MARCH 1955

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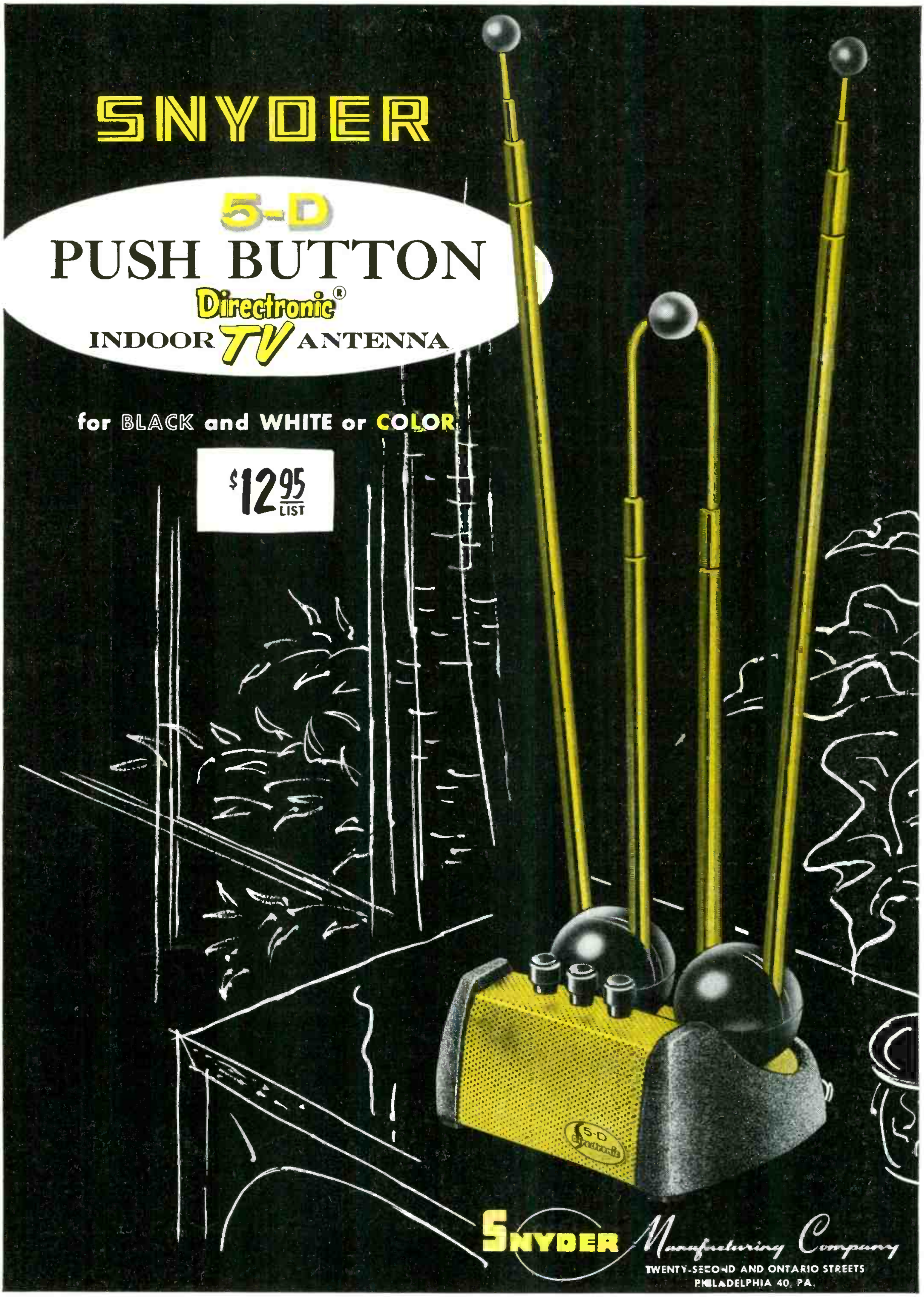
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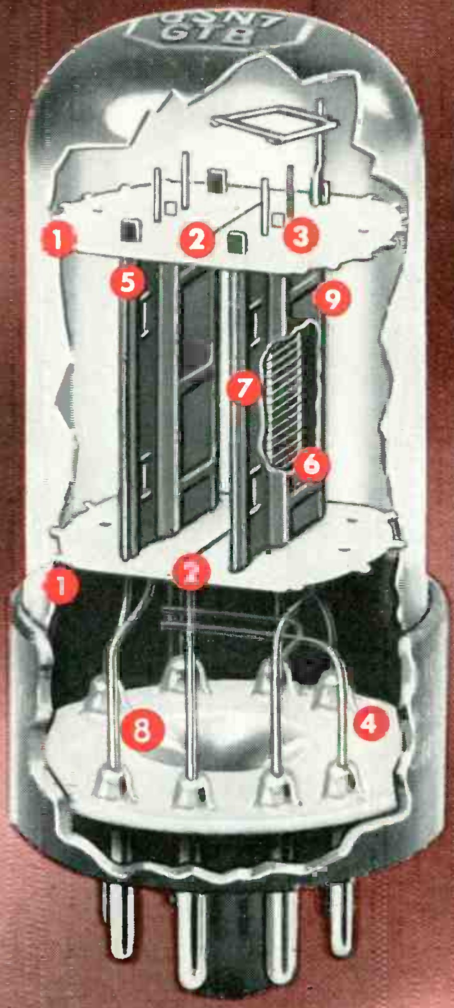

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VOL. 16, NO. 3 MARCH, 1955

FEATURE ARTICLES

CIRCUIT AND SERVICE FORUM

DEPARTMENTS

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EDITORIAL...

by S. R. COWAN
PUBLISHER

Wholesale Servicing Opposed

Our Nov. 1954 editorial disclosed that additional income is being obtained by many large service firms who now specialize in or make a practice of doing service work for less competent technicians or for smaller service firms which are either undermanned or overloaded with repair jobs.

This published observation brought an avalanche of critical letters from subscribers who are adverse to the practice of wholesale servicing. Having evaluated the many opinions expressed we are now inclined to believe that our critics have made out a very good case against the practice.

Practically every one who wrote stressed that in his own particular community there are many legitimate, ethical and responsible service firms who are successful despite the great competition—and that in addition there are a very large number of part-time servicemen who as a general rule provide irresponsible and unethical price-cutting competition. This group of part-timers, it seems, in the majority of cases, either because of incompetence or lack of proper test equipment, have "loused up" jobs so badly and so often that they must call upon real professionals to get "bailed out" of their self-imposed jams. That is—some of the more responsible part-timers seek professional aid whereas the irresponsible part-timers generally do NOT—and from this stems the greatest danger—the public's condemnation of the service profession as a whole.

An established service firm quite naturally tries faithfully to satisfy its customers in every respect. In contrast, the part-time servicer, having much less at stake, does not as a rule, maintain such high ethical standards. By working at cut prices part-timers in general seem to have the idea that his occasional customer is only getting the degree of service he is paying for—a low fee, an inferior type of service.

That being so, it is the consensus of professional service firm owners that under no circumstance should they aid and abet their most unethical, price-cutting competitors nor should they collaborate with the part-timers who, as a general thing, have been most guilty of undermining the set-owning public's respect for servicemen as a group. There's too much logic to that line of reasoning to refute, hence this addenda to our November editorial.

PREDICTIONS AND RESULTS

Unfortunately, my editorial remarks and predictions of an opposing-popular-view-nature are borne out and become reality all too often. When that happens, I could gloat, but there's nothing to be gained from being an "I told you so" guy.

Time and again, since December 17, 1953, when FCC gave compatible color TV the "green light" I alone of the technical trade journal editorial writers warned servicemen not to expect, as was blatantly predicted by others, that color TV would achieve mass production in short order. In February 1954, when others were still saying that color TV production would run from 100,000 to a million units in 1954 I warned that because of technical difficulties and cost factors it was quite likely that actual color TV production would probably not exceed 30,000 to 50,000 receivers. 1954 production figures will soon be available and they'll show I was quite right.

Several years ago I complained that too many so-called FM stations were following the wrong practice in playing so many ordinary commercial phono records having a 60-5000 CPS range. Now the record shows that most of the stations guilty of that "do it the easy way" practice have failed and have gone off the air. Sorrier still, most of the dealers in those stations' range, having sold customers FM receivers, are wrongly blamed by the set-buying public for having tricked them into a bad deal. But then, those of us in the servicing field are always being blamed for the other guy's fault.

Early last year I opined that too many new *uhf* TV stations not having TV network affiliation were going on the air, and thus were going to give their audience inferior programming, which in turn would endanger the stations' success and cause much grief amongst the TV viewers in those areas. Alas, the record again shows that many *uhf* stations have gone on the air and off again merely because they did not have network affiliation and thus their programming was so bad as to not justify public support. However, this sad practice may be brought to a halt. Last March 26th there was released an announcement that FCC had authorized AT&T to build 14 microwave relay stations to carry network programs to TV stations in New Mexico, Minnesota, and Wisconsin. We all hope for that day when networks will extend from coast to coast and village to village. Then *uhf* can be said to have grown into long pants.

Trade Flashes

Legislation to curb fraudulent practices in the testing and repair of television receivers and gas and electric appliances was introduced recently in the New York State Assembly. The bill covers unnecessary parts installation of any nature, and unnecessary service work in general, and requires that the serviceman submit a highly comprehensive itemized bill describing in detail the nature of replacement parts by number or symbol, and an itemized bill for his labor.

Color TV status throughout the nation: A representative of Raytheon declares that they will produce up to ten per cent of the total national output of color TV sets for 1955. Development of a color set in the 500-dollar range is not expected until 1957 . . . CBS-Hytron will market a rectangular color picture tube within the foreseeable future . . . Estimates of 1955 color set production . . . Total national production of color TV sets for 1955 will reach 300,000, according to Raytheon, though DuMont pegs it at 150- to 200.000. . . . NBC plans to maintain and develop its color programming schedule.

The National Fire Protection Association recently asked RETMA to modernize the National Electric Code in accordance with new electrical developments. RETMA, in turn, selected Doug Carpenter for the job. Doug is Chief Antenna Engineer for the JFD Manufacturing Co. Inc. The Association aims to improve methods of fire protection and prevention. Its membership is composed of over 15,000 individuals, corporations, organizations, etc., the majority of which are insurance companies and government agencies. Their National Electric Code is the accepted guide for all licensed electrical installations.

Retail sales of television receivers in 1954 increased by nearly 1 million units from the level of 1953 to establish a new high, and, in addition, manufacturers of cathode ray tubes sold nearly 10 million units during 1954 to establish a new record. For both cathode ray and receiving tubes, sales in December were above the level of the same 1953 month, the Association said.

EICO, of Brooklyn, N. Y., has just released their new 1955 Tube Tester Roll-Chart No. 625-04. This roll-chart contains hundreds of listings of the latest tubes just newly released by all the leading tube manufacturers. It thus widely increases the utility of all EICO Tube Testers.

Dr. A. Melvin Skellett, research engineer who holds more than 70 major patents in electronics, has been named director of color television tube planning and development for Tung-Sol Electric Inc..

For the past 25 years he has been active in the electronics industry in research and administrative capacities, including 15 years on the technical staff of Bell Telephone Laboratories.

Patent No. 2699500 has been issued to Telrex, Inc., Asbury Park, N. J., covering its well-known "Clover V-Beam" TV Antenna, which feature closed loop conical-v-beam dipoles and a unique transposed phasing harness which makes it possible to provide a wide aperture, high gain, 2-bay TV array which is small and light in weight.

On April 19th, General Electric will initiate its nationwide TV-Serviceman public relations promotion program. Entitled "TV Service Month," and implemented by mammoth ads in Look magazine, the program will feature a large cash prize contest for service customers. Entry blanks will be made available to the public through GE retailers, who will be stocked with promotion items by their GE distributors, and whose names will be listed, upon request, in extensive Look magazine ads. For program details, write GE, Tube Dept., Schenectady 5, New York.

The Cooper Union Alumni Association has designated William Dubilier, founder of the Cornell-Dubilier Electric Corporation, to receive the first annual

[*Continued on page 42*]

It's here... It's terrific... a great HI-FI speaker by Delco Radio

MODEL 8007—The Speaker with Thousands of Replacement Applications!

DELCO RADIO'S Model 8007
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Here is a sensational performer in the big Delco Radio line of speakers . . . a *Hi-Fi* replacement speaker for AM, FM, and TV receivers and phonographs that matches their service requirements with *a voice coil impedance of 4.1 ohms*—not too high, not too low, but just right! And it's ideal, too, for custom-built high-fidelity systems. Wherever installed, the model 8007 Delco Hi-Fi speaker will give new sparkle and life over the full tonal range.

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The Most Highs . . . the Most Lows . . . the Most Watts . . . in a Medium-Priced Speaker

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PHILCO StarBright 20/20

Look for this mark . . . it's your guarantee of Philco Quality!

These top features assure Philco StarBright dealers of top sales . . . top profits in picture tube replacements. They mean sharpness, clarity, detail and over-all performance that give "You are There" realism.

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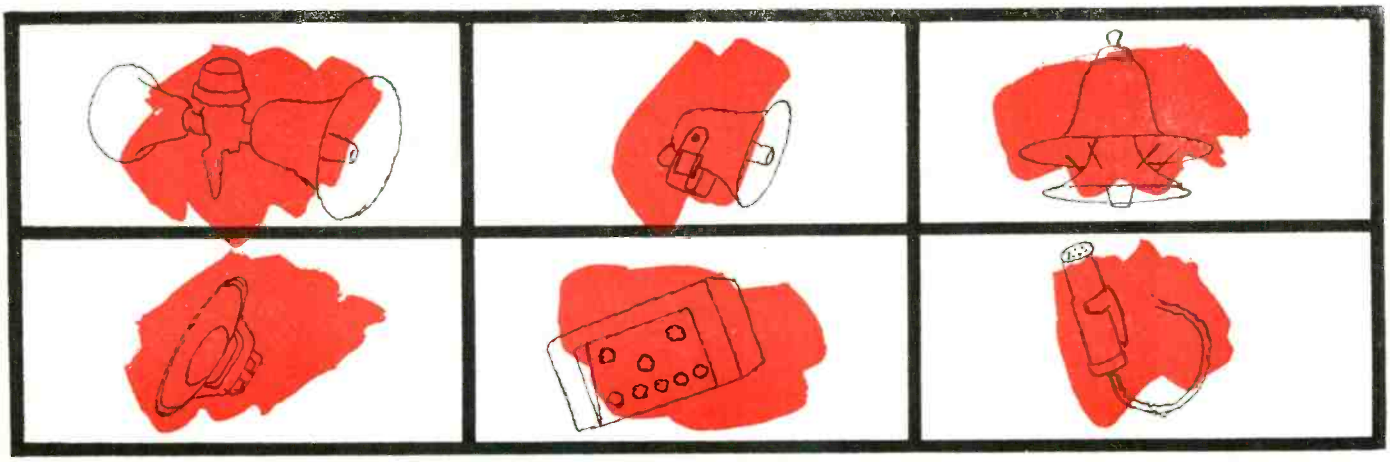


roundup of indoor P.A. Components

by SOL HELLER

ALTHOUGH we are well advanced in the season of the year and indoor public address work is just about stabilized, interest in its technical phases increases. The round-up of data presented in this article should therefore prove timely, and of value to both beginning and advanced *pa* technicians. The author makes no pretense of its being complete or comprehensive, although much effort to achieve maximum coverage has been made. The identities of companies who have supplied the data on which this article is based are obvious either from the text or illustrations.

Amplifiers

One of the more important components of the indoor *pa* system from a point of view of servicing, is the amplifier. The amplifier provides control over other units in the system; it is also capable of compensating for defects or undesirable characteristics in these units. Another reason for the importance of the amplifier rests in the fact that it is more susceptible to failure, and may thus require more service than other component. Care then should be used in choosing the proper amplifier for the system you plan to set up.

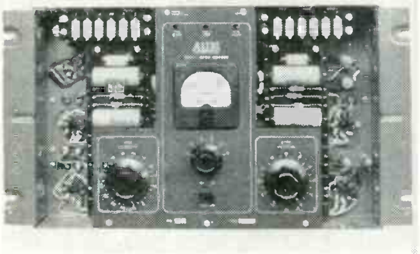


Fig. 1—Altec-Lansing Limiter Amplifier Model A-322C. Note rack mounting features.

Tone controls are important parts of an amplifier. Differences in acoustic conditions, volume levels, microphones, pickups, speakers and records necessitate varying degrees of boost or attenuation of bass, treble and high frequencies. At low volume operation, bass compensation is needed. This is so because the ear's response to low frequencies falls off markedly when volume is decreased. High-frequency attenuation may be necessary to minimize distortions in phonograph records, and needle scratch. Bass attenuation is called for when low-frequency noises are interfering with the clarity of speech, or when "boominess" is introduced by room acoustics. Check the tone control set-up on the amplifiers you are considering for a particular installation, and note any advantages one may offer over another in this respect.

A number of interesting features are present in amplifiers that are currently being manufactured. Altec-Lansing, for instance, is putting out a Limiter Amplifier (Model A-322C) *Fig. 1* which compensates for the undesired variations in volume that tend to occur when the person using the mike changes his position with respect to it. It also permits operation of the *pa* system at a higher level of sensitivity without danger of feedback. When used in conjunction with a high-powered *pa* system, the Limiter Amplifier prevents volume peaks from causing loudspeaker failure.

In the series of Bogen J series amplifiers provision is made for rapid conversion to low impedance microphone inputs through the use of plug-in transformers. The amplifiers are normally supplied for high impedance microphones but through the use of an inexpensive plug-in transformer they are readily converted to low impedance microphones.

The Bogen JX30 and JX50 amplifiers have provision for reducing or eliminating annoying feedback when the amplifiers are used in indoor installations. See *Fig.* 2.

There is also the Bogen JOH preamplifier which can be used with the type HO50 and HO125 booster ampli-

Fig. 2 — Bogen J Series Amplifier. Plug-in transformers are used.

fiers. There is practically no limit to the number of booster amplifiers that can be paralleled and there is one installation where HO125 amplifiers are paralleled to provide a total power output of 4,000 watts.

The Stromberg-Carlson AP-54 power amplifier is a 250-watt unit that may be used in large-sized indoor areas, particularly where the ambient noise level is high, incorporates two protective relays. One is a thermal relay (K-1, *Fig.* 3); the second is a magnetic relay (K-2). The two in conjunction prevent the application of *ac* voltages to the plates of the 866A mercury-vapor rectifiers for about 45 seconds after the amplifier has been turned on. This permits the 866A cathodes to reach operating temperature before they begin emitting. (In mercury-vapor rectifiers, damaging arc-overs tend to occur between plate and cathode if the cathode temperature is below normal when plate voltage is applied.)

A current-measuring meter is provided in the amplifier, to permit rapid tests of the various tubes and circuits in the amplifier. A meter switch permits measurements to be made in each stage. When meter readings occur outside a calibrated area on the meter, a defect in the stage being checked is indicated.

In Newcomb Custom K Series amplifiers (*Fig.* 4), audio bandwidth selectors are present that permit the selection of various upper-limit frequencies. These selectors, which are not tone controls in the usual sense, permit the elimination of annoying vocal or instrumental distortions. The attenuation of the offending high frequencies does not affect the remaining high, middle and low frequencies.

A dual electronic eye is incorporated in these amplifiers; this device indicates even slight overloading of the output tubes, and thus calls attention to incipient distortions before they become audible. A calibrated control is present that permits measurement of output volume in watts. Separate treble and bass controls permit regulation of tone without any reduction in volume. Another feature is a remote control unit that enables the *pa* system operator to mix and fade individual mikes located up to 2,000 feet away.

AMPLIFIER AND SPEAKER REQUIREMENTS MOTION PICTURE THEATER CONDITIONS		
Persons And/Or Seats	Amplifier	No. Of Speakers
750	20 Watts	1
1500	30 Watts	2
3000	60 Watts	3
6000	80 Watts	4

Fig. 5 — Amplifier and speaker requirements. (Electrovoice)

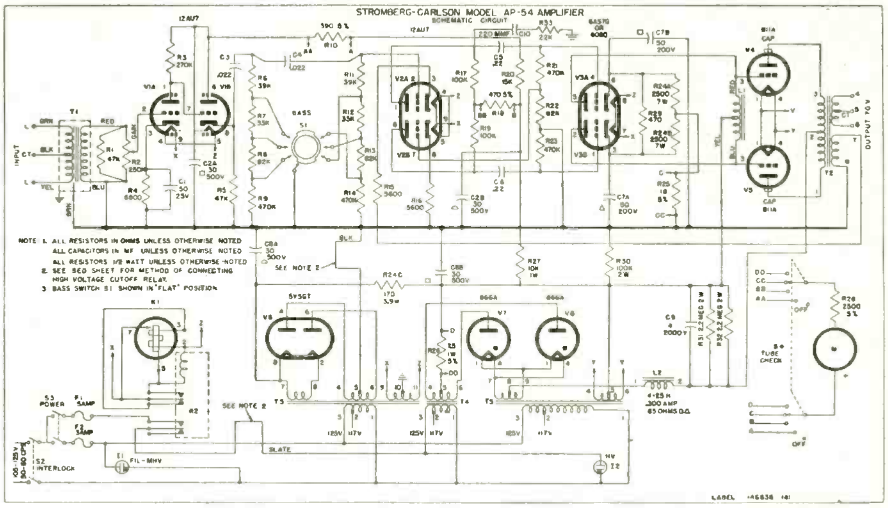


Fig. 3—Circuit diagram of Stromberg-Carlson AP-54 Power Amplifier.

Amplifier and Speaker Requirements in Different Installations

The determination of how much amplifier power is necessary for a given installation, as well as the number and power rating of the speakers needed, has some tricky aspects. One component

Fig. 4—Newcomb Custom K Series Amplifier with bandwidth controls.

manufacturer has devised an intricate chart to help the technician in this respect; another manufacturer questions the accuracy of such charts, and musters strong arguments in support of his position. A rather simple method to use when in doubt is to check an installation similar to the one you intend to set up, and find out what the amplifier power and speaker set-up is there.

It should be pointed out that a speaker's wattage rating is not necessarily an index of its efficiency. Speakers with lower wattage ratings may be more efficient than higher-wattage units; a speaker's characteristics must be considered as a whole, and compared to the requirements of the particular installation, to determine its suitability for that installation.

Keeping this caution in mind, it is interesting to examine a table provided by one speaker manufacturer (Electro-Voice) with regard to amplifier and speaker requirements (see *Fig.* 5). In the "no. of speakers" row, the manufacturer of course has his own speaker in mind; the unit is a coaxial type called the *Compound Diffraction Projector*, uses two horns of different sizes and has a rated input power of 25 watts. A speaker of comparable efficiency made by any other manufacturer can be substituted in this column.

The table covers conditions in motion picture theaters. If a *pa* installation is to be made in an auditorium, *double* the amplifier power and the number of speaker units. For factories and other sites where the ambient (i.e., surrounding) noise is even higher, multiply the basic requirements of a quiet motion picture theater by *three*—that is, use three times the amplifier power, as well as three times the number of speaker units employed in the case of the quiet theater. *Fig.* 6 illustrates two relatively high and low wattage speakers.

Choosing Loudspeakers

Some of the considerations that must be taken into account in choosing the speakers to be used in a *pa* installation are as follows:

1. Is the *pa* system to be a high-power or low-level set-up? If it's to be a low-level one, paging and intercom-type speakers—i.e., small, medium-efficiency units—will serve very well. If high power is needed, large trumpets and radial projectors with heavy-duty driver units are generally necessary.

2. Is music to be reproduced? If it is, the speaker (and amplifier system) will, desirably, have a relatively low cutoff frequency, as well as an extended frequency range. In locations where reverberation is a problem, however, speakers with a higher low-frequency cutoff may have to be employed; low-frequency reverberation will be reduced at the expense of fidelity, in such a case.

