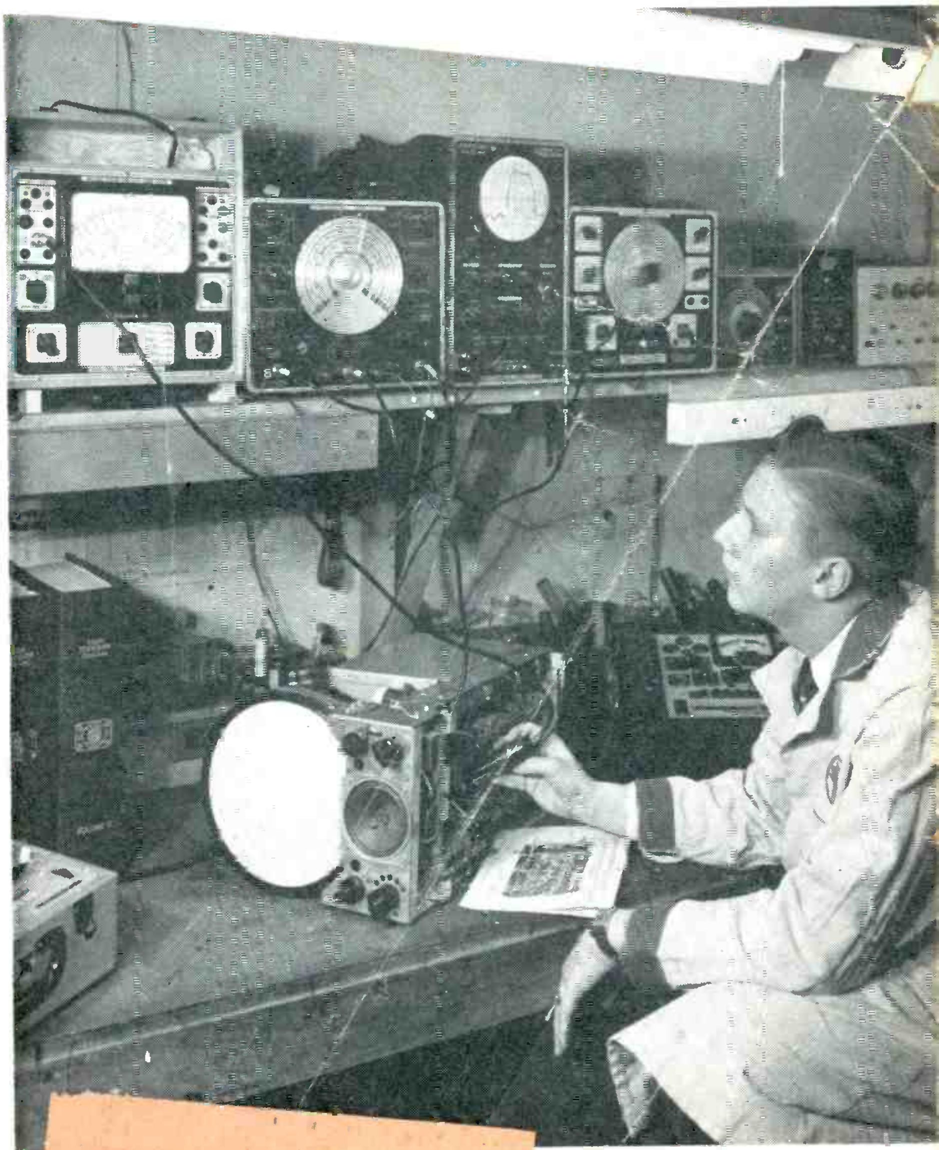
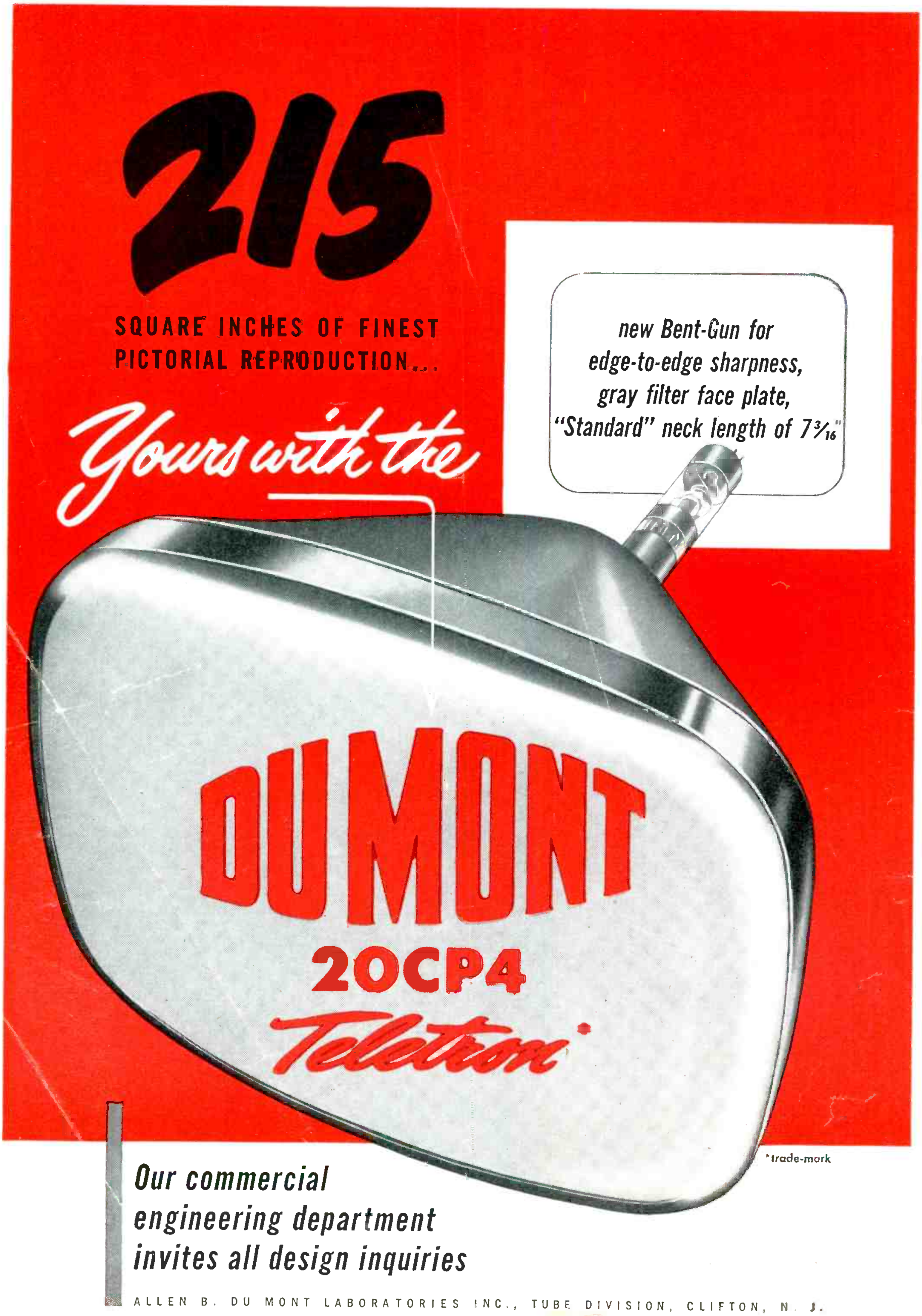
RADIO and TELEVISION maintenance



TV TUNER ISSUE

● Dynamic signal tracing with the right tools, such as the Precision Apparatus Co. equipment shown, is needed for correct TV front-end servicing ......

...951



215
SQUARE INCHES OF FINEST
PICTORIAL REPRODUCTION...
Yours with the
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edge-to-edge sharpness,
gray filter face plate,
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Our commercial
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RADIO INDUSTRY NEWSLETTER

SERVICE GROUPS ATTACK DU MONT SERVICE TIEUP

Service associations are loudly protesting the new agreement between Du Mont and Western Union, by which the wire company will, through its service division, maintain television receivers. Du Mont sets in three New Jersey counties will be taken care of by the trial agreement. If the test works out, Western Union Services may also take on other makes of receiver, and may go national in its program. Some forecasters see the move as a blow to individual TV maintenance shops.

RCA BACK IN TV BUSINESS AFTER PRODUCTION HALT

RCA reinstated thousands of workers, after heavy layoffs, when it received a new allocation of steel for television sets. Previously, the huge manufacturer had cut off TV set production entirely.

CBS BUYS HYTRON, TO MAKE COLOR TV RECEIVERS

Columbia Broadcasting System has arranged to acquire the business and assets of Hytron Radio & Electronics Corp. to provide CBS with facilities to manufacture color TV receivers (if and when the Supreme Court upholds FCC's approval of CBS color). Hytron and its subsidiary, Air King Products Co., will continue under the same management. The arrangement calls for the Hytron stockholders to receive 31 shares of CBS stock for each 100 shares of Hytron. Stockholders of both companies have to approve the deal.

N. J. SUPREME COURT HITS BAR TO BIG ANTENNAS

A recent decision by the New Jersey Supreme Court declares that antenna masts for non-commercial use can be erected on private property by the owner to any height he choses. Over-riding a local zoning ordinance which forbade a ham from gaining a permit to erect a 60-foot mast, the Court held that zoning ordinances were not intended to limit such construction.

2-OUNCE AMPLIFIER MAGNIFIES IMPULSE 3-MILLION TIMES

Bendix now has an electronic amplifier which weighs less than two ounces and is capable of magnifying electrical impulses 3,000,000 times. The amplifier is about the size of a woman's compact. It requires only 35 separate parts. The unit is being designed for radar equipment but may find application for auto radios, mobile radio systems and TV.

RTMA APPEALS FOR RELAXING OF REGULATION "W"

Declaring that Regulation W (which requires a 25% down-payment on TV receivers) be changed, RTMA officials told the Federal Reserve Board that the credit restriction was prompting "insistent warnings by dealers that many of them are facing bankruptcy." RTMA asked for a reduction to 15% down-payment requirement on TV receivers and that trade-ins be applied against down-payments as allowed in auto sales.

VOLUME VII NUMBER 5

RADIO AND TELEVISION MAINTENANCE is published monthly by International Publishing Corporation at 16 Union St., Somerville, N. J., U. S. A.

EXECUTIVE OFFICES
Ambassador Hotel
Atlantic City, N. J.
Phone: 4-3474

Entered as second class matter October 16, 1950, at Post Office, Somerville, New Jersey, under Act of March 3, 1879.

ADVERTISING OFFICES
New York
Room 705
40 E. 49th St.
MUrray Hill 8-7820

Representatives:
Cleveland
Harold L. Stuart
852 Leader Bldg.
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Subscription rates: U. S. and U. S. possessions, $2.00 per year by mail. Canada, $3.00 per year by mail. All other countries, $4.00 per year.

RADIO and TELEVISION *maintenance*

MAY 1951

FEATURES

DEPARTMENTS

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DEVOTED TO SERVICE OF RADIO-AUDIO-VIDEO

editorial

LET'S NOT PUT SCREWDRIVERS INTO THEIR HANDS!

WE DON'T consider a boon to society the medicine ads that suggest you can "cure yourself at home" . . . and we don't go along with the manufacturer who suggests the householder should take a screwdriver in hand to work on a TV receiver.

The conversion of a receiver to UHF might be every bit as simple as the current, full-page newspaper ad of a manufacturer claims for his receiver. The householder might easily take his screwdriver in hand and convert his set to UHF by "loosening two wires leading from the back of the set and connecting the Ultratuner." BUT, consider what it suggests to the average set owner!

We think the manufacturer is inviting trouble to spread the word that a TV receiver is fair game for the household handyman.

Contrasting with the ad of this manufacturer is one sponsored by Radio-Television Manufacturers Association which briefly explains the expansion of the number of TV frequencies and says: "If your reception is poor, either on low or high frequency stations, the man to call is your serviceman." This RTMA ad further states: "Learn to rely on the serviceman . . . he's your specialist in determining whether or not your reception can be improved."

RTMA'S advertising is the type that generates goodwill for the industry and makes a sound suggestion to the TV set owner.

On the other hand, regardless of how clear the full-page manufacturer's ad may state the case for easy conversion to UHF, it still implants the idea of bringing the untrained hand into the wiring of his receiver.

It's no *skin off the nose* of the service technician if the householder is invited to use a screwdriver on his receiver. It will probably double his business. BUT, what is it going to do to the industry if a handyman finds he can convert to UHF with a screwdriver and that he ought to probe further to see where the

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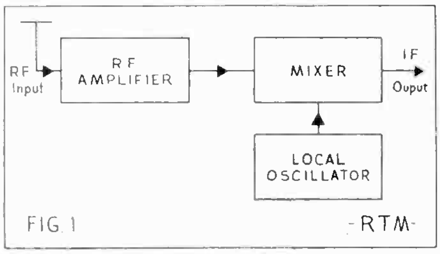
R&TM Survey

It's Well to Know the—

FUNCTIONS OF TELEVISION TUNERS

By RUDOLF F. GRAF



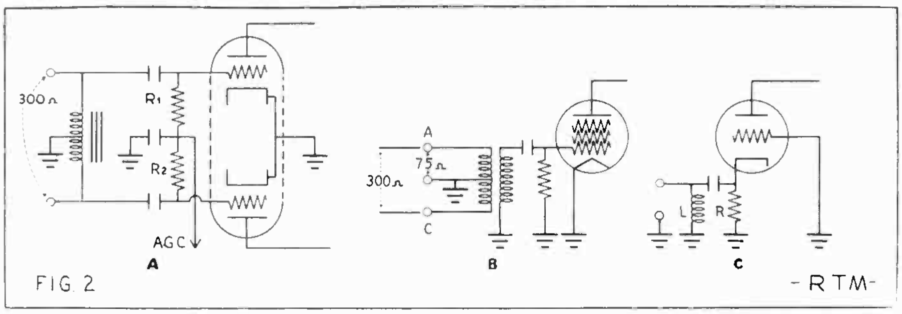
Block diagram of a typical TV tuner.

THE MAIN function of the television tuner is to convert the transmitted picture and sound signals to their respective intermediate frequencies. Although tuners of different manufacturers vary in circuit design and method of channel selection, they all consist basically of three main stages. These stages, the RF amplifier, mixer and local oscillator, are shown in block diagram form in Fig. 1. A well designed tuner should have the following characteristics: 1. Stable operation; 2. Good signal-to-noise ratio; 3. Satisfactory bandwidth; 4. Good image rejection; 5. Proper match to transmission line; 6. Reasonable amount of gain.

Antenna Input Circuit

The input circuit transfers the signal from the transmission line to the RF amplifier. In order to transfer a maximum amount of energy, the input circuit should offer an impedance which is constant for all channels and is equal to that of the transmission line. If proper matching is not attained, not all of the energy on the line will be absorbed and some of it will be reflected. These reflections will result in standing waves and may cause ghosts or blurred pictures. This particular type of ghost may be identified this way: rotate the antenna and watch the screen. If the ghost is due to line mismatch, the ratio of the intensity of the signal to that of the ghost will remain constant for all positions of the antenna. If, however, the ghost is due to external reflection, the ratio of the two signals will change as the antenna is rotated.

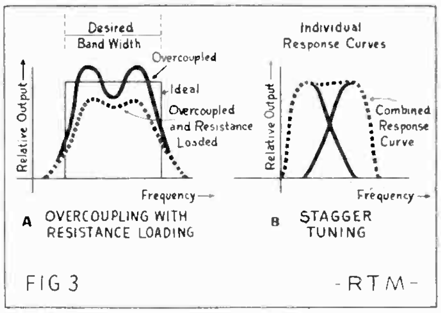
The input circuit is either balanced or unbalanced and sometimes offers a choice of either connection. Balanced input circuits are generally designed for the popular 300 ohm twin lead, and unbalanced circuits for 75 ohm coaxial line. In the balanced line the signal travels from the antenna to the receiver at equal amplitude in each lead of the transmission line. The line should be so connected that the distributed capacitance from each leg to ground is the same. In a coaxial line the signal is carried by the center conductor and the outer conductor makes up a shield. This line is used to great advantage in areas where the noise level is high and the line is subject to noise pickup.



Television input circuits. At A, a balanced 300-ohm input is shown, with a center-tapped choke. Circuit B shows an input with choice of either 300- or 75-ohm input, balanced one way, and unbalanced the other. At C, the 75-ohm input is into a grounded-grid RF amplifier. Input impedance depends largely on the value of resistor R.

