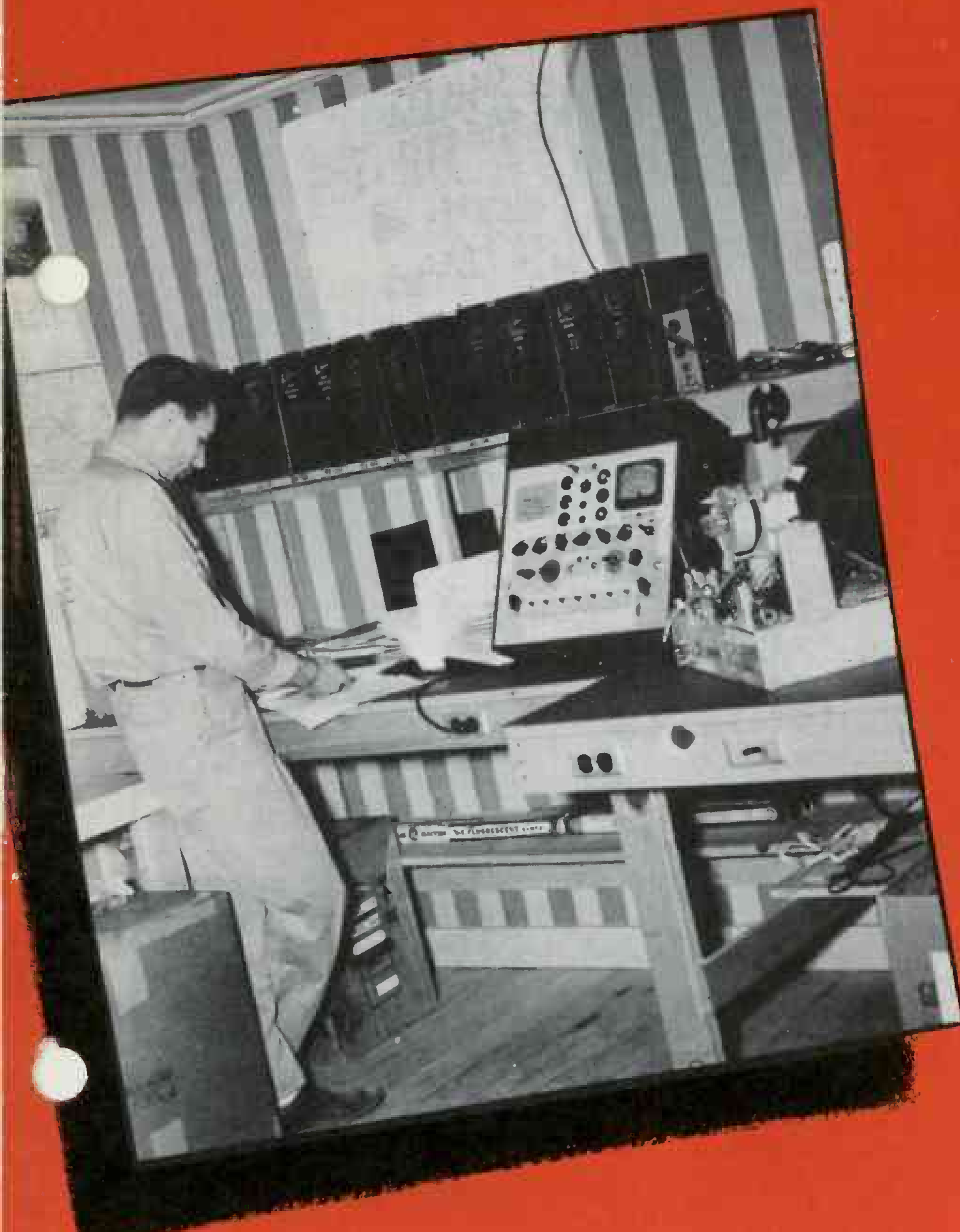
J. W. Sams

PHOTOFACT

INDEX

AND TECHNICAL DIGEST



Nov. • Dec. • 1951

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INDEX No.

29

COVERING PHOTOFACT FOLDER SETS 1 THRU 152

CONTENTS

10¢

HOW TO REPLACE 41 CONCENTRIC DUALS IN 484 TV MODELS—WITH ONE CONCENTRIKIT TWO SHAFT ENDS AND TWO BASE ELEMENTS

Widest Coverage—Minimum Investment

Here's an example of how IRC Concentrikit gives you extremely wide replacement coverage at a very minimum of investment—puts you in a position to make quick replacement without special trips or waiting for needed controls—saves you time *and* money—enables you to give your customer much faster service on TV Concentric Dual replacements.

Invest $2.75—Cover 484 TV Models

To stock original controls or exact duplicate replacements for these 41 Concentrics requires an investment considerably beyond most service shops ($30 to $40)—particularly since these cover only one combination of many occurring in TV sets. However, an investment of $2.75 in IRC Concentrikit and accessories puts you in a position to handle any one of these 41 different Concentrics!

Here's All You Need

1—IRC K1 Concentrikit
1—IRC Base-Element—B11-137
1—IRC Base-Element—B11-123
1—IRC Shaft End—E-187
1—IRC Shaft End—E-202

shafts. If you have had requirements for Vertical and Horizontal Hold Concentrics, you'll be prepared next time by having on hand the few IRC parts listed below.

Here's FULL Coverage

For greatest coverage, get the IRC Concentrikit Dealer Stock Assortment No. 13. Contains four complete Concentrikits plus a balanced stock of 37 Base-Elements and other accessories. Good-looking, four-drawer all-metal cabinet included at no extra cost. Dealers net price, $24.78.

Get The Handy TV Control Manual

IRC TV Control Manual covers both standard and concentric dual replacements in TV, and covers concentric duals in home and auto sets as well. Provides complete data on use of Concentrikit. Form SO86A. Available from your distributor or will be sent direct upon receipt of 50c, stamps or coins.

Write for Separate Chart

For separate chart on Vertical and Horizontal Hold Concentric Duals, plus coverage by Models, request Form SO54. Catalog DC2A provides complete data on Concentrikit Assortment No. 13.

CONCENTRIC DUAL CONTROLS FOR VERTICAL AND HORIZONTAL HOLD EMPLOYING ONE CONCENTRIKIT, TWO BASE-ELEMENTS AND SHAFT ENDS

Trade Name	Part No.	No. of Models	Use	IRC BASE-ELEMENT Panel	IRC BASE-ELEMENT Rear	Shaft End
ADMIRAL	75B11-5	89	Ver & Hor Hold	B11-137	B11-123	E-202
AIR KING	P970111-8	4	Ver & Hor Hold	B11-137	B11-123	E-187
ANSLEY	P970111-8	1	Ver & Hor Hold	B11-137	B11-123	E-187
ARTONE	PD-5	3	Ver & Hor Hold	B11-137	B11-123	E-187
	25B786	1	Hor & Ver Hold	B11-123	B11-137	E-202
BRUNSWICK	390036	7	Ver & Hor Hold	B11-137	B11-123	E-187
CAPEHART (Farnsworth)	78160	2	Hor & Ver Hold	B11-123	B11-137	E-202
CORONADO	25B786	1	Hor & Ver Hold	B11-123	B11-137	E-202
	25B861	1	Hor & Ver Hold	B11-123	B11-137	E-202
	78x2	10	Ver & Hor Hold	B11-137	B11-123	E-187
CROSLEY	W139173	4	Ver & Hor Hold	B11-137	B11-123	E-187
DELCO	1219250	2	Hor & Ver Hold	B11-123	B11-137	E-202
	25B786	1	Hor & Ver Hold	B11-123	B11-137	E-202
DEWALD	3034A	19	Ver & Hor Hold	B11-137	B11-123	E-187
EMERSON	390036	12	Ver & Hor Hold	B11-137	B11-123	E-187
	390074-3	1	Ver & Hor Hold	B11-137	B11-123	E-187
	390075	1	Bright & H Hold	B11-137	B11-123	E-187
	390087	1	Ver & Hor Hold	B11-137	B11-123	E-187
	390141	1	Ver & Hor Hold	B11-137	B11-123	E-187
FADA	52.21	10	Ver & Hor Hold	B11-137	B11-123	E-187
	52.66	19	Ver & Hor Hold	B11-137	B11-123	E-187
FIRESTONE	TVC-118D	1	Ver & Hor Hold	B11-137	B11-123	E-187
	TVC-501D	1	Ver & Hor Hold	B11-137	B11-123	E-187
GAMBLE-SKOGMO	25B786	1	Hor & Ver Hold	B11-123	B11-137	E-202
	25B861	1	Hor & Ver Hold	B11-123	B11-137	E-202
	78x2	10	Ver & Hor Hold	B11-137	B11-123	E-187
HALLICRAFTERS	25B786	6	Hor & Ver Hold	B11-123	B11-137	E-202
	25B788	8	Hor & Ver Hold	B11-123	B11-137	E-202
	25B894	8	Hor & Ver Hold	B11-123	B11-137	E-202
HOFFMAN	T4804	5	V. Hold & Bright	B11-137	B11-123	E-187
INTERSTATE STORES	PD-5	2	Ver & Hor Hold	B11-137	B11-123	E-187
MAJESTIC	C8.217-3	1	Ver & Hor Hold	B11-137	B11-123	E-187
MECK	VC12117	1	Ver & Hor Hold	B11-137	B11-123	E-202
MONTGOMERY WARD	C8.217-3	4	Ver & Hor Hold	B11-137	B11-123	E-187
	25B788	3	Hor & Ver Hold	B11-123	B11-137	E-202
	78x2	13	Ver & Hor Hold	B11-137	B11-123	E-187

Trade Name	Part No.	No. of Models	Use	IRC BASE-ELEMENT Panel	IRC BASE-ELEMENT Rear	Shaft End
NATIONAL	L285-1	16	Ver & Hor Hold	B11-137	B11-123	E-187
OLYMPIC	PT-1479	26	Ver & Hor Hold	B11-137	B11-123	E-187
PACKARD BELL	25820	8	Ver & Hor Hold	B11-137	B11-123	E-202
PHILCO	33-5563-3	15	Hor & Ver Hold	B11-123	B11-137	E-187
	33-5563-6	1	Hor & Ver Hold	B11-123	B11-137	E-187
	33-5563-20	7	Hor & Ver Hold	B11-123	B11-137	E-187
	33-5563-23	7	Hor & Ver Hold	B11-123	B11-137	E-187
RCA	P970111-8	14	Ver & Hor Hold	B11-137	B11-123	E-187
	P970111-24	19	Ver & Hor Hold	B11-137	B11-123	E-187
	P970913-26	37	Ver & Hor Hold	B11-137	B11-123	E-187
REGAL	CM4994	5	Ver & Hor Hold	B11-137	B11-123	E-187
	P970111-8	4	Ver & Hor Hold	B11-137	B11-123	E-187
SILVERTONE	TVC-501D	1	Ver & Hor Hold	B11-137	B11-123	E-187
SPARTON	PA-4430-1	6	Hor & Ver Hold	B11-123	B11-137	E-187
	PA-4439-1	8	Hor & Ver Hold	B11-123	B11-137	E-202
STARRETT	P970111-8	11	Ver & Hor Hold	B11-137	B11-123	E-187
	PT1479	4	Ver & Hor Hold	B11-137	B11-123	E-187
STROMBERG-CARLSON	145086	1	Hor & Ver Hold	B11-123	B11-137	E-202
TECHMASTER	P970111-8	7	Ver & Hor Hold	B11-137	B11-123	E-187
TELEKING	PD-5	7	Ver & Hor Hold	B11-137	B11-133	E-187
TELETONE	TVC-114D	3	Ver & Hor Hold	B11-137	B11-123	E-187
	TVC-118D	1	Ver & Hor Hold	B11-137	B11-123	E-187
	TVC-501D	2	Ver & Hor Hold	B11-137	B11-123	E-187
	TVC-512D	1	Ver & Hor Hold	B11-137	B11-123	E-187
TELEVISTA	970111-8	1	Ver & Hor Hold	B11-137	B11-123	E-187
TRUETONE	25B786	1	Ver & Hor Hold	B11-137	B11-123	E-202
	78x2	5	Ver & Hor Hold	B11-137	B11-123	E-187
VIDCRAFT	970111-8	1	Ver & Hor Hold	B11-137	B11-123	E-187
VIDEO CORP. OF AMERICA	970111-8	6	Ver & Hor Hold	B11-137	B11-123	E-187
WESTING-HOUSE	V-5912	2	Ver & Hor Hold	B11-137	B11-123	E-202
WILCOX-GAY	19-2222	2	Ver & Hor Hold	B11-137	B11-123	E-187

Why You Need Concentrikit

TV Concentric Duals for Vertical and Horizontal Hold functions widely use two electrical values: 1 megohm, linear taper (B11-137) and 50,000 ohms, linear taper (B11-123). Either value may be found in the panel section or in the rear section. In addition to this variation, there are numerous variations in shaft lengths, inner shaft diameters and in treatment of shaft ends for knob attachment. As a result, there are 41 different Concentric Dual Controls for Vertical and Horizontal Hold functions used in 484 Models among 39 makes or trade names of TV sets.

Check The Convenient Chart

The Chart above provides a list of the Trade Names involved with specific manufacturers' part numbers, number of models and the IRC parts to use with Concentrikit for each concentric control. No other method of Concentric Dual replacements offer so wide a coverage at so low an investment!

Handy Base Elements and Shafts

IRC Base-Elements may be used for *either* panel or rear sections. IRC universal shafts enable you to quickly duplicate original

IRC

Wherever the Circuit Says —⁄\/\/\—

INTERNATIONAL RESISTANCE CO.

423 N. Broad Street, Philadelphia 8, Pa.

Pick of the Trade

"Thus in the beginning the world was so made that certain signs come before certain events."
—*Cicero*

★ ★ ★

Too long have electronic assemblies been mystic mazes. The bottom of a television chassis with its myriad snips of wire and its dotting of solder joints, its 3- or 4-inch long variables, its inch-or-two long capacitors and resistors, its couple or three inch high tubes is a thing of the past which we have with us today. The joints and the wires, most of them, are going to lessen with the years.

It can take some time. This transformation will be looked upon askance by some companies with big investments in stuff going obsolescent; and by electronic engineers who still resent the intrusion of electrical, mechanical and efficiency engineers who are encroaching more and more on their hitherto sacred domain.

But, the evidence of today is the practical application of tomorrow. In a small batch of new-product items just checked over the desk is a hermetically sealed resistor 19/32 of an inch long, a miniature switch one could balance on his fingernail, a .93-ounce relay.

★ ★ ★

Signal Corps reports that by using a powdered iron core, a standard transformer for electronic applications can be shrunk from 4¾ cubic inch to ⅔ cubic inch.

★ ★ ★

Ultrasonics is at work on the production line at Schick, Inc. High-pitched sound waves generated through a liquid solvent remove oil, grease, and metal particles from small openings in electric shaver heads. Cleaning is more thorough, costs are down 50%, and the equipment takes one-third less floor space, says Schick.

Electronic Markets
July, 1951

★ ★ ★

"Don't overlook the possibilities of industrial electronics. I know it is hard to look at the electronic picture without being blinded by the reflected glare of television. Manufacturers see the untapped market for receivers. Distributors consider the untapped market for components and parts. Advertisers think of the tremendous impact upon the buying public. Educators see television as the instrument for raising the intellectual level of the entire country. Propagandists see TV as the most effective instrument ever devised for influencing the lives and opinions of the masses.

"Television may be many things to many people in addition to being the most dazzling development of present day electronic science. But when some historian of science, a few centuries from now, weighs the various developments in the light of their contributions to the advancement of human society, television may have had the greatest impact, but industrial electronics may far outshadow TV in its effect upon standard of living and way of life."

W. R. G. Baker of GE

★ ★ ★

TV at 20,000 ft.—The first attempt to receive television aboard a transpacific Hawaii-bound airliner recently succeeded on United Air Lines' Flight 49, outbound from San Francisco. Using a three-year old RCA table model with a 10-inch screen, the program came in clear while the Stratocruiser prepared for take-off. The image grew fuzzy during take-off but as the plane gained altitude it sharpened. Reception at 20,000 feet was perfect for 250 miles west of San Francisco. Beyond that mark the signal grew weak and finally faded out, 306 miles from the Coast.

★ ★ ★

Attic TV-Rooms may be the new style in home arrangements, when UHF becomes prevalent. Most UHF receiver demonstrations so far, it must be noted, have been made in 10th and 12th-story hotel rooms, suggesting that to get a good picture, the street-level householder at any distance from a UHF transmitter may have to move his television set up directly under his roof. Ordinary downleads at UHF frequencies show great loss of signal so that, by actual experience, a room dipole on UHF is about as effective as a roof-top pickup. Perhaps a slogan of the UHF-TV station of 1953 will be "Come UP and see me sometime."

Tele-Tech
October, 1951

PF PHOTOFACT INDEX

AND TECHNICAL DIGEST

VOL. 1 • NO. 6 NOV.-DEC., 1951

JAMES R. RONK, *Editor*

Editorial Staff: Merle E. Chaney • Robert B. Dunham
W. William Hensler • Ann W. Jones • Glenna M. McRoan
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Art Directors: Anthony M. Andreone • Thomas Culver

Production: Archie E. Cutshall

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HOWARD W. SAMS, *Publisher*

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The PF (PHOTOFACT) INDEX is published every other month by Howard W. Sams & Co., at 2201 E. 46th Street, Indianapolis 5, Indiana, and is available from PHOTOFACT Distributors in the United States and Canada.

ABOUT THE COVER: The photograph is of Joseph A. Ciskie, TV Specialist, Le Center, Minnesota. Mr. Ciskie writes: "I have the PHOTOFACT Library complete to date and honestly can say that every radio and television technician who is interested in better service shops should have your service."

MILTON S. KIVER

President, Television Communications Institute

Shop Talk

A recent survey conducted by the Howard Sams organization disclosed that information on the application of test equipment headed the list of topics desired by radio and TV servicemen. This is not a surprising result since a considerable amount of skill is required not only to connect test instruments properly, but then to interpret whatever indications are obtained.

In the field of television receiver servicing, unquestionably the most difficult instrument to use properly is the TV sweep generator, which is why more TV sets today suffer from poor alignment than from almost any other defect. You cannot accurately align even a stagger-tuned video IF system with an AM signal generator; all you can do is peak the various coils and hope that the response curve closely approximates the desired form. The only way to be certain is to view the overall response with the aid of a sweep generator.

It was discovered at studies carried out at Television Communications Institute that the serviceman using a sweep generator was principally disturbed by the variety of distorted patterns he obtained after the sweep generator was connected into the circuit. This stemmed either from his unfamiliarity with the instrument's controls, or from his negligence to take certain simple, but nonetheless important, precautions.

Consider, for example, the alignment of the video IF system of a TV receiver. The signal is applied at the mixer grid and there are several methods available for such signal application. Some tuners, like the widely used Standard Coil tuner, have a special terminal projecting above the tuner chassis to which the hot lead of the sweep generator can be connected. The generator ground lead, of course, attaches to the receiver chassis. Where no such simple connecting point is available, it may be possible to reach the mixer tube grid terminal at its socket although in many instances this is not readily accessible. But suppose none of these methods are possible - what then? Simply this. Take a metal tube shield and place it over the mixer tube. Be careful that the tube shield rests on the tube, but at the same time does not make electrical contact with the chassis or any other grounded metallic surface. Then clip the hot generator lead to the metal shield.

With the sweep generator in place, next connect the oscilloscope either across the video second detector load resistor, or between grid and chassis of the following video amplifier. The signal thus obtained is fed to the vertical input terminals of the scope.

The procedure thus far is fairly straightforward and should cause no technician any difficulty. Now, however, comes the more critical portion because it is here that the mistakes are made.

Consider first the oscilloscope. Are the controls set so that a visible trace is seen on the screen? Is the horizontal sweep being driven by a 60-cycle voltage obtained from the sweep generator? Is the vertical gain control set at mid-point (as a start)?

Of these points, the last two are the more important. Nearly all present day sweep oscillators have their frequencies varied by a 60-cycle driving voltage. To obtain the proper trace (or time base) for the beam in the scope, it too should be driven by a similar voltage. In recognition of this fact, an outlet is normally provided on the front panel of the sweep generator and a lead should be connected from here to the horizontal input terminals of the scope. Then the horizontal circuits of the scope should be set to receive this voltage by turning the horizontal frequency knob to the "external" or "off" position.

Your scope is now in a position to receive the response signal of the circuit under test. Let us look next to the sweep generator. Here the following points should be checked.

1. Is the instrument set to the proper range? To sweep over a range of frequencies from 21.5 mc to 26.5 mc, the tuning indicator should be at some point between these frequencies, preferably at the midpoint.

