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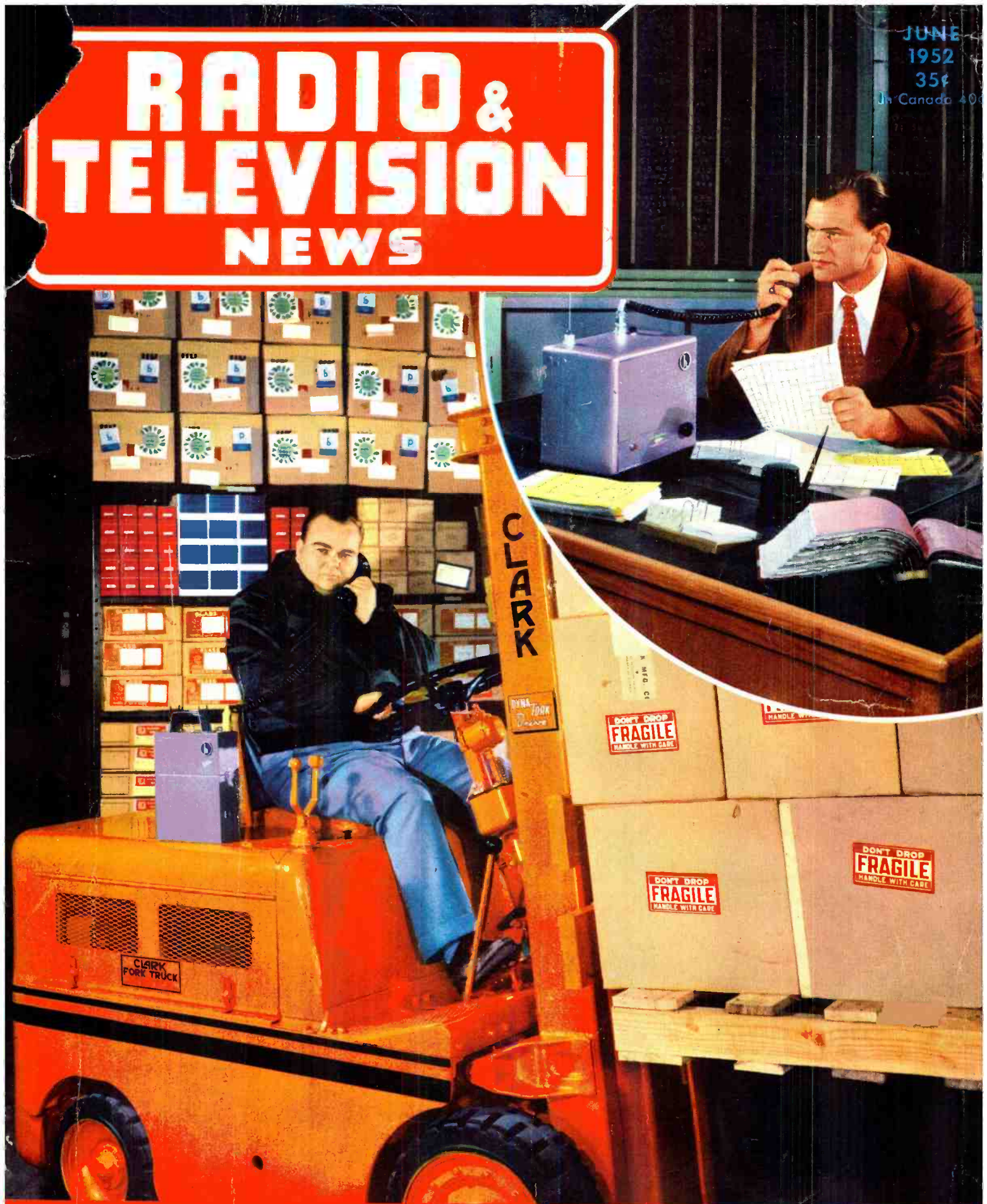
RADIO & TELEVISION NEWS



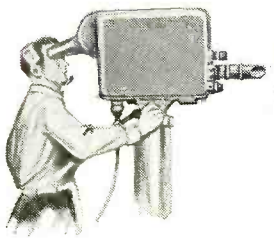
TWO-WAY RADIO FOR INDUSTRY

SEE PAGE 63

SMALL-TOWN TELEVISION ★ ★ ★ SPEAKER ENCLOSURES

Get out Front

with RCA's new Sales and Servicing aids



and watch your business grow!

NEVER BEFORE has RCA made available to you such a varied and colorful assortment of Radio-TV Sales and Servicing Aids to help you build your business—the most comprehensive and useful promotions in the industry. You'll find all the basic business builders . . . from traffic-stopping illuminated "Service" signs and displays to colorful mailing pieces and souvenir gift items, to build your local reputation as "TV-Radio Service Headquarters."

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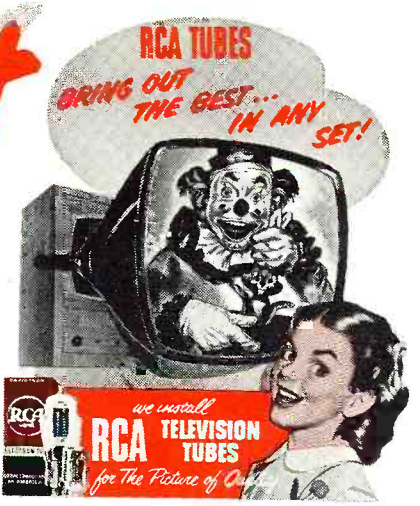
For the whole exciting story, ask your RCA Tube Distributor *today* for your free copy of the colorful brochure "In Focus for '52," that describes and illustrates 33 dynamic Sales and Servicing Aids to help you cash in on the fast-growing TV-Radio service business.



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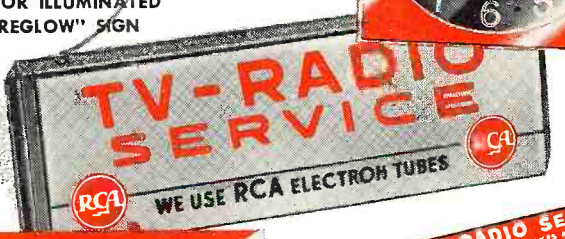

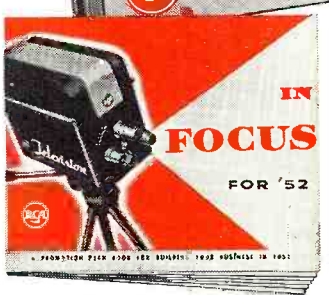

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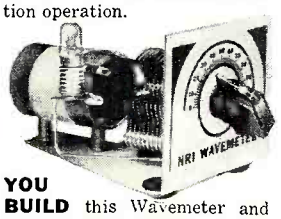
YOU BUILD this Transmitter Power Supply used in the basic experiments in RF and AF amplifiers, frequency multipliers, buffers, etc.

YOU MEASURE current, voltage (AC, DC and RF), resistance and impedance in circuits with Electronic Multitester you build. Shows how basic transmitter circuits behave; needed to maintain station operation.

YOU PRACTICE setting up code, amplitude and frequency modulation circuits (put voice, music, etc., on "carrier signals" you produce). You learn how to get best performance.



YOU BUILD this Wavemeter and use it to determine frequency of operation, make other tests on transmitter currents.

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Ever think HOW FAST Radio-Television Communications is changing, developing, growing? Have you considered what this amazing progress can mean to you?

Look at these facts. In 1946 only 6,000 Television sets were sold. In 1950, over 5,000,000. By 1954, 25,000,000 Television sets will be in use, according to estimates. 100 Television Stations are operating in 35 states. Authorities predict there will be over 1,000 Television Stations. This rapid growth means new jobs, more jobs, good pay for qualified men all over the U. S. and Canada. Then add development of FM, Two-way Radio, Police, Marine, Aviation and Micro-wave Relay Radio! Think what all this means! New jobs, more jobs for beginners! Better jobs, better pay for experienced men!

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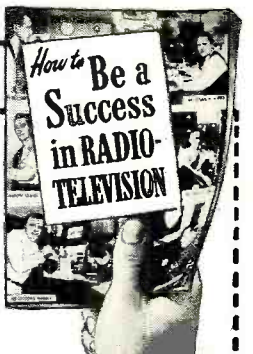

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CONTENTS

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TELEVISION RADIO-ELECTRONICS"

says

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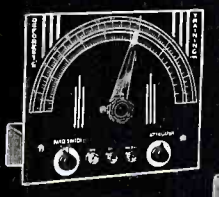

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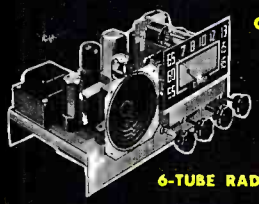
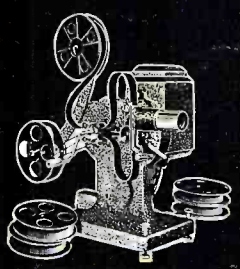


6-TUBE RADIO



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Tells Why "People Are Funny" Program Relies On *D. T. I.* In Program Tie-Ups.

"Most people would be just as amazed as we are if they were privileged to see the remarkable results obtained through DeForest's Training, Inc.'s labaratary and hame study training program," declared Art Linkletter, star of one of the nation's most populor radio network shows "People Are Funny."

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JACK DEMPSEY Tells Why

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4. Never have I heard young men praise a school as enthusiastically as do the students and graduates of D.T.I. They are its best boosters.

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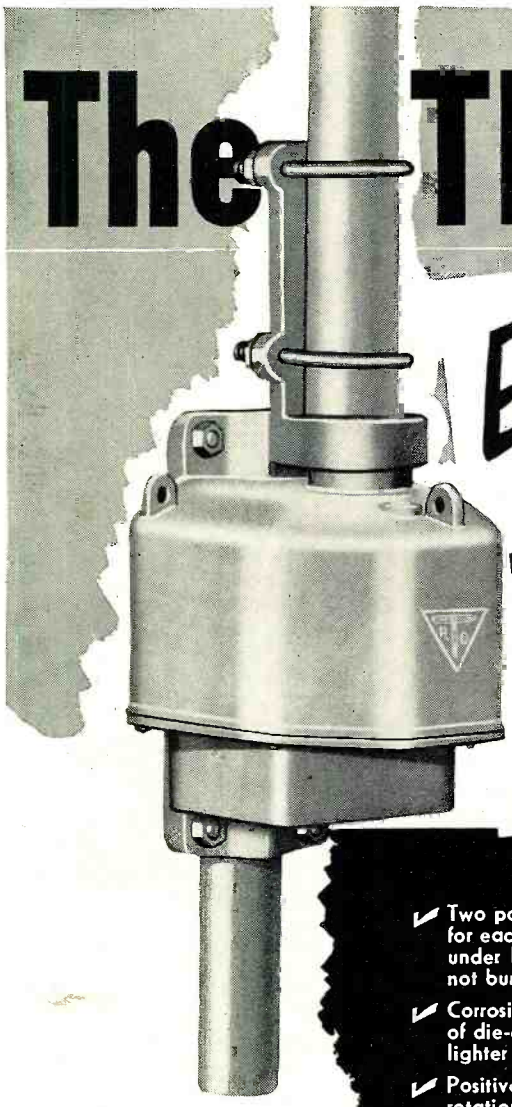
RN-6-1

The TRIO ROTATOR



Easy to Sell!

It's easy to sell a product with as many plus features to talk about as the TRIO ROTATOR. In design, in construction, appearance; it is by far the outstanding TV antenna rotator in the market today!

Stays Sold!

In addition to providing a powerful sales story, the features listed below are your assurance of complete customer satisfaction: Assurance that the TRIO ROTATOR will give dependable performance year in and year out — in all kinds of weather!

- Two powerful 24 volt motors used — one for each direction of rotation. Each motor under load only fraction of time — will not burn out!
- Corrosion resisting, weatherproof housing of die-cast aluminum for greater strength, lighter weight, perfect alignment of parts!
- Positive electrical stops at ends of 360° rotation prevent damaging or twisting of leads!
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- Rotator and mast holder fits any pipe size up to 2" OD!
- Precision built to extremely close tolerances!

Smartly Styled DIRECTION INDICATOR

The TRIO Direction Indicator is housed in a sturdy plastic cabinet of graceful lines. It is a beautiful instrument that will blend harmoniously with any furniture style.

Utmost ease in selecting the desired antenna direction is provided by a new "finger tip" control that operates at a light touch and the easy-to-read dial face that clearly and instantly indicates the exact antenna position.

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Each TRIO ROTATOR is thoroughly factory tested to the equivalent of 3 months of constant operation. This, plus an additional torque test guarantees each unit to be perfect in every detail of assembly.

The TRIO ROTATOR's sound design and construction has been proven by three years of extensive field testing under every extreme of weather.

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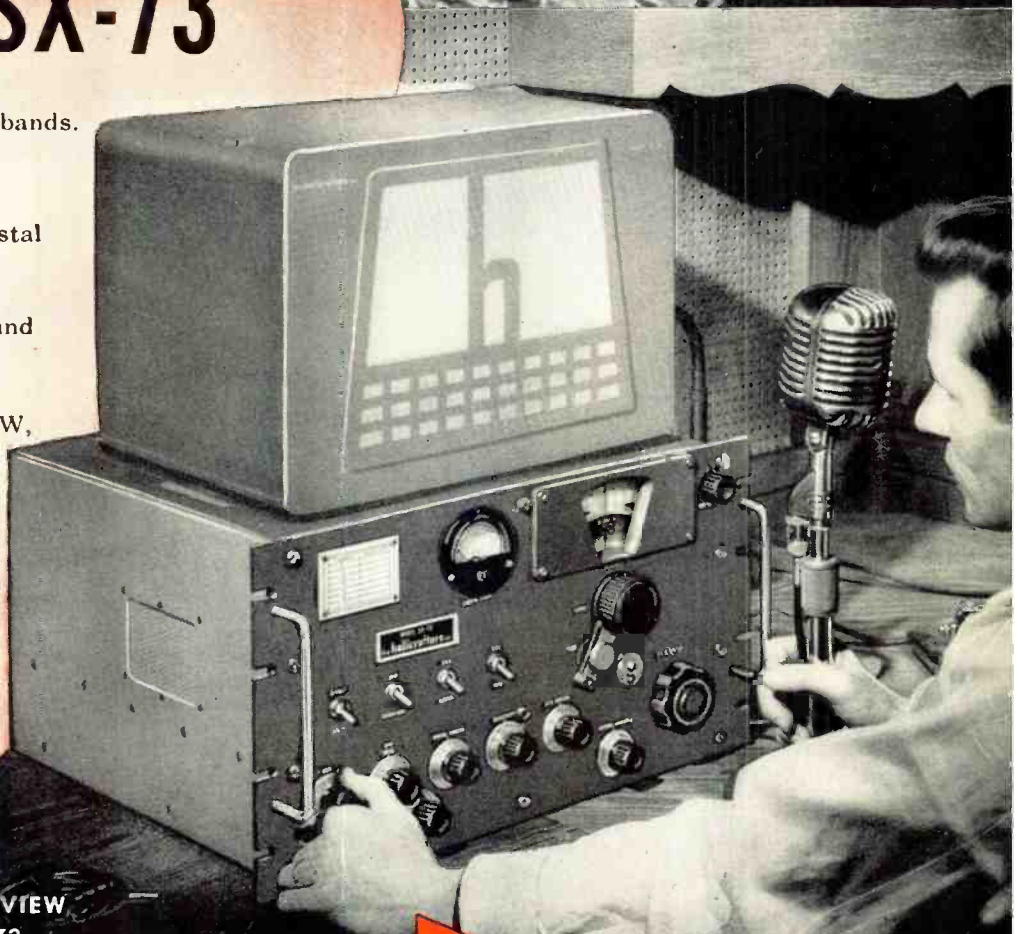

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SX-73

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For the RECORD

BY THE EDITOR

MANPOWER PROBLEMS—TODAY AND TOMORROW

THE urgent need for technicians in all segments of our vast electronics industry becomes greater with each passing day. The lifting of the TV freeze will place an added burden on a greatly overtaxed service industry. While the initial manpower demands —created by u.h.f. television—will be for design and construction personnel, nevertheless it won't be long until operating personnel will be in great demand for some 2000 new stations.

And, when we consider the servicing requirements for millions of sets in future TV areas, we visualize the great opportunity that exists *TODAY* for thousands of men who are technically-minded to train themselves *NOW* for a future in television.

We've been told by many service contractors that the majority of today's top-flight TV service technicians have taken an accredited course in television theory and practice at one of our many established institutes.

Contrary to general opinion is the fact that a qualified TV service technician need not possess a radio background or experience. Television servicing requires a specialized training in problems not encountered in radio servicing. The reverse is largely true in radio diagnosis.

It took several years to develop efficient service establishments and there remains plenty of room for improvement. The newcomer, as a TV technician or dealer, has the advantage and opportunity to profit by the mistakes that have plagued our industry for many months.

The end-of-freeze is, in fact, the beginning of a slow thaw. New television stations will be the exception rather than the rule for a year or more. Never again, perhaps, will the time be more ripe to lay the foundation for a career in television servicing, engineering, and industrial TV.

Television receivers for v.h.f. continue to be produced in large quantities and will present an additional burden on the service industry in years to come. Here are some recent statistics from RTMA.

A total of 178,571 television sets were produced in 1947. Of this total most were table models representing over 65% of production. Phonograph combinations comprised more than 14% and the remainder were TV consoles. Set production in 1948 increased by nearly 6 times to a total of 975,000 units. Table models (66.31%) continued to lead production followed by consoles (18.38%) and phono combinations (15.31%).

During 1949 consoles became a popular choice. Of a total production of 3,000,000 sets, consoles represented nearly one third of the total output. Table models continued to lead with 60% and phono combinations dropped to 7.2%.

Total 1950 production was 7,463,800 television sets. Of these the production of consoles increased to 3,820,060 or more than 51% of the total output. Table models dropped to about 40% and phono combinations to less than 10% of total 1950 production.

Over 5 million sets were produced last year. The 1951 figures show a slight percentage increase in table models (42.27%) as compared to a steady 51.53% for consoles and a drop for the combinations to 6.20%.

Radio set production figures, as a comparison, reveal a total set output (including home, auto, and portable receivers) in 1947 of 20,000,000 units. Production dropped to 16,500,000 during 1948. Total sets produced in 1949 amounted to but 11,400,000 units—a sizable drop resulting from the impact of TV and other factors.

The year 1950 was a good one for most set makers. More than 14½ million radio sets were produced.

The production of radio receivers continues at sizable figures in spite of the impact of television. Over twelve and a half million radios were produced last year. Since 1946 more than 75 million sets have been added to existing units. All of them, in time, will require maintenance. In radio—as in television—there aren't nearly enough technicians available or in training to do a nationwide maintenance job. There's plenty of room for more—thousands more!

Our recommendations to those looking to a future in television servicing as a profession are:

1. If possible visit an existing TV area and study the operations of well-established service operators.
2. Plan now to take a course in television theory and practice at one of the many excellent technical schools advertised in this publication.
3. If it is impossible to take a resident course—by all means study at home. Many complete and satisfactory "home-study" television courses are available.
4. Study in earnest. Keep informed on all TV developments and techniques through this magazine and other technical journals.
5. Take an active interest in local community affairs while at home. Be seen with your future customers.

By all means, do these things *NOW!*

. . . . . O.R.

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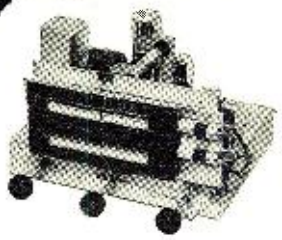

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Best buy in a quality tuner covering standard AM broadcast and 88-108 mc FM. Flat response within 2 db, 20-15,000 cps. Slide-rule dial; separate 3-gang condensers for AM and FM; input for phono and TV, with bandswitch; power supply; tuned RF on AM and FM; ceramic loop stick antenna for AM, FM line antenna. Size, 11½ x 6 x 9″; with 9 tubes and rect. For 110-120 v., 50-60 cy. AC. Shpg. wt., 8½ lbs.

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Features maximum stability on all TV channels by providing inductive and capacitive neutralization. Single tuning knob for easy operation. Fine tracking accuracy. Improves both picture and sound for greater TV enjoyment. Mahogany plastic cabinet, 4½ x 6 x 4½″. For 110-120 v., 60 cy. AC. Shpg. wt., 7 lbs.

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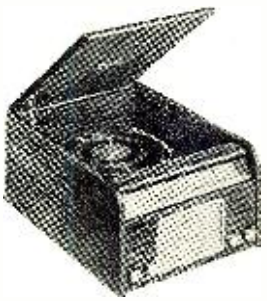

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Complete home entertainment at new low cost. Has V-M 3-speed intermix changer, with turnover cartridge—plays *all* records, all sizes and speeds—intermixes 10″ and 12″ records. Superhet radio covers 540-1730 kc; Alnico PM speaker, tone control. In attractive cabinet, 15 x 9½ x 19⅝″. With all tubes and loop antenna. For 105-125 v., 60 cy. AC. Shpg. wt., 35 lbs.

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Tunes out antenna-fed interference which causes annoying TV picture distortion. Eliminates, FM, diathermy, SW, ignition, amateur interference, etc. Matches any antenna. Easy to install and operate. Brown case, 4 x 3¼ x 1½″. Shpg. wt., ½ lb.

77-566. *Only* **$4.41**

WELLER SOLDERING IRON

Squeeze the trigger—you're ready to solder in 5 seconds! Double-tube electrode and long tip; with 2 spotlights that light up working area. Air-cooled transformer. 100-135 watt dual-heat type. Shpg. wt., 3 lbs.

46-589. *Only* **$10.73**

CHAMPION SPRAY GUN

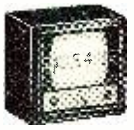
Smooth-working all-metal electric gun for spraying lacquer, paint, varnish, chemicals, insecticides, etc. No compressor—has motor right in handle—develops over 90 lb. pressure. Pistol trigger. 25-ounce glass jar. With 8 ft. cord. For 110-120 v., 60 cy. AC. Shpg. wt., 5 lbs.

46-139. *Only* **$9.57**

MICRO-VOX WIRELESS MICROPHONE

Mike with built-in midget radio transmitter plays through any radio within 50 feet for home entertainment or as small P.A. System. Complete with built-in batteries. Shpg. wt., 3 lbs.

99-485. *Only* **$5.85**



E-Z-I TV LIGHT AND CLOCK

Combination TV light and numeral-type clock. When placed on top of TV cabinet, helps reduce viewing eyestrain. Walnut plastic case, 5 x 5½ x 7½″. For 110 v., 60 cy. AC. Shpg. wt., 2½ lbs.

78-328. *Only* **$7.66**

WHEELER SELF-POWERED PHONE

Self-contained, self-powered telephone handset—no batteries or line voltage needed. Fine for inter-room use. Use with No. 16 or No. 19 twisted wire. With 3½ ft. cable, test clips, insulators. Shpg. wt., 1½ lbs.

59-350. *Only* **$9.62**

4 X 6″ OVAL SPEAKER VALUE

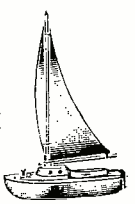
Ideal for replacement use in portable and table radios, TV sets and intercom. Fine buy for builders, experimenters. With 1.47 oz. Alnico V magnet. Voice coil imp. 3.2 ohms. Wt., 12 oz.

81-640. *Only* **$1.69**

PLASTIC SPRAY

Provides tough coating of clear flexible plastic on any surface. Guards against rust, tarnish, etching. Dries hard in an hour. Automatic spray. Shpg. wt., 1¼ lbs.

43-136. *Only* **$1.03**



NEW "TENNA-BOAT" TV INDOOR ANTENNA

Beautiful, practical. Ceramic boat hull is base; mast and boom are the antenna. Plastic sail is rotatable for best reception; has built-in tuning condenser.

97-047. Dark Green
97-048. Crimson
97-049. Harvest Moon
} **Each, *Only* $8.25**

All Prices F. O. B. Chicago

ALLIED RADIO

ALLIED RADIO CORP. Dept. 1-F-2
833 W. Jackson Blvd., Chicago 7, Ill.

FREE SEND FOR IT

☐ Send Free ALLIED Supplement No. 130.

☐ Enter order for. . . . . .

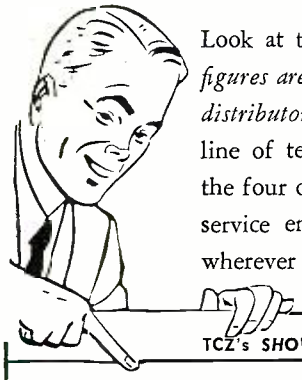
. . . . . $. . . . . enclosed

Name . . . . . .

Address . . . . . .

City . . . . . *Zone* . . . . *State* . . . . . .

LOOK AT THE BOX



Look at the figures in the charts below. *These figures are taken from current catalogs listing stock distributor items.* Compare Centralab's complete line of temperature compensating capacitors with the four other leading makes. You'll see why more service engineers are standardizing on Centralab wherever capacitors of this type are required.

Remember too — Centralab was the first manufacturer to offer temperature compensating ceramic capacitors to the market.

For r.f. and resonant circuits — where frequency drift is critical — Centralab Temperature Compensating Capacitors are the last word in accurate stabilizing — *safest and best for guaranteed servicing.*

TCZ's SHOW NO CAPACITANCE CHANGE OVER WIDE RANGE OF TEMPERATURE (-20°C to +85°C)

CRL				COMPETITOR A**			COMPETITOR B**			COMPETITOR C**			COMPETITOR D**		
600VDCW	1200VDCT			(tubular) 500 VDCW			Disc. 500 VDCW — 1000 VDCT			(tubular)			(tubular) 500 WVDC		
										Voltage 500 VDCW					
CRL Part No.	Cap. mmf.	Tolerance	Net Price	Cap. mmf.	Tolerance	Net Price	Cap. mmf.	Tolerance	Net Price	Cap. mmf.	Tolerance	Net Price	Cap. mmf.	Tolerance	Net Price
TCZ- .5	0.5	± .25 mmf	.45	*			†			†			†		
TCZ- .68	0.68	± .25 mmf	.45	*			†			.75	± .1 mmf	.45	†		
TCZ- 1.0	1.0	± .25 mmf	.45	*			†			†			†		
TCZ- 1.5	1.5	± .25 mmf	.45	1.0	± 1 mmf	.30	†			1.5	± .5 mmf	.30	1.5	‡	.30
TCZ- 2.2	2.2	± .25 mmf	.45	*			†			†			†		
TCZ- 3.3	3.3	± .25 mmf	.45	3.0 3.3	± 1 mmf	.30	†			3.0 3.3	± 1 mmf ± .5 mmf	.30 .30	3.0 3.3	‡ ‡	.30 .30
TCZ- 4.7	4.7	± .5 mmf	.36	4.7	± 1 mmf	.30	†			4.7 5.0	± .5 mmf ± 1 mmf	.30 .30	4.7 5.0	‡ ‡	.30 .30
TCZ- 6.8	6.8	± .5 mmf	.36	5.0 6.8	± 1 mmf	.30	†			6.8	± .68 mmf	.30	6.8	‡	.30
TCZ- 10	10	± .5 mmf	.36	8.2 10	± 1 mmf	.30	10	‡	.30	10	± 1 mmf	.30	8.2 10	‡ ‡	.30 .30
TCZ- 12	12	± .5 mmf	.36	*			†			†			†		
TCZ- 15	15	± .5 mmf	.36	*			15	‡	.30	†			†		
TCZ- 18	18	± .5 mmf	.36	*			†			†			†		
TCZ- 20	20	± .5 mmf	.36	20	± 10%	.30	†			20	± 10%	.30	20	‡	.30
TCZ- 22.0	22	± 2½%	.30	*			22	‡	.30	†			†		
TCZ- 24	24	± 2½%	.30	25	± 10%	.30	25	‡	.30	25	± 10%	.30	25	‡	.30
TCZ- 27	27	± 2½%	.30	*			†			†			†		
TCZ- 30	30	± 2½%	.30	*			†			†			†		
TCZ- 33	33	± 2½%	.30	33	± 10%	.30	33	‡	.30	33	± 10%	.30	33	‡	.30
TCZ- 36	36	± 2½%	.30	*			†			†			†		
TCZ- 39	39	± 2½%	.30	*			†			†			†		
TCZ- 43	43	± 2½%	.30	*			†			†			†		
TCZ- 47	47	± 2½%	.30	*			47	‡	.33	†			†		
TCZ- 51	51	± 2½%	.30	50	± 10%	.33	†			50	± 10%	.33	50	‡	.33
TCZ- 56	56	± 2½%	.30	*			†			†			†		
TCZ- 62	62	± 2½%	.30	*			†			†			†		
TCZ- 68	68	± 2½%	.30	*			68	‡	.33	†			†		
TCZ- 75	75	± 2½%	.30	75	± 10%	.33	†			75	± 10%	.33	75	‡	.33
TCZ- 82	82	± 2½%	.30	*			†			†			†		
TCZ- 91	91	± 2½%	.30	*			†			†			†		
TCZ-100	100	± 2½%	.30	100	± 10%	.33	100	‡	.33	100	± 10%	.33	100	‡	.33
TCZ-110	110	± 5%	.30	*			†			†			†		
TCZ-120	120	± 5%	.30	*			†			†			†		
TCZ-130	130	± 5%	.30	*			†			†			†		
TCZ-150	150	± 5%	.30	150	± 10%	.36	150	‡	.36	150	± 15 mmf	.36	150	‡	.36
TCZ-160	160	± 5%	.30	*			†			†			†		
TCZ-180	180	± 5%	.30	175	± 10%	.36	†			175	± 17.5 mmf	.36	175	‡	.36
TCZ-200	200	± 5%	.30	*			†			†			†		
TCZ-220	220	± 5%	.30	*			†			†			†		
TCZ-240	240	± 5%	.30	*			†			†			†		
TCZ-270	270	± 5%	.30	*			†			†			†		
TCZ-300	300	± 5%	.30	*			†			†			†		

**Name on request. *Not cataloged item — available on special order. †Not cataloged ‡Tolerance not listed in literature

SCORE! . . . Of the five leading makes of temperature compensating capacitors — Centralab gives you more values to choose from — closer tolerances you can rely on — at prices that are right!

TCN's *VARY CAPACITANCE* ACCORDING TO TEMPERATURE

CRL				COMPETITOR A** (tubular)			COMPETITOR B** (disc)			COMPETITOR C** (tubular)			COMPETITOR D**		
CRL Cat. No.	Cap. mmf.	Toler-ance	Net Price	Cap. mmf.	Toler-ance	Net Price	Cap. mmf.	Toler-ance	Net Price	Cap. mmf.	Toler-ance	Net Price	Cap. mmf.	Toler-ance	Net Price
TCN- 3	3	± .5 mmf	.36	*			†			†			†		
TCN- 5	5	± .5 mmf	.36	5	± 10% or ± 1 mmf	.30	†			5	± 10% or ± 1 mmf	.30	5	‡	.30
TCN- 10	10	± .5 mmf	.36	10	± 10% or ± 1 mmf	.30	10	‡	.30	10	± 10% or ± 1 mmf	.30	10	‡	.30
TCN- 12	12	± .5 mmf	.36	*			†			†			†		
TCN- 15	15	± .5 mmf	.36	*			15	‡	.30	†			†		
TCN- 18	18	± .5 mmf	.36	*			†			†			†		
TCN- 20	20	± .5 mmf	.36	*			†			†			†		
TCN- 22	22	± 2½%	.30	*			22	‡	.30	†			†		
TCN- 24	24	± 2½%	.30	*			25	‡	.30	†			†		
TCN- 27	27	± 2½%	.30	*			†			†			†		
TCN- 30	30	± 2½%	.30	*			†			†			†		
TCN- 33	33	± 2½%	.30	*			33	‡	.30	†			†		
TCN- 36	36	± 2½%	.30	*			†			†			†		
TCN- 39	39	± 2½%	.30	*			†			†			†		
TCN- 43	43	± 2½%	.30	*			†			†			†		
TCN- 47	47	± 2½%	.30	47	± 10%	.30	47	‡	.30	47	± 10%	.30	47	‡	.30
TCN- 51	51	± 2½%	.30	*			†			†			†		
TCN- 56	56	± 2½%	.30	*			†			†			†		
TCN- 62	62	± 2½%	.30	*			†			†			†		
TCN- 68	68	± 2½%	.30	*			68	‡	.30	†			†		
TCN- 75	75	± 2½%	.30	75	± 10%	.30	†			75	± 10%	.30	75	‡	.30
TCN- 82	82	± 2½%	.30	*			†			†			†		
TCN- 91	91	± 2½%	.30	*			†			†			†		
TCN-100	100	± 2½%	.30	100	± 10%	.30	100	‡	.30	100	± 10%	.30	100	‡	.30
TCN-110	110	± 5%	.30	†			†			†			†		
TCN-120	120	± 5%	.30	†			†			†			†		
TCN-130	130	± 5%	.30	†			†			†			†		
TCN-150	150	± 5%	.30	†			150	‡	.30						
TCN-160	160	± 5%	.30	†			†								
TCN-180	180	± 5%	.30	†			†								
TCN-200	200	± 5%	.30	†			200	‡	.30						
TCN-220	220	± 5%	.30	†			220	‡	.30						
TCN-240	240	± 5%	.30	†			†								
TCN-270	270	± 5%	.30	†			†								
TCN-300	300	± 5%	.30	†			†								
TCN-330	330	± 5%	.30	†			330	‡	.30						
TCN-360	360	± 5%	.30	†			†								
TCN-390	390	± 5%	.30	†			†								
TCN-430	430	± 5%	.30	†			†								
TCN-470	470	± 5%	.30	†			†								
TCN-510	510	± 5%	.30	†			†								
TCN-560	560	± 5%	.30	†			†								
TCN-620	620	± 5%	.30	†			†								
TCN-680	680	± 5%	.30	†			†								
TCN-750	750	± 5%	.30	†			†								

**Name on request.

Centralab Temperature Compensating Capacitors are available in five body sizes, *with most values in the smaller dimensions.* For more information, see your Centralab Distributor.

Centralab
CRL ®
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THE TV FREEZE S OFF

AIREX RADIO CORP.

AND HERE IS THE PERFECT CHASSIS FOR FRINGE AREA, UHF AND VHF RECEPTION . . .

NOW . . . . YOU CAN RECEIVE THE NEW UHF* CHANNELS

ON OUR SUPER DX "630" TV CHASSIS

WITHOUT USING EXPENSIVE OUTSIDE CONVERTERS

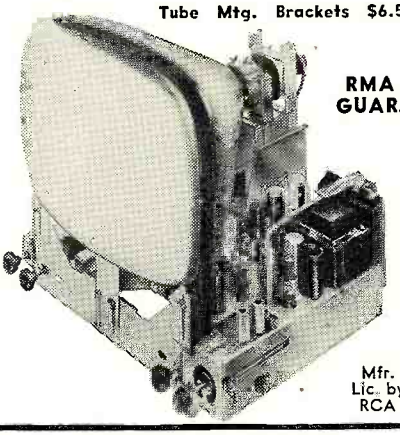
NEW 21 MC HAM BAND WILL NOT INTERFERE WITH OUR SET

This wonderful new 30 tube Super "630" DX handles all tubes from 10" to 24" . . . brings in better reception up to 200 miles without use of boosters. It will work where other sets have failed. Down to 4 microvolt sensitivity. The NEW STANDARD COIL CASCODE TUNER gives you greater sensitivity with less snow,* and is easily adapted to UHF in 2 minutes by merely changing the channel slug (no tools necessary) when a UHF station is installed in your area. Tuner is fully shielded against outside radiation, 6CB6 tubes in video IF, plasticized condensers, synchro lock, Armstrong FM sound system, keyed AGC, set aligned for 21.75 MC. Factory wired, aligned and tested before shipment. Phono and color connections on chassis. All parts and tubes fully guaranteed 3 months.

$49.95
Complete with 12" RCA Hi-Fi Speaker. Fed. Tax Included Less Picture Tube

COMPLETE SERVICE MANUAL FOR ABOVE SET, $1.00!

Tube Mtg. Brackets $6.50



RMA GUAR.

Mfr. Lic. by RCA

SENSATIONAL SPECIAL OFFER OF THE AIREX SUPER DX COMPLETE TV SETS . . . THE FINEST SET VALUE IN ITS PRICE CLASS

These outstanding sets were specially designed to meet our rigid specifications to assure you many pleasant hours of trouble free TV at an unequalled price. The mfr. is licensed by RCA. RMA guarantee. All you have to do is plug in and play.

17"—$154.95
20"—$179.95

AIR KING 6-TUBE CHASSIS
Superhet, AC-DC for custom installation. Complete with loop antenna, all tubes and extra RF stage. Ready to play. Reg. $25.
MATCHING PLASTIC CABINET $3.95
$11.95

17"—$174.95
20"—$199.95

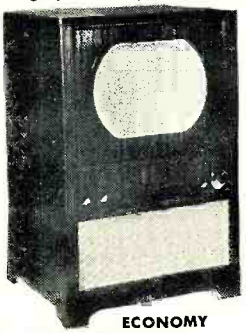
√ Check These Features

• Has standard coil Cascode tuner that brings in reception up to 200 miles • 20 tubes • Large HI-FI speaker • Hand rubbed, satin finished genuine mahogany cabinet • AGC • Moulded plastic condensers • Black, glareless picture tube, guaranteed for 6 months • Adaptable for UHF and color • Synchronized FM audio system • 5 hour heat run at factory • Factory wired, aligned and tested • Mounted in cabinet.

Price Smashing Values in TV Cabinets for "630" Chassis

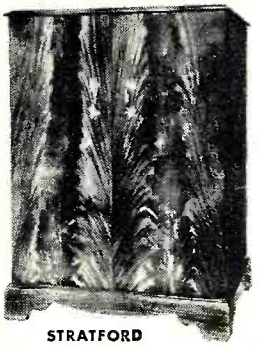
Beautiful, richly finished, hand rubbed mahogany cabinets to suit every taste. They are designed to house the "630" chassis, 12" speaker and up to 20" TV tube. The combination cabinets will hold up to a 20" TV tube, radio and Webster record changer, with ample record space.

All cabinets are equipped with mask and mounting brackets. The perfect chassis deserves a perfect cabinet. It will be a focal point of beauty in your home. Other models in stock. When ordering chassis and cabinet, no tube mounting brackets needed. Send for FREE circular on cabinets only.



ECONOMY
38x22½x22½—16" and 17" tube $49.95
41x25x23—16" to 20" . . 59.95
45x28x25—24" tube . . 74.95
Blonde $10 Additional

ELITE
Combination—39x40x23½. Red antique gen. leather. Gold leaf hand tooling $149.95
In limed oak, gold colored leather 159.95



STRATFORD
40x28½x23½. Genuine crotch Mahogany doors for 20" only . . . $89.95

All merchandise is brand new, factory fresh & fully guaranteed. Mail & phone orders filled upon receipt of certified check or money order for $25 as deposit on TV chassis, 20% on other items. Balance C.O.D., F.O.B. N. Y. Prices subject to change without notice. No Fed. taxes to pay. Prices lower than OPS Regs.

AIREX RADIO CORP. 171 Washington St., N.Y.C. 7, N.Y. Phone WOrth 2-4029

TV TUBE EXTRA

STANDARD BRANDS
BLACK-GLARELESS
Factory New—1st Quality
Guaranteed 1 Year

7JP4*	$14.95	17BP4	$27.95
10BP4*	17.95	20" TV Tube	34.95
16GP4*	24.95	21" TV Tube	39.95
16JP4*	24.95	24" TV Tube	69.95

Ring and Sleeve for 24" Tube . . $7.50
*Guaranteed for 6 months only

TV GOLD PLASTIC MASKS
16" & 17", $4.95; 20" & 21", $7.95; 24", $14.95

TV ANTENNA BARGAINS

Following antennas can be used with our sets and are perfect for fringe area use.

Single Conical	$ 3.95	5 Ft. Sect. Enam. Steel Mast	$1.00
Double Conical With Stacking Bars	8.95	Wall Brackets	.98
Single Vee	4.95	Chimney Mt. Brackets	1.75
Double Vee With Stacking Bars	10.95	Lightning Arrester	.75
		Mast Insul., ea.	.10
		Wall Insul., ea.	.07

AIR KING PORTABLE PHONO & RADIO

6 Tube AM radio, with extra RF stage. 3 speed, turnover cartridge, record player. Complete in simulated alligator leather carrying case. Regularly $100.
$59.95

AUTOMATIC RECORD CHANGER SALE!

GI—3 speed Turnover Cart. **$18.95**
RCA VICTOR 33⅓ & 78 RPM Turnover Cart. **$22.95**

RCA ACCORDION CONE SPEAKER

6" Diam. 21 oz. magnet. 3.2 VC. Regularly $22. Removed from original RCA equipment . . . **$4.95**

RESISTOR KIT

100 Assorted ½ to 2 Watt **$2.49**
1000 lots. **$22.00**

REAL BUY! 300 OHM TV LEAD IN WIRE

14 strands each leg. Heavy duty.
100 ft. . . . . $1.89; 1000 ft. $17.95

"NOW YOU CAN FIX YOUR OWN TV SET" Simplified book. Fix over 1,000 models listed by 39 manufacturers. **$1.00**

SPECIAL BARGAINS

- Espey 7C FM-AM Radio, 12 Tubes . . $69.95
- RCA Hi-fi speaker 4.95
- Standard Coil Cascode Tuner 24.95
- Quam-Nichols 4x6 Dual 2.79
- Regency Booster, Mdl DB410 . . . . . 19.11

COMPLETE LINE 630 PARTS
RADIO TUBES 50% TO 70% OFF LIST

SEND POSTCARD TO BE PUT ON FREE MAILING LIST

earn RADIO TELEVISION

—New Package Unit Plan—PAY AS YOU LEARN

NO MONTHLY PAYMENT CONTRACT TO SIGN!

I Send You 18 BIG KITS OF RADIO-TELEVISION EQUIPMENT

Approved for Veterans Under the G.I. Bill

TRAIN IN 10 MONTHS OR LESS

At Home in Your Spare Time

Now . . . be ready for Radio-Television's big pay opportunities in a few short MONTHS! Frank L. Sprayberry's completely new "Package" training unit plan prepares you in just 10 MONTHS . . . or even less! Equally important, there is NO monthly payment contract to sign . . . thus NO RISK to you! This is America's finest, most complete, practical training—gets you ready to handle any practical job in the booming Radio-Television industry. In just 10 months you may start your own profitable Radio-Television shop . . . or accept a good paying job in this fascinating expanding field at work you've always wanted to do. Mr. Sprayberry has trained hundreds of successful Radio-Television technicians—and stands ready to train you in less than one year, even if you have no previous experience. You learn by DOING . . . actually working with your hands with equipment of special design to illustrate basic theory instead of relying on books alone.

VALUABLE EQUIPMENT INCLUDED WITH TRAINING

The new Sprayberry "package" plan includes many big kits of genuine, professional Radio-Television equipment. While training you actually perform over 300 demonstrations, experiments and construction projects. In addition, you build a powerful 6-tube standard and short wave radio set, a multi-range test meter, a signal generator, signal tracer, many other projects. All equipment is *yours to keep* . . . you have practically everything you need to set up your own service shop. The interesting Sprayberry book-bound lessons and other training materials . . . all are yours to keep.

EARN EXTRA MONEY WHILE YOU LEARN!

All your 10 months of training is AT YOUR HOME in spare hours. Keep on with your present job and income while learning . . . and earn EXTRA CASH in addition. With each training "package" unit, you receive extra plans and ideas for spare time Radio-Television jobs. Many students pay for their entire training this way. You get priceless practical experience and earn generous service fees from grateful customers. Just one more reason why the Sprayberry new 10 MONTH-OR-LESS training plan is the best Radio-Television training in America today. If you expect to be in the armed forces later, there is no better preparation than good Radio-Television training.

FREE 3 BIG RADIO TELEVISION BOOKS

I want you to have ALL the facts about my new 10-MONTH Radio-Television Training—without cost! Act now! Rush the coupon for my three big Radio-Television books: "How to Make Money in Radio-Television," PLUS my new illustrated Television Bulletin PLUS an actual sample Sprayberry Lesson—all FREE with my compliments. No obligation and no salesman will call on you. Send the coupon in an envelope or paste on back of post card. I will rush all three books at once!

SPRAYBERRY ACADEMY OF RADIO
Dept. 25-K, 111 North Canal St., Chicago 6, Ill.

IF YOU ARE EXPERIENCED IN RADIO Men already in Radio who seek a short intensive 100% TELEVISION Training with FULL EQUIPMENT INCLUDED are invited to check and mail the coupon at the right.

Mail Coupon Today!
NO OBLIGATION
No Salesman Will Call

SPRAYBERRY ACADEMY OF RADIO, Dept. 25-K
111 North Canal St., Chicago 6, Ill.

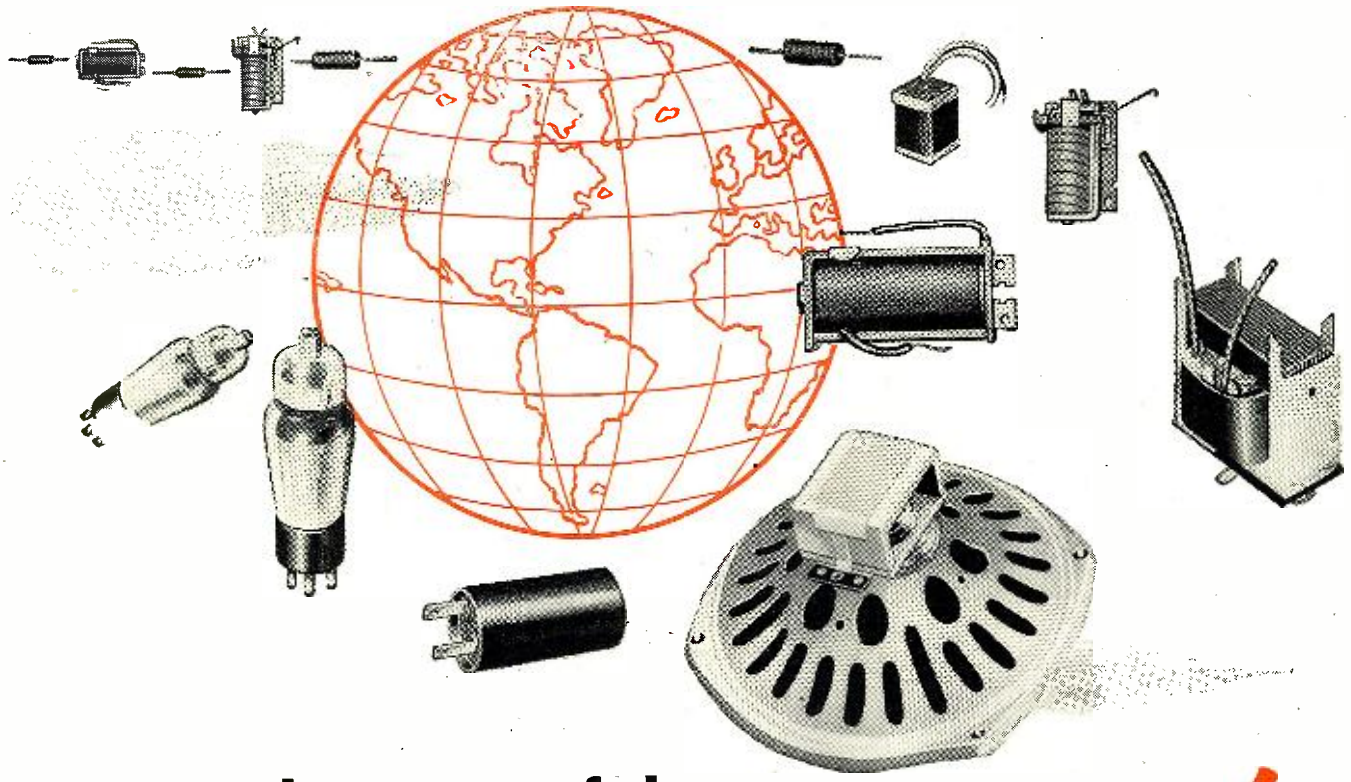
Please rush to me all information on your 10-MONTH Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me.

