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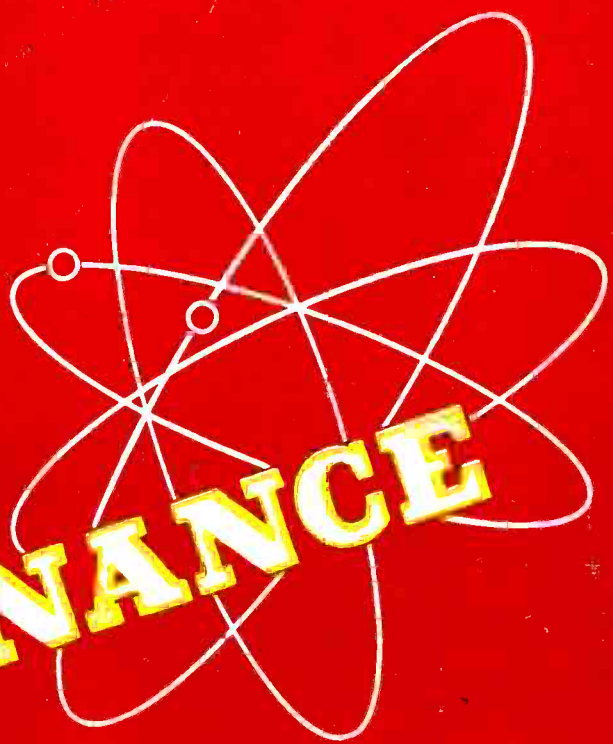

SEPTEMBER 1947

SERVICING IS BIG BUSINESS

ANTENNA SYMPOSIUM

THE TELEVISION PICTURE TUBE

SERVICING FM RECEIVERS
PART III

BOLAND & BOYCE INC., PUBLISHERS

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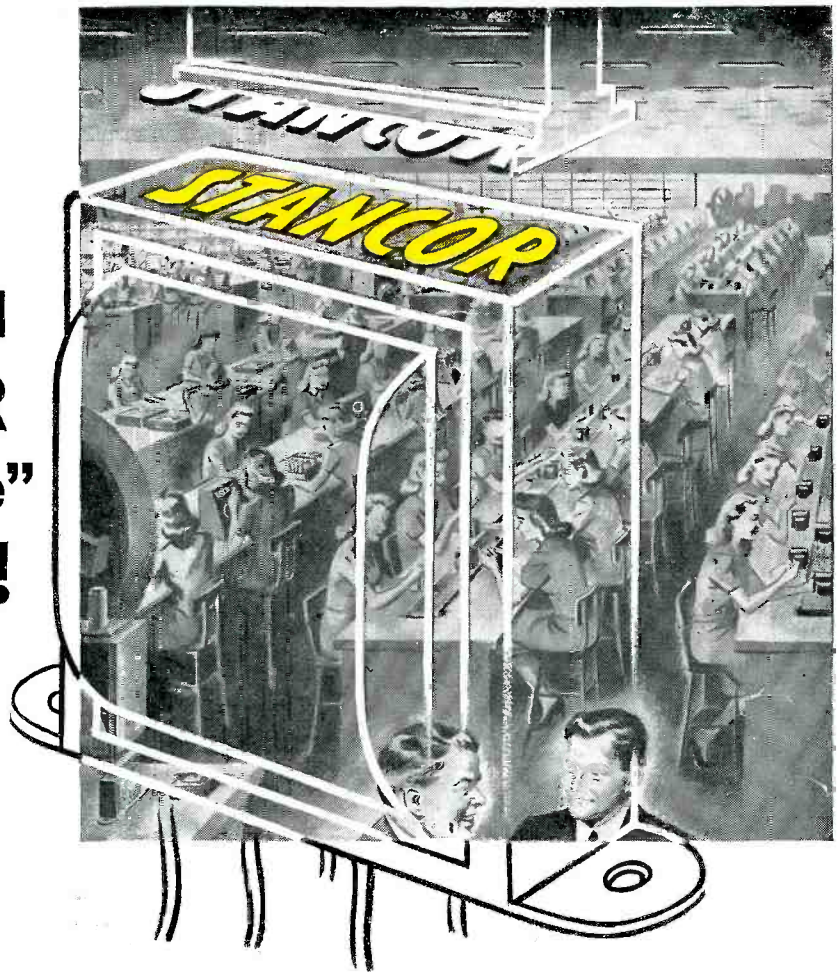

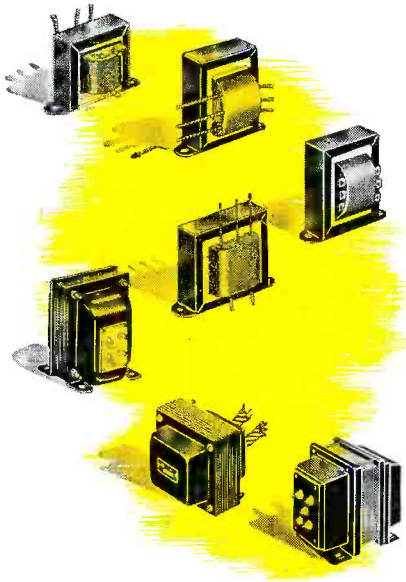

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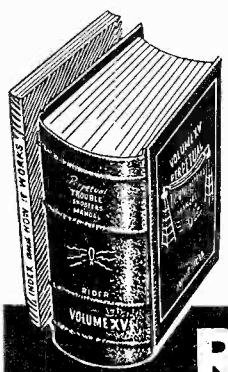

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RADIO MAINTENANCE

INCLUDING
ELECTRONIC
MAINTENANCE

Volume 3 SEPTEMBER, 1947 Number 9

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AUTO ANTENNA INSTALLATION

The procedures outlined here will make success and profit more certain in your auto radio installation jobs.

by R. R. Cull
RAD-EL-CO Mfg. Co.

With millions of auto radio sets in operation, and millions more potential set installations as new cars and new sets become available in volume, every serviceman needs to have a thorough understanding of available types of automobile antennas, relative efficiencies, correct installation procedures, and maintenance problems.

The purpose of an antenna is, of course, to deliver to the set a sufficiently strong signal voltage to override inherent set noise. The signal voltage should be free of ignition interference, wheel static, etc.

The vertical whip type of mast has proven the most efficient type for automobile use; and with such an antenna, the signal voltage induced by the radio wave is approximately proportional to antenna length. Maximum mast lengths, and thus maximum signal voltages, are limited by clearance requirements and by appearance considerations, many owners preferring a short aerial where the car is used primarily for city driving.

With the maximum signal voltage thus limited, it is highly important to transmit this voltage without excessive losses through the lead in cable to the set. The cable must be low in capacity for its capacity forms with the distributed capacity of the mast a circuit equivalent to a capacity voltage divider, and signal strength at the set is reduced as the lead capacity increases. A quality lead cable will not exceed one uufd per inch.

In addition, the insulating material between the cable shielding and the center conductor must have a low power factor. The makers of the best automobile antennas now have discontinued the use of asphalt impregnated paper loom insulation in the transmission cables. This material not only resulted in a high capacity lead, it also absorbed moisture in damp weather and power factor losses were serious.

Polyethylene is now used in place of the paper loom between the center conductor and the shielding on quality cables. This plastic has the lowest losses of any commercially available flexible insulating material. It was used widely in radar applications during the war, and antenna lead ins made with it have low capacity, low loss, and high Q.

One additional antenna lead in characteristic, the braided shielding, is important to a low noise level. This should be so tightly woven that no gaps are visible—so-called 100 per cent shielding. Loosely woven shielding may show as much as 50 per cent open spaces. This

results in pick up of ignition interference and is a potent source of customer complaints.

Typical lead in cables of the new and old types are shown in Fig. 1.

Choosing the Antenna

The choice of a car antenna is governed by available mounting locations. In order to reduce lead in losses, a location close to the set is essential. The losses for a short lead are, of course, much less than for a long lead. Aerials for installation by the serviceman commonly are made for mounting either on top of the cowl just forward of the windshield post, on top of a front fender, on the side cowl panel ahead of the car door, or (rarely) on the side of a fender.

Typical aerials for the several mounting positions are shown in Fig. 2. Type A was introduced at a time when all cars had a vertical side cowl panel. It is a proven type and very satisfactory for mounting under such conditions.

In the evolution of body styles, the so-called *torpedo* body style was first used on 1940 cars. On these cars, the side cowl slopes slightly inward, and in order to keep the mast vertical, a longer top insulator is used. By drilling the mounting holes at a separation dependent upon the slope of the cowl, the serviceman can make the insulators fit varying slopes and the mast will take a vertical position. This style is shown in 2B.

In order to provide an easier means of adjustment than by spacing the mounting stanchions, and also to provide a more pleasing appearance, a third type of side cowl antenna with adjustable mast angle was introduced. This type, shown in Fig. 2C, is easy to install and can be aligned for extreme sloping surfaces. It is very important to choose one which has a rugged locking feature. The antenna illustrated locks by means of two heavy set screws which bits into the disc holding the mast section.

Antennas designed for side cowl installation can, of course, be mounted on the side of the fender; but this position is recommended only on fenders which curve in toward the body at the rear where the antenna can be mounted in a protected position.

Many factory installed antennas

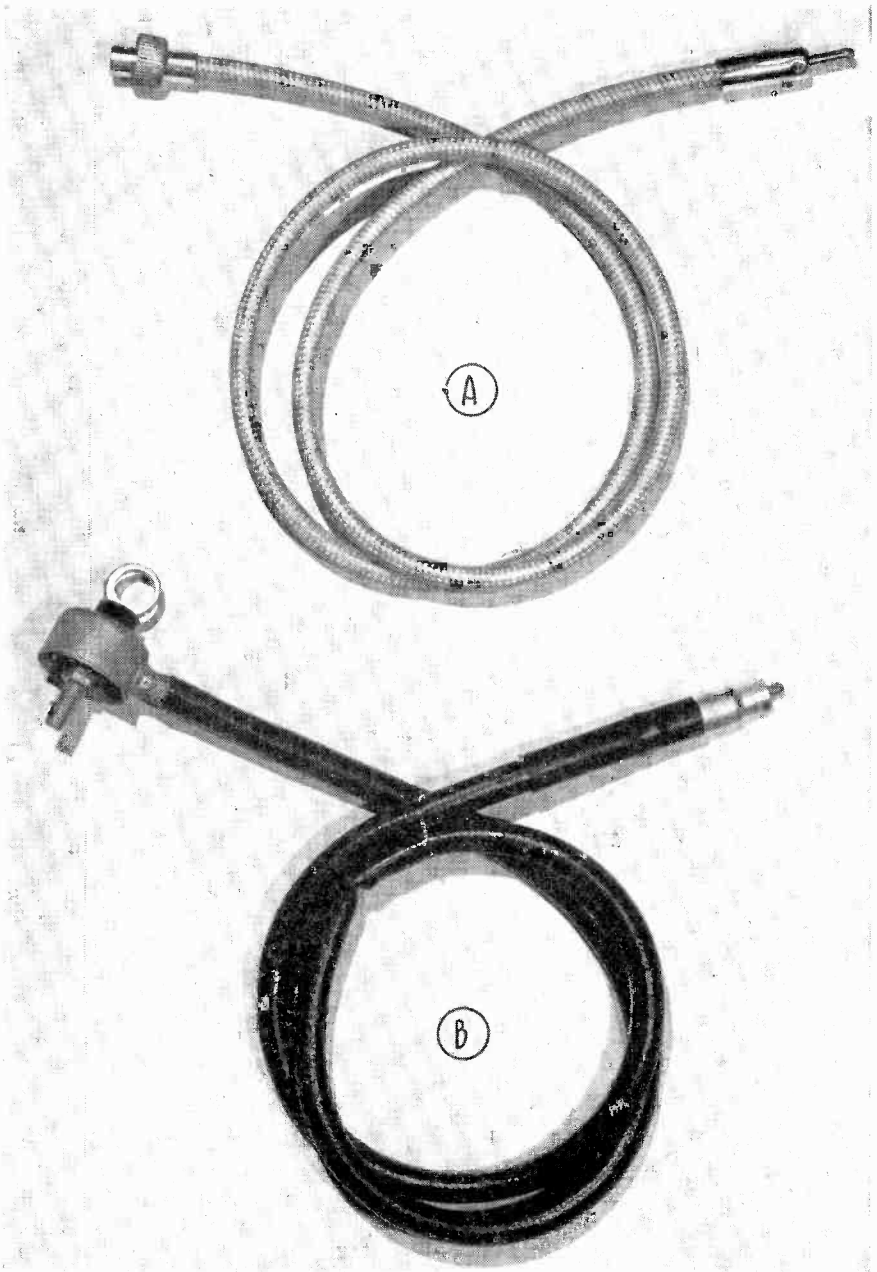


Fig. 1 Two types of antenna lead-in cable for automobile use: A, Polyethylene insulated type; B, older type using paper loom construction and shield can fitting. Choice of lead-in cable can have an important effect on efficiency of the automobile receiver.

are mounted on either the top of the cowl or the top of the fender, one reason being that several of the car manufacturers in 1941 introduced body styles which did not have a cowl panel separating the hood from the front door so that side cowl mounting was no longer possible. The trend has continued and the majority of 1946 cars cannot be fitted with a side cowl antenna.

An antenna for mounting in top cowl or top fender position presents special problems both of design and installation. The assembly mounts through a single hole, and all strains which the motion of the car sets up in the mast must be supported by a single mount. Also, the mast must be adjustable through a wide arc to compensate for the many variations in slope which will be encountered in replacement installations.

To make the mounting stronger, it has been common practice to provide braces or brackets underneath the body. These are rather difficult to install; and recently a mounting has been introduced which clamps a heavy reinforcing washer securely underneath the body metal. With this type, no braces are neces-

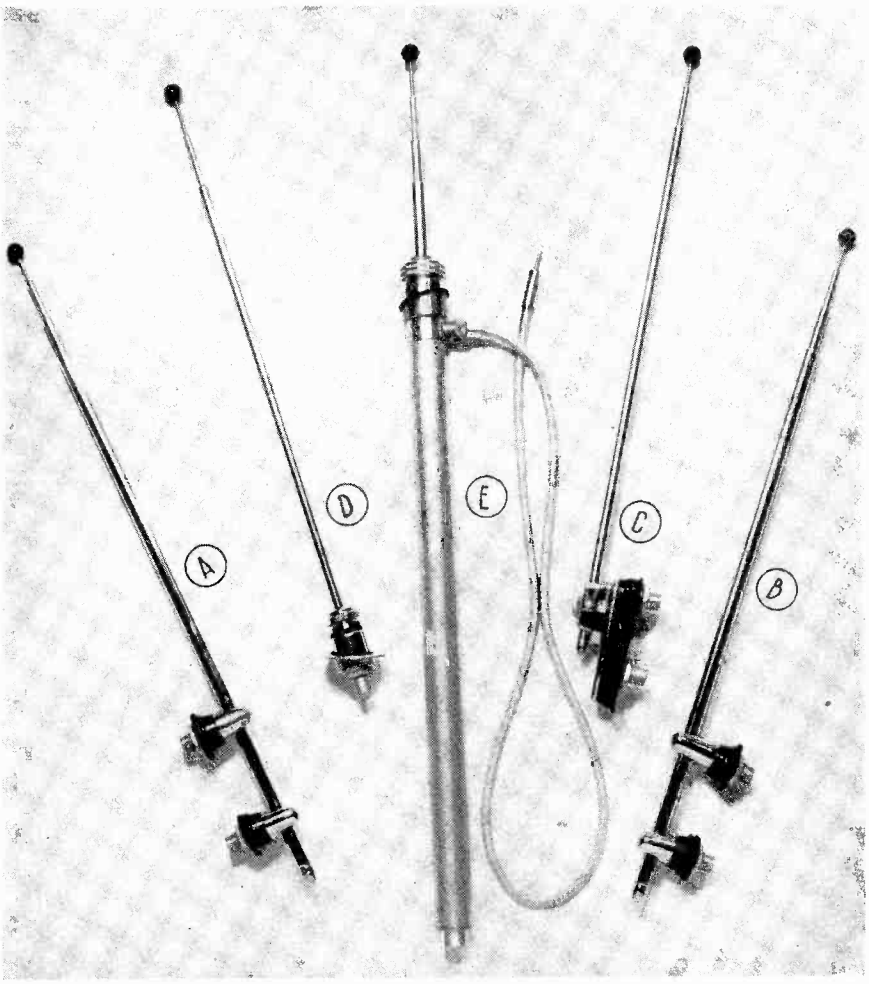


Fig. 2 Some typical automobile antennas: A, Two-insulator type for vertical side cowls; B, Two-insulator type for torpedo or slanting side cowl; C, Adjustable side cowl type; D, Adjustable top cowl or top fender type; E, Concealed type.

sary and installation is simplified greatly. An aerial of this type is shown in Fig. 2D.

Angular adjustment of the mast is obtained by several methods, some of which are time consuming and none too secure. In the antenna illustrated, the mast section is provided with a ball which rests in a socket. The assembly can be swivelled freely for alignment, and it is then locked permanently by pressure of the cap nut which forces the ball against a special hardened seat.

Just prior to the war, in response to a demand for a particularly trim, neat appearing aerial, the *concealed* or *disappearing* type was introduced. This type has a mast assembly which slides below the body surface in the down position so that all but a few inches can be hidden. Of course, for good reception of weak signals, the mast must be extended just as with conventional types of aerials.

This concealed aerial is of more complicated design than other styles; and consequently usually gives trouble in cheap, poorly engineered models. The best concealed aerials will give long service, free from water leakage, noisy contacts, shorting or other troubles. No serviceman who values satisfied customers should use any but the best quality concealed aerial. A concealed aerial is shown in Fig. 2E.

Installation

Installation of a well designed antenna should be an easy and profitable job for the serviceman. The principal job is to locate and drill the mounting holes. Antennas in all styles are available which mount through ½ inch holes. This size is within the capacity of a breast or electric drill. If a larger hole is required, a hole saw, circle cutter, or rat tail file can be used.

The mounting base must make good electrical contact with the body metal. This is insured by scraping interior body surface with any sharp edged tool such as the square end of a file to remove sound deadening felt, scale, or paint, and finishing with coarse sandpaper, emery, or steel wool.

After the mounting is inserted through the holes, the mounting nuts can be tightened with socket, open end, or crescent wrenches or even pliers.

When the mounting base is anchored securely, the lead must be attached to the antenna. With older types of leads, this was a rather fussy job in cramped quarters, but with the new plug-in type of lead, illustrated in Fig. 1A, the attachment can be made in a matter of seconds. The job is complete when the lead cable is plugged into the receptacle on the set.

Correct Installation Procedure

Determine suitable mounting location *before* drilling holes. Check exterior clearances with hood and door open. Check interior obstructions such as body braces. When sure that no obstructions will interfere at the chosen spot, center punch and drill the required holes, keeping the axis of the drill identical with the axis which will be taken by the part which will fit through the hole.

Clean around the interior surface of the hole to expose bare metal.

Insert mounting stanchions, put on lock washer, thread on mounting nuts and tighten firmly, but don't over-tighten. Stop before compression causes the rubber waterproofing gasket at the bottom of the exterior mounting assembly to curl at the edges.

Connect lead in to antenna either by plugging in or by fastening to binding post. With binding post type of connection, be sure to replace cover of shield can.

Run lead to set and plug end into receptacle. If plug-on end of cable does not match set receptacle, solder on the adapter which is supplied.

Alignment of Antenna Trimmer

When the aerial is connected and extended, tune the set to a weak station at about 600 kc with the volume control set at maximum. Adjust the antenna trimmer condenser until maximum volume is reached, then retune the same signal and

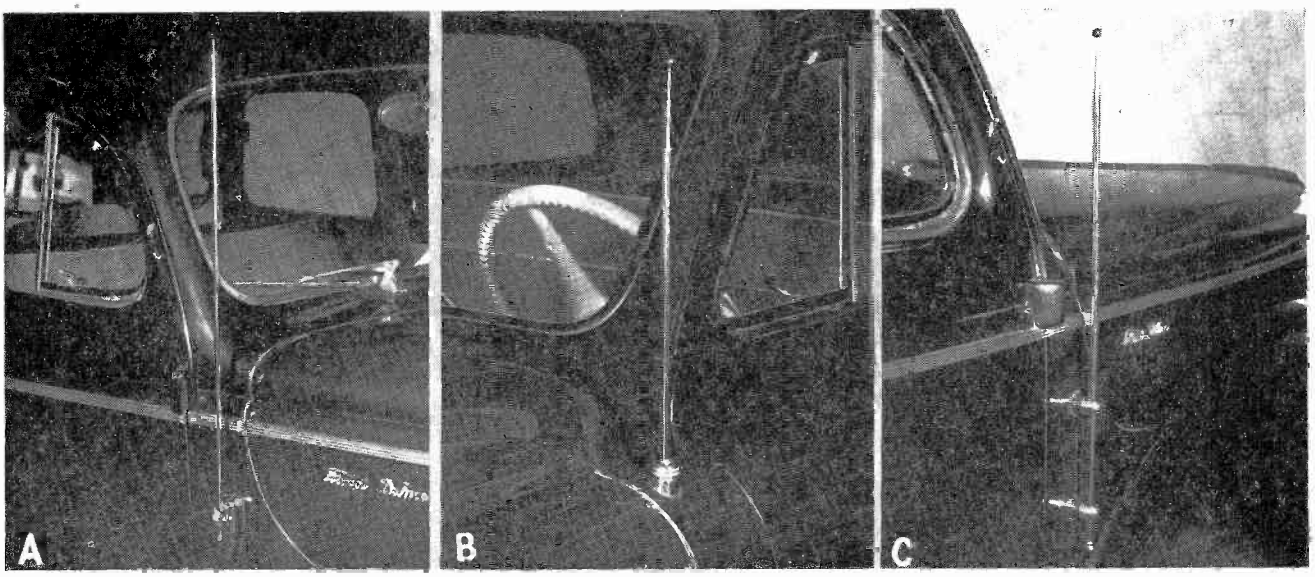


Fig. 3 Three different types of auto antenna mountings: A, Adjustable side cowl; B, Concealed type installation with mast about two-thirds withdrawn from hidden shield tube; C, Non-adjustable side cowl type.

again adjust the trimmer. If adjusting at 600 kc does not show a marked intensity peak, tune the set to a weak station near 1400 kc and adjust on this signal.

This matches impedances between the antenna and the input circuit of the receiver and gives maximum energy transfer.

Checking the Installation

It is good practice before considering the installation complete to check it with an ohmmeter. The circuit from the mast to the contact tip on the receiver plug should have a resistance too low to read on the ordinary meter. If this is not true, the lead probably is not making good contact with the aerial, or the lead itself may be defective.

The resistance between the shell of the plug to the receiver and the body of the car should be also too low to measure. If it is not, the mounting assembly is not making a good ground where it passes through the body; and the shielding on the lead may not eliminate motor interference.

The final check should be a reading of the resistance between contact tip of the receiver plug and shell of this same plug. Any value of resistance which can be measured on the ordinary meter indicates a leakage path which must be found and eliminated.

Maintenance Procedure

The ordinary car antenna requires little maintenance. The telescoping sections should be kept clean in order to work freely. The use of a good grade of metal polish is recommended, followed by a light coating of a hard body wax.

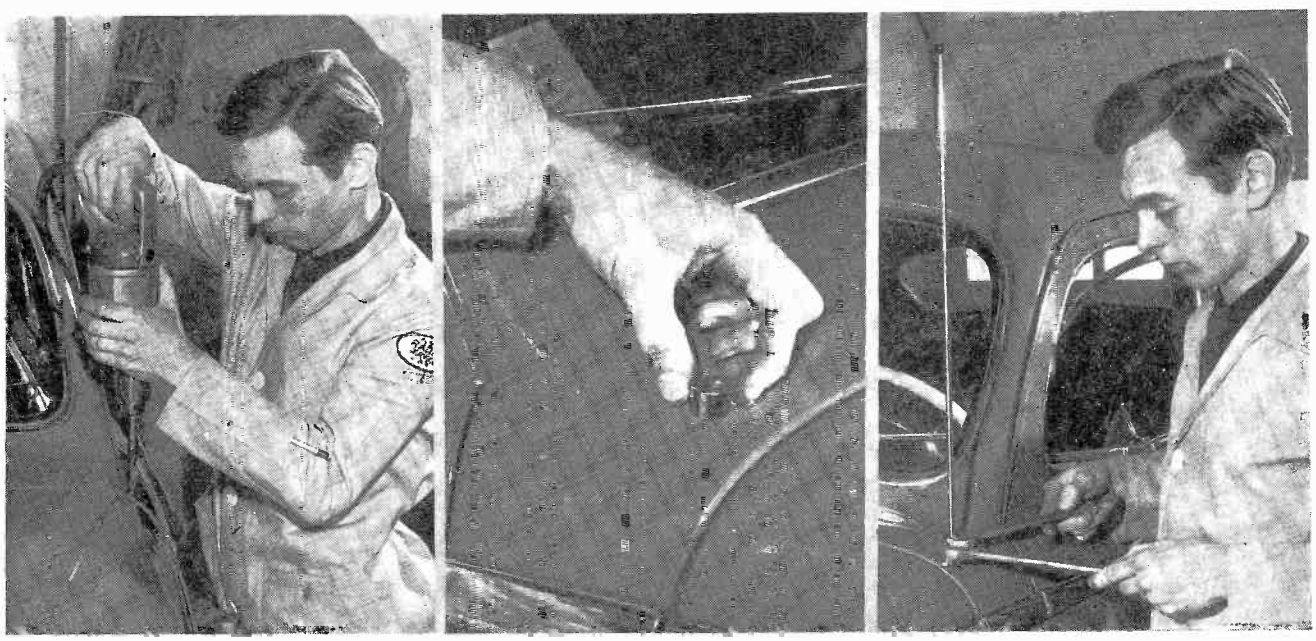
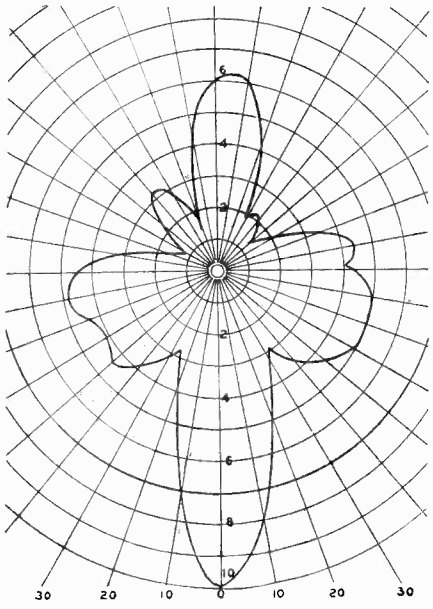
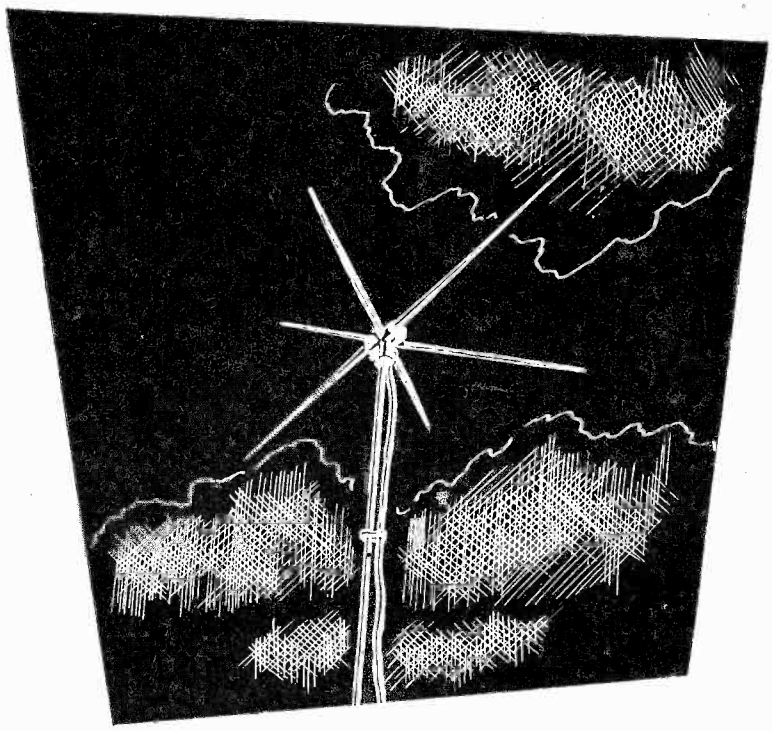


Fig. 4 Steps in making a top cowl antenna installation. Left, hold the drill in vertical position to complete drilling operation; center, using mounting fitting as a template to determine location of mounting hole for a top cowl installation. This gives finished job custom fitted appearance. Right, tightening mast in desired alignment.





