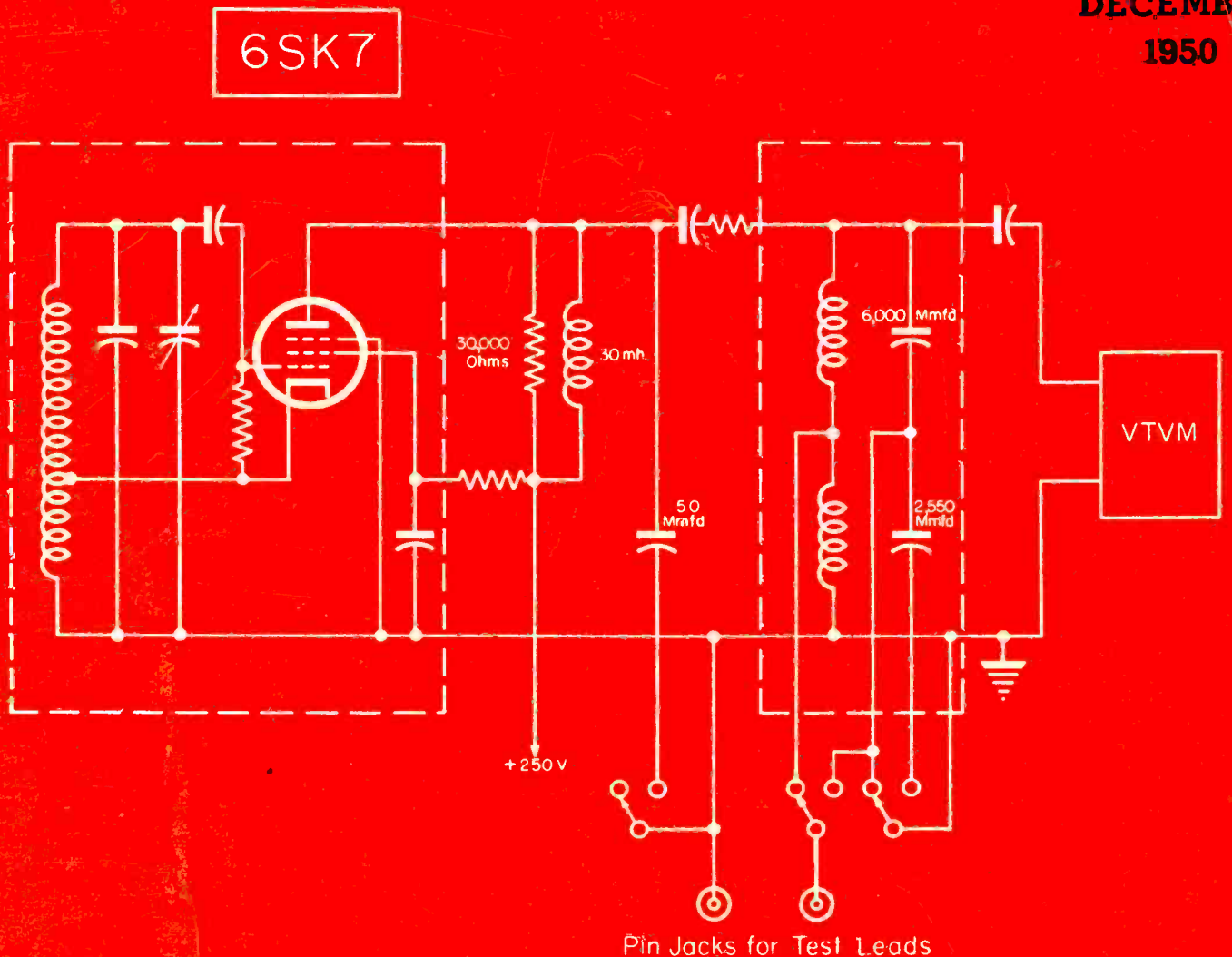
RADIO · TELEVISION · ELECTRONIC

SERVICE

DECEMBER
1950



Circuit of rf test instrument which features one inductance and two capacitance test ranges.

[See page 2]

THE TECHNICAL JOURNAL OF THE RADIO TRADE

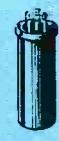
10 reasons why C-D type UP electrolytics are superior

For TV and auto radio applications; and wherever extremes of heat and cold are encountered

A special formation process which results in low leakage; permits operating temperatures as high as 85° C.

Special separator — exclusive with C-D electrolytics — prevents breakdowns under the worst field conditions.

Special construction results in lowest intercoupling between sections.



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Spot welded cathode tabs to mounting rings.

Saddle lug permitting easy wiring of the lugs.

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Other plants in New Bedford, Brookline and Worcester, Mass.; Providence, R. I.; Indianapolis, Ind., and subsidiary, The Radiart Corp., Cleveland, Ohio.

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RADIART SUBSIDIARY

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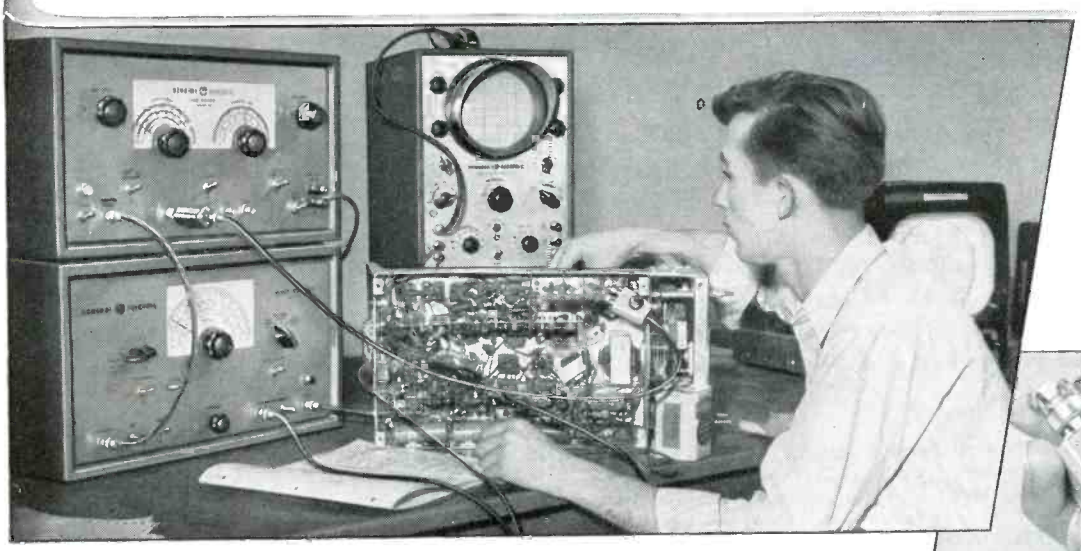
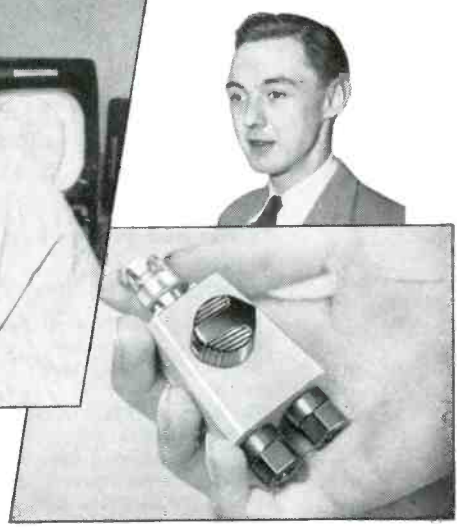


Says **JIM OTTMAN**
TV Service Supervisor
General Electric Supply Corp.
Buffalo, New York



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"COMPLETE alignments used to take us half a day when we used a conventional sweep. Now we do them in 15 minutes with our G-E Test Equipment Package!

"We align 60% of the sets that come into the shop—as an extra service to our customers. Result—we've been getting letters from pleased patrons who say their receivers work better than ever! *This has built our service business faster than anything we've done before.*

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"It does more things *better* than any equipment we've ever used. Without it we could never service so many receivers so fast, so accurately!"

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LET THE EQUIPMENT PAY FOR ITSELF!

You can put your confidence in—

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General Electric Company—Section 3120
Electronics Park
Syracuse, New York

Send me complete information on the G-E Television Test Package and new Balanced Adaptor—plus TERMS OF THE EASY BUDGET PLAN.

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ADDRESS_____

CITY_____ STATE_____

Vol. 19, No. 12

RADIO · TELEVISION · ELECTRONIC
SERVICE

December, 1950

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Editor

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Advisory Editor

Including *Radio Merchandising* and *Television Merchandising*.
Registered U. S. Patent Office

Published monthly by Bryan Davis Publishing Co., Inc.
52 Vanderbilt Avenue, New York 17, N. Y. Telephone MUrray Hill 4-0170

Bryan S. Davis, President — Paul S. Weil, Vice-Pres., Gen. Mgr. — F. Walen, Secretary — A. Goebel, Circulation Manager

Mid-West Representative: Stuart J. Osten, 333 N. Michigan Ave., Chicago 1, Ill. Telephone: Dearborn 2-3507
East-Central Representative: James C. Munn, 2253 Delaware Dr., Cleveland 6, Ohio. Telephone: ERieview 1-1726
Pacific Coast Representative: Brand & Brand, 1052 W. Sixth St., Los Angeles 14, Calif. Telephone: Michigan 1732
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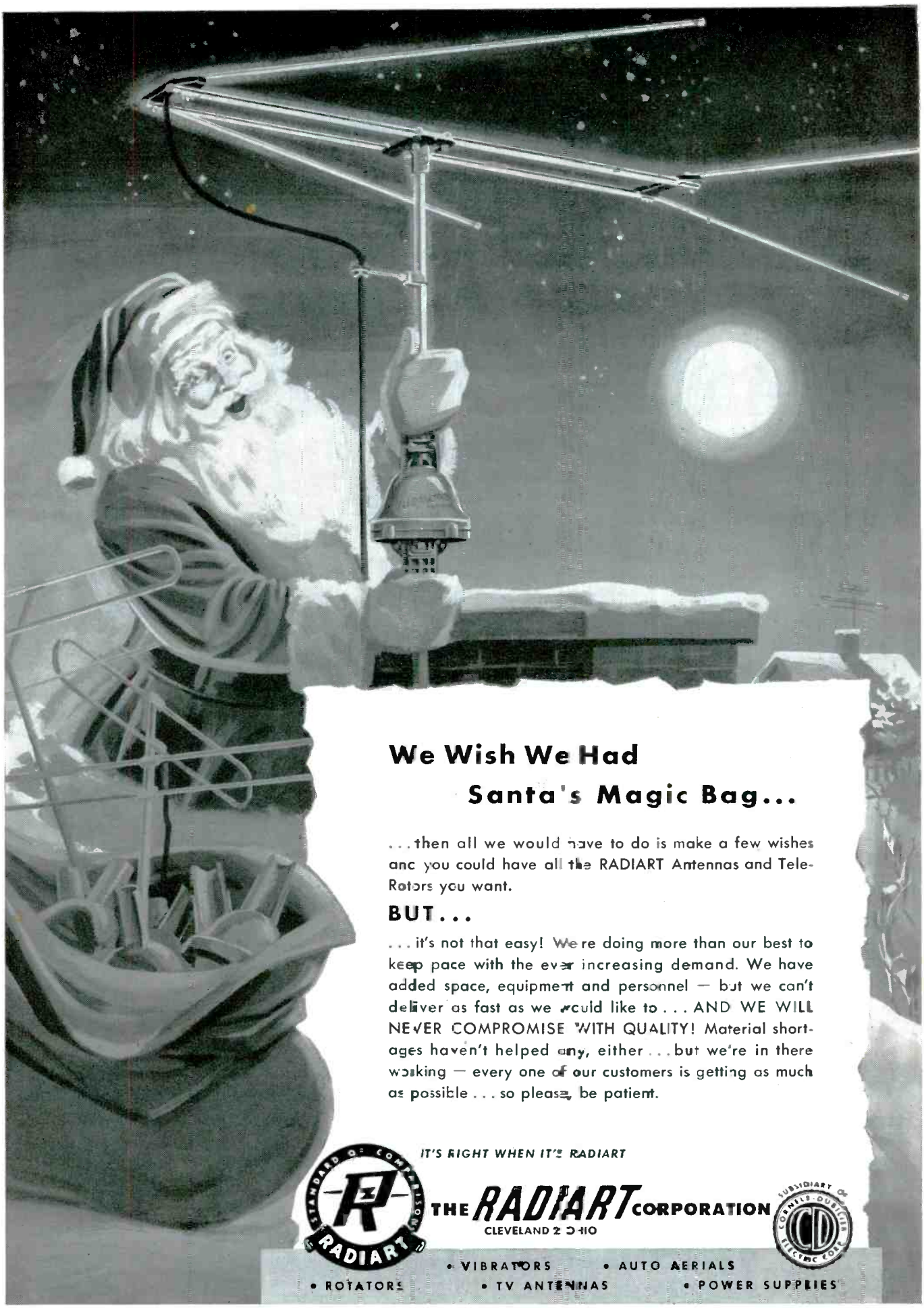
Entered as second-class matter June 14, 1932, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Subscription price: $2.00 per year in the United States of America and Canada; 25 cents per copy. $3.00 per year in foreign countries; 35 cents per copy.



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• ROTATORS • TV ANTENNAS • POWER SUPPLIES

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* * *

RCA has a complete line of quality speakers designed to RTMA rim-mount standards. From the miniature 2" x 3" to the superb new 15" duo-cone —each RCA speaker is skillfully designed, fabricated from the finest materials, and produced under rigid quality-control methods. For complete details on the RCA-515S2 duo-cone speaker, see your RCA Distributor, or write RCA, Commercial Engineering, Section 156V, Harrison, N. J.

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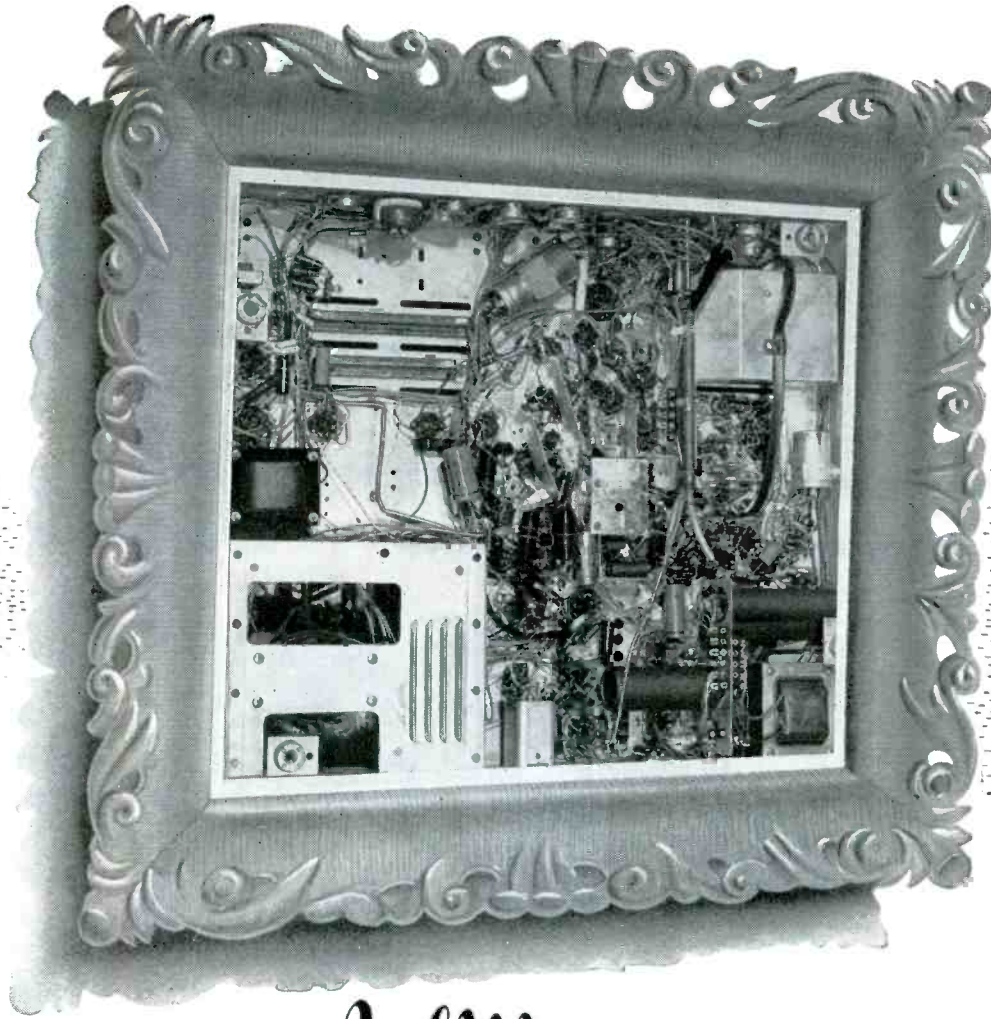

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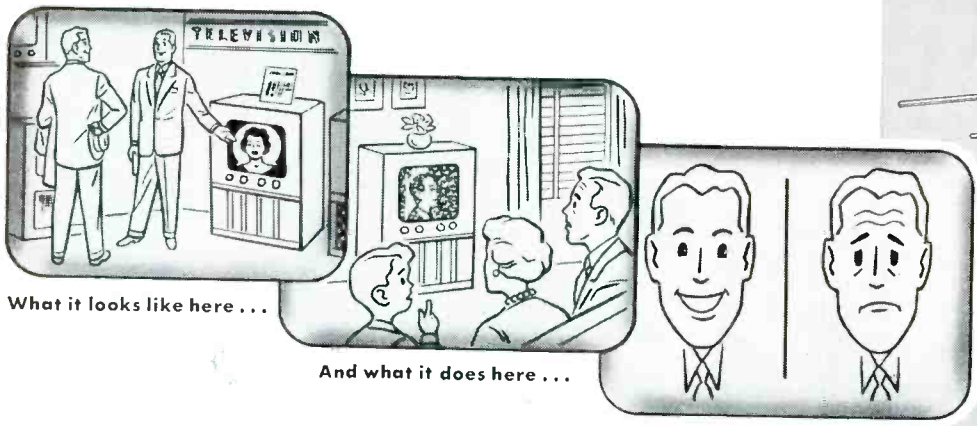
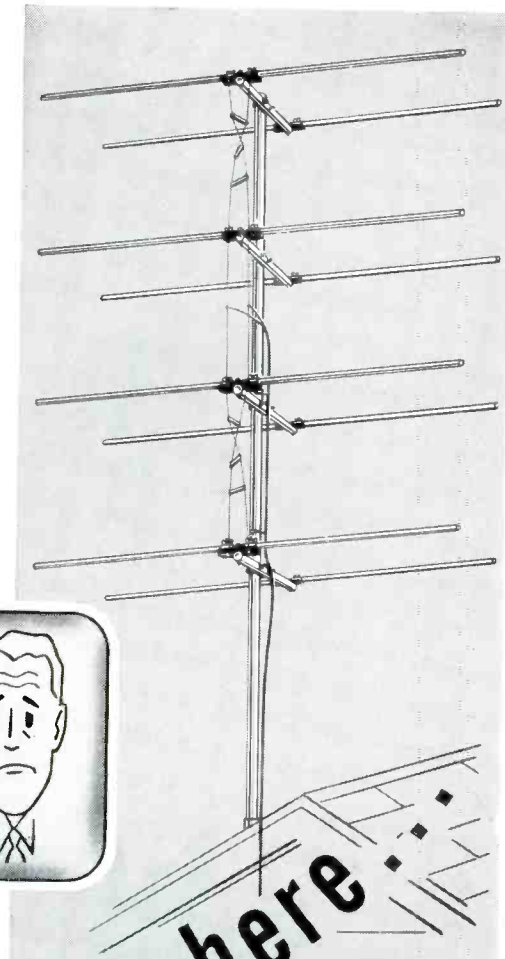
Satisfaction

the BIG WORD in TV reception





depends on what's up here . . .