2. Is the output control set at maximum (to start)?

3. Is the sweep width control (which determines the extent of the sweep) set at from 6 to 10 mc?

At this stage of the work, do not connect any external marker generators and/or be sure to reduce to zero any internal marker signal contained in the sweep generator. Your first step is to obtain a response curve of the system under test. Only after this has been achieved should you attempt to inject any marker pips. It was found that nearly everyone attempts to connect a marker generator at the same time that the sweep generator is connected and nine times out of ten it is the marker pip which destroys the sought for curve.

Now, if the sweep generator has been properly set up, and if the circuit under test is receiving the signal, you will get a response curve on the scope screen which will bear some resemblance to a video IF response. But let us suppose that you are not getting the curve you want - or any other recognizable curve for that matter - then let us see where you might be running afoul.

♦ ♦ Please turn to page 58 ♦ ♦

Crystal Phonograph Cartridges

... their construction and replacement.

by THOMAS W. MOWRY and VERAL M. SHIELDS

Certain crystalline substances develop a voltage upon their surfaces when they are subjected to a mechanical stress and, conversely, when a voltage is applied, a mechanical deformation of the crystal takes place. This phenomenon, discovered by the Curie Brothers in 1880, is known as the piezoelectric effect. The crystal phonograph pickup functions upon this principle.

The crystalline substance most commonly used for crystal cartridges is the crystalline form of Rochelle salts (sodium potassium tartrate). These crystals exhibit piezoelectric properties far greater than any other known material, being approximately 1000 times more active than quartz.

The crystals are first grown from a Rochelle salt solution in the form of large, clear homogeneous bars. These bars are cut into slabs from which the final crystal plates are cut.

The properties of these crystal plates may be expressed in the terms of the axes X, Y, and Z, as shown in Figure 1A. In the Rochelle salt crystal plate, the electric effect is greater along the X axis and, consequently, the plates are cut perpendicular to the X axis as shown in Figure 1B. The two fundamental "X-cut" plates, the expander and shear plates, are shown in Figures 1C and 1D. The expander plate is cut at an angle of forty-five degrees to the Y and Z axes and the shear plate is cut with the edges parallel to the Y and Z axes.

When a voltage of a given polarity is applied to the two faces of the plate, the mechanical motion developed will be at a forty-five degree angle to the Y and Z axes. As the expander plate (Figure 1C) is cut at a forty-five degree angle to the Y and Z axes, the mechanical motion developed by an applied voltage will increase its length and simultaneously decrease its width. On change of polarity of the applied voltage, the length will decrease and width increase. The cut of the shear plate as noted in Figure 1D is such that

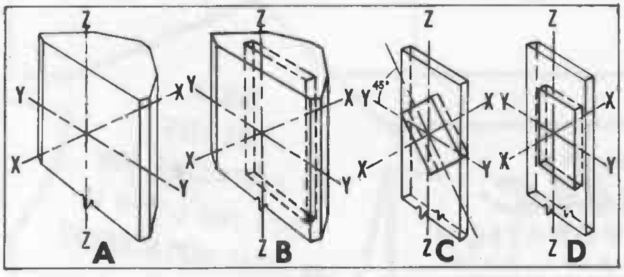


Figure 1. Cutting Angle of Expander and Shear Plate Phono Crystals Showing X, Y, Z Axes.

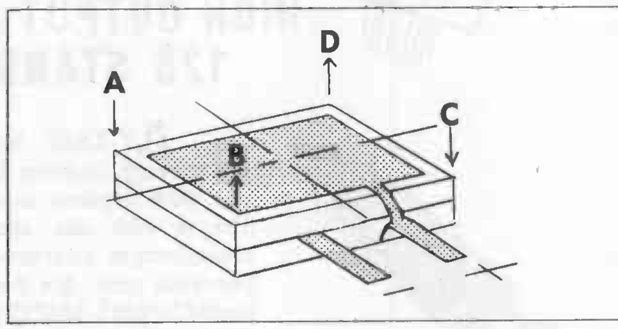


Figure 2. Movement of Corners in a "Twister" Element with a Potential Applied.

mechanical motion developed by an applied voltage will cause an expansion and contraction approximately along the diagonals of the plate.

Bender and twister elements, made commercially under the trade name "Bimorph," utilize two or more X-cut crystal plates cemented face to face.

In the "bender" type, the X-axis of two or more expander plates are so oriented that as one plate expands in either direction the other contracts. An applied electric potential tends to make one plate longer and narrower and the other shorter and wider and as a result, an unconstrained bender element tends to become saddle shaped. If one end of the element is clamped and an alternating voltage is applied, the other end moves to and fro. If both ends are clamped, the curvature in the breadth direction is largely suppressed and the central portion of the element vibrates like a diaphragm.

"Twister" elements consist of two or more shear plates cut in square, rectangular, or trapezoidal shape. When a voltage of given polarity is applied to the twister element, the shear plates tend to expand and contract along the diagonal. The plates are so oriented that the diagonal of one plate is expanding as the corresponding diagonal of the other plate is contracting.

The resultant motion of the twister element is such that corners A and C of Figure 2 have a downward motion while corners B and D have an upward motion. This action is reversed on change of polarity of the applied voltage. If the element is clamped at one end, as at BC, then the end face AD tends to rotate in its own plane. Twister elements are often mounted in this way in crystal cartridges.

Rochelle salt crystals operate safely from -40° to +130 degrees Fahrenheit. Their greatest piezo-

BOOSTERS PICKUPS MICROPHONES **PHONOGRAPH CARTRIDGES**

Astatic PRODUCTS DATA

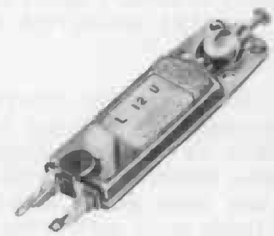
Amazingly Versatile New Astatic L-12-U Crystal Cartridge

• • •

LEAVE CONDENSER HARNESS ON FOR LOW OUTPUT (1.2 VOLTS) . . . OR SLIP IT OFF FOR HIGH OUTPUT (4.0 VOLTS) TO REPLACE OVER 125 STANDARD 78 RPM CARTRIDGES

Condenser harness slips on or off terminals with ease

AT LAST, here is the first completely satisfactory answer to a long-felt need! You can now replace most standard 78 RPM cartridges with one, single model . . . and get reproduction guaranteed to better or equal the previous unit. It's the newly perfected Astatic Dual-Output L-12-U Crystal Cartridge which puts this modern replacement magic at your finger-tips. Think of the savings in time and trouble . . . the streamlining of old problems, all the way from inventory to installation! Try the new Astatic L-12-U at the first opportunity . . . you'll adopt it at once as your number one standby.



LIST PRICE . $4.95
Code ASWSF

FEATURES:

1. Stamped steel housing.
2. Needle chuck limiting feature which restricts motion of the chuck both radially and lengthwise, prevents dislocation of chuck, and protects against crystal breakage from rough handling and when changing needle.
3. Dual-output, 1.25 or 4.0 volts at 1,000 c.p.s.
4. Range to 5,000 cycles.
5. Minimum needle pressure, 1 oz.
6. Net weight, 19 grams.
7. Furnished with complete installation instructions and listing of cartridges the L-12-U replaces.

SHURE				WEBSTER			ELECTRO-VOICE	AMERICAN	ADMIRAL
P30	P88	P93C	W57A	E4	N1	N10P	H-12	CR-1	409A1
P30B	P88S	P93D	W57AN	E9	N2	N11	H-60	CR-2	409A2
P30C	P89	P93S	W58A	F1P	N3	N11P	L-12	CR-4	409A3
P30D	P89S	P94	W59A	F2P	N4	Q1	L-12S	S-1	409A10
P30G	P90	P94B	W60A	F3P	N5	Q2	M-12	S-2	
P30S	P90B	W40A	W60B	F4P	N6		10		**PHILCO**
P30W	P90C	W41A	W61B	F5P	N6P		12		
P35	P90D	W42A	W65B	F6P	N7		50		352671
P35S	P90S	W42B	99-180	F7P	N7P		60		352671-1
P87	P92B	W42BH	99-181	F7P2	N8				
P87B	P93	W42H	99-182	F9P	N9				
P87S	P93B	W56A		F10P	N10				

Write for extra copies of complete replacement guide for L-12-U Cartridge

THE Astatic CORPORATION
CONNEAUT, OHIO
IN CANADA CANADIAN ASTATIC LTD., TORONTO, ONTARIO

Astatic Crystal Devices manufactured under Brush Development Co. patents

CHECK THIS LIST OF CARTRIDGES FOR WHICH THE L-12-U IS THE IDEAL REPLACEMENT

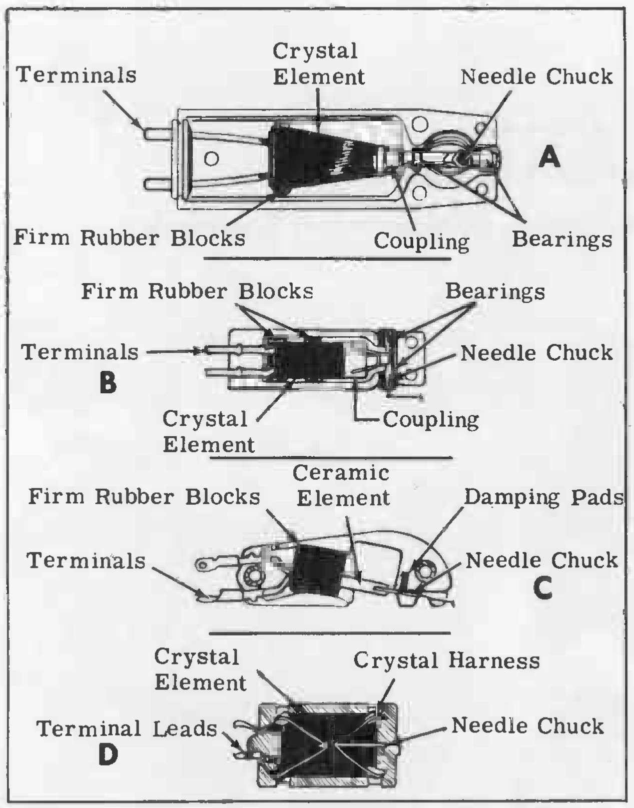


Figure 3. Examples of Various Types of Crystal Harnesses.

electric activity is at normal room temperature. When the crystals are subjected to temperatures above 130° Fahrenheit, they lose their piezoelectric properties permanently. In storing Rochelle salt crystal cartridges, care should be taken to insure that the cartridges are placed in relatively cool places. Exposure of the cartridge to the sun, as in window displays, should be avoided. If necessary to use a soldering iron on the cartridge when making an installation or servicing, the soldering iron should not be applied for a longer period than necessary to make a good joint. In climates of high relative humidity and temperature, the Rochelle salt crystal has a tendency to take on excessive moisture.

PN CRYSTAL

Another type of crystal element sometimes used in phono cartridges is the PN Crystal (Primary Ammonium Phosphate). This crystal is capable of operating at a higher temperature than the more common Rochelle salt crystal. The PN element will temporarily withstand temperatures as high as 212° Fahrenheit and will operate at temperatures as high as 140° to 160° Fahrenheit for a considerable period of time without permanent damage. Slightly higher open circuit output voltages may be obtained from the PN crystal as compared to a Rochelle salt element of the same size and in the same assembly.

The capacity of a PN crystal is approximately one-tenth the capacity of a Rochelle salt element of the same dimension. Because of the comparatively low capacity of the PN element, it should not be used to replace a Rochelle salt crystal cartridge directly. The lower capacity of the PN element makes it necessary to use a load resistance approximately 10 times the value used for a comparable Rochelle salt crystal cartridge, if the same frequency response is to be maintained.

A piezoelectric ceramic element is also used in phono cartridges. This element is especially adaptable for use in hot and humid climates. However, the output of the ceramic element is lower than for a comparable Rochelle salt crystal.

Drive Systems

Low mechanical impedance of the stylus in a phonograph pickup is very important in improving reproduction and in reducing record wear and needle talk. The high inherent stiffness of piezoelectric crystal elements necessitates the use of some efficient type of coupling between the crystal element and the needle if a high ratio of output voltage to stiffness is to be obtained. Considerable research and development have been devoted to the improvement of the coupling systems of crystal cartridges. The old, heavy, stiff-acting cartridges are being replaced by modern light weight cartridges that are much more compliant.

Several different methods are used to couple the torsional motion of the needle system to the crystal element. Some of the more common methods are illustrated in Figure 3. The crystal cartridge shown in Figure 3A uses a "twister" element. The twister element is clamped at the lead end by means of two firm rubber blocks. The needle chuck is mounted in two rubber or composition bearings. As the needle follows the groove of a record upon which sound has been recorded, the needle vibrates in proportion to the amplitude of the recorded sound. This vibration is transmitted to the soft rubber coupling between the needle chuck and the crystal element and this coupling is compressed in proportion to the torsional motion of the needle. The pressure thus developed acts upon the crystal, and a voltage is generated that is proportional to the amplitude of the recorded sound.

A crystal cartridge that uses a "bender" element is illustrated in Figure 3B. The same cartridge is shown in Figure 4A with the crystal, needle chuck, and coupling system shown separately. This cartridge

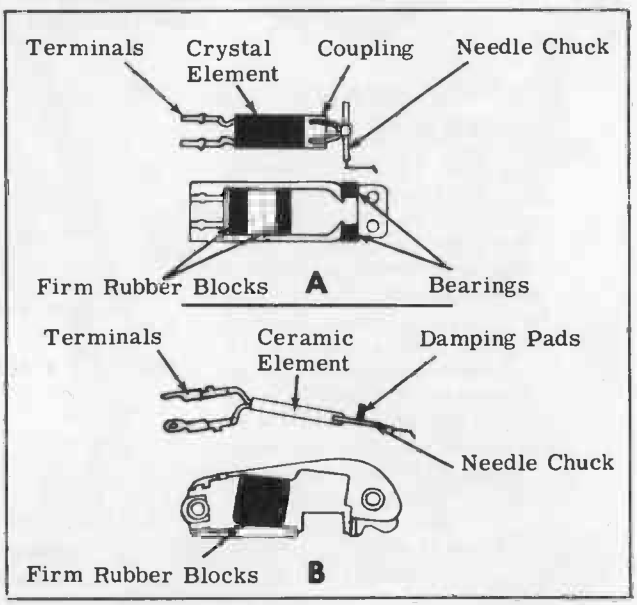


Figure 4. Crystal and Ceramic "Bender" Cartridges.

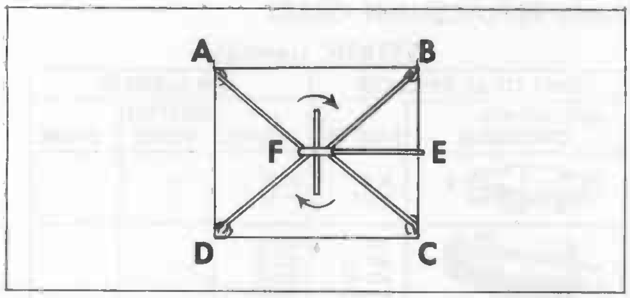


Figure 5. Harness Arrangement Employed with a Single Shear Plate Crystal.

has the crystal element clamped at approximately the middle as well as at the lead ends. The needle chuck is coupled to the crystal element in such a manner that any lateral motion of the needle applies a bending stress upon the crystal element proportional to the lateral motion. The vertical motion of the needle is absorbed by the rubber bearings of the needle chuck and produces relatively little if any bending stress upon the crystal element.

The cartridge shown in Figure 3C uses a piezoelectric ceramic element. Figure 4B is an illustration of the same cartridge with the ceramic element and needle chuck shown separately. The needle chuck is coupled directly to the ceramic element. This element is clamped at the rear portion by means of two firm rubber blocks. Any lateral motion of the needle exerts a bending stress upon the ceramic element causing a voltage to be generated that is proportional to the lateral motion of the needle.

A crystal cartridge that uses a single shear plate crystal is illustrated in Figure 3D. The harness that is attached to the corners of the crystal is composed of offset diagonals as shown in Figure 5. When a shear plate crystal is compressed along one diagonal and elongated along the other, a voltage is generated that is proportional to the applied force. If the needle chuck EF is rotated in the direction of the arrows, diagonal BD will be compressed while diagonal AC will be elongated. This distortion of the crystal produces a voltage between the faces of the crystal. Rotation of the needle chuck in the other direction compresses the crystal along diagonal AC and elongates it along diagonal BD, producing a voltage of opposite polarity between the faces of the crystal.

Another cartridge that uses a single expander plate crystal is illustrated in Figure 6. The expander plate is mounted in the harness in such a manner that when the needle chuck is rotated laterally in one direction the crystal is compressed lengthwise and expanded breadthwise, generating a voltage between the faces of the crystal. Rotation of the needle chuck in the other direction allows the crystal to expand lengthwise and contract breadthwise, producing a voltage of opposite polarity.

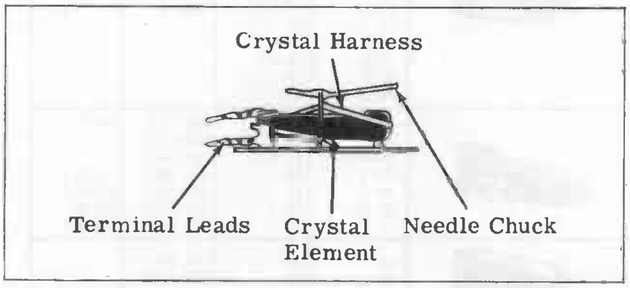


Figure 6. Crystal Harness Coupled to an "Expander" Crystal.

Lever Type Cartridge

The lever type cartridge shown in Figure 7 consists of a single lever formed of thin metal in a trapezoidal shape. The lever is slotted to allow entry of the crystal element. The rear portion of the lever and crystal assembly is held secure in the cartridge case by means of two firm rubber pads. The front of the lever is connected to the needle chuck through a composition pad which serves to provide a longitudinal shock isolation between the chuck and lever. Since the lever is rigidly coupled to the needle chuck, the lever will faithfully follow any rotary motions of the needle.

The torque transmitted from the needle chuck to the crystal by means of the trapezoidal shaped lever is built up several times. This permits decreasing needle-point stiffness without loss of output voltage.

Cartridge Replacement

Crystal cartridges are made in a variety of sizes and shapes as well as in a wide variety of electrical characteristics. The trend in recent years has been toward a lighter, more compliant cartridge with a wider frequency response. Typical old style cartridge cases were frequently cast of a heavy white metal and weighed approximately 30 grams. The modern cartridge using a stamped aluminum or bakelite case with a net weight of 4 or 5 grams is not at all uncommon. Improved needle design and more efficient drive systems have enabled manufacturers to produce a cartridge several times as compliant as the older models. The compliance or flexibility of the needle system allows the needle to more faithfully follow the modulated groove of a record and results in a more faithful reproduction.

Several million phonograph and record changers are still using the old, heavy, stiff model cartridges. This represents a potential source of income for the service technician. In many cases, these old model

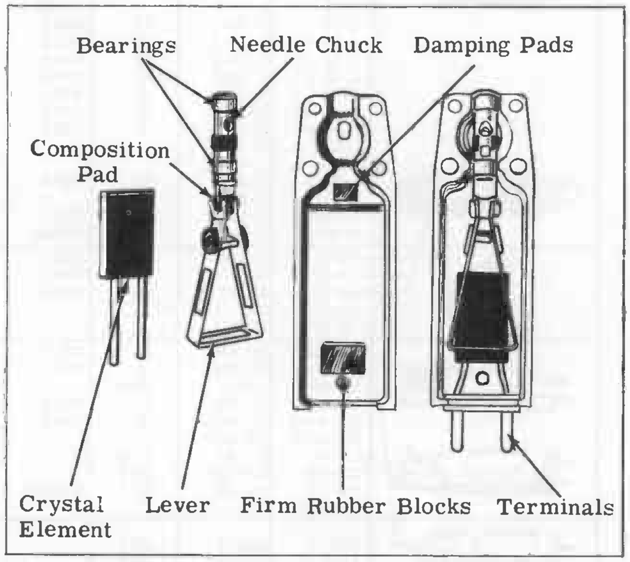
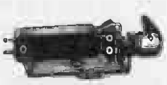
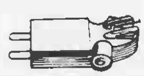
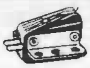
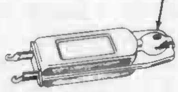
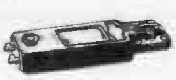
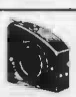
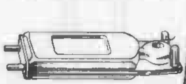
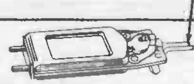


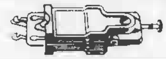
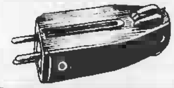
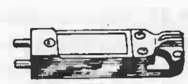
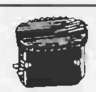
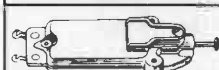
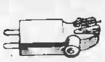
Figure 7. Details of Harness Employed with a "Twister" Element.