Name.....Age.....

Address.....

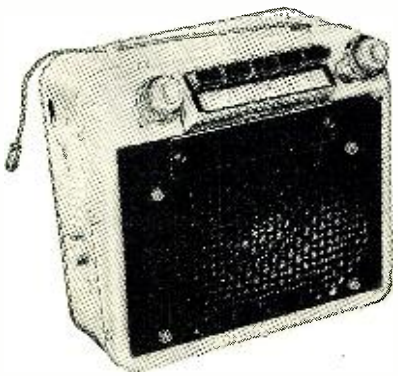
City.....Zone.....State.....

Please check Below About Your Experience
☐ Are You Experienced? ☐ No Experience



Have a Look at some of the

World's Finest Radio Parts!



Ordinary radio parts? Not at all! You see, these automobile radio parts—like thousands of others bearing the Delco Radio name—are of uniform high quality.

More than half of all radio-equipped cars are equipped with Delco Radios—*seven million* in all. Think of the volume-building opportunity for you!

THINGS TO REMEMBER ABOUT DELCO RADIO SERVICE PARTS

1. Offer largest market for original-equipment replacement parts.
2. Made in the world's largest factory devoted exclusively to automobile radios.
3. Designed by one of the largest and most forward-looking engineering groups devoted exclusively to automotive radio.

DELCO RADIO PARTS

A GENERAL MOTORS PRODUCT — A UNITED MOTORS LINE

DISTRIBUTED BY WHOLESALERS EVERYWHERE

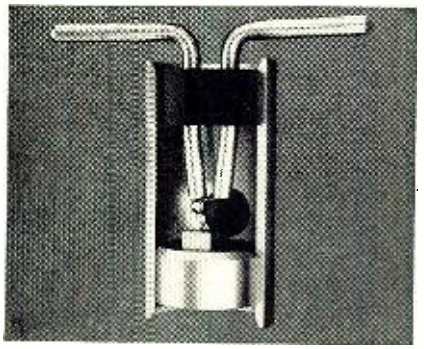
DELCO RADIO

DIVISION OF GENERAL MOTORS CORPORATION

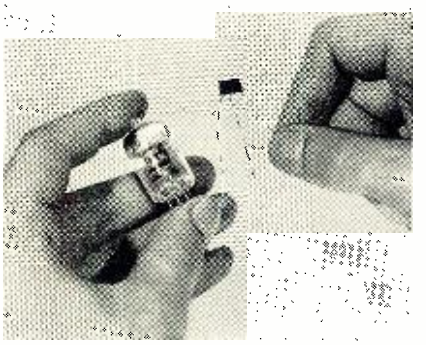
KOKOMO, INDIANA

THE TRANSISTOR

A picture report of progress



FIRST TRANSISTORS were of this point contact type (picture three times life size). Current is amplified as it flows between wires through a wafer of germanium metal. These transistors are now being made at the Allentown plant of Western Electric, manufacturing unit of the Bell System. They will be used in a new selector which finds the best routes for calls in Long Distance dialing.



NEW JUNCTION TRANSISTORS, still experimental, also use germanium but have no point contacts. Current is amplified as it flows through germanium "sandwich" —an electron-poor layer of the metal between two electron-rich ends. This new transistor runs on as little as *one-millionth* of the power of small vacuum tubes.

MUCH HAD TO BE LEARNED, especially about the surface of germanium and the effect of one part in a million of alloying materials. Transistors promise many uses—as amplifiers, oscillators, modulators . . . for Local and Long Distance switching . . . to count electrical pulses.

ASSEMBLY PROBLEMS, such as fixing hair-thin wires to barely visible germanium wafers, have been solved through new tools and mechanized techniques. Finished transistors withstand great vibration and shock. Engineers see many opportunities for these rugged devices in national defense.

MOIST PAPER AND COIN generate enough current to drive audio oscillator using junction transistors. Half as big as a penny matchbox, an experimental two-stage transistor amplifier does the work of miniature-tube amplifiers ten times larger.

A tiny amplifying device first announced by Bell Telephone Laboratories in 1948 is about to appear as a versatile element in telephony.

Each step in the work on the transistor . . . from original theory to initial production technique . . . has been carried on within the Laboratories. Thus, Bell scientists demonstrate again how their skills in many fields, from theoretical physics to production engineering, help improve telephone service.

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.

Spot Radio News

★ ***Presenting latest information on the Radio Industry.***

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

TV THAW STARTS SECOND "GOLD RUSH"

TELEVISION'S envisioned bright horizon, beclouded for nearly four years by conflicting engineering and legislative issues, has at long last been allowed to rise out of the murky mist and display its rich golden rays, spelling a glorious future for sound and sightcasting. For the ice age of TV has come to an end; the ether guardians in Washington have finally issued their historic report, the sixth, declaring that the freeze is over and the pattern has been set for the eventual construction of over 2000 stations in over 1300 communities. The possibility that so many stations may soon be viewcasting is truly quite a staggering fact, for today after 30 years of broadcasting, there are not many more radio stations on the air transmitting from almost as many communities. And that is not the only unusual note. Each of the new TV stations that can be built under the new plan will be able to provide wide coverage and on a round-the-clock schedule, whereas a quarter of the radio stations are still only able to operate during the daytime, and many of those on the air in the evening can be heard satisfactorily for only a few miles.

Notwithstanding the sharp criticism that has been fired at the Commission for the delays and even the allocation plan, as finally evolved, the government specialists merit resounding applause for excellence of the completed report, a 700-odd page affair, truly a herculean task. To compile the official book, over 21,000 pages of testimony and over 800 exhibits had to be studied. In addition, more than 1500 documents filed on the proposed city-by-city assignment table had to be carefully probed.

Commenting on the plan, during an address before the Institute for Education by Radio-TV in Columbus, Ohio, recently, FCC Headman Paul Walker said that it was realized that some would not approve of the assignments because of the allocations in remote areas, the power and tower restrictions and the educational channels. He noted that the plan was . . . "calculated to get stations and service into the smaller and rural areas . . ." even thought it was known that . . . "at the outset some of the communities listed in our table today might be considered too small to support their own stations." "We concluded," he added, "that enterprising individuals will come forward in many such communities to arrange the financing. . . . We considered that the television art is relatively new and that ambitious, ingenious operators will find various means of reducing costs."

The new chairman declared that the Commission's decision means that assignments are available to provide television service to practically every citizen of the country, no matter where he lives. Everyone was aware, Walker continued, that there are some . . . "differences in propagation characteristics of the ultra-high and very-high bands, but those differences are not nearly as significant as some have thought."

Describing the potentialities of the higher frequencies, the Commission's chief declared that . . . "we are convinced that the ultra-high band will be fully utilized and the u.h.f. stations will eventually compete on a favorable basis with stations in the v.h.f." Expressing his own views on the new channels, Walker said: "I have seen u.h.f. demonstrated . . . I am sold on it . . . u.h.f. is going to grow because it has to grow . . . It is needed . . . I suggest that those of you who wish to get into television, and your only chance to do so is via u.h.f., ponder very carefully before passing up that chance . . . You may be gnawed by the same remorse that has gnawed at the hearts of those during this long freeze who failed to file applications for the v.h.f. at a time when they were being granted quickly."

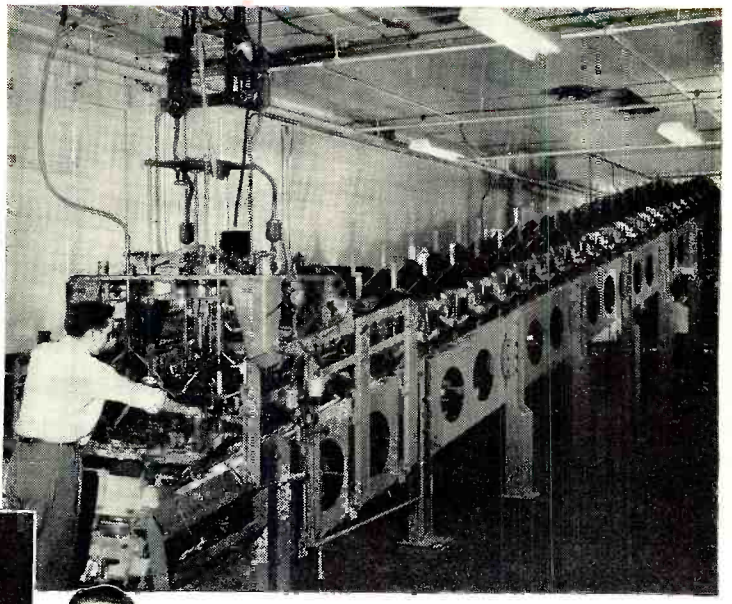
Praising the decision to set aside 242 channels for educators, the Commission's spokesman said that the allocation represents tremendous progress. TV might be used in some way, he felt, to provide instruction for the four-million now in classes, the one-million taking correspondence courses and the seven-million who attend demonstrations and classes conducted by county agents. It was also revealed, during the talk, that some forty per-cent recently interviewed indicated an interest in further education of a systematic kind, such as TV can afford.

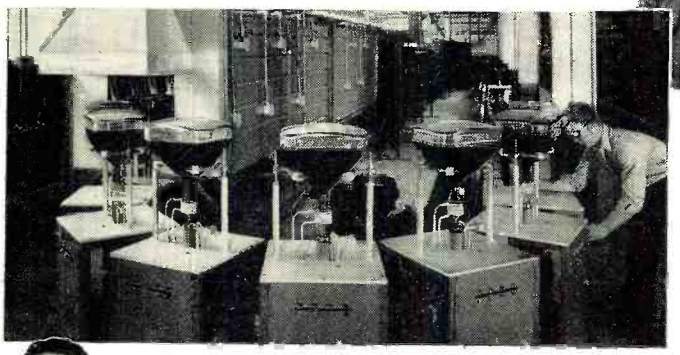
Anticipating the charge that educational institutions would not only be

"Let Me Tell You How It Happened..."

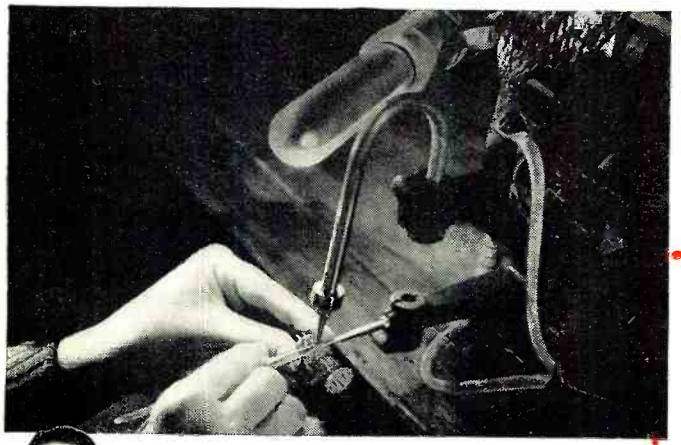
Carl Vineglass,
Al's Radio,
Lawrence, Mass.

"FOR YEARS I'VE BEEN BUYING TUBES...A LOT OF THEM CBS-HYTRON. But I didn't know too much about CBS-Hytron. Sure, I'd seen their ads. Read about their original rectangular tube. Their IX2A, 6BQ6GT, 12BH7, 12BY7, etc. Their handy service tools. (I just couldn't get along without my Soldering Aid.) Their Budget Plan. And so on.





"I like to know the fellows I buy from though. So last week I drove over to Salem. The CBS-Hytron gang, from President Bruce A. Coffin down, gave me a real welcome. Also the low-down on CBS-Hytron tubes, and what's behind them.



"First off, I discovered that CBS-Hytron is *big*... and getting bigger fast. I saw receiving tubes rolling out of their combined Salem and Newburyport plants at 300 a minute. With their new Danvers plant, it'll be 600 a minute! And their picture tubes run at 5000 a day! You may already know that CBS-Hytron is now a division of Columbia Broadcasting System, Inc.

"CBS-Hytron has a saying, 'Tubes are known by the company they keep.' In their shipping rooms, I saw tubes being rushed out to most of the top manufacturers and jobbers I ever heard of... and lots I don't even know.

"The reason for all the popularity wasn't hard to find. I never saw such painstaking manufacturing and testing in my life. From raw materials to finished tube. Every single tube gets the works.

"And is making tubes complicated! That ingenious machinery does everything but talk. The flying fingers of the girls assembling the tubes, though, are what caught my eye. I just couldn't believe you could get that watch-like precision with that amazing speed. And talk about engineers! I saw electronic, mechanical, chemical, metallurgical, production, industrial engineers by the score.

"I've read that CBS-Hytron's picture-tube plant is the most modern in the world. I believe it. It's really something the way that push-button, automatic plant handles those big bottles. And that new Danvers receiving-tube plant is more of the same. Floor space covers approximately five acres. Main production floor is longer (500 feet) than the longest home run ever hit by Babe Ruth. That plant has everything. They tell me the whole idea was to produce at economical top speed the finest receiving tubes in the world. To my way of thinking, they succeeded.

"Believe me, I'm glad I made that trip to CBS-Hytron. They're a real on-their-toes outfit. Before I never was too fussy what standard brand of tube I bought. But now I want CBS-Hytron, and that's that! You would, too, if you'd seen what I have."

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to all service-dealers and their distributors. You are mighty welcome to drop in at CBS-Hytron any time. How about this summer?

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HYTRON
RADIO AND ELECTRONICS CO.
A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

MAIN OFFICE: SALEM, MASSACHUSETTS

unable to finance television operations, but show little interest in accepting the challenge and favor a continuing delay before filing for a channel, Walker noted that there is nothing in the report that offers any assurance that the channels will be reserved . . . "as long as the grass grows and the water runs." For at the end of one year, he added, anyone . . . "may request the Commission to change an (unused) educational assignment to a commercial assignment."

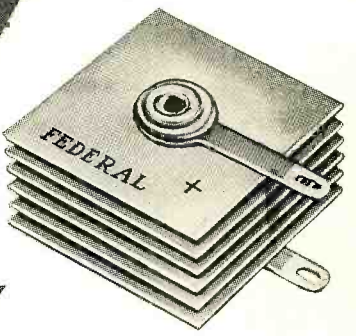
Earlier, in an address before the National Association of Radio and Television Broadcasters in Chicago, Walker issued another warning, directed, however, at the public and industry, and concerning the problem of application processing. He said that it was realized that everyone will expect a land-office business in the dispensing of grants as soon as the report becomes effective. "It just will not happen that way," he declared. The Commission does not have the staff required to roll out the grants, and a bottleneck will undoubtedly appear. Unfortunately, there are only seven examiners on hand who can conduct hearings. And they are obligated to handle other cases involving common carrier and special radio services. Not only is the Commission short of examiners, but engineers, lawyers, and accountants. The new budget, recently approved by the House committee, has been of little help. In fact, the situation has been aggravated, since some $7000 less than last year's budget has been allocated for general operations. In an attempt to assuage the Commission, the House appropriated $51,810 for . . . "new positions in connection with TV applicant processing," which was described as a piddling sum for the titanic job ahead.

SPECIFICALLY, the sixth report not only includes the assignment table, but station powers, separations, types of commercial and educational stations, processing procedures, and rules and technical standards. Many of the new rulings alter present concepts. For instance, a single class of stations now exists, in contrast to the three types that have been accepted as standard: community, metropolitan, and rural. The minimum effective radiated power has also been fixed at 50 kilowatts for stations serving a city with a population of one-million or more; 10 kilowatts in cities with from a quarter-of-a-million to a million people; 2 kilowatts for cities with from 50,000 to 250,000 population and 1 kilowatt for cities with less than 50,000. Maximum erp powers vary for channels. As an example, on Channels 2 to 6, 100 kilowatts can be used; on 7 to 13, 316 kilowatts; and on the ultra-high Channels 14 to 83, 1000 kilowatts.

Three geographic zones have also been set up, with channels assigned in accordance with the minimum mileage separations designated for each

(*Continued on page* 94)

"It pays to replace with the BEST" Federal-



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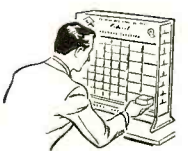

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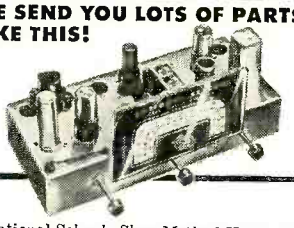

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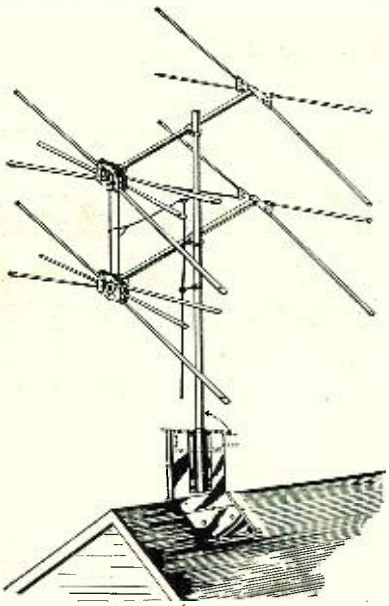

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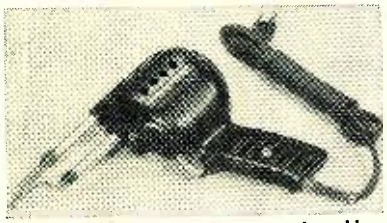

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1949-50—Dodge, Plymouth (with grill panel)

List Price, **$59.95**

YOUR PRICE.....**$41.95**

Radio Parts Company, 614 RANDOLPH ST., CHICAGO 6, ILL.

How far ahead can you be next year . . .

IN TV AND ELECTRONICS?

Send for this free CREI booklet today... and find out!

THIS BOOKLET can mean the difference between small, w-i-d-e-l-y s-p-a-c-e-d salary increases—and rapid advancement. Between routine work—and challenging opportunity. Between constantly defending your job against better-trained men — and dynamic confidence. Between short-circuited hopes—and high-powered ambition.

An exciting new world has opened up with such superspeed that even the most optimistic electronic experts fall short in their predictions of expansion.

Think of the 109 TV stations now in operation, and the 2,053 new TV stations which the recent freeze-lifting will make possible. Think of the 16,785,044 TV sets now in use and the millions more soon to come. Think of the 100,000,000 radios in current operation. (95% of the nation's homes have one or more sets.) Think of the tremendous defense orders now being placed for electronic equipment and installations.

Think of the thousands of radio-equipped fire and police departments throughout the U.S. Of the many radio-equipped railroads, of the hundreds of cities with 2-way radio service for cars and cabs. Think of the wide-ranging field of aviation communications—radio-controlled aircraft, navigation-and-traffic control, airport stations.

Think of the maritime world with its navigational aids, fathometers, ship-to-shore and ship-to-ship communications and radar. Think of electronic heating, fax and ultra-fax, of electronic medicine, and all the other applications of electronic know-how.

Countless positions must be filled—in development, research, design, production, testing and inspection, manufacture, broadcasting, telecasting and servicing. Who will get those positions? You—if you prepare today—if you are alert and have the ambition to advance your knowledge. You—if you take 2 minutes to send for a free copy of "Your Future in the New World of Electronics."

This helpful book shows you how CREI Home Study leads the way to greater earnings through the inviting opportunities described above.

However, being an accredited technical school, CREI does not promise you a "bed-of-roses." You have to translate your willingness to learn into saleable technical knowledge—via *study*. Since its founding in 1927, CREI has provided thousands of professional radiomen with technical educations. During World War II, CREI trained thousands for the Armed Services. Leading firms choose CREI courses for group training in electronics at company expense, among them United Air Lines, Canadian Broadcasting Corporation, Trans Canada Airlines, Sears Roebuck & Co., Bendix Products Division, All-American Cables and Radio, Inc., and RCA-Victor Division.

CREI courses are prepared by recognized experts, in a practical, easily-understood manner. You get the benefit of time-tested materials, under the personal supervision of a CREI Staff Instructor. This complete training is the reason why CREI graduates find their diplomas keys-to-success in Radio, TV and Electronics. CREI alumni hold top positions in America's leading firms.

At your service is the CREI Placement Bureau, which finds positions for students and graduates. Although CREI does not guarantee jobs, requests for personnel currently exceed supply by far.

Talk to men in the field and check up on CREI's high standing in electronics instruction. Determine for yourself right now that your earnings are going to rise with your knowledge—and that you get your rightful place in the Age of Electronics. All this CREI can promise you, provided you sincerely want to learn. Fill out the coupon and mail it today. We'll promptly send you your free copy of "Your Future in the New World of Electronics." The rest—the future—is up to you.

MAIL COUPON FOR FREE BOOKLET

CAPITOL RADIO ENGINEERING INSTITUTE

Dept. 116D, 16th & Park Rd., N.W., Washington 10, D. C.

Send booklet "Your Future in the New World of Electronics" and course outline.

CHECK FIELD OF GREATEST INTEREST

- ☐ TV, FM & Advanced AM Servicing
- ☐ Practical Television Engineering
- ☐ Broadcast Radio Engineering (AM, FM, TV)
- ☐ Practical Radio Engineering
- ☐ Aeronautical Radio Engineering

Name .....

Street .....

City ..... Zone ..... State .....

If residence school in Wash., D. C., preferred, check here ☐

Within the INDUSTRY

R. C. C. DUBOIS, JR. has been named sales manager for *RCA* mobile and microwave communications equipment.

Since 1950, he has been field sales coordinator for mobile communications and prior to that he served as a sales engineer for *RCA* broadcast and television equipment and the *RCA* Tube Department. He joined the company in 1946 after serving as a lieutenant in the U.S. Navy.

Mr. Dubois succeeds Dana Pratt, who has moved into the position of product manager for *RCA* broadcast transmitters.

* * *

TELETRONICS LABORATORY, INC. has moved its general offices and main plant to its recently-completed plant on Kinkel Street in Westbury, N. Y. The plant previously occupied by the company will be maintained as a laboratory and for engineering offices. The new building increases the company's available facilities approximately four times . . . **SHELDON ELECTRIC DIVISION** has moved its Chicago branch office and warehouse to 2300 N. Ashland Avenue where it now occupies an entire two-story structure. . . **LOWELL MANUFACTURING COMPANY** has opened a new plant at 3030 LaClede Station Road in St. Louis, Missouri to handle the increased demand for its line of speaker baffles and accessories . . . **CHESTER CABLE CORPORATION** of Chester, New York is currently in the process of adding 25,000 square feet of floor space to its existing facilities to handle the production of all types of industrial wiring material. This is the third time in the company's ten year history that such an expansion has been required.

* * *

WELLS R. CHAPIN has joined the *General Electric Company's* Electronics Division as a district sales manager for radio and television broadcasting equipment.

In his new position, Mr. Chapin will be responsible for the sale of *G-E* broadcast equipment throughout Missouri, Kansas, Nebraska, and most of Illinois and Indiana. He will make his headquarters at 4227 Lindell Blvd., St. Louis, Mo.

He was formerly chief engineer of radio station WIL in St. Louis and during the war worked as a field engineer for the *Raytheon Manufacturing Company*. His experience includes work on many types of radar, sonar, and radio communications equipment.

Mr. Chapin has been a ham for 32 years and is active in amateur activities in the St. Louis area.

* * *

HERMAN C. BELDEROK of Freeport, Long Island, New York has been named president of the newly-formed Alumni Association of *RCA Institutes*.

Other officers of the new organization include: Isaac Boreshafsky, vice-president; Rose Scarpa, treasurer; and Carl Bollinger, secretary.

The purpose of the Association is to create closer ties between graduates of the Institute and to further common interests in education, social activities, and technical recognition. All graduates of *RCA Institutes* are eligible to become members of the Association.

Alumni should contact the secretary at 157 E. 89th Street, New York, New York for additional information on scheduled meetings.

* * *

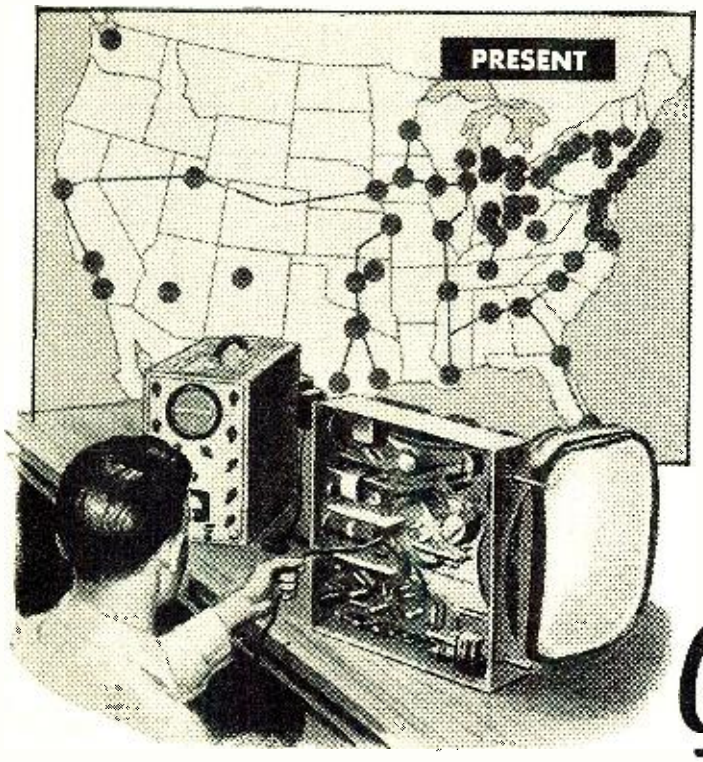
BRUCE E. VINKEMULDER has been named distributor sales manager of the Capacitor Division of *Sangamo Electric Company*, Springfield, Illinois.

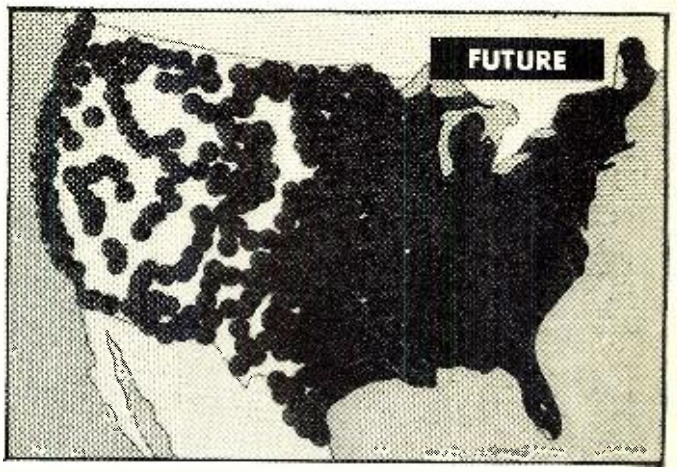
He joined the company in 1946 and has been in charge of engineering publications for electronic equipment manufactured by the firm at its Springfield plant.

Since the Capacitor Division is located in Marion, Illinois, Mr. Vinkemulder has moved his headquarters to the Marion factory.

* * *

ULTRASONIC CORPORATION of Cambridge, Mass. has acquired **THE MONITOR CONTROLLER COMPANY** of Braintree, Mass. The parent company will use the new subsidiary's production facilities for the manufacture of certain of its sonic and electronic computer equipment in addition to the continued production of *Monitor's* motor control and switch gear equipment . . . **COLUMBIA ELECTRONICS LTD.**, formerly of Los Angeles and North Hollywood, has merged with **ARROW SALES, INC.**, formerly of Chicago, and will operate as **ARROW SALES, INC.** with headquarters in its own recently-constructed building at 7640 Varna Avenue, North Hollywood, California . . . **NATIONAL ELECTRIC PRODUCTS CORPORATION** has announced the establishment of an Electronics Division with headquarters at Ambridge, Pa. The new division will consist of two departments—television and radio, and





FUTURE—*How new TV stations are expected to cover the nation.*
PRESENT—*Chart shows extent of current coverage.*

Cash in on this Great Opportunity

. . . for good-pay jobs in TV SERVICING

YES, thousands of opportunities are going begging right now for good-pay jobs in TV Servicing.

The lifting of the "freeze" on new television stations clears the way for the expansion of the industry for 2,053 new stations, in 1,291 communities in the United States, its territories and possessions. There are only 108 stations telecasting now.

This is your golden opportunity to get all set for a good job that can mean employment security and a bright future for years to come. It's a great opportunity that can lead you, as a trained and experienced TV Serviceman, into establishing a profitable business of your own.

Big shortage of TV Technicians creates opportunities—NOW

Industry experts have estimated over 130,000 experienced TV technicians will be needed for the installation, trouble-shooting and repairing of television receivers in use by 1955. There are fewer than 50,000 fully trained TV service technicians available today. What an opportunity this creates for you!

Here are some of the good-pay jobs you can choose—installation and trouble-shooting of TV receivers in homes . . . bench technician in radio-TV service shops . . . inspector, tester, repairman, field serviceman for TV receiver manufacturers, distributors and dealers . . . testing and servicing with electronic instrument manufacturers and companies with military contracts for electronic equipment . . . civilian serviceman with U. S. Military Bases . . . your own TV service shop—and many more.

RCA Institutes home study course trains you in your spare time

If you are associated with the radio-electronics industry, with no experience in TV servicing, the addition of the RCA Institutes Home Study Course in TV Servicing to your present experience will quickly qualify you to step out and grasp the good jobs now open in television.

The RCA Institutes course gives you a sound knowledge of television fundamentals . . . intensive practical instruction on the proper maintenance and servicing of TV receiver circuits . . . teaches you the "short cuts" on TV installation and trouble-shooting. Learn TV servicing (based on actual experience of hundreds of skilled technicians) from RCA engineers and experienced instructors—pioneers and leaders in radio, television and electronic developments.

RCA Institutes home study course planned to your needs

You keep your present job. In your spare time, you study at home. You learn "How-to-do-it" techniques with "How-it-works" information in easy-to-study lessons prepared in ten units. Cost of RCA Home Study Course in Television Servicing has been cut to a minimum—as a service to the industry. You pay for the course on a "pay-as-you-learn" unit lesson basis. You receive an RCA Institutes certificate upon completion of the course. The RCA Institutes Home Study Course in Television Servicing is approved by leading servicemen's associations.

Don't pass up this lifetime opportunity for financial security and a bright future in TV.

SEND FOR FREE BOOKLET

Mail the coupon—today. Get complete information on the RCA INSTITUTES Home Study Course in Television Servicing. Booklet gives you a general outline of the course by units. See how this practical home study course trains you quickly, easily. Mail coupon in envelope or paste on postal card.

RCA Institutes conducts a resident school in New York City offering day and evening courses in Radio and TV Servicing, Radio Code and Radio Operating, Radio Broadcasting, Advanced Technology. Write for free catalog on resident courses.

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A SERVICE OF RADIO CORPORATION of AMERICA
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Without obligation on my part, please send me copy of booklet "RCA INSTITUTES Home Study Course in TELEVISION SERVICING." (No salesman will call.)

Name_____
(please print)

Address_____

City_____ Zone_____ State_____

radar. The new division will manufacture and distribute a line of television antennas, masts, and a complete line of TV roughing-in materials, as well as special types of wire for TV use . . . **AUDIO ARTS ASSOCIATES** has been established at 1323 South Michigan Avenue, Chicago 5, Illinois to distribute high-fidelity audio-video equipment and supervise its installation and servicing. The company is also offering custom engineering and design services.

* * *

ROBERT J. TARLTON has been named chief field engineer for *Jerrold Electronics Corp.*, succeeding Caywood C. Cooley who recently became the firm's sales manager.

Mr. Tarlton formerly served as general manager of the *Panther Valley Television Co., Inc.*, one of the best known community antenna systems in the country.

As chief field engineer, he will assume the responsibility for guiding research and development of equipment and providing field service and maintenance for communities using *Jerrold* equipment throughout the U. S.

* * *

RADIO CORPORATION OF AMERICA has presented a documentary record of more than a half-century of radio pioneering and development to the Massachusetts Institute of Technology as an industrial supplement to the M.I.T. Library.

The historical array of documents, known as the "*RCA*-Clark Collection of Radioana," represents the equivalent of approximately 5000 volumes. It includes correspondence files of early radio companies, photographs, blueprints, specifications, research reports, records of litigation, log books, unpublished biographies of the great pioneers, scrapbooks, etc. with particular emphasis on the period between 1900 and 1935. George H. Clark, M.I.T. '03 and an *RCA* official, collected the material.

* * *

THOMAS B. KALBFUS has been appointed general radio and television sales manager for the *Westinghouse Electric Supply Company*. The supply firm is the national wholesale marketing outlet for the *Westinghouse Electric Corporation*.

In his new capacity, Mr. Kalbfus will be responsible for the distribution, sales, advertising, and promotion of the company's radio and television receivers through the supply firm's 110 branches.

A native of Rochester, New York,

(*Continued on page* 80)

Superior's

TE EV S ON BAR GENERATOR

THROWS AN ACTUAL BAR PATTERN ON ANY TV RECEIVER SCREEN!!

Two Simple Steps

1. **Connect Bar Generator to Antenna Post of any TV Receiver.**
2. **Plug Line Cord into A.C. Outlet and Throw Switch.**

RESULT: A stable never-shifting vertical or horizontal pattern projected on the screen of the TV receiver under test.

Features:

1. Provides linear pattern to adjust VERTICAL linearity, height, centering.
2. Provides linear pattern to adjust HORIZONTAL drive, width, peaking, linearity, centering.
3. Provides vertical sweep signal for adjusting and synchronizing vertical oscillator discharge and output tubes.
4. Provides vertical signal to replace vertical oscillator to check vertical amplifier operation.
5. Provides horizontal sweep signal for adjusting and synchronizing horizontal oscillator A.F.C. and output tubes.
6. Provides horizontal sweep signal to check H.V. section of fly-back and pulse operating power supplies.
7. Provides signal for testing video amplifiers.
8. Can be used when no stations are on the air.

Specifications:

Power Supply: 105-125 Volt 60 Cycles
Power Consumption: 20 Watts
Channels: 2-5 on panel, 7-13 by harmonics
Horizontal lines: 4 to 12 (Variable)
Vertical lines: 12 (Fixed)
Vertical sweep output: 60 Cycles
Horizontal sweep output: 15,750 Cycles

TV BAR GENERATOR COMES COMPLETE WITH SHIELDED LEADS AND DETAILED OPERATING INSTRUCTIONS. ONLY . . .

39.95 NET

SEND FOR YOUR *FREE* COPY OF OUR CATALOG TODAY!

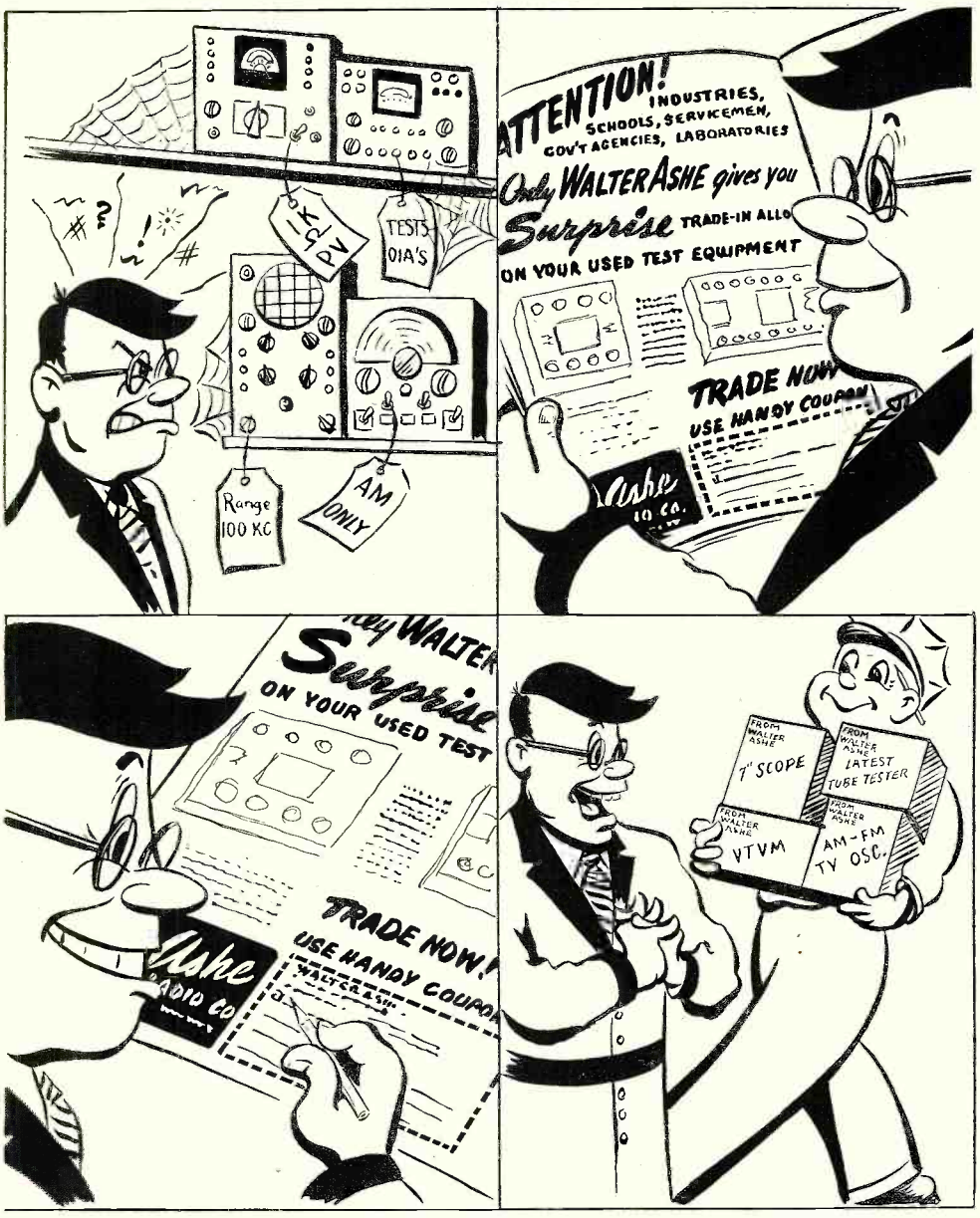
THE "SUPERIOR" LINE

We have been manufacturing Test Equipment for twenty years . . . rugged instruments designed for all 'round use—in the shop—in the basement—in the house. Our units can be piled in the back of your car with the rest of your gear. Accurate? We *must* make our units accurate to required tolerances to stay in this business. Not the 1/10th of 1% required by laboratory technicians but the 2% accuracy required for service work. Price? Compare the dealer's price of *any* model in our line with the price of any comparative unit. Ours is *always* lower priced.

Write Dept. RN-6 for your FREE Catalog

Manufactured and Guaranteed by
SUPERIOR INSTRUMENTS CO.
227 Fulton Street, New York 7, N. Y.

BUY IT AT YOUR RADIO PARTS JOBBER.



Choose From These Famous Brands

- B&W AUDIO OSCILLATOR
- SYLVANIA SCOPES
- SYLVANIA TUBE TESTERS
- RCA VOLTOHMYSTS
- HICKOK SIGNAL GENERATORS
- HICKOK TUBE TESTERS
- HICKOK SCOPES
- HICKOK CROSS HATCH GENERATOR
- HICKOK VTVM'S
- HICKOK VOLTAGE CALIBRATOR
- HICKOK 650 VIDEO GENERATOR
- JACKSON OSCILLATORS
- JACKSON CONDENSER TESTER
- JACKSON SCOPES
- JACKSON SIGNAL GENERATORS
- EMC VOM'S
- EMC VTVM'S
- SUPERIOR INSTRUMENTS *777* TUBE TESTER
- SUPERIOR INSTRUMENTS VOM'S
- SUPERIOR INSTRUMENTS SIGNAL GENERATORS
- SUPERIOR ELECTRIC BAR GENERATOR
- SUPERIOR ELECTRIC 670 VOM
- PRECISION APPARATUS SIGNAL GENERATORS
- PRECISION APPARATUS SCOPES
- PRECISION APPARATUS TUBE TESTERS
- PRECISION APPARATUS EV-20 VTVM
- EICO KITS
- EICO WIRED UNITS
- TRIPLETT VOM'S
- TRIPLETT VTVM'S
- SIMPSON VTVM'S
- SIMPSON VOM'S
- SIMPSON FIELD STRENGTH METER
- SIMPSON SIGNAL GENERATORS
- SIMPSON GENESCOPE
- SIMPSON MIRRORSCOPE
- SIMPSON CAPACITY BRIDGE
- SIMPSON OSCILLOSCOPE CALIBRATOR

NOW! HISTORY-MAKING TRADE-IN ALLOWANCES ON YOUR USED TEST EQUIPMENT

So great is the demand for our used, reconditioned test equipment that stocks are depleted. As a result, we have had to do something drastic to build up our supply. So we're forced to go higher than ever before with "Surprise" trade-in allowances on used test instruments. That's why you can now get the new equipment you need with the least possible strain on the old pocketbook. So make your choice from our complete stocks now on hand and ready for immediate delivery. Every instrument in factory-sealed carton. Get your trade-in deal working right now. Wire, write, phone or use the handy coupon.

All prices F.O.B. St. Louis • Phone CHestnut 1125

FREE! NEW 1952 CATALOG

Walter Ashe RADIO CO.
1125 PINE ST. • ST. LOUIS 1, MO.

Walter Ashe Radio Co. RTN-52-6
1125 Pine St., St. Louis 1, Mo.

☐ O. K. Walter, *Rush* "Surprise" Trade-in-offer on my

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for _____
(show make and model No. of new equipment desired)

☐ Rush Free Copy of your new Catalog.

NAME_____ ADDRESS_____

CITY_____ Zone____ STATE_____

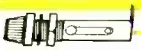
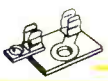
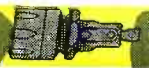
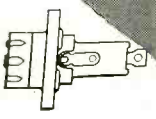
SEND FOR YOUR COPY TODAY!

Counterman Sales Aid Released By Littelfuse

The first completely illustrated list price sheet on fuses is published by Littelfuse, Inc., 1865 Miner Street, Des Plaines, Illinois. A four-page sheet contains actual-sized drawings of 25 fuse types and blowing characteristics.

By matching the blown fuse to the illustration the jobber counterman or service man can determine, quickly and accurately, the fuse needed.

A companion sheet accurately illustrates and prices various assortments and kits as well as the complete line of fuse mountings for quick, sure identification.

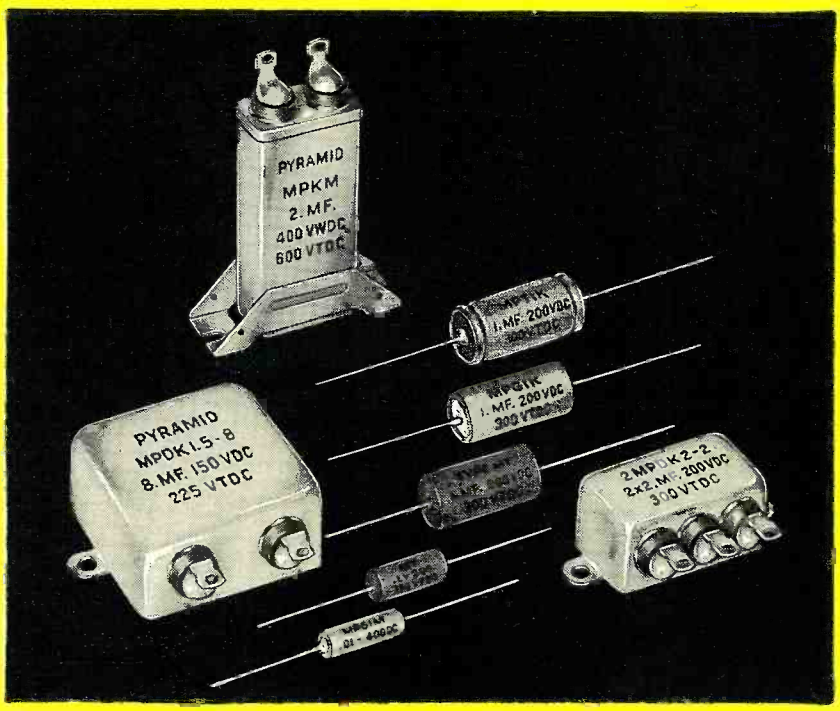
Bakelite In-line Fuse Retainers Assembled with Lead		For SFE For SFE For SFE For SFE 1 For SFE 2	
3AG Fuse Extractor Posts		Screwdriv	
		Finger ope	
		Miniature	
		Watertight	342006 2.35
3AG Mountings		Can cover, one pole, one spare	350019 1.00
		Can cover, one pole	351002 .40
		Hinged can cover, one pole	351005 .50
		Can cover, two pole	351007 .65
		Hinged can cover, two pole	351009 .75
		Through panel, one pole	353001 .25
3AG Mountings with Screw Terminals—Type "T"		Last two digits of catalog number indicate number of poles—as 356001, one pole; 356010, ten poles	
356(000) Series		1 Pole to 12 poles (list per pole)	.35
3AG Mountings with Solder Terminals—Type "S"		Last two digits of catalog number indicate number of poles—as 357001, one pole; 357010, ten poles	
357(000) Series		1 Pole to 12 poles (list per pole)	.15
8AG Fuse Extractor Posts	 	Screwdriver operated Finger operated	371001 .45 372001 .45
Fusible Binding Posts	 	For 1/4—28 thread For 10 —32 thread (.187) For 1/4—32 thread For 8 —32 thread For 1/4—40 thread	373428 1.50 373032 1.50 373432 1.50 373832 1.50 373440 1.50
8AG Mountings		Through panel, one pole Meter-back	383001 .25 383002 .20
8AG Mountings with Solder Terminals—Type "S"		Last two digits of catalog number indicate number of poles—as 387001, one pole; 387010, ten poles	
387(000) Series		1 Pole to 12 poles (list per pole)	.15
4AG Fuse Extractor Post		Watertight	442006 2.35
4AG Mountings with Screw Terminals—Type "T"		Last two digits of catalog number indicate number of poles—as 456001, one pole; 456010, ten poles	
456(000) Series		1 Pole to 12 poles (list per pole)	.40
5AG Mountings with Screw Terminals—Type "T"		Last two digits of catalog number indicate number of poles—as 556001, one pole; 556010, ten poles	
556(000) Series		1 Pole to 12 poles (list per pole)	.50
5AG Fuse Extractor Post		Watertight	571004 1.50

BURTON BROWNE ADVERTISING

Now in **MASS PRODUCTION...**

PYRAMID ULTRA-COMPACT

metallized paper capacitors



PYRAMID Series M CAPACITORS use a specially-prepared metallized paper, providing all-important savings in size and weight. . . . Pyramid now produces large quantities of these capacitors in a wide variety of cardboard or hermetically sealed metal containers.