3. Does sound have to penetrate a

Fig. 6A—Speaker by University.

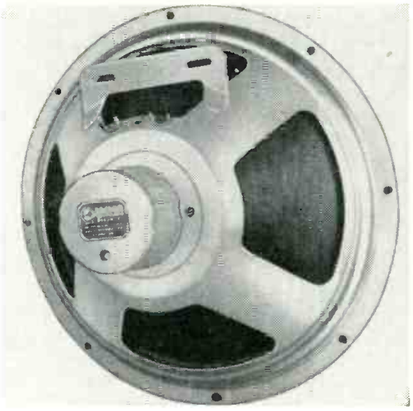


Fig. 68—Speaker by Quam-Nichols.

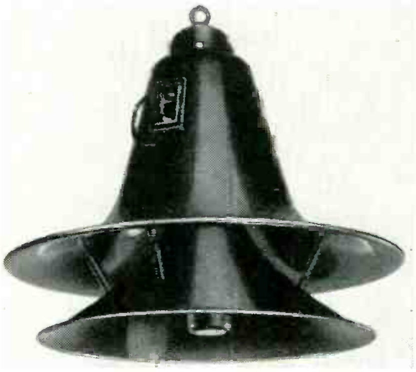


Fig. 6C—Soeaker by Jensen.

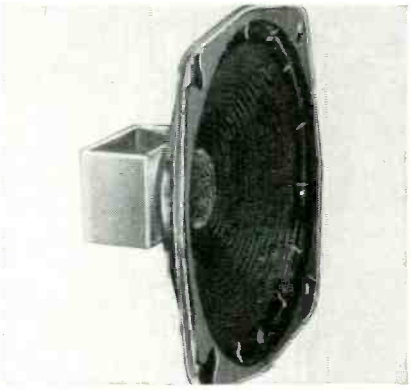


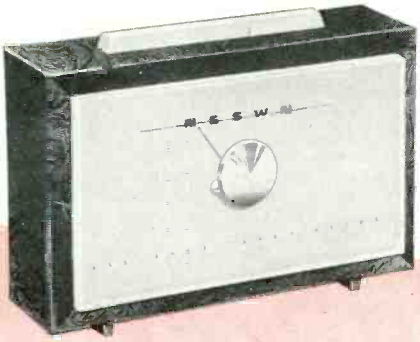
Fig. 6D—Speaker by Permoflux.

great distance from the speaker? If it does, a large trumpet with a sharp sound distribution pattern is called for.

4. Is the noise level at the site of

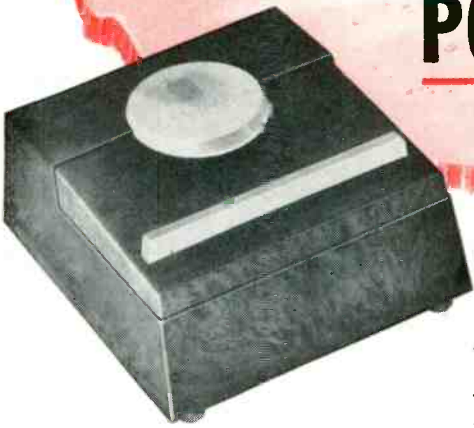
[Continued on page 52]

ALLIANCE TENNA-ROTOR MODEL T-10 — Highly accurate. Most modern styling. Fingertip electrical control. **$29.95**



ALLIANCE TENNA-ROTOR MODEL U-83 — Deluxe Model. The *only* fully automatic rotator! Just set it and forget it! **$34.95**

You profit most-Coast-to-Coast from ALLIANCE POWER-PACKED PROMOTION



ALLIANCE TENNA-ROTOR MODEL K-22 — Economy Model. Same *quality*, precision manufacture. Neat, compact, fully guaranteed. **$24.95**

We've said it before, but it's still true: "ALLIANCE TENNA-ROTORS are sold the most because they're seen the most!" Yes, we're into our seventh straight year of continuous TV advertising. ALLIANCE TV spot announcements—eye-compelling, sales-provoking "home demonstrations"—now appear on Key TV stations all over the country, are seen every week by millions of viewers.

That's impact! *That's* powerful pre-selling for YOU! It sends sales *your* way!

And that's not all! Add to this blanket of impression-making, brand-name promotion, ALLIANCE'S thorough magazine and newspaper advertising, point-of-sale displays, and saturation campaigns in key markets — and you have, coast-to-coast, a high demand for ALLIANCE.

To tie-in . . . to cash in . . . for *most* profits . . . it pays to push ALLIANCE!

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Plus

THESE OTHER TOP-QUALITY, *FAST SELLING* ALLIANCE ACCESSORIES:

ALLIANCE UHF CONVERTERS

ALLIANCE TRICEPTOR ANTENNAS

ALLIANCE LIFT-A-DOR *Automatic Garage Door Operators*

Attention Dealers! Here's extra cash right now!

Due to the tremendous response, we're extending for a limited time only, our popular 5% Bonus Deal. But hurry—it won't last much longer!

Here's what you get: When you buy Alliance Tenna-Rotors *in addition to* usual dealer discount you get: $1.31 *cash* for every U-83. $1.12 *cash* for every T-10, $0.94 *cash* for every K-22!

Here's how to get it: Simply mail to us proof of delivery, such as packing slips, delivery slips, duplicate or original invoices on all purchases of Alliance Tenna-Rotors. Just as soon as we receive this we'll mail to the Alliance obber of your choice a BONUS CHECK payable to you!

Get this extra cash right now . . . with ALLIANCE!

CHROMINANCE Systems in Color TV Receivers

by BOB DARGAN
and SAM MARSHALL

Part 4

IN the previous installment it was pointed out that the color demodulator performs the function of converting the color-sideband signals contained n the chrominance (chroma) signal into I/Q or R-Y/B-Y color-difference signals. The block diagram shown in *Fig. 1* illustrates the basic process of demodulating a chrominance signal. Notice that the filtered output of the in-phase demodulator section contains the I or R-Y color-difference signal, and that the filtered output of the quadrature demodulator section contains the Q or B-Y color-difference signal.

Block Diagram Analysis of Basic Color Demodulators

Present color TV receivers employ either high level or low level demodulator circuits. A low level demodulator (*Fig. 2A* and *2B*) is one in which the chrominance signal output requires further amplification before it can be applied to the color picture tube. This amplification is necessary because typical modulators of the pentode and gated diode types cannot handle large dynamic swings with proper linearity. Signal matrixing in low level systems generally follows the demodulation process. Recovery of the G-Y color-difference signal is then accomplished by mixing correct proportions of R-Y and B-Y in accordance with the formula:

G-Y = -.275 I - .636 Q

(or) G-Y = -.51 (R-Y) - .19 (B-Y)

In high level demodulation (*Fig. 2C*) the output is fed directly to the picture tube. A precision transformer is used to fix the desired ratio of color-difference output voltages and thereby eliminate the need for variable control elements to adjust the ratio. This voltage stepup generally precedes the demodulation process and recovery of the G-Y signal is accomplished by sampling the chrominance signal along the G-Y axis which is 214° removed from the R-Y axis as shown in *Fig. 3*.

Circuit Diagram Analysis of Basic Color Demodulators

Either pentodes or diodes are used in present-day low level demodulators. The system described in the previous installment is an example of a low level demodulator using pentodes. As shown in *Fig. 4*, gating is accomplished by the 3.58 *mc* reference signal fed into the suppressor grid. The sharp gating pulses of this signal, developed in the plate circuit, then sample the incoming chroma signal applied to the control

[Continued on page 19]

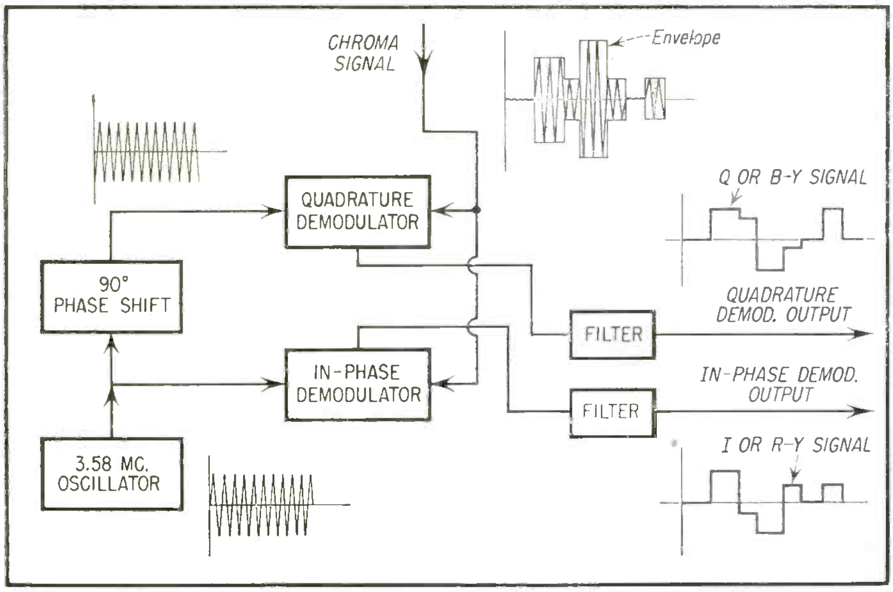

Fig. 1—Basic block diagram of two-phase demodulation process Waveforms shown in figure are not drawn to scale.

ASSOCIATION NEWS

Radio Technicians Association of Southern California

The Radio Technicians Association of Southern California, a non-profit corporation, was started in 1936, in Long Beach, and was granted a charter by the State of California in 1938. Its code of ethics covers the very best business standards. It has grown from the Mother

Chapter in Long Beach to six chapters at the present time, with another chapter in process of organization. Shown above are its newly elected officers, (L to R, rear) Ken Summers, Tech. V.P., Lee Johnson, Pres., Bob Bergman, V.P. (front) P. N. Nibbelin, Sec'y, and Bob Whitmore, Treas.

Radio-TV Technicians Guild of L. I. (N. Y.)

On Wednesday, January 19, 1955 an article appeared in a Long Island newspaper which spurred the Executive Board into instant action. "D.A. asks laws curbing TV gyps," it ran. The District Attorney in his annual report had recommended legislation to permit local control over television servicemen. This factor touched off a series of circumstances which led to an interview with the D.A. by members of the Guild Executive Board.

The Southern Pennsylvania Radio Television Technicians Association (SPRTTA)

This organization conducted their annual Election Monday, January 3, 1955. The following officers are to serve for the year of 1955: Willard Strayer, President; Joseph Hauser, Vice-President; James Mease, Secretary; Eugene Klinedinst, Treasury; G. W. Dean, Public Relations Officer, and Clarence Kissinger, Corresponding Secretary. SPRTTA on Monday, January 17, 1955

[Continued on page 42]

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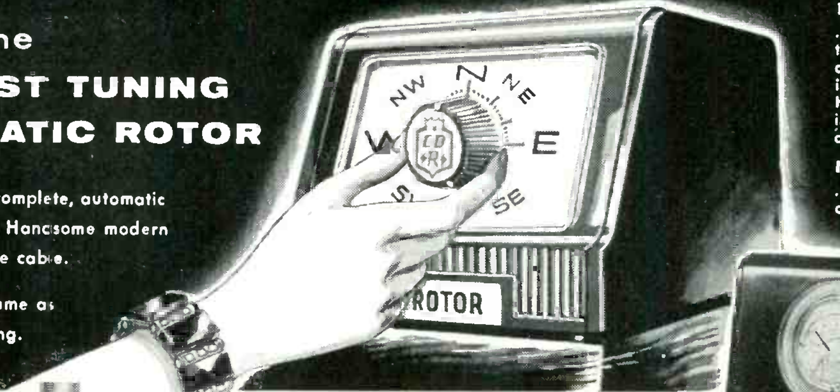

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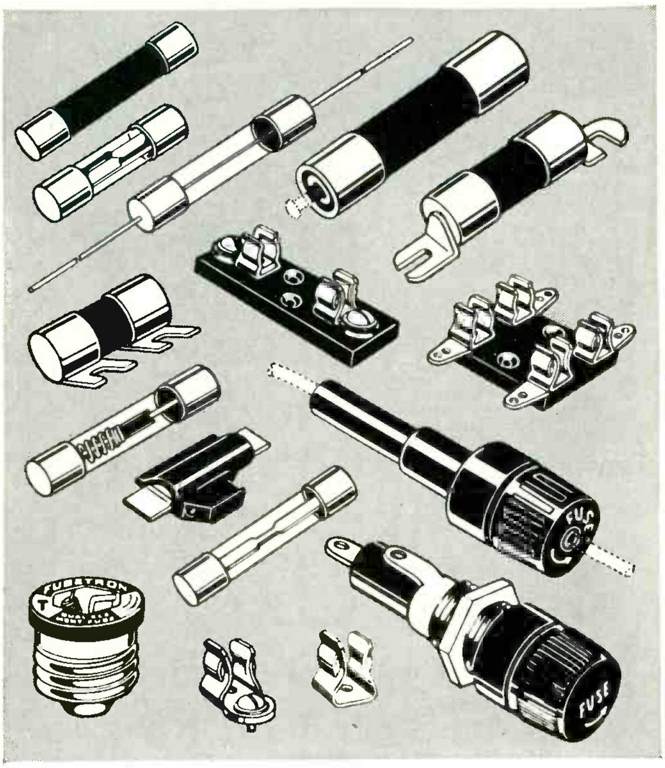

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COLOR *[from page 15]*

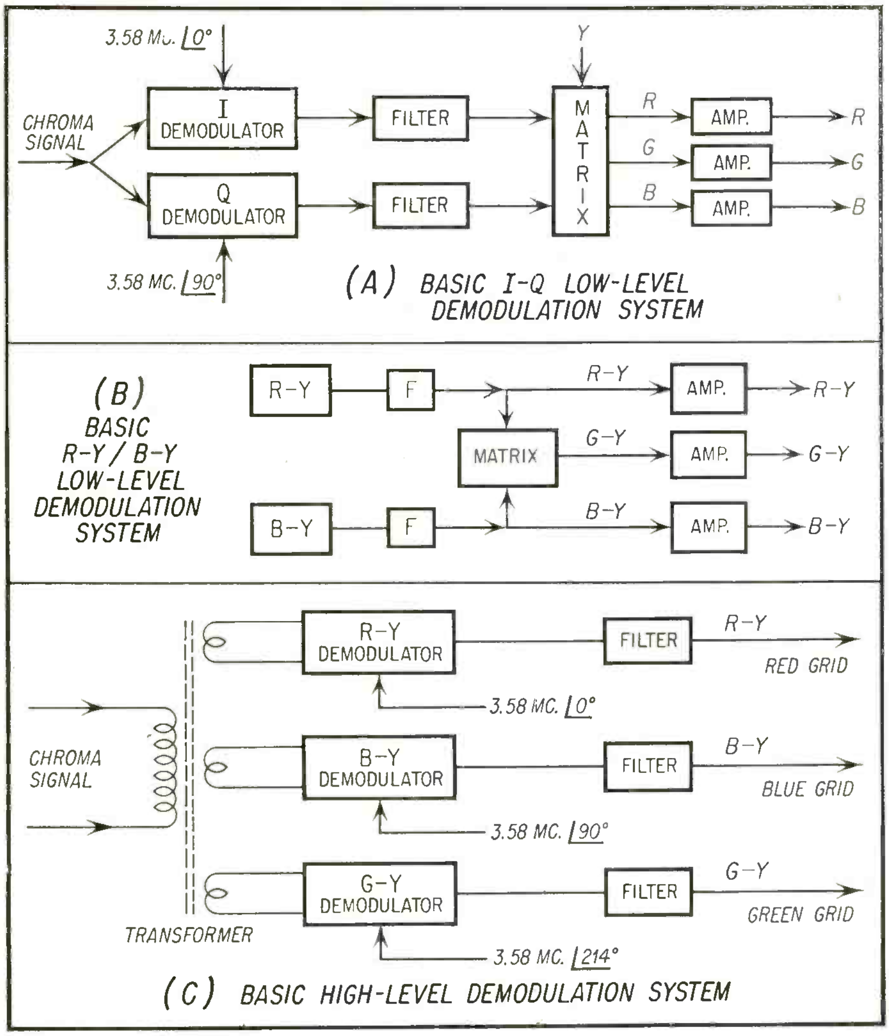

Fig. 2—Comparison between basic low and high level demodulation systems.

grid. The filtered output of the demodulator contains the in-phase or quadrature color-difference signal, depending upon which corresponding reference signal is fed into the demodulator. *Fig. 4* shows an in-phase section of the demodulator circuit.

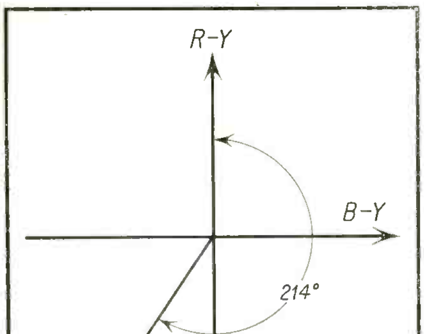

Fig. 3 — Relative positions of R-Y, B-Y, and G-Y axes.

Low-Level Diode Demodulation

A second type of low level demodulator in which diodes are used is shown in *Fig. 5.* Here the demodulated output is a function of the diode currents produced by the combined effects of the incoming chroma signal and the local 3.58 *mc* reference signal. Although *Fig. 5* shows only the R-Y demodulation section it must be borne in mind that a duplicate section is utilized for the demodulation of the B-Y signal; except that the sampling reference signal is displaced 90° from the R-Y signal.

In the circuit shown, the incoming chrominance signal is applied as two signals, 180° out of phase with each other, to a pair of series connected diodes. The 3.58 *mc* reference signal for R-Y demodulation is applied to the junction of the plate and cathode connections of V1 and V2. The R-Y demodulated signal is then taken off at the junction of the diode load resistors, *R1* and *R2.*

Analysis of *Fig. 5* readily shows that when V1 conducts and V2 does not, the side of C_1 connected to K_1 becomes +, and the R-Y point is positive. This may be seen by tracing the electronic flow from K1 to P1 through G1 to ground, and then up to *T1* to the other side of *C1.* Similarly, when diode V2 conducts and diode V1 does not, the electron flow proceeds from K2 within the second diode to P2, charging C2 negatively on the side connected to P2. On discharge, *C1* and C2 discharge in series through *R1, R2* and *T1.* If both charges are equal the potential between the center point of *R1-R2* and ground is zero. This center point is where the R-Y signal is taken off. It is obvious that if V1 conducts more than V2, the charge on *C1* will be greater than the charge on C2, and the R-Y point will be positive. Finally, if V2 conducts more than V1, the charge on C2 will be greater than the charge on *C1* and the R-Y point will be negative. These observations are summarized below to assist us in our analysis of the demodulation process.

1. If V1 conducts more than V2 the R-Y point will be positive.
2. If V2 conducts more than V1 the R-Y point will be negative.

We will now assume a number of different signal conditions and trace the resulting electron flow and voltage drops produced. To begin with, let us assume a condition where the chroma signal is zero as shown in *Fig. 6.* In going through a complete cycle, the 3.58 *mc* reference signal makes the plate of V1

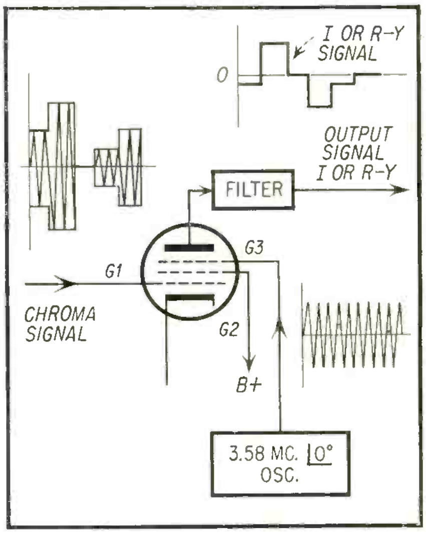

Fig. 4—Low level demodulator using a pentode. The 3.58 mc reference signal applied to G3 samples the in-phase chroma signal applied to G1, producing an I or an R-Y signal in plate circuit after proper filtering.

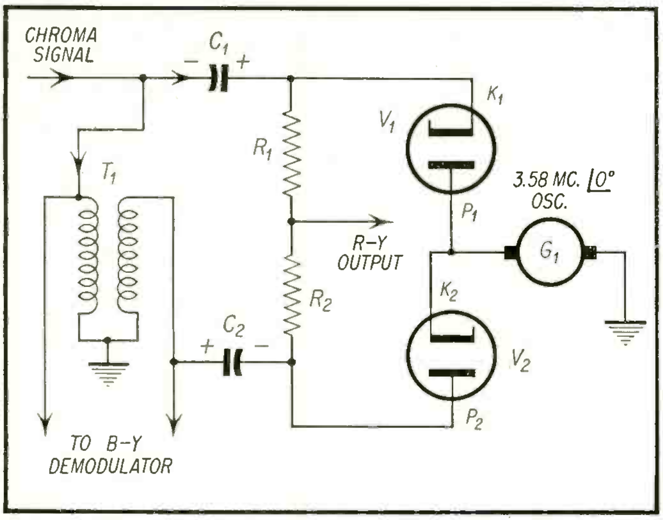

Fig. 5—Simplified diagram of R-Y section of basic diode R-Y/B-Y demodulator. In B-Y section 3.58 mc reference signal is 90° out of phase with R-Y reference signal.

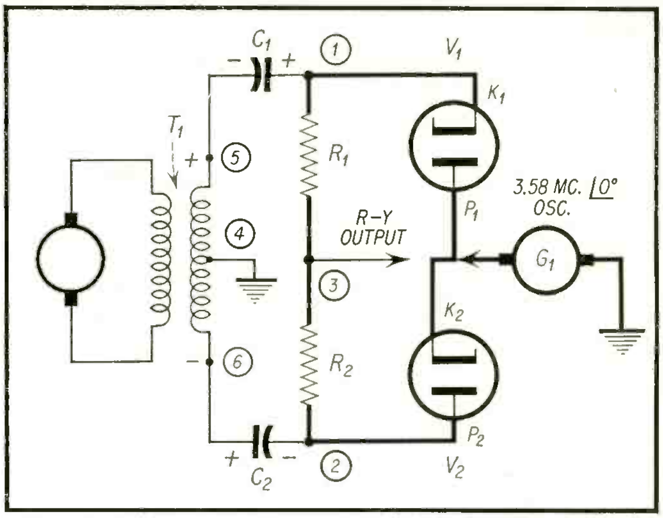

Fig. 6—Equivalent circuit diagram of R-Y demodulator. Heavy lines indicate electron flow for condition of no chroma signal.

positive during one half the cycle, and V2 negative during the other half. The direction of electron flow is such as to charge up *C1*, and C2 as indicated in the previous paragraph.

Since the circuit is symmetrical, the potential on *C1* and C2 will be the same. Hence, during the discharge of *C1* and C2 in series, through *T1*, *R1* and R2 in series, the potential at point (2) will be below ground (4) by the same amount that point (1) is above ground. As a consequence point (3) will be at ground potential.

Let us now assume a condition where the applied chroma signal is exactly in phase with the 3.58 *mc* reference signal as shown in *Fig. 7A*. For purposes of illustration we will further assume that the amplitudes of the chroma and reference signals are equal and have a peak amplitude of E. When the color sync voltage applied to P1 is equal in phase and amplitude to the chroma signal appearing at point (5) no current flows through V1; hence *C1* is not charged and remains at zero potential. V2, however, does conduct on the next half of the cycle, so that C2 is charged to the polarity indicated in *Fig. 6* with a potential of 2E since both chroma and reference signals are in series.