ANTENNA SYMPOSIUM

The result of an extended survey designed to answer in one comprehensive list the many inquiries we have received about available FM and television antennas.

THE antenna requirements for good FM and Television reception are much more exacting than those of ordinary AM receivers. In FM and television receivers the antennas rank in importance with the most critical components of the receivers themselves. Although the general public is apparently not yet aware of this fact, the radio serviceman certainly is, for Radio Maintenance has been receiving many requests during months past for information about FM and television antenna problems encountered by those installing these receivers. Since these problems are many and varied and each individual case is different, the staff of Radio Maintenance decided many months ago to conduct an extensive survey aimed at gathering all available data about the types of antennas suitable for home television and FM use. These are the types which will be installed in millions of homes in future months.

The antennas are listed alphabetically by manufacturer and the tables include the information necessary to determine the application and suitability of each type. Certain fundamentals should be kept in mind:

1. Due to the wide diversity of frequencies used for FM and television, it is usually advisable to make some sacrifice in gain to allow a broad frequency response.

2. Matching is an important factor, and substitution of other than the recommended transmission line can seriously impair the operation.

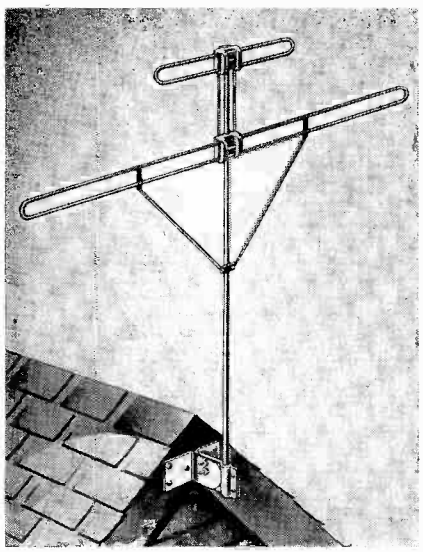
3. Proper height and location are necessary to bring out the full capabilities of any type of antenna. An approach to "line of sight" conditions nearly always is helpful.

4. Location of stations should be considered in choice of directivity characteristics. If all the stations within range are in one direction a unidirectional type may give more gain, but this antenna cannot be used in locations between stations.

Abbreviations have been used as follows:

bak—bakelite
bid—bidirectional pattern
cer—ceramic
DP—dipole
FM—frequency modulation
omni—omnidirectional pattern
poly—polystyrene
refl—reflector
TV—television
uni—unidirectional pattern

We wish to thank the participating manufacturers for their cooperation in supplying the information necessary to make this symposium a success.



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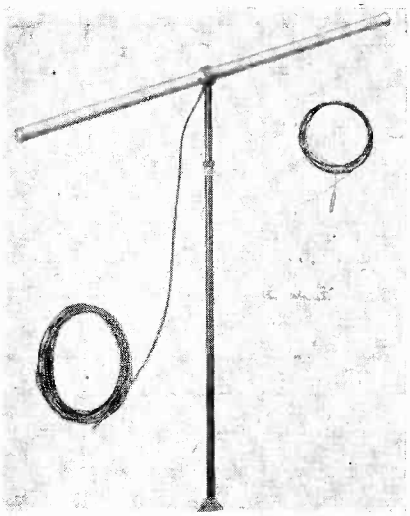

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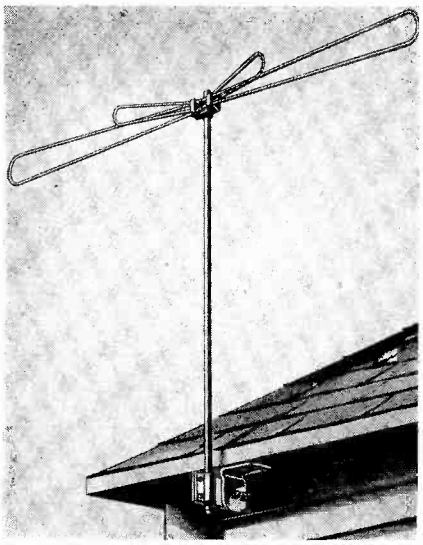

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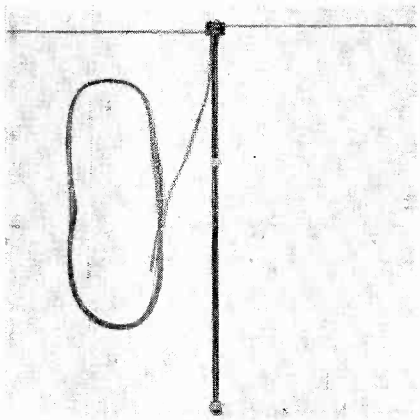

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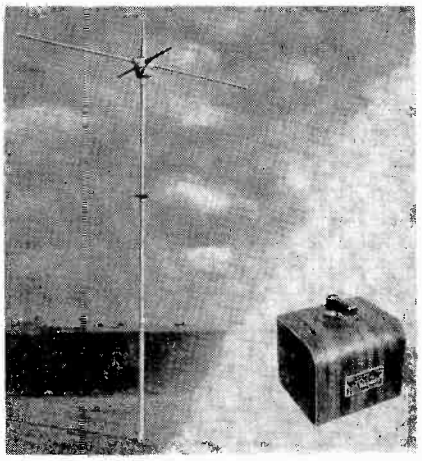

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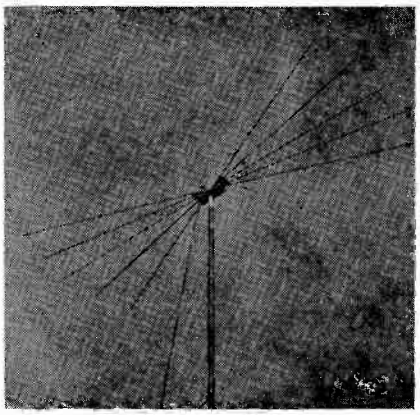

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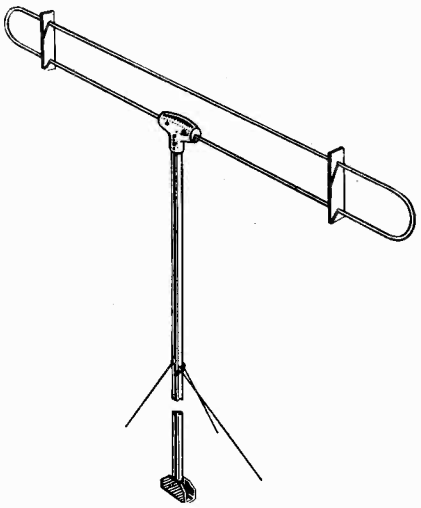
FM AND TELEVISION ANTENNA SYMPOSIUM

Manufacturer	Model	Illus. No.	Type Application Freq. Range	No. of Elements	Directivity	Dimensions	Weight Lb.	Insulating Material	Transmission Line Used	Special Features, Accessories, etc.
American Phenolic Corp.	107-104	4	DP - FM 88 - 108	1	bid	5' long	1.5	bak	300 ohm	5' alum. or steel mast and 75' of 300 line supplied
	124-001	2	All wave wire and DP (automatic)	1	bid	51'' and 65' wire		polyeth	52 ohm (Amph.21-157)	65' ant. covered with polyethylene, 5' steel mast and 50' of 52 ohm coax. included; special filter switches to proper antenna
Andrew Co.	710 Difan	6	FM and TV 44 - 216	Difan	bid	10'x4'	8	steatite	300 ohm	60' 300 ohm ribbon included, Mounting kits 711 & 712 extra
Bendix Radio	AD1F00		DP - FM 88 - 108	1	bid	70'' long	5	bak	300 ohm	5' steel or alum.(1'' dia.) and 75' 300 ohm line included
L. S. Brach Mfg. Co.			DP - FM 88 - 108	1	bid	70''		bak	300 ohm	5' CR steel mast and base clamp 50' 300 ohm line included
			DP and Refl. Low TV bands 44 - 88	2	uni	118''		bak	300 ohm	Same as above
			Folded DP - FM 88 - 108	1	bid	70''		bak	300 ohm	Same as above
			Folded DP & Refl. FM - 88 - 108	2	uni	100''		bak	300 ohm	Same as above
			Cross DP FM 88 - 108	2	omni	70''		bak	300 ohm	Same as above
		3	TV and FM 44-108; 175-210 (automatic)	1	bid	94''		bak	300 ohm	Same as above except 8' mast and choice of 'bazooka' or dividers for matching
		1	Dual dipole, TV 44 - 108 175 - 210	2	bid	94''		bak	72 ohm coax	8' mast, 7/8'' dia. & 50' 72 ohm coax included. Bazooka for matching. A refl. can be added

Manufacturer	Model	Illus. No.	Type Application Freq. Range	No. of Elements	Direc-tivity	Dimensions	Weight Lb.	Insulating Material	Transmission Line Used	Special Features, Accessories, etc.
Camburn Inc.	F-21		DP - FM 88 - 108	1	bid	60''		bak	300 ohm	Pretuned at factory; alum. mast ¾'' dia., 5' high, guy supports and mtg. bracket included; mast extensions available; 60' 300 ohm line included
	F-22	7	Folded DP - FM 88 - 108	1	bid	60''x2½''		bak	300 ohm	Same as above
	F-23		DP and Refl. FM - 88 - 108	2	uni	60''		bak	300 ohm	Same as above
	F-24	8	Folded DP & Refl FM - 88 - 108	2	uni	60''x2¾''		bak	300 ohm	Same as above
	SW40		Adj DP, FM - TV 44 - 108	1	bid	53'' - 112''		bak	75 ohm twin	Dipole length adjustable with locking arrangement; otherwise same as above
	SW41		Adj DP - TV 200 - 225	1	bid	23'' - 350''		bak	75 ohm twin	Same as above
	T31		DP - TV 44 - 216	1	bid	112''		bak	300 ohm	Same as Type F21
	T32		Folded DP - TV 44 - 216	1	bid	112''x 2¾''		bak	300 ohm	Same as Type F21
	T33		DP - TV 44 - 216	2	uni	112''		bak	300 ohm	Same as Type F21
Dielectric Products	72	17	Dual DP TV and FM 44-108; 174-216	2	bid	92''x16''	8	cer	72 ohm coax	High and low freq. DP elements in ''Bat-Wing'' arrangement; reflectors available; ant. kit includes wood or steel mast 5', 2'' dia., and base holder
General Electric	UKA-001	9	Folded DP - FM 88 - 108	1	bid			textolite	300 ohm	5' mast, mounting straps and 60'of 300 ohm line included
	UKA-002		Folded DP - TV 44 - 88	1	bid			textolite	300 ohm	Same as above
HiPar Products Co.	5D		DP - TV 88-108; 44-88	1	bid	60''	1.5	wood	300 ohm	¼ wave matching section; 3' mast 1¼ dia. and 50' 300 ohm line included
	FM4T	33	Cross DP - FM 88 - 108	1	omni	60''	2.5	cer	300 ohm	Quadrature feed loop and ¼ wave matching section; 3' mast, 1¼''dia included
Insuline Corp. of America (ICA)	6075		DP - FM 88 - 108	1	bid	56''	5 oz.	bak	300 ohm	5' steel zinc plated mast and mtg. base; 60' 300 ohm line included mast extension available
	6077	13	DP and Refl. FM - 88 - 108	2	uni	56''	3	bak	300 ohm	Refl. spacing adjustable; same other features as 6075
	6076		Folded DP FM - 88 - 108	1	bid	56''	6 oz.	bak	300 ohm	Same as 6075
	6078	14	Folded DP&Refl FM - 88 - 108	2	uni	56''	3.5	bak.	300 ohm	Same as 6077
	6008		Folded DP - FM 88 - 108	1	bid	57''	4 oz.	polyeth	300 ohm	Constructed of 300 ohm trans line
	6055		DP - TV 44 - 88	1	bid	94''	.5	bak	300 ohm	Same as 6075
	6056		Folded DP - TV 44 - 88	1	bid	94''	1	bak	300 ohm	Same as 6075
	6057	13	DP & Refl. - TV 44 - 88	2	uni	94''	3	bak	300 ohm	Same as 6077
	6058		Folded DP & Refl 44 - 88	2	uni	94''	3.5	bak	300 ohm	Same as 6077
J.F.D.	TA2		DP - TV 44 - 59	1	bid	98''		poly	300 ohm	6' wood mast 1¼'' dia. and 60' 300 ohm line included
	TA3	12	DP and Refl. TV - 44 - 59	2	uni	96''		poly	300 ohm	Same as TA2
	FD100		Folded DP - TV 44 - 59	1	bid	96''		poly		6' wood mast 1¼'' dia.
	FD200		Folded DP & Refl TV - 44 - 59	2	uni	96''		poly		Same as FD100
	TA22		Double DP with Refl.	4	uni			poly		Same as FD100
Kings Electronics	A1100	10	DP-Adj; TV, FM 44 - 872	1	bid		2	bak	72 - 300	Telescopic adjustment; calibrated 10' iron mast ½'' dia.
	A1200		DP - TV, FM 44 - 108	1	bid	105''	¼	bak	72 - 300	10' alum. mast, ¾'' dia. and all guy accessories included
	A1300		DP and Refl. Adj - 44-872	2	uni			bak	72 - 300	Telescopic adj. of elements spacing and elev. angle adj.
	A1400		FM and TV DP and Refl. FM-TV; 44-108	2	uni	105''	1.5	bak	72 - 300	10' iron mast ¾'' dia. included 10' alum. mast ¾'' dia. included
	A1500		Folded DP FM-TV; 44-108	1	bid	105''	1.5	bak	72 - 300	Same as A1400
	A1600		Folded DP & Refl FM-TV; 44-108	2	uni	105''	2¼	bak	300	Same as A1400
	A1000	5	Rotary Turnstile FM and TV 44-88; 174-216	4	uni	110''	8	mycalex and bak	72 - 300	Coax or ribbonline; 10' alum. mast, rotator with reversible motor and control box included
Oak Ridge Antenna	FMD3		DP - FM 88-108	1	bid	58''		lucite	72 ohm coax or twin	5' alum. mast ¾'' in dia., mast extensions available
	D3		DP - TV 44-88	1	bid	93''		lucite	72 ohm coax or twin	Same as FMD3
	FD3		Folded DP - TV 44-88; 174-216	1	bid			lucite	100 - 300 twin ax or ribbon	Same as FMD3
	DR3		DP & Refl.- TV 44 - 88	2	uni	93''-97''		lucite	72 ohm coax or twin	Same as FMD3
	FMDR3	27	DP & Refl.- FM 88 - 108	2	uni	58''-62''		lucite	Same as DR3	Same as DR3
	FDR3	30	Folded DP & Refl. TV, 44-88,174-216	2	uni	93''-97''		lucite	Same as FD3-	Same as FMD3
	DDR3		Double DP & Refl. TV, 44 - 88	4	uni	93''-97''		lucite	Same as D3	Same as FMD3



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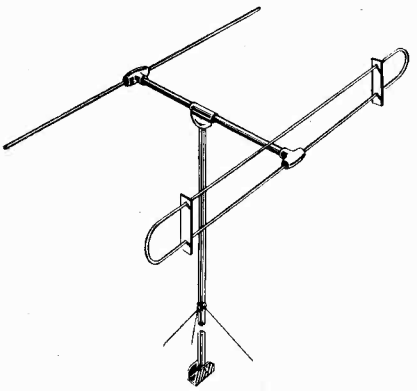

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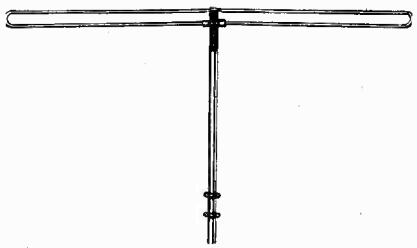

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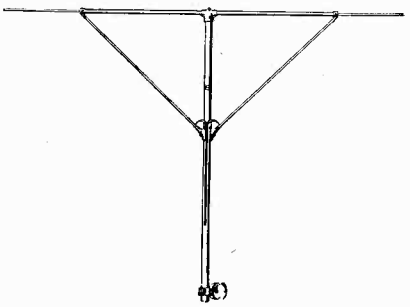

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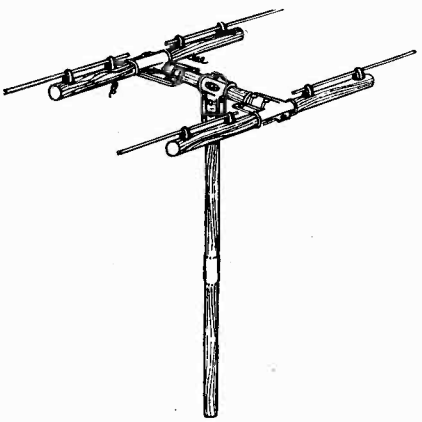

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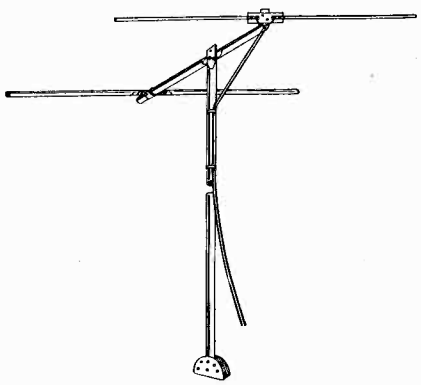

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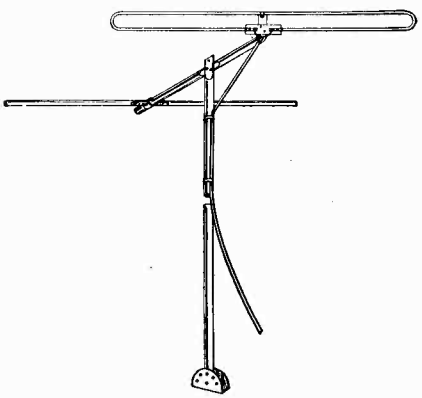

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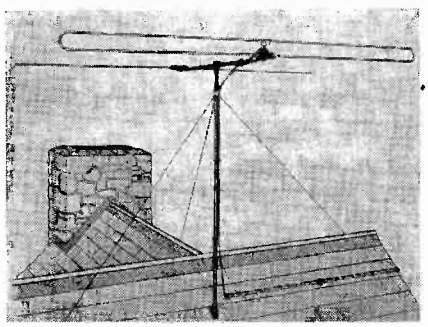

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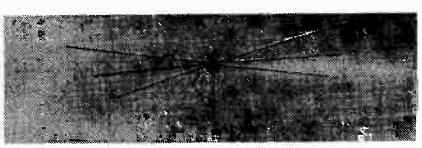

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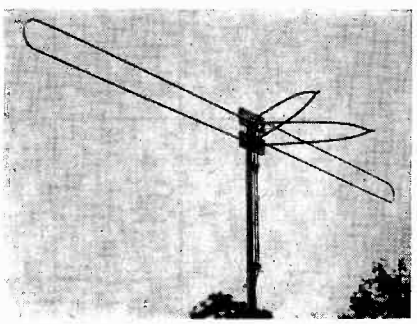

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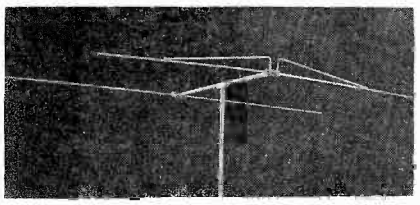
Manufacturer	Model	Illus. No.	Type Application Freq. Range	No. of Elements	Directivity	Dimensions	Weight Lb.	Insulating Material	Transmission Line Used	Special Features, Accessories, etc.
Philco Corp.			DP - FM 88 - 108	1	bid			bak and poly	150 - 300	A mast which simultaneously accommodates up to 5 antennas as an array or separate units is available. Alum. mast in two 4' sections included
			DP - TV 44-88; 174-216	1	bid			bak and poly	150 - 300	
			DP & Refl., FM 88 - 108	2	uni			bak and poly	150 - 300	
		16	DP & Refl., TV 44-88; 174-216	2	uni			bak and poly	150 - 300	
		18	Fan Type	3	bid			bak and poly	150 - 300	
Premax Products	FM130	25	Adj DP "V" FM, 88-108	1	bid	60"	2¾	bak	300	Polarization angle of dipole sections adjustable to form V of any angle. 4'2" steel mast and guy plate included. Mast extensions and line available extra
	FM230		Adj DP "V" with Refl - FM 88 - 108	2	uni	60" x 30"	5	bak	300	
	FM1254	11	Extended "V" FM-TV; 44-216	1	bid	8' x 2'	4	bak	300	Same as above, but 75' 300 ohm line supplied
Radio Corp. of America	226B	23	DP - FM 54 - 108	1	bid	2' x 5'	1.4	bak	300	Pattern quadirectional 174-216; lightning arrestor, terminals and stand-off screw eye insulators included. Mounting bracket No. 227 available.
	225B		DP & Refl. - TV 54-108; 174-216	2	uni	47" x 106"	5.4	wood	300	Same accessories as 226B
	228	22	Folded DP & Refl. FM; 88 - 108	2	uni	2' x 5'	1.4	bak	300	Same as 226B
Rauland Corp.	150	29	Folded multi-element - FM 88 - 108		omni				300	
S/C Laboratories	706		DP and Refl. 706A - TV 706B - FM	2	uni		5			Mast included
	705, 704	19	Broad DP & Refl. 705A, 704A - TV 705B, 704B - FM	2	uni		5.5			Mast included; 704 heavier construction, otherwise identical
	704-2	21	Dual DP & Refl. 704-2A - TV 704-2B - FM	4	uni		15			Mast included
Shur-Antenna-Mount	Interceptor	32	Adj DP & Refl. FM and TV 44 - 216	2	uni		2	synthane	72 ohm 300 with Q	Element length and spacing adjustable. Q section for matching 300 ohm line, birch or maple 7' mast, & 75' 300 ohm line available
Snyder Mfg. Co.	FM10		DP - FM 88 - 108	1	bid	60" x 4"	⅛	bak	300	Universal mount allows 300° in vertical, and 360° in horizontal plane adjustments.
	FM11		Folded DP; 88-108	1	bid	60" x 4"	½	bak	300	
	FM12		DP & Refl., FM 88 - 108	2	uni	60" x 6" x 15"	½	cer	300	
	FM13		Folded DP & Refl. FM, 88 - 108	2	uni	60" x 6" x 15"	¾	cer	300	
	TV11		Folded DP - TV 44 - 88	1	bid	75" x 4" x 4"	¾	bak	300	
	TV12		DP & Refl., TV 44 - 88	2	uni	75" x 4" x 4"	¾	cer	300	
	TV13		Folded DP & Refl. TV, 44 - 88	2	uni	75" x 6" x 18"	1	cer	300	
Technical Appliance Corp.	621	31	Folded DP & Refl. FM, 88 - 108	2	uni	5'		bak & poly	300	5' wood mast 2" dia. & 60' 300 ohm line included. FM-AM transformer available for all wave use.
		20	Cage Type		bid		10			Cone shape & multi-element construction provide broad band operation
Tricraft Prod. Co.	300	26	All wave special 44 - 216	2	bid	84" x 9"	7¼	bak	300	Short thick dipole connected through inductor rings to thin longer dipole giving broad band effect. 94" steel mast & 65' 300 ohm line and bracket included
Ward Products Corp.	FM60		DP - FM 88 - 108	1	bid	60"	4	bak	300	5' steel mast 1" dia. weatherproofed & 60' 300 ohm line included. Rigid steel tubing construction boom with adjustable angle. Mounting & guy ring also supplied
	FM55		Folded DP - FM 88 - 108	1	bid	55"	5	bak	300	
	TV88		DP - TV 44 - 88	1	bid	88"	4	bak	300	
	TV94		Folded DP - TV 44 - 88	1	bid	94"	5	bak	300	
	FMR63	28	Refl. kit for FM55 or FM60	2	uni	63"			300	Reflector kits make single antennas into two element arrays by simply bolting refl. to mast
	TVR92	15	Refl. kit for TV88 or TV94	2	uni	92"			300	
Workshop Associates	TV57		DP with director & Refl., TV Channel 2	3	uni		1.5	bak	72 ohm coax	Separate type for each channel optimum response at one freq. also good performance on adjacent channels. 7½ steel mast 1½" dia. included. Rotator, coax line & extra mast sections available extra
	TV63		" 3	3	uni		1.5		" " "	
	TV69		" 4	3	uni		1.5		" " "	
	TV79		" 5	3	uni		1.5		" " "	
	TV85		" 6	3	uni		1.5		" " "	
	FM1	24	Cross dipole	2	omni			bak	72 ohm coax	Same accessories as above
	FM2									Kit to convert FM1 to 3 element directive array



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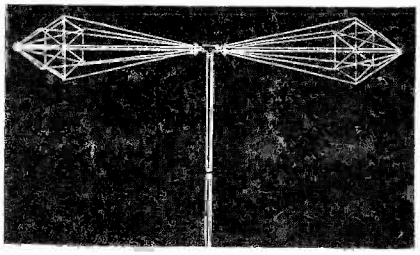

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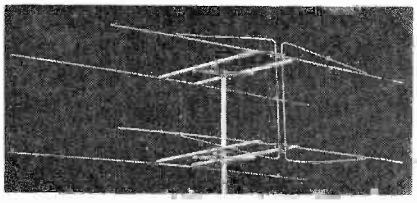

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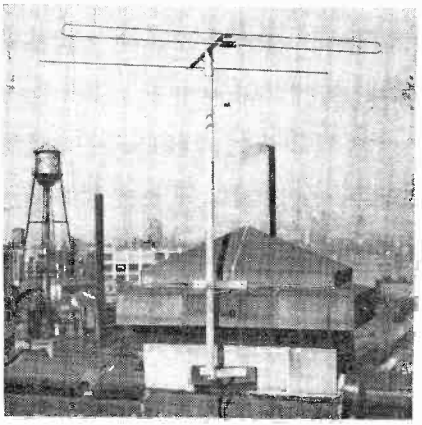

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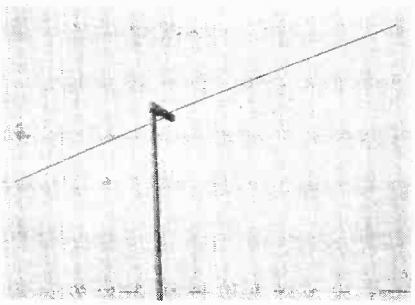

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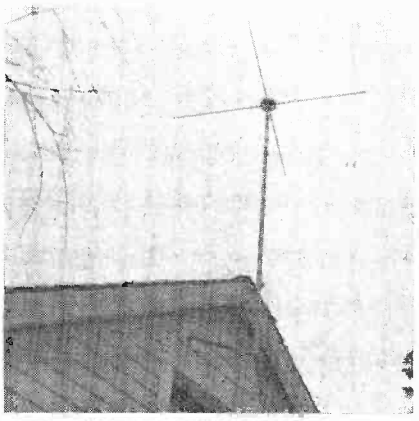

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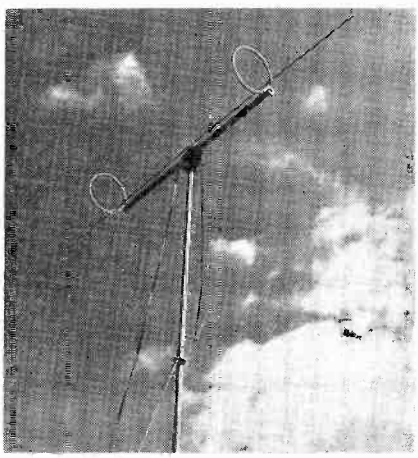

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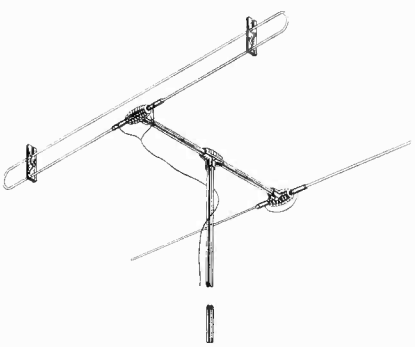