Your letterhead inquiries are invited

PYRAMID ELECTRIC COMPANY • 1445 HUDSON BLVD., North Bergen, N. J.

WTTV in Bloomington, Ind., has developed several popular "live" shows which are of local interest and feature "home-towners."

WHAT'S AHEAD for Small-Town Television?

With the lifting of the freeze a potential of nearly 2060 new stations exists. Careful planning is required before such stations go on the air. Here are some factors to consider.

By
NORMAN SKLAREWITZ

LIKE prosperity of the 1930's, small-town television in the '50's has been "just around the corner" for almost four years. During that time, a good percentage of the nation has impatiently awaited the advent of this, the most fabulous medium of mass entertainment that the world has ever seen.

Now finally, in the summer of 1952, it seems that we've at last rounded that elusive corner. Video broadcasting in farm towns, western county seats, and in dozens of other small and medium-sized communities will undoubtedly be a reality before the end of the year.

Now that the FCC, lifting its long-standing "freeze" on new station construction, has opened the door for 2053 potential stations throughout the U. S., the much heralded "gold rush" for building permits and licenses has begun. Even so, it is a safe bet that while you read this page, there is still as much fuss and confusion going on over the actual status of small-town TV as there was six months ago.

Of the more than 2000 new stations that will eventually be built, less than 100 will actually be putting out a signal before Christmas. This may come as a rude shock to many millions who thought they'd be seeing the World Series from their parlors regardless of where they lived. That just won't be.

In view of the fact that owners have been desperately trying to get on the air for years, the public and the industry alike are obviously going to ask a loud "Why?" Everyone assumed that only release from government restrictions was needed to open up these new stations.

But the situation isn't that simple. An understanding of two basic problems is needed to fully appreciate the complex background of the present picture. The first involves the reasons for the construction freeze in the first place. The second must take into consideration the many technical, legal, and financial issues involved in putting this unprecedented number of new stations on the air.

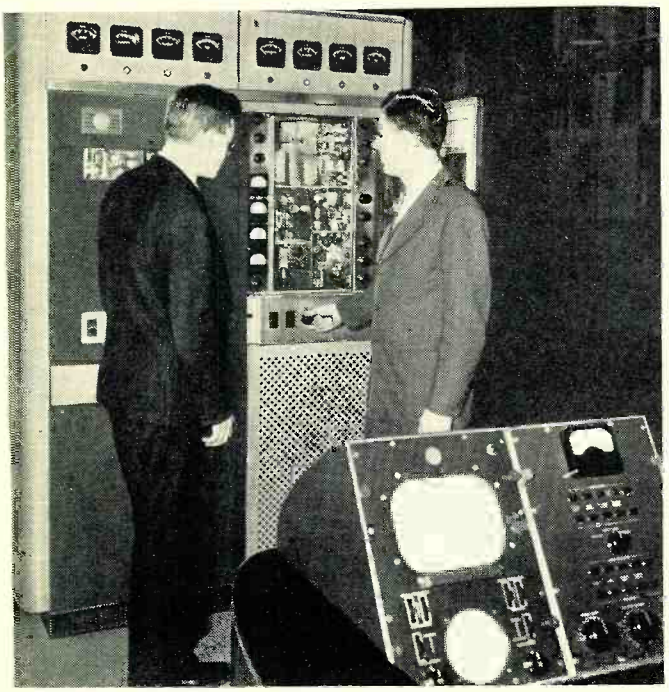
The freeze went into effect suddenly on September 30, 1948 when the FCC issued its now-famous "Report and Order" that prohibited any new TV stations from going on the air. At that moment 107 stations, all on v.h.f. channels, were in operation.

The halt was supposed to last only a short time. During this period, engineers were to work out details of proper separation of stations on the same and adjacent channels. This was necessary since certain stations were experiencing interference due to tropospheric bending of the waves far beyond the line of sight and into the service areas of other stations.

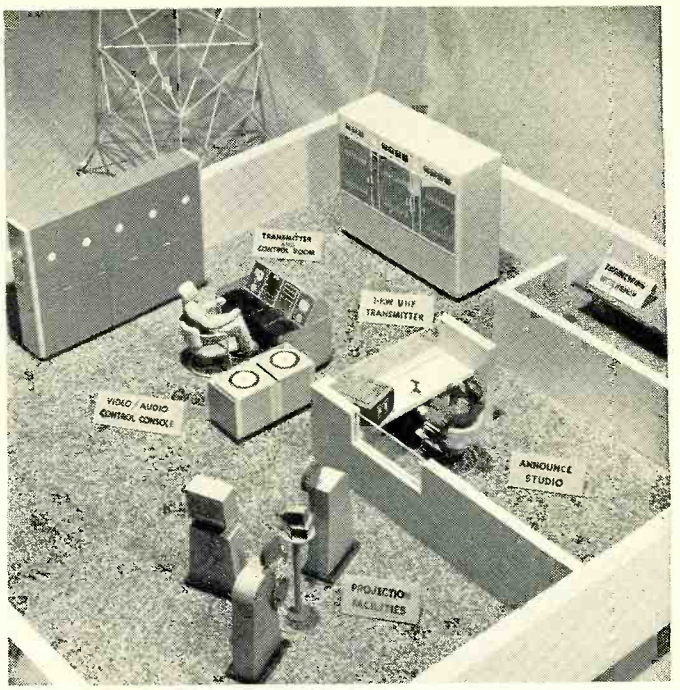
The 485-foot tower of WHBF-TV in Rock Island, Illinois. The antenna is in the downtown business section and adjoins the WHBF studio shown in front of steel tower.

That seemed harmless enough at the time. However, as the study moved along, the technicians found they were getting into something that involved more than simple frequency adjustment. Merely theoretical information about tropospheric effects in the band was available and new data could be had only by making involved tests and checks at different points around the country.

That took time and only served to reveal that more study was needed. The FCC found, for example, that separation of v.h.f. stations varied with their location in the country. The average figure was greater in the Gulf States area, for example, where tropospheric effects are prevalent for long periods of time, than it was in the thickly populated centers of the East where there was a greater demand for



RCA's TT500A 500-watt transmitter which has been designed for small-town installations. Compact in construction, the unit is housed in two identical cabinets, one for video and the other for audio. Console in foreground controls transmitter.



Model layout of RCA's "Basic Buy" station employing a 1 kw. u.h.f. transmitter. With the film facilities and announcing booth provided, network, film, slides, spots, and remote pick-ups can be handled by these relatively modest TV facilities.

	V.H.F.	U.H.F.
RADIATED POWER	10 KW.	20 KW.
Simplest station, film and network facilities only, no live cameras	$137,500	$145,000
Tower (if not available locally)	31,000	31,000
Total	$168,500	$176,000
Local studio equipment (two cameras and simple lighting for one studio)	70,000	70,000
Total	$238,500	$246,000
Remote pickup truck with relay (does not include additional live cameras)	24,700	24,700
Total	$263,000	$270,000

Note: The u.h.f. stations in cities under 1,000,000 population may start at 20 kw. radiated power at the costs indicated and then add an amplifier later to increase power to 200 kw. radiated.

Approximate costs for simplified TV stations suitable for small-town operation.

The Du Mont nine-channel master control studio director's console which gives the director complete control of all programs originating either inside or outside of the studio. The TV director sits at the center desk with an audio engineer at his left and a program director at his right. The console can lap, fade, superimpose, etc.

v.h.f. channels and where transmission characteristics were more favorable.

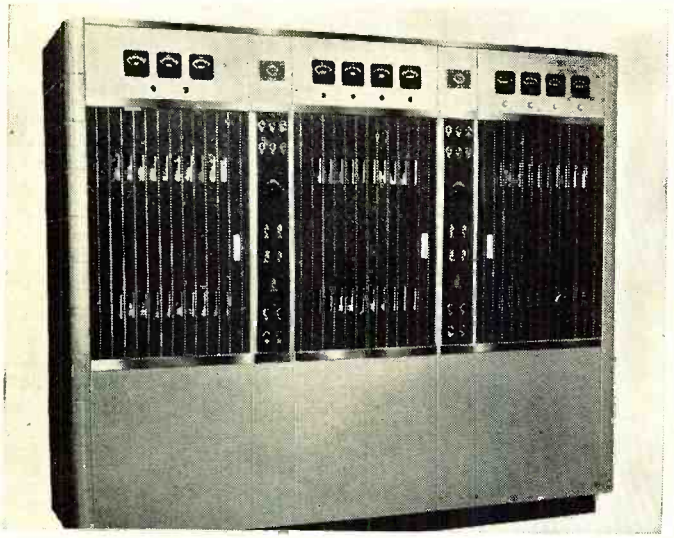
It was readily apparent that permitting new stations to go on the air under these circumstances would only aggravate the situation. So the freeze was ordered continued while engineering studies were extended.

As the project moved on, it became obvious that the demand for new stations could not be met within the limitations of the v.h.f. band. Here, from 30 to 300 megacycles, there was no room for expansion. But the FCC cast interested eyes upward to the u.h.f. band extending from 300 to 3000 megacycles.

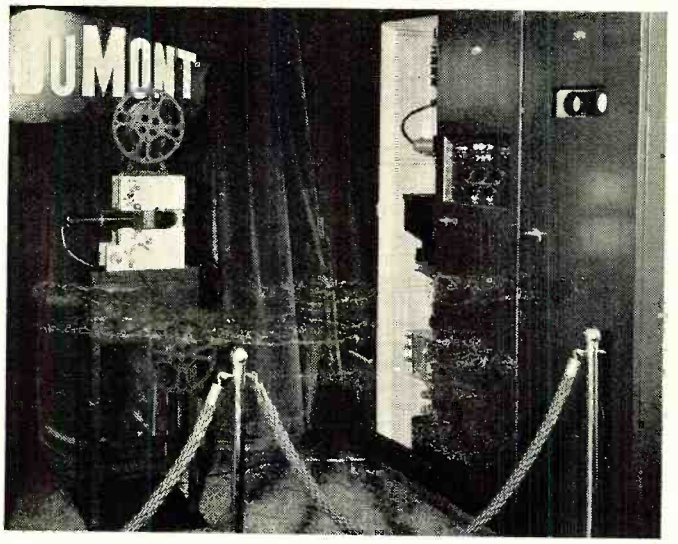
In that portion of the band extending from 470 to 890 megacycles, the FCC figured it could accommodate 70 additional TV channels as opposed to the scanty 12 available to v.h.f. Experimentation was begun soon afterward to test the practicality of u.h.f. Licenses were granted to 15 experimental stations with the most successful work being undertaken by *NBC* at Bridgeport, Conn. There experimental station KC2XAK went on the air on December 30, 1949 rebroadcasting, via u.h.f. programs picked up by a microwave link from WNBT in New York City.

Receiver manufacturers joined the project by testing home sets and converters to handle the proposed u.h.f. stations. The results of this work have been incorporated into most of the new models now available or soon to be announced to the consumer public.

After more than a year's research, the FCC was satisfied that the u.h.f. band had, indeed, the answer to the problems of new station allocation. It offered the possibilities for excellent,



RCA's first commercial TV unit for the u.h.f. bands. It is a 1 kw. transmitter which is housed in three aluminum cabinets having sliding front and rear doors which are properly interlocked. A vertical chassis type construction is used for convenience and accessibility. The front and back doors slide into the space between the end shields so that a minimum of floor space is required. The blower unit, providing air-cooling, is contained within the transmitter. The new Model TTU-1B is designed to operate on all u.h.f. channels from 14 to 83.



Du Mont's unique new 16 mm film system for TV broadcasting which combines the advantages of the flying spot scanner system with continuous-motion film in a single package. The unit is low in cost, easy to maintain, and requires no operator for shading adjustments. Its use poses no back or rim light problems. Scheduled for release to the public in twelve months, the manufacturer states that its adoption will not obsolete image orthicon studio equipment and that it can be adapted for color TV. The new system can be used as a film recorder.

almost interference-free, TV service. Especially interesting was its relative freedom from interference from ignition systems and other electrical and atmospheric sources that plague v.h.f. reception. Equally important, stations could be placed closer together permitting a far greater number of stations on the air.

All this work, however, was taking time. In the meantime, the commercial aspects of TV had blossomed forth in all their lush, greenback hues. Owners once pitied for rashly "throwing away their money" were now sitting atop the biggest entertainment gold mine in history. Others soon pounded on the doors of opportunity to be let in.

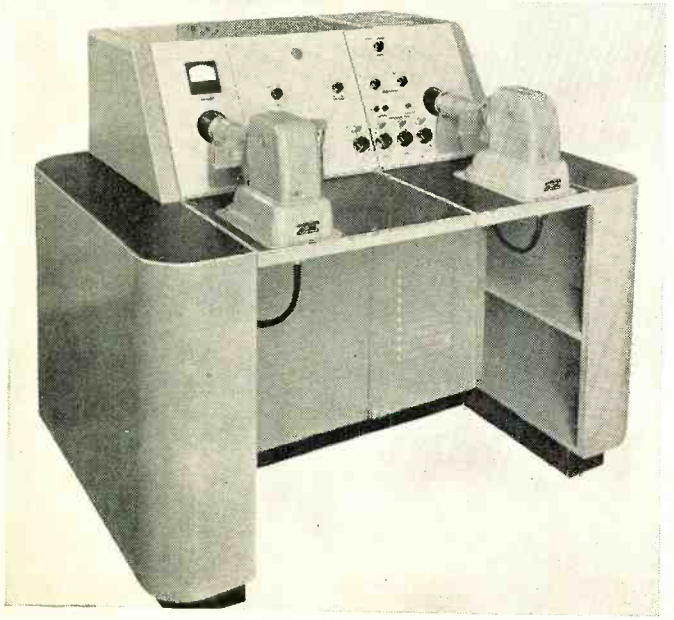
Pressure began to mount for the FCC to lift its ban. Even though it was working entirely in the public interest, the Commission found itself constantly harassed. Chairman Wayne Coy accurately noted that, "Seldom in our time has a 'freeze' managed to generate so much heat!"

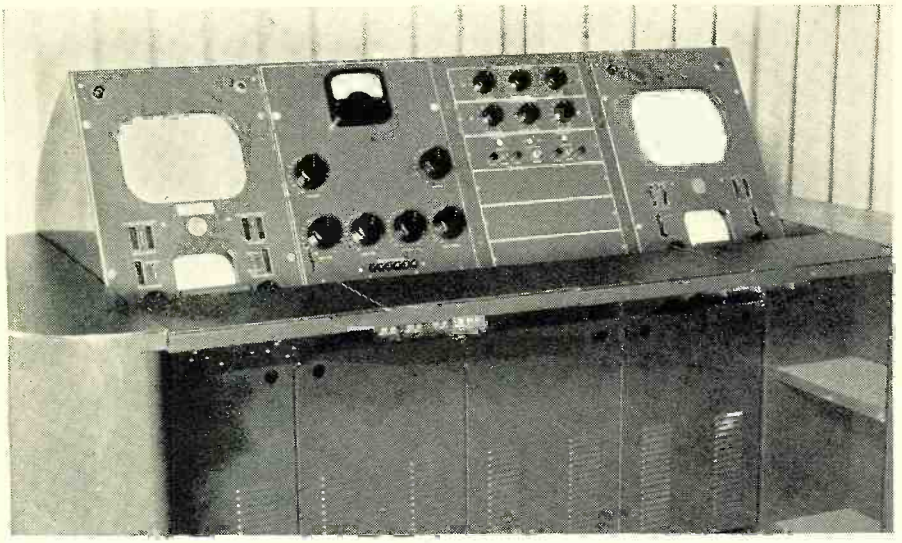
The Commission, however, didn't hesitate to point out that many of the same people now clamoring for space on the TV bands were the same ones who, in 1948, wouldn't even take channels when offered them. Then the huge financial losses experienced by the pioneers frightened away the timid.

But now that TV programs had tapped seemingly bottomless revenue,

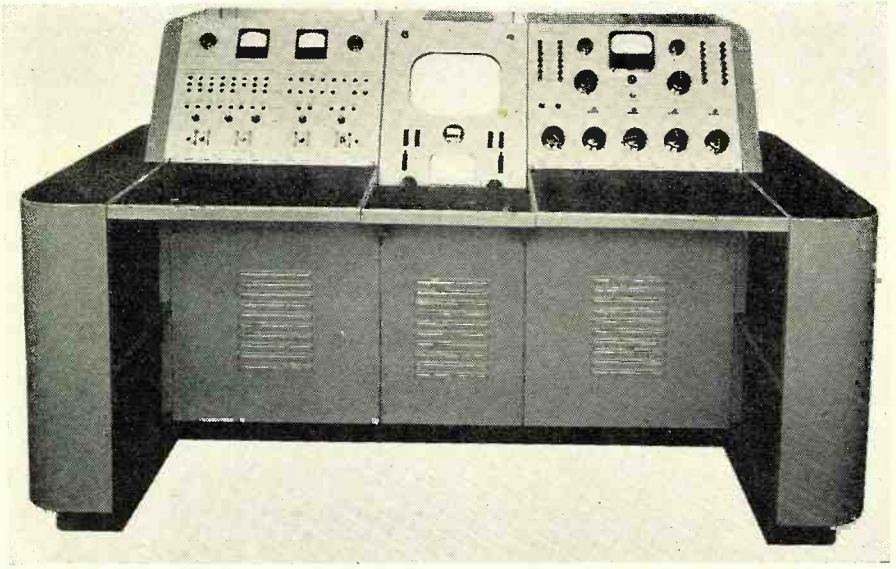
G-E's "Side-Fire Helical Antenna" for u.h.f. It has a power gain of 5 per bay and is available in any number of bays up to and including 5. There is one feedpoint per bay, with the supporting mast acting as the outer cylinder of coax feedline.

Federal's "Poly-Efex" scanner, Model FTL-93A, for small station operation. The unit provides complete program control, four-channel video switching, video signals from two slide sources, in addition to montages and various special effects.





Close-up view of the four console sections and associated control panels which are part of Radio Corporation of America's "Basic Buy" television station package.



Over-all view of the master control console for Federal's television transmitters.

thousands stampeded to get space. Even so, finding spectrum space for all these eager owners wasn't the only problem on board. Color television joined in to become a mean issue. Then it was "Phonevision," polycasting, "Stratovision," and educational TV. Each in its turn had to be considered and dealt with and each of these important decisions delayed lifting the freeze.

Thus it wasn't until January of this year that Mr. Coy announced to an audience of newspapermen at a banquet in Cleveland that the freeze would probably be lifted ". . . in a month or so." That was the first official word on the ban issued in months. Then came the April 13 announcement by Paul A. Walker, new chairman of the FCC, of the lifting of the freeze.

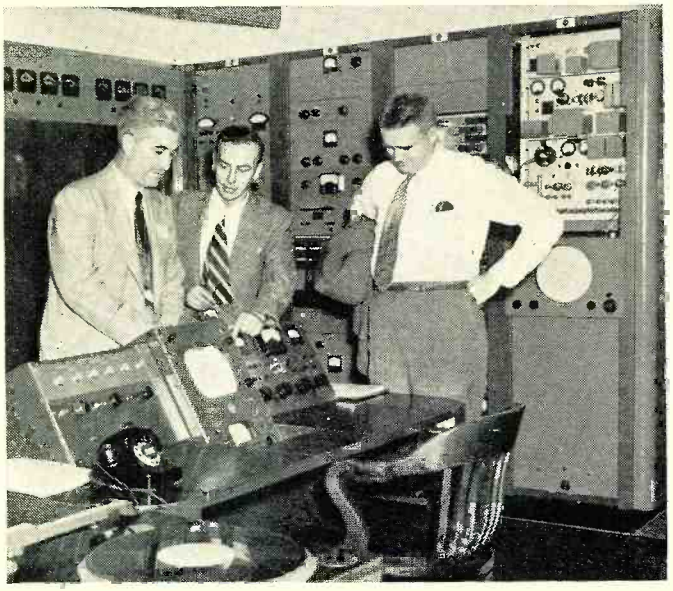
With this, the FCC announced its readiness to accept new station applications. This will go on for at least 60 days—perhaps 90. During this period of the so-called "gold rush," the FCC has braced itself to receive literally thousands of new applications. The final order and table of allocations invites applications for more than 2000 new television stations of which about 550 will be in the v.h.f. band and the remainder in the u.h.f. band.

From whom will these applications come? Well, many of them will originate with owners of radio stations and newspapers or others with experience in public entertainment or public service. But many hundreds more will undoubtedly come from private business interests who are willing to gamble a sizable fortune on a pretty sure thing.

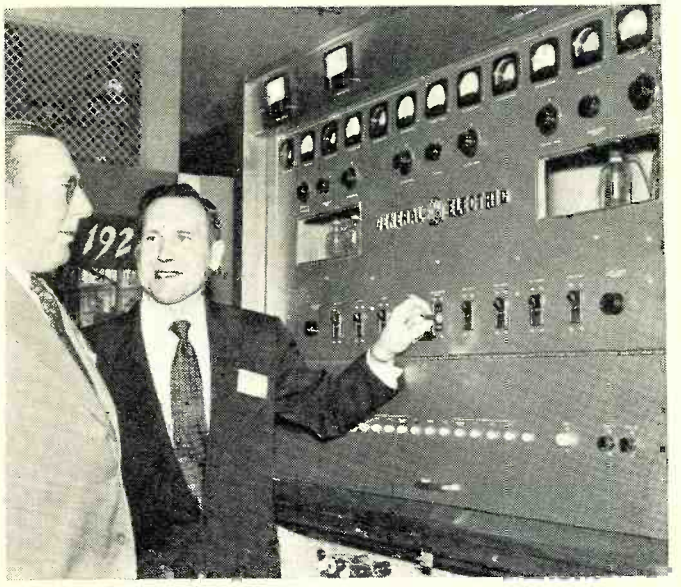
Actually the FCC states that ". . . any qualified citizen, firm, or group may apply . . . for authority to construct a commercial TV broadcast station. In general, applicants must satisfy the Commission that they are le-

(*Continued on page* 117)

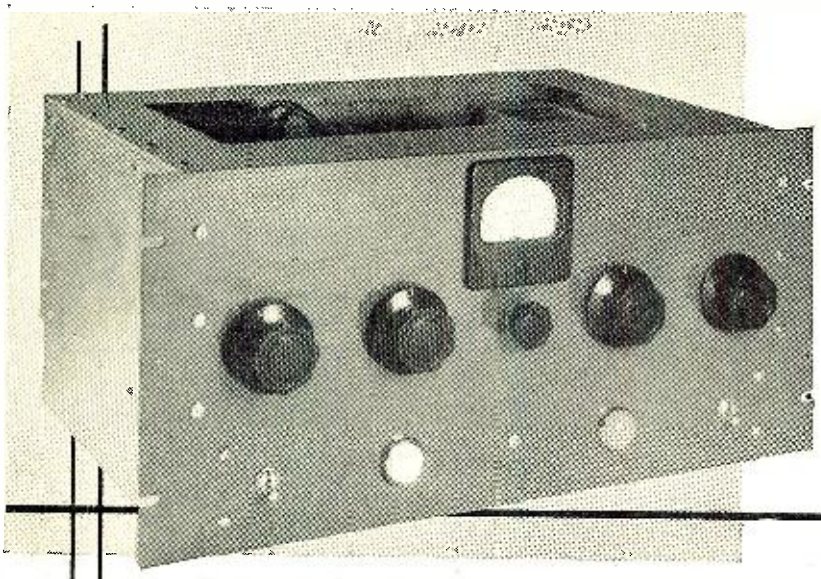
NBC's experimental u.h.f. station in Bridgeport. The transmitter is on the rear wall (left) and racked audio-visual equipment (right). Control console and turntables are in center.



Close-up view of General Electric's 100-watt u.h.f. transmitter. It has been especially designed for small-town stations and provides good reception up to from eight to ten miles.



A 250-WATT TVI-PROOF TRANSMITTER



Front panel view of the transmitter. The controls are: (left to right) the drive control (R_1); 6L6 plate tuning condenser; meter selector switch; variable link control; and final tank condenser. The bottom row of controls includes the filament switch, the filament pilot light, the plate pilot light, and the plate switch.

By
ROBERT F. LEWIS
W8MQU

Construction details on a well-designed transmitter which covers the 80, 40, 20, and 10 meter ham bands.

PROBABLY the most serious problem which has ever confronted the amateur fraternity is that of television interference. The situation has reached such proportions in many areas that hams have deserted the higher frequencies in droves. Some have even discontinued operation entirely. With television stations now increasing their air time periodically, it is constantly putting a greater squeeze on the amateur. This will continue until he is faced with the choice of finding a cure or throwing in the towel.

The problem is not too difficult to solve in cities where the television stations are located. This is especially true where the amateur is using moderate power or is operating on the lower frequencies. In outlying sections, however, where television signals are greatly attenuated, the situation may become very serious, regardless of operating frequency or power.

In general, television interference can be boiled down to two major causes. The radiation of harmonics which fall within television channels is the most common. Trouble can also result from blanketing by the fundamental signal. This, however, is usually due to some deficiency in the receiver, and steps to cure the trouble must then be taken accordingly.

Reduction of interference caused by harmonic radiation, however, falls right into the lap of the amateur. The amount of effort necessary to eliminate the trouble varies in inverse proportion to the strength of the television signal. The following is a description of a transmitter which was designed for operation in a city beyond the normal service area where TV fans really have to reach out for a usable signal.

A bit of serious thought should bring up two rather obvious methods of attenuating harmonics. The first, of course, is to design the transmitter so that it will generate a minimum of harmonic power. Then, inasmuch as it is impossible to completely eliminate harmonic generation, the next step would be to prevent any that remained from being radiated, by shielding and filtering.

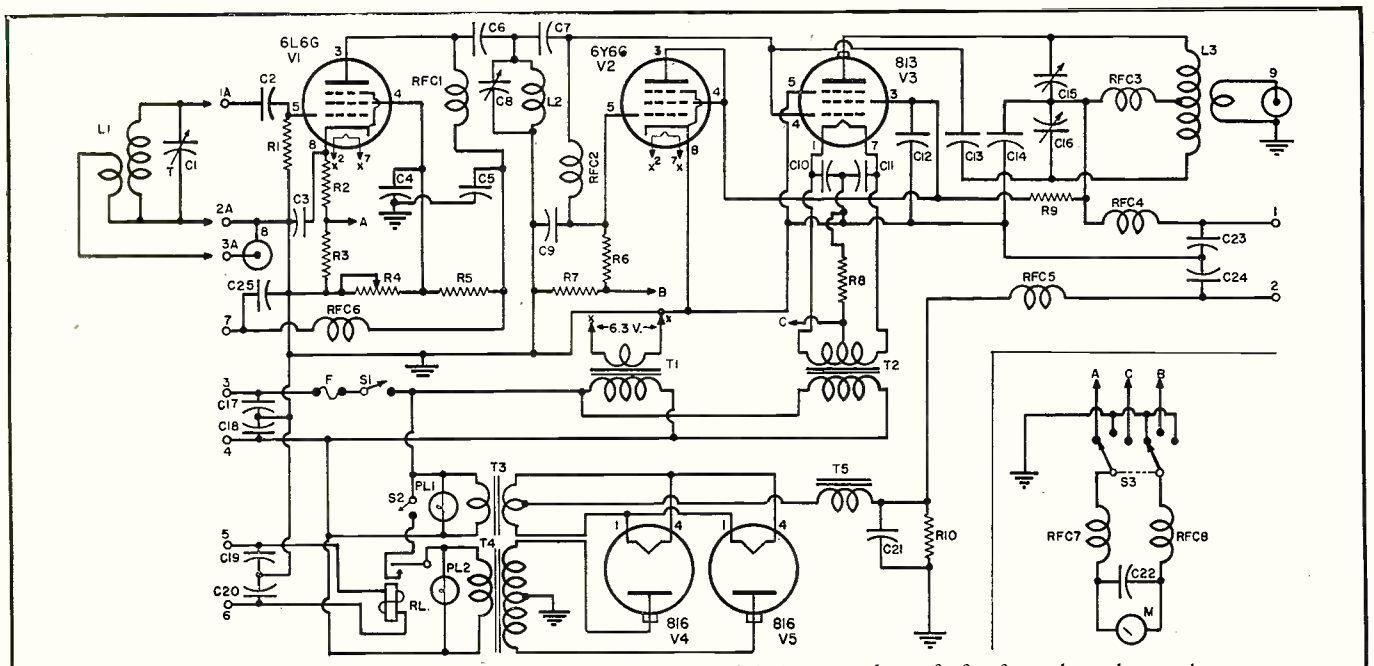
The collected experience of many authorities has shown that harmonic generation can be reduced by several means, such as operating amplifier stages with low driving power; by eliminating circuit resonances which might fall within TV channels; or by accomplishing frequency multiplication in low-power stages.

Keeping harmonic energy from leaving the cabinet entails many mechanical as well as electrical considerations. Radiation can take place from many sources other than the antenna. Radio frequency energy can be carried out of the cabinet on power or control leads. It can leak out of louvers, slots, meter holes, and various other locations in a cabinet. The solution, then, would be to completely shield the radio frequency section of the transmitter and to filter all leads leaving this unit. The only outlet for r.f. energy should be through a coaxial lead to the antenna system in which is inserted a low-pass filter having high attenuation to frequencies above 40 mc. This applies, of course, to transmitters operating below 30 mc.

Inasmuch as the purpose of this article is to consider the elimination of television interference, we will dwell, for the most part, on the design and construction of the radio frequency section of the transmitter. The audio portion will be covered briefly for those interested in constructing the complete rig for phone operation.

Two tubes are used in the transmitter, aside from the rectifiers and clamp tube. The final amplifier is a single 813 driven by a 6L6G. This unit was designed to be excited by the three-band v.f.o. which the author described ("A Low-Cost Bandswitching V.F.O.") in the June, 1949, issue of RADIO & TELEVISION NEWS. The exciter delivers power on the 80, 40, and 20 meter bands. Therefore the 6L6 stage can be operated straight-through on these three bands. It becomes a doubler for ten-meter operation. You will note from the circuit that the input terminals are numbered 1A, 2A, and 3A. These correspond to pins on a 4-prong coil form. Coil L_1 is used only on 10 meters when the 6L6 is operating as a doubler. On all other bands a dummy coil form is plugged into the socket. A jumper from 3A to 1A connects the coaxial input directly to the 6L6 grid. Any similar v.f.o. may be used as an exciter. However, it is recommended that it be operated at low power level. A half watt or so is sufficient to drive the 6L6, even with the untuned grid circuit. The v.f.o. should also be adequately shielded.

As was previously mentioned, one way to reduce harmonic generation is to use low driving power. This is accomplished by incorporating an 813 as a final amplifier with its low grid-drive requirements. In addition to this, the driving power can be controlled by means of a variable screen-voltage control in the 6L6 stage. (R_1). This control should be adjusted to the point which gives normal 813 grid current, with the 6L6 plate circuit tuned to resonance, of course.



R_1—50,000 ohm, ½ w. res.
R_2—330 ohm, 2 w. res.
R_3, R_7, R_8—Meter shunts (see text)
R_4—75,000 ohm, 7 w. var. wirewound res. (Mallory E75MP) ("Drive Control")
R_5—25,000 ohm, 10 w. wirewound res.
R_6—10,000 ohm, 10 w. wirewound res.
R_9—25,000 ohm, 100 w. wirewound res.
R_{10}—50,000 ohm, 50 w. wirewound res.
C_1—30 μμfd. ceramic trimmer (inside L_1, used on 10 meters only)
C_2, C_6—.001 μfd. disc ceramic cond.
C_3, C_4, C_5, C_9, C_{10}, C_{11}, C_{25}—.005 μfd. disc ceramic cond.
C_7—100 μμfd. tubular ceramic cond.
C_8—100 μμfd. midget var. cond., 1000 v. spacing
C_{12}—.002 μfd. disc ceramic cond.
C_{13}—Neutralizing cond. (see text)
C_{14}—.001 μfd. mica cond., 5000 v. peak
C_{15}, C_{16}—100 μμfd. (per sec.) dual-trans. cond., 3000 v. spacing
C_{17}, C_{18}, C_{19}, C_{20}—.1 μfd., 250 v. cond. (Sprague "Hypass")
C_{21}—8 μfd., 1500 v. oil-filled cond.
C_{22}—.01 μfd. disc. ceramic cond.
C_{23}, C_{24}—500 μμfd., 5000 v. ceramic cond.
T_1—Fil. trans. 6.3 v. @ 2 amps.
T_2—Fil. trans. 10 v. @ 5 amps.
T_3—Fil trans. 2.5 v. @ 10 amps., 5000 v. insulation
T_4—Plate trans. 1475-0-1475 v. @ 250 ma. (1250 v. d.c.) (Stancor PT8313)
T_5—Filter choke, 12 hy. @ 250 ma.
RFC_1—2.5 mhy., 125 ma. r.f. choke
RFC_2—1 mhy., 125 ma. r.f. choke
RFC_3—1 mhy., 300 ma. r.f. choke
RFC_4, RFC_5, RFC_6, RFC_7, RFC_8—7 μhy. r.f. choke (Ohmite Z50 or equiv.)
F—5 amp. fuse
S_1, S_2—S.p.s.t. heavy-duty toggle sw.
S_3—D.p.3-pos. rotary selector sw. ("Metering")
M—0-25 ma. meter
PL_1—117 v. pilot light (green)
PL_2—117 v. pilot light (red)
RL—S.p.s.t., 117 v. relay, a.c. coil
L_1—12 t. #22 en. wire, ½" long, 1" dia. 30 μμfd. ceramic trimmer mounted inside form. (Coil used only when 6L6G is functioning as a doubler from 20 to 10 meters)
L_2—80 m.—¾" #24 en., closewound 1" dia.; 40 m.—½" #22 en., closewound 1" dia.; 20 m.—10 t. #22 en., ½" long, 1" dia.; 10 m.—6 t. #22 en., ½" long, 1" dia.
L_3—B & W BVL series coils or equiv.
V_1—6L6G tube
V_2—6Y6G tube
V_3—813 tube
V_4, V_5—816 tube

Circuit diagram of the 250-watt transmitter. The terminal connections are: 1 and 2—high voltage to modulator (connect with jumper for c.w.); 3 and 4—117 v. a.c. supply; 5 and 6—remote control voltage, 117 v. a.c.; 7—360 v. d.c. (6L6G plate and screen supply); 8—r.f. input from v.f.o. (coaxial connector); and 9—r.f. output (coaxial connector).

In the interest of stability, the 813 is neutralized. The tube can be operated without neutralization, but not always with complete satisfaction. A 6Y6 clamp tube is used to simplify bias requirements and to prevent damage to the 813 when excitation is removed.

A look at the circuit will show that all leads which leave the cabinet are well filtered. Control and a.c. supply leads are filtered by *Sprague* "Hypass" condensers while all other leads are filtered with v.h.f. chokes and bypass condensers. Radio frequency power enters and leaves the unit through coaxial connectors.

The high-voltage supply, which utilizes a pair of 816 tubes as rectifiers, is an integral part of the r.f. unit. This is not a necessary feature as far as TVI-proofing is concerned, but it did permit the writer to install the rig in a small cabinet which was available.

Metering of the circuits, 6L6 plate current, and 813 grid and cathode current are accomplished with one meter, in conjunction with a selector switch. The meter in this case is one having a 25 milliampere scale. Shunts are adjusted so that the readings are multiplied by 10 for the 6L6 plate, by 1 for the 813 grid, and by 20 for the 813 cathode current. It should be remembered that in the 813 filament return position the meter will read screen and control grid current as well as plate current. Actual plate current, then, will run about 50 ma. less than the actual meter indication under normal operating conditions. This slight disadvantage could be eliminated by using a separate meter in the plate lead, but the system shown has advantages from an economy standpoint and it also simplifies the filtering job. It will be noted from the circuit that the meter leads are filtered and bypassed. In addition, the back of the meter itself is shielded to prevent r.f. leaks from the cabinet at this point. When calculating shunts for the meter, the resistance of the chokes must be included in the total. As the resistance of various meters differs, no attempt will be made here to give exact figures on the shunts. The resistance of meter shunts may be calculated by dividing the meter resistance by the scale multiplying factor minus one. As an example, if it is desired to multiply the scale reading by ten, the resistance of the meter should be divided by 10 minus 1, or 9, to find the value of the shunt.

Screen voltage for the 813 is obtained by the dropping-resistor method in this case, though it can be secured from other sources if desired. The buffer stage requires a plate voltage of about 360. In the author's rig the 6L6 is supplied from a surplus voltage available from the speech amplifier.

Before we go into a discussion of the actual construction, let's take a look at the photos. The top view was taken with the top of the shield box removed. Along the back of the chassis are located the plate transformer, 816 rectifiers, filter choke, and filter condenser. Directly in front of the power supply is the 813 final amplifier which is mounted horizontally with its socket mounted on a bracket fabricated from sheet aluminum. Tube manufacturers recommend that when tubes are mounted horizontally the plane of the plate should be vertical. Screen and filament bypass condensers are connected directly between socket pins and the nearest socket mounting screws. An L-shaped vertical shield separates the input and output circuits. On the left side of the shield are located the 6L6, driver tank circuit, 813 socket, L_1 socket, and 6Y6 clamper tube. On the right are the 813 tank components, meter, and selector switch. A round, close-fitting copper shield encloses the meter.

The 813 neutralizing condenser, which is mounted on the right hand side of the vertical shield, is very sim-

ple. Two small, flat metal strips, ⅜ by ¾ inch in size, mounted on stand-off insulators, form the plates of the condenser. Variation of capacity is accomplished by swinging the strips away from each other.

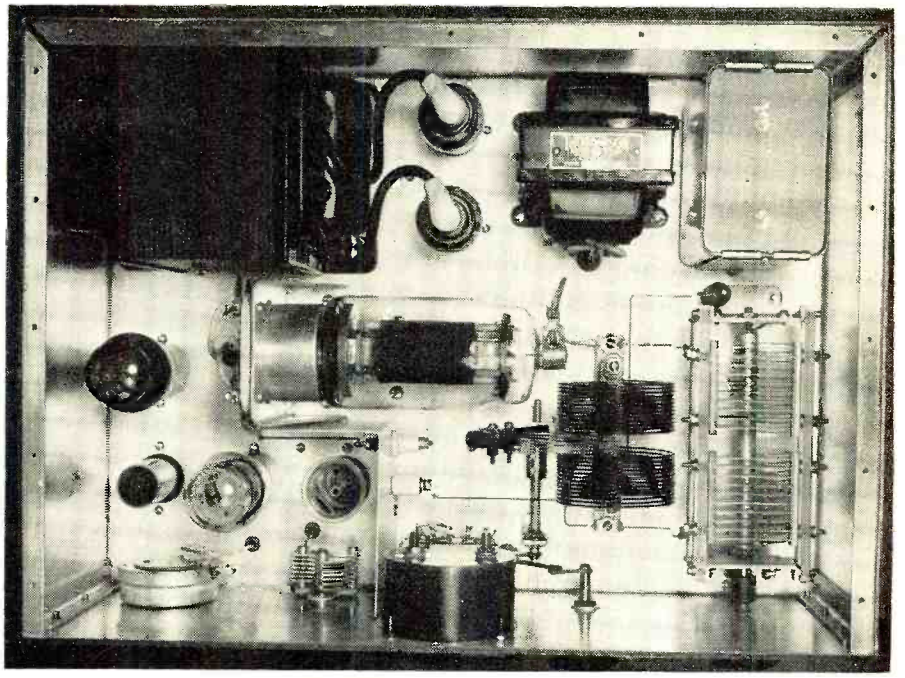
Controls on the front panel are as follows: Drive control (R_4), 6L6 plate tuning condenser, meter selector switch, variable link control, and final tank condenser. Below are the filament switch, filament pilot light, plate pilot light, and plate switch. Of interest is the method of controlling link coupling in the final tank. In order to preserve front-panel symmetry, a simple lever system was used to couple the variable link shaft to its control knob.

Location of all sub-chassis components can be ascertained by inspection of the photograph. Filament transformers, *Sprague* "Hypass" condensers, and bleeder resistors are all located under the chassis, along with other small parts.

The transmitter is mounted on an aluminum chassis, 17 x 12 x 3 inches in size, with an aluminum panel 19 x 8¾ inches. The top of the unit is completely enclosed with a shield box constructed of 16-gauge sheet aluminum. Aluminum angle stock is used in the corners to which the sides and top are bolted with 6-32 brass screws at intervals of about 2 inches, providing good contact along all edges. It is very important that there be no cracks at any of the joints, otherwise radio frequency energy is likely to leak out. Both the top of the box and the bottom of the chassis are covered with 17 x 12-inch aluminum sheets. A removable cover in the top of the shield box facilitates changing of coils and tubes. A series of one-inch holes in the lid, covered with copper screen, permits adequate ventilation while preserving the shielding properties. At first it was planned to use a hinged cover, but as no full-length hinge was immediately available the job was done with thumb screws.

After all sheet metal work was completed, the aluminum was placed in a lye bath. This treatment removes finger prints and light scratches, and at the same time gives a very nice satin finish which tends to resist further blemishes. The front of the panel was given a coat of enamel, but aside from that, the balance of the unit was left bare to permit full contact along all joints. It might be well to mention, in connection with the painting of aluminum, that a coat of zinc chromate primer is recommended over the bare metal.

There are no unusual features about the mounting of parts except the location of TVI filters. Chokes and bypass condensers should be mounted as close as possible to the point where the leads being filtered leave the chassis. If this is not possible, then the leads should be shielded between the filter and the point of exit. Condenser leads should be as short as possible, and the new ceramics are much superior to paper or mica condensers.



Top view of transmitter with shield box removed. Along the back of the chassis are the plate transformer; 816 rectifiers; filter choke; and filter condenser. Directly in front of the power supply is the 813 final amplifier mounted horizontally and the L-shaped vertical shield. To the left of the shield are the 6L6; the driver tank circuit; 813 socket; L_1 socket; and 6Y6 clamper tube. On the right are the 813 tank components; meter; and the selector switch.

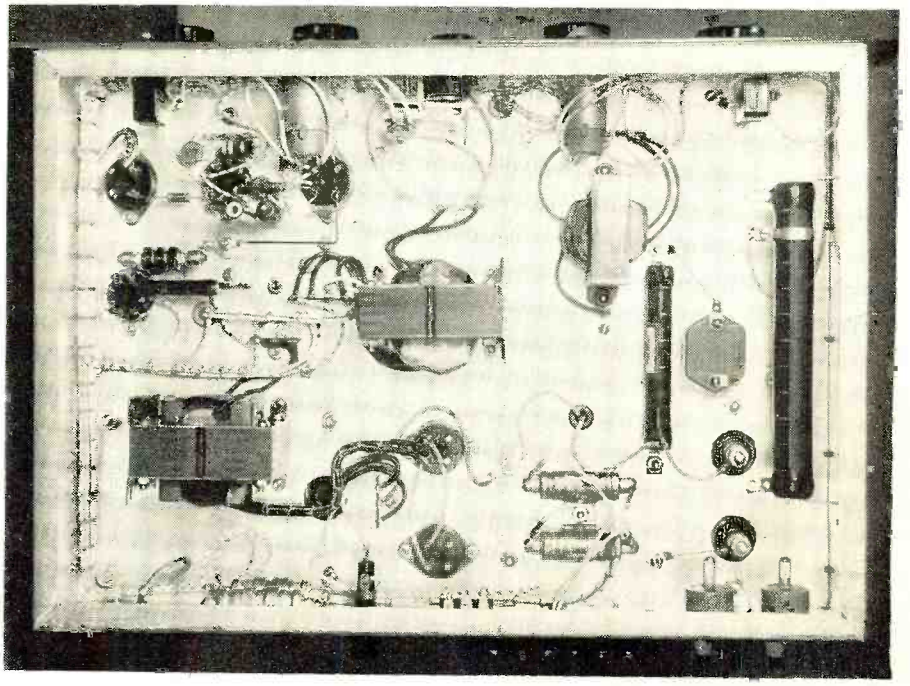
After all major parts were mounted, the unit was wired. All leads carrying 60-cycle alternating current or direct current were cabled and run around in the corners of the chassis. This not only improves the looks but it keeps these leads out of strong r.f. fields. All leads which carry radio frequency current (except coaxial runs) were run direct. Fairly heavy, solid wire is best for r.f. hookup. Bypass condensers were connected directly from the associated tube elements to the nearest socket mounting screw with a solder lug. Coupling condensers, resistors, and the like were mounted on bakelite lug strips in the low-voltage circuits.

When all wiring was completed, the circuit was checked with an ohmmeter as a precaution against possible errors.