Don't sell your customers short on complete TV satisfaction. Give them the brilliant performance they have a right to expect by *insisting* on a genuine VEE-D-X antenna installation. Whatever your area — primary, fringe, or remote — there is a VEE-D-X antenna to more than satisfy your customer requirements. The tremendous surge of preference for VEE-D-X (far ahead of the industry) is due to the fact that every VEE-D-X antenna is stronger structurally and is *the most powerful in its price class.* It is also an established fact that even the lowest priced VEE-D-X arrays are producing powerful, long distance reception never thought possible. Why gamble with customer satisfaction when you can be sure with VEE-D-X.

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COLINEAR ARRAY

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BUILDERS OF THE WORLD'S MOST POWERFUL ANTENNAS

Jensen Replacement Needle Chart...

TEAR OUT THIS PAGE AND HANG UP FOR QUICK, READY REFERENCE!

CARTRIDGE MFG.	CART. MFG. NEEDLE NO.	JENSEN NEEDLE NO.	ILLUSTRATION (Actual Size)	STYLUS	POINT MATERIAL	POINT SIZE	CARTRIDGE MFG.	CART MFG NEEDLE NO.	JENSEN NEEDLE NO.	ILLUSTRATION (Actual Size)	CARTRIDGE NUMBERS	POINT MATERIAL	POINT SIZE
Astatic	Q(M)	A-80		/ LQD, LQD-1	Osmium	Standard	Webster-Electric	M	W-02		M-1	Osmium	Standard
Astatic	Q-33(M)	A-80-LP		JD, LQD-1	Osmium	Micro-Groove	Webster-Electric	F-14	W-05		F14, F14-1, F14-2, F14-3, F14-4	Osmium	Dual
Astatic	Q-AG(M)	A-802		CQ-A-J-M; CQ-AG-J	Osmium	All-Groove	Webster-Electric Webster-Electric	A3S A1S	W-14 W-15		A1; A8 A1, A2, A3, A4, A5, A6, A8	Sapphire Sapphire	Standard Micro-Groove
Astatic Astatic	Q-J) Q-33-J)	A-81 A-81-LP		QT-J, QT2-J, QT3-J; LQD, LQD-1 QT-33-J; CQ-J; LQD, LQD-1	Sapphire Sapphire	Standard Micro Groove	Webster-Electric Webster-Electric	A1O A1O	W-16 W-17		A1M, A1M-1; A5M, A6M A1M, A1M-1; A2M, A5M, A6M	Osmium Osmium	Standard Micro-Groove
Astatic Astatic	D-M) D-33(M)	A-83 A-83-LP		LT-3D; LT-4D; LT-4D1; MD LTD-3D; LT-4; LT-4D; LT-4D1	Osmium Osmium	Standard Micro-Groove	Webster-Electric	Q1	W-30		Q1	Osmium	Standard
Astatic	D-AG(M)	A-832		LT-4-AG	Osmium	All Groove	Webster-Electric Webster-Electric	G3 G1	W-36 W-38-LP		G3M G1M	Osmium Osmium	Standard Micro-Groove
Astatic Astatic Astatic	G-78(M) G(M) G-AG(M)	A-84 A-84-LP A-842		GC-78-M; MG-78-M GC-M; GC-1M; MG-1M GC-AG-M; MG-AG-M	Osmium Osmium Osmium	Standard Micro-Groove All Groove	Webster-Electric Webster-Electric Webster-Electric	G2 W5 A1	W-362 W-37 W-37 LP		G2M W5 A1/4	Osmium Osmium Osmium	All Purpose Standard Micro-Groove
Astatic	T(M)	A-86		LT-1M, LT-2M; LT-3M	Osmium	Standard	Webster-Electric	A9	W-38		A9M	Osmium	All Purpose
Astatic	T-33(M)	A-86-LP		LT-33	Osmium	Micro-Groove	Webster-Electric	A2	W-412		Q3; A9, F-13	Osmium	All Purpose
Astatic Astatic	C-3(M) C-1(M)	A-87 A-87-LP		MD-3 MD-1	Osmium Osmium	Standard Micro-Groove	Webster-Electric	C9	W-422		C9	Osmium	All Purpose
Astatic Astatic	U-78(M) U(M)	A-88 A-88-LP		U-78-M U-M	Osmium Osmium	Standard Micro Groove	Webster-Electric	Q2	W-49		Q2	Osmium	Standard
Astatic Astatic	C-3(J) C-1(J)	A-89 A-89-LP		MD-3 MD-1	Sapphire Sapphire	Standard Micro-Groove	Webster-Electric Webster-Electric	F16-3 F16-1	W-72 W-73		F16, F16-1; F16-2 F16, F16-1; F16-2	Osmium Osmium	Standard Micro-Groove
Astatic Astatic Astatic	A-3(M) A-1(M) A-AG(M)	A-85 A-85-LP A-852		AC-78, ACD Series AC, ACD Series AC-AG-M; AC-AG-J	Osmium Osmium Osmium	Standard Micro-Groove All Groove	Webster-Electric Webster-Electric	F15-3 F15-1	W-81 W-82		F15, F15-1 F15, F15-1	Osmium Osmium	Standard Micro-Groove
Astatic	Nylon 1-M	A-82		Nylon 1J; Nylon 1M	Osmium	Standard	Webster-Electric	F7	15-LP		F7, 17-1, F7-2; Q2; F13	Osmium	Micro-Groove
Shure	A62A	JP-30		P-30, P-37, P-70, P-72, P-74AD, P-76, P-77; P-72A, P-85, P-88, P-89, P-94; PN-30; W-22A; W-61R, W-65R, W-66R, W-60HS; W-60PN; Admiral 409A11	Osmium	Standard	Webster-Electric Webster-Electric	F10 F10-1	JP-30 JP-30-LP		F10, F11; F11-1 F11, F11-1	Osmium Osmium	Standard Micro-Groove
Shure	A-62MG	JP-30-LP		Admiral 409A11, P-73, P-74AD, P-72V; P-76V	Osmium	Micro Groove	General Electric	RPJ-001	GE-10		RPX-040, RPX-041; RPX-046	Sapphire	Standard
Shure	A-66U	JP-312		Admiral 409A13-1, P-71, P-81; P-37	Osmium	Unipoint	General Electric	RPJ-003	GE-10-LP		RPX-040, RPX-041; RPX-046	Sapphire	Micro-Groove
Shure	A-61A	JP5-30		P-30, P-37, P-70, P-72, P-74AD, P-76, P-77, P-72A, P-85, P-88, P-89, P-94; PN-30; W-22A, W-60A	Sapphire	Standard	General Electric	RPJ-010	GE-11		RPX-050	Sapphire	Dual
Shure	A-65MG	JP5-30-LP		P-73; P-74AD, P-72V, P-76V; W-21A; W-21AR; W-22A; W-22AB	Sapphire	Micro Groove	Philco	45-1596	PH-10		Dynamic Reproducer 76-1622	Sapphire	Standard
Shure	A67U	JP5-312		P-71, P-81; P-37	Sapphire	Unipoint	Philco	45-1613	PH-11		45-1609	Osmium	Micro-Groove
RCA RCA	72545 74068	M-70 M-70-LP		70338; 70339 74067	Sapphire Sapphire	Standard Micro-Groove	Philco	35-2693	PH-12		76-4649	Osmium	Dual
RCA RCA	75046 75045	M-71 M-71-LP		70338, 70339 74067	Osmium Osmium	Standard Micro-Groove	Philco	45 1613	M-60-LP		45-1609	Sapphire	Micro Groove
RCA	39863	M-72		72551; 9890; 39919, 39550, 38598; 70332; 39851	Sapphire	Standard	Philco	45-1597	PH-14		35-2671	Osmium	Standard
RCA	38449	M-73		72551; 9890, 39919, 39550, 38598; 70332; 39851	Osmium	Standard	Philco	45-1651	PH-15		35-2671	Sapphire	Standard
RCA RCA	75497 75496	M-74 M-74 LP		75475 75475	Sapphire Sapphire	Standard Micro-Groove	Webster-Chicago	NE-215	NE-215		219247, 219402, 219403	Osmium	Dual
RCA RCA	75497 75496	M-75 M-75 LP		75475 75475	Osmium Osmium	Standard Micro-Groove	Webster-Chicago	NE-316	NE-368		219404	Osmium	Dual
Electro-Voice Electro-Voice	S-3 S-1	E-90 E-90-LP		M12-S, M12-S, L12-S 14-S, 22-S, 345	Sapphire Sapphire	Standard Micro-Groove	American Microphone	S-1	AM-20		S-1, S-1A, S-2, S-2A	Osmium	Standard
Electro-Voice	S-13	E-91		161T; 221T	Sapphire	Twin Point	American Microphone	CO-3	AM-21		C-3	Osmium	Standard
Electro-Voice	O-13	E-93		161T; 221T	Osmium	Twin Point	American Microphone	CO-1	AM-21-LP		C-1	Osmium	Micro-Groove
Electro-Voice Electro-Voice Electro-Voice	O-3 O-1 O-2	E-95 E-95-LP E-962		M12; M12, L12 14; 34; 33; 335	Osmium Osmium Osmium	Standard Micro-Groove All Purpose	American Microphone	CO-2	AM-212		C-2	Osmium	All Purpose
Columbia	101	M-60-LP		45-1609	Sapphire	Micro Groove	Crosley	145720	C-99		145749	Sapphire	Standard
Columbia	102 & 103	A-81-LP		CQ	Sapphire	Micro-Groove	Magnavox	560102	M-02		560101	Osmium	Standard
							Magnavox	560138	M-46		560133	Osmium	Twin Point

1. These needles are handled by all Radio Parts distributors.
2. A set of installation instructions is packaged with each needle.
3. Ask for them by the Jensen number indicated.

Jensen INDUSTRIES, INC.

331 SOUTH WOOD ST., CHICAGO 12, ILL.

Sell an ANCHOR BOOSTER for fast profits

and complete customer satisfaction...

ON EVERY FRINGE INSTALLATION

Why High Towers,  Hazardous Installations  for your men as well as your customers? WHY spend so many hours  on one installation when you *CAN* make 3 or 4 calls  and more profits  per installation in one afternoon?

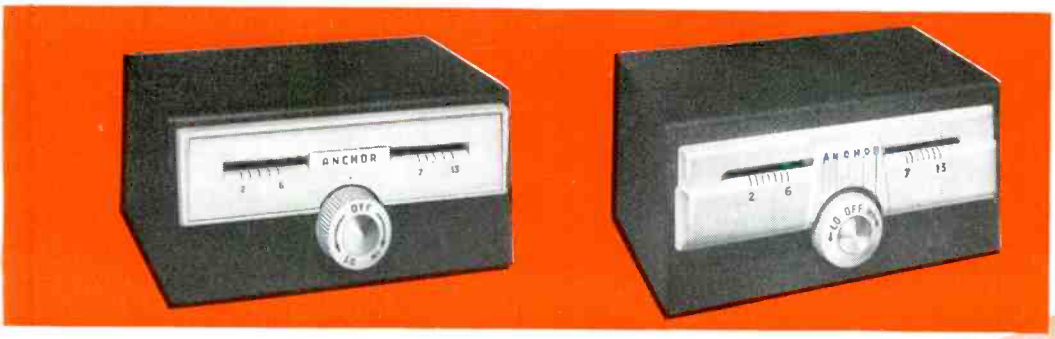
You, the Service Dealers, are recognized as experts in your community. Your advice is often asked and usually followed. Your men are the *one group* in the electronics field who actually get into the home . . . right at the point of sale. It stands to reason then that an installation of one of the many fine simple-to-install antennas, plus an ANCHOR Single or Two-Stage Booster would make a faster and more profitable installation for YOU as well as a completely satisfied customer. REMEMBER, returned calls due to dis-satisfaction are costly.

The New ANCHOR BOOSTERS Are Available. Order from your jobber Now.

BE SURE YOU KNOW ALL THESE FACTS

Only ANCHOR can provide your customers with ALL of the most Ultra-Modern advantages for consistent, top-notch, long-range TV reception. Here's why!

- ANCHOR has the highest gain of any TWO-STAGE BOOSTER.
- ANCHOR has the highest Signal to Noise Ratio.
- ANCHOR is the only non-regenerative unit available. The unit that is not returned.
- ANCHOR'S Single Knob Construction is so convenient for Booster is turned on and can be switched and tuned all on the same knob.
- ANCHOR'S New and Revolutionary method of construction of the RF Stage (Pat. Pend.) is the only real engineering advance in Boosters in recent years.
- ANCHOR'S TWO-STAGE BOOSTER is modernly styled with streamlined plastic escutcheon, soft mahogany leatherette finish.
- IMPORTANT ANCHOR'S TWO-STAGE BOOSTER is often the answer to installation difficulties well within the normal TV areas where their New Single Stage Model fails to give complete satisfaction.



ANCHOR'S NEW TWO-STAGE BOOSTER, ARC-101-100, increases original TV signal strength more than 5 times and assures consistently good reception over 100 miles.

ANCHOR'S NEW SINGLE-STAGE BOOSTER, ARC-101-75, especially recommended for low signal areas in or near cities where there may be any number of interference problems. Assures consistently good reception up to 75 miles.

ANCHOR RADIO CORP.

ANCHOR ENGINEERING ALWAYS A YEAR AHEAD

2215 SOUTH ST. LOUIS AVENUE CHICAGO 23, ILLINOIS

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SERVICE

PROBABLY NO PHASE OF SERVICING is overlooked so blandly as the business end. For some reason or other Service Men just seem to dread that word *business* and its implications. Yet, without a sound business program, a successful shop just can't exist.

What does the business regimen involve? Some think it is just accounting. Actually, accounting is but one of many of the facets which must be considered. There are the problems of skillful buying, effective stock controls, sound merchandising, proper pricing, adequate financing, helpful records, good housekeeping, service to customers and particularly, a friendly pleasing personality. Every item cited is important and soundly related. Good housekeeping, for instance, can contribute substantially to the successful shop, by providing adequate light, good ventilation, orderly arrangements on the bench, the shelves and in the window with attractive and sensible displays. Service to customers is extremely vital and closely allied with that friendly pleasing personality requirement. To be successful, the Service Man must recognize that basic fact that his customers are in reality his employers and that they will employ him and his shop only as long as he serves them well. Interest in the community is an integral part of any service program. Commenting on this point in a recent business aid report, Goodreau Soper, of the Department of Commerce small business division, said that the successful Service Shop owner usually has a personal interest in the community in which his store is located, the attractions it has for persons from the surrounding areas, and the social, recreational and educational facilities it provides for its citizens. In addition, such an operator takes an active part in the civic and charitable activities of the community, supporting those which will strengthen the town and make it a healthier and happier place in which to live and earn a living.

Successful Management in the Shop

There are other items on the successful business agenda which demand urgent recognition. Diagnosis is one of them. A quick and positive diagnosis can provide quite a handsome return. Oldtimer Charles Golenpaul, of Aerovox, in a striking commentary on this and other business aspects during a recent address before the PRSMA group in Philadelphia said that nothing is more vital in profitable servicing than a rapid assured diagnosis, a step which incidentally can be guaranteed by the use of the very best test equipment.

Parts Replacement

Discussing the step which follows diagnosis, parts replacement, Golenpaul accented the importance of the use of reputable components . . . "those carrying the names of recognized manufacturers, packed in original cartons, coded to indicate recent production runs." He pointed out that the Service Man just can't . . . "afford to take a chance on uncertain components which are apt to fail in short order and compel you to call back to make good. Sloppy material, quite as much as sloppy workmanship, can prove to be the easiest way to commit business suicide."

Salaries and charges, we were told, represent another business problem on most calendars. Unfortunately, there are too many Service Men who operate by the week. That can be disastrous, for the variable take-home pay never seems to keep pace with the expenses. "A salary is the best arrangement. "Pay yourself a fixed salary," said Golenpaul, "based on what the business averages by the month, or better still by the quarter. . . . See that the salary is available after you've accounted for those other items of business cost. And live on that weekly salary. Then, at the end of every quarter or half year, or year, see how much money is left over and above your salary." "That is profit," he emphasized, "and it's profit you are in business for, not just salary!" Following this pattern, declared Golenpaul, will assure that you're . . . "going to stay in business, going to grow and will be somebody some day."

Reviewing the delicate situation of material charges, Golenpaul stressed the need for list price charges. He stated that the trade discount given to the Service Man should not be discarded, for that discount is part of the Shop's profit.

Transportation charges, another key source of income or loss, were also analyzed at the meeting. It's important to charge for transportation, which can be placed on a mileage basis. "Make it clear to your customers and prospects," declared Golenpaul, "that you charge for your time from the moment you leave your shop and return, for transportation, for actual labor and again for material."

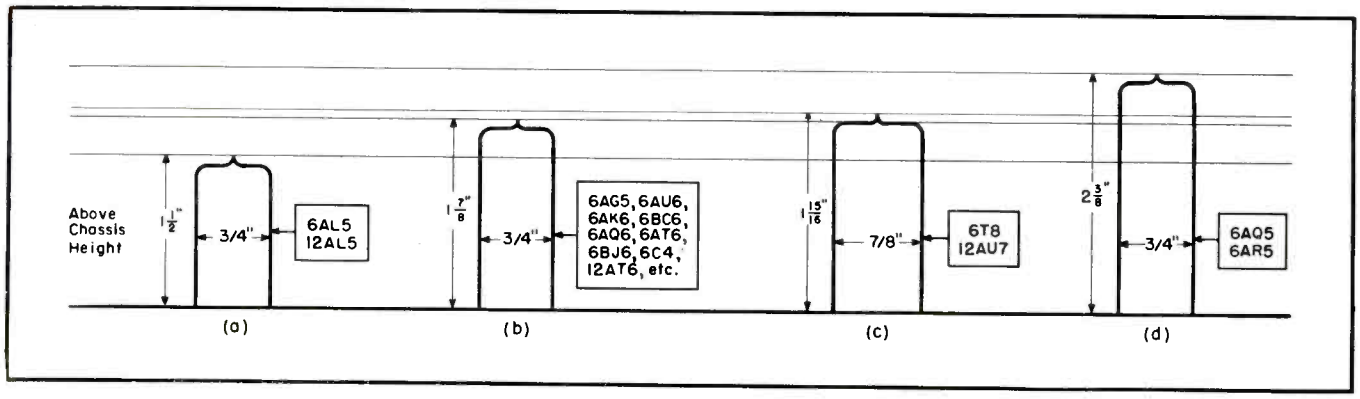
Business Building

Summarizing the means available to build business today, Golenpaul said: "To keep your charges fair and square, be mighty efficient. Make every hour count during the working day. Organize your jobs so as to minimize waste motion. Plan your calls so as to reduce travel mileage and time. Use the most efficient test equipment to arrive at the correct diagnosis promptly and dependably. Carry a reasonable stock of essential parts and materials so that you won't lose time chasing down to the jobbers for every job you handle. Use dependable parts and materials that won't let you down. Remember, labor is your greatest item of cost. Time is money. . . . You're in a good business. It's a business that can be as good as you make it. . . . Play it square. It's satisfied customers that can build up your business. By the same token, dissatisfied customers can chop off your head in short order. It's for you to decide, by your ethics and practices, whether you wish to remain in this game or not."

Here truly are words of wisdom which every Service Man should limelight in his resolutions for the New Year!—L.W.

(Below)
Fig. 1. Variations in miniature tube sizes. All types shown are seven-pin models, except the two listed in *c*, which have nine pins.

Finding Your Way



Application of Stage-by-Stage Check Procedures, Noting Specific Tubes, Components and Layouts Used, Disclosed as an Ideal Means of Locating Defects When Schematic or Chassis Data Are Not Available: Typical Analysis Cited for Single Chassis Models.