CRYSTAL PHONOGRAPH CARTRIDGE REPLACEMENT CHART

ASTATIC

UNIT TO BE REPLACED		REPLACEMENT		
CARTRIDGE	PART No.	ASTATIC	ELECTRO-VOICE	SHURE
	AC-C-AG-J	AC-C-AG-J	43	
	AC-C-J	AC-C-J	44	
	AC-C-78-J	AC-C-78-J	42	
	AC-J	AC-J	34	W31AR
	AC-R-J	AC-R-J		
	AC-AG-J	AC-AG-J	33	W26B
	AC-78-J	AC-78-J	32	W23B
	ACD-C-J	ACD-C-J		WC22AB
	ACD-C-1J	ACD-C-1J		
	ACD-C-2J	ACD-C-2J		
	ACD-J	ACD-J	96-T	W22A
	ACD-1J	ACD-1J	96-T	
	ACD-2J	ACD-2J	96-T	W22AB-T
	B-1	B-2		
	B-2	B-2		
	B-3	B-2		
	B-4	B 4		
	CQ-J	CAC-J	14	W31AR
	CQ-AG-J	CAC-AG-J	33	
	CAC-J	CAC-J	14	W31AR
	CAC-AG-J	CAC-AG-J	33	
	CAC-78-J	CAC-78-J	12	W23B
	GC-J	GC-J	44	
	GC-AG-J	GC-AG-J	43	WC36B
	GC-78-J	GC-78-J	42	WC33B
	L-10	L-12	60	
	L-12	L-12	60	
	L-22-A	L-26-A	12	W58A
	L-24-A	L-82-A	60	W59A
	L-25-A	L-70-A	12	W58A
	L-26-A	L-26-A	12	W42B
	L-27-A	L-26-A	12	W58A
	L-29	L-29	H-60	
	L 32-A	L-26-A	12	W58A
	L-36-A	L-82-A	60	W59A
	L-40-A	L-40-A	12	W42B
	L-41-A	L-40-A	12	W58A
	L-46-A	L-72-A	60	W56A
	L-50-A	L-72-A	60	W56A
	L-70	L-70-A	12	W58A
	L-70-A	L-70-A	12	W58A
	L-70-AS	L-70-A	12	W58A
	L-70-S	L-70-A	12	W58A
	L-71	L-71-A	12	W58A
	L-71-A	L-71-A	12	W58A
	L-71-AS	L 71-A	12	W58A
	L-71-S	L-71-A	12	W58A
	L-72	L-72-A	60	W56A
	L-72-A	L-72-A	60	W56A
	L-72-AS	L-72-A	60	W56A
	L-72-S	L-72-A	60	W56A
	L-73	L-74-A		W58HS
	L-73-A	L-74-A		W58HS
	L-73-AS	L-74-A		W58HS
	L-73-S	L 74-A		W58HS
	L-74	L-74-A		W58HS
	L-74-A	L-74-A		W58HS
	L-74-AS	L-74-A		W58HS
	L-74-S	L-74-A		W58HS
	L-75	L-70-A	12	W58A
	L-75-A	L-70-A	12	W58A
	L-75-AS	L-70-A	12	W58A
	L-75-S	L-70-A	12	W58A
	L-76	L-70-A	12	W58A
	L-76-AS	L-70-A	12	W58A
	L 76-S	L-70-A	12	W58A
	L-78	L-78		
	L-80	L-78		
	L-82-A	L-82-A	60	W56A
	L-82-V	L-82-A	60	
	L-92-A	L-92-A	60	W58A
	L-92-33	L-29	H-60	W53MG
	LP-6	LT-1M	12	W61B
	LP-21	QT-3J	12	W61B
	LP-23	QT-3J	12	W61B
	LP-33	U-J		
	LP-78	U-78-J		
	LT-1M	LT-1M	12	W61B
	LT-2M	LT-2M	12	W61B
	LT-3D	LQD-J	96-T	
	LT-3M	LT-3M	12	W60B
	LT-4-AG	LT-4-AG	73	W66B
	LT-4-78	LT-4-78		
	LT-4D	LT-4D	96-T	
	LT-4D1	LT-4D1	96-T	
	LT-4M	LT-4M	74	W53MG
	LT-5-AG	LT-5-AG		
	LQD-J	LQD-J	96-T	
	LQD-1J	LQD-1J	96-T	

ASTATIC (cont'd)

UNIT TO BE REPLACED		REPLACEMENT		
CARTRIDGE	PART No.	ASTATIC	ELECTRO-VOICE	SHURE
	M-22	M-22	60	
	M-23	M-22	60	
	MD-1J	MD-5J		
	MD-3J	MD-6J		
	MD-5J	MD-5J		
	MD-6J	MD-6J		
	MI-2J	MI-2J		
	MI-2J-33	MI-2J-33		
	MI-2M	MI-2J		
	MLP-1	QT-3M	12	W61B
	MLP-1J	QT-3J	12	W60A
	MLP-2	QT-3M	12	W61B
	MLP-3	QT-3J-PN		WC33B
	Nylon-1J	QT-3J	12	WC33B
	Nylon-1M	QT-3J	12	WC33B
	PT	PT	12	
	QC-J	GC-78-J	42	WC33B
	QT-J	QT-3J	12	W60A
	QT-M	QT-3M	12	W61B
	QT-MIR	QT-3J	12	
	QT-2J	CAC-78-J	12	
	QT-2M	CAC-78-J	12	
	QT-3J	QT-3J	12	W60A
	QT-3M	QT-3M	12	W61B
	QT-33	CAC-J	14	
	U-J	U-J		
	U-78-J	U 78-J		
	401-A	401-A	12	
	402-M	402-M		
	403-J	403-J	12	

ELECTRO-VOICE

UNIT TO BE REPLACED		REPLACEMENT		
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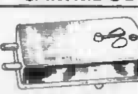
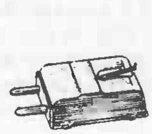
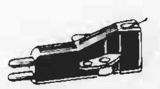
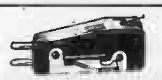
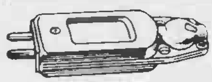
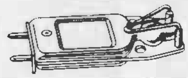
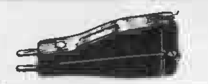
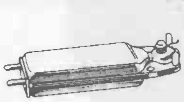
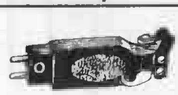
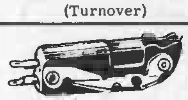
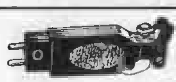
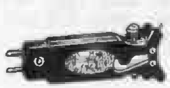
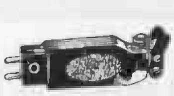
	10	12	LT-1M	W61B
	12	12	LT-4-78	
	L-12	12	LT-2M	W60B
	M-12	12	LT-2M	W60B
	H-12	60	LT-4-78	W56A
	13	33	AC-AG-J	
	14	14	CAC-J	W31AR
	14S4	14	CAC-J	
	16	16		
	16-0	16-0		
	16-S	16-S		
	16-3	16		
	16-5	16		
	32	32	AC-78-J	W23B
	33-S2	33-S	AC-AG-J	
	33-S4E	33-S	AC-AG-J	
	33-2	33	AC-AG-J	W26B
	33-3	33	AC-AG-J	W26B
	33-4	33	AC-AG-J	W26B
	34	34	AC-J	W31AR
	42	42	GC-78-J	
	43	43	GC-AG-J	
	44	44	GC-J	

CRYSTAL PHONOGRAPH CARTRIDGE REPLACEMENT CHART

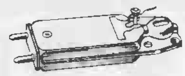
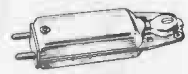
ELECTRO-VOICE (cont'd)

UNIT TO BE REPLACED		REPLACEMENT		
CARTRIDGE	PART No.	ELECTRO-VOICE	ASTATIC	SHURE
	50 60 H-60	60 60 H-60	L-92-A L-29 L-12	W42H W42H
	72 73 74	72 73 74		
	96 96-0 96-S	96 96-0 96-S	ACD-2J ACD 2J ACD-2J	

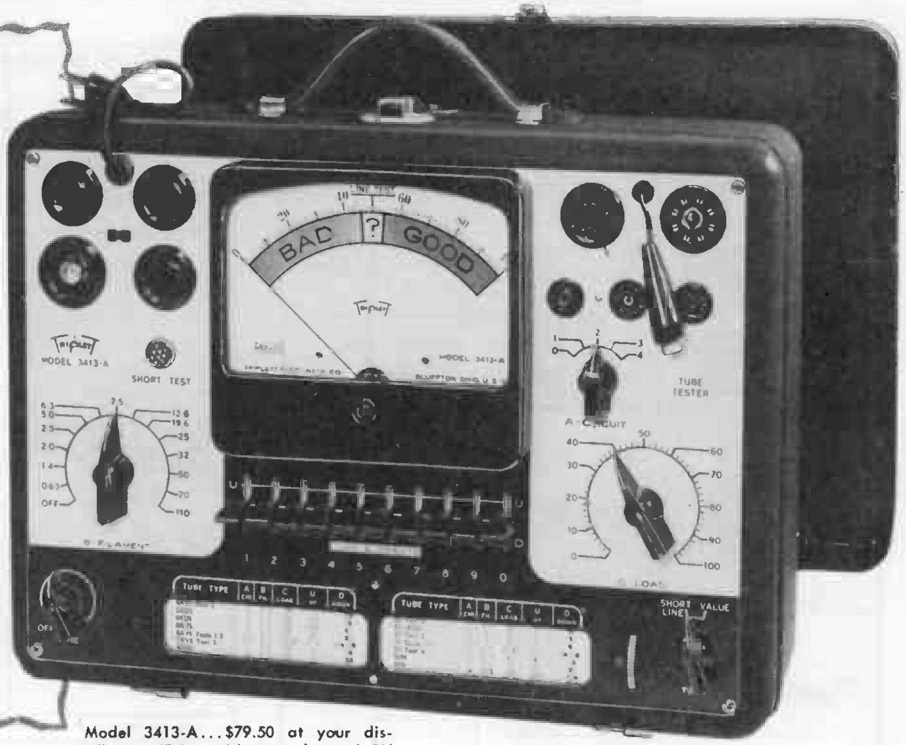
SHURE

UNIT TO BE REPLACED		REPLACEMENT		
CARTRIDGE	PART No.	SHURE	ASTATIC	ELECTRO-VOICE
 Muted Stylus	P30 P30B P30C P30D P30E P30G P30HS P30S P30W	W60B W60A W60B W61B W60HS W61B W60HS W61B W60A	PT PT PT PT PT PT PT	12 12 12 12 12 12 12 12 12
 Lever Type	P35 P35S	W56A W56A	LT-4-78 LT-4-78	H-60 H-60
 Muted Stylus	P37 P37A P37C P37CA	W66B W66B W66B W66B	LT-4-AG LT-4-AG LT-4-AG LT-4-AG	73 73 73 73
 Vertical Drive	P70 P70A P71 P71A P71B P71C P71CA	W23B W23B W26B W26A W26B W26B W26A	AC-78-J AC-78-J AC-AG-J AC-AG-J AC-AG-J AC-AG-J AC-AG-J	32 32 33 33 33 33 33
 Vertical Drive (Turnover)	P72 P72A P72AF P72V	W22AB W22A W22AB W22AB	ACD-J ACD-J ACD-J ACD-J	96-T 96-T 96-T 96-T
 Direct Drive	P73 P73A P73AR P73R	W31AR W31AR W31AR W31AR	AC-J AC-J AC-J AC-J	74 74 74 74
 Vertical Drive	P75 P75A	W21F W21F		
 Vertical Drive (Turnover)	P76 P76A P76AF P76AFV P76AV P76V P77 P77A P77AV P77V P79	W22AB W22A W22AB W22AB W22A W22AB W22AB W22A W22AB W22AB W22AB	ACD-J ACD-J ACD-J ACD-J ACD-J ACD-J ACD-J ACD-J ACD-J ACD-J ACD-J	96-T 96-T 96-T 96-T 96-T 96-T 96-T 96-T 96-T 96-T 96-T
 Vertical Drive	P80 P81 P81A P81AD P81C P81CA P81D P81E P85	W21F W26B W26A W26B W26B W26A W26A W26B W23B	 AC-AG-J AC-AG-J AC-AG-J AC-AG-J AC-AG-J AC-AG-J AC-AG-J AC-78-J	 33 33 33 33 33 33 33 32

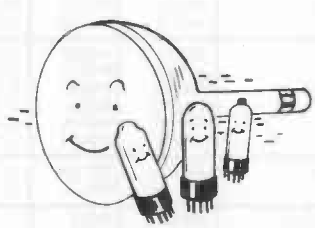
SHURE (cont'd)

UNIT TO BE REPLACED		REPLACEMENT		
CARTRIDGE	PART No.	SHURE	ASTATIC	ELECTRO-VOICE
	P86R	W56R		
 Lever Type	P87 P87B P87S P88 P88S P89 P89L P89R P89RE P89S P90B P90C P90D P90HS P90S P92B P93 P93B P93C P93D P93E P93MG P93S P94 P94B P94E P95MG	W57A W57A W58A W59A W59A W56A W56R W56R W56R W56A W58A W58A W57A W58HS W58A W58A W57A W57A W57A W57A W58HS W53MG W58A W57A W57A W58HS W53MG	L-29 L-29 L-92-A L-92-A L-92-A L-29 L-92-A L-92-A L-92-A L-29 L 92-A L-92-A L-29 L-29 L-29 L-29 L-29 L-92-A L-29 L-29 L-29	12 12 12 60 60 H-60 H-60 12 12 12 12 12 12 12 12 12 12 12 34 12 12 12 12 34
Direct Drive	PC30	WC33B	GC-78-J	42
Vertical Drive (Turnover)	PC72V	WC22AB	ACD-C-J	
Direct Drive	PN30 PN30S PN31S	WC33B WC33B WC33B	LT-3-PN LT-3-PN L-74-A	42 42 42
Lever Type	PN88 PN88S PN89 PN89D PN89E PN89S	W58HS W58HS W58HS W58HS W58HS W58HS	L-74-A L-74-A L-74-A L-74-A L-74-A L-74-A	12 12 12 12 12 12
Direct Drive	W21A W21AR	W31AR W31AR	AC-J AC-J	74 74
Vertical Drive (Single Needle)	W21E W21F	W21F W21F		
Vertical Drive (Turnover)	W22A W22AB W22AB-T	W22A W22AB W22AB-T	ACD-J ACD-J ACD-2J	96-T 96-T 96-T
Vertical Drive (Single Needle)	W23A W23B W26A W26B	W23B W23B W26A W26B	AC-78-J AC-78-J AC-AG-J AC-AG-J	12 12 33 33
Lever Type	W40A W42A W42B W42H W53MG W56A W56PN W57A	W59A W42B W42B W42H W53MG W56A W58HS W57A	L-92-A L-12 L-12 L-12 L-29 L-29 L-74-A L-29	60 12 12 60 34 H-60 12 12
Muted Stylus	W57AN	W60A	PT	12
Lever Type	W58A W59A	W58A W59A	L-92-A L-92-A	12 60
Muted Stylus	W60A W60B	W60A W60B	PT PT	12 12
Direct Drive	W60PN	WC33B	LT-3-PN	42
Muted Stylus	W61B	W61B	PT	12
Lever Type	W65B W65R	W56A W56R	LT-4-78	H-60
Muted Stylus	W66A W66B	W66B W66B	LT-4-AG LT-4-AG	73 73
Vertical Drive (Turnover)	WC22AB	WC22AB	ACD-C-J	
Direct Drive	WC60B	WC33B	GC-78-J	42
Lever Type	99-180 99-181 99-182	W59A W59A W42B	L-92-A L-92-A L-92-A	60 60 12

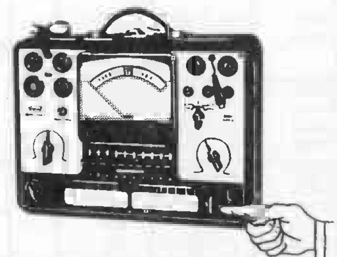
For accurate flexible and quick tube testing at low cost... model 3413-A



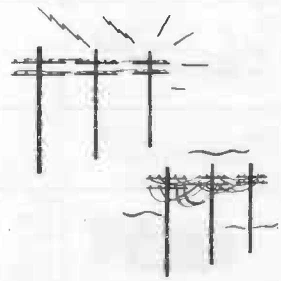
Model 3413-A...$79.50 at your distributor. (Price subject to change.) BV Adapter, $7.90 Add'l.



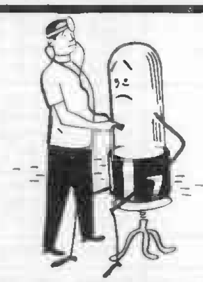
1. YOU CAN TEST MORE TYPES of tubes, also appliances for shorts and open circuits.



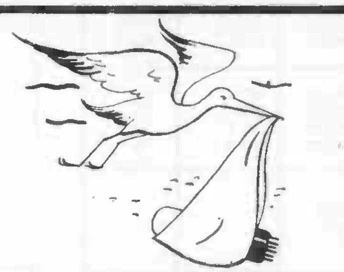
2. JUST SPIN THE KNOB—for correct, last-minute data, on the speed roll chart. Lists 700 tubes.



3. YOU CAN COMPENSATE for line voltage—just throw snap-action switch.



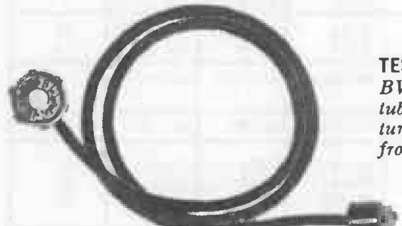
4. YOU CAN TEST EACH ELEMENT in each tube—by a simple flip of the switch.



5. YOU CAN TEST THE NEW TUBES—including those with low cathode current.

6. YOU GET NEW TUBE DATA—immediately, while it is still news. No waiting.

Nearly Half a Century of Service to the Service Man



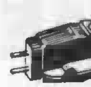
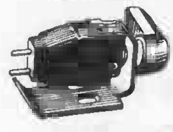
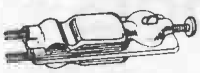
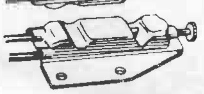
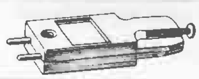
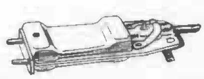
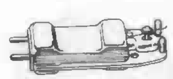
TESTS PICTURE TUBES, TOO! *With this BV Adapter, Model 3413-A tests every tube in a TV receiver, including the Picture Tube—without even removing tube from receiver or carton! Saves time!*

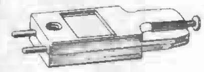
FOR THE MAN WHO TAKES PRIDE IN HIS WORK

Triplett

TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON, OHIO, U. S. A.