Representative Circuits

Three representative input circuits are illustrated in Fig. 2. Fig. 2A shows a balanced 300 ohm input circuit employ-

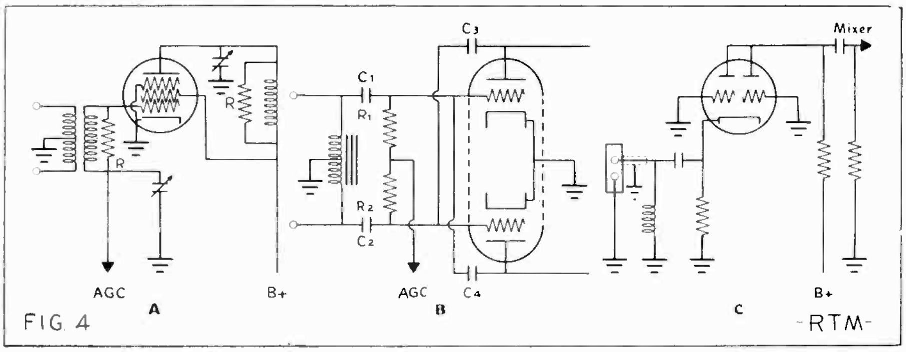


Methods of broadening the response curve of a TV stage.

ing a small center-tapped choke with a powdered iron core. This choke is grounded at the tap, and thus balances the circuit. The choke also serves as a high pass filter and acts as a virtual short circuit to all signals below the TV channels. Resistors R_1 and R_2 are 150 ohms each. They are the terminating resistors for the 300 ohm line.

The circuit in Fig. 2B offers a choice of either 300 ohm balanced input between terminals A and C, or unbalanced (75 ohms) between either end of the center tap B. Since we know that the impedance of a transfomer varies as to the square of the number of turns, it is easy to see that if the impedance of half the transformer is 75 ohms, the full winding will offer an impedance which is four times as large or 300 ohms.

In Fig. 2C the signal from a 75 ohm unbalanced line is impressed across an inductance and is then capacitively cou-



RF amplifier circuits commonly used in television tuners. Respectively, A, B and C are the conventional grid input circuit; the amplifier used in the RCA 630TS circuits; and the grounded-grid circuit. Grid acts as shield between input and output in circuit C.

pled to the cathode of a grounded-grid RF amplifier tube. The input impedance of this circuit is determined largely by the value of the cathode resistor R.

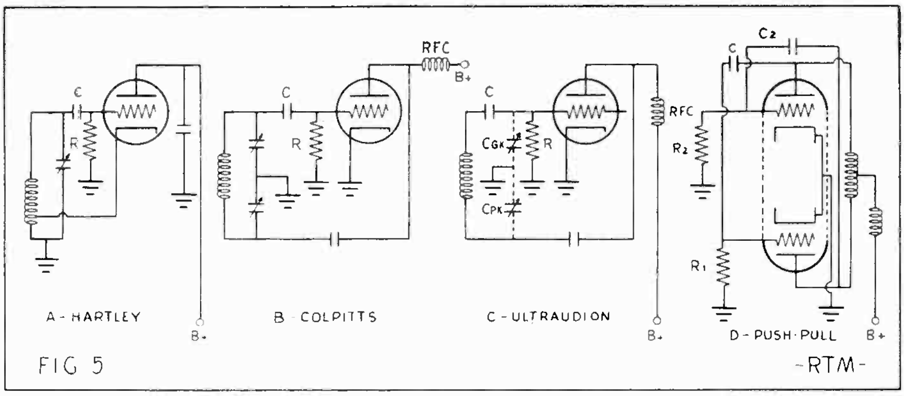
In some balanced input transformers, an electrostatic shield is placed between the primary and secondary windings in order to prevent any capacitive coupling of noise signals picked up by the balanced line. Since the noise impulses are of the same polarity in each leg of the line, they will cancel inductively, but there is still the possibility of capacitive coupling into the secondary due to the proximity of the windings. The shield may be a non-magnetic foil wound between the primary and the secondary.

RF Amplifier

The major function of the RF stage is to improve the signal-to-noise ratio, to increase the sensitivity of the receiver and to prevent radiation from the local oscillator. Due to the broad-band nature of the television signal, the TV tuner must accept and amplify a band of frequencies six megacycles wide at every channel. There are several methods which may be employed to obtain the necessary bandwidth.

If the coupling between the primary and the secondary of a transformer is increased more and more, the overall response curve of the circuit will have two distinct peaks after the point of critical coupling is passed. This results in a greater overall bandwidth and is called overcoupling. The two peaks may, however, be smoothed out if resistors are connected across the primary and the secondary or either winding alone. If this is done, the bandwidth is increased considerably, but the overall gain is reduced. This method of connecting resistors across transformer windings to increase bandwidth, is called resistance loading. See Fig. 3A.

Another method which is used frequently to obtain greater bandwidth is "stagger tuning." This is accomplished by resonating several tuned circuits at slightly different frequencies and then combining the output from the individual stages. A resultant response curve where two circuits are employed, is shown in Fig. 3B.



Representative circuit arrangements used for the local oscillators of television receivers. Note similarities of first three circuits. Most commonly used is the ultraudion shown at C.

RF Tube Types

Since the signal-to-noise ratio is much more important in the television receiver than it is in the broadcast set, we must be careful to use tubes in the RF stage which will themselves generate a minimum amount of noise. This indicates triodes, but pentodes are sometimes used because of the higher gain which may be realized. Typical tube types are 6J6, 6AK5, 6BH6, 6AU6, etc.

Three representative RF amplifier circuits are shown in Fig. 4. The first circuit is the conventional grid input circuit. The coils are resistance loaded to increase the bandwidth and the two circuits are also stagger tuned. Fig. 4B shows the RF amplifier used in the RCA 630TS circuit. A 6J6 dual triode is used in a push-pull amplifier circuit. Due to feedback between the plate and grid circuits neutralization is required to prevent oscillations. This neutralization is accompanied by the two condensers C4 and C3. These are 1.5 mmfd condensers and are approximately equal to the grid-to-plate capacitance of each triode section.

A frequently employed circuit is the grounded grid amplifier. In this circuit the control grid is at RF ground potential, and the signal is fed into the cathode circuit. The grounded grid acts as a shield between the input and the output circuits and prevents the possibility of oscillations. As a result neutralization is not necessary, even though triode tubes may be used. This circuit also offers a low impedance input so that the amplifier will more easily match the transmission line.

Mixer and Local Oscillator

The mixer circuit in a TV receiver serves the same purpose as the mixer in any other superheterodyne circuit. Two voltages, the RF and oscillator signals, are fed into the mixer stage as shown in Fig. 1, and as a result of the

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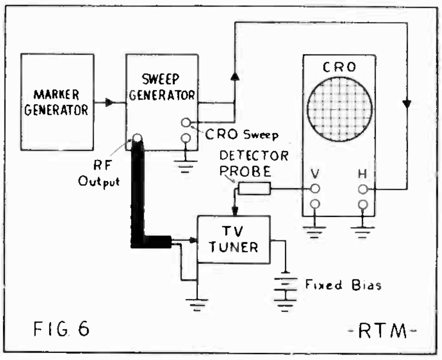

Connections between oscilloscope, sweep, and marker generators for alignment of TV front end.

Because a wide band of frequencies must be accepted, there are a number of special problems in —

FRONT-END DESIGN AND SERVICE

By RICHARD L. BROWNE

TELEVISION receivers require the acceptance of such a wide band of frequencies at the front end that the TV tuning unit presents a number of special problems, in design, in construction, and in servicing.

Unlike the tuner of an ordinary radio, which is required to pass a band not more than 10 Kc wide, or the front end of an FM receiver, which needs to accept only about 150 or 200 Kc total variation from the carrier, the RF stage of the television receiver must be able to pass signals varying through a six-megacycle band. Consider the tremendous width of such a band in comparison, say, with the broadcast radio band. One TV channel alone is about six times as wide as the entire band used for broadcast radio!

Consequently, when the engineers put their heads together to work out a new television tuner, they must dream up something that will cover this band adequately, that will remain comparatively stable and free from drift (in itself quite a problem at TV frequencies) and that will provide the great amplification the signal needs before it is fit for presentation to the first IF stage.

Add to all these requirements the need for the tuner to be able to select any one of the channels which are spread out from 55 to 211 megacycles, and you really have a problem. The high and low TV bands cover more than half the entire VHF spectrum, although, of course, the tuner can be designed to cover the two bands separately, and then does not need to be tunable throughout the distance between the limits.

Overcoupling and resistance loading are both used to achieve the necessary bandwidth in TV tuners. It is common practice to broaden the response curve of the tuned circuits by including a loading resistor in series with the changeable tuning coils, in the plate circuits of the RF and oscillator tubes.

Tuned Input Circuits

In the newer tuners, the RF input is tuned, along with the plate circuit of

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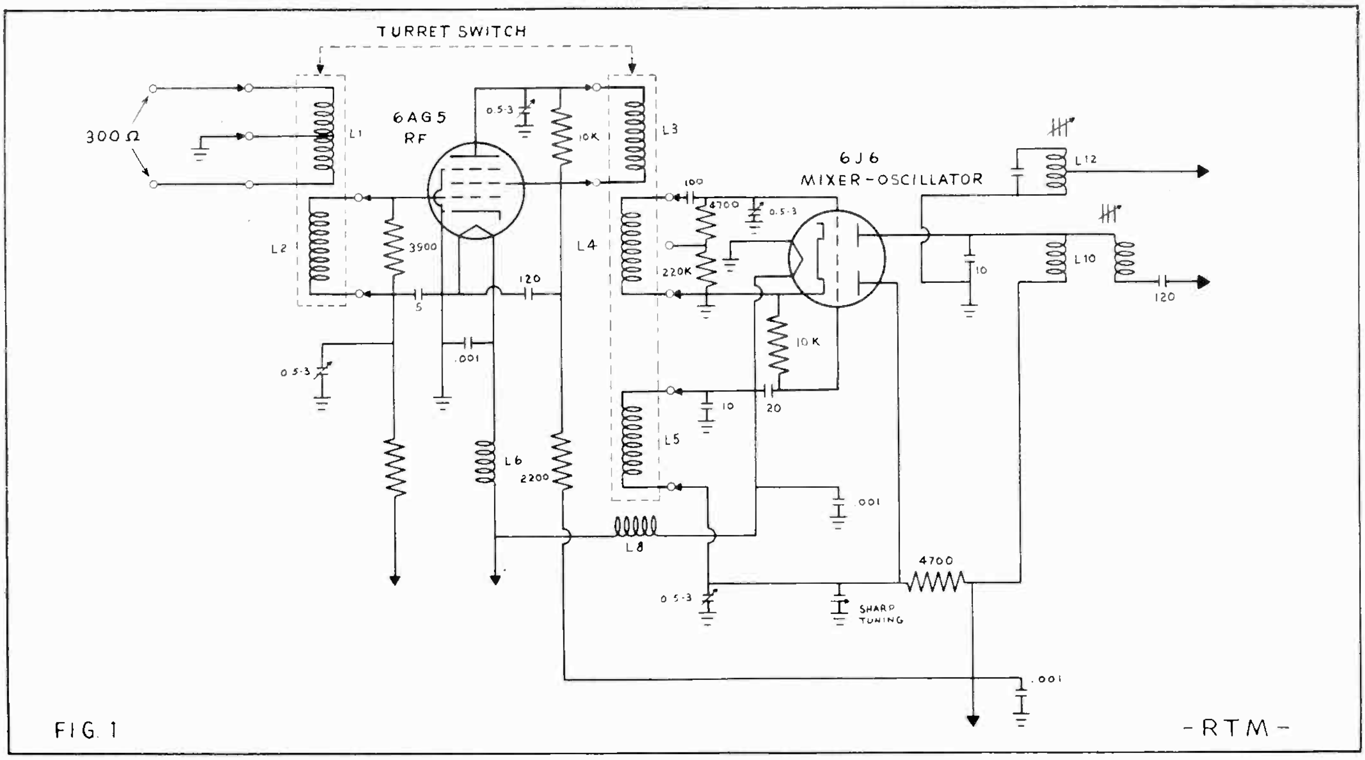


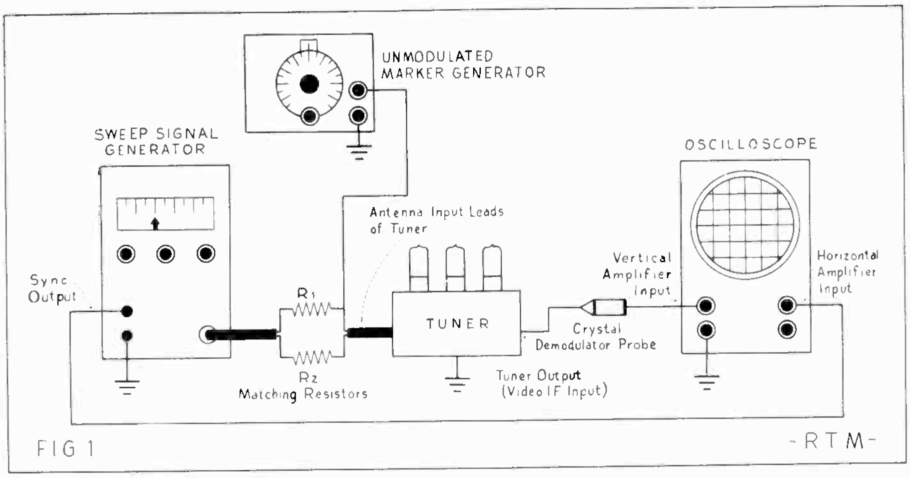
FIG. 1

Circuit of the widely-used Standard Tuner. In this turret-type unit, different coils are switched into the circuit for each channel. Note interchange input, with a separate input transformer for each channel. This feature makes the tuner one of the most popular with set manufacturers.

Service Technique

TV Tuners are Delicate and Critical. Preventive Maintainance Is Important to Keep Them Going!

By RUFUS P. TURNER



Setup for observing the response of the TV tuner to the input signal. Tests are easier if tuner is removed from the main receiver chassis.

CHECK UP ON TV TUNERS

THE tuner, or *front end,* is both the heart and brain of the television receiver. Picture, sound, synchronizing, and blanking signals are handled by this first section of the set with a high degree of channel-selectivity. In spite of the importance of the tuner, an impression has gained headway among TV service technicians that the front end requires little attention, aside from occasional correction of mechanical difficulties in switches and detents. But the performance and alignment of the tuner unit should be checked during *every complete inspection* of the TV receiver.

Any set which has been in continuous use for a year should have a careful front-end checkup, whether or not tuning trouble has been reported. This is a case of preventive maintenance. The tuner is on the receiving end of a great deal of manipulation by the set user and is subject to mechanical wear as well as loss of adjustment. Here are some points which should be checked by the service technician in tuner maintenance, and test procedures to be used in trouble shooting.

Tuners in present use embody a variety of designs, making it impossible to cover in a single article the detailed servicing of each type. The basic features common to all units are taken into consideration here, however, and we have tried to make our information suit a majority of cases.

Preliminary Checkup

Before attempting any adjustments of the tuner unit, the receiver should be switched on and, if possible, a station tuned in on each channel carrying local transmissions. The tuner should be switched successively to each channel position. In each position, the switch or turret should be turned slightly from side to side against each set of contacts with somewhat of a squeezing action, while watching the CR screen, to determine if there is a tendency to break contact or to slide out of position. Any breaking of the picture or streaking of the screen indicates faulty or dirty contacts or a worn detent.

Mechanical Service

Inspect all portions of the tuner mechanism for visible signs of wear, loose connections, broken parts, or intermittent contacts. Repair or replace any damaged parts.

Clean all sliding or rubbing contacts with the finest grade of abrasive paper or cloth. Brush or blow away all dust or filings remaining as a result of this buffing operation. Finally, apply a *thin* layer of good electrical lubricant to the contact surfaces. Several excellent materials for this purpose are available at distributors. Grease may be spread effectively over the contact surface with the flat end of a toothpick. Apply a light grease to the bearings, carefully wiping away any surplus. A good rule when lubricating at TV tuner is *a little goes a long way.* Don't overgrease.

Next, inspect the tube sockets for loose or corroded contacts. With the set operating, rock each tube back and forth in its socket while watching the picture tube screen for any tell-tale interference pattern. Miniature tube sockets which have developed faulty contacts are hard to recondition and should be replaced. Tighten any loose tube shields. In some atmospheres, the wire-like prongs of miniature tubes blacken and fail to make good contact with the socket springs. These prongs should be cleaned to a bright shine with fine abrasive paper or cloth. Carefully brush or blow away any metallic dust remaining on the tube after cleaning.

Check the fine-tuning control for smooth operation. Where this control is a variable capacitor, tighten any wiping or end-thrust contacts, to insure positive operation. Inspect the plates for satisfactory clearance between rotors and stators.

Electrical Service

Tubes: Check all tubes with a dynamic tube tester. Replace all tubes which show a transconductance less than 10 percent of the rated G_m value listed in tube tables. Make a complete test for interelectrode shorts.