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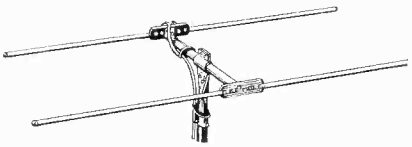

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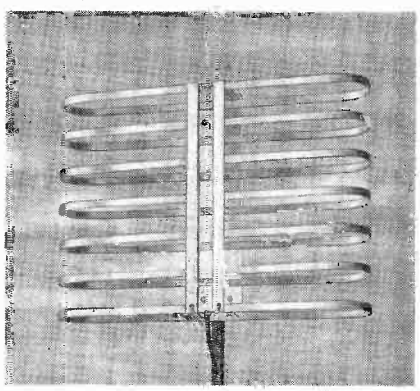

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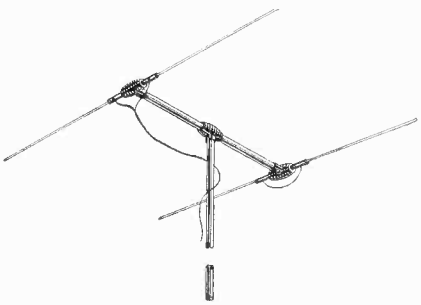

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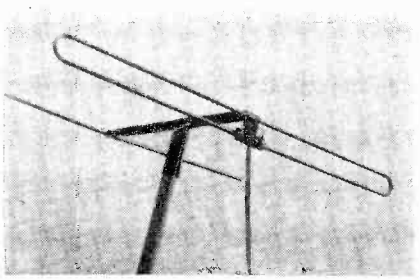

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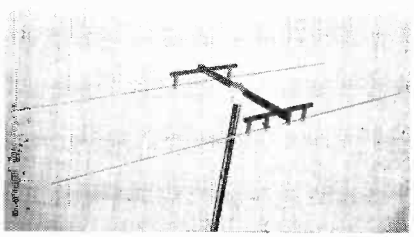

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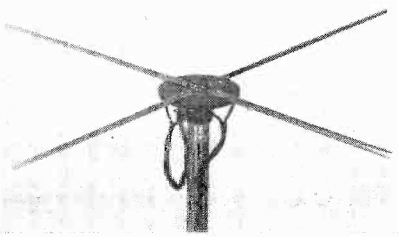

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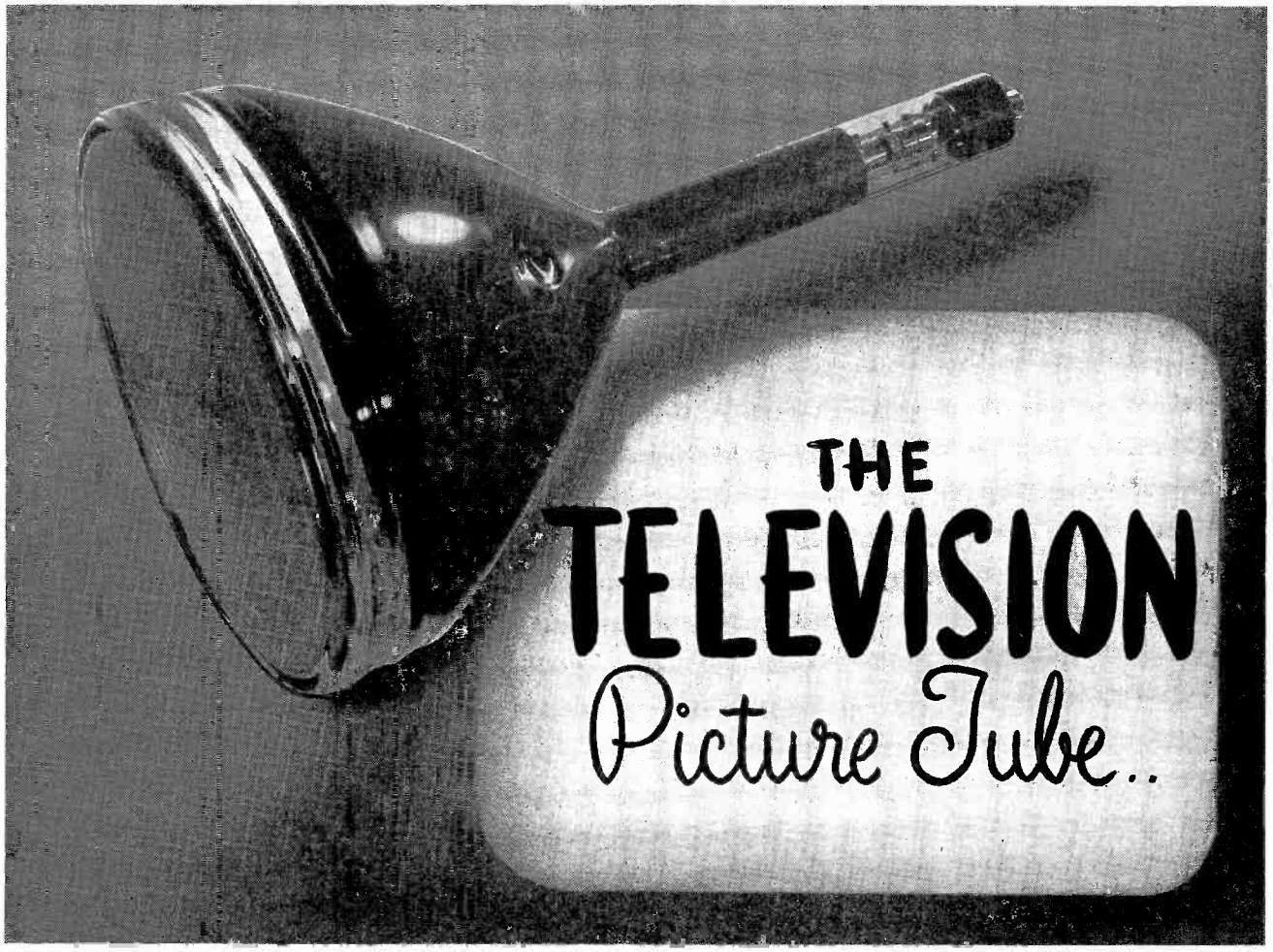

THE TELEVISION Picture Tube..

by Morton Scheraga
Allen B. DuMont Labs.

A discussion which brings you up-to-date information on the cathode-ray tubes used in television receivers. A convenient table of their characteristics is included.

WHEN television was introduced to the public in 1939, one of the serious objections raised against it by the viewing audience was that the screen was too small to provide bright, clear, and detailed pictures. The picture size was limited by the cathode-ray tube on whose face the image was traced. The largest magnetic type television tube introduced at that time was the 12AP4 which was capable of producing a picture 8 x 10 inches in size. A few electrostatic tubes of 14- and 20-inch diameters were also built, but the faces of these tubes were too round, resulting in distorted images.

Two approaches to solving this problem were tried. The first was to increase the face diameter of the tube while also making it substantially flat. The second method was to develop a small projection tube which produced an image sufficiently bright to be projected onto a screen. To date, 15-inch and 20-inch magnetic tubes have been developed, having screens of negligible curvature. The 20-inch tube is probably the largest commercial direct view tube that will be produced in view of the high cost and problems involved in its manufacture. Pictures 13 x 18 inches are obtained with the new 20-inch tubes. Projection systems, on the other hand, employ 3-, 4-, and 5-inch diameter tubes which with a suitable optical system throw an image as large as 19 x 25 inches on to a screen.

Though direct view tubes and projection systems are now developed to the point where large, good quality pictures can be produced, their main drawback is the high cost of receivers in which they are used. To meet the demands of the low-priced market, manufacturers have had to resort to the smaller, direct view tubes, compromising on picture size in order to produce a low cost receiver. However, a marked improvement has been achieved over earlier sets for the newer tubes are operated at higher voltages and give brighter, sharper pictures.

Three types of 7-inch diameter tubes are now being used in the lowest priced television receivers. In this group are the electrostatic types, 7EP4 and 7GP4, and the magnetic type 7DP4. The useful picture area of 7-inch tubes is approximately 4 x 5½ inches. The 7EP4 operates at the lowest accelerating potential, about 2500 volts. It thus requires the smallest high voltage supply and is used in receivers where cost is held to an absolute minimum. The 7GP4 is characterized by its higher accelerating potential of 4000 volts, greater light output than the 7EP4, and higher deflection sensitivity. Both tubes are electrostatically focused and deflected and have conventional electron gun designs.

The 7DP4 is the smallest mag-

netic tube that is now employed in television receivers. It is electrostatically focused and magnetically deflected and operates at 6000 volts. At this high voltage, it produces the brightest and sharpest picture of the 7-inch tube types. The deflection yoke and high deflection currents needed for the 7DP4 increase the cost of sets in which it is used somewhat above those employing the electrostatic tube types. A modern television receiver with a 7DP4 tube is shown in Fig. 1.

Fig. 1 A modern television receiver with a 7DP4 magnetic cathode-ray tube.

Ion Trap

An interesting feature of the 7DP4 is its ion trap type of electron gun. One of the characteristics of magnetic types is the ion burn that forms in the center of the screen after a few hours of operation. This ion burn appears as a brown spot about the size of a half dollar and is caused by the continual bombardment of the phosphor screen by the heavier and slower moving ions inside the cathode-ray tube. These ions are emitted from the electron gun along with the useful electrons, and are attacted by the high accelerating voltage towards the screen. To avoid this ion spot, the ion trap electron gun in combination with a magnet has been devised for magnetic tubes. As shown in Fig. 2, the first and second anode are constructed with an oblique gap which causes both electrons and ions to be deflected at right angles to the gap. The ion-trap magnet, placed at the neck of the tube behind the focus coil, applies a steady magnetic deflecting field to the electrons and bends them back along the axis of the tube. The heavier ions are not so readily affected by the magnetic field and are collected by the second anode. In this manner, the ions and electrons are separated, and the ions trapped within the gun structure. Fig. 2 shows the respective paths of the ion and electron beams.

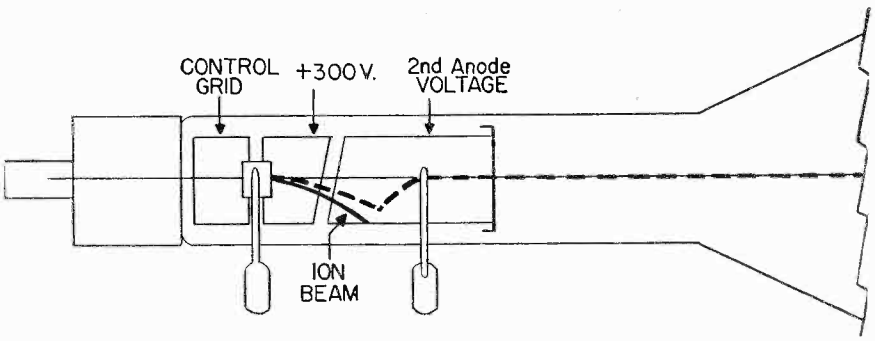

Fig. 2 This diagram shows the operation of the ion trap.

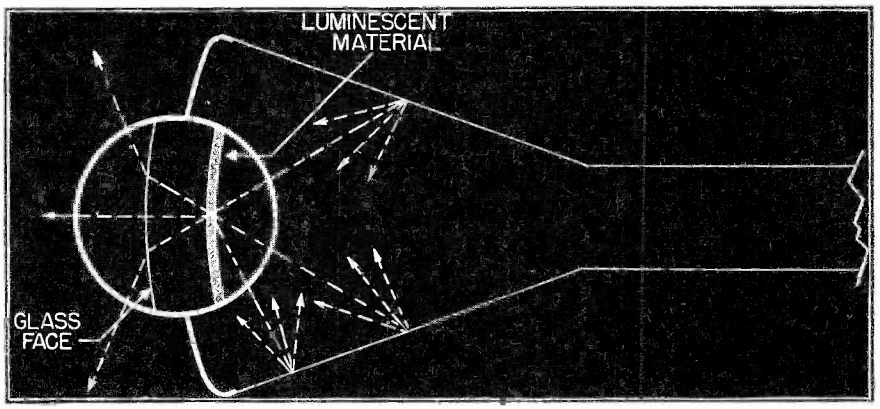

Fig. 3 Conventional cathode-ray tube showing typical distribution of light from a spot.

Magnet Adjustment

Adjustment of the ion-trap magnet may be difficult at first for the serviceman when replacing the cathode-ray tube, for, unless the magnet is correctly positioned, the electrons will also be collected by the second anode and no illumination will appear on the tube. The ion-trap magnet should, therefore, be adjusted first before attempting to line up the focus coil and deflection yoke. The magnet is initially positioned so that the rear magnet poles are over two small flags attached to the gun. This pre-positioning insures some illumination of the screen. The final position is that which gives maximum illumination and is made by observation of the screen, while the magnet is moved forward or backward with a slight rotational movement. The clamp on the magnet is then tightened to lock the assembly securely to the neck of the picture tube.

10-Inch Types

The next price range of tele-

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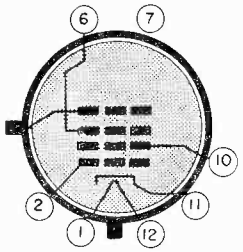
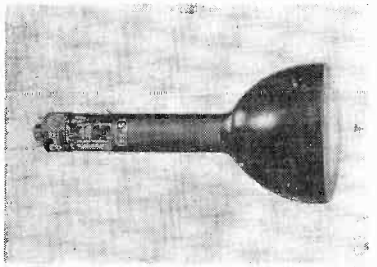
TELEVISION CATHODE-RAY TUBE CHART

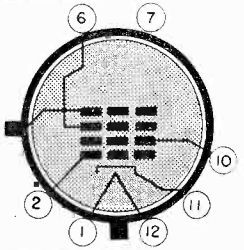
Type	Nominal Diameter Inches	Overall Length Inches	Base	Bulb Contact	Raster Size Inches	Focus Method	Defl. Method	Ion Trap	Defl. Angle	Heater Volts	Heater Amps.	Typical Operating Conditions				Type
												Anode no. 2 Volts	Anode no. 1 Volts	G2 Volts	G1 for Cut-Off	
5TP4	5	11¾	Duodecal 7 Pin	Recessed Small Cavity	3 x 4	E	M	No	50°	6.3	0.6	27000	4900	200	-7.0	5TP4
7DP4	7 3/16	14 1/16	Duodecal 7 Pin	Recessed Small Cavity	4 x 5½	E	M	Yes	50°	6.3	0.6	6000	1430	250	-45	7DP4
7EP4	7	15½	Medium Magnal		4 x 5½	E	E	No		6.3	0.6	2500	650		-60	7EP4
7GP4	7	14½	Diheptal 12 Pin		4 x 5½	E	E	No		6.3	0.6	3000	1000		-60	7GP4
10BP4	10½	17 5/8	Duodecal 7 Pin	Recessed Small Cavity	6 x 8	M	M	Yes	50°	6.3	0.6	9000		250	-45	10BP4
10EP4	10½	17 5/8	Duodecal 7 Pin	Recessed Ball Cap	6 x 8	M	M	Yes	50°	6.3	0.6	9000		250	-45	10EP4
10FP4	10½	17 5/8	Duodecal 7 Pin	Recessed Small Cavity	6 x 8	M	M	No	50°	6.3	0.6	9000		250	-45	10FP4
12JP4	12	17½	Duodecal 7 Pin	Recessed Ball Cap	7¾ x 10¼	M	M	No	50°	6.3	0.6	10000		250	-45	12JP4
15AP4	15 5/8	20 3/16	Duodecal 7 Pin	Recessed Ball Cap	9½ x 12¾	M	M	No	50°	6.3	0.6	12000		250	-45	15AP4
20BP4	20	28¾	Duodecal 7 Pin	Medium External Cap	12 7/8x17¼	M	M	No	50°	6.3	0.6	15000		250	-45	20BP4

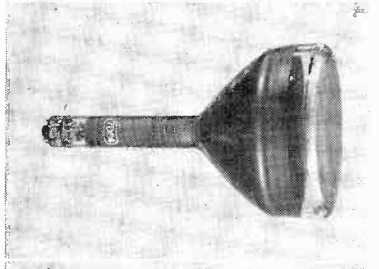
5TP4



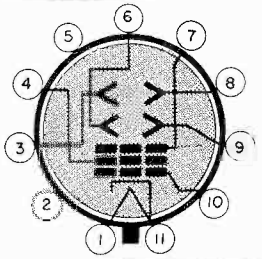


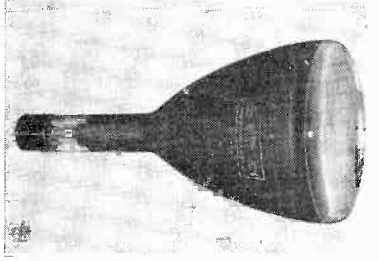
7DP4



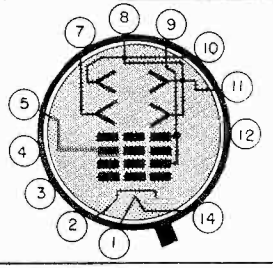


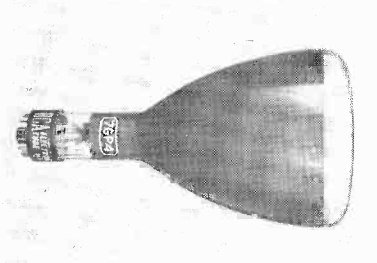
7EP4



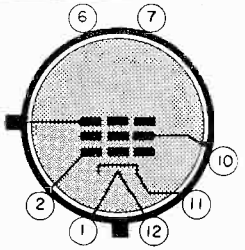


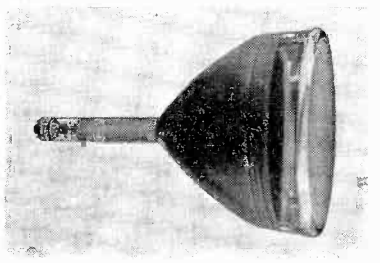
7GP4





10BP4





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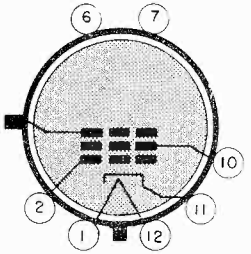
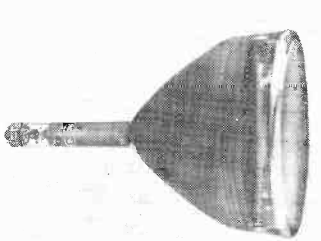
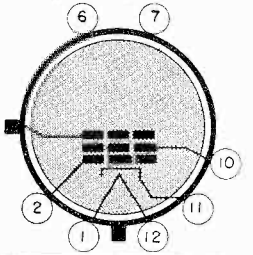
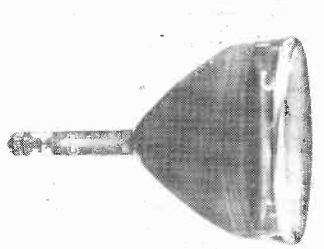


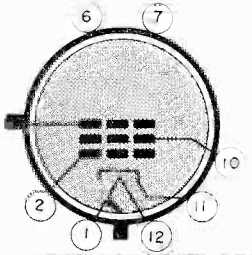


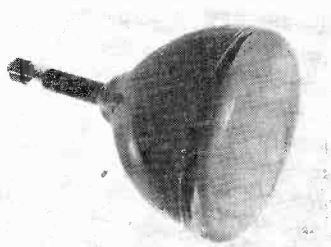
10FP4



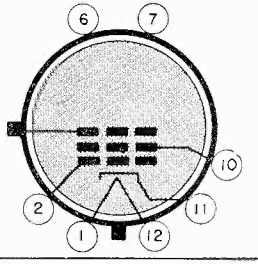


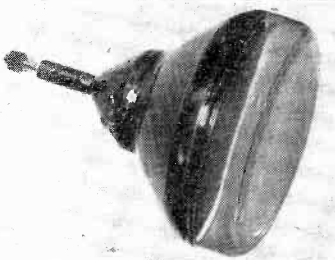
12JP4



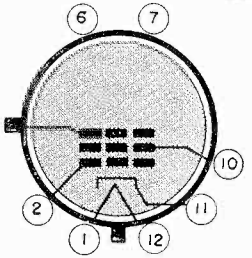


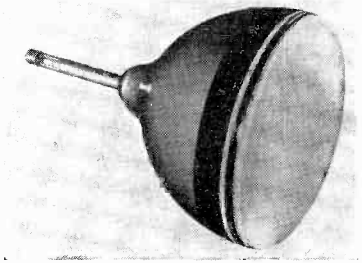
15AP4





20BP4





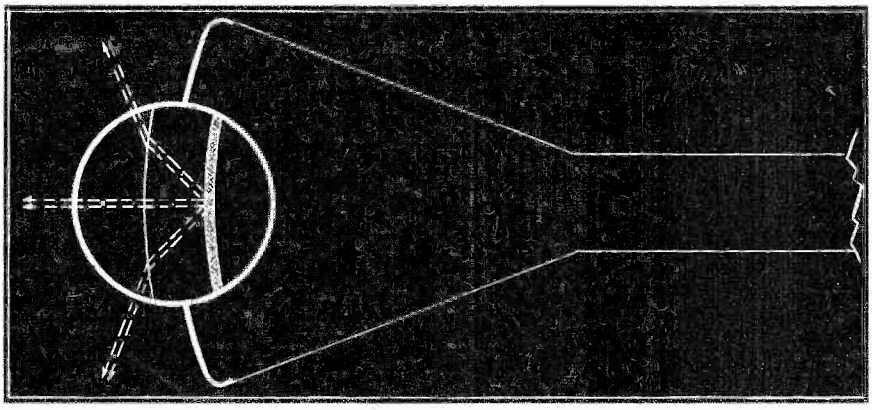


Fig. 4 Cathode-ray tube with aluminum backed screen showing gain of light output.

Fig. 5 Console receiver with 15AP4 cathode-ray tube.

vision receivers includes those with 10-inch tubes, having a picture size of approximately 6 x 8. These tubes are used in both table models and consoles. The 10-inch types include the 10BP4, 10EP4, and 10FP4. The 10BP4 and 10EP4 are identical except for the high voltage accelerating terminal. The former has the recessed cavity type, while the latter uses the ball type. The electron guns of the 10BP4 and the 10EP4 are similar to the 7DP4. They are magnetically focused and deflected and have ion traps. Their normal operating accelerating voltage is 9000 volts.

Aluminum Backing

The 10FP4 is the newest 10-inch tube featuring several important developments. These tubes have aluminum-backed screens, which permit greater brilliancy and contrast of image. The aluminum backing on the phosphor screen is a film of microscopic thickness, which not only permits passage of the fast moving electrons to the screen, but by its reflective qualities increases the light output. At the same time, the slow moving ions cannot penetrate the aluminum layer. Therefore, no ion spot can develop on the screen, and no ion trap gun and magnet are required. Also, the glow of the cathode which is sometimes visible through the thin phosphor screen on conventional tubes is eliminated by the opaque aluminum layer.

Fig. 3 and 4 illustrate how the advantages of the aluminum backed tubes are achieved. In Fig. 3, the region in the circle is a greatly magnified section of the face of a conventional tube of which one element of the phosphor is fluorescing. Generally at least 50 per cent of the light generated in the screen is emitted towards the electron gun in the tube. Another 15-25 per cent is lost by reflection from the glass on the inside of the tube face. Thus only 25-33 per cent of the total light generated passes through the glass face in the form of useful light output.

Fig 4 shows a tube whose screen is covered with a layer of aluminum which is thin enough to permit the electrons to pass, but sufficiently thick to serve as a good reflecting surface. Now it is seen that the light which previously would go towards the electron gun is reflected forward into the direction of viewing.

At present the 10FP4 and a few projection tubes are the only commercial types that are being aluminized. Eventually all television tubes, operating at 9000 volts and above will probably have metal backed screens, which improve the quality of television pictures and eliminate the need for ion traps.

The 10-inch tubes have received the widest acceptance by the television industry. The picture size obtained is adequate for viewing in the home and the length of the tube itself is about the limit for table model cabinets. More recently a 12-inch diameter tube has been introduced which is almost an inch shorter than standard 10-inch tubes. It thus can be used in table models as well as consoles, and with its 7¾ x 10¼ inch image it provides a picture area about 40 per cent greater than the 10-inch tube. This 12-inch tube type is the 12JP4. It operates at an accelerating voltage of 8,000-10,000 volts and is mag-

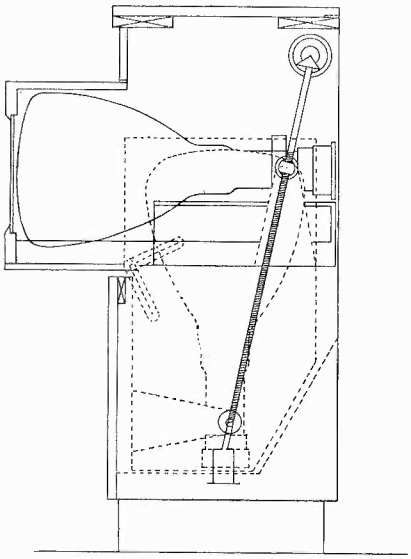


Fig. 6 Lift mechanism for 20" tube.

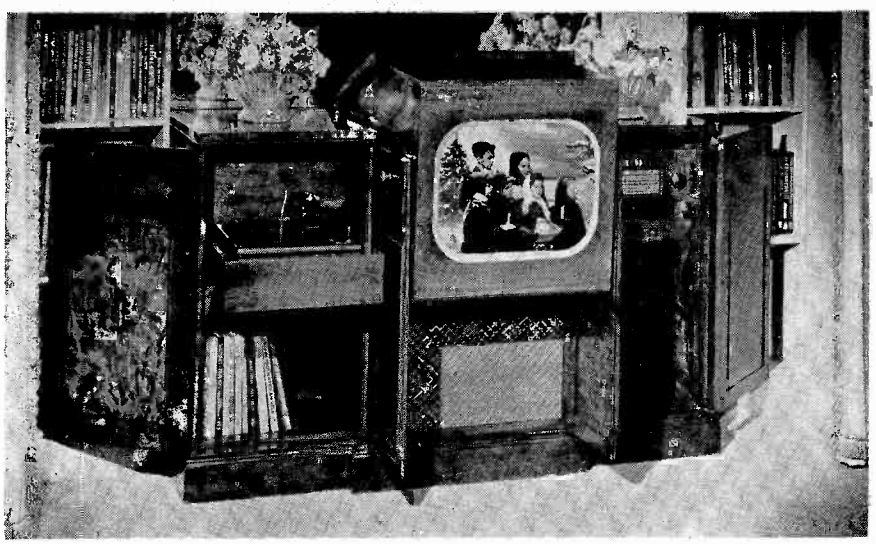


Fig. 7 Television receiver with 20BP4 tube.

netically focused and deflected. No ion trap is required with the 12JP4 since the ions are dispersed over a greater area and cause insufficient burning to be noticeable during the normal life of the tube. The 12JP4, which is only slightly higher in cost than the 10-inch tube, is being used in table models and consoles at about the same price as those with 10-inch tubes.

15-Inch Types

The 15AP4 is the newest though not the largest direct view television tube on the market. Its virtually flat face is a marked improvement over the pre-war round face 14-inch tube which was the nearest comparable size. For a tube of this large diameter, its length of 20 3/16 inches is relatively small and suitable for horizontal mounting without requiring too deep a cabinet. The 9½ x 12¾ picture obtained on the 15AP4 is a comfortable viewing size for the home as well as clubs, taverns and small auditoriums. A 15-inch tube receiver is illustrated in Fig. 5.

Typical operating voltage for the 15AP4 is 10-12,000 volts so that the power supply is only slightly larger than for the smaller 10 and 12-inch tube types. As with the 12JP4, no ion trap is required for the 15-inch tube. Up to the present, the 15AP4 has been used only in high-consoles.