CRYSTAL PHONOGRAPH CARTRIDGE REPLACEMENT CHART
WEBSTER ELECTRIC

UNIT TO BE REPLACED		REPLACEMENT		
CARTRIDGE	PART No.	ASTATIC	ELECTRO-VOICE	SHURE
 	AC-6		12	
	A1	ACD-J	96-T	W22AB
	AIM	ACD-J	96-T	W22AB
	AIM-2	ACD-J	96-T	W22AB
	A2	AC-J	34	
	A2M	AC-J	34	
	A3	AC-78-J	12	
	A3M	AC-78-J	12	
	A7-M1	ACD-2-J	96-T	W22AB-T
	A7-1	ACD-2-J	96-T	
	A7-8	ACD-2-J	96-T	W22AB-T
	A9M1	AC-AG-J	33	
	A91	AC-AG-J	33	
	B1		12	
 	C1	M-22	12	
	C2	M-22	12	
	C3	M-22		
	C5	M-22	12	
	C6	M-22	12	
	D2	B-2		
	E4	L-92-A	60	W58A
	E4-1	L-92-A	12	W58A
	E9	L-70-A	12	W58A
 	F1P	L-29	60	W57A
	F2P	L-92-A	60	W58A
	F3P	L-29	60	W57A
	F4P	L-92-A	60	W58A
	F5P	L-29	60	W57A
	F6P	L-92-A	60	W58A
	F7P	L-92-A	60	W60B
	F7P-2	L-29	60	W60B
	F8	L-29	60	
	F9P	LT-4-78	12	
	F10P1	L-29	60	W61B
	Fi2	L-29	14	W53MG
	F13M	CAC-J	14	W53MG
	F14M	LQD-1J	96-T	
	F14-2	LQD-1J	96-T	
	F15M	LQD-1J	96-T	
	F16M	LQD-1J	96-T	
	F18M	LQD-1J	96-T	
	GX-79	M-22	12	
	GX-80	M-22	12	
	GX-82	I.-70-A	12	W58A
	M1	MI-2J		

UNIT TO BE REPLACED		REPLACEMENT		
CARTRIDGE	PART No.	ASTATIC	ELECTRO-VOICE	SHURE
	N1	L-70-A	12	
	N1-N		12	W58A
	N1-1	L-70-A	12	
	N1-2	L-70-A	12	
	N1-3	L-70-A	12	
	N1-4	L-70-A	12	
	N1-5	L-70-A	12	
	N1-6	L-70-A	12	
	N1-7	L-70-A	12	
	N1-8	L-70-A	12	
	N1-9	L-70-A	12	
	N2	L-70-A	12	W58A
	N3	L-70-A	12	W58A
	N4	L-70-A	12	W58A
	N5	L-70-A	12	W60B
	N6	L-70-A	12	W58A
	N6P	L-70-A	12	W58A
	N6P-4	L-70-A	12	W58A
	N7	L-71-A	12	W58A
	N7-1	L-71-A	12	W58A
	N7-3	L-71-A	12	
	N7P	L-71-A	12	W58A
	N7P2	L-71-A	12	W58A
	N8	L-70-A	12	W58A
	N8P	L-70-A	12	W58A
	N9	L-70-A	12	W58A
	N10	L-12	60	W58A
	N10P	L-12	60	W58A
	N10P1	L-12	60	W58A
	N11	L-70-A	12	
	N11P	L-70-A	12	W58A
	Q1	LT-1M	12	W61B
	Q2	LT-4-78	12	W61B
	Q3	LT-4-AG	33	
	S-6031-1	M-22	12	
	S-6031-5	M-22	12	
	S-6031-11	M-22	12	
	S-6031-16	M-22	12	
	S-6031-18	M-22	12	
	S-6031-20	M-22	12	
	S-6031-22	M-22	12	
	S-6031-23	M-22	12	
	S-6031-24	M-22	12	
	S-6031-25	M-22	12	
	S-6031-33	M-22	12	
	S-6031-34	M-22	12	
	S-6106-1	M-22	12	
	S-6106-2	M-22	12	
	S-6106-4	M-22	12	
	W2	B-2		
	X79A	M-22	12	
	X80	M-22	12	
	X82	L-70-A	12	W58A
	X82CH1	L-70-A	12	W58A
	YN1	L-74-A		
	YN2	L-74-A		W58HS
	YN2-1	L-74-A		W58HS
	Y82	L-70-A	12	W58A

cartridges may be replaced by an equivalent modern cartridge that will give a better reproduction of records as well as reducing record and needle wear.

Both physical and electrical characteristics of a replacement cartridge must be considered by the service technician when replacing a cartridge. It can easily be determined whether or not an intended replacement will fit the tone arm physically. However, choosing a replacement cartridge, other than an exact replacement, that will duplicate or improve the electrical characteristics, is a hit or miss affair without a knowledge of the characteristics of the original cartridge. This information is not readily available to the service technician. Cartridge manufacturers, however, keep abreast of the cartridges on the market and publish from time to time replacement charts listing cartridges of similar characteristics. The cross reference replacement charts on pages 10, 11, and 13 have been compiled as an aid to the service technician in choosing suitable replacement cartridges.

FOR THE RECORD

In the September-October issue of PF INDEX and Technical Digest No. 28, there was an item in the "Dollar and Sense Servicing" writeup concerning television trade names vanishing from the field.

One of the names referred to was that of Mercury. We want to correct any impression that this reference concerned the Pacific Mercury line of receivers manufactured by Mercury Television and Radio Corporation, of Los Angeles, California. The reference in the "Dollar and Sense Servicing" article was to another Mercury line.

We want to take this opportunity to wish the Mercury Television and Radio Corporation, of Los Angeles, continuing success and long life on behalf of their Pacific Mercury Television Receivers.

\- Editor

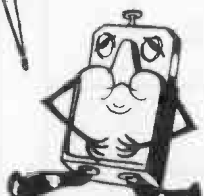
IT'S CARTRIDGE *Check-up* TIME!

REPLACE INEFFICIENT PHONO-CARTRIDGES NOW

with Modern, Lightweight, Compliant

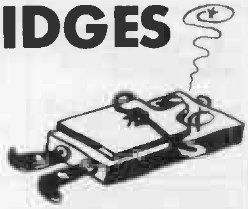
E-V CARTRIDGES

DETERIORATED

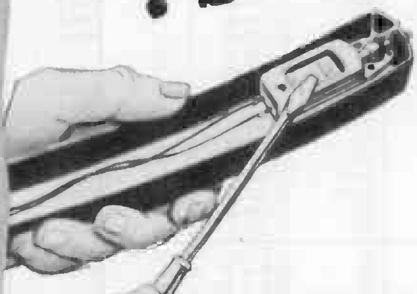


OBSOLETE

WORN OUT

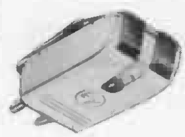


CARTRIDGES NEED NOT BE COMPLETELY DEAD TO NEED REPLACEMENT



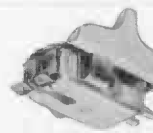
This is *a good time* to contact record-player owners and *check* the condition of their phono-cartridge. If it is not reproducing properly or is causing excess record and needle wear, chances are the cartridge has deteriorated or is obsolete—*and should be replaced.* You'll make new replacement sales, and open the way to other service business, too! A modern, lightweight, compliant E-V cartridge will give fullest record enjoyment and longer record life. *You can demonstrate the difference.* Remember, you can make most replacements with fewer E-V models!

Model 32 for 78 rpm
Model 33 for 78, 45 and 33⅓ rpm

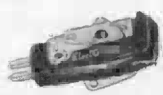


Model 12 for 78 rpm
Model 14 for 45 and 33⅓ rpm

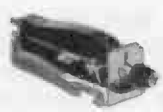
Model 34 for 45 and 33⅓ rpm



Model 16-TT for 78, 45 and 33⅓ rpm



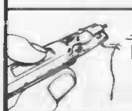
Model 42 for 78 rpm
Model 44 for 45 and 33⅓ rpm
Model 43 for 78, 45 and 33⅓ rpm



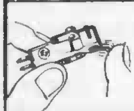
Model 96-T for 78, 45 and 33⅓ rpm

Licensed under Brush patents.

MAKE THE FINGER-TIP COMPLIANCE TEST



Old-style stiff-acting needle system



Modern, compliant needle system

FREE!

REPLACEMENT CHART

Large, complete Chart for wall or binder use. Gives handy cross-reference and valuable data. Tells when to replace a cartridge, what type to use, how to sell replacements. Ask your E-V Distributor or send for it now!

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Oscillations in TV Receivers

by MATTHEW MANDL

Undesired oscillations in television receivers are sometimes difficult to localize because almost every circuit is capable of generating spurious signals under certain conditions. Isolation of the offending stage is facilitated by proper evaluation of the symptoms which appear in either picture or sound and by recognition of the type of oscillation produced by the individual circuits when they develop defects. Once the factors of cause and effect are understood, needless checking of a number of stages will be narrowed down to just a few simple test procedures or corrective measures.

Amplifiers

Oscillations in video IF, sound IF, or RF stages are commonly caused by defective capacitors, though anything which will tend to raise circuit Q beyond normal can also contribute to oscillation or critical operation. Figure 1 shows a representative video IF amplifier circuit. The defects in this circuit which cause oscillation are also common to the sound IF stages or the RF stage in the tuner.

If, for instance, the coupling capacitor (C1) develops a high resistance leakage, some of the B+ voltage from the previous stage will leak across to the grid of the video IF amplifier. This will result in a decrease of bias and therefore an increase in gain for this stage, besides giving signal distortion (poor picture quality). Whether or not the stage goes into oscillation will depend on the amount of leakage and the strength of the incoming signal, for the latter will influence the final bias because of AGC action.

Capacitor C2 and resistor R3 form the "decoupler" network whose function is to isolate the amplifier stage from the power supply and other circuits. An open capacitor here will cause oscillation for several reasons:

1. Screen-grid bypass effect is lost.

2. The un-bypassed dropping resistor (R3) adds its value to the load impedance and increases gain beyond normal.

3. Circuit isolation is removed.

Even though the screen dropping resistor and bypass capacitor are independent of the coil section as shown for the second tube, the open screen capacitor (C4) would still cause oscillation because it removes the signal ground from the screen grid and thus permits feedback within the tube itself, as would occur with unneutralized triodes.

From the practical standpoint, localization of the defective stage should begin with the most simple method in order to save time. This would consist of bridging each screen bypass capacitor or decoupling capacitor with a known good one. In this manner the bypass and decoupler capacitors of a number of stages can be checked in rapid order. If bridging does not cure the trouble it can be assumed that the trouble is elsewhere. Shunting a shorted capacitor with a good one does not, of course, isolate a defective one - but neither would a shorted capacitor cause oscillations, and the foregoing check is for open types only.

Coupling capacitors which have developed leakage resistance can be checked with the R x 1 megohm scale of a vacuum-tube voltmeter. If the resistance measures less than 500 megohms the capacitor should be replaced. Preferably the resistance of the capacitor should measure well above 500 megohms, and paper or mica, when new, should have a DC resistance of several thousand megohms. The coupling capacitor must, of course, be disconnected at one end (or both) when checking for leakage resistance. A voltmeter placed between grid and cathode will also disclose coupling capacitor leakage because it will indicate reduced bias for a slight leakage, and a plus (+) grid voltage for a high leakage resistance.

A more uncommon cause for oscillations in the video IF amplifier circuits occurs when the loading resistor (R2) opens. This resistor (usually around 5,000 ohms) is placed across the coil to reduce circuit Q, and provide for the necessary wide-band response. When this resistor opens, the circuit Q increases with resultant instability. This resistor rarely opens,

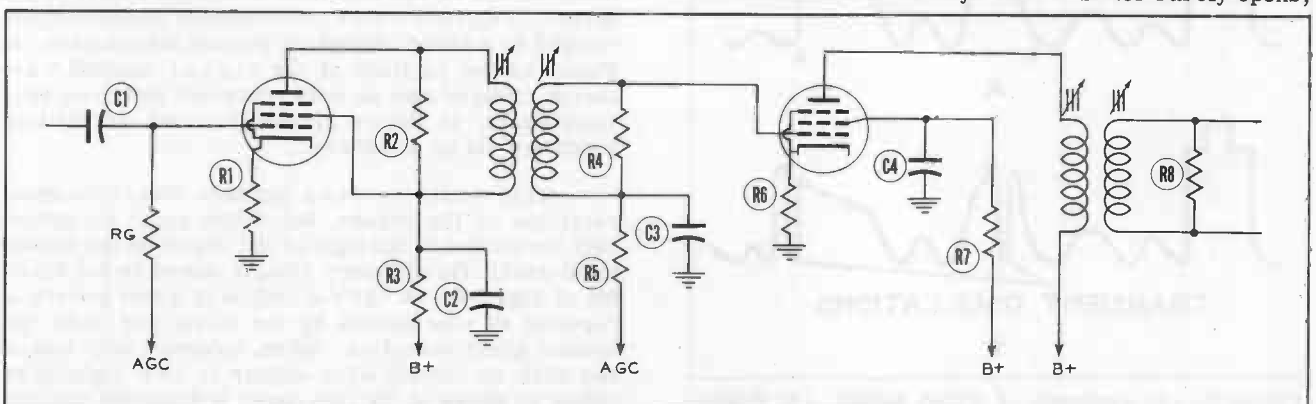

Figure 1. Typical Video IF Amplifier Stages.

however, because most of the current flow to the tube is handled by the transformer primary which the resistor shunts. The same type of shunting resistor is often employed in the grid circuits also (R4) but this rarely gives trouble unless originally defective or not up to standard. Inasmuch as only AGC voltages and signal voltage are present in the grid, sufficient power is not developed to damage R4.

The foregoing discussion is applicable to the sound IF stages also, for identical components are to be found performing the same function. The same also holds true for the RF stage in the tuner, as previously detailed. If the trouble lies in the tuner both sound and picture will be affected. This shows up in very low volume (depending on incoming signal strength) and poor quality picture. In the split-sound receivers, oscillations in the video IF will affect picture but not sound. In the sound IF stage, an oscillating circuit will virtually kill sound output and also couple sufficient oscillations into the video IF stages to give poor picture quality plus some diagonal interference.

Diagonal line interference results if the oscillating stage beats with the local oscillator, though the same type of interference occurs, of course, by heterodyning action between the local oscillator and any interfering signal picked up by the antenna or transmission line. If streaks, diagonal lines, and other interference patterns are present, disconnect the transmission line from the receiver to ascertain whether or not the trouble is caused by oscillation or is fed to the receiver from without.

Defective coupling capacitors can sometimes affect the tube sufficiently to damage it because of excessive current flow. For this reason tubes should be checked as well as the suspected component parts.

Video Amplifier Transients

Coupling capacitor and screen by-pass defects, as well as decoupler troubles occur in the video amplifier circuits in similar fashion to that described for the IF stages. Besides this, however, defects in peaking coils can give rise to transient oscillations which affect the picture in a far different manner from ordinary oscillations. An incorrect value peaking coil can over-peak the high frequency response of a video amplifier and cause it to oscillate only for the high frequency components of the video signal (around the 3.5 to 4 megacycle region).

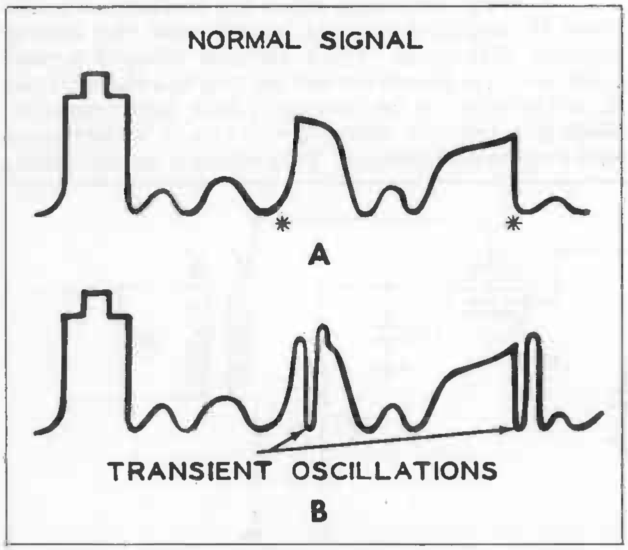

Figure 2. (A) Response of Video Signal. (B) Transient Oscillation in Video Signal.

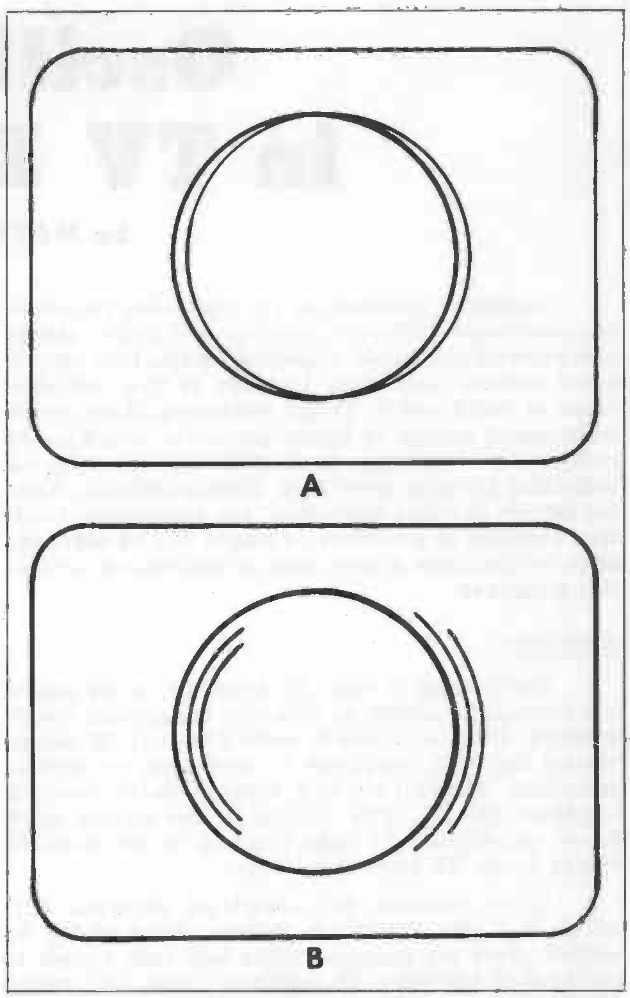

Figure 3. (A) "Ghost" Signal Caused by Reflected Signal. (B) "Echo" Effect Caused by Transient Oscillations.

Thus, whenever there is an abrupt change from black to white (or vice-versa) in the transmitted scene, the sharp change represents a high-frequency video signal and the video amplifier is pulsed into a very short duration oscillation. This causes the picture information to "repeat" itself, and inasmuch as it is the abrupt scene or object change which is involved, one or two thin lines follow the object on the screen. Figure 2 shows the transient oscillation developed by a sharp change of picture information. In Figure 2A the portions of the signal marked * are abrupt changes and as such represent high frequency components. In Figure 2B the transient oscillations which are set up are shown.

This condition often appears like slight ghost reception on the screen, but unlike ghost reception, only the section to the right of the object on the screen is affected. This is more clearly shown in the drawing of Figure 3. At "A" the outline of a test pattern is repeated as represented by the circle and this indicates ghost reception. When, however, only one or two dark (or white) lines appear to the right of an object as shown at "B", the cause is transient oscillation. This is also referred to as "echo" effect.

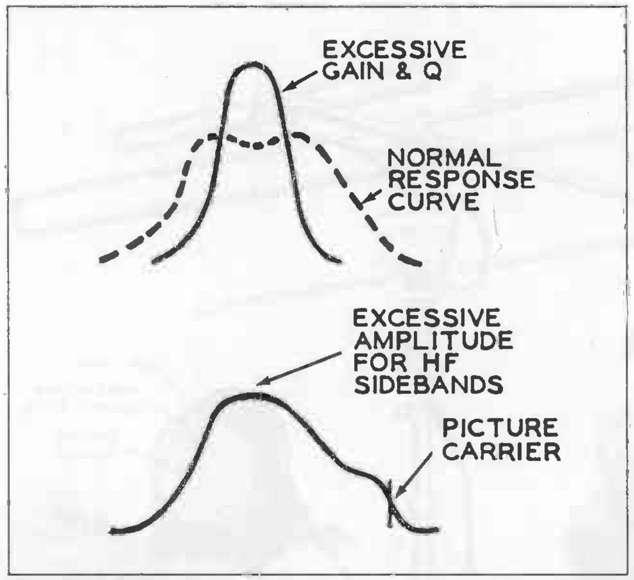

Figure 4. Response Curves of Improperly Aligned IF Amplifiers Which Might Cause Transient Oscillations.

This condition indicates the need for checking video amplifier circuits, particularly peaking coils or tubes which have changed characteristics.

Replacement peaking coils should have identical value of inductance as the original ones, and should be wired into the receiver so they are well spaced from the chassis or other components.

Both the transient oscillations which cause echo effect and the type oscillations produced by open or leaky capacitors could also be produced by improper alignment of the video and sound IF stages. This is particularly true with the stagger-tuned systems and also for any receiver which is so aligned that the high frequency sidebands have higher levels than the lower sidebands. (See Figure 4.) Oscillations will occur during the alignment process, particularly when trying for higher Q and gain in fringe areas. When properly aligned, however, oscillations in the IF stages will usually be caused by defective components.

Spurious Oscillations in Sweep

The appearance of one or two black vertical bars on the left-hand side of the screen as shown in

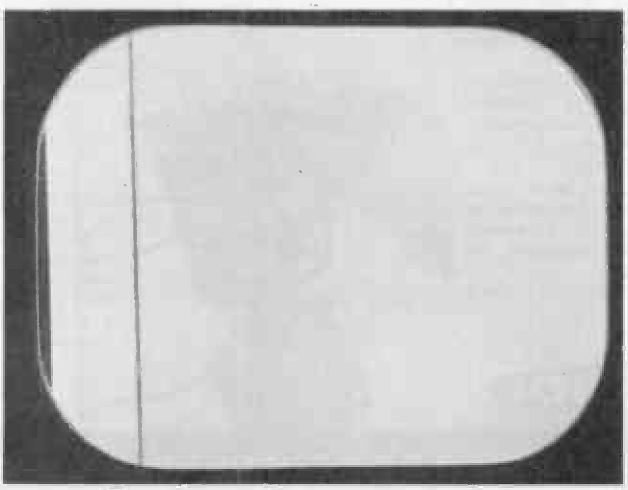

Figure 5. Effect of Barkhausen Oscillation.