AT THE SHOP or in the field, the Service Man is often confronted with TV models for which he has no chassis layouts and with which he may not be too familiar, circuitwise. There is no denying that such occasions should not exist, but they do, particularly during those sudden emergency calls. However, it has been found possible to solve this awkward problem with the aid of a check plan which provides for the location of a defective stage without a schematic to guide the way.

Briefly the plan provides for the location of various stages when the chassis is in the cabinet and when it is out of the cabinet.

The in and out approaches were found to be most logical in view of the fact that a certain proportion of troubles may be caused by defective tubes. In such cases, it evidently would be a waste of time to yank the chassis out of the cabinet. On the other hand, when the chassis is already out, there are additional ways which can be applied to find a given stage a little faster and perhaps make identification more definite.

Before looking for a defective stage, it is necessary to check the type of receiver since this will often influence which stages to probe. Most receivers fall into one of four categories:

(*1*) Electrostatic or electromagnetic deflection. It is essential to know which system is used because this generally provides information on the type of deflection circuits and their output connections.

(*2*) Transformer low-voltage supply or transformerless. If the last is used, the filaments are in series-parallel, and if one filament opens, there generally will be a string of tubes unlit or possibly even all of them.

(*3*) Kickback or *rf* high voltage supply. This information is handy in determining how to analyze a dark screen with satisfactory sound or in deciding what type of horizontal deflection circuits to expect.

(*4*) Intercarrier system or separate video and audio *if* stages. This is useful in determining where to look for troubles common to both sound and picture or to either one.

In looking over a new chassis, prior to trouble-shooting, it is surprising how much useful servicing information can be obtained at almost a glance.

If a set has a 7-inch screen, it almost definitely has electrostatic deflection. If the screen is 10-inch or larger, the tube is certainly an electromagnetic type. There have been only a few exceptions to this rule. For instance, in '46 RCA introduced a model (621) which used a 7DP4, having magnetic deflection and static focusing. An early Belmont model also used a 10-inch electrostatic tube, the 10HP4. An additional check, where one may be necessary, involves a study of the neck of the picture tube. Electrostatic tubes have bare necks Magnetic types are well surrounded with such items as a deflection yoke, focusing coil, and usually an ion trap magnet near the socket.

The transformer low-voltage supply or transformerless chassis can be identified by using the system applied in checking a broadcast model. A look at the chassis will reveal if there is a power transformer sitting on it. In TV, the transformer can't be missed. They are larger, of course, than in radio because of the greater load they must handle, and may have 3" or 4" of laminations or even more. If there is no transformer on the chassis, the conclusion is obvious.

Incidentally, transformerless sets usually have one or more tubes, such as 25L6 and 19BG6, that obviously can't get filament voltage from a transformer.

(There are only a small number of models with minor variations; some with filament transformer for heaters and transformerless $B+$ supply and others with transformer $B+$ and series-parallel filaments.)

It is important in servicing to know the type of low-voltage supply. For

Around a TV Chassis

by CYRUS GLICKSTEIN

American Radio Institute

example, if all the tube filaments are unlit in a transformer set, there may be no current at the outlet, or a blown fuse in the receiver, a line cord out or defective, or a bad transformer, etc. In transformerless sets, it may be any of the foregoing, except the last or it may be an open picture-tube filament. In many of these types of sets, there are two strings of filaments in series with the picture-tube filament. If the last is open (or if the picture-tube socket is off) no tubes will light. If one of the other filaments open, several tubes will be unlit and each must be checked with an ohmmeter to find the defective one. The kickback or *rf* high-voltage supply constitutes the two most important types of high-voltage power supplies in use at present.

Most seven-inch sets use the *rf* type of power supply, with a power amplifier tube such as a 6V6, 6Y6, 25L6, etc., used as an *rf* oscillator and the 1B3 as the high-voltage rectifier. The air-core coil, wound on a hollow bakelite form, looks like an overgrown radio *rf* choke with 4 or 5 pies or sections. This coil acts as the high voltage stepup transformer.

In addition, some 10 and 12-inch magnetic sets are now using the *rf* power supply. Most of the magnetic sets, however, use the kickback system. The tube lineup in this system is a definite clue. In older sets, we find the 6BG6 as the horizontal output tube, a 1B3 as a high voltage rectifier, and the 5V4 as a damping tube. In newer sets, the horizontal output has a 6BQ6, the rectifier a 1X2, and the damper a 6W4. Some more recent sets have some combination of the two; Table I; p. 14.

These tubes are generally found inside the high voltage cage. An additional clue to the kickback type of high voltage system is the kickback transformer; a combination high-voltage transformer and output transformer for the horizontal circuit. It has a unique construction and doesn't resemble any other type of coil or transformer in the set. It also has seven or eight leads coming off it, and is found in the high-voltage cage. Since there are generally perforations in the cage, it is easy to look in to see what is there without opening it, unless this becomes necessary.

The intercarrier or separate audio and video *if* sections are the most difficult to spot by inspection. In some intercarrier models, when the contrast control is turned all the way up while listening to a station, there is an *intercarrier buzz* (a rasping 60-cycle buzz) in the audio.

In the main, the 7-inch sets use intercarrier and many of the late model larger receivers, use the system, too. Since one of the basic purposes of intercarrier sets is to cut down the number of stages, when it is found that less than 20 tubes are used, it is more likely, though not absolutely definite, that it is an intercarrier model.

There are other checks which can be tried. For instance, if both the sound and picture are lost when the video detector tube is taken out, while the set is in operation, the set is an intercarrier model. If only the video is lost, it is not an intercarrier type. This check can be made only on transformer sets. In transformerless sets, with series-parallel filaments, it would be necessary to short out the video detector output to make the same type of check.

If there is only one audio *if* stage, intercarrier operation is also indicated.

Once the general characteristics of the set are observed, the individual stages can be identified. Before outlining the procedure, let us review the functions of the various stages.

There are 7 general sections in all TV receivers and each can be broken down into a number of stages as shown below.

(In intercarrier sets there are three to four common video and audio *if* stages up to the video detector. There

Section	*Function*	*Usual Number of Stages (Tubes)*
(*1*) Front end or tuner.	Receives two signals, video and audio. Provides local oscillator signal which beats with incoming ones to produce two *if* frequencies.	*3* (*rf*, oscillator, mixer) or *2* (*rf* with combination oscillator and mixer).
(*2*) Video strip.	Amplifies video *if* signal, detects it and amplifies video frequencies.	*3* (4 video *if* amplifier). *1* video detector. *1* (2 video amplifiers).
(*3*) Audio strip.	Amplifies audio *if* signal, detects and amplifies audio frequencies.	*2* (3 audio *if* stages). *1* discriminator or ratio detector. *2* audio amplifiers.
(*4*) Sync section.	Clips off sync pulses from video signal, amplifies them and feeds pulses to vertical and horizontal oscillator to trigger them at correct time to synchronize sweeps with incoming information.	*2* (3 sync separators and clippers). *1* horizontal *afc*.
(*5*) Sweep.	Provides horizontal and vertical deflection.	*1* (2 vertical oscillator and amplifiers). *2* (3 horizontal oscillator, horizontal output, and damper, if magnetic deflection).
(*6*) Low voltage.	Provides plate voltage for all stages except picture tube.	*1* (2 low voltage rectifiers; none, if selenium rectifiers are used.)
(*7*) High voltage.	Provides high voltage for picture tube.	*2* for *rf* system; oscillator and rectifier. *1* for kickback-rectifier.

is usually one audio *if* stage after the 4.5-mc audio *if* signal is taken off. However, some non-intercarrier sets have one or two common *if* stages following the tuner, before the two *if* signals are separated.)

Above-the-chassis inspection to identify each stage involves four points:

(*1*) Type of tube.

(*2*) Shape of tube.

(*3*) Location of tube with respect to other tubes and above-chassis components.

(*4*) Tube withdrawals to check identification.

When the chassis is out of the cabinet, there is a fifth factor to consider, too: Location of the tube with respect to below-chassis components and controls.

Type of tube: A variety of tubes are used in present-day receivers. However, a random selection of a number of TV receiver models over the past few years, including some '50 types has revealed that in many stages the tubes are similar. This information has been summarized in Table I.

Shape of tube: There are significant differences in the shapes of the various miniature tubes used in different sections of the receiver, and they can be immediately identified on inspection.

The most popular tubes for video and audio *if* stages, 6AG5, 6AU6, etc., are medium width and height. The exact tube size appears in Fig. 1*b*. The 6AL5, used as video detector, and less often as audio discriminator and in horizontal *afc* circuits, is a medium width type and smallest in height; Fig. 1*a*. The 6AQ5, used as audio power amplifier and sometimes as the last video amplifier, is medium width and tallest of the miniatures; Fig. 1*d*. The 6T8, used as a combination discriminator and first audio and the 12AU7 are medium height, but widest of the miniatures and have a 9 pin base; Fig. 1*c*. The 6T8 is also recognizable by the unique triple rectangular structure inside the bulb.

In standard size tubes, the 6SN7GT, which is a double triode, has part of the filament inside each triode section. As a result, a top view of a lit tube doesn't show a glow in the center but two glowing spots, one on each side. The 5U4G rectifier is one of the largest tubes in the receiver, with the old-fashioned shape. The 5V4G damping tube also has that shape but is somewhat smaller. The 6BG6, horizontal output tube, is in between the two. It

(*Continued on page* 31)

Table I
Tube types used in various stages of TV receivers.

Manufacturer and Chassis Model	Front End	Video IFs	Video‡ Detector	Video Amplifiers	Sound IFs and Limiter	Sound Discriminator and First Audio	Sound PA	Sync Amplifiers and Clippers	Vertical Oscillator and Amplifier	Horizontal AFC	Horizontal Oscillator	Horizontal Output	Horizontal Damper	High-Voltage Rectifier	Low-Voltage Rectifier	Picture Tube
Air-King† 2016(7)-R	6AG5 6J6	3–6AU6s*	6AL5[a]	6AC7	6AU6	6T8	6V6	12AU7	12BH7	6AL5	12AU7	6BG6	6W4	1B3	5U4 6X5	16-inch Rect.
Bendix† 2000, 3000	6AG5 6J6	3–6AU6*	1N60	6AU6	6AU6	6T8	6AQ5	6AU6	6SN7	6SN7	.....	6BQ6	.....	1B3	5V4	10BP4 12LP4
Crosley 9-404M 9-414B	2–6J6 6AK5	3–6AG5	6AL5[c]	12AU7	2–6AU6s	6T8	6V6	6SN7	6SN7	½ 6SN7	½ 6SN7	6BG6	5V4	1B3	2–5Y3s	10BP4
Emerson 637	6AG5 6J6	6AU6* 2–6AG5s	6AL5[a]	6AU6 ½ 12AU7	2–6AU6s	6T8	6V6	½ 12AU7 12AU7	6SN7 6K6	6SN7 6AL5	6SN7	6BG6	6W4	1B3	5U4	10BP4
Garod 10TZ1-3-4 12TZ1-3-6 15TZ6	3–6J6s	4–6BA6s	6AL5[a]	6AC7	2–6AU6s 6BA6	6T8	6K6	2–6SN7	6SN7 6AR5	6AL5	6SN7	6BG6	5V4	1B3	5U4 5Y3	10BP4 12J-L-QP4
G. E. 805-6-7	2–6AU6s 12AT7	3–6AU6s*	6AL5[b]	12AU7	6AU6	6AL5 6SQ7	25L6	12SN7	12SN7	½ 12SN7	½ 12SN7	19BG6	25Z6	1B3	(*4*)	10BP4 10FP4
G. E. 814	6AU6 12AT7	3–6AU6	6AL5[c]	12AU7	2–6AU6s 6SH7	6AQ7	6K6	6SN7	6SN7 6V6	½ 6SN7	½ 6SN7	6BG6	5V4	1B3	5U4 5Y3	12KP4
Hallicrafters 509 510 T-64	2–6AK5 6C4	4–6AU6s*	6AL5	6AU6 6AQ5(6V6)	6AU6	6AL5 6AU6	6K6	12AU7 (6SN7)	6SN7	6AL5	6SN7	6BG6	5V4	1B3	5U4	10BP4
Motorola TS9D	6AG5 6J6	3–6BA6s 6AG5	6AL5[d]	12AU7	3–6AU6s	6T8	6V6	2–12AU7s	6SN7	6AL5	6SN7	6BG6	5V4	1B3	2–5U4s	10BP4
Motorola TS-16	6AG5 12AT7	3–6AU6*	1N34	6AU6	6AU6	6AL5 ½ 12SN7	25L6	12SN7	½ 12SN7 6SL7	½ 12SN7	½ 12SN7	.....	.....	1B3‡‡ (*rf* osc-25L6)	(*4*)	7JP4
Philco† 50-T1400	6AG5 7F8	4–6AG5s*	½ of 12AU7	½ 12AU7 6V6	6BA6 6AU6	7X7	6V6	6SN7 7B4	½ 12AU7 6AQ5	½ 6SN7	½ 6SN7	6BG6	6W4	1B3	5U4	10BP4 12LP4
Raytheon† 12AX22	6AG5 6J6	4–6AU6s*	6AL5[b]	12AU7	6AU6	6T8	6K6	½ 6SL7[e]	6SN7	6AL5	6SN7	6BQ6	6W4	1X2	5U4	12LP4
RCA 630	3–6J6s	4–6AG5s	6AL5[b]	6AU6 6K6	2–6BA6s 6AU6	6AL5 6AT6	6K6	6SK7 6SH7 ½ 6SN7	6J5 6K6	6AL5 6AC7	6K6 ½ 6SN7	6BG6	5V4	1B3	2–5U4s	10BP4
RCA 8T241	2–6AG5 6J6	4–6AG5s	6AL5[c]	12AU7	2–6AU6s	6AL5 6AV6	6K6	2–6SN7s	6SN7 6K6	½ 6SN7	½ 6SN7	6BG6	5V4	1B3	5U4	10BP4
Stewart-Warner AVT-1 AVC-1, 2	6BH6 6J6	4–12AU6s*	12AL5[a]	12AU6	12AU6	19T8	50L6	12AU6	12SN7 50L6	.....	½ 12AU7** 12SN7	3–50B5s	2–35Z5s	1B3‡‡ (*rf* osc-35L6)	(*4*)	10BP4 10FP4
Teletone TV-249	6AU6 6AG5 6J6	3–6AG5s*	1N34	12AU7	6AU6	6AL5 6AT6	6K6	½ 6AL5[e] 6SN7	6SN7	½ 6SN7	½ 6SN7	6BG6	5V4	1B3	5U4	10BP4
Westinghouse† V-2150-111	2–6AG5 6C4	3–6BH6s* 6BJ6	6AL5[d]	6AH6	2–6BH6s	6AL5 6AV6	6Y6	12AT7 12AU7	12AU7 6AQ5	6AL5	12AU7	2–6AQ5s	6W4	1B3‡‡ (*rf* osc-6Y6)	2–5U4s	12LP4 12LP4A
Zenith† 23G22/23	6BJ6 6AG5 6C4	4–6AU6s*	1N64	12AU7	½ 12AT7	6BN6	6AG7	6AB4 6BN6	½ 12SN7 6AQ5	6AL5	6SN7	19BG6	25W4	1B3	5U4 25Z6 Series Fil.	12UP4 12UP4A

†1950 models.
*Intercarrier (common *if*s)
‡Video detector combined with *agc* diode[a]; *dc* restorer[b]; clamping diode[c]; noise limiter[d].
[e]Combined with *agc* diode or amplifier.
‡‡RF hy system.
A.: Selenium rectifier; series filament.
**Combined with *dc* restorer.

Servicing Helps

Installation of 6C4 Phase Detector in Place of 6C4 Phase Inverter and 6AL5 Horizontal AFC in Westinghouse Chassis . . . Stromberg-Carlson Service Notes: Improving Picture Focus; Removing Audio Buzz and Vertical White Streaks on Right Side of Picture; IF Tube Substitutions; Securing Ganged Cores to Tuner Carriage.

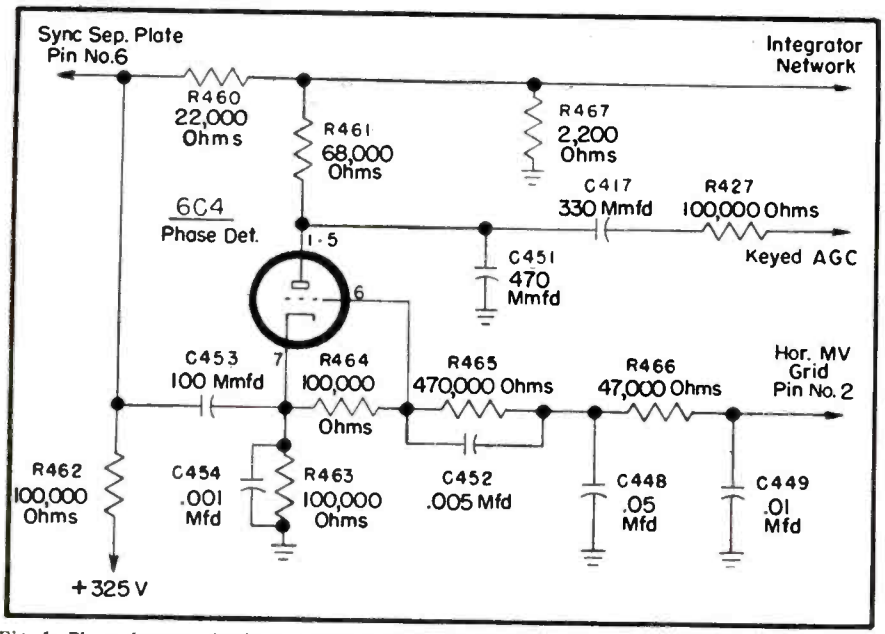
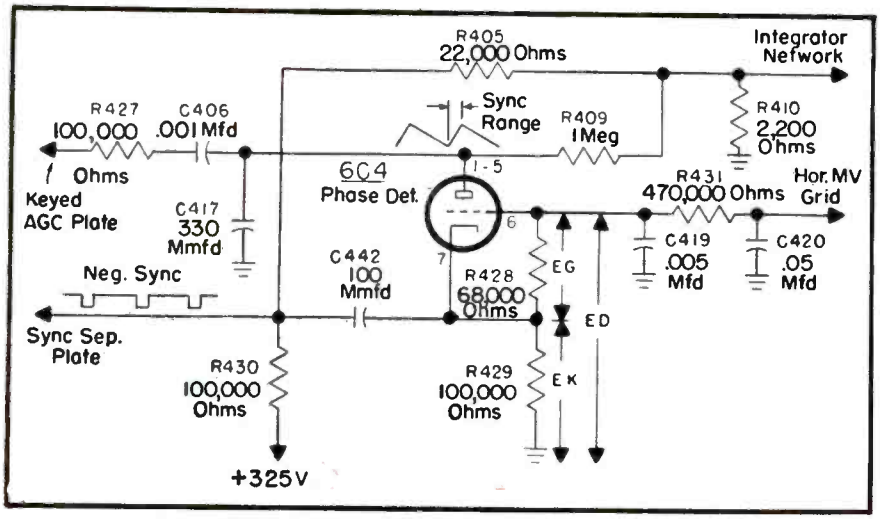


Fig. 1. Phase detector circuit now being used in Westinghouse H-627K16, H-628K16 and H-629K16 models.



by M. A. MARWELL

To DEVELOP CORRECTION voltage, that can be applied to the horizontal multivibrator in a TV chassis to control the frequency, there has been developed a 6C4 phase detector circuit, which can now be found in several runs of receivers. The system has been found so effective that Westinghouse has installed it in place of the 6C4 phase inverter and 6AL5 horizontal *afc* circuit. The corrected circuit appears in the H-627K16, H-628K16 and H-629K16 models; Fig. 1.

In Fig. 2 appears a basic circuit of the system as used in the Westinghouse B-2170 series of chassis.