The 20BP4 is the largest direct view tube found in commercial television sets and provides a 13½ x 18 inch picture which is ample for homes with large viewing rooms and for public demonstrations. Very bright images are produced at the high 12-15,000 volts at which the tube operates. The overall length of the 20BP4 is 28¾ inches so that if the tube were mounted horizontally too bulky a cabinet would be needed to house it. One novel means of mounting the tube, which overcomes this objection, is shown in Fig. 6. When the cabinet is closed, the tube is supported vertically (thus the cabinet has to be only a little deeper than the 20-inch diameter of the tube). By opening the lid of the cabinet, the tube is automatically lifted into the horizontal viewing position. Fig. 7 shows a receiver which uses this type of mounting for the 20BP4. As shown, the cabinet is open and the tube is in position for viewing. To close the cabinet the cover is again lifted and the tube pivots back into the vertical position.

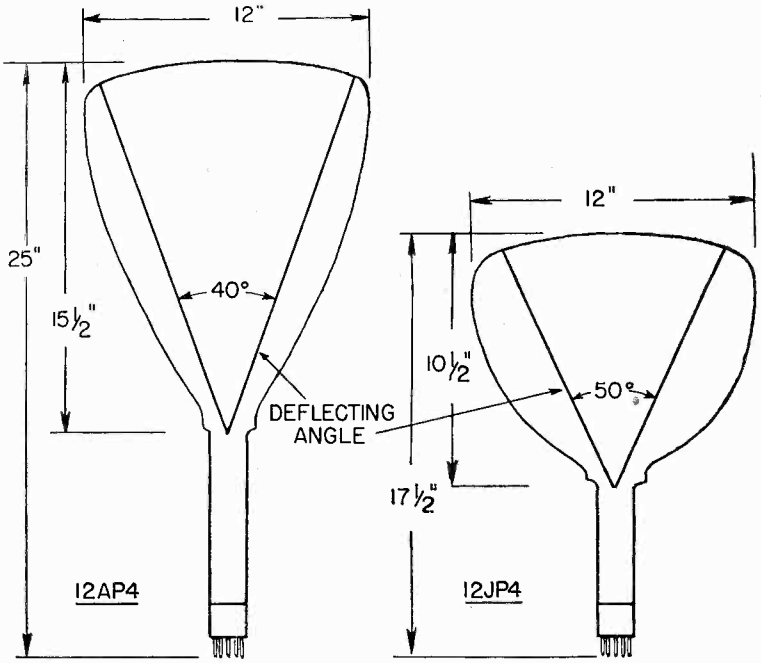


Fig. 8 Showing relative size and shape of old type 12AP4 and new type 12JP4 cathode-ray tubes. Though the screen diameters are the same, the new tube is approximately 7½" shorter.

Bulb Shape

A notable feature of modern magnetic tubes is the similarity in shape of the bulbs. The older type tubes had a 40 degree funnel angle

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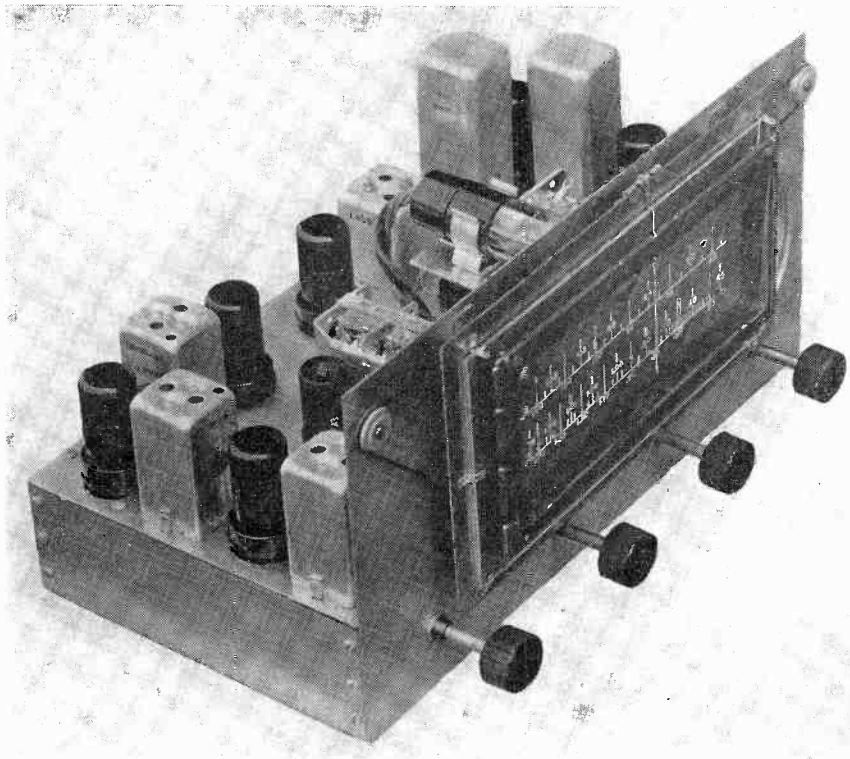

SERVICING FM RECEIVERS

by Milton Kaufman

The discriminator is the heart of the FM receiver. This article describes the principles of its operation.

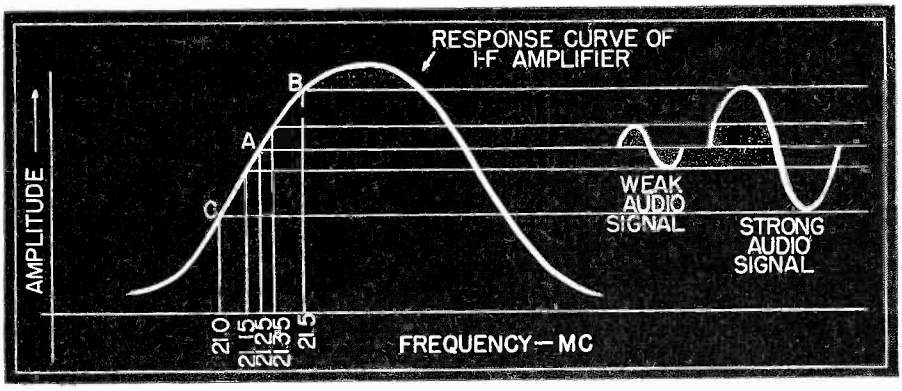

Fig. 1 How slope detection may be used to receive FM signals on an AM receiver. The frequencies shown are those used in the sound channel of a television signal.

IN order to detect a frequency modulated wave, it is necessary to have a device whose DC output voltage rises when the IF deviates in one direction, and falls when the deviation is in the other direction. Since a frequency modulated wave of a broadcast station deviates in exact accordance with the audio modulating signal, the variations in the output DC will be a reproduction of the modulating signal.

Slope Detection

Fig. 1 shows how frequency modulated signals can sometimes be received on an AM receiver. The signal is detuned so that operation takes place on the side of the receiver's response curve. This is done by simply tuning the receiver to the side of the incoming signal until the center frequency is located at point A. In this figure, the IF of the standard television sound channel is used for an example. Let us assume that we are on the low side of the response curve. Then, as our incoming signal deviates higher in frequency (toward B) the receiver output increases and deviation lower in frequency (toward C) causes a decrease in output. We have thus changed frequency modulation to amplitude modulation, and our AM detector will respond properly. This method is sometimes referred to as "slope detection."

Slope detection is seldom used for the following reasons:

1. The detector is not balanced like some other types and therefore does not reject AM noise or signals.

2. The side of a response curve can seldom be made linear and distortion results. This is especially true in connection with standard broadcast FM with its deviation of ±75 kc.

Because of the second point, slope detection is sometimes found in the less expensive television receivers; the television sound channel uses a deviation of only 25 kc as compared to the broadcast FM deviation of 75 kc. The frequencies, as illustrated in Fig. 1, are those of the television sound channel. To obtain *all* the noise-eliminating benefits of FM, however, it is necessary to use a circuit in which both a limiting and a canceling action against noise are provided. This is usually accomplished with a *discriminator*.

Coupled Circuits

To make the operation of a discriminator clear, it is necessary to review the simple relations among currents and voltages in a double-tuned IF coil, such as shown in Fig. 2, when both circuits are tuned to resonance. The following fundamental facts apply:

1. The resonant condition causes only resistance, and no reactance, to be reflected into the primary. The primary current I_1 will, therefore, be in phase with the primary voltage E_1.

2. The voltage across the secondary, E_2 is produced by means of a mutual reactance M, which results from the coupling between the coils.

3. Since this mutual inductance is a reactance, *the secondary voltage E_2 is 90 degrees out of phase with the primary voltage E_1.*

4. The secondary current, I_2, is in phase with the secondary voltage E_2, because of the resonant condition. *The secondary current is, therefore, also 90 degrees out of phase with E_1.*

Now suppose the secondary is center-tapped as shown in Fig. 3. If the center point is considered as a reference, we now have a balanced circuit, that is, the voltage across the upper half is 180 degrees out of phase with that across the lower half. Notice that with respect to the center point, E_x and E_y are equal but opposite in phase.

Effects of Deviation

Now consider what happens when the frequency of E_1 changes. Suppose the frequency suddenly becomes *higher*. Since we are now off resonance in the secondary, the parallel resonant circuit becomes capacitive causing the secondary voltage to lag behind the secondary current. This means that E_x is less than 90 degrees away from E_1, and E_y is more than 90 degrees from E_1. Although these phase changes have taken place, the size (no. of volts) of E_x and E_y are substantially the same as in the resonant case. If the frequency changes to lower than resonance, the situation will be reversed as far as phase is concerned. E_x will now have a phase angle of more than 90 degrees while E_1 and E_y will have an angle less than 90 degrees.

To summarize:

1. With a signal at the resonant frequency, (normally 10.7 mc), E_x and E_y are equal and opposite, each being out of phase 90 degrees with E_1 but in opposite directions.

2. When the signal goes higher than resonance, E_x and E_y are the same in magnitude, but with respect to E_1, the phase of E_x is less than 90 degrees, that of E_y is more than 90 degrees.

3. With a signal lower than resonance magnitudes are still the same, but E_x's phase is more than 90 degrees while E_y's is now less than 90 degrees.

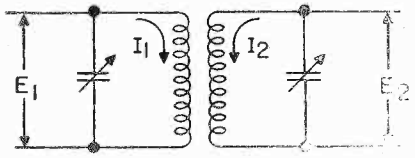

Fig. 2 A diagram of a double-tuned IF coil showing currents and voltages discussed in the text.

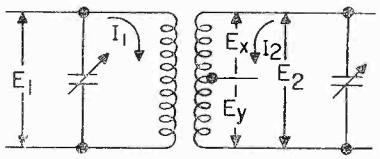

Fig. 3 Schematic of an IF coil with a center-tapped secondary winding such as used with Foster-Seeley and ratio discriminators.

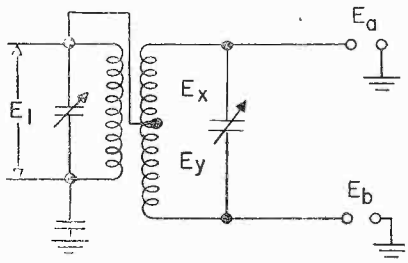

Fig. 4 Showing how two voltages E_A and E_B are produced for application to the plates of the diodes. E_A and E_B vary in magnitude as the frequency of the input changes.

Now suppose we arrange the circuit as shown in Fig. 4. The bottom of the primary coil has been grounded, and the top has been connected to the center tap of the secondary. Let us now investigate the voltage of the ends of the secondary with respect to ground. These voltages are labeled E_a and E_b. By tracing the circuit from the low side of the primary through the coil and then through one half of the secondary, it can be seen that at any given instant:

$e_1 + e_x = e_a$ and $e_1 + e_y = e_b$

At resonance, when E_x and E_y are each 90 degrees from E_1, E_a and E_b are equal. Under off-resonance conditions, however, the changed phase relations will cause one to be larger than the other. To clarify this, refer to Fig. 5.

In Fig. 5A, two voltages, E_m and E_n are plotted. They are equal in magnitude, but *less* than 90 degrees apart in phase. In Fig. 5B are the same two voltages plotted *more* than 90 degrees apart. In each case, the voltages are added, and the sum represented by the dotted line. These diagrams show that when the phase is *less* than 90 degrees, the sum is larger than when the phase is greater than 90 degrees.

The same principle applies in Fig. 4. When the frequency is higher than resonance, the phase angle between E_1 and E_x is greater than that between E_1 and E_y. E_a, the sum of E_1 and E_x, is, therefore, greater than E_b, the sum of E_1 and E_y. When the frequency is lower

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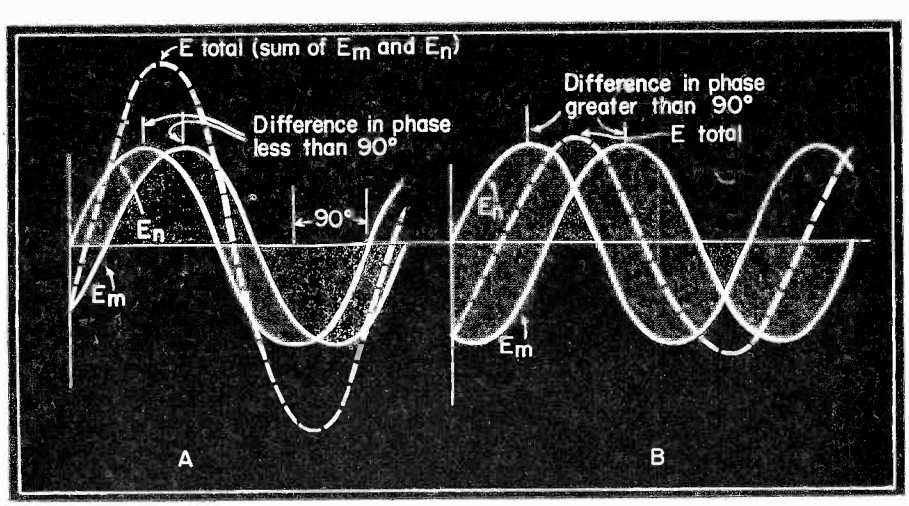
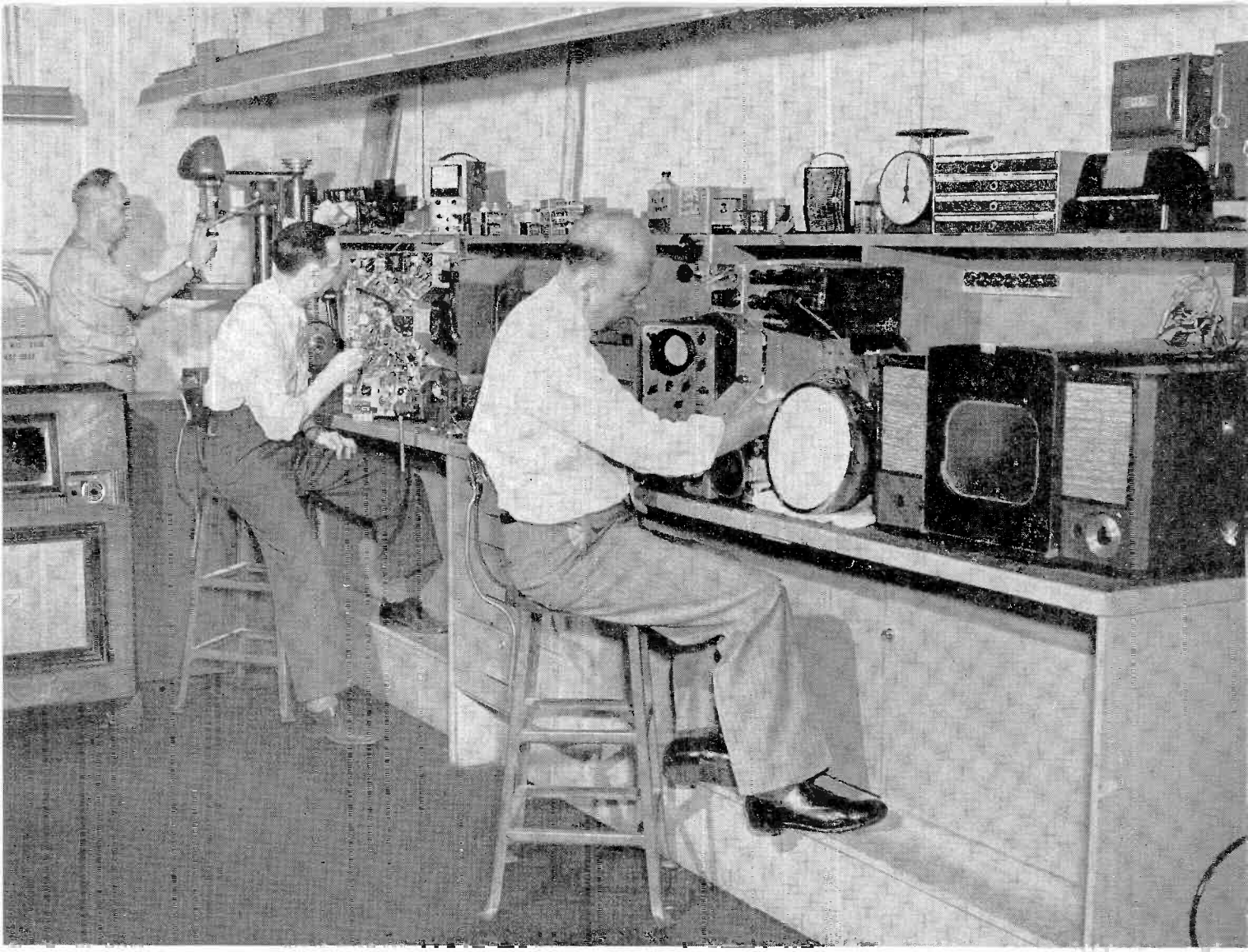


Fig. 5 Graphs of sine waves showing how two AC voltages can produce a sum voltage whose amplitude varies with a change of phase between them.



RADIO SERVICING IS BIG BUSINESS

How radio servicing developed from an obscure origin to the present level of over half a billion dollars of business annually.

by J. R. James

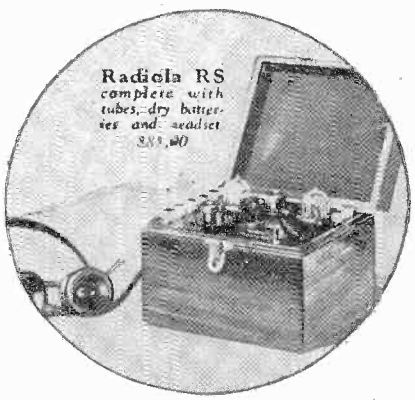


Fig. 1 One of the early commercial two-tube "bloopers."

THE origin of the first serviceman is obscure. No monument or memorial of any kind is left to his glory, and it is quite likely that he himself had no knowledge of the significant part he played. But we can speculate that Hertz, Marconi, and other early experimenters had assistants who were responsible for keeping "bugs" out of the equipment. After the first successful scientific experiments, the hearts of many adventurous souls all over the world were stirred by the possibilities of wireless communication and built their own receivers. Others built transmitters also and became the first "hams". The builder became a serviceman as soon as his equipment failed to operate. Gradually he learned more, not only about his own equipment, but also other types being used by his fellow hams and experimenters. It was not long before these pioneers were building additional sets for use in the homes of their layman friends.

Thus it was that the early serviceman was also a manufacturer. He had little trouble understanding the receivers he serviced because he had designed or, at least, built them. Gradually, as investors began to see the possibilities in the new field, capital was made available and radio receiver companies began to func-

tion. By the year 1925, several companies had begun to produce home receivers in quantity.

Yes, they *were* receivers, but only those of us who were in the game at that time can appreciate how remote is the resemblance to what we have today! Let us examine the characteristics of the "super-bloopers" which so excited us back in the twenties.

Regenerative Detectors

For the first few years of commercial production the regenerative detector was standard; it was followed by one or two stages of audio amplification. Tube types were no problem, since four or five covered all uses in all receivers. For instance, a typical receiver of the early twenties was the Radiola No. 2, which could be bought as a two tube job, and later it would be "boosted" to a three tube by means of an extra amplifier unit.

All operation was on batteries, the most common arrangement being two B batteries and one 6 volt storage battery to light the filaments of the most used tube—the "201A" (now listed as the'01A). So prevalent was this type that a couple of extra 201a's constituted full tube equipment on any ordinary service job.

For a while the regenerative detector's radiation characteristics became a real problem, especially in crowded city sections, where one was considered lucky to get through a program without loud whistling noises from the receiver next door.

Early Servicing Problems

What were the servicing problems of this period? As mentioned before, tubes were nearly all of one type. There were only detectors and audio amplifiers in sets and since the same type of tube performed both functions "swapping" any tube with any other tube was part of the regular service procedure. Volume was controlled by regulating filament current with wire wound rheostats, one of which was placed in series with each filament. Tube life was enhanced by this arrangement and the writer has seen a number of 201A's which are twenty years old and still in good condition. Thoriated tungsten was used for the filaments, so when emission became low they could be "reactivated". The reactivation process consisted

Fig. 2 One of the few crystal sets which were built commercially for home use is described in this advertisement, which appeared in 1922.

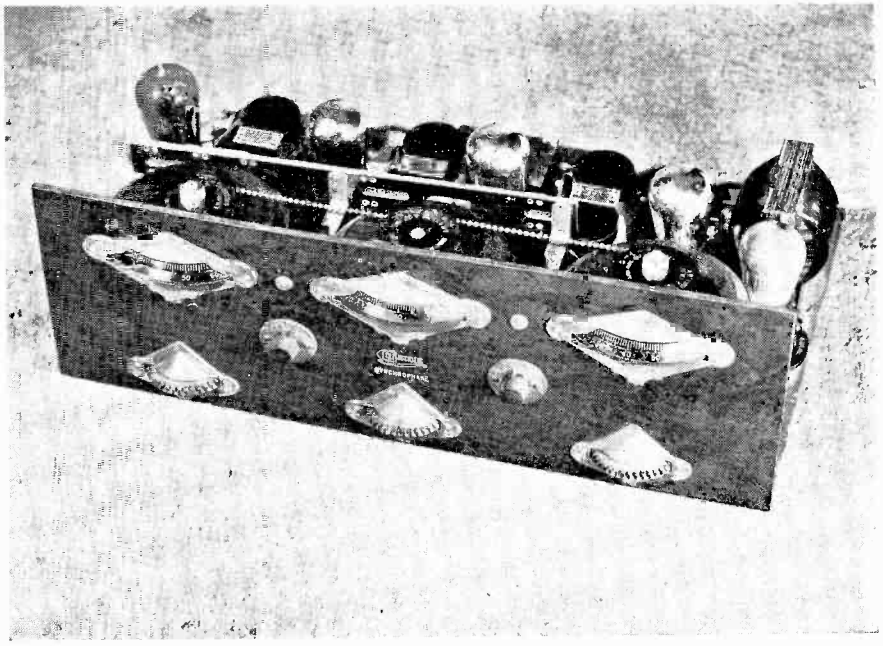


Fig. 3 The famous Grebe "Synchrophase," a battery-powered TRF receiver. This is one of the first receivers employing gang tuning, which was accomplished by a chain drive visible in the photograph.

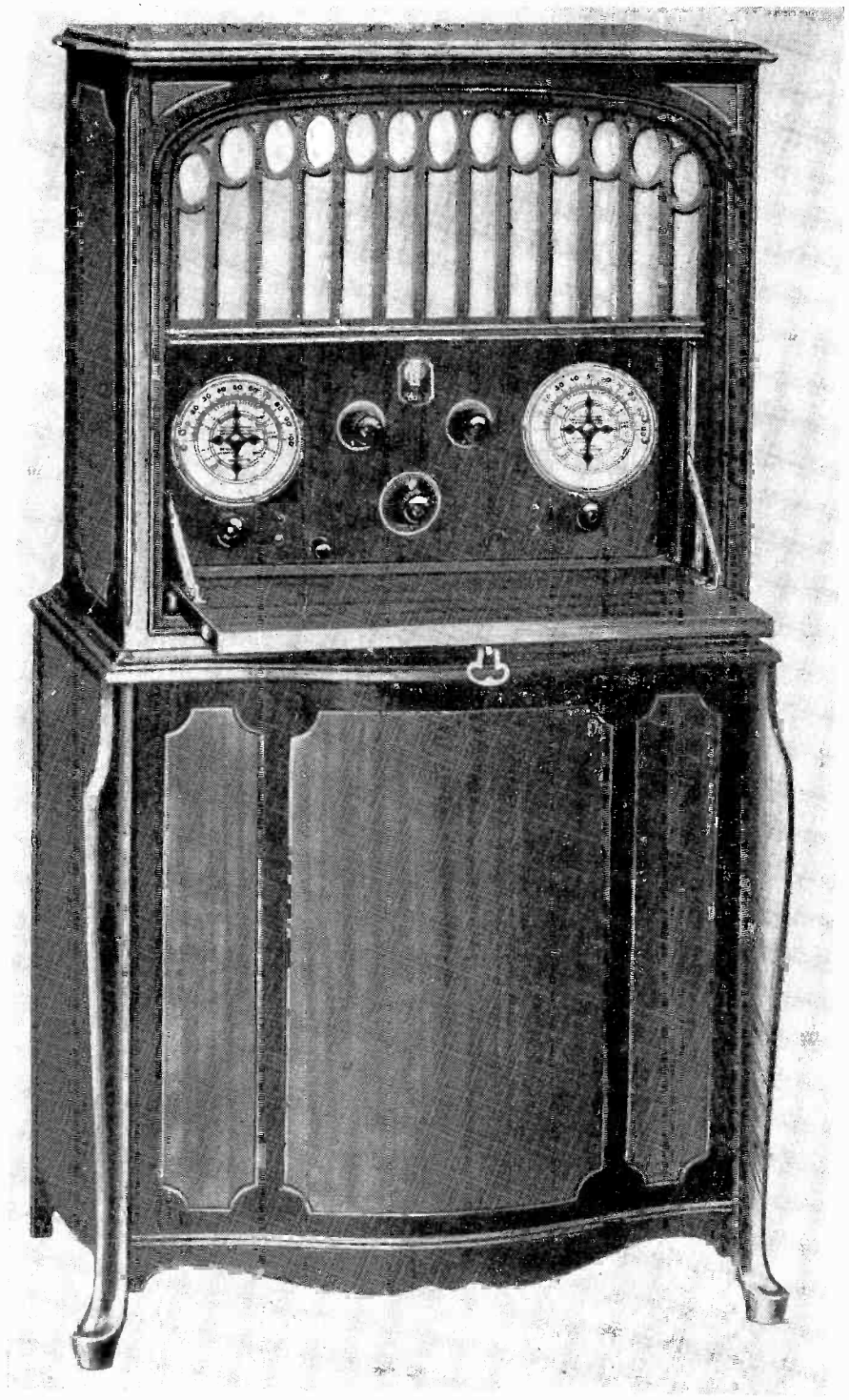


Fig. 4 This receiver, which was a product of about 1929, shows an early trend toward console models. Although two dial tuning was still being used, dial calibration had progressed to marking station call letters on the dial face.

of applying a small overload of AC voltage for a certain length of time. The voltage was then gradually lowered to normal and, when changed back to DC, produced normal emission again. Reactivating units were used extensively by early servicemen and many commercial models were sold.

The TRF Appears

While people were engrossed with such spectacular occurrences as the destruction of the dirigible Shenandoah and Lindbergh's epoch flight, mass production was developing into the radio receiver field. The TRF receiver was coming into its own; it rode in on the crest of the "roaring twenties" wave and took the radio receiver completely out of the experimental field and into the home.

Although a fairly large number of regenerative receivers had come into use, real mass production did not start until the TRF type came on the scene. The screen grid tube had not yet been developed, so early radio frequency amplifiers had to be neutralized to prevent oscillation. Several ingenious ideas were developed to provide this neutralization, of which probably Hazeltine's "neutrodyne" was the most famous.

The neutrodyne and other TRF circuits developed at about the same time made possible the use of more stable detectors, and the elimination of the noisy regenerative type. Probably stability was just as important a factor in its popularity as the added amplification provided by the RF stages. The writer will never forget the thrill of hearing an early TRF set for the first time; its relative sensitivity and quiet operation were, at that time, nothing short of amazing.

