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SERVICE NEWS

Service News

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DIRECTOR'S CORNER

BY

Harold J. Schulman

Something new has been added to the service scene to further confuse the public regarding TV service requirements. Playing on the natural mechanical curiosity of the American public, booklets are appearing which promise to make electronic wizards out of people who can't tell their brightness from their contrast control.

We are now able to see two opposite extremes in point of view. One says that TV sets are so simple to repair all you need is a tube chart, a screw driver and a magic manual which you can buy for $1.98. You will then be able to save enough money on repair bills to send your children through college.

The other point of view says that TV sets are so complex that it takes an infinite number of years to become a "good" serviceman. The whole atmosphere is one of mystery. The serviceman enters the house and the family stands in awe at the great brain who has come to solemnly inform them that the line cord was not pushed into the wall receptacle tight enough.

I think it is time to dispel both of these ideas. TV service is not so simple that the public at large should be led to believe they can service their own sets. Booklets which state otherwise are a fraud.

However, I think it is also important to dispel the idea that all TV service is so complex, that only supermen should be allowed to look into the back of the set.

By making TV service seem too complicated we can add subtle dis-

(CONTINUED ON PAGE 24)

FIELD TESTING

THE RA-160, RA-162 TELESET

BY CARL QUIRK

By now many of you reading this article have taken the new RA-160-162 Du Mont Teleset to your favorite test location and have acquainted yourselves with its outstanding performance.

This fine Teleset is no accident. It is the result of many thousands of hours of intensive design by the country's top television receiver engineering department, coupled with a long and exhaustive field testing program.

The story of the RA-160-162 began many months ago. As early as May, 1951 field tests of preliminary engineering models were made. The purpose of the tests was to observe the operation of the set under all of the conditions which would be encountered after it was placed on the market; to prove out performance characteristics indicated in laboratory tests; and to turn up design deficiencies so that they could be corrected before production. When the field tests revealed performance characteristics which did not meet expectations, appropriate design changes were made. This process was repeated on numerous occasions until the receiver met the desired performance specifications.

Most of the early fringe area performance tests were made at a field laboratory in New Haven, Connecticut. New Haven, which is approximately 90 miles from New York City, is in the fringe area of stations operating on channels 2, 4, 5, 7, and 11 in New York City; and channels 9 and 13 in New Jersey. In addition, a strong local signal is available from the chan-

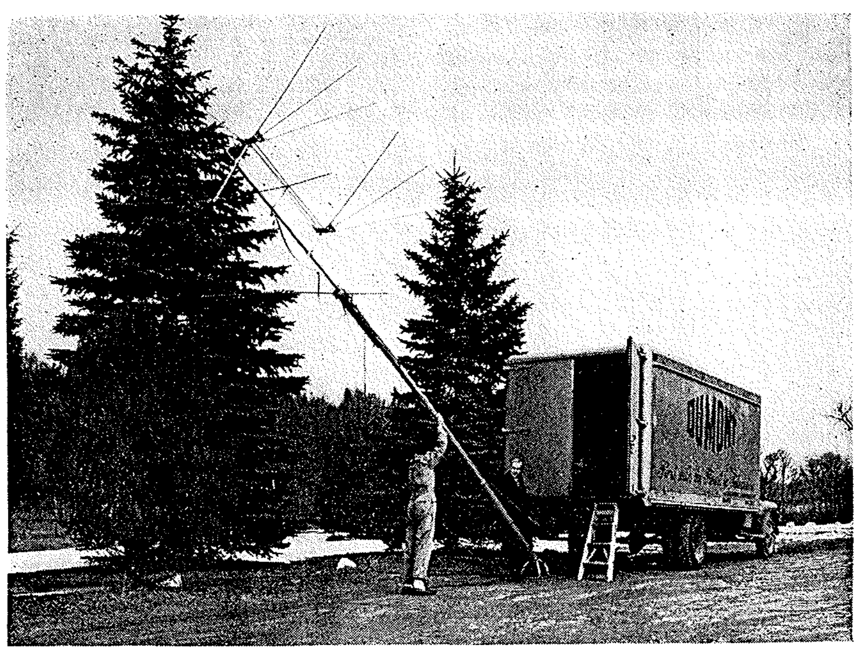

Figure B-1. Du Mont's laboratory on wheels setting up for a field test at Port Jervis, N. Y.

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nel 6 station located in New Haven itself. The laboratory is in the down-town shopping district where the noise level is extremely high. These conditions permit observation of the noise immunity of sound, sync, and a-g-c circuits under very adverse reception conditions.

Field tests of final engineering models began in November, 1951. Special attention was given to adverse receiving conditions, such as those which occur in noisy fringe area locations, and in extremely strong signal areas where overloading becomes a problem. Tests were made of performance under every type of receiving condition for all 12 channels. Quantitative and qualitative measurements of over 100 performance characteristics were made.

Many of the tests were made in a laboratory on wheels. It consisted of a large van, 18 feet long and 7 feet wide. The van was fitted with a special rack which held eight receivers. In addition to the engineering models of the RA-160 - 162, representative top competitive models purchased at random were mounted in the rack for side-by-side performance comparisons.

One antenna was used on all receivers to assure that each set operated under identical conditions. To permit rapid switching from one set under observation to another, and to prevent interaction between receivers, the distribution and switching system shown in Figure B-2 was used. Other equipment available in the mobile laboratory consisted of a communications receiver, a VHF signal generator, a high-frequency oscillograph, a low-frequency oscillograph and a vacuum-tube voltmeter.

In order to duplicate, as closely as possible, the conditions which are encountered in typical consumer installations, power for the equipment in the van was obtained from the a-c power lines at each location.

Evaluating Fringe Area Performance

When discussing the fringe area performance of a TV receiver, sensitivity is usually regarded as the most important factor. Actually, "noise figure" in combination with sensitivity determines a receiver's ability to produce usable pictures in difficult fringe areas.

Because there is no substitute for fringe area conditions when evaluating the weak signal performance of a receiver, all tests were made in areas where reception ranged from slight snow to barely perceptible pictures.

Observations of sensitivity and noise figure were made in locations which were as free from interference (ignition noise, etc.) as possible. Such locations eliminate the distractions caused by interfering signals and permit more accurate evaluation of the characteristics in question. Fringe area reception tests in the presence of noise were made separately and will be discussed later. An important consideration in the selection of locations for fringe area tests is the availability of low and high channel signals. Experience indicates that the high channel and the low channel performance of many TV receivers differ greatly. Therefore both high and low channel performance must be evaluated separately.

Some of the characteristics of TV receivers which result in superior fringe performance are discussed in the following paragraphs.

To completely evaluate the weak signal performance of a receiver the receiver must be observed under three conditions of signal strength; weak, very weak, and extremely weak.

Weak Signal Performance

In weak signal areas where snow just begins to appear in the picture a highly sensitive receiver will not produce more than a barely perceptible improvement in picture quality, as compared to a receiver with reasonable sensitivity and noise figure. However, if a receiver has both a better noise figure and a higher second anode voltage, it will produce a picture whose superiority is pronounced.

Very Weak Signal Performance

In areas where signals are so weak that reception is normally masked by snow or noise, a new group of conditions is found. In such areas noise figure becomes the most important

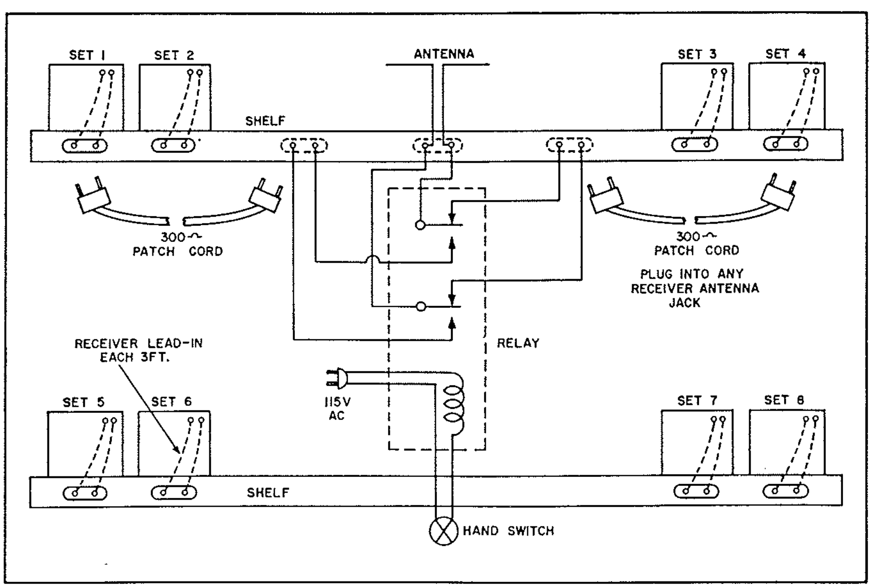


Figure B-2. Schematic of the antenna distribution system used during field tests. The relay switches the antenna from one patch cord to another, enabling accurate comparisons to be made of any two receivers.

factor. When comparing receivers under very weak signal conditions the contrast ratios of the receivers being checked must be identical, since increased contrast results in greater snow.

Extremely Weak Signal Performance

In extremely weak signal areas — those areas where receivers of last year's vintage produce a visible but unusable picture — the sensitivity and the noise figure of a receiver are both put to the test. Comparison of a number of sets has resulted in the following observations: 1) receivers having good noise figures but lacking in sensitivity cannot produce any semblance of a picture; 2) receivers with good sensitivity but poor noise figures are useless in these areas because the pictures they produce are masked with snow; 3) a receiver with high sensitivity and low noise figure, produces the best overall picture under these conditions.

A-G-C Action

Another important factor affecting the fringe area performance of a receiver is its ability to maintain a picture in the presence of a gradually fading signal. Such an effect is produced by a passing aircraft — and is referred to as "airplane flutter." A similar condition is encountered when highway traffic intercepts the line of sight between the receiving and transmitting antennas. To minimize the effects of signal fading a receiver must have a combination of adequate sensitivity and a-g-c action.

Performance tests of the RA-160 - 162 were made near busy airports and in locations where highway traffic passed between the receiver and the transmitter.

Sync Noise Immunity

To provide superior performance in fringe areas a TV receiver must be able to maintain a motionless picture when subjected to external interference, such as heavy ignition noise.

When some TV receivers are subjected to noise in a weak signal area the picture jumps up and down. On other receivers the picture will wobble from side to side when the interference is moderate, and pull violently when the interference is heavy. Still other receivers will suffer complete loss of sync in the presence of heavy interference.

This last condition is usually due to poor a-g-c noise immunity. If the a-g-c noise immunity of a receiver is poor, heavy noise bursts produce a-g-c bias, reducing the gain of the controlled stages sufficiently to cause loss of sync. To accurately evaluate the sync noise immunity of a TV set, tests must be made with various signal and noise levels.

The RA-160 - 162 was compared to competitive receivers by stopping the mobile laboratory at a number of points along a highway running away from New York City. In this way it was possible to check noise immunity at different signal levels, with a constant high ignition-noise level. Many of the noise immunity tests were made at a busy intersection 90 miles from the stations being received. Experience indicates that a receiver which can perform satisfactorily at the latter location will hold sync practically anywhere.

The results achieved with the RA-160 - 162 Teleset have more than justified the time and effort expended in the field tests. Its outstanding performance characteristics permit operation in many locations in which TV reception has previously been considered unsatisfactory.

During the latter part of the field tests, when production models were available, local dealers in the vicinity in which the tests were made were invited to bring their favorite competitive sets for comparison with the RA-160 - 162, under noisy fringe reception conditions. In every instance they went away convinced that the new Du Mont RA-160 - 162 is tops in performance.

In the next issue, field testing with particular reference to interference problems will be discussed.

TROUBLESHOOTING
HORIZONTAL A-F-C CIRCUITS

PART II

BY WALTER BOIKO

In the last issue methods for troubleshooting the reactance tube a-f-c circuit were discussed. In this article horizontal instability in the pulse-width system will be covered. When it has been determined that the preceding stages are operating properly, each portion of the a-f-c system should be checked using the methods outlined here.

As shown in Figure A-1 the pulse-width a-f-c system consists of a blocking-tube oscillator and a control-tube stage.

Horizontal Oscillator

The blocking tube oscillator produces a sawtooth voltage, across C247, which is used to develop the horizontal sweep and the CRT high voltage. In addition a portion of the sawtooth voltage is applied through R263 and C241 to the grid of the control tube as shown in Figure A-1. At the grid it is added to the incoming sync signal to produce an error voltage which is used to control the operation of the oscillator. While the presence of high voltage is an absolute indication that the oscillator is operating, the waveform at the output of the oscillator should be examined whenever poor horizontal sync stability occurs. To accomplish this the vertical input terminals of an oscillograph should be connected between terminal D of Z210 and ground.

The waveform at this point should be similar to that shown in Figure A-2. If the waveform does not appear as shown, voltage and resistance measurements will usually locate the component at fault.

There is some interdependence between the operation of the horizontal oscillator and the amplitude of the boosted B+ which is obtained from the horizontal-deflection circuit. When taking voltage measurements remember that low voltage readings may be caused by faults in the horizontal-deflection circuits. The criterion for isolating the cause of low boosted B+ voltage is the sawtooth voltage waveform at the output of the oscillator.

If the sawtooth waveform at this point appears normal it may be assumed that the oscillator is operating properly. After it has been determined that the oscillator is operating properly, the cause of low boosted B+ voltage can safely be attributed to a fault in the deflection circuits.

Improper adjustment of the horizontal oscillator transformer, Z210, can also cause poor horizontal-sync stability, therefore the transformer adjustment should be checked whenever instability is encountered. An adjustment procedure for the transformer will be found in the service information covering the Teleset in question.

If the above checks indicate that the oscillator is operating properly, the control-tube stage should be carefully examined.

Control Tube

The control tube compares the frequency of the horizontal oscillator with that of the incoming sync signal and produces a positive error voltage in its cathode circuit when the two are not identical. As shown in Figure A-1 the oscillator grid circuit and the control-tube cathode network form a common circuit. As a result the positive cathode voltage of the control tube is applied to the grid of the horizontal oscillator. This voltage opposes the negative grid voltage of the oscillator and serves to correct its frequency whenever it deviates from that of the incoming sync signal (15,750 cps).

As previously mentioned the incoming sync signal is added to the oscillator sawtooth voltage appearing at the grid of the control tube. A check should be made to determine whether or not both voltages are present at the grid. The waveforms observed should be similar to those shown in Figure A-3. To check for the presence of the sync signal the vertical input terminals of an oscillograph should be connected between ground and the control-tube grid. The oscillator tube should be removed from its socket when this check is made. When checking for the presence of the sawtooth voltage at the grid of the control tube, the oscillator tube should be re-inserted in its socket and the antenna disconnected from the receiver. The peak-to-peak value of the sawtooth voltage appearing at the control-tube grid is quite critical. 17 volts ± 10% is required for stable operation of the circuit. The correct sawtooth amplitude may be obtained by setting the horizontal-frequency-control trimmer, C240A, approximately 1/4 turn counter-clockwise from its extreme clockwise position. If a variation in the amplitude of the sawtooth voltage at the control-tube grid is not obtained as C240A is varied, C240A,

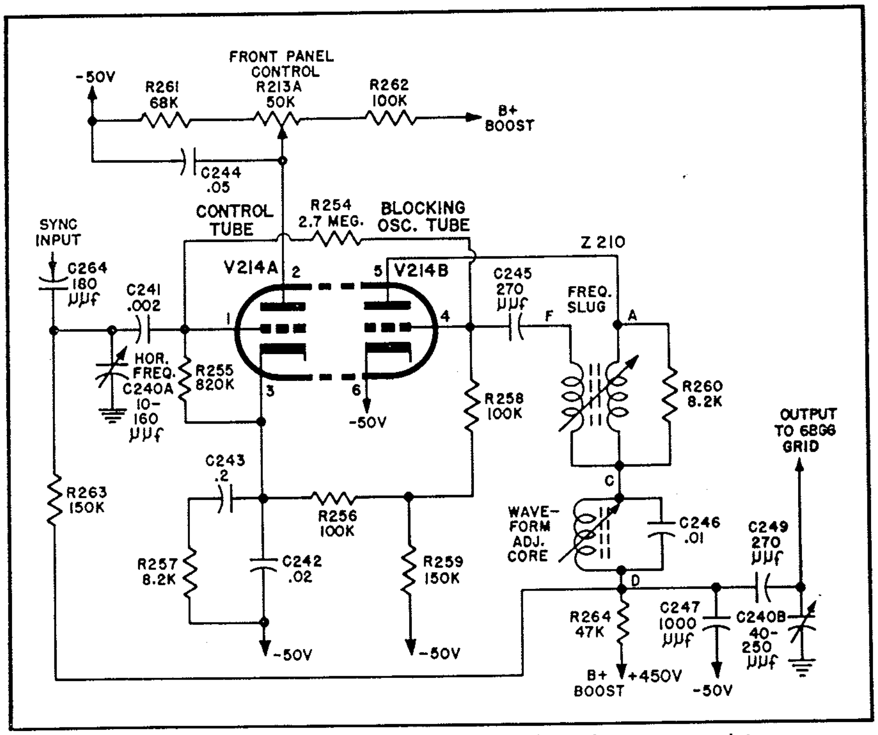


Figure A-1. Schematic diagram of pulse-width a-f-c circuit used in RA-112A, RA-113, and RA-117A Telesets.

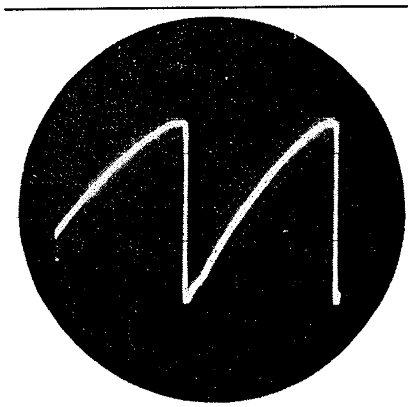


Figure A-2. Sawtooth voltage appearing at terminal D of Z210.

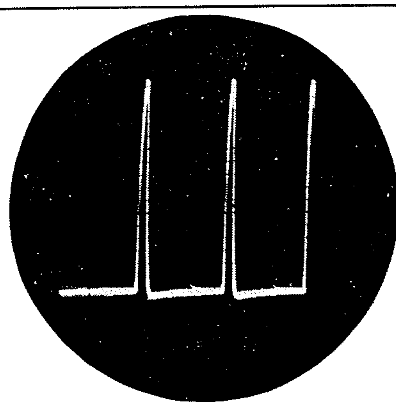


Figure A-3a. Horizontal sync signal appearing at grid of control tube. The oscillator tube should be removed when observing this waveform.

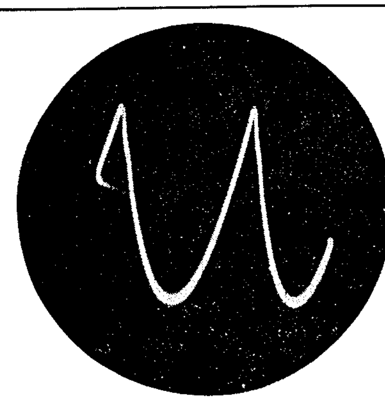


Figure A-3b. Portion of oscillator sawtooth voltage appearing at grid of control tube. The antenna should be disconnected from the receiver when observing this waveform.

C264 and their associated components should be carefully checked.

The plate circuit of the control tube may be checked by measuring the plate voltage as the front-panel hold control, R213A, is varied throughout its range. This should cause the plate voltage to vary from approximately 55 to approximately 140 volts. If this voltage variation is not obtained, C244 and the other components of R213A should be checked.

Leaky capacitors within the pulse-width a-f-c system will cause oscillator drift. Capacitors capable of causing this condition are C241, C242, C243, C244, C245, and C264. This drift condition may occur at any time from a few minutes to several hours after the oscillator transformer adjustments have been made.

The following is a suggested procedure for locating a leaky capacitor:

1. Bring the picture into sync by making the proper oscillator transformer adjustments.
2. Allow the set to warm up. At the first sign of drift, set the front panel hold control at its most critical point (that point where the picture just stays in horizontal sync).
3. Apply the heat of a soldering iron to the body of each suspected component for approximately 10 seconds.
4. When the leaky capacitor is heated the picture will lose horizontal sync.

Common Field Problems

The "Christmas Tree" effect, shown in Figure A-4, is a characteristic fault of receivers using the pulse-width type of a-f-c. Very often, after careful oscillator transformer adjustment, and after changing the horizontal a-f-c tube, the condition will persist at certain settings of the horizontal-hold control. In these cases the effect can be minimized by changing the horizontal-oscillator grid capacitor, C245, from 270 mmf to 220 mmf. (See Figure A-1.) After this change has been made, the horizontal a-f-c circuits should be re-adjusted.

Constant resetting of the horizontal-hold control or complete loss of horizontal sync is often a result of leakage in one of several critical capacitors associated with the pulse-width circuit. As previously mentioned, one of the following capacitors may be at fault: C241, C242, C243, C244, C245, or C264. Leakage in C264, the input coupling capacitor, is usually identified by horizontal jitter at the top of the picture. Unless a meter which will measure leakages as high as 300 megohms is available, the best way to check these capacitors is by substitution or by using the soldering-iron method outlined earlier.

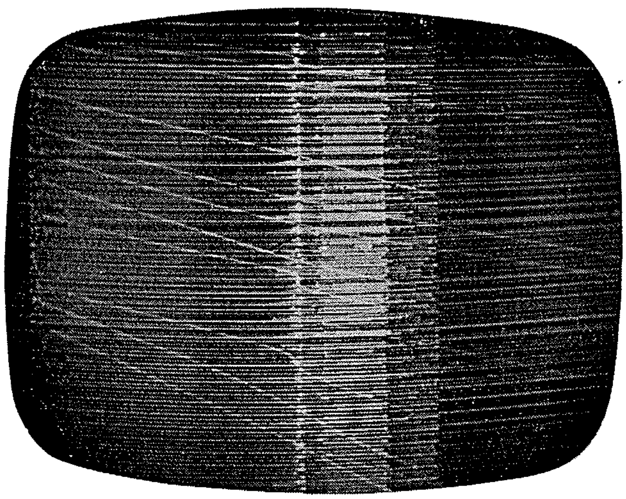
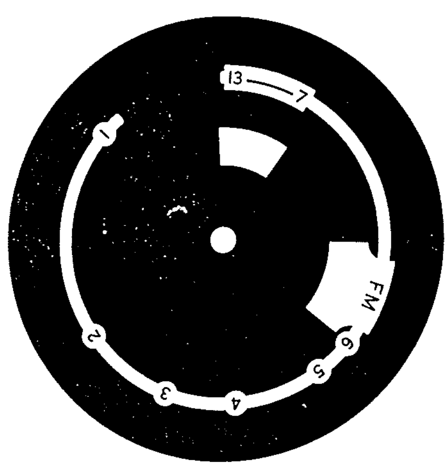


Figure A-4. "Christmas Tree" effect caused by multiple triggering of the horizontal oscillator.

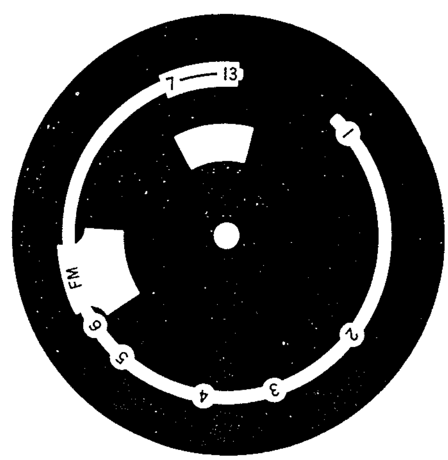
ORDERING REPLACEMENT DIALS

During the production of RA-103C, RA-105A, RA-105B, RA-106, RA-108. and RA-109A Telesets the dials used with these receivers were changed. As a result some difficulty has been encountered in determining the proper part number when ordering replacements.

The dials used with these Telesets are illustrated in Figures D-1 through D-4 and their distinguishing features are described in the captions. Note that the RA-103C dials consist of two parts, a main-tuning dial and a transparent vernier dial. 15B12564 and 15B12565 are used together as are 45000221 and 45000211.

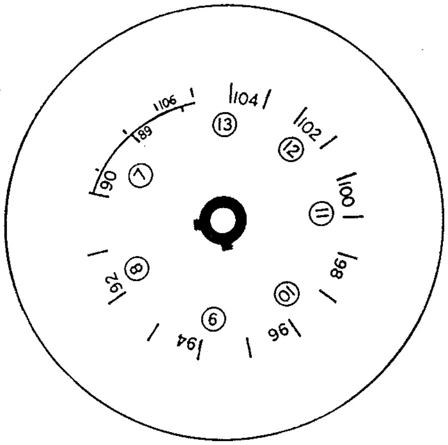


Part Number 15B12564

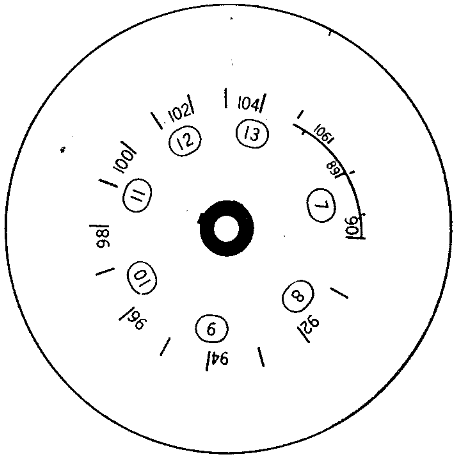


Part Number 45000221

Figure D-1. RA-103C main tuning dials: 15B12564 is numbered counter-clockwise. 45000221 is numbered clockwise.



Part Number 15B12565



Part Number 45000211

Figure D-2. RA-103C vernier dials: 15B12565 is numbered counter-clockwise. 45000211 is numbered clockwise.

Part Number 45000242

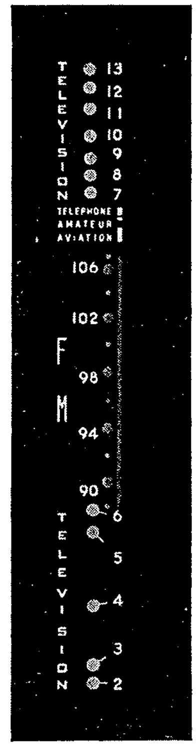
Part Number 45000243

Part Number 45000245

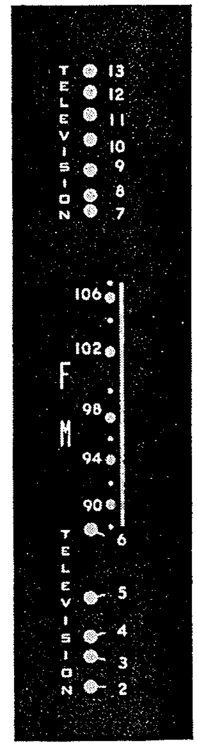
Part Number 45000246

Figure D-3. RA-105A, RA-105B, RA-106, and RA-108 dials: The distinguishing features of each are listed below.

Part No.	Tuning Range Beyond Channel 13	120 mc. marking directly opposite Channel 7	Low Channel Tuning Range Starts at
45000242	1/8"	No	50 mc.
45000243	5/8"	No	50 mc.
45000245	5/8"	Yes	50 mc.
45000246	5/8"	Yes	Channel 2



Part Number 45001741



Part Number 45002091

Figure D-4. RA-109A dials: 45001741 includes airplane, amateur, and telephone bands. 45002091 does not include the airplane, amateur, and telephone bands.

RA-160 SERVICE NOTES

Due to variations in tube manufacture, it has been found that a percentage of the 6BL7's (V306—vertical oscillator) will heat up to the point of becoming erratic when a shield is placed over the tube. Current production, therefore, does not include this shield.

It is recommended that the shield covering the 6BL7 (V306) be removed when the set is installed.

Complaints of vertical sync drift can usually be cleared up by removing the shield. If the vertical drift still persists, after the tube cools, replace the 6BL7 (V306) and leave the shield off.

Current tests indicate that the RCA-6CD6 will give best results as a replacement for the horizontal sweep amplifier tube (V302) in RA-160 and RA-162 Telesets.

TROUBLESHOOTING HINTS

Teleset: All

Symptom: Microphonic sound, not caused by tubes.

Probable Fault: Loose clip on top adjusting screw of sound discriminator transformer.

Remedy: Solder clip on top adjustment screw to top of transformer can.

Teleset: RA-109A, and RA-130A

Symptom: Unstable horizontal sync. No bias voltage present at grid of reactance tube with antenna disconnected.

Probable Fault: C265, the negative 12 volt filter capacitor, is shorted.

Remedy: Replace C265.

Teleset: RA-109 FAS, RA-130A

Symptom: Horizontal pull, buzz in sound.

Probable Fault: T401 or T402, i-f amplifier stage input and output transformers misaligned.

Remedy: Realign T401 and T402.

Teleset: RA-112A, RA-113, RA-117A and RA-147A

Symptom: No vertical or horizontal hold. Picture appears overloaded.

Probable Fault: L214, at narrow band sync amplifier grid, is open.

Remedy: Replace L214.

Teleset: RA-112A, RA-113, RA-117A, and RA-147A

Symptom: No high voltage; when C291, the .02 mfd B+ boost capacitor, is shorted a raster appears.

Probable Fault: Defective 6W4, damper tube.

Remedy: Replace 6W4.

Teleset: RA-112A, RA-113, RA-117A, and RA-147A

Symptom: Horizontal jitter at top of picture.

Probable Fault: C264, coupling capacitor between 2nd sync clipper and horizontal control tube, is leaky.

Remedy: Replace C264.

Teleset: RA-112A, RA-113, RA-117A, and RA-147A

Symptom: Loss of vertical and horizontal sync.

Probable Fault: C261, the coupling capacitor between sync detector and 1st sync clipper, is open.

Remedy: Replace C261.

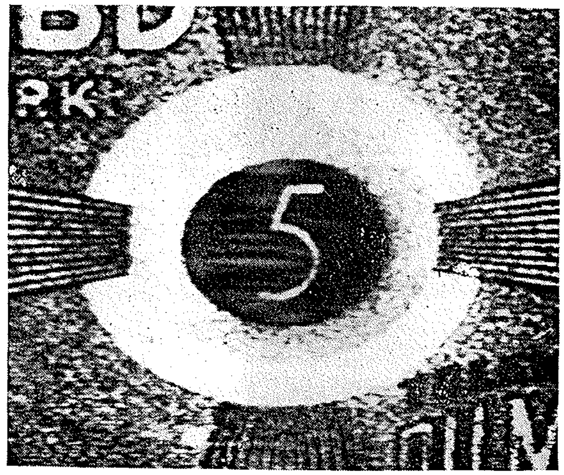


Figure T-1. Portion of a test pattern showing random white streaking caused by corona in the yoke anti-ringing capacitor. Note that the white streaking becomes quite visible when viewed against a dark background.

Teleset: RA-119A

Symptom: Excessive number of vertical retrace lines 60-cycle buzz in sound. Vertical relay opens on slightest disturbance when vertical size or vertical hold controls are adjusted.

Probable Fault: Defective vertical-output transformer.

Remedy: Replace vertical-output transformer.

Teleset: All using single 1-v rectifier tube

Symptom: Insufficient horizontal size, rotation of the vertical size control indicates lack of normal vertical size reserve.

Probable Fault: Defective low-voltage rectifier.

Remedy: Replace the low-voltage rectifier.

Teleset: RA-160 - 162

Symptom: Horizontal jitter at top of picture and/or random white streaks in picture as shown when receiving moderately weak signals.

Probable Fault: Internal corona in C501, the anti-ringing capacitor connected across part of the yoke winding.

Remedy: Replace C501 with a 68 mmf, 2kv capacitor, Part Number 03 112 700. This capacitor is used in current production.

Teleset: RA-160 and RA-162

Symptom: Sync buzz.

Probable Fault: Oscillator slug improperly adjusted.

Remedy: Check fine tuning range. If it is not correct readjust the oscillator slug or slugs. If buzz persists check for the presence of L215, connected between pin 5 of Z205 and one end of R280. If L215 is present remove it and connect R280 directly to pin 5 of Z205. L215 is not used in current production.

SERVICE NOTES

The leads on many of the horizontal BTO transformers (Z301) used in RA-160 and RA-162 Telesets are color coded rather than lettered as indicated on the schematic. Listed below are the colors used and the letters to which they correspond:

A—Blue lead
F—Red lead
C—Green lead
D—Black lead

The i-f transformers used in the RA-109A - RA-111A - RA-112A - RA-113 - RA-116A - RA-117A - RA-119A and RA-120 do not have their terminals marked as were the transformers in previous Telesets. Instead a colored dot is placed near one terminal (identifying it as the lower end of the primary winding).

The dot is placed near terminal number 1 on video i-f transformers and near terminal number 2 on sound i-f transformers. Other terminals may be identified by counting in a clockwise direction from the terminal with the dot, while viewing the transformer from the bottom.

When using the Electro-Voice Tenna-Top Booster with the RA-119A Teleset the relay in the booster junction box will burn out unless it is modified. The manufacturer recommends that a resistance of 0.1 to 0.2 ohms be connected in parallel with the relay winding to remedy this condition. A suitable resistor can be made up by connecting five, 1 ohm, 1 watt resistors in parallel.

The present relay is designed to operate with receivers using a maximum of 500 watts. The RA-119A uses 650 watts.

DIRECTOR'S CORNER (Cont.)

couragement to the average technician. He then thinks to himself that "he'll never be able to understand *all* that."

Most TV repairs are fairly simple. It has already been established that 60% to 70% of trouble calls can be cured by tube substitution and minor adjustments. Other repairs can also be taken in stride by an average technician with good training.

Here and there you get the real difficult cases where specialists are required. But that is true of automobiles, or washing machines or any other device that requires service.

The above observations are made because we want to encourage dealers in remote or newly opened areas to learn some of the more simple service procedures and adjustments. By becoming familiar with the functions of each tube and adjustment control, the dealer, or his salesmen will be able to handle a wide variety of conditions which otherwise might create a problem.

Yes, there is some danger if an uninformed person pokes around carelessly inside a set. So is there danger when a hobbyist plays with a circular saw. Common sense and good caution will keep a sincere would-be serviceman from hurting himself.

Naturally, more harm than good will result if indiscriminate tinkering substitutes for knowledge. These remarks are intended for the well-meaning, sincere, intelligent man who wants to help his sales picture by honest service effort.

