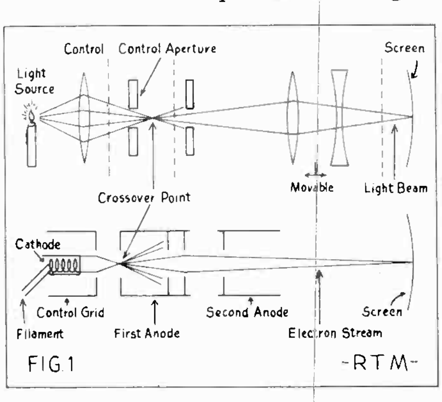
If the control grid is made very negative with respect to the cathode, it will completely cut off the electron stream just as in any other vacuum tube. So we see that the potential on the control grid regulates the number of electrons which are permitted to travel towards the screen. Since the number of electrons which strike the screen at any one particular moment determine the intensity of the spot, we insert the video signal from the television receiver at the control grid.

We now have an electron stream which comes to a focus slightly beyond the control grid aperture but then begins to diverge again. It is now necessary to re-focus the beam so that we will get a pin-point image at the screen of the tube. This is accomplished by again operating two electrodes at different potentials so as to set up another electrostatic field. If the electron stream is passed through this field and the potentials are properly adjusted, the beam will come to a sharp focus at the screen. The factor which determines where the focal point will occur is the potential difference between the two electrodes. Therefore, in order to provide for fine focusing, the potential difference must be made adjustable between certain limits. The two electrodes which are employed to accomplish this focusing action are called the first and the second anode. The first anode is closest to the control grid and is the one whose potential is varied by means of the focus control.

Focusing

Fig. 1 shows a comparison between an optical and an electron focusing system. The first crossover point (focal point) will occur very close to the first anode, while the second crossover point occurs at the screen. We see thus that there will be interaction between the control grid and the first anode as the brightness and focus controls are adjusted. To prevent this interaction another electrode was inserted in the electron gun between the first anode and the control grid. This new element is called the accelerating grid. It is at the same potential as the second anode.

Most of the newer types of cathode ray tubes employ a "zero-first anode-current" gun. This new type of gun employs a lengthened accelerating grid which has several apertures. The grid



Comparison between the electrostatic focusing system and an optical system. Electrons are focused similarly to light rays, using charged electrodes in place of lenses.

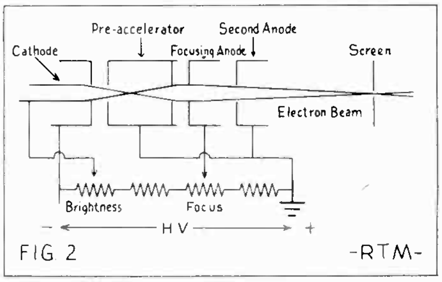
is generally known as the pre-accelerator. The first anode has been reduced to a disc and is called the focusing anode. This type of gun structure offers better focusing characteristics and has the added advantage of not drawing any current at the focusing connection to the high voltage power supply. Therefore changes in the power supply voltage will not affect the focusing of the tube. Also, changes in brightness control setting no longer affect the focus. The proper connections for a "zero-first-anode-current" type of gun are shown in Fig. 2.

Deflection

We now have an electron beam which will strike the center of the screen unless it is subjected to a field which will change its course and cause a deflection either horizontally or vertically. This deflection is accomplished by mounting two pairs of parallel plates at the end of the electron gun in such a position as to allow the electron beam to pass mounted in the horizontal and the other pair is mounted in the vertical plane. Since the electron stream is negatively charged, it is attracted to a positively charged body and is repelled by a negatively charged body.

If we create a potential difference between a pair of plates, the electron stream will be attracted towards that plate which is positive, and will be repelled from the one which is negative. The plates which are in a horizontal plane affect the movement in a vertical direction and those in the vertical plane control the horizontal movement. By applying potentials simultaneously to both sets of plates the beam can be made to strike the screen at any point desired.

The deflection voltages employed in a television receiver have a sawtooth shape. The horizontal deflection plates (located in a vertical plane) get a sawtooth voltage of comparatively high frequency, which causes a fast left to right movement of the beam. The vertical deflection plates (located in a horizontal plane) get a sawtooth voltage of relatively low frequency, thus causing the beam to move slowly downward. Since both of these voltages are applied simultaneously, we are able to scan a complete raster.



Connections for the "zero-first-anode-current" electron gun, commonly found in the newer tubes using electrostatic focusing.

Nomenclature

The nomenclature used to identify cathode-ray tubes has been standardized and the following system has been adopted: The first number, whether it consists of one or two digits (5, 7, 10, 16, 20, etc.) indicates the diameter of the screen to the nearest inch. This number is followed by a letter which is used to differentiate between tubes having the same screen diameter and screen material, but having different electron gun structures or other differences. These letters are assigned by the RTMA in the order in which the tubes are registered.

The first letter is always followed by the letter P and a number. This letter and the number indicate which phosphor is used for the screen material. The type P4 screen is used for television. It has a color composition which appears as white and is so chosen that a minimum of eye fatigue is caused when the screen is observed for long periods of time. The persistence is balanced to minimize flicker and yet give clear pictures of fast-moving objects.

The 7JP4, for example, has a P4 screen with a 7-inch diameter. The 7PG4 also has a P4 screen with a 7-inch diameter, but it has different electrical characteristics. A letter following the tube type number (12UP4, 12UP4A, 12UP4B) indicates a later design which may be used in place of the original tube without any changes in the circuit. This does not mean, however, that circuits designed for the later types will work satisfactorily with the original style tubes.

Service Technique

FAILURE TO IMPROVE WEAK VOLUME AND TONE QUALITY IS OFTEN THE RESULT OF NOT PROPERLY CHECKING THE OUTPUT TRANSFORMER FOR . . .

SHORTED TURNS

By WALTER J. SWONTEK

A SHORTED turn in a power transformer usually makes its presence known in short order, with smoke and smell! In an output transformer, though, usually nothing of the kind happens. Of course, in high-power audio gear the same thing does happen, it burns up and is easily diagnosed.

But what about the thousands of receivers that pass through service shops? The output transformer in these is usually on the order of 4 to 12 watts, and the audio output is not enough to cause any obvious symptoms.

How many receivers are floating around from service shop to service shop with the usual complaint, weak volume and poor tone quality? As each service man checks the set, all voltages check OK, tubes are good, and a signal tracer traces the signal beautifully right up to the plate of the output stage. There, the signal is so loud it usually overloads the tracer, so down comes the gain, and it's OK there too. Then the tracer goes across the voice coil, with the same result. The speaker is checked by substituting a known good one, and no noticeable difference results.

Naturally, the serviceman has put in some time on the set, and must get paid for it to stay in business. So the set goes out with either a service charge, or perhaps a slightly leaky bypass condenser has been found.

Along with the bill goes the explanation that "this set wasn't designed for very large power output." But the customer knows different! He heard the set when it was working properly. Right then and there he usually wastes another hour of the serviceman's time with an argument, and when he leaves, the opinion of that shop that he may express to his friends will certainly not do the shop's business any good.

Common Misconception

The solution to this problem is usually simple: an output transformer with shorted turns. Trouble occurs, however, due to a common misconception. This is shown by the fact that it is common practice to say that a transformer has 10,000 ohms on the primary and 6 ohms on the secondary. Actually, it would be much more accurate to say that a transformer *will have* 10,000 ohms on the primary *when* 6 ohms is *connected across* the secondary.

The primary impedance is reflected from the secondary, and its value depends mainly upon the turns ratio and the power drawn from the secondary by the load impedance. Now, it is easily seen that a shorted turn in either winding will absorb power and thereby will reduce the primary impedance severely. This impedance will be too low to match the tube. Loss of power, and distortion, are the results.

Impedance Bridge

Once the nature of the problem is known it is easily handled. If an impedance bridge is available, the primary impedance can be measured and compared with the recommended load resistance from the tube manual. When measuring the primary impedance, two cautions should be observed. First, the transformer secondary should be connected to the speaker voice coil while measuring, as otherwise the primary would read much too high with a good transformer, and might read correctly with a bad one. Second, the measurement should be made at the standard test frequency for audio, 440 cycles. Most signal generators have an audio output jack marked 400 cycles, and this frequency is close enough for all ordinary work.

Although impedance bridges are more common now than formerly, there are still many service shops unequipped with them. Let's take a look at the problem from that point of view. Most servicemen would think of an ohmmeter check immediately. The ohmmeter check will show an open or grounded transformer winding, or a badly shorted one, but it *will not* reveal a single shorted turn, nor even several shorted turns. As long as the DC resistance of these turns is a small percentage of the total, the difference in reading is unnoticeable.