During discharge, because there is no potential across *C1*, point (1) will be at ground potential, and point (2) will be 2E below ground, making the output signal voltage at point (3) –2E below ground. By a similar analysis it can be shown that a reversal of the chroma signal phase will make point (2) zero and point (1) plus 2E, making the

[Continued on page 47]

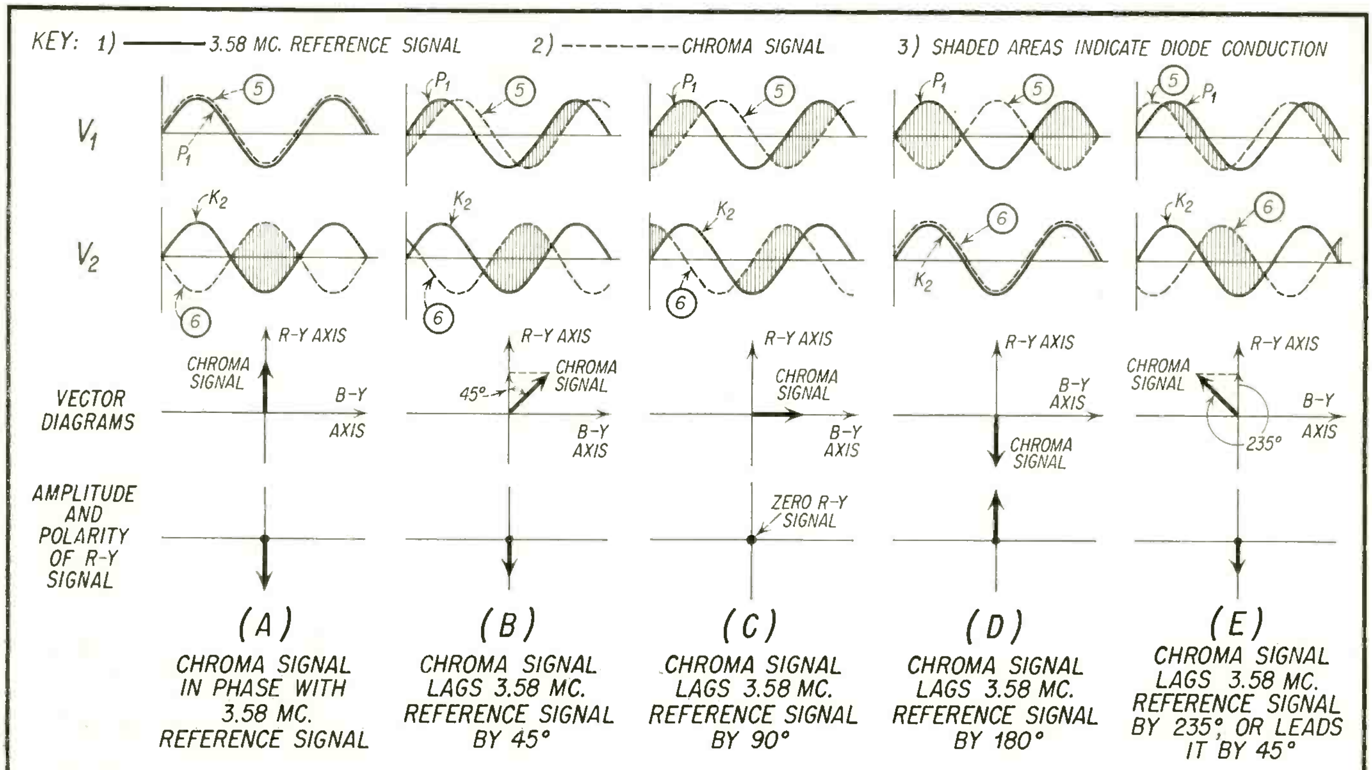

Fig. 7—Conduction of V_1 and V_2 takes place when the plates of the tubes are positive with respect to the cathodes. From (A) to (E) are shown conduction periods for various phase conditions between chroma and reference signals.

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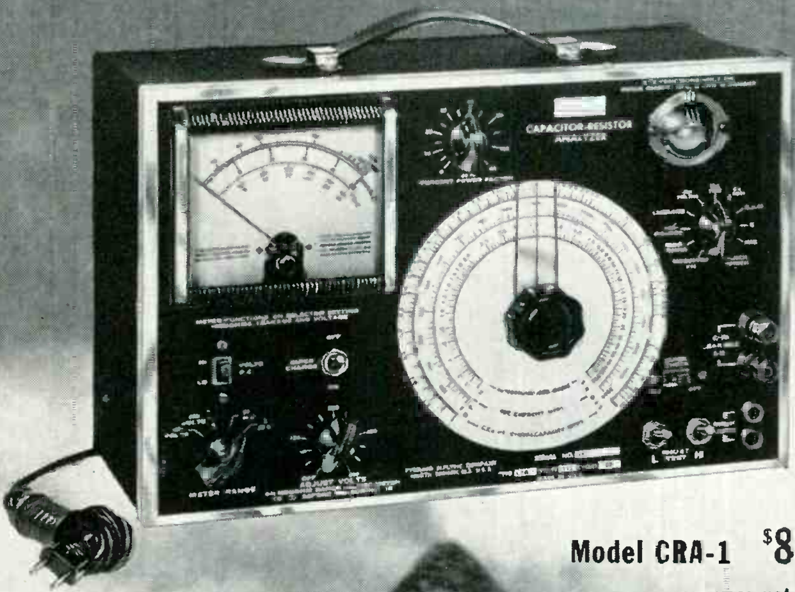

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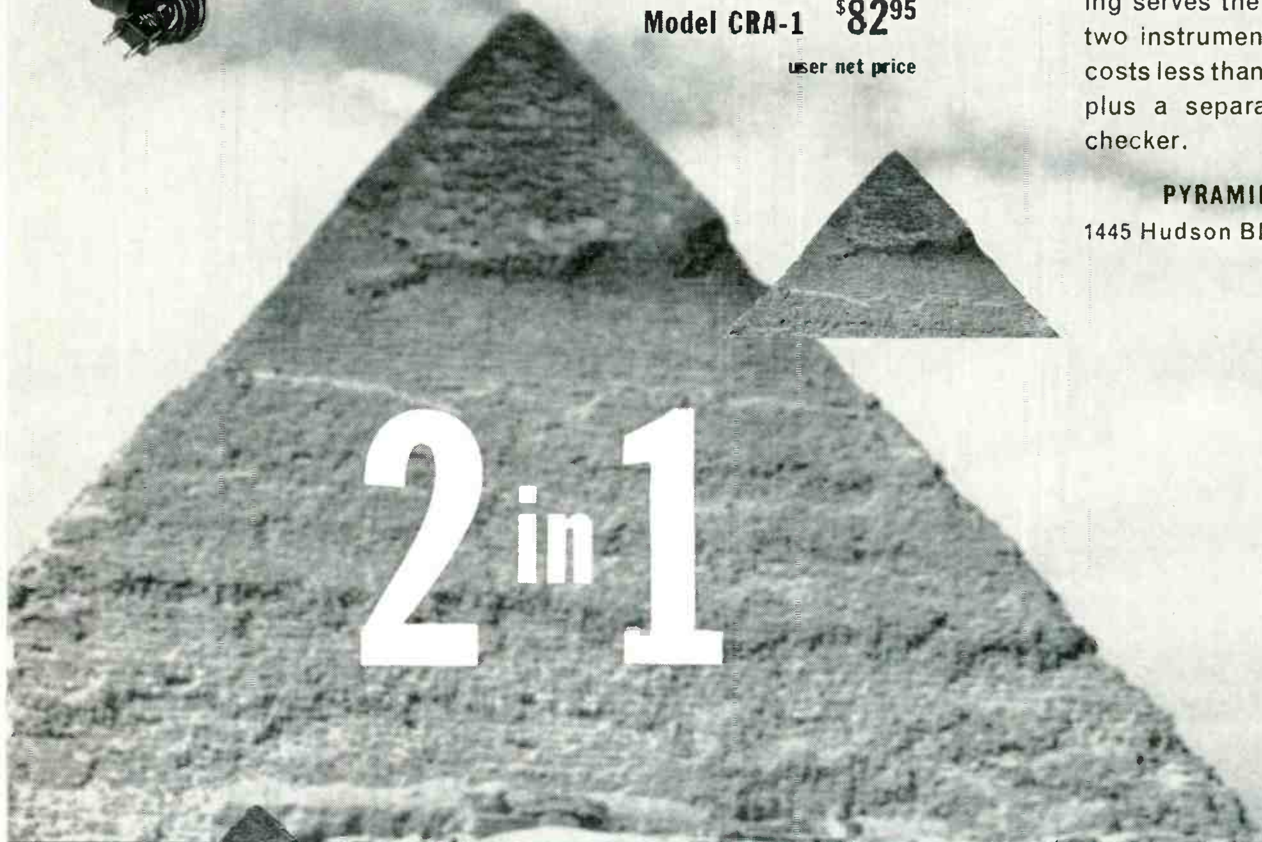

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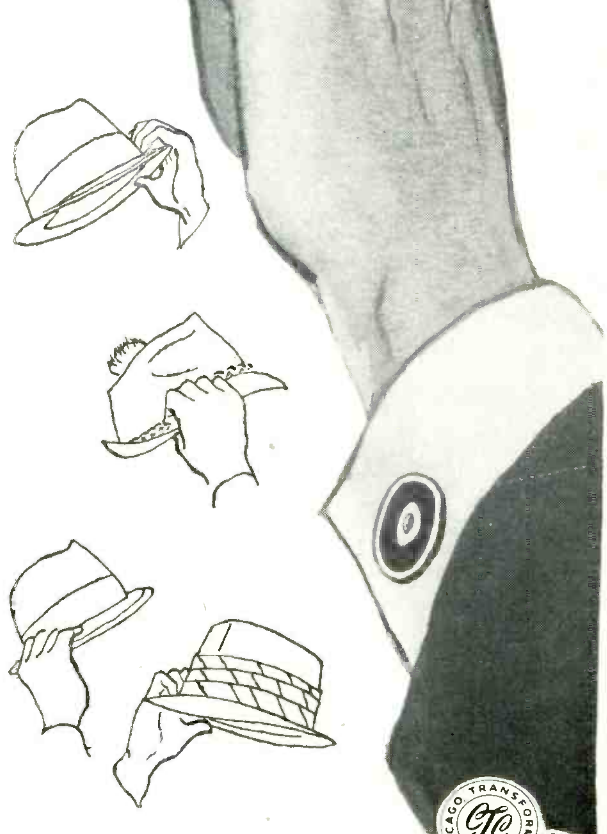

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TV INSTRUMENT CLINIC

PART 9

Based on CHALLENGE CLINIC demonstrations, this new series discusses many measurement and test problems raised by service technicians.

By ROBERT G. MIDDLETON

Chief Field Engineer, Simpson Electric Co. Author of "Pix-O-Fix Troublefinder Guide," published by Rinehart & Co.; "TV Troubleshooting & Repair Guidebook," Vols. I & II; and co-author (with Alfred A. Gherardi) of "How to Use Test Probes," published by John F. Rider, Publisher.

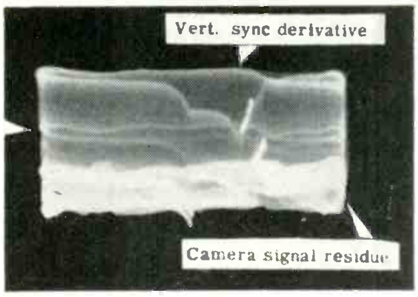


Fig. 1 — After the composite video signal passes through the clipper circuit, most of the camera signal is eliminated, leaving the horizontal and vertical sync pulses. This waveform has both 15,750-cycle and 60-cycle components; the 60-cycle sync-pulse residue is seen as a depressed section near the central portion of the display. This depressed portion is sometimes termed sync "punching"; the vertical sync action is not affected unless "punching" is excessive.

Q. Is it possible for an experienced person to analyze a scope pattern and to tell what is wrong with a circuit in the receiver?

A. To a limited extent, this is possible. To illustrate the extent of the difficulties involved in a complete analysis, however, *Figs 1, 2,* and 3 show waveforms obtained at different points in the sync system of a receiver. Both vertical- and horizontal-sync-pulse residues are evident in the pattern, and it is apparent in a general way that differentiating and integrating actions are taking place. These waveforms can be compared in shape and in peak-to-peak voltage with the data plovided in the receiver service manual, and a knowledge of whether they depart from normal is thereby easily obtained. However, the next step, which concerns identification of faulty components on the basis of the particular distortion which appears, is far more difficult. It may, however, be concluded that the differentiating action is excessive, for example, which would usually indicate a series capacitor having too low a value, or a shunt resistor having too low a value. But it can be said that this field of troubleshooting is exceedingly complex, and defies a large proportion of the attempts which are made to reduce the data to a utilitarian basis.

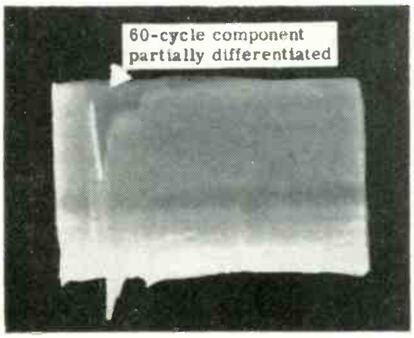


Fig. 2 — Here the mixed waveform has passed through a limiting amplifier, which further reduces the camera signal residue; then through a coupling capacitor which imposes some degree of differentiating action on the 60-cycle component. Sync "punching" is also evident at this point.

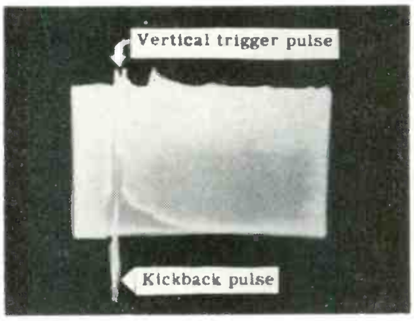


Fig. 3—Now the scope is being applied in the integrator network, and both differentiating and integrating are evident. The partial differentiation imposed by the sync amplifier is still apparent; however, partial integration is also seen, occurring in a direction opposite to the "punching." The integration progresses until the horizontal component is practically eliminated, and only the vertical trigger pulse remains. The kickback from the vertical blocking oscillator is apparent at all points in the integrator circuit as the sharp downward pulse indicated in the photo.

It is well to note (*Fig.* 3) that the voltage of the vertical kickback pulse is much greater than the voltage of the trigger pulse. This prominence of the kickback pulse is often a source of confusion, it being wrongly regarded as the trigger pulse. In case of doubt, the technician should remove the vertical oscillator tube, to see which component of the waveform disappears.

Q. Why does the shape of the *r-f/i-f* response sometimes change as the fine-tuning control is turned?

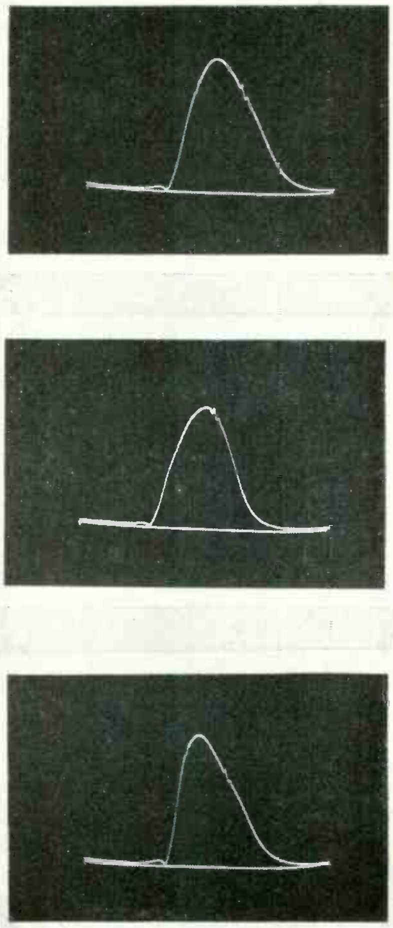
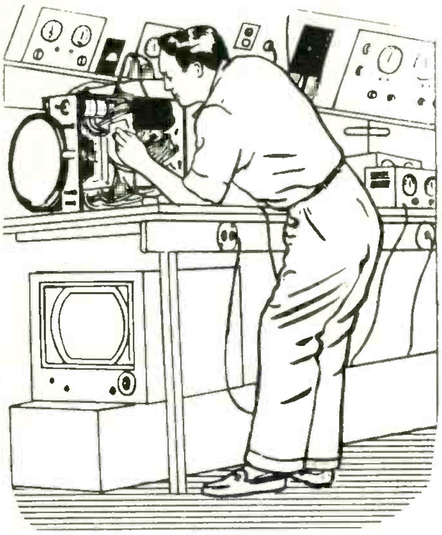


Fig. 4—Varying tuner produces different rf/if response.

A. This change in curve shape, illustrated for a typical situation in *Fig.* 4, is the result of mixer regeneration. When

[*Continued on page 44*]



The Work Bench

by PAUL GOLDBERG

This Month:

VERTICAL PROBLEMS

TWO vertical problems have been chosen for this installment. With proper diagnosis problems of this type can be solved with ease.

Admiral 19F1A

The receiver was turned on and the raster showed a fold over at the bottom. The vertical hold was varied and found to be working properly. We concluded, therefore, that the trouble was not in the vertical oscillator section. It is important to mention at this point that there is a fairly good set of rules to follow in cases of this kind which are as follows:

1. When the fold over is at the *bottom* of the raster the trouble is generally in the cathode circuit of the vertical output tube.

2. Trouble affecting the *entire* vertical sweep, such as insufficient vertical sweep with good linearity usually can be most often traced to the plate circuit of the vertical output tube.

Although these are not iron clad rules they do serve as a valuable basis for trouble shooting vertical sweep problems.

At this point, the 6S4, vertical output tube was replaced without effect. A study was made of the grid circuit of the vertical output tube. *Fig. 1A* shows the wave form at the grid of the vertical oscillator V303B, ½ 6U8. It may be observed that when V303 B is cut off, *C407* charges through *R412*, *R413* and *R414*. Now, when the grid leak action of the vertical oscillator permits V303B to conduct, *C407* discharges through the T401 secondary and V303B. This discharge current builds up a magnetic field in T401 which in turn induces a positive voltage at the grid of V303B. This positive voltage on the grid lowers the plate resistance of V303B and allows *C407* to discharge more rapidly. When *C407* is nearly discharged completely the magnetic field in T401 collapses and drives the oscillator grid negative. The operation then repeats itself.

Knowing these facts the scope was set up and a wave form was taken at the grid of the 6S4, the vertical output tube. The service notes were referred to and it was obvious that the wave form was incorrect (refer to *Fig. 1B*). A voltage leakage check was taken of *C408*, 1 µf, but it showed no leakage. A voltage leakage check was taken next of *C407*, .047 µf, but this condenser also showed no leakage. *R415*, the grid resistor, was then resistance checked and found to measure only

[*Continued on page 51*]

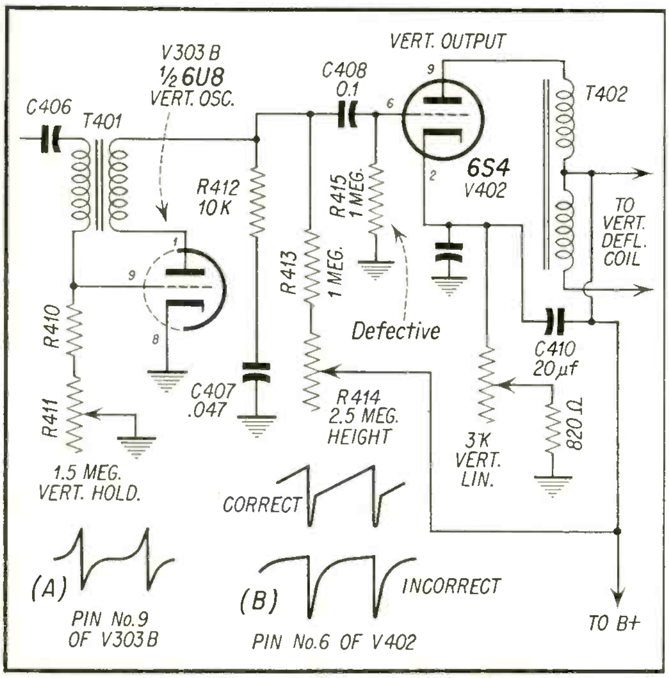


Fig. 1—Partial schematic of Admiral 19F1A.

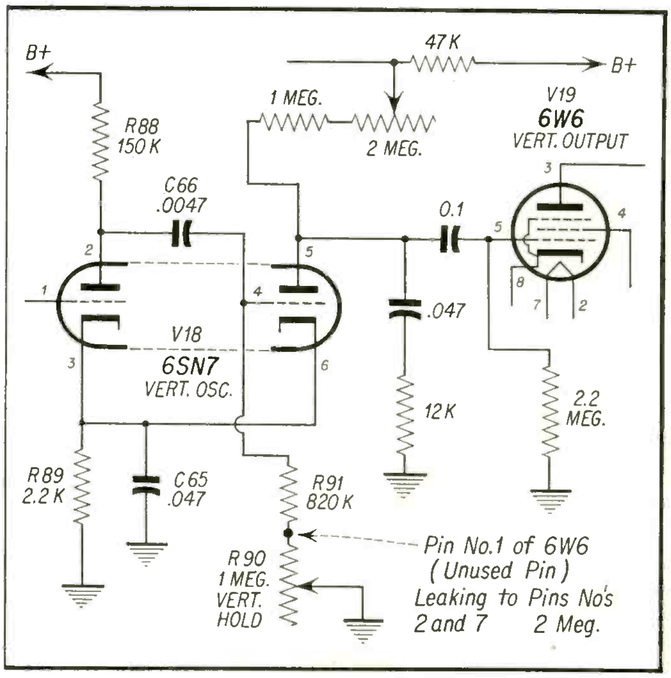


Fig. 2—Partial schematic of Emerson 734B.