PRODUCTION CHANGES

RA-160-162

No. 604788

Reason:

To increase the AGC voltage developed and assure an AGC adjustment which will result in a 3 volt peak-to-peak video detector signal level.

Procedure:

Add R800, a 470K 20% ½W resistor, from pin 8 of V209B to ground.

Parts Required:

SYMBOL	PART NUMBER	DESCRIPTION	LIST PRICE
R800	02 032 580	Res F C 470K 20% ½W	.05

The first chassis so modified is:
Serial Number 604788 Coded RC 3

No. 606059

Reason:

To eliminate the possibility of audio buzz.

Procedure:

Remove L215, connected between terminal 5 of Z205, the ratio detector transformer, and TB15 in the signal chassis. Disconnect R280, 270 ohms 10% ½W, from TB15 and reconnect it to terminal 5 of Z205.

The first chassis so modified is:
Serial No. 606059 Coded RC 3

No. 608850

Reason:

To prevent damage to the vertical output transformer in the event of a short in the vertical amplifier tube.

Procedure:

Remove the red lead of the vertical output transformer, T301, from C332B and connect it to TB9-4. (Refer to the RA-160 Sweep Chassis Schematic. The terminal board lugs of TB-9 are numbered 1 to 4, the top lug is No. 4. An example of TB numbering may be had by referring to TB-3.) Connect a ⅛ amp pig tail fuse between C332B and TB9-4. Cover R349, connecting to TB5-1, with an insulated sleeve.

Parts Required:

SYMBOL	PART NUMBER	DESCRIPTION	LIST PRICE
F302	11 001 110	Fuse ⅛ amp cartridge with pig tail leads	.21

The first chassis so modified is:
Serial No. 608850 Coded R 4

No. 6011459

Reason:

To increase the mechanical hold range of the vertical hold control.

Procedure:

1. Remove R242, 1.8 meg 10% ½W resistor connected across R247A, the vertical hold control.
2. Change the value of resistor R329 from 680K 10% ½W to 1.2 meg 10% ½W. R329 is located at TB15.
3. Add resistor R341, 2.7 meg 10% ½W from the junction of C326, T202 yellow lead and R329 to ground.

Parts Required:

SYMBOL	PART NUMBER	DESCRIPTION	LIST PRICE
R329	02 032 140	Res F C 1.2 meg 10% ½W	.06
R341	02 032 180	Res F C 2.7 meg 10% ½W	.06

The first chassis so modified is:
Serial Number 6011459 Coded R-5

NOTE: Chassis coded R-5 are not interchangeable with chassis bearing an earlier code number.

DuMont — First with the Finest in Television — SERVICE NEWS

Service News

PUBLICATION OF THE TELESET SERVICE CONTROL DEPARTMENT
ALLEN B. DU MONT LABORATORIES, INC., PATERSON, N. J.

Volume 2 | MAY, 1952 | Number 4

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DIRECTOR'S CORNER

BY

Harold J. Schulman

Many people besides TV servicemen earn their living by rendering service to others. The range of such activities covers doctors and plumbers, lawyers and auto mechanics, and engineers and TV servicemen.

The one thing in common to all these service activities is a general air of suspicion that the people involved "do too little to earn their fee." The same TV technician who is disturbed when his customer questions the $5.95 charge for replacing a tube on a house call, becomes annoyed himself when the plumber charges him $5.00 to change a washer on a leaky faucet.

Recognizing that this feeling is universal is the first step in coping with it. It is hoped that all men who service Du Mont Telesets carry with them the self-assurance, knowledge and confidence required to persuade their customers of the honesty of their charges.

I am reminded of the service engineer who was called in to find out what was stalling a huge printing press in the middle of an expensive press run. He started the machine rolling again in five minutes by lightly tapping a small switch with a hammer.

He presented a bill to the printing company for $100. The flabbergasted management asked for an itemization of such apparently exorbitant charges for so little work. Here is what the engineer re-submitted:

For tapping the switch	$ 5.00
For knowing where to tap	95.00
	$100.00

The service engineer knew what he

(CONTINUED ON PAGE 30)

FIELD TESTING
THE RA-160, RA-162 TELESET
PART II

BY CARL QUIRK

In the design of a television receiver careful consideration must be given to the elimination of interference. One of the most important factors affecting interference problems is the intermediate frequency employed.

The RA-160-162 Telesets use an intermediate frequency in the 41 to 45 mc region. This intermediate frequency was chosen for the following reasons:

1. Almost complete elimination of oscillator radiation interference with other TV receivers is achieved, due to the fact that the local oscillator never operates within a TV channel. See Table I.
2. Improved image rejection over lower i.f.'s This is particularly important because the RA-160-162 is adaptable for UHF reception.
3. Increased immunity to diathermy (27.12 mc) and radio amateur interference (particularly from the 10 and 11 meter bands).

When a manufacturer changes the i.f. of his receivers he must examine a new group of possibilities with regard to interference. If he is to obtain maximum advantage from the change he must thoroughly field test the circuitry employed to detect new interference conditions which may occur.

One of the first steps which must be taken to check a new i.f. is to determine the mathematical relationships between the i.f. and the television channels. The relationships between the television channels and the i.f. used in the RA-160-162 are shown in Table II.

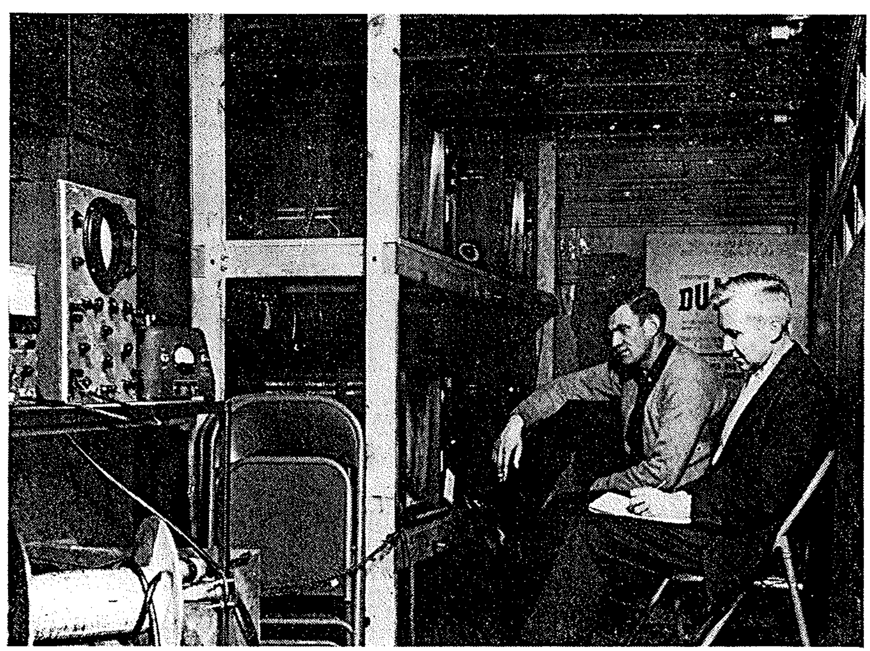

Figure F-1. Engineers observing the performance of RA-160-162 and competitive receivers in the mobile laboratory.

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Harold J. Schulman .... SERVICE MANAGER
Carl J. Quirk .... TECHNICAL SUPERVISOR
Joseph J. Roche .... EDITOR

TABLE I

Channels	Video Carrier	Osc. Freq.
2	55.25 MC	101 MC
3	61.25 MC	107 MC
4	67.25 MC	113 MC
5	77.25 MC	123 MC
6	83.25 MC	129 MC
7	175.25 MC	221 MC
8	181.25 MC	227 MC
9	187.25 MC	233 MC
10	193.25 MC	239 MC
11	199.25 MC	245 MC
12	205.25 MC	251 MC
13	211.25 MC	257 MC

TABLE II

Channel		Sound i-f Harmonics (41.25 MC)		Video i-f Harmonics (45.75 MC)	Beat Freq.
No.	Freq.	2	5	4	
6	82-88	82.50			.75 MC
8	180-186			183	1.75 MC
12	204-210		206.25		1.0 MC

Because channels 6, 8, and 12 are harmonically related to the i.f. a series of field tests were made to determine whether or not an interference problem existed. These tests were made under several different reception conditions, because signal strength often affects interference conditions. If the received signal is very strong it may mask the interference. If the signal is too weak thermal noise (snow) may mask the interference. If interference exists it will usually appear at signal strengths between these two extremes. As a rule moderately strong signals aggravate interference conditions of this type.

Other Services

The next step is to determine what other services operate within the i-f band. These are as follows:

40-42	Government, Industrial Scientific and Medical (40.68)
42.02-42.94	Public Safety—Police
42.98	Industrial—Low Power
43.02-43.18	Industrial—Special Industrial; Maritime, Mobile

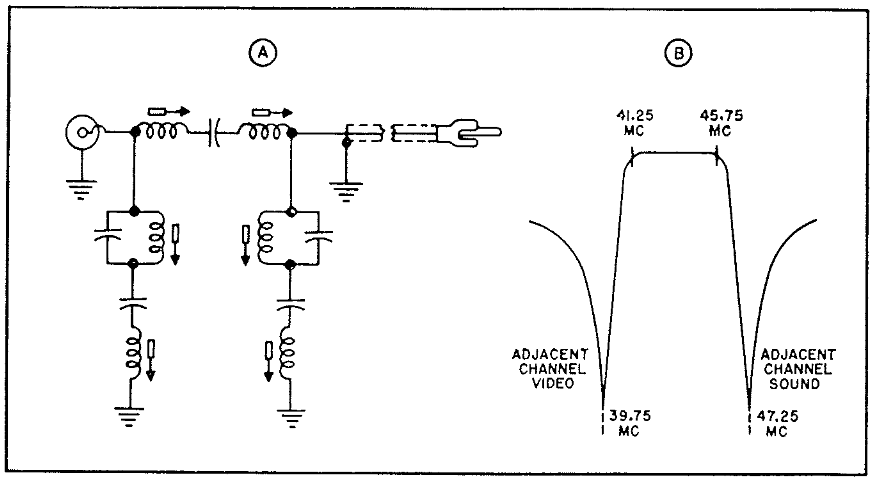

Figure F-2. A—Circuit of the "M" derived adjacent channel filter. B—Response curve of the filter.

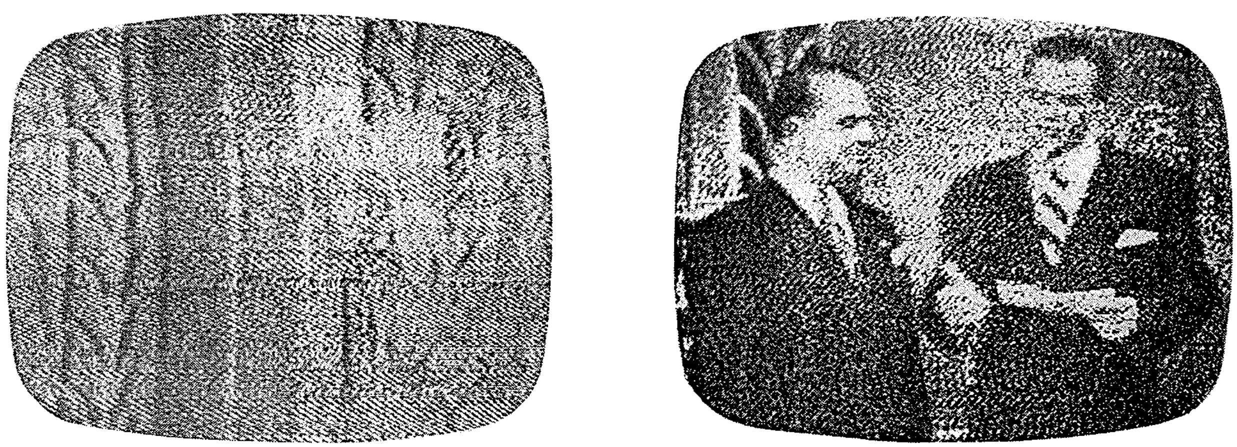

Figure F-3. A—Picture obtained on best competitive receiver. B—Picture on RA-160-162 under identical conditions (filter connected in circuit).

43.22-43.66 Domestic Public
43.70-43.98 Land Transportation—Intercity Bus
44.02-44.30 Land Transportation—Intercity Bus
44.34-44.58 Land Transportation—Urban Transit
44.62-46.02 Public Safety—Police
46.06-46.50 Public Safety—Fire
46.54-46.82 Public Safety — Forestry Conservation

The frequencies allocated for Police use are utilized primarily by state police departments. There are, however, a few local and township police departments which use them.

To check the immunity of the RA-160-162 Teleset to interference from these sources a number of field tests were made in the vicinities of police transmitters. Both fringe and strong signal locations were used in the tests. Most of the tests were made within less than a mile from a transmitter. The immunity with and without a high-pass filter was determined. In most cases the filter was not required, while in a very few instances the interference could not be reduced sufficiently without the filter. As a result of the tests a high-pass filter has been incorporated in the RA-160-162, even though the locations in which the interference would be noticeable are very few.

The high-pass filter not only reduces the possibility of interference from signals within the i-f passband, it also provides immunity to interference from all other signals below 50 mc.

Adjacent Channel Interference

In areas where signals are received on adjacent channels, both signals will pass through the r-f tuner of a TV receiver when the receiver is tuned to one of the adjacent channel signals. The undesired signal enters the video i-f stages and if provisions are not made to eliminate it, interference is produced.

The usual provisions for the elimination of adjacent channel interference consist of one or more traps tuned to the interfering frequency and located in the video i-f circuits. These traps are used in previous Du Mont Telesets and provide sufficient attenuation to eliminate interference in locations approximately half way between the adjacent channel stations.

In the design of the RA-160-162 it was desired to insert sufficient attenuation to permit reception of a distant station despite the presence of a nearby adjacent channel transmitter. In such locations the usual adjacent channel traps are inadequate and the distant station is unusable.

A suitable filter, for insertion between the tuner and the video i-f strip was designed and thoroughly field tested. A number of tests were conducted in the vicinity of Woodbridge, N. J.

In this area — approximately 20 miles from New York City and approximately 70 miles from Philadelphia — channels 2, 4, 5, 7, 9, 11, and 13 are received very strong; while weak signals are received on channels 3, 6, and 10. With the usual traps located in the video i-f stages, channels 3, 6, and 10 cannot be received. With the filter in use, channels 3 and 6 can be received satisfactorily. Channel 10 is affected by atmospheric conditions and can be received when conditions permit.

Since such locations are in the minority, it was felt that the filter should be made up as a plug in unit for use only in those areas where severe adjacent channel interference is encountered. The filter is basically an "M" derived bandpass network, as shown in Figure F-2a. Its response curve is shown in Figure F-2b. Note that there is very little attenuation of frequencies which fall within the i-f passband. However, at those frequencies which correspond to the adjacent channel sound and video, the attenuation provided is very high.

The effectiveness of the filter is illustrated in Figure F-3. A is the picture obtained on the competitive receiver having the highest adjacent channel attenuation. B is the picture obtained on an RA-160-162 with the filter in place. Both sets were tuned for the best combination of sound and picture. The photographs show that the filter makes possible the reception of signals which cannot be received on a set equipped with the usual adjacent channel traps. The filter, properly mounted on a chassis, is shown in Figure F-4.

In addition to interference from the known sources described here, extensive field tests were made to detect possible interference from unexpected sources. As a result of these tests, the RA-160-162 has been made as immune to interference as it is possible to make a television receiver at the present state of the electronic art.

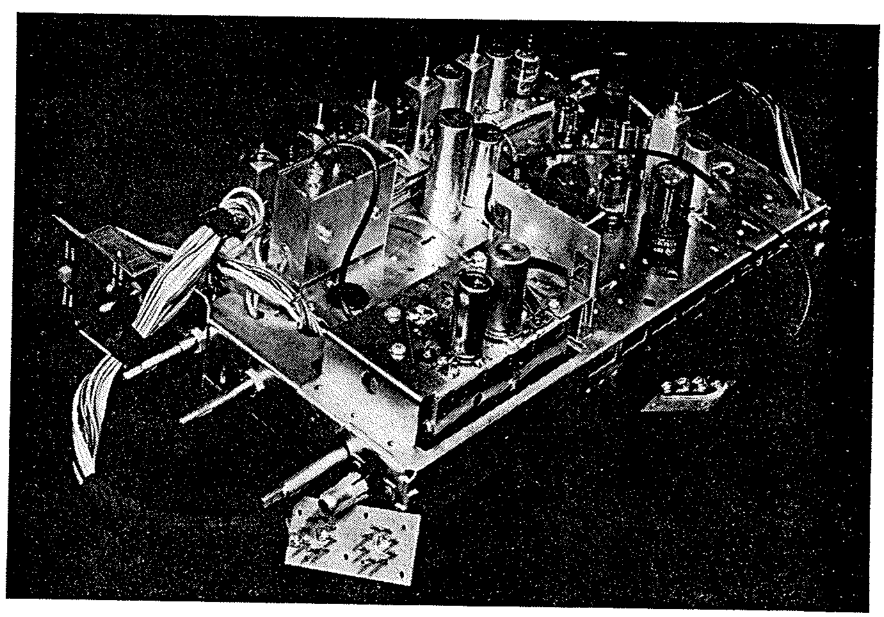

Figure F-4. The adjacent channel filter mounted on chassis. The filter may be installed without removing chassis from cabinet.

TROUBLESHOOTING

HORIZONTAL SWEEP CIRCUITS

BY WALTER BOIKO

Some of the more common television receiver faults are those occuring in the horizontal-sweep circuits. The purpose of this article is to point out some of the common troubles occurring in these circuits and to review the methods used for localizing them.

As shown in the block diagram of Figure H-1 a horizontal sweep trouble may be caused by the improper operation of any stage between the horizontal oscillator and the horizontal-deflection coil.

Horizontal Oscillator

As mentioned in the preceding article on troubleshooting a-f-c circuits, the horizontal oscillator generates the signal which is used to produce the horizontal sweep and CRT high voltage.

While the presence of high voltage indicates that the oscillator is oscillating, it does not necessarily indicate that it is operating properly.

The presence of high voltage sometimes misleads the serviceman into thinking that the fault is in the deflection circuits, when actually it is due to improper operation of the oscillator. To avoid being misled an oscillograph should be used to check the voltage waveform at the grid of the horizontal-sweep amplifier. If the waveform does not appear similar to that shown in Figure H-2 the fault may be located by working back toward the oscillator stage.

There is some interdependence between the operation of the horizontal oscillator and the amplitude of the boosted B+ which is obtained from the horizontal deflection circuit. When making voltage measurements in the horizontal oscillator, remember that low readings may be caused by faults in the horizontal-deflection circuits as well as in the oscillator. The criterion for isolating the cause of low boosted B+ voltage is the sawtooth voltage waveform at the output of the oscillator. If the sawtooth waveform is normal, the cause of low boosted B+ voltage can be safely attributed to the deflection circuits. Consequently, the next step is to check the operation of the sweep amplifier.

Horizontal-Sweep Amplifier

The horizontal-sweep amplifier provides the current for one half of the horizontal sweep. As shown in Figure H-3 its conduction is controlled by the oscillator signal appearing at its grid.

The first step in checking the operation of the sweep amplifier is to determine whether or not the stage has sufficient grid drive. This may be accomplished by observing its grid voltage waveform. If the waveform at the output of the oscillator (terminal D of Z210) is normal, but the grid waveform is not normal, the components in the sweep amplifier grid circuit should be checked. A typical case in which the grid-voltage waveform is improper and the oscillator waveform is correct occurs when C249 is leaky. This condition results in the sweep-amplifier grid-voltage waveform shown in Figure H-4 and causes foldover at the right side of the picture.

As shown in Figure H-3 the flyback transformer forms the plate load of the horizontal-sweep amplifier. Since the transformer circuit includes a relatively large number of components, it is advisable to check the operation of the sweep-amplifier stage independently of the transformer circuit.

This may be accomplished as follows:

1. Remove the sweep-amplifier plate cap.
2. Connect a 100K, 2 watt, resistor from the sweep-amplifier plate terminal to any 200 volt terminal on the chassis.
3. Connect the vertical-input terminals of an oscillograph between the sweep-amplifier plate and ground.

The waveform at the plate of the sweep amplifier should be similar to that shown in Figure H-5. This waveform is not representative of that normally appearing at the plate of the amplifier. It serves, however, as a check on the operating condition of this stage when the 100K resistor is used for the plate load. If the waveform does not appear as shown, voltage and resistance measurements will usually locate the component at fault.

When it has been determined that the sweep-amplifier stage is operating properly, the flyback transformer circuit should be examined.

Flyback-Transformer Circuit

The flyback transformer circuit includes the damper stage, the deflection-

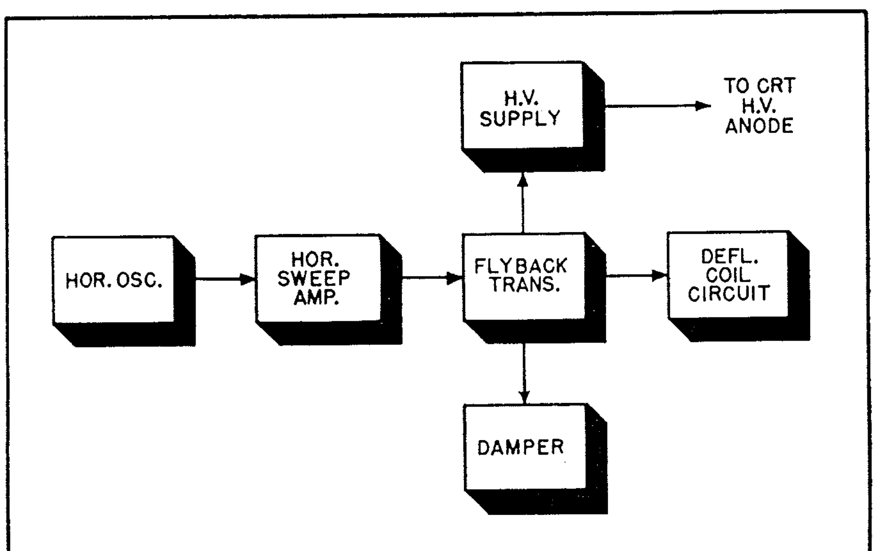

Figure H-1. Block diagram of Sweep Circuits for the RA-112, 113, and 117 chassis.

coil circuit and the high-voltage rectifier circuits.

While there are a relatively large number of associated components in this circuit a logical method of approach can be used to locate the one at fault.

The flyback transformer matches the high plate impedance of the sweep amplifier to the horizontal-deflection coil. In addition, it provides the path through which the high-amplitude pulse voltage (developed during the horizontal-retrace period) is applied to the high-voltage rectifier circuits. While resistance measurements may be used to detect an open transformer winding they will not show up shorted turns or windings.

The replacement of a flyback transformer usually requires more time and effort than replacement of other components. Many servicemen have replaced flyback transformers only to find that the receiver fault was still present. To avoid such a mistake all other components in the flyback-transformer circuit should be thoroughly checked before the flyback transformer is replaced.

The voltage waveform at the cathode of the damper tube, shown in Figure H-6, is helpful in troubleshooting the flyback-transformer circuit. This waveform is the high-amplitude pulse voltage developed across the secondary winding of the flyback transformer and the deflection coil, during the horizontal-retrace period.

The amplitude of this voltage is approximately 1400 volts (peak-to-peak). Since this is far above the safe input voltage of the average oscillograph, a suitable attenuator should be connected in series with the vertical input terminals of the oscillograph. The circuit of a capacitive divider network suitable for this purpose is shown in Figure H-7. As shown in the figure the divider network consists of two lengths of coax and a 100 mmf, 500 volt capacitor. The outer shield is completely removed from the short length of coax. Part of the shield should also be removed from the longer length of coax, as indicated. Half of the short length of coax (A-B in Figure H-7) should then be fastened to that portion of the long length of coax from which the shield was removed. Electrical tape should be used for this purpose. The 100 mmf capacitor is connected from the inner conductor to the outer coax shield of the long length of coax as shown in Figure H-7. The attenuation or stepdown ratio obtained with this capacitive divider network is approximately 100:1.

One way to become acquainted with the voltage waveform present at the cathode of the damper tube is to exam-

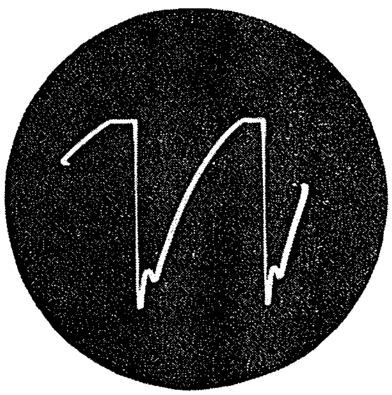

Figure H-2. Normal waveform at grid of sweep amplifier.

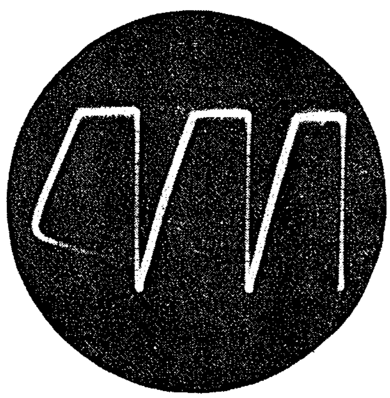

Figure H-4. Waveform at grid of sweep amplifier when C249 is leaky.

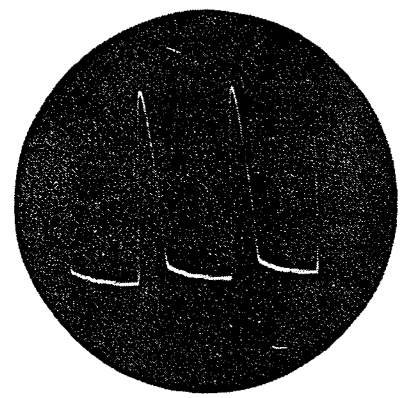

Figure H-5. Waveform at plate of sweep amplifier connected through a 100K, 2W resistor to a 200 volt source.

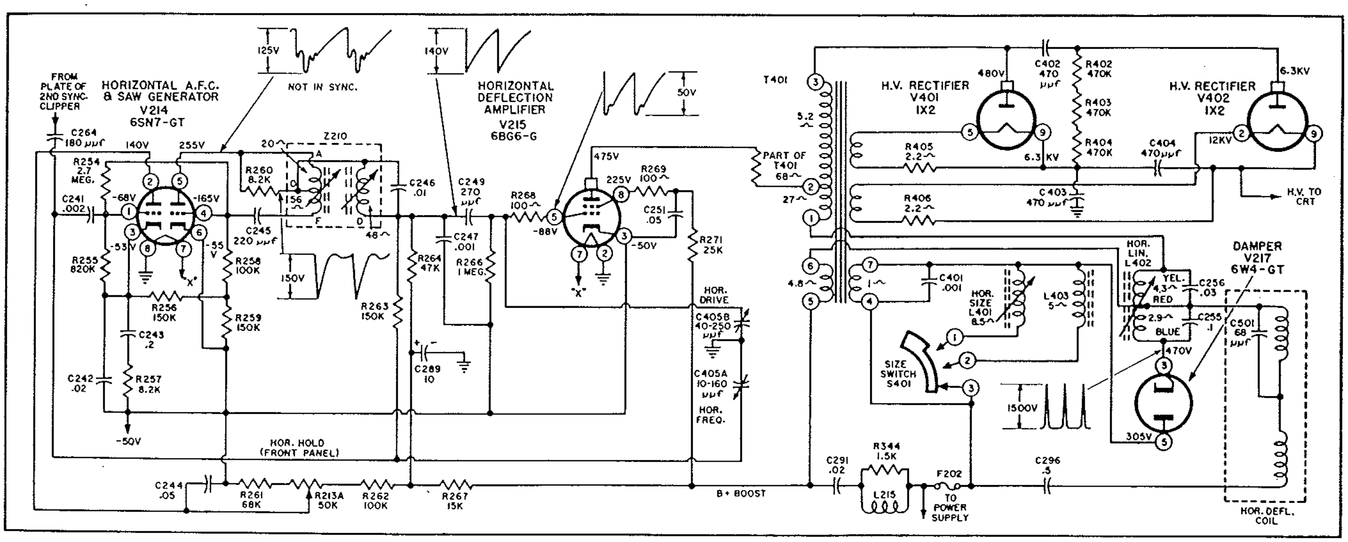

Figure H-3. Schematic diagram of horizontal sweep circuits. (RA-112)

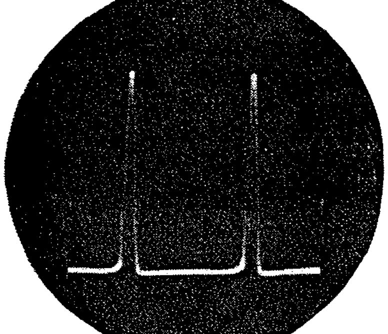

Figure H-6. Normal waveform appearing at cathode of damper tube. (Use attenuator in series with scope.)

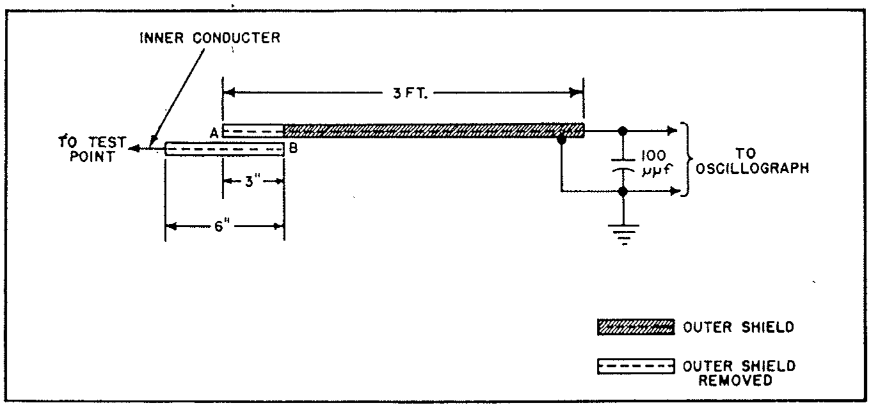

Figure H-7. Drawing of a suitable attenuator for use with the scope when observing high amplitude voltages.

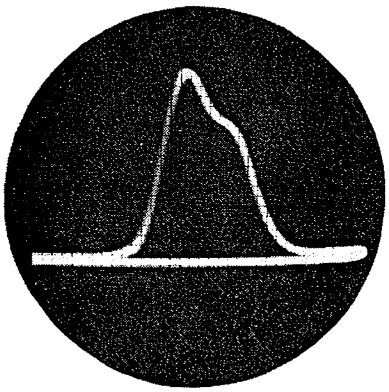

Figure H-8. Damper cathode waveform resulting from a shorted C291 or C296.

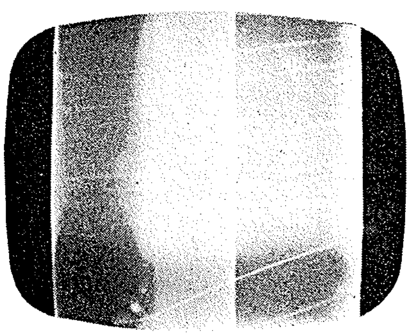

Figure H-9. Effect on raster of a short in either C291 or C296 when damper tube is removed from its socket.

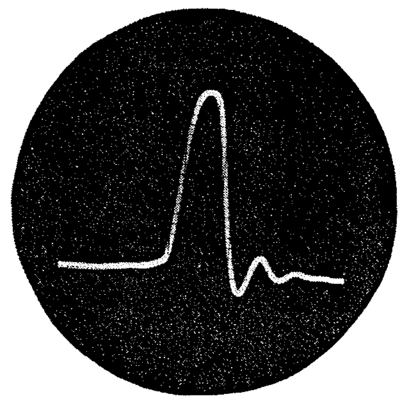

Figure H-10. Waveform at 1X2 plates.

ine a receiver which is operating normally.

Figure H-8 illustrates the waveform at the damper cathode when either C291 or C296 is shorted. Another method of determining if either of these capacitors is shorted is to remove the damper tube from its socket. If one of the capacitors is shorted, the raster will appear similar to that shown in Figure H-9, when the damper is removed.

The procedure below may be followed to check the flyback-transformer circuit.

Connect the vertical input terminals of an oscillograph to the damper tube cathode through the attenuator network shown in Figure H-7. The voltage waveform at this point should appear similar to that shown in Figure H-6. If the waveform does not appear as shown, disconnect one terminal of C296, the direct-current blocking capacitor for the deflection coil. This removes the horizontal-deflection coil from the flyback-transformer circuit. It may be logically assumed that the deflection-coil circuit is at fault if the damper cathode waveform is normal when this is done. If the waveform does not appear normal after this is performed, each half of the linearity coil should be shorted with a jumper wire to determine if it is at fault. Should the waveform appear normal when this is done, the linearity coil should be checked and replaced if necessary.

If the damper cathode waveform does not appear normal after the linearity coil is shorted, the flyback transformer is probably at fault.

The high voltage rectifier circuits may be checked by arcing the rectifier plates to ground. The oscillograph is also helpful in checking these circuits. The capacitive divider network should be used with the oscillograph. The pulse voltage appearing at each of the rectifier plates should appear similar to that shown in Figure H-10. If the waveform at the plate of V401 does not appear as shown, but the damper cathode waveform is normal, winding 2-3 of the flyback transformer should be checked. If the pulse voltage appears normal at the plate of V401 but does not appear normal at the plate of V402, C402 should be examined. If the waveforms appear normal at both rectifier plates but high voltage is not present, examination of the rectifier circuit components will locate the fault.

The above discussion has been confined to those chassis utilizing the pulse-width a-f-c system. However, the same troubleshooting technique may be applied to the RA-109A, RA-130, RA-119 and other chassis which use reactance tube a.f.c.

DIRECTOR'S CORNER (Cont'd)

was doing. He wanted to be paid for his knowledge.

That's just about what our service industry must strive for. We must work to improve the quality of service rendered — to increase customer satisfaction. And then, for the good of the industry we must gain acceptance for honest charges for legitimate service.

THE NEW AMATEUR BAND

A number of newspaper articles have recently appearing playing up the FCC's announcement of the opening of the 21 to 21.45 mc radio amateur band. Many of these articles predict dire effects on television reception when the amateurs begin to use their new frequencies. One article went so far as to intimate that 17,000,000 TV receivers would be unusable. The alarm among TV receiver owners which is following in the wake of the articles has prompted a number of dealers to request information regarding the immunity of Du Mont Telesets to amateur signals in the new band.