The *dc* correction voltage, that will control the frequency of the horizontal multivibrator, must be a measure of the phase difference between the incoming horizontal sync pulses and the horizontal sweep voltage developed in the receiver.

As shown in the Fig. 2 circuit, no *dc* potentials are applied to the 6C4 phase detector elements with the exception of a small positive bias of approximately 3 volts which is applied to the plate to stabilize the operation. Instead, the operation of the circuit depends upon the application of *ac* voltages. A portion of the saw-tooth voltage from the horizontal output stage is applied to the plate of the phase detector. The peak-to-peak amplitude of the saw-tooth voltage at the plate is 20 volts or more. Sync pulses with a peak-to-peak amplitude of approximately 10 volts are applied to the cathode, and these sync pulses extend in a negative direction.

An important point in the consideration of the circuit is that when a vacuum tube is operated in such a manner that grid current flows, the magnitude of the grid current is greatly affected by the amount of voltage applied to the plate. When the plate voltage is zero or negative, maximum grid current will flow, and the grid current will decrease as the plate voltage increases in a positive direction.

The .005-mfd capacitor (C_{419}) which is connected between the control grid

(*Continued on page 46*)

Fig. 2. Another version of the phase detector circuit used in Westinghouse models H-633C17, H-634C17, H-635T17, H-636T17 anr H-638K20.

Announcing

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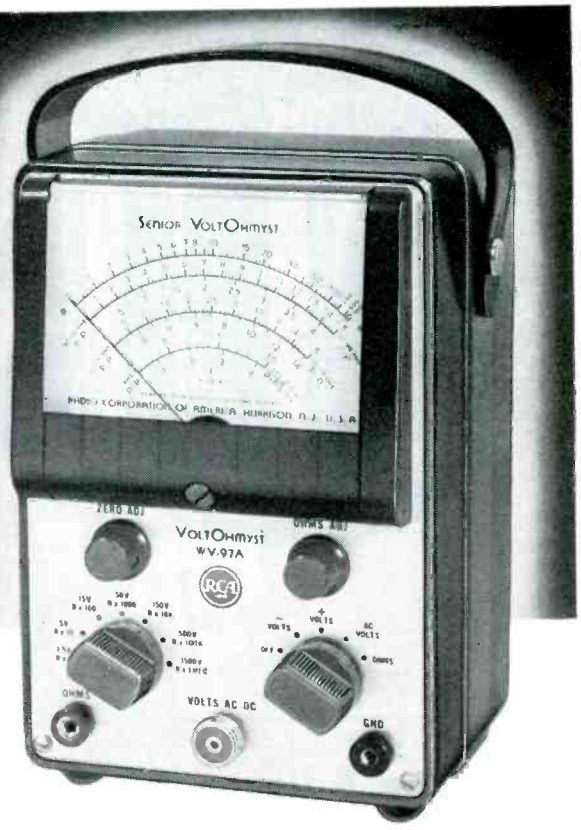

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5. Has 7 non-skip ranges for both resistance and voltage.
6. All full-scale voltage points increase in a uniform "3-to-1" ratio.
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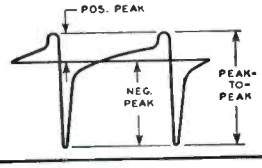
The WV-97A measures peak-to-peak voltages directly. Hence, it quickly provides information essential for servicing TV receivers with their pulse-type waveforms.



The WV-97A has a range of usefulness extending beyond that of any other instrument in the field. Its quality, dependability, and accuracy make it a true laboratory instrument; it is exactly what is needed for television in the design laboratory, factory, and service shop.

The new Senior VoltOhmyst measures dc voltages in high-impedance circuits, even with ac present. It reads the rms values of sine waves and the peak-to-peak values of complex waves or recurrent pulses, even in the presence of dc. Its electronic ohmmeter has a range of ten billion to one.

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An outstanding feature is its usefulness as a television signal tracer . . . made possible by its high input resistance, wide frequency range, and direct reading of peak-to-peak voltages.

For complete information on the new RCA WV-97A Senior VoltOhmyst, see your RCA Test Equipment Distributor, or write RCA, Commercial Engineering, Section 56X, Harrison, New Jersey.

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DC Voltmeter:
Seven continuous ranges . . . . . 0 to 1.5, 5, 15, 50, 150, 500, 1500 volts
Input resistance (including 1 megohm in dc probe):
All ranges . . . . . 11 megohms
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Peak-to-peak ranges . . . . . 0 to 4, 14, 40, 140, 400, 1400, 4000 volts
Maximum peak-to-peak input voltage . . . . . 1400 volts
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Frequency Response with WG-218 Direct Probe and Cable:
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Center scale values . . . . . 10, 100, 1000, 10,000 ohms; 0.1, 1, 10 megohms
Dimensions: 7¾" high; 5¼" wide, 3¾" deep
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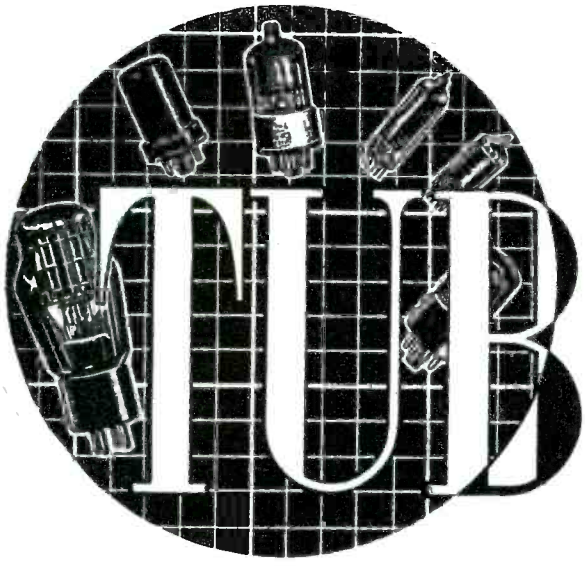


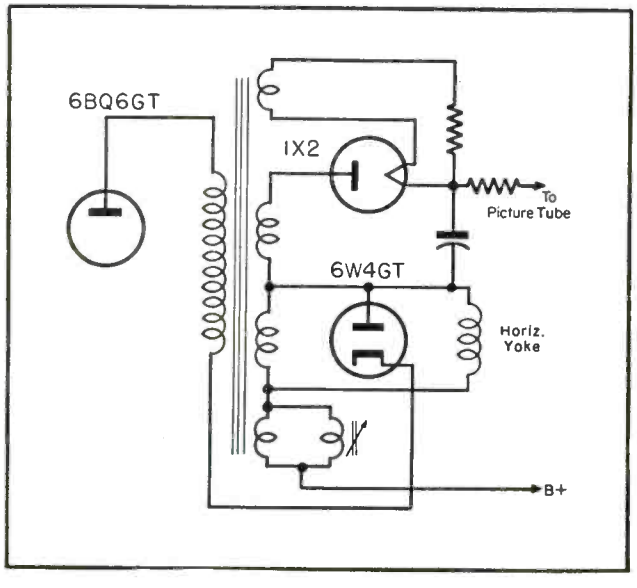
TUBE News

by L. M. ALLEN

Centering Adjustment Considerations for the Short Metal 16GP4

IN THE PICTURE-TUBE arrangement, there are three associated components which are particularly important; the deflecting yoke, focusing coil, and ion-trap magnet. Their proper adjustment is vital to the effectiveness of the reproductions on the screen. While these adjustments are normal factory procedures, there are many instances where readjustments must be made in the shop or home. For best results it is prudent to follow the adjustment procedures used at the plant. In the case of the deflecting yoke of the short metal 16GP4 tube. for instance, when the deflecting yoke is placed on the neck of the tube, the screen end of the yoke is centered by pushing the yoke forward so that the windings are pressed firmly against the glass cone. To center the base end of the yoke and maintain its axial alignment with the tube neck, a small cylindrical wedge of insulating material is usually inserted between the base end of the yoke windings and the tube neck. The yoke should be mounted so that it may be rotated for alignment of the raster with the tube mask. Grounding of the yoke core is advisable to keep radiation to a minimum.

*From copyrighted notes prepared by the tube department of RCA.



Circuit of typical flyback power supply with a 6BQ6GT, 1X2 and 6W4GT. The 1X2, a miniature filamentary-type rectifier, which serves as a high-voltage rectifier supplying power to the anode of the picture tube, is being used as a replacement for the 1B3GT/8016.
(Courtesy Hytron)

Focusing Device Considerations

A focusing field, supplied by an electromagnetic coil, permanent magnet, or a combination of the two, is required to concentrate the electron beam into a focused spot at the screen. The field must have excellent radial symmetry. When a coil is used, it must be supplied with direct current from a well-filtered source. The focusing field must be spaced at least one-half inch from the deflecting coils to reduce interaction between the focusing and deflecting fields. If the focusing field is placed too close to the deflecting fields, interaction between them may produce reduced deflection sensitivity and corner resolution, as well as objectionable rotation of the fluorescent pattern as the focus is varied. On the other hand, if the focusing field is located too close to the electron gun, resolution will be reduced and pattern distortion may occur as a result of intersection of the focusing field with the ion-trap-magnet field.

As the air gap of the focusing device is moved away from the deflecting yoke, the corner resolution will be improved at the expense of a slight loss in center resolution. The strength of the focusing field required for focus will increase as the distance between

(Continued on page 50)

NEW INDICATOR ION TRAP

Now in all Rauland Tubes

The response to Rauland's new Indicator Ion Trap, after its introduction in the 12LP4-A, has been so enthusiastic that this feature has now been incorporated in all Rauland tubes—as a standard feature of the new Rauland Tilted Offset Gun.

In the field or on the assembly line, this new Indicator Ion Trap reduces Ion Trap Magnet adjustment time to a matter of seconds, eliminates mirrors and guesswork, and assures accuracy of magnet adjustment. It can increase profits for every service man and service dealer—and at the same time assure better customer satisfaction.

A bright green glow on the anode of the picture tube signals when adjustment is incorrect. Correct adjustment is made instantly, by moving the magnet until the glow is extinguished or reduced to minimum.

Only Rauland offers this advanced feature—one of a half-dozen important post-war developments from Rauland.

RAULAND

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Indicator Ion Trap

Luxide (Black) Screen

Reflection-Proof Screen

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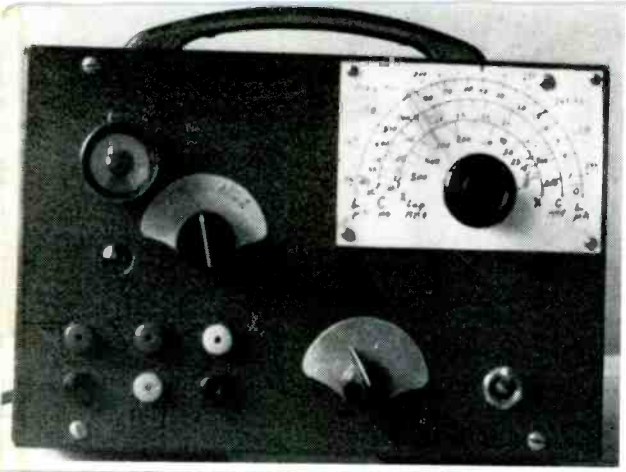


RF Reactance

[*See Front Cover*]

by PHILIP H. GREELEY

Above, at left appears *rf* instrument ready for operation. View at left, bottom, illustrates instrument ready for accessory tests. Only the two left pin jacks are required for *rf* testing.

RADIO-FREQUENCY TESTING can be unusually effective in spotting defective capacitors and inductors. By employing a favorable frequency range or ranges, satisfactory tests can be carried out on components in their circuits.

Basic principles of *rf* measurement testing are old in the art, having been described in such early texts as the *Wireless Telegraphist's Pocket Book*, J. A. Fleming, 1915. These employ the wavemeter approach, which takes the general form of the layout shown in Fig. 1, where two circuits, *A* and *B*, are *loosely* coupled and must be tuned to the same frequency for best response of the indicator, which can be a simple neon bulb. Provision is made for the insertion of an unknown capacitor or inductor in either circuit *A* or *B*, and one of the circuits *A* or *B* can then be retuned for a resonance indication. Reading the amount of retuning required gives the value of the unknown capacitor or inductor either directly or by calculation.

Service work normally follows a definite pattern: apparatus fails completely or works poorly for one reason or another with often a good preliminary indication of the type of trouble and sometimes its approximate location. Observation and testing of tubes, and tests with a simple ohmmeter or voltmeter will locate many troubles, but these are of negligible help if capacitor or coil defects other than straight breakdowns exist. The *rf* measurement type tests are a particularly effective aid in specifically locating capacitor and coil defects such as: an open capacitor or one that has loose internal or external connections subject to changes when pressing or moving the part; an electrolytic capacitor that has deteriorated to the point of showing excessive series resistance; a coil that has shorted turns or a shorted tuning capacitor across it; a coil that is open or has loose connections or conductor defects; or, a coil that is inefficient by reason of moisture absorption or poor insulation.

It is true that perhaps only 25 per cent of radio, TV, and other electronic apparatus service jobs will have capacitor and coil defects, but much time is often spent in locating such troubles.

The idea of *rf* measurement testing is not related to signal tracing and has little direct concern with the tuning alignment of circuits or the checking of their performance. The main purpose is to provide quick and satisfactory means for identifying and noting the condition of reactance elements, capacitors and coils, in substantially similar fashion to the way an ohmmeter is used to identify and note the condition of resistance elements. Both the ohmmeter and the *rf* measurement type tester are primarily circuit and component checkers, working on their own power and adapted for point-to-point testing with ability to run down a specific circuit component that is defective or sub-standard. Repair and replacement work can proceed efficiently only where faults are definitely located. It is obviously a waste of time, with a good chance of increasing difficulties, to experiment with tuning adjustments where failure or poor performance of apparatus is caused by a defective circuit component.

Instrument Design

Circuitry of a general purpose *rf* test instrument[1] appear in the schematics on the cover and in Fig. 2 (p. 24). The tube, which may be a 6SK7, is operated as an electron-coupled Hartley type oscillator having a variable frequency range of slightly under 2 to 1 as from 150 to 296 kc, which requires a variable tuning capacitor range of 3.9 to 1. The plate output circuit of the tube is coupled through a capacitor and resistor to a specifically designed test circuit (*B*) having a control selector switch providing input connections for unknown capacitors and inductors. By employing a series-parallel coil arrangement for inductance tests and a series-parallel capacitor arrangement for capacitance tests, the frequency range of the test circuit can be held under testing conditions just within the oscillator frequency range. Circuit *B*, then, may have a frequency range of 155 to 284 kc which requires a capacitance or inductance change ratio of 3.35 to 1. This means, for example, that coil L_2 has 2.35 times the inductance of coil L_1, so that if L_2 is

Measurement Tests

shorted out on a test the inductance of L_1 will be sufficient to keep the resonant frequency of circuit B from going higher than 284 kc, maximum. If different coils of increasing inductance value are test connected across L_2, the frequency of circuit B will decrease gradually to 155 kc, when the coil under test has a high inductance value exceeding 50 times that of coil L_2. An ac *vtvm*, coupled across circuit B, serves to show when oscillator circuit A and circuit B are tuned to the same frequency. Since, on inductance testing, any *rf* coil connected across coil L_2 changes the frequency of circuit B, oscillator circuit A must be reset for resonance indication, and the dial of oscillator A can be calibrated for the inductance value inserted in circuit B. Capacitance tests are similar to inductance tests with, of course, the interchange of capacitance instead of inductance variation in circuit B, by the setting of the selector switch. When inductance testing, the tuning capacitance of circuit B is fixed and the effective inductance varies; when capacitance testing, the tuning inductance of circuit B is fixed and the effective capacitance value varies. The dial of oscillator A can also be directly calibrated for capacitance values tested in circuit B.

In designing circuit B and using the series-parallel testing scheme, as well as a limited oscillator-frequency range several factors were considered. Capacitor value measurement tests can have satisfactory accuracy only where comparison is made with a reference or standard capacitor not too far distant in value from that of the capacitor to be measured. About the limit of satisfactory accuracy has been found to be a reference ratio of 20 to 1, though useful indications can extend to a much higher ratio. Commonly used paper capacitors have a value tolerance of 10 per cent and have rated values up to .1 mfd. To have more than 1/20 the value .1 mfd, the main tuning capacitor of circuit B should have a value of .005 mfd or more, perhaps .006 mfd. The first capacitor measurement range of the instrument then can have satisfactory accuracy on values from .12 mfd to 300 mmfd, with useful qualitative indications on capacitors larger than .12 mfd. A second capacitor measurement range has been found to provide more accurate readings on values below 500 mmfd.

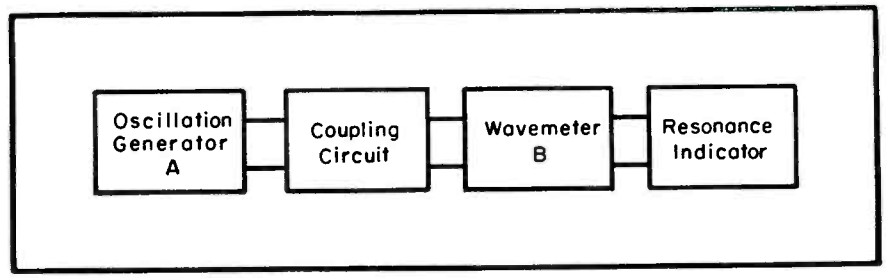
[1] U. S. Pat. 2471033.

Use of RF Test Techniques with Instrument Featuring One Inductance Test Range and Two Capacitor Test Ranges Found to be Effective for Locating Capacitor and Coil Defects, Including Open Capacitors or Those with Loose Internal Connections, Electrolytics That Have Deteriorated, Coils With Shorted Turns or Shorted Capacitors Across Them, Coils That Have Loose Connections or Poor Insulation, etc.

Good test coverage of capacitors used for bypass, audio and video coupling in common circuits is of major importance in service work. Test circuit B must, as stated, have a relatively large value main tuning and reference capacitor which makes it difficult to re-tune this circuit to any fixed oscillator frequency. Holding test circuit B to a specified frequency range and re-tuning the oscillator is not difficult, but resonance voltages applied to the *vtvm* indicator tend to vary widely on different capacitor and inductor tests and change of oscillator frequency. This resonance voltage variation is unpleasing and a nuisance in requiring constant resetting of the *vtvm* indicator control; however, this trouble has been overcome to a satisfactory degree in the plate output circuit of the oscillator tube. This plate circuit includes a choke of about 30 *mh*, paralleled by a 30,000-ohm resistor, and the choke with tube interelement and other small circuit capacities is resonant near 270 kc. On inductance tests this plate circuit has been found to have an effective impedance increasing from 25,000 to 30,000 ohms, with increase of frequency. Coil L_1 of circuit B, designed to have a Q value of about twice that of coil L_2 keeps up the effective resonance impedance of the circuit as the frequency increases and the inductance value is reduced when testing an unknown inductor. By increasing the applied oscilator voltage, resulting from the increasing plate impedance and the improved efficiency of circuit B at higher frequencies, indicator voltages can be left relatively even. On capacitance tests, switch S_2 in the system connects a 50-mmfd capacitor across the plate circuit of the oscillator tube and the impedance falls from 25,000 to 12,000 ohms with an increase of frequency. The applied oscillator voltage then decreases to compensate for the rising impedance value of circuit B, as the effective tuning capacitance decreases.

Series-parallel testing does sacrifice measurement accuracy, but provides a greatly increased operating speed desirable in service test work. By this arrangement a capacitor and an inductor scale may each cover a very wide value reading range, permitting a capacitor or inductor to be identified for value and condition within a single sweep of the oscillator tuning. Measurement accuracy, though sacri-

Fig. 1. Block diagram of *rf* measuring system featuring oid wavemeter principles.