Substitute Transformer

The only effective procedure in this case is substitution. Insert an audio signal at the grid of the first AF tube, adjusting it until the AC voltage on the grid of the power amplifier is about seven-tenths of the peak AF grid voltage as read from the tube manual. If the signal is undistorted there, the tube is known to be good, and plate, screen and bias voltages are normal; then substitution is advisable. Keep a universal output transformer handy for this purpose, and be sure to use the correct taps, according to the chart that comes with the transformer.

A similar situation often arises in television, particularly with respect to sweep output transformers. One saving fact is that the set is not acceptable to the customer at all even with only one shorted turn, as the picture is badly distorted. With an understanding of what happens in an impedance matching output transformer, a similar procedure is easily used.

WHAT'S THE PATTERN?

Test Your Ability to Determine the Effects of Deflection Defects—Answers on Page 28

By ED BUKSTEIN

MOST books and magazine articles dealing with the problems of TV have been profusely illustrated with photographs of defective test patterns. Each pattern is captioned to show the cause of the particular type of distortion involved. This approach to TV servicing has its advantages; it develops rapid servicing techniques. It does, however, have a serious disadvantage. It teaches the service technician to associate a certain type of image defect with failure of a specific component of the receiver, but it does not teach him to "think through" the intervening line of reasoning from cause to effect. The service technique thus becomes *mechanical* rather than *logical,* and as a result, problems other than the most common types will leave the technician with no logical plan of attack.

In the following questions, the usual procedure has been reversed; the circuit defect is indicated, and the technician is to determine the effect on the test pattern. He is thus compelled to follow through the logical line of reasoning from cause to effect. Only one answer in each group is correct.

1. If the filament of the vertical oscillator should become open:

(a) the test pattern will be jumpy.
(b) only a bright vertical line will appear on the screen.
(c) only a bright horizontal line will appear on the screen.
(d) sound bars will appear in the test pattern.

2. If the leads to the horizontal deflection coils are reversed:

(a) the test pattern will be upside down.
(b) the normally light portions of the picture will be dark and vice versa.
(c) the lines will be scanned from right to left and the pattern will be reversed like a mirror image.
(d) there will be no horizontal scanning.

3. If a defect in the high voltage power supply causes the anode voltage of the picture tube to be lower than normal:

(a) the test pattern will become larger.
(b) the pattern will become smaller.
(c) the pattern will remain the same.

4. If the filament of the high voltage rectifier should open:

(a) the test pattern will be darker than normal.
(b) there will be a raster but no test pattern.
(c) there will be no raster, but sound will be normal.
(d) there will be a raster but no sound.

5. With the receiver tuned to an unused channel, the technician adjusts the height and width controls so that the raster is the same size as the mask. When the set is tuned to an active channel:

(a) the test pattern will be larger than the mask.
(b) the test pattern will be smaller than the mask.
(c) the test pattern will be the same size as the mask.
(d) the test pattern will be smaller than the mask horizontally, and larger than the mask vertically.

6. If a PM type of loudspeaker is mounted too close to the neck of the picture tube:

(a) only a bright, vertical line will appear on the screen.
(b) only a bright, horizontal line will appear on the screen.
(c) the test pattern will be normal, but there will be no sound.
(d) the test pattern will be distorted; the raster will no longer be normally rectangular.

7. If the power transformer is mounted too close to the neck of the picture tube:

(a) the sides of the picture will be S shaped.
(b) there will be a raster but no test pattern.
(c) contrast will be reduced.
(d) picture will be shortened vertically.

8. If the vertical sweep frequency is adjusted to 30 instead of 60 cps:

(a) the test pattern will roll vertically.
(b) two test patterns will appear side by side on the screen.
(c) two test patterns will appear, one above the other, on the screen.
(d) sound bars will appear on the screen.

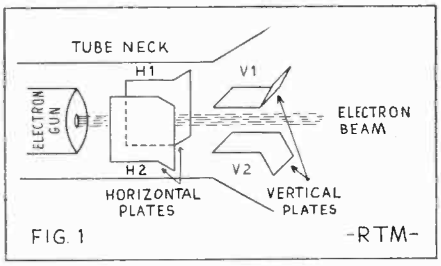
9. If the filament of the local oscillator becomes open:

(a) there will be no raster and no sound.
(b) there will be sound but no raster.
(c) there will be a raster but no test pattern and no sound.

10. If the filament of the horizontal oscillator should become open in a receiver employing a fly-back power supply:

(a) there will be a raster but no test pattern.
(b) there will be no raster and no sound.
(c) there will be no raster, but sound will be normal.
(d) only a bright vertical line will appear on the screen.

"IT DON'T MEAN A THING IF YOU AIN'T GOT THAT SWING"



Deflection-plate arrangement in a typical electrostatic-deflection CR tube.

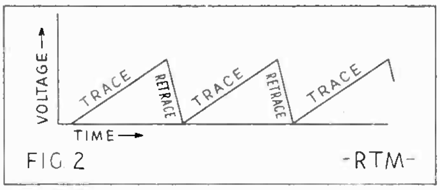
ALL THE rest of a television receiver may be working perfectly, but "it don't mean a thing if you ain't got that swing"—"that swing" being the precisely-timed deflection of the electron beam from side to side and from top to bottom that produces the raster. Since this beam-bending business is such an important one, it will not hurt any of us to do a little brushing up on just how it is done.

Electrostatic System

Deflection systems come in two types: the "electrostatic" and the "electromagnetic." Figure 1 shows the running gears of an electrostatic system. As you can see, it consists of two sets of small plates mounted inside the neck of the cathode ray tube near the muzzle of the electron gun, and arranged so that the plane of one set of plates is at right angles to the plane of the other set.

JOHN T. FRYE

When we have two objects near each other with different charges or different degrees of charge on them, an electrostatic field exists between these objects. This field consists of electrostatic lines of force moving toward the object with the higher positive potential. Since an electron is a small particle of negative electricity with a great yen for a positive charge and a strong dislike for another negative charge, upon entering an electrostatic field it receives a push in the same direction the electrostatic lines of force are moving.

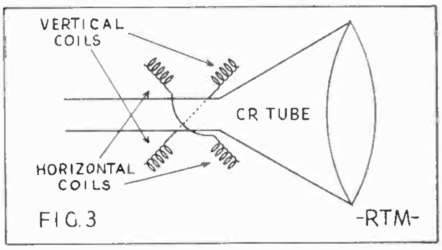


Approximate voltage waveform on one of a pair of the deflection plates of an electrostatic tube. Voltage on the opposing plate would be similar, but opposite in polarity.

As long as plates H_1 and H_2 have the same charge on them, the electron beam passing between them is not influenced in any way, but the instant one of the plates—say H_1—becomes more positive than H_2, the beam is deflected toward H_1.

Degree of Deflection

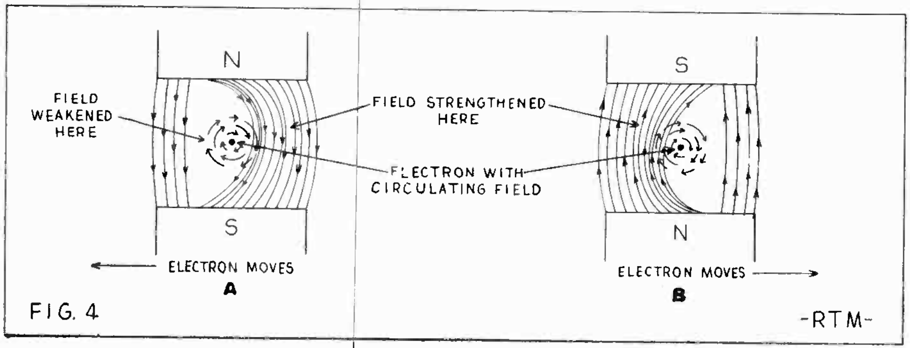
How far it is deflected depends upon two considerations: first, how much difference in potential exists between H_1 and H_2, and second, how fast the electron beam is moving when it passes between the plates. This makes sense. The greater the voltage difference between the plates, the stronger is the electrostatic field between them; and the stronger this field the more vigorous push given to the beam. The speed of the beam, determined by the beam voltage, determines the length of time it is under the influence of the electrostatic field. When the electrons are travelling fast, this time is short and the deflection is slight; but when the electron stream is just loafing along, the field has a longer time to work on the beam and succeeds in pushing it nearer the more positive plate before the electrons pass beyond the influence of the field.