Du Mont Telesets should be relatively immune to interference from this source.

The lowest i.f. used in Du Mont Telesets is 21.75 mc, while the majority of Du Mont sets built since 1946 utilize an i.f. of 21.9 mc. These frequencies are the sound i-f carrier frequencies. Since the sound channel extends from 100 to 200 kc above and below the sound-carrier frequency, the i-f pass bands extend to approximately 21.55 mc and 21.7 mc, respectively. Thus the i-f pass bands of Du Mont receivers are outside the amateur band.

A number of manufacturers have produced receivers using a sound i.f. of 21.25 mc. Since this i.f. is in the amateur band it is quite possible that these receivers will suffer from interference.

If a television receiver is located quite close to an amateur station it is possible for the amateur signal to brute force its way through the i-f stages, or overload the front end and generate harmonics which cause interference. This can happen regardless of the intermediate frequency of the receiver. The new amateur band presents no new problem in this respect — signals in the 28 mc amateur band can do the same thing. Yet such cases have been comparatively few, and high-pass filters have been very effective in remedying those which have occured.

The newspaper publicity given the FCC announcement will undoubtedly lead many consumers to blame amateurs for interference originating from other sources. When such complaints are received they should be investigated carefully before blaming an amateur station. If the interference is due to a 21 mc band signal a high-pass filter should remedy the condition.

I-F Decoupling Networks

When a number of amplifier stages are operated from a single B supply, means must be provided to decouple the amplifier circuits from the supply. This is particularly true in high-frequency, high-gain amplifiers such as the video i-f stages of a television receiver. If proper decoupling is not provided the B+ supply serves as a feedback path and regeneration results. In severe cases oscillation or motorboating may occur.

Decoupling networks are normally provided in the plate and screen-grid circuits of each stage. These networks usually consist of a resistor and capacitor, as shown in Figure D-1. In the plate decoupling network C1 serves the dual function of plate return and decoupling capacitor. R1 is the decoupling resistor. C2 serves as a screen bypassing and decoupling capacitor, while R2 decouples the screen from the B+ supply and also acts as a dropping resistor, to reduce the B+ voltage to a value suitable for application to the screen grid. The decoupling circuits present a low impedance to ground at the signal frequency, and at the same time present a high impedance in series with the power supply lead, preventing the signal from entering the supply circuits. At low frequencies a single resistor and capacitor provide adequate decoupling. However, at high frequencies the effectiveness of ordinary resistors is greatly reduced by their internal shunting capacitance.

The equivalent circuits of a resistor at low frequencies and at 45 mc are shown in Figure D-2. At low frequencies the resistor may be considered a pure resistance, while at 45 mc its internal shunting capacitance is great enough to cause it to act as a parallel

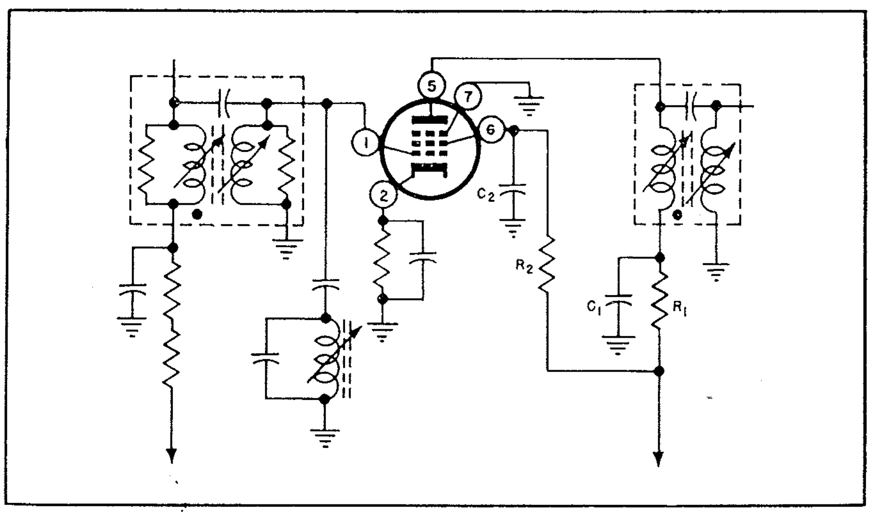

Figure D-1. Schematic diagram of a video i-f stage. Note R1 and C1 which form the plate decoupling network of the stage. R2 and C2 form the screen decoupling network.

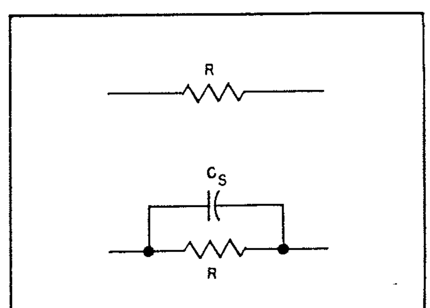

Figure D-2. Equivalent circuit of a resistor at low frequencies and at 45 Mc.

RC circuit. An ordinary one watt resistor has a shunting capacitance of approximately 3 mmf. Therefore, a 27 K, 1 watt resistor used for decoupling at 45 mc presents an impedance of approximately 1200 ohms. Thus the internal shunting capacitance of the resistor greatly reduces its ability to provide decoupling at this frequency.

In the RA-160-162 Teleset this situation is overcome through the use of two one-half watt resistors in the screen decoupling networks of the first, second, and third video i-f stages, as shown in Figure D-3. A screen dropping resistance of 27 K with a one watt dissipation is required. This is provided by a 12 K, one-half watt, and a 15 K, one-half watt resistor in series. The internal shunting capacitance of a one-half watt resistor is approximately 1 mmf. By using two one-half watt resistors their individual shunting capacitances are placed in series giving a total shunting capacitance of approximately one-sixth that of a single one watt resistor. Thus the impedance of the decoupling network is increased sufficiently to provide adequate decoupling.

Two resistors are used in the plate circuit of the third video i-f amplifier. These resistors provide decoupling, and in addition make it possible to locate the resistor which dissipates the majority of the heat remote from the i-f can. R214 is a 1 K, one-half watt unit, while R291 is a 6.8 K, 2 watt unit. Consequently, most of the heat is dissipated by R291 which is located away from the i-f can.

It is important when replacing these decoupling resistors that exact replacement parts are used. A single resistor should never be substituted for two resistors, nor should one watt units be used in place of one-half watt components.

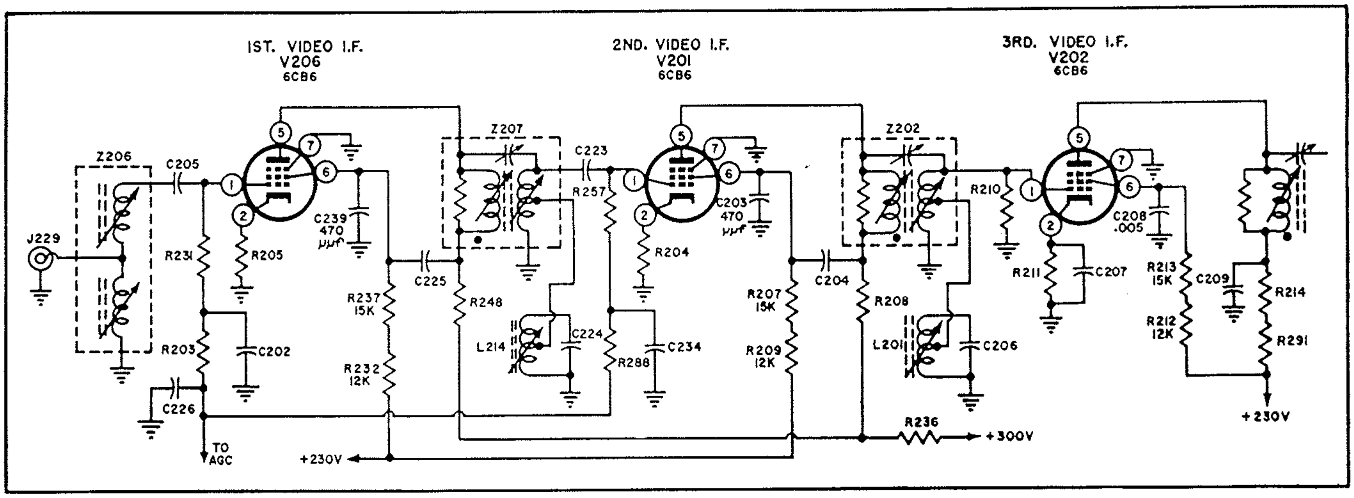

Figure D-3. Schematic diagram of the RA-160 video i-f stages. Resistors R237, R232, R207, R209, R213, and R212 form the screen grid decoupling resistance for the first three stages.

PRODUCTION CHANGES

RA-133A

Reason:

To permit operation from a 115-230 volt 50-60 cycle a-c power source.

Procedure:

The RA-109A has been modified and designated the RA-133. This set may be easily recognized by its separately mounted power supply. Consult the Installation Instructions packed with each Teleset for information on preparing the Teleset for operation. Figure T-1 shows the power supply connections for each of the different power sources from which the set may be operated.

The following leads are affected:

A — Black jumper
B — Black jumper
C — Brown wire
D — Blue wire
E — Orange wire

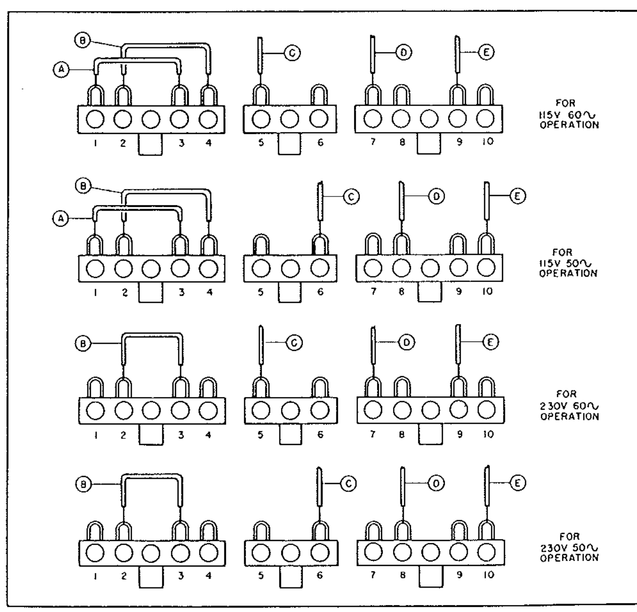

Figure T-1.

DU MONT
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SERVICE NEWS

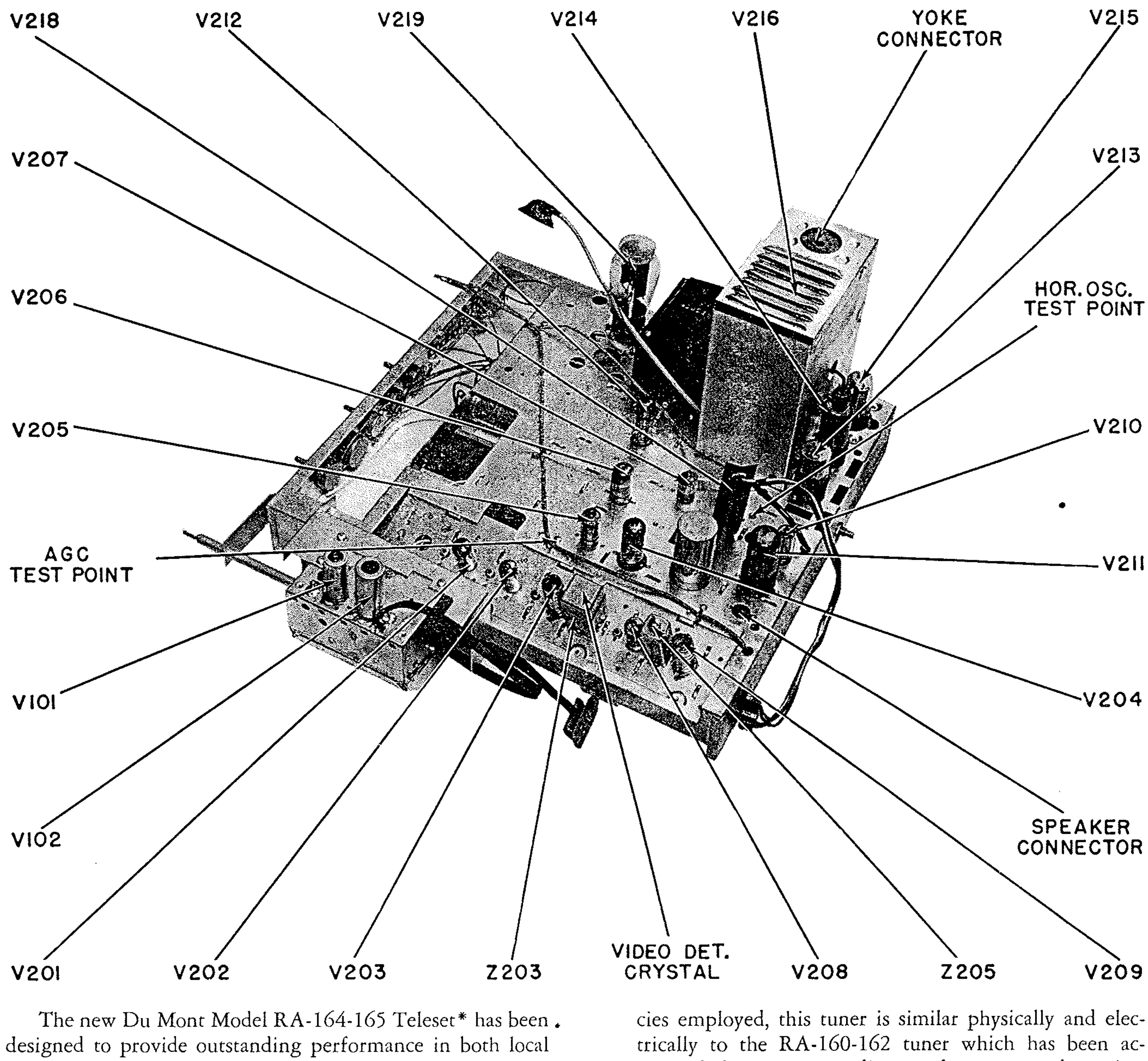
Service News

PUBLICATION OF THE TELESET SERVICE CONTROL DEPARTMENT
ALLEN B. DU MONT LABORATORIES, INC., PATERSON, N. J.

Volume 2 AUGUST, 1952 Number 7

THE RA-164-165

A GREAT NEW DU MONT CHASSIS



The new Du Mont Model RA-164-165 Teleset* has been designed to provide outstanding performance in both local and fringe areas. Among the many outstanding features of this new Teleset are:

1. A low-noise 12 channel switch-turret tuner, with a cascode r-f amplifier for unexcelled fringe area performance. With the exception of the intermediate frequencies employed, this tuner is similar physically and electrically to the RA-160-162 tuner which has been acclaimed for its outstanding performance and serviceability.
2. Du Mont's Selfocus* Teletron* — provides fully automatic focus.
3. A stagger-tuned intercarrier video i-f strip — simpl

* Trade Mark

alignment procedures.

4. Fast acting keyed AGC system — insures instantaneous control of the receiver gain.
5. Vertical-retrace blanking circuit — eliminates retrace lines regardless of control settings.
6. Provisions to clean face of the CRT from the front of cabinet.
7. Conveniently located controls — the most used adjustments are on the front of the chassis.
8. Shipped completely adjusted, ready for operation when unpacked.

MODELS

Model	Name	CRT	Cabinet
RA-164-A1	Clinton	17 inch rect.	Table model Brown and Bl.
RA-165-B1	Milford	21 inch rect.	Table model Mah. and Bl.
RA-165-B2	Beverly	21 inch rect.	Console Mah. and Bl.
RA-165-B3	Wakefield	21 inch rect.	Console Mah. and Bl.
RA-165-B4	Ridgewood	21 inch rect.	Console Mah. and Bl.
RA-165-B5	Shelburne	21 inch rect.	Console Mah.

ELECTRICAL AND MECHANICAL SPECIFICATIONS

POWER RATING
- Requirements .... 105-129 volts, 60 cycles
- Consumption at 117 volts .... 200 watts

NUMBER OF TUBES .... 18 plus 2 Rectifiers, 1 Crystal, and 1 CRT

OPERATING CONTROLS .... Channel Selector, Fine Tuning, Picture, Volume, and On-Off

HIDDEN FRONT PANEL CONTROLS
- Operating .... Brightness, Vertical Hold and Horizontal Hold
- Service .... Vertical Size and Vertical Linearity

ANTENNA INPUT IMPEDANCE .... Balanced 300 ohm

FREQUENCY RANGE .... Channels 2 through 13
- Fine Tuning Range .... Channels 2-6: 500 kc; Channels 7-13: 1500 kc

INTERMEDIATE FREQUENCIES
- Video I-F Carrier .... 25.75 mc
- Sound I-F Carrier .... 21.25 mc
- Sound Intercarrier Frequency .. 4.5 mc
- Adjacent Channel Sound Trap 27.25 mc

PICTURE TUBE
- Type .... RA-164: 17KP4 or 17HP4; RA-165: 21KP4A or 21FP4A
- Dimensions .... RA-164: 11 x 14¼; RA-165: 13⅞ x 19⅛

CRT HIGH VOLTAGE .... 14 kv

SWEEP DEFLECTION .... Magnetic

FOCUS .... Automatic Electrostatic

LOUDSPEAKER
- Size .... Table Model 5 inch; Console 10 inch
- Impedance .... 3.2 ohm at 400 cycles

CABINET DIMENSIONS

	Height	Width	Depth
RA-164 Clinton	19 1/16"	21½"	19 13/16"
RA-165 Milford	21⅞"	24"	20⅝"
RA-165 Beverly	37⅞"	24½"	20 13/16"
RA-165 Wakefield	37¼"	24¾"	22 7/16"
RA-165 Ridgewood	37⅞"	24¾"	22 7/16"
RA-165 Shelburne	37¼"	24¾"	22 7/16"

TUBE COMPLEMENT

SYMBOL	TYPE	FUNCTION
V101	6J6	R. F. Oscillator and Mixer
V102	6BQ7	R. F. Amplifier
V201	6CB6	1st Video I.F.
V202	6CB6	2nd Video I.F.
V203	6CB6	3rd Video I.F.
V204	12BY7	Video Amplifier
V205	6BE6	1st Sync Clipper
V206	12AT7	2nd Sync Clipper / Vertical Oscillator
V207	6AL5	Horizontal Phase Detector
V208	6AU6	Sound I.F.
V209	6AL5	Ratio Detector
V210	6AT6	1st Audio Amplifier
V211	6W6GT	2nd Audio Amplifier
V212	6S4	Vertical Deflection Amplifier
V213	6SN7GT	Horizontal Oscillator
V214	6BQ6GT	Horizontal Deflection Amplifier
V215	6W4GT	Horizontal Damper
V216	1B3GT	High Voltage Rectifier
V218	6AU6	AGC Amplifier
V219	5U4	Power Rectifier

GENERAL DESCRIPTION

A block diagram of the RA-165 Teleset is shown in Figure A-1. The tuner is a 300 ohm input, switch-turret type employing a 6BQ7 in a low noise cascode circuit.

The output of the tuner is fed to a three stage stagger-tuned video i-f strip utilizing intercarrier design. The intermediate frequencies employed are, 25.75 mc for video, and 21.25 mc for sound. A-g-c voltage is applied to the first and second i-f stages. The entire i-f strip, including the video detector, is a sub-assembly which may be removed from the main chassis.

The video detector is a crystal diode which is readily accessible from the top of the chassis for test or replacement purposes. The detector is fully shielded to minimize i-f harmonic interference. Direct coupling is used between the video detector and the video amplifier; and between the video amplifier and the CRT; eliminating the need for a d-c restorer.

A single high-gain video amplifier stage is employed. The composite video signal is positive at the plate of the video amplifier; the polarity necessary to feed the cathode of the CRT.

A 6BE6 pentagrid is used in a unique circuit which provides both clipping action and noise elimination. Two composite video signals, 180° out of phase with each other, are applied to the number 1 and number 3 grids of the tube. These signals are obtained from the output of the video detector and the output of the video amplifier respectively. The circuit is so arranged that sharp noise bursts cause the tube to cut-off preventing the noise from entering the sync circuits.

Automatic frequency control of the horizontal oscillator is provided by the familiar phase detector circuit. The output of the 6BE6 sync clipper is applied to a triode phase inverter. The out-of-phase sync signals, appearing at the plate and cathode of the triode, are fed to the phase detector.

The phase detector compares the sync signal with a reference signal obtained from the horizontal deflection coils and produces an error voltage whenever the signals differ in phase.

The horizontal oscillator is a stabilized cathode-coupled multivibrator. The operating frequency of the oscillator is controlled by the voltage produced in the phase detector circuit mentioned above.

The output of the horizontal oscillator is applied to the grid of the horizontal sweep amplifier. This stage is followed by a conventional flyback high-voltage supply which provides a CRT anode voltage of 14 kv.

The vertical sync signal is separated from the composite sync at the output of the second sync clipper by means of a three stage cascaded integrating network.

The output of the integrating network is applied to the vertical oscillator. This stage employs one section of a 12AT7 dual triode which operates in conjunction with the vertical-output stage (6S4 triode) as a multivibrator.

Vertical-retrace blanking is secured by applying the vertical deflection pulse to the grid of the CRT. The pulse voltage is obtained from the vertical output transformer.

A keyed a-g-c system is incorporated in the RA-164-165 chassis. The a-g-c circuit consists of a 6AU6 high-gain amplifier. The composite video signal, obtained from the output of the video amplifier, is applied to the grid of the a-g-c amplifier. The horizontal sweep signal supplies the plate potential of the a-g-c amplifier, permitting it to conduct only during the horizontal pulse interval.

The 4.5 mc sound i-f signal is taken off at the output of the video detector, amplified by a single 4.5 mc sound i-f stage and applied to a ratio detector. To provide optimum sound quality two stages of audio amplification are employed. The audio output stage uses a 6W6GT beam power pentode.

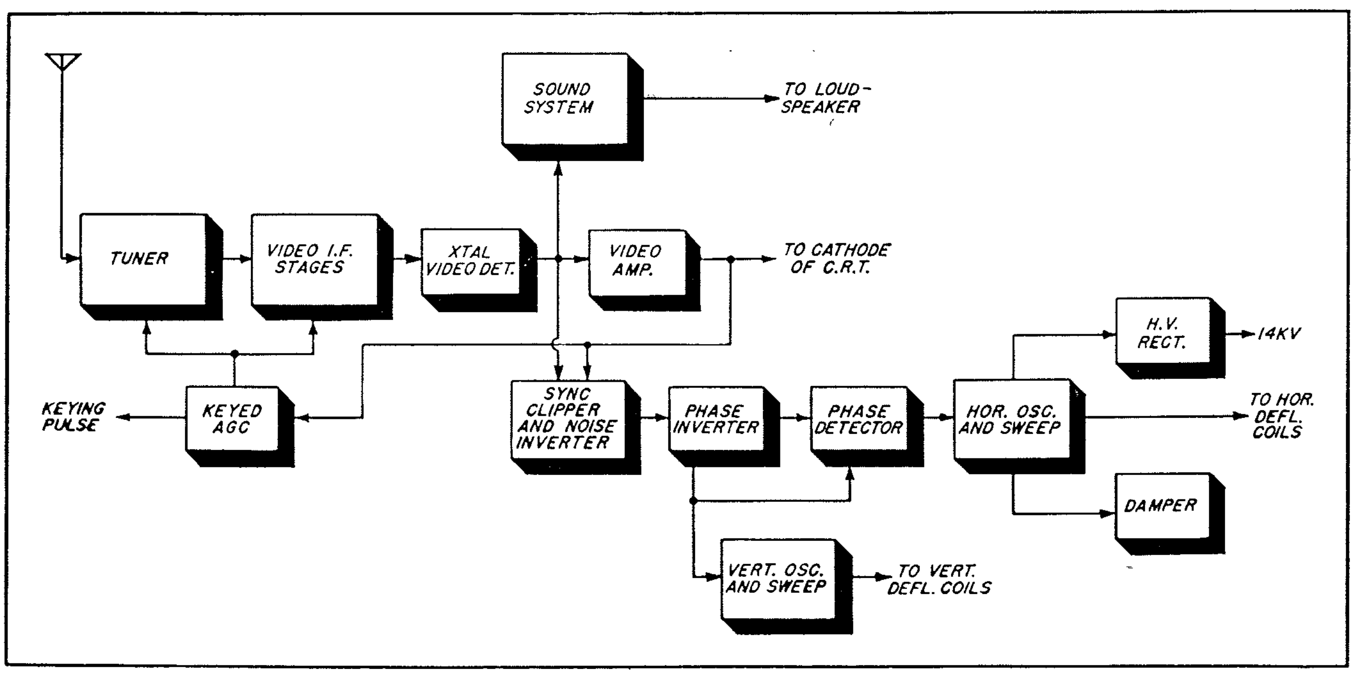


Figure A-1. Block diagram of the model RA-164-165 Teleset.

SERVICING PROCEDURES

SCHEMATIC AND ALIGNMENT INFORMATION. — A separate schematic and alignment sheet for the RA-164-165 is available. This sheet is being mailed to all Service News subscribers with this issue.

CHASSIS, CRT REMOVAL AND REPLACEMENT

1. Remove all front panel knobs.
2. Remove CRT socket, the HV Anode connector, the deflection yoke cable plug and grounding clip, speaker connector, and antenna terminal board.
3. Remove the four hex-head tap screws holding the chassis in place.
4. Pull chassis straight back out of the cabinet.
5. Remove the ion trap and centering magnet from the neck of CRT.
6. Remove the two deflection retainer springs as in Figure A-2. Grasp each spring in turn with a pair of long nose pliers and push forward on the pliers until spring is unhooked.

   CAUTION: One hand should be placed between the CRT and the pliers to prevent the pliers from striking the tube if they slip.
7. Slip the deflection coil retainer and yoke off the CRT neck.
8. Remove the two ¼-20 hex-nuts holding the two straps of the CRT rear support. The rear of the CRT should be supported as straps are loosened.
9. Still holding rear of CRT with one hand, remove the four ¼-20 hex-nuts holding the two CRT front support plates to front of cabinet.
10. Carefully remove CRT assembly.
11. Set CRT on its face on some soft cloth and remove straps and support plates by loosening the two 10-24 x 1½ screws.
12. To install the CRT and chassis follow the above procedure in reverse.
13. When the CRT has been installed the ion trap and centering magnets should be adjusted as described on the schematic and alignment sheet.

CLEANING THE CRT AND SAFETY GLASS OF THE RA-164

1. Unscrew the four Phillips-head screws holding the plastic bezel.
2. Remove the bezel and the safety glass.

CLEANING THE CRT AND SAFETY GLASS OF THE RA-165

1. Unscrew the two Phillips-head machine screws holding the strip of moulding across the top of the safety glass, and remove moulding.
2. The safety glass and mask assembly can be removed by gently pulling out and up at top of safety glass.

REPLACING THE TUNER COIL STRIPS. —

1. Remove the tuner bottom cover by pulling its front end away from the tuner and unhooking its rear edge.
2. Using a screwdriver pry the spring finger, holding the strip, away from the turret end plate and lift out the strip.
3. To install the new strip, insert the two projections into the holes in the detent ring.
4. Pry the spring finger away from the end plate, push the strip in place, and let the spring finger snap over the end of the strip.

CLEANING THE TUNER CONTACTS. — Remove the tuner bottom cover and several of the coil strips as described in steps 1 and 2 of the above paragraph. Rotate the turret so that the wiping contacts are accessible through the opening made by removing the coil strips. Clean the coil strip and wiping contacts with a soft cloth moistened with No Noise.

ADJUSTING THE TENSION OF THE WIPING CONTACTS. — Remove the tuner bottom cover and several of the coil strips. Rotate the turret to permit access to the contacts through the opening thus provided. Using a small screwdriver bend each contact spring until it extends approximately ⅛ inch inward from the surface of the plastic contact-mounting plate.

To check the tension of the spring contacts, place the turret in a position between channels and note the clearance between the contact spring and the surface of the coil strip. The clearance should be approximately 1/64 inch.

TUNER OSCILLATOR ADJUSTMENT. — Tune the Teleset to the channel on which the oscillator is to be adjusted. Remove the fine-tuning knob and the dial. The oscillator slug is accessible through a hole approximately ¾ inch to the right of tuning shaft. Set the fine tuning control at the center of its mechanical range. Using an insulated alignment tool, adjust the slug so that proper sound and picture are obtained.

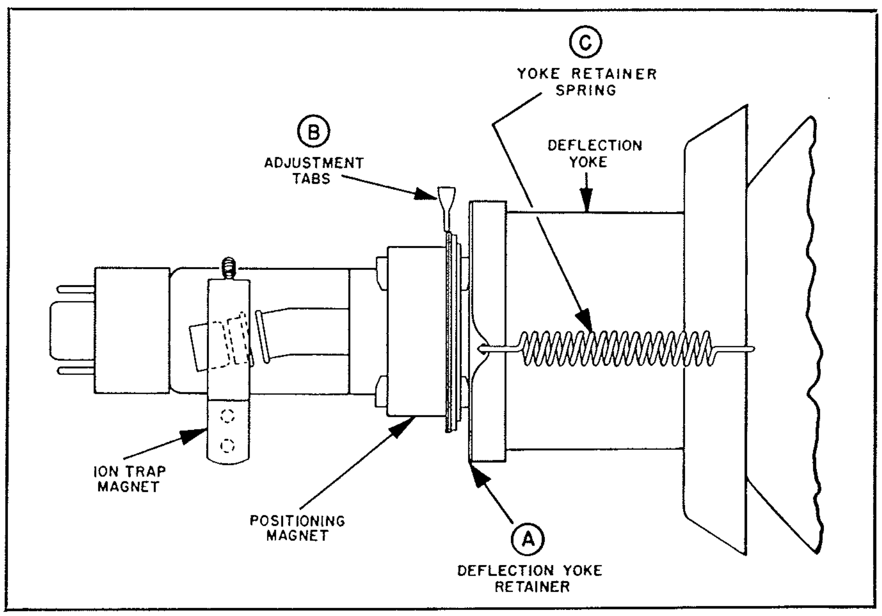


Figure A-2

ADJUSTING THE A-F-C CIRCUITS

1. Turn the set on and allow it to warm up for 15 minutes.
2. Set the front panel Horizontal-Hold control at the center of its mechanical range.
3. Short the a-f-c test point to ground with a short length of wire.
4. Adjust the Horizontal-Stabilizer control, L213 (on rear of chassis) until the picture holds sync momentarily. NOTE: With the a-f-c test point shorted the a-f-c circuits are not functioning and the picture will not continue to hold sync.
5. Remove the short from the a-f-c test point.

HORIZONTAL-DRIVE CONTROL ADJUSTMENT.—The presence of a bright vertical line near the center of the picture indicates the need for readjustment of the horizontal drive control. To adjust the control, rotate it until the bright line disappears. The proper setting is just beyond the point at which the line is no longer visible.

If the range of the control is not great enough to eliminate the bright line, remove the jumper across R277 and try readjusting the control. If this does not eliminate the line, remove the jumper across R299 and repeat the adjustment.

A-G-C ADJUSTMENT.—The a-g-c control is properly adjusted at the factory and normally does not require readjustment in the field. However, in some cases better results can be obtained by adjusting the control to suit the conditions at a particular location. If any of the following conditions are encountered, the a-g-c control should be readjusted.

1. Insufficient contrast.
2. Poor horizontal or vertical noise immunity.
3. Sync buzz.
4. Overloading; as indicated by picture distortion or loss of vertical hold, due to sync compression.

To remedy these conditions, tune the receiver to the channel affected and rotate the a-g-c control until the difficulty is eliminated.

In areas where both very strong and very weak signals are received the a-g-c control should be adjusted to prevent overloading on the strongest signal.

When adjusting the a-g-c to prevent overload by a strong signal the following procedure should be used:

1. Set the front panel horizontal-hold control for minimum whip (straight vertical wedge on test pattern) at the top of the picture.
2. Adjust the a-g-c control until the overload is eliminated.
3. Switch the Station Selector on and off the channel in question. Under some conditions this will cause the overload to reappear.
4. If this occurs, reset the a-g-c control and again rotate the Station Selector until the overload does not reappear when switching on and off the channel.

TROUBLESHOOTING PROCEDURES

SOUND

Symptom	Procedure
Cannot Be Tuned In Properly Probable Cause: H-f oscillator frequency misadjusted	1. Check oscillator slug adjustment 2. Substitute V101
Dead or Weak Probable Cause: Loss of gain in audio or sound i-f stage	1. Substitute V208, V209, V210 and V211 2. Check speaker plug and speaker audio transformer 3. Check voltages on V208, V209, V210 and V211 4. Check components associated with V208, V209, V210 and V211 5. Check sound i-f alignment
Distorted	1. Check fine tuning adjustment 2. Substitute V209, V210, and V211 3. Check alignment of Z205 4. Check voltages on V210 and V211 5. Check components in 1st and 2nd audio amp.
Intercarrier Buzz Probable Cause: Vertical sync in sound	1. Check fine tuning adjustment 2. Substitute V208 and V209 3. Check sound i-f alignment
Microphonics — Audible Probable Cause: Mechanical modulation of h-f oscillator (V101) or audio amplifier tubes	1. Check for binding knobs or control shafts 2. Substitute V101 3. Substitute V210
Poor Quieting Probable Cause: Improper operation of ratio detector or sound i-f stage	1. Check fine tuning adjustment 2. Substitute V209 3. Check alignment of Z205 4. Substitute V208 5. Check components of ratio detector, V209

PICTURE

Symptom	Procedure
Bright Horizontal Line **Loss of Vertical Size**	1. Substitute V206 and V212 2. Check voltages, waveforms and associated components of V206 and V212 3. Check yoke and vertical output transformer, T202
Critical Vertical Hold	1. Check waveforms in integrator network
Drive Line in Center	1. Check setting of drive control
Insufficient Horizontal Size	1. Check settings of horizontal size and linearity controls 2. Substitute V214, V215 and V213 3. Check Boosted B+ and associated components 4. Check C280 and C282
Insufficient Vertical Size	1. Check setting of vertical-size control **Control Has No Effect** 2. Check vertical size pot. R294 **Control Does Not Give Normal Size** 2. Substitute V206 and V212 3. Check voltages, waveforms and associated components of V206B and V212
Loss of Horizontal and Vertical Hold Probable Cause: Faulty sync clipper stage	1. Check settings of front panel hold controls 2. Substitute V205 and V206 3. Check voltages, waveforms and associated components of V205 and V206A
Microphonics — Visual Probable Cause: Mechanical modulation of tuner or video i-f tubes	1. Check control shafts and knobs for binding against cabinet. 2. Substitute V101 and V102 3. Substitute V201, V202, V203 and 204
No Brightness	1. Check for presence of high voltage at CRT connector **High Voltage OK** 2. Check CRT for open filament (look for glow) 3. Check adjustment of ion trap 4. Check voltages and associated components of CRT **No High Voltage** 2. Check the 1/4 amp. fuse (F201) in high voltage cage 3. Substitute V216, V215, V214 and V213 4. If a picture of reduced size with heavy horizontal fold-over appears when V215 is removed, replace C282 5. Check voltages, waveforms and associated components of V216, V215, V214 and V213
No Horizontal Hold — or Critical Horizontal Hold Probable Cause: Defective a-f-c circuit	1. Check setting of front panel horizontal hold control 2. Substitute V207 and V213 3. Check setting of L213 horizontal-stabilizer control located on rear of chassis 4. Check voltages, waveforms and associated components of V207 and V213
Picture Oversize — Low Brightness Probable Cause: Insufficient high voltage	1. Substitute V216 2. Check h-v rectifier components

PICTURE (Cont.)