Oscillator: To check the oscillator stage for operation, (1) disconnect the antenna from the set, and connect a DC vacuum tube voltmeter (set to its 0-3- ground. If a dual triode oscillator tube resistor. The negative meter terminal must be connected to the grid end of this resistor and the positive terminal to ground. If a dual triode oscollator tube with two grid resistors is used, the technician must be careful to connect to the resistor of the tube section which is in operation on the channel selected for the test. (2) The meter will be deflected by the voltage drop produced across the grid resistor by DC grid current. If the oscillator is not operating, there will be no grid current and therefore no voltage drop. (3) To verify oscillation, touch the grid terminal of the tube socket with the finger. A sharp change in the meter deflection indicates positively the presence of oscillation. (4) Repeat the test on each TV channel, adjusting the fine tuning control to verify oscillation over its entire range.

RF: The RF amplifier stage may be checked quickly by means of a conventional AM signal generator and an untuned signal tracer. The signal tracer used here is the conventional combination of crystal diode probe, high-gain audio amplifier, and indicator (headphones, magic eye, or meter). Most service technicians own signal tracers of this type. A crystal probe-and-oscilloscope tracer may be used alternatively.

Test Procedure

The following test procedure is recommended: (1) Connect the signal generator to the receiver antenna terminals. (2) Remove the oscillator tube temporarily from the tuner. (3) Switch on the receiver and signal generator. (4) Set the signal generator to the center frequency of the channel to which the tuner is switched. Table 1 lists the center frequencies of all the VHF channels. (5) Switch on the internal audio modulation of the signal generator. (6) Set the signal generator output to about 0.1 volt, or to its highest output level. (7) Connect the signal tracer input probe to the grid of the mixer tube in the tuner. Tune the signal generator carefully for maximum indication in the signal tracer. (8) If no indication is obtained, the RF stage is not operating and tests must be made of operating voltages and circuit components. (9)

FIG. 2 -RTM-

Tuner response curves may be upright or inverted on the 'scope face.

The test should be repeated on each channel setting of the tuner. The signal generator also should be tuned throughout each channel (See Table 1 for band limits) to check response of the RF amplifier over each range. (10) Replace the oscillator tube in the tuner.

Mixer: After establishing that both RF amplifier and oscillator stages are operating, mixer operation may be checked. (1) Connect the signal generator to the antenna input terminals of the tuner. (2) Set the tuner to channel 2. (3) Set the signal generator to the center frequency of channel 2 (See Table 1). (4) Switch on the receiver and signal generator. (5) Switch on the internal audio modulation of the signal generator and set the generator output to maximum. (6) Connect the signal tracer to the mixer output (video IF input). (7) Adjust the fine tuning control of the tuner for maximum response of the signal tracer. No response at all indicates failure of the mixer stage. (8) Repeat the test on each other TV channel. The signal generator must be set to the center frequency of each channel, as given in Table 1, and the fine tuning control of the tuner adjusted in each instance for maximum signal tracer response.

Checking Isolated Tuner: Any one or all of the tests described in the foregoing sections may be performed on a tuner completely removed from the TV receiver, by supplying normal filament and DC voltages to the tuner.

In most cases, the potentials required will be 6.3 volts AC for the tube heaters and 200 to 300 volts DC for the plates (or plates and screens). These operating voltages may be supplied by a portable bench-type variable power supply.

Often, it is possible to service the tuner more easily when it is removed from the crowded environment of the receiver chassis.

Tuner Alignment: The tuner does not often become seriously misaligned unless it has been tampered with. Alignment adjustments therefore should not be disturbed unless there is good basis for believing the unit to be out of line.

Visual Method

Since the tuner embodies circuits having flat-topped response curves, alignment can be performed quickly and satisfactorily only by means of the visual method. For this purpose, a sweep signal generator with at least 10-megacycle sweep width, a good oscilloscope with crystal-diode demodulator probe, and an unmodulated RF signal generator as a marker generator will be required. The author recommends the Sylvania Type 500 TV-FM Sweep Signal Generator and Sylvania Type 400 TV Oscilloscope. The Sylvania Type 216 General Purpose Signal Generator, or its equivalent, may be used for marker generation. A demodulator probe is required, since the oscilloscope amplifiers are not capable of operation at the extremely high frequencies handled by the tuner.

Figure 1 shows the equipment setup for tuner alignment. While separate grounds are shown for simplicity in Fig. 1, the ground terminals of the signal generators, tuner, and oscilloscope must be connected together by means of a solid wire lead. This connector should not be smaller than No. 12 and must be run as directly as possible. It will be advantageous also to set up the

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TABLE 1
CENTER FREQUENCIES OF TV CHANNELS

Channel	Limits (Mc)	Center Frequency (Mc)
2	54-60	57
3	60-66	63
4	66-72	69
5	76-82	79
6	82-88	85
7	174-180	177
8	180-186	183
9	186-192	189
10	192-198	195
11	198-204	201
12	204-210	207
13	210-216	213

TABLE 2
MARKER FREQUENCIES

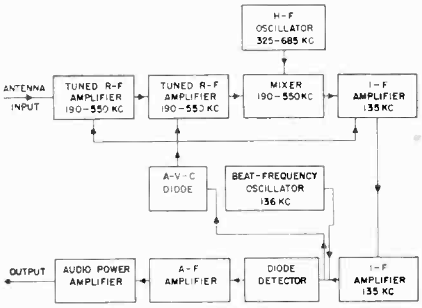
Channel	Video Carrier (Mc)	Sound Carrier (Mc)
2	55.25	59.75
3	61.26	65.75
4	67.25	71.75
5	77.25	81.25
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

New Developments

National Bureau of Standards Develops Set Less Than One-Fifth the Size of Original

A Subminiature Low-Frequency Radio Receiver

Gustave Schapiro compares his subminiature LF receiver with the original model of the same set.



Block diagram of the subminiature set. Conventional superhet circuit is used.

A TWELVE-TUBE subminiature radio receiver for aircraft use, continuously tunable from 190 to 550 kilocycles and utilizing a 135-Kc intermediate-frequency amplifier, has been developed by Gustave Shapiro and associates of the National Bureau of Standards in Washington. This assembly is the functional equivalent of a World War II unit more than five times as large.

With the use of more and more electronic equipment within the limited space of military planes and tanks, reduction of size has become increasingly important. The Bureau of Aeronautics of the Department of the Navy has therefore initiated at the National Bureau of Standards a broad program of subminiaturization of airborne equipment. Designed and constructed as part of this program, the new receiver embodies some unusual design principles.

Just 55 Cubic Inches

The new equipment, a radio-range receiver used to keep aircraft on course, occupies about 55 cubic inches, while the volume of the original version is approximately 300 cubic inches. Characteristics of the receiver include continuous tuning from 190 to 550 kilocycles, IF of 135 kilocycles, a sensitivity of 5 microvolts for 6 Db signal-to-noise ratio, and a power output of 100 milliwatts. The 12 tubes provide two tuned-RF amplifier stages, a mixer, a local oscillator, two IF stages with a bandwidth of about 2 Kc, a diode detector, an avc diode, a beat-frequency oscillator, an audio amplifier stage, and a push-pull-parallel power output stage.

All stages operate with 26 volts DC on heaters, screens, and plates. Under these conditions of operation, four subminiature audio power output tubes are required for adequate power output.

Several design problems were presented by the need for hermetic sealing and the high operating temperatures resulting from the very compact construction.

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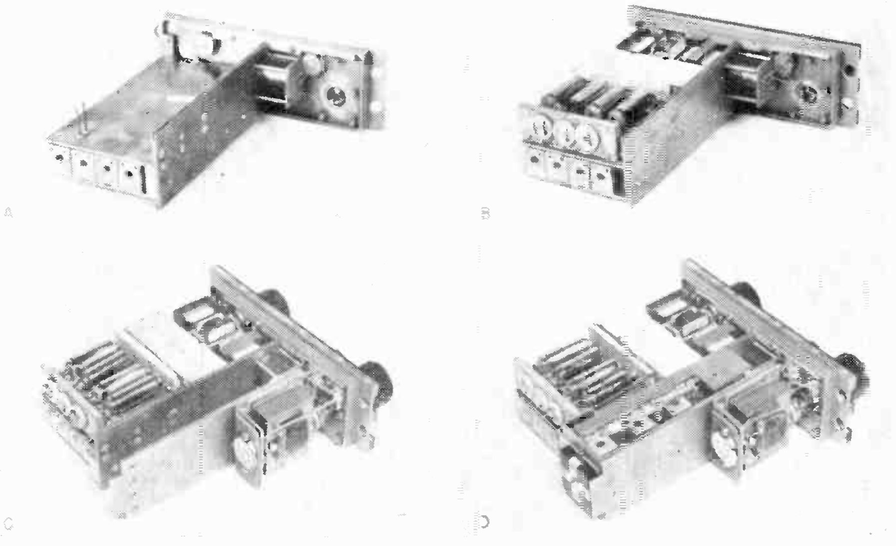
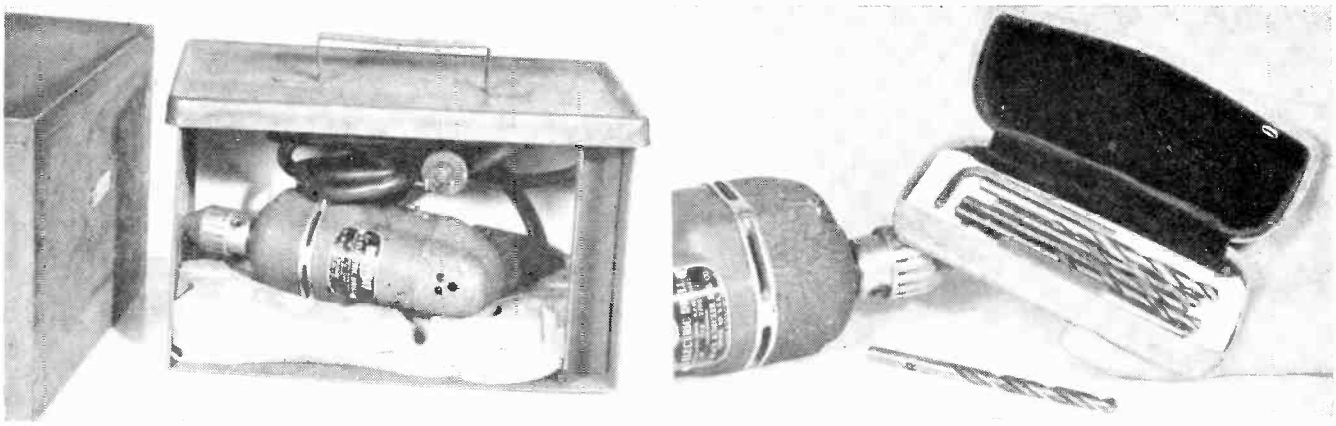


Subassemblies used in the new receiver. A shows tuning assembly and RF inductors in place. At B, RF amplifier and power-filter assemblies have been added. At C, output transformer, potentiometer, and other hardware are in place. At D, IF amplifier, input-output connector are installed and the set is ready to be sealed in its case. Audio output tube assembly is plugged on the outside of case for easy replacement.



An ammunition carrier can easily be made into a handy carrying case for the quarter-inch drill gun. At left, gun is shown resting on sponge rubber inside the drawer of the case. At right, an old spectacle case makes a good holder for drill bits, chuck tightening key, other small accessories.

A UTILITY CASE FOR YOUR ELECTRIC DRILL

War Surplus Provides a Handy Accessory for a Handy Tool

By HARRY F. LEEPER

AN ELECTRIC drill gun is an almost indispensable item in the tool kits of many radio and television servicemen. These handy, highly maneuverable tools have lightened the burden of many a servicing job, both inside and outside the shop.

But how is the technician to take care of his drill properly, and how is he to keep it protected from the shocks resulting from knocking around in his truck or car, and yet keep it handy enough so that there is no trouble in getting it ready for use? There are several answers to this question. One of them is to buy a kit of supplementary equipment for the drill. These kits, which are certainly second only to the drill itself in handiness, are available wherever the machines are sold, and come with a steel carrying case for the devices.

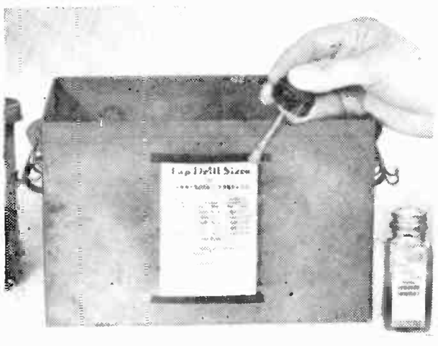
Surplus Box

Perhaps a better answer, however, is to buy an old ammunition case at the nearest war surplus store. In this, the buyer saves a good deal of money, and still has a highly useful box for his gun and drill points. The box shown is constructed so that an inner, sliding drawer fits into the outer shell of the case, and is locked into place by hooks.

The electric drill fits comfortably into the box, with plenty of space to spare for extras, such as an extension cord, a box of drills, taps and dies, assorted reamers and hole enlargers, chassis punches, and whatever else is thought to be needed. A piece of sponge rubber is fitted into the bottom of the box, to protect the drill. The sponge rubber itself will serve very well for various purposes on service calls. Often, the technician finds it tiresome kneeling next to a radio or TV set while he is working on it. The sponge rubber can save much wear on the knees during a day full of calls. In addition, the holes in the sponge rubber act as convenient holders for tubes when they are removed temporarily from receiver or carton; the rubber prevents the tubes from rolling around, and saves the time usually spent in looking for a safe place to put them.

Other Accessories

As a further accessory to the box, a chart of tap drill sizes can be pasted on the front of the case, and made permanent with a coating of radio cement, which will keep the chart clean and legible.

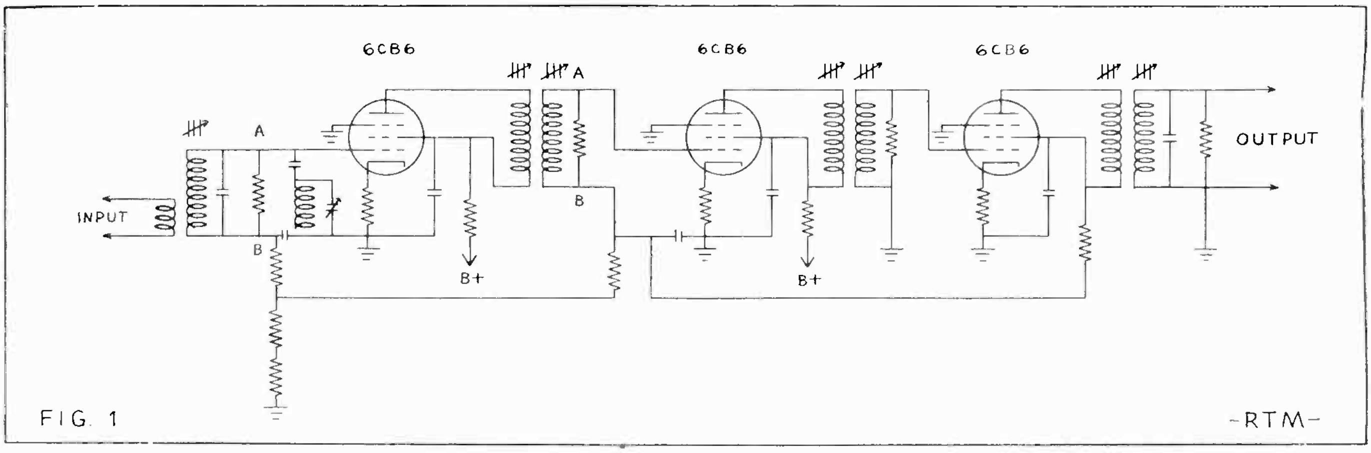


A convenient reference chart of tap drill sizes, or other information, can be pasted onto the side of the case, and kept there permanently by covering it well with radio cement.

To carry the most-often-needed drills, an old spectacle case just fills the bill. Perhaps several of these cases could be labeled for different sets of drills, or one could be set aside for carbon drills, with another for high-speed drills. Some entirely different arrangement might be more suited to the individual type of work.

Much extra equipment is available to improve the all-around usefulness of the drill gun. Grinding and polishing wheels of different sizes, mandrels for wire brushes, burs, and cutters can be obtained which permit all kinds of work on metal chassis—work that would be impossible, or excessively time-consuming, with hand tools.

When the drill, in its case, is not being used on a service call, the case is a dustproof, and practically moisture-proof, container for the machine. Particularly in view of the fact that the gun is so irregular in shape, storage when it is not in use could easily present a problem. This problem, which would involve possible damage to the device through its knocking around the shop, or being set down in just any place, is solved by keeping the gun in the sturdy box, and by keeping the accessories right there with the basic unit, so that they can be put into use within a few moments.