Schematic representation of deflection coils on the neck of a magnetic-deflection picture tube.

In the same way that changing voltages on the *rear* set of plates move the beam left and right, varying potentials on the *front* set of plates, V_1 and V_2, move it up and down. With a fixed beam voltage, getting a greater swing in either plane is simply a matter of applying greater potentials across the proper set of plates. In practice, potentials are usually applied to a set of plates in a push-pull fashion. When one plate is going positive the other is going negative, and vice versa. Since the *difference* in plate potentials is what determines the strength of the deflecting electrostatic field, this push-pulling permits the maximum amount of deflection with a minimum voltage swing applied to a particular plate.

As you know from your study of scanning (or if you don't, you had better start studying), the formation of a raster requires that the spot be moved horizontally from left to right across the



Lines of force created by passing a current through the deflection yoke of a magnetically-deflected picture tube. The action occurs in the horizontal pair of coils and the vertical pair simultaneously, to cause complete scanning of the raster.

face of the tube at a uniform rate of speed for the drawing of each line. At the same time the beam is deflected also uniformly but at a much lower rate of speed from top to bottom to form each field. It is of the essence that these deflections of the spot proceed at a steady gait. If they do not, the resulting picture will be distorted. It will be crowded where the spot moves slowly, and stretched where it speeds up.

Since the deflection is directly proportional to the potential difference between a pair of plates, all we need do is apply a voltage across these plates that increases at a steady rate with respect to time, and the thing is done. Figure 2 shows the proper saw tooth of voltage that will result in a linear deflection of the spot. It is called linear because when the increasing voltage is plotted against time, the result is a straight line. Any time the rising portion of this graph is *not* a straight line, you can be sure that the spot is not moving at a steady pace across the screen.

Electromagnetic System

Electromagnetic deflection is far more popular in TV receivers at present. Figure 3 shows the essential elements of such a system—four coils arranged ninety degrees apart around the neck of the CR tube. Opposite coils are wired in series so that when a current passes through their turns, the consequent magnetic fields work together to pass a strong magnetic field directly through the intervening neck of the tube. The top and bottom coils produce vertical lines of force; the other pair produce horizontal lines of magnetic force.

Just as a wire carrying a current is surrounded by a rotating magnetic field, so is an electron in motion accompanied by a circulating magnetic field. If the thumb of the left hand is pointed in the direction the electron is traveling, the curled fingers will indicate the motion of this circulating field.

Figure 4A represents a looking-from-the-front view of a single electron wading through the magnetic field produced by the pair of coils mounted above and below the neck of the tube. As you can see, the circulating field of the electron is mixing it up with the magnetic lines of force flowing downward through the tube. On the right side, the magnetic forces combine and strengthen the field; but on the left side, they oppose, cancel each other, and weaken the field. The electron, following the line of the least resistance, moves to the left, into the weaker field. At 4B the current through the set of coils has been reversed, causing the lines of force to go from bottom to top. This places the weaker field on the right; so the electron moves to the right.

An electron beam responds exactly the same as the single electron, and it can be deflected to the right or left by changing the direction of current through the coils placed above and below the tube neck. In the same way it can be deflected up or down by controlling the current passing through the set of coils mounted on the sides of the tube. With a particular set of coils, the direction of current determines which way the spot moves on the screen, and the amount of current decides how far it moves. The amount of deflection is directly proportional to the coil current.

Linear Waveshape

When an applied voltage tries to drive a current through an inductance, a bucking voltage produced by self-induction tries to hold this current back. However, if the applied voltage is held at a fixed value, it triumphs over this bucking voltage in such a manner that the current rises at a linear rate; but if the applied voltage changes during this time, as it does with the saw tooth wave form applied to electrostatic plates, the current-rise is not linear.

Since we need a linear current rise for linear spot deflection, it would seem that the application of a square wave of voltage to the deflection coils would be just the old mustard for producing the needed saw tooth of current. It would, too, were it not for the fact that the deflection coils possess D.C. resistance in addition to their pure inductance. But let's see now: a saw tooth of voltage across a resistance will produce a saw tooth of current as shown at Figure 5A; a square wave of voltage across a pure inductance will produce the saw tooth of current at 5B; so-o-o-o, a combination of square wave and saw tooth voltage applied to a combination of resistance and inductance will still produce a saw tooth of current as shown in 5C! If the deflection coil is chiefly inductive, our applied voltage is mostly square wave; if it is chiefly resistive, we accent the saw tooth feature.

Electrostatic deflection requires less power in the deflection circuits; it

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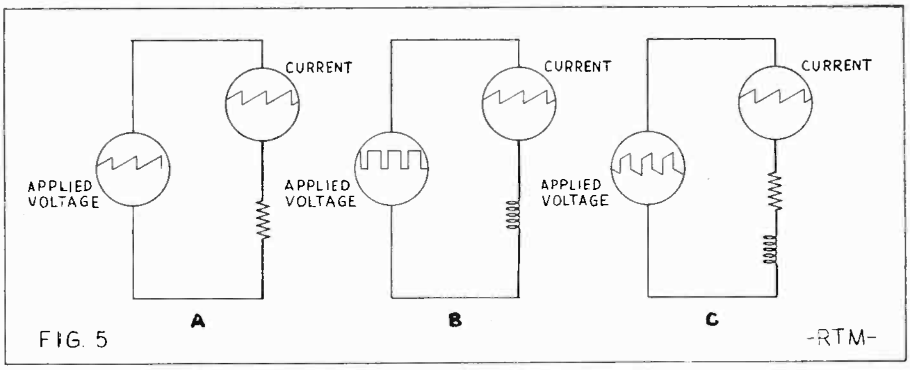
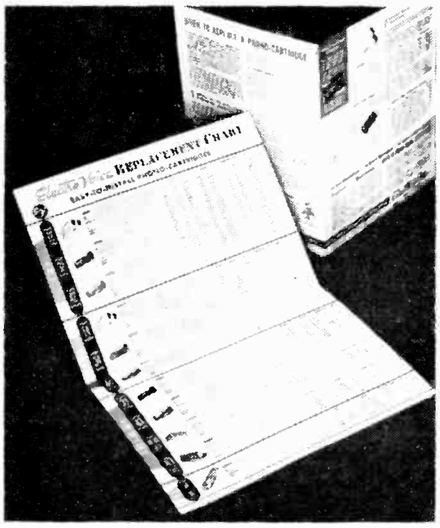


Relationship of voltage and current waveforms when voltage is seen across pure resistance, pure inductance, and a combination of the two, respectively. A applies to electrostatic deflection circuits, and C applies to electro-magnetic circuits.

trade LITERATURE

PHONO CARTRIDGE CHART



ELECTRO-VOICE, INC., Buchanan, Michigan, is now offering, free, a phono-cartridge replacement chart, an 11- by 16½-inch card suitable for hanging on the wall or for counter use. The chart tells when to replace cartridges, what tests to make, and what cartridge to use. According to the company, it provides a comprehensive and up-to-date listing of the products of other manufacturers, in addition to the firm's own line.

—RTM—

FM EDITION

MILLTON S. KIVER'S "FM Simplified" has just been put into a second edition by D. Van Nostrand and Co. This volume, which is listed among the standard works on the subject, gives a really complete picture of frequency modulation, from the theory of modulation on through to the various types of detector circuits found in modern receivers.

There is no question that this 450-page book is a first-class one, for the serviceman or engineer. Treatment of the subject is complete enough for the most advanced readers, yet carefully written, as the title suggests, to be not too complicated in style for those who are not familiar with the principles. The author starts off with the basic data on the comparison between FM and AM, and proceeds gradually to the details, all in terms which can be easily understood.

Systematically, Mr. Kiver gives the reader a thorough understanding of the operation of FM, including modulation principles, noise elimination, antenna characteristics and design, vector analysis, and the different circuits of commercial receiving sets.

The author's explanations of receiver operation will probably be the most interesting sections of the book to servicemen, since it explains in detail the why and how of many common troubles found in sets now in use.

Procedures for receiver alignment, including the steps to be taken when using a sweep generator and oscilloscope are given, as are general servicing outlines.