Growth of the Jobber

The serviceman now became an important factor as a separate individual instead of the combination serviceman, set builder and experimenter. During this period of radio market development the various elements forming the present structure of the industry began to appear. Certain servicemen were stocking quantities of parts for other smaller servicemen in the territory. These grew into jobbing houses. Others developed into servicing organizations and still others left service work for dealerships in appliances, radio, etc. The writer recently was reminiscing with Mr. Aaron Lippman, of the famous jobbing house which bears his name, about his early experiences as a serviceman and set producer. As early as 1922 Mr. Lippman was producing a radio of his own design, called the "Radiodyne". Later, when large scale commercial production started, service work took full time, and then the Aaron Lippman Co. was started. Today, Mr. Lippman is the owner of one of the largest and most "up-to-date" distributing houses in the country and is president of the Na-

→ To Page 26

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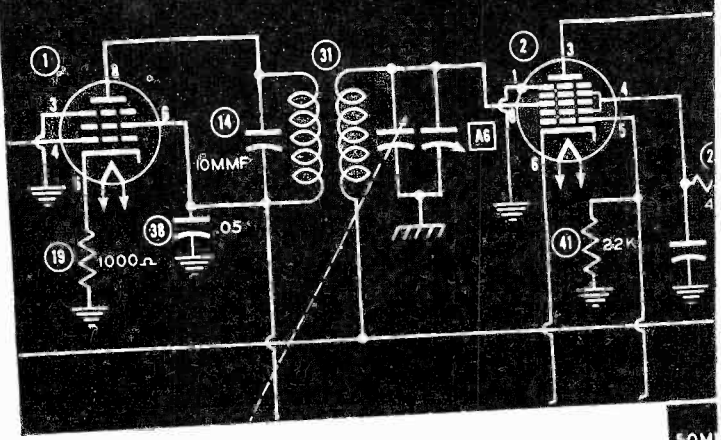

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Advent of AC Receivers

Although the advent of the TRF has been mentioned as the big factor in the beginning of mass production, and the development of the radio serviceman; it was soon followed by a change even bigger and more revolutionary, namely, the transition from batteries to the AC power supply. This transition was made practical by the development of the separately heated cathode, which eliminated the hum troubles which had previously retarded attempts to make AC sets. The AC power supply, coupled with the use of screen grid tubes opened the way for radios as we know them today.

The compactness provided by using screen grid tubes and rapid development of special types of separate cathode tubes allowed the superheterodyne to be produced in large quantities and eventually to outstrip the TRF. Multipurpose tubes like the 6A8 and the 6Q7 aided in this latter change.

Midget sets came into vogue during the early thirties and AC-DC types soon became numerous. People started to become interested in short wave and foreign broadcasts, increasing the demand for the "all-wave" type.

Need For Test Equipment

But what of the serviceman during this period? Gradually, through the early thirties he began to realize a growing need for test equipment. He found that he needed something more than a voltmeter, and that a tube tester could save him much time and expense. He also felt the need for a signal generator for the alignment of superheterodyne and all-wave receivers.

By 1940 the developments we have mentioned had placed him in a position in which he could no longer afford to be without a set of test equipment and still carry on a successful service business. The old battery "bloopers" had only one type of tube of which you could carry a spare or two, and troubles were simple enough to be located

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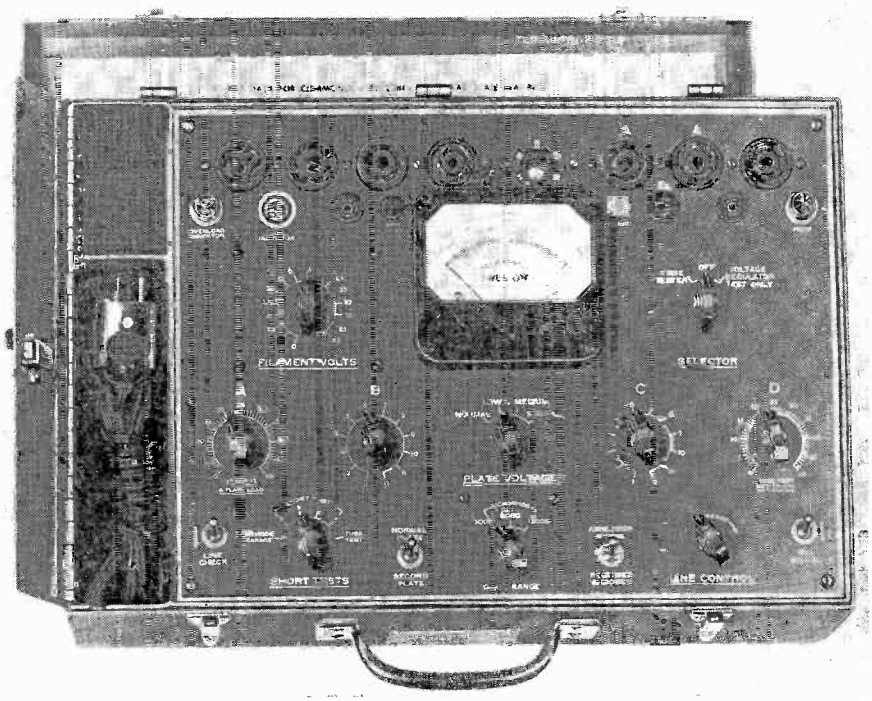

Fig. 5 Comparison between old and new models of tube testers. Above: An early tube and set tester popular when most tubes had only four prongs. Below: A late model tube tester with its many tube sockets and extra features.

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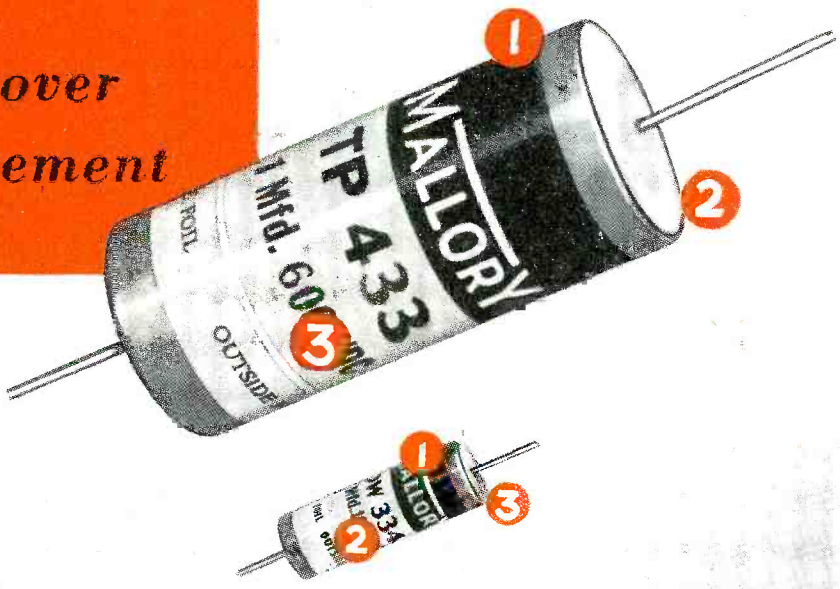

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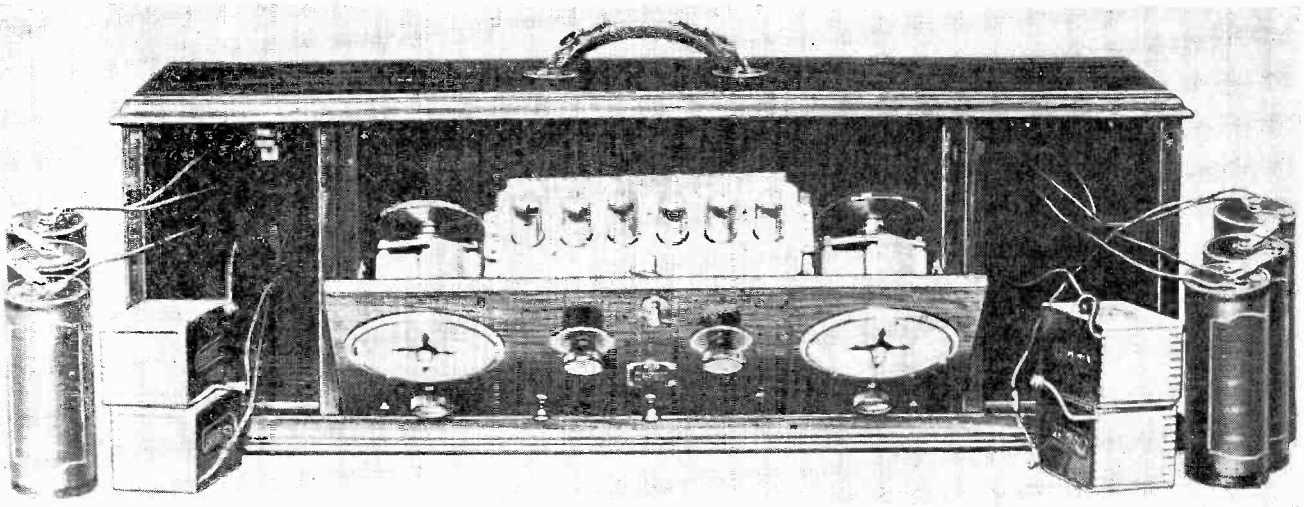

Fig. 6 A definite step forward was marked by the development of this Radiola battery powered superheterodyne.

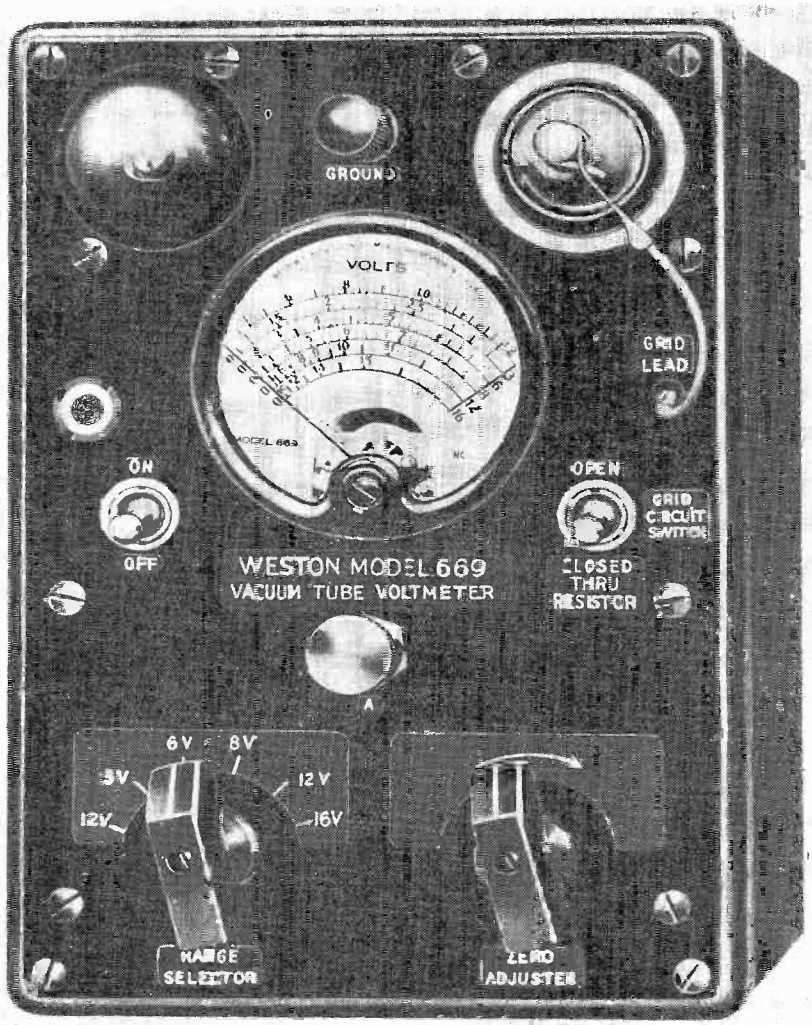

Fig. 7 An early voltohmmeter, product of the late twenties. Note that electronic types were already being used.

Servicing Is BIG Business

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with a piece of wire and a bulb or, more often, by simply *looking*. But now what a difference! Tube types had increased so rapidly you needed a tube manual to keep track of them. Most sets had all different types of tubes in them and the "swapping" method had become obsolete. Wiring had become very much more complicated, and a multiplicity of condensers, resistors, chokes and other paraphernalia were found where only audio transformers were before. More and more shops were installing a complete complement of test equipment. Frequency modulation receiver production was becoming a large volume business, and television was in the offing.

By 1942 one shop in New York, specializing in television maintenance, was earning over $25,000 a year.

World War II produced technological advances in every phase of radio, including AM-FM television and other consumer electronic devices.

Before the war most test instruments were designed as laboratory units and although very useful, they were expensive and often studded with adjustments and gadgets which were of no interest to the maintenance man. Today, the radio maintenance industry keeps 14 test equipment manufacturers busy producing over 100,000 test instruments annually.

The radio shop serves the public with over one-half a billion dollars worth of repair work and materials annually and buys over one hundred million dollars worth of renewal tubes, parts, etc.

Many new and important businesses serving the radio mainte-

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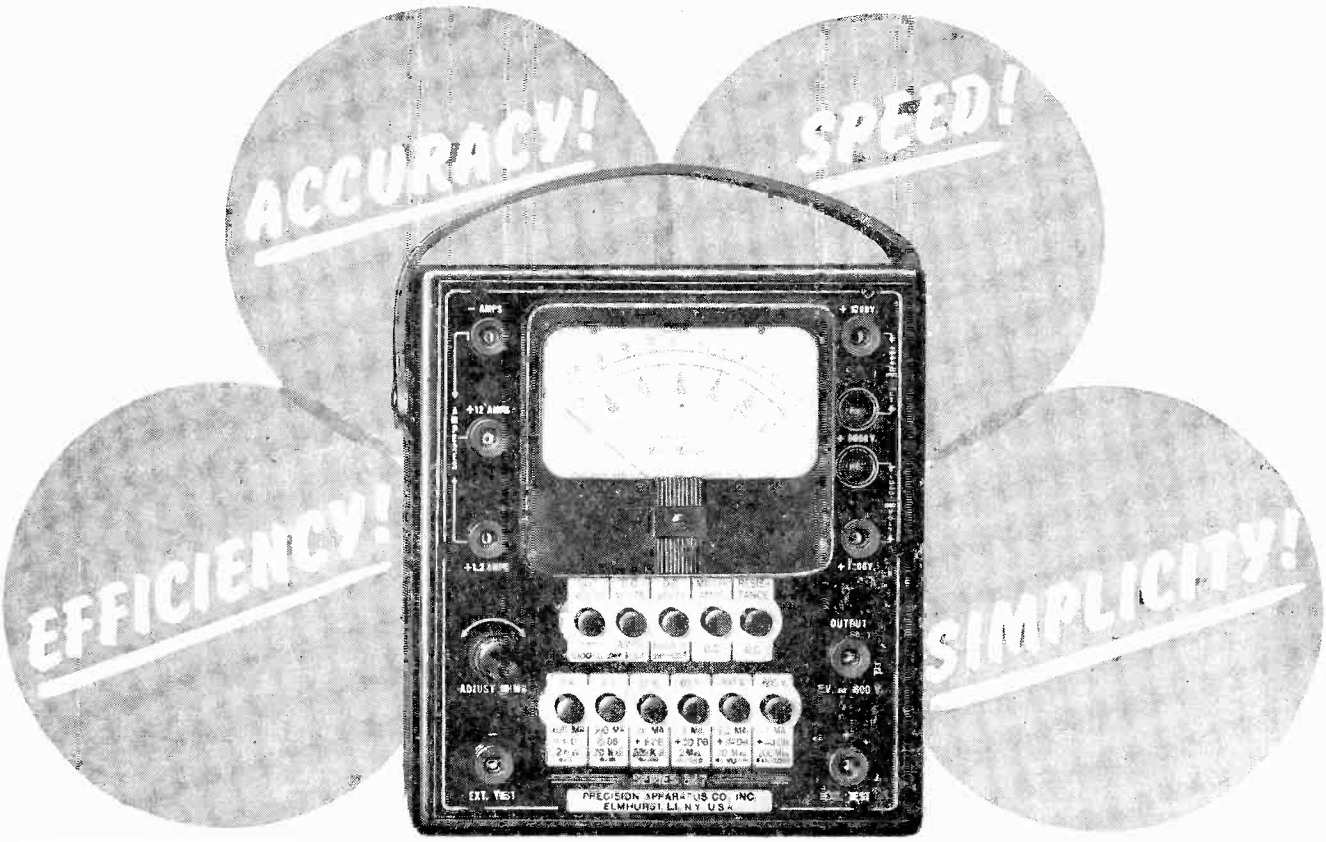

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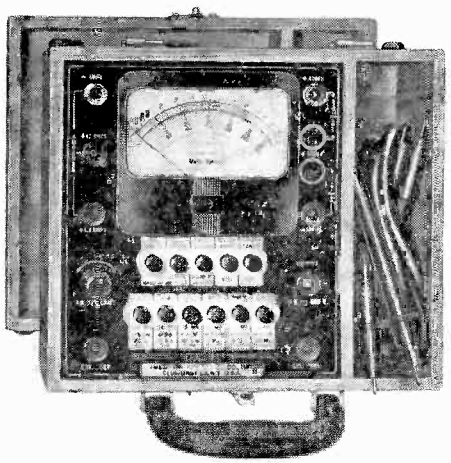

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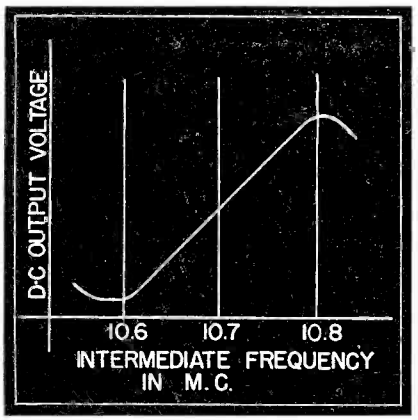

Fig. 7 Typical discriminator characteristic.

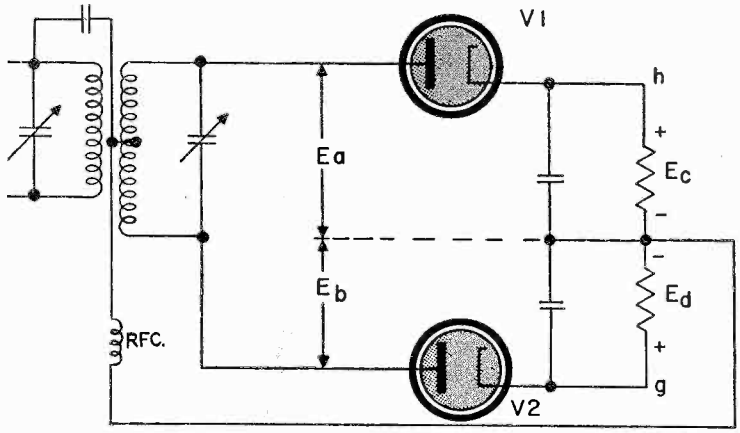

Fig. 6 Basic circuit of the Foster-Seeley discriminator. In practice, point g is usually grounded. Then the audio output appears at point h and AVC or tuning eye voltage can be obtained from the center tap of the resistor.

Servicing FM Receivers

→ From Page 21

than resonance, the opposite is true and E_a is less than E_b.

Another way to explain the above relations is by the use of vectors. Fig. 9 shows a vector diagram for each of the three important conditions described above. Notice E_a and E_b are made larger and smaller according to the phase of secondary voltage.

In Fig 6 we have applied the voltages E_a and E_b, which are AC to diodes V1 and V2, and our circuit now becomes basically a Foster Seeley discriminator. These AC voltages are rectified and filtered and produce the DC voltage E_c and E_d. These DC voltages are proportional to E_a and E_b respectively and have the polarities indicated on the diagram.

Now the discriminator output is the voltage between points g and h. Since E_c and E_d oppose each other, the total voltage is equal to the difference in magnitude and will have the polarity of the larger voltage. At resonance these voltages are equal and the total voltage (g to h) is zero. At a frequency higher than resonance, E_c is larger than E_d. The total output voltage will then be E_c minus E_d with h positive and g negative. When the frequency is lower than resonance, the polarity of the output will be reversed, and the voltage will be E_d minus E_c.

Thus when the IF changes above and below the resonant frequency, the discriminator output will vary in magnitude in the same way. This circuit is known as the Foster-Seeley type of discriminator.

Fig. 7 shows the characteristic typical of a good discriminator. The curve of amplitude versus frequency should remain straight (linear) for all frequencies within the deviation range.

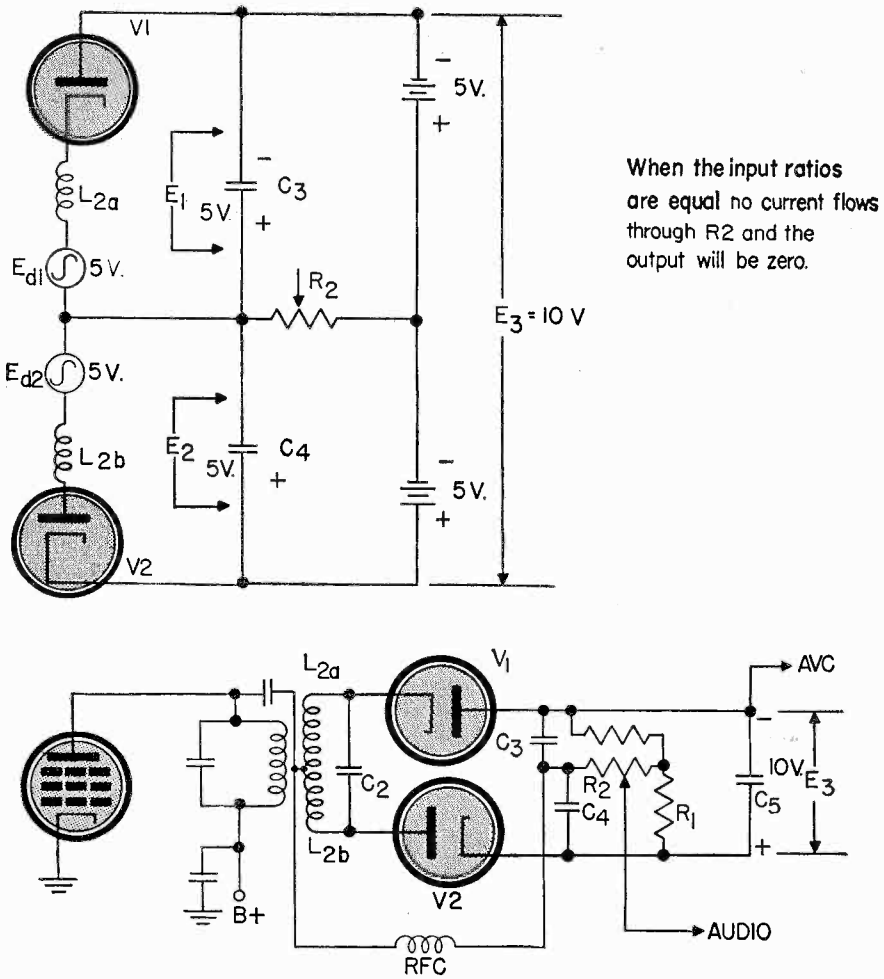

Fig. 8 The ratio discriminator. Below: Schematic diagram, Above: equivalent circuit discussed in the text.

Ratio Detector

In order to eliminate noise effectively, when a conventional discriminator is used, it is necessary to precede this stage with a limiter

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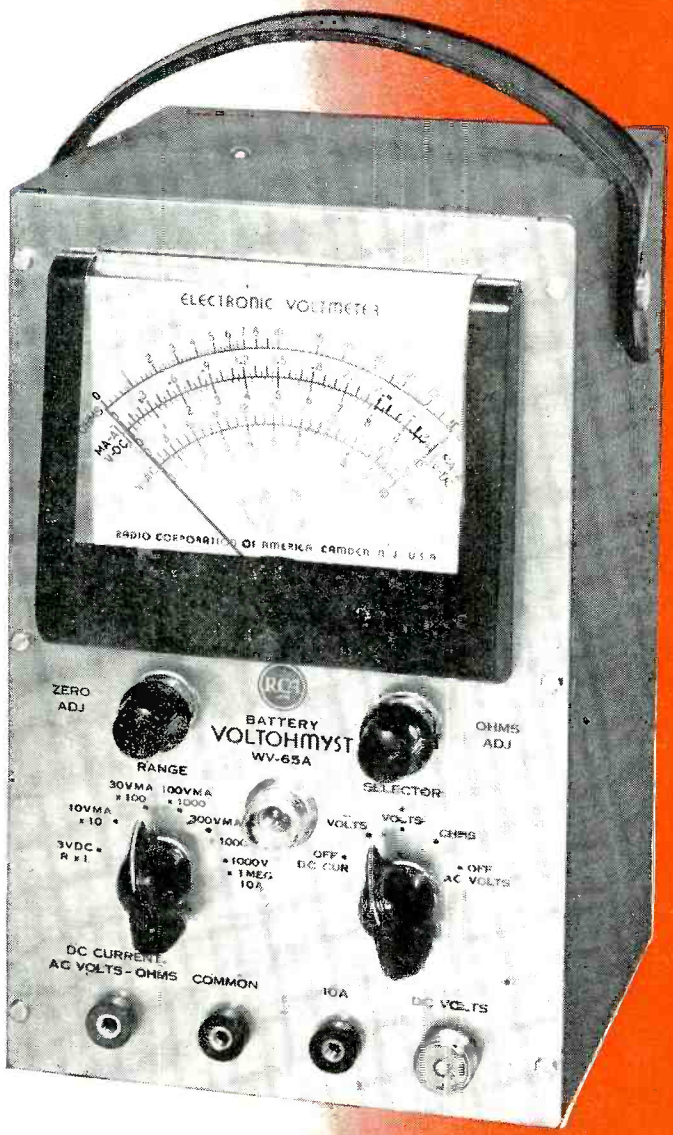

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and high gain IF stages, because the discriminator itself responds to amplitude variations unless previously "clipped" by the limiter. A circuit which demodulates FM waves without responding to amplitude variations, the *ratio detector,* is shown in basic form in Fig. 8A. The secondary circuit L_2C_2 is similar to that of the Foster-Seeley discriminator with a relatively high Q (about 200) being necessary for good design. Again we use the instantaneous sum of the two applied potentials E_{1a} and E_{xy}, although the diode V_1 has been reversed so that the diodes are now in series. When the FM wave is at the center or resting frequency, the potentials applied to both diodes are equal. When the FM wave deviates above resonance (10.775 megacycles), E_{d1} is greater than E_{d2} by some ratio, say 12 volts to 8 volts. When the FM wave deviates below resonance (10.625 megacycles) E_{d1} will be less than E_{d2} by a ratio of 8 volts to 12 volts. Thus, except at resonance, there always exists some ratio between the voltages applied to the two diodes. A detector whose output is made proportional only to this ratio, (which is changing at an audio rate), becomes independent of amplitude variations and does its own limiting. Such a device is the *ratio detector.* An equivalent circuit (Fig. 8) will simplify the discussion. The RC entwork R_1C_5 is connected in series with the two diodes, the direction of electron flow being such that the top of C_5 will be negative, and the bottom positive. The time constant of R_1C_5 is quite long, about .2 of a second, so that its potential remains relatively fixed even for the lowest frequency audio variations. Actually the charge in C_5 is a function of the average carrier strength. This potential is shown as a battery of 10 volts magnitude and tapped at the center (Fig. 8).