Test points on the grid resistors of video IF stages. Service procedure with only VTVM and other basic field equipment (see text) will usually be sufficient to detect IF faults. When defect is localized to the IF strip, voltage and resistance checks usually pinpoint the trouble.

SERVICING THE VIDEO IF

Test Procedure In An All-Important Section of the Receiver

By DAVID T. ARMSTRONG

WHEN a video IF section is suspected of faulty operation, the very first thing to do is to check each tube separately by replacing it with one known to be good. Don't bother with a tube checker; it is not likely to reveal all defects.

Take microphonics, for example. In a bad case the picture will bounce whenever the set is jarred. In a heavy traffic neighborhood this may occur as frequently as trucks or cars pass in the street. If the picture bounces, suspect the tube for microphonics. To make sure put the suspect tube into a good circuit and tap the tube; if the bounce appears on the screen, get rid of that tube *permanently.*

Systematic Servicing

Failure of the video IF system will remove the image from the screen. In an intercarrier system there will be no sound but in receivers with a separate sound IF, the sound will be normal if the defect is localized in the video IF strip. With IF failure there is likely to be a scanning raster on the screen, since the sync circuits are self-oscillating. This is an important point.

Supposing that the sound is normal, but the picture is out; what do we know diagnostically about the receiver?

1. The RM amplifier, mixer, and oscillator are functioning properly, or there would be no sound.

2. With the intercarrier system, the IF strip must be all right, or there would be no sound.

3. With separate sound and video IF strips the sound IF must be good.

4. The vertical and horizontal sync circuits must be operating, if there is a raster.

5. Both high and low voltage supplies are functioning properly, or there would be no sound.

This localizes a defect to the video IF, the detector, or the video amplifier. Here we are concerned with the IF strip only.

Incorrect alignment of trap circuits in the video IF system usually shows up in interference patterns on the screen. When sound voltages reach the face of the CRT they appear as black and white horizontal bars which vary in width with sound intensity. One quick check for misalignment of trap circuits is to switch to a channel where it is known that there is no adjacent channel interference. A good picture here almost pinpoints the difficulty to poor alignment of the trap circuit at a given frequency.

Adjacent channel interference does not produce any noticeable screen pattern, but it may be surmised from the following symptoms:

1. There may be an appearance of two images. This will occur when the interference is from a picture carrier in an adjacent channel.

2. There may be white and black ripples across the screen. This will occur when the interference is from a sound carrier in an adjacent channel.

3. The horizontal and vertical sync circuits will be unstable and the picture will not remain locked in; resetting the vertical and horizontal controls will be frequently necessary and will do no permanent good.

It is presumed here that the serviceman is working in the field and that no 'scope or signal generator is included in his basic truck equipment. Of course, a 'scope would make this job easier, but let's be practical. You just don't lug laboratory equipment around all over the field. Let's take this servicing with a good piece of more portable equipment like the RCA "VoltOhmyst," the Sylvania "Polymeter," or the equivalent.

Suppose the defect has been localized to the video stages and you are fairly certain it must be in the IF, detector, or amplifier. Nearly always, a careful voltage and resistance check at this point will reveal the defective stage and component.

Picture smearing may occur with incorrect bias voltage. Low plate and screen voltages may also produce smearing, because the tube will be easily overloaded under such improper operating potentials. If this is a cause of smearing it will show up when the contrast control is moved counterclockwise. Any contrast control that is part of the video IF system should be set so that it is at midposition when the receiver is properly aligned.

Oscillations in IF

Video IF oscillations are not common, but provide one of the trickiest servicing problems. Every serviceman should be acquainted with some of the fundamental facts, diagnostic symptoms, and troubleshooting procedures. The picture is too contrasty; adjustment of the contrast control has little effect toward improvement. The voltage reading across the detector load resistor is generally excessive; the value should be about one volt, but when oscillations are present it may be 15 to 30 volts. The oscillations may be caused by a number of factors, chief among which are the following:

1. Lead dress may have been changed or components may have been shifted in place sufficiently to change circuit capacitances.
2. One of the components, such as a condenser that is leaky or a resistor that has changed its value, may be sufficiently defective to cause the oscillations.
3. The IF strip may be incorrectly aligned.

Servicing for this difficulty is a time-consuming procedure, because there is so much to be done. The basic cause may be simple, but finding it is not simple.

First align the IF strip correctly, following the manufacturer's recommendations. This sometimes removes the cause of the oscillation.

Suppose the realignment did not remove the trouble or the cause of the trouble. Next make a resistance-voltage check of all parts of the IF system. Compare the voltages for the plate, screen, control grid, and cathode. If any of the IF tube grids measures less negative than is normal there may be a gassy tube or a leaky condenser.

For each tube measure the voltage at both ends of the grid load resistor—see Fig. 1, points A and B; this should be the same with respect to ground. Where it is not, keep the vacuum tube voltmeter connected to the grid of the tube suspected. Remove the tubes ahead of and behind the point in question. If the voltage on the high side of the grid load resistor is still less negative than normal the cause is most probably a leaky coupling condenser; replace it. If, in this test, the voltmeter shows normal reading after the tubes have been removed, suspect that one of the tubes is gassy; replace it with one of known quality.

Measure the values of all grid and plate load resistors and check screen and decoupling resistors to observe any change in value. These checks are better made when the set is cool than when it is hot. Check for open screen grid bypass or open decoupling condensers in the grid and plate circuits. When these checks are made with the voltmeter measuring the load across the detector, a decrease in voltage toward normal indicates the correct troubleshooting procedure; conversely, an increase in voltage indicates a wrong technique.

Lead Dress Critical

Check lead dress very carefully. In well designed receivers, the same technique of lead dress is frequently used from stage to stage; but be careful—the lead dress may have been changed slightly at the factory in one stage to prevent regeneration. The grid and plate leads, of course, must be very short and well separated. Shielding between the grid and plate is always advisable when oscillations are present. Check the filament choke to make certain it is not bent out of shape; this may cause trouble. Check the heater bypass capacitors; they might set up spurious oscillations under certain conditions.

This is where an RF probe comes in very handy. It will help locate the stage of the system in which the oscillations are being set up; it is the most desirable means of checking for the presence of RF in an IF system. There should be an RF probe and a high voltage probe with every vacuum voltmeter; it's mistaken economy to try to get along without them.

On a peculiar problem of this type, it is extremely important to keep in touch with the manufacturer and to keep abreast of the latest revisions to the manuals and service hints. Some defects show up in the field and, on the basis of the numerous complaints from the servicemen, the manufacturer looks into the matter, locates the trouble, and devises a means for correcting it. It pays to save part of your day for consideration of the instruction sheets issued by the manufacturer or his distributor.

IF Alignment

Poor picture quality may be the result of poor alignment of the pix IF amplifier. Try this yourself on a shop receiver so that you will get to know what improper IF alignment will do to the picture when everything else is percolating properly. Take a 27.95 Mc sound trap and detune it to about 26 Mc. This will reduce the gain of the amplifier near the picture carrier frequency of 25.75 Mc, which will decrease the amplitude of the low frequency modulation and show up in poor phase response. In the picture, the longer horizontal lines which represent low frequency picture signals will be weak (gray), and the lines in the vertical wedges of a test pattern, which represent the high frequency signals, will be stronger and blacker. The outer circle will reveal many shades from white to gray to black. Poor alignment may cause other troubles too, in addition to deteriorated picture quality. There may be unstable sync, inadequate blanking of the return lines, excessive noise in the picture, regeneration, and interference.

With normal alignment, the carrier is placed about 50 percent down the slope of the response curve. On high frequency signals, where there is only one sideband, it falls on the flat top of the response curve so it is amplified 100 percent. On low frequency signals both sidebands are received; one is amplified less than 50 percent while the other is amplified more than 50. For some particular low frequency picture signal one sideband may be amplified 40 percent while the other is amplified 60 percent; at some higher signal frequency the gain is 10 and 90, etc. The two sidebands add together to provide approximately 100 percent amplification. Therefore, with normal alignment, the amplification is the same both for low frequency and high frequency picture signals. This is the type of response most generally desirable. When the carrier is placed lower than 50 percent the gain at low frequencies is reduced; when the carrier is placed higher than 50, the gain at low frequencies is increased.

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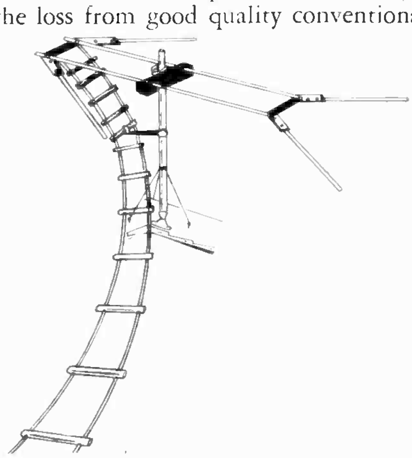
OPEN TRANSMISSION LINE

Originally developed for "problem" installations in remote and fringe areas, and where atmospheric conditions are destructive to conventional leadin, T.V. Wire Products "Open Line," provides low signal loss and permanent resistance to weather, according to the Los Angeles manufacturer.

Tests show that open line insures 1/6 the loss from good quality conventional



twin leadin. Released figures show 0.5 Db loss per 100 feet at 200 Mc, making possible longer line installations in remote and fringe areas.

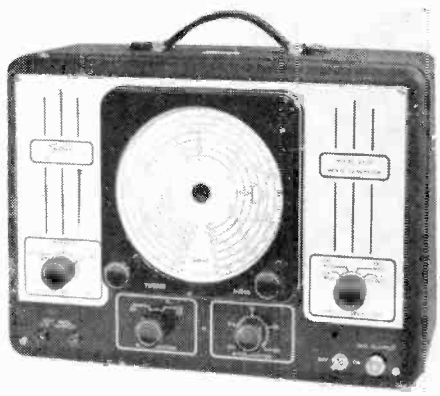
Extensive 300-hour salt spray corrosion tests have proven the line's ability to withstand the elements in any climate in any area, the maker reports. Another feature which distinguishes open line from conventional leadin is "air insulation," made possible through the use of polystyrene spacers placed every 6 inches throughout the run.

— RTM —

TEST OSCILLATOR

A wide-range test oscillator, with uniformly illuminated dial is the new Triplett Model 3432. Seven long (330°) scales with widely separated divisions are used, while lighting also provides an ON-OFF indicator.

Five fundamental ranges, 165 Kc to

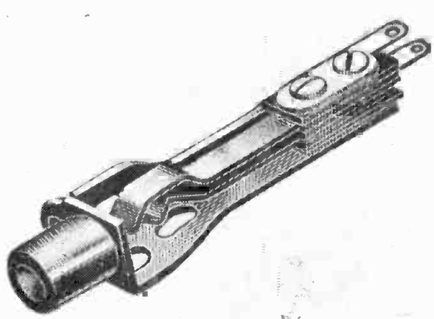


40 Mc, and two harmonic ranges directly calibrated 36 Mc to 120 Mc, are included in the instrument. The range selector is a five-position follow-up coil switch with complete shielding. An RF selector provides high and low RF output, and an output attenuator provides fine control of RF output and a co-axial output cable connector.

The circuit selector provides for internally modulated signal (variable 0 to 100% at 400 cycles). Variable amplitude of external modulation of 40 to 15,000 cycles. All RF and audio circuits are double shielded with copper plated steel shields.

— RTM —

TELEPHONE-TYPE JACK



A new long frame type jack, commonly referred to as a telephone jack, has been announced by Switchcraft, Inc.

Called the "T-Jax," the unit was designed especially for communication equipment, to meet the specifications of the armed services.

The steel frame is press welded, to provide rigidity and dimensional stability.

The springs are produced in dies of Switchcraft design and are made of an alloy of nickel silver, insuring maximum spring life and corrosion resistance. Silver contacts are standard in switching circuits; palladium cross bar contacts are also available.

Insulation is in accordance with military standards. The jack is available in all standard circuit combinations.

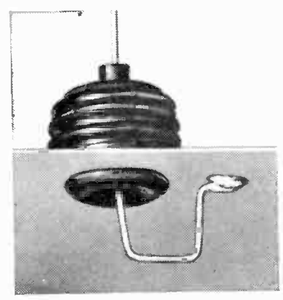
The manufacturer of the unit is Switchcraft, Inc., 1328 N. Halsted St., Chicago 22, Ill.

— RTM —

15 KV CERAMICS

A new 500 mmf. 15,000 volt ceramic capacitor, consisting of a ceramic slug encased in a sturdy molded rubber jacket has been introduced by the Sprague Products Company, North Adams, Mass., and is now available through the firm's distributors.

Known as the Type 510C1, the capacitor is rated for continuous operation at 85° C., and will withstand a 22,500 volt dielectric test. Its mini-



mum insulation resistance is 10,000 megohms.

Composition of the special rubber jacket is such that it will withstand a corona atmosphere without physical deterioration.

— RTM —

TV ANTENNA SYSTEM

Completeness is a feature of a new antenna distribution system just announced by Javex, of Garland, Texas.

Designed to mount flush, with or without the usual wall box, the new product incorporates a 300 ohm distribution system integral with a wall plate of conservatively modern design. The units come in ivory or brown, complete with plugs and mounting screws.

The surface box design eliminates cutting into a wall or using a wall box. A 1/4" leadin hole is easily covered by the plate, making for a neat installation.

In the case of some masonry walls, a

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hints by HARPER

Miniature Testers for Television Field Work

THE CURRENT trend toward miniaturization of electronic equipment is being followed in the design of many radio and television test instruments. Miniature meter movements, subminiature tubes, dime-size potentiometers and rheostats, match-stem capacitors, tiny batteries, Ouncer transformers, and reduced-size crystals are representative of components which now make small-sized instruments possible. Printed circuit techniques promise eventually to give the radio-television service technician test instruments of hearing-aid dimensions.

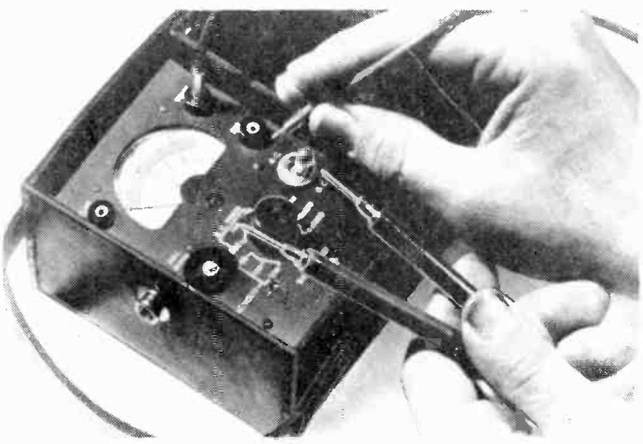
Pocket-sized test instruments are not stunt items. The array of equipment necessary to shoot trouble in modern radio and electronic equipment makes a heavy load for the service technician. It has become nearly impossible to make correct *on-location* diagnoses and estimates because the required test equipment is too heavy to carry to the remote place of installation. Can you imagine a doctor carrying anything as heavy as some of our instruments on his rounds?

Typical of the new line of small, readily portable instruments is the miniature multitester manufactured by International Instruments, Inc. This multimeter, although literally pocket-sized, has the following ranges: 0-50-150-300 DC volts at 10,000 ohms per volt (plus or minus 2 percent accuracy); 0-50-150-300 AC volts at 10,000 ohms per volt (plus or minus 5 percent accuracy); 0-2000-20,000-200,000-2,000,000 ohms at plus or minus 2 percent accuracy. This meter, shown in the accompanying photograph, is just about the size of the palm of your hand.

TV Instruments

A complete line of equally tiny television test instruments has been made available by Oak Ridge Products. Included are: Model 101 Substitution Tester, a signal tracer with loudspeaker, as well as a resistance and capacitance substitution unit. Model 102 High Voltage Tester, a 0-500-15,000-30,000 volt DC meter with 10,000 ohms per volt sensitivity. Model 103 Signal Generator, a general-purpose instrument for TV alignment and signal injection. Model 104 Synchro-Sweep, a special generator supplying sync and sweep signals for checking sync and sweep circuits in a TV receiver without oscilloscope or test pattern.

For establishing quickly whether or not the signal circuits of a TV receiver are operating, a broad-band untuned signal device of the noise-generator type is invaluable. Such an instrument is available in pocket-size under the trade name "Pen-Oscil-Lite" and is manufactured by General Test Equipment Co. Supplying a signal output between zero and 125 volts, this device covers the range 700 cycles to more than 600 megacycles.