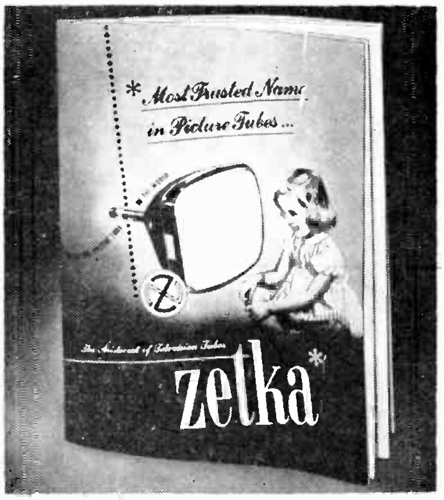
Special circuits, such as the Philco FM detector, are given consideration along with the more common limiter-discriminator, ratio detector, and other circuits.

The author devotes a complete chapter to IF design and operation, and another section to high fidelity, as made possible in a home receiver through frequency modulation.

On the whole, "FM Simplified" is well worth the $6.50 price to anyone interested in FM and high fidelity audio work, or to the technician who wants to know his subject as thoroughly as possible. —A. G. C.

—RTM—

ZETKA CATALOG



ZETKA TELEVISION TUBES, INC., has just announced publication of a new, 12-page catalog. The booklet, sent free to members of the trade, covers the firm's 16, 17, 19, and 20-inch picture tubes.

All tubes shown are described thoroughly, with accompanying diagrammatic drawings. Requests for the catalog can be made to Murray Shindel, sales manager of the company, at 131-137 Getty Ave., Clifton, N. J.

—RTM—

CRT CONVERSION

"CONVERTING TO LARGE PICTURE TUBES," a 42-page booklet recently put out by the American Distributing Co., gives detailed, step-by-step instructions to technicians on the procedure of converting TV receivers to larger, rectangular tubes.

Covering the necessary electronic changes first, and then proceeding to the cabinet changes for several typical receivers employing the smaller picture tubes, the book presents its subject very clearly, with sufficient detail so that none of the work need be figured out on the spot by the serviceman doing the job.

Of course, there are many sets which are not covered, but the information included in the book is broad enough in scope so that the procedures listed may be applied to nearly all popular models and makes.

Since the war emergency will probably reduce production of new receivers severely, servicemen may well look to conversion business as a large source of income for some time to come, and this booklet is recommended for study by those enterprising technicians who will go after the business.

—N. L. C.

—RTM—

BRITISH COMMUNICATIONS BOOK

A. W. LADNER and C. R. STONER'S book "Short Wave Wireless Communication, Including Ultra-Short Waves," has just been published in its fifth edition by John Wiley and Sons.

A comprehensive handbook on communications, the volume presents the theory of communications, modulation, wave propagation, feeders, antennas, waveguides, and other aspects of high-frequency work. Also included are many transmitter and receiver circuits, multiplexing details, and other information.

Selling for $8.00, the book, which

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Some of the interesting new items being made available currently in the Radio and TV service field are presented in this column. For further information, write to: Products Editor, RADIO AND TELEVISION MAINTENANCE, P. O. Box 867, Atlantic City, N. J.

DISTRIBUTED-WINDING YOKE

Edge-to-edge sharp focus, along with increased sensitivity, is claimed for the new Du Mont Series Y2A deflection yoke just announced by the Electronic Parts Division of Allen B. Du Mont Laboratories, Inc., East Paterson, N. J.

The Ferrite core deflection yoke features the Du Mont distributed winding. It is designed for use with TV tubes of 60 to 70 degree deflection angle.

The yoke is available for use with transformer or auto-transformer output circuits, with different networks and lead lengths, or without networks and leads. In several standard stock types it covers the needs of servicemen and set owners for improving existing equipment. For the service trade, the yokes come packed in individual boxes with installation instructions.

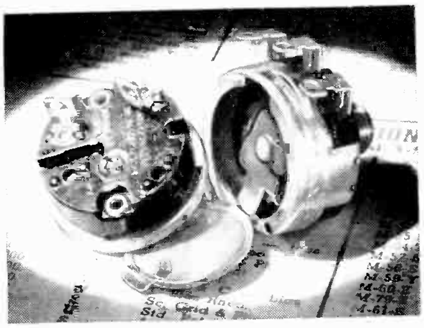
Rugged in mechanical design, the yoke can withstand continuous operating temperatures up to 90° C., and voltages up to 4KV between any windings or between windings and frame, it was reported. Standard horizontal inductance is 10.5 millihenries, and vertical inductance 42 millihenries.

—— RTM ——

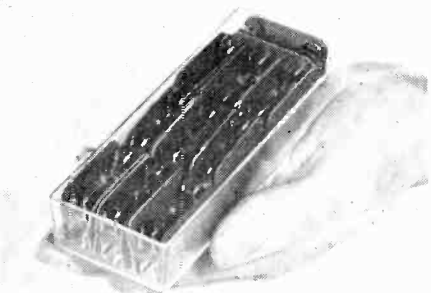
SIMPLIFIED CONTROLS

Clarostat has come out with a simplified version of its "Ad-a-Switch" control, with a back dust cover which pries open and tears off, for simplicity and ease of replacement.

Available in six types, the controls can be used with 12 different shafts. To attach the switch, two lugs on the switch engage side straps on the control, and are bent to hold the attachment in place. The switch mechanism and the control rotor are aligned so that the assembled unit functions correctly.



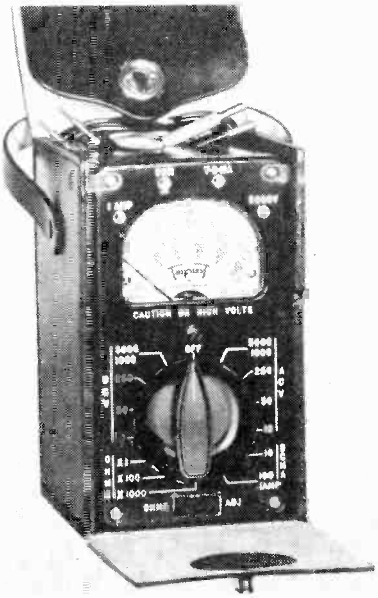
—— RTM ——



FUSE HOLDER BOX

A transparent plastic box is the latest package used by Littelfuse for its "Snap-on" TV fuse holders. Holding 10 of the fuse holders, the box is intended to be used for all small parts, hardware or other supplies used commonly by radio and TV technicians, when the holders have all been used. Its dimensions are 5⅛ by 2 by 1⅛ inches. The box is supplied free with a purchase of 10 fuse holders.

—— RTM ——



VOLT-OHM-MILLIAMMETER

A new 1,000 ohms-per-volt volt-ohm-milliammeter has just been announced by Triplett.

With AC-DC ranges from zero to 5,000 volts, direct current readings to 10 amperes, and resistance measurements to three megohms, the instrument, which is guaranteed, has black and red dial markings on a white background.

One selector switch, used for all settings, is completely enclosed in molded plastic. According to the maker, direct connections without cabling eliminate the possibility of short circuits.

Titled the Model 666-RL, the instrument can be used in its leather case by opening the front and top flaps. A strap handle is provided, as are test leads and batteries.

—— RTM ——

HIGH VOLTAGE CONDENSERS

Designed specifically for high voltage, high temperature applications in such equipment as television receivers, industrial electronic equipment and vibrator power supplies, a new line of 26 condensers in working voltage ranges of 3000, 5000, 6000 and 10,000 volts DC was just announced by the Accessory Division, Philco Corporation.

The new condensers, rated for dependable operation up to 85°C., are housed in a newly designed molded phenolic casing which is said to be hu-

→ to following page

WE NEED YOUR HELP!

A gigantic editorial program is being devised for future issues of RTM. In order to insure that this program fits the needs of each and every reader, it is necessary that we know exactly who you are. If you haven't returned the questionnaire card which was sent to each subscriber, please do it right now! If you lost your card, please fill out the lines below, paste on the back of a penny postal card and mail to: Editorial Department, RADIO AND TELEVISION MAINTENANCE, Box 867, Atlantic City, N. J.

I am: ☐ independent serviceman ☐ employed serviceman ☐ dealer or jobber

My employer is: ☐ retailer ☐ service organization ☐ other..........................

NAME .... JOB TITLE ....

ADDRESS .... CITY .... STATE......

BIGGEST SCHMIDT SYSTEM LENS

CAMBRIDGE, Mass.—The largest correcting lens for a Schmidt optical system ever manufactured commercially—theater television unit—is now being made here by Polaroid Corporation, it was announced.

Designed to produce a giant television picture, 15′ x 20′, the 22½-inch lens is cast from liquid plastic by a unique war-born technique developed under the sponsorship of the National Defense Research Council.

The RCA theater television projection system using the new lens is already installed for commercial use in several theaters across the nation.