Symptom	Procedure
Picture Too Small (Horizontal and Vertical) Probable Cause: B+ low	1. Substitute V219 2. Check B+ line and associated components
Poor Horizontal Linearity	1. Check setting of horizontal-linearity control 2. Substitute V214 and V215 3. Check voltages, waveforms and components associated with V214 and V215
Poor Vertical Linearity	1. Check setting of vertical-linearity control 2. Substitute V212 3. Check voltages, waveforms and associated components of V212 and V206B
Sound Bars in Picture Probable Cause: Misalignment	1. Check fine tuning adjustment 2. Check video i-f alignment
Vertical Instability Probable Cause: Faulty vertical oscillator	1. Check setting of front panel vertical hold control 2. Substitute V206 and V212 3. Check voltages, waveforms and associated components of V206B and V212
Weak Picture	1. Substitute V204 2. Check voltages and components associated with V204

PICTURE AND SOUND

Symptom	Procedure
Overload in Picture — Buzz in Sound Probable Cause: Loss of a-g-c voltage	1. Check setting of the a-g-c potentiometer 2. Substitute V218, V201, V202 3. Check voltages, waveforms and components associated with V218
No Picture, No Sound, Brightness OK	1. Substitute V101, V102, V201, V202, V203, V211 and crystal detector 2. Check voltages on V101, V102, V201, V202, V203, V211 and speaker plug connection NOTE: The 135V source is the cathode of V211, the 2nd audio amp., therefore, a defective tube, speaker plug connection or output transformer will result in loss of the 135V
No Picture, No Sound, Low Brightness (brightness control set at maximum)	1. Substitute V204 2. Check voltages and components associated with V204

THE NEW MODEL RA-162B

The model RA-162B Teleset is a new version of the RA-162 which was introduced earlier this year. A number of new features have been included in the RA-162B to provide increased operating convenience and improved performance.

The RA-162B differs from the RA-162 as follows:

1. The 6BL7GT vertical oscillator and sweep amplifier tube (V306) has been replaced with two separate tubes. In the new circuit, a 6C4 (V309) is used in the vertical oscillator circuit and a 6AU5GT (V306) is used in the vertical output stage. The circuit is shown in Figure B-1.
2. V213, the 12AT7 sync-clipper has been replaced with a 6AB4.
3. C243 and C244 have been changed from mica to ceramic capacitors.
4. Two coils L215 and L218 have been added in the output of the ratio detector. L215 is connected between C243 and C245 while L218 is connected between the

DIRECTOR'S CORNER

BY

Harold J. Schulman

With this issue of the Service News we are putting into practice our determination to provide Service Information simultaneously with the introduction of a new line.

At the factory, the introduction of a new line is always an exciting event. Especially to those who are privileged to be in on its development from the moment of conception right up to the travail of birth.

The bright, new Telesets emerging for fall installation will once again show proof of Du Mont's policy of designing sets with the serviceman in mind.

We are well aware of the many problems presented to the service fraternity when a new Teleset is placed on the market.

You now have to learn the ins-and-outs of a new chassis. The parts placement, the circuit tricks, the voltages and resistances, and the individual idiosyncrasies are all part of the new information which a conscientious serviceman has to add to his store of knowledge.

Because we know what this means to the serviceman in terms of time and effort, we devote our full energies to simplifying and pre-digesting service information before we pass it on to you.

From the comments we have received on our recently published RA-160 Service Manual, we know that our efforts are worthwhile and we are encouraged to continue to create finer service information.

For the new RA-164-165, we are happy to present, in this issue of the Service News, the preliminary information you will require to properly install and service these sets. The circuit diagram to be supplied will give you once again, the cleanest, most useful schematic in the business.

In this issue you will also find preliminary information on the RA-162B which will enable you to familiarize yourself with this new Teleset before it reaches the market.

We hope that as you see more and more of our Service Publications, you will agree that Du Mont is also "First with the Finest" in servicing aids.

RA-162B (Cont.)

other end of C245 and C244.

5. The vertical-yoke damping resistors R501 and R502 have been changed from 390 ohms to 560 ohms. C501, the horizontal anti-ringing capacitor has been changed from 68 mmf to 82 mmf.
6. Molded paper capacitors are used for C219, C230, C236, C237 and C255 instead of wax-impregnated paper capacitors.
7. The TV-Phono switch has been located on the front panel behind the small door rather than on the rear of the signal chassis.

In addition to the above, two f-m traps have been included in the high-pass filter connected between the antenna terminals and the tuner input. Because these traps are not required in most areas, all receivers will be shipped with the f-m traps shorted out, to eliminate their slight insertion loss.

If f-m interference is encountered, the following procedure should be used:

1. Remove the signal chassis from the cabinet.
2. Remove the cover from the high-pass filter, Z208.
3. Clip the jumper wires connected across the f-m traps. The f-m traps are located between the high-pass filter and the transmission line from the antenna terminals of the receiver.
4. Replace the high-pass filter cover and mount the signal chassis in the cabinet.
5. Adjust the f-m trap slugs for minimum interference.

The RA-162 production changes described in the March-April and June 1952 issues of the Service News are incorporated in the RA-162B. A new schematic sheet covering the RA-160, the RA-162 and the RA-162B is being mailed with this issue of the Service News.

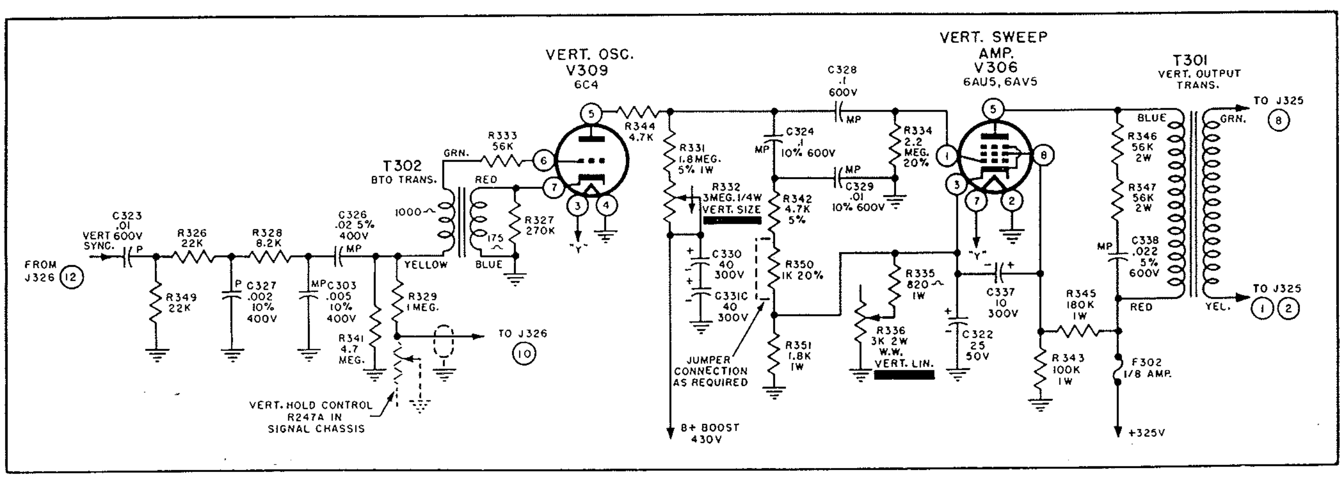


Figure B-1. RA-162B Vertical Output Circuit.

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PUBLICATION OF THE TELESET SERVICE CONTROL DEPARTMENT
ALLEN B. DU MONT LABORATORIES, INC., PATERSON, N. J.

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DIRECTOR'S CORNER

BY

Harold J. Schulman

So often we hear of servicemen, as individuals, companies or associations, belaboring manufacturers in general for not doing "enough" for the serviceman.

A manufacturer's reputation depends on the performance of his product in the field. Since an important requirement for superior performance is swift, efficient service when required, all reliable manufacturers attempt to develop favorable service conditions, in their own way.

A serviceman has the right to expect fast, accurate and pertinent service data on the receivers he services. He has a right to expect prompt local replacement of in-warranty parts. He has a right to expect parts to be available for purchase as required. He has a right to expect help from time to time when he is confronted with a problem that puzzles him. And finally, he has a right to sympathetic understanding on the part of the rest of the industry toward his various problems.

We believe that our organization is doing an outstanding job in implementing the rights listed above. We know we aren't perfect, but by and large you will have to look far to find anyone who gets service data out faster than we did on our latest chassis. Our distributors do a good job in supplying you with parts and technical assistance. And our field service representatives make regular visits to all our markets to assist in making Du Mont Service better service.

Now that we have agreed that servicemen have a right to expect certain things from a manufacturer we would like to point out that a manufacturer

(CONTINUED ON PAGE 64)

RA-164-165
CIRCUIT DESCRIPTION

The RA-164-165 r-f tuner is a 12-channel switch-turret type. It incorporates a 6BQ7 low noise cascode r-f amplifier and 300-ohm balanced input.

With the exception of the intermediate frequencies used the tuner is similar electrically and mechanically to the RA-162B tuner. You will find a complete description of the tuner circuitry in the RA-160-162 Service Manual.

Video I-F Stages

An intercarrier type i-f system is used in the RA-164-165, as shown in Figure R-1. The video i-f strip consists of three stagger-tuned stages, each of which uses a 6CB6 sharp cut-off pentode.

In a stagger-tuned i-f strip the bandpass of each i-f stage is narrower than the desired overall bandpass. To obtain the required overall video i-f response, successive coupling circuits are peaked at different frequencies. Hence the name stagger-tuned.

In the RA-164-165 chassis two video i-f coupling circuits (L110 and Z202) are peaked at 23.1 mc. The other two (Z201 and Z203) are peaked at 25.5 mc.

L201 - C202, in the coupling circuit between the mixer output and the first video i-f amplifier, is a parallel resonant trap tuned to 27.25 mc. The trap attenuates the lower adjacent-channel sound i-f carrier.

A-g-c voltage is applied to the first and second video i-f stages. To prevent their input capacity from changing with the a-g-c voltage (Miller effect) degenerative feedback is incorporated in the first and second video i-f amplifiers. The feedback is obtained by using unbypassed cathode resistors (R202 and R207). If the input capacities of these stages were permitted to change their grid circuits would be detuned when the a-g-c voltage changed.

Video Detector

A crystal is used in the video detector. The output of the third video i-f amplifier is applied to the cathode of the crystal. This provides a negative detected signal.

D-c coupling is used between the detector and the video amplifier. L202 and the 5 mmfd capacitor connected from the crystal to ground form a filter which attenuates the sound and video i-f signals. L203 provides high-frequency compensation. L204 is broadly self-resonant at 75 mc and acts as a parallel resonant trap to suppress radiation of the third video i-f harmonics generated in the video detector. Radiation of this harmonic would result in beat interference on channel 5.

Video Amplifier

A single 12BY7 video amplifier stage is employed as shown in Figure R-2. The amplifier is cathode biased by means of resistors R214, R218 and R290B. R290B is the contrast control. It permits variation of the amount of bias degeneration and hence the gain of the stage. R214 in combination with C219 provides some high-frequency compensation of the video amplifier.

The basic plate load of V204 is R221. L206 provides high-frequency compensation. D-c coupling is employed between the video amplifier and the CRT to eliminate the need for d-c restoration and to provide good low-frequency response. To further improve the low-frequency response a large screen bypass capacitor (C292C) is used. L209 is broadly self-resonant

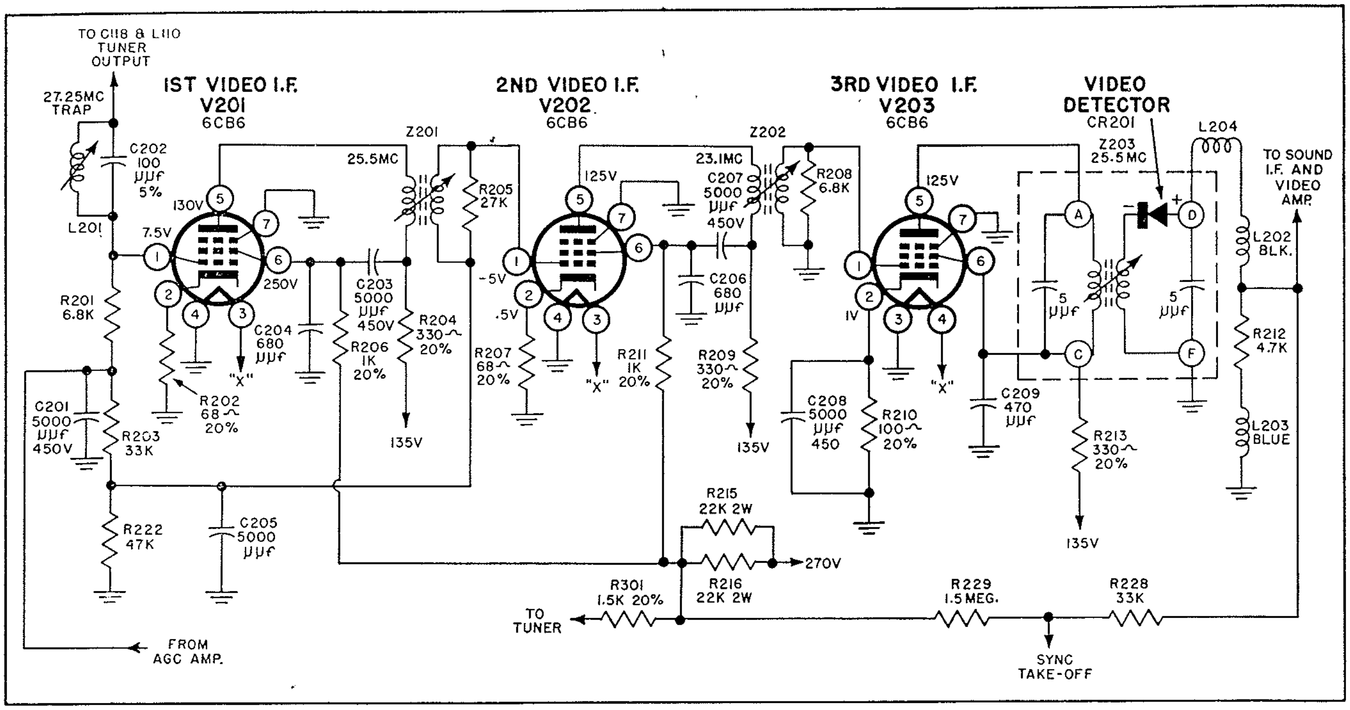

Figure R-1. Schematic diagram of the RA-164-165 video i-f and video detector stages.

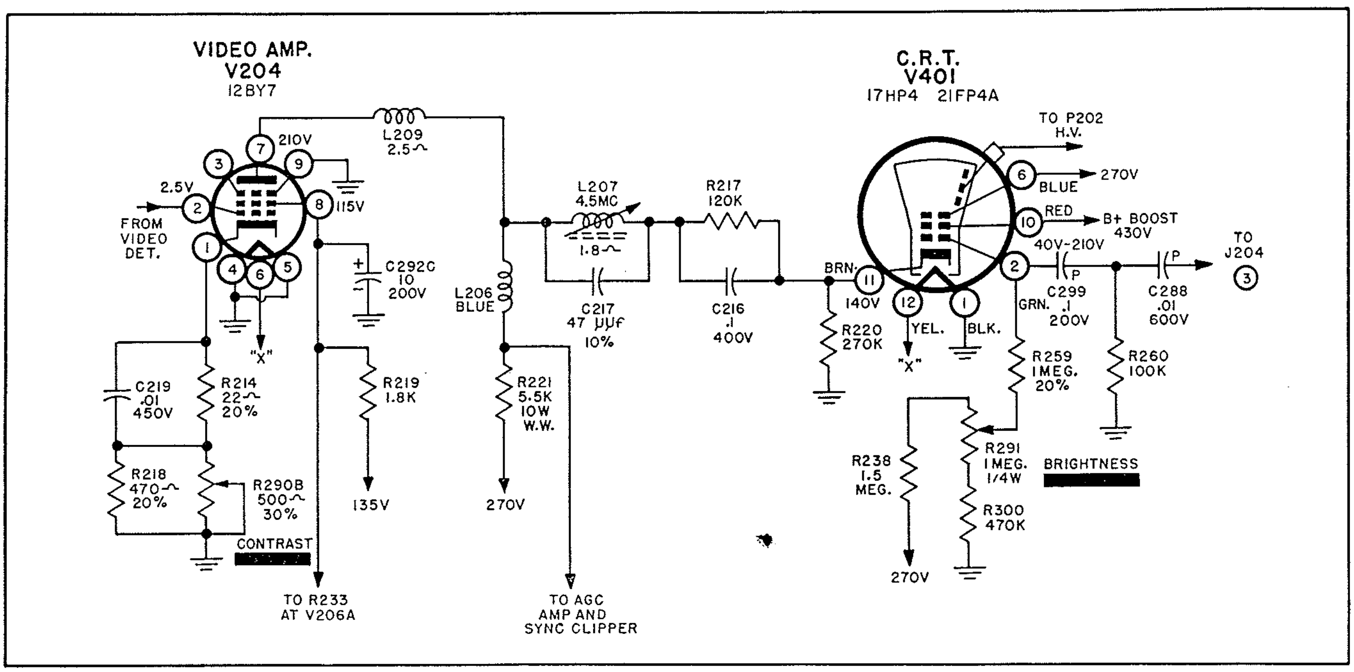

Figure R-2. The video amplifier and picture tube circuits.

at 75 mc and acts as a parallel resonant trap to suppress the third video i-f harmonic which is generated in the video detector. This harmonic falls in channel 5.

To prevent the 4.5 mc sound i-f signal from reaching the CRT a parallel resonant trap (L207 and C217) has been inserted in series with the output of the video amplifier, V204.

Because d-c coupling is used between the video amplifier and the CRT, the plate voltage of V204 is present at the cathode of the CRT. To reduce this voltage to a value within the rated heater-cathode potential of the CRT a voltage divider (R217 and R220) has been inserted in the coupling circuit.

The brightness control is located in the grid circuit of the CRT. R258; the brightness control R291 and R300 form a variable voltage divider network which applies a positive d-c voltage to the grid of the CRT. This positive voltage is less than the positive voltage on the cathode and the grid operates at a negative potential with respect to the cathode.

R259 is connected between the CRT grid and the center arm of the brightness potentiometer (R291), to prevent the CRT grid from drawing excessive current.

Du Mont Selfocus* Teletrons* are used in the RA-164 and the RA-165.

The RA-164 uses a 17HP4 while the RA-165 uses a 21FP4A. These CRT's differ from earlier Selfocus types in that the focusing anode is brought out to a base pin to which 270 volts is applied. In earlier types the focusing anode was tied internally to the cathode.

Sync Separator Circuits

The sync separator circuits of the RA-164-165 chassis consist of a first sync-clipper noise-eliminator stage (V205 in Figure R-3), and a second sync-clipper phase-inverter stage (V206A in Figure R-5).

The first sync clipper, V205, is a 6BE6 heptode. The composite-video signal is applied to the first and third grids. The signal on the first grid (pin 1) is negative and is obtained from the output of the video detector. The signal applied to the third grid (pin 7) is positive and is obtained from the output of the video amplifier. Thus, the signal on the third grid is 180° out of phase, and of considerably higher amplitude than the signal on first grid, as shown in Figure R-3.

The operation of the circuit is illustrated in Figure R-4. The signal on the first grid (A in figure) tends to produce a positive signal at the plate of V205; while the signal on the third grid (B in figure) tends to produce a negative signal at the plate of V205.

Because the amplitude of the signal on the third grid is much greater than that of the signal on the first grid, the effects of the signal at the first grid are cancelled and the plate signal is negative (C in figure).

The first grid is biased so that cut off occurs at a voltage just slightly more negative than the sync-tip amplitude. When a noise pulse whose amplitude exceeds the sync signal occurs, the first grid cuts off the tube. The noise pulse also appears on the third grid. However, since the tube is cut off by the action of the first grid, the noise pulse does not appear in the output of V205. Thus the stage eliminates noise that slightly exceeds the sync-tip amplitude.

Noise pulses that exceed the sync level, but that do not drive the first grid into cut off, appear in the output of V205. However, since most noise is of high enough amplitude to drive the first grid into cut off, the circuit is very effective.

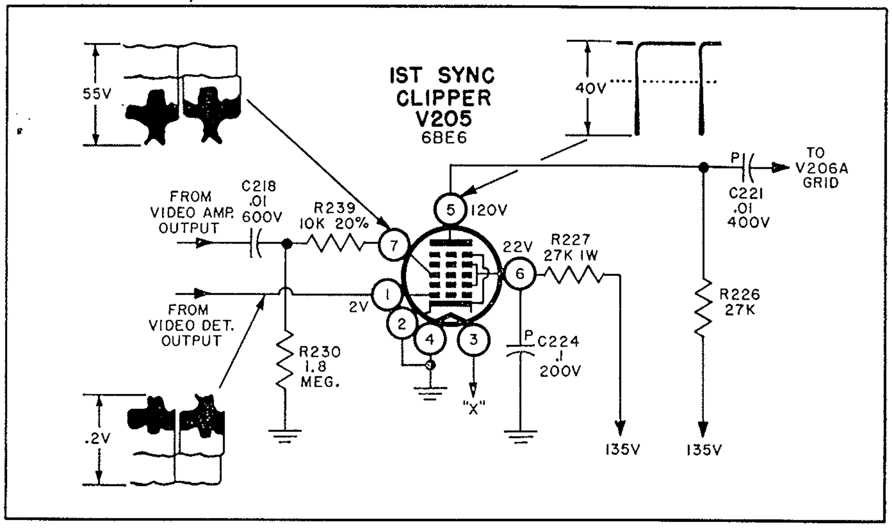

Figure R-3. The sync-clipper, noise-eliminator stage.

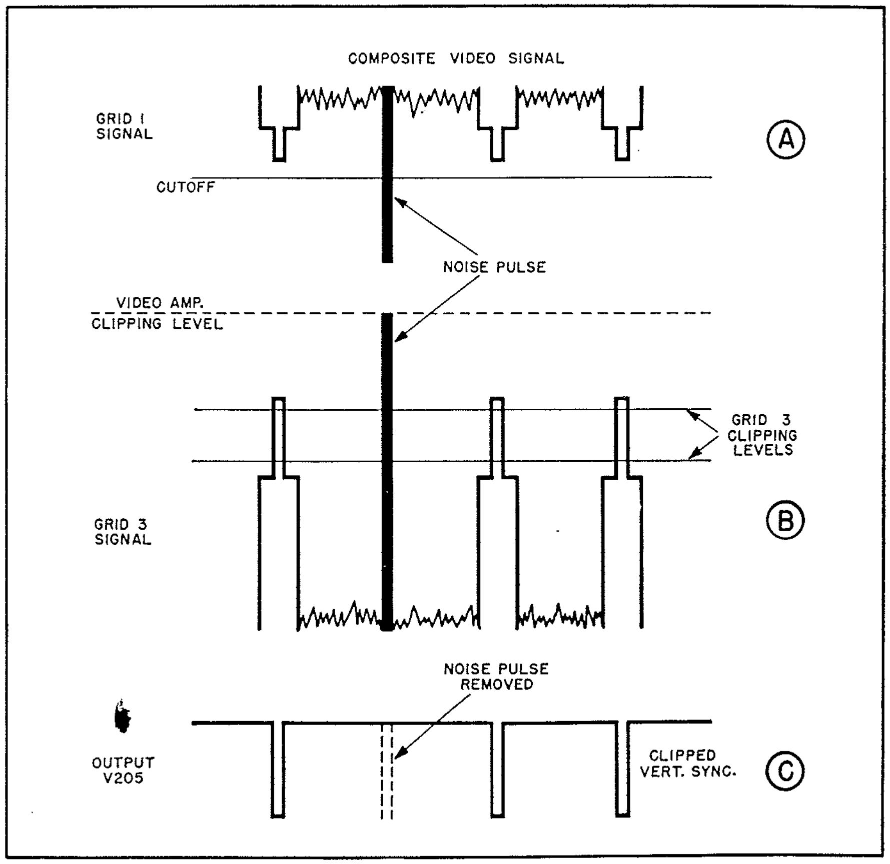

Figure R-4. Operation of the sync-clipper, noise-eliminator stage.

If a noise pulse is superimposed on the sync signal the action of the circuit will eliminate both the noise and the sync pulse. Since the sync-pulse interval is relatively short compared to the interval between pulses, this will not occur often. When sync pulses are lost the flywheel action of the horizontal oscillator keeps the oscillator in sync for a period equal to several sync pulses.

In addition to its noise elimination action V205 functions as a sync clipper. Negative clipping is accomplished through the use of a large resistance (R230 and R239) in the third grid circuit. The input signal is of suffi-

• Trade Mark

cient amplitude to drive this grid positive causing it to draw current and bias the tube beyond cut off.

Positive-clipping action is secured through the use of a low screen voltage which reduces the saturation point of the tube and permits the signal on the third grid to drive the tube to saturation.

Second Sync Clipper

The clipped sync pulses at the output of the V205 are applied to the grid of the second sync clipper (V206A) through coupling capacitor C221, as shown in Figure R-5. V206A is primarily a phase splitter. Its purpose is to provide out-of-phase sync signals of equal amplitude. These out-of-phase signals are required for operation of the phase detector which will be described later. Since the sync signal at the grid of V206A is negative, a positive sync signal appears at its plate. V206A's cathode resistor is not bypassed and a negative signal appears at the cathode.

The component values in the circuit have been chosen so that the plate and cathode output signals are of equal amplitude.

Horizontal Phase Detector

A phase detector circuit is used in the RA-164-165 to provide automatic frequency control of the horizontal oscillator as shown in Figure R-5.

The phase detector circuit compares the horizontal-oscillator output signal with the incoming horizontal-sync pulses. When their frequencies differ it produces a control voltage that is applied to the horizontal oscillator to bring it back in step with the sync pulses.

The positive sync signal at the plate of the second sync clipper (V206A) is applied to the plate of the upper diode, D1. The negative sync signal at the cathode of V206A is applied to the cathode of the lower diode, D2. The component values in the second sync clipper have been chosen so that the negative and positive sync signals are of equal amplitude.

A reference signal, obtained from the deflection yoke, is applied to the cathode of D1 and the plate of D2. These elements are tied together.

The reference signal is an inverted sawtooth as shown in Figure R-5. Since this signal is the amplified output of the horizontal oscillator it is suitable for use as a reference voltage for comparison of the oscillator- and sync-signal frequencies.

To clarify the operation of the phase detector assume that the sync signal is present but the sawtooth is not.

Referring to Figure R-5 the positive sync pulses on the plate (pin 7) of D1 produces a current through the circuit as indicated by the dotted arrows. The negative sync pulse on the cathode (pin 5) of D2 also produces a current, as indicated by the solid arrows. Since the cathode of D1 (pin 1) and the plate of D2 (pin 2) are both at zero potential, and the negative and positive sync pulses are of equal amplitude, both currents are equal.

Note that these currents flow through R240 in opposite directions and thus do not produce a drop across the resistor.

Now let's examine the circuit when the sawtooth is present. Three conditions occur as shown in Figure R-6.

In "A" the sync-and-sawtooth signal frequencies are equal and the sync pulse occurs at the instant the sawtooth is passing through zero. At this instant the plate (pin 7) of D1 is 5 volts positive and the cathode of D2 (pin 5) is 5 volts negative. Since the cathode (pin 1) of D1 and the plate (pin 2) of D2 are at zero potential the voltages across both diodes are the same; the currents through R240 are equal and opposite; and the voltage drop across R240 is zero.

In Figure R-6B the horizontal oscillator is running too fast. Note that at the instant the sync pulse occurs, the sawtooth is passing through +2 volts. As in condition "A" the plate (pin 7) of D1 is 5 volts positive and the cathode (pin 5) of D2 is 5 volts negative. However, the cathode (pin 1) of D1 and the plate (pin 2) of D2 are now 2 volts positive. This gives a total drop across D1 of 3 volts and a total drop across D2 of 7 volts. Consequently, the current through D2 is greater than the current through D1; and the resultant current through R240 is from the grounded end to the ungrounded end, producing a positive voltage at point A in Figure R-5. This voltage is the positive control voltage applied to the horizontal oscillator to reduce its frequency.

In Figure R-6C the horizontal oscillator is running slow and at the instant the sync pulse occurs, the sawtooth is passing through 2 volts negative. The plate (pin 7) of D1 is again 5 volts positive and the cathode (pin 5) of D2 is 5 volts negative. However, the cathode (pin 1) of D1 and the plate (pin 2) of D2 are now 2 volts negative. This results in a 7 volt drop across D1 and a 3 volt drop across D2. The current through D1 is now greater and the resultant current through R240 is from the ungrounded to the grounded end, causing point A

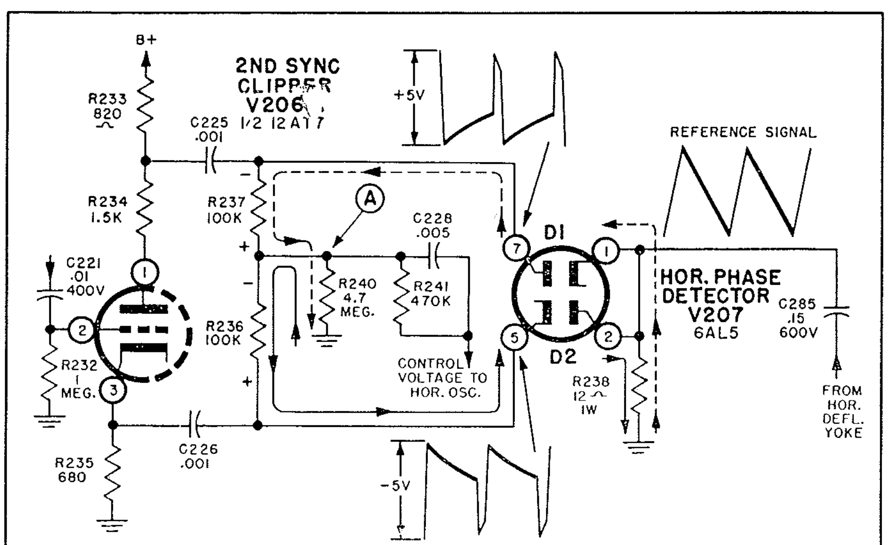

Figure R-5. Schematic diagram of the 2nd sync-clipper and horizontal-phase-detector stages.

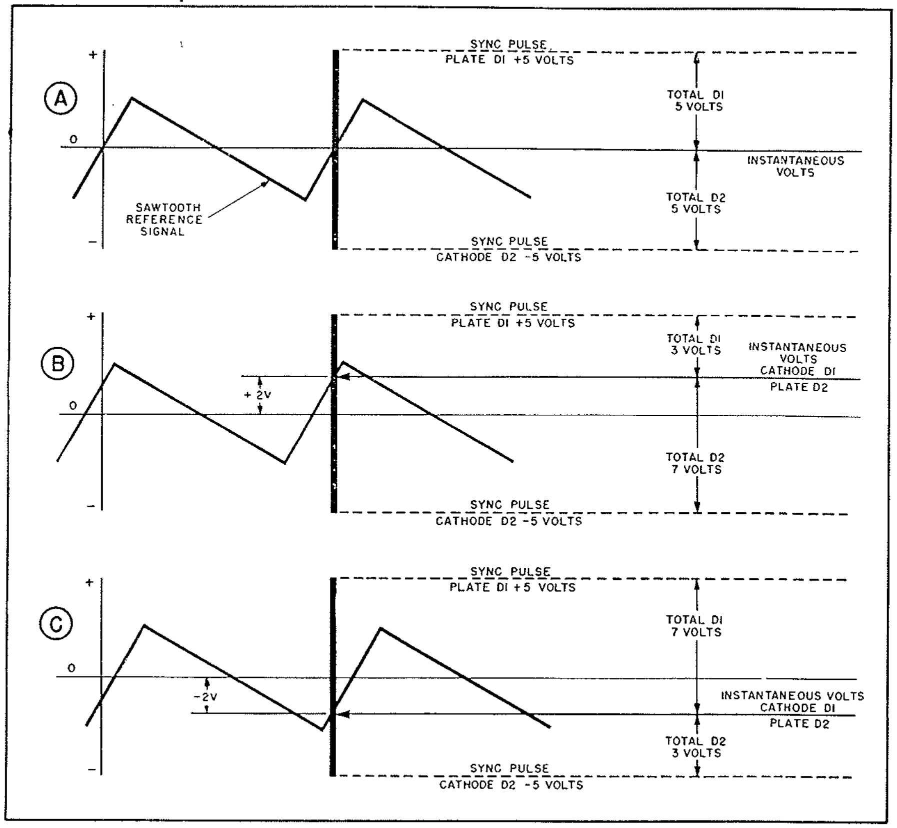

Figure R-6. Operation of the horizontal phase detector.