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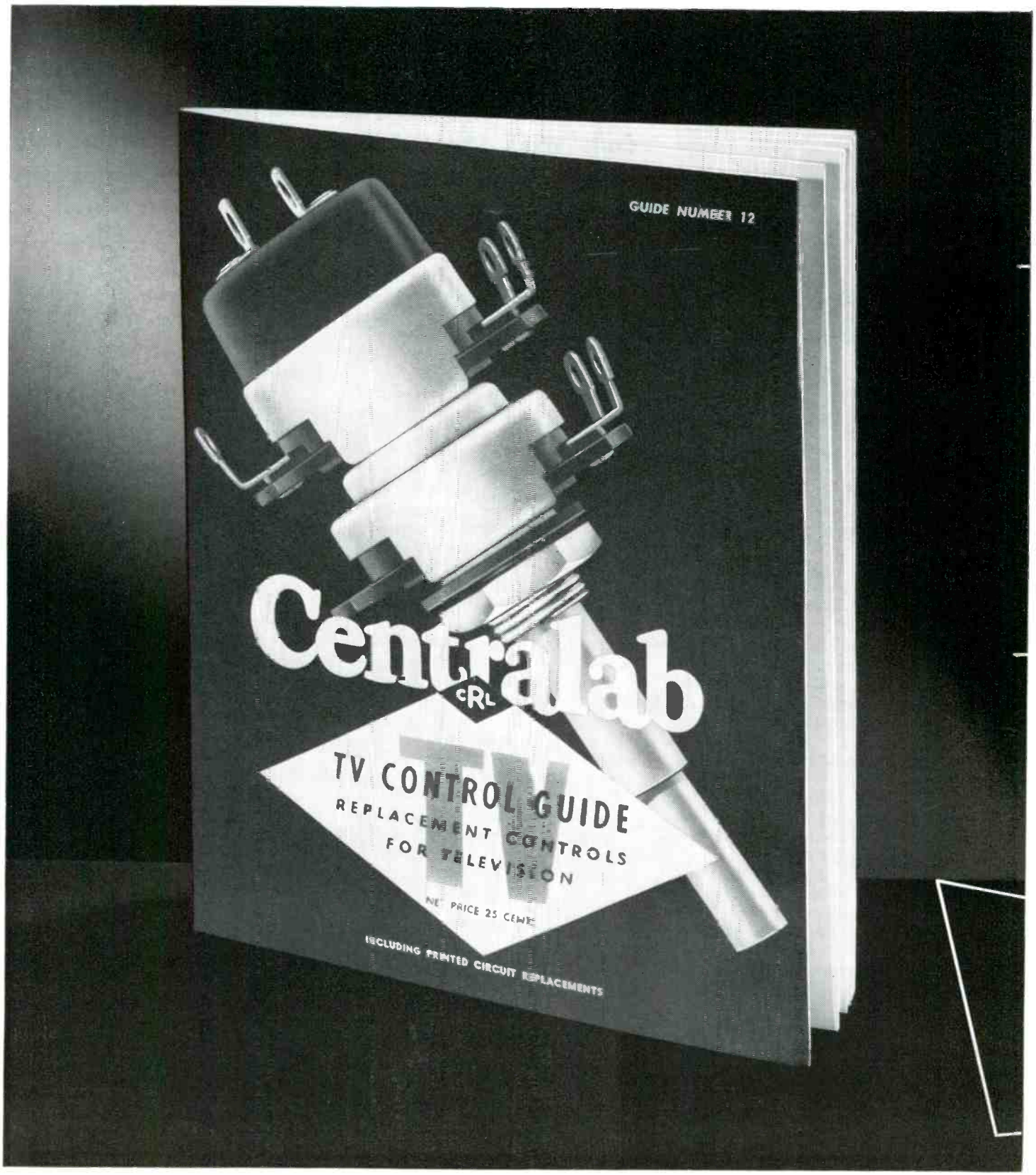

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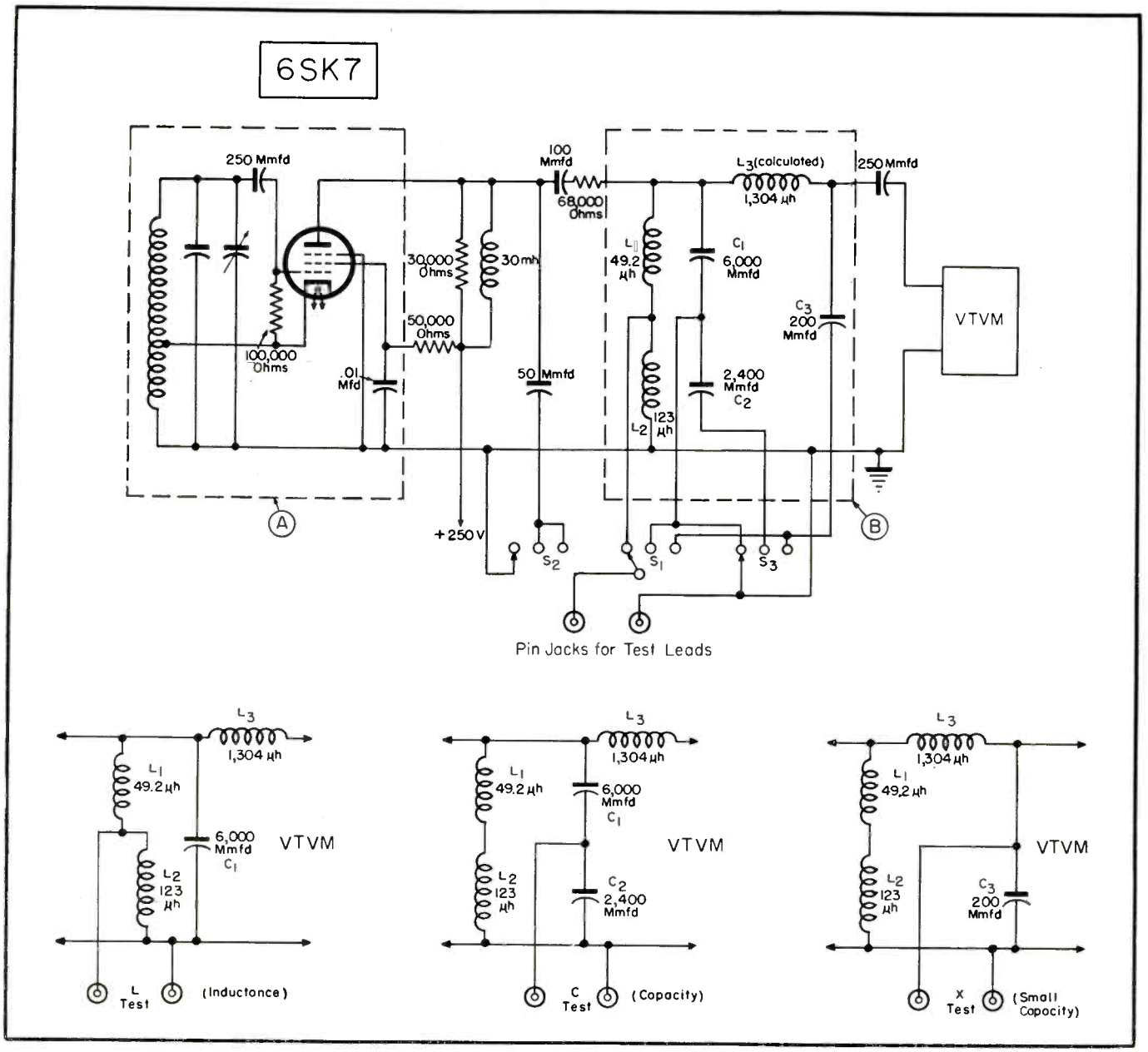

Fig. 2. The Greeley *rf* test circuit. The *L*,*C* and *X* test circuits, shown separately are controlled by a three-pole three-position wafer switch. The C_1, C_2 and C_3 capacitors are silver mica type with 2 per cent tolerances. The coils L_1, L_2 and L_3 are adjusted to value through a powdered iron core. (The circuit shown on the *cover* is a simplified version of the system illustrating the main inductance and capacitance test circuits. The small capacitance omitted operates only when a small capacitor under test is disconnected from its circuit.)

ficed below precision standards, may still be as good as 3 per cent for center scale values and average 10 per cent over the major part of a scale range. The Service Man is primarily interested in rapid checking of parts in their circuits. For example, a capacitor suspected of cutting out or having a loose internal connection can be read for value, but with closer observation of steadiness of the resonance indicator, as the capacitor is pressed or moved. Measurements cannot be made with precision accuracy unless a part is removed from its circuit, which generally is not permissible or necessary in routine service testing.

Restricting the oscillator and test circuit frequency ranges to a ratio of less than 2 to 1 has the important advantage of eliminating harmonic or repeat responses in testing. A high-amplitude electron-coupled oscillator develops very strong harmonics in the plate circuit, but the second and higher harmonics give no response where the test circuit cannot resonate to harmonics which are two or more times the fundamental oscillator frequencies. Also, an oscillator circuit having a sizable tuning capacitor value is readily made to have good frequency stability. A fixed silver mica capacitor of 250 mmfd, across a variable capacitor having a maximum of 730 mmfd (a parallel connected 365 mmfd dual unit) in the oscillator circuit provides a tuning range just under 2 to 1. The minimum circuit capacity value is about 250 mmfd, and the effective tuning capacity value of test circuit *B* has been found to be at least six times that of the oscillator circuit.

Uses of Instrument

This general purpose instrument has been found of practical usefulness in rapidly locating capacitor and inductor defects.

Ability to check components in their circuits and test tuned circuits themselves has been found to be a major advantage of the instrument. A .05 mfd capacitor, for example, has only about 20 ohms reactance at the test frequency and can be checked in a resistive circuit unless connected resistors are unusually low in value, as below 200 ohms. Capacitors employed in

(*Continued on page 47*)

12 Improvements IN NEW 1951

MODEL O-6 PUSH-PULL

Heathkit OSCILLOSCOPE KIT

- ★ New AC and DC push-pull amplifier.
- ★ New step attenuator frequency compensated input.
- ★ New non frequency discriminating input control.
- ★ New heavy duty power transformer has 68% less magnetic field.
- ★ New filter condenser has separate vertical and horizontal sections.
- ★ New intensity circuit gives greater brilliance.
- ★ Improved amplifiers for better response useful to 2 megacycles.
- ★ High gain amplifiers .04 Volts RMS per inch deflection.
- ★ Improved Allegheny Ludlum magnetic metal CR tube shield.
- ★ New synchronization circuit works with either positive or negative peaks of signal.
- ★ New extended range sweep circuit 15 cycles to over 100,000 cycles.
- ★ Both vertical and horizontal amplifier use push-pull pentodes for maximum gain.

Only $39.50

The new 1951 Heathkit Push-Pull Oscilloscope Kit is again the best buy. No other kit offers half the features — check them.

Measure either AC or DC on this new scope — the first oscilloscope under $100.00 with a DC amplifier.

The vertical amplifier has frequency compensated step attenuator input into a cathode follower stage The gain control is of the non frequency discriminating type — accurate response at any setting. A push-pull pentode stage feeds the C.R. tube. New type positioning control has wide range for observing any portion of the trace.

The horizontal amplifiers are direct coupled to the C.R. tube and may be used as either AC or DC amplifiers. Separate binding posts are provided for AC or DC.

The multivibrator type sweep generator has new frequency compensation for the high range it covers; 15 cycles to cover 100,000 cycles.

The new model O-6 Scope uses 10 tubes in all — several more than any other. Only Heathkit Scopes have all the features.

New husky heavy duty power transformer has 50% more laminations. It runs cool and has the lowest possible magnetic field. A complete electrostatic shield covers primary and other necessary windings and has lead brought out for proper grounding.

The new filter condenser has separate filters for the vertical and horizontal screen grids and prevents interaction between them.

An improved intensity circuit provides almost double previous brilliance and better intensity modulation.

A new synchronization circuit allows the trace to be synchronized with either the positive or negative pulse, an important feature in observing the complex pulses encountered in television servicing.

The magnetic alloy shield supplied for the C.R. tube is of new design and uses a special metal developed by Allegheny Ludlum for such applications.

The Heathkit scope cabinet is of aluminum alloy for lightness of portability.

The kit is complete, all tubes, cabinet, transformer, controls, grid screen, tube shield, etc. The instruction manual has complete step-by-step assembly and pictorials of every section. Compare it with all others and you will buy a Heathkit. Model O-6. Shipping Wt., 30 lbs.

New INEXPENSIVE MODEL S-2
ELECTRONIC SWITCH KIT

Twice as much fun with your oscilloscope — observe two traces at once — see both the input and output traces of an amplifier, and amazingly you can control the size and position of each trace separately — superimpose them for comparison or separate for observation — no connections inside scope. All operation electronic, nothing mechanical — ideal for classroom demonstrations — checking for intermittents, etc. Distortion, phase shift and other defects show up instantly. Can be used with any type or make of oscilloscope. So inexpensive you can't afford to be without one.

Has individual gain controls, positioning control and coarse and fine switching rate controls — can also be used as square wave generator over limited range. 110 Volt transformer operated comes complete with tubes, cabinet and all parts. Occupies very little space beside the scope. Better get one. You'll enjoy it immensely. Model S-2. Shipping Wt., 11 lbs.

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Hi-Fi Amplifier Kit Circuitry . . . Two-Way Speaker Systems . . . Tweeters . . . 10-Watt Phono Amplifiers for Custom-Built Installations . . . Lab Type Amplifier with Noise Suppressor.

SHOP BUILDING OF HI-FI audio systems has become quite a popular practice among Service Men. With the excellent assortment of components and accessories in kit and completely assembled form available, it has become possible to provide an unusual assortment of setups to fit practically every requirement.

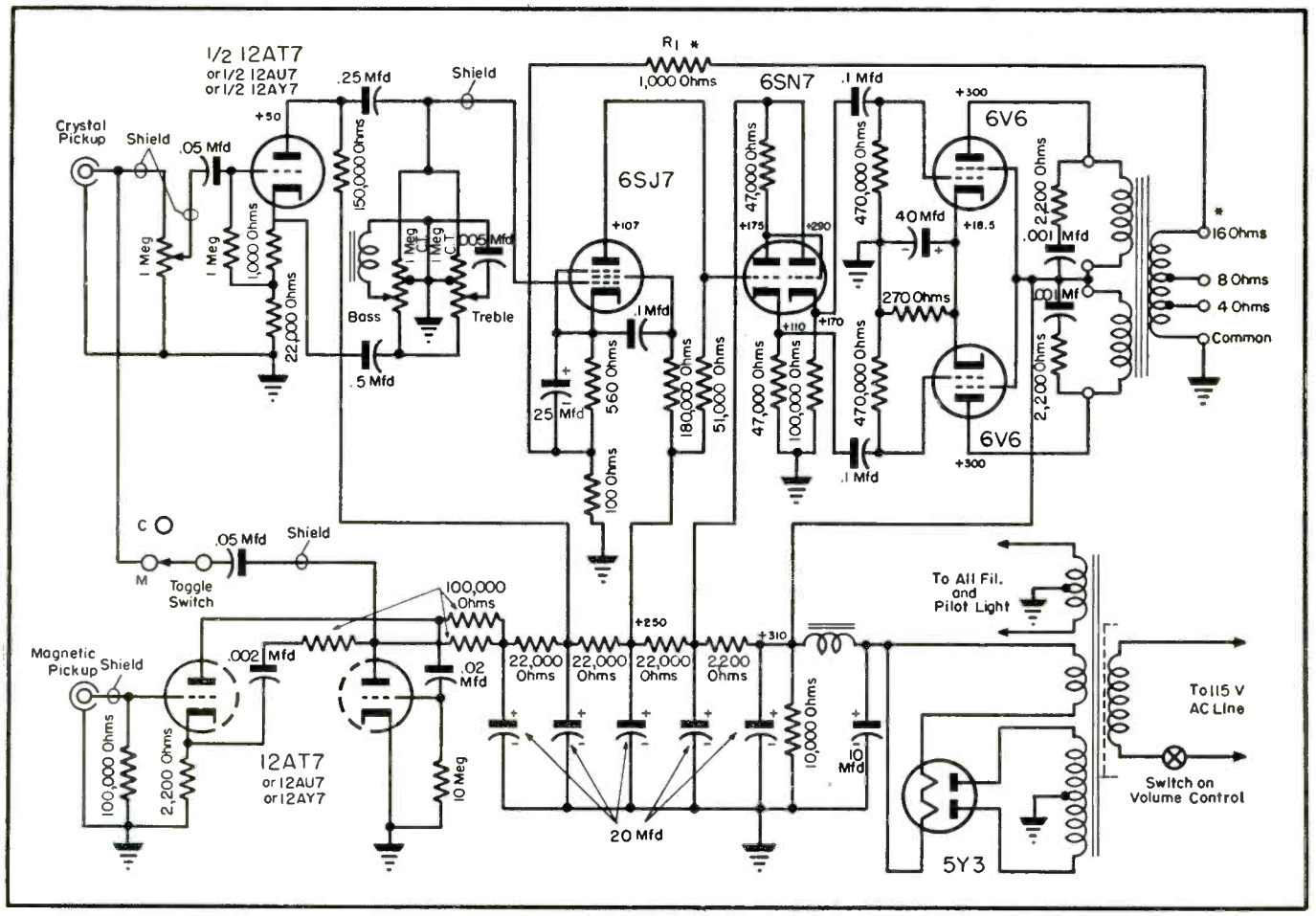
Kits, long absent from the audio scene, have been particularly interesting in their circuitry design. In one hi-fi type of kit[1] illustrated in Fig. 1, provision has been made for magnetic and crystal pickups, and 4, 8 and 16-ohm output. The amplifier is said to have a distortion of less than 2% from 50-18,000 cps at 10 watts output, and less than 1% from 20-20,000 cps at 5 watts. Equalization is provided continuously, variable to +12 db or —30 db at 50 or 8,000 cycles. A gain of 74 db is said to be available from crystal microphone or radio receivers; 96 db (equalized for magnetic pickup) through preamp.

Speakers and housings have received concerted attention on the design front, too, and as a result reproduction possibilities have been strik-

(*Continued on page 28*)

[1]HF-10; Triad Transformer Mfg. Co., 2254 Sepulveda Boulevard, Los Angeles 64, Calif.

Fig. 1. Triad hi-fi amplifier kit circuit.



Why there's big profits ahead for Webster-Chicago dealers!

12 million† RECORD CHANGERS need replacement

AMERICA'S FINEST! SENSATIONAL NEW Webster-Chicago Diskchanger*

Balanced Tone Arm
Gives perfect record touch on all size and all speed records.

Velocity Trip
New mechanism gives all records increased quality playing life.

Cushion-Drop
New spindle gently lowers records; heavy flock turntable cushions drop.

Easiest to sell because it has every wanted feature!

Webster-Chicago dealers are cashing in on this huge conversion market because they sell Webster-Chicago Diskchangers—the only replacement changer with *all* these features:

- Automatically plays 12-inch, 10-inch or 7-inch records at 33⅓, 45 or 78 rpm without any special adjustments.
- Pick-up arm comes to rest position after last record is played.
- Idler wheel retracts when control speed is off; eliminates flat spot which causes "wow."
- Fewer working parts for longer life of carefree operation.
- New automatic manual position plays home recordings or "inside-out" records without special adjustment.

Webster-Chicago dealers know fast sellers like this Diskchanger mean bigger profits...that's why they're stocking up now for the big fall-winter selling season!