Half as large as the record-breaking glass lens for the huge camera at the famed Hale Observatory on Palomar Mountain, the new plastic lens is twice the size of any previously produced for a mass market. Its cost is described as "only a small fraction" of the cost of a similar glass lens.

The lens is based on the design conceived by the late Dr. Bernhard Schmidt and used at Palomar for mapping the stars in telescopic photography. The correcting lens bends the light of the stars so that a mirror can bring them to perfect focus on the photographic plate. The theater TV system uses the same principle in reverse, to project a television image from a spherical mirror without distortion or imperfect focus around the edges.

For its plastic Schmidt-type lens, Polaroid uses a special process which requires no grinding or polishing of the lens surfaces.

—RTM—

the maintenance mill

RADIO AND TELEVISION MAINTENANCE

"Junior, leave that set alone! . . . You know how it disturbs your father when you fix a set that he has already spent days trouble-shooting."

Products for the Trade

→ from preceding page

midity resistant, non-inflammable and mechanically sturdy.

Corona has been minimized in the electrical design of the condensers, and a specially treated mineral oil has been utilized as the condenser impregnant. Stamped with rated voltage and capacity, each condenser has a tolerance of plus or minus 20%.

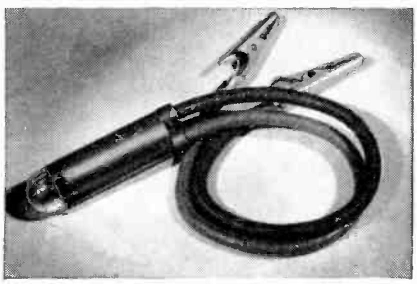
The line is available from Philco distributors.

—RTM—

TEST LIGHT

Wide voltage range is listed as a feature of the "Lo-Volt" test light recently announced by Industrial Devices.

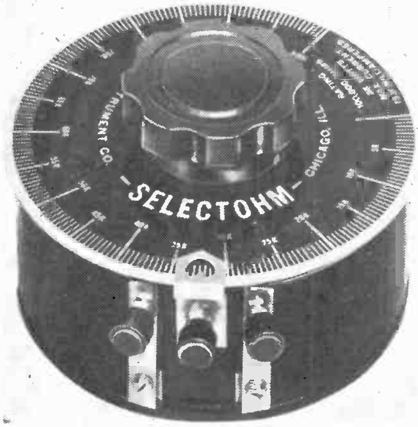
Housed in a plastic case which is reported to stand considerably more abuse than a glass globe, the new device is supplied with 10-inch leads equipped with spring clips. The bulb lights up at any voltage from three to 25, AC or DC. Another model of the unit covers the six to 50-volt range.



LINEAR POTENTIOMETER

Designed for use as a resistance substitute in shop work, a new variable linear potentiometer, calibrated from zero to 100,000 ohms, has been put into production by the Chicago Industrial Instrument Co.

Labeled the "Selectohm," the new device is rated at 25 watts. In a recent



statement, the maker said that it provides "a fast means for determining the values of blackened, burned-out resistors when it is substituted in radio, television, and other electronic circuits."

For laboratory work, the unit, within its limits, may be used in place of a resistance box.

—RTM—

RADAR SWEEP GENERATOR

The "Rada-Sweep," a new wide-band sweep generator with markers, for alignment of radar IF amplifiers, is now in production at the Kay Electric Co.

Center frequencies of the unit are 30

and 60 Mc, with fine tuning control to center the 'scope pattern. The wide band sweep width is 20 Mc, while the narrow band width is 3 Mc.

Crystal-controlled markers at 25, 35, 55, and 65 Mc are included in the generator, with special marker frequencies available. Output is up to 0.5 volt, at a 70-ohm impedance terminal.

—RTM—

FUSE DISPENSER

For the fuse needs of the service man, Littlefuse, Inc., of Chicago now pack-

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What's your problem?

This department of RADIO AND TELEVISION MAINTENANCE is devoted to helping to solve the difficult service problems of our readers. Tough ones of general interest will be printed, and readers will send in answers. The best solutions will be printed in later issues. If only one answer to a problem appears here, its originator will receive $5.00 in cash. If two or more different ways of beating the poser are of nearly equal merit in the opinion of RTM editors, the second best will be worth $3.00 to the man who submits it, and the third best will bring home $2.00. Send your question or solution to: Problem Editor, RADIO AND TELEVISION MAINTENANCE, P. O. Box 867, Atlantic City, N. J.

AM INTERFERENCE

GENTLEMEN:

I have a problem of man-made static on an old Arvin AC-DC set, Model 722. The customer has been using the set for years, and putting up with the static which occurs every time his oil burner starts up. Then, there is a continual buzzing, which ruins the sound of the radio, until the burner shuts off again.

Recently, the set owner called me in to fix the trouble. I immediately suspected the lead-in from the outdoor antenna, because the lead-in went through the cellar, fairly near to the burner.

I shifted the lead wire to a position as far from the burner as I could get it, and installed a condenser-type static suppressor on the motor of the burner, but these measures had hardly any effect on the interference.

The set itself is apparently all right, because it works very well when the motor is not running, but the static comes in almost as bad when the antenna lead is disconnected. Reversing the power plug makes almost no difference in the buzzing. There is no trouble when the water pump, also in the cellar, is running. Would cleaning the burner motor eliminate the static? Or would a different suppressor do the trick?

ALFRED J. BERNARD,
Camden, N. J.

—— RTM ——

SELECTIVITY PROBLEM

GENTLEMEN:

What can I do to improve the selectivity of an FM set? I just made an installation a short time ago, of a Philco AM-FM console. For the FM antenna, I put a folded dipole with director on the peak of the roof, orienting it towards Philadelphia, which is about 90 airline miles away.

The signals from several Philadelphia stations come through fine, but on one of them, there is considerable interference which I suspect is co-channel interference. When the station is first tuned in sharply, it sounds all right, but then it seems to drift slightly, and another station interferes. Two stations do this, one on the low-frequency side of the carrier wanted, and another on the high-frequency side.

The interfering stations are, I think, closer than the Philadelphia one. As long as only this one station is affected, I don't want to change the manufacturer's alignment, but I would like to know of something I can do within the set to improve the rejection of the unwanted signals.

MARTIN BLACKBURN,
Weatherly, Penna.

—— RTM ——

LAUNCH ALNICO SCRAP DRIVE

The official opening of a drive sponsored by Jensen Mfg. Co., Chicago, is shown here, as Bill Schoning, president of the Lukko Sales Corp., Chicago distributor, and Thomas A. White, Jensen president, launch an effort to salvage discarded Alnico V loudspeakers. According to White, the drive will not alleviate the war shortage of magnet metal completely, but will probably increase distributors' supplies of speakers above allocations. Special cardboard boxes will be sent to jobber headquarters throughout the country, and special allocations of new speakers will be made by the sponsoring firm in consideration of the quantity of discarded units returned.

Products for the Trade

→ from page 21

ages 5 fuses in metal box dispenser. The sliding top, designed as a permanent part of the box, eliminates loss of tops. Because the lid slides back only far enough to release one at a time, fuses cannot spill out.

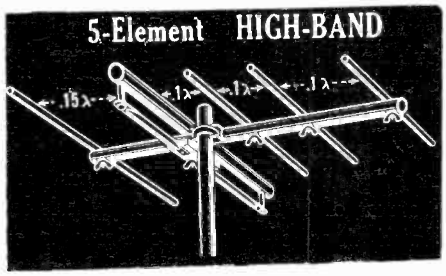
As an added help, a fuse size guide has been printed on the back of the box. This guide makes proper replacement process of simple comparison with the chart.

—— RTM ——

NEW 5-ELEMENT YAGIS

"Long-Ranger" five-element yagi antennas, are included in a new group which has recently been added to the JFD line.

All aluminum, the new antennas are made with one-inch O.D. crossarms, and one-inch and 3/8-inch O.D. elements.



Included in the design is the "Quick-Rig" feature, by which the antennas simply unfold and tighten for assembly. The units are cut individually for the channels they are to be used on.

Further information is available from the JFD Manufacturing Co., 6101 16th Ave., Brooklyn, N. Y.

The Cover . . .

A time-saving device for TV technicians is the "Snap-on TV Fuse Holder," developed by Littelfuse Corporation.

The holder snaps on to a blown pigtail unit within the set, thus saving the time and effort required to unsolder the blown fuse and solder in a replacement. Another advantage of the fiber attachment is that it eliminates the danger of blowing a fuse with a hot iron.