To this center point is connected one end of the volume control R_2. The other end of the volume control is connected to the junction of C_3 and C_4. While a fixed potential of 10 volts is used at this time, it must be remembered that this potential may vary slowly with changes in the average carrier strength. L_2 is shown in two sections with generators E_{D1} and E_{D2} representing the induced voltages for any given deviation of the FM wave. The conditions which must be present in this circuit are as as follows:

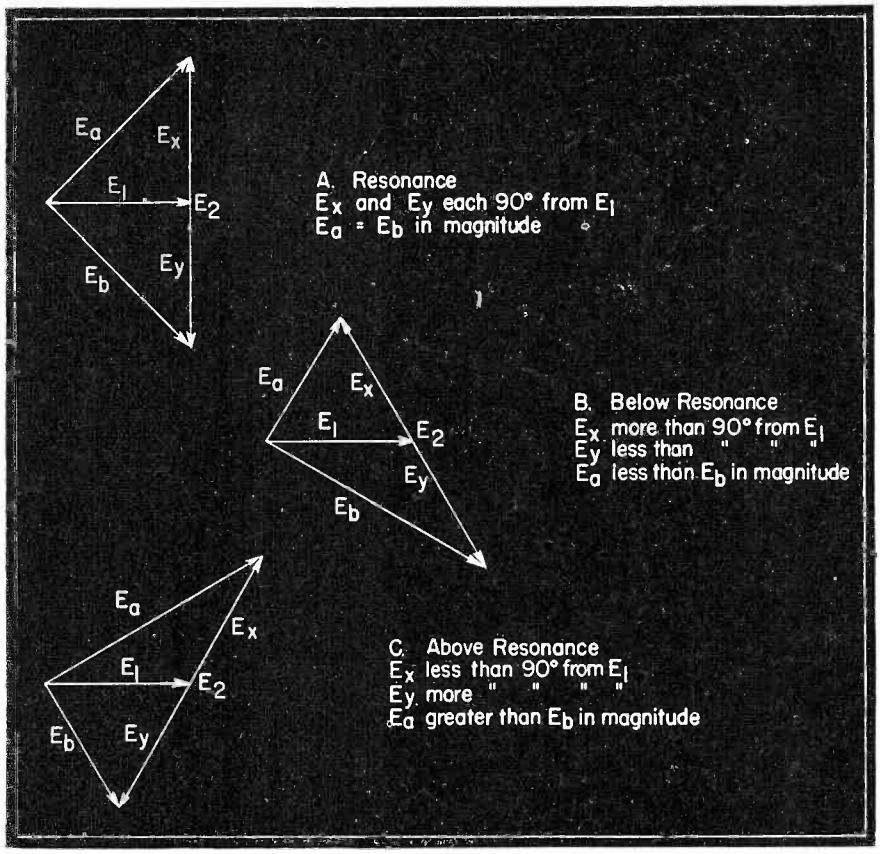

Fig. 9 Vector relations in the Foster-Seeley and ratio discriminators.

First, the ratio of E_{D1} and E_{D2} must equal the ratio E_1 to E_2

$$\frac{E_{D1}}{E_{D2}} = \frac{E_1}{E_2}$$

Secondly; the sum of E_1 and E_2 must always equal the charge in C_5, which is E_3.

$$E_1 + E_2 = E_3$$

Assume that

$$\frac{E_{D1}}{E_{D2}} = \frac{5}{5}$$

If no drop exists in the diodes, then

$$\frac{E_1}{E_2} = \frac{5}{5}$$

and no current can flow through R_2. Thus at the resting frequency of the FM wave, the DC output will be zero.

Going above resonance now, assume that

$$\frac{E_{D1}}{E_{D2}} = \frac{8}{2} = \frac{E_1}{E_2}$$

Under this condition current will flow through R_2, and the drop across R_2 will be 3 volts and positive at the junction of C_3 and C_4, thus producing the positive half of the audio cycle.

Deviating below resonance:

$$\frac{E_{D1}}{E_{D2}} = \frac{2}{8} = \frac{E_1}{E_2}$$

Current will now flow in the reverse direction through R_2 producing the negative half of the audio cycle.

In the rejection of amplitude modulation, the action is as follows. Suppose that a sharp increase in the carrier amplitude caused the ratio of

$$\frac{E_{D1}}{E_{D2}} \text{ to become } \frac{16}{4}$$

The ratio obviously remains the same but the ampltude has doubled. However, E_1 —E_2 remains fixed as determined by E_3, and the amplitude change can not take place. E_3 *tends* to get higher, but the time constant of R_1C_5 is made so large that noise pulses or amplitude modulation are too rapid to change this voltage. If the carrier level should

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FOR SALE — #260 Simpson ohm-volt meter, brand new, $35. Stanley J. Dembowsk, 1204 Ereerett St., Camden, N. J.

WILL TRADE 10-vol. sets of standard encyclopedia for R.C.A. or Simpson signal generator or similar type. Roy's Service, Route #2, Brigham City, Utah.

FOR SALE—National radio course, good condition, only $20. Or will trade for Instructograph. C. Sontare, 318 E. 124 St., New York, N. Y.

WANTED—Chanalyst, camera and condenser analyzer. Have 28v. D-C motors; various crystals and tubes, mikes, headsets, etc. Write for my trading list. J. Q. Crouch, General Delivery, Pocahontas, Ark.

FOR SALE OR TRADE—BC-348-A receiver, a-c operation, DX, $75.95; 2½" 'scope, $25; also various radio parts. Need sig. generator or tube tester. Write for details. Vincent De La Cruz, 3227 Mooheau Avenue, Honolulu, T.H.

SWAP—Complete I.C.S. course in industrial elec. engineering, mathematics included, plus Audels Handy Book of Practical Electricity in good condition. Want 3 Ghirardi radio books, Radio Physics Course, Modern Radio Servicing and Troubleshooter's Handbook or what have you? Louis Hermans, 2 Prospect St., Valley Falls, R. I.

WANTED—Good tube tester and small ac-dc radio. Will swap or sell Remington Shaver #28; Weston 0-100 milliammeter; Polar Cub elec. vibrator; Astatic D-9 pick-up arm with crystal and course in banking and finance by LaSalle Ext. University. D. N. Coble, 5423 Hyde Cir., Norfolk 2, Va.

SWAP OR SELL—Complete radio servicing course, cost $198. Will trade for radio diagrams or diagram manuals. Lloyd Bobo, 308 Riverside Ave., Canon City, Colo.

FOR SALE—New N.R.I. vacuum tube voltmeter complete with tubes, batteries and test probes. $15. Roy Musselwhite, P.O. Box 458, China Grove, N. C.

SWAP OR SELL—N.R.I. radio course for recording outfit exclusive of amplifier. Geo. R. Ferguson, 808 First Ave., Gadsden, Ala.

SWAP OR SELL—Brand new BC412 oscilloscope, 115v. 60 cy. for what have you? T. Nelson, Box 206, Wheaton, Ill.

SWAP OR SELL — Clough-Brengle sig. generator model OC, up to 30 mc., $20. A-1 condition, very accurate. 1935 and '36 Chevrolet radio model 600249 in good condition. New filters and vibrator. Built for running board ant. and works well. $17.50. H. Ray Boyer, P.O. Box 68, El Dorado, Texas.

WILL SWAP—Critical tubes of equal value for good tube tester. Have many hard-to-get numbers. Write for list. Hillis Radio Service, 6310 Williamson St., Dearborn, Mich.

SWAP OR SELL—Rotary converter 110v. d-c to 110 v. a-c 60 cy. 600 watts. Like new. Want record changer and speakers. Ralph Best, Box 894, 11 Oak St., Denville, N. J.

SELL OR TRADE—Model 850 sig. generator for 110 to 120 v. a-c operation. Want 3" scope. Ernest Overman, 450 Driver Ave., Durham, N. C.

WANTED—Electronic tester R.C.P. #688 or condenser analyzer bridge or modern tube tester. Have new Browning 16 ga. automatic shotgun with cowhide case, two automatic pistols, 25 01A tubes and #210 power tubes. W. F. Onder, Rt. #1, Box 330, Arnold, Mo.

SELL OR TRADE—Stromberg-Carlson 30-watt amplifier #20 less mike and speakers; one phono and 2 mike inputs. Lists $105, will sell for $30 or trade for sig. generator, 'scope, camera or what have you? Robert W. Lassell, 44 Oak Crest Rd., Needham 92, Mass.

FOR SALE—Precision #915 counter tube checker in original carton, practically new with latest roller chart. Also checks ballasts and batteries. Cost $84.41, will sell for $65. Al's Sales & Service, 727 State St., Schenectady 7, N. Y.

FOR SALE—RCA 167B test oscillator in A-1 condition, used about 2 weeks. Also old type tubes UX216B, 874, 876 brand new in original cartons. E. P. Mallandain, Box 696, Rimouski, Que., Canada.

FOR SALE—Precision 954P combination tube & set tester, 20,000 ohms per volt; Also Precision E-200 sig. generator. Guaranteed—used only for teaching purposes. Lair's Radio Service, Lock Box 144, Buffalo, Ohio.

FOR SALE—Warner Brush electroplater, industrial model P-M, $60 value, complete with nickel, silver, copper and gold compounds and anodes. Silver fine for recoating radio contacts. Full directions. $30. Heins Radio Service, Clara City, Minn.

FOR SALE—Presto Recorder D7, overhead drive, with mike and stand. United Research Laboratories, 1650 Broadway, New York 19, N. Y.

FOR SALE—New tubes: 3526G, $1.80; 25AC5G, $2.20; 25A7G, $2.20; 32L7GT, $2.65; 39/44, 50c. Discounts up to 40% to reduce large stock. May have just the tube you need. Ben's Radio Service, North Tonawanda, N. Y.

FOR SALE—5 ea. Thordarson T-60S48 matching transformers; 500 ohm line-to-voice coil with 7 taps for var. voice coil matching. Also 2 Universal output trans. 3 taps on pri., 6 on sec., $12 for all 7—and guaranteed. Leo Pfauth, Vinsons Amusement Service, Chillicothe, Mo.

FOR SALE—Superior #650 sig. generator, almost new, A-1 condition, $45. Russel Gustafson, % Lake Electric Shop, Titonka, Iowa.

FOR SALE—Master analyst, #504, made by Radio City Products Co. Complete with plug and adapters. Never used. Cost $15. Stevens Radio Shop, Raymond, N. H.

FOR SALE—Rider manuals VII, VIII, X, XI, XII, XIII in new condition. $65 postpaid. Still fully used test eqpt. at big saving. T. H. Thomas, 502 W. Broad St., Freeport, Texas.

FOR SALE—Supreme Vedolyzer complete with all cables and instructions. Used very little. $120. Also have 100 new tubes, mostly scarce types, list over $200, will sell for $50. Write for list. Victor Dudley, 517 7th St., Franklin, Pa.

FOR SALE—Used radio books postpaid: Math. for Elect. and Radiomen—Cooke, $2.25. Cathode Ray Tube at Work — Rider, $2; Inside the Vacuum Tube — Rider, $3; Aircraft Radio—Morgan, $1; Aircraft Servicing — Page, $1.25; High Frequency Techniques — Brainerd, $2.50. S. Marzycki, 1308 W. Rodedale, Chicago 40, Ill.

FOR SALE—Superior #450 tube tester compl. with all charts. Excellent condition, used only 60 days. Will sell for $30 or trade for what have you? Also have old style tube tester for sale or trade. Write for details. George Lyon, Martin Radio Service, Martin, So. Dak.

FOR SALE—Model CA-11 signal tracer, like new, $12.50. W. H. Post, Shavertown, Pa.

WANTED—Thordarson T75R50 power and T19P59P and T19P62 plate transformers. Must be in new condition. Also want pair of HK-254 tubes. Eddie Howell, 501 W. Harden St., Graham, N. C.

WANTED—Instruction book on SCR-522-A; Nov. '46 issue of Radio News and May '46 issue of CQ. G. A. Wheeler, 3801 St. Bernard St., Houston 4, Texas.

WANTED—Used 7- or 8-watt amplifier, not necessarily in working condition, with or without mike and speaker. Wayne Schmidt, Wrightstown, Wisc.

WANTED—Burned out transformers of any kind, larger sizes preferred. List sizes, weights and original ratings if known. State price. Will pay cash or trade for misc. radio eqpt. H. Z. Lehman, W7KYD, 3014 Hoyt, Everett, Wash.

WANTED—Rider Manuals, any or all of the volumes from I to XV. A. R. Twiss, "Radiolab", Lyndhurst Ave., London, N. 12, England.

WANTED—Capacitor tester from .00001 to 200 mfds. or to 600 mfds. Any condition. Brad's Radio Service, 122 Morgan St., Suffolk, Va.

WANTED—6A5G tubes in original cartons, Sylvania, KenRad, etc. H. L. Chadbourne, 238 Gravilla St., La Jolla, Calif.

WANTED—Philco chassis No. 37-60 with or without speaker or cabinet. J. A. Collins, 2632 Washville St., Pittsburgh 4, Pa.

WANTED—Rider Manuals vols. 2, 4, 5, 6 with indexes for vols. 4, 5, and 6. Must be reasonable condition with no pages missing. Fred M. Merrill, Box 92, Callicoon, N. Y.

YOUR OWN AD RUN HERE FREE

The Sprague Trading Post is a free advertising service for the benefit of our radio friends. Providing only that it fits in with the spirit of this service, we'll gladly run your own ad in the first available issue of one of the six radio magazines in which this feature appears. Due to the large number of ads received, it is not always possible to have them appear as fast as we would like to.

Write CAREFULLY or print. Hold it to 40 words or less. Confine it to radio subjects. Make sure your meaning is clear. No commercial advertising or the offering of merchandise to the highest bidder is acceptable. Sprague, of course, assumes no responsibility in connection with merchandise bought or sold through these columns or for the resulting transactions.

Send your ad to Dept. RM-97

SPRAGUE PRODUCTS COMPANY, North Adams, Mass.
(Jobbing distributing organization for products of the SPRAGUE ELECTRIC COMPANY.)

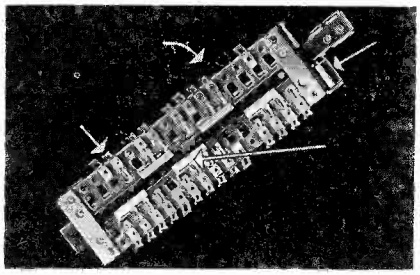
THE INDUSTRY PRESENTS

CONTROL AND SWITCH KIT

A new kit of controls, known as the Junior Control Cabinet has been introduced by the International Resistance Co., 401 N. Broad St., Philadelphia. This kit is an assortment of nine 1/2, 1 and 2 meg. controls plus four switches and four special shafts. The assortment is factory-packed in a cardboard cabinet finished in blue, yellow, and silver. The four drawers with twelve compartments are individually identified.

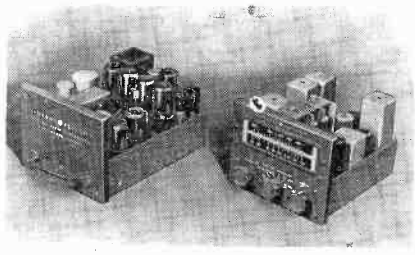
HIGH FIDELITY SPEAKER

Altec Lansing's new two way speaker with a multicellular horn reproduces the entire FM range of 50-15000 cycles per second. Distortion and intermodulation are minimized, and a wide angle of high frequency distribution is provided by the design of the high frequency horn. For complete technical information write to Altec Lansing Corporation, 250 West 57 St., New York 19, New York.



FM-AM SWITCH

A slide switch for use in FM-AM receivers and for similar applications is being produced by Centralab division of Globe Union, Milwaukee, Wisconsin. Available with or without index, this unit can be obtained in any length from a minimum of 5 clips per side to a maximum of 20 clips per side. Complete technical data on this unit are contained in bulletin #953 issued by the manufacturer.



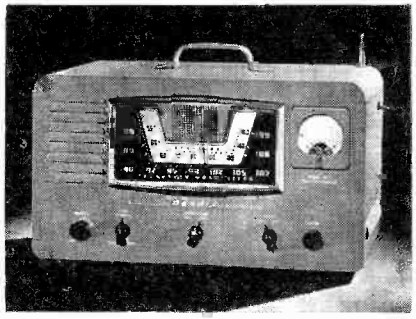
TWO-WAY RADIOPHONE

A new two-way Flying Radiophone, Type AS-1C, with an overall length of 9 1/2 inches, has been made available by the Transmitter Division of General Electric Company's Electronics Department.

Operating directly from a 12-volt power system, the AS-1C weighs 12 1/2 lbs. Features of its receiver, which functions at frequency ranges of 200-420 kc and 500-1500 kc, include automatic volume control, a directional loop antenna arrangement, and a voice filter.

The transmitter operates at 3105 kc, crystal controlled, and furnishes 12 watts carrier output.

Further details on the newly announced AS-1C may be obtained by writing the Transmitter Division, General Electric Electronics Department, Syracuse, N. Y.



FM SIGNAL STRENGTH METER

The Factometer, an AC operated portable AM-FM receiver equipped with a signal strength meter, is a product of the Bendix Radio Division of Bendix Aviation Corporation. It is completely self-contained, including a telescoping antenna. With this instrument, relative field strengths of signals can be determined by readings on the meter and most favorable locations for FM receivers can be ascertained. "Dead spots" in certain parts of houses can thus be avoided. The Factometer can also be used for general FM demonstration purposes.

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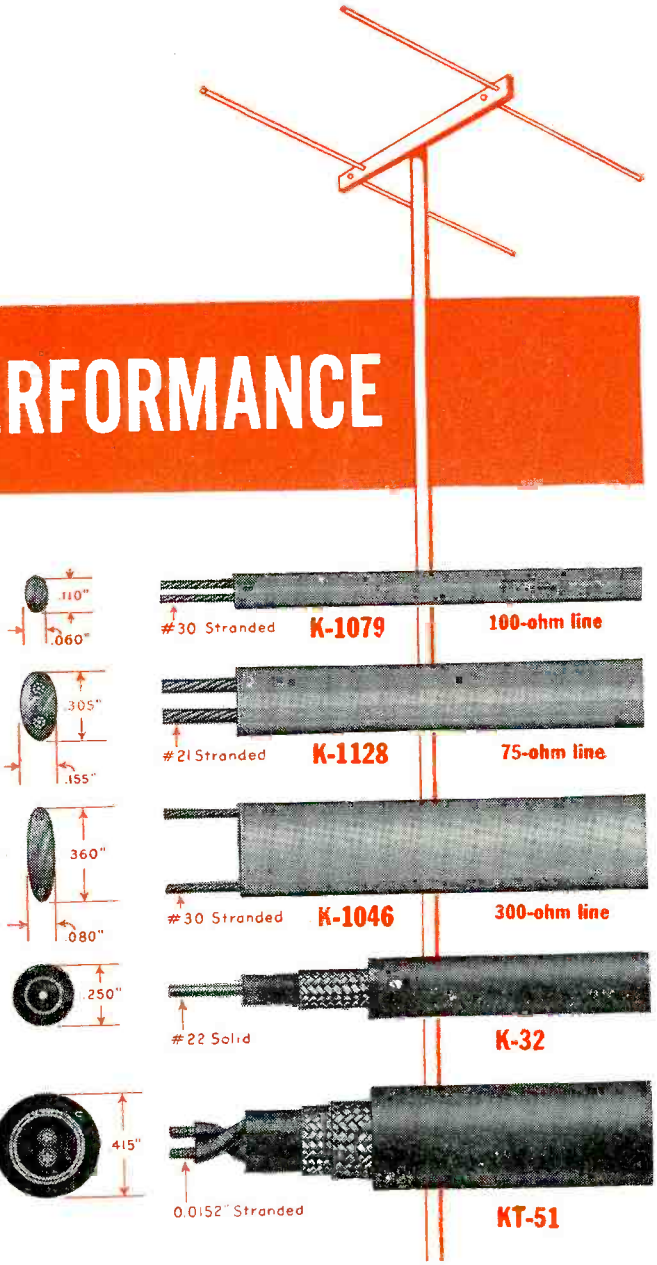
Here's Why Your Antenna Installations Will Give

LONGER-LASTING PERFORMANCE

with Federal's Intelin® H-F Transmission Lines



1. **Their unusually low attenuation losses assure the most efficient transfer of energy between antenna and receiver or transmitter.**
2. **Their uniformity and permanence of characteristics permit peak receiver performance, without annoying distortion from locally-induced interference.**
3. **Their flexibility and outstanding resistance to weathering, moisture and abrasion contribute to years of trouble-free service.**

IN THE FIVE ITEMS listed here, there's a high-frequency cable for practically every antenna application. The K-1128 75-ohm line, for transmitter use—the K-1079 and K-1046 lines for general FM and Television service. The smooth oval cross-section of these 75, 100, and 300-ohm lines prevents the accumulation of foreign matter, thereby maintaining stable capacity characteristics. The K-32 and KT-51 coaxial cables offer peak performance for applications where locally-induced interference is severe.

For complete information and prices on these cables, see your local distributor. For other high-frequency cables —write to Federal, Dept. D-182.

DATA FOR FEDERAL H-F CABLES

Type Number	Characteristic Impedance Ohms	Velocity of Propagation (in percent)	Capacitance Per Ft. mmf	Attenuation, Db per 100 Ft. Frequency in Megacycles				
				1.0	1.7	30	100	300
K-1079	100	71	15.5	.6	.75	2.8	5 2	8.8
K-1128	75	71	19.5	.3	.4	2.0	4.0	7.3
K-1046	300	81	4.0	.38	.57	.85	2.0	—
K-32	73	66	22	—	—	2.0	3.8	7.0
KT-51	95	66	16	—	—	1.8	3.8	7.5

*Reg. U. S. Pat. Off.

KEEPING FEDERAL YEARS AHEAD... is IT&T's world wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N. J., is a unit.

Federal Telephone and Radio Corporation

SELENIUM and INTELIN DIVISION, 1000 Passaic Ave., East Newark, New Jersey

In Canada: — Federal Electric Manufacturing Company, Ltd., Montreal.
Export Distributors: — International Standard Electric Corp., 67 Broad St., N. Y. C.

the Organizations

In the last few years, there has been a marked increase in organizational activity in the trade. Feeling that the reader would like to know more about the organizations and their activities, Radio Maintenance is inaugurating this column containing correspondence received from servicemen's organizations. If you are a member of an organization, we would like to hear about the activities of your group.

THE Associated Radio Service Dealers of Columbus, Ohio, break into our column for the first time with the following letter (the first of many letters we hope) from J. P. Graham: "You will find enclosed the June issue of the Associated Radio Service Dealer's News. The News is issued monthly about the 20th, so to arrive half way between meetings, which are held monthly on the first Wednesday evening of the month. The News is always of three or four pages along the line as is reflected in our June issue. The writer is the Editor and has been since the ARSD News first saw the light over three years ago.

Our present President is Lou Riebel, owner of Riebels Appliance Store of Columbus. Our organization was formed on November 11, 1943, exclusively for service dealers, in other words self-employed or owners of service stores and membership is by invitation only, thus assuring a control of the type of dealer members. Servicemen employees cannot become members, but are invited to all technical meetings. All servicemen are invited (both in and out of the organization) to every technical meeting. You will note the announcement of the coming technical meeting in our ARSD News.

The Associated Radio Service Dealers are incorporated and include in their membership practically all the best and the largest service organizations in Columbus. All parts jobbers are associate members as well as several radio set distributors. These jobbers pay the same dues that any member pays, that is $24.00 a year.

Each monthly meeting is started with a good dinner, of which the ARSD pays $1.00 toward the cost for each member. Each quarter we hold an Associate Jobbers meeting at which time all the jobbers attend the dinner at no cost to them.

With few exceptions we have experienced wonderful co-operation of our parts jobbers, particularly in eliminating selling across the counter to those not in the trade and selling these fellows at wholesale prices. Right now we are circulating petitions among all service organizations in the town suggesting that the jobbers restrict trade discounts to the trade. We are experiencing wonderful co-operation from the non-members in the signing of the petitions.

We have had, for over two years, co-operative weekly advertising of the type you will note by the enclosed copy; we have now discontinued this type of advertising and are having erected seven of the reflector type billboards on the main roads to the approach to our city. ARSD had a booth at our State Fair last year, and right at a time when you could not buy a radio, we gave several away. The booth was laid out with complete shop testing equipment, which was furnished by one of our Associate Jobber members.

As you will note, our annual ARSD picnic will be held on the third of August. Over 125 attended our first picnic last year, and we expect at least 150 this year.

Each of our members display our 'Certified' Radio Service Dealer insignia and all of our advertising is built around it, so that those re-

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Servicing FM Receivers

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suddenly drop, the potential E_3 would still be maintained, and this drop would not appear in the output.

Since the potential across C_5 varies with the average carrier strength, it serves as an excellent source of AVC voltage.

An important advantage is the fact that there is no "threshold" effect in the ratio detector; that is, there is no minimum carrier level necessary to cause noise attenuation as with limiter circuits.

The Organizations

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quiring service will readily identify a member.

We have just 33 members, quality not quantity is what we are trying to obtain. But if the number of members may seem small to you, it represents one out of every three service organizations listed in the Columbus Telephone Directory, and you must remember our organization is strictly for radio service dealers, the owners of the business.

Wishing you success with your splendid magazine, which the writer has subscribed to, through our store, since the very first issue."

J. P. Graham, Editor
Associated Radio Service Dealers

A report from the **Associated Radio Service Men of Central Pennsylvania** follows:

"At our regular business meeting on June 3rd, we elected the following officers for the coming year. They take office on July 1st.

Gordon Phipps, President.
Louis Steffan, Vice-president.
A. R. Guild, Treasurer.
Carl W. Smith, Corresponding Secretary.
John Barsophy, Recording Secretary.

The Secretary of the Federation of Radio Servicemen's Associations of Pennsylvania—Art Guild—told us some of the plans for the forthcoming convention of radio service-

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The Organizations

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men in Philadelphia this September. All of us are looking forward to this event as a sort of milestone."

John Barsophy, Secretary

"A delegation of members of the Vancouver section of the **Associated Radio Technicians of British Columbia** motored to Chillawack on Wednesday, June 4th to attend an organization meeting at the Empress Hotel for the purpose of forming a Fraser Valley Branch of the A.R.T. of B.C.

The large attendance of Radio Technicians included representatives from every Fraser Valley business district from White Rock to Hope. The discussions showed all are keenly interested in placing the radio repair trade on the highest possible level of reliability and efficiency by co-operating in good fellowship, by identifying the honest and competent through their association with the A.R.T. and at the same time encourage the beginner to improve himself in the use of modern methods and fairness, thus protecting the radio owner from exploitation by the incompetent and dishonest.

The employer also gains as he has an authoritative body to gauge the competence and ability of his staff or those he may desire to employ in the future.

Al Johns, Pres. of the Vancouver A.R.T. welcomed the gathering and called on Fred Stucky to introduce the groups to each other; Wilf Munton recalled some of the accomplishments of the association since its foundation in 1929 (and consequent incorporation under the societies act in 1934) and outlined a few of the aims and objects by reading excerpts from the constitution; Bill Filtness described the methods used by the examining board to grade the members; Monte Lennox explained the treasurer's view of the financial angles of the association.

After a very active discussion Jim Fraser of Abbotsford was elected Secretary pro-tem till June 16th when a meeting is planned to

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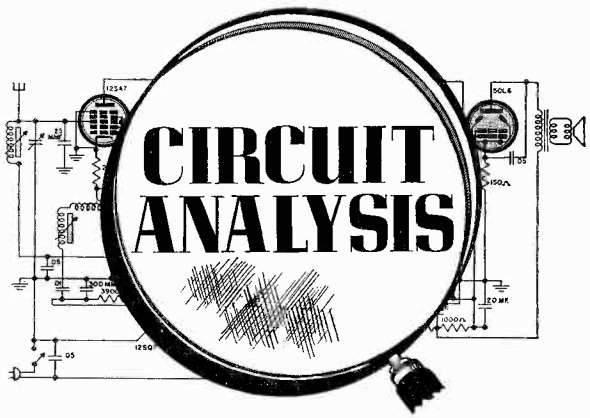

by
J. Richard
Johnson

Next we present an analysis of the Buick model 980744-5 which is typical of good quality automobile receivers. It will be noticed in the schematic that all coils used are equipped with adjustable slugs. A ganged permeability (slug) tuner provides the tuning and tracking. Slugs S1, S2 and S3 are mechanically connected in the tuning unit to provide this tracking.

Impedance Coupled RF Stage

A combination resistance and impedence coupling is used between the RF and mixer stages. A schematic of this section is given in Fig. 3. Up to the mixer grid resistor R2, ordinary resistance coupling is used. But between the top of this grid resistor and the grid itself we find a parallel tuned circuit. The voltage between point A and ground, which is the RF output of the 6SK7, appears across C1, since the other side of this condenser goes to ground. But this condenser is also a part of the tuned circuit. The RF voltage is thus injected into the resonant circuit, which builds up a relatively high voltage on the grid for the desired signal.