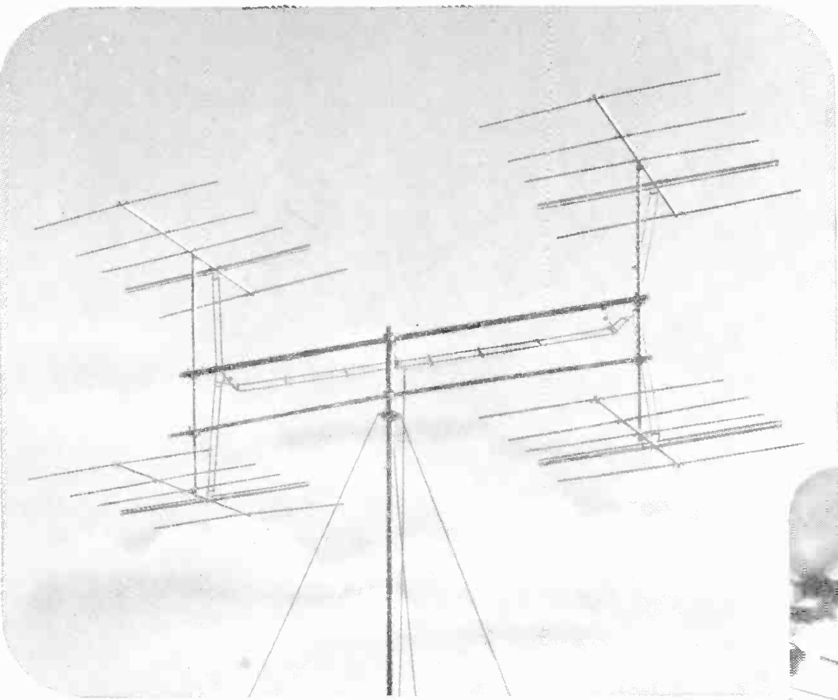


Miniature multitester manufactured by International instruments. The meter, although small in size, is large in utility; it has three DC ranges and three AC ranges at 10,000 ohms per volt, plus four resistance ranges.

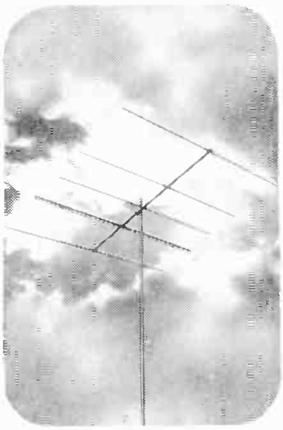
NEW STACKED ARRAYS

OF THE JC YAGI

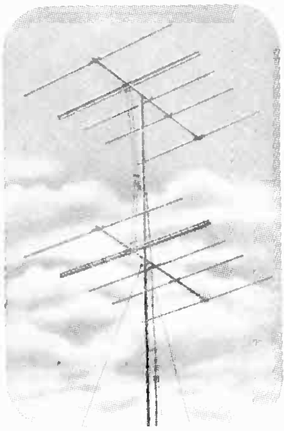
PRODUCE SHARP, CLEAR PICTURES AT AMAZING DISTANCES



Four Stacked Side-by-side JC Array — a radically new type of array developed for highest gain in hilly and mountainous terrain. Provides powerful long distance reception.



Standard JC Yagi Array — unsurpassed for all normal single-channel requirements.



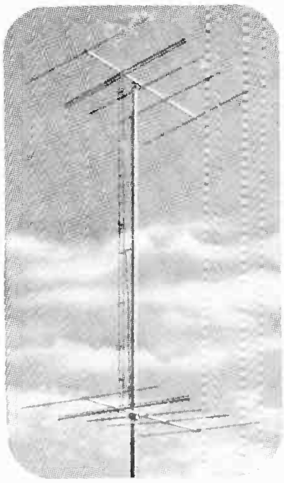
Double Stacked JC Array with half-wave spacing. Provides added gain and better signal-to-noise ratio.

SUPER POWERFUL

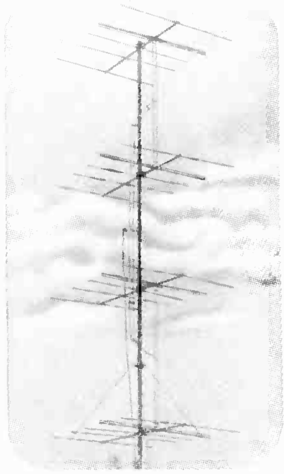
For Single Channel Performance

VEE-D-X — largest producer of Yagis — brings you new stacked arrays that provide still higher gain and further reduce noise interference. Perfected by VEE-D-X engineers in collaboration with a foremost authority on wave propagation, these stacked arrays make a world of difference in picture quality. In addition to the already popular double stacked array with half-wave spacing, you can employ double stacked arrays with full-wave spacing and half-wave four stacked, either vertical or side-by-side. Choice of array depends on area terrain and reception conditions.

THE LaPOINTE PLASCOMOLD CORPORATION
Windsor Locks, Connecticut



Double Stacked JC Array with full-wave spacing. Provides highest possible gain in low noise areas.



Four Stacked Vertical JC Array provides extremely high gain and excellent improvement of signal-to-noise ratio. Ideal for long distance reception areas with relatively flat terrain.

CHICAGO SHOW
BOOTH NO. 691
DISPLAY ROOM 660

VEE-D-X

BUILDERS OF THE WORLD'S MOST POWERFUL ANTENNAS

INSIDE FACTS ON THE MALLORY INDUCTUNER FORTY

EVER since I built my first crystal receiver around a home-manufactured two-slide tuning coil, over a quarter of a century ago, variable inductance tuning systems have intrigued me. Possibly that accounts for the keen interest I felt in the Mallory "Inductuner" when it was first brought out a few years back, and for the continuing curiosity with which I have followed the developments and refinements in this television receiver tuning mechanism.

JOHN T. FRYE

Engineering Advantages

There are certain definite engineering advantages in varying the inductance of a tuned circuit instead of changing the capacity. For one thing, this method of tuning makes it possible to maintain the Q of the tuned circuit practically constant over the entire tuning range; or, if desired, even to achieve a rising Q with an increase in frequency. Frequency drift that is usually caused by capacitive changes in the tuning condenser itself with a change in temperature is materially reduced. At the same time, the stray inductances and capacitances represented by the leads connecting the tuning condenser to the band switch and by the contacts of the band switch are eliminated. Finally, microphonic conditions produced by mechanical vibration of the tuning condenser plates cease to be a problem when there is no tuning condenser!

An awareness of these advantages is indicated by the acknowledged high quality of the television receivers employing variable inductance tuning. They include such names as Du Mont, Radio Craftsmen, Andrea, Sylvania, and Crosley.

Inductuner

The Mallory tuning unit itself is called the Inductuner. A complete television front-end, including RF, mixer, and oscillator stages, is built around the Inductuner by the Mallory Company and is called the Teletuner. This is the tuner pictured and diagrammed, and it is the one that is employed, with only minor changes, in the Sylvania and Radio Craftsmen television sets.

Another complete television front-end is built around the Inductuner by the Du Mont Company—the "Inputuner." This Inputuner is used in both Du Mont and Andrea receivers.

Still another TV tuning assembly based upon the Inductuner is produced by the Crosley Company for its line.

Since the Inductuner is the heart of the tuning systems employed in these popular makes of television receivers, a

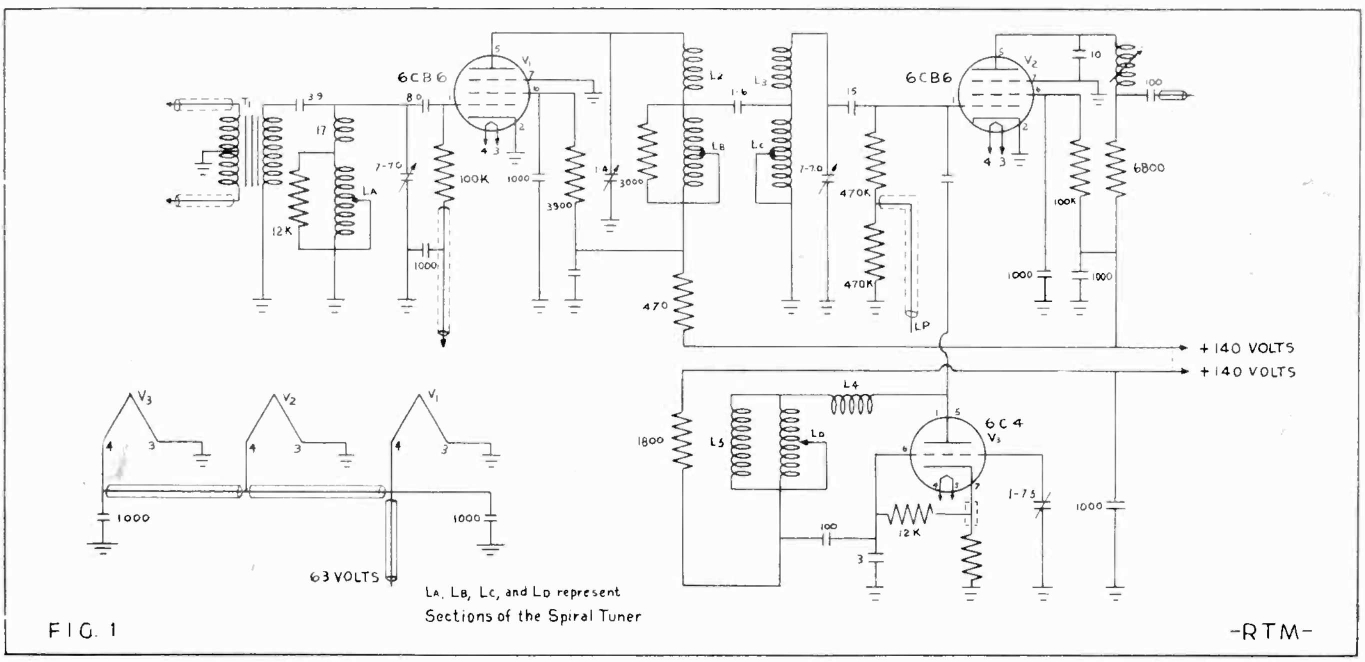


FIG. 1 — LA, LB, LC, and LD represent Sections of the Spiral Tuner

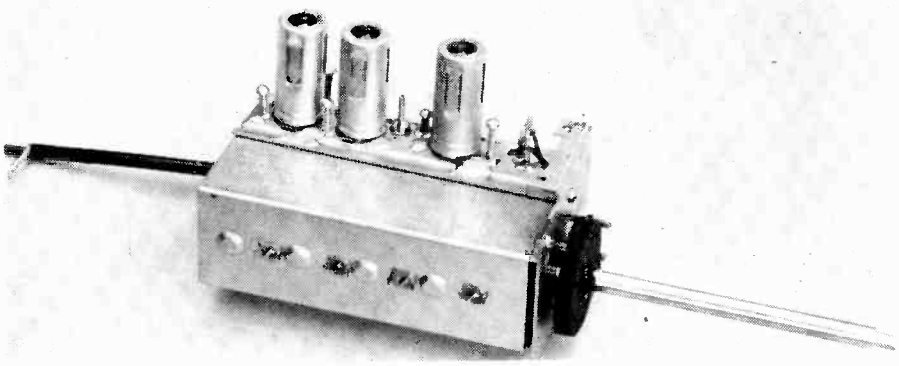
brief discussion of the construction, application, and service of the unique tuning device should be of interest to every television serviceman.

The original Inductuner was introduced back in 1946. It consisted of three solenoid-type inductances wound on a common ceramic shaft. When this shaft was turned, shorting fingers moved along the wire of each solenoid so as to change the amount of inductance presented by each. The three inductances were shielded from each other, and their effective inductances were varied in ganged unison. Ten revolutions of the tuning shaft were required to cover the tuning range of about 42 to 220 megacycles. Many thousands of these Inductuners were installed in television receivers and are still in active service.

Design Improvements

But, as is always the case, there was room for improvement. The solenoid type of tuner was comparatively bulky; it was expensive to manufacture; the frequency change was not linear, causing the high frequency channels to be bunched together on the tuning dial; the ceramic shaft was rigidly held in bearings at both ends, and excessive side pressure on the tuning shaft would cause it to break; dissimilar expansion coefficients of the ceramic shaft and the die-cast frame supporting it caused the bearing friction—and consequently the torque needed to turn the shaft—to vary considerably with different temperatures; and the ten revolutions of the shaft required to cover the tuning range was considered excessive.

In 1949 the Mallory engineers brought out the "Spiral Inductuner" as their answer to these shortcomings. In this unit, as can be seen in the picture, the inductance elements are six-turn spirals of silver-clad copper ribbon pressed into accurately molded low-loss plastic forms. The moving shorting fingers are mounted



The "Teletuner," a complete front end built by Mallory around its four-gang "Inductuner" (see cut at bottom of page).

on the rotating shaft which is supported by a single sturdy bearing at the front of the tuner. This eliminates the rigid mounting that caused shaft-breakage in the solenoid tuner and also, by cutting the bearing friction in half, reduces the torque required to turn the shaft.

As for size, the case of the three-gang solenoid-type tuner measured 7-1/4 inches long, but a *four-gang* Spiral Inductuner measures only 5-7/8 inches. A three-gang Spiral Inductuner is only 4-11/16 inches long. At the same time the dimensions have been reduced, the price of the unit has also been materially lowered because the Spiral Inductuner is much easier to manufacture.

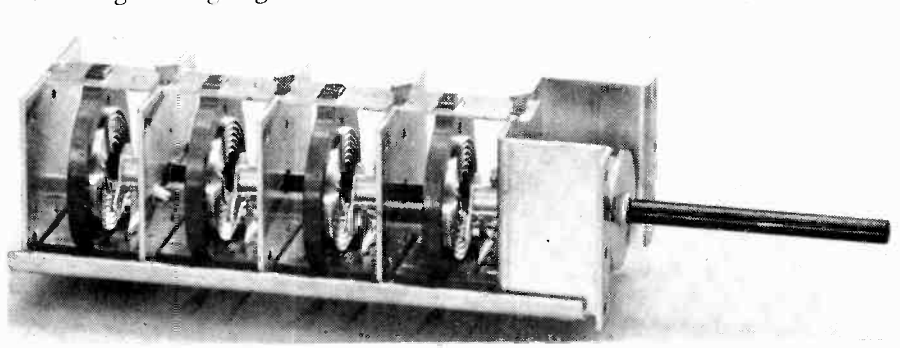
It is easy to see that as the contact finger progresses from the outside to the inside of the spiral ribbon, a decreasing amount of inductance change is produced by each revolution of the tuning shaft. This corrects the former crowding at the high-frequency end of the tuning range and makes the Spiral Inductuner's tuning-shaft-revolutions-vs.-inductance-change response almost linear.

Skip-Band Feature

A clever skip-band feature has been added to the Spiral Inductuner in order to avoid tuning any unwanted portion of the tuning range lying between the limits of 52 and 216 megacycles. This is accomplished by using two shorting fingers instead of one on each inductance. These fingers rest at different points on the spiral ribbon and are arranged so that one of them can be lifted from the ribbon at a predetermined point. This produces a result exactly the same as if a single shorting finger were suddenly shifted from one turn of the spiral to another: a sharp "step" is produced in the normal gradual inductance change.

By applying this principle, the Inductuner can be made to skip entirely the band of frequencies lying between Channel 6 and Channel 7 or to skip all of this except the FM band. The 6-turn Spiral Inductuner covers everything from 52 to 216 megacycles. The 4-turn tuner covers all TV channels and the FM band. The tuner using three revolutions of the tuning shaft covers only the TV channels.

As can be seen in the diagram, each variable inductance of the Inductuner is used in series with another fixed inductance, called the "end inductor," that determines the upper limit of the frequency range of the variable tuned circuit. This end inductance has a very high Q, and as the total inductance is reduced, the Q of the entire tuned circuit is determined more and more by the Q of this end inductor. The result is that the overall Q of the tuned circuit actually rises at the higher frequency end of the range, where the resulting increase in selectivity is most needed.



The four-gang "Inductuner." Note mechanical simplicity of this unit, which is a basic tuner for front-ends built by several companies in addition to Mallory. Shorting fingers and spiral inductances can be seen in this picture.

Service Procedure

While Inductuners are designed to have an expected noise-free life of 50,000 complete cycles, they may in time develop some noise during tuning. In that event, the recommended service

→ to page 25

trade LITERATURE

HIGH FREQUENCIES

THE second edition of the first-rate engineering text, "High-Frequency Measurements," by August Hund, has just been put on the market by the McGraw-Hill Book Co.

Although this work is thorough to an extreme, is very well presented, and makes some of the most involved phenomena clear to the reader, its value to the service technician is probably limited.

It would certainly be an asset for the serviceman to know the precise relationships between various circuit elements in the high frequencies, but it is questionable whether a technician, whose time is fairly well filled with looking after defective receivers, could spare the hours that would be necessary for him to learn the facts and theories given.