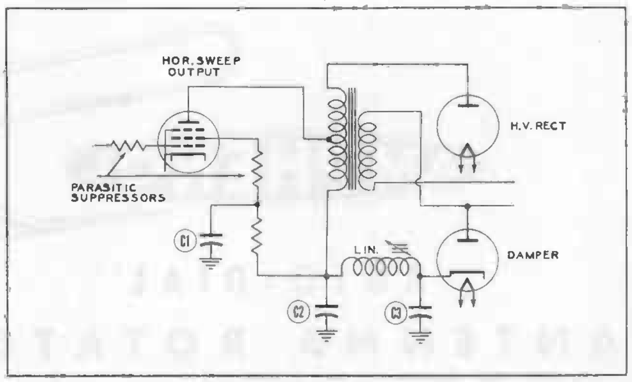

Figure 6. Parasitic Suppressors to Reduce Oscillations in the Horizontal Sweep Circuit.

Figure 5 indicates the presence of Barkhausen oscillations. These are generated in the horizontal output tube when the characteristics of the latter, combined with stray capacity and lead inductance, form a resonant circuit for the transient oscillation frequency. If the tube is the offender several others can be tried until one is found which does not produce the oscillation.

The Barkhausen oscillations will show up to a more pronounced degree with weak signals where the contrast control is advanced or AGC is reducing the bias on the video RF and IF tubes and thus increasing gain. The Barkhausen oscillation radiates sufficiently to be picked up by the tuner and is heterodyned, producing a microsecond or so of blanking at the picture tube grid during the initial trace of each horizontal line. With the gain high, the transient is amplified to a greater degree and shows up more clearly on the picture tube. If the vertical bars are not present during normal reception their occasional appearance for very weak stations may not be objectionable, for in such instances the reception is generally too poor to be enjoyed.

A magnet can also be fastened to the tube and positioned to reduce the oscillations. If the receiver lacks parasitic suppression resistors, one should be placed in series with the grid and screen grid of the tube as shown in Figure 6. These resistors can range anywhere from approximately 43 ohms to about 120 ohms. Reduced grid drive also helps eliminate the Barkhausen oscillations, and the drive control should

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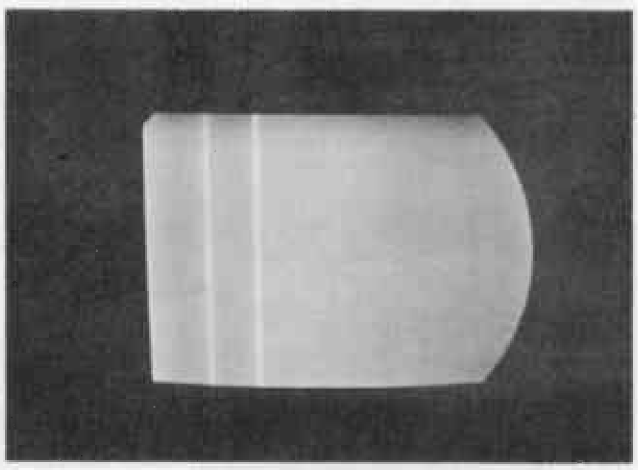

Figure 7. Effect of Improper Damping.

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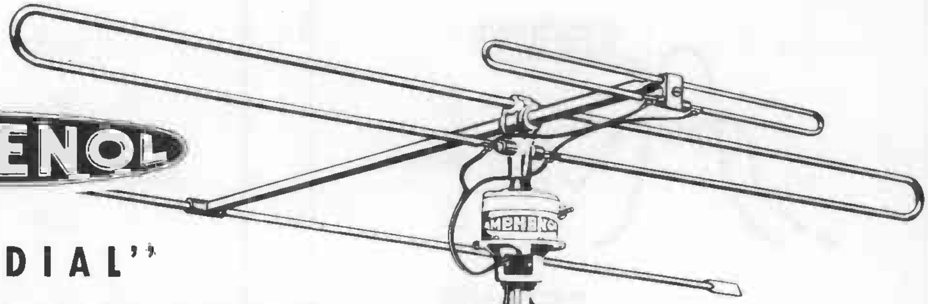

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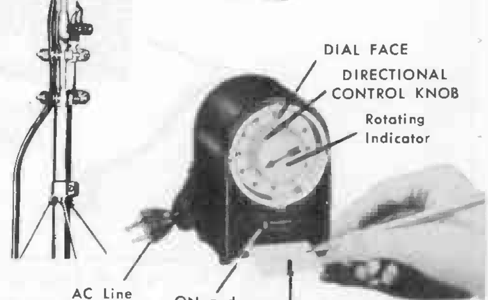

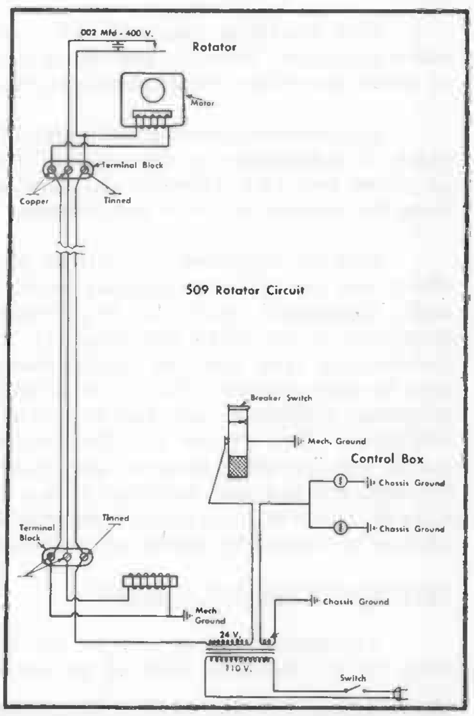

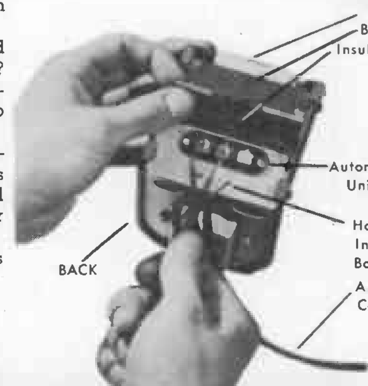

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Eliminating BC Interference Caused by TV Receivers

by **MERLE E. CHANEY**

A type of interference that may affect broadcast receivers results from the radiation of 15.75 kc harmonics from nearby television receivers. This interference is especially annoying as it causes garbled sound, squeals and howls. Fortunately the distance over which this signal is radiated is quite small, and unless the boradcast receiver and TV set are in the same house using a common power line or otherwise spaced but a few feet apart, there is usually no disturbance.

The source of the interference is the horizontal deflection circuits which operate at a frequency of 15,750 cycles. Pulse voltages of several thousand volts occur in these circuits. They are of complex wave shapes and rich in harmonics. The 35th harmonic of 15.75 kcs is 551.25 kcs which falls at the lower end of the broadcast band, while the 100th harmonic is within the upper limits of the band. Interference, therefore, is greater at the low end of the band than at the upper end. This is easily observed by turning the broadcast tuning dial from the low to high limits of the band. The interfering signal, gradually decreases as the higher frequencies are tuned in.

At first glance it would seem that the 35th to 100th harmonic of a signal would be of such small magnitude as to be negligible. It is true that the harmonic signals are weak, but it is conceivable that the signal strength of the interference present at the broadcast receiver may be equal to, or greater than the strength of the signal from a broadcast transmitter located several miles distant. Because of the small magnitude of the harmonic signal it is often possible to listen to a local broadcast station whose signal far overrides the interference. However, as soon as a distant station is tuned in, the sound in the broadcast receiver may be so garbled as to be unintelligible. This is noted particularly when the frequency of the broadcast signal occurs at an harmonic of 15.75 kcs.

Elimination of harmonic interference takes the form of application of techniques associated with the construction of a shielded alignment booth, since the interference from the television receiver may be transmitted through the air or conducted by the AC power lines. Application, therefore, of one or more of the following methods will usually reduce interference to an insignificant degree.

1. Shielding.
2. Filtering.
3. Lead dress.

The necessity for shielding is determined when it is found that specific circuits, components or leads are acting as radiators of the interfering signal. Usually the greatest offender in this respect is the horizontal output circuit, since it is the source of the interference. Shielding therefore is highly important in minimizing direct radiation from this source. Many television sets have the horizontal output transformer and high voltage contained in a shielded cage. This not only reduces the shock hazard but radiation from these components is also decreased. In some instances the horizontal output transformer and associated components are mounted beneath the chassis whereby the chassis and aprons tend to form a loose shield about them.

Deflection yoke leads are a major contributor to radiation difficulties. In a large number of cases these leads were found to be the real cause of the interference. Observation of several TV sets shows that these leads are often contained in a shield formed by the supporting metal bracket for the yoke and focus unit. In the absence of such a shield one may be formed out of metal to loosely enclose the leads. Care should be exercised that the leads are not run directly in contact with the metal bracket since this could introduce too much capacity in the circuit, thus altering linearity in the picture. Cabling the yoke leads might be a satisfactory solution were it not for the high voltages present and the possibility of changing circuit capacitance.

Figure 1 illustrates the manner in which the yoke leads were treated in one chassis. The yoke and focus coil leads are loosely grouped and held in position within the supporting frame members by an insulated paper forming a loop about them and secured to a metal frame.

Another type shield sometimes found effective is a screen wire or metal bottom plate placed on the bottom of the TV chassis. This decreases radiation from components and leads beneath the chassis.

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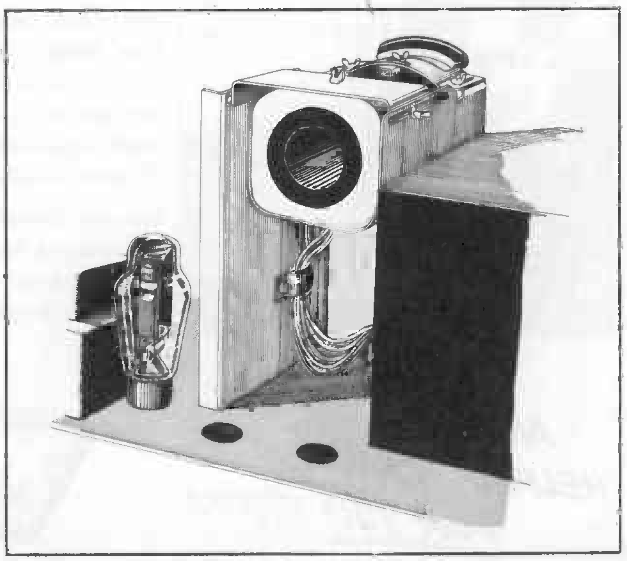

Figure 1. Example of Deflection Yoke Lead Dress to Reduce Radiation.

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Checking Horizontal Output Transformers

by W. WILLIAM HENSLER and GLEN SLUTZ

Horizontal output transformers are often suspected of being the cause of certain deflection system troubles, such as insufficient width, poor linearity, low second anode voltage, etc. The usual procedure for checking the transformer is to first measure the resistance of all of the windings. Obviously, if a winding is open this check will reveal the defect. There are other defects, however, which will not show up with a resistance check alone. In the case of a few shorted turns, or even a shorted layer of turns, the resistance reading which is obtained may be well within tolerance, and the defect will not be detected. If the transformer seems okay as far as resistance readings are concerned, the next step is the substitution of a new unit. A check is then made on the receiver operation. If the operation is normal, it can be assumed that the old transformer was defective.

Although this procedure is effective in making the repair, it has certain disadvantages. Quite often after substituting the new transformer, which is a time-consuming job, it is found that operation is the same, indicating that the trouble is elsewhere in the circuit. The transformers must then be interchanged again, resulting in a further loss of time.

Also a new unit is not always available for the substitution check which means that the repair must be delayed until a transformer is obtained.

The following test is designed to make possible the detection of shorted turns in the output transformer to determine if it is necessary to substitute a new unit. The test can be made without removing the transformer from the chassis and usually only one or two connections need be removed. Since this test is to be made only after a resistance check has been made, these leads will already have been removed.

The equipment required is an audio oscillator having a range extending up to 100 kc and a VTVM type AC voltmeter. Care should be taken that the voltmeter used operates as a VTVM on the AC range. The use of a regular AC meter results in serious loading of the transformer.

The basis for this test is the required feature of all horizontal deflection systems in that they possess a natural resonant frequency within a certain range. This frequency must be such that one-half cycle of oscillation occurs in approximately 7 microseconds, which provides proper horizontal retrace. A frequency of 71 kc satisfies this condition. In production, however, the natural resonant frequency of some horizontal deflection systems is lower, perhaps as low as 55 kc. To assure that the resonant frequency of the horizontal system falls within certain limits, the transformer alone, without the deflection yoke coil, and other external circuits, must have a natural resonant frequency considerably lower than that of the complete system. The reason for this is that the connection of the yoke and width coil effectively decreases the inductance of the transformer which makes the resonant frequency of the complete system higher.

In conducting a series of measurements on many horizontal output transformers of various makes and designs, it was found that their natural resonant frequencies fell within a well defined range between 20 and 50 kc. With a shorted turn the resonant frequency in every case rose sharply, indicating decreased inductance caused by the shorted turn.

The diagram in Figure 1 shows the setup which should be used to test a doubtful transformer. An ohmmeter check is, of course, an obvious preliminary test and will reveal open conditions and possibly even "shorts" of entire layers of windings where resistance differences become apparent. Measurements should also be taken to see that no shorts exist between windings or from windings to the core. To perform this ohmmeter check, it will be necessary to unsolder the connections indicated in Figure 1, and hence, no further circuit changes are needed for the resonant frequency check. It is not necessary to remove the high voltage rectifier or to remove the filament leads from the socket.

The connections from the signal generator and voltmeter are made as shown in Figure 1. The decoupling resistors must be used to keep the loading on the transformer at a minimum. The generator must be capable of producing frequencies up to at least 100 kc, preferably 200 kc. The voltmeter should have an essentially flat response to frequencies within the operating range, 20 to 200 kc. The generator leads are connected across that portion of the transformer included in the plate circuit of the horizontal output tube. The voltmeter is placed across the complete secondary winding or, in the case of an autotransformer, that portion of the winding associated with the deflection output. By varying the frequency of the generator, a frequency will be found which provides a peak voltage reading on the voltmeter. This frequency is the natural resonant frequency of the transformer.

If the resonant frequency is between 20 and 50 kc, the transformer can be considered good and the trouble is probably elsewhere in the circuit.

This test supplements the resistance check and aids in determining whether a replacement transformer is required. The final test, of course, is the operational check after replacement of the transformer. The use of the resonant frequency check, however, should reduce the number of false replacements.

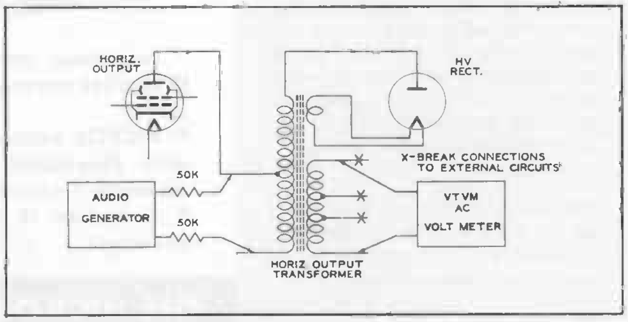

Figure 1. Test Equipment Connections for Checking Horizontal Output Transformer.

Examining DESIGN FEATURES

by MERLE E. CHANEY

The Radio Craftsman Model RC201 television receiver is a chassis assembly designed for custom installation. Several electrical and physical features of the chassis are worthy of comment.

Boost Switch

One of these is the incorporation of a boost switch which enables the viewer to increase the gain of the receiver under weak signal conditions.

Figure 1 is a schematic of the video IF section showing four stages of amplification. Observation of the output circuit of the 2nd video IF stage shows the 3rd video IF coil, L3, and a "boost" switch for shunting another coil, L2, across a portion of the turns in L3. L2 consists of about four turns of wire located externally to the L3 shielded can. When L2 is switched across part of L3 the total inductance L3 is decreased resulting in a higher resonant frequency.

Stagger tuning is employed in the video IF circuit to achieve the normal response curve as shown in Figure 2. Also the response curve resulting from switching in the shunting coil L2 is shown. Note that when the "boost" switch is actuated the video IF response is narrowed with greatly increased gain obtained at the frequency of the video IF carrier. With the shifted response and narrowed band width, advantage of the double sideband transmission of the video IF carrier is utilized for increased gain.

The position of the "boost" switch close to L2 and L3 permits the use of short leads. Operation of the switch is accomplished by means of long shaft extending from the switch through the front of the chassis and is located immediately above the fine tuning control.

Narrowing the bandpass of the video IF amplifiers has no effect on the sound IF circuits. Since the sound take-off is at the converter output of the tuner, adequate bandwidth at that point provides the correct signal for both sound and video IF stages.

Bridge Type Power Supply

The power supply for the Radio Craftsman consists of a power transformer with the high voltage secondary winding center tapped, and four selenium rectifiers arranged in a bridge circuit to provide high and low B+ voltages.

Figure 3 is a schematic of the power supply. When high B+ voltage is obtained, the center tap of the transformer is not used. On one alternation, SR3 and SR2 rectify the voltage across the full secondary winding while SR4 and SR1 rectify on the second alternation.

Low B+ voltage is obtained by alternately rectifying each half of the high voltage secondary. SR1 rectifies on one alternation and SR2 rectifies on the second. This circuit thus operates as a full wave rectifier in a similar manner to that of the full wave rectifier tube.

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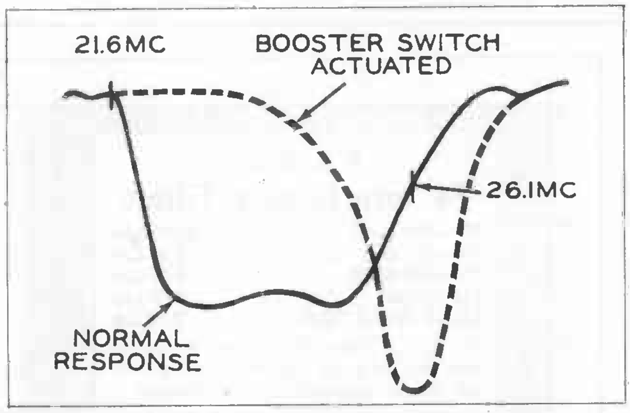

Figure 2. Video IF Response Patterns with Boost Switch "On" and "Off."

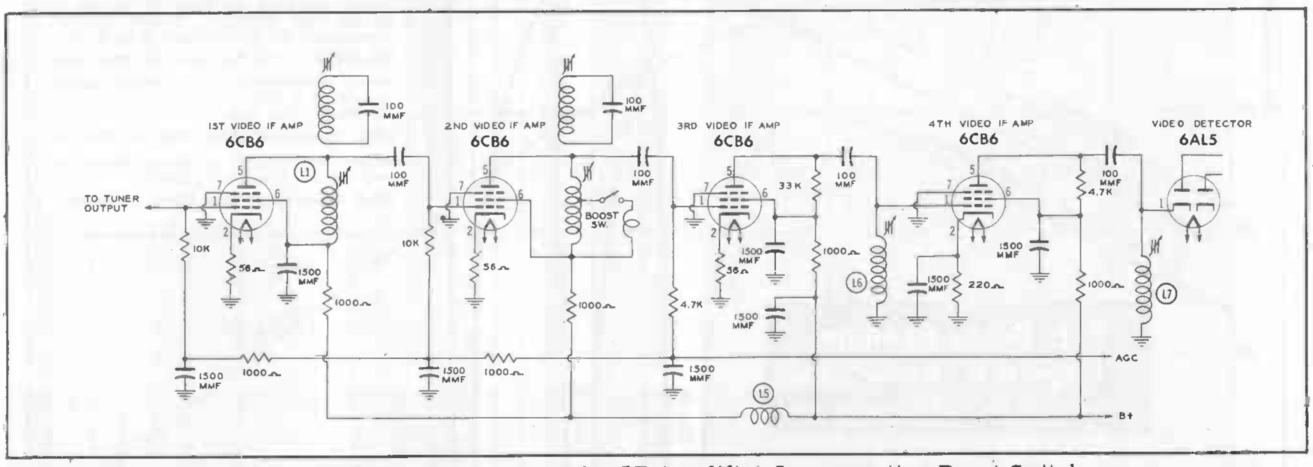

Figure 1. Radio Craftsman Video IF Amplifier Incorporating Boost Switch.