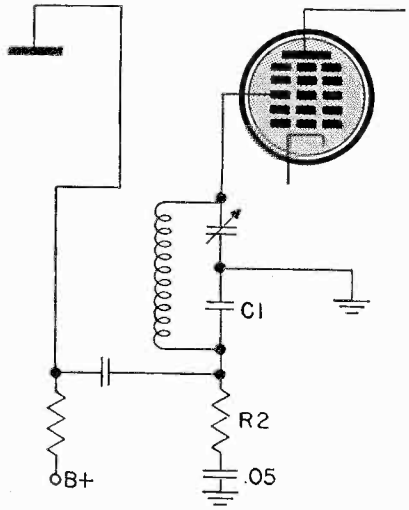

Fig. 3 Impedance coupling used in the RF section of the Buick Model 980744-5.

The oscillator circuit of this receiver is a little unusual, as shown in Fig. 4. At A we see the usual "tapped coil" type of oscillator circuit and at B is type used in this receiver. At A, even though there is only one coil, notice that it is divided into two parts with the cathode tapped between them. The part from a to b is effectively between

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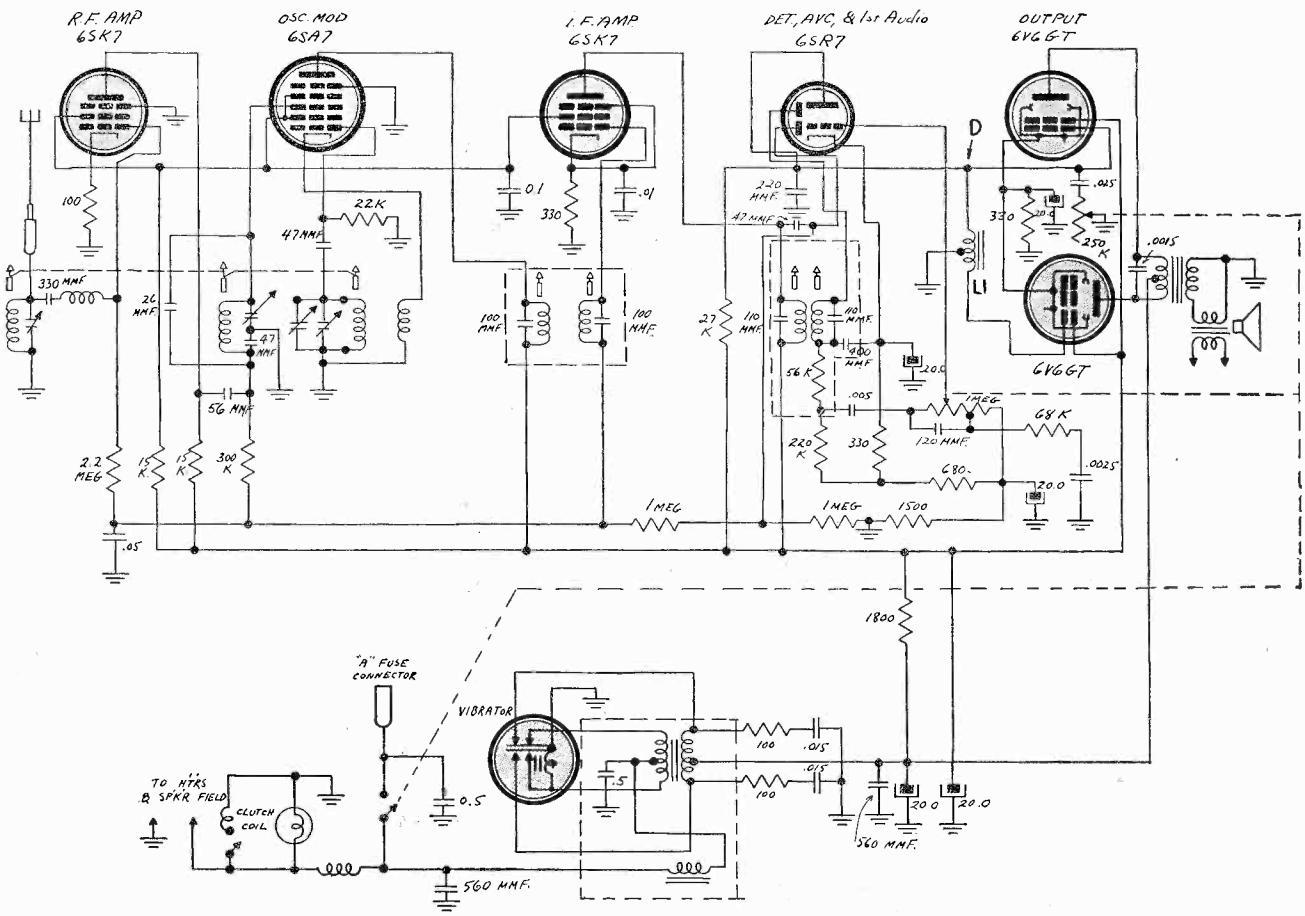
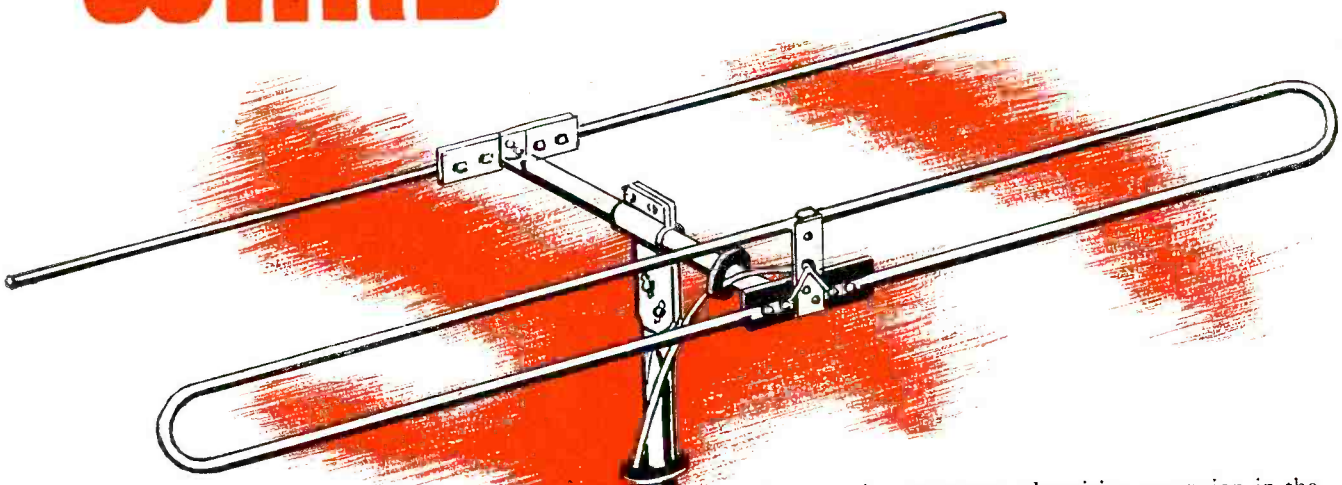


Buick Model 980744-5

WARD sets the stage



–for a "boom" in FM and Television aerial sales

An intensive consumer advertising campaign in the Saturday Evening Post and leading newspapers is convincing millions of present and prospective FM and Television set owners that:

(1) *Quality reception is difficult, if not impossible, without a good outside dipole antenna.*

(2) *Ward "Magic Wand" FM and Television Aerials offer the finest FM and Television reception at modest cost.*

Alert radio dealers are finding this campaign exceedingly helpful in creating extra sales and profitable installation jobs. In addition these dealers are winning satisfied customers who can now enjoy the true beauty of FM or television reception.

Available in straight or folded dipoles for both FM and television bands (reflector kits available), Ward "Magic Wand" Aerials are products of the world's largest makers of aerials for car and home.

Listing at only $9.00 to $12.00 (reflector kit $5.25) they are priced to encourage volume sales and an adequate profit margin.

Phone or see your nearest Ward distributor today for full details on how to capitalize on this hard-hitting consumer advertising for Ward "Magic Wand" FM and Television Aerials; or write direct to:

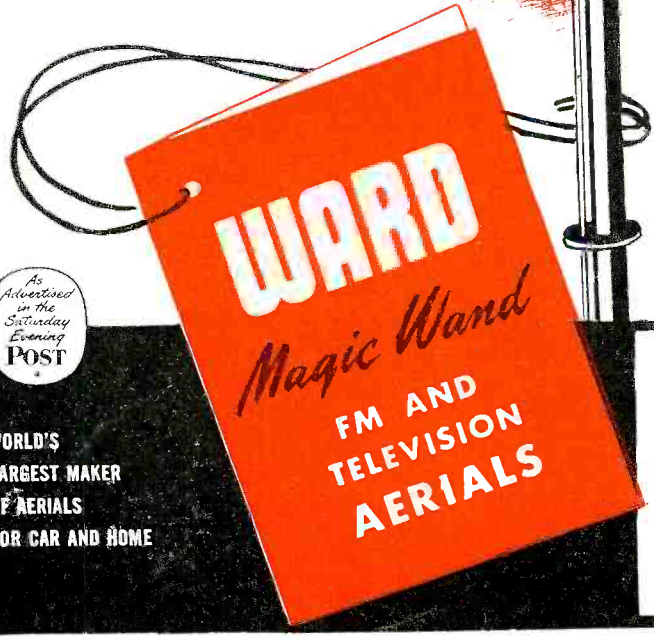
THE WARD PRODUCTS CORPORATION

1523 East 45th Street, Cleveland 3, Ohio

DIVISION OF THE GABRIEL COMPANY

EXPORT DEPT.: C. W. Brandes, Mgr., 4900 Euclid Ave., Cleveland 3, Ohio.

IN CANADA: Atlas Radio Corp., 560 King St., W., Toronto, Ont., Canada.



As Advertised in the Saturday Evening POST

WORLD'S LARGEST MAKER OF AERIALS FOR CAR AND HOME

FM-TELEVISION AERIAL OPPORTUNITY!

WARD PRODUCTS CORP.
1523 East 45th St., Cleveland 3

Please advise how I can profit from your national advertising for "Magic Wand" FM and Television Aerials.

NAME_____

COMPANY NAME_____

ADDRESS_____

STATE_____ CITY AND ZONE_____

MY JOBBER IS_____

The Television Picture Tube

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which meant that the electron beam had to be deflected through this angle for full picture size. The newer magnetic tubes have a 50 degree funnel angle, permitting a shorter funnel and overall tube length. The relative shapes of the old and new type bulbs is shown in Fig. 8 Though the new bulbs have the advantage of being shorter, the wider deflecting angle requires greater deflecting currents.

In Fig. 9, the sizes and shapes of the 7-, 10-, 12-, 15-, and 20-inch tubes are compared. Note that the larger picture sizes are obtained by virtue only of the added bulb length, but the deecting angle of all the tubes is the same. In other words, if the accelerating potentials were the same, the same deflecting current required for a 7-inch tube would be sufficient for a 20-inch tube. However, the deflection coil current varies as the square root of the accelerating voltage. Thus the 10-inch and 12-inch tubes which operate at about the same accelerating potential have the same deflecting currents, which are a little higher than the 7-inch tube requirements. A single 6BG6, (the conventional type 807 which has been modified for television sweep circuits), is capable of handling the deflecting currents of the horizontal sweep amplifiers used for 7-, 10-, and 12-inch tubes. Two sections of

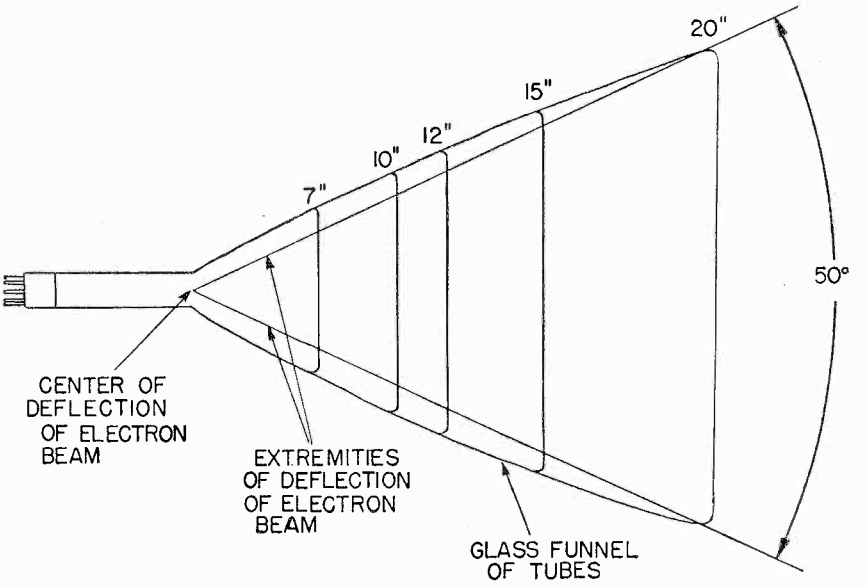

Fig. 9 Relative sizes of magnetic type television tubes.

a double triode type 6SN7 in parallel are adequate for the vertical deflection amplifiers. The current requirements of the higher voltage 15- and 20-inch tubes are slightly above the maximum ratings of a single 6BG6, hence, two are used in parallel for the horizontal sweep. Two sections of one 6SN7 in parallel will provide sufficient vertical sweep for the 15AP4 and 20BP4.

Projection Systems

Projection systems work on the principal of magnifying a small intensely brilliant picture formed on a small cathode-ray tube. Because the transmission efficiency of a lens is low, the light output of the cathode-ray tube has to be much higher than on a direct-view tube. To obtain these brighter pictures, projection tubes have to be operated at voltages as high as 30,000 volts.

A single projection system is shown in Fig. 10. The tube is mounted vertically in the cabinet, and the light projected by a refractive lens system onto a 45 degree angle mirror, which in turn throws the picture onto a translucent screen. This method of projection has not, however, been employed in home receivers, because the cost of a quality refractive lens with high transmission efficiency is excessive. A cheaper and more efficient means of projection has been

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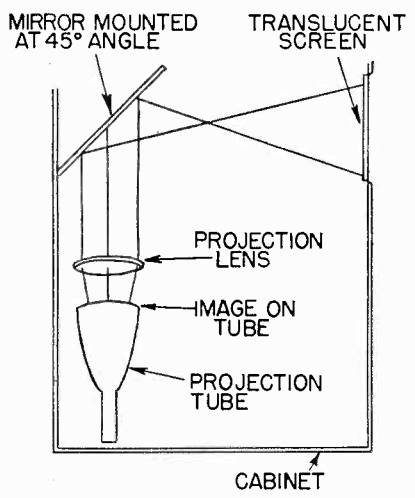

Fig. 10 Projection system using refractive lens.

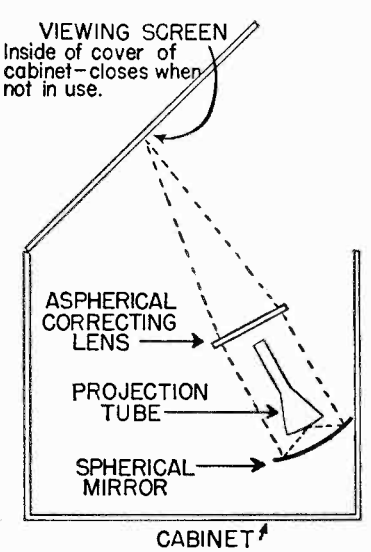

Fig. 11 The Schmidt projection system.

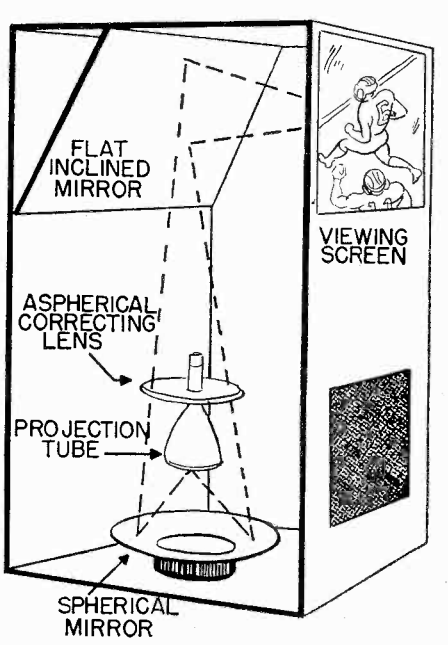

Fig. 12 Schmidt system in which picture is projected on opaque screen.

Circuit Analysis

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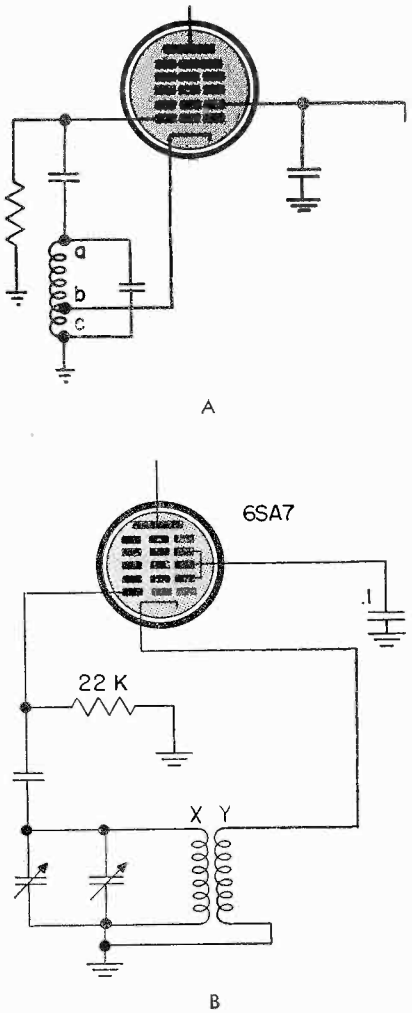

Fig. 4 Similarity between the conventional "tapped coil" (Hartley) oscillator and the type used in the receiver described in the text.

grid and cathode; that from b to c is between cathode and ground (through which it couples to the screen). In Fig. 4B the only difference is that the sections are separated and have become individual coupled coils. Coil X corresponds to section a-b and coil Y to section b-c.

This receiver also features a type of phase inverter circuit which doesn't appear very often. Refer to the full schematic of the set. The signal output of the first audio amplifier (6SR7 triode) is passed through the coupling condenser C2 and appears at point d. Between this point and ground, the audio frequency current passes through one half of audio frequency inductor L1. By auto-transformer action, an equal voltage with a 180 degree phase relation is induced in the other half of the inductor. This latter signal voltage is applied to the grid of the second push-pull tube and the proper balanced output obtained. ✓ ✓ ✓

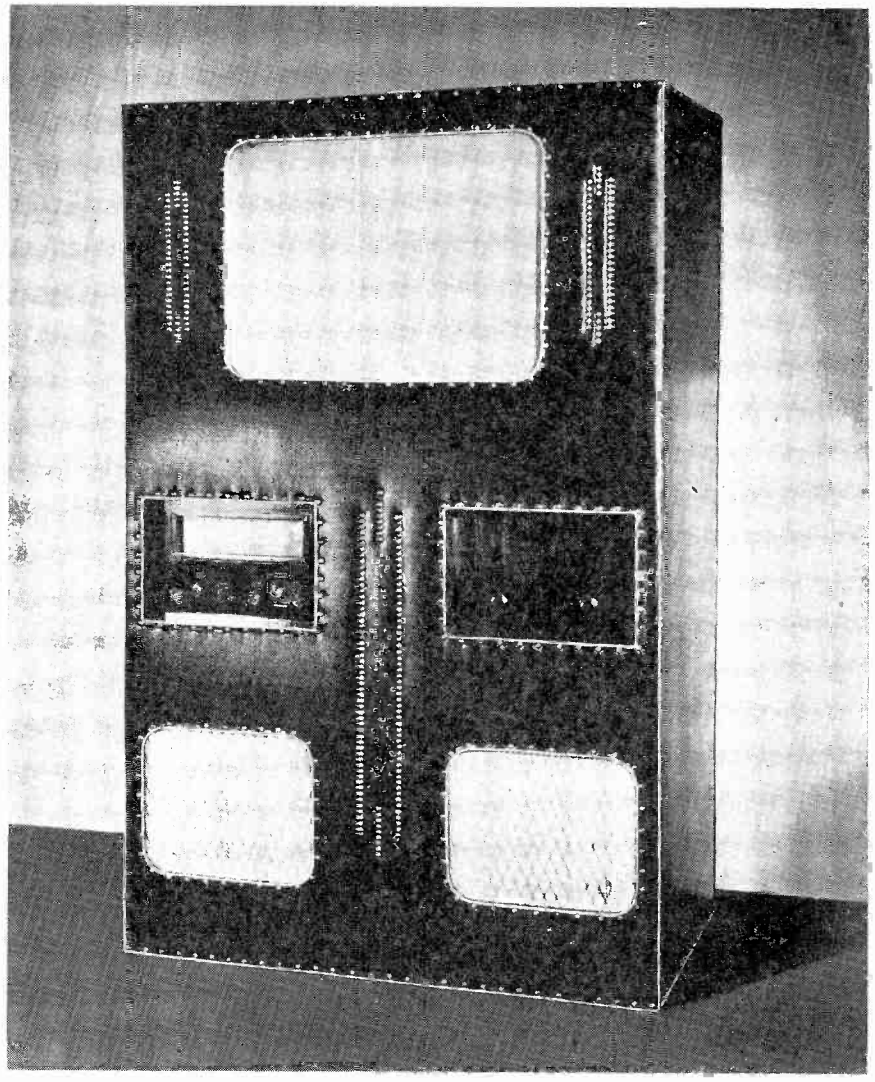

Fig. 13 New U.S. Television tavern type receiver using projection system. The picture size is 25 x 19 inches.

The Television Picture Tube

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developed, based on the Schmidt optical system, which has been used for many years in reflective astronomical telescopes. The Schmidt principle, as applied to projection television systems, is illustrated in Fig. 11. The cathode-ray tube is mounted vertically facing downward and projects its picture toward a spherical reflecting mirror. The mirror collects most of the light from the tube and transmits it to a 45 degree mirror, thence to a vertical translucent surface. An intervening lens molded of lucite corrects the spherical aberration caused by the reflecting mirror. The transmission efficiency of this system is much higher than that shown in Fig. 10.

A variation of the Schmidt principle is shown in Fig. 1. Instead of projecting into a 45 degree mir-

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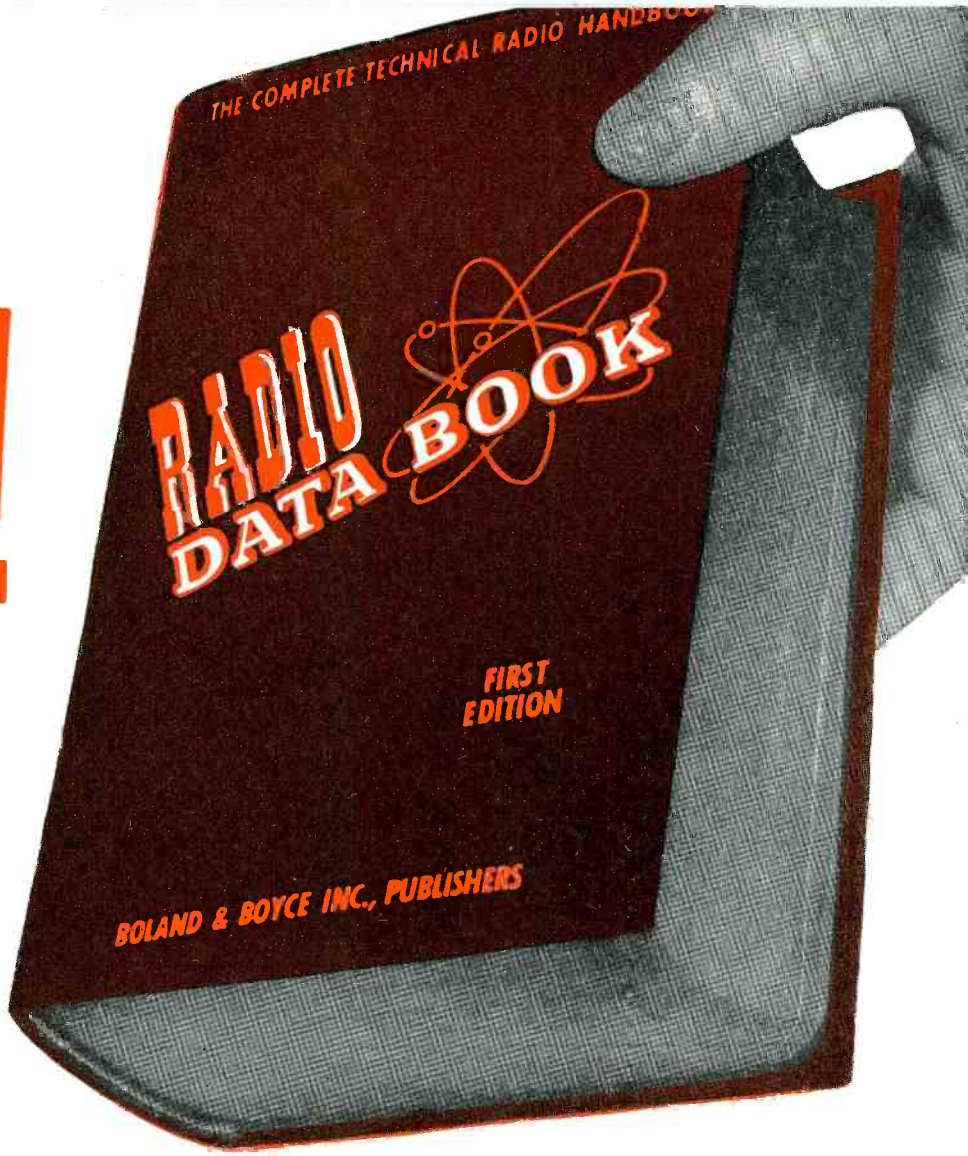

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ror and through a translucent screen, which adds light loss to the system, the picture is thrown directly onto an opaque beaded screen. As before, a correction lens is incorporated into the system.

Pictures as large as 16 x 20 inches and 19 x 25 inches are obtained in commercial receivers. One type is shown in Fig. 13. These often use the type 5TP4 projection tube, driven at about 27,000 volts. A 3 x 4 inch image is formed on the 5-inch diameter tube.

Alignment of the optical system requires care and precision. The principal objective in the alignment process is to have the axis of the tube coincide with the axes of the spherical mirror and correction lens so as to obtain the sharpest focus. These adjustments are facilitated by an optical barrel into which tube, lens, and spherical mirror are mounted. Another point to remember when replacing any part of the optical system is to maintain the same position of the reflecting mirrors, lens, and translucent screen, for these are designed for a fixed focusing distance.

To summarize the features of present day cathode-ray tubes, a table of tube characteristics for industry standard types is presented on pages 16 and 17.

In the next article on new television receiver developments, we will consider recently developed RF tuning systems and wide band receiving antennas.

The Organizations

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be held at Abbotsford to induct new members and elect a full slate of directors.

S. Beyer, Publicity
Associated Radio
Technicians of B. C.

Mr. Beyer reports further:

"The regular meeting of the Vancouver Associated Radio Technicians was held on June 9th with Pres. Al Johns presiding.

The minutes of the last regular and executive meetings were read

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OVER THE BENCH

by John T. Frye

RECENTLY I was reading a medical article outlining the methods used in the second World War to prevent the high mortality from infection and gas gangrene as was the case in the first World War. While the new drugs were given great credit, it was stressed again and again that careful thoroughness in cleansing the wound and in cutting away the injured tissue were prime factors in the lowered death rate.

Debridement is the technical term for this surgical removal of macerated tissue, and the article emphasized that it was necessary to be absolutely certain that this process was complete. In fact, it was better to remove a little healthy tissue than to leave some doubtful material that could destroy all the rest of the work and the patient himself.

Perhaps it seems a long way to you from a discussion of surgical problems to the problems of radio servicing, but it really is not. With the human factor removed, the problems are very similar. The serviceman is called upon to operate upon an ailing receiver and to restore it to its former state of health. To do so, he must first make a complete examination and diagnosis of the set's condition. He is aided in this, just as is the surgeon, by a number of complicated instruments that permit him to *see* and *hear* things that the unaided senses cannot detect.

Finally he determines the treatment called for and proceeds with the removal of defective parts and their replacement with new ones. Sooner or later, though, he is confronted by this surgeon's problem of thorough debridement. By that I mean he is forced to decide upon what parts are to be left in the receiver and what ones are to be replaced.

The surgeon does not like to cut away any more tissue than absolutely necessary, for to do so is to increase the length of the operation, to increase the shock of the operation, and to enlarge the job that nature must perform in replacing the material removed.