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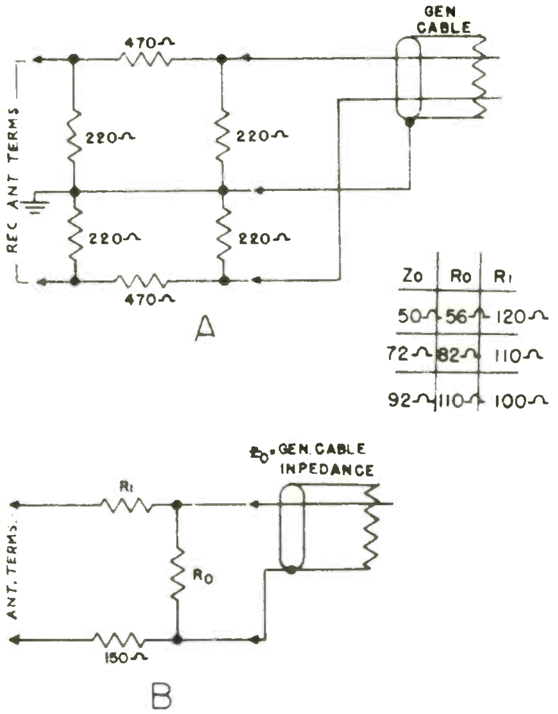

Figure 1

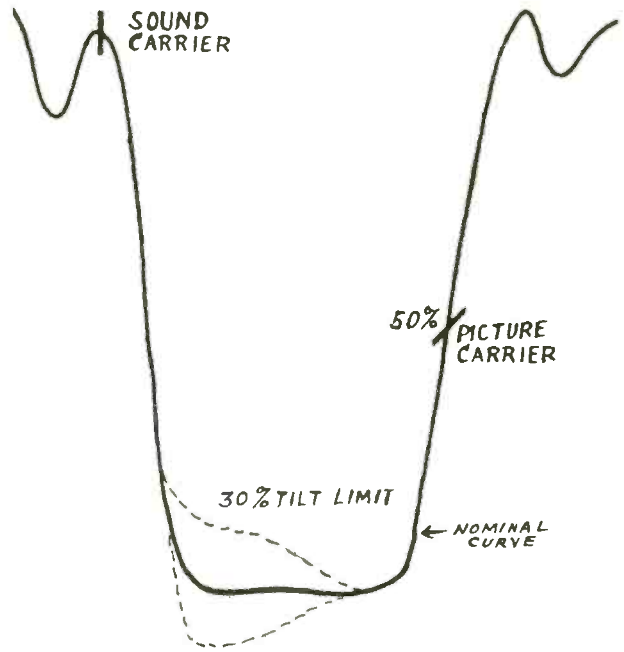

Figure 2

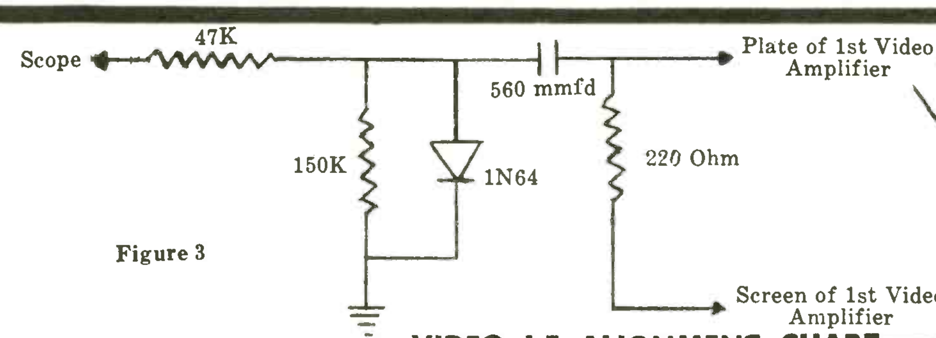

Figure 3

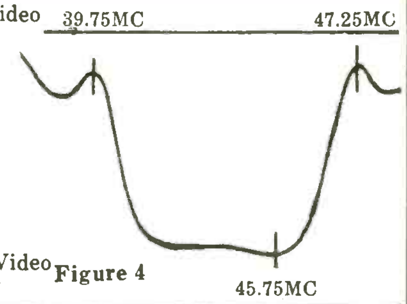

Figure 4

OSCILLATOR ALIGNMENT CHART

Step No.	Set Sweep Generator to:	Set Marker Generator to:	Connect Generator Output Cable to:	Connect Oscilloscope to:	Set Channel Selector to:	Adjust	Refer to Note/s:
1	Sweep Channel 13	211.25MC, 215.75MC			Channel 13	A1	1, 2, 3, 4, 5, 6
2	Sweep Channel 12	205.25MC, 209.75MC			Channel 12		
3	Sweep Channel 11	199.25MC, 203.75MC			Channel 11		
4	Sweep Channel 10	193.25MC, 197.75MC			Channel 10		7
5	Sweep Channel 9	187.25MC, 191.75MC	Receiver		Channel 9		
6	Sweep Channel 8	181.25MC, 185.75MC	Antenna Input	Pin 2 of V204 (12BY7)	Channel 8		
7	Sweep Channel 7	175.25MC, 179.75MC	Terminals		Channel 7		
8	Sweep Channel 6	83.25MC, 87.75MC			Channel 6	A2	8
9	Sweep Channel 5	77.25MC, 81.75MC			Channel 5		
10	Sweep Channel 4	67.25MC, 71.75MC			Channel 4		9
11	Sweep Channel 3	61.25MC, 65.75MC			Channel 3		
12	Sweep Channel 2	55.25MC, 59.75MC			Channel 2		

VIDEO I-F ALIGNMENT CHART

Step No.	Set Sweep Generator To:	Set Marker Generator To:	Connect Sweep Generator To:	Connect Oscilloscope To:	Adjust	Refer to Note/s
1.	44MC (10MC Sweep)	41.25MC			T202 (Top)	1-2-3-4
2.	44MC (10MC Sweep)	47.25MC			T201 (Top)	1-2-3-5
3.	44MC (10MC Sweep)	44.1MC	Pin #1 of V201-Grid of First I. F. Amplifier Test Point on R.F. Unit (Pin #4)	Thru a 10K Isolation Resistor To Pin #2 of V204 Grid of Video Amplifier	T203 (Bottom)	1-2-3-6
4.	44MC (10MC Sweep)	42.5MC			T202 (Bottom)	1-2-3-7
5.	44MC (10MC Sweep)	45.75MC			T201 (Bottom)	1-2-3-8
6.	44MC (10MC Sweep)	47.25MC			T204 (Top)	9-10
7.	44MC (10MC Sweep)	39.75MC			L201 (Bottom)	9-10
8.	Channel #9 (10MC Sweep)	Channel #9 Picture Carrier	VHF Antenna Terminals	Thru the Detector Network to First I. F. Amplifier	T102 (on tuner) T204 (Bottom)	11-12 13-14

4.5 MC SOUND ALIGNMENT CHART

Step No.	Set Generator To	Connect Scope Vertical Input Gable To	Connect Generator To	Adjust	To Obtain	Refer To Notes
1.	4.5MC 50% AM Modulation	Detector Network As in Figure 5		T301 (top & bottom)	Minimum	1, 2, 3
2.	25KC Dev. Max. Output 4.5MC	Direct to Junction C312 & R311	Pin 2 of V204 (12BY7)	L302	Maximum	4, 5
3.	25KC Dev. Max. Output 4.5MC	Direct to Junction C312 & R311		L301	Maximum	6
4.	Remove Short From T202 and Connect Set to Antenna. Turn on Station and Attenuate Signal until Noise & Hiss is Apparnet			R307	Min. Noise and Hiss.	7
5.	Set Connected to Antenna with Full Signal			L302	Maximum	8

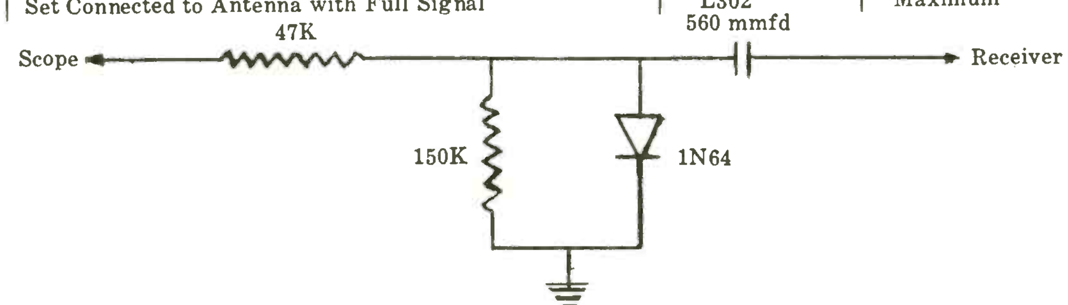

Figure 5

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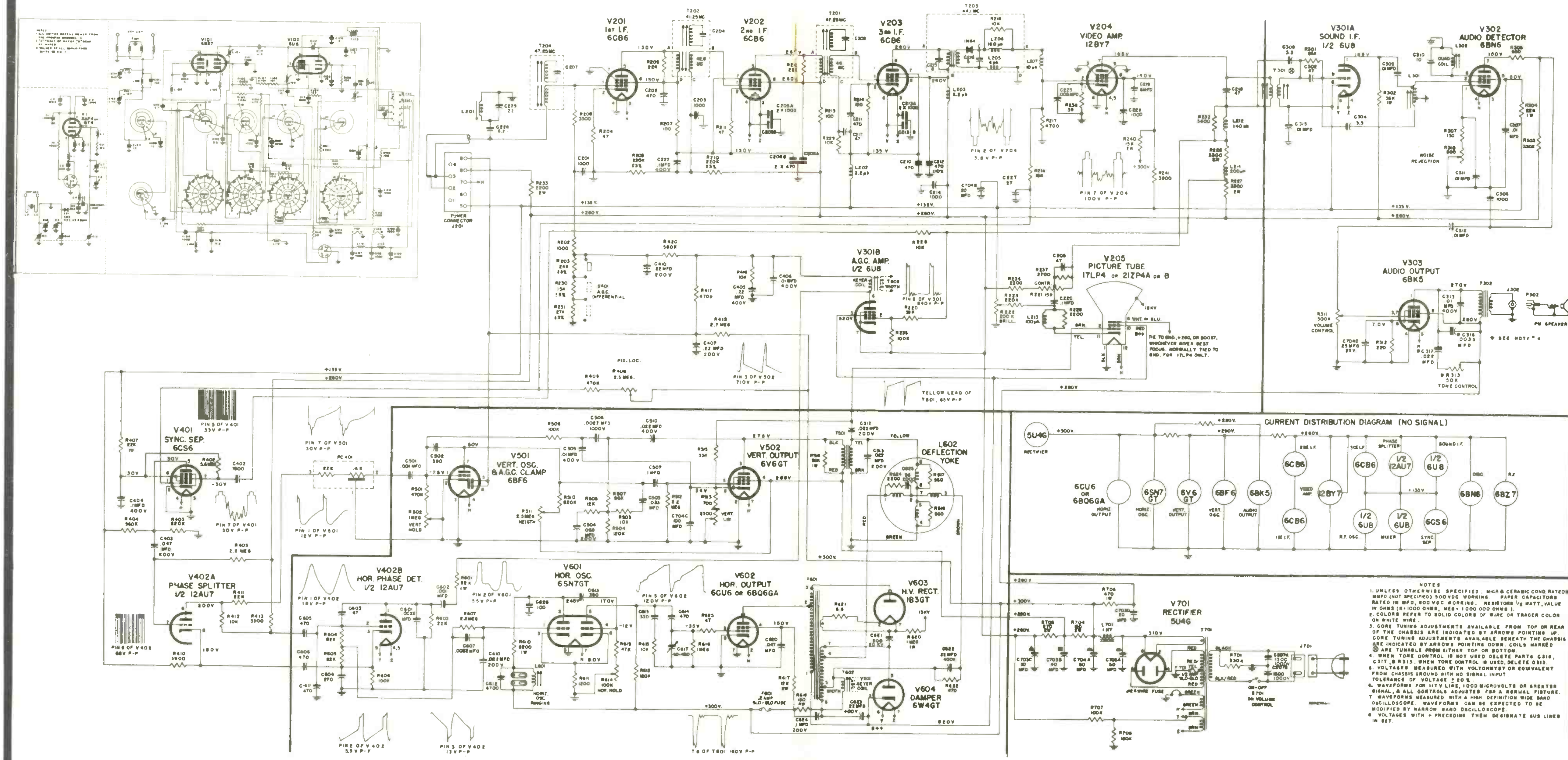

PRODUCTION CHANGE NOTES

The above schematic is correct for chassis coded "CX-38 R-2". Chassis coded "CX-38 R-1" do not contain the following changes:

(1) To eliminate the possibility of "blocking" in the 3rd I-F.

A. R229 (10K, ½W, 10%) was added between terminal "C" of T201 and the junction of L202, R214 and C211. Previously terminal "C" was connected directly to this junction.

B. C217 (47mmf „ Tubular Ceramic) was added in parallel with R229.

(2) To eliminate the possibility of "blocking" in the Video Amplifier.

A. R240 (15K, 2W, 10%) was added from pin 8 of V204 to +300V. R219 (33K, 1W, 10%) which was connected from pin 8 to +260V was deleted.

B. R241 (3.9K, ½W, 10%) was added from pin 8 of V204 to +135V. R702 (33K, 2W, 10%) which was connected from +135V to +300V was deleted.

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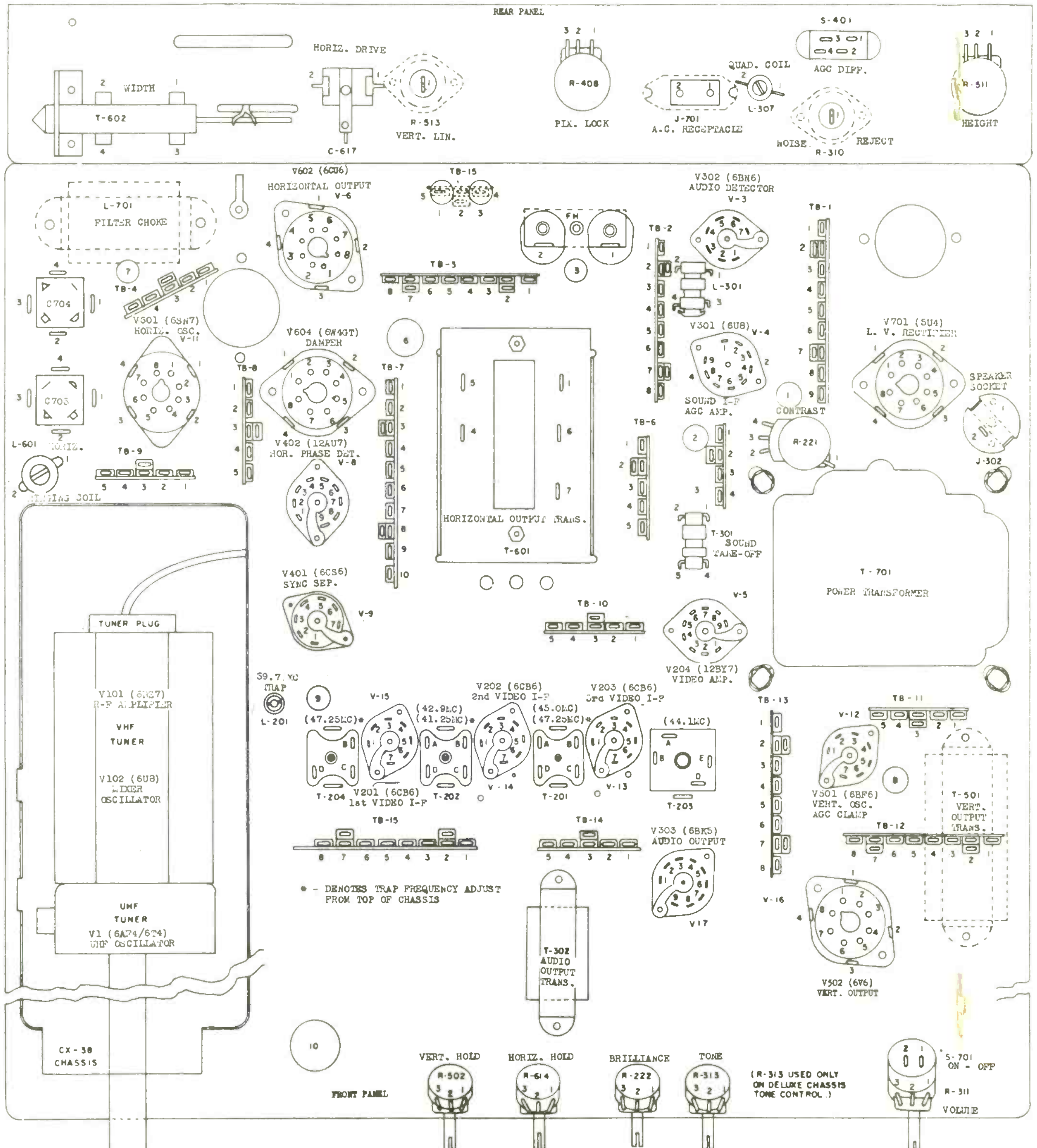
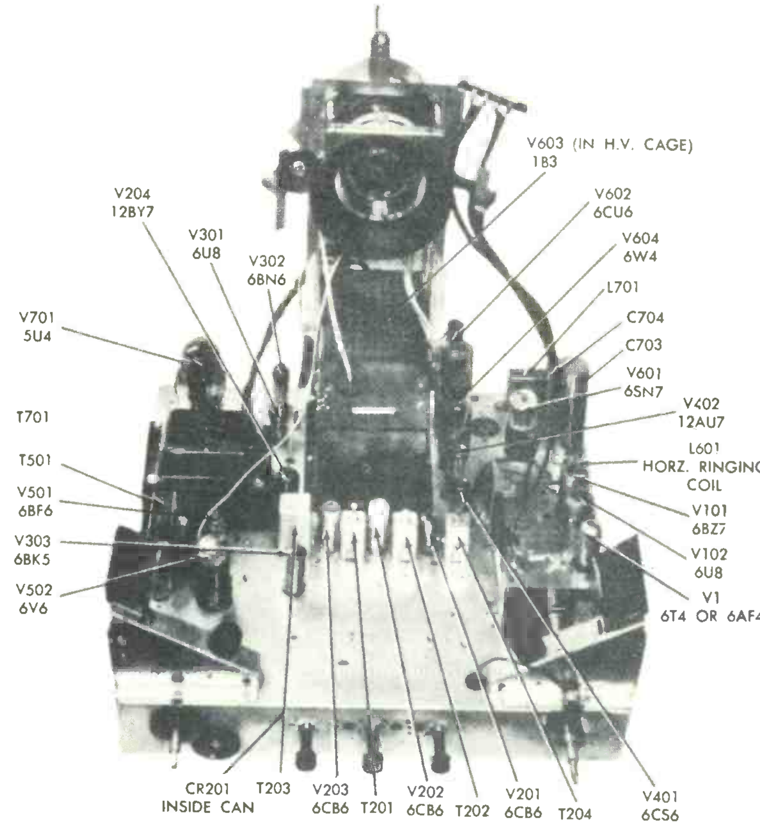
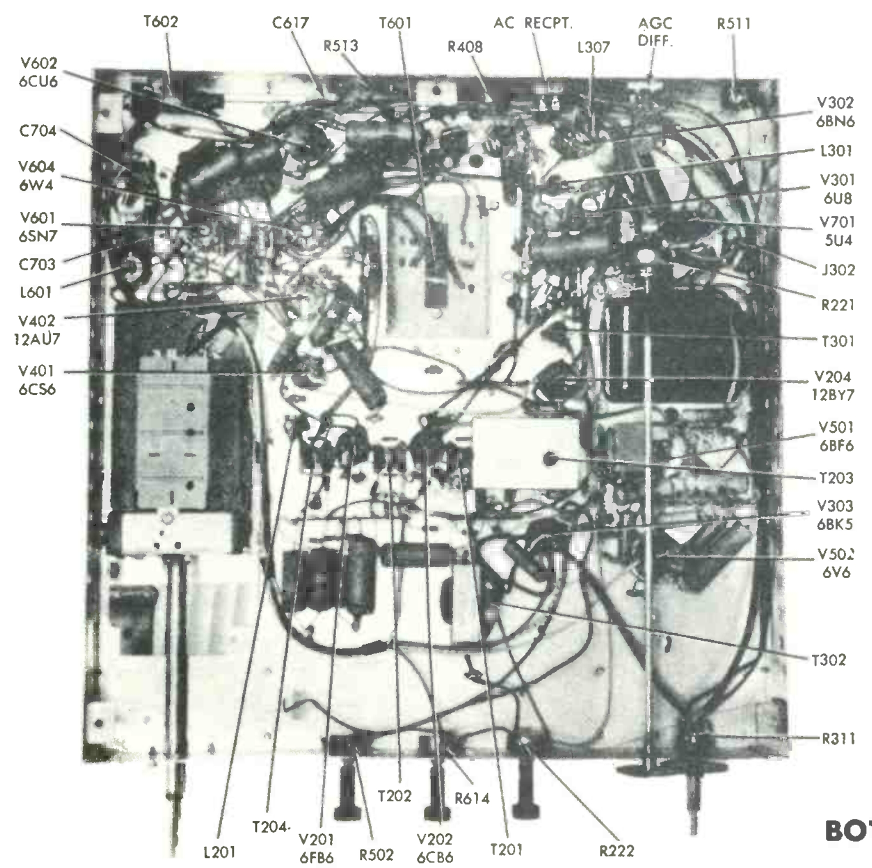
CHASSIS LAYOUT



"CX-38" CHASSIS LAYOUT — BOTTOM VIEW



TOP VIEW



BOTTOM VIEW

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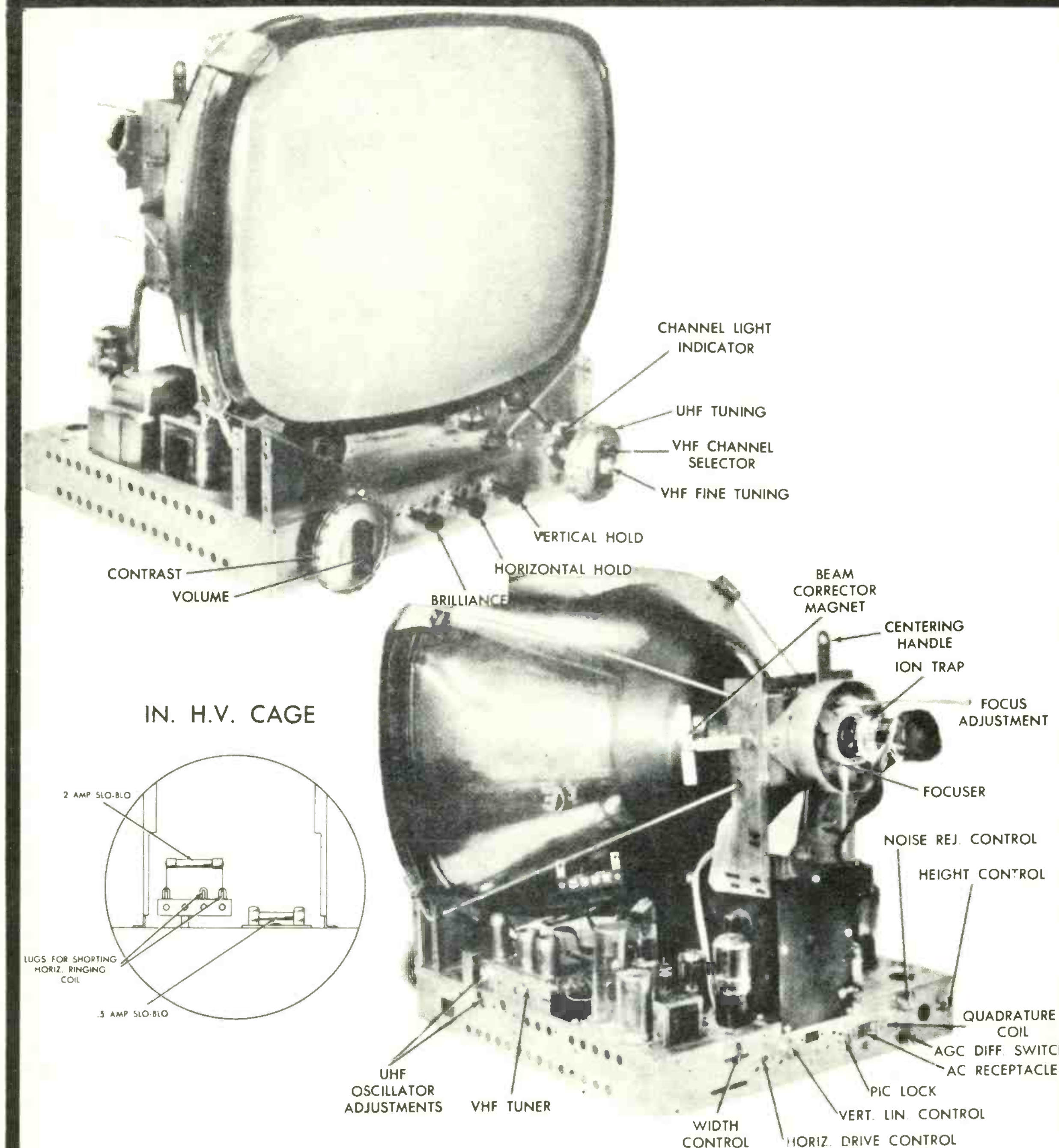