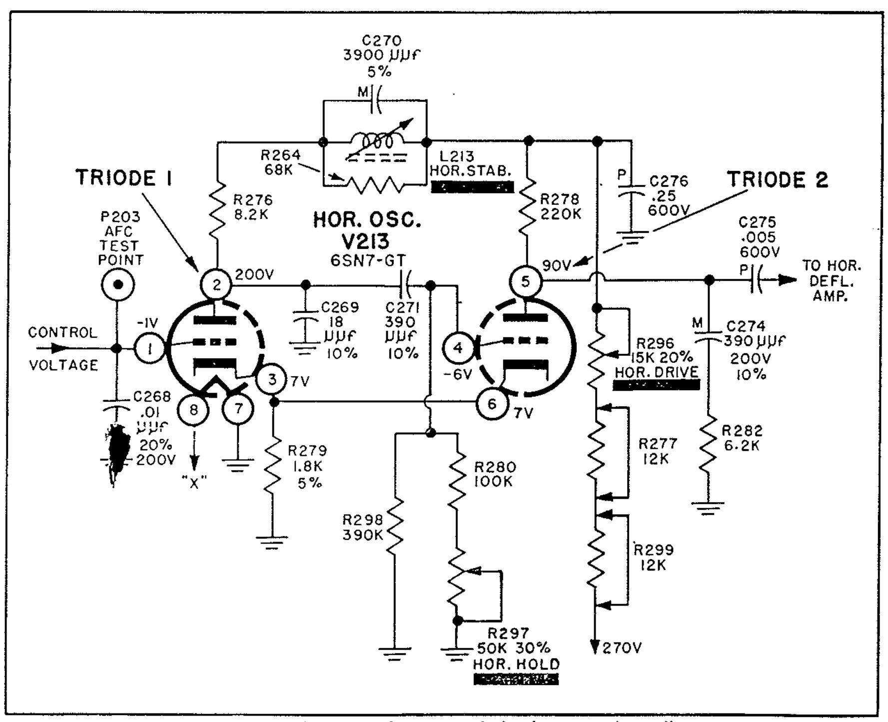

Figure R-7. Schematic diagram of the horizontal oscillator.

in Figure R-5 to become negative. This negative voltage is applied to the horizontal oscillator, through R241 and C228, to increase the oscillator frequency.

Thus the phase detector produces a positive correction voltage when the horizontal oscillator frequency is too high, and a negative correction voltage when the oscillator frequency is too low. This correction voltage is applied to the oscillator stage to bring it back in step with the sync signal.

In the foregoing discussion of the phase detector it has been assumed that the circuit is exactly balanced and that no correction voltage is developed when the horizontal oscillator is in sync. The actual circuit produces a small voltage when the oscillator frequency is correct. The oscillator is adjusted to operate at the proper frequency with this voltage present.

The output of the phase detector is coupled to the horizontal oscillator through an RC network consisting of C228, R241, and C268. The network eliminates sudden changes in correction voltage when noise pulses reach the phase detector, or when sync pulses are eliminated by the action of the first sync clipper, as previously described. In this way a flywheel effect is achieved and the oscillator remains in sync even though one or two sync pulses are lost.

Horizontal Oscillator Circuit

The horizontal oscillator circuit in the RA-164-165 is a stabilized cathode-coupled multivibrator, as shown in Figure R-7.

The basic purpose of the multivibrator is to act as a switch which opens and closes at the horizontal-sync frequency rate. This function is illustrated in Figure R-8.

Switch "S" represents the horizontal oscillator. S is normally open and C274 charges through RT and R282, producing an output voltage which rises in a linear fashion as shown at A. The path of the charging current is indicated by the solid arrows.

When S is closed C274 discharges through the path indicated by the dotted arrows. Since S, when closed, connects the upper end of C274 directly to ground, the discharge is very rapid as indicated on the right of the figure. The slight negative peak in the output signal is produced by the drop across R282.

By opening and closing S in step with the horizontal sync pulse a synchronized sawtooth-sweep signal is produced.

In the RA-164-165, triode II performs the function of the switch. It is alternately opened (cut off) and closed (permitted to conduct) by the action of the complete oscillator circuit.

The oscillator is fundamentally a

two stage resistance coupled amplifier with feedback provided by a common cathode resistor.

A simplified schematic of the circuit is shown in Figure R-9.

When B+ is applied to the circuit the following action takes place:

1. C3 charges rapidly. The charging current of C3 flows through R3 (in the direction indicated by arrow) causing the grid of V2 to become positive.

2. This causes V2 to draw a large current through R1, biasing V1 beyond cut off and permitting the plate voltage of V1 to rise to the B+ supply voltage. The above condition is reached almost instantaneously.

3. As C3 charges to the B+ supply voltage the current through R3 decreases exponentially, decreasing the voltage on the grid of V2.

4. This causes a reduction in the current through V2 and R1, reducing the bias on V1. The process continues until V1 comes out of cut off.

5. As V1 conducts its plate voltage decreases, reducing the voltage across C3 and allowing the capacitor to discharge.

6. The discharge current of C3 flows through R3 causing the grid of V2 to become negative.

7. This decreases the current through V2 and R1; the drop across R1; and the bias on V1.

8. As a result the current through V1 is increased; the plate voltage of V1 is reduced; and C3 continues to discharge through R3 making the grid of V2 more negative. This process continues until V2 is driven into cut off. Steps 5 through 8 occur almost instantaneously.

9. When V2 is cut off there is no further reduction in current through the tube or R1. Thus the bias and plate current of V1 remain constant.

10. The circuit remains stable under these conditions for a considerable length of time. V1 is conducting heavily, V2 is cut off, and the discharge current through C3 is decreasing at an exponential rate.

11. The discharge current through C3 continues to decrease until the drop across R3 is not great enough to keep V2 cut off. V2 then begins to conduct.

12. The current through V2 increases the current through R1 and the bias on V1, reducing the current through V1.

13. This increases the plate voltage of V1 causing C3 to charge through R3 and the cycle begins again, as in step 1.

During the cut off period of V2, C4 charges through R4 and R5 producing the rising portion of the sawtooth waveform. When V2 conducts C4 discharges through R5 and V2 to form the retrace portion of the waveform.

The waveform at the grid of V2 is shown in Figure R-9. The cut off period of V2 is determined by the discharge rate of C3. The conduction period is determined by the charging rate of C3. The reason that the cut off period is much longer than the conduction period is explained below with reference to Figure R-10.

As mentioned during the previous discussion of the circuit, V2 is cut off by the current through R3, produced when C3 discharges. The circuit through which C3 discharges is shown in Figure R-10A.

V2 is brought out of cut off by the charging current of C3 through R3. The circuit through which C3 charges is shown in Figure R-10B.

The grid of V2 is positive during the charging period, and the grid-to-cathode resistance of V2 acts as a shunting resistance (in series with R1) across R3. If we assume that the grid-to-cathode resistance of V2 is 5K ohms, then the total resistance in series with C3 will be approximately 16,500 ohms.

During the discharge period the grid of V2 is negative; the grid-to-cathode resistance of V2 is infinite and does not affect the circuit. However V1 is conducting, permitting C3 to discharge through this tube. Assuming V1 has a plate-to-cathode resistance of 5K ohms, the total resistance in the discharge circuit will be 107K ohms.

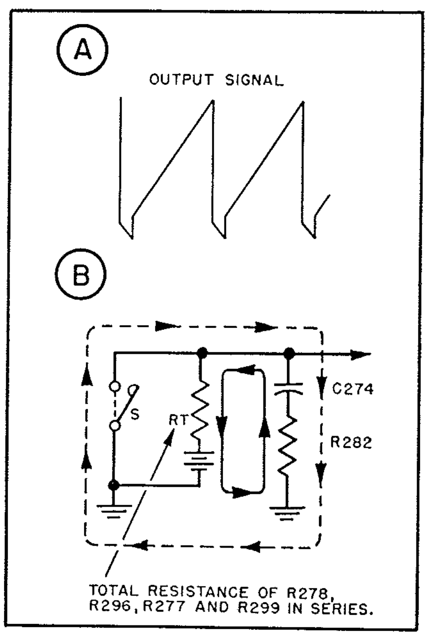

Figure R-8. Mechanical sawtooth generator.

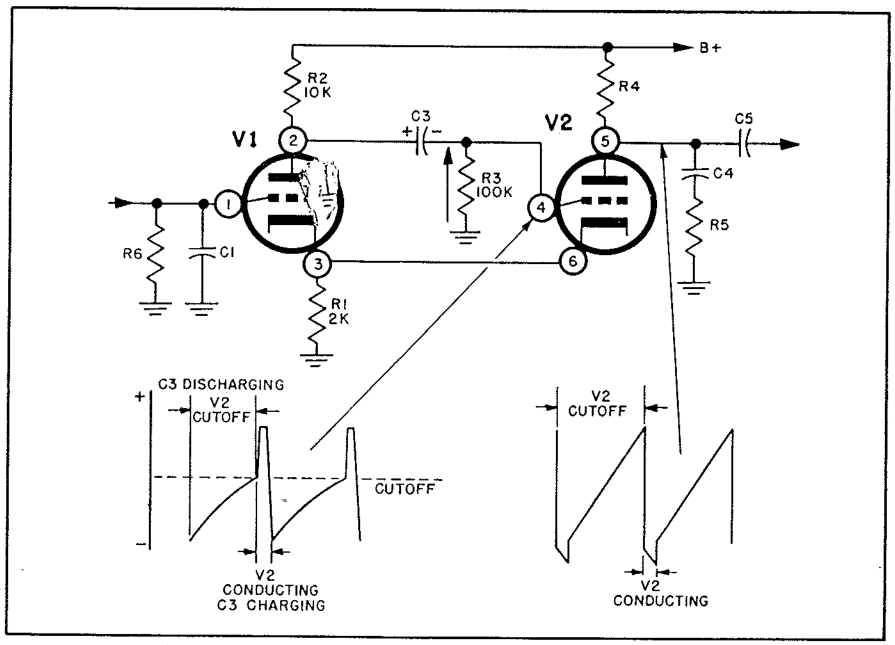

Figure R-9. Simplified diagram of the horizontal oscillator.

Since the resistance in the charging circuit is approximately 16,500 ohms and the discharging circuit resistance is 107K ohms, the discharge period will be several times the charging period.

Frequency Control

The operating frequency of the multivibrator can be controlled by the application of a d-c voltage to the grid of V1.

If a positive voltage is applied to the grid of V1, the plate-to-cathode resistance of the tube is reduced. As a result C3 discharges more rapidly; V2 is permitted to come out of cut off sooner; and the oscillator frequency increases.

If a negative voltage is applied to the grid of V1, the plate-to-cathode resistance of the tube is increased; C3 discharges more slowly; V2 remains cut off longer; and the frequency of the oscillator is reduced.

Referring now to figure R-7 we can compare the simplified multivibrator circuit to the RA-164 horizontal oscillator. In the RA-164 circuit R3 is replaced with a variable resistance network. Rotation of potentiometer R297 changes the time constant of the coupling circuit and the operating frequency of the oscillator.

To permit adjustment of the amplitude of the sawtooth output signal a variable resistance (R296) is placed in series with the B+ supply. R277 and R299 may be shorted out when the Teleset is shipped. By removing or replacing the jumpers across one or both of these resistors the technician can change the amplitude of the sawtooth if R296 does not provide sufficient range.

C270, L213 and R264 form a resonant circuit whose purpose is to improve the stability of the oscillator. When a pulse is applied to such a circuit, energy is absorbed by the circuit. This energy oscillates between the electromagnetic and the electrostatic fields of the resonant circuit, producing a voltage across the circuit similar to that shown in Figure R-11A. The striking of a bell with a hammer is analogous to the application of the pulse to the resonant circuit. The oscillations in the resonant circuit will gradually fade away, as does the sound of a bell

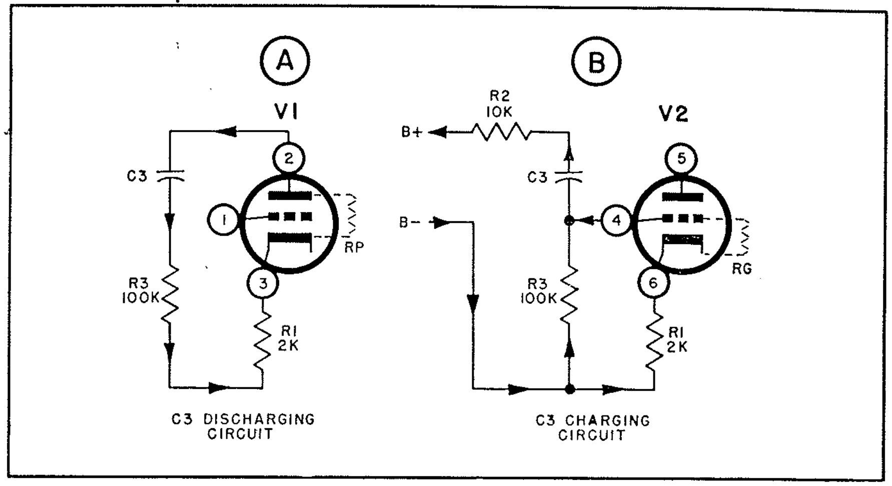

Figure R-10. Charge and discharge circuits of a cathode coupled multivibrator.

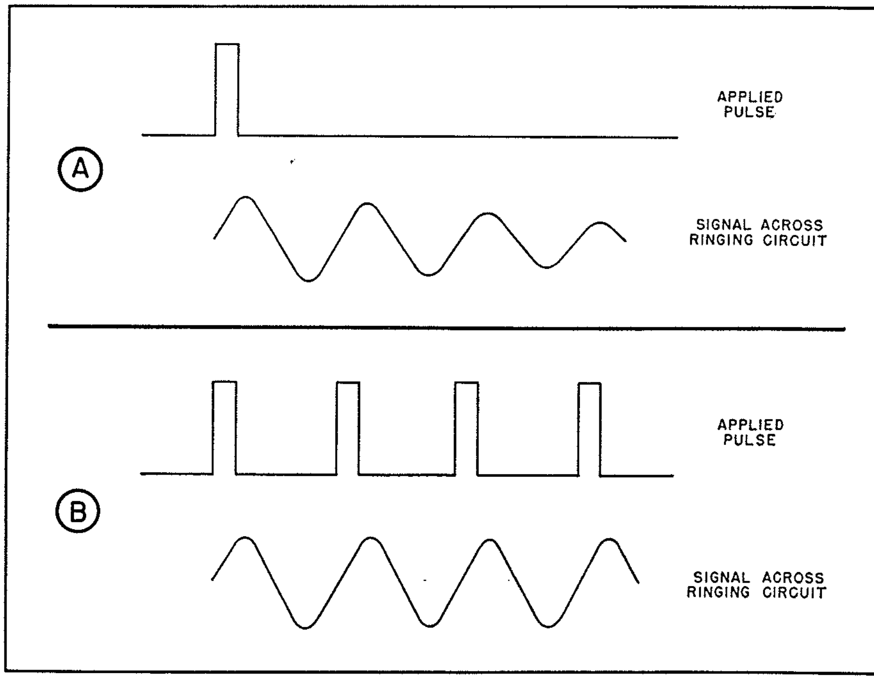

Figure R-11. Operation of a ringing circuit.

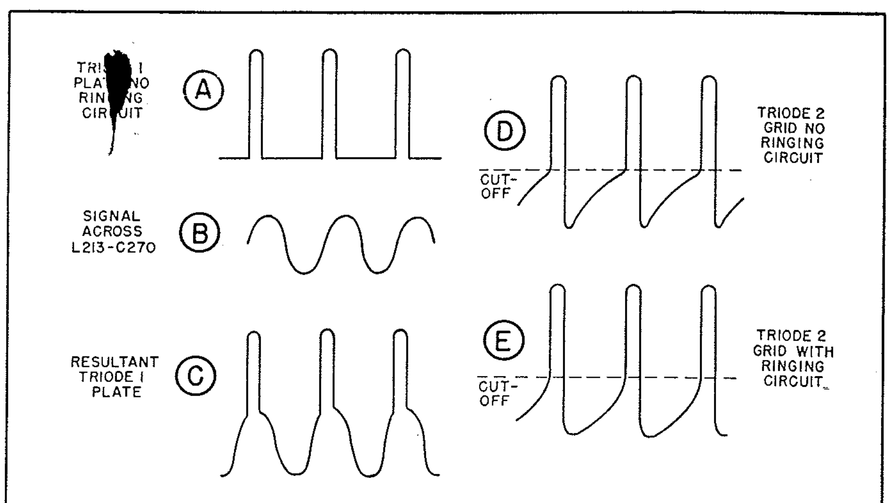

Figure R-12. Multivibrator waveforms with and without a ringing circuit.

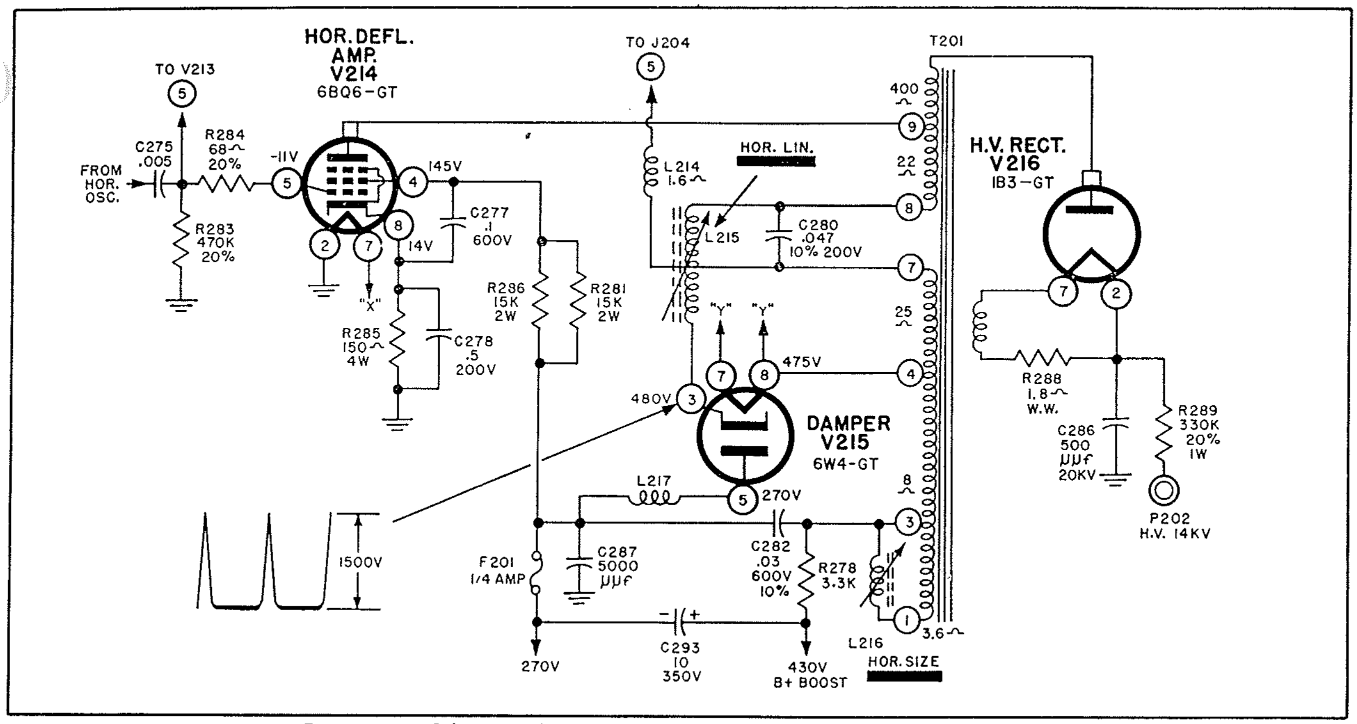

Figure R-13. Schematic diagram of the RA-164-165 horizontal-deflection circuit.

after it has been struck. Thus, the circuit is called a "ringing circuit."

If a continuous series of pulses are applied to the circuit, instead of a single pulse, the circuit will continue to oscillate, as shown in Figure R-11B. This is done in the RA-164 horizontal oscillator.

Part of the 15,750 cycle pulse at the plate of triode I (Figure R-7) appears across the resonant circuit formed by C270 and L213, shock exciting the circuit into oscillation.

The purpose of the ringing circuit is shown in Figure R-12. A shows the signal which would be present at the plate of triode I (Figure R-7) if the ringing circuit were not used. B shows the signal produced by the ringing circuit. C is the resultant signal at the plate of triode I.

D is the signal of the grid of triode II when the ringing circuit is not used and E is the grid signal with the ringing circuit.

As shown in C the normal plate pulse of triode I is superimposed on the sine wave produced by the ringing circuit. This results in a change in the waveform at the grid of triode II. It is this change in waveform that is important. Note that as the grid signal (D in figure) approaches cut off it is very close to cut off for an appreciable part of the cycle. If during this period the circuit is disturbed by noise, line-voltage variations, etc., the grid may be driven out of cut off prematurely, causing poor oscillator stability.

The addition of the ringing circuit to the oscillator changes the grid signal waveform (E in figure) so that the signal approaches the cut off triode II more sharply. Thus, disturbances which occur just prior to the normal triggering time cannot trigger triode II, unless they are of comparatively high amplitude.

In addition to its stabilizing effect the ringing circuit has considerable effect on the oscillator frequency. For this reason L213 has been made variable so that it may be used to set the oscillator frequency. As previously mentioned, R297 is also an oscillator frequency control. Its range is much less than that of L213 and it serves as a front panel horizontal hold control.

Horizontal Deflection Amplifier and High-Voltage Supply

The 15,750-cycle sawtooth signal generated in the output of the horizontal oscillator (V213) is applied to the grid of the horizontal deflection amplifier (V214) through coupling capacitor C275, shown in Figure R-13.

A flyback type high-voltage supply is used. The output of the rectifier is filtered by C286 and R289, providing a 14-kv CRT anode voltage.

For a more detailed description of the horizontal output and high-voltage-supply refer to the RA-160-162 Service Manual.

In the next issue the vertical sweep and A-G-C circuits will be covered.

DIRECTOR'S CORNER (Cont'd)

also expects certain loyalties — from servicemen. The manufacturer expects the serviceman to read and digest the service information so painstakingly prepared. The manufacturer has a right to expect the serviceman to render prompt, efficient and honest service on his product. The manufacturer hopes the serviceman will understand some of his problems too. For instance, none of us likes paper work — but without it how does a manufacturer limit his legitimate liability on replacement parts?

At Du Mont we have a healthy respect for the talents, problems and integrity of the service fraternity. Mutual respect can go a long way in solving our industry problems. Reckless finger pointing gets us nowhere. Constructive suggestions will always find a ready and willing ear in this office.

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Service News

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DIRECTOR'S CORNER

BY

Harold J. Schulman

The freeze is off and the heat's on. In Denver and Portland the industry has already demonstrated its capacity to move with electron speed.

To many of us television has become such a commonplace, that we have forgotten what our living rooms looked like before Hopalong Cassidy and Captain Video moved in. But to the hundreds of thousands in newly opened markets television has all the novelty, the thrills, the mystery and the pleasure of a new born baby.

On a number of occasions while visiting the hectic Denver area last month, I had the strange feeling that it was 1948 all over again. As you may recall that was television's first big year.

Faced with the problem of learning to live with the new arrival, everyone in Denver was crying for information about television. The dealers wanted to know *how* to service receivers, while the consumers wanted to know *why* the receivers needed service in the first place.

For the dealers and service men we set up a school, run by our ace instructor Pete Buttacavoli. For the consumers, it wasn't that easy.

The question of consumer enlightenment and acceptance of service is a problem all over the country, especially in new areas. A survey of the complaints received at the factory reveals that up to 80% of the consumer complaints center around some customers' inability, or perhaps unwillingness, to accept the fact that those complex electronic instruments known as television receivers require service from time to time.

(CONTINUED ON PAGE 71)

RA-164-165

CIRCUIT DESCRIPTION

PART II

Keyed a-g-c is employed in the RA-164-165 chassis.

The composite video signal developed across R221 (Figure R-2, September issue) is applied to the grid of the a-g-c amplifier (V218) through R224, as shown in Figure R-14. V218 is a 6AU6 sharp cut off pentode.

Since a coupling capacitor is not used between the video-amplifier plate circuit and the grid of V218, the video-amplifier plate voltage appears at V218's grid, making the grid positive.

A positive d-c potential is applied to the cathode of V218 through R231, which is returned to the 135-volt line. Under normal operating conditions the positive cathode voltage is greater than the positive grid voltage and the grid is negatively biased.

The composite-video signal on the grid is positive. The grid is biased sufficiently beyond cut off so that only the sync pulses drive the grid out of cut off.

A positive pulse, obtained from terminal 4 of the horizontal-output transformer, is applied to the plate of V218. This pulse occurs at the same time as the sync pulse and causes the tube to conduct.

As a result a negative voltage is developed at the plate of V218. This negative voltage appears across R223 and R222, assuming that S202 is open. That portion of the negative voltage which appears across R222 is the a-g-c voltage.

The negative voltage across R222 is applied to the second video i-f stage. R223 and C212 serve as a filter which removes the pulse component from the a-g-c voltage.

A detailed discussion of the manner in which the a-g-c amplifier operates

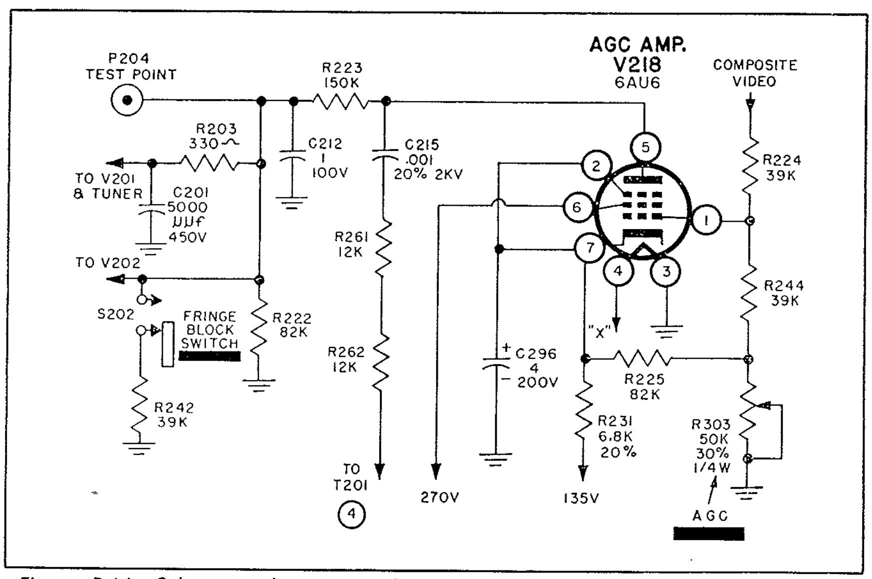

Figure R-14. Schematic diagram of the RA-164-165 a-g-c circuit. A positive pulse obtained from terminal 4 of T201, the horizontal-output transformer, is applied to R262. The Fringe Block switch is shown in its Normal position.

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follows. While reading it pay particular attention to Figure R-15. The circuit in Figure R-15A is a simplified version of the a-g-c circuit. Note that V218 is shown as a diode. If we assume that the grid has a constant bias of less than cut-off value, the tube will conduct whenever its plate is positive. Under these conditions the grid may be disregarded because V218 will act as a diode.

After the circuit has been in operation for a period equal to several cycles the conditions illustrated in Figure R-15 will exist. B shows the waveform at the plate of V218. C shows the voltage waveform across capacitor C215. D is the flyback pulse applied between the input side of C215 and ground.

Referring to point "1" in Figure R-15 B, C, and D, note that C215 is charged to 100 volts with the polarity indicated in Figure R-15A, and that the instantaneous plate voltage of V218 is 100-volts negative.

When the applied flyback pulse rises to 300-volts positive (points 1 to 2) the instantaneous voltage at the plate of V218 becomes 200-volts positive. For the duration of the applied pulse (points 2 to 3) V218 conducts, charging C215.

Assuming that the time constant of the charging path (plate-to-cathode resistance of V218 and C215) is such that C215 accumulates an additional charge of 50 volts (total of 150 volts) the plate of V218 will be +150 volts at point 3.

At this instant the applied pulse voltage falls to zero (points 3 to 4).

Since C215 cannot change its charge instantaneously, the voltage at the plate of V218 drops 300 volts to −150 volts.

The plate of V218 is now negative and the tube cannot conduct, therefore C215 must discharge through R223 and R222. Assuming that the time constant of the discharge circuit is such that C215 discharges 50 volts in the interval between flyback pulses (points 4 to 5), the drop across the resistors will cause the plate of V218 to be −100 volts at point 5.

Now the instantaneous applied voltage rises 300 volts, the plate of V218 becomes 200-volts positive, and the tube conducts replacing the 50 volt charge on C215 which was lost during interval 4-5.

This process continues as each flyback pulse occurs. As long as the applied pulse is of the same amplitude, and the charging and discharging time constants remain unchanged, the plate potential of V218 will continue to alternate between −150 volts and +200 volts.

In addition to providing a discharge path for C215; R223 and R222 act as a voltage divider. The portion of the plate signal of V218 which appears across R222 is the a-g-c voltage. The addition of C212 provides a filtering action. When the pulse occurs on the plate of V218, C212 charges. During the interval between pulses C212 discharges through R222 maintaining a constant potential across the resistor. This potential is equal to the average value of that portion of V218's plate signal which appears across R222.

The average value of the plate signal is negative, therefore the a-g-c voltage is negative.

It should be noted that in the previous discussion C215 charged through V218; while it discharged through R223 and R222. If V218 were a diode, as we assumed, the a-g-c voltage would remain constant.

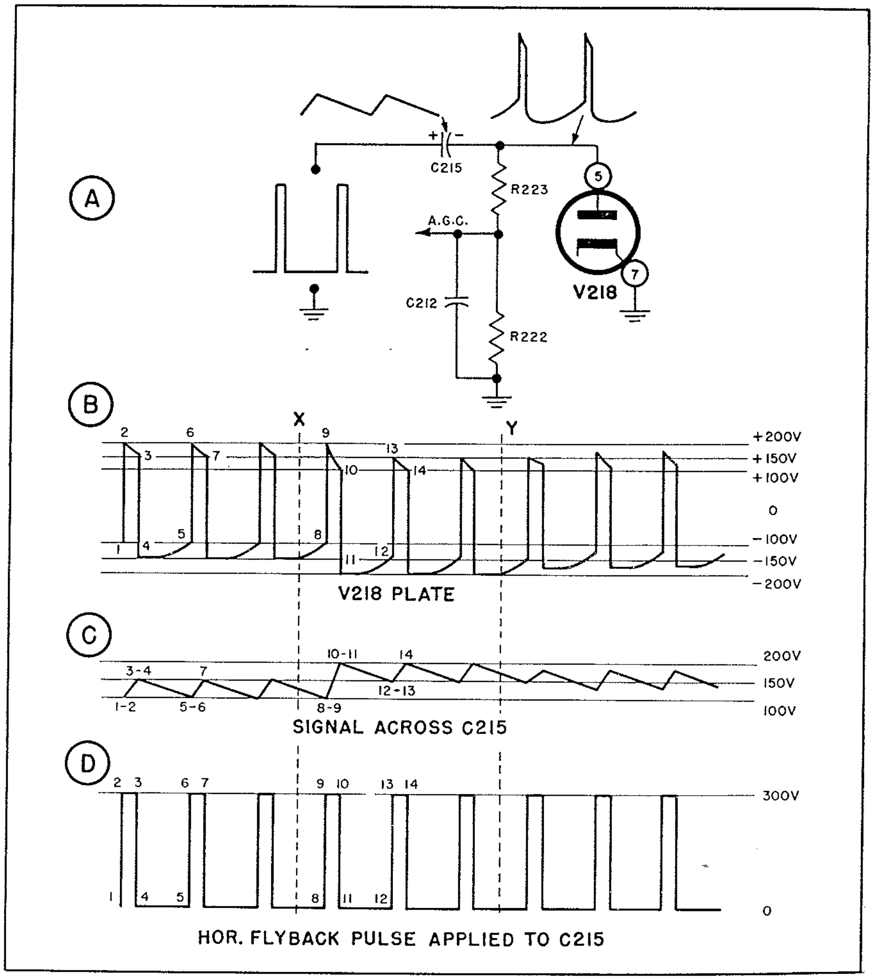

Figure R-15. Operation of the a-g-c amplifier.

Since V218 is actually a triode (see Figure R-14) the grid voltage has an effect upon the operation of the circuit. If the grid voltage of V218 is increased its plate-to-cathode resistance will decrease. This will shorten the time constant of the charging path. The portion of Figure R-15 between dotted lines X and Y illustrates what occurs.

When the instantaneous flyback pulse voltage rises from 0 to +300 volts (points 8 to 9), the plate of V218 becomes 200 volts positive as in the previous explanation, and C215 charges through the tube. Previously the time constant of the charging circuit was such that C215 charged 50 volts during the pulse (points 9 to 10, equal to 2 to 3).

If we assume that the increase in V218's grid voltage is such that the time constant of the charging path is reduced enough to permit C215 to charge 100 volts during interval 9-10, then C215 will be charged to 200 volts at point 10. The plate voltage of V218 will be reduced a like amount to +100 volts – as compared to +150 volts in the previous description (point 3). Now when the applied pulse falls to zero (points 10 to 11), the plate of V218 becomes 200-volts negative. Since the discharge path remains unchanged, approximately 50 volts of the charge on C215 is dissipated in the interval between pulses (points 11 to 12). When the applied signal again rises to +300 volts (points 12 to 13) the plate of V218 becomes 150 volts positive. Note that the plate potential of V218 is now alternating between +150 volts and –200 volts, instead of between +200 volts and –150 volts. The average voltage of the signal has thus become more negative.

Decreasing the voltage on the grid of V218 will cause its average plate voltage to become less negative, as illustrated in the portion of Figure R-15 on the right of dotted line Y.

In this manner an increase in the voltage at the grid of V218 causes the a-g-c to become more negative; while a decrease in the grid voltage causes the a-g-c voltage to become less negative.

As noted at the beginning of this discussion the signal at the grid of V218 is a positive composite-video signal. The grid is biased so that only the sync pulses drive the tube out of cut off. The grid bias of V218 is determined by the setting of the a-g-c control R303. Under normal operating conditions the sync pulse occurs at the same time as the horizontal pulse applied to C215. Thus the sync-pulse amplitude determines the grid voltage of V218 during the interval the tube is conducting.

Fringe Block Switch

One of the advantages of this circuit is that noise pulses which occur in the interval between sync pulses will not develop a-g-c voltage. Between sync pulses the plate of V218 is negative and the noise does not appear in its output. As a result the a-g-c circuit is comparatively immune to noise.