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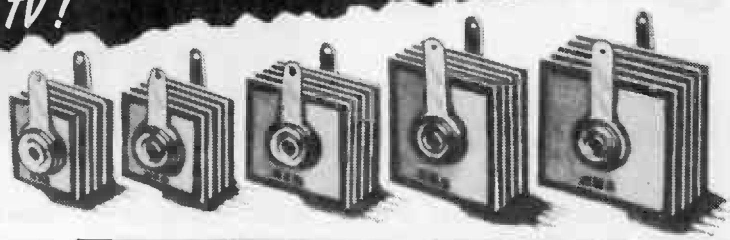

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8J1	11/16" sq.	9/16"	130	380	65 MA
5M4	1" sq.	11/16"	130	380	75 MA
5M1	1" sq.	7/8"	130	380	100 MA
5P1	1 3/16" sq.	7/8"	130	380	150 MA
6P2	1 3/16" sq.	1 3/16"	156	456	150 MA
5R1	1 1/2" x 1 1/4"	7/8"	130	380	200 MA
5Q1	1 1/2" sq.	1 1/8"	130	380	250 MA
6Q1	1 1/2" sq.	1 1/8"	156	456	250 MA
6Q2	1 1/2" sq.	1 3/8"	156	456	250 MA
6Q4 (†)	1 1/2" sq.		130	380	300 MA
5QS1	1 1/2" x 2"	1 1/8"	130	380	350 MA
6QS2	1 1/2" x 2"	1 1/4"	156	456	350 MA
5S1	2" sq.	1 1/8"	130	380	500 MA
6S2	2" sq.	1 3/8"	156	456	500 MA

* This rectifier is rated at 25 MA when used with a 47 ohm series resistor.
(†) Stud mounted—overall: 2"

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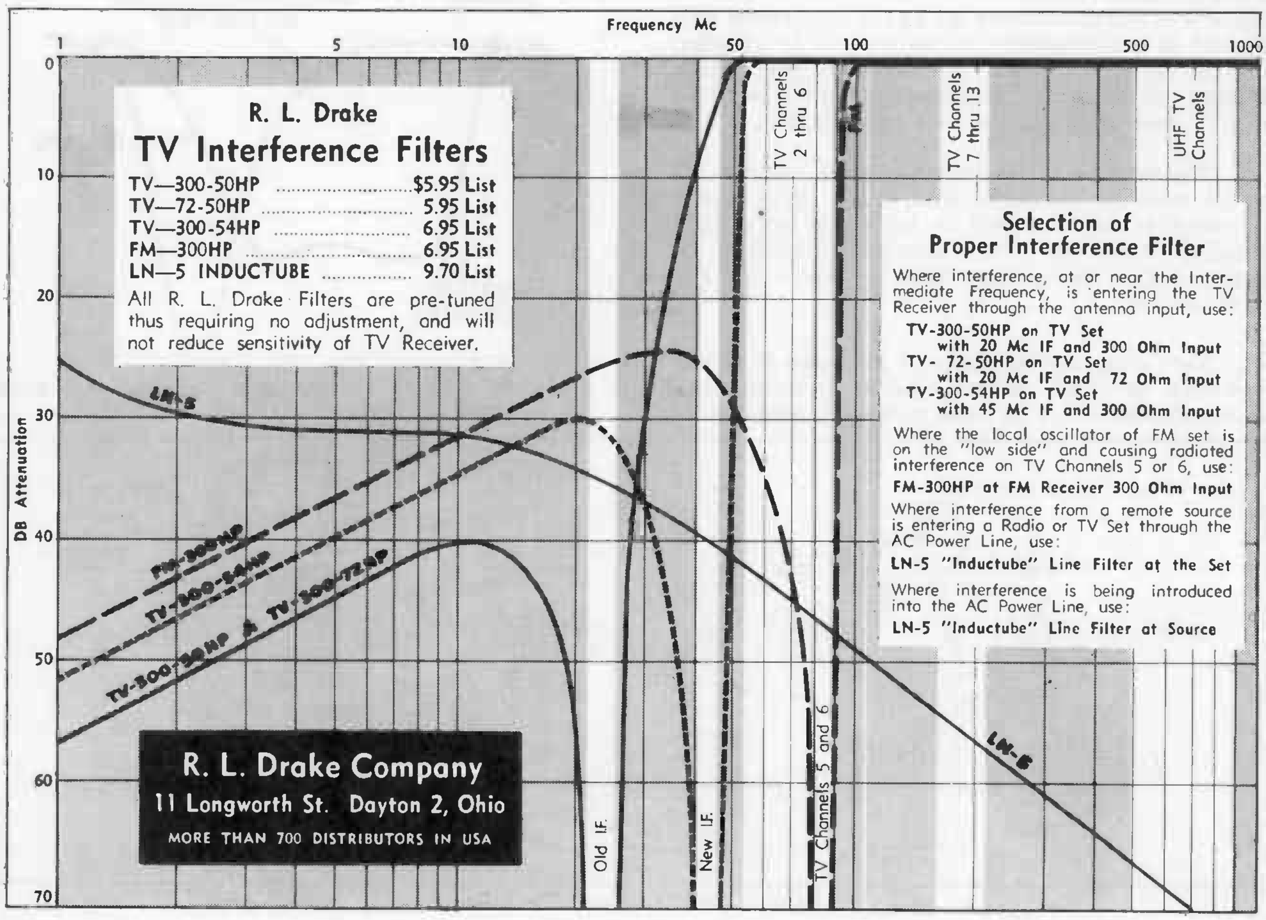

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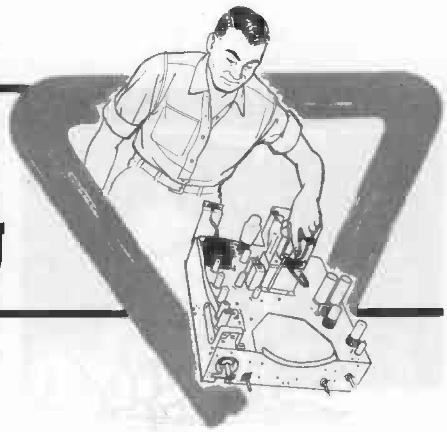

by GLEN SLUTZ

Extension Cables

Cabinet mounted picture tubes present a problem when servicing the removed chassis. The cables to the yoke, tube base, and second anode have an annoying tendency to be just a little too short. If the chassis can be positioned in such a way that the cables reach, then in many cases controls are no longer easily accessible or servicing the chassis becomes generally awkward. The answer to this problem is a set of extension cables or, better yet, two sets - one for the bench and another for the tool kit for use on house calls. Such a set of extension cables is shown in Figure 1.

With few exceptions, nearly all yoke cables from cabinet-mounted picture tubes terminate in eight pin octal-type plugs. Therefore, the extension cable for the yoke should be made with such a plug on one end and a matching eight pin octal socket on the other (Figure 1A). These connectors can be obtained with black japanned steel snap-on caps and rubber grommets. The cable length is not particularly critical, about three feet should be sufficient in most cases. The wire used is No. 19 stranded with insulation breakdown voltage of 1000 volts AC. No. 20 may be used, although the larger wire is preferable. The wires are most easily manageable for twisting and cabling after connection is completed to one of the end connectors. It is advisable to code the wires in some way before twisting in order to speed and insure the correct matching of wires at the two connectors.

The extension cable for the picture tube itself requires a twelve pin television tube socket on one end and a matching plug on the other. The base from a broken picture tube serves very well for the plug connector. Only five wires are needed for this cable, connecting to pins 1, 2, 10, 11, and 12. Such a cable is shown in Figure 1B. The length of the cable is a factor to be considered. It should not be any longer than is necessary to perform its function. The longer the cable, the greater the loss in detail suffered in the picture. It is best not to twist the wires in this extension; instead allow them as much separation as possible. The wire used should be at least No. 20 standard. This picture tube extension may be modified, if desired, to extend its use to electrostatically focused tubes. Pin six on the plug is needed and another wire added to the cable to connect pin six to the corresponding socket terminal. A small amount of smear and loss of detail in the picture is unavoidably introduced when an extension is used and this should be kept in mind while trouble-shooting a receiver.

A third extension is the high voltage lead to the picture tube (Figure 1C). Here insulation is the primary consideration. High dielectric strength (at least 20,000 volts), high corona resistance, and minimum leakage are desired in the insulation whether it be rubber, polyethylene, or some other material. No. 20 stranded is a satisfactory wire size. Alligator or mesh teeth test clips are generally most suitable as terminal connectors for the high-voltage extension. The length of this cable is not particularly important. Flexible insulators for the clips may be added if desired.

When using the extensions described above, the picture tube is usually left in its mounted position in the cabinet. The cables should all be long enough to reach between bench and cabinet and permit freedom of movement of the chassis on the bench. When the cabinet is a floor model it may be placed next to the bench, facing away from the operator; the screen being viewed by means of a mirror. In this way, the distances for which the extensions are required are kept as short as possible. Also the ion trap and centering and focus adjustments are within easy reach of the operator.

With a table model, the service set-up is very similar, the cabinet actually being placed on the bench beside the chassis. In some cases, servicing may be necessary with the tube removed from its

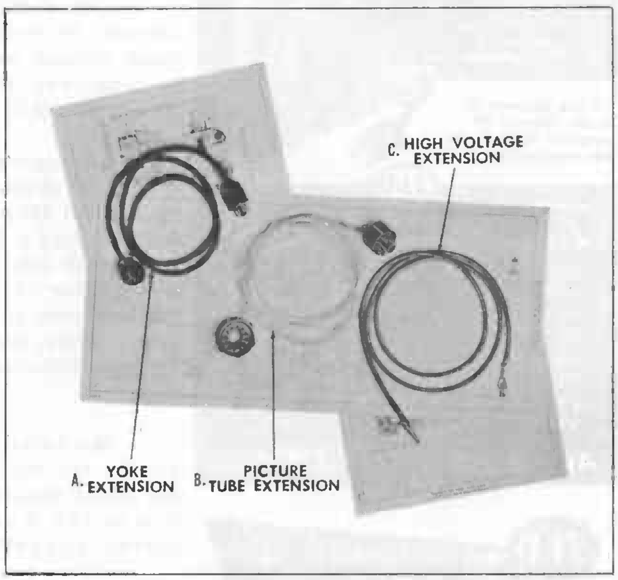

Figure 1. Extension Cables to Aid in Servicing Television Receivers with Cabinet-Mounted Picture Tubes.

mounting in the cabinet. In such a situation, extreme care in handling the tube must be taken. Strain on the neck of the tube, and undue jarring on any part of the tube, must be avoided. The jig used to hold the tube securely on the bench should be designed to comply with the above safety precautions. In addition the jig must also provide sufficient insulating for the metal tubes with their exposed high potential surfaces.

Low B+ Voltage

Certain checks are valuable aids in solving the problem of low B+ voltage in conventionally powdered AC radios and television sets.

A measurement of the line voltage on the power transformer primary should be taken. Even if it is only 10 volts low, it could mean as much as 30 volts difference in voltage on the secondary side of the transformer because of the step-up action.

A visual check for overheated components is another preliminary measure which might possibly lead to the difficulty by indicating excessive current drain on some particular stage.

Voltage checks may be taken over the whole receiver, stage by stage, but they tend to be misleading since they will all be low if the B+ source is low. Of course, any extremely low voltage measurement will provide a clue to the trouble.

The rectifier tube should be checked by substitution. The filament voltage on the rectifier may be measured; if it is low, it could be a cause of low B+ voltage.

The power supply filter should be checked, particularly for open input filter capacitors. This may be done by checking the B+ voltage as the input is bridged by a capacitor of known quality. If a marked rise in voltage is noted as this is done, it is an indication that the input filter capacitor is probably open.

Measure the AC voltage across the secondary terminals of the power transformer and see that it is at its rated value with the correct line voltage on the primary.

An accurate check for excessive current drain may be made by inserting a suitably shunted

♦ ♦ Please turn to page 56 ♦ ♦

Audio-Facts

by Robert B. Dunham

The audio amplifier section of the Olympic Model 945 is representative of the audio system in many, if not the majority, of television receivers. In the process of improving the listening qualities of this receiver some problems and interesting effects were encountered which will also apply to receivers with similar audio systems.

The first result desired was a reduction of distortion and then improvement of the low and high frequency response. These improvements were to be accomplished with the least number of mechanical and electrical changes to keep the cost and time down to reasonable amounts. Figure 1 is a partial schematic of the original audio section of this receiver. Following is a description of the circuit changes which were tried before arriving at the circuit of Figure 2.

In this instance, push-pull output was not considered, mainly because of circuit complication and current drain. The tentative ideas were to use a larger output transformer, some negative feedback, a loudness control and an improved speaker if necessary. Any one of these could have a great effect upon the quality of the sound output.

One of the first things to consider in choosing the output transformer was its physical size, since mounting space can be a critical item. In the Olympic Model 945, enough space was available in the location of the original transformer to accommodate a larger one and the new unit can be mounted by drilling another mounting hole. Also, price is practically unlimited when purchasing a high fidelity audio output transformer, but for this application, a fairly inexpensive open frame type of 8 watts rating was selected.

Negative feedback with the output transformer included in the feedback loop was considered desirable. Of course gain had to be sufficient to take care of the circuit loss due to feedback. A loudness control gives very good results in an application such as this where no tone control is used. In actual operation a loudness control equalizes the lows and highs so well at all sound levels that at times there seems to be no change in volume when the control is rotated. Space to mount loudness controls is usually a problem since their construction is such as to make them quite large in comparison with conventional volume controls. The IRC Loudness Control (described on the inside front covers of PF Index No. 26 and No. 27) will mount in the same panel space occupied by the usual volume control in most instances, providing there is some space available directly behind it. There was sufficient space in the Olympic Model 945 to install the IRC Loudness Control complete with the IRC 76-Off-On Switch. RG-59/U cable was used to connect to the input and output of the control, replacing the shielded lead originally used. There must be enough gain in the amplifier to allow for the 6 Db loss due to the insertion of the loudness control into the circuit.

A change of tubes in the audio stages was the first change tried to increase the gain. A modified version of the circuit shown in Figure 3 on Page 51 of PF Index No. 26 was tried. A 6AU6 tube replaced the 6AT6 first audio amplifier and a 6V6GT replaced

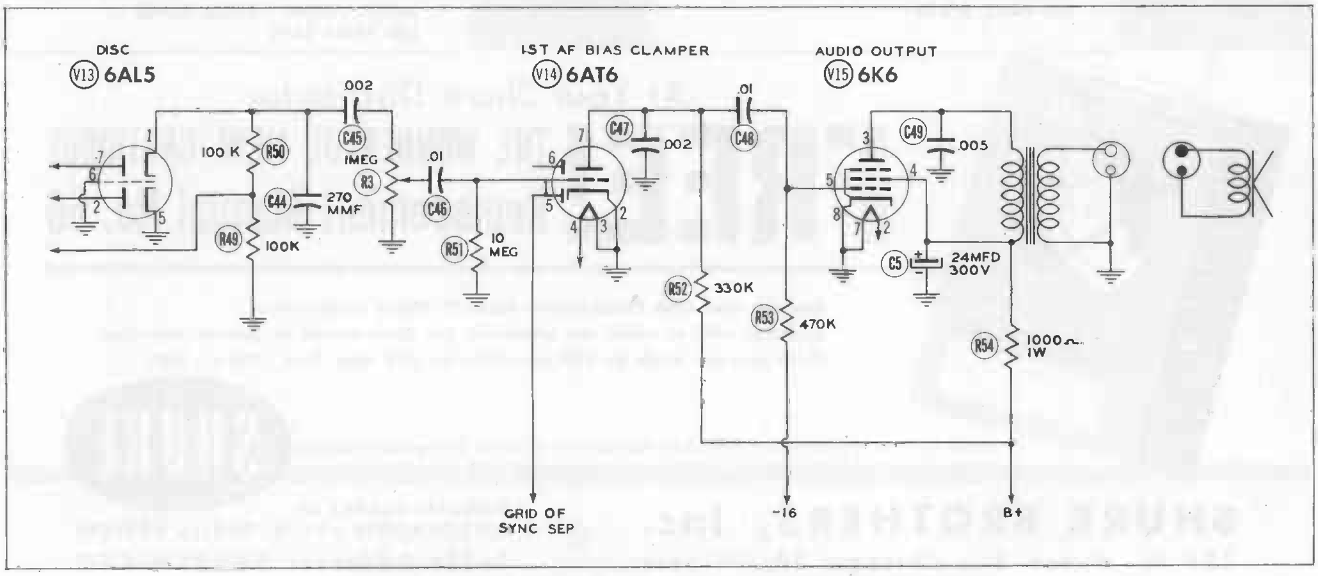

Figure 1. Original Audio Circuit of Olympic Model TV945.

SHURE

2 New phono pickup cartridges to help simplify cartridge replacement

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A high quality extended range "Vertical Drive" Cartridge complete with positive turnover mechanism. Has sapphire tipped fine-groove and osmium tipped standard-groove needle.

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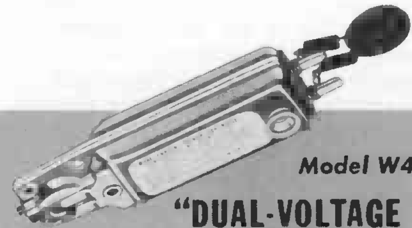

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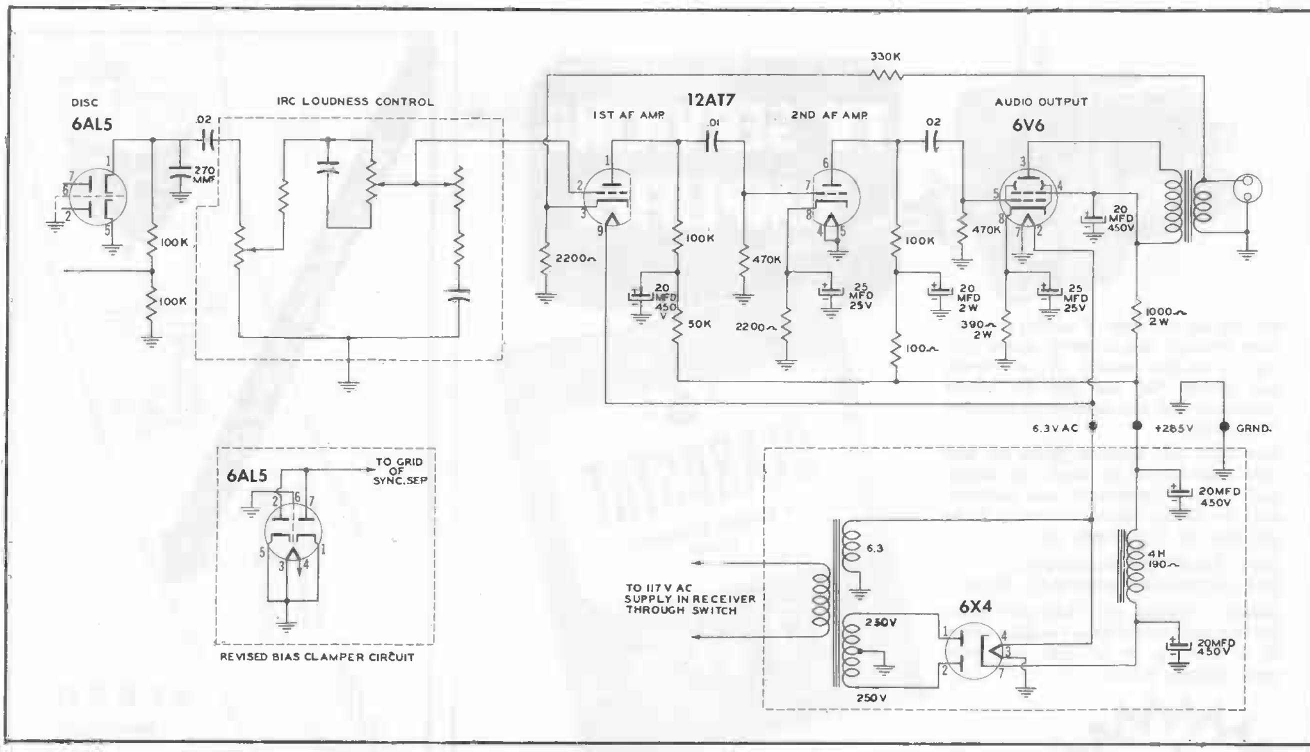


Figure 2. Revised Audio Circuit Showing Connection to Alternate Power Supply.

the 6K6GT output tube. A 6AL5 tube was connected into the circuit, under the chassis near the sync separator tube socket, to replace the diode in the 6AT6 originally used as the bias clamper. The socket for the 6AL5 was mounted rigidly by the short lengths of solid wire used to connect it into the circuit. The 6AL5 was employed since a germanium crystal diode would not operate correctly when shunted across the 3.9 megohm resistor in the bias clamper circuit. A universal output transformer rated at 18 watts was used and the great improvement of sound quality was very apparent with this circuit. The performance of the 8-inch PM speaker used in this consolette cabinet was considered to be satisfactory. But the gain with circuit using negative feedback and the loudness control was not sufficient.