The first operating checks were

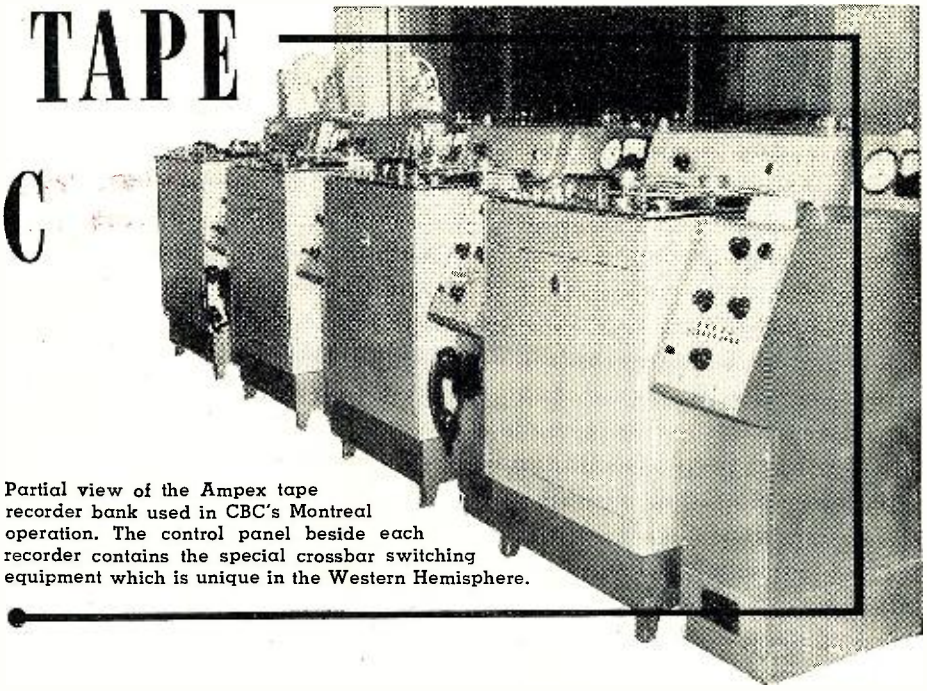
(*Continued on page* 149)

Under-chassis view of unit showing the filament transformers; the "Hypass" condensers; bleeder resistors; and other small components which are used in circuit.



MAGNETIC TAPE and the CBC

By
LEON A. WORTMAN
Director of Adv. & Sales Promotion
Audio & Video Products Corporation



Partial view of the Ampex tape recorder bank used in CBC's Montreal operation. The control panel beside each recorder contains the special crossbar switching equipment which is unique in the Western Hemisphere.

The maximum utilization of tape recordings permits the Canadian Broadcasting Corp. to service its many networks from coast-to-coast as well as overseas.

BECAUSE it hasn't been publicized to any great extent, few of us realize the important role which the *Canadian Broadcasting Corporation* has played in the professional acceptance of magnetic recording. *CBC* began to use magnetic recording as early as 1934, probably making it the first studio tape recording installation of its kind in North America. In order to more fully appreciate the *CBC's* problems and their magnetic tape solutions, it would be well to understand its organization and operation more completely.

Patterned after the *BBC,* the *CBC* is the sole radio network operator in Canada. By the Canadian Broadcasting Act of 1936 (amended in 1951), the *CBC* operates three distinct networks:

The Trans-Canada Network is composed of 16 *CBC* stations and 29 private stations with the key station, CBL, located in Toronto, Ontario. This network operates 18 hours a day and covers Canada all the way from St. Johns, Newfoundland to Vancouver, British Columbia. Operated simultaneously with these AM stations are 4 *CBC* and 9 private FM transmitters.

The Dominion Network is composed of 1 *CBC* station and 47 private stations with the key station CJBC located in Toronto, Ontario. This network operates between 4 and 6 hours a day and covers Canada from Halifax, Nova Scotia to Victoria, British Columbia. Twelve FM transmitters, associated with 12 of the private stations, are operated simultaneously.

The French Network is composed of 3 *CBC* stations and 12 private stations with the key station CBF located in Montreal, Quebec. It operates 17 hours a day and covers the Province of Quebec, portions of neighboring provinces, and border states of the United States of America.

Present plans call for a second French Network to provide service in the same areas as the Trans-Canada and the Dominion Network.

To service these networks, the *CBC* operates seventeen studio plants, eight 50-kw. stations, four 10-kw. stations, five 1-kw. stations, two 250-watt stations, one 100-watt station, and twenty-seven 20-watt repeater transmitters. The repeaters are located in the central communities in the Province of British Columbia, Ontario, and New Brunswick. The network repeaters are located at points where receiving conditions are poor. Broadcast service is thus made available to those communities through the small 20-watt transmitters.

At Sackville, New Brunswick, the *CBC* operates an International Shortwave Service. This consists of two 50-kw. transmitters which are licensed to operate on 17 different frequencies. They utilize 13 antenna arrays, 11 of which are of the curtain variety, equipped with slewing and reversing facilities to alter their beams as required to achieve the desired coverage.

The *CBC* broadcasts for the Domestic Service (Trans-Canada, Dominion, and French Networks) are primarily for a Canadian population of fifteen million people, but are heard satisfactorily in all northern states of the U.S.A. The International Short-wave Service broadcasts in 15 languages.

It was a rare, bold step in 1934 for the *CBC* to install magnetic recording. There was very little precedent for such a move in early commercial and government radio services, when, in the Fall of that year, the *Marconi-Stille-Blattnerphone* "Steel Tape Recording and Reproducing System" was ordered. The tape was wound on a large cast aluminum spool about 20" in diameter. The tape was 0.00325" (3¼ mils) thick and 0.118" wide. Tape speed was maintained at 90-meters per minute (54" per second) and the spools contained sufficient tape to permit a quarter-hour of voice or music to be recorded. A spool of tape for this machine costs slightly over $100.00.

During the latter part of World War II, wire recorders were furnished *CBC's* overseas reporters and early in 1946, *General Electric* Models 50 and 51 and *Brush* BK-303 magnetic wire recorders were placed in operation in the larger studio plants. In 1947 and 1948, *Brush* Model BK-401 semi-professional magnetic tape recorders were introduced.

Practically all of the studio recordings made prior to 1949 were on discs.

The first modern studio tape recording installation at *CBC* went into service on October 12, 1949 at the Winnipeg studios. This installation consisted of three channels of rack mounted recorder-reproducers. These units were installed to help carry the delayed broadcast load. This load is

(*Continued on page* 84)

Close-up view of the recording equipment. The control panel selects any of 59 input channels. These machines can be remotely controlled from any of 39 studio locations.

Front End Control Unit for Williamson Amplifier

By
ARTHUR J. ROSE

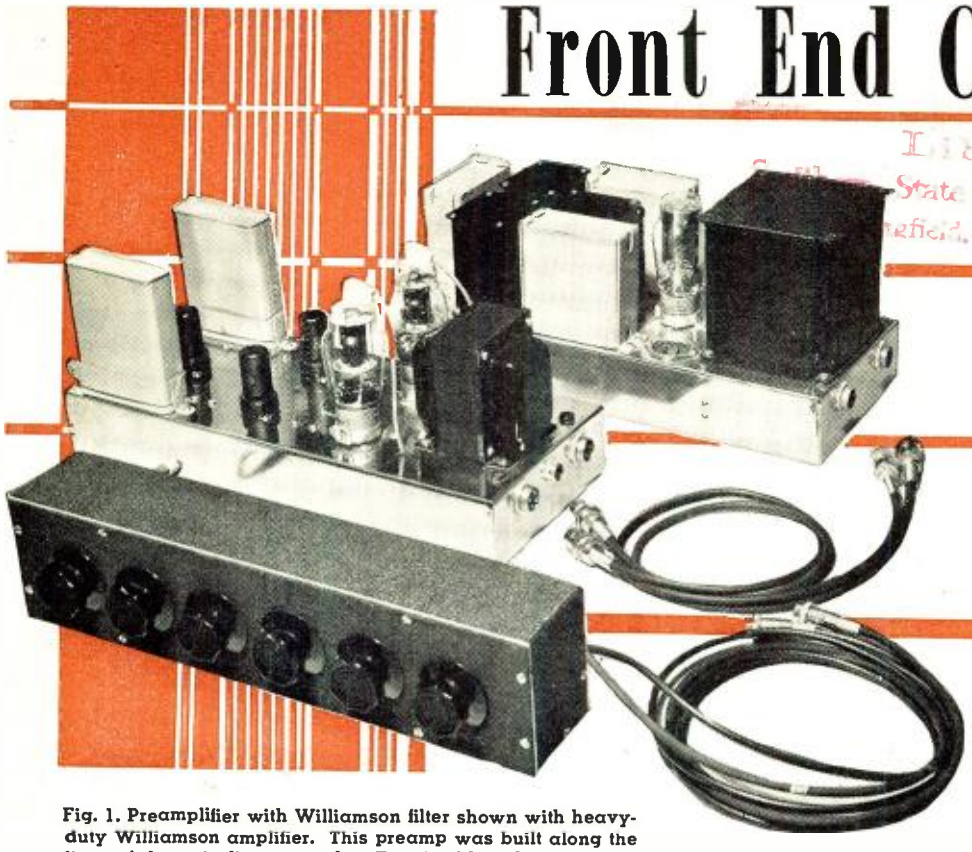


Fig. 1. Preamplifier with Williamson filter shown with heavy-duty Williamson amplifier. This preamp was built along the lines of the unit diagrammed in Fig. 4, although two cables are used here. Cabinet measures 3" x 4" x 17". Amplifier in background has 300 ma. power supply for stable 450 v. required. Lower rated supplies restrict bass output.

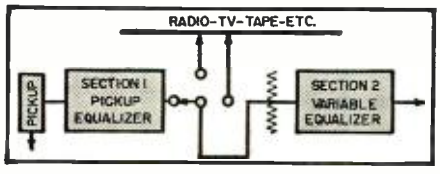
Preamplifiers—covering complete design details on two well-engineered units along with important points to consider when building your own preamp.

AN INHERENT disadvantage of triode output stages is actually put to work in the equalizer-preamplifiers to be described. Although the units are designed for use with the Williamson amplifier and contain some of D.T.N. Williamson's circuitry, they will perform equally well with many other final amplifiers. Variations will be outlined and the individual can choose the particular combination that best suits him. Each has the same features that provide equalization for all types of recordings and other program material. Distortion is not added in any perceivable degree to the over-all system.

Equalizers must provide a lot of bass boost. A recording properly equalized for its low-frequency, constant-amplitude characteristic and for hearing losses may require as much as 40 db of bass boost. 40 db more are required to increase the level of a magnetic cartridge output to drive the final amplifier. This brings the total voltage gain to 10,000. Obviously, it is very easy to introduce hum with such a system. Elaborate precautions are necessary and it is almost impossible to eliminate this disturbance by conventional means. Even a few microvolts of hum admitted into the initial stages of a high gain amplifier will be audible by the time it reaches the speaker. The usual compromise is either to accept the hum or settle for lower gain. In addition, instability at low frequencies prevails with high gain. However, that malfunction is easier to cure. A well-designed decoupling network will eliminate tendencies towards instability and motorboating.

Hum is most commonly admitted through the heaters or heater wiring. Power supply ripple needn't be considered because it is a fairly simple matter to reduce ripple to a fraction of a per-cent. When considering an equalizer with high gain, the surest way to avoid grief is to keep the unit completely isolated from all hum sources. By operating the heaters with d.c., hum is virtually eliminated and 99% of the precautions that usually have to be taken can be disregarded. Heater leads need not be twisted and carefully dressed. Grid and plate leads can be long and unshielded. In fact, the designer can place parts and wiring for the most pleasing appearance and ease of construction.

Fig. 2. Block diagram showing basic arrangement of the various preamplifier sections.



Triodes are notorious for their large current drain. At best they are inefficient. In spite of this, the superlative results obtained with circuits such as the Williamson keeps them popular. The triode-connected KT-66's, 807's, or 5881's used in that amplifier draw about 120 ma. of the smoothest d.c. that can be supplied. Advantage is taken of the large drain by diverting it to the filaments of the preamplifier tubes. There is no need for a separate rectifier and the advantages of d.c. heaters are easily realized. Any tube with a 150 ma. heater can be used.

All is not yet golden. Once hum has been wiped out, an unpleasant "rushing" noise remains. There is only one way to eliminate this particular enemy of high gain amplifiers and that is to use wirewound resistors in all plate and unbypassed cathode circuits. All that now remains is tube thermal noise in the form of high frequency hiss. Its magnitude varies slightly from tube to tube, but substantial reduction of this disturbance is accomplished only at the expense of bandwidth or gain. Fortunately, tube hiss is not objectionable enough to warrant the elaborate procedures necessary for its elimination.

Schematics for two preamplifiers are shown in Figs. 4 and 9. They are cut to the barest essentials and are trouble-free. Each unit is in two sections (Fig. 2): fixed equalization de-

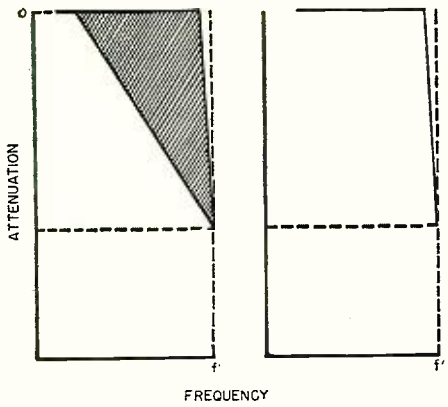


Fig. 3. Comparison of slow and sharp rates of attenuation for noise filters. For an equivalent amount of attenuation at some particular frequency, f', the sharp cut-off version is the more desirable one.

termined by the recording and type of pickup, and variable equalization to alter the flat response to suit the listener. The major difference between the units is the type and location of the scratch suppressor.

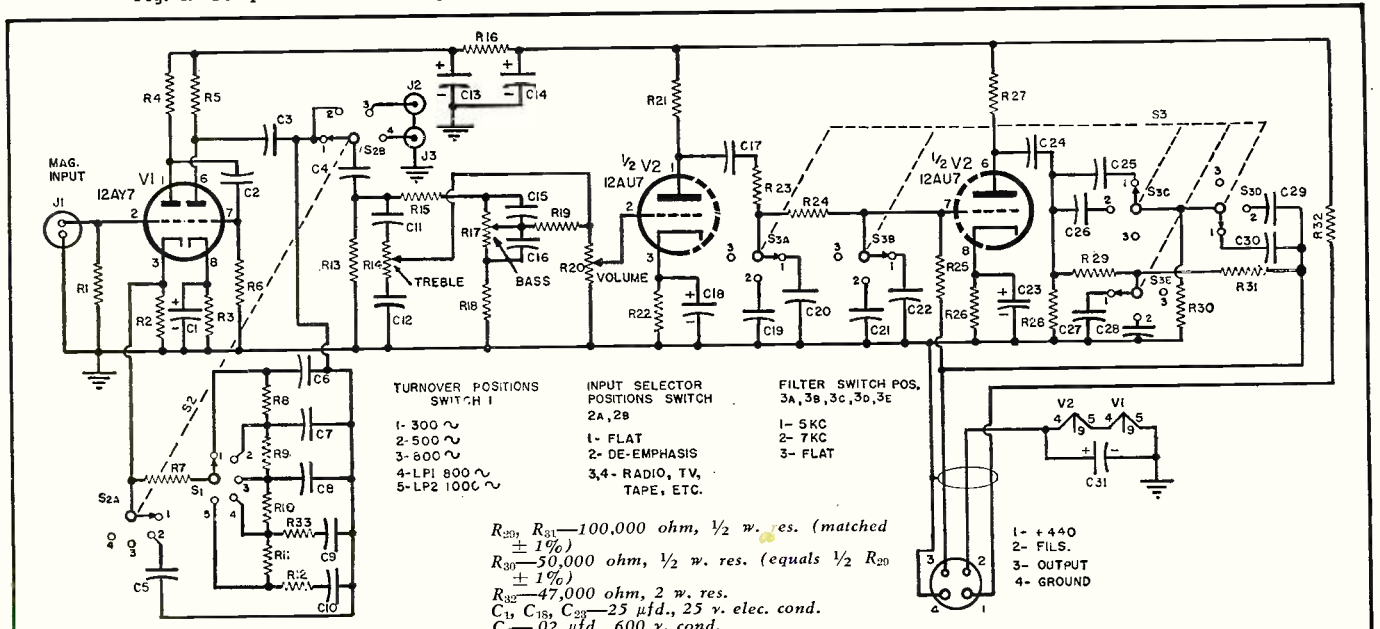
The first section incorporates a 6 db-per-octave boost below a selection of turnover frequencies for constant velocity pickups such as the *Pickering, G-E, Audax,* etc. For constant amplitude pickups such as the *Pfanstiehl* "Strain Sensitive," the reader is referred to the manufacturer's literature regarding proper equalization for the particular cartridge. If the use of such a unit is contemplated, it will be necessary to substitute the recommended circuit for the first sections given in this article. In addition to fixed boost, a de-emphasis network can be included in the first section although it is not mandatory. De-emphasis can be provided later on as will be described. As an extra refinement, a boost in over-all gain can be provided to compensate for the lower output of Microgroove recordings. This is worked into the turnover selector switch as a special *LP* position.

Following the low-level pickup equalizer section, further equalization is necessary to accommodate hearing differences at various volume levels. This accommodation is necessary to overcome scale distortion—a form of distortion due to the fact that the playback is generally at a different volume than the original. Consequently, the frequency response is altered to match the ear response at the playback level to the response it has at the original level. The necessary compensation is determined by the *differences* of response and proper application is dictated by the nature of the material being reproduced. For example, a symphony played at medium room volume requires a fair degree of bass and treble boost while a performance of lower intensity, such as a piano solo played at the same volume as the symphony, requires considerably less boost because the playback level is close to the original. Voice requires droop in many instances where it is reproduced above natural volume.

It appears then that a flexible system that will alter the bass and treble response for *any* setting of the volume control will best accommodate a wide variety of program material. The familiar "loudness" control offers only one degree of fixed boost for any given sound level. While this type of control offers perfect compensation for music of originally loud proportions where the response of the ear is nearly flat, it falls short where accurate reproduction of less intense material is required. It is totally unsuitable for louder-than-original playback. Bass and treble compensation systems employed in the second section consist of infinitely variable boost and droop. A modification to boost only is satisfactory as bass droop is almost never used in playback and treble droop is used only rarely. Turnover frequencies are based on average hearing curves similar to those derived by Fletcher and Munson. A channel selector precedes this section and a volume control is inserted in the grid circuit.

Finally, because noisy records are often encountered, some form of scratch filter must be considered. The extent of circuit elaboration for the removal of record hash is limited only by individual resources. Schemes have been devised ranging from simple treble attenuators to complex variable bandpass filters. Success of each is determined by the amount of highs that remain or *apparently* remain after the scratch is eliminated. Excellent results have been obtained with high-frequency cut-offs between 20 and 60

Fig. 4. Complete schematic diagram of a preamplifier using a Williamson filter and including boost-droop controls.



R_1—27,000 ohm, ½ w. res.
R_2, R_3, R_{22}—2200 ohm, ½ w. wirewound res.
R_4, R_5, R_{21}, R_{27}—100,000 ohm, ½ w. wirewound res.
R_6, R_{13}, R_{24}, R_{25}—470,000 ohm, ½ w. res.
R_7, R_{12}, R_{15}, R_{19}, R_{28}, R_{33}—100,000 ohm, ½ w. res.
R_8, R_9, R_{10}, R_{11}—10 megohm, ½ w. res.
R_{14}, R_{17}—1 megohm audio taper pot.
R_{16}—33,000 ohm, 1 w. res.
R_{18}—10,000 ohm, ½ w. res.
R_{20}—500,000 ohm linear pot.
R_{26}—3300 ohm, ½ w. res.
R_{29}—1 megohm, ½ w. res.
R_{29}, R_{31}—100,000 ohm, ½ w. res. (matched ± 1%)
R_{30}—50,000 ohm, ½ w. res. (equals ½ R_{29} ± 1%)
R_{32}—47,000 ohm, 2 w. res.
C_1, C_{18}, C_{23}—25 μfd., 25 v. elec. cond.
C_2—.02 μfd., 600 v. cond.
C_3, C_4, C_{17}, C_{24}—.05 μfd., 600 v. cond.
C_5, C_{10}—500 μμfd. mica cond.
C_6—.0035 μfd., 400 v. cond.
C_7, C_{15}—.002 μfd., 400 v. cond.
C_8, C_{12}—.0015 μfd., 400 v. cond.
C_9—750 μμfd. mica cond.
C_{11}—150 μμfd. mica cond.
C_{13}, C_{14}—20 μfd., 450 v. elec. cond.
C_{16}—.02 μfd., 400 v. cond.
C_{19}—200 μμfd., mica cond. ± 1%
C_{20}—300 μμfd. mica cond. ± 1%
C_{21}—50 μμfd. mica cond. ± 1%
C_{22}—100 μμfd. mica cond. ± 1%
C_{25}, C_{30}—150 μμfd. mica cond. (matched ± 1%)
C_{26}, C_{29}—100 μμfd. mica cond. (matched ± 1%)
C_{27}—300 μμfd. mica cond. (equals twice value of C_{25} ± 1%)
C_{28}—200 μμfd. mica cond. (equals twice value of C_{26} ± 1%)
C_{31}—50 μfd., 50 v. elec. cond.
S_1—S.p. 5-pos. shorting-type rotary sw.
S_2—D.p. 4-pos. shorting-type rotary sw.
S_3—5-pole, 3-pos. shorting-type rotary sw.
J_1—Two-contact shielded receptacle
J_2, J_3—RCA-type phono jack
V_1—12AY7 tube
V_2—12AU7 tube

db-per-octave. A comparison of the response curves of Fig. 3 will illustrate why sharp cuts yield better results. With a majority of recordings, scratch predominates above some particular frequency. There is no need to attenuate below that frequency. To do so would destroy brilliance unnecessarily and result in a muddy sound that is as undesirable as the scratch. Removal of scratch starts with 6 db attenuation. That much will give an indication that something is being done. Actually, effective removal requires a much greater cut. It is reasonable to assume that the sharp rate of attenuation will cut frequencies in the noise range without removing those below. A slower rate will attenuate as much in the desired region, but the cut has to have a much greater "head start." The shaded area illustrated in Fig. 3 shows the unnecessary loss of high frequencies with a slow rate of attenuation.

Preamplifiers built by the author have included cuts ranging from 20 to 60 db-per-octave with increasing effectiveness. The simpler type of filter giving about 20 db-per-octave is the familiar *RC* shunt across the magnetic cartridge. Filters such as these are merely *LC* low-pass filters with the *"Q"* lowered by the addition of the shunt resistor to smooth out the peak. The inductance is furnished by the pickup coil and calculations are based on *"Q's"* from .8 to 1 to determine the correct resistor to use.

A more complex, but exceedingly effective, filter giving attenuations starting at 40 db-per-octave and rapidly turning to 60 db-per-octave, is based on the parallel-T network. In essence, this circuit takes the very narrow bandpass characteristic of the parallel-T (Fig. 6A) and removes the upper pass region by the application of negative feedback via a phase-shifting network. The result is the sharp cut-off, low-pass filter of Fig. 6B. This configuration is described in detail elsewhere by D. T. N. Williamson.[1] The author has simplified the arrangement to three-position switching and adapted it to American tubes. Experience has shown that additional cut-offs above 7 kc. are unwarranted. Because of its location in the preamplifier unit, this filter may be used on broadcast programs—a boon to the long suffering listeners of noisy records and transcriptions from FM stations.

For constructors who desire the ultimate in preamplifiers, the choice of the unit with the Williamson filter is recommended. For those who want an excellent unit, but do not believe that their present equipment demands the refinements of a more ambitious undertaking, the other preamplifier is suggested. Parts of the units may be interchanged. For example, the variable bass and treble sections are equally good and are adaptable to either preamplifier. The simpler circuit shows boost only, while the more elaborate unit is shown with "center position flat" boost-droop controls. If the constructor feels that droop will never be used, then the straight boost type is to be preferred since a finer adjustment can be effected with full pot. rotation. Front end refinements may also be used in the simpler unit. These include a de-emphasis switch and the special *LP* positions in the turnover switch.

While the selection of parts for these units is perhaps more arduous than ordinarily required, the ensuing construction need only be a subdivision of methods commonly termed "straightforward." Wirewound resistors must be used where indicated. Do not use the metallic film type resistor as they give almost as much noise as carbons. It is necessary to match several resistors and condensers closely for the Williamson filter. Their absolute values may be within 10% of those listed, but they must be within 1% of each other. Within the housing of the units, no special techniques are required. However, the entire preamplifier must be fully enclosed in a metal box.

When choosing components for your unit, take advantage of the many miniatures now offered, such as "Discaps," for values up to .02 μfd., "Aerolites" and other very small condensers from .02 up, and "Ceramicons" for low values in the filter circuit. Small wirewound resistors in the 100,000 range are made by *Shallcross* and *IRC* as precision resistors. They can be purchased from surplus for very little as odd values, *e.g.*, 112,300 ohms. Accuracy is not important here. Resistances below 10,000 ohms are available wirewound in the standard form as type BW.

Heater supply connections for the Williamson output stage are shown in Fig. 7. Note that only a three-wire shielded cable is needed from the amplifier to the preamplifier with this arrangement. This connection can be

(*Continued on page* 112)

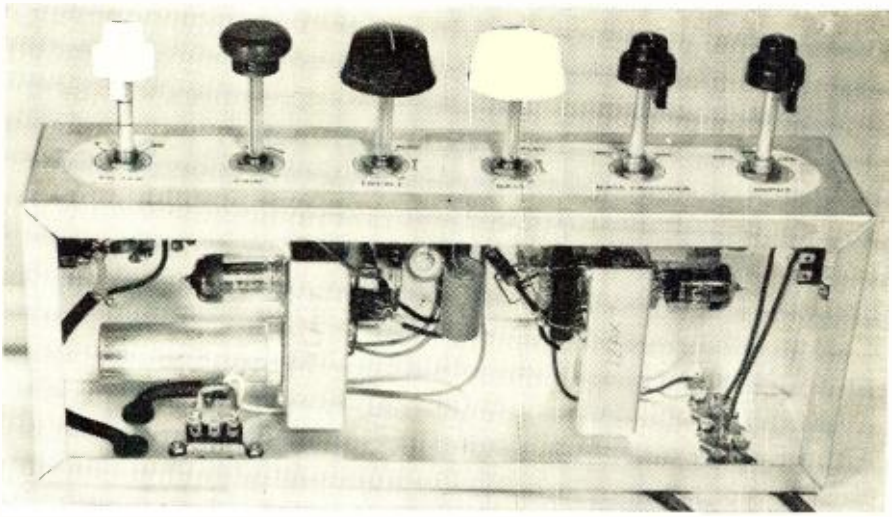


Fig. 5. Close-up view of preamp of Figs. 1 and 4. Coaxial cable is used for the output and two-wire lamp cord is employed for "B+" and heater supply.

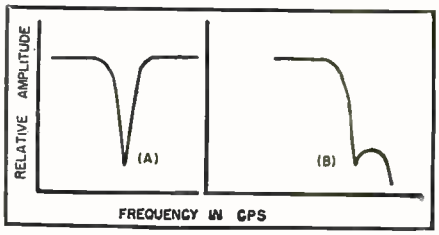


Fig. 6. Typical parallel-T narrow bandpass characteristic (A) transformed into low-pass filter and (B) by application of a negative feedback through the network.

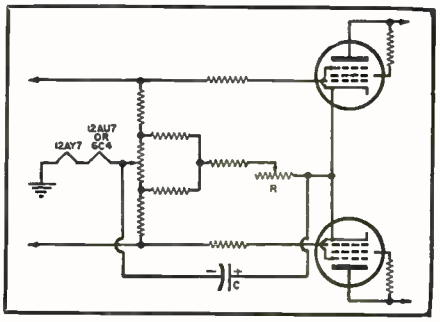
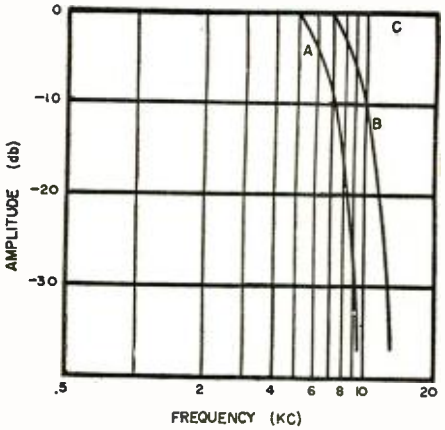


Fig. 7. Method of obtaining heater current from Williamson output stage. Adjustment of R affects tube drain and should be set for proper heater operation. Cathode bypass, C, is returned to center arm of balance pot. for stability and protection in event of an open in filament string.

Fig. 8. Williamson filter positions. (A) at 5 kc., (B) at 7 kc., and (C) flat.



[1] "Design of Tone Controls and Auxiliary Gramophone Circuits," *Wireless World*, Oct.-Nov. 1949.

THE NEW G-10 GERMANIUM DOT RECTIFIER

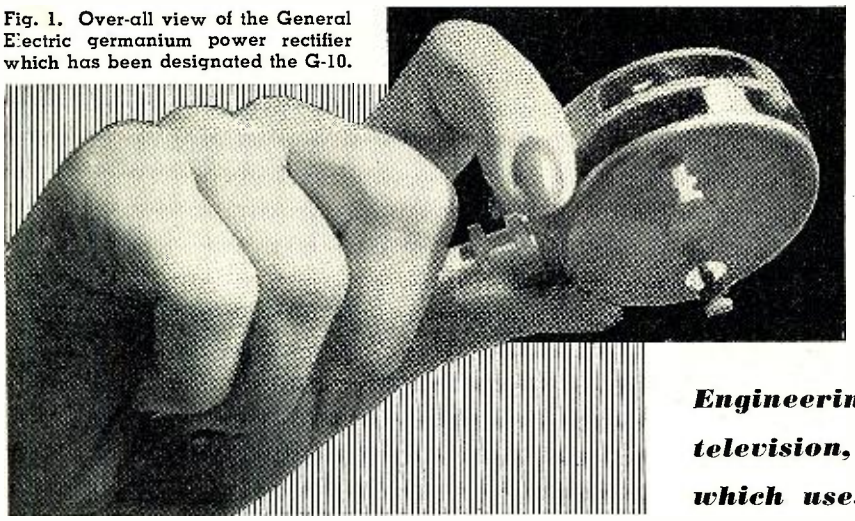


Fig. 1. Over-all view of the General Electric germanium power rectifier which has been designated the G-10.

Engineering data on a new unit for radio, television, and allied power applications which uses no critically-short materials.

By
T. J. FERGUSON
Crystal Eng. Sec., Comm. & Gov't. Equip. Dept.
Electronics Div., General Electric Company

GENERAL Electric Company has long been aware of the important characteristics that make germanium rectifiers superior to other types of rectifiers. These characteristics are their lower forward resistance, higher back resistance, longer life expectancy, and reliability. The advantageous characteristics of the germanium diode plus the techniques for increasing the area of the rectifying surface, developed by the *General Electric* Research Laboratories, have been responsible for a germanium rectifier that could be used in television, radio, and allied power supply applications. The *G-E* Germanium Dot Rectifier, designated G-10, having these characteristics, grew out of this investigation. In addition, it was found commercially feasible to manufacture the Germanium Dot Rectifier without the use of critical materials.

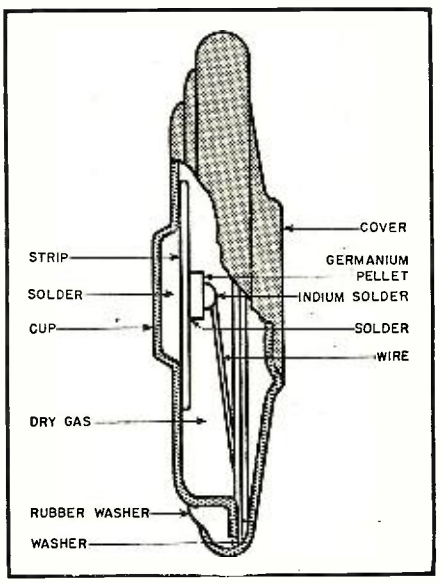
The G-10 is composed of two "button" rectifiers, each consisting of a ⅛ square inch pellet of spectroscopically pure germanium placed in the center of metal cups sealed with butyl rubber, as shown in Fig. 2. These rectifiers are series mounted on two inch diameter, 1/32 inch thick metal dissipating fins. A high coefficient of thermal conductivity is the governing qualification for the choice of metal used in the dissipating fins. Copper and aluminum have been successfully used. Production units will probably use aluminum dissipating fins.

Rectifiers are stabilized electrically by 24 hours of operation at full load. This stabilization serves to remove the remaining gaseous impurities from the rectifying surface and to relieve any mechanical strains within the button due to changes of temperature with operation.

In order to insure an equal division of the peak back voltages across series-connected rectifiers, it was found necessary to use units with the same dynamic back currents. Any increase in temperature results in an increased back current. There are two factors that vary from rectifier to rectifier that must be considered when selecting rectifiers for their inverse currents. The first is the heat generated by the currents in the forward and back resistance. The second is determined by the thermal characteristics of the contact between the rectifier and the dissipating fin.

Both of these factors can be evaluated simultaneously by applying full forward current during the selection test. Therefore, the rectifiers are sorted with respect to their dynamic back currents at the full rated load. This sorting and selection is done at the factory, hence the finished products are electrically stable and only a very slight change occurs in the inverse current during the life of the rectifier.

Fig. 2. Cross-section view of one of the "button" rectifiers used in the G-10 assembly.



To further insure that mismatched, damaged, or otherwise defective units are not shipped to customers, the completed rectifiers are checked under maximum operating conditions for forty-eight hours at 130 volts a.c., 350 ma., and 55°C. This results in an extremely efficient rectifier that does not change its electrical characteristics significantly with time.

Fig. 3 shows the static characteristics of an average G-10 taken at different ambient temperatures. The rather rapid increase in inverse current at the higher temperature tends to place an upper limit on the useful temperature range of the Germanium Dot Rectifier. This upper limit is believed to be inherent in most semi-conductor devices, as it is thought that inverse currents are largely generated by thermal agitation at the rectifying surface.

Fig. 4 shows the static resistance, at room temperature, for an average G-10. It is of interest to note that the rated peak-to-peak voltage of the G-10 (400 volts) falls on or near the point of maximum resistance of the Germanium Dot Rectifier at room temperature.

In many circuits the efficiency of this unit is at least 98%. For example, with a 50-watt resistive load, the power dissipated within the rectifier as heat is usually less than 1 watt. Operation at 50°C does not materially affect this efficiency. Other types of rectifiers may lose as much as 5% of their room temperature efficiency at 50°C.

Another advantage of this rectifier is the low effective capacity, usually

about 20 μμfd.; making it possible to operate dry disc type power supplies from 25 cycles to about 50 kilocycles. This characteristic is of particular advantage in lightweight installations, such as aircraft and mobile power units. Here a high frequency alternator with a G-10 rectifier and a small filter will provide low noise and ripple content d.c. power over wide extremes of temperature, vibration, and altitude.

The life expectancy of the Germanium Dot Rectifier is believed to be well in excess of 10,000 hours at full load and 40°C. At the present time, several units have been on test for more than 4000 hours at full load, at 40°C with no significant changes in their electrical characteristics. This figure has been limited only by a lack of time in which to take the test to completion.

Some typical characteristics for the Germanium Dot Rectifier with various filter condensers at room temperature are shown in Figs. 5 and 6 for two types of rectifier circuits. An average selenium rectifier is shown for comparison. It will be noted that the slope of the curve is mainly a characteristic of the size of the condensers used, but that the efficiency of the rectifier determines the position of the curve.

A doubler circuit has been successfully used at temperatures as high as 90° C ambient with the characteristics as shown in Table 1.

Excessive overload in the half-wave circuit, or the voltage doubler circuit, generally causes the rectifier to short-circuit. This usually opens a series fuse or surge resistor and damages the rectifier irreparably. If this occurs, there is no disagreeable odor from the G-10 as is often the case with other type rectifiers.

The recommended surge or current limiting resistance has been tentatively established at the same values used with selenium rectifiers, *i.e.*, approximately 5 ohms. There is some indication, however, that this may be reduced to approximately half of this value. Even at 5 ohms, the series condenser ripple-current ratings must be increased to prevent condenser damage, due to the higher surge and ripple currents that result from the lower forward resistance of the Germanium Dot Rectifier.

The Germanium Dot Rectifier is not seriously deteriorated by humidity due to the butyl rubber sealed metal case; several test units have successfully completed 50 or more cycles of operation under maximum load conditions at 90% to 95% relative humidity. Each cycle consists of two periods of four hours of rectifier operation separated by an eight hour period of inactivity.

Additional research is underway to improve the accuracy of tests and to provide a faster and more complete stabilization, together with operation at higher temperature ambients and current ratings than are presently possible. —30—

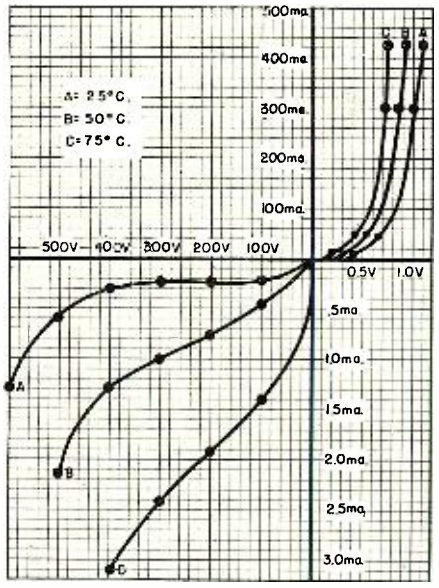


Fig. 3. Static characteristics of an average G-10 taken at different ambient temperatures ranging from 25 to 75 degrees C.

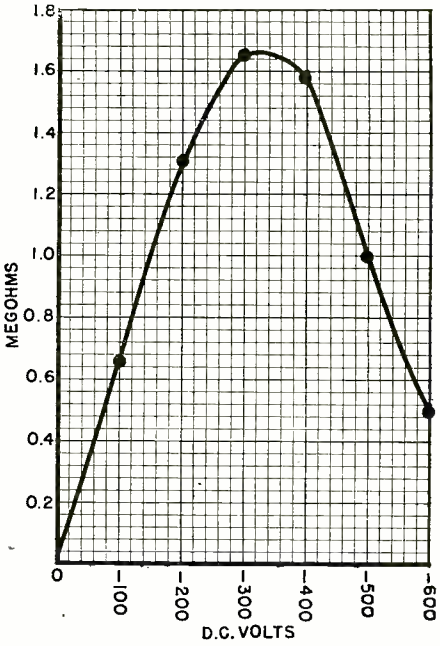


Fig. 4. Static resistance at room temperature.

Degrees (C) maximum free-flowing air temperature	90
Milliamperes maximum average forward current	100
Amperes maximum forward surge current	5
Maximum voltage (peak-inverse-voltage)	70
A.C. voltage input	27
D.C. voltage output	55
D.C. current output (in milliamperes)	100
Filter capacitance in μfd.	150
Series surge resistor in ohms	5
Approximate load resistance in ohms	550

Table 1. G-10 characteristics in a doubler circuit at ambient temperatures to 90° C.

AMBIENT TEMPERATURE	25°C to 40°C	55°C	60°C
RMS input voltage	130	130	130
RMS current	1.2 amps.	1.2 amps.	.2 amps.
D.C. output current	400 ma.	350 ma.	50 ma.
D.C. surge current	25 amps.	20 amps.	2.5 amps.
Peak forward current	3 amps.	3 amps.	.5 amps.
Peak inverse voltage	400	400	400
Max. full load voltage drop	1.5	1.4	1.3
Operating frequency	50 kc.	50 kc.	50 kc.

Table 2. Tentative electrical characteristics for the G-10 Germanium Dot Rectifier.

Fig. 5. Some typical characteristics for the G-10 in condenser-input power circuit.

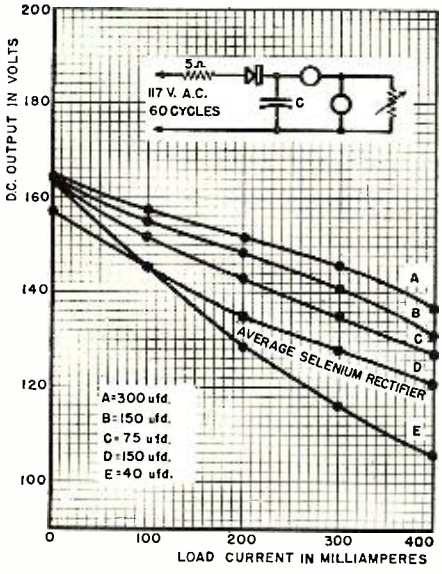
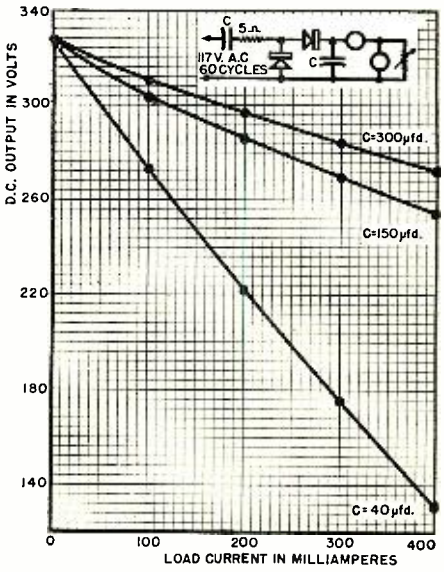


Fig. 6. Performance graph of the G-10 when used in a conventional doubler circuit.



An Improved RESONANCE INDICATOR

By
IRVING GOTTLIEB

Rear view of the home-built resonance indicator. It is fairly easy to build and requires no critical circuit adjustments.

Details on a unit which serves the purpose of a grid dip meter but is entirely free from meter variation. It covers from 3.1 to 31 megacycles.

THE status of the grid dip resonance meter as an indispensable adjunct to the well-equipped electronic laboratory has persevered since the early days in the radio art. The esteem bestowed upon this instrument by the radio fraternity stems from the appreciation of a simple and rapid means of bridging the gap between theoretical computation and practical results in the construction of apparatus using radio frequency resonant circuits. The calculation of the resonant frequency of a coil-condenser combination is always somewhat indeterminate due to unknown factors such as stray capacitance, stray inductive coupling, lead inductance, and tuning slug permeability. A device which permits measurement of actual resonance as produced by the cumulative effect of all stray parameters is indeed a useful one. The grid dip meter performs this function; however anyone who has used the commercial versions of this instrument is aware that ofttimes considerable caution must be exercised to prevent masking of a weak resonance by the meter needle which drifts as the instrument is tuned. A resonance indicating device which indicates only the establishment of resonance, and which is devoid of indicator fluctuations due to its internal characteristics would constitute a definite improvement over the time-honored grid dip meter. The instrument to be described has been devised by the author to serve the purpose of the grid dip meter but without the annoyance of the meter variation.

Although it is possible to design oscillator circuits so that reasonably constant grid current will be maintained over wide frequency excursions, the author believes the approach depicted in the schematic diagram of Fig. 1 is a much better one. The indictator needle remains at zero until the *LC* circuit undergoing measurement is resonated, whereupon a deflection takes place. The principle of operation can best be grasped by first considering the plate circuit of the 12AU7 tube. Assuming for the moment that the circuit parameters of both triodes of this tube are identical, a sensitive meter will not detect any potential difference when connected from plate to plate. Regardless of the value of the respective plate currents, the fact that they are the same and that these currents flow through identical circuits prohibits any potential difference between the two plates. This operating condition should be readily accepted before proceeding further. Perhaps a little more light is cast on the nature of this portion of the circuit by stating that the 12AU7 is operated very much like a push-pull class C r.f. amplifier tuned considerably off-resonance. Although a class C amplifier operating under such circumstances would draw heavy current from the power supply, no difference in d.c. potential would exist from plate-to-plate providing the circuit was a balanced one. Furthermore, no difference in plate-to-plate potential would result from variation of grid excitation. A step further in our consideration of the analogous class C amplifier reveals that it makes no difference whether the grids are driven in- or out-of-phase insofar as the existence of d.c. potential from plate-to-plate is concerned. No r.f. energy will be delivered to the plate loads in either case by virtue of the specified off-resonance tuning adjustment. *Only an unbalance in the push-pull circuit will allow the development of a d.c. potential from plate-to-plate.*

Returning now to Fig. 1, the 12AU7 should actually be considered a class C amplifier with plates in push-pull and grids in parallel. The equivalent of off-resonant operation exists for any frequency because the plates are heavily bypassed to ground. Attention should now be focused upon the cathode circuits of the 12AU7. Both cathodes contain equal resistances to limit the plate currents to a safe value since plate circuit resonance is not used to achieve such a condition. Also, both cathodes contain 15 inch lengths of coaxial cable terminated by small link-type coils. There is one difference in the physical symmetry of the push-pull circuit at this point; one coaxial cable is coiled up and permanently secured to the underside of the chassis, whereas the other coaxial cable is brought out through the panel and is used with its pickup link in exploring the *LC* combination to be measured. This situation does not

Table 1. Winding data for L_1, L_2, and L_3.

L_1—3.1 to 5.2 mc.—30 t.; 5.4 to 8.5 mc.—13 t.; 8.7 to 13.6 mc.—6 t.; 13.9 to 22.5 mc.—3 t.; 23.0 to 31.0 mc.—2 t. All coils closewound of #20 plastic covered solid hook-up wire on 1½" dia. form. The form is cemented over the outer dia. of 6V6 tube bases or bases from other tube types with similar dimensions. Pins 1 and 5 are used for the coil connections.
L_2, L_3—15" length of RG-59/U coaxial cable. These cables are terminated by a two-turn coil of stiff wire with a diameter of 1". One cable is brought out from the panel and its pickup coil is coupled to the LC circuit undergoing measurement. The other cable is coiled beneath the chassis and is included just for the sake of circuit balance.