† Radio and Television Retailing—May

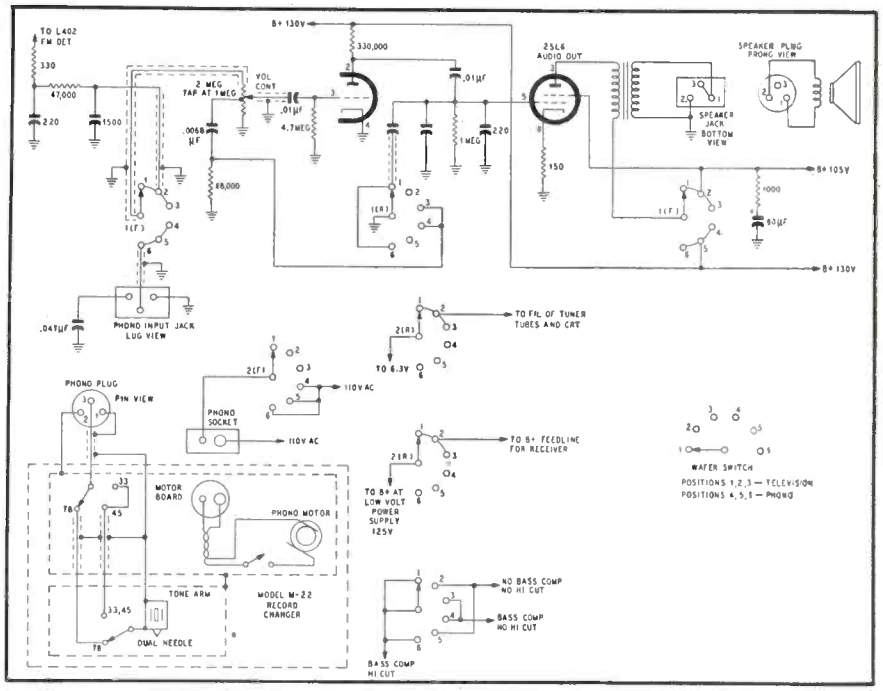
*T. M. Reg.

Another WC Product

WEBSTER-CHICAGO
Chicago 39, Illinois

Phono

(*Continued from page 26*)



Sound system section of the Philco 51-PT1207 TV chassis series, which features use of the narrow-neck picture tube described in the *Ser-Cuits* section of November SERVICE.

ing. In one wide range type of cabinet-speaker system[2], shown in Fig. 2, a low-frequency speaker, dividing network and high-frequency driver and horn have been included. Power input to these speakers has been stipulated as 25 watts (above 1200 cps for the *hf* unit).

A tweeter[3], which is said to have a response to 12,000 cycles, with usable output to beyond 15,000 cycles, has also been developed. When used with a 12-15" cone speaker and proper network, the unit is said to handle 25-30 watts of program material. Its impedance is 15 ohms.

The horn (6½" *w* x 3" *h* x 6" *d*) is built of cast aluminum, and is flared for widest distribution pattern. Crossover is 1500 cycles.

Factory-Built Amplifiers

Completely assembled amplifiers primarily designed for record reproduction in custom installations, have also become available. One such unit[4], rated at 10 watts output, is equipped with a 3-position input selector switch for magnetic or crystal pickup and high level auxiliary input. Features include a built-in preamp for magnetic pickup (not in circuit when high level inputs are used), separate boost-type bass and treble tone controls, and compensated volume control which increases lows when volume is reduced.

Output, measured at 100, 400, and 5,000 cps, is said to be 10 watts at 3% harmonic distortion. Percentage intermodulation distortion taken at 60 and 7,000 cycles with 4 to 1 ratio is said to be 2 watts 1.5% (home level), 5 watts 3%, 10 watts 5%. Gain for a magnetic pickup is said to be 103 db (10,000 ohms); crystal pickup (auxiliary) input, 80 db (500,000 ohms), 73 db (100,000 ohms). Tone controls:

Fig. 2. Lansing hf-lf speaker system.

[2] D-130A *lf* speaker, N1200 dividing network and D175H *hf* driver; James B. Lansing Sound, Inc., 2439 Fletcher Drive, Los Angeles, Calif.
[3] CHU-5; Racon Electric Co., Inc., 52 East 19 Street, New York 3, N. Y.

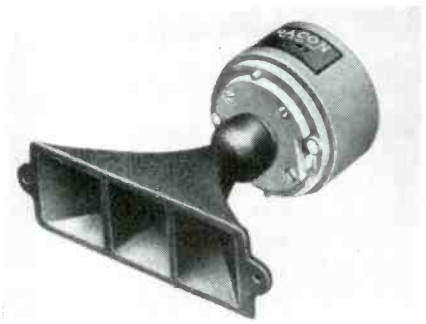


Fig. 3. Racon tweeter.

bass, +13 db to −7 db at 40 cycles; treble, +10 db to −20 db at 15,000 cycles. Output impedances: 4, 8, 16 ohms. Tubes: *1*-6SC7, *1*-6SQ7, *1*-6SL7, *2*-6V6GT, *1*-5Y3GT.

Laboratory Type Amplifier

An amplifier[5], described as a lab type, which matches all speakers from 1 to 24 ohms, is also available for the hi-fi fan. Featured is a preamp which is operated entirely on *dc*. Has a 500 cycle turnover frequency. Effective turnover frequency is said to be adjustable by bass control to compensate for turnover frequency between 250 and 1,000 cycles.

An adjustable distortion filter allows maximum range to be limited when input signal is distorted: 6, 12 and 22 kc ranges.

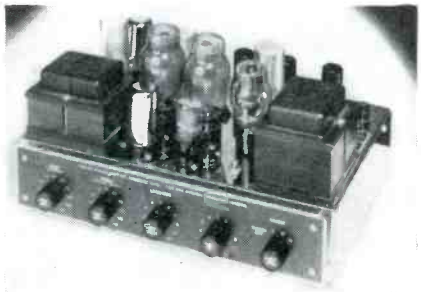
Has a dynamic noise suppressor with wide-range dynaural gate circuits

(*Continued on page* 30)

[4] Model 1810; Rauland-Borg Corp., 3523 Addison St., Chicago 18, Ill.
[5] 210-B; Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge, Mass.

Rauland-Borg 10-watt amplifier.

H. H. Scott amplifier.



Phono

(*Continued from page 29*)

which open to full range of amplifier. Said to suppress high-frequency noise, (scratch, etc.) 20-30 db, low-frequency noise (rumble, etc.) 15-20 db. Adjustable or may be cut out completely when not needed.

Tubes: *2*—12SL7GT, *1*—6SN7GT, *1*—6SQ7. *2*—6SG7, *1*—6J5, *2*—6L6G and *1*—5V4G.

Needle Replacement Manual

A pocket manual[6], which provides a concise, up-to-date summary of all phonos by year, model number, cartridge and needle, has been published. Presented is a listing of all cartridges with drawings, model numbers, prices and installation notes.

The manual, a condensation of the Walco master control index, is supplied with a purchase of thirteen basic needles.

[6] Electrovox Co., Inc., East Orange, N. J.

Push-button console switching system which provides instantaneous selection and playing of any one of over 371,000 different custom music component combinations. Console is connected to approximately 60 units: pickups, turntables, record changers, noise suppressors, equalizers, preamplifiers, tuners, tape recorders, power amplifiers, and speakers.
(*Courtesy Allied Radio Corp.*)

Portable 3-speed automatic phono featuring a featherweight pickup arm, utilizing dual needles. Full range tone and volume controls. Alnico 5 speaker. Size: 9" x 14½" x 16¼".
(*167; Tone Products Corp., 225 W. 17, N.Y.C.*)

Finding Your Way

(*Continued from page* 14)

has the same shape, but with a plate connection coming out from the top. The 1B3 has the GT shape, but it is taller and also has a plate connection on top. The newer 6W4 damping tube is the standard *GT* size and *shape*. The 6BQ6 and 1X2, horizontal output and high-voltage rectifier, are smaller editions of their predecessors, with anode connections on top. Both have the general *GT* shape, though not the exact size.

Location with respect to other tubes and above chassis components: Once the Service Man has a general idea as to which tubes are most common in various circuits, and the shapes of the tubes, one more clue to their identity is their location. Generally, the front end is located in the front of the chassis, either in the left or right corner. It is a self-contained unit, the antenna leadin is attached to it, and the channel selector switch comes out from it. There is no trouble in identifying it. The *rf* stage usually is alongside the antenna connections. The oscillator is generally more shielded than the other tuner stages.

Immediately behind the tuner, since long leads would be undesirable, will be found the first video *if* stage (6AG5, etc.), an *if* coil, the second video *if* stage, another *if* coil, a third *if* tube and coil, and perhaps a fourth and then a smaller tube, the 6AL5 video detector. The video *if* coils, incidentally, may not be in cans above the chassis. They very often are not enclosed and placed below the chassis. However, the bolts protrude through the top of the chassis (for tuning powdered iron cores) and they are instantly recognizable. In other words, where we have three or four of the same size tubes in a line with bolts or cans between them and going to a 6AL5, we can be fairly safe in assuming they are the video *if* stages, or common *ifs* in intercarrier sets.

The audio *if* transformers are usually in cans and located on top of the chassis. Also, the discriminator or ratio detector can generally is a little larger than the others. Therefore, where there is a can, a 6AU6, another can perhaps a little larger, and the unmistakeable 6T8 followed by a power tube (6K6, 6V6 or the miniature 6AQ5) we are obviously dealing with the audio strip. Instead of the 6T8, there may be a 6AL5 and a miniature pentode and then the power tube.

[To Be Concluded in January]

Servicing *FM* Detectors

Part II . . . Comparison of the Ratio Detector and Discriminator Detector Systems and Their Alignment With a VTVM and Single-Frequency Generator of AM Type.

by ALLAN LYTEL

Temple University Technical Institute

THE RATIO DETECTOR, found in the majority of straight FM models and in the FM sections of the TV chassis, is quite unique in its circuitry. Actually, by means of several simple modifications, the discriminator may be changed into a ratio detector, which is insensitive to amplitude changes in the signal and thus requires no limiter stage. In Fig. 1 appears the circuit of a ratio detector which can be considered as an extension of the discussion of the discriminator.[1] One of the diodes is reversed so that the output voltages are now additive. The two load resistors are now connected series aiding and a large capacitor appears across both of these resistors. As the diodes conduct, in a manner similar to the discriminator, the large capacitor will be charged to the total voltage across the series resistors. The time constant of this capacitor in conjunction with $R_1 + R_2$ is sufficiently large, so that it acts as a battery keeping the voltage across the load resistors constant, in spite of changes in input signal level. Thus, the *ratio* between the voltage drops across R_1 and R_2 can change, but the total voltage is kept constant by the 8-mfd capacitor shown in the circuit.

Audio output is obtained across one of the load resistors used alone, and not both. The voltage across both resistors or the voltage across the 8-mfd capacitor, which is the same thing, is

(*Continued on page 49*)

[1] SERVICE, November, 1950.

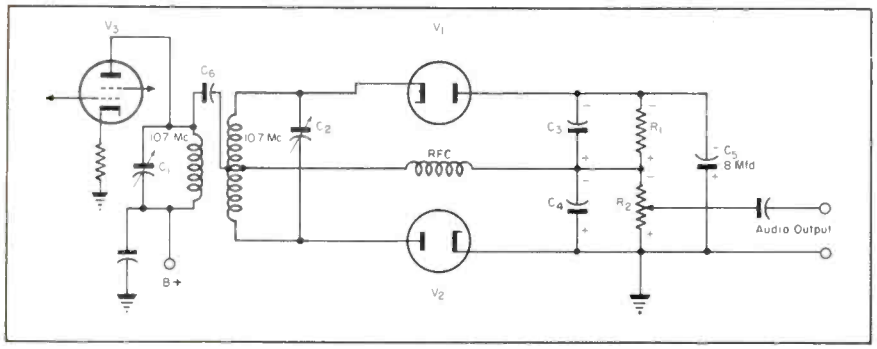
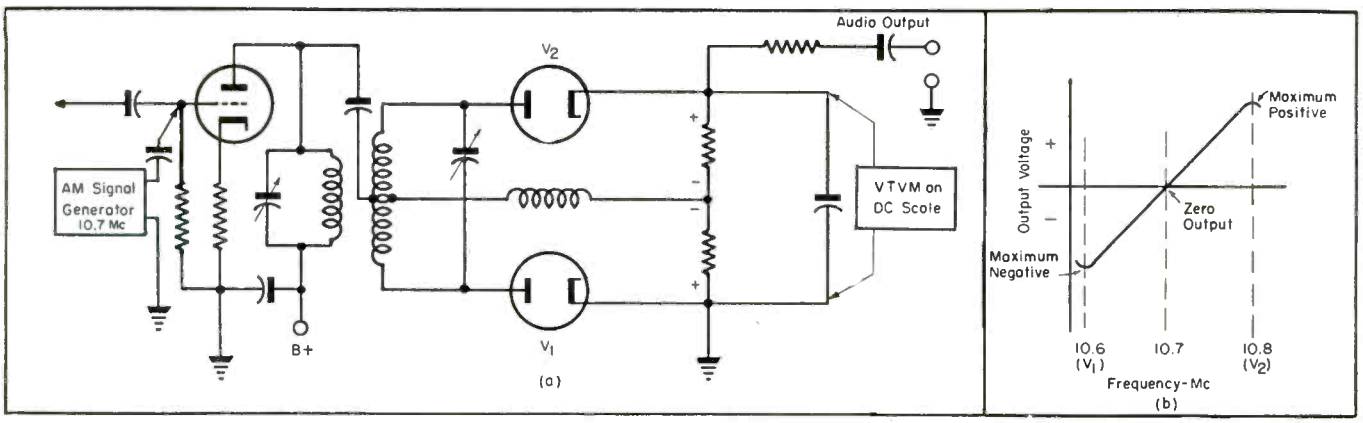


Fig. 1. Circuit of the ratio-detector system.

	Voltage Across R_1 (From V_1)	Voltage Across R_2 (From V_2)	Discriminator Output		Ratio Detector Output	
	+2	−2	0		0	
	+4	−4	0		0	
Increase in Signal Amplitude	+3	−6	−3	Output Increases	−2	No Change in Output
	+6	−12	−6		−2	
	+12	−24	−12		−2	
	+6	−3	+3		+2	
Increase in Signal Amplitude	+12	−6	+6	Output Increases	+2	No Change in Output
	+24	−12	+12		+2	

Table I. Compilation of voltage increases in the outputs of the ratio and discriminator type circuits.

Fig. 2. Discriminator alignment setup with an AM signal generator and a *vtvm*. At right appears a plot of the output voltage from a discriminator.



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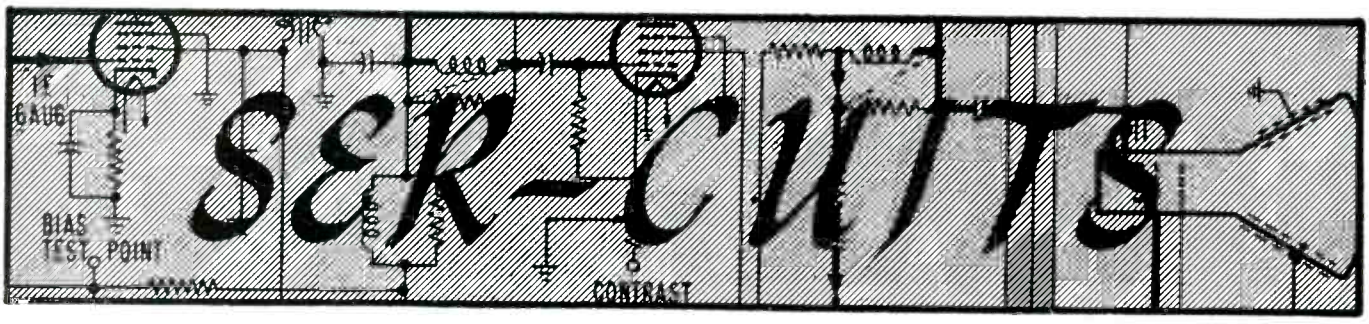


Automatic TV/FM Booster System . . Raytheon 16 and 17-Inch Rectangular Picture-Tube Chassis Circuit Features.

In the installation of TV chassis in noise or interference-ridden areas, fringe locations, buildings where only window or indoor antennas can be accommodated, or low-signal obstruction and out-of-line local sites, the booster has become a must accessory. Many a sale has been salvaged by the introduction of a booster in what appeared to be a hopeless situation. Aware of the importance of these units, the labs have set up intensive developmental schedules and evolved many effective amplifying systems.

Recently, one manufacturer[1] produced an *automatic* type of booster, which amplifies the TV and FM bands, eliminating the need for tuning or switching.

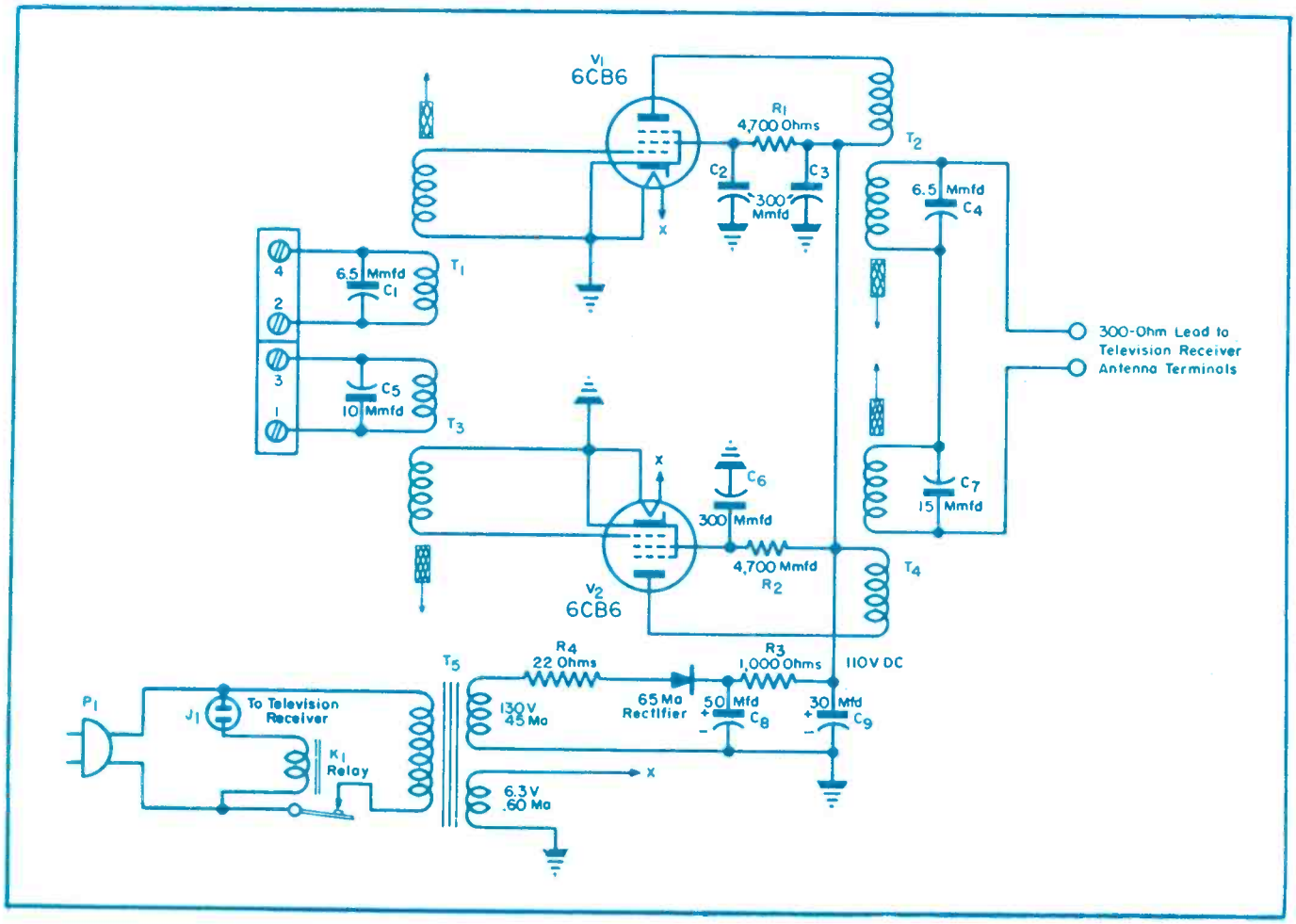
A magnetic relay provides *on* and *off* operation.