To obtain the necessary gain, a 12AT7 tube was used in place of the 6AU6. A nine pin miniature socket replaced the original seven pin miniature socket and the circuit wired as shown in the schematic of Figure 2. This circuit proved very satisfactory.

With these improvements of audio response some instabilities in the operation of the receiver were noted. Motor boating was now audible and visible in the picture. Some occurred at such a low frequency that it could not be heard, but it was very evident on the picture tube and when read with a meter. Larger filter and decoupling capacitors helped to minimize this effect, but loud sounds, especially at low frequencies, would tend to make the picture jump. Tapping a tube in the tuner would result in a loud noise out of the speaker and would cause the picture to jump. From these symptoms one of the tubes in the tuner was thought to be defective but substitution proved that this was not the trouble. Then some capacitor or resistor was suspected of being defective, but it was found that upon removing the audio output tube from its socket the picture was steady with of course no sound from the speaker.

A study of the original circuit discloses that the power for the audio output stages is taken directly off the B+ line through the 1000 ohm 1 watt resistor (R54) with the 24 mfd. 300 V decoupling capacitor C5. It is practically impossible to make C5 large enough to reduce the effect of this varying drain on the B+ line which in turn affects the other circuits. With a restricted or narrow frequency response as usually found in TV receivers this effect is not so noticeable, but if the low frequency response is increased or boosted, the picture can become very unstable.

To eliminate the possibility of picture instability due to the power demands of the audio tubes, a small power supply was constructed and used to furnish this power. The heater, plate and screen supply leads of the audio tubes were disconnected from the receiver proper and connected to the separate power supply as shown in the revised circuit in Figure 2.

As previously stated, the original audio section of this particular model is representative of the circuitry used in many TV receivers. The incorporation of the circuit shown in Figure 2 should greatly improve the sound reproduction of such receivers.

Although a separate power supply was required in this particular modification, it may not be required in most cases. The audio circuit of the receiver which is to be modified should be checked to determine whether any complication might arise after making the change. For instance, some receivers are so designed that the audio output tube is in series with other stages in the set. A modification in this circuit might affect the operation of the other stages. If a conventional B+ distribution system in used, however, no problems should arise providing the total increase in current of the modified circuit is not too great.

John Markus Editor-in-Chief, McGraw-Hill Radio Servicing Library

Dollar and Sense Servicing

MORNING GLORIES. Yes, they were - climbing right up the mast and out onto the dipoles of a stacked array atop a Minneapolis suburban home. Heavenly blue was the variety, heavenly was the appearance, but we never did find out what effect they had on the TV picture.

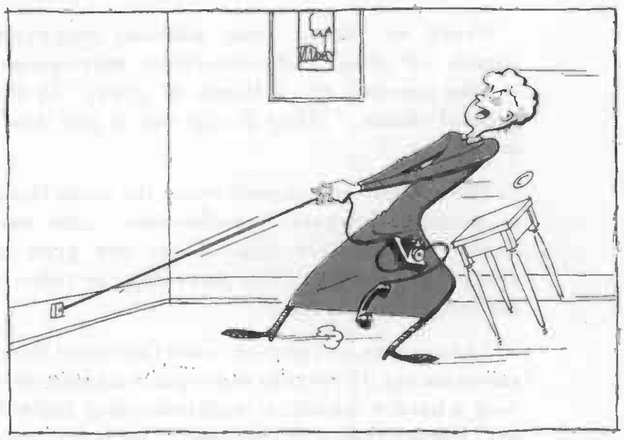
GLOVES. Though goggles and gloves are what TV manufacturers prescribe with bold life-and-death warning notices in their service manuals, a TV servicing school in Providence teaches that wearing gloves is the sure way to drop the picture tube. Their reasoning, backed by observation of students at work in the shop, is that gloves are both slippery and clumsy when it comes to handling glassware.

SOUTH OF THE BORDER. Some 300,000 people in three huge Texas counties are hot prospects for TV sets, now that XELD-TV has gone on the air in Matamoros, Mexico, using channel 7. Though licensed to the owner of Mexico City's XETV (Latin America's first TV station), this newcomer is for all practical purposes another American station and has many U. S. commercial sponsors. Other Mexican border towns are similarly planning for TV stations. All are fully within their international legal rights in using their assigned channels and American program standards, even though U. S. towns across the border have theirs still frozen solid.

TUBE FAILURES. About 75% of all TV service calls are the result of tube failure, according to M. B. Long in September 1951 Radio & Television News. This is quite a jump up from the 40% figure we got two years ago by checking records of large service organizations. Perhaps the new figure is a bit high, but nevertheless it seems logical to have the tube percentage go up as manufacturers improve wiring and inspection techniques. Or could it be that tubes are being worked harder in new circuit designs to get the most oomph out of each tube, thereby shortening tube life?

EPIDEMIC. 'Twas a most unusual summer, they'll say, no matter where you go. In the eastern states, week after week of high humidity brought a bonanza of jobs to TV service shops. It didn't take long for servicemen to realize that they had an epidemic of leaky and shorted paper condensers, with an occasional open output transformer or blocking oscillator transformer and with a lot of corona around high-voltage components. For corona, New Jersey serviceman Gene Ecklund recommends turning the room lights down low and watching till the glow is spotted, then simply inserting a small sheet of vinylite in the corona path. This gives the set time to heat up and bake out. Majority of sets going bad were out of contract, hence the epidemic brought in welcome income. Even with best organizations, about half the summer-complaint sets had to be brought to shop for elaborate troubleshooting, there being few things harder to find on a customer's living-room rug than a leaky C.

LONG LINES. TV servicemen have no exclusive on odd complaints. According to Bell Telephone's house organ, Long Lines, an elderly lady phoned the Toronto telephone office and plaintively complained, "My telephone cord is too long; would you please pull it back at your end?

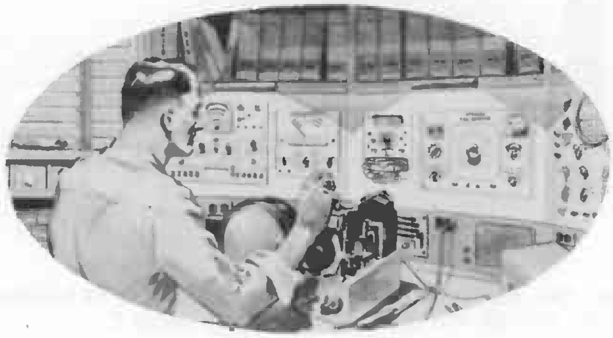


VIDEOTOWN, U. S. A. On an average weekday evening 86% of the 5,500 TV sets in Videotown are turned on. Only 65 families in this town own 2 TV sets each and only 32 of these families use both sets. Some 21% of the sets in use are 10"; 32% are 12-1/2"; 31% are 16"; 16% are 17" and above. These are the latest survey figures from Cunningham & Walsh advertising agency, who have chosen this 40,000-population community as the typical mature market town for TV. Location is a secret, though they've revealed it's about 40 miles from New York City. Set owners get quizzed and questionnaired regularly to feel the pulse of the TV market; 3.8% intend to replace their sets this year, with two out of three wanting a bigger screen and the third wanting better performance primarily.

RATTLES. With quality of plywood deteriorating despite skyrocketing cost, it's quite possible for knots in inner laminations to work loose and make like castenets when someone turns up the volume of a console having a 15-inch woofer. A doctor could quickly find the location of the rattle with his stethoscope, but leaning your ear against one end of a stick of wood while moving the other end over the suspected area of the cabinet works just as well. The cure - - drill a small hole partly through the plywood from the inside and squirt in glue or even speaker cement.

INDUSTRIAL TV. Though as yet no appreciable factor in the TV servicing business, the 111 industrial TV installations in this country are proving so satisfactory for seeing around corners that there may be many more soon. Each system comprises one or

♦ ♦ Please turn to page 53 ♦ ♦



WINDOW-SIZE REPRINTS OF THIS MESSAGE . . . are yours for the asking. Please send 10¢ to cover handling and postage.

ARE SERVICEMEN GYPS?

Every so often, some national magazine sounds off about radio-television servicemen. "Servicemen are a bunch of gyps," is the general theme. "They'll clip you if you don't watch out."

They might just as well write the same thing of doctors, lawyers, storekeepers, auto mechanics—or anyone else. There are gyps in every line. Actually, the percentage in radio is far lower than in most.

The average serviceman—and I have met thousands during 30 years in radio parts manufacture—is a hard-working, straight-shooting individual. Rather than gyp customers, he is far more likely to spend more time on a job than he knows he will be paid for—simply as a matter of personal pride in doing things right.

The other evening, a friend's TV set went bad. A serviceman called for it in his truck and returned it in good working condition within 48 hours. His bill came to $10 for service plus $2.68 for replacement parts.

My friend argued that this was too much—yet he would never dream of complaining to the medical specialist who charged him $10 for a 15-minute office visit; the lawyer whose bill for writing a simple will was $75; or the garage man who, as my friend laughingly admits, charges $5 for "just raising the hood" of his car.

In a very large Eastern city the Better Business Bureau received fewer than 1,000 complaints about service in a year. Most of the complaints came from folks who expected first-class reception in doubtful fringe areas; who tried to operate their sets without suitable antennas, or who had bought sets "wholesale" or at ridiculously low prices from cut-rate dealers who could offer little or no service.

Actually, it takes almost as long to become a good serviceman as it does to train for any other profession. Beyond this, it calls for regular study to keep up with the constant stream of new developments. Also, it requires a surprisingly big investment in test instruments, manuals and other shop equipment. The modern radio or TV receiver is by far the most intricate piece of equipment the average person ever owns or uses.

Servicemen are not fly-by-night businessmen. Ninety-nine out of 100 radio-television servicemen run their businesses properly. The other one per cent—the gyps—can usually be spotted a mile away. Nine times out of ten, they are the shops that feature "bargain" prices and ridiculously liberal service contracts. And their victims are generally set owners who expect to beat the game by "getting something for nothing."

Good television sets or good TV service are not things to be bought on a "bargain counter" basis. Set owners who recognize this aren't likely to get gypped.

Instead, they'll find that they get more real value for their television entertainment dollars than for almost any other dollars they spend!

Harry Kalker
PRESIDENT
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"BC INTERFERENCE" (Continued from page 19)

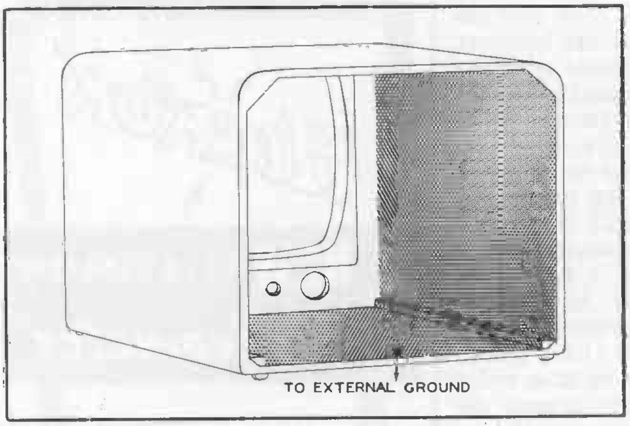

Figure 2. Cabinet with Screen Mounted to Reduce Radiation.

An excellent shield for reducing direct radiation from the television receiver consists of metallic foil, screen wire or hardware cloth formed on the interior of the cabinet enclosing the TV chassis as shown in Figure 2. This shield must make good contact with the chassis and also be connected to an external ground.

A possible remedy for interference conducted by the AC power line or house wiring is through the use of a filter network in the AC leads where they enter the TV chassis. The filter usually consists of two .01 mfd. capacitors in series connected across the AC leads with the junction of the two capacitors connected to chassis and to an external ground.

Grounding the chassis before application of shielding may conduct most of the interfering signal to ground. (See Figure 3.) It might be wise to try this before more complicated measures are employed. Do not attempt this, however, on a transformerless receiver, since some of these TV sets may have chassis connected to one side of the AC line.

The television antenna system may also be responsible for radiation of harmonics of 15.75 kcs.

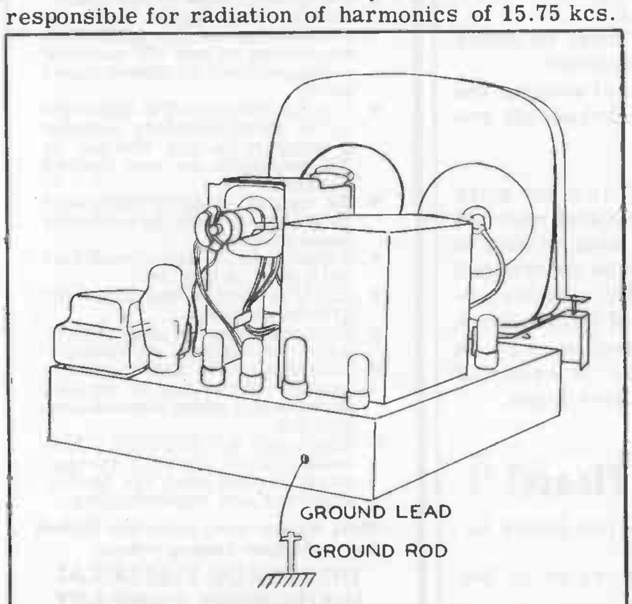

Figure 3. Example of Chassis Grounding Technique to Lessen BC Interference.

For reduction of interference emanating from this source, a high pass filter is inserted in the lead-in, from the antenna to the TV set. One filter for this purpose is a two-section, M-derived circuit, designed to cut off at 50 mc and to attenuate all lower frequencies. Such a filter is shown in use in Figure 4.

High pass filters for this purpose are manufactured by the R. L. Drake Co., of Dayton, Ohio. Units are available for use with either 300 ohm line (type TV-300-50 H. P.) or for 72 ohm coaxial line (type TV-72-50 H. P.). Another filter (type TV-300-54 H. P.) is designed for use with receivers employing video IF frequencies in the 45 mc region. This unit has sharper cut-off characteristics which allow the passage of Channel 2 signals, but effectively reject any video IF signals which might be coupled back to the antenna terminals. These filters are connected externally to the TV receiver as shown in Figure 4 and are easily installed. They should prove helpful in preventing any interfering signals being coupled to the antenna.

In addition to alternating interference being generated in the receiver, the filter also suppresses interference signals which might otherwise pass on through the tuner and cause poor reception. This is especially true of a signal which falls within the IF range of the receiver.

Proper lead dress is considered good practice in reducing the tendency toward radiation of unwanted signals. Where leads are found that are radiating a signal, they should be dressed close to the chassis, in chassis corners, as much as possible, and within supporting frame members. In some cases channeling of these leads to confine their radiation often produces satisfactory results.

A misadjusted horizontal oscillator control may be instrumental in changing the nature of the interfering signal causing additional sound distortion. An instance of this might occur when a ringing coil in a horizontal oscillator circuit is out of adjustment. A strong signal may be capable of pulling the oscillator into sync, but the phase shift caused by the pulling action of the ringing coil has a serious effect on the emanated signal. Correct adjustment, in this case, of the ringing coil, could very well change the type of interfering signal in a manner to have decreased effect on the broadcast receiver.

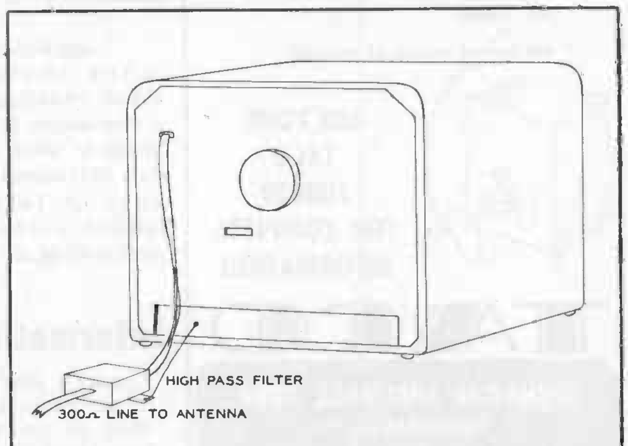

Figure 4. Proper Connection of High Pass Filter to Reduce Radiation from the Antenna.

"BC INTERFERENCE (Cont'd)

There is very little that can be done at the broadcast receiver to remedy the harmonic interference since the signal frequency is within the broadcast spectrum. Employing traps in the broadcast receiver antenna lead-in would be of no value since the interfering signal and the signal from the broadcast station would both be attenuated. However, a filter network inserted in the AC leads to the receiver might prove effective. Also an external antenna placed above the roof of the building would help by increasing the distance the television interference signal has to travel, and improve the signal to interference ratio. A shielded lead-in from the antenna to the broadcast receiver would prevent signals being picked up in the lead-in.

A summation of methods discussed for reducing harmonic interference to broadcast receivers is given below:

1. Shield horizontal deflection circuits.
2. Dress yoke leads within supporting brackets.
3. Use shield or bottom plate on TV chassis.
4. Use shield inside TV cabinet.
5. Use filter on power leads to TV set.
6. Ground TV chassis to external ground. (Except some AC-DC type receivers.)
7. Use high pass filter in TV antenna lead-in.
8. Correctly adjust horizontal oscillator control.
9. Use line filter on power leads to broadcast receiver.
10. Use external antenna and shielded lead-in to broadcast receiver.

Application of one or more of the above suggested methods aid in reducing the interference to a minimum. If it can be determined initially what specific circuits result in transmission of interference, appropriate measures may be applied without the necessity of performing all the above steps.

Information, Please!

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What do you want or need in the year ahead?

Address J. R. Ronk, Editor, PF Index and Technical Digest.

"DOLLAR and SENSE" (Continued from page 31)

more simplified TV cameras feeding one or more receivers over wire lines within the factory. Electric utilities, the biggest user, have 100 installations and find TV most useful for watching gages high up on boilers. Other installations are: steel industry - 5; auto industry - 2; photographic industry - 2; coal industry - 1 (for TV-monitored film camera). Figures are from September 8th issue of TV Digest.

FILM. Over 30% of all TV programs are made on or come from film, according to Eastman Kodak, with the trend increasing now that film projectors for TV are giving improved performance. Most programs being filmed are in 16-mm; a year's supply of this for TV is estimated at some 350 million feet, which would go about 2-1/2 times around the world at the equator. Thus does TV help other businesses.

TV DX. Good argument for a rotator sale is possibility of matching some of the sporadic-E DX reception records that are being set when ionospheric storms are developing and when auroral conditions are observed. Then is when Long Islanders watch Cuban beauties in Havana; then is when a Halifax televiewer got the thrill of watching a program from PRF3-TV on channel 3 in Sao Paulo, Brazil. Cool, calm evenings following bright sunny November days are best time to try, with the first part of the month being better than the last. Some of these signals may come in so clearly and steadily for several evenings in a row that viewers may think they should continue the year round; here an over-the-phone explanation of this tropospheric phenomena can save a service call.

WEIRD THUMP. Latest gem gleaned from a certain manufacturer's service manual is the cure for a thumping sound made by the TV set at regular intervals; just move the tag hanging from the high-voltage lead of the picture tube. The tag makes the thump each time it is pulled against the tube by electrostatic attraction.

MORE COLOR. Recent showings of RCA color television and of the new Lawrence color tube point inevitably to a reconsideration of the whole color question by the F. C. C., with eventual approval of the RCA compatible system along with or in lieu of the 13,500,000-incompatible-set CBS system. Four recent color demonstrations by industry for top F. C. C. staff engineers were held primarily to get agreement on set of new standards to be field-tested from here on. Though color pictures seen on RCA sets were close to perfect, the 54 tubes used per set were a bit too many for some. It is conceivable that by year-end, RCA engineers will be able to subtract 15 to 20 tubes from the set one by one without impairing quality, just as they did originally with black and white TV. But no matter what, color is still a long way from being just around the corner.

Note: It's an even longer way off. Mr. C. E. Wilson, Defense Mobilization Chief, requested a discontinuance of color receiver construction for the duration of the present emergency. His request, issued on October 19, seems to take care of at least the immediate future. - Editor

AUTOFOCUS. Production of automatic-focusing picture tubes is now well under way in DuMont and GE plants and perhaps in others. Both are making the 17" rectangular, with DuMont having a 20" in production also now, and GE planning for a 21". The new tube saves scarce material, substitutes easily for older tubes, requires no focus controls, focus coils, network resistors or mechanical focusers and yet gives just as good a picture as previous tubes. Voltage for the focus electrodes is only a small fraction of second anode voltage hence is easily obtained from the receiver power supply circuit.

BLINKERS. Flashes like heat lightning every few seconds for up to several hours after a TV set is turned off are due to cold emission from the picture tube cathode, according to John Frye in Radio & Television News. The explanation is that the filter condensers in the high-voltage circuit retain their charge for a long time and maintain potential on tube electrodes after power is cut off. This directs bursts of electrons to the screen and makes it flash. Engineers don't know how to prevent it and say there is nothing to worry about.