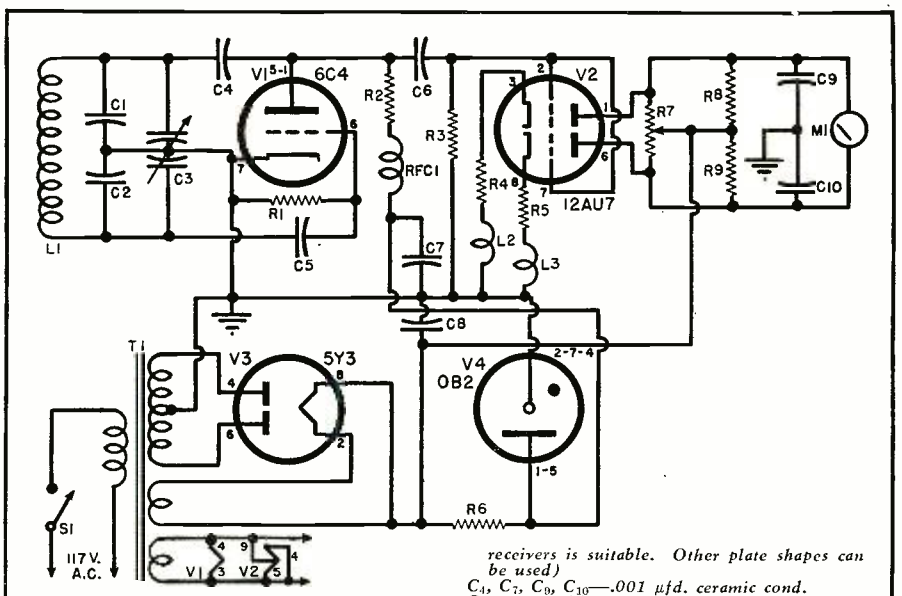
cause electrical unbalance except in one special case. (A coaxial cable may be stretched taut or wound in a coil without altering its characteristics.) The special case is that in which the r.f. energy in the pickup link is identical in frequency with the resonant frequency of the nearby *LC* circuit. Let us now analyze why this is so.

The proximity of a resonant *LC* combination to the pickup loop extracts energy from the loop and thereby decreases the r.f. drive to the input of the triode section associated with the pickup loop. This triode section now draws less plate current than the other triode section, the grid drive of which has not been affected. The plate of the affected tube assumes a positive potential with respect to that of the other plate. This is so because the diminished plate current of the affected tube allows a higher plate voltage to exist at its plate than in the case of the unaffected tube. With both tube sections the respective plate voltage equals the difference between power supply voltage and the *IR* drop in the plate-load resistances. Consequently, a d.c. meter will read zero voltage from plate-to-plate when the circuit is balanced. When a state of asymmetry is produced in the grid drive by proximity of a resonant circuit to the pickup loop, the d.c. meter will indicate the resultant potential difference in the plate circuits.

So far nothing has been mentioned concerning the oscillator. Its function is simply to cover the desired frequency range and to furnish sufficient drive to the 12AU7 so that the grid circuits of that tube operate as would be the case in a conventional class C amplifier. Other than this, it is not required that the output level of the oscillator remain constant with respect to frequency. A simple Colpitts oscillator designed around a 6C4 proved quite satisfactory. It was found necessary to provide a substantial amount of minimum capacitance in order to eliminate unstable performance at the high frequency end of the tuning range. This applies to all frequency ranges and the solution consists of the addition of the small condensers C_1-C_2. The trimmer condensers should be physically removed from the tuning condenser if they are present; their presence is not conducive to stability of frequency calibration. The plate supply voltage to the 6C4 is regulated so that line voltage variations will not appreciably affect frequency calibration. The effect of R_2 on plate voltage regulation to the 6C4 is negligible. Coil winding data is given in Table 1 to allow continuous coverage from 3.1 to 31 megacycles, thereby encompassing the popular amateur bands.

Higher or lower frequency coils can be wound as desired. In the case of the frequencies above 31 mc., there will be one "dead spot" corresponding to the frequency at which the coaxial cables resonate with the pickup loops. In this particular design, the dead spot is approximately 36 mc., well beyond the highest frequency covered. The dead spot can be shifted to the vicinity of 70 mc. by using shorter coaxial ca-

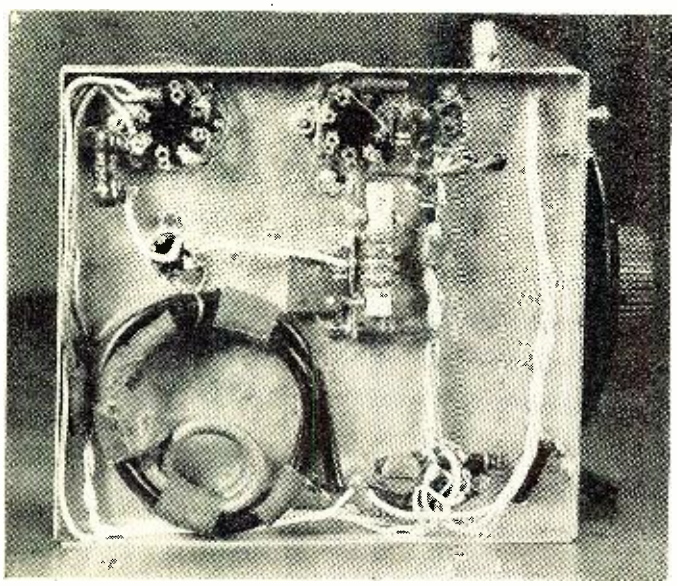
(*Continued on page* 144)



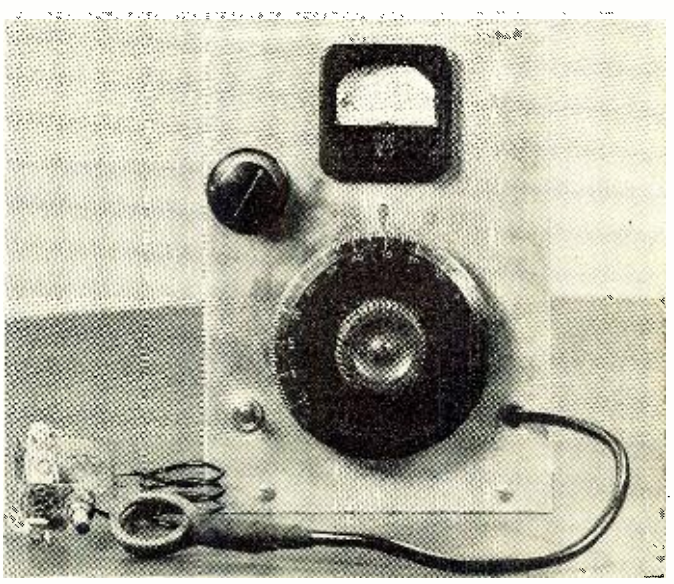
R_1—*22,000 ohm, 1 w. res.*
R_2—*2200 ohm, 1 w. res.*
R_3—*10,000 ohm, 1 w. res.*
R_4, R_5—*330 ohm, 1 w. res. (These two resistors should be selected by means of ohmmeter measurement for identical resistance)*
R_6—*5000 ohm, 5 w. wirewound res.*
R_7—*250,000 ohm carbon pot.*
R_8, R_9—*10,000 ohm, 1 w. res. (These two resistors should be selected by means of ohmmeter measurement for identical resistance)*
C_1, C_2—*39 μμfd. ceramic or mica cond. (These are in addition to the trimmer condensers)*
C_3—*350/350 μμfd. dual-gang, straight-line var. cond. (Type commonly found in small b.c. receivers is suitable. Other plate shapes can be used)*
C_4, C_7, C_9, C_{10}—*.001 μfd. ceramic cond.*
C_5—*270 μμfd. ceramic cond.*
C_6—*50 μμfd. ceramic cond.*
C_8—*8 μfd., 450 v. elec. cond.*
T_1—*Power trans. 340-0-340 v. @ 70 ma.; 6.3 v. @ 2.5 amps; 5 v. @ 2 amps.*
RFC_1—*2.5 mhy. r.f. choke*
M_1—*0-.5 ma. or 0-3 v. d.c. meter. The basic movement of many milliammeters and voltmeters consists of 0-.5 ma. or even more sensitive meters*
S_1—*S.p.s.t. switch*
V_1—*6C4 tube*
V_2—*12AU7 tube (select for matched sections)*
V_3—*5Y3 tube*
V_4—*0B2 tube*

Fig. 1. Complete schematic diagram and parts list covering the resonance indicator.

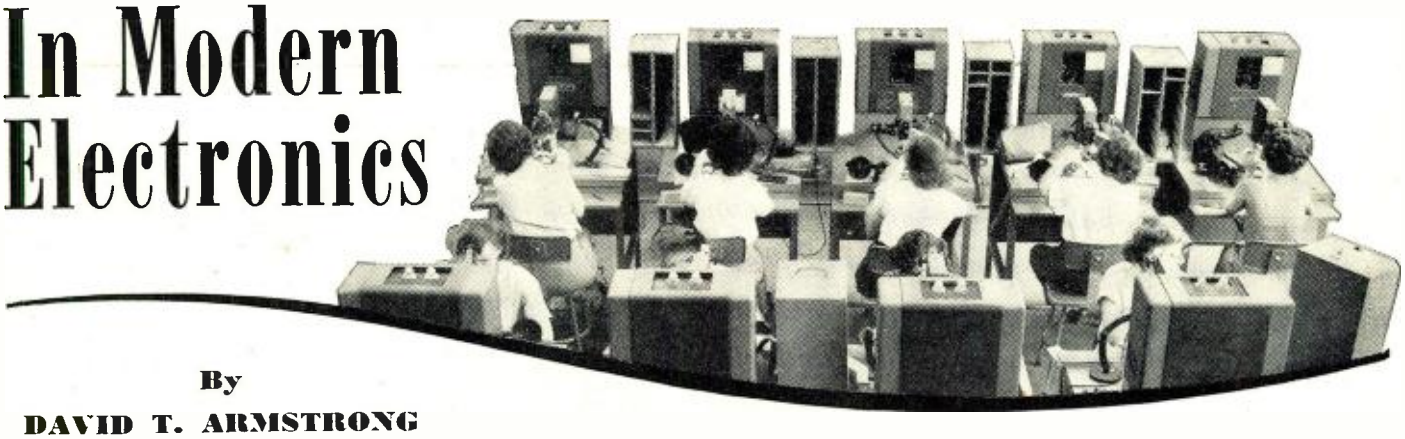
Underchassis view of unit. See text for data on coax cable.



Front panel view of the compact resonance indicator unit.



CRYSTAL DIODES In Modern Electronics



Several banks of catwhisker machines at the General Electric Clyde, N. Y. plant. The factory's production is devoted exclusively to the manufacture of germanium products for industry.

By
DAVID T. ARMSTRONG

Part 8. Concluding article of this series covers a.f.c. sync circuits and a.g.c. in video receivers.

THE triggering of the impulse generator in a TV receiver is susceptible to interference from certain types of impulse noise. Under ideal conditions the scanning generators of a typical TV receiver provide high quality synchronization; but they provide comparatively poor performance in areas where there is high amplitude impulse noise.

Horizontal scanning circuits are particularly susceptible to noise pulses slightly greater in amplitude than the peak video intelligence level, particularly when such pulses occur near the end of a scanned line, where the impulse generator is sensitive to triggering. See Fig. 1.

It is true that certain types of video amplifiers provide some noise limiting, but conventional sync circuits can not differentiate between a normal sync pulse and a random noise pulse, particularly:

1. When the random pulse is of the same polarity as the sync pulse.
2. When the random pulse is of sufficient amplitude to pass through the separator circuits.
3. When the noise pulse occurs at that part of the scanned line where the impulse generator is sensitive to triggering.

Thus it becomes desirable to provide some additional control for synchronization in addition to direct action of the sync pulse on the impulse generator because high amplitude random noise pulses near the "front porch" of the horizontal sync pulse may tear the picture.

Indirect Control

While such additional control may be imposed upon a scanning system directly or indirectly, the simple and economical circuits are of the indirect type. The indirect method of control is based upon the repetition frequency of a large number of successive sync pulses rather than upon individual pulses. There is a continuous comparison for phase and repetition frequency of sync pulses with the waveform of the local oscillator scanning system; there is also the development of an "error voltage" proportional either to a phase or frequency difference between the compared sets of sync pulses.

This error voltage is applied to correct the frequency of the local oscillator and is similar in many ways to a.f.c. circuits for FM and AM. Because horizontal phase comparators do not make use of tuned circuits, they are not critical to adjust, nor are critical components required.

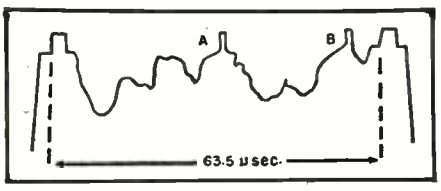
There is no limitation on the type of impulse generator used in the scanning system, as it may be: the clipped sine wave type; the multivibrator type; any of the blocking oscillator types; or any type capable of being controlled for frequency by a variable reactance or resistance tube.

The control circuit must be adapted to the particular oscillator used and should be so designed that it effects a smooth variation of the oscillator frequency over approximately ±10% of the nominal oscillator frequency.

The Phase Comparator

The phase comparator is the heart of the control system; this may be either a phase discriminator or a double diode combining circuit. In the double diode circuits it is common to apply the sync pulse out-of-phase to the two diodes with the locally generated sweep voltage applied in-phase. Irrespective of which type circuit is used, a d.c. voltage proportional to the phase or the frequency difference of the applied voltage must be developed. It is also necessary to insure that the polarity of this d.c. voltage be such as to react properly whether the frequency of the local oscillator is above or below that of the sync pulse repetition frequency; this is important, but not difficult to attain.

Fig. 1. A noise pulse occurring at A would not trip pulse generator, but a noise pulse occurring at B, when pulse generator is just ready for triggering, would be quite likely to trigger the generator prematurely and cause deterioration of image on the cathode-ray tube screen.



Basically, a.f.c. sync control circuits maintain some small constant frequency or phase difference between sync pulses and local oscillator pulses. This small difference provides a control voltage which holds the oscillator to the desired frequency. Fig. 2 shows a typical a.f.c. sync circuit designed to be used with a blocking oscillator type impulse generator.

A.F.C. With Blocking Oscillator

V_3 is the blocking oscillator tube with its associated transformer T_1. The frequency controlling elements are C_9, R_9, and R_{10}. V_2 is a medium-mu triode operating as a d.c. amplifier of the a.f.c. control voltage developed by the phase comparator germanium diodes, CR_1 and CR_2. The amplified d.c. voltage variations appear as changes in the d.c. plate voltage of V_2; these appear as grid bias changes of the sweep oscillator V_3. These changes in grid bias are reflected as changes in frequency of the sweep oscillator V_3.

Potentiometer R_9 is a fine frequency control which should be adjusted to approximately the correct frequency; the action of the a.f.c. circuit corrects the oscillator under all conditions of operation when the frequency of the oscillator is ±10% of the sync pulse repetition frequency.

The inverse feedback network C_8 and R_6 makes V_2 relatively unresponsive to changes in grid voltage which occur at a rate faster than approximately 0.5 second. Triode V_1 is a phase inverter

to supply the 180 degree phase difference between the sync pulses at the input of the phase comparator. The locally generated sweep impulse is derived from the plate of the blocking oscillator triode through the wave shaper network, C_{10} and the 8200 ohm resistor.

The operation of the phase comparator circuit is such that when locally-generated pulses lag or lead the sync pulses one of the diodes passes more current than the other. This produces a voltage across the common load resistor R_5. The polarity of this voltage is determined by the direction of phase shift and the magnitude of voltage is proportional to the phase shift. The correction necessary to shift the frequency of the oscillator is provided in the grid bias of V_3.

This type circuit has much to recommend it. It is quite simple and contains relatively few components; it affords reliable synchronization over a rather wide frequency range; the d.c. amplifier is practically unresponsive to variations in control voltage; the performance of this circuit in the presence of impulse noise is excellent; and, synchronization remains steady under noise conditions that mask out the picture. The use of germanium diodes eliminates diode contact potential effects which may unbalance the system and show up in a slow drift in the operating point of the d.c. amplifier.

Sine-Wave Oscillator and A.F.C.

Blocking oscillator and multivibrator impulse generators are unstable as the supply voltage changes. A stabilized sine-wave oscillator possesses all the virtues and none of the defects of these oscillators; when combined with a suitable wave shaping network, it lends itself nicely to a.f.c. circuits. The discriminator reactance tube combination has proved itself in performance; a circuit of a grounded-plate Hartley oscillator is shown in Fig. 4.

V_1 is a sine wave oscillator pentode. V_1 oscillates violently at some frequency determined by the resonant frequency of the inductance. The plate current swings to cut-off during the most negative portion of the cycle, and a clipped sine wave appears across the plate load resistor R_6. C_5 and R_7 differentiate the clipped sine wave and a positive impulse appears at the output of the network. This is the impulse that may be used to control a discharge tube.

V_2 is a high mutual conductance pentode connected as a variable inductive reactance across the oscillator tank circuit. The oscillator frequency is controlled by the d.c. bias on the grid of V_2. This d.c. bias is provided by the germanium diode phase discriminator consisting of CR_1 and CR_2, the transformer T_1, and the associated circuit components.

The out-of-phase components of the oscillator voltage are derived from the tuned balanced secondary winding of T_1; the primary of T_1 is the oscillator tank inductance. The network C_{12} and R_{15}, together with C_{13}, is an integrator network to keep rapid changes in the control voltage, derived from the discriminator, from affecting the reactance tube bias. This permits the reactance tube to follow only the average changes in control voltage.

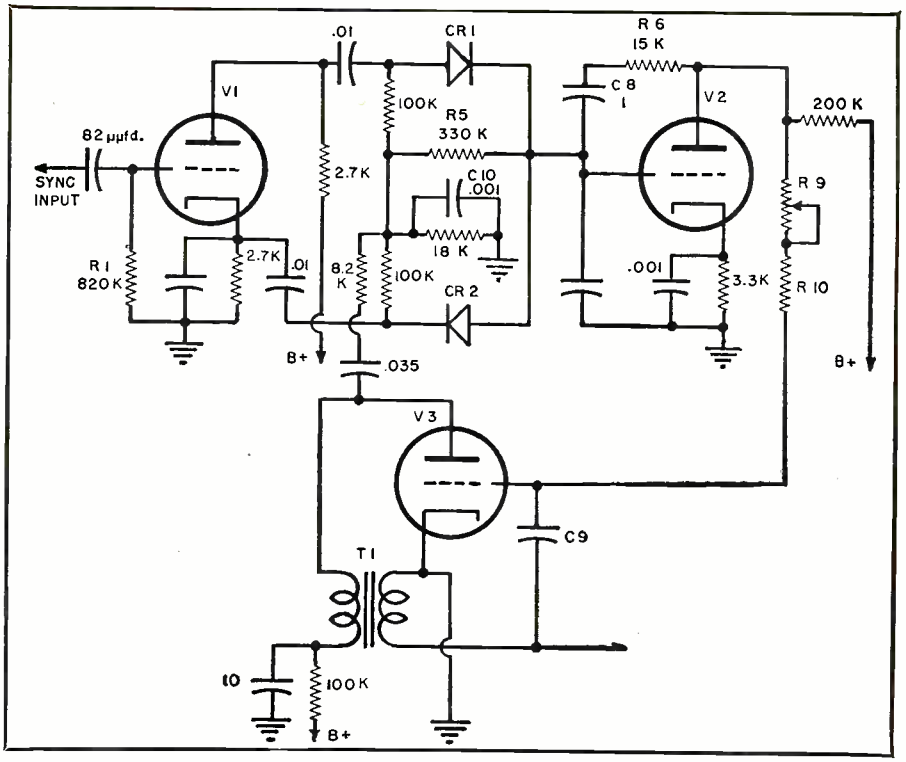


Fig. 2. Circuit of a.f.c. sync with horizontal blocking oscillator. CR_1 and CR_2 may be either 1N34's or 1N48's. V_1 is the phase inverter, V_2 a d.c. amplifier, and V_3 is a blocking oscillator. The crystals perform the function of a horizontal phase detector and a comparator in this particular television circuit.

Horizontal Phase Detector

A commercial application of this control circuit is shown in Fig. 3. The clipped sync pulses are direct coupled to the grid of the triode vertical sync amplifier. This also serves as a phase inverter for horizontal pulses. The output of this phase inverter provides

(*Continued on page* 108)

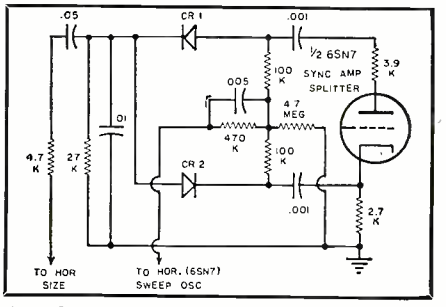
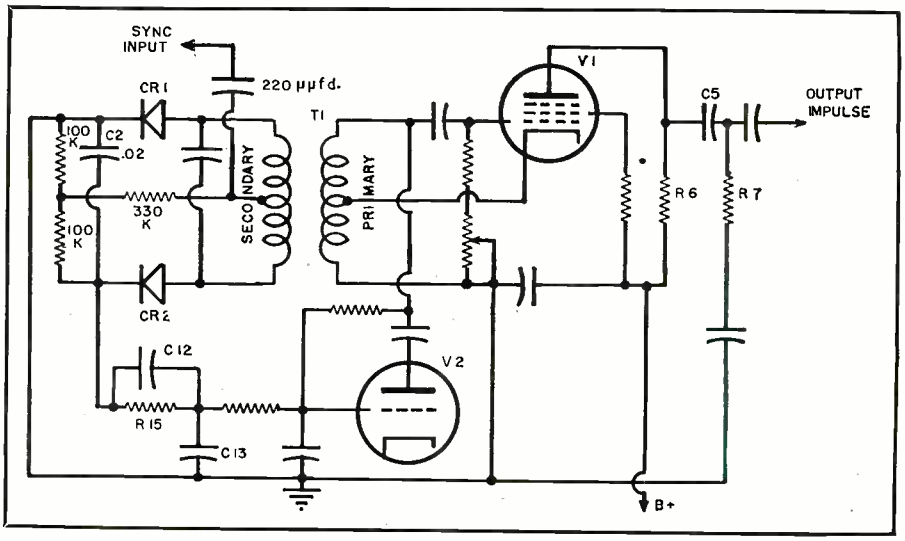
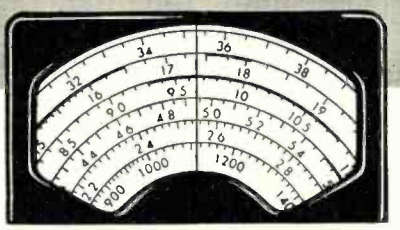


Fig. 3. Horizontal phase detector and comparator. CR_1 and CR_2 are 1N64 crystal diodes. This particular circuit is used by Meck Industries in its television chassis No. 9018 and illustrates the theory discussed.

Fig. 4. An a.f.c. sync circuit with a stabilized sine-wave oscillator. This is a grounded-plate Hartley oscillator. V_1 is a sine-wave oscillator pentode, V_2 is a reactance tube, and CR_1 and CR_2 may be either 1N34's or 1N48 type crystals.



International SHORT-WAVE



***Compiled by* KENNETH R. BOORD**

BY THE time you read this, the *Voice of America* should be broadcasting from the high seas.

The United States Coast Guard Cutter *Courier*—first of a potential fleet of sea-going radio broadcasting stations of *VOA*—was recently commissioned in ceremonies attended by members of Congress, top government officials, and civic leaders. This radio flagship, carrying its "Cargo of Truth" and the most powerful transmitters ever installed on a vessel, is the first of a proposed fleet of *VOA* "Truth Ships."

Following an initial trip to the Nation's capital for inspection by President Truman, a shakedown cruise to the Caribbean, and a period of testing, the *Courier* was to begin her task of frustrating jamming by operating as closely as possible to target audiences, thus covering vast areas of the "Iron Curtain" countries beyond the reach of *VOA's* present medium-wave broadcasting equipment. The "Truth Ship" adds new mobility to *VOA's* present world-wide radio network in broadcasting 50 program hours daily in 46 languages and dialects.

The vessel carries a 150 kw. medium-wave transmitter (three times as powerful as the largest American commercial medium-wave broadcasting station); two 35 kw. *short-wave* transmitters; supporting communication equipment; Diesel engines capable of generating 1,500,000 watts of electrical power for the radio equipment; permanent *short-wave* antennas atop the forward deck; captive barrage balloon—65 by 35 feet—with a capacity of 150,000 cubic feet of helium, to float 900 feet in the air to support the medium-wave antennas. The vessel also may broadcast from land-based antennas.

The floating relay base is a former Navy cargo vessel, 5800 tons, 338 feet; it was de-mothballed and transferred first to the Department of State, then to the Coast Guard.

Commanded by Captain Oscar C. B. Wey, United States Coast Guard, the *Courier* is manned by a Coast Guard crew of 10 officers and 80 men, plus three *VOA* radio engineers to supervise the operation of the transmitting equipment.

Although the "Truth Ship" can originate and broadcast programs from the open sea—flying her antennas from the helium-filled captive balloon—she is scheduled to anchor at strategic ports to relay programs broadcast from *VOA's* New York studios. Her mobility allows the *Courier* to shift from place to place on short notice—to more ably serve the *Voice's* purpose where most needed.

Conceived by *VOA* engineers, the project was approved by President Truman, the Joint Chiefs of Staffs, and the Congress. It was developed by leading American scientists, technicians, ship builders, and Coast Guard officers under the direction of George Q. Herrick, *VOA's* chief engineer, and Jean Seymour, project engineer.

At the commissioning ceremonies, Dr. Wilson Compton, Administrator of the International Information Administration which operates *VOA*, said:

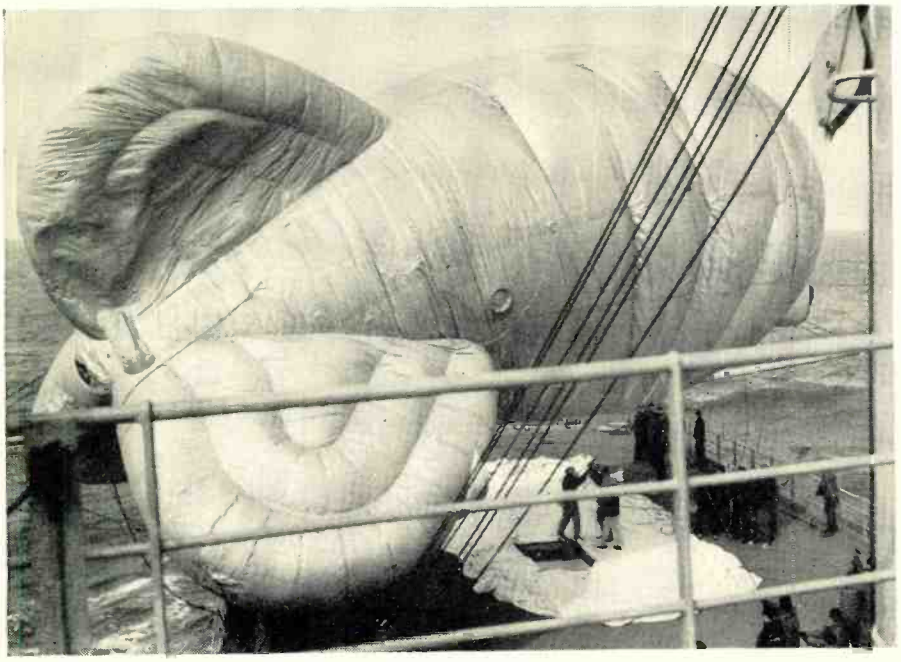
"History demonstrates it is difficult to quarantine ideas. By sending the Courier *with its message of hope and freedom to the seven seas, we aim to show the interest of America in other peoples, and broadcast the precepts of democracy as opposed to the dogmas of totalitarianism. The Coast Guardsmen who sail the ship will be pioneers, setting out for a new kind of beachhead with a new kind of weapon."*

Bon voyage!

* * *

(Note: Unless otherwise indicated, all time is expressed in American EST: add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

A captive balloon is used to support the antenna for "Voice of America" broadcasts behind the Iron Curtain. The U. S. Coast Guard Cutter "Courier" has been assigned to "VOA" duty and will cruise Mediterranean waters and off-shore areas near the Iron Curtain. The balloon used to carry the antenna is 69 x 35 feet in size and holds 150,000 cubic feet of helium. It is held by means of a winch-operated line.



This Month's Schedules

Afghanistan—Radio Kabul, 9.975, noted on Sunday opening in *English* 1115; after brief news, had music to 1145A closedown. (Catch, Pearce, England)

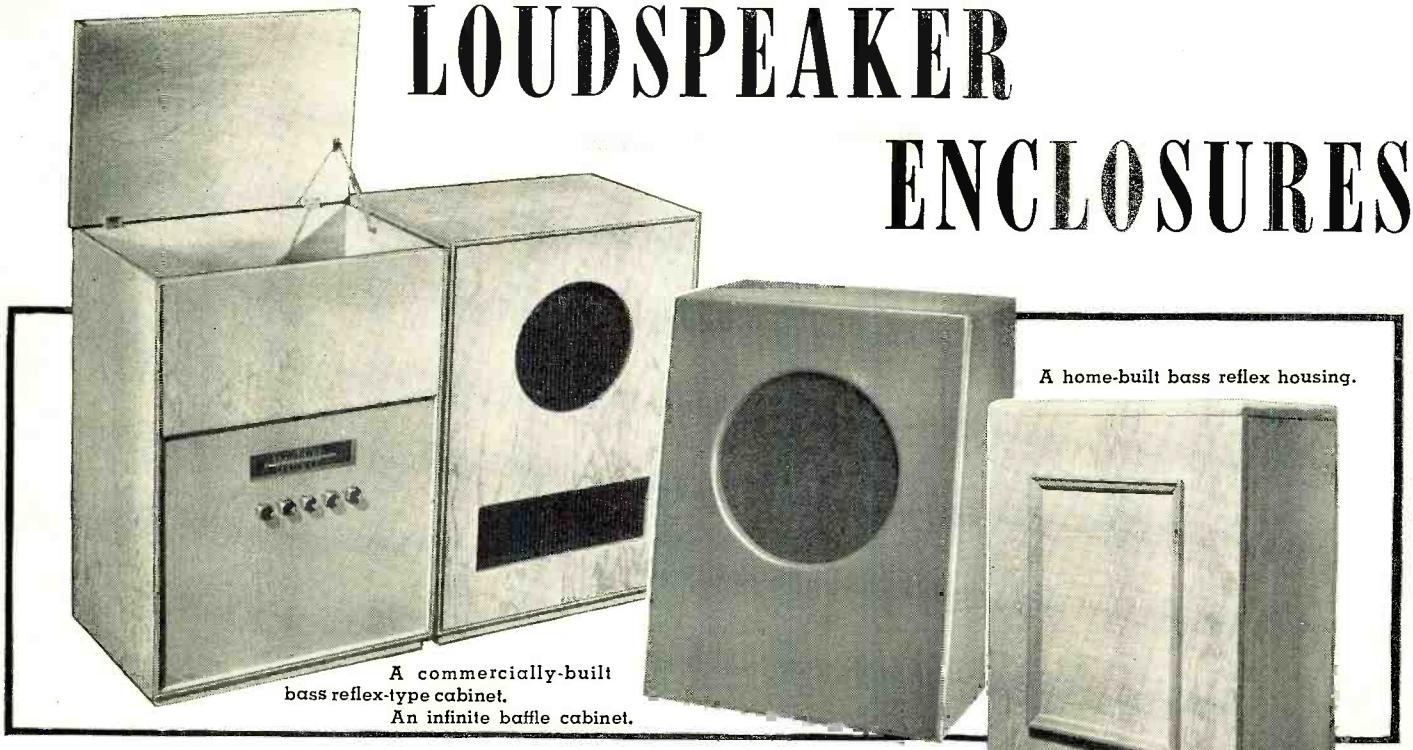
Albania—Shkodra, 8.215, noted in English 1245 with accordion music. (Catch, England)

Algeria—Radio Algerie, 7.280, noted 1650; heard on 6.145 from 1430; believed to close 1745. (Pearce, England)

Angola—Radio Clube de Angola, 11.862, Luanda, is good level in Indiana to 1730 closedown. (Leary) Usually becomes audible before 1500. (Niblack, Ind.) Noted parallel on 9.632 from 1330; faded out around 1600 but presumably closes down 1730 also. (Pearce, England) *Radio Clube de*

(*Continued on page* 91)

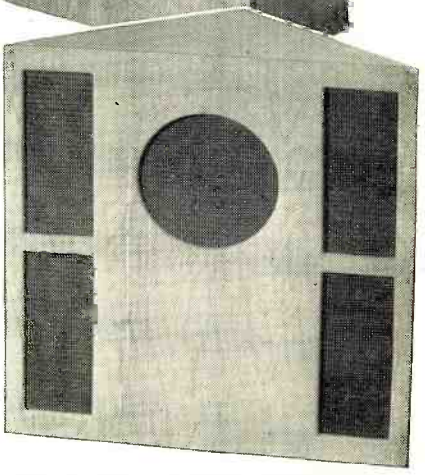
LOUDSPEAKER ENCLOSURES



A commercially-built bass reflex-type cabinet.

An infinite baffle cabinet.

A home-built bass reflex housing.



Commercial corner folded horn cabinet.

By DAVID FIDELMAN

Improve sound reproduction by housing your speaker in a correctly-engineered and properly-built cabinet.

THE most difficult question which faces the high-fidelity enthusiast or the audio experimenter in setting up a high-quality sound reproduction system is what loudspeaker arrangement to use. Unfortunately, there is no simple and easy answer to this question, as the choice of a loudspeaker system depends upon both the amount of money and the effort which can be invested in it.

In reproduction of sound, the loudspeaker is required to produce the same sound which is produced by all the instruments of a large orchestra, over the entire audible frequency range. It is required to project into the air of the listening room low-frequency vibrations identical with those of the large instruments such as the bass viol and the pipe organ, and the high-frequency vibrations of the triangle and the piccolo. The difficulty of accomplishing this function is obvious and most of the improvement which has taken place in the quality of sound reproduction has resulted directly from the improvement in loudspeaker design and manufacture.

The loudspeaker performs its functions as an electromechanical system, and its performance is limited by the wavelength and the amount of air it can move at the low frequencies, and by the mass of the moving parts at the high frequencies. Because of these fundamental difficulties, the quality of the loudspeaker system usually is the major factor which determines the over-all fidelity of any sound reproduction system. The other components of the system can be made to give good performance at a fairly reasonable cost, whereas good loudspeakers are quite expensive. In the design and construction of any sound reproduction system, the loudspeaker which is selected should be the best one which can be afforded, and the necessary expense or effort should be put into the choice of the proper enclosure for the loudspeaker. If the proper attention is thus paid to the loudspeaker system, the effort and expense will be justified by the improvement in over-all sound reproduction quality.

The selection of the loudspeaker itself is primarily a matter of listening to a number of different units in appropriate enclosures, studying the performance specifications supplied by the manufacturer, and making a choice which almost always represents a compromise between individual preferences and expense. Some of the important factors which should be found in a good loudspeaker are:

(*a*) The response should be reasonably flat over a frequency range of 50-10,000 cps.

(*b*) The frequency response curve should be fairly smooth, with as few sharp peaks and dips as possible, since these discontinuities in the curve represent mechanical resonances which result in bad transient response.

(*c*) The power rating of the speaker or speakers used should correspond to the power output of the amplifier and to the requirements of the listening room, so that there will be no distortion at high sound levels. A loudspeaker which has these properties will generally be capable of giving very good sound reproduction when properly baffled and used with a good electronic system.

Once the loudspeaker has been chosen, the question arises as to the type of enclosure in which to mount it. The type of enclosure to be used must be given careful consideration, since good results can be obtained from loudspeakers only when they are properly baffled. This article will describe the most widely used acceptable types of loudspeaker enclosures, and will give dimensions and constructional information that will permit the audio experimenter to construct his own baffle for whatever speaker has been selected. Home construction instead of a purchased commercial baffle has the two advantages for the experimenter that: (*a*) he can select the dimensions and size to suit any special space requirements he may have, and (*b*) the amount of money saved can make

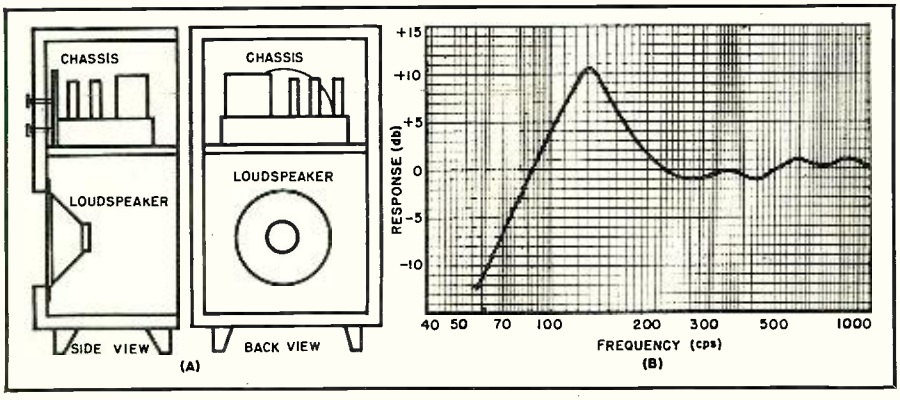


Fig. 1. (A) Method of mounting loudspeaker in conventional open-back cabinet. (B) A typical frequency response curve for a loudspeaker mounted in open-back cabinet.

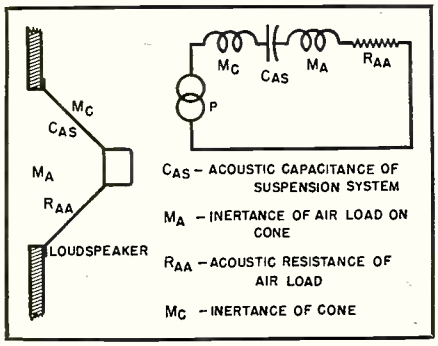


Fig. 2. Equivalent electrical circuit representation of loudspeaker performance.

possible the purchase of a better loudspeaker and result in better reproduction quality.

The reasons for the difficulty in obtaining proper baffling for loudspeakers may not be immediately apparent until it is realized that the primary purpose of the baffle is to prevent sound from the back of the speaker cone (which is 180° out-of-phase with that from the front) from cancelling the sound transmitted from the front of the cone. The smaller the difference in air path compared to the wavelength of the sound, the more complete is the cancellation. Therefore if the loudspeaker is not mounted in a baffle, or is mounted in a very small one, there will be cancellation up to a relatively high frequency and the reproduced sound will be deficient in low frequencies. If the speaker is mounted on a flat board, which is the simplest type of baffle, this board should measure at least 8 feet on each side (with the speaker mounted away from the center) if adequate response is to be obtained below 100 cps.

Because of the large size required if flat boards are used for loudspeaker mountings, a number of different types of baffles have been developed which do not require as much space. Some types perform the additional function of improving the low-frequency response by increasing the coupling between the loudspeaker cone and the air into which the sound is radiated. At low frequencies the area of the loudspeaker becomes insufficient for proper coupling to the air—this is one reason why small loudspeakers are not capable of the same low-frequency response as larger loudspeakers. The enclosures which increase the low-frequency response do so by increasing the area of radiation into the air at low frequencies.

The most common type of housing for loudspeakers is the unsatisfactory conventional open-back cabinet found in almost all commercial radio and radio-phonograph combinations sold at the present time. When the sound path from the back of the cone is sufficiently long (as in the case of the large console cabinets) the low frequencies are reproduced; while in the midget radio cabinets the sound path from the back to the front is very short and the low frequencies are not reproduced because of the out-of-phase cancellation. However, the most objectionable acoustical feature of such cabinets is that the back of the cabinet behind the loudspeaker acts as a resonant enclosure. It is an open-ended resonant tube (such as, for example, an organ pipe) which accentuates the loudspeaker response at the frequency of resonance due to the increased efficiency of the acoustical system. A diagram showing the typical physical layout of such a system is shown in Fig. 1, together with the type of frequency response obtained. The cabinet resonance causes the sharp peak in the response, generally in the range between 100 and 200 cps, which very unfavorably affects the intelligibility and naturalness of the reproduced sound and is especially noticeable in the reproduction of music and male speech. This is the "boomy" quality so characteristic of almost all commercial radio receivers. This open-back construction of the loudspeaker enclosure is used in mass-produced receivers because of its low cost and simplicity of construction, but it should be avoided in any system being set up for high quality reproduction.

The faults of the open-back loudspeaker enclosure can be eliminated by use of a properly designed loudspeaker housing which will give wide-range reproduction of sound with good frequency response and without undesirable peaks. In general, proper design of a housing for best loudspeaker performance consists of incorporating acoustical networks into the cabinet to eliminate the faults of the open-back cabinet and to improve the loudspeaker characteristics.

"Infinite Baffle" Cabinets

The simplest type of loudspeaker cabinet is one with a completely enclosed back. By making the cabinet as rigid as possible and padding the inside with absorbent material, the sound from the back of the loudspeaker cone is completely prevented from reaching the front. Such a cabinet is sometimes known as an "infinite baffle" cabinet, since its effect is similar to mounting the loudspeaker on an infinitely large flat board. However, the volume inside the box must be sufficiently large, or else the low-frequency response will be reduced.

The best way to understand the effect of the enclosure upon the performance of the loudspeaker is to consider the electromechanical equivalent circuits. The electromechanical equivalent circuit of the loudspeaker mounted on an infinitely large flat board is shown in Fig. 2. (It should be understood that this is not the actual electrical circuit of the loudspeaker, but is just an analogy in which its mechanical and acoustical properties are represented by electrical quantities.) Thus the loudspeaker has the same properties as the series *LCR* circuit. It has a resonant frequency above which the sound output is independent of frequency, while it falls off rapidly below resonance.

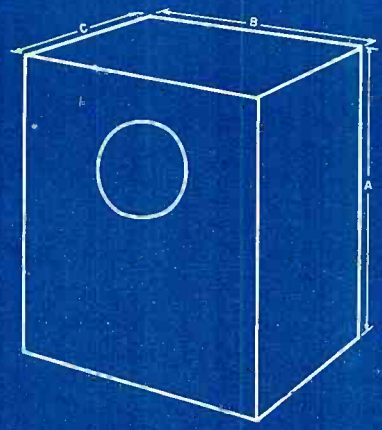
When the loudspeaker is mounted in an infinite baffle closed box, the volume of the box has the effect of capacity added in series in the circuit, as shown in Fig. 3. A capacity added in series in such a circuit lowers the effective capacity and raises the resonant frequency—and the larger the capacity the less will be this effect of raising the resonant frequency. The cabinet volume should, therefore, be made as large as is conveniently possible, so that it represents a large acoustic capacity and will have a minimum effect upon the resonant frequency of the system.

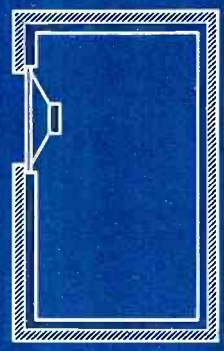
The constructional details of infinite baffle cabinets for the various types of loudspeakers in common use at the present time are given on the "Data-Print." Typical dimensions are indicated which show minimum volumes for the particular loudspeakers in question. If the space requirements make other dimensions preferable, the same minimum volume should be maintained, although the volume may be decreased slightly if the consequent decrease in low-frequency response is not objectionable.

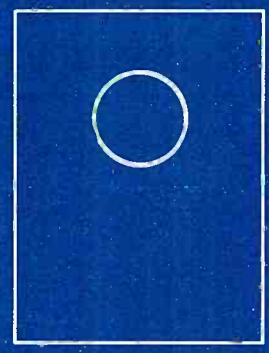
The size of the cabinet may, of course, be made as great as desired, subject only to practical limitations. The limiting case of this type of cabinet occurs when the loudspeaker is mounted in a door or wall between two different rooms, or between a room and a closet. This method has been used extensively in many installations where the room arrangement permits

(*Continued on page* 55)

LOUDSPEAKER ENCLO





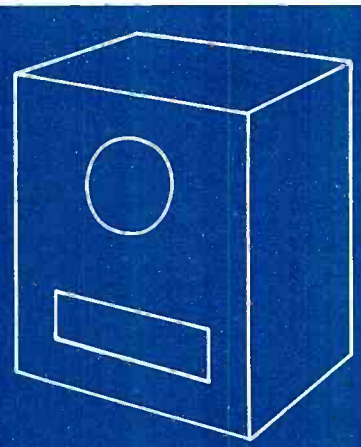


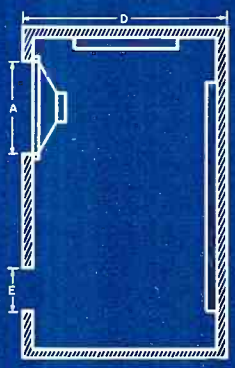
INFINITE BAFFLE CABINET

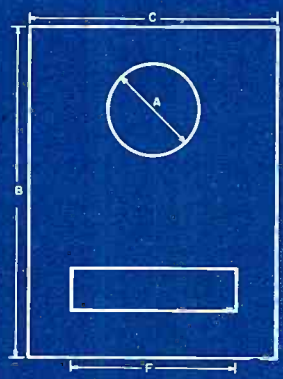
LOUDSPEAKER SIZE	OPENING	OVER-ALL CABINET DIMENSIONS A	B	C
8"	6½" diam.	29½"	22"	12"
		Enclosed volume—7800 cu. in.		
10"	8½" diam.	34"	25"	13½"
		Enclosed volume—11500 cu. in.		
12"	10½" diam.	38"	28"	15"
		Enclosed volume—16000 cu. in.		
15"	13¾" diam.	43"	32"	18"
		Enclosed volume—24800 cu. in.		

CORNER

LOUDSPEAKER SIZE
12"
15"

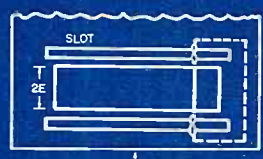




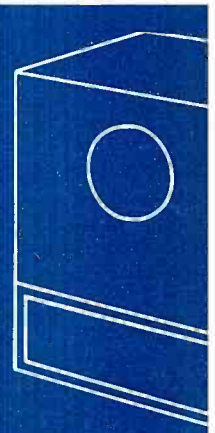


BASS REFLEX CABINET

LOUDSPEAKER SIZE	OPENING A	OVER-ALL CABINET DIMENSIONS B	C	D	VENT DIMENSIONS E	F
8"	6½" diam.	23"	17¾"	10¼"	3"	9¼"
		Enclosed volume—2800 cu. in.			Area—28 sq. in.	
10"	8½" diam.	28½"	22"	12½"	4"	12½"
		Enclosed volume—5700 cu. in.			Area—50 sq. in.	
12"	10½" diam.	34"	26"	14¾"	5¼"	16½"
		Enclosed volume—10,000 cu. in.			Area—86 sq. in.	
15"	13¾" diam.	41"	30½"	17¼"	7¼"	21"
		Enclosed volume—16,200 cu. in.			Area—150 sq. in.	



DETAILS OF THE SLIDING PANEL CONSTRUCTION BY WHICH THE VENT OPENING MAY BE ADJUSTED TO CHANGE THE RESONANT FREQ. OF THE CABINET.