Two 6CB6s are used, which it is claimed, offers a 9 X (18 db) gain on the low and a 5 X (14 db) gain on the high TV channels, with provision for field realignment to provide higher gain on troublesome channels. Booster provides for either a single or double input, permitting the use of separate high- and low-frequency antennas and transmission lines.

When employed with master antenna systems, the unit can be used alone or cascaded with other amplifiers. It can also be used as a primary source of in-

[1] Industrial Television, Inc.; 1T-75A Autowave

Fig. 1. The ITI FM/TV automatic booster.



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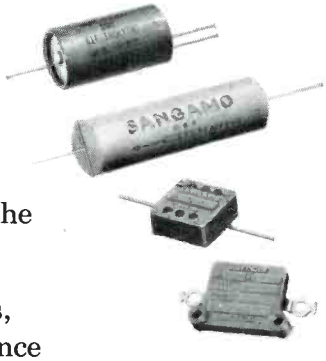

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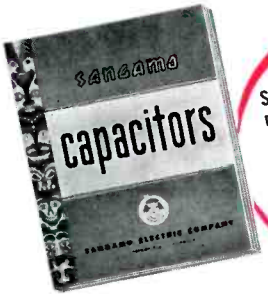

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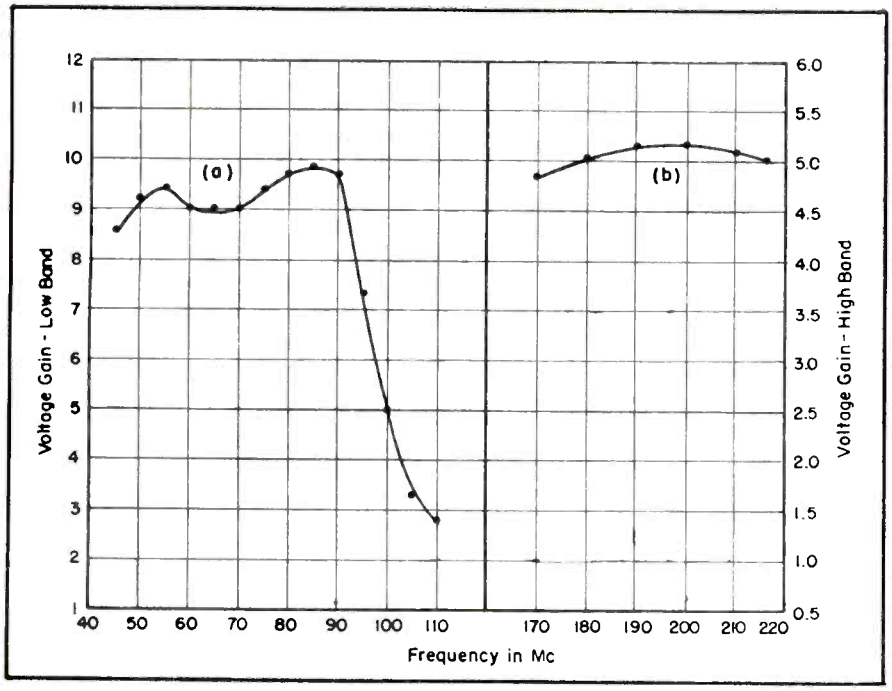

Fig. 2. Plot of insertion gain of IT1 booster; curve in (*a*) represents response on channels 2 to 6 and the FM bands, while the (*b*) curve covers the high-band or 7 to 13 channels.

terference suppression, or in addition to other units that give insufficient rejection.

For decoupling and interference elimination, resistors (150 ohms on each side of the line in the 300-ohm case) are used to tap off the signal from the common transmission line. An *unshielded* 300 ohm line is then run to the booster which is mounted in the rear of the television cabinet. The output of the booster is then tied to the receiver. This method is said to provide a greater amount of isolation than any passive network, and each outlet is completely independent, including short or open circuits of all the other receivers connected to the system. The isolation does not result in any loss as encountered in other methods, but instead provides a considerable gain in signal level. It is claimed that coax lines between receiver and outlet can be eliminated because the unidirectional properties of the booster eliminate the undesired signals *directly* at the offending receiver. Thus, there is no possibility of the conecting line acting as an antenna and radiating the undesired signals, causing a large amount of interference. This type of decoupling is said to be particularly applicable to master antenna installations in existing buildings, for it is only necessary to run a single lead for each of the risers, rather than an individual lead for each of the receivers on the riser.

The use of this booster as a decoupling amplifier prevails, it is said, because of the automatic operation of the unit. Since the magnetic relay turns the booster on and off automatically with the television *on-off* switch, power is not drawn by the preamp until the television set is turned on.

Reporting on the booster's circuitry characteristics, Walter Tyminski, IT1 project engineer, states that one rather unconventional feature of the booster is the operation of the 6CB6 at *zero* grid bias. This was done to obtain the highest transconductance possible, resulting in an increased gain. A study of the transconductance curves of a pentode, plotted for a constant plate and screen voltage, reveals that the transconductance increases very rapidly as the grid bias is reduced to zero. Since the cathode current also increases it is necessary to lower the plate and screen voltages so as not to exceed the tube ratings, but even at reduced voltages, it has been found that an increase in transconductance can be obtained over conventional operation.

Provision at the input circuit to accept a single combined input, or separate high-band and low-band inputs

Fig. 3. Rear view of automatic preamp.

without switching, has been accomplished by operating the tuned inputs separately for the dual input, or by placing the two inputs in series (by connecting terminals 3 and 4 on the antenna input board) in the single input case. It might be pointed out that a double-tuned transformer is actually a bandpass filter which has a negligible impedance on the top band, when the frequency deviation is great. Thus, in the combined input the low-frequency voltages will appear across the low input transformer, and the high-frequency voltage across the high band input.

The magnetic relay will work over a range of 1 to 4 amps with a negligible voltage drop.

Raytheon TV Chassis

The rectangular picture tubes, a short while ago a feature of only a few chassis and usually in the 14-inch type, have become pretty much of a standard item on the runs of many manufacturers and in many sizes.

In models recently produced by Raytheon the 16 and 17-inch picture tubes appear in their 21-tube chassis; 16AY21, 17AY24, 16AY28 and 17AY21; Fig. 4, p. 38.

In these models, the tuner is composed of a separate sub-chassis using a 6AG5 (pentode) *rf* amplifier and a 12AT7 (twin triode) for the oscillator and converter. Separate high and low band coils and trimmers are used with a switching device to change bands. The tuner selects and amplifies the station signal and converts it to carrier *if* frequencies of 26.75 mc for video and 22.25 mc for sound.

Video IF Amplifiers

The *if* amplifiers, video detector and *dc* restorer stages are all mounted on a subchassis. The *if* amplifier section consists of four stagger-tuned stages using 6AU6s (pentodes) with self-resonant slug-tuned coils. Since the receiver is of the intercarrier type, both the video and sound *if* frequencies are amplified simultaneously. The signal is then detected by one half of a 6AL5 (twin diode) and coupled to the video amplifier. The other half of the 6AL5 is used as a *dc* restorer.

Sound Section

The sound section is also mounted on a subchassis and consists of 6AU6 *if* amplifier, 6T8 (triode, triple diode) detector and audio amplifier and a 6K6 (pentode) output tube. Due to the heterodyne action between the video and sound *if* frequencies, a 4.5-mc signal

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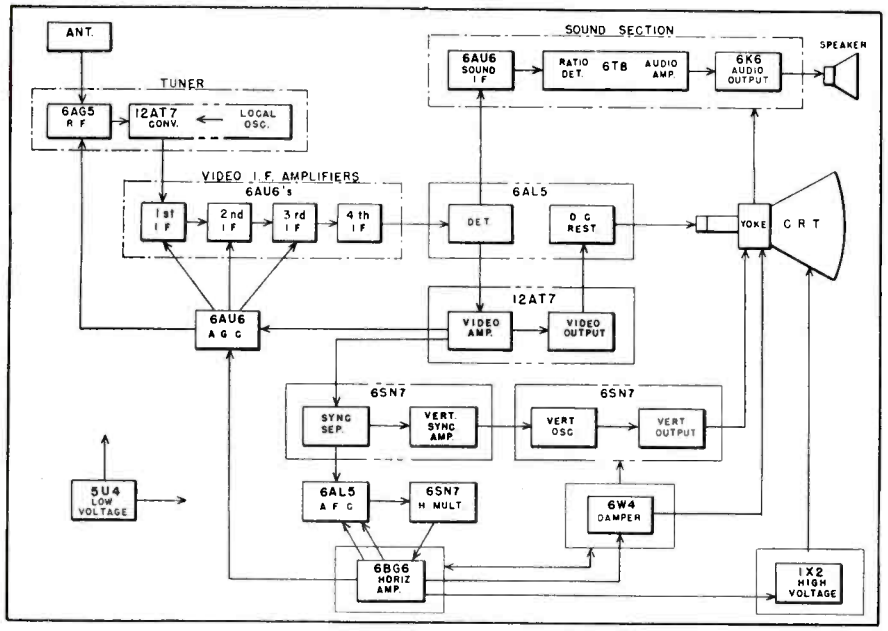

Fig. 4. Block diagram of Raytheon 16AY28, 17AY21, 16AY211 and 17AY24 chassis. In the 21 and 28 chassis, the audio output tube is a 6V6.

is obtained containing the audio information. After the detector, the audio information is separated from the video signal by a pick-off coil, T_8. The signal is then amplified, detected and further amplified by the triode section of the 6T8 and 6K6. (The 16AY28 and 17AY21 chassis incorporate a 6V6 audio output tube.)

Video Amplifier

The video section is a conventional two stage amplifier using the 12AT7 (twin triode) tube. A parallel resonant video trap coil (L_{18} and C_{65}) is tuned to 4.5 mc to separate the audio from the video. A combination of shunt and series peaking coils are used with a degenerative contrast control to vary the signal to the grid of the picture tube.

DC Restorer

One half of the 6AL5 is used as the *dc* restorer. Since the video is coupled to the grid of the picture tube by capacitor C_{64} the *dc* component of video signal will not be passed; therefore, the background level of the picture will vary. A bias voltage proportional to the average video signal level will be developed across resistor R_{73} and maintain proper brightness level.

Sync Separator and Vertical Amplifier

The sync pulses from the plate of the first video amplifier are coupled to the sync separator tube (½ of 6SN7) through capacitor C_{103}. The sync pulses are then separated from the blanking pedestal and due to the low plate voltage, sync clipping is accomplished. The horizontal pulses are coupled to the *afc* discriminator through capacitor C_{125} and the vertical pulses are coupled through capacitor C_{120}; they are amplified by the other half of the 6SN6 before being fed to the intergrating network of the vertical deflection circuit.

Vertical Deflection

The vertical deflection circuit consists of a 6SN7 (twin triode) one half of which is used as a blocking oscillator and the other half as a pulse amplifier. The vertical hold control varies the oscillator's operation point, thus providing an adjustment for synchronization. The vertical size control varies the amplitude of the pulse to the grid of the amplifier thus controlling the amount of vertical deflection. The vertical linearity control varies the cathode resistance, thus changing the operating characteristics of the amplifier tube to provide a linear sawtooth pulse. Therefore, it can be seen that the vertical size and vertical linearity controls must be operated in conjunction with one another.

AFC Discriminator

The automatic-frequency control section utilizes a 6AL5 (twin diode). The sync separator feeds the horizontal sync pulses to the *afc* tube, while at the same time two voltages of opposite polarity are fed back from the horizontal deflection transformer. Any phase shift between the horizontal sync pulses and the horizontal multivibrator signal will cause the input voltage applied to one diode section to differ from that of the other. This results in a *dc* bias voltage applied to the grid of the multivibrator. The output of the *afc* discriminator thus synchronizes the horizontal multivibrator to the horizontal pulse of the video signal. This arrangement has been found to improve horizontal stability and offer ease of operation.

Horizontal Multivibrator

The horizontal multivibrator circuit (6SN7) is of the conventional cathode coupled type using a parallel resonant circuit (L_{25} and C_{107}) as a hold adjustment to stabilize the frequency of oscillation. The horizontal sawtooth pulse is then fed to the grid of the pulse amplifier.

Pulse Amplifier

The horizontal drive control, C_{109}, which is in the grid circuit, controls the amount of voltage applied to the pulse amplifier. (Increasing the capacity decreases the drive). A 6BG6 (beam tetrode) is used to develop the necessary power for the flyback pulse and the horizontal deflection coil. The horizontal size coil, L_{24}, shunts a portion of the horizontal deflection transformer winding. Varying the inductance of the horizontal size coil varies the high voltage which in turn controls the size of the picture.

Damper

The damper tubes (6W4) main function is to damp out oscillations which occur over part of the horizontal scanning cycle. The damper tube is connected in such a way as to give an increase in plate supply voltage for the vertical output amplifier. This additional voltage is developed across a 10-mfd 50-volt capacitor and provides an approximate 90-volt increase in plate supply voltage. Varying the inductance of the horizontal linearity coil, L_{26}, changes the damper tube's operating point and thus controls the linearity of the horizontal sweep.

High Voltage Supply

High voltage is obtained from an auto-transformer type primary winding of the horizontal output transformer. When the plate current of the pulse amplifier tube is cut off, the field built up in the primary winding collapses and induces a high voltage surge which is rectified by a 1X2, filtered by the capacity of the aqua-dag coating of the picture tube and then applied to the second anode.

Automatic Gain Control

Plate voltage for a 6AU6 (pentode) gated *agc* tube is obtained from a separate winding on the horizontal de-

(*Continued on page* 50)

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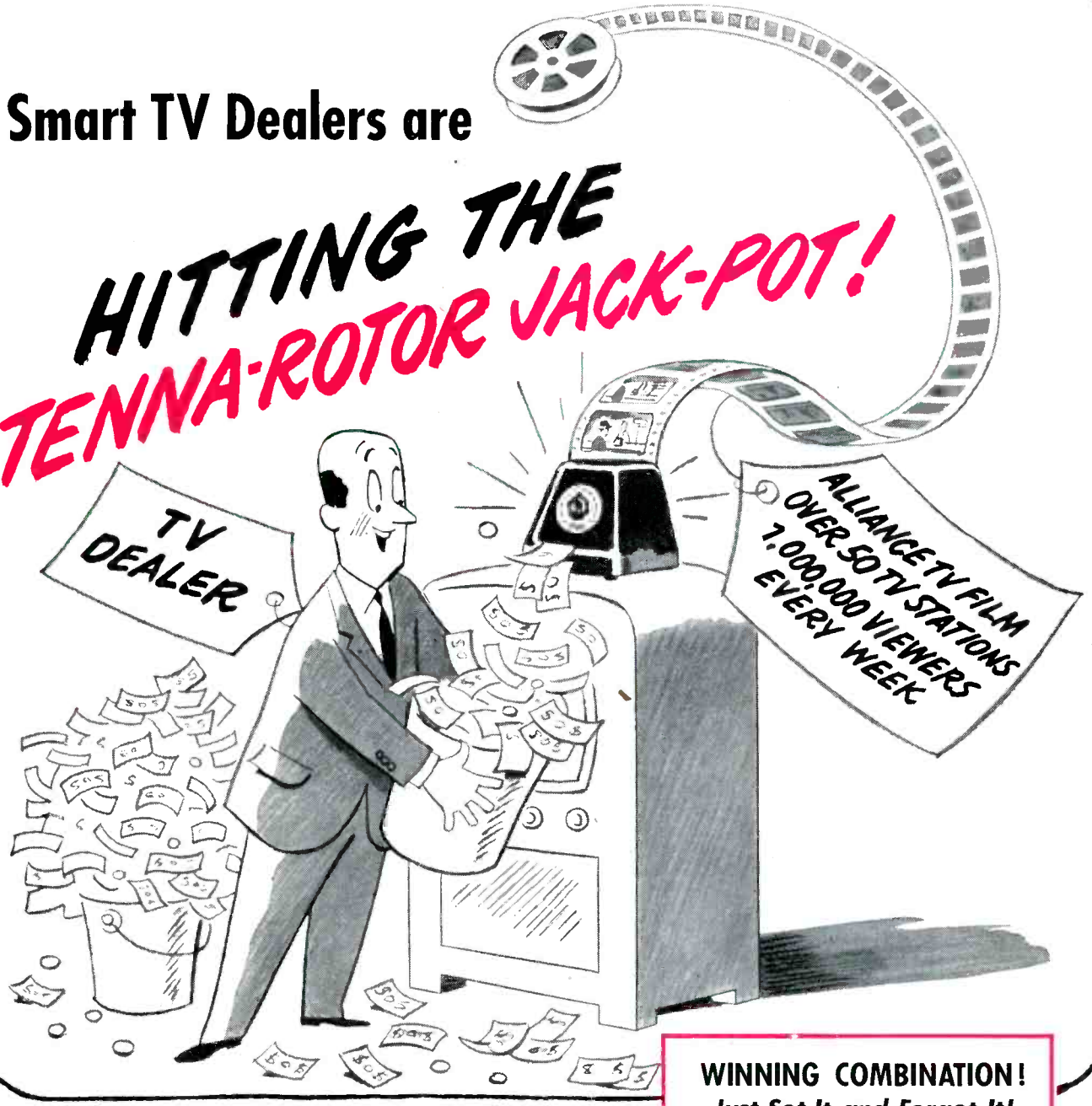

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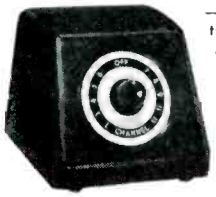

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Association News

NAET

THE FORMATION of a national association of electronic technicians was proposed during a recent meeting of representatives of the Empire State Federation of Electronic Technicians, the Federation of Radio Servicemen's Associations of Pennsylvania, and other Service Men's associations in Boston, Washington, Trenton, and Rochester.

It was pointed out that the proposed association, expected to include membership of employers and employees, would strive to accent the caliber of Service Men and their reliability. The formation of a plan which would provide coordinated sales and distribution practices between manufacturers, distributors, and Service Men, was also suggested at the meeting.

Temporary officers named included Dave Krantz of PRSMA and FRSAP, chairman; Max Liebowitz, ARTSNY prexy, vice chairman; and Norman Chalfin, also ARTSNY, secretary.

The delegates were asked to outline the national plan to the members of their groups and return, with perhaps members of other groups, on January 28 in Washington, D. C., to consider the official formation of the national group.

ARTSNY

A BILL proposing the regulation of television servicing, which was reintroduced by Councilman Charles E. Keegan, in New York City, was soundly criticized by Max Leibowitz, association prexy, during a recent meeting of the group. Liebowitz declared that the independent Service Man was not responsible for the present malpractices around which the bill is written, and therefore, he should not be penalized for conditions beyond his control. Liebowitz felt that the levying of a high license fee, featured in the measure, was not just. In his opinion, if one year contracts were replaced by per-call arrangements, most of the present abuses would disappear.

It was pointed out that ARTSNY has had a very successful year with their policing system, featuring the operation of a grievance committee, who have protected the public from any unsatisfactory servicing practices.

The bill was also the subject of special consideration during an open meeting of the association in the grand

(Continued on page 48)

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and ground presents a relatively low impedance to the 15,750-*cps* sync pulses, and the control grid can be considered to be at ground potential at this frequency. Since the negative-going sync pulses are applied between the cathode and ground and the control grid is effectively at ground potential, it is apparent that the cathode is negative with respect to the control grid during the time of each sync pulse. Under this condition, the grid conducts and the flow of current charges C_{419}. After the sync pulse passes, C_{419} discharges and current flows down through R_{428} and R_{429} developing a voltage (E_d) which is negative at the grid with respect to ground.