SCRATCH GAGE. When is a scratch on the faceplate of a new picture tube sufficient cause for free replacement? GE engineers have developed a delicate gage for answering this question. A wire about the thickness of a human hair is built into the gage. If the wire projects above the surface of the glass when laid in the scratch, forget about getting a replacement.

WHISTLE. The 15,750-cps squeal occasionally heard in some TV sets does not come from the loudspeaker. It may be caused by the electron beam hitting the side of the picture tube at the end of each scanned line. It may also come from the horizontal output transformer or from some other horizontal sweep circuit part that carries 15,750-cps current. Being above the audibility range for most people, it is seldom heard even when present, and has been eliminated by most manufacturers in new sets.

DIVORCE PROBLEM. Domestic Relations Court judges in Providence report that all usually goes well during division of property of a divorced couple until it comes to the TV set. Invariably there is then a wrangle. Frequently the TV set is the only piece of furniture specifically mentioned in divorce procedings. Another argument for having two TV sets in the family?

"DESIGN FEATURES" (Continued from page 23)

Since rectifiers SR3 and SR4 only function to rectify the high B+ voltage while SR1 and SR2 must rectify for both high and low B+ voltages, SR3 and SR4 may be of smaller size. The nominal rating of SR1 and SR2 is 200 ma. and that of SR3 and SR4 is 75 ma. Figure 4 shows these 4 selenium rectifiers mounted as a unit on a single bolt and located beneath the chassis.

Picture Tube Mounting Provisions

To simplify the work of custom installations, the brackets for the deflection yoke and focus unit are adjustable to accommodate different size picture tubes. Also the bracket may be removed and mounted externally to the chassis. The picture tube may be placed as far as eight feet away from the chassis. To facilitate the external mounting of the tube the yoke leads and all connections to the picture tube terminate in plugs simplifying the addition of extension cables for remote operation.

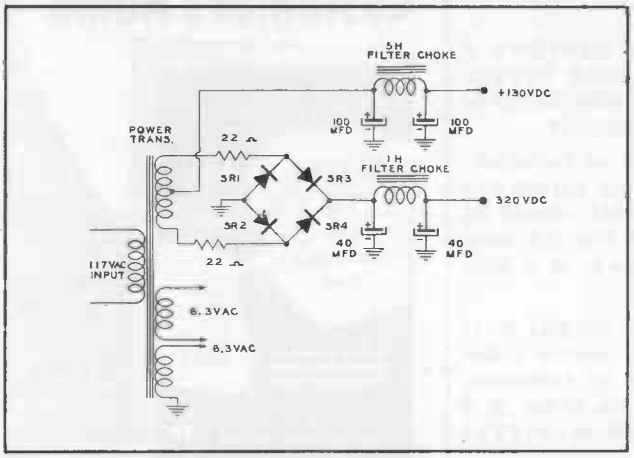

Figure 3. Bridge Rectifier Power Supply Employed in Radio Craftsman.

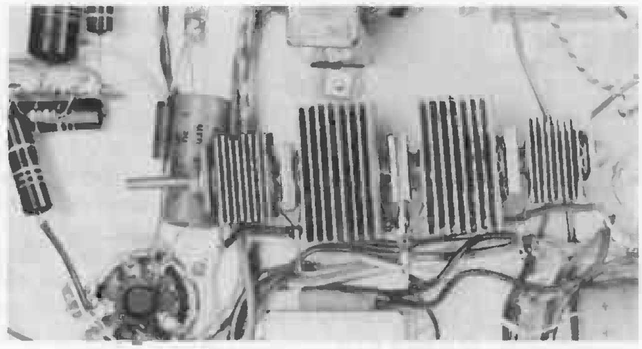

Figure 4. Mounting Detail of Selenium Rectifier.

Dual Shadow Tuning Eye

A dual shadow tuning indicator tube, type 6AL7GT, is employed in the Radio Craftsman chassis for visually indicating proper tuning. This type tube has been used quite extensively in the past for simplifying tuning of FM receivers. Its use in TV receivers is not so common, but it functions in the same manner as for FM receivers. Under normal operation tuning the television receiver for best sound also automatically establishes the correct setting to receive the video signal.

"OSCILLATIONS" (Continued from page 17)

be adjusted for minimum drive consistent with good linearity.

The appearance of one or two white vertical bars instead of black indicates the horizontal sweep trace is repeating itself at specific intervals in its sweep from left to right. This repetition for successive lines gives the appearance of vertical bars lighter in color than the raster or scenic background. Two such bars are shown in Figure 7, where the contrast has been turned down to show the transients more clearly. The raster has also been shifted to the right in order to show the relative distances of the vertical bars from the edge of the initial sweep. Figure 8 will help make clear how these bars are formed because of transient oscillations which are not properly damped in the horizontal sweep.

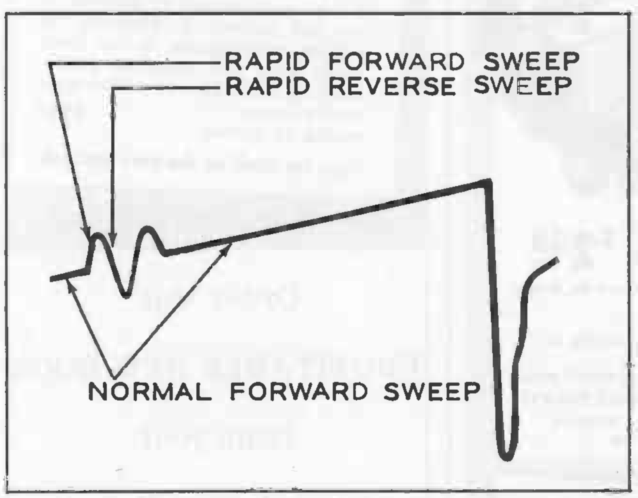

Figure 8. Waveforms of Sweep Voltage Containing Oscillations.

It is the purpose of the damper tube to eliminate transient oscillations by conducting during the first positive alternation which occurs. Inasmuch as the transients are developed because of the collapsing field of the horizontal coils during retrace, undamped oscillations appear toward the left (beginning of horizontal trace). Poor linearity, improperly set drive-control, bad damper tube and an off-value capacitor (C3 of Figure 6) in the voltage boost system can be contributing causes and should be checked.

Lead Dress

Virtually all types of oscillations can also be produced by improper lead dress, both in the picture section as well as in the sweep circuits. For this reason care should be exercised during repair procedures of any nature to see that lead dress is not disturbed. In particular any wires carrying signal currents (such as leads from IF transformers) should be well separated in any of the picture stages. The same holds true for wires carrying sweep signal currents in both the horizontal and vertical oscillator, discharge, and output circuits. When oscillations are present separate all leads which might be involved and during installations of new transformer or other units observe the same precautions.

"QUICKER SERVICING"
(Continued from page 26)

milliammeter in the B+ line or in a suspected circuit.

If a stage is found that is drawing too much current, check the coupling capacitor to the control grid to make sure that it isn't leaking and changing the bias of the stage. In the case of a power pentode or beam power tube, the lack of excitation on the grid may cause the current drain to be abnormally high. Also check for shorted cathode bypass capacitor.

A test for leaky capacitors in the filter and in bypass circuits may be made by substitution of condensers of known quality.

A measurement of the alternating current in the primary of the power transformer should be made. It will reveal shorted turns in the transformer by a high current indication.

A greater than normal voltage drop across the series filter choke or resistor is an indication of either a high current drain or a high-resistance condition in that component.

The tests listed above, if followed carefully, should lead to the cause of low B+ voltage.

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"SHOP TALK" (Continued from page 4)

1. Have you disabled the local receiver oscillator? If this cannot be conveniently done, then rotate the channel selector switch to a non-interfering position.

2. Is the bias on the video IF stages about -3 volts? (If the set is to be operated in a fringe area, it is recommended that it be aligned with a bias of -1 volt.)

3. When there is no pattern at all visible on the scope screen, check to see if the vertical gain control of the scope has been turned up.

4. Rotate the sweep generator frequency dial from about 15 mc to 30 mc (assuming a video IF of 25 mc or so). It is fairly common to find that the dial calibration of the generator is off. Usually the error is small, but it is actually of little consequence as long as the sweep generator is oper-

ating properly in all other respects. The precise frequency of every point on the response curve can be determined by use of an accurate marker.

5. Where you get two response curves on the scope screen, adjust the "Phasing" control on the sweep generator until the two curves blend as closely as possible into each other. If you find that the two cannot be brought closely together it may either be that the sweep width is too small or else the sweep generator dial has been set too close to the edge of the desired band.

With the foregoing points carefully checked, you should, if the equipment is operating properly, obtain some type of response curve. When you do obtain a curve, make the following check before proceeding.

Vary the sweep generator output control and observe whether the response curve (as seen on the scope screen) increases in height as the output is increased. If the video circuits under test are not being overloaded and the video amplifiers of the scope are not being overdriven, then the curve will vary in amplitude in step with the output control rotation. This check is to avoid producing a curve which has a beautiful flat top only because the stages under test are being overdriven. It is amazing what a wonderful looking response curve can be obtained under these conditions.

Overdriven stages will manifest themselves in still another way. Alignment adjustments made on some of the video IF coils (those affecting the top of the response curve) will have little or no effect on the response curve. When this condition is encountered during the course of an alignment, make the check suggested above first. If it turns out that the stages are not being overdriven, then check the coil under alignment. The slug may be rotating but not moving in or out of the coil - or the coil may be open. Every coil adjusted should have some noticeable effect on the response curve.

It is only after the sweep generator and the scope are operating satisfactorily that the marker signal is introduced. If the sweep generator contains an internal marker oscillator then the marker output is slowly increased until the marker pip or indication can just be seen on the response curve. In most instances this is as far as you can advance the marker output without noticeably affecting the response curve. If you find that you can increase the pip more without affecting the response curve, fine and good. But watch this very closely or you will unquestionably disrupt the curve.

Where an external marker generator is employed, the chief problem is to find a suitable point in the circuit under test where the marker signal can be injected without again affecting the response curve. As a first step, try connecting the "hot" lead of the marker generator in parallel with the "hot" lead of the sweep generator at the point where the latter connects into the circuit. If you find that the effect of this action causes a noticeable disturbance to the response curve, you might try isolating the "hot" lead of the marker generator by means of a 10,000-ohm carbon resistor (1/2 watt will do). This proves satisfactory in most instances and the alignment can then proceed.

For the few remaining cases where the marker signal still swamps the response curve, the writer has found it convenient to just clip the marker "hot" lead to the body of a resistor which is electrically connected into the video IF system. Note that the marker lead itself is not making direct connection to the video system, but rather feeds its energy into the circuits via radiation and/or capacity effects. This method is simple and effective.

Whenever connections are made between receiver chassis and any test instrument, be sure that the grounding contacts are well made. Failure to observe this precaution will cause the shape of the response pattern to change as your hands move close to the connecting wires. Some men prefer to work on benches covered with a large metallic sheet. Many shop benches, however, do not have this convenience.

It was previously mentioned that the dial calibration of the sweep generator is frequently off and while this does not affect the operation of the instrument, it does cause some confusion to the serviceman who is not full familiar with sweep alignments. To determine exactly how much the dial calibration is off or if the dial can be reset, by how much it should be reset, the following method is very useful.

Connect the sweep generator and the marker generator as indicated previously, using the response curve of the video IF system. Set the marker frequency until the pip falls somewhere near the center of the curve. Then gradually decrease the sweep width of the sweep generator, being careful to keep the pip at the center of the oscilloscope curve. It may be necessary to adjust the sweep generator's tuning dial to achieve this. The process is continued until the pip occupies the full width of whatever curve is seen on the scope screen and at this point the frequency indicated on the sweep generator's tuning dial is the same as the marker frequency.

With a little practice this calibration can be carried out in two or three minutes and it will reveal, with an accuracy equal to that of the marker generator, how far the sweep generator's dial calibration is off.

The foregoing suggestions have been used many, many times both by men who are experienced in radio, and by beginners, and the results have been uniformly good. After you have become proficient in the use of this equipment, you may want to do many operations at once. But in the beginning a little patience is worth a lot of time.

Before we leave the subject of video IF alignment, a word about another difficulty sometimes encountered. After a set has been adjusted properly, the serviceman may find when a test pattern is viewed on the screen that the frequency response is not nearly as good as the previous alignment indicated.

The question is: Why? Investigation in these instances revealed that the RF or tuner circuit response was sufficiently off to degrade the overall frequency response of the receiver. Some men, not familiar with the cause of this condition, informed the writer that after every video IF alignment, they always "retouched" the slugs of the various IF coils, using a test pattern as their guide. Obviously what these men are doing is simply to readjust the video IF response so as to compensate for the misalignment

of the RF circuits. The fallacy of this procedure is evident.

REVIEW: This month we are concerned with an article discussing the effects of mismatch in the audio field. The article is:

"How Far Can I Mismatch?"

by Saul J. White
Audio Engineering - January 1951
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342 Madison Avenue
New York 17, New York

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Optimum operation of audio equipment can only be obtained with properly matched networks. Occasions are encountered, however, when it is not possible to attain this end and then the question arises, "How far can I mismatch and still obtain essentially the same results?" Thus, suppose you have an audio amplifier possessing an 8-ohm output and the only speaker on hand is rated at 16 ohms. Or, suppose you have a receiver to which you want to connect a second speaker. How much would the sound quality be degraded if the second speaker is simply connected in parallel with the original speaker? These are practical problems that are met in everyday service work and it would be helpful to have some simple rules-of-thumb available.

In Figure 1 there is shown a group of curves relating the output power and the load impedance of several commercial amplifiers. Along the axis marked "Mismatch Radio", at the point 1.0, we have a perfect match and for this condition maximum undistorted power output is obtained. On either side of point 1.0 mismatching occurs with consequent power loss. To the right of 1.0 the amplifier works into a higher impedance; to the left it works into a lower impedance.

Consider, for example, case 2 which indicates that the amplifier is working into a load impedance twice its own. This would occur if we connected a 16-ohm speaker to an 8-ohm amplifier (output impedance). This represents a 100 per cent mismatch and results in a reduction in output power of from 10 per cent (for curve A) to 50 per cent loss (for curve E). Naturally, with greater mismatching the reduction in

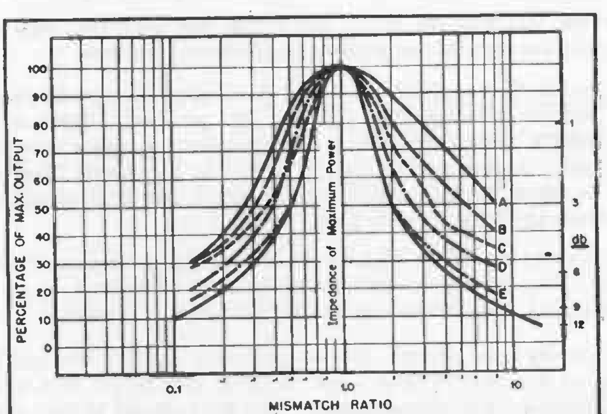

Figure 1. Curves showing the relationship between output power and the load impedance.

TABLE 1

Load Resistance Connected to 500 Ohm Output	Total Harmonic Distortion at 400 cps	Output Power
500 ohms	5% r.m.s.	32.2 watts
1,000 ohms	8% r.m.s.	25.0 watts
250 ohms	13% r.m.s.	24.3 watts

maximum available power would be correspondingly greater.

The most immediate consequence, then, of a mismatch is a decrease in available power. How important this is would depend upon the particular application of the amplifier. If you had an amplifier rated at an output of 10 to 15 watts and it was to be operated under normal living room conditions, then you would seldom require more than 2 watts with perhaps 6 watts allowed for unusual high level peaks. Under these conditions the amplifier could readily stand a 200 per cent mismatch without noticeably affecting the usefulness of this unit for the conditions stated. Where you would run into trouble would occur in those situations where you needed an amount of power close to the rated power output of the amplifier.

The second point that is of interest concerns the harmonic distortion that results from a mismatch. This can best be illustrated by Table 1 where it is shown what happens when load resistances of the correct value, twice this value, and half this value are connected to an amplifier. When the load resistance possesses twice the value of the correct resistance, the power output drops from 32.2 watts to 25.0 watts. At the same time the total harmonic distortion rises from 5 per cent to 8 per cent, at full power output. The change in distortion is not very large and if the amplifier is operated well below its maximum output, the increase in distortion would not be noticeable.

Consider the other side when the load impedance is but half the correct value. The decrease in power output is approximately the same as in the former instance, but now the total harmonic distortion has risen appreciably to 13%. It will almost invariably be found that mismatching downward results in a much higher rise in distortion than mismatching upward. This is attributed chiefly to a loss of magnetization inductance when the output transformer is abnormally shunted down.

The importance of the foregoing results, aside from their factual information, is that they demonstrate again that glib, general statements should not be accepted until the serviceman has determined under what conditions they are true and under what conditions they are not. Many of us have heard (or read) statements warning against the bad effects of mismatching and yet the foregoing results contradict this in many instances.

While we are on the subject of audio amplifiers, it should be noted that the rated "load impedance" of an amplifier is that impedance into which the amplifier will deliver its maximum power for a given distortion. Actually, the true "internal impedance" of the amplifier is considerably lower than its rated load impedance. However, what we are primarily concerned with in audio amplifiers is not maximum power but maximum undistorted power and therein lies the reason for using a rated load impedance which is higher than the true "internal impedance" that is approximately two and one-half times the internal output impedance of the amplifier.

+ More or Less –

With this issue, the PF INDEX and Technical Digest completes its first year of publication. Instead of a five or six hundred word bit on the glories of planning for the future (what you hope that screwball staff is going to turn out), let's meet some of the regular contributors and staff members responsible for our efforts to date.

1. W. William (Bill) Hensler - - A living contradiction of the theory that beauty and brains are never found in a combined state. An excellent writer, one of the best informed technical men I know, and a swell guy. I'd say more but the stinker won't let me beat him bowling.

2. Milton S. (Milt) Kiver - - You simply don't joke about the best. Milt's "Shop Talk" columns are consistently highly valued by all. Our hat is off in sincere admiration and respect for a real craftsman.

3. Merle E. Chaney - - The "E" must represent energy and effort. Viewing his painstaking research would make you understand the thoroughness characteristic of his articles. I can see quite a future for Merle. (He lost one game to me this year.)

4. John Markus - - Most readers of the PF INDEX are familiar with John's writing on the serious side in publications such as the McGraw Hill Radio Servicing Library. In his "Dollar and Sense Servicing" column, John shows a new and highly entertaining facet of his writing capability.

5. Glen E. Slutz - - The newest member of our staff, but already proven highly capable in all phases of the electronic field. Particularly well grounded in fundamentals and mathematics, you'll be seeing a lot more of his contributions in the very near future.

6. Robert B. Dunham - - You're familiar with Bob's good work on TV Conversions, and other writeups. He's equally interested in music, art, photography, audio, and glamour gals. A bachelor (cuss him), if we can steer him clear of the femme fatale his work should show increasing breadth of subject, extending (I hope) to some of his collections.

To Matthew Mandl, Walter Buchsbaum, Veral Shields and Tom Mowry our genuine thanks for contributions of highest quality. May we have more like them.

Leaving writers, as such, since I'm not sure this next guy can pen his own name without assistance, we have -

7. Archie E. Cutshall - - or A. E. C. (sometimes known as the Atomic Energy Kid). Credit for general layout of the PF INDEX to date goes to my long-suffering associate, Mr. Cutshall. A gem really. All you have to do is yell "Layout" and he does, completely. Thanks, Arch, for putting up with deadline ignoring, writers and editors.

Art Directors, Tom Culver and Tony Andreone, have done a fine job. The only complaint to date concerns lack of pretty girl illustrations in highly technical articles.

And finally Ann Jones, my harshest critic, who stiffles some of my best efforts - but labored late to get this in and foil Charlie (the lithographer) who threatened to throw this column out if I didn't meet the deadline.

J. R. R.

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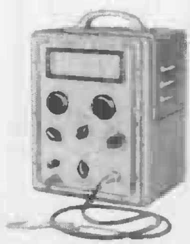

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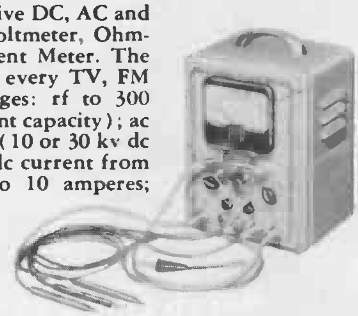

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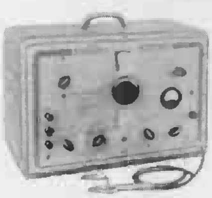

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