CAPEHART CX-38 SERIES TV CHASSIS REPLACEMENT PARTS PRICE LIST

Resistors

All Resistors Are ½w 10% Unless Specified Otherwise

Ref. No.	Description	Parts No.
R-621	6.8 Ohm	650101A-22
R-238	39 Ohm	3229-390
R-204, 211, 625	47 Ohm	3229-470
R-207, 213	100 Ohm 20% ½w 20%	3230-101
R-214	120 Ohm	3229-121
R-307	150 Ohm	3229-151
R-704	150 Ohm 2w 10%	3235-151
R-618	180 Ohm 4w 10%	650101A-25
R-312	220 Ohm	3229-221
R-705	270 Ohm 2w 10%	3235-271
R-622	470 Ohm ½w 20%	3230-471
R-706	470 Ohm 1w 10%	3232-471
R-305	680 Ohm	3229-681
R-202	1K Ohm ½w 20%	3230-102
R-611	1.2K Ohm	3229-122
R-236	2.2K Ohm	3229-222
R-233	2.2K Ohm 2w 10%	3235-222
R-237	2.7K Ohm	3229-272
R-208	3.3K Ohm	3229-332
R-226, 227	3.3K Ohm 2w 10%	3235-332

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R-410, 413, 241	3.9K Ohm	3229-392
R-217	4.7K Ohm	3229-472
R-610	8.2K Ohm 1w 10%	3232-822
R-416, 503, 615, 225, 412, 229	10K Ohm	3229-103
R-505	12K Ohm	3229-123
R-617	12K Ohm 2w 10%	3235-123
R-230, 216	15K Ohm ½w 5%	3228-153
R-240	15X Ohm 2w 10%	3235-153
R-205, 212, 603, 411	22K Ohm	3229-223
R-407, 304	22K Ohm 1w 10%	3232-223
R-203	24K Ohm ½w 5%	3228-243
R-231	27K Ohm ½w 5%	3228-273
R-515	33K Ohm	3229-333
R-219	33K Ohm 1w 10%	3232-333
R-702	33K Ohm 2w 10%	3235-333
R-220	39K Ohm	3229-393
R-301, 507	56K Ohm	3229-563
R-302, 514	56K Ohm 1w 10%	3232-563
R-613	68K Ohm	3229-683
R-604, 605	82K Ohm	3229-823
R-601	82K Ohm 1w 10%	3232-823
R-235, 506, 606, 707	100K Ohm	3229-104
R-504, 612	120K Ohm	3229-124
R-708	180K Ohm	3229-184
R-206, 210, 403, 223	220K Ohm ½w 5%	3228-224
R-303, 701	330K Ohm	3229-334
R-406, 417, 501	470K Ohm	3229-474
R-404, 420	560K Ohm	3229-564
R-510	820K Ohm	3229-824
R-616	1 Meg Ohm	3229-105
R-620	1 Meg Ohm 1w 20%	453477A-1
R-512, 405, 607	2.2 Meg Ohm	3229-225
R-415	2.7 Meg. Ohm	3229-275
R-402	5.6 Meg. Ohm	3229-565

Transformers & Inductances

Ref. No.	Description	Parts No.
T-701	Power Transformer	850300B-3
T-601	H.V. Transformer	850285D-1
T-602	Width Transformer	650589B-1
T-501	Vert. Output Transformer	750354C-2
T-301	4.5 MC I.F. Transformer	650929A-1
T-302	Audio Output Transformer	650216A-3
T-204	I.F. Coil	750460C-1
T-203	Detector Transformer	750468D-1
T-202	1st I.F. Transformer	750462D-1
T-201	2nd I.F. Transformer	750461D-1
L-701	Filter Choke	650215A-5
L-601	Horiz. Osc. Ringing Coil	650637B-1
L-602	Yoke	850221C-2
L-301	4.5 MC Sound	650638B-1
L-302	Quadrature Coil	650776A-1
L-201	39.75 MC Trap	650948A-1
L-202	2.2 mh. choke	450338A-4
L-206	150 mh. Peaking Coil	750597A-1
L-207	10 mf. RF Choke	450338A-5
L-212	140 mh. Peaking Coil	750597A-2
L-213	100 mh. Peaking Coil	750597A-3
L-214	200 mh. Peaking Coil	750597A-4

Capacitors

Ceramic Capacitors Rated at 500 V
Unless Specified Otherwise

C-304, 308	3.3 mmfd	650030A-5
C-310	10 mmfd	650030A-18
C-227	27 mmfd	2271-9022
C-208, 218, 302	47 mmfd	650030A-17
C-202, 210, 211	470 mmfd	450469A-11
C-206	470 mmfd (Dual)	650858A-1
C-621	500 mmfd 20 KV	650153B-2
C-201, 203, 214, 226	1000 mmfd GMV	450469A-5
C-306	1000 mmfd	450469A-7
C-205, 213	1000 mmfd (Dual)	600881A-9
C-402	1500 mmfd GMV	600881A-5
C708A & B	1500 mmfd (Dual)	453521A-4
C-225	5000 mmfd	450469A-12
C-305, 307, 311, 312, 315	10000 mmfd	600881A-8

All Mica Capacitors Rated at 500V
Unless Specified Otherwise

C-603	47 mmfd	2272-21470
C-626	100 mmfd	2272-21101
C-604	270 mmfd	2272-21271
C-615	330 mmfd	2272-21331
C-502, 613	390 mmfd	2272-23391
C-212, 605, 606, 611, 614	470 mmfd	2272-21471
C-612	4700 mmfd	2272-43472

All Tubular Capacitors Are Rated
at 20% Unless Specified Otherwise

C-501, 602	.001-600V	2248-1020
C-601, 607	.0022-600V	2248-2220
C-506	.0027-1000V 10%	2249-2729
C-313	.01-400V	2247-1030
C-406, 505	.01-200V	2246-1030
C-510	.022-400V	2247-2230
C-512, 513, 610	.022-200V	2246-2230
C-503	.033-600V 10%	2248-3339
C-620	.047-600V	2248-4730
C-403	.047-400V	2247-4730
C-504	.068-200V 10%	2246-6839
C-220, 507	.1-600V	2248-1040
C-222, 404	.1-400V	2247-1040
C-624	.1-200V	2246-1040
C-405, 622, 623	.22-400V	2247-2240
C-407, 410	.22-200V	2246-2240

Electrolytics

Ref. No.	Description	Parts No.
C-219	8 mfd-250V	650228A-13
C-703A-B-C-D	50, 40, 30, 20 mfd-400V	750090B-42
C-704A-B-C-D	50 mfd-400V, 20 mfd-200V, 100 mfd-150V, 25 mfd-25V	750090B-41
R-311	Off-On-Vol. Control	650928A-1
R-221	Contrast Control	650927A-1
R-222	Brilliance Control	453328A-3
R-502	Vert. Hold Control	453466A-1
R-614	Horiz. Hold Control	453328A-2
R-408, 511	Height & Pix Lock Control	650777A-1
R-513	Vert. Linearity Control	650642A-3
R-310	Noise Rejection Control	650642A-5

Miscellaneous

	UHF RF Unit	750593A-1
	VHF RF Unit	850330A-1
	Ion Trap	650276A-5
	Focuser	850291A-1
	Width Transformer's Tuning Core	453118A-1
F-701	3AG 125V 500 MA Fuse	450317A-16
F-601	3AG 125V 200 MA Fuse	450183A-2
PC-401	Vertical Integrator	453214A-1
	Picture Tube Socket	650596C-6
J-302	Speaker Connector	450972A-2
C-617	Horiz. Drive Trimmer (40-450)	450527B-1
S-401	AGC Differential Switch	452729A-1
	Fuse Block	453639A-1
J-701	Interlock Receptacle	452580A-2
	Antennae Binding Post	650972A-1
	Tuner Connector	650971A-G1

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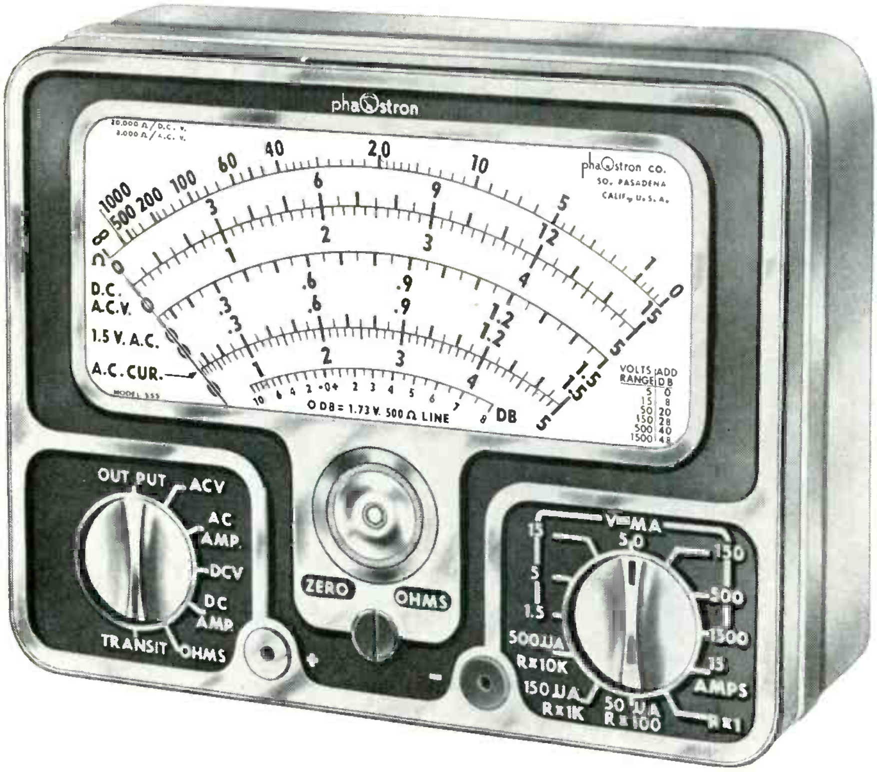

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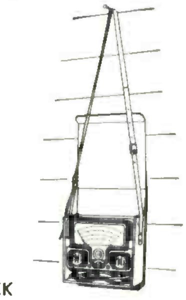

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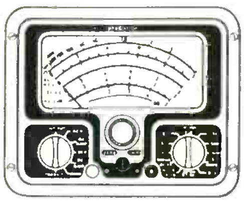

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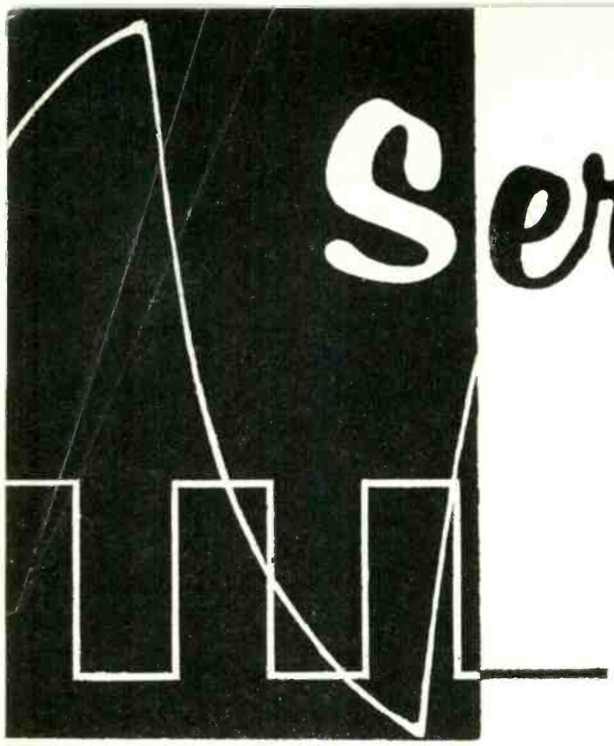


Servicing with the SQUARE-WAVE GENERATOR

PART 1

by OSCAR FISCH

IT would be generally agreed, in the the opinion of the author, that the square wave generator is not a familiar piece of test equipment to the average serviceman. At the present time, there are very few shops equipped with a generator of this type. A few manufacturers of test equipment have added the square wave generator to their line in recent years. Basically, this generator is used to check frequency response and phase distortion in wide band amplifiers, such as those found in high fidelity audio amplifiers and in TV video amplifiers. It may also be used, incidentally, as a bar generator for adjusting horizontal and vertical linearity. In most cases, a switch is provided to give a sine wave rather than a square wave output. This permits the use of the instrument in making accurate quantitative measurements of the frequency characteristics of an amplifier. These applications will be discussed in more detail later, and are mentioned briefly here simply to give an idea of what may be expected of the square wave generator. Since understanding goes hand in hand with the intelligent use of such a device, it is the purpose of this article to explain the basic principles involved in square wave testing.

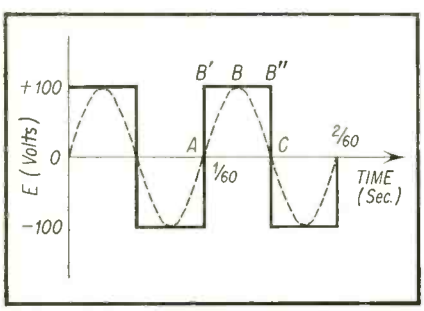


Fig. 1 — Comparison of sine and square waves.

Makeup of Square Wave

It will be necessary at the outset to examine the makeup and the characteristics of a square wave. In *Fig. 1*, the solid line represents a square wave of voltage having an amplitude of 100 volts, and a frequency of 60 *cps*. The dashed line represents a familiar sine wave *ac* voltage having the same amplitude and the same frequency. These are both *ac* waves of voltage but there is one obvious and essential difference between the two. In the sine wave, the voltage rises gradually from zero at A to its maximum value at B, and then falls gradually back to zero at C. In the square wave, however, the voltage rises very rapidly from zero at A to its maximum value of 100 volts at B′, remains at this value for almost half the cycle and then rapidly drops back to zero, or from B″ to C on the diagram. A similar variation in voltage takes place during the negative half cycle. The reason that the time taken from B′ to B″ is *almost*, but not quite, a half cycle is that the rise in voltage from A to B′ and the fall from B″ to C are not instantaneous but do take up a small amount of time.

Why is a square wave of such importance? The answer lies first in the fact that a square wave may be considered to be made up of an infinite number of sine waves, starting with the fundamental, and including all the *odd*

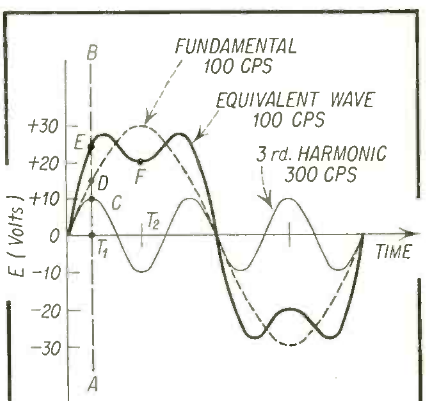


Fig. 2—Combination of fundamental and 3rd harmonic as the first step in the synthesis of the square wave.

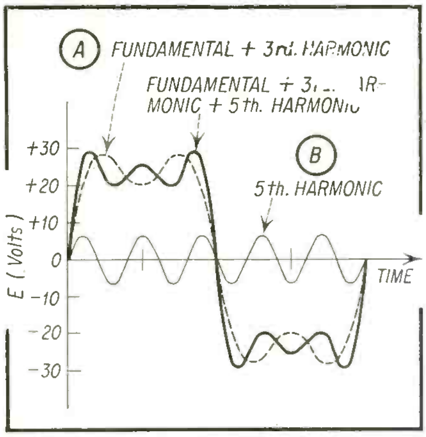


Fig. 3 — Closer approach to truer square wave is observed as additional harmonics are added.

harmonics. Secondly, in passing through the various circuits of an amplifier, even though the square wave appears to be a single wave, it behaves just as if all of the harmonic frequencies of which it is composed are going through the amplifier simultaneously. In a theoretically perfect amplifier, all of these frequencies would be amplified equally, and they would all maintain the same phase relationships with each other so that their combination at the output would result in a square wave having the same shape as that which entered at the input, except of course for its increase in amplitude. *By comparing the wave shape of the output with that of the square wave input, and interpreting any differences, defects in the amplifier may be diagnosed.*

It was stated in the preceding paragraph that a square wave may be considered to be made up of an infinite number of sine waves, starting with the fundamental and including all the odd harmonics. To be more specific, suppose a theoretically perfect square wave had a frequency of 100 *cps*. The mathematics of square wave analysis shows that this square wave would contain the following sine wave components.

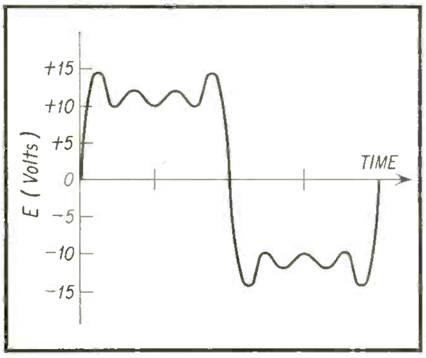


Fig. 4—Equivalent voltage obtained when 3rd, 5th, and 7th harmonics are combined with the fundamental.

a) A fundamental whose frequency is the same as that of the square wave, namely, 100 cps, and whose amplitude depends on the amplitude of the square wave.

b) A third harmonic (300 cps) whose amplitude is 1/3 the amplitude of the fundamental.

c) A fifth harmonic (500 cps) whose amplitude is 1/5 the amplitude of the fundamental.

d) And so on down the line for the 7th, 9th, 11th, etc., etc., harmonics. To further clarify this concept, suppose we examine what happens when we combine these harmonics graphically. In *Fig.* 2, the dashed line represents the fundamental of 100 cps, and the light line represents the 3rd harmonic, the amplitude of which you will notice is 1/3 the amplitude of the fundamental. To find the curve of voltage which is the equivalent of these two acting simultaneously, the following procedure is used.

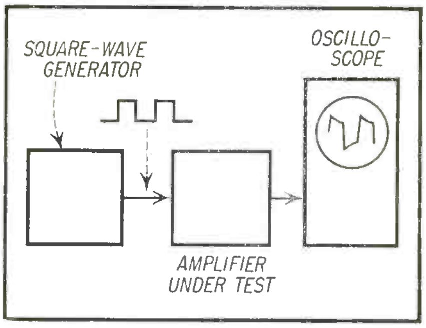
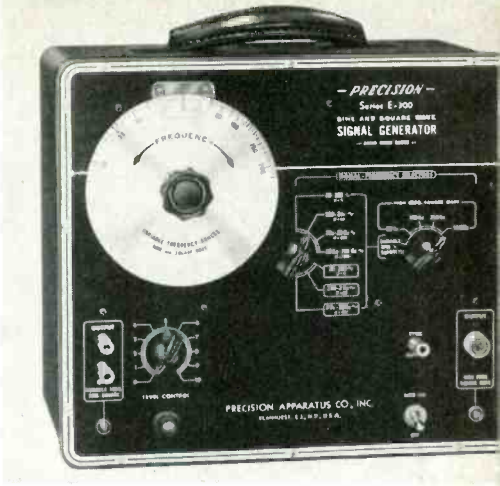


Fig. 5—Block diagram of test set-up for square wave testing of an amplifier.

1. Select any point along the time axis such as t_1.
2. Draw a light line perpendicular to this axis at the selected time t_1. This would be the line AB.
3. At this time, the voltage contributed by the fundamental is the voltage at point D/or +15 volts. The voltage contributed by the 3rd harmonic is the voltage at point C, or +10 volts.
4. Combining these two gives a resultant voltage of +25 volts. Thus, at the time selected, the equivalent voltage is +25. This locates point E, on the t_1 line and 25 volts above the axis.

A similar procedure would show that at t_2 the contributing voltages are +30 from the fundamental and −10 from the 3rd harmonic, giving a resultant of +20, as indicated by F of *Fig.* 2.

Points E and F therefore are two points on the curve of voltage which represents the combination of fundamental and third harmonics. By following the same procedure for many other points along the time base, the curve of voltage indicated by the heavy solid line would be obtained.



The Precision Model E-300 Sine and Square Wave Generator is a typical commercial product.

In *Fig.* 3, the dotted line is simply a repetition of the solid line curve of *Fig.* 2, and represents, as noted previously, the combination of a fundamental and a third harmonic with 1/3 the amplitude of the fundamental. Of course this is a far cry from a square wave, but it is certainly closer to a square wave than fundamental sine wave we started with. Its sides are steeper, and in spite of the dip at the center, the top is beginning to flatten out.

The light solid line in *Fig.* 3 represents the fifth harmonic of the fundamental, with an amplitude one fifth that of the fundamental. Without repeating the details, curves A and B in this figure may be combined by the same procedure previously outlined for the combination of the fundamental and 3rd harmonic. The result would be the curve shown by the heavy solid line of *Fig.* 3. When the 7th harmonic is added to this, *Fig.* 4 results. Comparing *Figs.* 2, 3, and 4 indicates that:

1. As these odd harmonics are added, the sides of the wave get steeper.
2. At the same time the top of the wave gets flatter in the sense that, although the number of ripples gets larger, the amplitude of these ripples gets smaller.

With this as a basis, it should not be difficult to accept the fact, previously mentioned, that if an infinite

[Continued on page 49]

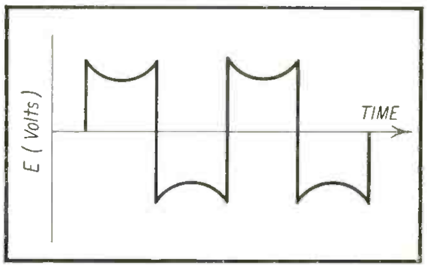
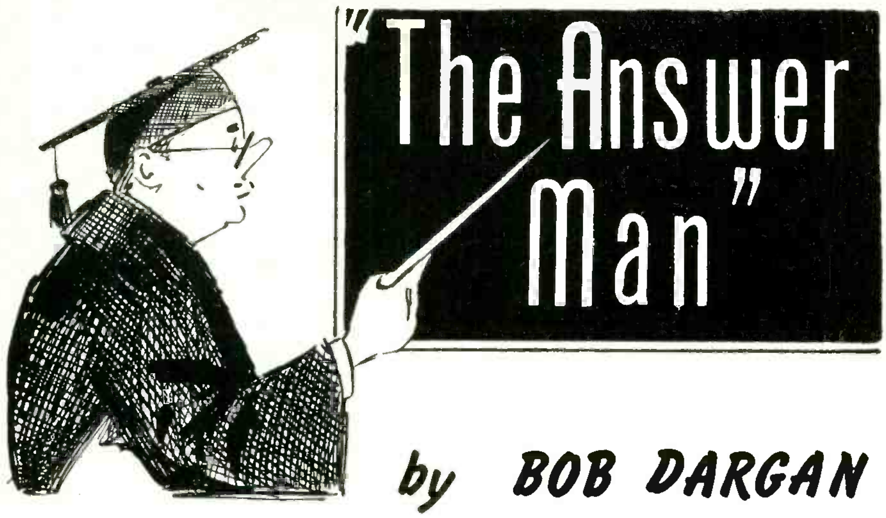


Fig. 6—Output of an amplifier with poor low frequency response, when input is a square wave.



"The Answer Man"

by BOB DARGAN

Do you have a vexing problem on the repair of some radio or TV set? If so, send it in to the Answer Man, care of this magazine. All inquiries acknowledged and answered.

Note: Only communications with Radio-TV Service Firm letterheads will be considered and answered. Please indicate make, model, and chassis number of receiver.