Fuse holder and the blown fuse remain in the set permanently. When a replaced fuse is blown, it can be pulled out easily, and a new one inserted in a moment or two.

..ucing New FM Receiver ..ivil Defense Application

SYRACUSE, N. Y.—A new FM receiver for civil defense use in two-way radio systems has just been developed by General Electric Co. here.

Called the "Civil Defender," the new unit permits headquarters of the two-day system to broadcast messages to several groups of receivers at once, or to separate groups individually. In this way, an announcement of the system pointed out, a group will hear only messages which it is intended to receive.

In addition, the receiver can be used to start and stop air raid sirens or other devices automatically. Controlled by a switch at the headquarters, a special tone on the receiver operates a relay to activate a warning device.

When a message is received, a lamp lights on the receiver, and stays lighted until it is turned off by the operator. With this, the operator, if he is away from the set at the time of transmission, will know that a message has come through, and will be able to check with headquarters.

Two models of the receiver, one for the 30-50 Mc band, and one for the 152-174 Mc band, are being produced. Both will operate from 117-volt, AC supply, with an inverter available for use with a six-volt battery. The units are double conversion superhets, with two crystal controlled oscillators.

— RTM —

TRADE LITERATURE

→ from page 18

contains more than 700 pages, will be very useful to those who are interested in communications, although it will have little direct application to the service of radio and television receivers.

—R. L. B.

— RTM —

RADIO FUNDAMENTALS

THE McGraw-Hill Book Company has recently published a second edition of "Understanding Radio," a comprehensive study of the elements of the subject, by Herbert M. Watson, H. E. Welch, and George S. Eby.

Not aimed at technicians already working in the field, the volume discusses only the fundamentals. It presents these in such a clear way, however, that it should provide a good grounding for beginning students, and should be excellent as a preparation for more advanced study.

Priced at $5.50, the book contains about 700 pages. A. G. C.

— RTM —

ENGINEERS' HANDBOOK

PENDER'S "Electrical Engineers' Handbook," fourth edition, is now available from John Wiley and Sons.

In two volumes, one on Electric Power, and the other on Communications and Electronics, the work is divided into sections, each section written by an expert in the particular field covered.

— RTM —

COLOR TELEVISION

A BOOKLET on color television in which the fundamentals of proposed systems are described in text, diagrams and photographs, has just been published as a practical reference for experimenters and TV servicemen.

The notebook, written by Edward M. Noll, author of "Television for Radiomen," and a products consultant and lecturer of Temple University, includes descriptions of the basic elements of color TV; the adaptation of standard TV receivers for black and white reception of color signals; adapters and converters for color signals; the CBS, RCA, CTI and other color TV systems; tricolor picture tubes; color wheel assembly and control units; tabular summaries of performance characteristics of different color TV systems; and a brief chronology of television development.

Copies may be obtained by sending $1.00 to the Paul H. Wendel Publishing Co., Inc., P. O. Box 1321, Indianapolis, Ind.

— RTM —

BOOKS

Publisher Will Announce New Books

NEW YORK—New publications which will shortly be getting under way at John F. Rider Publisher, Inc., of this city, will be announced at the Parts Distributors Conference and Show, May 21-24 in Chicago.

The publishing firm reports that it now has under consideration several manuscripts from prominent authorities in the electronics industry, some of them authors of books already produced by the company.

The proposed titles and a schedule of publication dates will be made public at the show.

SERVICING DEFLECTION WITH OSCILLOSCOPE

→ from page 11

measure accurately the peak-to-peak voltage at the last two points, the voltage-division ratio of the capacitative voltage divider must be known, as well as the oscilloscope screen calibration.

In each of the test steps outlined here, it is necessary to observe two important factors—wave-form and peak-to-peak voltage. Each of these is important in determining how closely the deflection voltages correspond to rated values and how closely the wave shapes resemble prescribed forms. This dynamic analysis of the deflection circuits will enable the technician to localize trouble to one section of the circuit. Conventional tests of DC operating voltages and of components in that portion of the circuit then will establish the seat of the trouble.

Deflection Currents

In the foregoing tests, *voltage* waveforms and peak-to-peak values were observed. The purpose of the deflecting voltage is to establish sawtooth current waves in the deflecting coils. It is conceivable that the deflection circuits may set up the proper voltage wave, but because of a defect in the coil will not generate a satisfactory *current* wave. In some instances, therefore, it will be expedient to observe the current as well.

Fig. 5 shows a setup for observing deflection coil current. Here, a one-ohm non-inductive resistor is connected temporarily in series with the deflecting coils under test. This resistance is negligible compared with the characteristics of the coil and will not introduce a detrimental voltage drop. Current is interpreted in terms of the IR drop across the resistor. For this purpose, full vertical amplification of the oscilloscope is used, since the one-ohm voltage drop is small. The case of the oscilloscope (normally ground) will be operated at the high potential of the deflecting coils, so the technician must use *extreme care* to prevent coming into contact with any uninsulated portion of the instrument.

When checking current in the vertical coils, set the internal sweep of the oscilloscope to 30 cycles. Use an internal sweep frequency of 7875 cycles for the horizontal coils.

→ to following page

at each set sawtooth in char- wave shape departs mark- om this configuration, while the voltage waveform has been found in the previous tests to be correct, the deflection coils under test (or resistors or capacitors associated with them) are defective and should be replaced. Resistance of the coils should be checked with a DC ohmmeter and compared with resistance values given in the manufacturer's service data.

Interaction Effects

With some oscilloscopes used in tests of this type, difficulties due to interaction between the receiver and oscilloscope are occasionally experienced. This condition usually is evidenced by hum interferenece on the displayed pattern. Reversing the power plug either of the oscilloscope or the receiver will often correct this trouble. In each of the tests, except the current measurement, the oscilloscope ground post and the receiver chassis must be bonded solidly together by means of a short, heavy lead and the two connected to a good *earth* ground. The shield braid of the test probe cable must not be relied upon for a ground connection between the receiver and oscilloscope. Use of a stout bond between the two also will serve to reduce interaction and hum coupling.

—RTM—

SENSITIVE METER FOR DC

→ from page 9

way will permit measurements of many kinds of small potentials, such as those delivered by crystal-type 1st and 2nd detectors and those put out by crystal mixers operated on weak signals. When a conventional crystal probe is used ahead of this vacuum tube millivoltmeter, signal tracing may be carried on even in the 1st front-end stage of a radio or television receiver where the low signal strength ordinarily makes it impossible to obtain a reading on a conventional meter.

—RTM—

TROUBLESHOOTING TV DEFLECTION SYSTEMS

→ from page 6

netic systems, commonly the fault of the focusing coil, or of the potentiometer employed to control the current through the coil. This will not apply to some of the new sets, which will use electrostatic focusing in conjunction with electromagnetic deflection. For conventional receivers, however, such troubles can ordinarily be shown to consist of either an open circuit in the focusing coil, a shorted coil, or shorted turns in the coil. Several resistors are usually shunted across the coil, and the defect might lie in any one of these parts. If none of these faults is apparent, the difficulty may simply be in the positioning of the coil or the ion trap magnet. Twisting or tilting these units may achieve correct focusing. The focusing control should finally be adjusted for the least current through the coil giving proper focus.

Centering

The centering controls just vary the DC value in the deflection yoke. When these controls have no effect on the position of the raster, it can be assumed, in the majority of cases, that there is a short in either the potentiometer concerned, or in the condenser which shunts it. Here again, the yoke itself should be positioned mechanically for proper centering, if the other components are known to be in working condition.

Inability to focus an electrostatic set is due to a short in the high voltage bleeder, or to a short or open circuit at the control. The control may not be connected to the first anode of the tube. An ohmmeter check of the focusing potentiometer and the associated condensers is indicated. If some adjustment can be made on the focus, but true clarity in the picture is not obtainable by rotation of the control, the defect is probably in part of the bleeder regulating the second anode voltage, or the voltage used for the focusing network.

Both vertical and horizontal centering can be checked in electrostatic-deflection sets with an ohmmeter. When the picture cannot be centered by manipulation of the controls, try the continuity with the meter, beginning at the picture tube pin connected to the deflection plate in question, and check the leads, the control, the condensers, and the high voltage bleeder networks, from the second anode through to ground. The most common fault in this section will be a shorted bypass condenser or potentiometer.

Edge Wrinkling

Foldover, wrinkling, and other effects ordinarily confined to the edges of the picture, are more of the troubles which are due to some faults in the deflection circuits. If adjustment of the synchronizing controls has no effect on such distortions, it is evident that the sweep circuits are to be suspected, with the horizontal section the most likely to be the one that is at fault. These effects on the vertical edges are not so common in receivers with electrostatic deflection as they are in magnetic sets.