For those who are interested, however, in going deeply into the subject, it is unlikely that a better all-around book on measurements, and how they change as frequency is increased, could be found.

Price of the book is $10.00.

—A. G. S.

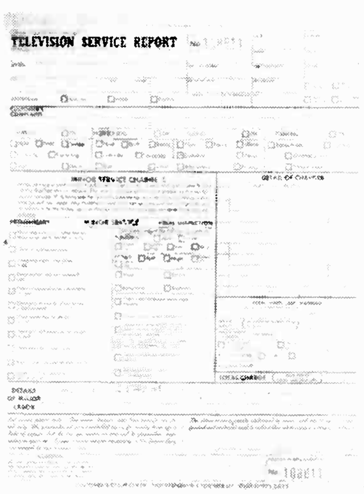
—RTM—

TV SERVICE REPORT

A TELEVISION service report, for use on servicemen's calls or shop work, is now available from Oelrich publications, 4135 North Lawyer Ave., Chicago, for technicians and service-dealers.

The report, which is a triplicate form with self-enclosed carbon paper, is part of a line of forms which includes blank TV job tickets, forms for service contracts, service records, and other bookkeeping helps for service businesses.

A four page catalog of the forms is available from the company on request.


TELEVISION SERVICE REPORT

—RTM—

NEW GHIRARDI BOOK

VERY occasionally, the receiver of technical books comes across a new volume that stands out from all the rest.

Such a book is "Radio and Television Receiver Circuitry and Operation," by Alfred A. Ghirardi and J. Richard Johnson. This work, which really covers the field, and still presents the important details, is one that should be in the reference library of every working serviceman.

In about 600 pages, these authors give information on just about every subject that is likely to be interesting to the radio or television technician. All the contents of the work are carefully listed both in a table at the beginning of the volume, and alphabetically arranged in the excellent index.

There can be little doubt that Mr. Ghirardi is among the leaders in the radio field, for completeness of presentation in his subjects, for clarity of language, and for technical accuracy. And his collaborator, J. Richard Johnson, a former staff member of RADIO AND TELEVISION MAINTENANCE, has undoubtedly given him the right kind of help.

The book, which is published by Rinehart Books, Inc., 232 Madison Ave., New York, costs $6.00, and is worth every cent of the price.

For an example of the completeness with which the authors go into their subjects, see what is provided in the subsection "Fm Tuning Indicators," in the chapter on FM receivers: about five pages of text covering what is desirable in FM reception and how it is obtained, plus a discussion of the 6AL7GT indicator tube and its operation; three schematic circuit diagrams; three response curves; six pictorial illustrations; and two block diagrams. All this is given in the one specialized section of the FM discussion. Yet this coverage is typical of the book.

As a successor to "Modern Radio Servicing," the volume is listed as the first of a series called the "Modern Radio and Television Service Library." Let's hope that the rest of the books in the series are as good as the first one is.

—A. G. S.

—RTM—

SHELF STICKERS

A MODERN tube shelf identification system is now available through Raytheon radio and television tube distributors.

Printed on pressure-sensitive adhesive labels in bold type are over 480 current radio and television receiving tube type designations, bound in standard booklet form for easy handling. The size of the labels has been determined as one that will fit most shelf-end surfaces and give maximum visibility.

Labels are designed to be easily detached from the book and affixed by the distributor or dealer to his stock shelves. Tube type designations are alphabetically arranged for quick selection.

—RTM—

TUBE DATA

THE "Bullet-in" holder for tube data is being furnished free to 20,000 distributors of radio and television equipment by Jackson Electrical Instrument Co., Dayton 2, Ohio, it was announced recently.

About two weeks after a manufacturer has made the characteristics of a new tube available, a test setting data bulletin is issued to distributors. Display of the bulletin enables customers to copy the data for use until a revised roll

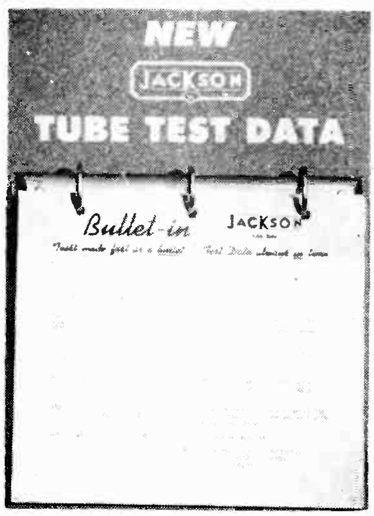


chart is issued. This is intended to keep dealers and technicians fully up to date on new tubes.

From time to time, the bulletins will announce when a revised roll chart will be ready. Then charts can be ordered by the Jackson instrument users who are no longer entitled to free chart service.

—RTM—

RIDER TV VOL. 6

JOHN F. RIDER Publisher, Inc., 480 Canal St., New York, has announced that the Television Manual, Vol. 6, is now available at distributors.

Sixty-six manufacturers contributed their servicing data for the period August, 1950-January, 1951. About 600 models are incorporated into the manual.

All information is accessible quickly through the use of the accompanying cumulative index for TV Manuals, Volumes 1 through 6.

The manual contains schematics, chassis views, tube layouts, voltage and resistance readings, alignment procedures, test patterns, waveforms, parts lists and parts values, listings of up-to-date changes for previously published data, boosters, tuners, etc. It is priced at $24.00.

—RTM—

GREYLOCK SUPPLEMENT

THE GREYLOCK Electronics Supply Co., 115 Liberty Street, New York, has announced its new catalog supplement, No. 15.

This new supplement brings the regular Greylock catalog up to date with the inclusion of the latest parts and accessories, including prices, for the radio and TV field.

Copies can be obtained by writing directly to the company.

—RTM—

TRANSFORMER CATALOG

THE Crest Transformer Corp. has just issued a new 1951 "Crestran" catalog.

On the 16 pages of this illustrated catalog will be found data on the entire Crestran line of radio, television, and electronic transformers.

The catalog can be obtained free by writing to Crest Transformer Corp., 1834-36 W. North Avenue, Chicago 22, Illinois.

—RTM—

PREVENTING ION BURNS

HOW to prevent TV screen damage by ion burns is described in a new brochure just issued by Sheldon Electric Co., division of Allied Electric Products, Inc., entitled "Ion Burns."

The pamphlet describes the ion trap, how ion burns occur and what can be done to prevent this trouble.

It also specifies five basic points to remember when adjusting the ion trap to prevent screen damage by ions.

The booklet entitled Bulletin T-2, "Ion Burns and How to Prevent Them," will be sent on requests made to Sheldon Electric Co., Irvington 11, New Jersey.

—RTM—

ENGINEERING BULLETIN

A NEW Engineering Bulletin is now being offered by Technical Appliance Corporation, Sherburne, N. Y., covering the application of the Taco "Special Twin-Driven Yagi" antenna in overcoming the problem of co-channel interference.

The new antenna is said to have a front-to-back ratio of twice that of the usual yagi antenna.

Engineering Bulletin No. 65 is available through Taco jobbers, or from Taco directly. Complete technical information as to gain and directivity is given in curves and graphs, while other electrical characteristics are written up in the accompanying copy.

FRONT-END DESIGN AND SERVICE

→ from page 8

the stage. An example of this is shown in Fig. 1. Note the changeable coils in the grid circuit of the RF tube. Thus, a tuned, balanced transformer is switched into the circuit for each channel to be tuned in, a great improvement over the untuned input circuits previously found in most commercial receivers.

Television local oscillators are not very different from the oscillators found in radio receivers. Stability, however, is a much more important factor in TV than it is in radio, since a drift which, in the same degree, would not be noticeable in a radio, could throw TV reception well off the desired point. The percentage drift in each case could be the same, but the more critical requirements of the TV IF system demand a closer adherence to the desired frequency. In television sets, the stability which is present is ordinarily due to careful mechanical construction and layout. Compensating components, such as condensers with negative temperature coefficients, are used also, to allow for normal warmup variations in values.

Mixer Stage

Mixing of RF and oscillator frequencies is done in the TV set just as it is in any other superhet. The amplified signal from the RF tube and the oscillator signal are fed into the grid of the mixer tube, which sends the converted signal into an IF transformer. In the circuit shown in Fig 1, where a duo-triode is used for both mixer and oscillator, the signal from the plate of the oscillator section of the 6J6 is returned to the oscillator grid directly through a winding of the transformer, L_5. The oscillator signal is inductively coupled to the grid winding of the mixer, L_4. As can be seen, the IF signal is then taken from the plate of the mixer triode.

Selector Types

At TV frequencies, lead length is so important that special care must be taken in factory production and design to insure that the tuning unit is as compact as possible. On the other hand, the unit must still be so constructed that the trimmer condensers or tuning slugs used for alignment are easily accessible. In tuners using switches to select the channels, the switch wafers are mounted very close to the tubes to which they are connected. As an example of a switch-type tuner, examine the RCA KRK2 tuning unit, which was used not only in the early RCA receivers, but in many other makes of receiver as well. In this tuner, as in others, the tuned-line principle of tuning is used. That is, the coils are connected in series, and the switch contacts travel down the series, shorting out coils as higher channels are tuned in. Conversely, the "shorting bar" which is formed by the switch contacts re-inserts coils into the circuit as the channel selector is turned back down to the lower frequencies.

Now, a coil for one of the high-frequency channels is just a short piece of wire; consider the effect that an equal piece of wire, in the form of a pigtail lead on a resistor or condenser, has on the resonance of the circuit. The inductance value of even a short lead to a small component may be as large as the value of one of the tuning coils. For this reason, plus that of stray capacitances, which further upset the data theoretically assigned to a tuner design, it is obvious that lead length is more important here than in any other branch of commercial radio.

Similarly, the fact that the placement and length of these components is so highly critical, demonstrates why it is so essential that the serviceman must not disturb the parts in the positions where they were placed at the factory. It is easy to see why TV tuners are so often built on separate subchassis; in a a good many cases, it pays the technician to replace the entire tuner when it is defective, rather than to try to replace individual faulty components within the tuning unit.

Permeability Tuning

Among continuous TV tuners, an interesting version is one in which the inductance of the coils is varied by changing the permeability of the core. This is done in the Belmont tuner, where the mechanism of the unit consists of powdered iron slugs which move in and out of the coils. The trouble with this design is that single coils, thus varied, cannot cover the entire television range. Therefore, the tuner must include two sets of coils, which are switched in and out automatically when the line between the TV bands is crossed. A similar problem, that of adequate coverage of the bands, is encountered in the tuner produced by the Variable Condenser Company. Here, the tuning is done by means of flat coils. The coils are printed on plastic, and copper plates like those in a variable condenser, are rotated to change the values of the coils. But again, the change only covers one band

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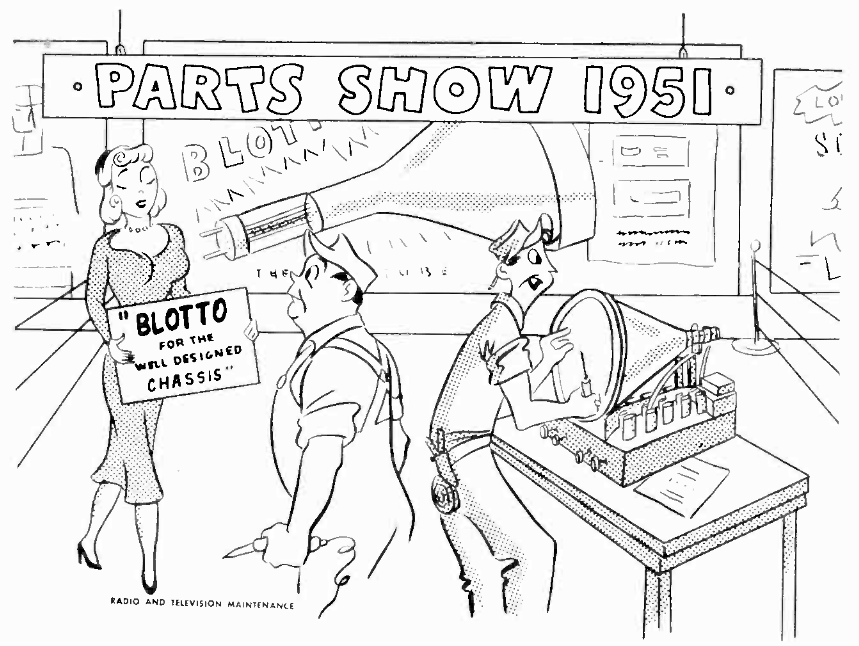
the maintenance mill



"No, Herbert, **this** is the chassis the boss wanted us to look over before the show opened."

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.

HORIZONTAL HOLD TROUBLE

A few months back, Reader Bernard J. Hellman wrote in a problem he had with a horizontal hold control. on a Model 255 Teletone TV set.

Mr. Hellman said the picture ran horizontally almost constantly, and that he couldn't do anything to repair it.

A solution was suggested in a later issue by Roy T. Fischel. who explained that he'd had a similar difficulty with a receiver, and described the method he used to get the set into proper condition.

Reader Joseph M. Rice wrote in to say that he doesn't agree with Mr. Fischel's analysis of the trouble. In his letter, he also suggests an answer to a trouble that Mr. Fischel had, a hum bar on a Motorola 16-inch set.

By way of encouragin such discussions among readers over difficult servicing jobs, which often have more than one good answer, this department is herewith printing Mr. Rice's letter, and sending him its $3 second prize for an answer to a service problem:

GENTLEMEN:

Regarding the TV problem of Mr. Bernard J. Hellman—his problem was a very critical hold control of the horizontal oscillator. Roy Fischel's answer doesn't seem to fit the case.

It is granted that plate saturation of one of the IF stages or any other condition that could cause limiting action could destroy the sync pedestal and could be overcome by jumping that stage.

But the problem specified horizontal troubles. It seems to me that the discriminator or phase detector of the control circuit of the horizontal oscillator was where the trouble originated. It seems too that it definitely indicated a lack of control voltage on the oscillator grid. This could have been caused by lack of sync pulses or an unbalanced condition of the 100,000-ohm resistors, or anything that would disable the phase detector.

Regarding the Motorola 16VK7R set that Mr. Fischel had trouble with, he stated that there was a hum bar (I assume he meant 60-cycle) on the pix tube on channels four and five, but not on channels seven and nine. Thus the trouble is isolated to the front end, because it occurs only on the low band.

After checking the diagram, I found that the high-band coil section is separate from the low-band section. It is my belief that there is either a short from the filament RF choke to the low-band coils of the RF stage, or that there is severe induction from the filament choke to these coils.

Even a tube short could cause this on the low band, but I believe that it is a filament short.

—JOSEPH M. RICE,
Covington, Kentucky.

ANTENNA STACKING

GENTLEMEN:

I have three four-element Yagi antennas, one cut for channel three, the second cut for channel six, and the third cut for channel 10.

How could any two of the antennas be stacked vertically?

Also, could all three antennas be stacked vertically?

Or can they be stacked horizontally?

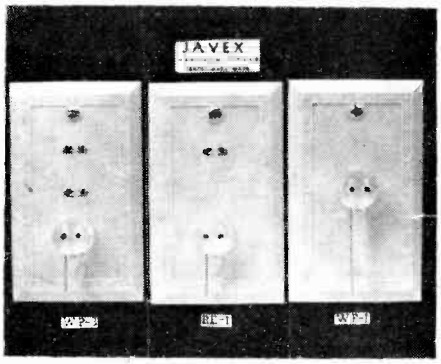
—ROY WALZ,
Easton, Pa.

Products for the Trade

→ from page 15

twin lead has to be run on the surface, then the surface box, being scored and recessed, will accept the leadin from any direction.

Also available are double and triple arrangements for multiple and bi-directional installations.

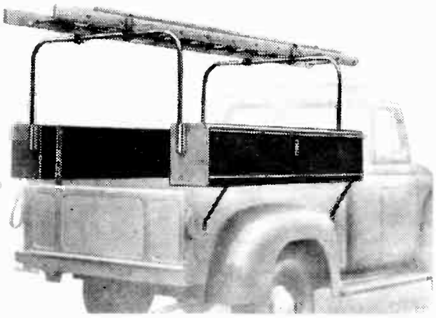


— RTM —

UTILITY COMPARTMENTS

Compartments of all-steel construction are now available for converting the standard pick-up truck body to a service body, with accommodation for tools and materials.

Described as "Model 50" by Artisan Products, the manufacturer, the com-



partments come equipped with bins and shelf arrangements, with compartment door locks and mounting brackets. The equipment is reported to be easily installed on the truck body.