Dear Answerman:

I have an Admiral 21F1 chassis in which I am unable to make the vertical oscillator circuit function. When I got the receiver I realized that some other technician had been working on it because condensers and resistors were hanging loose. During the course of rewiring in accordance with the schematic I found that the screen resistor feeding the horizontal output tube had burned open. A new resistor was installed thereby providing horizontal sweep and high voltage. However, I could not get vertical deflection and I since have been unable to locate the cause of this trouble. All components in the vertical oscillator circuit have been thoroughly checked and the oscillator transformer and tube has been replaced without success. The voltages in the oscillator circuit are about normal but there is no waveform developed to drive the output stage. This has been determined with a scope. Do you have any idea that might be of help?

D. S.
Floral Park, L.I.

On examining the schematic diagram of the Admiral 21F1 chassis of a widely distributed schematic publisher it is found that the vertical oscillator circuit has a mistake in it. In checking other published schematics of the same chassis it is found that this error has been duplicated.

Figure 1 shows the partial schematic for the vertical deflection system with the incorrect connection of the .047 *uf* charging condenser and its 8.2K peaking resistor. This condenser-resistor

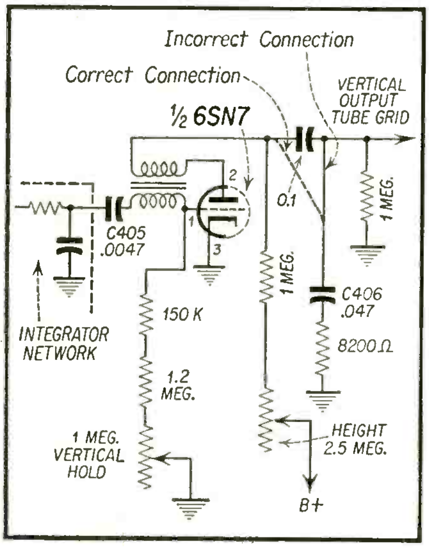


Fig. 1 — The correct connection for the vertical oscillator charging condenser and peaking resistor in the Admiral 21F1.

combination, when connected to the vertical output tube grid side of the .1 *uf* coupling condenser does not permit the development of a sawtooth voltage.

The condenser-resistor circuit must be connected to the plate circuit of the vertical oscillator tube as shown in the dashed lines of *Fig. 1*. Only in this fashion will the electrons be removed from the top plate of *C406* during the period when the vertical oscillator tube is being held at cut-off by the grid bias. These electrons flow from the top side of the condenser through the 1 meg resistor and the 2.5 meg height control to B plus. During the removal of these electrons from the one side of the condenser a sawtooth voltage is developed across it, this voltage being coupled to the vertical output tube causing vertical deflection. Just before the sync pulse comes along, the negative bias developed in the grid circuit has been decreased by discharge of electrons from the *C405* through the transformer and the grid leak resistors. With the sync pulse the tube is triggered into conduction and provides a discharge path for the voltage developed across the charging condenser *C406*; and the next sawtooth begins.

Understanding the circuit operation makes it possible to pick out mistakes in schematic such as above. In the preparation of service literature it is impossible to prevent errors from occurring. If this does happen it takes a rather informed technician to spot the trouble.

Dear Mr. Answerman:

I have three television receivers with picture tubes that arc in the neck between the elements.

Does the arcing mean that the picture tubes are defective or could some circuit defect cause the arcing. If so, what could possibly do this? The sets work okay otherwise.

P. K.
Madison, Pa.

Arcing or flashing in the neck of picture tubes is commonly caused by particles lodging in the electron gun. It usually is visible just forward of the ion trap. Flourescent material from the coating of the inside face of the tube loosened during transportation or manufacture may have caught in the electron gun structure. These particles can intermittently short the high voltage anode to other elements.

Often, after a period of operation of a new picture tube, the particles burn themselves open without steps having to be taken for their removal.

In some cases the accumulation of the particles may be so great as to cause a complete short between two elements such as the cathode and grid or between the filament and cathode. In such cases the picture signal is shorted out or the background or brightness control of the picture is made inoperative. In any event, it is very unlikely that some circuit defect will cause this type of difficulty as it usually is solely a picture tube problem.

However, the condition does not necessarily mean that the picture tube must be replaced. Many cases of arcing can be corrected by either of two possible methods.*

1. These particles lodged in the gun structure can frequently be loosened by

[*Continued on page 51*]

Mfr: Fada **Model** S1055

Card No: FAS55-1

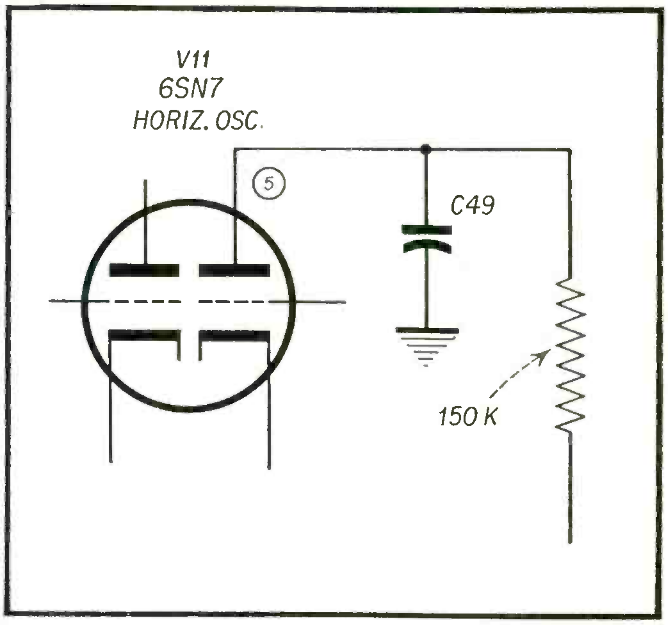
Section Affected: Raster

Symptom: No high voltage

Cause: Shorted condenser in horizontal discharge circuit

What to Do:

Replace: *C49* (390 $\mu\mu f$)



Mfr: Fada **Model** S1055

Card No: FAS55-2

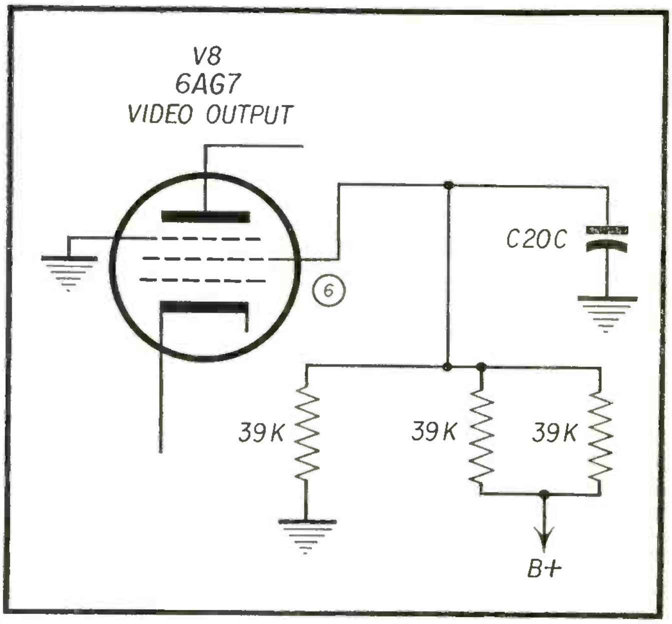
Section Affected: Pix

Symptom: No video

Cause: Shorted video screen condenser

What to Do:

Replace: *C20C* (10 μf)



Mfr: Fada **Model** S1055

Card No: FAS55-3

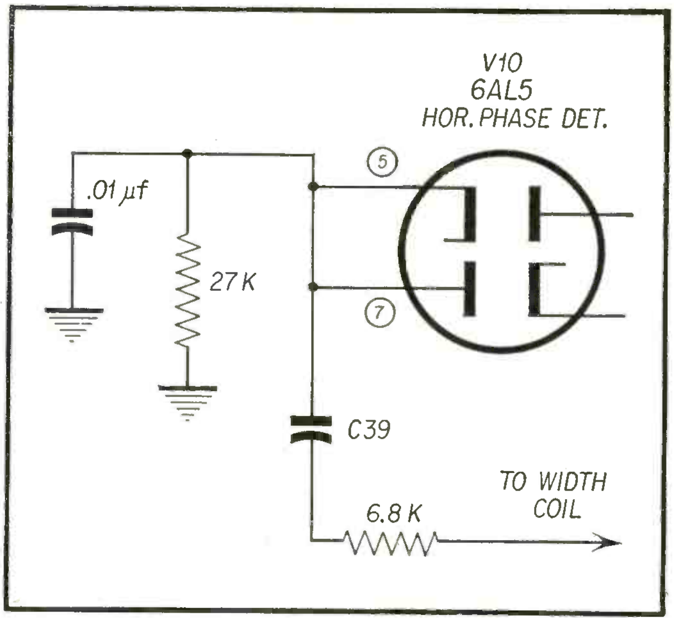
Section Affected: Sync

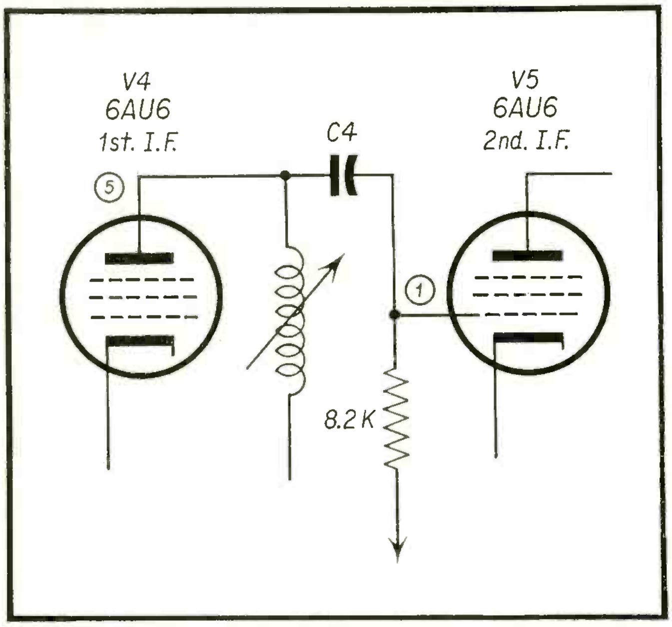
Symptom: Critical horizontal hold

Cause: Leaky condenser in phase detector

What to Do:

Replace: *C39* (.05 μf)





Mfr: Fada **Model** S1055

Card No: FAS55-4

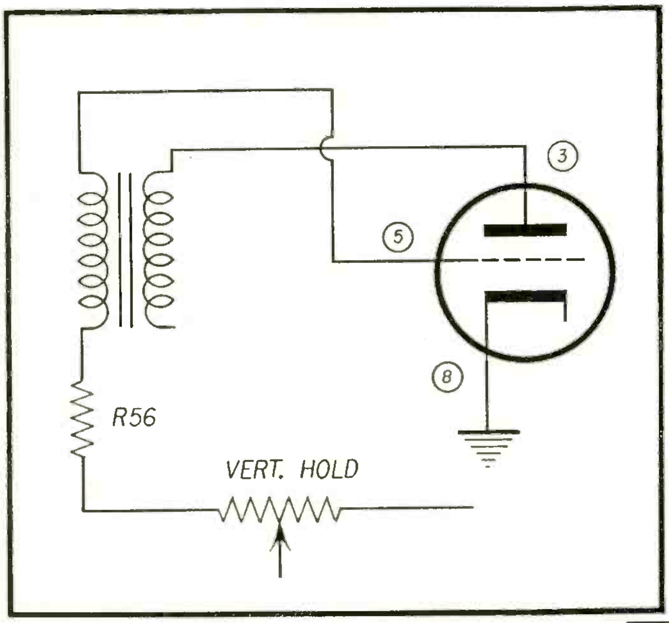
Section Affected: Pix

Symptom: Video overload on normal contrast control settings

Cause: Leaky coupling condenser

What to Do:

Replace: *C4* (120 *μμf*)



Mfr: Fada **Model** S1055

Card No: FAS55-5

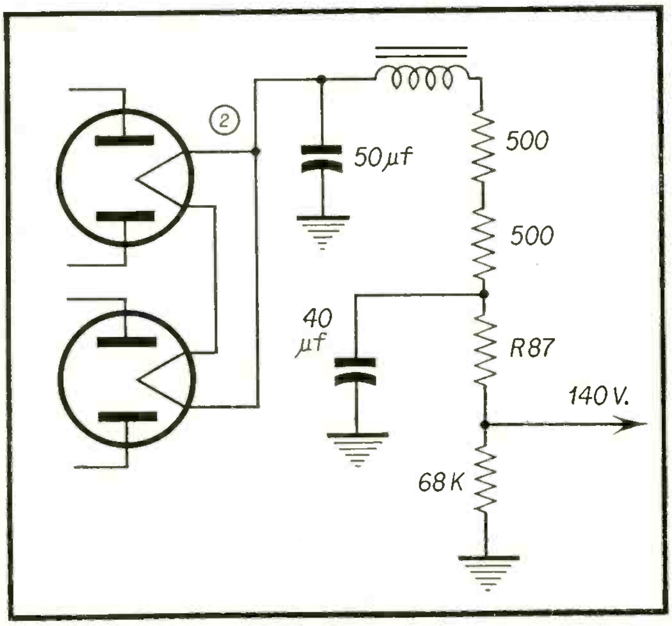
Section Affected: Sync

Symptom: Vertical hold drifts out of range

Cause: Vertical oscillator resistor increases in value

What to Do:

Replace: *R56* (1.5 meg)



Mfr: Fada **Model** S1055

Card No: FAS55-6

Section Affected: Sound & pix

Symptom: No sound or pix

Cause: Open voltage divider

What to Do:

Replace: *R87* (1750 ohms-20W)

TV FIELD SERVICE
Pre-published from Rider "TV Field Service Manuals"
by Rider & Alsberg

ZENITH

MODEL		CHASSIS
K2872R	27"	28K20
K2873E	27"	28K20

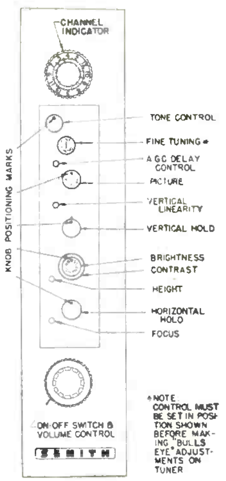
TUBE LIST

SYMBOL	TYPE	CIRCUIT FUNCTION
V1	6BK7	RF Amp.
V2	6U8	Mixer, RF Osc.
V3	6CB6	1st IF Amp.
V4	6CB6	2nd IF Amp.
V5	6CB6	3rd IF Amp.
V6	6U8	1st Video, Intercarrier Sound Amp.
V7	6BN6	Audio Detector
V8	6J5	Sound Inverter
V9	6BK5	Sound Output
V10	6BK5	Sound Output
V11	12AX7	AGC Amp, Vert Sync
V12	12AU7	2nd Video Amp, Video Output
V13	6BE6	Sync Clipper
V14	6SN7GT	Vert. Osc.
V15	6AH4GT	Vert. Output
V16	6AH4GT	Vert. Output
V17	6AQ7GT	Hor. Phase Det., Control
V18	6J5	Hor. Osc.
V19	5U4	Rectifier
V20	5U4	Rectifier
V21	6J5	Hor. Discharge
V22	6CD6G	Hor. Output
V23	6CD6G	Hor. Output
V24	1B3GT	H.V. Rectifier
V25	1B3GT	H.V. Rectifier
V26	6V3	Damper
V27	6V3	Damper
V28	27AP4A	*Picture Tube

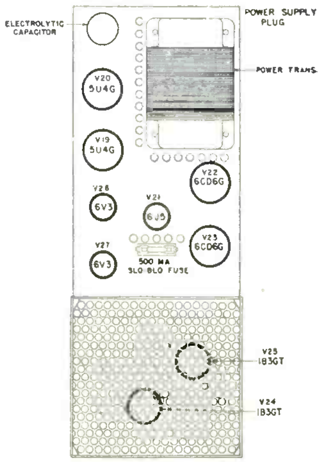
KEY VOLTAGES

B+, plate of damper, V26, V27 pin 2, 7, and 9	350 vdc
Booster B+, cath. of damper, V26, V27 tube cap.	645 vdc
Plate(s) of VERT. OSC., V14 pin 2	99 vdc
pin 5	64 vdc
Plates of Vert. Out., V15, V16 pin 5	330 vdc
Plate of Hor. Osc., V18 pin 3	250 vdc
Plate of Hor. Osc. control, V117 pin 5	270 vdc
Grids of Hor. Out., V22, V23 pin 5	—38 vdc

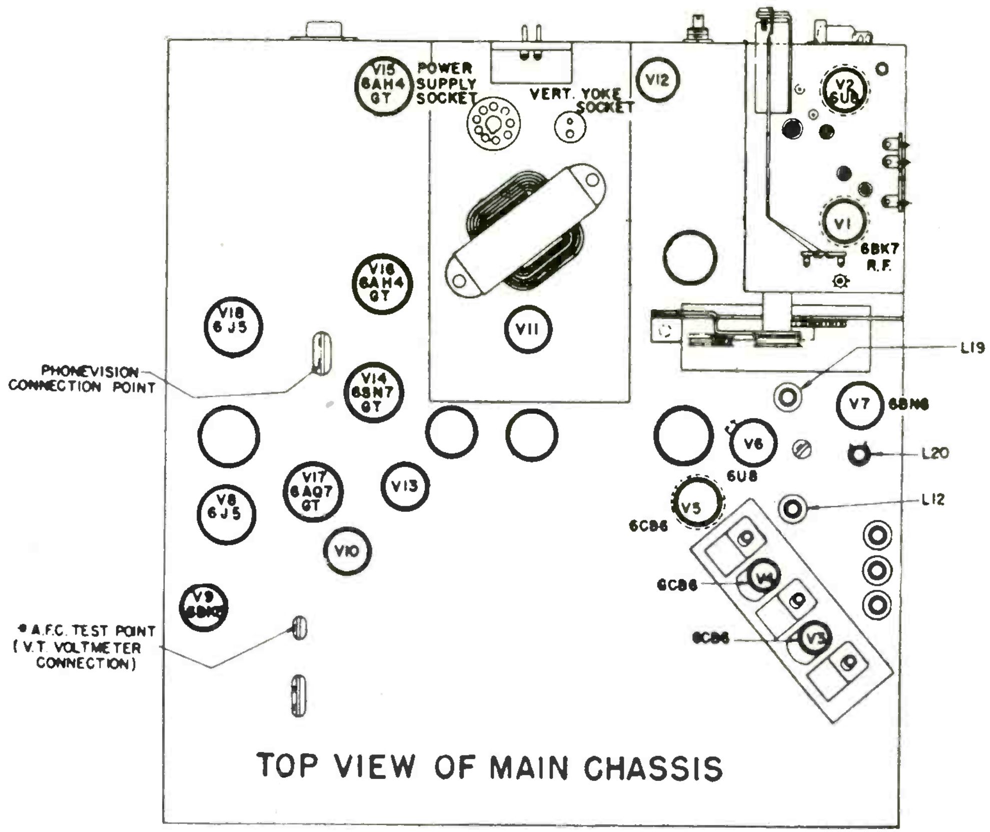
All voltages are measured with a VTVM connected between the tube pins and chassis.



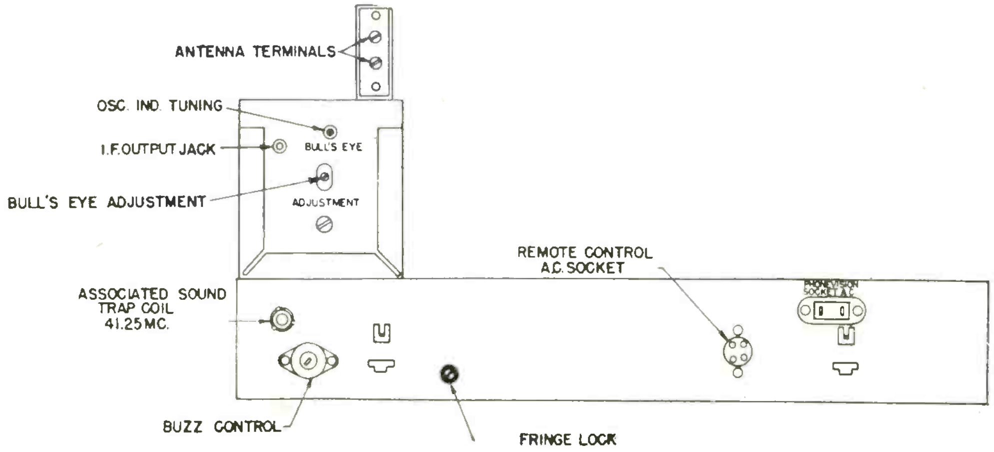
FRONT CONTROLS



TOP VIEW OF POWER SUPPLY CHASSIS



TOP VIEW OF MAIN CHASSIS



REAR CONTROLS OF MAIN CHASSIS

ADJUSTMENTS

FRINGE LOCK ADJUSTMENT

1. Turn the fringe lock control fully clockwise and then back it off approximately ¼ turn. Adjust the vertical and horizontal hold controls and check operation of the receiver to see that it syncs normally when the turret is switched from channel to channel.

2. If the picture jitters or shows evidence of delay, tearing, split phase, etc., back down the fringe lock control further, a few degrees at a time, each time readjusting the hold controls and switching from channel to channel until normal sync action is obtained. It will be found that under normal signal conditions, the correct adjustment will be near the counterclockwise position of the control.

3. In fringe and noisy areas, the best adjustment will be found at or near the maximum clockwise position of the control.

CORRECTOR MAGNET ADJUSTMENT

Two corrector magnets are used to obtain straight, sharply focused sweep lines across the face of the picture tube. These magnets are mounted on the deflection coil mounting bracket and can be moved in and out or up and down by bending the flexible arms which support them. The corrector magnets are adjusted at the factory and should not require re-adjustment unless accidentally bent out of position. If this occurs, adjustment can then be made as follows:

1. With the vertical and horizontal size controls, reduce the size of the picture to a point where the four corners and sides of the picture are visible.

2. Bend the corrector magnet arms until the corners become right angles and the top of the raster is parallel with the bottom and the left side is parallel with the right side. After adjustment, the picture should be restored to normal size.

NOTE: Mis-adjustment of the corrector magnets may cause pincushioning, barreling, keystoning, poor linearity, etc.

CENTERING ADJUSTMENTS

Two types of centering assemblies have been used in production.

The S-18118 assembly consists of two magnetic rings mounted in two movable washers. The washers are provided with tabs so that the magnets can be turned independently of each other to vary the total magnetic flux. This unit is installed approximately ¾" behind the yoke to prevent the yoke from demagnetzing the ring type magnets. Adjustment is made by gradually rotating the tabs with respect to each other and rotating the entire unit until the picture is centered.

The S-18439 assembly utilizes a small bar type magnet which can be turned by means of a knurled shaft. This assembly can be installed within ⅛" of the yoke and is adjusted by turning the knrled shaft and rotating the entire unit until the picture is centered on the screen.

AFC ADJUSTMENTS

The AFC adjustment can effectively be made by setting the horizontal hold control L27 to a position where it is virtually impossible to "throw" the receiver out of horizontal sync when switching from channel to channel.

BULLS-EYE TUNER ADJUSTMENTS

To adjust the receiver for bulls-eye tuning, set the fine tuning control to its approximate center position. Without further adjustment of the fine tuning control insert an alignment wrench into the tuner and adjust each operating channel to resonance. It will be noted that tuning to one side of resonance results in a faded, washed-out picture with the spacing between the wedge lines fogged and tuning in the opposite direction causes the spaces between th lines to clear up. However, going beyond this point causes the picture to take on a "wormy" appearance from sound getting into the picture. Correct adjustment is obtained by tuning to the "wormy" picture and then backing the control off slightly until the picture clears up.