However in weak signal areas the noise immunity of the receiver can be improved by reducing the ability of noise to produce a-g-c voltage.

This is accomplished by the addition of S202 and R242. Under noisy weak signal conditions S202 is closed placing R242 is parallel with R222. The combined resistance of R222 and R242 is approximately 26K or 1/3 R222 alone.

As a result the maximum a-g-c voltage which can be developed with S202 closed is approximately 1/3 that with S202 open. This provides sufficient a-g-c range for weak signal reception yet reduces the amplitude of the a-g-c voltage developed by noise. Consequently, the noise immunity of the a-g-c circuit is increased when S202 is closed.

Note that S202 must be open in strong signal areas to enable the receiver to develop enough a-g-c voltage to prevent overload.

It should be noted that normal a-g-c voltage will not be developed unless the flyback pulse occurs at the same time as the sync pulse. For this reason this type of a-g-c system is referred to as a "coincident" system. It is important to keep this point in mind when servicing the RA-164-165 chassis. Do not expect to find the proper a-g-c voltage when the horizontal sweep circuits are out of sync.

Vertical Sweep Circuits

The vertical sweep circuits of the RA-164-165 consist of a three section integrating network, and a multivibrator circuit that performs the dual function of vertical-sweep generator and deflection amplifier.

The clipped composite-sync signal at the plate of the second sync clipper (V206A) is applied to the vertical integrating network as shown in Figure R-16. The vertical sync pulse at the output of the network is used to trigger the vertical oscillator.

The vertical oscillator is a modified multivibrator circuit. This circuit requires two triode tubes. One triode (V206B) is half of a 12AT7 twin triode. The other is a 6S4 which serves as part of the oscillator and as the deflection amplifier.

The operation of this circuit is basically the same as that of the horizontal oscillator covered in the September issue, except for the method used to secure the necessary feedback.

In the horizontal oscillator the feedback was provided by a common cathode resistor. In the vertical oscillator it is provided by an RC network connected between the grid of V206B and the plate of V212.

The output voltage waveform required for linear vertical sweep is a trapezoid as shown at the plate of V212 in Figure R-16B.

Figure R-16A is a simplified schematic of an unbalanced multivibrator in which V2 conducts for a longer period than V1. This is accomplished by making the time constant of C1-R1 longer than that of C2-R2.

This circuit is basically the same as the RA-164-165 vertical oscillator shown in Figure R-16B.

As previously mentioned a trapezoid waveform is required for linear vertical sweep. This waveform is obtained by the addition of C260 and R272. In the normal unbalanced multivibrator of Figure R-16A the waveform at the plate of V1 is a negative pulse. The addition of C260 and R272 changes the waveform to a trapezoid. The manner in which the trapezoid is formed is shown in Figure R-17. A is the pulse due to conduction of V206B. B is the voltage waveform across C260. The manner in which a sawtooth voltage waveform is generated across a capacitor is described on page 61 of the September issue. C is the voltage waveform across R272. The voltage across both C260 and R272 is shown at D. This is the waveform applied to the grid of V212 through C262.

This signal is amplified by V212. The phase reversal produced by the tube results in a negative signal at the plate.

While this is the desired output waveform, the oscillator will not function properly if it is fed back to the grid of V206B in this form. The required signal is a positive pulse, as shown at the plate of V2 in Figure R-16A.

In the circuit of Figure R-16B this pulse is obtained by the addition of a waveshaping network in the coupling circuit. The network produces the required positive pulse at the junction of R242 and C266. The pulse charges C266. The time constant of C266, R270 and R293 is such that the voltage drop across R270 and R293 keeps V206B cut off until the vertical sync pulse occurs.

Vertical retrace blanking is provided in the RA-164-165 chassis. The blanking is accomplished by feeding a negative pulse to the grid of the CRT during the vertical retrace period.

The pulse is obtained by applying the vertical output signal to a differentiating network consisting of C288 and R260 (see Figure R-2, September issue). This network changes the vertical output waveform to a pulse. The pulse is applied to the CRT grid to cut off the tube during vertical retrace.

Sound I-F and Audio Stages

The sound circuit of the RA-164-165 consists of a single 4.5 megacycle i-f amplifier (V208), a ratio detector (V209), and two audio amplifier stages (V210 and V211), as shown in Figure R-18.

A 4.5 mc sound i-f signal is produced in the video detector. This signal is a hetrodyne resulting from the 21.25 mc sound i-f carrier and the 25.75 mc video i-f carrier.

The 4.5 mc signal is coupled to the grid of the sound i-f through C230 and

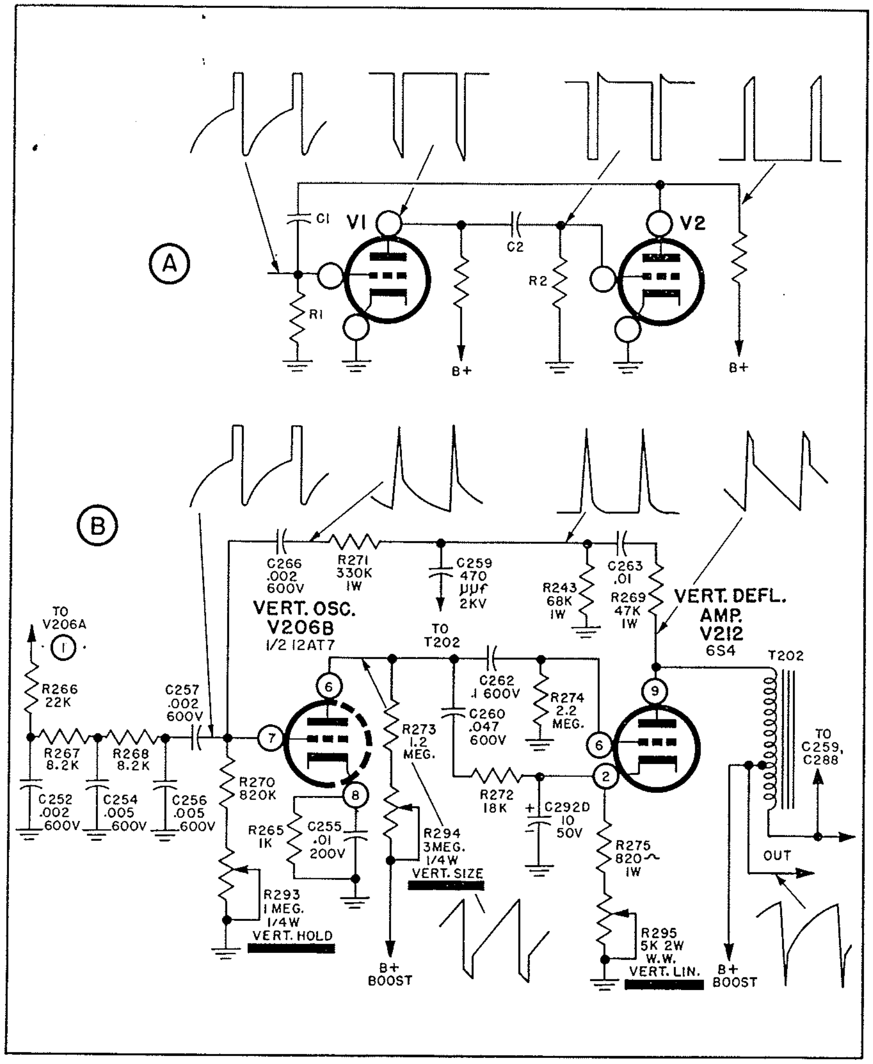

Figure R-16. Schematic and simplified diagrams of the vertical oscillator circuit.

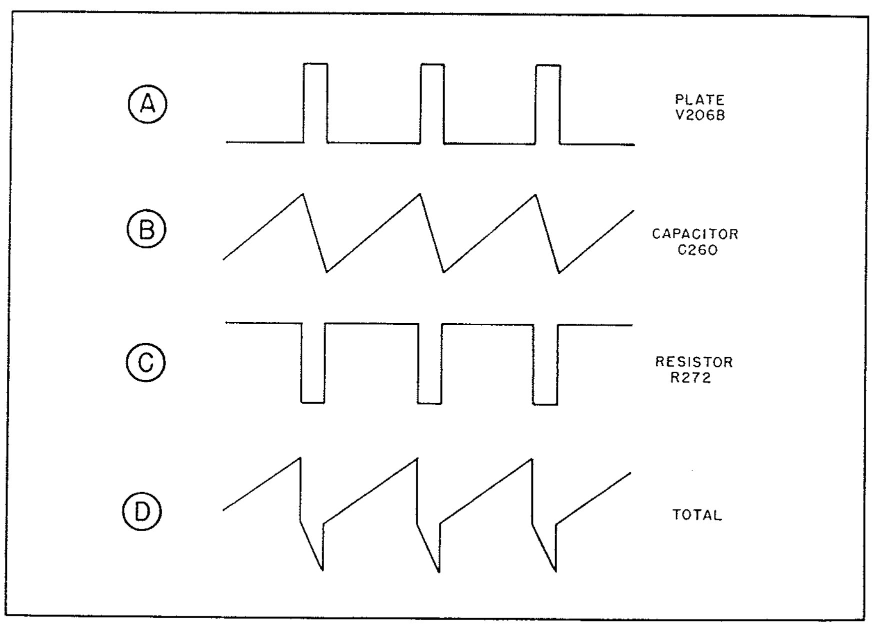

Figure R-17. Formation of a trapezoid waveform in a grid coupled multivibrator.

L203. L203 and the distributed capacitance of the circuit form a pi network which passes the 4.5 mc signal and rejects all others.

The output of the sound i-f amplifier is applied to the ratio detector. R252 and C241 form a de-emphasis network which compensates for the high frequency emphasis in the transmitted signal.

V210 is a conventional class-A voltage amplifier. Its output is fed to the grid of V211, the beam-power audio-output stage. The output stage is conventional except for the manner in which it is biased.

Cathode bias is used. Instead of the conventional cathode resistor a number of other circuits in the chassis are connected between the cathode and ground. The total resistance of these circuits is such that a cathode voltage of +135 volts is developed.

This serves the dual purpose of providing a 135-volt source, for circuits requiring this potential, and furnishing the necessary bias for V211.

Obtaining the 135-volt source in this manner, rather than from the usual bleeder resistor network, has an added advantage in that it provides voltage stabilization of the 135-volt source.

If for any reason, the voltage on the 135-volt line changes, the bias of V211 is also changed. This produces a change in the plate-to-cathode resistance of V211 which returns the line potential to 135 volts.

If the 135-volt line potential increases, the bias on V211 increases, increasing the plate-to-cathode resistance of the tube. This increase in the plate resistance tends to return the cathode voltage to normal.

V211 requires a grid bias of approximately –20 volts. To reduce the bias to this value the grid is made approximately 115 volts positive by connecting it to the 270-volt line through R256 and R257.

When servicing this chassis, keep in mind the fact that the 135-volt source is dependent upon the current through V211. Should this tube be removed or become defective, the 135 volts will not be present and the receiver will be inoperative.

Low-Voltage Supply

The low-voltage-supply circuits of the receiver are conventional. A 5U5G full-wave rectifier is used.

A separate damper-filament-supply transformer is provided. This transformer incorporates a Farraday shield to prevent the horizontal sweep signal from entering the power line and producing interference with other equipment.

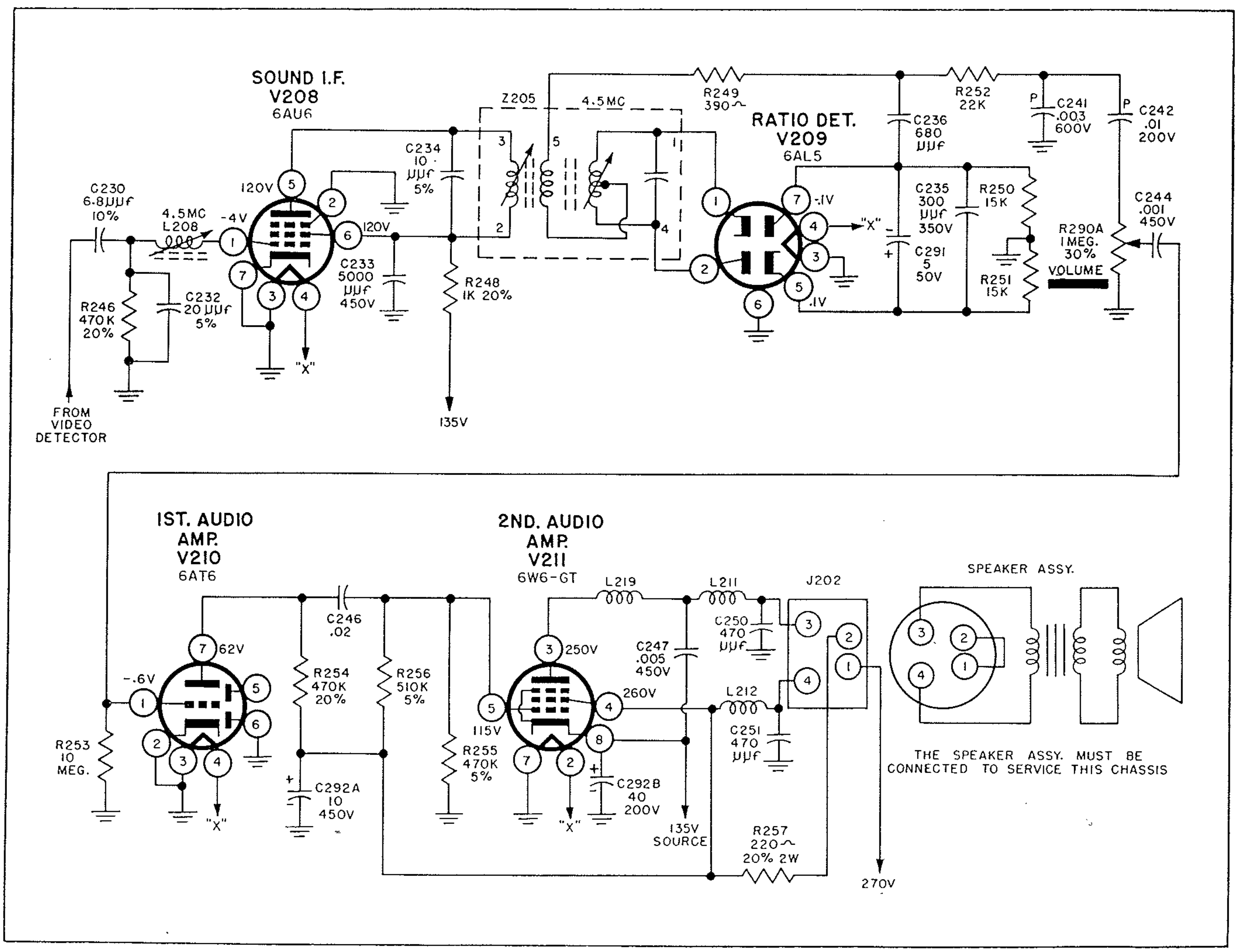

Figure R-18. Schematic diagram of the sound i-f and audio stages.

PRODUCTION CHANGES

No. 656400A

Reason:

To increase the efficiency of L209, the channel 5 beat trap.

Procedure:

1. Remove L209. Connect pin 7 of V204, the video amplifier, to the junction of C217-L206-L207.
2. Disconnect C217-L207, the 4.5mc beat trap, from the junction of C216-R217. Connect L209 between these two junction points.

The first chassis so modified is:
Serial Number 656400 Coded C-2

No. 656400B

Reason:

To improve the picture quality by increasing the vertical interlace stability.

Procedure:

1. Remove R265.
2. Disconnect C259 from ground. Connect the free end of C259 to the red lead of T202, the vertical sweep output transformer.
3. Remove R242 and connect the junction of C263-R243 to the junction of C259-R271.
4. Replace R243 with a 68K, 10%, 1W resistor.
5. Replace R270 with an 820K, 10%, ½W resistor.
6. Replace R272 with an 18K, 5%, ½W resistor.
7. Replace R273 with a 1.2 meg, 10%, ½W resistor.
8. Disconnect pin 8 of V206, the vertical sweep oscillator, from ground.
9. Connect C255, a .01 mf, 20%, 200V condenser, between pin 8 of V206 and ground.
10. Connect R265, a 1K, 10% ½W resistor, between pin 8 of V206 and ground.

Parts Required:

SYMBOL	PART NUMBER	DESCRIPTION
C255	03 119 780	Cap F Pa .01 mf, 200V
R243	02 034 990	Res F C 68K, 10%, 1W
R265	02 031 770	Res F C 1K, 10%, ½W
R270	02 032 120	Res F C 820K, 10%, ½W
R272	02 030 780	Res F C 18K, 5%, ½W
R273	02 032 140	Res F C 1.2 meg, 10%, ½W

The first chassis so modified is:
Serial Number 656400 Coded C-2

No. 656400C

Reason:

To minimize the possibility of audio modulation in the picture, and beats on channels 5, 7 and 11.

Procedure:

1. Remove R302. Connect pin 5 of the second audio amplifier (V211) to the junction of C246, R255 and R256.
2. Disconnect pin 3 of V211 from pin 3 of J202 (speaker plug).
3. Disconnect C247 from pin 3 of V211. Connect the free end of C247 to pin 6 of V211.
4. Connect L219 between pins 3 and 6 of V211.
5. Connect L211 between pin 6 of V211 and pin 3 of J202.
6. Connect C250, a 470 mmf, 500V capacitor, between pin 3 of J202 and the nearest ground lance.
7. Disconnect pin 4 of V211 from pin 4 of J202, and connect L212 between these two points.
8. Disconnect R256 from pin 4 of J202 and connect it to pin 4 of V211.
9. Connect C251, a 470 mmf, 500V capacitor, between pin 4 of J202 and ground. Use the same ground as in step 6.

Parts Required:

SYMBOL	PART NUMBER	DESCRIPTION
C250	03 016 480	Cap F Ce 470 mmf 500V
C251	03 016 480	Cap F Ce 470 mmf 500V
L211	21 010 331	Inductor Fixed
L212	21 010 331	Inductor Fixed
L219	21 010 331	Inductor Fixed

The first chassis so modified is:
Serial Number 656400 Coded C-2

No. 656611

Reason:

To eliminate the possibility of picture hook.

Procedure:

Remove C255 (connected between the junction of R223, R234 and pin 7 of V207) and replace it with a 1000 mmf, 450V, ceramic capacitor.

Parts Required:

SYMBOL	PART NUMBER	DESCRIPTION
C225	03 100 490	Cap F Ce 1000 mmf, 450V

The first chassis so modified is:
Serial Number 656611 Coded C-2

No. 657071

Reason:

To improve picture quality by reducing mixer thermal noise.

Procedure:

1. Replace R203 (located in the a-g-c circuit) with a 330 ohm, 20%, ½W resistor.
2. Replace R222 with an 82K, 10%, ½W resistor.
3. Disconnect the a-g-c input lead from the junction of C201-R201-R203 and the tuner green lead and connect it to the junction of C205-R203-R222.

Parts Required:

SYMBOL	PART NUMBER	DESCRIPTION
R203	02 032 390	Res F C 330 ohm 10% ½W
R222	02 032 000	Res F C 82K 10% ½W

The first chassis so modified is:
Serial Number 657071 Coded C-3

No. 6516462

Reason:

To increase the immunity of the AFC circuit to short duration noise pulses when receiving weak signals. This design modification prevents horizontal displacement of individual scanning lines with noise.

Procedure:

1. Replace C228 with a .01 mf, 20%, 200V condenser.
2. Replace C268 with a .05 mf, 20%, 200V condenser .
3. Replace R241 with a 220K, 10%, ½W resistor.

Parts Required:

SYMBOL	PART NUMBER	DESCRIPTION
C228	03 119 780	Cap F Pa .01 mf 20% 200V
C268	03 000 950	Cap F Pa .05 mf 20% 200V
R241	02 032 050	Res F C 220K 10% ½W

The first chassis so modified is:
Serial Number 6516462 Coded C-3

No. 6522466A

Reason:

To minimize the possibility of sync-pulse buzz in the audio.

Procedure:

Remove R250 and R251 and replace them with 15K, 10%, ½W resistors.

Parts Required:

SYMBOL	PART NUMBER	DESCRIPTION
R250	02 031 910	Res F C 15K 10% ½W
R251	02 031 910	Res F C 15K 10% ½W

The first chassis so modified is:
Serial Number 6522466 Coded C-4

No. 6522466B

Reason:

To improve sync stability in noisy fringe areas.

Procedure:

An a-g-c switch is incorporated in the chassis. The switch is physically located behind the hidden control panel and is called the Fringe Block switch. The switch circuit is illustrated in Figure S-1.

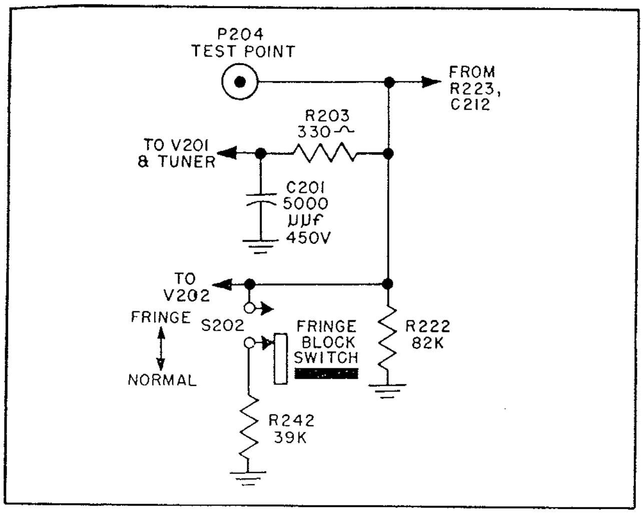

Figure S-1.

Parts Required:

SYMBOL	PART NUMBER	DESCRIPTION
R242	02 031 960	Res F C 39K 10% ½W
S202	05 004 200	Slide Switch

The first chassis so modified is:
Serial Number 6522466 Coded C-4

No. 6526306

Reason:

To increase picture drive and contrast range.

Procedure:

1. Remove C219 and R214 at cathode of V204 (Video Amplifier).
2. Connect pin 1 of V204 to the junction of R218 and R290B (Contrast Control).
3. Remove R258 and replace with a 1.2 meg, 10%, ½W resistor.
4. Remove R300 and replace with a 390K, 10%, ½W resistor.

Parts Required:

SYMBOL	PART NUMBER	DESCRIPTION
R258	02 032 140	Res F C 1.2 meg 10% ½W
R300	02 032 080	Res F C 390K 10% ½W

The first chassis so modified is:
Serial Number 6526306 Coded C-5

NOTE: Steps 3 and 4 are not required unless the brightness range is inadequate after steps 1 and 2 have been completed.

Troubleshooting Hints

Teleset: RA-164-165

Symptom: Overload when contrast control is turned up, loss of a-g-c.

Probable Fault: Defective video detector crystal.

Remedy: Replace crystal.

Teleset: RA-164-165

Symptom: Hook in picture.

Probable Fault: C225, the 1000 mmf coupling capacitor between 2nd sync clipper and the horizontal phase detector (V207), is leaky.

Remedy: Replace C225 with a 1000 mmf, 450V ceramic capacitor.

Teleset: RA-160-162

Symptom: Intermittent reduction in picture width.

Probable Fault: Width coil (L303) in horizontal output circuit arcing. When the core is screwed all the way in, an arc is produced between the core and the coil terminal.

Remedy: Readjust the width coil slug.

Teleset: RA-160-162

Symptom: No high voltage, buzz in sound, no a-g-c.

Probable Fault: C231, the 120 mmf capacitor in the cathode circuit of the a-g-c gate (V209B), is shorted. This causes R264 and R239 to burn up.

Remedy: Replace C231, R264 and R239.

Teleset: RA-160-162

Symptom: Critical horizontal sync, horizontal and vertical instability, loss of sync and/or low brightness.

Probable Fault: R348B, the power supply voltage divider, is open or intermittent.

Remedy: Replace R348.

Teleset: RA-109-116-119-130-133

Symptom: Erratic a-g-c action.

Probable Fault: L216, at the grid of the NBS amplifier V216, is opening intermittently. To check for this condition, observe the signal at the grid of V216 on an oscillograph. If L216 is open the signal on the scope screen will reverse phase about 15 seconds after the probe is connected to the circuit. The scope may be left in the circuit when checking for an intermittent.

Remedy: Replace L216.

DIRECTOR'S CORNER (Cont.)

The Service Committee of the Radio and Television Manufacturers Association is considering a number of proposals intended to help enlighten the television buying public. One item that is already available is a booklet prepared jointly with the National Better Business Bureau. This booklet, entitled, "Things You Should Know About the Purchase and Servicing of Television Sets," is an interesting, impartial, authoritative discourse on the facts of television life.

In the interest of better public relations for *all* segments of *our* industry I urge every dealer and service company to obtain a supply of these booklets to pass out to customers as needed. Sample copies and quantity rates can be obtained by writing to Mr. K. B. Willson of the National Better Business Bureau, Chrysler Building, New York 17, N. Y.

A NEW RA-164-165 TUNER

A new tuner (part number 89 012 601) is now being used alternately with tuner part number 21 010 781. These tuners are mechanically and electrically interchangeable. Either tuner may be supplied with present production Telesets. The schematic of tuner 89 012 601 is shown in Figure T-1, the parts list is given below.

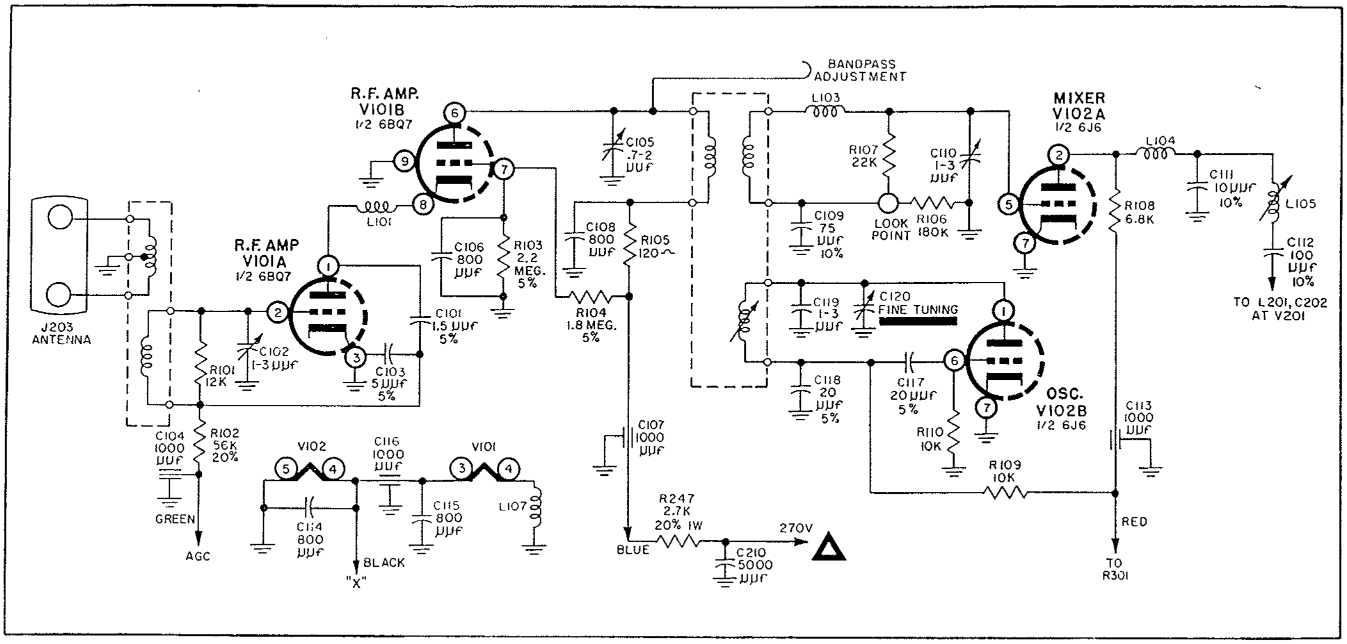

Figure T-1. Schematic of Du Mont tuner part number 89012601.

PARTS LIST

Symbol	Part No.	Symbol	Part No.	Symbol	Part No.	TUNER STRIPS Channel	Part No.	MECHANICAL PARTS Part No.	Description
C101	03 125 000	C113	03 125 180	R101	02 031 900				
C102	03 019 840	C114	03 124 790	R102	02 031 980	2	40 013 121	35 025 600	Bearing Plate
C103	03 124 780	C115	03 124 790	R103	02 031 280	3	40 013 122	30 035 020	Detent Roller and Spring
C104	03 125 180	C116	03 125 180	R104	02 031 260	4	40 013 123	30 035 030	Spring Retainer
C105	03 124 770	C117	03 125 130	R105	02 031 660	5	40 013 124	30 035 040	Snap Ring
C106	03 124 790	C118	03 125 130	R106	02 032 040	6	40 013 125	30 035 050	Shaft and Coil Drum
C107	03 125 180	C119	03 019 840	R107	02 031 930	7	40 013 126	42 002 900	Tube Shield V101
C108	03 124 790	C120	03 125 140	R108	02 031 870	8	40 013 127	42 004 580	Tube Shield V102
C109	03 125 100	L101	21 011 440	R109	02 031 890	9	40 013 128	42 007 930	Bottom Shield
C110	03 019 840	L103	21 011 450	R110	02 031 890	10	40 013 129	42 007 940	Side Shield
C111	03 125 110	L104	21 011 460	V101	25 007 000	11	40 013 131	60 408 200	Screw Bottom, Side Shield
C112	03 125 120	L105	21 011 470	V102	25 000 190	12	40 013 132	60 409 600	Screw Bearing Plate
		L107	21 011 480			13	40 013 133		

Somerset, Dynasty, and Newbury Record Changers

The above Telesets are equipped with drawers for record changers which are not sold with the sets.

The following universally available 3-speed record changers are suitable for use with these Telesets.

Webster-Chicago Model 122
V M Model 956
RCA Model 2JS1

Installation of the changers is extremely simple, just follow the instructions given on the label on the bottom of the drawer.

RA-160 CABLE KIT

A kit for use in making up an interchassis cable extension for RA-160-162 Telesets is now available from your Du Mont Distributor. The cable enables the user to operate a Teleset with one or both chassis removed from the cabinet for convenient servicing. It is also useful on the test bench.

The kit includes all necessary parts except wire. Complete instructions are enclosed in each kit.

DU MONT
First with the Finest in Television
SERVICE NEWS

Service News

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DIRECTOR'S CORNER

BY

Harold J. Schulman

This issue of the SERVICE NEWS is our first attempt to bring to our readers some practical information on UHF. Placed in proper perspective, we see that UHF really presents few new problems to service technicians.

The UHF portion of a receiver, concentrated as it is in the front-end, represents only a small fraction of the components and circuitry, and hence the service needs of a receiver.

Despite the apparent emphasis on UHF problems, the serviceman in UHF areas will find the greatest portion of his service efforts still concerned with the usual sync, i-f, output and high voltage circuits.

These words are written to assure servicemen in areas about to receive UHF stations that television will still be television, whether it's UHF or VHF. The customer relations problems are the same. The knowledge required to service receivers is about the same. And the pleasure your customers will find in television programming will be the same.

The only reason for using the symbols VHF and UHF is to have a convenient means for designating two bands of frequencies required to accomplish the single objective: To bring a whole new world of entertainment, pleasure, information and education into *all* American homes.

Of course, some new concepts will have to be added to the serviceman's knowledge. Discarded at UHF frequencies are our traditional ideas of an inductor, a capacitor and ground potential connections. You will read in this issue that even a short run of wire

(CONTINUED ON PAGE 80)

U. H. F.
Installation

By Carl Quirk

On September 18, 1952 station KPTV in Portland, Oregon began operation on channel 27, UHF television became a reality and a new phase in TV development began.

Here at Du Mont we have been at work testing antennas, transmission lines and converters, and in general assessing the installation and service problems which will be encountered in the UHF band. This article is intended to acquaint you with the important differences between VHF and UHF, as they affect the service technician.

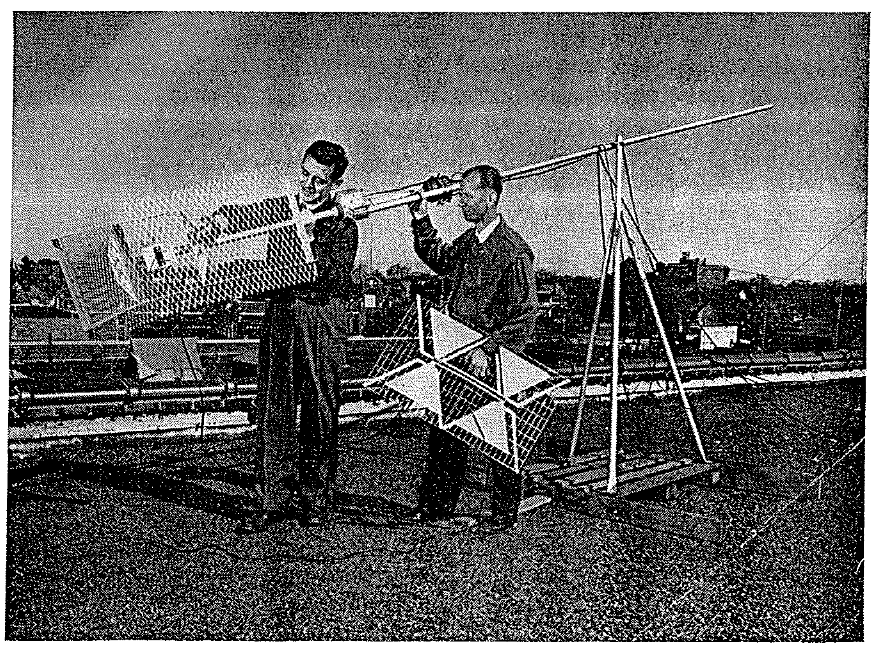
UHF vs VHF

What makes the UHF band a new problem? How does it differ from VHF? Before discussing UHF service problems we will try to answer these questions briefly.

The UHF television broadcast band extends from 470 to 890 mc and includes 70 TV channels. The upper end of the present VHF band is at 216 mc. Thus, in the UHF band we are dealing with frequencies several times those which are now in use.

The propagation characteristics of these higher frequencies differ somewhat from those of the VHF. The practical effects of these differences in which the service technician is interested are as follows:

1. Antenna height is more critical. Increasing the height of an antenna several feet may cause a decrease in signal strength. This effect is due to differences in phasing between the direct signal and the ground reflected signal, as shown in Figure A-1. You may have noted this characteristic in VHF work. It is much more pronounced at ultra-high frequencies.
2. As the receiving location is moved away from the transmitter the sig-



Du Mont engineers setting up for another UHF antenna test.