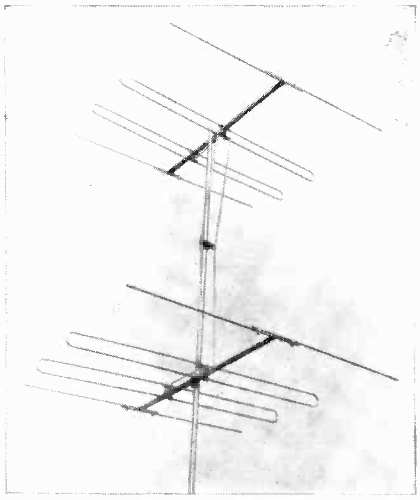
Descriptive literature is available from Artisan Products, Inc., 3495 West 140th st., Cleveland 11, Ohio.

— RTM —

TWIN-DRIVEN YAGI

The first antenna designed to minimize, and in many cases entirely eliminate, co-channel interference, has been announced by Technical Appliance Corporation, Sherburne, N. Y. The new antenna provides a front-to-back ratio of 30 Db, according to the maker.

The new antenna is designated the "Taco Special Twin-Driven Yagi." The



design is said to sacrifice no forward gain, yet to maintain an average of 30 Db front-to-back ratio throughout the entire 6 megacycle bandwidth of the channel for which it is tuned. Terminal impedance has been maintained at 300 ohms to match standard leadin.

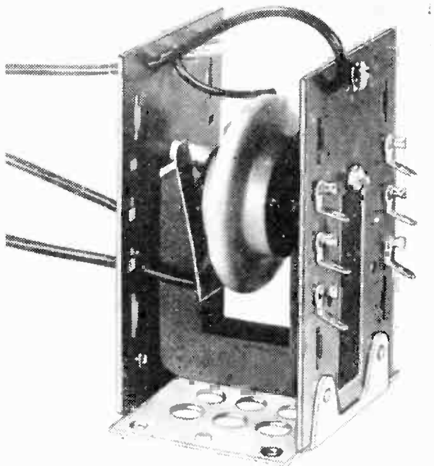
Available for any of the low-band channels, the unit may be used as a single antenna, or as a stacked array. The elements consist of a director, two driven elements, and a reflector. Terminals are located on the rear driven element.

— RTM —

FLYBACK TRANSFORMER

RAM Electronics, Inc., South Buckhout Street, Irvington-on-Hudson, New York, has just announced release of a new Flyback Transformer for replacement and conversion.

The new RAM XO45 is specifically designed as a replacement transformer



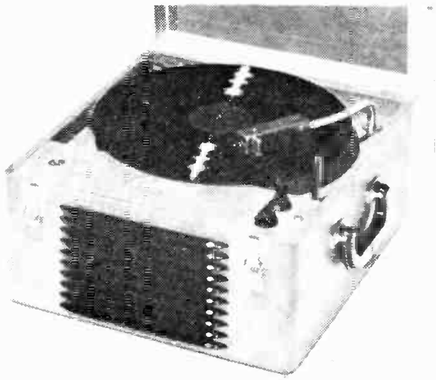
for all TV receivers originally using 1B3 or 6BG6 tubes. For 16″ and 20″ round and rectangular tubes, it generates 12.5-14 Kv and 13.5 Kv respectively, with horizontal sweep sufficient for 20″ picture tubes.

PORTABLE RECORD PLAYER

A new manually operated, three-speed record player, incorporating many features of their transcription-player line, has been developed by the Califone Corporation, Hollywood, California.

Designed for lightweight portability, the new unit weighs less than a portable typewriter and reproduces music and voice from either 33-1/3, 45 or 78 rpm records.

It features a new printed-circuit amplifier, a 6-inch oval PM speaker, tone control, and incorporates Califone's

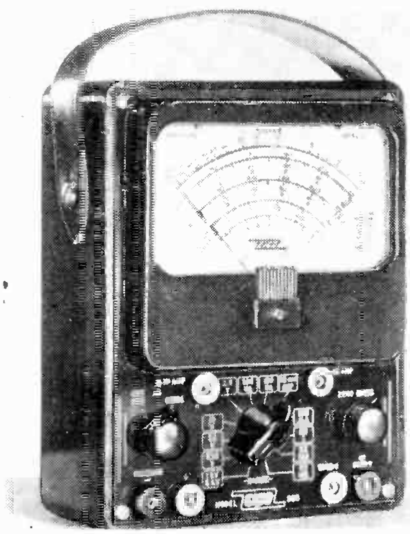


"wrist-action" pick-up, which is claimed to provide perfect tracking of the finest record grooves.

Cover of the case can be closed while playing 12-inch records. The unit is equipped with a special connection for addition of separate amplifiers, headphones or an additional loudspeaker.

— RTM —

MULTIMETER



The new 20,000 ohms-per-volt Multimeter, Model 555, just released by the Electronic Instrument Co., Inc., 276 Newport Street, Brooklyn 12, N. Y., incorporates 31 different ranges.

The 4½-inch meter has a 50 μa D'Arsonval movement. All resistors have 1% or better accuracy. The integral

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FRONT-END DESIGN AND SERVICE

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at a time, and a switch, this time a manual one, is provided to cross over from one band to the other.

One of the most important continuous tuner designs, that of the Mallory "Inductuner," utilizes coils mounted on ceramic forms. The coils are rotated, and a contact shorts out part of the turns. In the newer Inductuners, a special transformer is used, which permits either 75 or 300 ohm input. The use of a sliding contact was at first troublesome in this tuner, since the contacts sometimes became noisy; but the difficulty was eliminated in later models of the unit.

Advantage of Continuous Tuner

A great advantage of the continuous tuner is that it permits easy inclusion of the FM band in the coverage of the receiver: with the Mallory unit, for example, in the models of the tuner that cover the spectrum from the low end of the low band to the high end of the high band, no extra parts are necessary to permit reception of the 88 to 108-Mc FM band. In this way, the usefulness of the receiver is greatly improved without materially adding to the production cost.

The third major division of TV tuners, the turret variety, is the type used in Philco units, in the new RCA printed-circuit device, and in the Standard Coil Products Co. tuner diagramed in Fig. 1. In the Philco tuner, only eight positions of the turret are possible, and the frame of the rotating unit is octagonal in shape. The coils snap into place in the frame, with protruding contacts to connect with fixed contacts mounted on the chassis of the unit. Since only the eight positions are available, not all channels can be received on the same set without changes; but no more than eight channels will be available in one locality in any case. With the coils mounted on separate plates, which fit into the rotating frame, a set can be quickly adjusted to bring in the available channels in a listening area by the serviceman.

Printed-Circuit Tuner

The RCA printed-circuit tuner has a great inherent advantage over units with wirewound coils, because the printed coils (described in RADIO AND TELEVISION MAINTENANCE, June, 1950) can be manufactured within much closer specifications than wire coils. Hence, very little alignment is necessary. As is the case with the Standard Coil tuner, the input to this unit permits use of either a 300-ohm twinlead or a 72-ohm coaxial line.

—RTM—

FIX ON THE FACTS

→ from page 19

procedure is as follows:

Remove the four twist snaps along the tuner case and take off the aluminum cover. Apply copious quantities of carbon tetrachloride with a camel's hair brush to the sections of the Inductuner, to wash away completely all traces of dirt and lubricant. After the cleaning fluid has completely evaporated, coat the tuner with Standard Oil Company's #15 Lubricant. This oil has been especially selected because of its excellent lubricating and low noise qualities. In addition, it contains no sulphur components to tarnish the silver contacts and ribbon, nor will it adversely affect the Q of the tuned circuits. The cover should be replaced immediately after oiling so that no dust will collect on the oiled contacts.

In conclusion, the writer wishes to acknowledge his indebtedness to the P. R. Mallory Company for their many suggestions and factual information in preparing this article.

—RTM—

Begins Government Program

NEW YORK—Ira Kamen, director of electronics of the Brach Division, General Bronze Corporation, announced the negotiation of subcontracts for several million dollars' worth of radar, electronic and electrical equipment from various radio and automotive manufacturers who are prime contractors.

The Brach and other divisions of the company will manufacture radar antennas, radar control pedestals, radar direction finders, servo amplifiers, servo systems, ordnance cable harnesses, electric control boxes, radio whip antennas and other accessories.

—RTM—

Speaker Department Enlarged

NEW YORK—Because of increased demands for service, Leotone Radio Co., of this city, has announced the expansion of its Speaker Repair Department. The new facilities will allow most of repairs to be completed within 24 hours, it was reported.

Products for the Trade

→ from page 24

rectifier is hand-calibrated and hand tested.

The instrument is housed in a Bakelite case and panel, into which figures and symbols are imbedded for long wear and legibility.

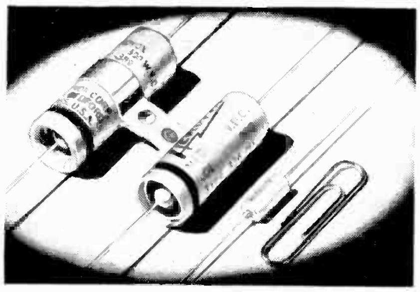
Ranges of the meter include: DC voltage—0-2.5, 10, 50, 250, 1000, 5000, at 20,000 ohms-per-volt. AC voltage: same ranges, at 1000 ohms-per-volt. Output voltage: same ranges, with 0.1 mfd internal series condenser. Decibels: −12 db to −55 db, in 5 ranges. DC resistance: Rx1, Rx100, Rx10,000. DC current: 0-100 μa, 10 ma, 100 ma, 500 ma, 10 A (250 millivolts).

DC accuracy is 3% of full scale. AC accuracy: −5% of full scale.

The instrument is available factory-wired or in kit form.

—RTM—

SMALLER, TOUGHER CAPACITOR



Aerovox Corporation, New Bedford, Mass., has announced production of a new miniature capacitor with a higher temperature rating than previous items.

The Type 123Z tubular is rated at an operating temperature of 85° C., and can be operated at 100° C. In its .01 mfd., 200-volt value, it measures just .175 by 7/16 inch. It has a vitrified ceramic sealed metal can.

The new unit compares with earlier models, in the same value, measuring 2-3/16 and 1⅛ inches long, respectively.

—RTM—

WIDEBAND SWEEP GENERATOR

To speed up, and at the same time give more accurate alignment of video and other wide-band amplifiers, Kay Electric Company, Pine Brook, N. J., has engineered and is manufacturing a new wide band sweeping oscillator. It is called the Marka-sweep-model video.

Its features include two bands selectable by front panel switch—50 Kc to 10 Mc and 50 Kc to 20 Mc; pulse type markers connected directly to oscilloscope crystal positioned at 1, 2, 5, 10, 15, 20 Mc; output of 0.3 volts, 72 ohms; all-electric sawtooth sweep; sawtooth available for sweeping oscilloscope; output flat within 0.1 Db per megacycle; continuous and switching output signal attenuator.

—RTM—

CONDENSER PACKAGE

The "Domepak," a double-purpose package containing five "Telecap" molded tubular capacitors of the same value has been introduced by the Sprague Products Company, North Adams, Mass.

Decorated in blue, white and orange, the pack consists of a clear plastic protective dome container mounted on heavy cardboard backing. The capacitors are thus kept in optimum condition.

Five values of 600-volt molded tubulars .005, .01, .02, .05 and .1 mfd. are available in the pack.

—RTM—

UNIQUE HOLDING JIG

To surmount some of the "watchmaker" problems of holding, building up and soldering delicate mechanisms, Potter and Brumfield, relay manufacturers, have developed a unique ball-and-socket universal holding jig. A small vise, closed by means of an eccentric cam at the flip of a finger, is mounted on a 20-pound steel ball the size of a croquet ball. The device "floats" freely in a flat stand, which is cut to receive the ball. The result is a small vice that is easily rotated, twisted or turned to any desired position while firmly securing the item under construction. Potter and Brumfield machinists fabricate the entire unit, including the steel ball.

—RTM—

TV INSTALLATION KITS

A series of eight television antenna installation kits, designed to meet practically all receiving requirements in either primary service or fringe areas, was announced by the Insuline Corporation of America, 36-02 35th Ave., Long Island City, N. Y.

The simplest kit contains a single conical aerial, a five-foot steel mast, and fifty feet of lead-in-wire. The others are progressively more elaborate, the largest kit containing a stacked conical aerial, ten-foot mast, base mount, guy wire, 100 feet of lead-in, lightning arrestor, clamps, insulators, and other accessories.

All the kits are packaged for ease of handling by both jobber and user.

—RTM—

Resistor Ohmages Extended

Clarostat "PR 5 F Greenohms"—five-watt fixed wirewound resistors with the characteristic inorganic-cement coating—are now available in the increased resistance values of 8000, 8500, 9000 and 10,000 ohms. Heretofore the top resistance value has been 7,500 ohms.

In the Series "AC 10 F or 10-watt Greenohms," 9000 ohm value has been added between the 8500 and 10,000 ohm numbers.

FUNCTIONS OF TELEVISION TUNERS

→ from page 7

beating of these two signals a third signal of lower frequency results.

It would be most economical to use a single tube both as an oscillator and mixer, as is usually done in low frequency circuits. However, at the higher frequencies employed for TV, the conventional pentagrid converter circuits do not perform satisfactorily. It is therefore necessary to use separate oscillator and mixer tubes. The energy from the RF stage and the oscillator may be inductively or capacitively coupled to the mixer, or a combination of both methods may be used.

Either triode or pentode tubes may be employed as mixers, but lately the triode mixer has been most frequently used. The tube used is generally a dual triode, half of which is used to produce the local oscillator signal. Better signal to noise ratio may be obtained by keeping the plate current low and the voltage from the local oscillator reasonably high. Frequently used tubes are the 6J6, 7F8, 6C4, and 6CB6. Crystal diodes are particularly useful as high frequency mixers, but are not used for present day TV frequencies because they provide no gain. They will, however, probably be used as mixers in tuners for the new UHF channels. The extra gain may then be obtained in the IF stages.

Since the frequencies at which the local oscillator in a TV receiver operates are very high, the distributed capacitance of the circuit, as well as the interelectrode capacitance of the oscillator tube, becomes an important factor in the operation of the circuit. An oscillator is essentially nothing more than an amplifier where a sufficient amount of the output is fed back into the input in the proper phase to overcome the losses of the circuit and sustain oscillation. There are a great number of oscillator circuits to choose from, and each of them has certain frequency ranges over which it will perform most efficiently. The two basic requirements of the oscillator are that it be very stable and produce sufficient voltage for efficient operation of the mixer stage.

Fig. 5A shows the floating-cathode Hartley oscillator. This circuit is very extensively used in present day broadcast receivers, and though it is a very excellent oscillator for lower frequencies, it is not particularly adaptable as a local oscillator for TV tuners. Perhaps the most frequently used circuit is the ultraudion oscillator. This circuit, as shown in Fig. 5C, is very similar in operation to the Colpitts oscillator shown in 5B. Instead of the split stator condenser shown with the Colpitts oscillator, the interelectrode capacitance of the oscillator tube is utilized to provide the proper feedback voltage. The ultraudion oscillator has the distinct advantage of requiring only a single untapped coil. Thus the problem of channel selection is greatly simplified.

Another very popular oscillator circuit used in TV tuners is the push-pull oscillator shown in Fig. 5D. The circuit is very similar to that of the push-pull RF amplifier discussed previously. Feedback is provided by the two 4.7 mmfd condensers C_1 and C_2.

A compensating condenser with a negative temperature coefficient is sometimes connected across the oscillator tuned circuit. This compensating condenser is used to take care of a slight increase in the capacitance of various oscillator circuit components during the warmup period. If this capacitance change were not corrected, it would cause the local oscillator frequency to change. As a result the sound IF signal might drift out of the bandpass of the sound IF stages and cause loss of sound. This particular type of trouble is not experienced in intercarrier receivers, since the sound IF is not determined by the local oscillator frequency, but rather by the difference in sound and picture carrier frequencies.

The mixer output circuit used depends on whether the receiver has intercarrier of conventional sound. If the receiver has "split" sound, the sound IF signal must be obtained from a sound take-off circuit in the output of the mixer, where a sound trap is used. This trap serves the dual purpose of supplying a signal to the sound IF stages, and of preventing the sound signal from causing interference in the picture circuit. The mixer output may be series or shunt tuned, or transformer coupled. In order to reduce adjacent channel interference, a series resonant trap is sometimes used in the mixer output. This trap is tuned to the adjacent lower channel video carrier. Once adjusted, it is effective for all channels.

Alignment and Troubleshooting

Tuner troubles may be broadly divided into two categories: mechanical and electrical. Mechanical repairs, as the name implies, consist of adjustments, lubrication, cleaning and replacement of springs, detents, wafers, etc. Before attempting any repair or alignment of the tuner, it is important to establish the fact that there actually exists a defect in this portion of the receiver. Furthermore, before attempting any alignment it is necessary to know the exact location of the various trimmers and slugs, and to have accurate and reliable equipment available.