REMOVING TURRET TUNER FROM CHASSIS

1. Pull out the power and IF connector cables and disconnect the antenna transmission line.

2. Look through the U-shaped opening in the top of the tuner and rotate the fine tuning control until the allen head screw on the fine tuning shaft is straight up.

3. Loosen (do not remove) the hex head set screw in the turret dial cord pulley assembly.

4. Slide the pulley towards the front of the chassis until it clears the fine tuning shaft.

5. Remove the four wing or hex nuts and gently pull the tuner assembly straight out of its case.

REMOVING CHANNEL STRIPS

1. Remove the tuner from the case and lay on its side.

2. Rotate the turret drum until the strip to be removed is readily accessible.

3. Insert a small screwdriver in the slot. Push in the direction of arrow until the channel strip clears the drum slot then lift straight out in direction of screwdriver shaft.

CAUTION: TO AVOID DAMAGE TO CHANNEL STRIPS, DO NOT USE PRYING ACTION IN REMOVING STRIPS

REMOVING TURRET DRUM ASSEMBLY

1. Use long nose pliers and remove the two turret shaft tension springs from the front and rear of the tuner assembly. Slide the bronze turret shaft grounding spring out of its slot at the rear of the tuner.

2. With a pair of long nose pliers, grasp the first turn of the spiral index spring and lift spring off its hook. This takes pressure off the detent arm and may cause the roller to fall out and become lost.

3. Slide the drum out of its slot. Reverse this procedure to re-assemble the tuner.

ZENITH TROUBLE SHOOTING CHART

ENGRAVED EFFECT IN PIX
Tuner fine tuning
Contrast con.
V2, V3, V4, V5, V6, V11, V12, V28
AGC Delay con.
Check 0.01 μf cap. connected to pin 2 of V12
Check Vid. Det. and Amp. peaking coils

VERT. BARS
Hor. Drive con.
V22, V23, V26, V27
Check cap. connected to yoke terminals
Defl. yoke ringing

PIX BENDING
Hor. Hold con.
AGC Delay con.
V13, V17, V18, V21
Check 680 $\mu\mu f$ cap. connected to pin 5 of V17

WEAK OR NO PIX—SOUND WEAK—RASTER OK
Tuner fine tuning
AGC Delay con.
V1, V2, V3, V4, V5, V6
RF and IF alignment

INTERMITTENT RASTER—SOUND OK
Brightness con.
V17, V18, V21, V22, V23, V24, V25, V26, V27, V28
Hor. Out. trans.
Check 2.5 Meg Ω resistors connected between V24 and V25

RASTER BLOOMING
Hor. Drive con.
V22, V23, V24, V25, V26, V27, V28
Check 2.5 Meg Ω resistors connected between V24 and V25
Check HV Filter cap.

INSUFFICIENT RASTER WIDTH
Hor. Drive and Width con.
V19, V20, V22, V23, V24, V25
Check 330 and 680 $\mu\mu f$ caps. connected to pin 3 of V21
Hor. Out. trans.
Low line voltage

NO RASTER—SOUND OK
Brightness con.
Check HV Fuse (0.5 Amps. slow-blow)
Ion trap
V17, V18, V21, V22, V23, V24, V25, V26, V27, V28
HV trans. Hor. yoke CRT connections

WEAK PIX—SOUND AND RASTER OK
Tuner fine tuning
Contrast con.
V2, V3, V4, V5, V6, V11, V12
AGC Delay con.
Check Vid. Det. xstal XI (Part of T4)

POOR HOR. LIN.
Hor. Lin. and Drive con.
V22, V23, V26, V27
Check 0.15 μf cap. connected to hor. lin. coil
Hor. Out trans.

POOR VERT. LIN.
Vert. Size and Lin Con.
V14, V15, V16
Check 0.001 and 0.1 μf caps. connected to pin 2 of V14
Check 100 μf Elec. cap. connected to pin 8 of V15 and V16
Vert. Out. trans.

PIX JITTER SIDEWAYS
Hor. Hold con.
V13, V17, V18
Check 56 and 75 $\mu\mu f$ cap. connected to pin 2 of V17

PIX JITTER UP & DOWN
Vert. Hold and Contrast con.
AGC Delay con.
V11, V13, V14

SMEARED PIX
Tuner fine tuning
Contrast con.
V3, V4, V5, V11, V12
Check Vid. Det. and Amp. peaking coils
Check 0.047 μf cap. connected to pin 7 of V12
IF and RF alignment

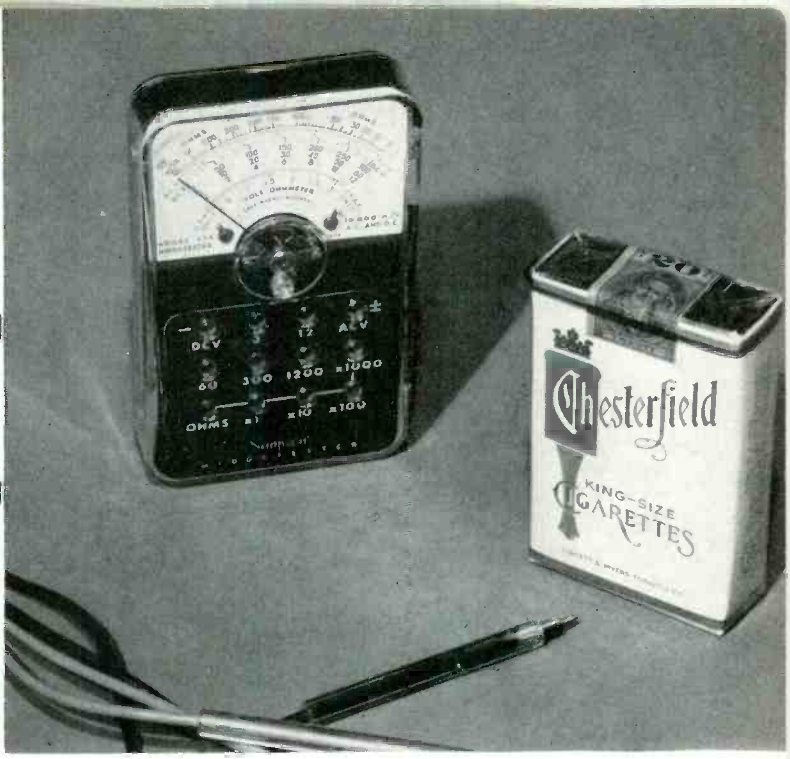
POOR PIX DETAIL
Tuner fine tuning
Focus con.
V3, V4, V5
Check Vid. Det. and Amp. peaking coils
Check Vid. Det. xstal XI (Part of T4)
IF and RF alignment

INSUFFICIENT RASTER HEIGHT
Vert. Size and Lin. con.
V14, V15, V16, V19, V20
Check 0.01 and 0.001 μf caps. connected to pin 2 of V14
Vert. Out. trans.
Low line voltage

NO VERT. DEFL.
V14, V15, V16
Check 0.01 and 0.001 μf caps. connected to pin 2 of V14
Vert. Defl. coils (yoke)
Vert. Osc. trans.

NO VERT. SYNC.—HOR. SYNC. OK
Vert Hold con.
Vert. Int. network
V11, V13, V14, V15, V16
Check 0.0047 μf cap. connected to pin 1 of V14

a Miniature Volt-Ohmmeter



by Edward McArdle

THE current crop of new test equipment produces a unique volt-ohmmeter from the standpoint of utility and circuitry. This instrument is the Simpson Midgetester Model 355 shown above. It is so small that it actually can be carried in your shirtpocket. Its measurements are 2¾" x 4½" x 1" overall.

What It Does

This instrument functions as a 5-range *dc* voltmeter, a 5-range *ac* voltmeter, and a 4-range ohmmeter. Function switching, that is from an *ac* voltmeter to a *dc* voltmeter, to an ohmmeter, is accomplished by small switches located under the tip jacks marked ACV+, –DCV, and OHMS. These switches are closed by screwing the black test lead into any of the above mentioned tip jacks. The red test lead is then screwed into the tip jack providing the desired range.

Ohmmeter

The circuit diagram of the instrument is shown in *Fig. 1.* As an ohmmeter the ohms switch is depressed by inserting the black lead into the OHMS tip jack. Assuming that the x1 range is used, shorting the test leads inserted into the aforementioned tip jacks does two things. First, it connects a 120 ohm resistor across the battery. Second it provides a voltage for the meter circuit which is adjusted to full scale (78 microamperes) by the Ohmmeter Zero Adjustment potentiometer, the knob of which is located in a recessed pocket on the right side of the instrument.

If the test lead short across OHMS and x1 is removed and an external 120 ohm resistor connected across the leads the meter will read half scale because half the battery voltage is now made available for the ohmmeter. This half scale reading is calibrated as the 120 ohm reading of the x1 scale ohmmeter. By simple ohms law calculations the other ohms scale readings may be similarly derived.

The ohms ranges provided by x1, x10, x100 use a 1.5 volt battery (Burgess Battery Co. Type Z), and the x1000 ohms range uses an Eveready Type 404E 15 volt battery. These range provide useable readings of resistance values from 1 ohm to 10,000,000 ohms.

DC Voltmeter

For *dc* voltage measurements the black probe is screwed into the –DCV tip jack. This depresses the switch indicated by the dashed line which shunts the 78 microampere meter with a 5455 ohm resistor. The latter draws 22 microamperes so that the entire meter becomes a 100 microampere meter which is equivalent to a 10,000 ohms per volt meter.

Five *dc* voltage ranges are provided. When using a voltmeter the service technician must be sure the instrument does not unduly load down the circuit under test. To calculate the loading effect in ohms of any range of this instrument one merely multiplies the voltage range

[*Continued on page 45*]

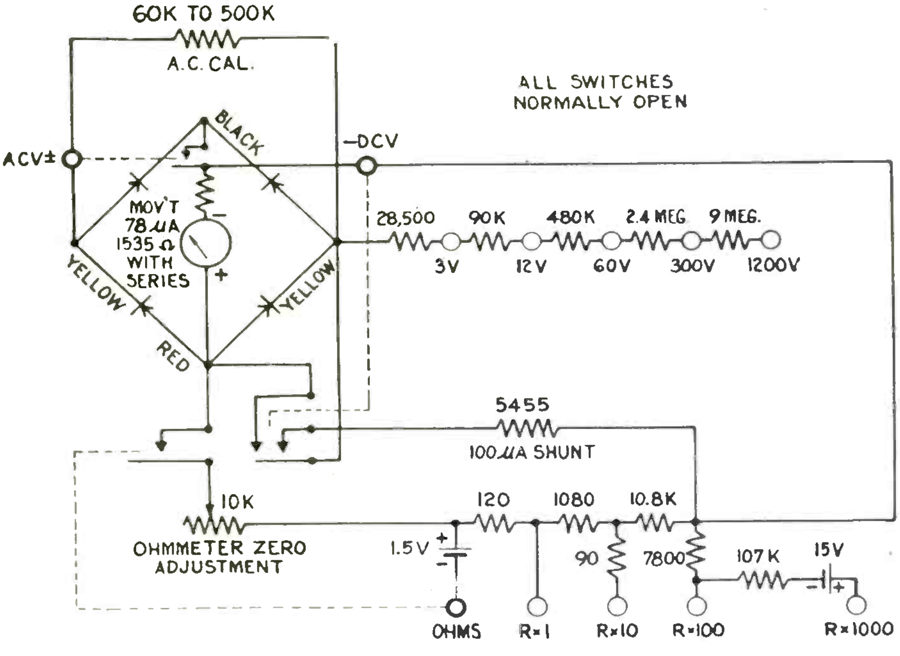


Fig. 1—Circuit diagram of Simpson Midgetester Model 355.

TRADE FLASHES

[*from page 6*]

award of the Gano Dunn medal. Established this year, the medal will be awarded annually to an alumnus of the Cooper Union for outstanding professional achievement. Mr. Dubilier is being honored by his Alma Mater for his inventions and development of high voltage condensers, or capacitors, an important element which helped the tremendous growth of the electrical and electronic industries.

Blonder-Tongue Labs, Inc. of Westfield, New Jersey has put into full operation its second plant located in Newark, N. J., providing over 30,000 square feet of additional manufacturing space.

The new Blonder-Tongue plant is now fully equipped and staffed with qualified technical and production personnel to do contract manufacturing of all types of commercial electronic equipment.

A new dealer finance program, providing for both dealer inventory and retail sales financing to be underwritten by Raytheon Manufacturing Company in conjunction with the dealer's local has been announced. The program contains a complete manufacturer's obligation to repurchase any repossessed merchandise.

H. Ward Zimmer, at the age of 57, died on January 28 at the New York Hospital after a brief illness. Mr. Zimmer was President of Sylvania Electric Products, Inc., and a pioneer in the electronics industry.

A television receiver specifically designed to operate on both direct current and alternating current without the use of an inverter or converter has just been introduced by Emerson Radio and Phonograph Corporation, it was announced yesterday by Michael Kory, Director of Sales.

ASSOCIATIONS

[*from page 16*]

was honored to have as its guest in charge of the educational program, Donald Landis of the local Naval Ordnance Plant. Mr. Landis is an electronics engineer and well qualified in the field of TV service.

Radio-TV Service Association of St. Paul, Inc.

First Annual Banquet of Radio-Television Service Association of Saint Paul, Inc., was held January 12, 1954 at the Officers Club, Fort Snelling St. Paul, Minn. Local television and radio stations will furnish entertainment after the banquet. Facilities were provided and 400 people were in attendance.

New Officers for 1955 who were installed at this banquet are as follows:

President—Clyde Orlando
Vice President—Harry Winkler
Treasurer—Robert Rohweder
Secretary—Ross Hilker
Asst. Treas.—Joe Driscoll
Asst. Secy.—Clarence Thoele
Board Member—Jim Dorfsman.

New Hampshire Radio & TV Association

Harvey O'Dowd of Goffstown was reelected president of the New Hampshire Radio and Television Association, a servicing organization, at the annual meeting in the New Hampshire Technical Institute here.

Other officers elected were Paul Frost of Concord, first vice-president; George Bennett, Manchester, second vice-president; Ernest Tetrault, Manchester, treasurer; Emile R. Gelinas, Manchester, executive-secretary, and Warren Davis, Hampton, secretary.

Horace Bradford of Laconia; George Hill and Earl Whittemore of Keene;

John Condon and Henry Cantin, Manchester, were named directors.

TV Installation Service Association —Illinois

At the annual election meeting of the Television Installation Service Association the following officers were elected for 1955: Frank J. Moch of Aide Service Corp. was reelected President unanimously. Elected to serve with him for 1955 were Walt Krzak of Television Engineers, Inc., 1st Vice President; Russ Havill of Havill's TV, 2nd Vice President; Larry Corlew of Electronic Engineers, Inc., Secretary; George Hingson of Courtesy TV Service, Treasurer; and Mel Brown of B & M Radio & TV Service Sargeant at Arms.

Calling North Carolina Associations

Readers in the Clarkston, N.C. area would like to know of any service association meeting hereabouts. Associations please write in forwarding address to Editor. Thanks.

R.A.T.E.T. Assn. Inc. (N. Y.)

Lectures this year will be held at The Cornish Arms Hotel. Zenith Radio Corp. of N. Y. will give a lecture on March 24, on the new Zenith chassis—Troubleshooting, alignment, etc. In April JFD Manufacturing Co., Inc. will give a lecture on new TV antenna and new installation accessory developments. Emerson Radio & Phonograph Corp. will lecture in May. We anticipate a series of four color lectures by Sylvania Electric Products Co. in June. After the Summer Vacation RATET will continue this fine program of presenting more of the leading manufacturers to you.

At its last meeting December 16, 1954 the following were elected to hold office during 1955:

President, Charles Vassalo; Vice President, Leon Sievers; Secretary, George Saddler; Treasurer, Rudolph Stone; Editor, George Steinburg; Sergeant-at-Arms, Ray Calderon; Registrar, Myron Rawluk; Inter-State Affairs, G. Wager Hill; Chairman of Associate Members, Robert Fenster; Chairman of TV Store Owners, Norman Weston.

Association of TV Service Companies, Cincinnati, Ohio

ATSCO observes that Miami, Florida is the scene of the latest activities of the Better Business Bureau, and the District Attorney—nine service company operators have been charged with petty larceny based on false billing of TV service repairs.

Could the reason for this be the low service charges that prevail in Miami?

Quote from a Miami newspaper advertisement "No Charges, if TV is not operating to your satisfaction with two or less new tubes. Free Estimate if set requires shop labor." Or from the same newspaper "No Charge, if set is not repaired in your home for under $6.00. Parts included!" or "$1.50 TV Service Call in your home." Just proves the old saying "You can't *'give'* something for nothing." Be honest with yourself and your customers. Keep your prices at a level where you can make a reasonable profit. Don't let this happen here!

Long Island Electronic Technicians Assoc., Inc. (N. Y.).

Shown below is Dick Carey, President of L.I.E.T.A. 'sweating it out' during the holiday rush season. He attributes his success in the servicing busi-

ness to the fact that he belongs to and takes an active part in Association work and Association programs. Mr. Carey has two trucks on the road and keeps four men busy besides himself. He is one of the old-timers in the business, having had a radio shop in the earliest days.

Syracuse (N. Y.) TV Technician Assn.

STTA in cooperation with ESFETA (Empire State Federation of Electronic Tech. Assoc.) is presenting a lecture series that will benefit all electronic technicians. Be sure you attend these important meetings that will cover the manufacturing and maintenance of new electronic components to be used in present and future design of Radio & T. V.

TV INSTRUMENT CLINIC

[from page 23]

the fine-tuning control is turned, the frequency of the local oscillator is varied. In consequence of the local-oscillator frequency change, the *i-f* output frequency from the mixer changes correspondingly. The first *i-f* stage generates a certain amount of harmonic signal; when mixer regeneration is present, the harmonic signal feeds back from plate to grid of the mixer stage via the plate-grid interelectrode capacitance of the mixer tube. This harmonic signal beats with the incoming *r-f* signal, and in some cases the beat is in-phase while in other cases the beat is out-of-phase. The phase relations change as the fine-tuning control is turned, and hence the shape of the response curve changes likewise. Mixer regeneration is usually less in front ends of modern design.

Q. When making a single-stage check in an *i-f* amplifier, what should be looked for?

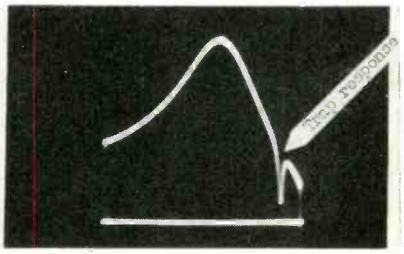


Fig. 5—Typical single IF response on a 15 mc sweep.

A. Fig. 5 shows a typical single *i-f* stage response, displayed on 15-*mc* sweep. Note that the bandwidth is large; in this example the bandwidth (measured between the half-voltage points) is greater than 10 *mc*. In other cases, the bandwidth may be less, perhaps 5 *mc*. But substantial bandwidth is characteristic of normal operation, and narrow bandwidths in a single-stage response indicate the presence of regeneration, or open damping resistors. The gain of a single stage should be about 10 times, at low bias.

Q. Why is sine-wave sweep used in alignment work, rather than sawtooth sweep?

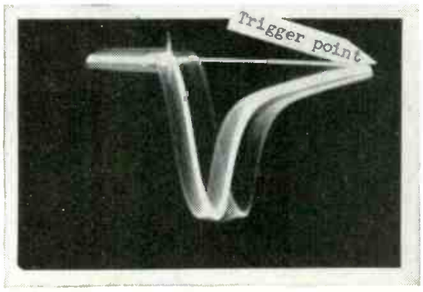


Fig. 6—Difficulty of synchronization is shown above with sine-wave sweep.

A. Synchronization is sometimes a problem when sawtooth sweep is used, as illustrated in *Fig. 6.*

VOLT-OHMMETER

[from page 41]

by 10,000. Thus, the loading effect of the 300 volt range is 300 x 10,000 = 3 megs. A good rule to follow when measuring voltages in high resistance circuits such as *agc,* is to use the highest possible scale of the instrument that will provide a useful reading.

AC Voltmeter

The *ac* voltmeter is put into operation by inserting the black probe into the ACV+ tip jack which depresses switch shown by the dashed line. *AC* voltage measurements are made by rectifying the *ac* voltage with an internal *full wave bridge type instrument rectifier.* The resulting *dc* voltage causes a proportional current to flow through the meter. An internal *shunt* resistor, individually *calibrated* to the characteristics of each meter and rectifier, is connected in parallel with the meter and rectifier. The same set of series resistors as were used for *dc* voltage ranges will increase the total instrument resistance to *10,000 ohms per volt* for *ac* voltage ranges also.

All *ac* voltages indicated with the Simpson Midgetester Model 355 are *rms* values based on full wave rectification. If the input voltage is a sine wave, multiply the indicated value by 2.828 for the peak-to-peak value, or by 1.414 for the peak value.

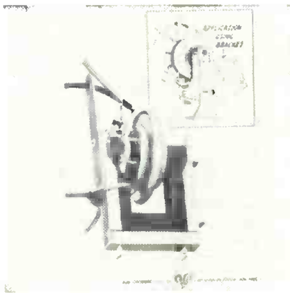
New Products

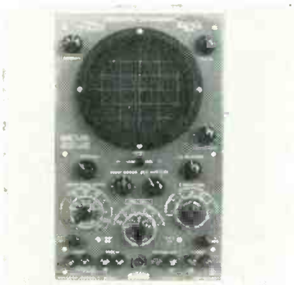
Brach "Magne-Tenna"

A new indoor antenna engineered and developed by the Brach Manufacturing Corporation, a Division of the General Bronze Corporation, and trademarked "Magne-Tenna." It measures 14" x 6" x 4" has no protruding rods and is enclosed in a decorative cabinet which can be placed on the top of the home TV set. Best pictures are received by simply turning a knob which operates the same as tuning your radio set. For information, write Brach Manufacturing Co., 200 Central Ave., Newark, N. J.

Ram Flyback Transformers

Ram Electronics Sales Co., Irvington-On-Hudson, New York, announced two horizontal output transformers for replacement in Zenith receivers. Models XO70 and X116 feature unique anti-corona spray, special terminal lead distribution and high voltage stand-off construction. An instruction brochure, including circuit diagrams, is supplied with each unit. For further information, write directly to Ram.



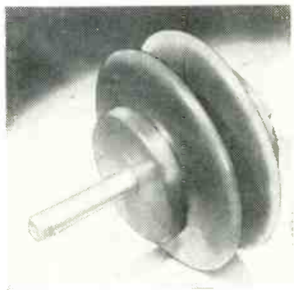


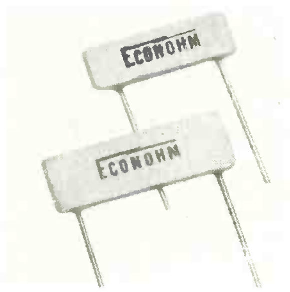
DuMont Oscillograph

The DuMont Type 324, by Instrument Division, Allen B. DuMont Laboratories, Inc., Clifton, N. J., makes possible accurate d-c measurements of amplitude in the millivolt and microvolt region with excellent stability and low noise. Full scale amplitude ranges in 16 steps from 4 mv full scale to 400 v full scale with balanced input available on 7 ranges. Frequency response flat from dc up to 300 kc, depending on sensitivity range.