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Harold J. Schulman .... SERVICE MANAGER
Carl J. Quirk .... TECHNICAL SUPERVISOR
Joseph J. Roche .... EDITOR

nal strength is gradually reduced. However, points of maximum and minimum signal strength are observed. Thus, moving farther from the transmitter can produce an increase in signal strength. This characteristic coupled with the usual obstacles (hills, buildings, etc.) results in wider variations in signal level in the area covered by a transmitter.

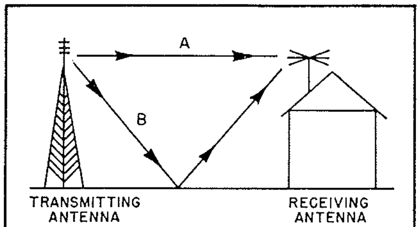

Fig. A-1. The phase difference between the direct signal A, and the ground reflected signal B, produces a cancellation effect which varies with antenna height.

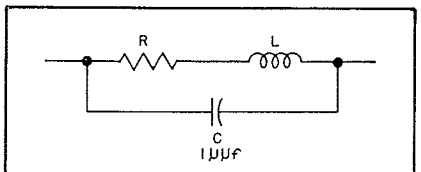

Fig. A-2. Equivalent circuit of an ordinary one-half watt carbon resistor at UHF.

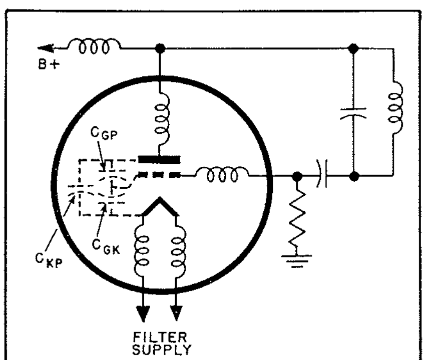

Fig. A-3. Equivalent circuit of a triode in a UHF oscillator circuit.

3. Ghosts are more common. However, due to their smaller dimensions, it is easier to build high gain directive antennas for UHF. This tends to compensate for the difficulties described above.

Circuit Requirements

Circuits designed for operation at UHF differ considerably from those designed for VHF. The need for a different approach to circuit design can be appreciated when we realize that a piece of wire three inches long has an impedance of approximately 300 ohms at 700 mc. As a result the usual techniques of connecting components must be almost completely dispensed with at UHF.

An ordinary one-half watt resistor has a shunting capacitance of approximately 1 mmf, as shown in Figure A-2. At low frequencies this capacitance is negligible. However, at 700 mc 1 mmf presents an impedance of only 227 ohms. The body and leads of a resistor form an inductance which may be considered to be in series with the ohmic resistance. Thus, a resistor actually forms a resonant circuit at ultra-high frequencies. The impedance of this circuit depends upon frequency and must be given consideration in UHF circuit design.

The leads of a capacitor, as well as the capacitor itself, have inductance. While this inductance is negligible at low frequencies, it becomes important at UHF.

Another important point in UHF circuit design is grounding. In low frequency circuits the chassis is usually used as a common ground. The distance between grounds in a typical TV chassis is often more than a foot. The wavelength of a 7 mc signal is approximately 147 feet. At this frequency there is very little difference in potential between two ground points a foot apart. However, at 700 mc the wavelength is approximately 16½ inches. Obviously, this would result in a wide variation in the potential at various points on a chassis if the usual grounding methods were used.

From the above it is obvious that new methods of component construction and new circuit techniques are required in the UHF band.

Electron Tube Limitations

To provide satisfactory operation at UHF new types of vacuum tubes are required. The equivalent circuit of a triode in a UHF oscillator is shown in Figure A-3. Note that the inter-electrode capacitance of the tube, in series with the inductance of the leads within the tube, shunts the tank of the oscillator. If the inductance and capacitance of the external circuit is reduced to a minimum the highest possible operating frequency will be determined by the inter-electrode capacity, and the lead inductance of the tube. To increase the maximum operating frequency it becomes necessary to reduce the capacity and the inductance of the tube.

Another factor which limits the maximum operating frequency of a vacuum tube is referred to as "transit time." Transit time is the period required for electrons to pass from the cathode to the plate of a tube. In ordinary tubes the transit time is negligible at low frequencies, however, in the UHF band it becomes an appreci-

TABLE I

Type	Gain	
	Front	Back
Single Bow-Tie	6.5	5.5
Single Bow-Tie with Reflector	8	2
Stacked Bow-Tie	11	10
Stacked Bow-Tie with Reflector	21	3
Stacked V	20	11.5
Double V	15	9.5
Trombone	12.5	8
Parabolic	12.5	4.5

able part of a cycle. When the transit time is greater than about one-fourth of a cycle at the operating frequency, the losses which occur become prohibitive.

To overcome these problems new types of tubes are required.

These component and circuit problems are important mainly in the design and construction of UHF tuners and converters. Since the technician is concerned with the service and installation aspects of UHF, the balance of the article has been devoted to those problems.

Antennas

To determine which types of antennas will provide the best UHF and UHF-VHF reception a test setup has been installed at the Du Mont Teleset Service Department building in Paterson, N. J. Samples of all types of antennas and transmission lines are being checked to determine their performance.

Of the commercially available UHF-VHF antennas checked, three were found which are worthy of consideration. They are referred to here as the "double V," the "trombone," and the "stacked V."

A comparison of these antennas in terms of voltage gain is shown in Table 1.

The double V is shown in Figure A-4. This antenna is sturdy, light in weight, easy to assemble and mount, and provides good gain in both the VHF and UHF bands. The characteristics of the antenna are determined to a great extent by the angle between the elements, and the particular antenna tested had provisions for changing this angle. Our tests indicated that an angle of approximately 90° gives best results for VHF only, 60° is optimum for VHF-UHF, and 45° for UHF only.

The directivity pattern of the antenna at 710 mc is shown in Figure A-4. Note that in addition to the primary lobe there are several secondary lobes of comparatively high amplitude. This condition can lead to difficulty with ghosts under some conditions. Except for this rather poor directivity pattern the double V is an excellent VHF-UHF antenna and will do an

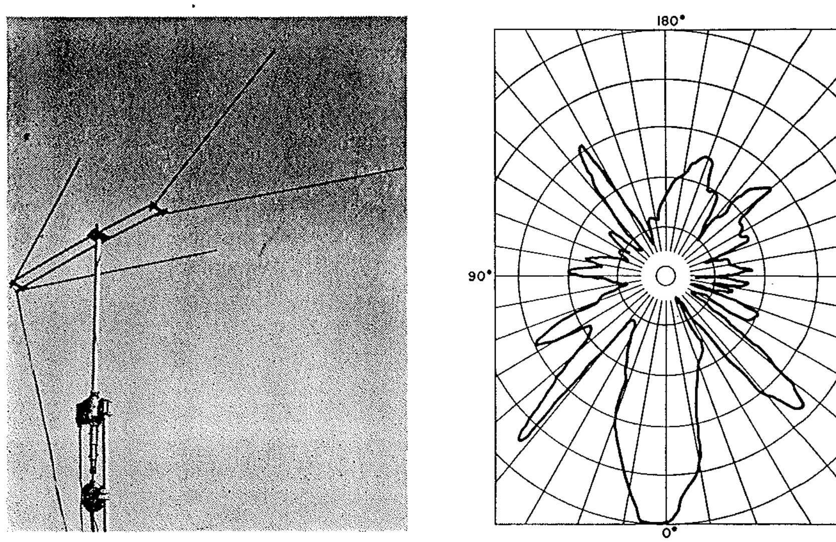

Fig. A-4. The double-V antenna and its directivity pattern at 710 mc.

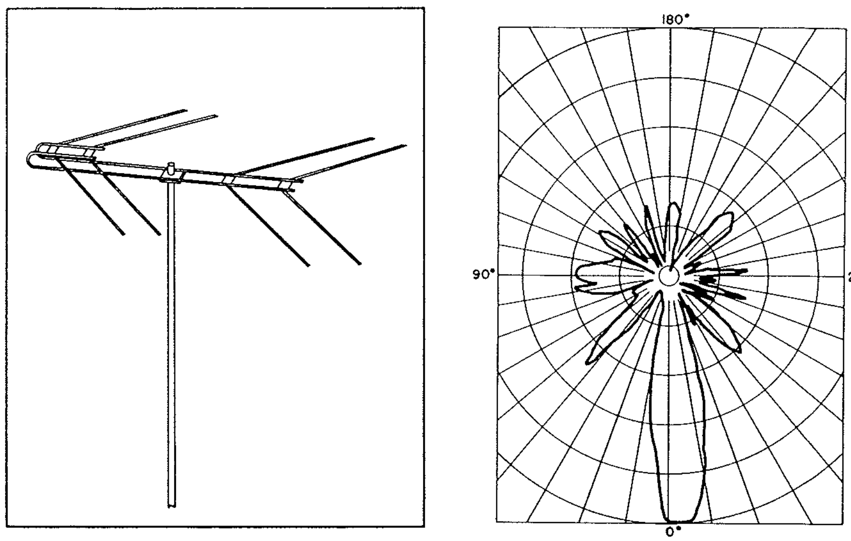

Fig. A-5. The trombone antenna and its directivity pattern at 710 mc.

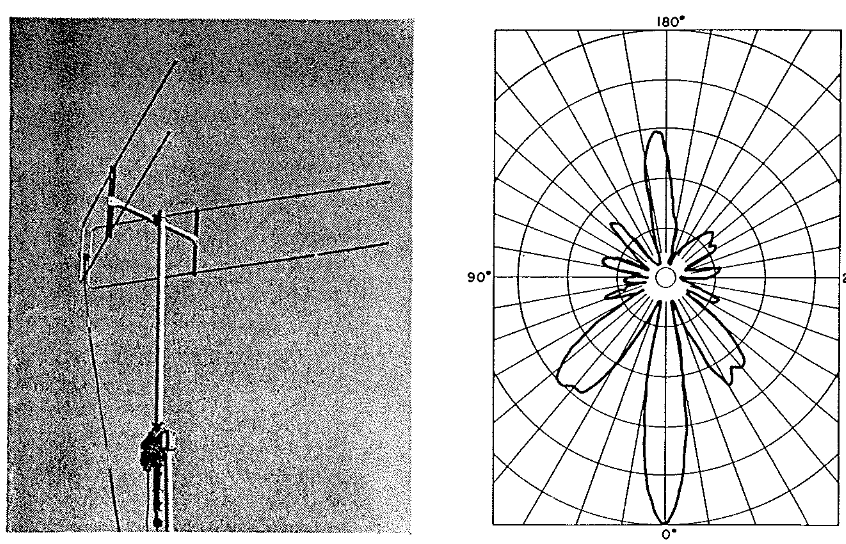

Fig. A-6. The stacked-V antenna and its directivity pattern at 710 mc.

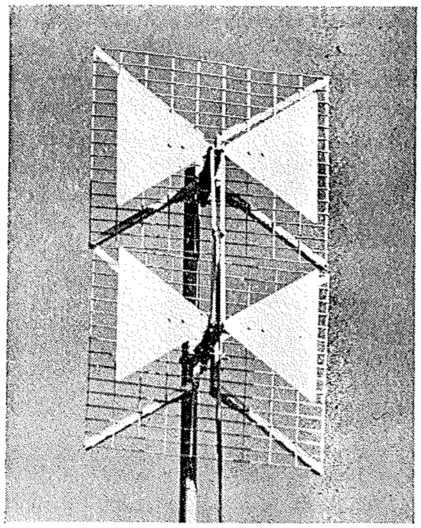

Fig. A-7. The stacked bow-tie antenna with reflector.

excellent job in locations where ghosts are not a problem.

The presence of high amplitude secondary lobes is not always a disadvantage. In areas where stations are received from different directions it is often possible to orient the antenna so that the major lobe is directed at one station and one of the minor lobes at another. In orienting the antenna the secondary lobe is directed toward the stronger station and the weaker station is received on the major lobe. The major lobe is usually wide enough to overcome slight differences in angle between the antenna lobes and the received signals.

The antenna illustrated in Figure A-5 is a form of V antenna referred to as the "trombone." The angles between the elements are adjustable as in the double V. As shown in Table 1 the VHF and UHF gain of the trombone are not as good as that of the double V. The directivity pattern of the trombone is shown in Figure A-5. It has a number of secondary lobes similar to the double V, however, the amplitudes of these lobes are much lower than those of the double V. The trombone is therefore superior to the double V with respect to rejection of ghosts.

A stacked-V antenna is shown in Figure A-6. The unit shown was made up specially for our tests, however, this antenna is now being manufactured and will be available through your Du Mont Distributor. The stacked V gave the best results of the three VHF-UHF antennas tested. Its gain in the UHF band is comparable to that of the best "UHF only" antenna tested. Its gain in the VHF band, while not outstanding, is satisfactory for most installations.

The directivity pattern of the stacked V is shown in Figure A-6. It has the multiple minor lobes typical of all of the V antennas tested. As indicated by the pattern it has a poor front-to-back ratio, a possible source of difficulty in locations where ghosts are encountered.

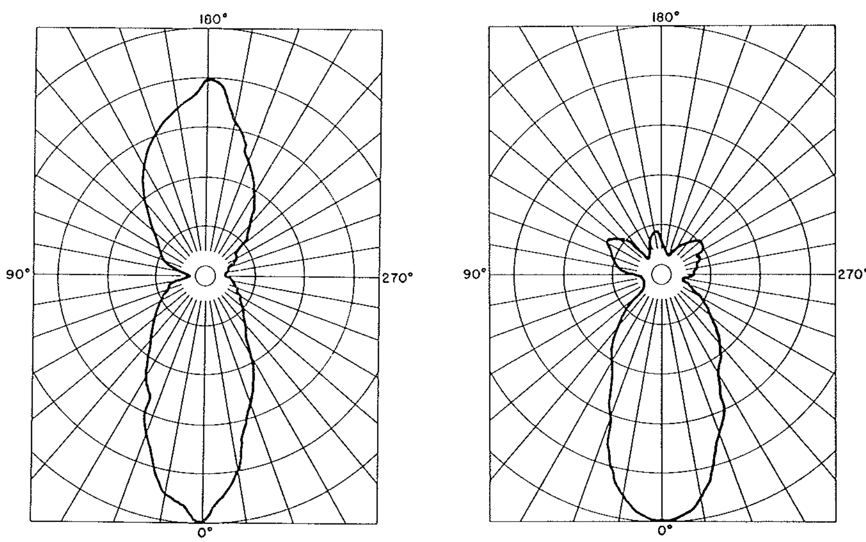

Fig. A-8. Directivity patterns of the stacked bow-tie antenna at 710 mc. Left—without reflector. Right—with reflector.

Antennas for UHF Only

In addition to the combination UHF-VHF antennas previously described, two of the antennas designed only for UHF reception gave satisfactory performance. These antennas are referred to here as the "bow-tie" and the "corner reflector" types.

The bow-tie is shown in Figure A-7. The antenna illustrated is a stacked version with reflector screen. This antenna is designed to be used single or stacked, with or without reflector screen. A comparison of the different versions is given in Table 1. As might be expected the stacked version with reflector, gives the highest gain.

The directivity patterns of the stacked version with and without reflector are shown in Figure A-8. As shown the addition of the reflector greatly improves the front-to-back ratio. This high front-to-back ratio is useful in locations where ghosts are received from the rear of the antenna.

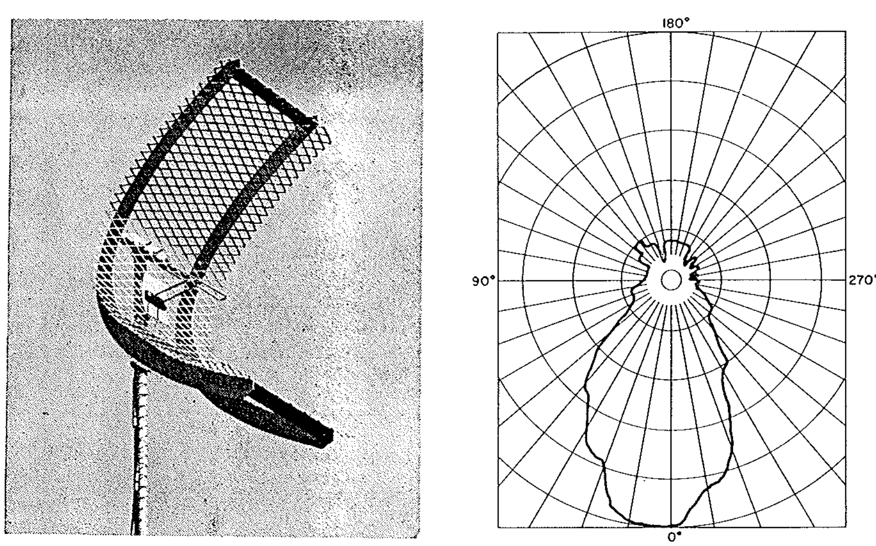

Fig. A-9. Corner or parabolic reflector type antenna and its directivity pattern at 710 mc.

In locations where ghosts are received at angles only slightly different from the desired signal, the wide main lobe of this antenna can cause difficulty.

As noted in Table 1 the stacked bow-tie with reflector gave the highest UHF gain and front-to-back ratio of all of the antennas tested.

The corner reflector type antenna is illustrated in Figure A-9. It consists of a half wave folded dipole and reflector. The reflector differs from the usual type in that it is parabolic in shape. This antenna combines a fair front-to-back ratio with satisfactory gain. The reflector is comparatively large and cannot be disassembled, making the antenna rather bulky to handle and ship. This antenna, however, should be useful in noisy or ghosty locations.

The combination UHF-VHF antenna has the advantage of economy, and for that reason it will be preferred in most installations where both UHF and VHF stations are received. In strictly UHF areas or in fringe, ghosty or noisy locations a separate, high gain, directional UHF antenna will give the best results.

Built-in antennas deserve consideration for UHF reception. Experience has shown that built-in antennas often give excellent results in good signal areas although as a rule, better performance is obtained using an outdoor antenna.

In the UHF band transmission line losses tend to alter this situation somewhat. In locations where a long transmission line is required the losses in the line may be great enough to attenuate most or all of the additional signal voltage available at the outdoor antenna. As a result, the outdoor antenna may be no better than, and in a few cases not as good as, the built-in antenna. In view of the above when an indoor antenna is available, it should be tried.

Transmission Lines

Most technicians are familiar with the fact that as the frequency is increased transmission line losses also increase. In the UHF band you will encounter the same problems which are found in VHF installations, except that they will be much more severe.

A

B

C

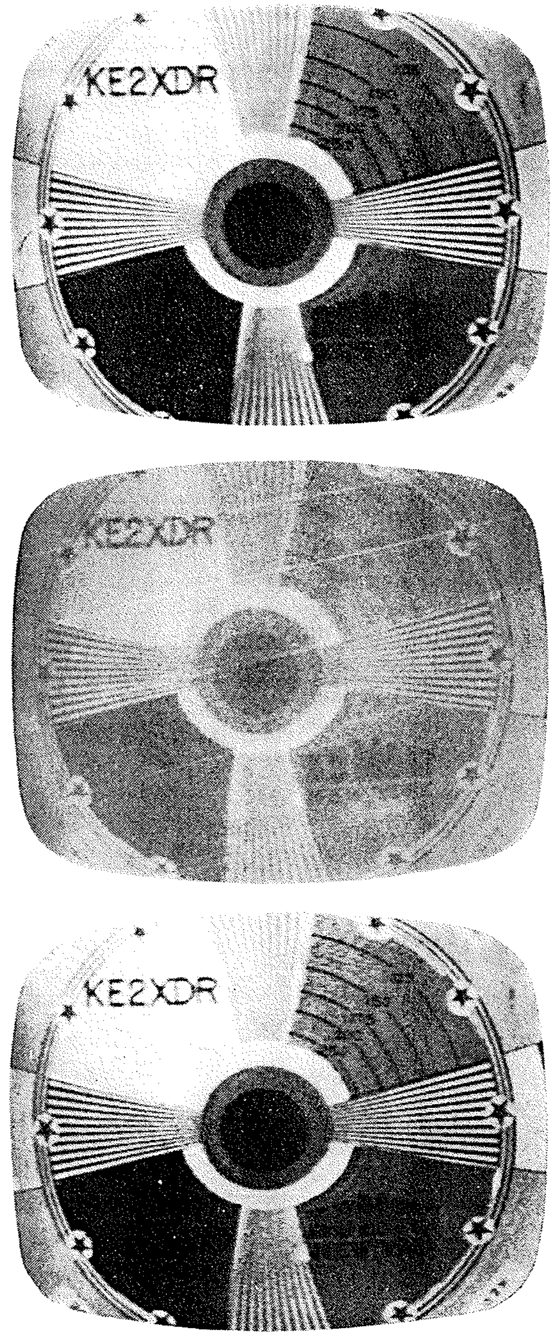

Fig. A-10. Effects of moisture on transmission line losses. A—Picture obtained using 100 feet of dry 300-ohm ribbon or tubular line. B—Picture with 100 feet of wet 300-ohm ribbon. C—Picture with 100 feet of wet 300-ohm tubular line.

TABLE 2

Type	Loss in DB/100 feet			
	100 mc		700 mc	
	Dry	Wet	Dry	Wet
300-ohm Ribbon	1.2	7.3	3.6	26.5
300-ohm tubular	1.2	2.5	3.6	8.2
RG-59/U Coax	3.7	3.7	11.7	11.7
RG-11/U Coax	1.9	1.9	6.2	6.2

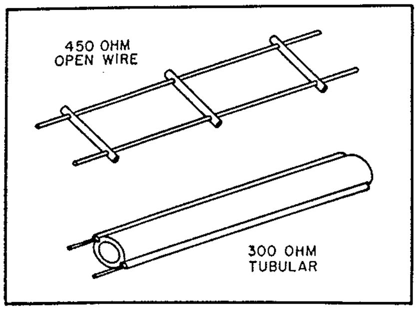

Fig. A-11. Left—300-ohm tubular transmission line. Right—450-ohm open-wire line.

A comparison of the losses of several popular types of transmission line is shown in Table 2. Note that the losses of each type of line are proportionately greater in the UHF band.

In the table the losses of each type of line are shown for both wet and dry conditions. Comparing the various transmission lines we find that there is a definite increase in the attenuation of the open wire lines when they become wet, while there is no change in the attenuation of a coaxial line. This same effect occurs on the high VHF channels but is usually not serious enough to cause difficulty. In the UHF band the increase in loss is great enough to rule out twin-lead in most installations which required a transmission line longer than 100 feet. Figure A-10 illustrates the effects of moisture on 300-ohm ribbon. A shows the picture obtained using 100 feet of dry twin-lead. B shows the effect on the picture when the line becomes wet.

Shown in Figure A-11 is a tubular type of open wire 300 ohm transmission line. This type of construction greatly reduces losses due to moisture. Its attenuation when dry is the same as that of 300-ohm ribbon and when the tubular line was substituted for the ribbon the picture obtained was identical to one shown in Figure A-10A. The effects of moisture on the tubular line are shown in Figure A-10C. The very slight deterioration in signal which takes place when the line is wet is negligible when using 100 feet of line. Thus, the tubular line overcomes this important disadvantage of ordinary 300-ohm twin-lead.

RG-11/U coaxial transmission line was checked under the same conditions. The picture obtained was identical to Figure A-10A with wet or dry line.

It should be pointed out that the loss in signal level which occurs when 300-ohm twin-lead becomes wet does not completely eliminate the use of this type of transmission line in UHF installations. In strong signal areas the additional losses may not affect the picture. Assuming that the signal available with the line dry is 10,000μv, and that it drops to 5,000μv when the line is wet, it is doubtful that the loss of signal would be noticeable. However, if the signal strength is 100μv at the antenna terminals of the receiver with a dry line, and drops to 50μv when the line is wet, the effect on the picture would be rather drastic. From the above we can conclude that 300-ohm twin-lead will be useful in strong signal areas, particularly if a short transmission line is used, but that the losses which occur when the line becomes wet will prohibit its use in weak signal areas.

The pictures in Figure A-10 were taken at the Teleset Service Depart-

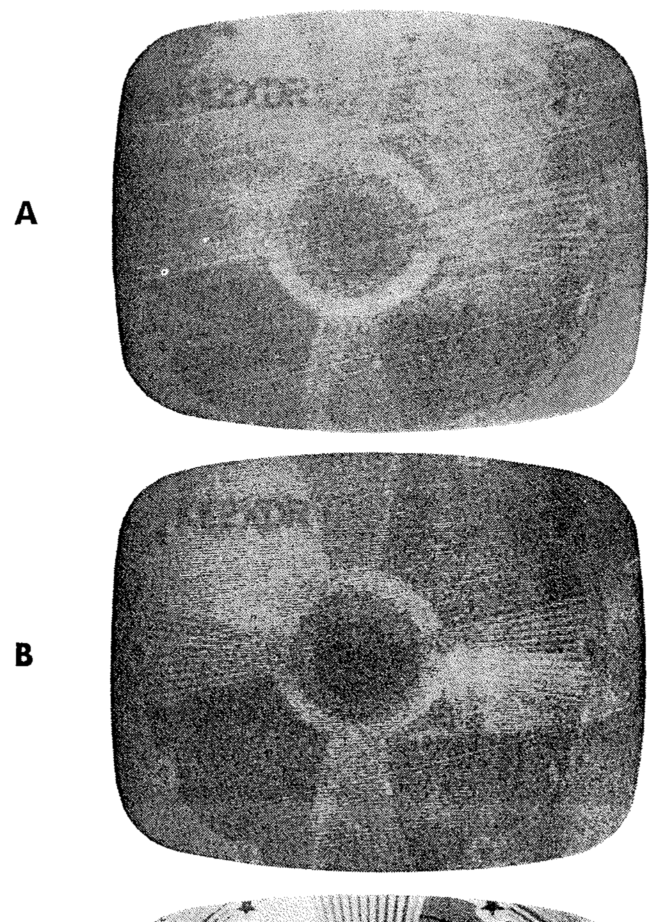

Fig. A-12. A—Signal obtained using 100 feet of dry 300-ohm ribbon with line laid on roof. B—Same as A using 300-ohm tubular line. C—Same as A using RG-11/U Coax.

ment building in Paterson, New Jersey. KE2XDR is located in New York City, 16 miles away, and is operated by the Research Department of Allen B. Du Mont Laboratories for experimental purposes. The effective radiated power of the transmitter is 4.5 KW. Since the maximum permissible effective radiated power of UHF TV broadcast stations is 1000 KW, the receiving location in Paterson is actually in the deep fringe area of the station. KE2XDR transmits a picture carrier on 709.25 mc and a sound carrier on 713.75. Since this is approximately the center of the UHF band the transmission line losses which occurred during our tests should be typical of the results obtained under fringe area conditions.

Open wire transmission line has another disadvantage when used for UHF reception. If the line is run close to a wall or other object, part of the signal is lost through absorption. This is illustrated in Figure A-12. A shows the picture obtained when using 100 feet of 300-ohm twin-lead, with the line laid on the roof of the building, B shows the picture obtained using 100 feet of tubular 300-ohm line under the same conditions; and C shows the results obtained using RG-11/U coaxial cable. The receiving conditions and equipment used were the same used to obtain Figure A-10A, except for the manner in which the transmission line was run. The picture in Figure A-10A was obtained with the line supported approximately 3 feet from the roof by means of wooden poles. Note that the absorption which occurs when 300-ohm twin-lead and 300-ohm tubular line are laid on the roof almost completely eliminates the picture, while no effect is noted when RG-11/U is run in the same way.

Obviously, if either type of 300-ohm line is used, it must be kept clear of all objects which will absorb energy from the line and result in attenuation of the signal. Where it is impossible to keep the line in the clear, coaxial cable should be used, unless very strong signals are available.

Transmission line losses are usually discussed in terms of decibels of attenuation. To illustrate the practical effect of attenuation the pictures shown in Figure A-13 were taken. In the receiving set up a UHF converter was used in conjunction with a Du Mont model RA-160 receiver. When using the converter the receiver is tuned to channel 5 or 6. Figure A-13A was obtained with the converter located at the receiver with 200 feet of RG-59/U run from the antenna to the converter. The converter was then moved to the antenna so that only a few feet of transmission line were required between the antenna and converter. Two hundred feet of RG-59/U were then used to connect the output of the converter to the input of the receiver. The result is a dramatic illustration of the effects of transmission line losses.

It also indicates a possible method of greatly reducing losses when a long transmission line is required, namely mounting the converter at the antenna instead of at the receiver.

One other type of transmission line which we have not previously mentioned, was checked. This was a 450-ohm open-wire line using plastic spacers. While it has the lowest losses of all of the types checked, it is more difficult to handle and install than 300-ohm tubular line. Using lengths up to 300 feet little difference in signal was noted between 300-ohm tubular and the 450-ohm line. The 450-ohm line suffers from absorption as do the 300-ohm lines. In view of the above it is felt that the 450-ohm line will be useful only in special cases where extremely long transmission lines must be used.

The following sums up our findings with respect to transmission lines for UHF:

1. 300-ohm twin-lead is useful in strong signal areas or when a very short line is required.
2. Where longer lines are required or where signals are weak the losses which occur when 300-ohm twin-lead is wet are prohibitive, and either 300-ohm tubular line or coaxial cable must be used.
3. When 300-ohm tubular or twin-lead line is used it must be kept clear of all objects which will absorb the signal.
4. When the transmission line cannot be supported in the clear coaxial cable will give the best results. For installations requiring short transmission lines or where strong signals are available RG-59/U is the best choice.
5. Due to its lower cost 300-ohm tubular line is preferable to RG-11/U except as stated above, and in general seems to be the logical choice for the majority of installations.

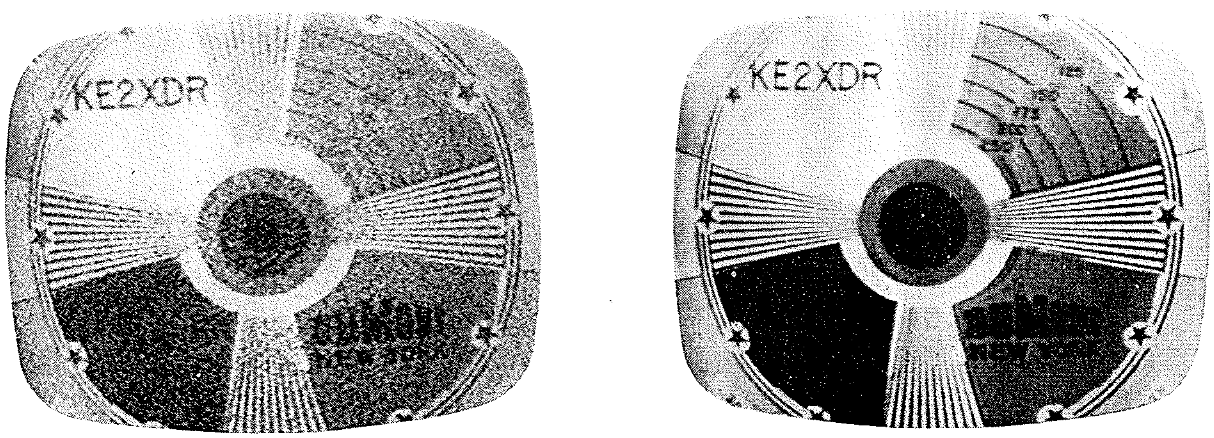

Fig. A-13. Effects of transmission line losses on received signal. Left—Converter at receiver, 200 feet RG-59/U from antenna to converter. Right—Converter at antenna, 200 feet of RG-59/U from converter to receiver.

Installing UHF Antennas

The installation of a 300-ohm transmission line for UHF reception requires greater care than is necessary with VHF installations. As already pointed out the line must be supported so that it does not run too close to walls or other surfaces. The line should be kept a minimum of six inches away from all objects.

When running a line sharp turns should be avoided whenever possible. If 300-ohm tubular line is used the antenna end of the line should be sealed to prevent water from entering the hollow center. This can be accomplished by using electrical tape or by heating the end of the line until it softens and forcing it closed.

The installation should be surveyed carefully to find the shortest path for the transmission. In all other respects normal precautions should be followed — all connections should be clean and tight, the cable should not be pieced, etc.

The same general rules used in VHF antenna installation apply to UHF installation with one exception. The antenna height should be varied while the signal amplitude is checked. As mentioned earlier in this article lowering an antenna a few feet may improve the signal pickup.

PRODUCTION CHANGES

RA-164-165

No. 6542251

Reason:

To improve picture quality in weak signal areas by reducing picture noise and increasing sync stability.

Procedure: See Figure S-1.

1. Remove the jumper between terminals 2 and 3 of TB-2, and connect R245 a 27K, 10%, ½W resistor between these terminals.
2. Remove the blue lead from the junction of R203-R222 and connect it to terminal 3 of TB-2.
3. Replace C218 with a .02 mf, 20%, 600V condenser and C221 with a .02 mf, 20%, 400V condenser.
4. Replace R230 with a 3.9 meg, 10%, ½W resistor, R226 with a 22K, 10%, ½ resistor, R227 with an 18K, 10%, 1W resistor and R242 with a 27K, 10%, ½W resistor.

Parts Required:

SYMBOL	PART NUMBER	DESCRIPTION
C218	03 120 770	Cap Pa .02 mf, 20%, 600V
C221	03 120 570	Cap Pa .02 mf, 20%, 400V
R226	02 031 930	Res C 22K, 10%, ½W
R227	02 034 920	Res C 18K, 10%, 1W
R230	02 032 200	Res C 3.9 meg, 10%, ½W
R242	02 031 940	Res C 27K, 10%, ½W
R245	02 031 940	Res C 27K, 10%, ½W

The first chassis so modified is:
Serial Number 6542251 Coded C-7

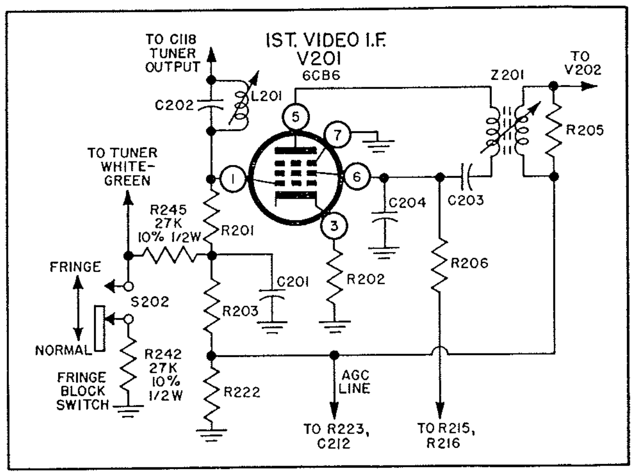

Fig. S-1. R245 is placed in series with the tuner green white a-g-c lead, but does not affect the tuner a-g-c voltage when the Fringe Block switch, S202, is open. When S202 is closed R203, R242 and R245 are shunted across R222, the a-g-c bleeder resistor, reducing the source a-g-c voltage. The tuner a-g-c voltage is further reduced by the R242, R245 resistor divide down.