Wrinkling along the vertical lines at the edges of the picture can often be ascribed to 60- or 120-cycle interference from the power supply; in electrostatic sets, the 120-cycle wave is usually coming from the high voltage supply. A coupling capacitor connected to the deflection plates may be leaky, thus adding a pulsating DC voltage to the plate supply of the output amplifier. This particular fault can easily be detected by a voltage check on all the output amplifier plates; if one of the values is too high, a leaky condenser is the cause. The interference might also be traced to an open filter capacitor in the B supply, or a bad shunting condenser on a center-tap resistor at the power transformer. The output amplifier tube might be bad, or there might be an open screen bypass condenser in the horizontal sweep section.

In magnetic deflection systems, a weak damping tube can cause either horizontal overlap or wrinkles, by permitting the existence of an oscillation in the flyback circuit, one of the effects which results from the relatively high sweep frequency necessary in the horizontal section. If the effect is not corrected by replacement of the horizontal damping tube, then the trouble is probably in the damping resistor on the tube. In difficult cases, the voltage waveform can be checked with an oscilloscope, traced back from the grid of the horizontal output tube to the sawtooth generator.

A bad damping resistor or a defect in the vertical deflection coils can cause overlap at the top of the picture; when this trouble is noted on inspection of the picture, it is best to begin the investigation by a check of the values of the resistors mounted on the deflection yoke. The resistance of both vertical deflection coils should also be checked. The small DC resistance of these coils, although it amounts to only a few ohms, should be the same for both coils. If, however, the foldover or squeezing-together of the scanning lines is due to a fault in the vertical sweep output tube or sawtooth generator, the best procedure for locating the offending component is to trace the signal with an oscilloscope.

A faulty deflection yoke, or a bad condenser shunting the coils is the usual cause of wrinkling on the left side of the picture. Here the horizontal part of the yoke should be checked, as should the components across the yoke. These parts probably cause wrinkling more often than does a bad damping tube. When wrinkling is noticed, the small parts should be replaced first, and if that does not cure the difficulty, then the yoke itself should be replaced with one known to be good. AC hum may also be responsible for scalloped edges in this case, just as it can cause trouble in electrostatically-deflected sets. Suspected filter and bypass condensers can be checked by simply shunting a large condenser across each one, until the defect in the picture is improved. Another possibility is that there is an open bypass connection in the centering circuit, causing the wrinkling. Shorting out the centering control will reveal this defect, since the wrinkling will disappear, although the raster will move to one side when the control is shorted out.

Non-Linearity

Unequal operation of the two output amplifiers in the vertical and horizontal circuits is the most frequent cause of non-linearity in electrostatic deflection systems. If a duo-triode is used in this circuit, as is often the case, substitution of a new tube may pinpoint the trouble, which causes "squeezing" of one part of the picture. Plate voltage of both sections of the tube, if a dual tube is used, should be compared, and should be almost equal. Another check is to connect an oscilloscope to the output of each amplifier. The sawtooth voltages should be of equal amplitude, but opposite in phase. If this stage checks OK, then there may be a fault in the coupling condensers leading to the deflection plates. If, however, the outputs are not equal, the inputs may be responsible for the inequity. The usual network used to invert the sawtooth may be causing the trouble, producing the wrong amplitude on the section section. Oscilloscope tracing can be used to make sure that the non-linearity does not come from the discharge tube, or the sawtooth generator. A shorted bleeder resistor may cause the plate voltage of the discharge tube to be too low. A defective part can generally be isolated through a complete voltage and resist-

→ to page 29

RADIO CONVENTION EVER STAGED

IRE Meeting Covers Every Phase of Radio Electronics Field

NEW YORK—The largest meeting ever held in a single field of engineering or science became history here last month as the 1951 Institute of Radio Engineers national convention drew to a close. Over 23,000 radio engineers and scientists from the United States and 30 foreign countries gathered at the Waldorf-Astoria Hotel and Grand Central Palace, overflowing to the Belmont-Plaza, on March 19-22, to witness a comprehensive program of 210 technical papers and 280 exhibits.

The papers and exhibits covered every phase of the radio-electronic field with particular attention being given to the impact of the mobilization effort on the industry and to recent developments in television.

The subject of television received a send off when, on the first day of the convention, a 14-foot scale model of the multiple TV antenna atop the Empire State Building was unveiled at a ceremony attended by FCC commissioners and the heads of the broadcast stations that will be using the new antenna in the near future. The model was later placed on display at Grand Central Palace where, on the following day, a symposium was held by the IRE Professional Group on Broadcast Transmission Systems at which the electronic and mechanical constructional features were described in detail.

Papers were presented on every phase of radio and television transmission and reception and embraced such subjects as the following: color television; broadcast station maintenance, operation, and design; a UHF transmitter tube capable of a continuous power output of 5 kilowatts; the use of ceramics in making high-power tubes for UHF; a 30-inch TV picture tube which is wider than it is long; an analysis of internal television receiver intereference resulting from harmonics of the audio and video IF; UHF converters; receiver power supplies; a 55 cubic inch subminiature radio receiver; and a compact direct-coupled amplifier for TV receivers containing only 35 parts as against the usual 204, making for improved reliability and less frequent servicing.

The important subject of tube reliability and quality control was the subject of a symposium at which tube designers, manufacturers and users discussed tube life and causes for failure. During an Audio session an interesting 4-tube circuit was demonstrated which when attached to a radio receiver would eliminate commercials from a program. The device distinguishes between various types of speech and music, and can even recognize singing commercials.

Grand Central Palace was the scene of 280 exhibits where over $7,000,000 worth of the latest electronic devices were on display. The exhibits featured materials, components, transmitters and receivers, measuring instruments of all descriptions, and complete communication systems. Coil winding machines, an electronic organ, and color-television demonstrations by Du Mont and by CBS were among the many interesting demonstrations on view.

The Navy, Air Force, and Signal Corps combined to put on a mammoth Armed Services exhibit depicting the latest military electronic apparatus not on the restricted list. Radiation detection devices, cloud height indicators, telemetering systems, and facsimile equipment were given prominent attention. The Signal Corps displayed a model of the "G-string" transmission system which may eventually replace coaxial cables for television networks. The system works on the principle that an electromagnetic wave can be propagated along the surface of a single wire conductor with a dielectric coating.

—RTM—

answers to WHAT'S THE PATTERN?

→ from page 15

1. c; 2. c; 3. a; 4. c; 5. b; 6. d; 7. a; 8. c; 9. c; 10. c.

TROUBLESHOOTING TV DEFLECTION SYSTEMS

→ from page 27

ance check of the stages, except for the charging condenser, which should be checked by substitution.

Oscilloscope Check

Checking horizontal non-linearity on electromagnetic sets usually requires the use of an oscilloscope to examine the voltage waveform at the deflection yoke. At this point, however, an allowance must be made for the fact that a linear sawtooth displayed on the 'scope does not mean that a sawtooth current, which is required for correct deflection, is present. In order for the desired sawtooth current to exist in the yoke, the voltage waveform must have a square-wave component, in addition to the sawtooth part of the voltage form. If the sloping portion of the wave appears to be anything but straight, then, there is some fault in the circuits associated with the yoke.

Each pair of coils should present the same ohmic value for proper linearity. In the circuits connected to the horizontal portion of the yoke, the most likely source of trouble is the discharge circuit of the sawtooth generator and the sweep output amplifier. A check of waveforms, to see whether they agree with those provided in the manufacturer's data, will often localize a defect preceding the grid of the output tube. For the vertical circuits, which are simpler, voltage and resistance checks will discover any trouble, in general.

— RTM —

FIX ON THE FACTS

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makes an ion trap unnecessary; and it responds readily to very high deflection frequencies. On the other hand, electromagnetic deflection permits the construction of shorter, cheaper, more rugged CR tubes, permits slightly better focusing, and provides easier deflection at high anode potentials. This is because that while an accelerated electron spends less time in the deflecting magnetic field, it also acquires increased magnetism from its increased velocity; and interaction between this increased magnetism and the deflecting magnetic field produces increased deflecting force.

While increased anode voltage makes the magnetically-deflected beam harder to bend just as it does the electrostatically-deflected beam, this increase in beam "stiffness" with increasing anode potential is much more gradual in the case of magnetic deflection.