Aerovox High-Voltage Ceramics

To meet the higher operating voltages of color TV receivers, a heavy-duty ribbed-case ceramic capacitor is produced by the Hi-Q Division of Aerovox Corporation, Olean, N. Y. Of particular interest in high-voltage applications is the special ribbed construction which provides an extra-long "creepage path" in a small size. Rated at a working voltage of 30 kvdc, or a test voltage of 50 kvdc for one minute, the ceramic "Cartwheel" is encased in a cast insulating material.





TV Replacement Resistors

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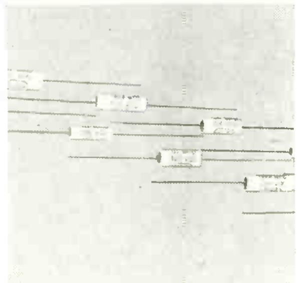
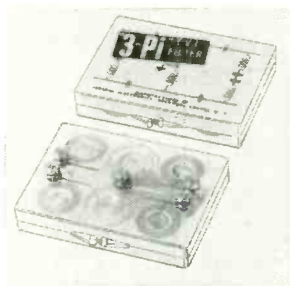
C-D Midget Tubular

Cornell-Dubilier has announced production of STT Midget "Budroc" Steatite-cased paper tubular capacitors. Miniaturized versions of the company's regular "Budric" line, the new Midgets range in size from 7/32" dia. and 11/16" length to ⅜" dia. and 1⅛" length. For complete information, send for Engineering Bulletin 159. Write to Cornell-Dubilier Electric Corporation, South Plainfield, N. J.



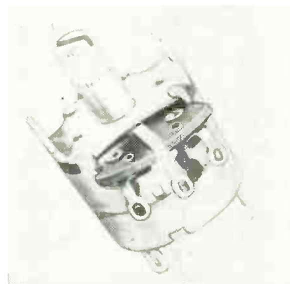


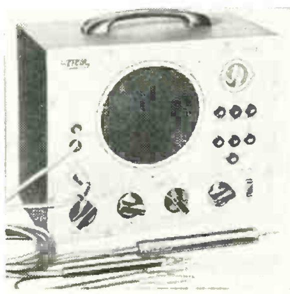
Federal Electronics Filter

Federal Electronics of Rockville Centre, N. Y., announces the "3-Pi" T.V.I. Filter for the suppression of television interference. The unit features printed circuit design to effectively suppress TV interferences caused by auto ignition systems, medical diathermy and X-ray equipment, neon signs, and electrical appliances. For details write: Federal Electronics, Federal Electronics Building, Rockville Centre, N. Y.

Twisted-Tab-Mounting Controls

Clarostat Mfg. Co., Inc., Dover, N. H., announces a new low-cost mounting method for their Series 47 twisted-tab mounting controls. Material saving is accomplished by elimination bushings, mounting nuts and lock washers. Utilizing readily available tools, mounting of control is completed in one operation. Available with (as illustrated) or without power switches. Controls with plastic shafts are adjustable from front or rear.



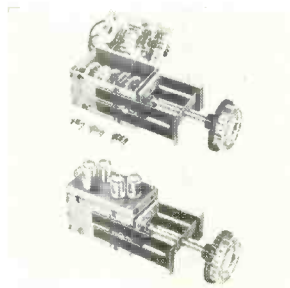


Eico Signal Tracer

A new deluxe milti-signal tracer featuring facilities for RF, IF and audio signal tracing and trouble-shooting in AM, FM and TV sets has been produced by EICO (Electronic Instrument Co.,) 84 Withers Street, Brooklyn 11, N. Y. Cataloged as Model 147, it has separate high gain rf and low gain audio input channels, built-in 5" test speaker, and a magic eye monitors both channels for easier estimation of signal strength and gain-per-stage.

Anchor TV901 Tuner

A new 82-channel TV tuner designed to give the customer the convenience of instant station selection, whether VHF or UHF, has just been announced by Anchor Radio Corp., 2215 S. St. Louis Ave., Chicago 23, Illinois. Channel segments (not converter strips) to suit local TV station requirements are snapped into the easily accessible turret in any desired order: they consist of simple circuits which are factory tuned and need no field adjustment.



COLOR *[from page 20]*

voltage at point (3) plus 2E v. This condition and intermediate phase relations are clearly shown in *Fig. 7*.

Notice that as the phase of the chroma signal varies with the phase of the 3.58 *mc* reference signal, different values of R-Y signal both in amplitude and phase are developed. Needless to say, the phase of the chroma signal is directly related to the *color* of the chroma signal; and the amount of R-Y signal it produces is the amount of R-Y signal required to reproduce that color on the picture tube screen. Amplitude and polarity variations at the R-Y point for different phase angles between the chroma signal and the 3.58 *mc* reference signal are shown in *Fig. 8*.

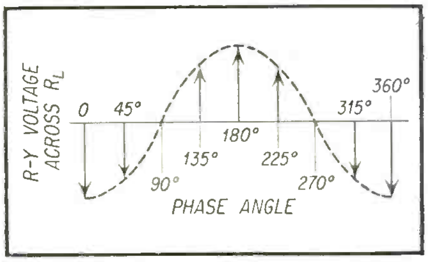


Fig. 8—Amplitude and polarity variations for different phase angles between the chroma and the 3.58 mc reference signals.

To summarize this particular section, two-phase demodulation utilizing diodes involves the addition and subtraction of diode currents produced simultaneously by the chroma signal and the 3.58 *mc* reference signal. The pair of diodes utilizing the in-phase reference signal comprises the R-Y demodulator, and the pair of diodes utilizing the quadrature reference signal comprises the B-Y demodulator.

High Level Triode Demodulation

A basic high level demodulation circuit is shown in *Fig. 9*. Here, as in low level pentode demodulation, we again employ the principles of gating and sampling. Now however we use a

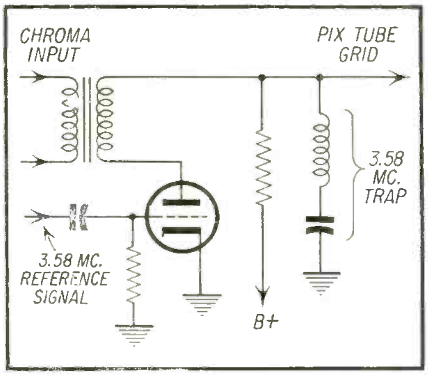


Fig. 9—Basic high level demodulator circuit.

triode. In low level pentode demodulation the reference signal is applied as a gating pulse to the suppressor grid, and the chroma signal to be sampled is applied to the control grid. In high level demodulation the reference signal is applied to the control grid of each demodulator tube, and the chroma signal to be sampled is fed into the plate circuit by transformer coupling. The resultant color-difference output signal is then applied to a 3.58 *mc* trap where the 3.58 *mc* reference signal component is removed. The demodulated signal however is sent on to its correct picture tube grid.

By a simple system of transformer step-up before demodulation (to be described in detail in the next installment) the correct ratios of R-Y, B-Y, and G-Y required for proper B & W color rendition are made available at the three grids of the color tube.

Coupling of each chroma signal into the plate circuit makes possible the use of high input chroma signal levels. In turn the demodulated outputs are now high enough to be applied directly to the grids of the color picture tube. This practice does away with the need for color signal amplifiers which are characteristic of low level demodulators.

In operation, a high level demodulator (taking one of the three as an example) utilizes a self biased grid so that the tube is operated beyond cutoff on the application of the 3.58 *mc* reference signal. This results in a series of sharp plate current sampling pulses much the same as in a pentode operated low level demodulator. These plate current pulses establish an average "no chroma-signal" plate voltage around which the signal driven plate voltage varies.

When a chroma signal is applied to the plate circuit it is sampled by the 3.58 *mc* gating pulses, and modulation takes place. A set of waveforms for an assumed chroma input signal is shown in *Fig. 10*. A chroma signal in phase with the sampling pulses appears as a demodulated color difference signal in the output of the plate circuit. However, if the chroma signal is in quadrature with the reference signal, its effect on the output of the demodulator will be zero, because during plate conduction the quadrature chroma signal passes through the zero axis. This principle of quadrature signal rejection in the in-phase demodulator was discussed extensively in the previous installment.

The demodulated signal in the plate circuit contains the 3.58 *mc* reference *cw* signal in addition to the chroma signal. However, this *cw* signal is filtered out by means of the 3.58 *mc* trap mentioned previously. (See *Fig. 9*). The

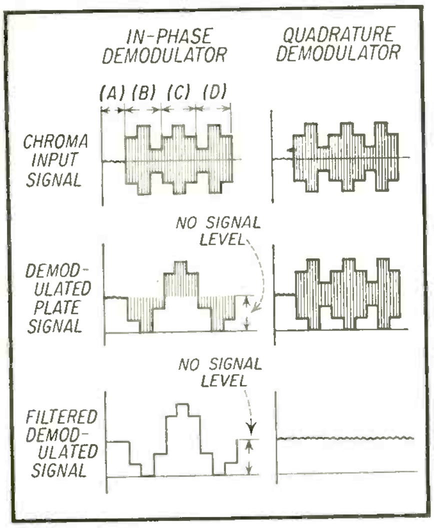


Fig. 10—Waveforms observed in one of the high level demodulators. (A) represents no chroma input signal. (B) and (D) are chroma signals 180° out of phase with the 3.58 mc sampling plate voltage pulse. (C) is a chroma signal in phase with the sampling pulse.

filtered output of the demodulator is then applied as a color-difference signal to one of the picture tube grids.

In the next installment we will discuss how the correct color signal levels are obtained for proper operation of the color picture tube. This installment will describe the methods by which the correct color signal proportions are obtained in both low and high level demodulation systems.

[To Be Continued]

SQUARE-WAVE GENERATORS

[from page 25]

number of these odd harmonics were combined, the result would be a perfect square wave. In actual practice, a square wave containing only the first ten odd harmonics has sufficiently steep sides, a sufficiently flat top, and sufficiently sharp corners to make it suitable for practically any servicing problem.

Figure 5 is a simple block diagram showing a typical setup for square wave checking of an amplifier. Amplifiers are not perfect. They all exhibit several types of distortion. The better the amplifier the smaller the amount of distortion. If we could obtain a perfect amplifier, the trace on the scope would be a square wave every bit as good as the square wave fed in by the generator. Let us suppose however, that the particular amplifier under test has a poor low frequency response. This would mean that the low frequency components of the square wave such as the fundamental, and let us say the third harmonic would not be amplified as much as the higher order harmonics.

If we were now to combine the various frequency components as outlined for *Figs.* 2, 3, and 4, keeping in mind that the fundamental and the 3rd harmonic are not as large in amplitude as they should be (because of poor low frequency response in the amplifier), the resulting wave would have the shape shown by *Fig.* 6. Thus, if a wave such as that shown in *Fig.* 6 appears on the scope in the setup of *Fig.* 5, it immediately tells us that this amplifier has a poor low frequency response.

A word of caution must be injected at this point. Suppose that the amplifier under discussion cuts off rather sharply all frequencies below 200 *cps*. If the frequency of the square wave input to the amplifier is 60 *cps*, then naturally it will contain a 60 *cps* component and a 180 *cps* component, both of which will be severely attenuated and therefore give rise to the distorted square wave output shown in *Fig.* 6. Suppose now, however, that a 1000 *cps* square wave is fed into the input of the amplifier instead of the 60 *cps*. In this case the lowest frequency component being fed into the amplifier would be the 1000 *cps* fundamental. All the

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other harmonic components would be higher in frequency. In this case (assuming that the high frequency response is good, and that there is negligible phase distortion) the trace on the scope would indicate a good square wave output IN SPITE OF THE FACT THAT THE AMPLIFIER HAS A POOR LOW FREQUENCY RESPONSE. This of course is very misleading. The technician therefore must be sure to select square wave frequency which will include harmonics within the range being tested. This leads to a system of two and three point testing which will be discussed in the next installment.

[To be continued]

ANSWERMAN

[from page 28]

placing the picture tube in a face down position and lightly tapping the neck and base of the tube. It may be possible to perform this operation with the picture tube in the cabinet if normal caution is observed concerning pressure on the controls on the front of the cabinet. It is usually advisable to place some soft material on the floor before turning the cabinet over.

2. If the above procedure does not alleviate the arcing or shorted condition it may be desirable to attempt to burn loose the particles before replacing the picture tube as defective. First, of course, determine between which elements the particles are located. This can usually be done with an ohmmeter. Then ground one of the shorted element socket pins with a jumper and connect a positive voltage to the other element pin. This operation is best performed with the picture tube in a face-down position. The application of the voltage, possibly boost B plus, usually will cause sufficient current to flow to burn open the shorting particles. It is to be hoped that at the same time the electrode connections are not burned open first, however.

*See Jan. RTSD, pages 14 and 24.

WORKBENCH

[from page 26]

100K instead of 1 meg. When *R415* was replaced the receiver functioned properly.

In order to understand why a vertical fold-over occurs when *R415* drops in resistance to 100K let us refer to the diagram. The RC time (T=RC) of *C408*, .1 μf and *R415*, 1 meg is large enough to pass the incoming vertical saw-tooth without any distortion. However, when *R415* drops to 100K, the RC time is now 1/10 its previous value. *C408* will now be able to charge up so quickly that during the remainder of the incoming saw-tooth time, it cannot charge much more so that appears flat topped as in *Fig. 1B*. Depending on the vertical linearity and size adjustments, grid current could be drawn causing an even greater flattening effect, which on the raster appears as a fold over on the bottom. Naturally, the smaller *R415* gets, the greater will be the fold over at the bottom of the raster.

Emerson 734 B, Chassis 120169-B

The receiver was turned on and the vertical hold was adjusted properly. After about ½ hour the vertical frequency started to drift out of range. Because this was a vertical frequency problem, the vertical oscillator V18, 6SN7, was replaced but had no effect.

The diagram was then studied and it was observed that the receiver uses a cathode coupled vertical multi-vibrator as an oscillator. Most receivers use the blocking oscillator type to generate the vertical sweep voltage. In V18 feed back occurs across the common cathode. The vertical hold control, *R90*, 1 meg, controls the free running frequency. In this multi-vibrator all the components in the circuit will effect frequency to some degree. However, the components that affect frequency most are *C66*, .0047 µf, *R91*, *820K*, and *R90* the 1 meg vertical hold control.

C66 was voltage leakage checked and found to be okay. *R91* was then measured and its resistance also checked correctly. However, when *R90* was measured, instead of reading 1 meg at maximum, it only measured about 700K. The vertical hold control was then clipped out and measured again. It now measured properly at 1 meg. It was concluded therefore, that some parallel resistance was taking effect.

The circuit was then traced out and it was discovered that *R91* and *R90* were connected at Pin #1 (unused pin) of the 6W6, vertical output tube. *R91*, 820K was next clipped from pin #1 and a resistance measurement was taken from pin #1 of the 6W6 to ground. To our amazement even though this was an unused pin with nothing connected to it at this time, the meter read 2 megs. The 6W6 tube was next pulled out of the socket and the meter now read infinite. On further examination of the 6W6 tube a leakage of 2 megs was discovered from pin #1, unused, to the filaments pins #2 and 7. *R91* and *R90* were next soldered directly together, eliminating the use of pin #1 as a tie point, and a new 6W6 was put in. The receiver was checked for two days and showed no sign of vertical frequency drift.

P.A. ROUNDUP

[from page 13]

the installation high? Where the answer is "yes," medium or high-power directional-type speakers are called for.

5. When a long narrow area (such as a school corridor) is to be covered, bi-directional speakers are economical.

6. If the speaker is to be used in an atmosphere of extreme humidity, excessive dust, or chemical pollution, a sealed-in or "submergence-proof" speaker is a must.

7. In locations where a spark from the speaker mechanism could cause an explosion, explosion-proof speakers are called for.

8. When wide-angle coverage is desired, radial-type speakers with a 360-

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Sworn to and subscribed before me, this 20th day of August, 1954.
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degree sound distribution pattern are economical.

Matching Speakers to Amplifiers

For distortionless, efficient operation, speakers must be matched to the output impedance of the amplifier used. When more than one speaker is employed, series of parallel connection of the units is possible. Parallel connection is generally preferred, in part because failure of one speaker will not render the others inoperative.

To determine the impedance of speakers in parallel, divide the impedance of one speaker by the number of speakers used (it is assumed that all the speakers have the same impedance). In the case of series-connected speakers, the net impedance is equal to the sum of the individual speaker impedances.

Speakers should be connected so that they move in phase with each other. Proper connection of identical speakers is indicated in *Fig. 7*.

Location of Speakers

Speakers should be so located that the space between the speaker and its area of coverage is free of obstructions. The speaker should be beamed toward the center of the area covered.

When a speaker and a microphone must be set up in the same vicinity, they should be positioned in such a way that a minimum of direct or reflected sound will be returned to the mike, otherwise feedback will result.

Speakers should be oriented so that sound is kept off the ceiling and side walls, which are highly reflective, and concentrated instead on areas where people will be seated.

Speaker Housings

The choice of an enclosure for a speaker is an important part of an indoor *pa* installation. Some of the factors to be considered in the choice of an enclosure are:

1—Location where enclosure is to be used.

2—Frequency response desired in system.

3—Angle of coverage.

4—Method of mounting.

5—Cost.

In the case of installations in churches, auditoriums, and similar sites, reverberation is often a problem. Reverberation produces a loss in intelligibility, and must therefore be minimized. Reverberation of low frequencies is more of a problem than high-frequency reverberation, because the time of reverberation is longer. Certain types of compact housings will, by attenuating the low-frequency response, reduce low-frequency reverberation.

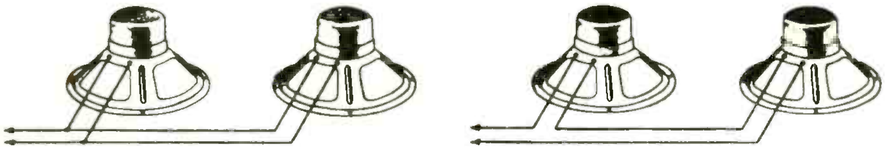


Fig. 7—Properly phased connection of speakers in parallel (left); in series (right). (Courtesy Newcomb Audio Products Co.)

Fig. 8—Altec-Lansing "Lipstik" miniature microphone.

Some housings serve as two-way speaker enclosures; because of their design, sound coverage from both the front and rear of the speaker is permitted. This is advantageous in long, narrow areas.

Different degrees of tilt are available in different enclosures, permitting downward beaming of the speaker at the angle best suited to maximum coverage of the area.

Overload Protection of Speakers

Speakers are apt to break down under temporary overload, rendering the *pa* system at least partly inoperative. One of the methods of preventing such inconvenient and costly breakdowns is described below.

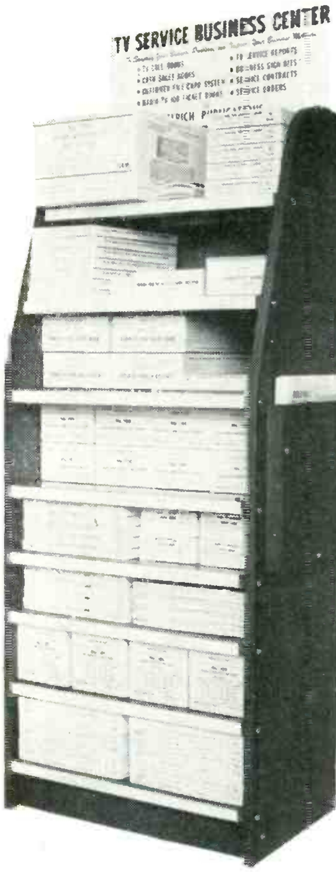
"Grasshopper fuses"—the kind commonly used by the telephone company—are employed to protect the driver unit of each speaker.

Fuses rated at approximately 1 amp. are generally employed, in the case of speakers using less than 25 watts of power. When a 25-watt driver with a 16-ohm voice coil impedance is used, a fuse with a rating of 1¼ watts (but not larger) is recommended. The fuses described are inexpensive, and may be obtained from the Graybar Electric Co. Blowing of a fuse causes a contact arm to be released, removing the voice coil from the circuit and causing a 15-ohm resistor to be substituted in its place.

Microphone Considerations

An important consideration that is often overlooked in the choice of a mike is the cable length that will be used with it. If a cable 25 feet or longer is to be employed, and high-frequency reproduction is demanded of the system, a high-impedance mike should *not* be employed, because the long line required will reduce the frequency response of the system. A low-impedance mike is preferable in such a case, because a long line will not seriously affect its response. The greater ruggedness of the cables used with low-impedance microphones makes it preferable to use this microphone type in cases where the cable associated with it will be subjected to considerable abuse (as in a night club installation, for example).

Important characteristics of a mike are: frequency response; power output; sensitivity; directional characteristics; output impedance; hum pickup; and cost. Physical characteristics such



as size, weight and ruggedness must also be considered in many applications.

An interesting member of the microphone family is Altec-Lansing's "Lipstik" mike (*Fig. 8*) said to be the smallest microphone on the market. The mike uses a sub-miniature tube in a base that is highly shock-resistant. A printed circuit is employed between tube socket and microphone cord, minimizing the space needed for wiring. Mike and base are 3⅛ inches long and 0.6 inches in diameter. The unit is intended for applications where microphone concealment and unimpeded mobility of the performer are desirable.

Microphone Stand Development

An interesting development in microphone stands is a "Safety Air Lock Cushion" used in a boom stand being put out by the Atlas Sound Corp. (see *Fig 9*). The mechanism prevents any sudden accidental slipping of the telescoping section. Such slipping can, in the case of other types of stand, cause a blast of sound to come from the amplifier, to say nothing of the possible damage it can cause the microphone. If the clutch-holding adjustment is insufficiently tightened or accidentally released, the resultant controlled escapement of air permits only a slow, smooth and quiet collapse of the stand.

Fig. 9—(Left) Mike stand by Atlas Sound Corp. The mike stand on the right is by Snyder Mfg. Co.

Another mike stand with a collapsible base is shown in *Fig. 9*. This item is manufactured by Snyder Mfg. Co. of Philadelphia and goes under the model No. MS-2.

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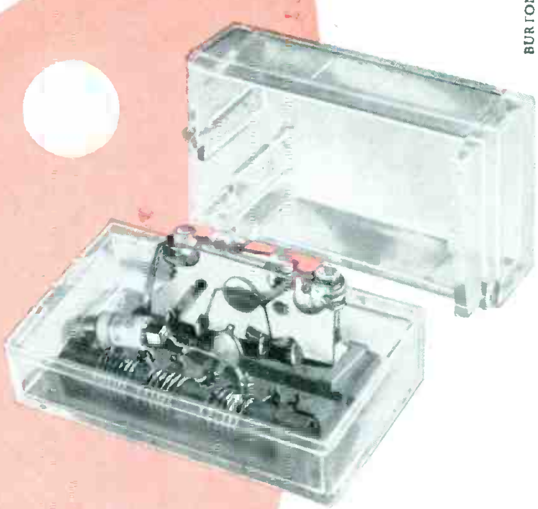

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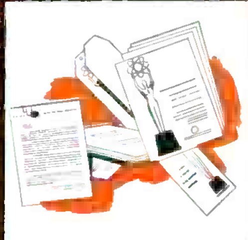
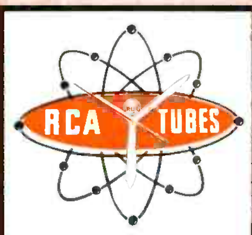
Use These Promotional Materials

ELECTRONIC STATUETTE (3F220)



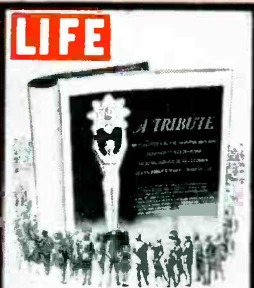
PROMOTION KIT (3F223)



ELECTRONIC SYMBOL CLOCK (3F226)

TV SERVICE SIGN (3F230)

TEST EQUIPMENT AWARDS



A "TRIBUTE" IN LIFE