DIRECTOR'S CORNER (Cont.)

three inches long can have an impedance of 300 ohms.

The primary interest of servicemen will focus initially on the practical requirements for a good UHF installation. Herein lies the major differences with which we must concern ourselves.

Good, directional antennas will be required. Transmission line losses are important, especially in wet weather. Placement of lead-in is critical.

We are sure that these and other problems of a good UHF installation will be met with the serviceman's typical ingenuity. Portland has already shown the way. With no experience behind them, Portland servicemen have put up thousands of satisfactory UHF installations.

When we look back at the progress our industry has made in a few short years we can feel confident in our ability to take UHF in stride.

LINE REGULATING TRANSFORMER

In locations where wide variations in line voltage are encountered television reception can be greatly improved by stabilizing the line voltage at the input of the set.

This can be accomplished by means of a line-voltage regulating transformer. A transformer suitable for use with Du Mont Model RA-160, 162, 164 and 165 Telesets is the Sola type CVA, catalog number 7202, manufactured by the Sola Electric Co., of 4633 W. 16th Street, Chicago, Illinois. This transformer has an output capacity of 300VA. Its output voltage is regulated to within ± 3% with line voltage fluctuations of 95-130 volts.

DU MONT
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SERVICE NEWS

Service News

PUBLICATION OF THE TELESET SERVICE DEPARTMENT
ALLEN B. DU MONT LABORATORIES, INC., PATERSON, N. J.

Volume 2 DECEMBER, 1952 Number 11

DIRECTOR'S CORNER

BY
Harold J. Schulman

I am wondering whether or not we, as members of the television service fraternity, are taking sufficient advantage of the science of semantics. This science deals with the emotional connotations of words, rather than the actual words themselves.

A long time ago the airlines learned that they could help remove the butterflies from the stomachs of first-time passengers by calling the belts that held the passengers in their chairs, Seat Belts instead of Safety Belts. Nowadays, they never tell you that "we're rushing into a storm." They say "mild turbulence ahead."

Perhaps we can increase the public's acceptance of service and its attendant costs, if we call our work "maintenance" instead of repair.

If you replace a small tube for a customer one week and find that two weeks later you are called back to replace another one, the impact of the second call, on the customer, will be lessened if during the first call it is pointed out that small tube replacement is part of the normal maintenance of a television receiver; that it may very well be necessary to replace any of the other small tubes at any time.

This can be compared to replacing a fouled spark plug in a car. The auto mechanic doesn't thereby guarantee the remaining plugs. This similarity can be pointed out to the customer, tactfully, as a matter of information.

Some people don't like the idea of being told that your service work is done on a C.O.D. basis. Then why

(CONTINUED ON PAGE 87)

U H F
Reception

Two methods are currently being used to receive UHF stations on existing VHF receivers. One system involves the use of special tuner strips which are inserted in place of the tuner strips for an unused channel. The other system makes use of a UHF converter ahead of the receiver. To familiarize the service technician with these methods of UHF reception a brief description of each follows.

UHF Converters

The purpose of a converter is to heterodyne or convert the frequency of the desired signal to a lower frequency, within the range of the VHF receiver. For maximum flexibility the converter should provide the following features:

1. It should cover the entire UHF band from channel 14 through channel 83, a frequency range of 470 mc to 890 mc.
2. It should provide output on at least two VHF channels, so that the user can select an unoccupied channel.
3. Output impedances of 72 and 300 ohms.
4. It should have its own power supply.
5. A switch should be provided to simultaneously turn the converter on and off, and transfer the input of the VHF receiver from the output of the converter to the VHF antenna.

A block diagram of a typical UHF converter which fulfills the above requirements is shown in Figure R-1. A switch located on the converter shifts the input of the VHF receiver between the VHF antenna and the output of the converter. Simultaneously this switch turns the converter off and on.

A high-pass filter is provided at the UHF antenna input of the converter. This filter *cuts off* in the neighborhood of 300 to 400 mc, passing everything above, and attenuating all signals below, the cut-off frequency. The purpose of the filter is to prevent VHF signals from feeding through the converter into the receiver when receiving UHF signals. If VHF signals enter the receiver under these conditions interference will result.

From the output of the high-pass filter the signal is fed to a preselector

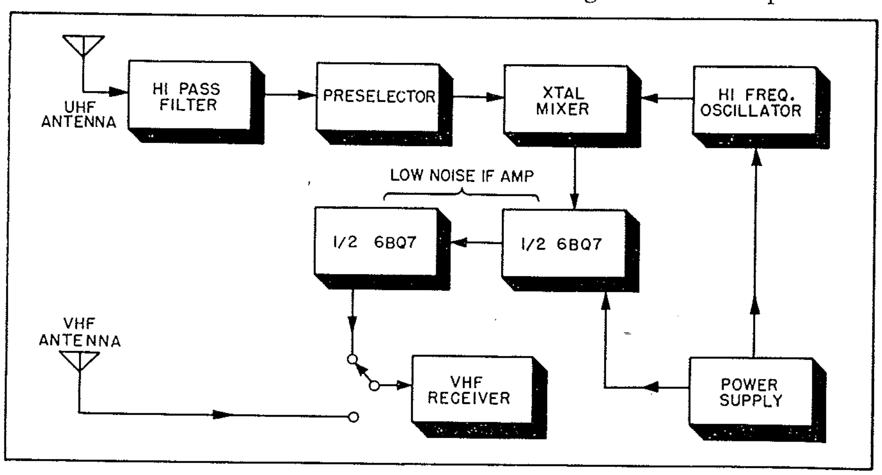

Fig. R-1. Block diagram of a UHF converter.

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circuit which passes the desired channel and rejects all others. In other words, the actual channel selection takes place in the preselector. It usually consists of a number of cascaded tuned circuits, to provide the required selectivity and a small amount of gain.

The output of the preselector is applied to a crystal mixer in conjunction with the signal from the high-frequency oscillator. The high-frequency oscillator is tuned to a frequency equal to the frequency of the desired UHF channel minus the output frequency of the converter. As an example, if the converter is to operate into a receiver tuned to channel 5 (77.25 mc video and 81.75 mc sound) and the converter is tuned to channel 27 (549.25 mc video and 553.75 mc sound) the local oscillator would be tuned to 549.25 mc minus 77.25 mc or 472 mc.

The output of the mixer is amplified by a 6BQ7 low-noise i-f stage before application to the input of the receiver. This stage eliminates the possibility of degrading the converter noise figure in the event the converter is used with an early receiver having a noisy tuner.

In some converters, the high-frequency oscillator is operated at a submultiple of the required frequency, and a harmonic is used to beat with the incoming signal. Sufficient tuning range and band width are provided so that converter output can be obtained on two channels (usually channels 5 and 6), to permit the user to select a channel which is not in use in his area.

Tuner Strips

The tuners used in Du Mont model RA-160, 162, 164 and 165 receivers are of the 12-channel turret type. The tuner coils are mounted on small strips which clip in place in the tuner turret.

These receivers can be used to receive UHF stations by removing the tuner strips from an unused channel, and substituting special strips for the desired UHF station. The construction of the UHF strips is shown in Figure R-2.

The UHF strips are actually compact converters. With the addition of the UHF strips the set becomes a dual conversion UHF receiver. The circuits mounted on the strips convert the incoming signal to an intermediate frequency in the 100 to 174 mc range. The particular intermediate frequency used depends, among other things, upon the UHF channel involved. The intermediate frequency signal is then applied to the tuner r-f amplifier. In the regular tuner mixer stage the signal is converted a second time, to provide the receiver's normal i-f signal. A block diagram of a tuner with UHF strips is shown in Figure R-3.

Miniature preselector and crystal mixer circuits are mounted on the antenna strip. The desired UHF signal is converted to a frequency within the normal tuning range of the receiver in the crystal mixer. It is then fed to the input of the tuner r-f stage. This stage functions as an i-f amplifier. The input and output coils of the i-f amplifier are located on the strips.

To convert the incoming UHF signal to a lower frequency, a local oscillator signal must be applied to the crystal mixer with the UHF signal. This local oscillator signal is obtained by applying the tuner oscillator signal

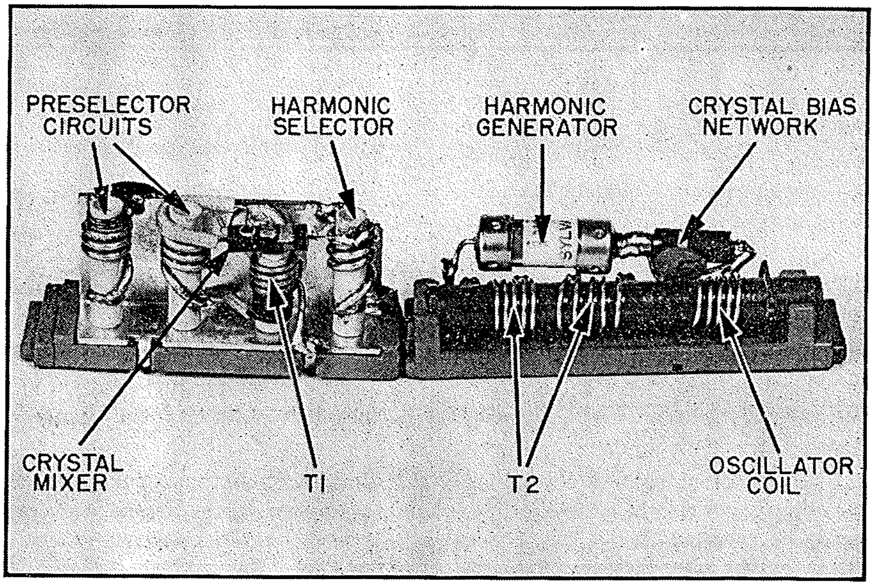

Fig. R-2. Turret tuner UHF channel strips.

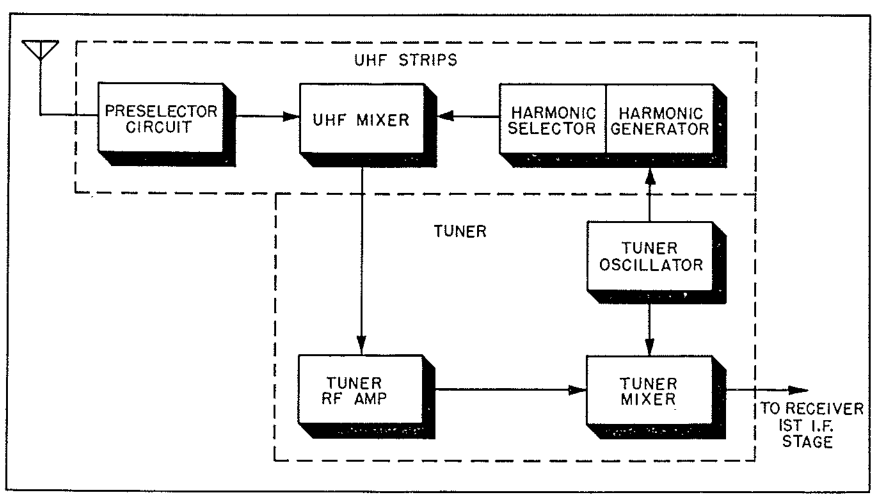

Fig. R-3. Block diagram of turret tuner UHF channel strips.

to a crystal harmonic generator located on the oscillator-converter strip.

An interconnecting lead feeds the output of the harmonic generator to a tuned circuit located on the antenna strip. This tuned circuit selects the proper oscillator harmonic for application to the UHF crystal mixer.

The circuit diagram of a set of UHF strips is shown in Figure R-4. The incoming signal is coupled to the preselector circuit by means of coil L_1. The preselector consists of two cascaded tuned circuits, L_2 - C_2 and L_3 - C_3.

The output of the preselector is inductively coupled to the mixer, as shown in Figure R-4.

To provide the required local oscillator signal, the tuner oscillator signal is applied to a crystal harmonic generator (on the oscillator-converter strip) through R_1 and C_6. The output of the harmonic generator is fed to a harmonic selector tuned circuit, L_4-C_4, on the antenna strip.

The output of the crystal mixer is coupled to the input of the tuner r-f stage by means of transformer T_1. This transformer consists of two coils mounted on the antenna strip. As previously mentioned the r-f stage functions as an i-f amplifier. The i-f amplifier plate to tuner grid coupling circuit consists of T_2 located on the oscillator-converter strip.

The tuner mixer functions in the usual manner, converting the output of the tuner r-f stage to the receiver i-f frequency.

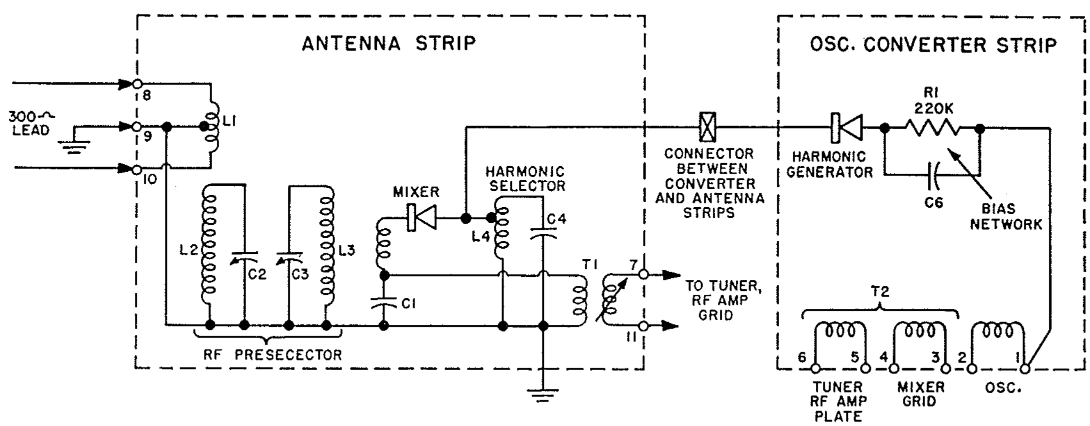

Fig. R-4. Schematic diagram of turret tuner UHF channel strips.

Test Pattern Analysis

A great deal of information has appeared in literature describing the use of the test pattern in the adjustment and troubleshooting of television receivers. However, little information has appeared discussing the use of the test pattern as an indicator of video response. Several of the video response characteristics which can be determined by observation of a test pattern will be discussed here.

High-Frequency Response

The high-frequency response of a television receiver can be determined by observing the vertical wedges of the test pattern. If the high-frequency response of a receiver is good, the lines in the vertical wedge will be sharp and clear at the point where they meet the center of the pattern. If the high-frequency response of a receiver is poor, a portion of the lines will be indistinguishable near the center of the pattern.

The overall video frequency response of a receiver can be determined by finding the total number of vertical lines which can be resolved. The frequency response in megacycles may then be calculated from the total number of lines.

The "number of lines" that can be reproduced is determined in the following manner:

1. Note the innermost point on the vertical wedge at which it is possible to clearly distinguish between the black and white lines.
2. Measure the width of the wedge at this point.
3. Measure the height of the picture.
4. Count the total number of black and white lines in the vertical wedge.
5. The total number of lines resolved can be found as follows:

$$N = \frac{\text{height of pix x total lines in wedge}}{\text{width of wedge at point in question}}$$

Once the number of lines has been established, the frequency in mc, at the point in question, can easily be determined as follows:

$$f_{mc} = \frac{N}{80}$$

For example, if the resolving capability is 300 lines then the frequency response needed to reproduce the 300 lines is as follows:

$$f_{mc} = \frac{300}{80} = 3.6 \text{ mc}$$

In other words, 1 mc response corresponds to 80 lines resolution.

It should be noted that the maximum high-frequency response which can be determined in the above way depends upon the particular test pat-

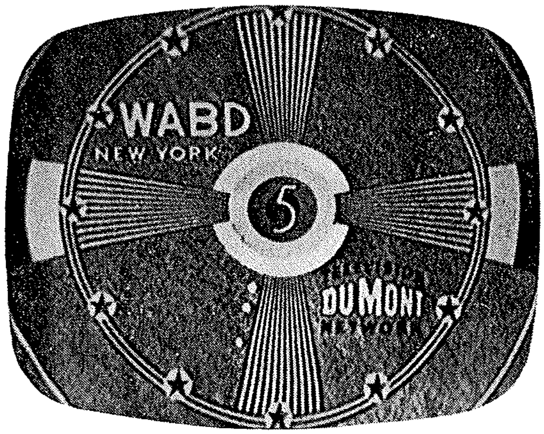

Fig. P-1. Test pattern showing a response in excess of 3.5 mc. The vertical lines are resolved down to the center of the pattern.

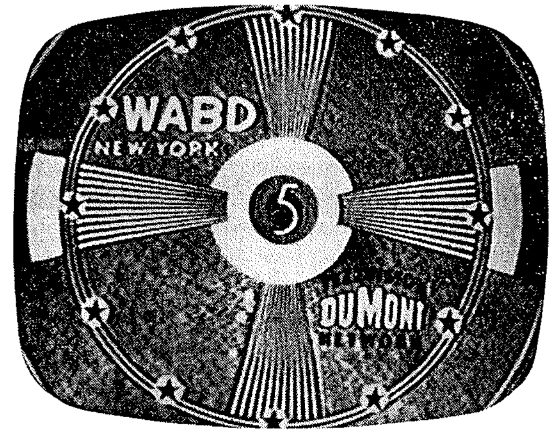

Fig. P-4. Reduction in contrast in portion of vertical wedge indicating dip in response as shown in figure 5.

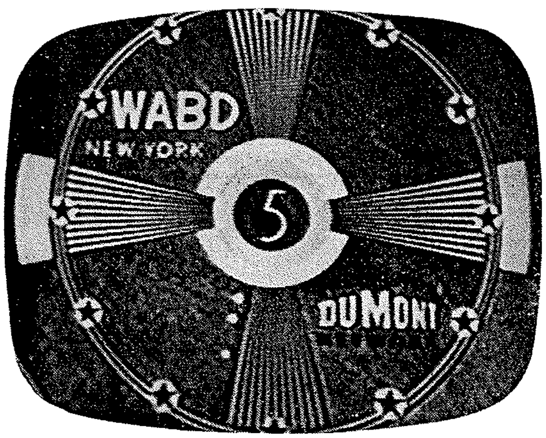

Fig. P-2. Test pattern showing an excessive low frequency response, the contrast of the horizontal wedge is greater than in the vertical.

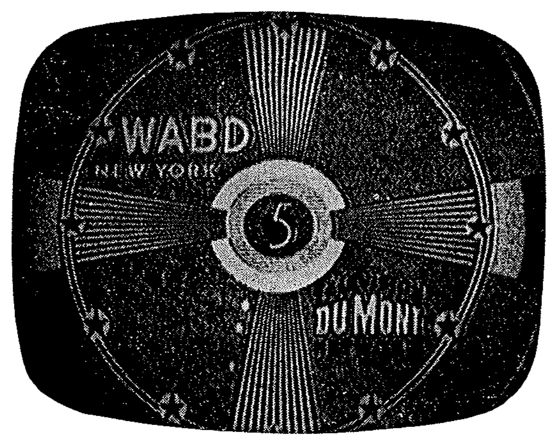

Fig. P-6. Trailing whites often caused by low video i-f carrier position. Note lack of contrast in horizontal wedge.

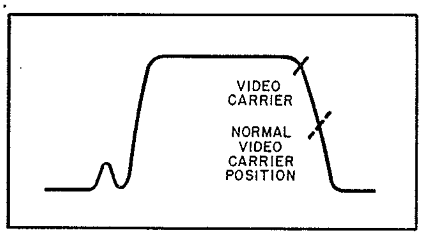

Fig. P-3. High carrier position causes excessive low frequency response as illustrated in figure P-2 above.

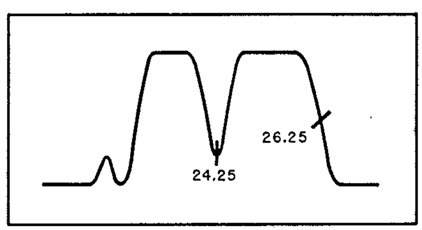

Fig. P-5. Dip in i-f response due to improperly aligned trap produces effect illustrated in figure P-4.

tern used. As an example, the test pattern in Figure P-1 indicates a high-frequency response in excess of 3.5 mc when the lines in the vertical wedge are resolved at the point where they meet the center of the pattern. To determine the high-frequency response required to reproduce the inner end of the vertical wedge of a particular test pattern, measure the width of the inner end of the wedge and use the formulas on page 83.

The flatness of the overall response of a receiver can also be determined by observing a test pattern. Equal contrast in the vertical and horizontal wedges indicates a fairly flat overall response. If the contrast of the horizontal wedges is greater than that of the vertical wedges as shown in Figure P-2, the low-frequency response is excessive.

This condition is usually due to incorrect video i-f carrier positioning (the carrier is too high on the curve), as shown in Figure P-3.

A reduction in contrast in a portion of the vertical wedges, as shown in Figure P-4, indicates a dip in the video i-f response curve. The alignment curve which produces this condition is shown in Figure P-5. Note that the depression in the curve occurs approximately 2 mc from the video carrier. This corresponds to the loss of response indicated by the test pattern. This condition can be caused by a badly misadjusted trap or i-f transformer.

Figure P-6 shows a test pattern exhibiting the effects of poor low-frequency transient response. This is indicated by the trailing whites. The condition is often due to a low video i-f carrier position, which can be remedied by realignment.

Ringing

Another condition which can be detected by observation of a test pattern is shown in Figure P-7. It is usually referred to as ringing and is caused by a sharp peak in the video i-f response curve. A sudden change in the amplitude of the signal produces a damped oscillation at the frequency of the peak in the curve. The effect produced is similar to, and is often confused with, ghosts.

Note that the ghost produces a complete displaced image, as shown in Figure P-8, while ringing only produces a multiple image at the frequency of the response peak. An easy way to distinguish between ringing and ghosting is to detune the receiver slightly. When this is done the spacing between the ghost and the image will remain the same, while the spacing between the image and the ringing will change.

Overpeaking in the video amplifier or a high-frequency peak in the video i-f response, can cause regeneration which shows up in the test pattern as illustrated in Figure P-9.

Figure P-10 shows a test pattern illustrating the effect produced when sound reaches the picture tube. Note that the vertical wedges are fuzzy and distorted. This condition is usually due to an improperly adjusted sound trap or an incorrect video i-f carrier position (too low).

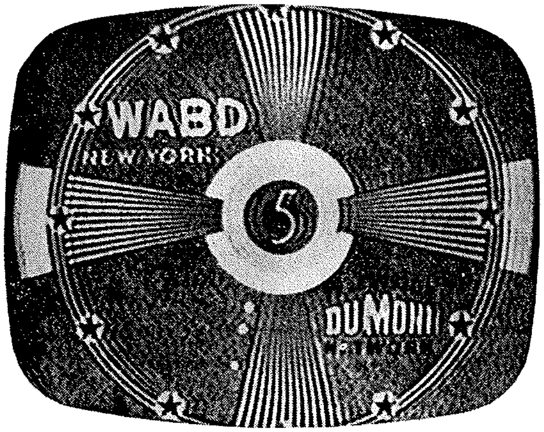

Fig. P-7. Test pattern illustrating ringing. This condition is caused by a sharp peak in the video i-f response curve.

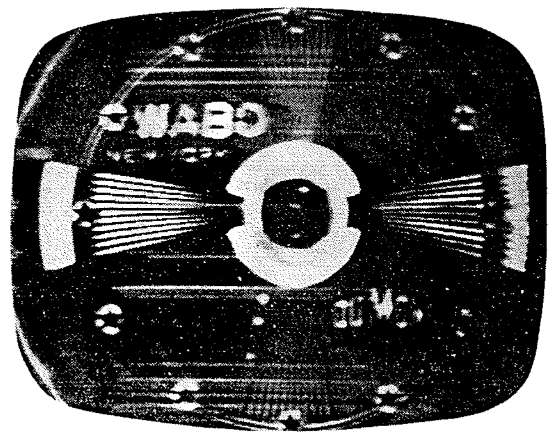

Fig. P-9. Test pattern showing the effects of regeneration. This condition causes an extremely poor, unstable picture.

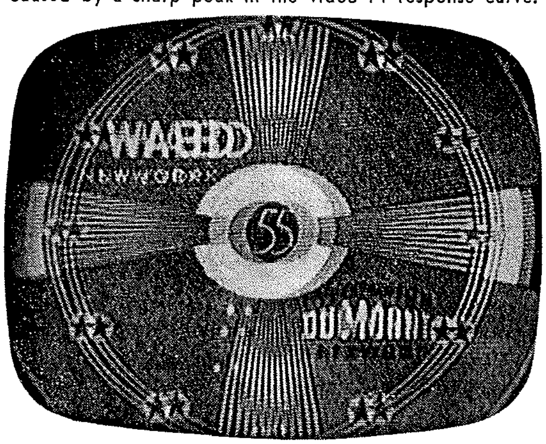

Fig. P-8. Test pattern illustrating a ghost. The multiple image is caused by dual path reception.

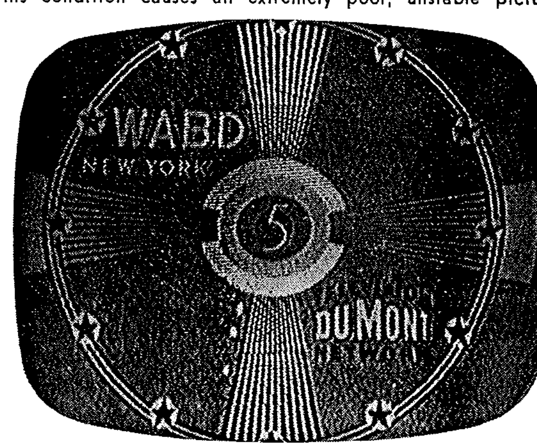

Fig. P-10. Sound in the picture. Note the ripples in the vertical wedge which destroy picture resolution.

REPLACING

RA164-165 CRYSTAL DETECTORS

A crystal diode is used in the video detector stage of the RA-164-165 Teleset, as shown in Figure D-1. While the crystals used are very dependable, defective crystals will occasionally be encountered.

In addition to complete loss of video, several other symptoms can be produced by a defective crystal. The overload condition, shown in Figure D-2, occurs when the output of the crystal falls off. This causes a reduction in the amplitude of the signal fed to the a-g-c circuit, permitting the gain of the set to increase to a point which produces overload of the video i-f stages. This condition will only occur in strong signal areas.

In weak to moderate signal areas a reduction in the output of the crystal will result in a reduction in contrast.

Figure D-3 illustrates a horizontal hook condition due to sync compression in the video detector.

Other symptoms caused by the video detector are shown in Figures D-4 and D-5. D-4 shows sound in the picture. This condition can occur in an RA-165 Teleset if it is improperly tuned. However, if sound appears in the picture when the fine tuning control is adjusted for maximum resolution, the possibility of a defective crystal is indicated.

Figure D-5 shows a bad smear which can be caused by a faulty crystal.

All of the symptoms just described can, of course, be produced by other circuits in the set, consequently, the usual checks should be made before assuming that the crystal detector is defective.

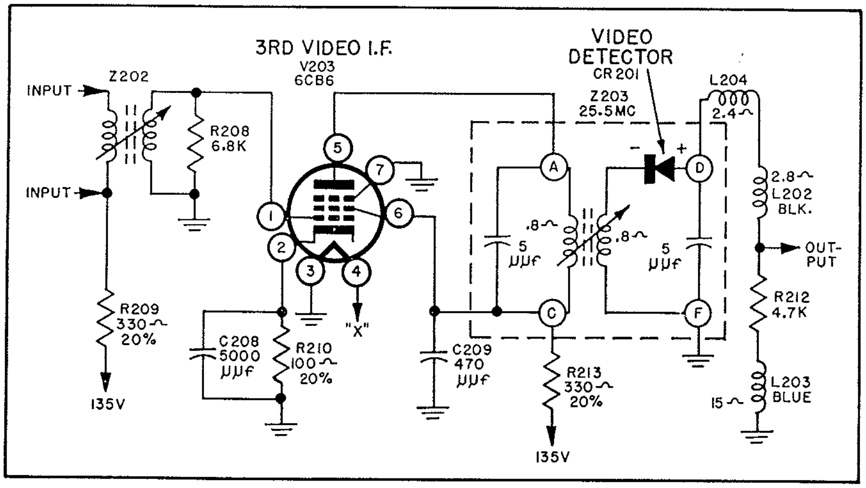

Fig. D-1. Schematic diagram of the RA 164-165 crystal video detector.

Checking Crystals

Crystals are often checked by measuring their front and back resistances. Unfortunately, this technique is of little use in determining whether or not a crystal will function properly as a video detector.

The only sure way to check a crystal is by substitution. When performing this check the last i-f transformer must be realigned when the new crystal is substituted, since individual crystals have different loading effects on the transformer.

Replacement

A crystal will be damaged if it is heated excessively. Grasp the crystal leads with a pair of long nose pliers when soldering or unsoldering them. The pliers should be placed between the body of the crystal and the solder joint as shown in Figure D-6.

Application of B+ voltage to a

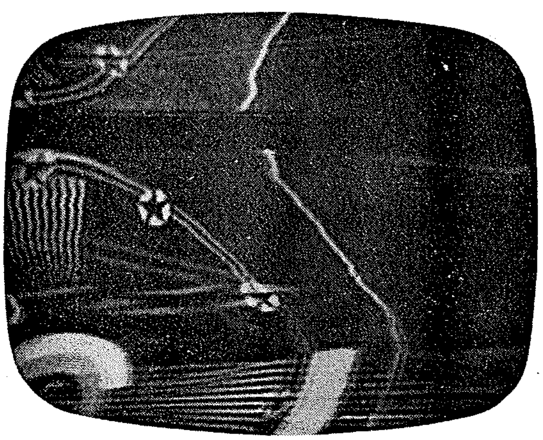

Fig. D-2. Picture overload due to a defective crystal. The a-g-c voltage drops and overload occurs in the i-f stages.

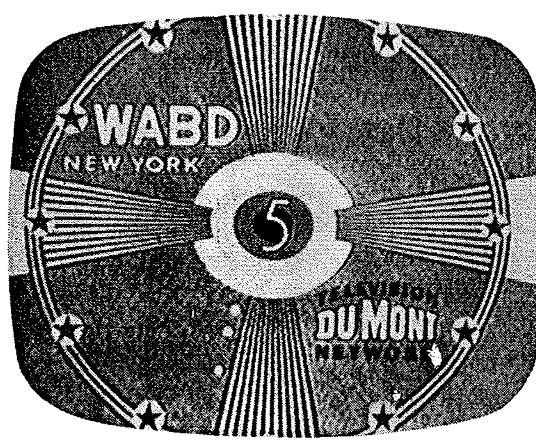

Fig. D-4. Sound in the picture due to a defective crystal. The proper tuning point and disappearance of sound ripple no longer coincide.

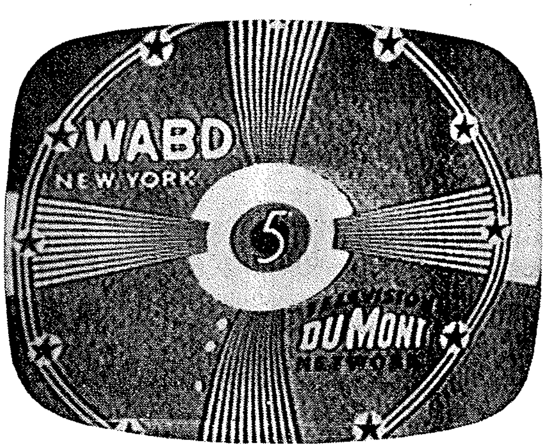

Fig. D-3. Picture hook due to a defective crystal. The condition is produced by compression of the sync pulses in the crystal detector.

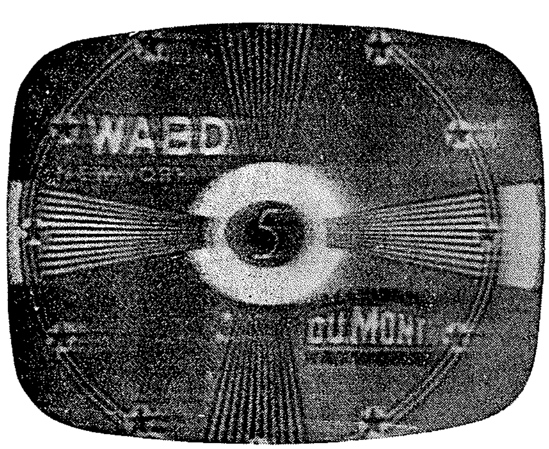

Fig. D-5. Smear, as illustrated above, can be caused by a defective crystal which loads down and detunes the last i-f transformer.

crystal will damage it. When working on a receiver exercise care to prevent this from happening.

Use an exact replacement part whenever possible. The crystals used in RA-164-165 Telesets are specially selected for their performance in these receivers. Du Mont part number 26 001 081 is the exact replacement.

If locally purchased crystals are used for replacement, several will usually have to be tried before satisfactory performance is obtained.

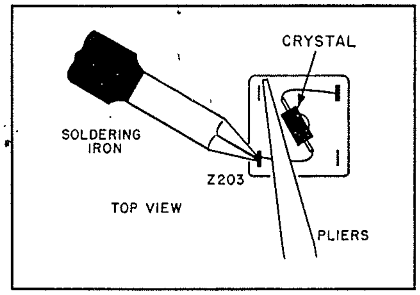

Fig. D-6. Illustration showing a pliers being used as a heat guard. The heat of the iron is bled off protecting the crystal.

DIRECTOR'S CORNER (Cont.)

not call it "pay as you go maintenance."

I am sure that if you give a little thought to all the words and actions that go to make up a service call — from the time the telephone rings to the moment you close your tool kit on a satisfactory repair — you will agree that there is plenty of room for much more *sell* in both our *words* and our *actions.*

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