The first thing to do, if the trouble is not of a mechanical nature, is to try several known good tubes, one at a time, and observe any improvement. If new tubes do not remove the trouble, a signal generator together with a VTVM or oscilloscope may be used to locate the defect. If the set is completely dead, the trouble is most likely in the local oscillator and the signal generator may be used to supply a substitute signal. If the signal from the generator is fed into the mixer at the point where the oscillator voltage is applied and an antenna is connected, a station signal should come in.

If the trouble is poor sensitivity, connect the VTVM across the video detector load resistor. With the generator set to the center frequency of the channel to which the set is tuned, adjust the generator output for about 2 volts DC on the meter. Now move the generator lead back towards the antenna terminals and observe the meter. At the RF amplifier grid, the meter reading should be much greater due to added gain of the RF stage. When checking the tuner in this manner, the AVC circuit should not operate and a fixed bias voltage from about 1-1/2 to 4-1/2 volts should be used. Fig. 6 shows the proper connections between the tuner and the test equipment required for front-end servicing. The ground connections between the various units should be made with care, and if possible to one point on the chassis. If touching various parts of the chassis changes the waveshape, it indicates an improper ground connection, which should be corrected.

—RTM—

SERVICING THE VIDEO IF

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It must be clear, however, that incorrect alignment is not always the primary reason for poor IF response. Off value damping resistors (across the tuned circuits) open plate, screen, and grid return bypass capacitors, open coupling capacitors, off value coupling components, regeneration and feedback, all affect IF response in one way or another. Abnormal bias on one or more IF tubes may be due to a leaky coupling capacitor or to a defect in the AGC circuit.

Increasing IF Gain

There are several things which may be done in an IF stage to increase the gain:

1. In a stagger-tuned amplifier, it may be possible to realign the stages to give less bandwidth. The greater the gain in an IF stage, the less the bandwidth, and the more the bandwidth the less the gain. Take a good receiver with four stages of stagger tuned IF with a 4.0 Mc bandwidth and realign it to provide only 3.0 Mc bandwidth. The gain will increase sufficiently to bring in a good picture and the loss in bandwidth will be compensated for by the voltage gain, in signal quality.

It may be necessary to tune coils to slightly different frequencies to avoid regeneration. For remote fringe area reception, the IF may be peaked to 23.5 Mc and 25.0 Mc respectively to provide a 2.0 Mc bandwidth; this won't be good, but it is much better than nothing at all.

2. Increase the voltages at which the circuits operate. Seldom are IF amplifiers operated at their maximum permissable ratings. It is common to operate the tubes with 125 to 150 volts on the plate. This may reasonably be increased to 175 or 200 for most of the tubes. Consult a tube manual to be sure a given tube will operate at the proposed higher plate and screen voltage.

Adding about 1.5 volts of positive DC in series with the AGC bias will help overcome residual bias due to noise.

3. Substitute other tubes. 6AG5, 6AK5, or 6CB6's will improve the gain because these tubes provide more than the usual amount of IF amplification. The 6AK5 and the 6CB6 are excellent tubes that produce phenomenal amplification.

Tube Substitution

If a 6AG5, a 6AK5, or a 6CB6 is substituted for another type tube in an IF stage it is absolutely necessary to realign the entire stage, because the interelectrode capacitances of these tubes vary. Some rewiring may be necessary and some change in bias may be desirable.

When the grid bias of an IF amplifier is changed to vary the gain, both the input capacitance and the input conductance of the tube vary also; the shape of the pass band changes. To compensate for such changes with the 6CB6, an unbypassed cathode resistor should be used, because this tube has a separate grid 3 connection. A 47-ohm resistor is just about optimum, but because it is too small in value to provide proper bias, it is desirable to supplement with fixed bias, or with additional cathode bias supplied by a 130 ohm bypassed resistor. The 6CB6 tube works best with fixed bias of –1 to –4 volts in the IF strip.

With the 6AK5 and the 6CB6, it is difficult to ground the screen grid effectively because of the inductance effect of the screen grid and the bypass capacitor lead. The use of a button mica here is important. It may be possible to adjust the lead inductances so that they are in series resonance with the bypass capacitor for effectively grounding the screen grid. This is helpful, because it works at only the frequency you are dealing with in a given IF stage.

EDITORIAL

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other wires go (assuming he gets the right ones for the conversion in the first place)?

Let us not forget those fatal voltages lurking in the TV receiver!

The public now maintains a healthful regard for the intricacies of the TV set. Let's not try to change this view.

As radio technicians, we want to aid the progress of our industry. We have no objection to home conversion to UHF, color, three-dimension, or anything else the inventors might conceive. But, Mr. Manufacturer, if you want the householder to do it himself, let's make the conversion with a simple jack and plug . . . and advertise *that!* Keep the screwdriver out of the owner's hands!

—RTM—

CHECK UP ON TV TUNERS

→ from page 10

equipment on a grounded metal-top table or bench.

Resistors R_1 and R_2 are employed as a dummy antenna to match the sweep generator output impedance to the tuner input impedance. These are 1-watt carbon resistors and each has a value in ohms equal to half the difference between Z_1 and Z_2, where Z_1 is the tuner input impedance and Z_2 the sweep generator output impedance. As an illustrative example, consider a sweep generator with 75-ohm output impedance which is to be coupled to a tuner with 300-ohm input impedance. Here, $Z_1 = 300$ and $Z_2 = 75$. $Z_1 - Z_2 = 300 - 75 = 225$ ohms. One-half of this value equals $225/2 = 112.5$ ohms. Each resistor accordingly should have the value 112.5 ohms. In practice, the nearest integral value may be used.

The sweep generator is set to the center frequency of the channel selected (See Table 1) and is adjusted for maximum output—at least 0.1 volt. Prepare the oscilloscope in the following manner: (1) Set the VERTICAL and HORIZONTAL GAIN controls to about half maximum. (2) Set the SYNC switch to its INTERNAL position. (3) Set the SYNC AMPLITUDE control to about three-fourths maximum. (4) Switch off the internal sweep of the oscilloscope. (5) Set the INTENSITY, FOCUS, HORIZONTAL CENTERING, and VERTICAL CENTERING controls to their normal operating positions.

Set the unmodulated marker generator a few megacycles below the low-frequency band limit of the selected channel (See Table 1) and reduce the output of this generator to zero.

The following procedure is recommended for the visual alignment: (1) Tune the sweep generator carefully to the center frequency of the selected channel. (2) Set the generator sweep width to between 8 and 10 Mc. (3) Unless the tuner is considerably misaligned, a selectivity pattern similar to Fig. 2A will be seen on the oscilloscope screen. In many cases, the image will be inverted, as in Fig. 2B. If the tuner is badly out of line, the trimmers or slugs will have to be adjusted to produce the pattern. (4) Adjust the phasing control of the sweep generator to give *one* single-lined image on the oscilloscope screen. (5) Adjust the VERTICAL and HORIZONTAL GAIN controls of the oscilloscope for a pattern of satisfactory height and width. (6) Note that the response curves are reasonably flat-topped. Tune-in the swept signal more carefully with the fine tuning control of the tuner, if necessary. (7) Now, tune the unmodulated marker generator to the video carrier frequency of the selected channel and increase the marker generator output slowly. Note that a pip or wiggle appears on the response pattern, as shown in Fig. 2C. (8) Tune the marker generator to the sound carrier frequency of the selected channel, noting that the marker pip now moves to the other hump of the curve. Use the lowest possible marker generator output which will give a visible pip on the pattern. Too strong a signal will distort the pattern, failing to give a true picture of tuner response. The video and sound carrier frequencies are given in Chart II. (9) Consult the receiver or tuner manufacturer's alignment data for proper positions of the marker pips on the curves. (10) Adjust the trimmers or slugs of the tuner, in accordance with the manufacturers' service notes, to give the proper flat-top characteristic to the curve. (11) inspect the response curve for each channel setting of the tuner.

The frequency at any point along the tuner response curve may be determined by tuning the marker generator to place a pip at the point of interest. The frequency of that point then is read directly from the dial of the marker generator.

Oscillator Alignment with VTVM: When the oscillator only is known to be out of adjustment and the tuner is installed in the receiver which otherwise is in operating shape, a DC VTVM may be employed in the following manner: (1) Set the meter to its 0-3-volt range and connect it to the output of the ratio detector or discriminator in the second channel. (2) Connect an unmodulated signal generator to the antenna input terminals of the receiver. (3) Set the signal generator carefully to the sound carrier frequency of the channel to which the tuner is set. Table 2 shows the correct frequencies. (4) Adjust the oscillator trimmers or slugs for zero reading of the meter. Since the detector to which the meter is connected is an FM stage, the meter will be deflected upward (positively) when the oscillator adjustment is off in one direction, and downward (negatively) when the adjustment is off in the other direction. When the oscillator is adjusted correctly, the FM detector will have zero DC output and the meter accordingly will read zero.

Installation of New Tuner: It often will be feasible to replace the tuner unit completely when repairs cannot be made profitably. In such cases, the old tuner must be removed from the receiver with the least disturbance to other adjacent wiring and components. An exact replacement tuner should be used whenever possible.

Every effort should be made to install the new tuner with the connecting leads in the same positions they occupied with the old tuner. At television frequencies, lead dress often is important in duplicating results. Since the connecting leads usually are of stiff, solid hookup wire, they may be unsoldered carefully from the old tuner and left extending in their approximate original positions to be reconnected to the new unit.

Even when the new tuner has been factory-aligned, its performance may be expected to be below par until adjustments have been made in the receiver. This condition is due to stray capacitances in the receiver. Top performance may be secured by slight touching up of the various trimmers or slugs in the tuner according to the alignment instructions given previously in this article.

Bear in mind that the criterion of correct performance is not laboratory results but actual behavior of the receiver when the new tuner has been installed. For this reason, any job of tuner replacement or alignment cannot be considered completed until a careful check has been made with the receiver tuned to a test pattern on each channel.

—RTM—

SUBMINIATURE LF RECEIVER

→ from page 11

To facilitate mass production, seven detachable subassemblies, each of which can be built independently, are employed in the receiver This also permits somewhat easier servicing The subassemblies are fastened to one another and to the front panel, which takes the place of a chassis.

Uses Printed Circuits

Printed circuits are used to a considerable extent. They are of value both in conserving space and for economical mass production. The wiring is printed on steatite or silicone-impregnated fiberglass.

Hermetic sealing of the entire unit affords protection against moisture and contamination. It also permits elimination of protective coatings for the individual components, which saves space. A soldered copper band seals the housing to the front panel; this band can be removed for repair purposes with a key of the type used for opening coffee cans. The air in the unit was replaced with nitrogen before sealing to prevent any possibility of oxidation.

The bushings of the two shafts projecting from the front panel for control purposes also had to be hermetically sealed, and this presented a serious problem. The solution finally devised made use of commercially available rotary seals of the "wobbling-bellows" type. As these were too large to be enclosed in the unit, they were housed in the control knobs, which must be of conventional size for easy manipulation, particularly when the operator must wear gloves.

Engineering Problems

The tuning of the receiver over its wide operating frequency range was a difficult engineering problem. A straight-line tuning characteristic (frequency proportional to control angle) was required, and this could best be attained in the limited space allowable by the use of a variable-pitch screw to drive the slugs in and out of the radio-frequency coils. These screws were readily produced on a standard lathe fitted with a special linear cam attachment designed by Robert O. Stone of the NBS staff. The tuning slugs are made of the newly developed ferrite base materials, more stable at high temperatures than powdered-iron cores. It was expected that production control of these new materials might present a difficulty; mechanical means were therefore provided in the tuner to compensate for possible nonuniformity of core material.

The IF transformers have an over-all size of 1/2 by 1/2 by 1-3/8 inches. They are double-tuned and use permeability-tuned inductors of about 2.8 millihenries, which have Q's of 70 at 135 Kc. The resonating capacitors are washer-shaped and mounted in the ends of the transformers. The RF coil structures resemble those of the IF transformers so that similar parts may be used in both.

High-temperature capacitors of the tantalum electrolytic type are used for the large-capacity applications. Glass dielectric bypass capacitors are also employed. Both steatite and silicone-impregnated fibre glass serve as insulating materials. The audio-frequency transformers (two are needed) and chokes (two line-hash filter-chokes are used) employ high-temperature insulating materials and ceramic-insulated wire, and are impregnated with silicone varnish.

Panel controls involved yet another problem: the small size of the panel (5-3/4 by 1-7/8 inches) and the need for hermetic seals made it undesirable to have more than two external controls. Since one of these was required for tuning, the other had to fill the three distinct functions of gain control, on-off switch, and beat-frequency-oscillator on-off switch. All these latter functions are performed by a special compact switch, designed to be produced entirely by stamping operations.

Special Gain Control

The specially designed miniature gain control uses a high-temperature adhesive-tap resistor, also developed by the National Bureau of Standards. The tape is applied around a small glass cylinder, 3/16 inch in length and 1/2 inch in diameter, on which 120 axial lines of silver paint have been deposited to form commutator segments. A precious-metal brush makes contact with the projecting ends of these silver lines.

Aside from its inherent usefulness as an ultra-compact piece of airborne communication equipment, the new range receiver has also served as the focal point for the development of several novel components and fabrication techniques. These components, engineered to meet the rigorous size and temperature requirements of subminiature equipment, may well afford superior permanence and reliability when used in equipment of more conventional and less compact design.

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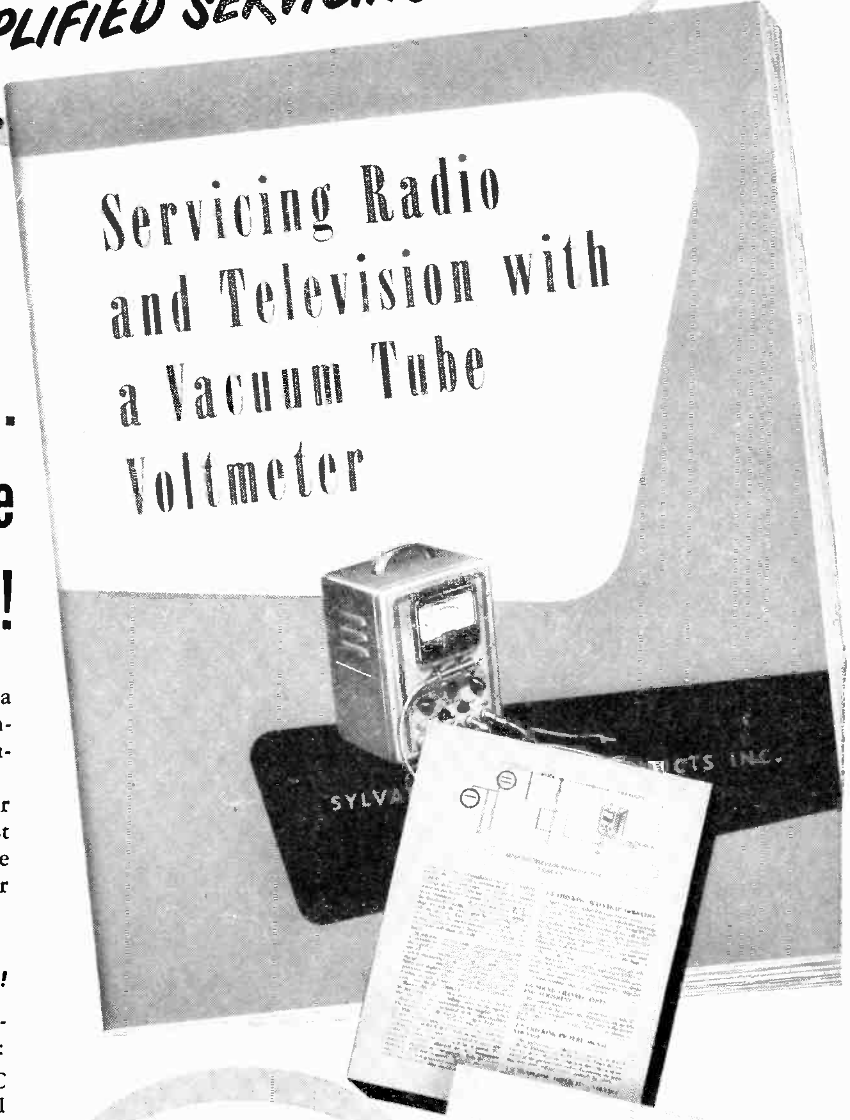

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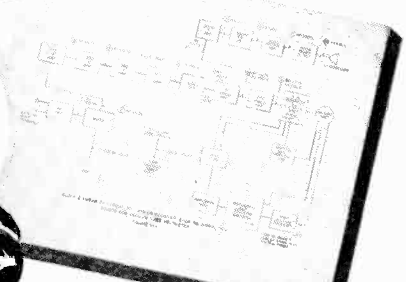

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