LABYRINTH C

4"T-

TYPICAL COMMERCIAL LOUDSPEAKERS

8 Inch	10 Inch	12 Inch
Altec Lansing 400B, 755A	General Electric S1001D	Altec Lansing 600B
Electro-Voice SP8-B	Jensen P10SX	Electro-Voice SP-12, SP-12-
General Electric S800D, S810D, S818D	Stephens 100	General Electric S1201D
Jensen P8SX	Wharfedale W10CSB, W10CSB/T	Jensen P12SX, K-210
Jim Lansing 208		Jim Lansing D-131
Permoflux 8T-8-1, 8UP-8-1		Permoflux 12T-8-1, 12UP-8
University "Diffusicone"		Quam 12A6CO
Utah SP8JW		Stephens P-22FR
Western Electric 755A		University 6201, "Diffusicon
Wharfedale 8/CS, 8" Bronze		Utah SP-12-LW
		Western Electric 728B
		Wharfedale W12CS/AL

DECIBEL TABLE

Voltage Ratio (Equal Impedance)	Power Ratio	← — db + →	Voltage Ratio (Equal Impedance)	Power Ratio
1.000	1.000	0	1.000	1.000
0.989	0.977	0.1	1.012	1.023
0.977	0.955	0.2	1.023	1.047
0.966	0.933	0.3	1.035	1.072
0.955	0.912	0.4	1.047	1.096
0.944	0.891	0.5	1.059	1.122
0.933	0.871	0.6	1.072	1.148
0.923	0.851	0.7	1.084	1.175
0.912	0.832	0.8	1.096	1.202
0.902	0.813	0.9	1.109	1.230
0.891	0.794	1.0	1.122	1.259
0.841	0.708	1.5	1.189	1.413
0.794	0.631	2.0	1.259	1.585
0.750	0.562	2.5	1.334	1.778
0.708	0.501	3.0	1.413	1.995
0.668	0.447	3.5	1.496	2.239
0.631	0.398	4.0	1.585	2.512
0.596	0.355	4.5	1.679	2.818
0.562	0.316	5.0	1.778	3.162
0.531	0.282	5.5	1.884	3.548
0.501	0.251	6.0	1.995	3.981
0.473	0.224	6.5	2.113	4.467
0.447	0.200	7.0	2.239	5.012
0.422	0.178	7.5	2.371	5.623
0.398	0.159	8.0	2.512	6.310
0.376	0.141	8.5	2.661	7.079
0.355	0.126	9.0	2.818	7.943
0.335	0.112	9.5	2.985	8.913
0.316	0.100	10	3.162	10.00
0.282	0.0794	11	3.55	12.6
0.251	0.0631	12	3.98	15.9
0.224	0.0501	13	4.47	20.0
0.200	0.0398	14	5.01	25.1
0.178	0.0316	15	5.62	31.6
0.159	0.0251	16	6.31	39.8
0.141	0.0200	17	7.08	50.1
0.126	0.0159	18	7.94	63.1
0.112	0.0126	19	8.91	79.4
0.100	0.0100	20	10.00	100.0
3.16×10^{-3}	10^{-3}	30	3.16×10	10^{3}
10^{-2}	10^{-4}	40	10^{2}	10^{4}
3.16×10^{-3}	10^{-5}	50	3.16×10^{2}	10^{5}
10^{-3}	10^{-6}	60	10^{3}	10^{6}
3.16×10^{-4}	10^{-7}	70	3.16×10^{3}	10^{7}
10^{-4}	10^{-8}	80	10^{4}	10^{8}
3.16×10^{-5}	10^{-9}	90	3.16×10^{4}	10^{9}
10^{-5}	10^{-10}	100	10^{5}	10^{10}
3.16×10^{-6}	10^{-11}	110	3.16×10^{5}	10^{11}
10^{-6}	10^{-12}	120	10^{6}	10^{12}

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G-E SPEAKERS

CATALOG NUMBER	SIZE (INCHES)	MAGNET WEIGHT (OZS.)	RATING POWER (WATTS)	V. C. IMP. (OHMS)	V. C. DIAMETER (INCHES)	RESONANCE (CYCLES)	RESPONSE (CYCLES)	BAFFLE OPENING (INCHES)	SHIPPING WEIGHT LBS.	SHIPPING WEIGHT OZS.
400D	4	1.3	4	3.2	5/16	185	140 to 7,000	3½		10
402D	4	1.0	4	3.2	5/16	185	140 to 7,000	3½		10
403D	4	.68	4	3.2	5/16	185	140 to 7,000	3½		8
500D	5	1.3	4	3.2	5/16	160	125 to 8,000	4⅜		12
503D	5	.68	4	3.2	5/16	160	125 to 8,000	4⅜		10
525D	5¼	1.3	4	3.2	5/16	160	120 to 7,000	4¾		12
526D	5¼	1.0	4	3.2	5/16	160	120 to 7,000	4¾		12
527D	5¼	.68	4	3.2	5/16	160	120 to 7,000	4¾		12
625D	6½	1.3	4	3.2	5/16	140	110 to 9,000	5⅜		14
626D	6½	1.0	4	3.2	5/16	140	110 to 9,000	5⅜		14
650D	6½	2.98	8	3.2	¾	150	100 to 10,000	5⅜	1	6
703D	6x9	1.47	8	3.2	¾	100	70 to 13,000	8⅜x5½	1	12
800D	8	2.98	8	3.2	¾	100	80 to 11,000	6⅞	1	12
810D	8	6.8	12	3.2	1	100	80 to 10,000	6⅞	2	8
818D	8	6.8	12	8.0	1	100	80 to 10,000	6⅞	2	10
1000D	10	6.8	12	3.2	1	75	60 to 7,000	8¾	3	12
1001D	10	14.5	25	8.0	1¼	70	60 to 8,000	8¾	5	2
1003D	10	9.0	25	8.0	1¼	70	60 to 8,000	8¾	3	14
1012D	10	3.16	12	3.2	1	75	60 to 7,000	8¾	3	6
1018D	10	6.8	12	8.0	1	75	60 to 7,000	8¾	3	12
1200D	12	6.8	12	3.2	1	75	60 to 8,000	10¾	4	12
1201D	12	14.5	25	8.0	1¼	70	50 to 13,000	10¾	6	8
1203D	12	9.0	25	8.0	1¼	70	50 to 13,000	10¾	5	2
1212D	12	3.16	12	3.2	1	70	60 to 8,000	10¾	4	4
1218D	12	6.8	12	8.0	1	70	60 to 8,000	10¾	4	8
400C22	4	1.3	4	3.2	5/16	200	160 to 7,000	3½		10
525C18	5¼	1.3	4	3.2	5/16	160	120 to 7,000	4¾		12
		★		★		★				

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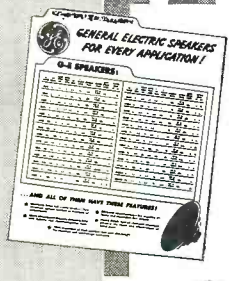

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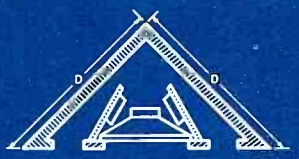
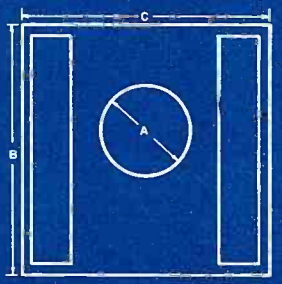
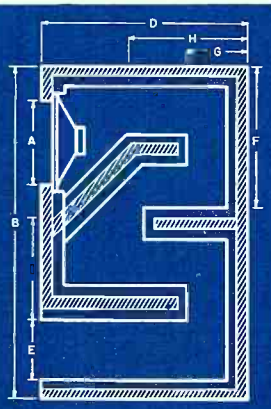
SURE DESIGN DATA

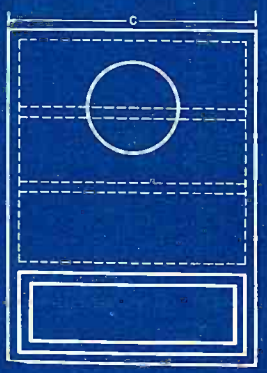




OLDED HORN CABINET

SPEAKER OPENING	GABINET DIMENSIONS		
A	B	C	D
10½" diam.	32"	32"	22½"
13¾" diam.	32"	36"	24½"





BINET

LOUDSPEAKER SIZE	SPEAKER OPENING	OVER-ALL CABINET DIMENSIONS			PARTITION POSITIONING					MATERIAL
	A	B	C	D	E	F	G	H	I	
8"	6½" diam.	17"	14"	11½"	3"	9½"	2½"	5"	3¾"	½" plywood ½" felt padding
10"	8½" diam.	21¾"	17"	14"	4½"	10½"	4"	5"	3"	¾" plywood ¾" felt padding
12"	10½" diam.	27¾"	21"	16¾"	6"	13½"	5¾"	6¼"	5"	¾" plywood 1" felt padding
15"	13¾" diam.	35"	25"	21"	7"	18"	6½	7½"	4"	¾" plywood 1" felt padding

Construction Notes

1. In assembling cabinets, all mating joints should be securely glued and screwed together. Cracks or holes should be filled with plastic wood.
2. Large surfaces of the cabinet should be stiffened on the inside to prevent low-frequency vibrations. Stiffening braces should be fastened to such surfaces to eliminate any low-frequency resonances. When surfaces are tapped, only highly damped high-frequency vibrations should result, and various sections should have different resonant frequencies.
3. Interior of the cabinet should be padded to prevent standing waves from being set up. Absorbing material should be placed directly behind the loudspeaker, and on one of each pair of opposing surfaces.
4. Grill cloth should be as light in weight and as porous as possible for minimum loss of high frequencies.
5. The dimensions given for each of the loudspeaker enclosures included may be varied to suit individual room space requirements. However, in the enclosed baffle and bass reflex cabinets, the internal volume and vent area must be maintained. For the labyrinth and folded horn cabinets, the line length and cross section must be maintained.

Typical Sound Insulating Materials

Rock Wool	Acousti-Celotex
Kimsul Insulation	Fiberglas, type FP-0C9
Cellufoam	Tufflex

Fiberglass padding or tile

15 Inch
Altec Lansing 604B, 603B
Electro-Voice SP15
Jensen G-610, H-510, K-310
Jim Lansing D-130
Quam 15A10CO
RCA LC-1A, 515S-2
Stephens 106AX, 102FR

RADIO & TELEVISION NEWS

DATA-PRINT 2

it. If the room or closet at the rear is large, the mounting approaches the properties of an infinite plane and no treatment of either room is needed. When the room or closet at the rear is so small that it approaches the dimensions of the cabinets as listed in the chart (*i.e.*, where the maximum dimension of the enclosure is less than a quarter-wavelength at the low frequencies), the walls must be lined with absorptive material as shown for the smaller cabinets—in such cases it might be better to construct a suitable cabinet which would then be built into the room or closet.

Bass-Reflex Cabinets

The bass-reflex cabinet is probably the most popular and widely used of all the different loudspeaker cabinet designs. It is very simple to construct and, when properly designed, gives excellent acoustic results. Many manufacturers provide such cabinets for use with their loudspeakers, and they have been used commercially for loudspeakers ranging in size from 8-inch to the large 18-inch low-frequency units of dual systems used in theaters and auditoriums.

The basic principle of operation of the bass-reflex cabinet is the use of acoustical networks to increase the low-frequency response of the loudspeaker. The construction is shown on the "Data-Print," and can be seen to consist of a closed cabinet with an opening in the front close to the loudspeaker. The volume of the cabinet has the properties of an acoustical capacity, while the opening in the front has the properties of an inductance in series with the acoustic resistance of the air. The effect of the bass-reflex cabinet on the response of the loudspeaker is, therefore, the same as if the system were replaced by the circuit of Fig. 4. The response at low frequencies is that of two tuned circuits coupled together, with the currents in the two resistors representing the sound radiated into the air. The low-frequency response is increased by the coupling of the two tuned circuits, because the currents in the two resistors are in phase, and the sound from both the front and the back of the cone is therefore useful.

However, good results are obtained from the bass-reflex cabinet only when it is properly designed to match the size and resonant frequency of the loudspeaker with which it is to be used. Improperly designed cabinets will produce undesirably boomy and resonant bass, therefore the experimenter who constructs his own bass-reflex cabinet should be careful to use proper dimensions in his construction. The design conditions which have been found to give satisfactory results are that:

(*a*) The resonant frequency of the vented enclosure should be approximately the same as that of the loudspeaker.

(*b*) The aperture or area of the vent should approximate the effective radiating surface of the loudspeaker.

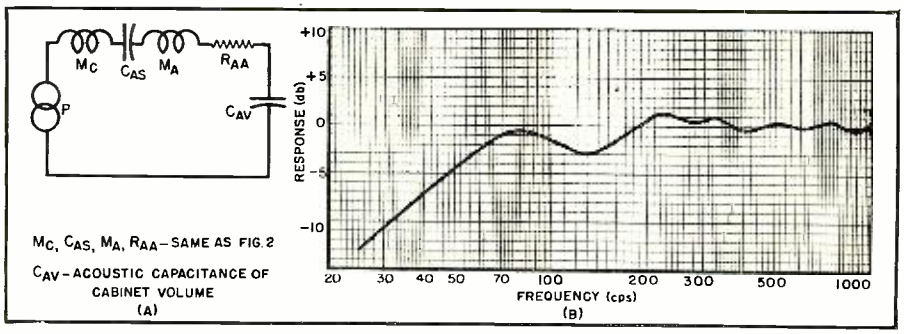


Fig. 3. (A) Equivalent electrical circuit representation of speaker mounted in infinite baffle cabinet. (B) Frequency response of speaker in infinite baffle cabinet.

The table shown in connection with the bass-reflex information in the "Data-Print" gives the various physical values and dimensions for the design of bass-reflex cabinets for any of the good standard and high-fidelity 8-inch, 10-inch, 12-inch, and 15-inch loudspeakers in general use at the present time. Acoustical absorbing material is placed on the inside of the back wall opposite the speaker and on one of each two opposing walls, to absorb the middle and higher frequencies in the cabinet to prevent any destructive interference with the radiation from the front of the speaker, and to eliminate any resonant vibrations inside the cabinet. The vent should be placed close to the loudspeaker, since mutual coupling between the two results in better sound radiation into the air. Because of normal variations in different commercial loudspeakers, the dimensions given in the chart may not be exactly optimum for the particular loudspeaker used in any individual application, and certain adjustments of these dimensions may be necessary.

The simplest method of adjusting the characteristics of the cabinet is by making the area of the vent adjustable. The constructional details of such an adjustable vent arrangement are shown in the "Data-Print." A sliding panel held in place by wing nuts is used to tune the cabinet by changing the port opening, and the initial opening is made larger than required to permit tuning above and below the optimum frequency. The adjustment of the opening can then be done by ear until the cabinet has been matched to the loudspeaker and the room to give the best overall reproduction quality.

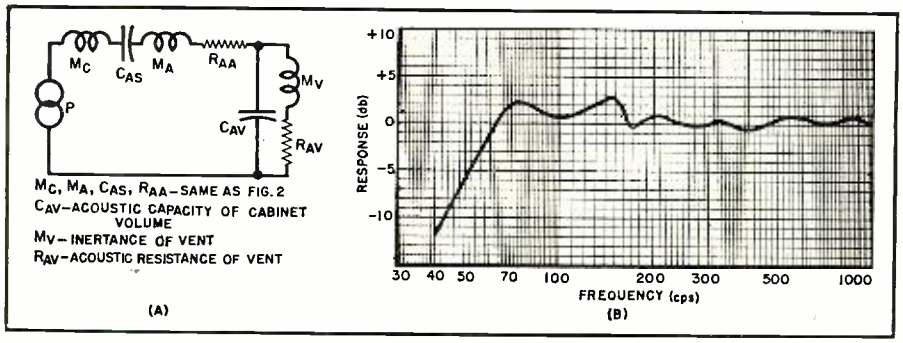
Acoustical Labyrinth Cabinets

Another type of resonant phase inverter cabinet which makes the radiated sound from the back of the loudspeaker cone useful at low frequencies is the acoustical labyrinth. In this type of enclosure, the acoustic tuned circuit of the bass-reflex cabinet is replaced by a resonant line. An absorbent-walled tube is coupled to the back of the loudspeaker at one end, and is open to the air at the other end. At the frequency for which it is one-quarter wavelength long, this tube sees a low impedance at the open end, and therefore presents a high impedance to the back of the loudspeaker cone. Thus, by choosing the length of the tube so that it is a quarter-wavelength at the resonant frequency of the loudspeaker suspension, the resonance of the speaker is damped in the same manner as with the bass-reflex cabinet. At double the resonant frequency, the tube is a half-wavelength long and the phase is reversed, therefore the sound through the tube is in-phase with that from the front of the loudspeaker and the response is increased. The tube lining absorbs almost all of the sound above 150 cps therefore the higher resonances have no effect.

In the labyrinth cabinet, this resonant tube is folded so that the total outside dimensions are practical for use in the home or studio. The practical values and physical dimensions for construction of typical labyrinth cabinets for the various commercial loudspeakers are given on the "Data-Print." For the same loudspeaker, the labyrinth occupies less space than the bass-reflex cabinet, while the bass-

(*Continued on page 98*)

Fig. 4. (A) Equivalent circuit of a loudspeaker in a bass-reflex cabinet. (B) A typical frequency response curve for a loudspeaker in a bass-reflex cabinet.



U.H.F. Conversion Methods

Part 1. Although tuners and converters are now ready, the end of the freeze brings many new design problems for engineers and technicians.

By
NOEL EDWARDS

Fig. 1. RCA's ultra-high-frequency converter for use in any area having u.h.f. stations. It provides coverage of the entire u.h.f. band. The unit is housed in a compact cabinet which has two knobs—the left-hand knob has three positions ("off," v.h.f., and u.h.f.) while the right-hand knob is for tuning. This converter is designed to be used with any present-day video receiver.

THE conversion of a standard v.h.f. receiver for u.h.f. reception - - is not difficult. It consists of either replacing an unused v.h.f. channel strip with a u.h.f. version, Fig. 5, or adding an external converter that will supply a signal to the antenna input of the v.h.f. receiver, Fig. 1. Consequently, with a few connections u.h.f. reception can be added to a present v.h.f. receiver. At many sites it will be far more difficult to overcome the vagaries of propagation and antenna performance than it will be to handle the signal after it reaches the end of the transmission line.

Plug-In Strips

Certain v.h.f. receivers, depending on the type of tuner employed, can be prepared for u.h.f. reception with a plug-in adapter strip. When a turret-type tuner is used, an unused v.h.f. channel strip can be removed and a u.h.f. replacement strip inserted in its stead. If there is more than a single u.h.f. allocation in your area, additional unused strips can be removed and replaced with u.h.f. channel strips. In general, a separate strip will be required for each u.h.f. channel to be received in a given area.

Instead of vacuum tubes the u.h.f. channel strip employs two crystals—a crystal mixer and a crystal harmonic generator. The mixer crystal, a high frequency type, is small in size, has low capacity, and an excellent signal-to-noise ratio, while the crystal harmonic generator is larger physically and a more common type (such as the 1N34). This latter crystal is often biased carefully to enhance its harmonic generating ability.

The operating principle of the u.h.f. plug-in strip, Fig. 2, is to first mix the incoming u.h.f. signal with a u.h.f. local oscillator component derived from the v.h.f. local oscillator through harmonic generation. The difference frequency at the output of the crystal mixer matches the frequency on which the v.h.f. tuner must be set for u.h.f. reception. Thus the r.f. amplifier of the v.h.f. tuner acts as a *high frequency* i.f. stage. The signal is mixed again but now with the fundamental v.h.f.-tuner local-oscillator frequency to produce the standard i.f. output range (can be considered the low frequency i.f. section of a double conversion process).

A mathematical interpretation will clarify the technique. Let us assume we want to receive a u.h.f. signal on the first u.h.f. channel (picture carrier frequency of 471.25 megacycles). If a 98.5 mc. high i.f. frequency is decided upon, the u.h.f. local oscillator frequency would be 471.25 minus 98.5 or 372.75 mc. The u.h.f. local oscillations must have a frequency lower than the u.h.f. signal frequency to obtain correct relative positioning of sound and picture carriers at the out-

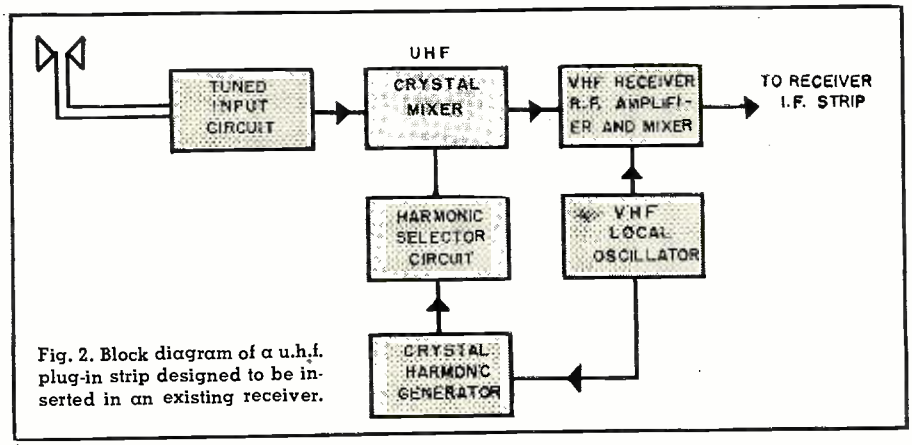


Fig. 2. Block diagram of a u.h.f. plug-in strip designed to be inserted in an existing receiver.

put of the v.h.f. mixer. Picture and sound carrier frequencies at the output of the u.h.f. mixer would be:
471.25—372.75=98.5 mc. picture carrier
475.75—372.75=103 mc. sound carrier

This output is applied to the r.f. amplifier input of the v.h.f. tuner. Tuned circuits of the r.f. amplifier and mixer have been set on this frequency by the v.h.f. coils of the u.h.f. plug-in strip. Thus the r.f. stage acts as a high frequency intermediate amplifier. At the v.h.f. mixer the signal is mixed with the v.h.f. local oscillator frequency to produce standard i.f. frequencies of the v.h.f. receiver or:
124.25—98.5=25.75 mc. picture carrier
124.25—103=21.25 mc. sound carrier

Observe that the u.h.f. local oscillations represent the 3rd harmonic of the v.h.f. oscillator fundamental frequency. It is the function of the crystal harmonic generator to develop a strong third harmonic from the fundamental local oscillator frequency. An arrangement such as this, employing a v.h.f. harmonic for u.h.f. mixing, means that the u.h.f. strip requires no separate u.h.f. oscillator tube and associated circuit components.

Commercial Plug-Ins

The u.h.f. channel strip arrangement can be used with the *Zenith* turret tuner and a similar method is planned by *Standard Coil,* Fig. 8, for those receivers using their tuner. The *Zenith* plug-in strip has three basic functional sections. There is a u.h.f. section consisting of an input filter, double-tuned input transformer (coupling between antenna and crystal mixer), and a u.h.f. crystal mixer.

The u.h.f. antenna system is coupled into the strip through a two-turn loop, Fig. 3, at the low impedance end of the primary of the double-tuned transformer. Consequently, an impedance match and voltage step-up is obtained through transformer action. A double-tuned transformer between the antenna and mixer permits peak selectivity, high "*Q*", and excellent off-frequency signal rejection. The antenna, mixer, and multiplier resonant circuits are completely shielded in individual cavities to minimize spurious resonances and direct feedthrough of undesired signals. Coupling between the two sides of the double-tuned transformer is a mutual inductance in the form of a small cylindrical bushing at the low impedance ends of the resonant windings. No resistive damping is required as suitable bandwidth is attained with the damping influence of antenna and crystal mixer.

A small loop links the secondary or mixer-tuned circuit with the crystal circuit while the mixer circuit also includes a small portion of the multiplier inductor serving as a means of introducing u.h.f. local oscillations.

The i.f. output of the crystal mixer is coupled into the v.h.f. section of the tuner through a low-pass section that filters out u.h.f. variations. The signal is applied to the grid of the r.f. amplifier and is amplified by this stage,

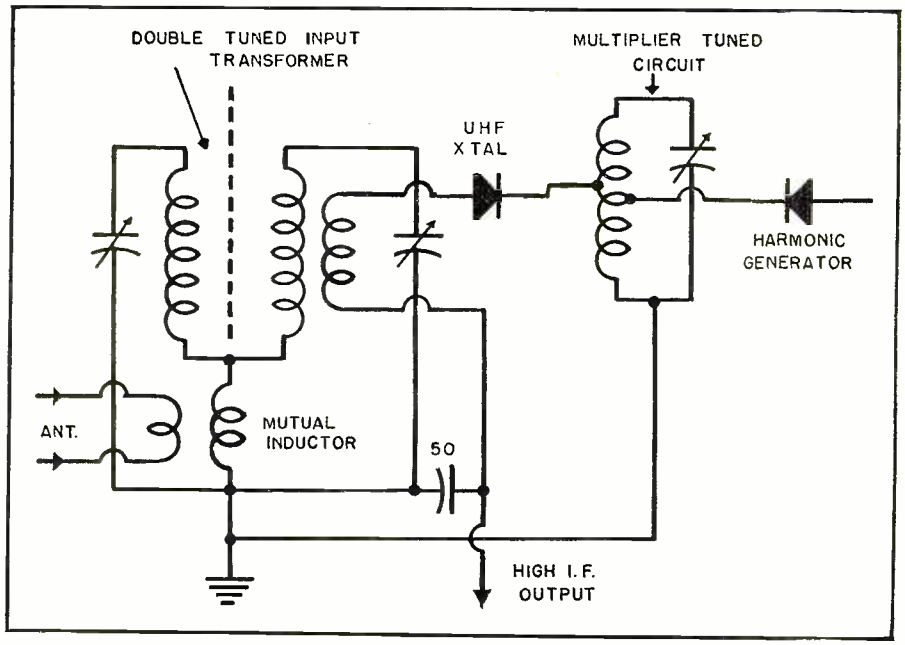


Fig. 3. The u.h.f. section of the Zenith ultra-high-frequency converter strip.

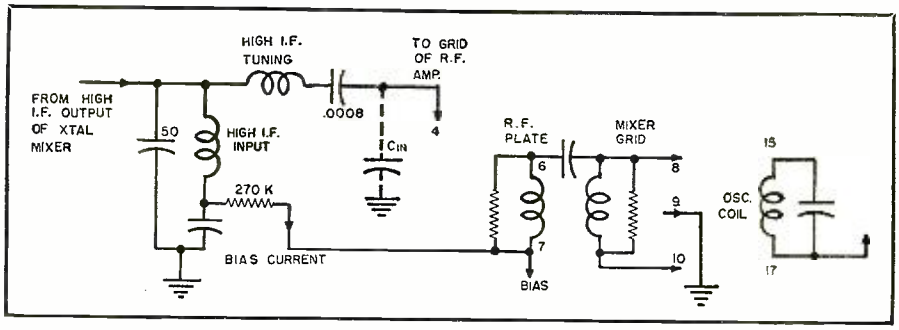


Fig. 4. The v.h.f. section of the u.h.f. strip used in Zenith TV receivers.

the v.h.f. tuner r.f. amplifier plate and mixer grid circuits being resonated to the i.f. frequency of the crystal mixer output. Inductors of these resonant circuits are mounted on the u.h.f. strip, Fig. 4. This high frequency i.f. and v.h.f. local oscillator signal heterodyne to produce a still lower frequency i.f. that corresponds to the i.f. range of the v.h.f. receiver.

The v.h.f. local oscillator is also the fundamental source of signal for the u.h.f. harmonic generator section of the tuner strip. Excitation is obtained from the plate circuit of the v.h.f. oscillator, Fig. 7, and is applied through an *RC* time constant to the multiplier crystal. This *RC* circuit biases the crystal so its current flows just on crests of excitation, producing crystal

Fig. 5. The simple manner in which u.h.f. channel strips can be substituted for the v.h.f. channel strips in the Standard Coil Products TV tuner.

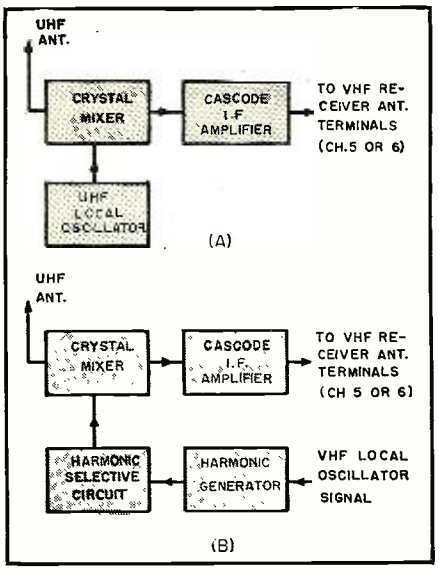


Fig. 6. Two u.h.f. converter methods.

current bursts that are rich in harmonics. These current bursts excite the multiplier resonant circuit which is tuned to a harmonic of the fundamental frequency. Thus a harmonic sine wave is formed that serves as an injection signal for the u.h.f. crystal mixer.

To produce a strong u.h.f. harmonic component some biasing of the crystal is helpful. Bias current as obtained through a 270,000 ohm resistor to "B+", selects an operating point near maximum curvature of the crystal characteristic. Non-linearity at this point accents harmonic levels.

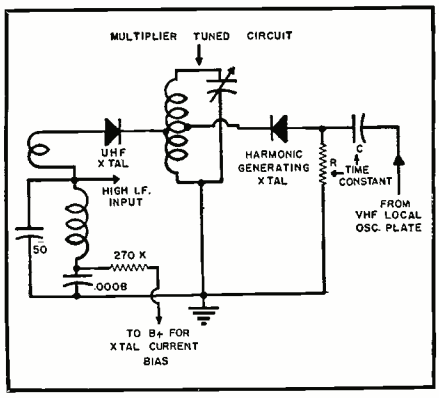
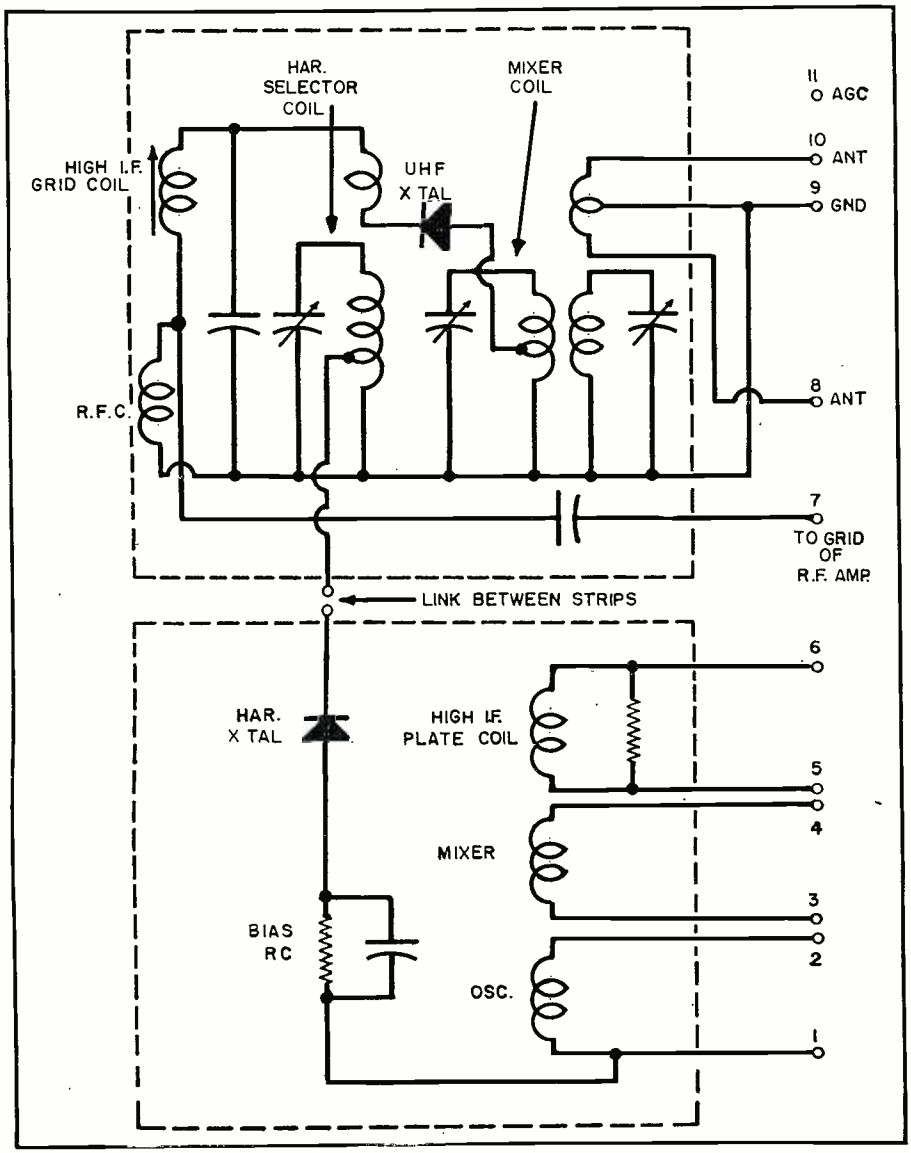


Fig. 7. Harmonic generating section.

The *Standard Coil* plug-in strip has the same plan. Note that the terminals on the right, Fig. 8, correspond to the numbered terminals of the *Standard Coil* tuner. The antenna is connected through terminals 8 and 10. The antenna coil is coupled to the primary of the double-tuned mixer transformer while the crystal mixer taps off a low impedance point of the secondary and is also coupled to the harmonic selector resonant circuit to obtain a u.h.f. injection signal.

The mixer output circuit is resonated to a high i.f. frequency and the i.f. signal is applied to the grid of the r.f. amplifier via terminal 7. The r.f. amplifier plate, mixer grid, and v.h.f. local oscillator circuit inductors are also a part of the v.h.f. strip. The local oscillator signal must also be applied to the crystal harmonic generator through an *RC* biasing network, the proper harmonic being selected by the u.h.f. resonant circuit to develop an exciting u.h.f. sine wave for the u.h.f. crystal mixer.

Fig. 8. Standard Coil Product Company's u.h.f. converter plug-in strip.



Basic Converter Types

The most common type of u.h.f. converter, Fig. 6, consists of a crystal mixer, u.h.f. local oscillator, and a single cascode i.f. amplifier. At present this plan permits production of an economical and effective u.h.f. unit, capable of tuning over the entire v.h.f. band. It can be attached to all types of v.h.f. receivers.

A second possibility, like the plug-in arrangement, employs a system of harmonic generation using a low fundamental local oscillator frequency and proper harmonic mixing to derive u.h.f. local frequency. Initially, r.f. amplifiers will not be prevalent because of the expense involved in establishing a suitable signal-to-noise ratio using vacuum tubes in the u.h.f. band.

A crystal mixer without a preceding r.f. stage lends itself well to converter application because of its favorable u.h.f. performance. A crystal mixer has a low noise content and requires only a low local oscillator injection level. Therefore, a high signal-to-noise ratio can be retained and the local oscillator radiation problem minimized.

A crystal mixer attenuates rather than amplifies the applied signal. The usual vacuum tube mixer, although it does not have a high enough gain for straight amplifier use, at least has some gain when used as a mixer. The crystal mixer can introduce a 6 to 9 db loss—signal level at the output of the crystal mixer being substantially less than the input signal level from an antenna system. It is significant that the output frequency is also much lower, however, and it will be easier to establish favorable signal-to-noise relations.

Insofar as vacuum tube operation is concerned, a given tube will have a higher noise content and a resultant poorer signal-to-noise ratio the higher

(*Continued on page* 113)

INTERPRETING that TV PATTERN

By
KEN KLEIDON
Belmont Radio Corporation

Part 3. Concluding article covers a.f.c., the horizontal oscillator and deflection, and the high voltage section of TV set.

THIS is the third and final article in this series. By referring to the two previous articles, it can be realized that this television troubleshooting procedure is based on using the picture tube as a source of servicing information or as a readily available piece of test equipment. By analyzing the deviations from a normal picture, the TV technician can determine which section of the receiver is causing the trouble and then logically proceed to localize the defective stage. Then by the use of resistance or voltage measurements, the defective component or components can easily be found. Learning to interpret the information presented on the face of the picture tube into circuitry has proven to be a quick, easy, and modern method of TV troubleshooting for the ambitious or enterprising technician.

This article deals in general with troubles occurring in the automatic horizontal frequency control, horizontal oscillator, horizontal deflection, and high voltage sections of a television receiver. The various other sections were covered in the two previous articles.

The condition of horizontal non-synchronization as illustrated in Fig. 1 is a common trouble known to all technicians. The usual cause of this trouble is the misadjustment of the horizontal hold control. Most manufacturers provide two horizontal hold controls, one on the front (variable resistor in place of R_{93} in Fig. 7) as a "Fine Horizontal Hold" control and a coarse stabilizing coil adjustment at the rear of the set (L_{23}). If the front control will not bring the picture in sync then the rear control adjustment at the stabilizing coil should be attempted. Before adjusting the coarse control it is a good practice to first place the "Fine" control in the center of its adjustment range. This will provide the customer with a full adjustment range at the front of the receiver. Because of the wide pull-in range of the a.f.c. circuit, a front control is not utilized in present *Raytheon* receivers. After adjusting the coil control for steady picture, set the coil core to the center of its range, (center position before going out of sync in either direction). This will provide a more stable sync operation. As a check to determine whether the controls are adjusted properly, simply switch from one station to another and observe the face of the picture tube. The picture should stay in sync. Rotation of the horizontal hold control will vary the horizontal centering of the picture. This control should not be used to center the picture as an out-of-sync condition may occur when switching from one channel to another.

Other defects causing an out-of-sync condition horizontally may be a weak or dead a.f.c. or horizontal oscillator tube, input grid leakage, defective frequency controlling components in the oscillator, or an unbalance in the a.f.c. network. Almost all receivers use some form of automatic frequency controlling circuit to provide a more stable sync operation. Fig. 7 shows a unique a.f.c. circuit where two feedback pulses obtained from a separate center-tapped winding in the horizontal deflection transformer are integrated and applied to the plates of a dual-diode a.f.c. tube. The two pulses are of opposite polarity and are of the

Fig. 1. Poor horizontal sync illustrated here is approximately 300 cycles slower than the station's horizontal frequency. The horizontal blanking diagonal bars will slope in the other direction if frequency is 300 cycles faster than the station's.

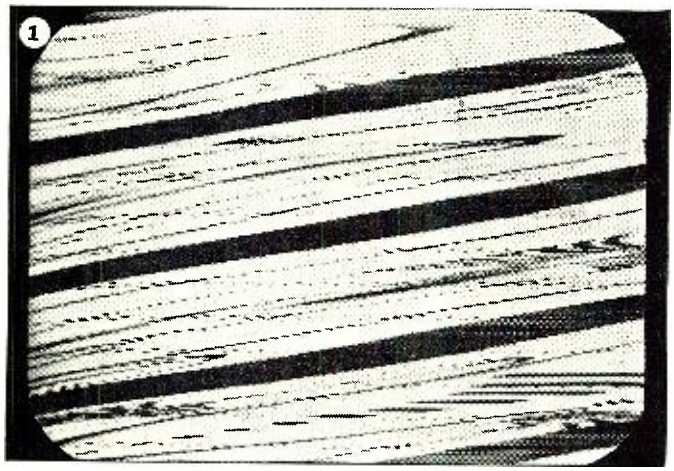
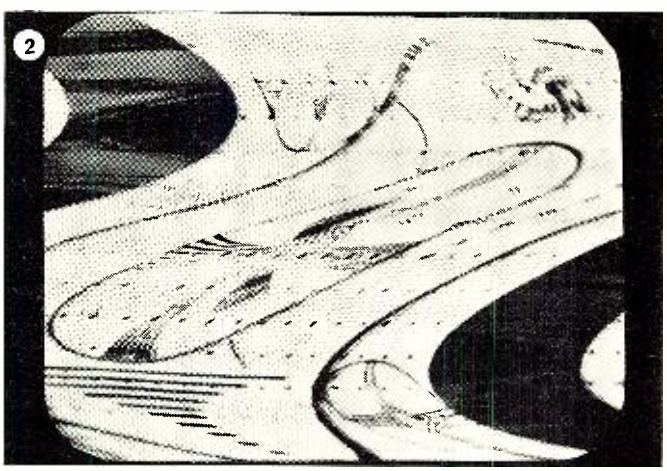


Fig. 2. Hum in a.f.c. The 60-cycle component modulating picture is evidenced by a single sine-wave distortion of horizontal phase. The amount of distortion will vary with the magnitude of the 60-cycle component. It may move vertically on screen.



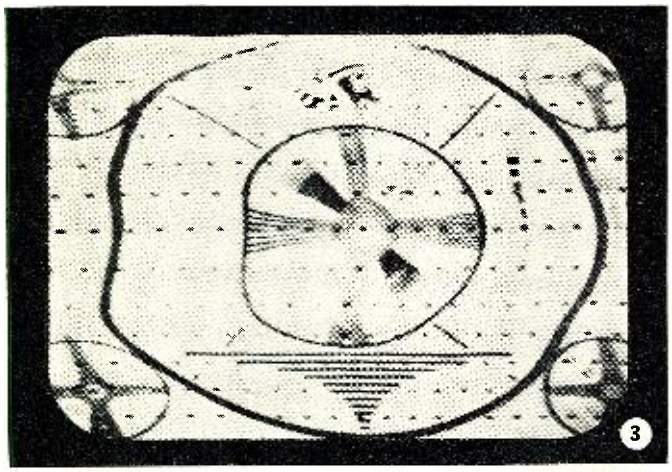


Fig. 3. A 120-cycle component modulating the picture is evidenced by a double sine-wave distortion of horizontal phase. Amount of distortion will vary with magnitude of component.

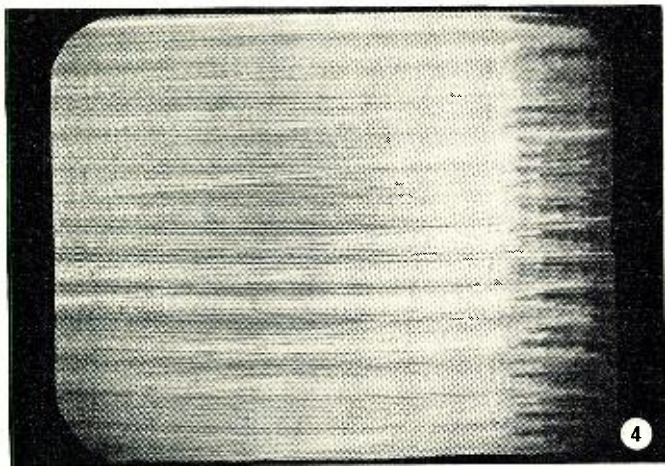


Fig. 4. Horizontal squegging. Tearing, pulling, or ripping of picture in horizontal direction may appear in many different forms. Bright flashes and high-pitched noise are also present.

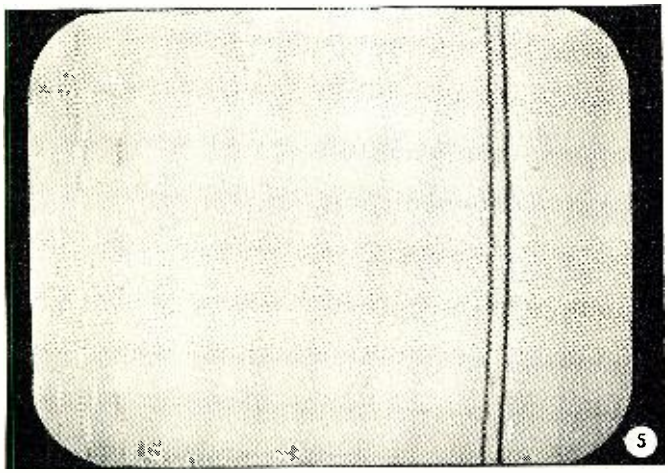


Fig. 5. Barkhausen effect. Interference appears as black vertical lines which generally vary with tuning. These bars may appear in various positions on the screen of the picture tube.

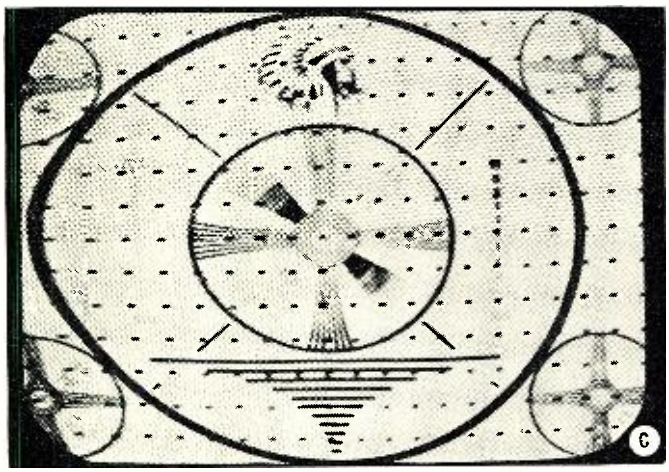


Fig. 6. Improper geometrical distribution of the picture horizontally results in a bulged or egg-shaped appearance on screen.

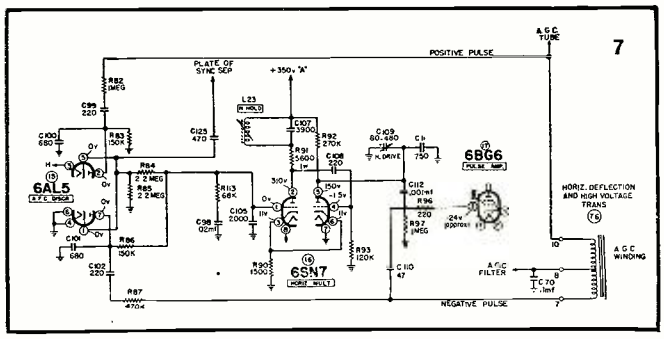
Fig. 7. Schematic of a.f.c. and horizontal oscillator section of recent model television receiver manufactured by Raytheon.