The serviceman's problem is more nearly one of ethics and craftsmanship. As an ethical serviceman, he does not wish to replace a single part that is not absolutely needed; but as a craftsman who takes pride in his work, he wants to do a thoroughly good job that will last. Added to this, there is often a personal knowledge of the customer's limited means that causes the serviceman to wish to "go as easy" on the total cost of repairs as possible.

Some compromise between a first-class repair job and a relatively inexpensive one would seem to be indicated, but it is fallacious reasoning that leads to this conclusion. From repeated experience I have learned—and I am confident you old-timers will bear me out—the only way to repair a radio is to correct every single fault you find in it.

Filter condensers that are "a little weak," volume controls that are just a trifle noisy, tubes that are in the questionable category, resistors that have been charred by temporary overloads—every one should be ripped out and replaced with new units with the same inexorable honesty that the surgeon employs in his debridement, and here is why:

Every job you turn out is more than just a job in itself. It is an integral part of your reputation. As such, no consideration will be given

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The Organizations

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and adopted. Monte Lennox gave a report on the financial status of the association, followed by Jim Summerby giving the highlights of the Chillawack meeting of Fraser Valley Radio Technicians; Sid Summers gave an outline of speakers and films he hoped to have available for future meetings.

Wilf Munton has plans for a bigger and better convention this year, with tentative dates Sept. 24-25th. Most manufacturers and jobbers have promised full co-operation in supplying exhibits.

Bunny Cosman reported that the annual A.R.T. picnic will be held at Bowen Island Aug. 10th; this will be a change of scenery from previous years.

Non-members as well as members are invited to attend both the Convention and the picnic, with a good time assured to all who are able to attend.

Following the regular business of the meeting Sid Summers introduced the guest speaker, Mr. J. E. Gibbard, U.B.C. graduate, past president of Vancouver United Nations Society and delegate to the U. N. Assembly at San Francisco in 1945. Mr. Gibbard gave a very interesting description of the functions of the various councils and Committees by comparing them with present forms of national governments, stating that some of his remarks may not be new to the audience but that they are well worth repeating to refresh memories. He concluded by explaining how the general public can participate in its operation through the United Nations Societies formed in most cities in many countries.

The meeting adjourned at 10:15 P.M."

S. Beyer, Publicity
Associated Radio
Technicians of B. C.

The Industry Presents

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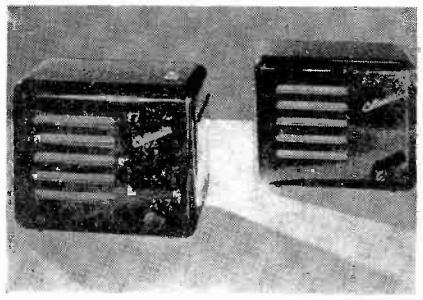
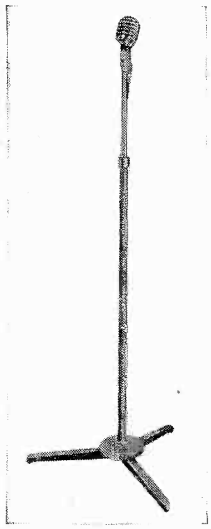
INTERCOMMUNICATOR

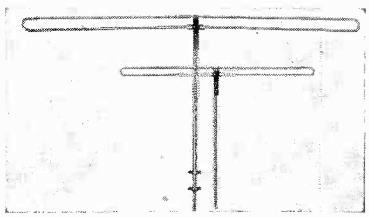
The new 1947 "CALLMASTER" electronic intercommunicator features improved sensitivity and power output. The cabinets are of the mahogany plastic type. The Model CM-10 shown is a "master and sub" combination and permits two way communication between two remote locations. They are sold as a "packaged" unit and are easily installed by the user.





MICROPHONE STAND

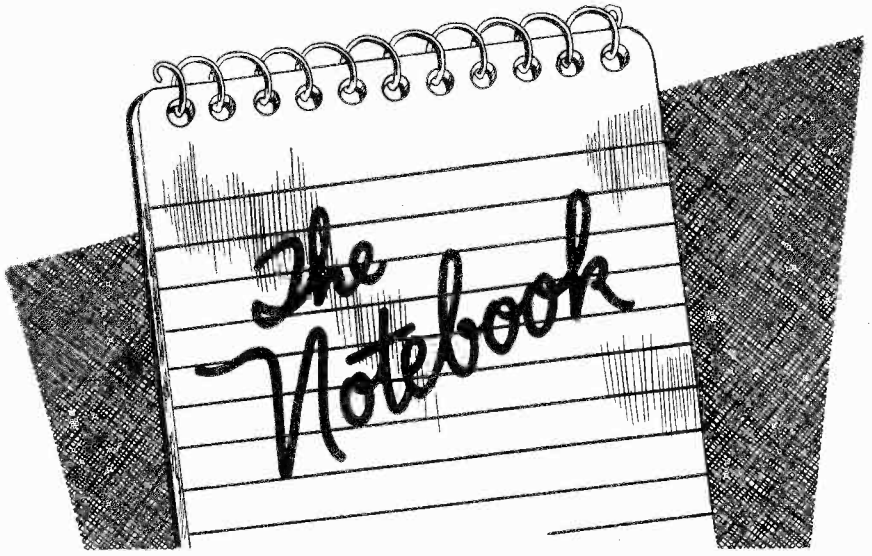
The Utility Model 430 Button-Control floor type microphone stand, announced by Electro-Voice, Inc., Buchanan, Michigan, features a single button which gives quick finger-tip control of shaft height. Release of button automatically locks the shaft in position. The shaft may be rotated without any adjustment. When writing for further information, ask for Bulletin No. 134.



FOLDED DIPOLES

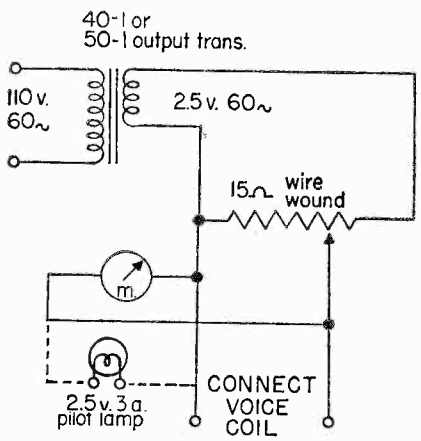
Two folded-dipole FM and television antennas, designed to match 300-ohm transmission lines, have been announced by General Electric Company. The dipole elements are constructed of reinforced aluminum tubing and are directional both front and rear broadside to the antenna. Masts provided are five ft. high. All metal parts of the assemblies are either painted, electroplated or made of aluminum to insure maximum protection against the elements.

Further information of the new antennas, Models UKA-002 and UKA-001, may be obtained by writing R. S. Fenton, Specialty Div., G-E Electronics Dept., Wolf St., Syracuse, N. Y.



Each month the reader sending in the best suggestion receives a crisp ten dollar bill. For all others published, RADIO MAINTENANCE will pay five dollars. Let's hear from you.

A GADGET which is useful for checking a speaker voice coil for crackling and buzzing due to intermittents and mechanical troubles can be built as shown in the diagram. One hundred and ten volt line power is supplied to the primary of the output transformer, and the test leads connected to the voice

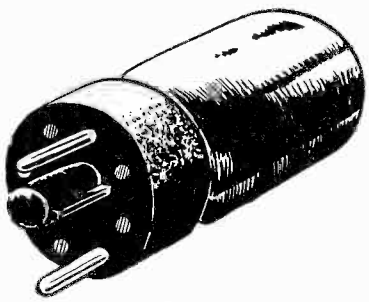


coil of the speaker being tested. Advance the wire wound resistor until the 60 cycle hum is heard in the speaker. This hum should be steady and the bulb should not flicker. Otherwise, an intermittent condition is indicated.

R. P. Acland
55 West Street
Warminster, Wiltes,
England.

Dummy Tube

In an AC-DC set, we often wish to remove one tube to help to anlyze the trouble, but are prevented from doing so by the series arrangement of the filaments. A "dummy tube" will solve this problem. A tube with low emission but whose filament is still good can be used if we remove all the base prongs except those



connected to the filament. If we remove a tube with similar filament rating and replace it with the dummy, that circuit has been made dead and we can test accordingly.

Royce Nevin
8 Circlewood
Tuscaloosa, Ala.

Adapting Pilot Lamps

When you need a pilot lamp with a bayonet type base and have only the screw type on hand, the latter can be converted by depositing bumps of solder on opposite sides of the base to serve as pins.

The screw base will slip into the bayonet socket and the solder bumps will lock the lamp in place. The best

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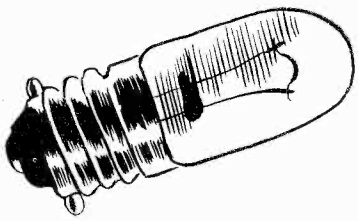

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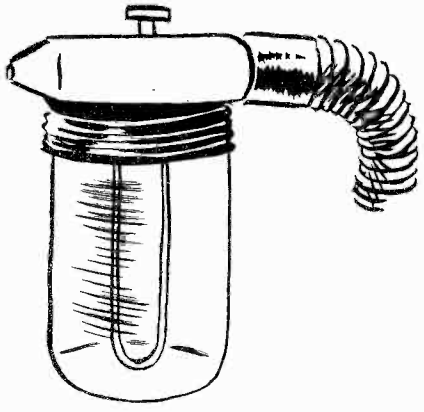
way to form the solder bumps is as follows: First clean a small spot at the proper pin location, apply a little flux, and then with the pointed tip of the soldering iron, apply a small drop of solder.

John T. Bailey
86 Great Hills Road
Short Hills, N. J.

Paint Sprayer

A simple and efficient paint Sprayer for radio panels, cabinets, etc., can be produced by harnessing the power from a vacuum cleaner. The sprayer mechanism is obtainable in any hardware or appliance shop. After removing the dust bag from the vacuum cleaner, connect

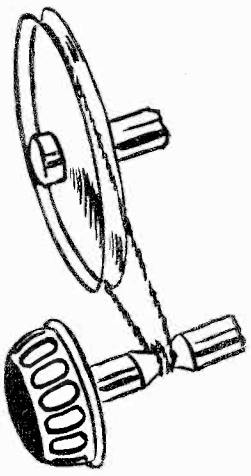


the sprayer head by means of the flexible cable to that point where the dust bag had been attached. The flexible cable is a part normally supplied with the machine and, therefore, does not represent any additional expense. A push-button affair on top of the sprayer head controls the flow of paint.

C. C. Erhart
Brooklyn, N. Y.
60-61 Myrtle Ave.

Dial Cord Guide

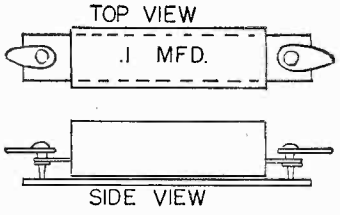
In some sets in which dial cords



are used, trouble is experienced with the cord slipping off the drive shaft. This trouble can usually be eliminated by filing a slight groove around the shaft. A small rat tail file can be used for this purpose.

Conrad Stoss
832 Mohn St.
Enhaut, Pa.

One way to protect those parts used for temporary substitution testing is to mount them on a piece of fiber as shown in the picture, using a small screw or stud on each



end and a lug for support. This eliminates warped and twisted wire leads and makes it easy to get good contact with test prods.

Albert Rodriguez
601 W. 140 St.
New York 31, N. Y.

PHOTOGRAPH CREDITS

RADIO MAINTENANCE—September 1947

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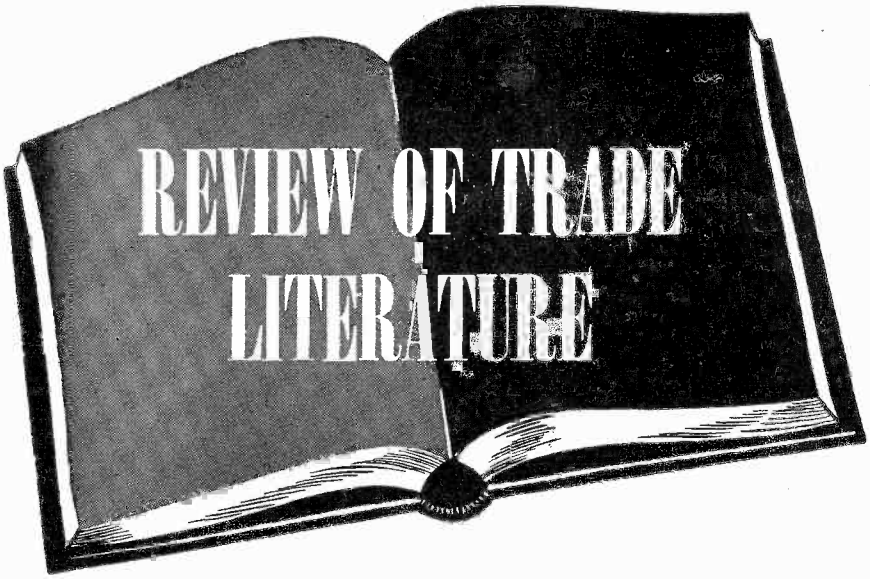

To avoid delay when writing to the manufacturer give issue and page number.

THE new catalogue J-4, containing complete information on various types of DC dry electrolytic capacitors, is available from the Pyramid Electric Company. Included are metal tube, cardboard wax impregnated, and metal can types. The new type F-1 radio noise filter is also described. The catalogue is printed in two colors on a good grade of paper. It is available free of charge by writing to the Pyramid Electric Company, 155 Oxford, Paterson, New Jersey.

Three new catalogues are now obtainable from the David Bogen Company. No. P6-47A is copiously illustrated with photographs in its 24 pages. All sorts of PA equipment, including amplifiers of up to 70 watts output, booster amplifiers, multi-channel preamplifiers, microphones, speakers, record players, and other items are included. No. C5-47P catalogue describes Bogen inter-communicator systems and units along with auxiliary equipment. A page is included on planning different types of intercommunication systems. The third catalogue, No. C5-47S, describes centralized sound systems suitable for schools, hotels, hospitals, stores, and the like. Any or all of these catalogues are available without charge by writing to David Bogen Company, Inc., New York 12, New York.

A 24-page brochure on universal electronic parts, ESD-93, radio service, has been published by the Specialty Division of General Electric Company's Electronics Department.

The new publication lists the price, specifications, and other data on sixteen parts in the division's line. Resistors, controls, antennas, the variable reluctance pickup, and loudspeakers are among the parts described in the new brochure.

Copies of ESD-93 may be secured from General Electric distributors or by writing the Specialty Division, G-E Electronics Department, Syracuse, N. Y.

The Alden Products Company has published two charts covering tube caps and tube cap connectors. All types are listed in tabular form with a cross-sectional, dimentional drawing of each. Uses and types of wire suitable are described. Write to Alden Products Company, 117 North Main Street, Brockton 64, Mass., for this free information.

The Walsco catalog No. 46 contains listings and photographs of various types of hardware and miscellaneous items necessary in the service shop. A complete line of screws, nuts, wing nuts, washers, cable clamps, brackets, and many other similar items are featured. There is also much information on cements, glue, cleaning fluids, scratch remover, and the like. This catalog may be obtained without charge by writing to Walter L. Schott Company, 9306 Santa Mon-

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Trade Literature

→ From Preceding Page

ica Boulevard, Beverly Hills, California.

Information on vitreous enameled resistors is presented in a very complete form in the Lectrohm bulletin No. 99. This booklet has 15 pages printed in two colors and features a clear photograph of each resistor type and tabulated data about current and power ratings. Also included is a chart which can be used to determine the physical size of a resistor of a given power rating. Available free of charge by writing to Lectrohm Incorporated, 5125 W 25th Street, Cicero 50, Illinois.

The Sangamo catalog No. 76 contains full information about paper, oil filled, mica, and silver mica condensers manufactured by the Sangamo Company. Both transmitting and receiving condensers of the midget, can, molded bakelite, and cased types are included. To obtain this 15-page, three color catalog write to Sangamo Electric Company, Springfield, Ill.

Over the Bench

→ From page 49

to your good intentions in trying to hold the cost down. All that will count is whether or not you did a good job. Ironically enough, the very person you tried to help will often be the first to turn against you when the doubtful part you left in his set fails, even though you explained the case clearly to him at the time.

Customers may raise their eyebrows at a comparatively high repair charge, but if the receiver works splendidly, they will bring it back to you the next time it needs service. On the other hand, any charge is exorbitant for a half-repaired set. If any doubt lingers in your mind, just consider which of these two statements you would rather hear about your work:

"His work is not too good, but he is cheap."

"His prices are high, but he turns out first-class work."

You are probably wondering about the cases in which the customer brings you a set and tells you that he wants it repaired just as cheaply as possible. This is usually the case when he intends to sell the receiver. In that case, I go over the set just as thoroughly as I do any receiver and make a careful note of every fault that I can find. Then I call up the customer and tell him the entire list, explaining what effect each repair, or the lack of it, will have on the operation of the receiver. When he has made his decision as to what he wants done, I do exactly that; but—and this is important—*I list all the faults I found, both on his bill and on my copy; and I write opposite the ones not corrected that such was the customer's wish.* This is my protection in case he keeps the set and a failure of the doubtful parts does

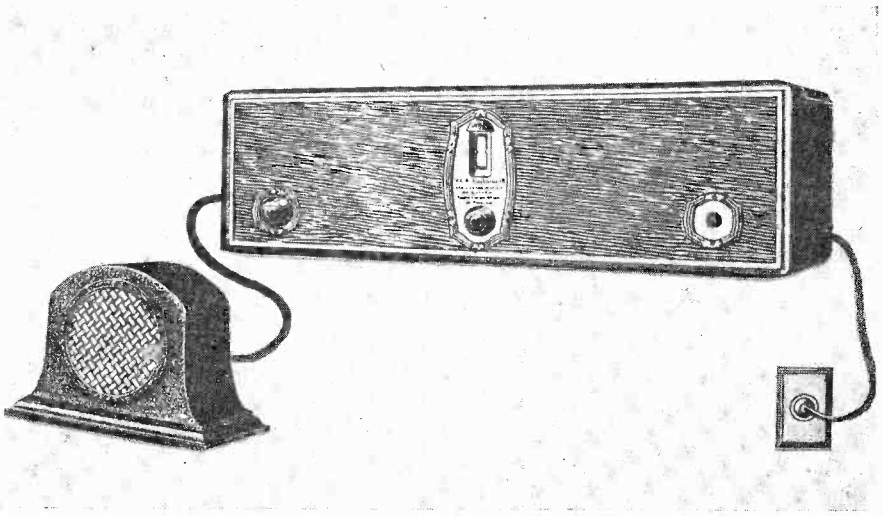

Fig. 8 One of the first "all AC" receivers, the Radiola 18.

occur, or in case he tells the purchaser that he had me give it a complete overhaul just prior to the sale.

Let me repeat once more: be thorough in your service work. Do not let a set leave the shop with a fault of which you are aware but which you have not corrected.

I know that it takes will power to do this. It is so easy to ignore a small item that the customer has not mentioned. Often the difference in performance does not seem worth the work involved. For example, it is common to put a dead set on the bench, locate a shorted condenser and replace it, replace the set in the cabinet and then discover after it has been bolted into position that there is slightly more hum present than should be there. When the speaker was out of the baffle, the 120 cycle note could hardly be heard, and it still is not bad in the cabinet, but you know in your heart that there is a filter condenser in that receiver that should be replaced. What you do about it determines what kind of a serviceman you are.

The discipline of forcing yourself to yank the chassis out and put in the new condenser carries its own reward. In the future, in order to avoid doing unnecessary work of this kind, you will be much more thorough in your checking on the bench. That is what you want to achieve. ✓ ✓ ✓

Servicing Is Big Business

→ From Page 28

nance industry have been created. The RMA is establishing a service clinic at their own expense for the purpose of solving various servicing problems.

The serviceman's job has now become highly technical. Slipshod or unplanned methods or equipment cannot be tolerated. He must produce high quality with maximum efficiency.

The serviceman is a business man. He is part of an industry which has grown larger every year since its beginning regardless of the state of the national economy.

Today radio servicing is a big business. From the first servicemen of old, who were combination set builders, experimenters, and hobbyists, the industry has grown to be specialized. The service technicians of 1947 do *one half a billion dollars* worth of business in the United States each year! Every twelve months he buys a hundred million dollars worth of replacement parts, tubes, and test equipment, largely from jobbers who make them available. Many of these jobbers are themselves former servicemen.

Since the volume of service calls has been proportional to the number of sets in service, and since the number of receivers in use is increasing at a rate of five million per year, it is evident that the service industry will grow for many years to come. ✓ ✓ ✓

JOHN RIDER SAYS . . .

Calibrate Periodically

Periodic calibration of test equipment should be a rigid requirement in all radio service shops. Granted that radio service measurements are less critical than those required in radio engineering, the need for ascertaining whether voltage, current and resistance indications are correct, and that signal source frequency calibrations are right, is definite.

Confidence in one's testing apparatus cannot be developed unless its proper operation is known. This not only assures longer life for the equipment and enables greater familiarity with the units, but also permits rapid diagnosis without any hesitancy or doubt.

BACK NUMBERS

Our first announcements of the availability of back numbers of RADIO MAINTENANCE brought a response much greater than we anticipated. As a result we are continuing to comply with the demand of radio servicemen for these back issues. We don't know how long we may be able to fill orders for the earlier issues as the supply is dwindling fast, and some are already sold out. Only those listed are now available, so if you are anxious to get them, send in your request as soon as possible.

JANUARY 1946
THE PROBLEMS OF ORGANIZATION
TELEVISION RECEIVER INSTALLATION — This article will initiate the serviceman into the first step in television—its installation.
RADIO MAINTENANCE IN AVIATION
USING THE OSCILLOGRAPH FOR DISTORTION MEASUREMENTS

APRIL 1946
PA SYSTEMS—This article covers a general discussion of all the opportunities and procedures for the serviceman about to enter the public address field.
A MIDGET AUDIO FREQUENCY OSCILLATOR
IF I WERE A SERVICEMAN
AN EQUALIZED AMPLIFIER FOR MAGNETIC PICKUPS

MAY 1946
PA SYSTEMS—This article covers initial layout of a modern PA system in bars, dance halls, auditoriums, etc.
TEST PANEL FOR THE MODERN BENCH
RINGING THE BELL

JUNE-JULY 1946
FUNDAMENTALS OF TELEVISION
VOLUME CONTROL TAPERS
THE ELECTRONIC VOLT OHMMETER
VECTOR ANALYSIS

AUGUST 1946
AVC CIRCUITS
FM TROUBLESHOOTING
TELEVISION RECEIVER FUNDAMENTALS
RECORD CHANGERS

NOVEMBER 1946
PART II TEST & ALIGNING TELEVISION RECEIVERS
DON'T FORGET THE DIAL LAMP
THE OSCILLOGRAPH . . . HOW TO USE IT
CRYSTAL PICK-UPS

DECEMBER 1946
TELEVISION RECEIVERS . . . THE RF SECTION
TUNING INDICATORS
PART II THE OSCILLOGRAPH . . . HOW TO USE IT
REPLACING AUTO CABLES

JANUARY 1947
SERVICING BY EAR
TELEVISION RECEIVERS . . . VIDEO CHANNEL
PART III THE OSCILLOGRAPH . . . HOW TO USE IT
MINIATURE TUBE CHART

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- ☐ April 1946
- ☐ May 1946
- ☐ June-July 1946
- ☐ August 1946
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- ☐ January 1947

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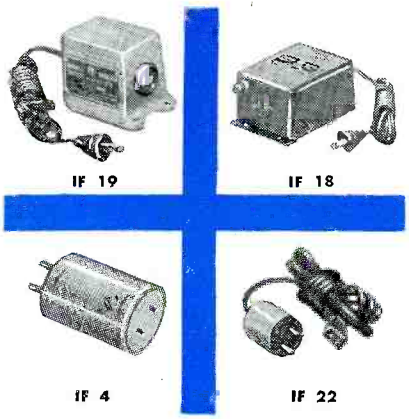

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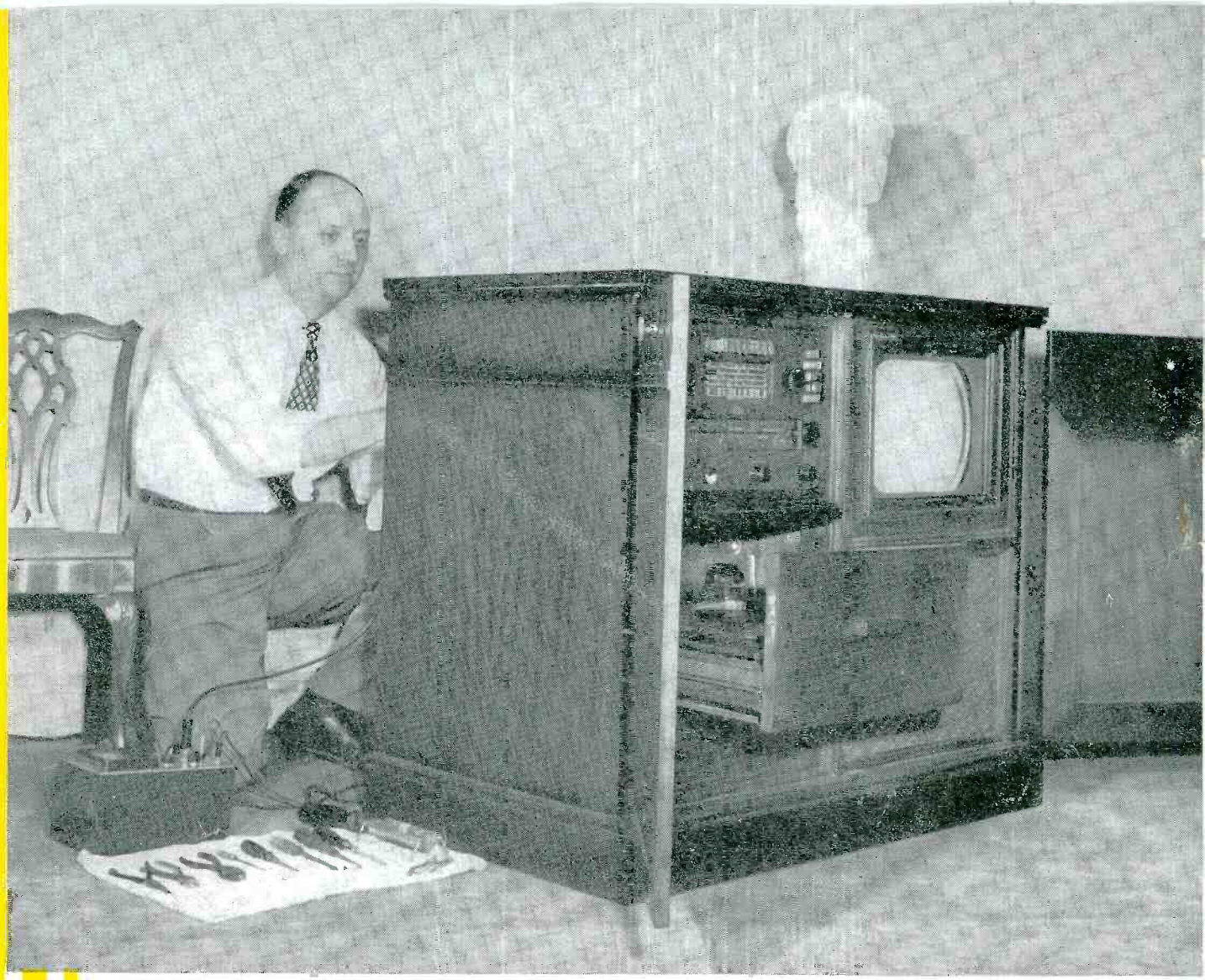

Servicing is a BIG Job!

FM is a big thing now, and Television is getting bigger every day. People are getting bigger and more complex radio sets, and the radio serviceman is encountering more responsibilities, more varied tasks, and developing a bigger business. An expanding service business needs an efficient jobber who knows what servicing problems are, who can provide fast delivery, whose prices are the lowest in the top quality field, whose product lines are the best. We can help you grow by giving you better service—faster response to your mail orders. Stop in and see us or give us a call *today*. Say you saw this ad in Radio Maintenance and find how well we can serve you!

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