Sawtooth Lagging Sync

If the sync pulse is applied to the cathode at the same time as the most-negative part of the sawtooth is applied to the plate (sawtooth lagging sync), the negative potential on the plate will allow maximum grid current to flow, and maximum negative (E_d) will be developed. At the same time, the negative potential on the plate will prohibit any plate current flow. The negative correction voltage (E_d) is filtered by C_{419}, R_{431} and C_{420} and is applied to the grid of the horizontal multivibrator to correct the oscillator frequency.

However, if the sync pulse is applied to the cathode at the same time as the most-positive part of the sawtooth is applied to the plate (sawtooth leading sync), the positive potential on the plate causes plate current to flow. The flow of plate current up through R_{429} develops a voltage (E_k) that is positive on the cathode end of the resistor. At the same time, the positive voltage on the plate causes a reduction in grid current flow, and the voltage across R_{428} (E_g) is reduced. The voltages E_g and E_k add algebraically to produce a correction voltage (E_d) which is positive with respect to ground.

Since the correction voltage varies from negative to positive depending on the relationship between the sync pulses and the sawtooth output, it follows that the voltages will balance out to zero under the intermediate or synchronized conditions.

Stromberg-Carlson Service Notes

Model 119 . . . Improved Picture Focus: The action of the focus control has been improved by removing the R_{286} 4,700-ohm resistor which shunted

the focus potentiometer and the R_{285} series resistor. This change allows proper picture focus to be obtained nearer the mid-range of the focus control. The beam spot on the picture tube screen has been reduced in size to improve the overall in-focus picture area by raising the voltage supplied to the picture-tube screen. This voltage increase has been accomplished by disconnecting the screen lead from video amplifier screen supply point and reconnecting it through a 100,000-ohm resistor to the *boosted dc voltage* that appears at the No. *3* terminal of the horizontal output transformer. The screen side of the 100,000-ohm resistor is bypassed to ground with a .01-mfd capacitor.

Model 17-RPM . . . Audio Buzz: Some cases of *audio buzz* with the volume control completely off, have been experienced in these receivers. This condition has been traceable to vertical sync getting into the leads to the tone control and hence into the audio circuits. The tone control lead is now being shielded in production units, and receivers in the field can be cured by physically separating the lead wires going to the vertical control and to the tone control.

Model TC19 . . . Vertical White Streaks on Right Side of Picture: The condition can usually be corrected by replacing the 100-ohm parasitic resistors (R_{202} and R_{203}) in the grid circuits of the two 6BG6 horizontal sweep output tubes.

Model 17 . . . IF Tube Substitution: In anticipation of shortages of 6AH6s, the wiring at the fourth *if* socket has been modified. Pin *2* of the *if* (V_{23}) socket is now being wired to pin *7* of the same socket instead of to ground. This wiring revision permits 6AH6s and 6BH6s to be used interchangeably. Realignment is required when direct tube substitutions are made in receivers so modified. Tube labels and circuit diagrams designate the 6AH6 type in this position, but replacements of tubes in this position should be made with same type removed. Slight loss of gain in this stage can be expected when 6BH6s are used.

Models 116, 17, and 119 . . . Securing Ganged Cores in Tuner Carriage: The powdered iron cores, mounted in the movable carriage of the tuner unit, are being held in position after aligning adjustments by a rubber cement compound applied at the junction of the adjusting screw body and the supporting rubber grommet. Speed nuts were previously used in this position. If these core positions are changed with respect to the carriage, they should be recemented in place.

RF Test

(*Continued from page 24*)

common audio and video amplifiers, other *rc* circuits, and in many bypass applications can be checked quickly and effectively. This is a check for capacity value, good terminal connections, and no leakage breakdown; slight leakage does not affect the capacity value test. If a capacitor must be replaced because of leakage as may have been shown by tests with a *vtvm*, a replacement capacitor may be matched with the original by this test.

[To Be Continued]

TUBE SALES AID

Above: Julius Haber, (left) RCA tube department advertising and sales promotion manager presenting first copy of copper tube display plaque to L. S. Thees, (right) general sales manager of the tube department.

Associations

(*Continued from page* 40)

auditorium of the Central Commercial High School, N. Y. City.

The extremely interesting series of television lectures, inaugurated last year, are being continued, and recently representatives of Emerson and Oak Ridge Products appeared to deliver talks on horizontal sync circuits and rapid servicing methods of television receivers, respectively.

ESFETA

THE '50-'51 SERIES of TV lectures were recently begun by the Empire State Federation of Electronic Technicians with a talk in New York City by John F. Rider. In other talks detailed for the New York area, Hickok, Bendix and Philco representatives have been scheduled to appear. Members of these companies have also been calendared for appearances in Long Island, Poughkeepsie-Kingston, Endicott-Binghamton, and Rochester. In the latter two areas, Motorola experts are expected to appear, also.

Irving Brown will present the talks for Emerson on horizontal *afc*.

NATESA

A LETTER from Frank Moch, president of the National Alliance of Television and Electronics Service Associations, sent out recently covered the proposed plans of their new group, and in addition contained an invitation to industry to participate in a discussion in Chicago of such problems as material, warranties, manpower, color TV.

Moch declared in his letter: "This association is suggesting this meeting in a cooperative spirit. We know that the serious problems of the industry can not be solved by one group, and that rather than expend strength in fighting each other, the many elements of the industry should recognize existing problems and join in mutual solutions of these problems."

FM Detectors

(*Continued from page 32*)

a steady state *dc* voltage, which may be used for *avc*. The audio-output voltage will now be a function only of frequency change and not amplitude change. As the diodes conduct different amounts, due to the phase shift introduced above and below resonance, the output resistors and their associated capacitors, act only as a voltage divider network whose total voltage is kept constant. In this manner, no amplitude variations are effective, since the total output voltage across $R_1 + R_2$ is constant and can only change at a very slow rate.

The ratio detector shown in Fig. 1 is similar to the discriminator, at least insofar as the voltage relations in the secondary are concerned. The *if* amplifier, V_{3a}, operates at 10.7 mc, which is the frequency to which its tank circuit is tuned with capacitor C_1. Two signals are introduced in the secondary of this transformer. One is coupled directly, by means of the capacitor C_6 and the other signal is induced by the magnetic coupling between primary and secondary. The transformer arrangement and its voltage relationships are the same for the ratio detector as they were for the discriminator: Only the diodes and their load resistors are different.

By reversing one of the diodes, the output loads are now additive; this may be seen by tracing the current flow for either tube from cathode to plate through the secondary winding, through the *rf* choke, and from minus to plus across the load resistor.

The action of the ratio detector, in being non-responsive to amplitude variations in signal, may be seen from Table 1. Let us suppose that we had a discriminator whose output voltage we could compare to this ratio detector. If one output load resistor had a positive *2* volts and the other output resistor a negative *2* volts, the ratio detector output would be zero and the discriminator output would also be zero under the same conditions. These two output voltages would only be zero when the frequency being received was 10.7 mc, corresponding to an unmodulated *if* signal. If the two output voltages were *+4* and *–4* volts, both the ratio detector and discriminator would again have zero output.

When a modulated signal is being received, the output load resistors are unbalanced to provide an output signal. If the voltages are *+3* and *–6*, the discriminator would have the difference between these as its output, or *–3* volts. A ratio detector would have an output proportional to the ratio between these voltages, or *–2* volts. If the incoming signal increases in amplitude (and the frequency stays the same) the output voltages could change to *+6* and *–12* (which is twice the first output voltage of *–3*). This output voltage is *–6* for the discriminator. The ratio detector, however, still has an output of *–2*, since *3* is to *6* as *6* is to *12* and the ratio in both cases is *2*. A further increase in signal amplitude providing a *+12* and *–24*-volt signal across the load resistors, would produce a *–12* volts in the discriminator. But, the ratio detector output would remain at *–2* volts. An increase in signal amplitude, but not frequency, would result in an *increase* in the discriminator output, but *not* in the ratio-detector output.

We have been considering an output voltage which is negative; exactly the same action can be seen with a positive output voltage. If the two load resistors produced voltages of *+6* and *–3*, the discriminator output would be their difference or *+3* volts, while the ratio detector output under the same conditions would be *+2* volts, which is the ratio of *6* to *3*. If an increase in signal amplitude doubles these voltage outputs, we would have *+12* and *–6* or a *+6* volts for the discriminator and the unchanged *+2* volts from the ratio detector.

[To Be Concluded in January]

Tube News

(*Continued from page* 18)

the deflecting yoke windings and air gap of the focusing device becomes greater.

Ion-Trap-Magnet Requirements

The 16GP4 employs a tilted gun to provide correct beam alignment with a single-field ion-trap magnet. The ion-trap magnet is placed on the neck of the picture tube approximately opposite grid No. *1*. The direction of the magnetic field of the ion-trap must be such that the north pole is adjacent to vacant pin position No. *8* and the south pole to pin No. *2*. The field strength required of the ion-trap magnet will vary directly with the square root of the anode voltage.

When difficulty is encountered in obtaining centering, reversing the field of the focusing device often provides easier centering. When an electromagnetic type of focusing device is used, reversal can be accomplished by changing the direction of current flow. For a permanent-magnet type of focusing device, the field can be reversed only by turning the focusing device end for end. This expedient, however, is not recommended if the air gap is not physically symmetrical with the two ends of the focusing device. If centering of the raster still remains difficult, the desired centering range can be provided by rotating the picture tube or by turning the ion-trap magnet end for end but keeping the poles on the same side of the gun. When an ion-trap magnet having a non-uniform field in the region where the beam passes is used, turning the magnet end for end will place a different field strength in the region where the beam passes.

Ser-Cuits

(*Continued from page* 38)

flection transformer. The plate voltage is thus applied at a horizontal rate, while the grid signal is obtained from the output of the first video amplifier. The *agc* voltage is developed across a resistor, R_{50}, and fed to the first three *if* amplifiers. Due to the divided network of R_{44} and R_{51}, only a portion of this voltage is fed to the *rf* amplifier. The *agc* voltage will vary considerably according to the strength of the transmitted signal, but should be in the vicinity of the voltage across R_{37} (detector output).

Antenna Distribution Outlet

An antenna distribution system has been developed to provide any combination of ten 300 or 72-ohm receivers with television signal from a master-antenna amplifier; Jerrold ADO-10.

In addition to distributing television signal to many number of receivers, the unit also decouples the receivers from each other, thereby preventing interaction.

The isolation of receivers from the line is said to be accomplished by the use of 6AK5s connected as pentodes, which are heavily loaded in the plate circuit to obtain broadband characteristics.

NEWS

HESS NAMED VEE-D-X SALES MANAGER

Frederick A. Hess has been appointed sales manager for Vee-D-X TV antennas and accessories. Hess was formerly connected with Harold A. Chamberlin, Vee-D-X rep.

F. A. Hess

Austin Ellmore

* * *

AUSTIN ELLMORE NAMED CRESCENT VICE PRESIDENT

Austin Ellmore, formerly director of sales and engineering with Crescent Industries, Inc., Chicago, has been appointed vice president in charge of sales and engineering.

Ellmore was formerly with Utah Radio, where he was vice president in charge of Utah Radio Products Division of International Detrola Corp.

* * *

RIDER PUBLISHES TV MASTER ANTENNA SYSTEMS BOOK

A 368-page book *TV Master Antenna Systems* by Ira Kamen and Richard H. Dorf, has been published by John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y.

Presented are detailed explanations of amplified and nonamplified master antenna systems, complete with actual schematic diagrams, performance figures, and design data.

Book contains 234 illustrations and is priced at $5.00.

* * *

RUSSELL NOW UTC GSM

Hank Russell has become United Transformer Company's general sales manager replacing Ben Miller, who retired from his post.

Hank Russell

Ben Miller

* * *

ALTEC'S MIKE WINS AWARD

Altec Lansing's miniature condenser microphone received the *Electrical Manufacturing* product design award for 1950 recently.

* * *

BILL ROLLINS BECOMES CRESCENT VP

Bill Rollins has been named vice president in charge of production and purchasing.

SECOND EDITION OF SAM'S RED BOOK

A second edition of the *Radio and TV Industry Red Book* has been published by Howard W. Sams and Co., Inc., 2201 E. 46 St., Indianapolis, Ind. Covers TV and radio replacement parts for approximately 20,000 sets made from '38-'50.

Includes complete listings of all major replacement components. Lists correct replacement parts made by 19 leading manufacturers. Covers original parts numbers, proper replacement numbers and installation notes on: TV and radio tubes, capacitors, transformers, controls, *if's*, speakers, vibrators, phono-cartridges, batteries, selenium rectifiers, plus TV replacement parts for sweep oscillator and horizontal and vertical output systems. Over 600 pages, 8½" x 11". Price, $3.95.

MURRAY HILL BOOK NAME CHANGE

Murray Hill Books, Inc., Technical Division, publishers of the Ghirardi and other technical books will now operate under the name Rinehart Books, Inc., Technical Division, 232 Madison Avenue, New York 16, N. Y.

* * *

ERIE RESISTOR CERAMIC-CAPACITOR CHART

A ceramic capacitor interchangeability chart, covering general-purpose bypass and coupling ceramics, temperature compensating types, disc types in single and dual styles, feed-thru models, stand-off's, *hv* capacitors, ceramic trimmers, tubular TV trimmers and *hv* transmitting capacitors has been published by the Erie Resistor Corp., Erie, Penna.

New Parts . . . Tools . . . Instruments

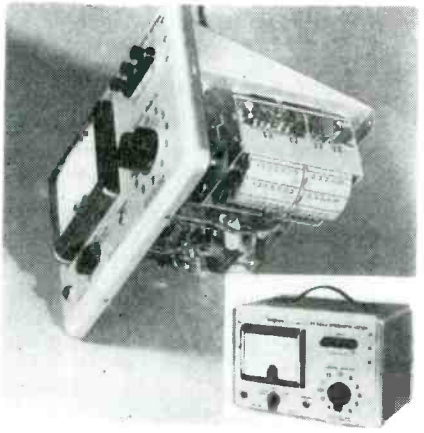
SIMPSON FIELD STRENGTH METER

A TV field strength meter, model 488, which incorporates a 12-channel television tuner (Standard Coil Products tuner) with each channel separately adjustable, has been announced by Simpson Electric Co., Chicago, Ill.

There are four ranges of sensitivity: 50 microvolt full scale range for fringe area installation: 500-microvolt range; 5,000-microvolt range; and 50,000-microvolt range.

A phone jack is included for making audible tests so that the operator can identify the type of signal being measured.

Meter is a 4½" type. Case measures 8" x 11" x 8½".



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JFD VOLTAGE REGULATOR

Voltage regulators for TV chassis have been developed by JFD Manufacturing Co., Inc., 16th Ave., Brooklyn 4, N. Y.

Two types are available: No. 93-7, 300 watts, and No. 93-8, 375 watts.

The male end of the regulator is plugged into the wall socket and the TV set line cord is plugged into the female end of the regulator. The voltage drop of the regulator is said to be negligible at 110 volts, but increases as the line voltage.

RCP TUBE TESTERS

A line of tube testers and combination tube and set testers has been announced by Radio City Products Co., Inc., 152 West 25th Street, N. Y. C.

Testers provide two additional, not used, element circuit switches and two additional socket blanks.

Approximately 1,000 listings are on a high speed roll chart.

Testers provide short leakage tests, with each element tested individually.

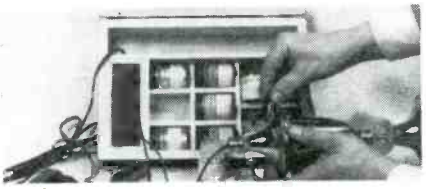
Available in open face, model 323C, combination case 323PC, and 323M counter merchandiser.

* * *

HOFFMAN PLATING SET

A plating set permitting electroplating in gold, silver, nickel, copper, brass, cadmium, tin, and zinc is now available from Hoffman Manufacturing Co., Wiconisco, Pa.

Set consists of 1-ounce jars each of gold, silver, nickel, copper, brass, cadmium, zinc, tin; 1-ounce jars each of cleaner, metal polish, and gold and silver polish; and anode brush and clips, all packed in a wooden chest with built-in power supply for use in 110-volt *ac*.



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BURGESS NO. 6 CELL BATTERIES

The Burgess Giant No. 6 is now available in two styles, with screw terminals for ignition applications and with spring clips for telephone service: No. S461 6-volt battery consists of four No. 6 cells sealed in a weatherproof *Metalclad* container with strap handle and insulated terminals.

L. H. Harriss, Burgess sales manager, and the recently developed giant dry cells.

JOTS AND FLASHES

RECTANGULAR TUBES have become a feature of the majority of the new television chassis, according to a report from RTMA in Washington. October sales of these tubes comprised 58 per cent of the sales to set producers. The trend to larger type picture tubes is also continuing; 92 per cent of the sets made during October had tubes 16 inches and larger. . . . A new organization, the Phonograph Manufacturers Association, Inc., has been formed and Ronald J. Kalb (vice president of Steelman Phono & Radio Co., Inc., Mt. Vernon, N. Y.) has been named president. Joseph Dworken, president of Dynavox Corp., Long Island City, was named secertary-treasurer; while Ben Birns, president of Sonic Industries, N. Y. C., was appointed vice president. Other charter members of the association are: Al Herbst, president of Tone Products Corp., N. Y. C.; Isador Rothman, secretary-treasurer of Electronic Creations, Inc., N. Y. C.; Bernard Berger, president of B & R Electronic Corp., N. Y. C.; Jerome L. Herold, president of Herold Radio and Television Mfg. Co., Mt. Vernon, N. Y.; Fred Buhlman, vice-president of Hedco Mfg. Co., Mt. Vernon, N. Y.; Harvey L. Everett, secretary of Hudson Electronic Corp., Mt. Vernon, N. Y.; Alfred H. Suekoff, Portofonic Sales Corp., Long Island City, N. Y.; Ben Schiffman, president, United Case Corp., Mt. Vernon, N. Y.; and Walter Klug, secretary-treasurer of Porto Case Co., Inc., N. Y. C. . . . Drawing for space at the 1951 Parts Distributors Show will be held at the Hotel New Yorker, January 10, according to Ken Prince, show manager. . . . Round and rectangular tubes in 16, 17, 19 and 20-inch sizes are now being made by Zetka Television Tubes, Inc., 131-137 Getty Avenue, Clifton, N. J. . . . Warren Frebel has been appointed purchasing director of the Majestic Radio & Television division of the Wilcox-Gay Corp., Brooklyn, N. Y. . . . A second edition of the *Radio Operator's License Q and A Manual* by Milton Kaufman, instructor at RCA institutes, has been published by John F. Rider, Publisher, Inc., 480 Canal St., New York 13, N. Y. Book contains 776 pages and is priced at $6.60. . . . Recent issues of the *Telrex News* contain an interesting assortment of technical antenna information disclosing the characteristics of bi-directional reception, and installation procedures. . . . A 4-page bulletin describing high fidelity music systems has been published by the Concord Radio Corp., 901 West Jackson Blvd., Chicago 7, Ill. . . . Sidney A. Joffee is now president of Pathe Radio and Television Corp. and Harley R. Wahl has been elected treasurer. . . . Clifford M. Rigsbee is now manager of the radio-phono-television group of the RCA Service Co. . . . Ben Snyder, president of Snyder Manufacturing Co., returned recently from a trip to the southwest and west coast. . . . A 16-page manual, No. 110, entitled *How to Make Your Job Easier with the Amprobe* is now available from Pyramid Instrument Corp., 49 Howard St., New York 13, N. Y. . . . A plating plant has been added to the facilities of Phoenix Electronics, Inc., Lawrence, Mass.

ADVERTISERS IN THIS ISSUE

SERVICE INDEX—DECEMBER, 1950

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MALLORY FP CAPACITORS

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Remember, too, that the quality and dependability of RCA kinescopes mean fewer service failures and fewer costly call-backs. There is, therefore, more profit in every RCA kinescope you sell.

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