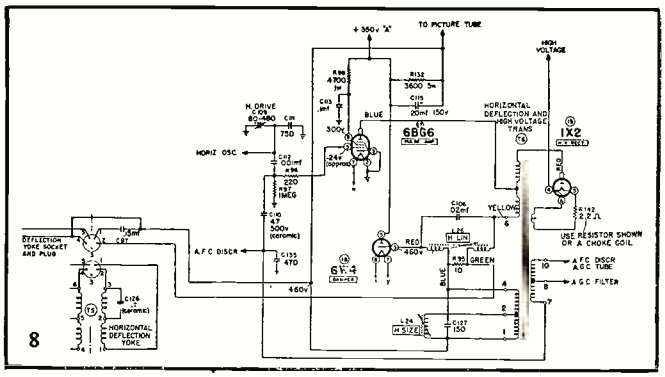
same frequency as the horizontal oscillator. The station horizontal sync pulse is applied to the cathodes from the sync separator through condenser C_{125}. Any frequency or phase shift occurring between the station horizontal sync pulse and the feedback pulses will cause one diode section to conduct more than the other. This will produce a d.c. bias voltage which is applied to the grid of the horizontal oscillator to change the oscillator's operating frequency to agree with that of the station. Therefore, if there is any unbalance in the a.f.c. network an incorrect bias voltage will be applied to the grid and may cause an unstable out-of-sync condition depending upon the degree of unbalance.

Another condition of horizontal non-synchronization may appear as shown in Fig. 2, after the hold control is adjusted for a steady picture. This condition is evidenced by a single sine-wave distortion of the picture horizontally. Since the vertical frequency in the present television system is 60 cycles, a modulating frequency of 60 cycles will appear as one full sine-wave. (A portion is lost in retrace.) Most of the present day television receivers make use of full-wave rectification in the low-voltage power supply which produces a 120-cycle component. Therefore, if the receiver under observation incorporates a full-wave rectified supply and the condition illustrated exists, then the only possible cause of the trouble could be traced to the 60-cycle filament supply. The usual cause of the condition illustrated in Fig. 2 is due to a cathode-to-filament short or leakage in either the automatic frequency control (a.f.c.) or horizontal oscillator tubes (usually sync handling tubes having high cathode impedance to grid).

The amount of distortion in the horizontal direction will vary with the degree of the 60-cycle component. A severe condition is illustrated to make the effects more apparent. The 60-cycle hum displacement from the local power line may move vertically (snaking) when receiving network programs. This is due to the transmitter being operated from a different 60-cycle power source or a crystal for the vertical frequencies. However, this condition will remain stationary even when the vertical is allowed to roll if it results from vertical loading at the boost or boot-strap electrolytic. If substitution of the a.f.c. or horizontal oscillator tubes does not eliminate the trouble, then check condenser C_{115} (boot-strap electrolytic). See Fig. 8.

The condition illustrated in Fig. 3 represents the effects of a 120-cycle component modulating the picture. This is evidenced by the appearance of two complete sine waves distorting the picture horizontally. Here again, the amount





of distortion or displacement will vary with the amount of 120-cycle component. The 120-cycle hum illustrated is similar to the horizontal displacement condition shown in Fig. 6 in Part 2 of this series (May issue). Close observation should distinguish the difference. The horizontal displacement condition will generally vary in vertical positioning with changing picture composition whereas the 120-cycle hum condition may vary vertically only while receiving network programs. The 120-cycle hum condition is generally due to improper low voltage filtering caused by defective filter condensers, filter chokes, or low voltage rectifier tubes. A similar condition may be due to an unstable horizontal oscillator caused by improper value of plate load resistor R_{92} or hold coil L_{23}. Refer to Fig. 7.

The condition of horizontal squegging (Fig. 4) may appear in various forms. Whenever this or similar conditions are observed on the face of a picture tube, the receiver should immediately be turned off as transients resulting from squegging may result in surge voltages that can cause arcing which may damage the pulse amplifier tube or horizontal deflection and high voltage transformer. This condition may be tunable, that is, it may occur intermittently when tuning from channel to channel. This is generally due to strong Barkhausen radiating frequencies. Refer to Fig. 7 and section on Barkhausen in this article. Other possible causes of this condition may be an unbalance in the a.f.c. network, check R_{82}, R_{87}, C_{99}, C_{102}, or balance of C_{100}-C_{101}, R_{83}-R_{86}, R_{84}-R_{85}, or a defective horizontal oscillator tube. Improper "Q" of the hold coil or the incorrect value of resistor R_{92} may cause this condition.

Barkhausen is an interference oscillation generated by spiralling electrons within the horizontal pulse amplifier tubes. One example of this type of interference is illustrated in Fig. 5. This phenomenon is not a fault of the receiver, but is due to the construction of the 6BG6 tubes and is related to inherent screen grid and plate voltage relationships. The interference admittance will vary with tuning and can be disregarded if it appears between active channels. If the interference persists while receiving a picture, the following suggestions should be tried to either reduce or eliminate the effects: dress the antenna transmission line as far away from the a.c. line cord or the horizontal output section of the receiver as possible, or try substituting 6BG6 tubes. In low signal areas, more than one tube substitution may be necessary. When the tube is inserted which eliminates the effects in the picture, the original or the previously substituted tubes are not necessarily

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Fig. 8. The horizontal deflection section of a Raytheon TV set.

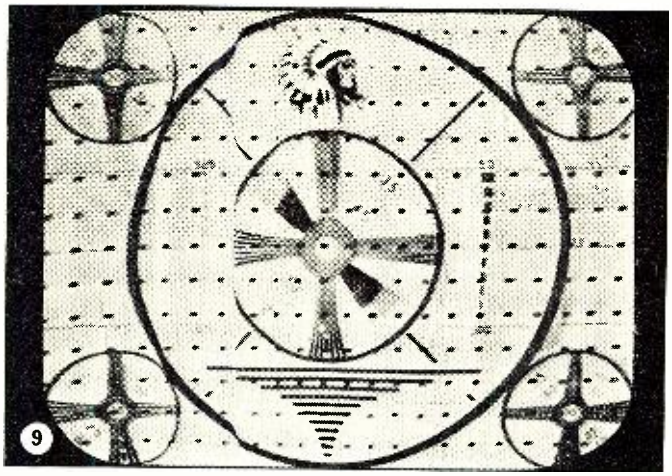


Fig. 9. Drive bars. Bright white vertical line or lines usually cause scan slow-down, resulting in picture foldover. Generally it will appear in center or at left-hand section of the screen.

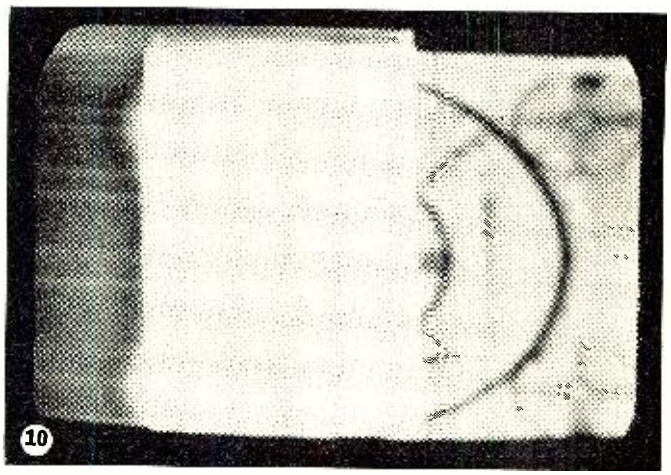


Fig. 10. Damping failure. Severe center foldover results in a partial or total loss of the picture from the cathode-ray tube.

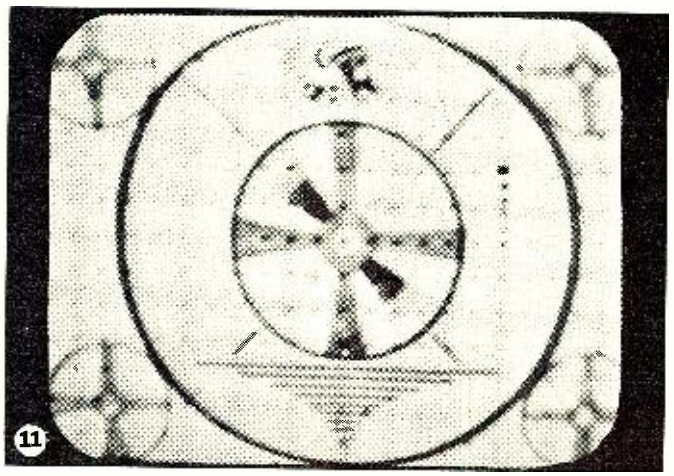


Fig. 11. An example of poor focus. Loss of picture definition with poor horizontal and vertical wedge resolution are typical.

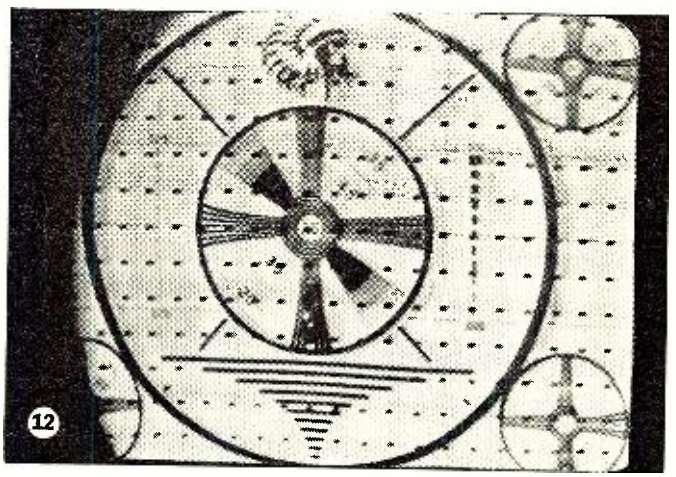
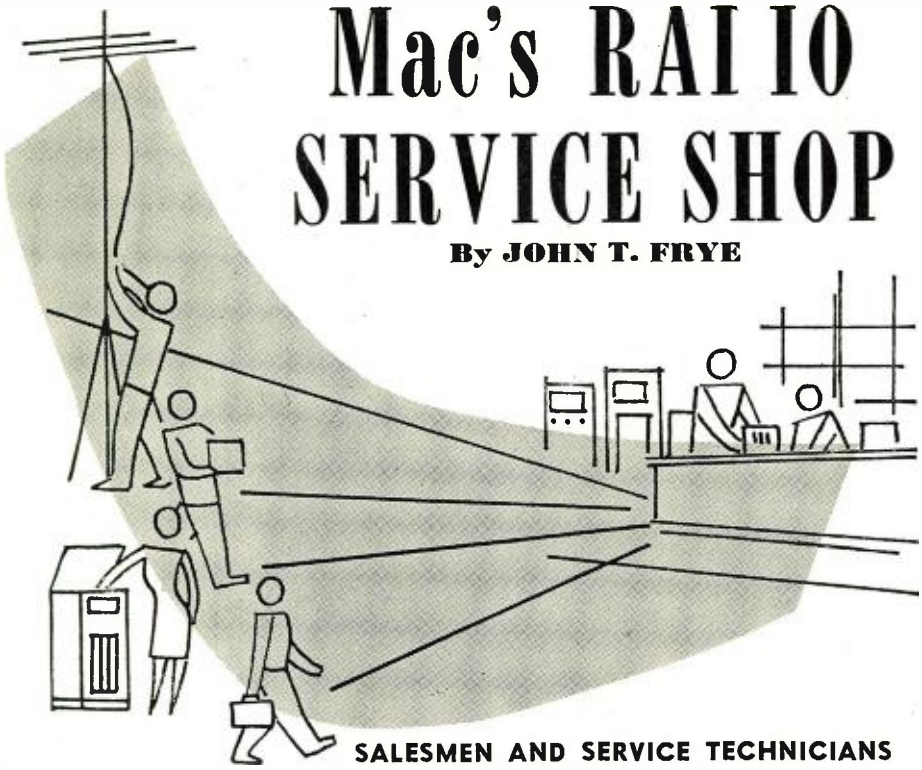


Fig. 12. Yoke misorientation and miscentering. In this instance vertical and horizontal edges are visible and picture may be tilted. Corner or neck shadow may be present in this case.

Mac's RADIO SERVICE SHOP

By JOHN T. FRYE



SALESMEN AND SERVICE TECHNICIANS

"SNAP . . . b-o-o-o-o-m!" went the nearby stroke of lightning, and this was all the cue Mac and his assistant, Barney, needed to send them scrambling around pulling switches and grounding antennas in the service shop.

"These late-spring thunder storms can certainly sneak up fast," Mac commented as he double-checked to make sure none of the test instruments nor any of the radio or TV sets in the shop was connected to the line. This done, he washed and dried his hands and then squatted tailor-fashion on one end of the bench with a heavy, black-and-yellow jacketed book in his lap.

"Finally get around to reading *Gone With the Wind?*" Barney asked curiously.

"Nope, you might say that I'm doing my homework. Last night I was caught with my audio down. A fellow came to the house and told me he had been appointed chairman of a committee to buy some recording equipment for his church, and he had a list of questions as long as your arm that he expected me to answer right off the reel. When he started asking which was better: wire or tape? why was it better? how much better? which recorders had remote control features? etc., I was jarred by the realization that we have been so busy trying to hang on to the flying coattails of television that we've let recent developments in audio slip away from us.

"I candidly told the fellow I was not prepared to advise him until I had done a little research on the latest recorders but, if he would give me a couple of days to study up on the newest wrinkles in that field, I'd try to give him all the dope he wanted. I began trying to dig the information out of my files of back issues of magazines, but I soon found that sifting what I wanted out of that wealth of material was going to be a long, tedious process. Fortunately, there are some good books on the subject. I was lucky enough to pick up a copy of the latest edition of the standard reference book, *The Recording and Reproduction of Sound,* released by *Howard Sams.* Wire and tape recorders are compared from every possible angle and, in each case, it is explained why one is superior to the other."

"What else does the book cover that would make it worthwhile spending my valuable time, not to mention my dazzling brain power, to read it?" Barney asked, as he bent over Mac's shoulder and peaked at the diagrams.

"The chapters on p.a. equipment, installation, and service are right up our alley," Mac replied. "So is the material on custom sound installations and the detailed description and illustration of how to use the scope in audio servicing. I just now noticed, too, that complete constructional information is given on building several different types of speaker enclosures. I'll pass that along to Paul Cockley, who has been hounding me ever since Christmas for some down-to-earth information along that line. In fact, I believe that just about any question that comes up in connection with sound equipment here in the shop will find an up-to-date answer in this book; and here and now I am assigning it to you as required reading just as soon as I am finished with it."

Before Barney could answer, the front door banged open beneath the onslaught of two men hurrying to get in out of the downpour.

"Well, well," Mac observed; "I've read that when the weather is bad enough, rabbits and rattlesnakes will den up together, but I didn't think a spring shower would drive a couple of rival parts salesmen to doing the same thing. Hello, Art. How are you, Dick?"

"I'm okay," Dick replied; "but aren't you afraid you'll hurt Art's feelings calling him a rattlesnake?"

"It's just that those jackass ears of yours fool him into thinking you're the Easter Bunny," Art retorted; "but just to show you what a great and generous soul I am, you may have Mac first. Take him into the back room, get out your rubber hose, and try to beat an order out of him while I stay up here and make mad love to Matilda; then I'll take him."

"That won't be necessary," Mac answered as he took a couple of sheets of paper from a desk drawer and handed one to each. "There are your orders, all fixed out. And now if Matilda will order some sandwiches and *Cokes,* I'll stand treat all around."

In a few minutes all of them were comfortably seated in the service shop munching sandwiches the boy had brought from the restaurant next door. Matilda occupied the high stool in the middle of the floor, and the men were lined up on the service bench in front of her.

"Suspense is keeping me from enjoying this to the full," Dick said slowly. "I keep wondering what it's going to cost me. When a flinty old Scotchman like Mac breaks down and starts shelling out his rusty nickels in this unseemly fashion, there's something behind it."

Mac's eyes squinted in a grin as he tilted his *Coke* bottle toward the ceiling. "Always looking a gift horse in the molars," he murmured. "It does so happen, though, that I've been wanting to talk to you two leeches. I'm slated to give a little talk at our next technicians' organization meeting on how parts salesmen and technicians can help each other, and I thought you two might have some suggestions.

"Do we!" Art and Dick answered in chorus.

"For one thing," Art led off, "not one technician in ten has his order ready for us as you just did, even though he knows that we call on him at the same time each week. If he would just do that one thing, it would save a lot of time for him and us, too."

"And a lot of them never order by manufacturer or part number," Dick added. "They just point at a chassis and say, 'I need a new contrast control for that one.' If they would just use the replacement catalogues we leave with them, or the parts numbers given in the service manuals, it would not only save time for everyone concerned, but it would also avoid mistakes in filling orders."

"The technician who gets me," Art chimed in, "is the one who deliberately

(*Continued on page* 109)

TWO-WAY RADIO for INDUSTRY

Two models of the Hallicrafters' "Littlefone," one with handset and the other with earpiece and portable hand microphone.

By
FRITZ A. FRANKE
Asst. Sales Mgr., Radio & Communication
The Hallicrafters Co.

Lightweight, portable units speed operations for a wide variety of industrial plants and stores.

THE two-way radio-telephone system for industrial and commercial application is a new "tool" for production, processing, and scheduling of factory operations.

This type of hand-carried and fixed equipment is exemplified by the new *Hallicrafters* "Littlefone." Simplicity is the keynote of these radio-telephone units. The main switch is turned on and, if the channel is clear, the press-to-talk button in the center of the handset is depressed and the contact is made. When the transmission is completed, the button is released and the called party can then reply. Built-in squelch is provided so that no sound is heard either from the receiver in the handset or from the loudspeaker unless a message is coming in. There are no popping, frying, or crackling noises because of this squelch circuit. In addition, both the receiver and transmitter operate as an FM system. The equipment itself is simple to use. Even the most unskilled personnel can obtain maximum utility from the equipment.

All radio transmitters must be licensed by the Federal Communications Commission. The FCC has defined the various categories under which radio transmitters may be licensed, *i.e.,* amateur, aviation, broadcast, public safety, maritime, and industrial radio services. A further division is made in the case of industrial radio services to describe a "low power industrial service" wherein the transmitter input does not exceed three watts. Any person, association, or corporation engaged in a commercial enterprise who can show that it is in the public's convenience, necessity, or interest that they be granted a license is usually granted such a license by the Commission.

While it is beyond the scope of this article to discuss all of the classifications of services, as defined by the FCC, which may use this type of equipment, suffice it to say that the application of such systems is virtually unlimited. A copy of Part 11 of the Federal Communications Commission Rules which covers this type of service is available from the U.S. Government Printing Office. It is interesting to note, however, that all stations licensed under the "low power industrial service" classification are licensed as mobile stations even though they may never be moved from an office desk. The frequencies available for assignment to low power industrial stations, other than aircraft, are as follows: 33.14, 35.02, 42.98, and 154.57 mc. The frequency of 27.57 mc. is also available for equipment installed in aircraft.

The actual application of this type of equipment is almost beyond the scope of the imagination. One large lumber yard has found that by equipping its yardmen with portable units and installing the central station in the yard office, it is possible to speed up the monthly inventory operation sixfold. In a large industrial plant maximum utilization of expensive stock handling machinery has been accomplished by installing "Littlefones" on the lift trucks so that they can be dispatched efficiently, thus more than tripling the utility of the lift trucks.

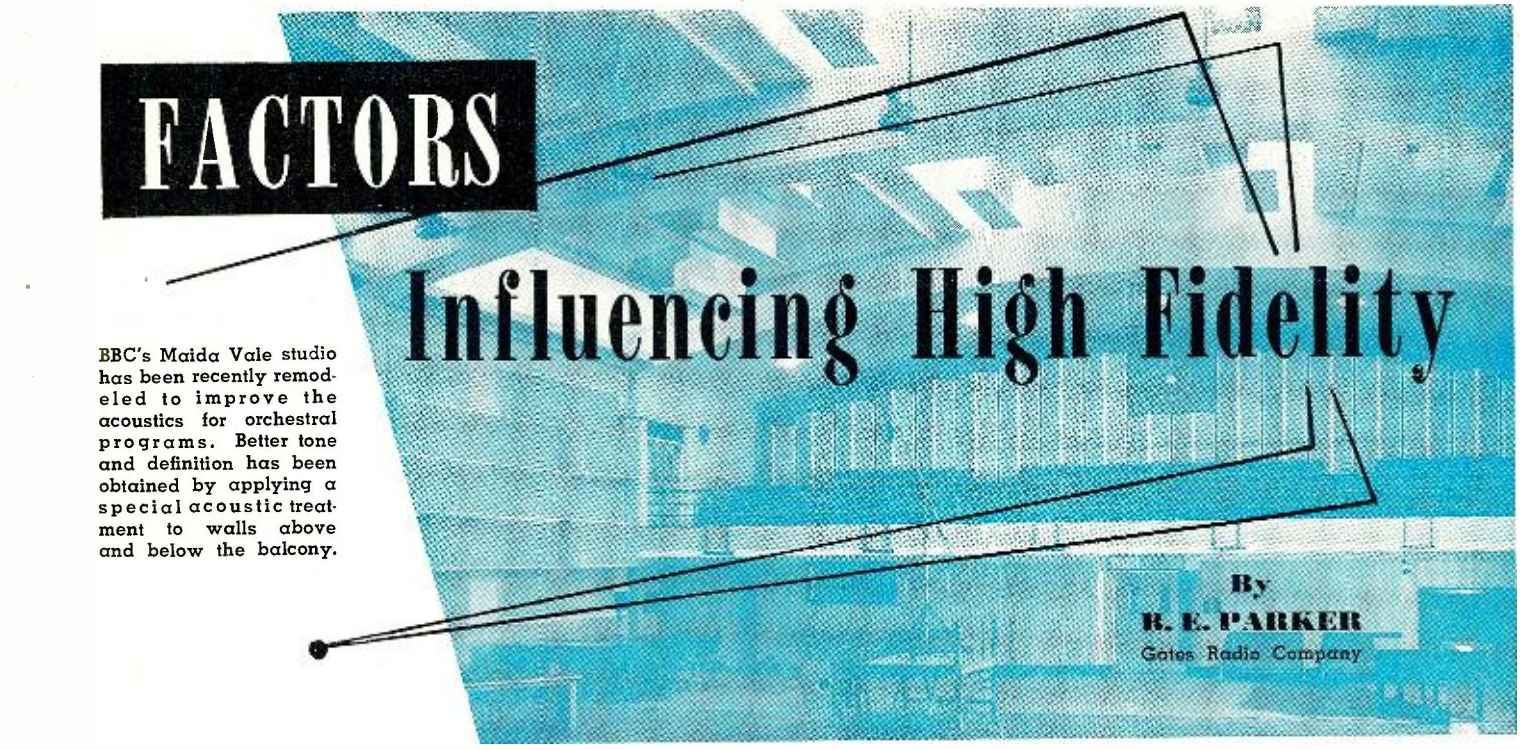
The portable, hand-carried version of these units weighs from 9½ pounds for the dry battery models to 14 pounds for the higher powered rechargeable storage battery units. Two of these units, when used at ground level, provide radio-telephone communication over a distance of approximately two miles in industrial areas. Reinforced concrete and internal structural steel in large buildings do not appreciably affect transmission. Such units have been employed successfully to communicate from the top to the bottom floors of massive structures such as the Conrad Hilton Hotel and the Merchandise Mart in Chicago —two of the world's largest buildings.

Two-way communications have been maintained from the bottom to the top of mine shafts ranging up to a half mile in depth. With the proper antenna heights, distances up to two miles can be covered between moving autos, trucks, or trains. Any two or more of these sets, when operating on

(*Continued on page* 145)

A "Littlefone" in action. A carrying strap leaves hands free to operate unit.

FACTORS Influencing High Fidelity



BBC's Maida Vale studio has been recently remodeled to improve the acoustics for orchestral programs. Better tone and definition has been obtained by applying a special acoustic treatment to walls above and below the balcony.

By
R. E. PARKER
Gates Radio Company

The role of circuitry and components in obtaining high-quality performance from audio equipment.

BUILDING an audio amplifier is relatively easy, but building an amplifier having wide frequency response, low distortion, and low noise level can be most difficult as many of us can testify. The following will serve as a rough guide. It is based on actual shirt-sleeve practice in the design of commercial amplifiers. The writer has found it of value in the initial layout and design as well as the evaluation of the results obtained in testing the initial unit.

Noise

Noise as treated here may be divided roughly into two groups.

(*a*). Noise of a periodic nature, such as hum or microphonics. This is noise which has a definite repetition rate or frequency.

(*b*). Noise of an aperiodic nature, such as hiss or scratch having no definite repetition rate or frequency. Viewed on an oscilloscope, it is displayed as random pulses or "grass." This type noise is usually due to thermal agitation or the "Johnson effect."

The thermal agitation noise originates mostly in resistors and components through which current flows. Carbon resistors are by far the greatest source of this type noise. "Johnson" noise originates within the tube proper and is due to the fact that the electrons are not emitted by the cathode in a steady stream but in a stream of varying intensity. It may be compared to the sparks given off from molten steel. This effect is also commonly known as the "shot effect."

The following design considerations are directly related to the final noise level achieved in the finished product.

1. *Low Gain-Per-Stage*—Low noise level and low gain-per-stage are always synonymous in low level circuits where the signal or audio level is on the order of —40 dbm or lower. This means more stages of amplification and a consequent increase in cost. The low gain-per-stage prevents each tube from contributing excessively to the noise level since the amplification at that point will be only a small proportion of the over-all amplification.

It is interesting to note that low gain-per-stage results in a decided decrease of microphonics. In fact, the increase in cost of an additional low gain stage may be largely offset by eliminating shock mounting of the low level stages.

2. *Low Grid-to-Grid (in push-pull) or Low Grid-to-Ground Impedance*—This lessens inductive hum pickup in the case of low level input transformers to a large degree. Fortunately, a low grid-to-ground impedance in input transformers also results in better high-frequency response. Practice indicates that grid-to-grid or grid-to-ground total impedance should be no greater than 60,000 ohms.

3. *Use of a Common Ground Bus Bar*—A common ground bus bar insulated from the chassis and grounded at one point only eliminates hum pickup due to "ground loops." Ground connections in each stage should tie on at the same point on the bus bar. This insures the absence of ground return loops which may introduce hum or form a means of undesirable coupling between stages resulting in oscillations or instability.

Fig. 3 shows a broadcast amplifier employing this type of common ground bus bar construction. Note the manner in which it is insulated and supported above the chassis.

In practice, the exact ground point on the bus bar is best found by experimentation. As a rough rule and as a starting point, it is better to ground the high level end, that is, the end of the bus next to the output stage or stages.

4. *Use of Triodes*—Triodes in the low level stages result in less noise of both the periodic and the aperiodic type. This is at the expense of gain, however. As pointed out previously, both high gain and low noise level in one stage are seldom obtainable in high quality amplifiers.

Triode-connected pentodes perform quite well, and will be found in many broadcast quality amplifiers.

There is less "hum modulation" in triodes due to smaller grid-to-plate spacing, that is, external as well as internal fields affect the electron stream to a lesser extent.

Hiss or shot-type noise is less troublesome, because there is less "partition noise" in triodes than there is in multi-element tubes.

Noise in triodes is largely shot noise, which is reduced by the high space charge at the cathode.

Microphonics are less troublesome in triodes, since the gain is considerably less per stage.

5. *Non-Magnetic Chassis*—The use of non-magnetic chassis material having good electrical conductivity pays real dividends in high quality amplifiers where the hum level must be kept to an absolute minimum. Aluminum has good electrical conductivity along

with its non-magnetic properties. For this reason, it makes excellent chassis material.

The chassis shown in Fig. 3 is of all aluminum construction.

An aluminum chassis is to be preferred over steel for two reasons. It has higher electrical conductivity which results in less voltage drop from one point on the chassis to another, hence there is less chance of chassis noise pickup. Since it is non-magnetic, it does not conduct the magnetic field set up by the power transformer which may easily cause high hum level, due to the inductive pickup in low level stages.

6. *Power Transformers of Low Flux Radiation*—It is the magnetic flux from the power transformer that is often the worst offender in amplifier layout and design. If this source can be eliminated at the beginning, the layout problem becomes decidedly easier. Shielded power components confine the magnetic flux to the power transformer proper. Completely encased transformers are to be preferred for this reason over the open or shell type construction.

7. *Vertical Mounting Power Transformers*—Where it is not feasible to use shielded power transformers of low flux density radiation, vertical mounting transformers are to be preferred. They may be more readily turned or rotated for minimum noise level than the half-shell horizontal mounted transformer. The half-shell horizontal mounted transformer introduces much more magnetic flux into the chassis since the chassis virtually becomes a transformer lamination. In steel chassis this flux may extend for several inches. While less serious in aluminum chassis since there is no magnetic conduction, there may be heavy eddy currents set up which may easily introduce considerable hum.

8. *Rotating Low Level Transformers*—Input transformers or other low level transformers, even though of multi-shielded construction, should be capable of at least 120° rotation if minimum hum pickup is to be achieved. Fig. 2 illustrates a low level input transformer of multi-shielded construction.

9. *Grid Return Path*—The grid return path should not carry heater current. Since this lead, whether it is the chassis, bus bar, or a strap, must have at best a small amount of resistance, there will be a minute voltage drop developed due to the heater current flow. This drop appears as an a.c. generator inserted in series with the grid return. The remedy and precaution here is obvious. Even though both the heater lead and grid return lead go to ground, separate wires or leads should be used to tie into the common ground point for the stage. All too often this is overlooked because of the temptation and convenience presented by the socket terminals as convenient tie points.

10. *Tube Socket Material* — Mica-filled bakelite, ceramic, or polystyrene sockets are to be preferred in high quality audio equipment. Even bakelite sockets of reputable manufacturers have been the source of noise of both the shot or "scratch" type as well as a.c. hum. In the case of hum, the noise is due to minute leakage currents between the tube pins, particularly from heater to grid. The shot or "scratch" type noise is caused by a variation in the resistance between the socket terminals. This is a most annoying and trying type noise to pin down in servicing or testing. From the manufacturing and wiring viewpoint, the mica-filled bakelite is to be preferred since it has good mechanical stability and does not deteriorate or melt when solder is applied.

11. *Double-Ended Tubes* — While single ended tubes such as the 6SJ7, 6SK7, etc. lend themselves nicely to neat and convenient construction, they do not have the low noise pickup of their double-ended counterparts the 6J7 and 6K7, which have the grid caps on top. The increased hum pickup of the single ended tubes is probably due to the closeness of the grid terminal lead to that of the heater leads with their attendant magnetic field; and to the minute current flow in the base, since at best this material can never be a perfect insulator.

As a rule of thumb, it is advisable to use tubes having grid caps on top in very low level stages. This is particularly true if pentodes are used.

12. *Metal or Glass Tubes*—The use of metal or glass tubes with shields is a question which can usually be best answered as "it is a matter of opinion." Tests have been conducted which show that the glass type tube with a good close fitting shield will give a noise figure within two to three db of the metal counterpart.

13. *Gain Control Shafts and Can-Type Electrolytics*—The gain control shaft may often become a source of noise pickup. This can be eliminated by insulating the shaft and mounting bushing from the chassis by means of insulating washers. The shaft is then connected to the common ground bus bar at the point achieving the greatest hum reduction. Electrolytic condensers, whether they are used for filtering, decoupling, or bypassing, can be, if

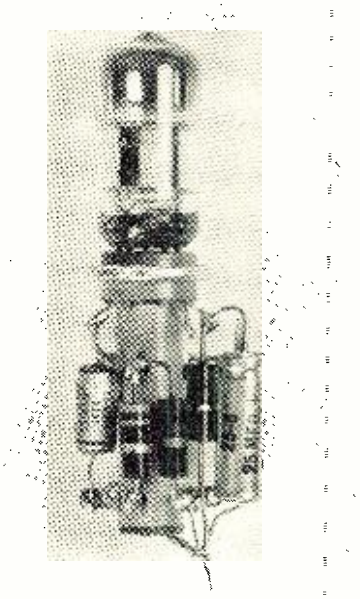


Fig. 1. A turret-type socket with a common ground terminal is suitable for audio work.

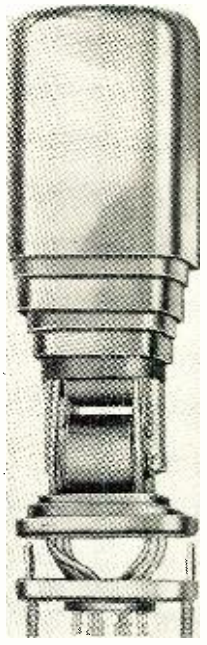
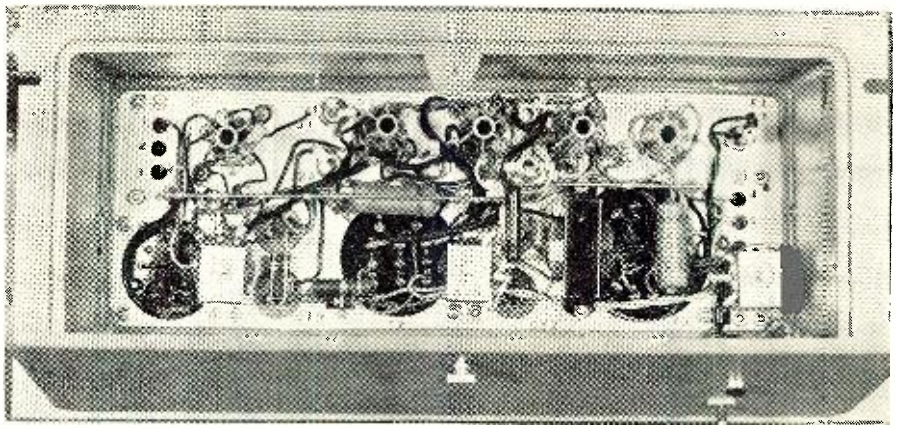


Fig. 2. A multi-shielded input transformer is characterized by minimum hum pickup.

Fig. 3. Broadcast audio amplifier using a common ground bus bar.



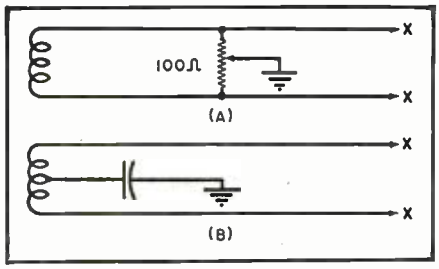


Fig. 4. (A) Hum reduction by varying electrical center of heater supply. (B) Hum reduction by connecting heater transformer center-tap to ground through condenser.

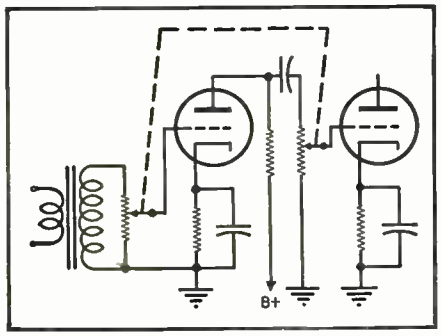


Fig. 5. The use of tandem gain controls for obtaining optimum signal-to-noise level.

they are the metal can type, a source of hum pickup. This can be prevented by mounting the condensers with insulated wafer sockets which insulate the case from ground, permitting a separate wire to be run over to the common ground bus bar.

14. *Turret-Type Sockets* — Turret sockets such as illustrated in Fig. 1 lend themselves nicely to parts layout. The associated resistors and condensers can be mounted right on the socket, affording short leads and isolation. The amplifier illustrated in Fig. 3 uses octal sockets of this type.

Referring again to Fig. 1, the common ground terminal may be seen on the bottom end of the turret assembly. A common ground of this nature combats hum pickup and aids in preventing possible coupling due to common grounds between stages. The common ground lug may then be connected to the ground bus bar as discussed previously in this article.

15. *Heater Center Tap*—As a general rule the heater winding should be grounded by means of the transformer center tap. This precaution often is an absolute must where low level inputs of –60 dbm are encountered. High quality microphones practically always have output levels this low or even lower.

A further improvement can sometimes be made by connecting a 100 ohm potentiometer across the heaters and grounding the center arm as shown in Fig. 4A. When this method is used, obviously the center tap on the transformer filament winding is not grounded. The potentiometer is adjusted for minimum hum level. It is not uncommon to effect a 6 to 8 db reduction in noise. The improvement is not always due to finding the exact electrical center tap for the heater. The potentiometer can be a means of balancing out other hum by outphasing.

Another hum reducing heater center tap scheme which has been used with considerable success in broadcast amplifiers is shown in Fig. 4B. The center tap of the heater winding is connected to ground through a .5 or .25 μfd. paper condenser. The effectiveness of this scheme is largely dependent on the power transformer construction. No definite rule can be given here for its use other than merely "try it," and note if there is a noticeable decrease in hum level. Instances have been observed where this effected as much as a 10 db noise reduction over the usual grounded center tap.

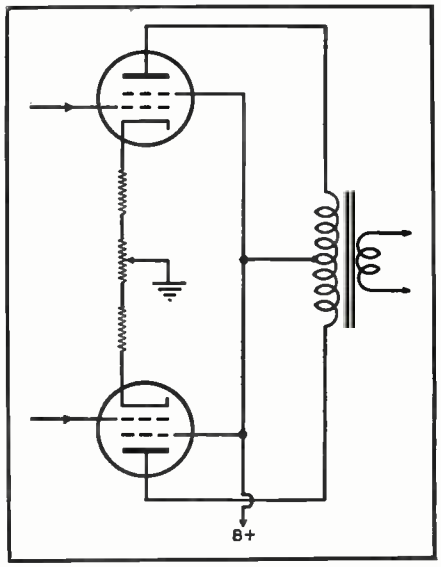
16. *Low Noise Resistors*—Carbon resistors are always a potential source of noise of the hiss or scratching type. In many commercial amplifiers the hiss noise created by the resistors used often is greater than the unavoidable tube hiss noise. While they are much more expensive, wirewound resistors do not introduce this type of noise. However, wirewound resistors are inductive and may introduce hum due to magnetic coupling to a.c. fields.

Obviously, we cannot recommend one brand of resistor over another. A good guide is to follow the broadcast equipment manufacturer's choice. You may be reasonably sure that the brand of resistors he uses in his low level audio equipment is good and has relatively low noise level.

Of one thing you may be sure. Bargain resistors are never a bargain for use in low level audio stages.

17. *Tandem Gain Controls*—Where the amplifier must handle an extremely wide range of input levels, a dual gain control affords an excellent method of maintaining the optimum signal-to-noise ratio. It is usual practice to wire the first section of the control between the input transformer and the first grid and the second section between the first and second stage as in Fig. 5. In practice, as much as 10 db noise reduction may be gained by ganged or tandem gain controls.

Fig. 6. Circuit for a dynamic balancing control to be used with a push-pull output.



Distortion

The causes of distortion are many and would probably fill a book. The following, however, are some of the practical aspects often overlooked by the experienced builder or designer:

1. *Matching of Tube to Output Transformer*—The output transformer must closely match the output impedance of the tube if there is to be a maximum transfer of power. Fortunately, most transformer manufacturers have adopted the policy of stating what tube the transformer will match as well as giving both the primary and secondary impedances. Even this is hardly enough as the values of plate, screen, and bias voltages determine the actual output impedance. For instance, the tube handbook shows that the plate load value for a 6L6 changes from 2500 ohms to 4200 ohms when the plate voltage is increased from 250 to 300, and the grid bias from 14 to 18. From this, it becomes apparent that the transformer must be chosen for a given tube with a given set of operating constants.

In selecting the output transformer, attention should be given to the amount of core material. Transformers having very little "iron" may easily saturate from the high plate current of single ended stages, reducing the effective inductance to a low value. A rough criterion of an output transformer is the size of the core. To be sure, the highest grade of oriented silicon steel requires considerably less size but even this occupies quite a bit of space in a good transformer.

2. *Low Value of Grid Resistors*—High values of grid resistors may cause excessive distortion, and the maximum values given in the tube handbook must never be exceeded. In fact, it is advisable to stay well under this value. The writer knows one well-known audio engineer who uses the rule that the grid return resistance should not be more than five times the value of the plate resistor of the preceding stage. In high quality, wide-response amplifiers, this means the grid resistance would be on the order of 100,000 to 250,000 ohms.

3. *Balancing Cathode Currents*—In output stages, difficulty may be experienced in achieving a dynamic balance due either to a slight off-center center tap on the output transformer or slight differences between the tubes themselves. A small balancing potentiometer connected as shown in Fig. 6 can correct this to a large extent. The potentiometer is not adjusted for equal cathode currents but for minimum distortion when the amplifier is running near its maximum output rating.

4. *Screen Voltage Regulation*—The screen voltage of the output stage requires close attention to its regulation and bypassing. Supplying the screen voltage through a dropping resistor is to be avoided as this forms a very

(*Continued on page* 140)

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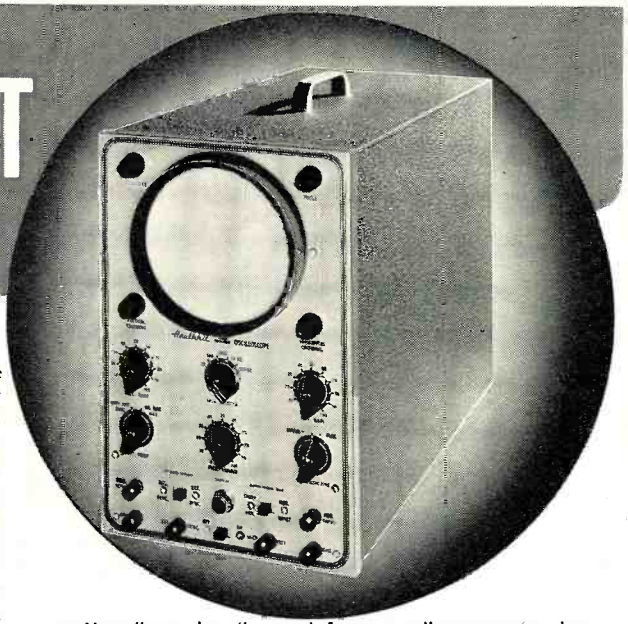

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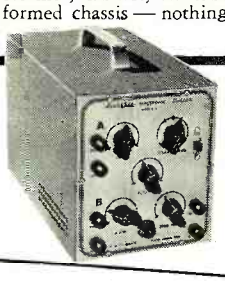
Ideal for TV servicing — steep wavefronts encountered in TV work are easily handled. Fine for production line testing — rugged quality components can stand up under continuous hour-after-hour use. Excellent for laboratories — electrical performance comparable to scopes costing 4 and 5 times as much.

You'll like the complete instructions showing all details for easily building the kit — includes pictorials, step-by-step construction procedure, numerous sketches, schematic, circuit description. All necessary components included — transformer, cabinet, all tubes (including CR tube), completely punched and formed chassis — nothing else to buy.

- **New "spot shape" control for spot adjustment — to give really sharp focusing.**
- **A total of ten tubes including CR tube and five miniatures.**
- **Cascaded vertical amplifiers followed by phase splitter and balanced push-pull deflection amplifiers.**
- **Greatly reduced retrace time.**
- **Step attenuated — frequency compensated — cathode follower vertical input.**
- **New mounting of phase splitter and deflection amplifier tubes near CR tube base.**
- **Increased frequency response — useful to 5 Mc.**
- **Tremendous sensitivity .03V RMS per inch Vertical — .6V RMS per inch Horizontal.**

MODEL S-2



Heathkit ELECTRONIC SWITCH KIT

SHIPPING WT. 11 LBS.

$19.50

The companion piece to a scope — Feed two different signals into the switch, connect its output to a scope, and you can observe both signals— each as an individual trace. Gain of each input is easily set (gain A and gain B controls), the switching frequency is simple to adjust (coarse and fine frequency controls), and the traces can be superimposed for comparison or separated for individual study (position contol).

The kit is complete with tubes, switches, cabinet, power transformer and all other parts, plus a clear detailed construction manual.

NEW Heathkit AUDIO FREQUENCY METER KIT

MODEL AF-1
SHIPPING WT. 15 LBS.

$34.50

The ideal instrument for determining frequencies from 20 cycles to 100 KC. Set the selector switch to the proper range — feed the signal into the input terminals — and read the frequency from the meter — completely simple to operate, and yet dependable results.

Quality Simpson 200 microampere meter has two plainly marked scales (0-100 0-300). These scales read in conjunction with the seven position selector switch, give full scale readings of 100, 300, 1000, 3000, 10,000, 30,000, and 100,000 cycles. Convenient ranges for fast and easy readings.

For greatest accuracy, the 1-3-10 ratio of ranges is maintained and each range has an individual calibrating control.

A signal voltage anywhere between 2 and 300V can be fed directly into the instrument and a change in signal voltage between these limits will not affect the meter reading. In addition, input wave shape is not critical (the unit will read the frequency of either sine wave or square wave input).

The tube complement consists of a 6SJ7 amplifier and clipper, 6V6 amplifier and clipper, 6H6 meter pulse rectifier, 6X5 power supply rectifier, and OD3/VR150 voltage regulator.

Construction is simple, and quality components are used throughout.

Heathkit INTERMODULATION ANALYZER KIT

Intermodulation testing of audio equipment is rapidly being accepted by more and more engineers and audio experts as the best way to determine the characteristics of audio amplifiers, recording systems, networks, etc.

The Heathkit Intermodulation Analyzer supplies a choice of two high frequencies (approx. 3000 cycles and 7000 cycles) and one low frequency (60 cycles). Both 1:1 or 4:1 ratios of low to high frequencies can be set up for IM testing, and the ratios are easily set by means of a panel control and the instrument's own VTVM. An output level control supplies the mixed signal at the desired level with an output impedance of two thousand ohms. The Analyzer section has input level control and proper filter circuits feeding the instrument's VTVM to read intermodulation directly on full scale ranges of 30%, 10% and 3%. Built-in power supply furnishes all necessary voltages for operating the instrument.

MODEL IM-1
SHIPPING WT. 18 LBS.

$39.50

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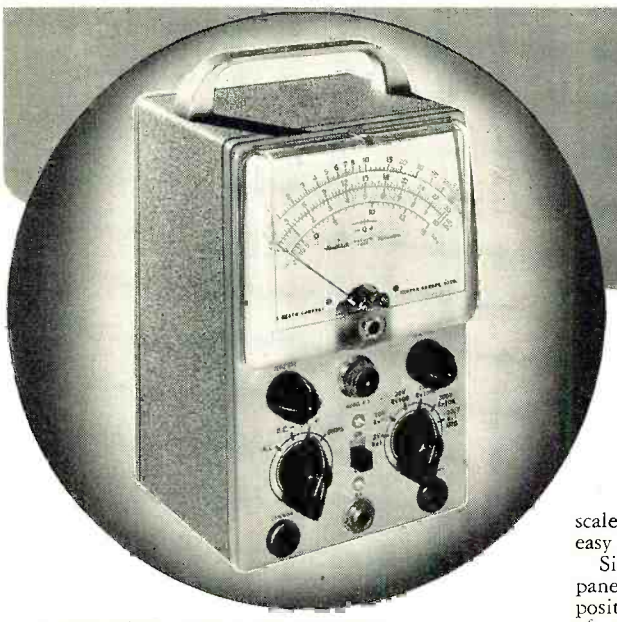


THE New 1952 Heathkit VTVM KIT

MODEL V5-A
SHIPPING WT. 7 LBS.