Intensifier Anode

Until quite recently, the advantages of magnetic deflection far outweighed its disadvantages; but now that it is necessary to conserve scarce materials, the cobalt, copper, and other scarce items used in ion traps, focusing coils, and deflection coils are causing engineers to re-examine electrostatic deflection. In fact, they are already producing tubes with electrostatic focusing and electrostatic deflection. One way of overcoming the increase in beam stiffness with an increase in anode potential is to permit the electrons to loaf along until after they have been deflected and *then* speed them up. This is done by using an *intensifier* anode right at the front end of the tube so that its step-on-it influence is not felt by the beam until after it has passed through both sets of deflection plates.

— RTM —

SERVICING THE TV FRONT END

→ from page 8

light on the screen indicate that signals are getting through, but that oscillator voltage is not reaching the mixer. If these quick rough tests do not reveal the trouble, it is likely that resistance and voltage checks are necessary.

Trouble is suspected in the front end when neither sound nor picture is obtained. The trouble may be with the antenna. Disconnect the antenna leads and short a screwdriver across the terminals and move the metal part of the screwdriver back and forth over the terminals. Set the contrast control at maximum and the brilliance control low. If flashes of light are visible on the face of the CRT, the front end is quite likely functioning. But if no light flashes are seen, an attempt should be made to isolate the trouble to the RF, mixer, or oscillator stage.

Another quick "disturbance" type test is to set the volume control at maximum. Remove the RF amplifier tube and replace it quickly several times in rapid

→ to following page

SERVICING THE TV FRONT END

→ from preceding page

succession. If any noise is heard from the speaker the mixer stage is probably operating or it would not be passing the signal.

When the oscillator is suspected, short the signal grid to ground. The negative voltage will be shorted out, which will change the current flowing through the tube and will produce a noise signal at the speaker. If the oscillator is inoperative, there will be no negative voltage and no current change is possible.

At this point, voltage and resistance checks will help to localize the precise trouble. These rough tests are not absolutely reliable, nor are they good for all situations, but they do help to localize a defect quickly.

Oscillator Stability

For good quality sound reception, it is required that a receiver with separate video and sound strips have a local oscillator stable enough to permit the converted sound carrier to pass through the narrow sound IF amplifier and the detector without either distortion or loss of sound.

This requirement alone imposes restrictions upon stability, which are many times more severe than it is generally possible to achieve with commercially available tubes and components in a given price range. Thus, to achieve and maintain proper stability, either AFC systems or highly refined oscillator circuits are resorted to. Therefore, in any system with separate sound and video strips, if the front end seems not to be operating efficiently suspect the oscillator first.

Microphonism imposes its own severe requirements on front ends. Slight vibrations of the oscillator tube or associated components may cause frequency variations in the local oscillator. These are frequency variations which will appear at the detector output as ringing noises. Wherever this phenomenon occurs, these vibrations and their effect may be reduced by shock mounting the tuner on the chassis. Wrapping several layers of tinfoil around the tube itself may help to dampen the vibrations of the tube.

Suppose a defect is traced to the front end and the oscillator is suspected. Change the oscillator tube, mixer, and RF tubes, in that order, replacing them with tubes known to be good. Check the tuning circuit operation to be sure that the defect does not lie in an open, or short, or some other defect that would prevent normal functioning on all channels. Measure the voltage between the control grid and the cathode of the oscillator tube. This will help to show whether the oscillator stage is functioning. It will be necessary to use a high resistance voltmeter, or the reading may be quite misleading. The voltage normally present on the oscillator control grid with respect to the cathode will have some value from −1 to −12 volts, but in every instance this should be verified by data from a service manual.

If the voltage found is low, it may be due to low operating potentials (measure plate and screen to determine this) or to low cathode emission. Low cathode emission reduces oscillator voltage generated; this causes lower transconductance. Eventually the tube will cease functioning, but it will cause trouble long before it will test NOT GOOD on a tube tester.

It is important to measure the oscillator grid voltage for every single channel received, since it is possible that the oscillator tube may function well at some frequencies, but not at others. This may reveal a defect in the switching system or the fact that the necessary oscillations are not generated at the higher frequencies.

Alignment

With respect to alignment, the front end is the last section of the receiver to be aligned. No alignment of the front end should be attempted unless it is positively known that there is misalignment in the section. Procedure for aligning the front end varies. Some begin with the RF, follow with the mixer, and finish up with the oscillator, while others begin with the oscillator.

The oscillator must be set very precisely for each channel frequency to be received. There are several ways of doing this. One of the simplest is to apply a signal at the RF sound carrier frequency and note the indication at the FM sound detector output.

After alignment is completed, study a test pattern to note that all vertical wedges are visible up to about 300 lines. Details should be clear. Whenever the picture is fuzzy, readjust the input and RF coils until the pattern is as clear and sharp as possible.

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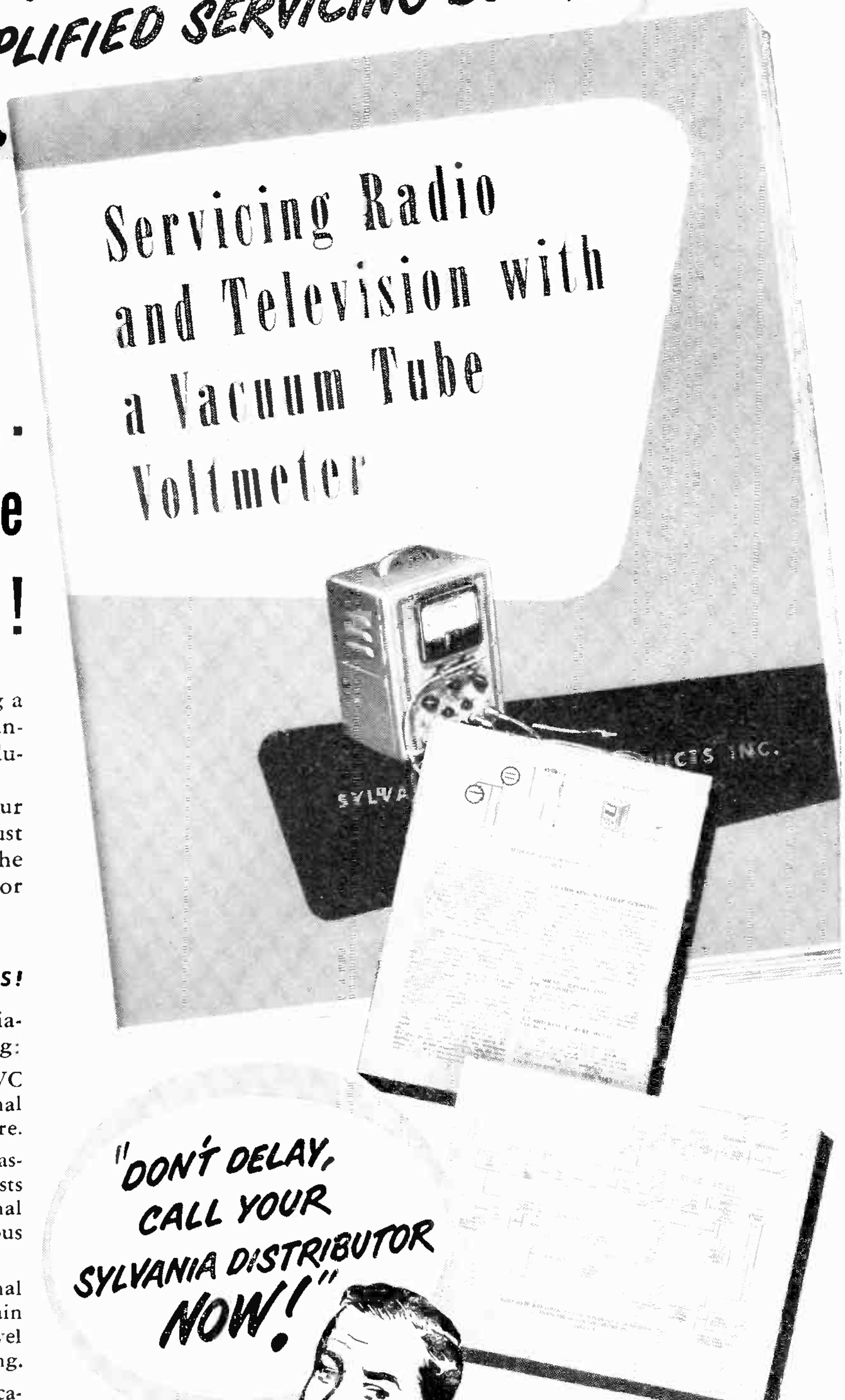

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