$24.50

- New styling, — formed case for beauty.
- New truly compact size. Cabinet 4⅛" deep by 4-11/16" wide by 7-3/8" high.
- Quality 200 microamp meter.
- New ohms battery holding clamp and spring clip — assurance of good electrical contact.
- Highest quality precision resistors in multiplier circuit.
- Calibrates on both AC and DC for maximum accuracy.
- Terrific coverage — reads from ½V to 1000V AC, ½V to 1000V DC, and .1 to over 1 billion ohms resistance.
- Large, clearly marked meter scales indicate ohms, AC Volts, DC Volts, and DB — has zero set mark for FM alignment.

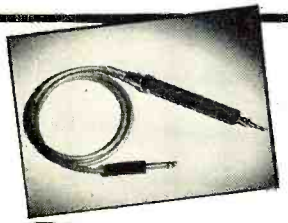
Designed to take up a minimum of space, yet designed to be the most important and useful instrument on your workbench. Really handsome looking — note the rounded edges on front panel and rear cover. New compact size has cabinet dimensions of only 4⅛" deep x 4 11/16" wide x 7⅜" high.

Tremendous coverage — will read from ½V to 1000V AC, ½V to 1000V DC, .1 to over 1 billion ohms resistance, and Db. Meter scale has zero-set mark for FM alignment — all scales clearly marked for easy and fast readings and Db scale is in red for easy identification.

Simple to operate. Ohms adjust and zero adjust controls located on front panel along with selector and range switches. Selector switch has four positions: AC, DC—, DC+ and Ohms to set up the instrument for type of reading desired. DC— position allows negative voltages to be taken without reversing test prods. AC and DC voltage ranges are full scale 3V — 10V — 30V — 100V — 300V — 1000V and resistance ranges are RX1, X10, X100, X1000, X10M, X1 Megohm. Convenient ranges for fast and accurate readings.

Strictly highest quality components used throughout — 1% precision resistors in multiplier circuit, Simpson 200 microampere meter movement, sturdy cabinet, excellent positive detent smooth acting switches, etc. New miniature tube used in meter balancing circuit and new battery holding clamp and spring clip assure good contact to ohms string of resistors.

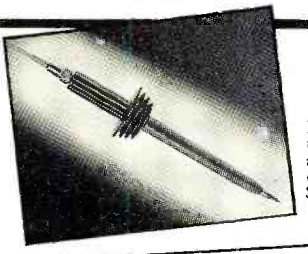
Kit comes complete — and the instruction manual with its step-by-step instructions, pictorials, figures, and schematic makes assembly a pleasure.



Heathkit R F PROBE KIT

Extends range of Heathkit VTVM to 250 MC ± 10%. Designed for taking RF measurements. All parts furnished including probe housing and crystal diode detector. Shipping Weight 1 lb.

$5.50



Heathkit 30,000 V DC PROBE KIT

For taking readings up to 30,000 V DC when used with the Heathkit VTVM (or any standard 11 megohm VTVM). Comes with two color molded plastic probe body and all parts. Shipping Wt. 2 lbs.

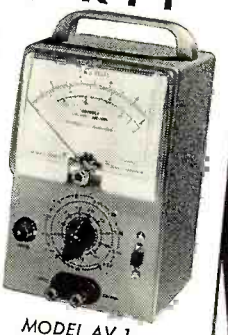
$5.50

Heathkit A. C. VACUUM TUBE VOLTMETER KIT

Now — as a Heathkit — at a price anyone can afford, an AC VTVM. Makes possible those sensitive AC measurements required by audio enthusiasts, laboratories, and experimentors. The kit audio men have been looking for. Ten ranges consisting of full scale .01, .03, .1, .3, 1, 3, 10, 30, 100, 300 volts RMS assure easy and more accurate readings. Ten ranges on DB provide for, measurements from −52 to +52 DB. Frequency response within 1 DB from 20 cycles to 50 KC.

The ingenious circuitry incorporates precision multiplied resistors for accuracy, two amplifier stages using miniature tubes, a unique bridge rectifier meter circuit, quality Simpson meter with 200 microampere movement, and a clean layout of parts for easy wiring. A high degree of inverse feedback provides for stability and linearity.

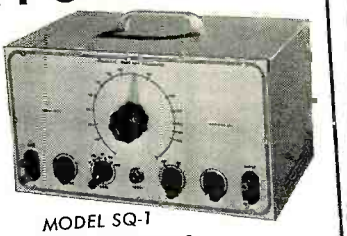
Extremely compact, cabinet size — 4-1/8" deep x 4-11/-16" wide x 7-3/8" high. Newly designed cabiner makes this the companion piece to the VTVM.



MODEL AV-1
SHIP. WT. 5 LBS.

$29.50

Heathkit SQUARE WAVE GENERATOR KIT



MODEL SQ-1
SHIP. WT. 14 LBS.

$29.50

The Heathkit Square Wave Generator is an excellent square wave frequency source with features you won't want to be without. Especially notable is the wide range of the instrument — 10 cycles to 100 kilocycles continuously variable. This wide range makes it useful for television and wide band amplifier work as well as audio experimentation. The output impedance is low, and the output voltage is continuously variable between 0 and 20 volts. Because a multivibrator stage cannot be accurately calibrated, terminals on the front panel can be used for synchronization to an external source should it be desired.

The circuitry consists of a multivibrator stage, a clipping and a squaring stage, and a cathode follower output stage. The power supply is transformer operated and utilizes a full wave rectifier tube with 2 sections of LC filtering.

For a good, wide range, and low priced square wave generator, the SQ-1 just can't be beat.

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SIGNAL GENERATOR KIT

Model SG-6
Shipping Wt. 7 lbs.

$19.50

The new Heathkit Signal Generator Kit has dozens of improvements. Covers the extended range of 160 Kc to 50 megacycles on fundamentals and up to 150 megacycles on useful calibrated harmonics; makes this Heathkit ideal as a marker oscillator for TV. Output level can be conveniently set by means of both step attenuator and continuously variable output controls. Instrument has new miniature HF tubes to easily handle the high frequencies covered.

Uses 6C4 master oscillator and 6C4 sine wave audio oscillator. The kit is transformer operated and a husky selenium rectifier is used in the power supply. All coils are precision wound and checked for calibration making only one adjustment necessary for all bands.

New sine wave audio oscillator provides internal modulation and is also available for external audio testing. Switch provided allows the oscillator to be modulated by an external audio oscillator for fidelity testing of receivers. Comes complete, all tubes, cabinet, test leads, every part. The instruction manual has step-by-step instructions and pictorials. It's easy and fun to build a Heathkit Model SG-6 Signal Generator.

Heathkit

CONDENSER CHECKER KIT

Only

$19.50

Model C-2
Shipping Wt. 6 lbs.

Checks all types of condensers — paper — mica — ceramic — electrolytic. All condenser scales are direct reading and require no charts or multipliers. Covers range of .00001 MFD to 1000 MFD. A Condenser Checker that anyone can read. A leakage test and polarizing voltage for 20 to 500 V provided. Measures power factor of electrolytics between 0% and 50% and reads resistance from 100 ohms to 5 megohms. The magic eye indicator makes testing easy.

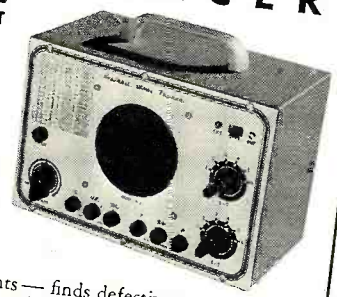
The kit is 110V 60 cycle transformer operated and comes complete with rectifier tube, magic eye tube, cabinet, calibrated panel and all other parts. Has clear detailed instructions for assembly and use.

NEW *Heathkit*

SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

$19.50

Model T-2
Shipping Wt. 7 lbs.



The popular Heathkit Signal Tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker — locates intermittents — finds defective parts quicker — saves valuable service time — gives greater income per service hour. Works equally well on broadcast, FM, or TV receivers. The test speaker has an assortment of switching ranges to match either push-pull or single output impedances. Also tests microphones, pickups and PA systems. Comes complete: cabinet, 110V 60 cycle power transformer, tubes, test probe, all necessary parts, and detailed instructions for assembly and use.

Model TC-1
Shipping Wt. 12 lbs.

$29.50

Heathkit

TUBE CHECKER KIT

The Tube Checker is a MUST for radio repair men. Often customers want to SEE tubes checked, and a checker like this builds customer confidence. In your repairing, you will have a multitude of tubes to check — quickly. The Heathkit tube checker will serve all these functions — it's good looking (with a polished birch cabinet and an attractive two color panel) — checks 4, 5, 6, 7 prong Octals, Loctals, 7 prong miniatures, 9 prong miniatures, pilot lights, and the Hytron 5 prong types. AND IT'S FAST TO OPERATE — the gear driven, free-running roll chart lists hundreds of tubes, and the smooth acting, simplified switching arrangement gives really rapid set-ups.

The testing arrangement is designed so that you will be able to test new tubes of the future — without even waiting for factory data — protection against obsolescence.

You can give tubes a thorough testing — checks for opens, shorts, each element individually, emission, and for filament continuity. A large BAD-?-GOOD meter scale is in three colors for easy reading and also has a "line-set" mark.

You'll find this tube checker kit a good investment — and it's only $29.50.

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NEW 1952 *Heathkit*

BATTERY ELIMINATOR KIT

Model BE-3
Shipping Wt. 17 lbs.

- Can be used as battery charger.
- Continuously variable output 0 - 8 Volts — not switch type.
- Heavy duty Mallory 17 disk type magnesium copper sulfide rectifier.
- Automatic overload relay for maximum protection. Self-resetting type.
- Ideal for battery, aircraft and marine radios.
- Dual Volt and Ammeters read both voltage and amperage continually — no switching.

The new Heathkit Model BE-3 incorporates the best. Continuously variable output control is of the variable transformer type with smooth wiper type contacts.

There are no switches or steps and voltage between 0 and 8 Volts is available at 10 Amperes continuous and 15 Amperes intermittent. Maximum safety from overloads and shorts provided by automatic overload relay which resets itself when overload is removed.

The new rectifier is a 17 plate Mallory magnesium copper sulfide type. This is the most rugged type available for long trouble-free use.

Output is continuously metered by both a 0 - 10 Volt Voltmeter and a 0 - 15 Amp Ammeter. Shorted vibrators indicated instantly by ammeter.

Equip now for all types of service — aircraft — marine — auto and battery radios — this inexpensive instrument vastly increases service possibilities — better be ready when the customer walks in.

NEW *Heathkit*

SINE AND SQUARE WAVE AUDIO GENERATOR KIT

Model AG-7
Shipping Wt. 15 lbs.

$34.50

Designed with versatility, usefulness, and dependability in mind, the AG-7 gives you the two most needed wave shapes right at your fingertips — the sine wave and the square wave.

The range switch and plainly calibrated frequency scale give rapid and easy frequency selection, and the output control permits setting the output to any desired level.

A high-low impedance switch sets the instrument for either high or low impedance output —on high to connect a high impedance load, and on low to work into a low impedance transformer with negligible DC resistance.

Coverage is from 20 to 20,000 cycles, and distortion is at a minimum — you can really trust the output wave shape.

Six tubes, quality 4 gang tuning condenser, power transformer, metal cased filter condenser, 1% precision resistors in the frequency determining circuit, and all other parts come with the kit —plus, a complete construction manual — A tremendous kit, and the price is truly low.

THE NEW *Heathkit*

HANDITESTER KIT

$13.50

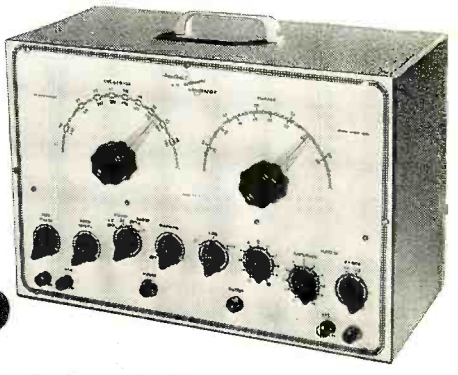
Model M-1
Shipping Wt. 3 lbs.

A precision portable volt-ohm milliammeter. Uses only high quality parts — All precision 1% resistors, three deck switch for trouble-free mounting of parts, specially designed battery mounting bracket, smooth acting ohm adjust control, beautiful molded bakelite case, 400 micro-amp meter movement, etc.

DC and AC voltage ranges 10 - 30 - 300 - 1000 - 5000V. Ohms range 0 - 3000 and 0 - 300,000. Range Milliamperes 0 - 10 Ma, 0 - 100 Ma. Easily assembled from complete instructions and pictorial diagrams.

NEW *Heathkit*

T.V. ALIGNMENT GENERATOR KIT



Here is an excellent TV Alignment Generator designed to do TV service work quickly, easily, and properly. The Model TS-2 when used in conjunction with an oscilloscope provides a means of correctly aligning television receivers.

The instrument provides a frequency modulated signal covering, in two bands, the range of 10 to 90 Mc. and 150 to 230 Mc.— ALL ALLOCATED TV CHANNELS AS WELL AS IF FREQUENCIES ARE COVERED.

An absorption type frequency marker covers from 20 to 75 Mc. in two ranges—therefore, you have a simple, convenient means of frequency checking of IF's, independent of oscillator calibration.

Sweep width is controlled from the front panel and covers a sweep deviation of 0-12 Mc.—all the sweep you could possibly need or want.

And still other excellent features are: Horizontal sweep voltage available at the front panel (and controlled with a phasing control—both step and continuously variable attenuation for setting the output signal to the desired level—a convenient instrument stand-by position—vernier drive of both oscillator and marker tuning condensers—and blanking for establishing a single trace with base reference level. Make your work easier, save time, and repair with confidence—order your Heathkit TV Alignment Generator now!

Model TS-2
Shipping Wt. 20 lbs.

$39.50

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Heathkit IMPEDANCE BRIDGE KIT

Model 1B-1B
Shipping Wt. 15 lbs.

$69.50

This Impedance Bridge Kit is really a favorite with schools, industrial laboratories, and serious experimenters. An invaluable instrument for those doing electrical measurements work. Reads resistance from .01 Ohms to 10 meg., capacitance from .00001 to 100 MFD, inductance from 10 microhenries to 100 henries, dissipation factor from .002 to 1, and storage factor from 1 to 1000. And you don't have to worry about selecting the proper bridge circuit for the various measurements — the instrument automatically makes the correct circuit when you set up for taking the measurement you want. Bridge utilizes Wheatstone, Hay, Maxwell, and capacitance comparison circuits for the wide range and types of measurements possible. And it's self powered — has internal battery and 1000 cycle hummer. No external generator required — has provisions for external generator if measurements at other than 1000 cycles are desired. Kit utilizes only highest quality parts, General Radio main calibrated control. Mallory ceramic switches, excellent 200 microamp zero center galvanometer, laboratory type binding posts with standard ¾ inch centers, 1% precision ceramic-body type multiplier resistors, beautiful birch cabinet and ready calibrated panel. (Headphones not included.)

Take the guesswork out of electrical measurements — order your Heathkit Impedance Bridge kit today — you'll like it.

Heathkit LABORATORY RESISTANCE DECADE KIT

$19.50

Shipping Wt. 4 lbs.

An indispensable piece of laboratory equipment — the Heathkit Resistance Decade Kit gives you resistance settings from 1 to 99,999 ohms IN ONE OHM STEPS. For greatest accuracy, 1% precision ceramic-body type resistors and highest quality ceramic wafer switches are used.

Designed to match the Impedance Bridge above, the Resistance Decade Kit has a beautiful birch cabinet and attractive panel. It's easy to build, and comes complete with all parts and construction manual.

Heathkit LABORATORY POWER SUPPLY KITS

Limits:

No load	Variable	150-400V DC
25 MA	Variable	30-310V DC
50 MA	Variable	25-250V DC

Higher loads: Voltage drops off proportionally

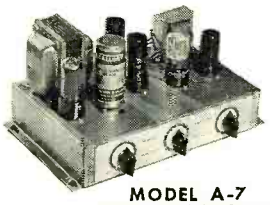
$29.50

Model PS-1.....Ship. Wt. 20 lbs.

Every experimenter needs a good power supply for electronic setups of all kinds. This unit has been expressly designed to act as a HV supply and a 6.3 V filament voltage source. Voltage control allows selection of HV output desired (continuously variable within limits outlined), and a Volts-Ma switch provides choice of output metering. A large plainly marked and direct reading meter scale indicates either DC voltage output in Volts or DC current output in Ma. (Range of meter 0-500V D.C., 0-200 Ma. D.C.). Instrument has convenient stand-by position and pilot light.

Comes with power transformer, filament transformer, meter, 5Y3 rectifier, two 1619 control tubes, completely punched and formed chassis, panel, cabinet, detailed construction manual, and all other parts to make the kit complete.

Heathkit ECONOMY . . . 6 WATT AMPLIFIER KIT



MODEL A-7
Shipping Wt. 8 lbs.

$14.50

- **Choice of 4-8-15 ohm output impedances.**
- **Response flat ± 1½ db from 20—20,000 cycles.**
- **6 watts output.**
- **Good fidelity at low cost.**
- **Output tubes working in push pull.**
- **Volume, bass, and treble controls.**
- **Two separate inputs.**

The purpose of this kit is to provide to the kit builder a low cost amplifier with excellent fidelity. The circuit consists of four tubes with following functions: a 12SL7, one section working as an amplifier and one as a phase splitter, two 12A6 output tubes working in push pull, and a 5Y3 rectifier in a full wave rectifier circuit.

The unit operates from a husky power transformer, and has good output transformer with a choice of 4—8—15 ohm output impedances. (Speaker not included).

The kit provides excellent listening pleasure and the price is really low. Compare it with all others. You won't find a better buy.

MODEL A-7: For tuner and crystal phono inputs. Has two position selector switch for convenient switching to type of input desired.

Model A-7-A: Has a 12SH7 preamplifier stage with special compensation network for operation with reluctance phono input.
Shipping Wt. 8 lbs.....**$16.50**

Heathkit HIGH FIDELITY 20 WATT AMPLIFIER KIT

MODEL A-8
Shipping Wt. 18 lbs.

$33.50

The A8 (or A-8A) is a high quality amplifier for those who want high fidelity output at moderate cost. Frequency response within ± 1db from 20–20,000 cycles. Distortion at 3db below maximum power output (at 1,000 cycles) is only .8%. Kit has a Chicago power transformer in drawn steel case and a Peerless output transformer with output impedances of 4—8—16 ohms. Bass and treble controls permit listener to select output with tonal qualities of his own liking.

The tube lineup is composed of a 6SJ7 voltage amplifier, a 6SN7 amplifier and phase splitter, two 6L6's in push-pull output and a 5U4G rectifier. All parts furnished (speaker not included) and the construction manual makes assembly easy.

MODEL A-8: For tuner and crystal phono inputs. Has two position selector switch for convenient switching to type of input desired.

MODEL A-8A: Features an added 6SJ7 stage (preamplifier) for operating from variable reluctance cartridge phono pickup, mike input, and either tuner or standard crystal phono pickup. A three position selector switch provides flexible switching. Shipping Wt. 18 lbs.....**$35.50**

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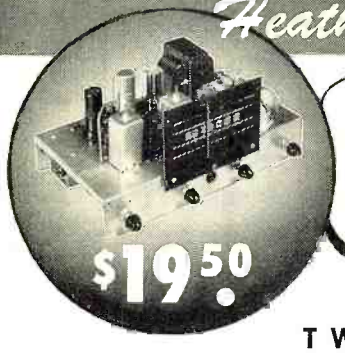
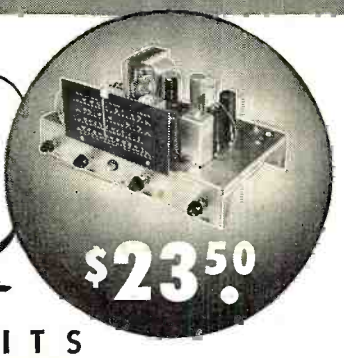
Heathkit RECEIVER & TUNER KITS for AM and FM



$19.50

Model BR-1 Broadcast Model Kit covers 550 to 1600 Kc. Shipping Wt. 10 lbs.

Model AR-1 3 Band Receiver Kit covers 550 Kc. to over 20 Mc. continuous. Extremely high sensitivity. Shipping Wt. 10 lbs.



$23.50

TWO HIGH QUALITY Heathkit SUPERHETERODYNE RECEIVER KITS

Two excellent Heathkits. Ideal for schools, replacement of worn out receivers, amateur and custom installations.

Both are transformer operated quality units. The best of materials used throughout — six inch calibrated slide rule dial — quality power output transformers — dual iron core shielded. I.F. coils — metal cased filter condenser. The chassis has phono input jacks, 110 Volt output for phono motor and there is a phono-radio switch on panel. A large metal panel simplifying installation in used console cabinets is included. Comes complete with tubes and instruction manual incorporating pictorials and step-by-step instructions (less speaker and cabinet). The three band model has simple coil turret which is assembled separately for ease of construction.

Model FM-2
Ship. Wt. 9 lbs.

$22.50

TRUE FM FROM Heathkit FM TUNER KIT

The Heathkit FM Tuner Model FM-2 was designed for best tonal reproduction. The circuit incorporates the most desirable FM features — true FM.

Utilizes 8 tubes: 7E5 Oscillator, 6SH7 mixer, two 6SH7 IF amplifiers, 6SH7 limiter, two 7C4 diodes as discriminator, and 6X5 rectifier.

The instrument is transformer operated making it safe for connection to any type receiver or amplifier. Has ready wound and adjusted RF coils, and 2 stages of 10.7 Mc IF (including limiter). A calibrated six inch slide rule dial has vernier drive for easy tuning. All parts and complete construction manual furnished.

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- ☐ Express
- ☐ Freight
- ☐ Best Way

Quantity	Item	Price	Quantity	Item	Price
	Heathkit Oscilloscope Kit — Model O-7			Heathkit H.V. Probe Kit — No. 336	
	Heathkit VTVM Kit — Model V-5-A			Heathkit R.F. Signal Gen. Kit — Model SG-6	
	Heathkit FM Tuner Kit — FM-2			Heathkit Condenser Checker Kit — Model C-2	
	Heathkit Broadcast Receiver Kit — Model BR-1			Heathkit Handitester Kit — Model M-1	
	Heathkit Three Band Receiver Kit—Model AR-1			Heathkit Power Supply Kit — Model PS-1	
	Heathkit Amplifier Kit — Model A-7 (or A-7-A)			Heathkit Resistance Decade Kit — Model RD-1	
	Heathkit Amplifier Kit — Model A-8 (or A-8A)			Heathkit Impedance Bridge Kit — Model IB-1B	
	Heathkit Tube Checker Kit — Model TC-1			Heathkit A.C. VTVM-KIT — Model AV-1	
	Heathkit Audio Generator Kit — Model AG-7			Heathkit Intermodul. Analyzer Kit—Model IM-1	
	Heathkit Battery Eliminator Kit — Model BE-3			Heathkit Audio Freq. Meter Kit — Model AF-1	
	Heathkit Electronic Switch Kit — Model S-2			Heathkit Square Wave Gen. Kit — Model SQ-1	
	Heathkit T.V. Alignment Gen. Kit — TS-2				
	Heathkit Signal Tracer Kit — Model T-2				
	Heathkit R.F. Probe Kit — No. 309				

On Parcel Post Orders, include postage for weight shown and insurance. (We insure all shipments.)

On Express Orders, do not include transportation charges — they will be collected by the Express Agency at time of delivery.

Enclosed find ☐ Check ☐ Money Order for_____

Please ship C.O.D. ☐ Postage enclosed for_____lbs.

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ROCKE INTERNATIONAL CORP.
13 E. 40th ST.
NEW YORK CITY (16)
CABLE ARLAB-N.Y.

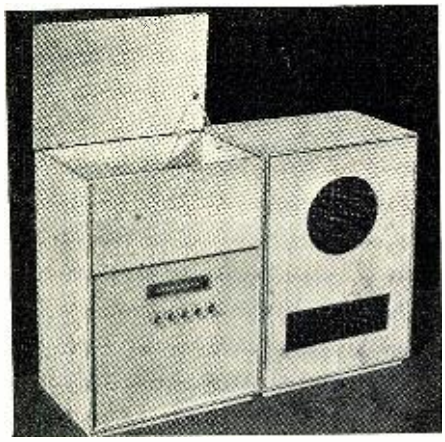
The HEATH COMPANY
. . . BENTO HARBOR 15, ICHIGAN

WHAT'S New in Radio

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page, and the issue number, delay will be avoided.

CABINETS AND KITS

G & H Wood Products Company, 75 North 11th Street, Brooklyn 11, New York now has available a new equipment cabinet which will accommodate



any *Webster, Garrard,* or *Rek-O-Kut* changer and any combination of standard tuners and amplifiers. The tuner compartment measures 20" high by 21¾" wide, and 15¼" deep.

The companion bass reflex cabinet has a volume of approximately 6 cubic feet. The speaker baffle is pre-cut for 12" or 15" speakers.

The over-all dimensions of each unit are 33½" high, 23" wide, and 16" deep. They are constructed of ⅝" thick fir plywood. All of the cabinets are supplied unfinished. The assembled units come sanded, ready for finishing while the kits are supplied ready for assembling.

ANTI-STATIC COMPOUND

Merix Chemical Company, 1021 E. 55th Street, Chicago 15, Illinois has developed a new anti-static compound which is especially suitable for plastic dial windows, television lenses, Vinylite and plastic records, color discs for color TV, and plastic radio and television cabinets.

Designated as #79, the new compound is said to keep plastic surfaces free from static charges for many months. The compound is non-inflammable, dries fairly fast, and is practically invisible when dry.

A data sheet on this new product is available from the company on request.

RECORD-PLAYBACK HEAD

The Indiana Steel Products Company, Valparaiso, Indiana has introduced an improved high output record-playback head which is designed to provide high fidelity sound reproduction from ordinary ¼" magnetic coated recording tape.

The TD-704 head has a frequency response flat within 1 db from 100 cycles to 7000 cycles at a tape speed of 7.5 inches-per-second. At a tape speed of 15 inches-per-second, the maximum frequency response is increased to nearly 12,000 cycles. Signal output is on the order of 5 millivolts.

The new unit utilizes a track width of .200" assuring maximum output and signal-to-noise ratio and a constant over-all level of the playback signal. Impedance is 1000 ohms at 1000 cps.

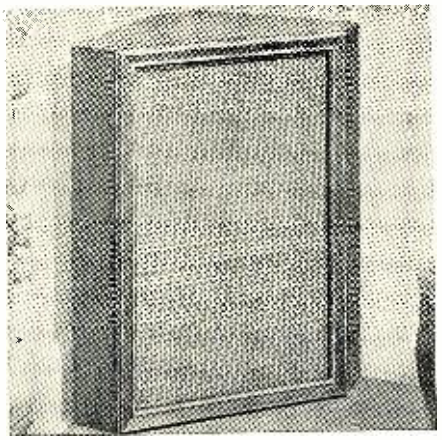
Descriptive literature is available on the TD-704. Write direct to the company for copies.

CORNER HORN ENCLOSURE

Permoflux Corporation, 4900 W. Grand Avenue, Chicago, Illinois is now marketing a corner horn enclosure for an eight-inch speaker.

Special features of the new unit include a smooth over-all response, decreased distortion because the speaker's cone is limited in its travel due to proper loading, and corner-type construction which reinforces the tonal qualities of the unit to give a performance curve from a low of 30 cycles to a high of 12,000 cycles.

Although specifically designed to house the company's "Royal Eight" speaker, the enclosure can be used with other eight-inch speakers. The



unit is designed to fit in the corner of a living room, den, or study, although it can be used in any position.

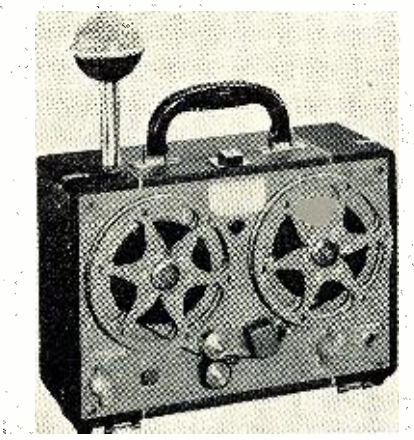
The cabinet is available in two finishes, blonde and mahogany. The console stands 25" high and is 20" wide by 11" deep.

BATTERY TAPE RECORDER

Amplifier Corp. of America, 398 Broadway, New York 13, New York is now in production on a new battery-operated midget tape recorder which has been tradenamed the "Interviewer."

Designed to simplify recording of interviews and conferences, the new unit carries its own power supply of small dry-cell flashlight batteries so that it can be operated anywhere, irrespective of available power supply. An unusual feature is its detachable non-directional microphone which plugs directly into the microphone input jack, and is supported by its own rigid tubing. An auxiliary table stand, complete with extension cable, is also available.

The recorder is housed in a two-tone leatherette-covered cabinet, measuring



11½" x 8½" x 5½" and weighing 9¾ pounds, including batteries.

Technical specifications on the "Interviewer" are available on request.

COOLING DEVICE

Condor Radio Mfg. Co., 116 N. Montezuma Street, Prescott, Arizona is now marketing a new cooling device for various types of electronic apparatus.

The "Cooler" is used to conduct heat generated by tubes, resistors, etc. to a suitable heat sink, such as the front panel or outside skin of the equipment, thus reducing the temperature rise inside the equipment and prolonging component life.

The unit consists of refrigerant sealed inside a short length of metallic tubing, with a mounting plate at each end. The conductivity above room temperature (25 degrees C) is about ten times that of solid copper. Below room temperature the conductivity decreases producing a gradual thermostatic action.

A data sheet on the new "Cooler" is available from the company on request.

"SUPER-TWEETER"

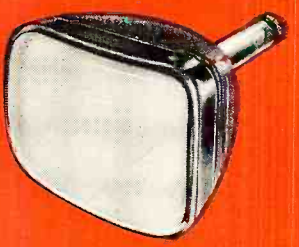
Jensen Manufacturing Company, 6601 S. Laramie Avenue, Chicago 38, Illinois has developed a new high frequency unit which makes a three-way system out of any coaxial speaker or a two-way system out of a single unit direct radiator.

The RP-302 "super-tweeter" is adapted from the high-frequency channel of the *Jensen* G-610 triaxial speaker. Installation is simple, the unit sits on top of the cabinet or mounts flush on the baffle or panel in a 1 11/16" hole.

Makeshift replacements...reduce picture quality

Replacements with Raytheon Television Tubes assure picture quality

Right for Sight



RAYTHEON PICTURE TUBES

Remember! Raytheon Picture Tubes with Corona Inhibitor give constant picture clarity whatever the weather.

RAYTHEON®

Excellence in Electronics

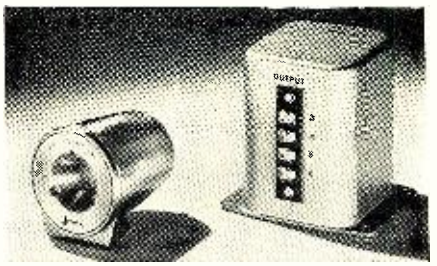
RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division

Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Calif.

RECEIVING AND PICTURE TUBES • RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • RADIAC TUBES • MICROWAVE TUBES

The new unit provides highs from 4000 cycles up, extending the range to the limits of audibility (approximately



18,000 cycles) with extremely low distortion. A small "Hypex" horn disperses the sound with a useful coverage angle of 120 degrees in the horizontal and vertical planes. A special plastic diaphragm prevents break up.

Complete information on the RP-302 is available from the company. Please request Form DZ.

PORTABLE V.T.V.M.

American Chronoscope Corporation, 316 W. First Street, Mount Vernon, New York is now marketing a portable v.t.v.m. which has been designated the Model 601.

The unit is a self-contained universal test instrument which is battery-operated and requires no external source of power. The meter measures a wide range of a.c. and d.c. voltages. resistances, and currents. It has six d.c. voltage ranges from 3 to 1200 volts full scale, five a.c. ranges from 3 to 300 volts full scale, six resistance ranges covering from 1 to 100 meg-

ohms, and six current ranges reading from 3 to 1200 ma. Input impedance is 13 megohms on the d.c. voltage scales and 6 megohms on the a.c. range.

The entire unit measures 10" x 6⅝" x 5⅝". Battery life is better than 100 hours at normal operation.

MOBILE ANTENNA

To reduce the breakage encountered in high-mounted mobile antenna installations such as on busses and trucks, *Ward Products Corp.*, 1523 East 45th Street, Cleveland 3, Ohio has introduced the new Model SPPC-88 mobile antenna.

The antenna consists of three basic parts. The whip has a coil base serving both as a spring and part of the whip. This section matches a friction-

free spring, effectively providing two springs for maximum flexibility and permitting a minimum clearance when deflected only 4 inches. At the base of the assembly is a junction box that contains a series condenser to assure good match to regular 50-ohm coaxial cable.

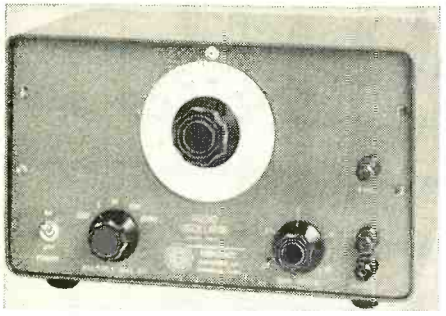
TEST RECORD

Clear-View Television, Inc., 5542-44 Ridge Avenue, Philadelphia 28, Pa. is now merchandising a 45 rpm test record with a large center hole for the adjustment of *RCA* record changers.

According to the company, by using this record the over-all performance of the changer can be checked rapidly and accurately. The "Kwik-Disc" takes approximately 15 seconds to run through its cycle. It is made of unbreakable vinyl and a stroboscope is incorporated in the label, indicating the correct speed. No modulation is used since it is not normally required.

AUDIO OSCILLATOR

A new audio oscillator, designed especially for engineering, research, and production work, has just been released by *Krohn-Hite Instrument Company* of 580 Massachusetts Avenue, Cambridge 39, Mass.



The Model 430-A covers the frequency range from 4.5 to 520,000 cps in five over-lapping bands. A single scale logarithmic dial is used. Calibration is held to ± 2% accuracy.

Two output terminals are provided. The voltage on one of them is controlled by a calibrated output level control while the other provides a fixed sine-wave signal for scope synchronization.

Other features include low distortion and hum at any setting of the output level control and good amplitude constancy over the entire frequency range. A descriptive booklet on this unit is available on request.

NEW V.T.V.M.

Freed Transformer Company, Inc., 1718 Weirfield Street, Brooklyn 27, New York has developed a new vacuum-tube voltmeter which is now being offered to the trade.

Designated as the No. 1040, the new unit is a high-impedance, wide-frequency range voltmeter which can be used at audio and ultrasonic frequencies. The instrument is composed of a high impedance, precision five-step attenuator, an *RC*-coupled multistage amplifier, a balanced rectifier, a balanced d.c. amplifier, and a special meter in which deflection is proportional to the logarithm of the current through it. A high amount of degeneration is used in both the a.c. and d.c. amplifiers. The switching from one voltage range to another is accomplished in the input circuit.

Complete specifications on the No. 1040 may be obtained from the company direct.

PERMANENT REACTIVATOR

Crest Laboratories, Inc., Whitehall Building, Far Rockaway, New York has recently introduced a plug-in type cathode-ray tube rejuvenator which is designed to be permanently wired into the television receiver.

The new unit is compact and may be installed without soldering or lead hookup. By means of a uniquely-designed autotransformer, the input volt-

(*Continued on page* 86)

TVI TROUBLE AHEAD

Service technicians and amateurs have a new interference problem on their hands with the opening of the 21-mc. ham band.

A NEW and particularly troublesome problem currently faces ham radio operators and TV set owners since the opening of the new 21-mc. amateur band on May 1st.

Although it is too early to determine the volume of complaints which will result, serious repercussions are expected because of the great number of television receivers, now in the hands of the public, whose i.f. frequency falls in the 21-mc. band. Although many manufacturers have now switched to higher i.f.'s, this move upwards will not help set owners who have older model receivers in their homes.

Specifically, ham transmitters operating in the 21-mc. band are capable of entirely disrupting television reception in nearby receivers having a 21 mc. i.f. even though the ham transmitter is properly shielded and TVI-proofed. One solution will be for service technicians to realign the i.f. to a slightly higher frequency to eliminate the 21-mc. interference. Another solution is to use a 21-mc. wave trap at the receiver antenna terminals. This will trap the interference at this point.

Although the opening of the 21-mc. band to ham transmissions has been expected for several years, the "go-ahead" has caught vast segments of the industry off guard. Not only will hams in the United States be operating on the new band, but amateurs in Canada, New Zealand, Belgium, Ecuador, and Denmark will begin transmissions in this portion of the frequency spectrum within the next month or so.

At first the authorized transmissions will be by code which will have the effect of temporarily blanking out the television signal or causing extreme variations in picture brightness. Later when phone transmissions are authorized for this band, the television set owner may encounter sound bars on his television screen, or possibly the amateur signals in the audio section.

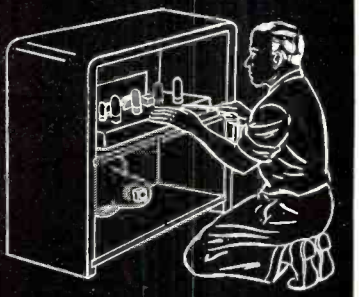
In anticipation of the hue and cry that will arise from millions of TV set owners, the *ARRL* has written to each manufacturer reminding him of the opening of the new 21-mc. band and soliciting his cooperation in disseminating the correct servicing information to combat the new interference problem. This cooperation will do much to reduce complaints.

As there is virtually no likelihood that the new band will be withdrawn from amateur service, since it was established as a result of an international agreement, the burden of coping with the new problem will rest squarely on the shoulders of the manufacturers and the service technicians handling set maintenance. The solution of this problem is relatively simple.

This is by way of warning to service technicians to be on the lookout for this new interference source and a general hint on how the condition will have to be handled. In this specialized case the ham transmitter is not at fault since it will, presumably, be operating within a legally assigned band. All of the procedures necessary to eliminate TVI will have to originate at the receiver rather than at the transmitter.

-30-

Where Will You be in ELECTRONICS 6 Months from Today?



ADD TECHNICAL TRAINING TO YOUR PRACTICAL EXPERIENCE

GET YOUR FCC LICENSE IN A HURRY!

Then use our Amazingly Effective JOB-*FINDING* SERVICE

Get this Valuable Booklet FREE

TELLS HOW YOU CAN GET A FREE TELEVISION ENGINEERING COURSE

TELLS HOW—

WE GUARANTEE

TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET

YOUR FCC LICENSE

If you have had any practical experience—Amateur, Army, Navy, Radio repair, or experimenting.

TELLS HOW— Employers make

JOB OFFERS Like These to Our Graduates Every Month

Letter from Chief Engineer, Broadcast Station, North Carolina, "Need men with radiotelephone 1st class license, no experience necessary. Will learn more than at average station for we are equipped with Diesel Electric power, transmitting and studio equipment."

Telegram from Chief Engineer, Broadcast Station, Wyoming. "Please send latest list available first class operators. Have November 10th opening for two combo men."

These are just a few examples of the job offers that come to our office periodically. Some licensed radiomen filled each of these jobs . . . it might have been you!

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY WITH OUR Coaching AT HOME in Spare Time.

Name and Address	License	Lessons
Leo Worthy, 2210½ Wilshire St., Bakersfield, Calif.	2nd Phone	16
Clifford E. Vogt, Box 1116, Dania, Fla.	1st Phone	20
Francis X. Foerch, 38 Bender Pl., Bergenfield, N. J.	1st Phone	38
S/Sgt. Ben H. Davis, 317 North Roosevelt, Lebanon, Ill.	1st Phone	28
Albert Schoel, 110 West 11th St., Escondido, Calif.	2nd Phone	23

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
CARL E. SMITH, E.E., Consulting Engineer, President
Desk RN-42, 4900 Euclid Bldg., Cleveland 3, Ohio

TELLS HOW—

Our Amazingly Effective JOB-FINDING SERVICE Helps CIRE Students Get Better Jobs

Here are a few recent examples of Job-Finding results:

GETS JOB WITH CAA

"I have had a half dozen or so offers since I mailed some fifty of the two hundred employment applications your school forwarded me. I accepted a position with the Civil Aeronautics Administration as a Maintenance Technician. Thank you very much for the fine cooperation and help your organization has given me in finding a job in the radio field."

Dale E. Young, 122 Robbins St., Owosso, Mich.

GETS FIVE JOB-OFFERS FROM BROADCAST STATIONS

"Your 'Chief Engineer's Bulletin' is a grand way of obtaining employment for your graduates who have obtained their 1st class license. Since my name has been on the list I have received calls or letters from five stations in the southern states, and am now employed as Transmitter Engineer at WMMT."

Elmer Powell, Box 274, Sparta, Tenn.

OURS IS THE ONLY HOME STUDY COURSE WHICH SUPPLIES FCC-TYPE EXAMINATIONS WITH ALL LESSONS AND FINAL TESTS.

GETS CIVIL SERVICE JOB

"I have obtained a position at Wright-Patterson Air Force Base, Dayton, Ohio, as Junior Electronic Equipment Repairman. The Employment Application you prepared for me had a lot to do with me landing this desirable position."

Charles E. Loomis, 4516 Genesee Ave., Dayton, Ohio.

Your FCC Ticket is recognized in all radio fields as proof of your technical ability.

Get All 3 FREE

MAIL COUPON NOW

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RN-42—4900 Euclid Bldg., Cleveland 3, Ohio
(Address to Desk No. to avoid delay)

I want to know how I can get my FCC ticket in a minimum of time. Send me your FREE booklet, "How to Pass FCC License Examinations" (does not cover exams for Amateur License), as well as a sample FCC-type exam and the amazing new booklet, "Money-Making FCC License Information."

☐ Tell me how I can get your Free Television Course.

Name .....

Address .....

City ..... Zone ..... State .....

Paste on 2-cent postcard or send air mail.

Within the Industry

(*Continued from page 26*)

he joined the company in 1937. He entered the Navy in 1942, serving three years. He became associated with the *Hunter-Douglas Corporation* in 1949 and relinquished this post to rejoin *Westinghouse*. He will maintain headquarters at the company's New York executive offices.

* * *

DONALD W. JACKSON, west coast representative for *Belmont Radio Corporation,* has been promoted to the post of assistant sales manager with headquarters at the Chicago office of the firm.

He was formerly associated with *Goodyear Rubber Company* and joined *Belmont* in 1950 as district manager for the Michigan and Ohio territories. He took on the west coast assignment last year and has since been stationed in Los Angeles.

* * *

ROBERT R. PORTER has been named vice-president and sales manager of the *Ford Instrument Division* of *The Sperry Corporation.* He joined the division in 1949 as assistant to the president . . . **JOHN C. McDEVITT** is the new assistant sales manager of the radio sales section of the *Crosley Division.* He has been with the company since 1949 and will make his headquarters in Cincinnati . . . **DONN F. KING** has been named east central district sales manager of the Parts Division of *Sylvania Electric Products, Inc.* In his new post he will have district sales supervision over all metal, mica, and plastic parts, components, and finished products manufactured by the Parts Division . . . The Television and Broadcast Receiver Division of *Bendix Radio* has named **ARTHUR E. WELCH** to the post of assistant general manager. He was formerly associated with *Raytheon Manufacturing Company* where he held the post of national merchandising manager . . . **DR. LEWIS WARRINGTON CHUBB,** director emeritus of the *Westinghouse Research Laboratories,* died recently at his home in Pittsburgh. He was associated with the company for 42 years, retiring in 1948 . . . **WILLIAM H. GIBBONS** is the new advertising manager of *Tinnerman Products, Inc.* of Cleveland. He joined the company in March 1950 . . . **JOHN J. RADIGAN, JR.** has been placed in charge of industrial relations at *P. R. Mallory & Co., Inc.* with the title of vice-president. He was formerly industrial relations director at the *E. W. Bliss Company* of Canton, Ohio . . . The newly-created post of sales manager for the radio division of *Admiral Corporation* is being filled by **HENRY A. BROWE.** He has been with the company since 1948 . . .

EARLE POORMAN has joined *William N. Scheer, Advertising,* as vice-president in charge of merchandising. He was formerly associated with *General Electric Appliances, Inc.* of New York . . . **FRED A. LYMAN** has been promoted to the post of national merchandise manager of the receiver sales division, *Allen B. Du Mont Laboratories, Inc.* He was formerly manager of the company's New York factory distributor branch . . . **TOM PAXTON** is now in charge of the distributor operation in Indianapolis, Ft. Wayne, Louisville, St. Louis, and Cincinnati for the *Hallicrafters Company.* He formerly was a Chicago representative for *Zenith Distributing Company* . . . **CHARLES W. HALE** has joined *Star Electronic Distributors, Inc.* of Chicago. He will handle the sale of electronic parts and equipment to industrial accounts . . . **A. M. REPSUMER** has been appointed television supervisor for the *Baker Manufacturing Company* of Evansville, Wisconsin, manufacturer of television masts, towers, and roof mounts. He joined the company in 1950 immediately after his graduation from the University of Wisconsin . . . *Sparton Radio-Television* of Jackson, Michigan, has named **WILLIAM B. FORS** to the post of advertising and sales promotion manager.

* * *

BERNARD L. CAHN, general sales manager of the *Insuline Corporation of America,* has been elected 1952 chairman of the Sales Managers Club, Eastern Division.

Other officers chosen for the year include Jerome Kirschbaum, *Precision Apparatus Co., Inc.,* vice-chairman; Walter Jablon, *Espey Manufacturing Company,* secretary; and Vincent Ulrich, *National Union Radio Corporation,* delegate to the industry's show corporation board.

The Sales Managers Club is an association of executives of electronic parts and equipment manufacturers, dedicated to the improvement of industry relations. It is one of the sponsors of the annual Parts Show. —30—

AMPLIFIER NOTES

FREDERIC T. C. BREWER has forwarded some additional notes regarding his article "A Low-Cost Audio Amplifier" which appeared in the March issue.

Mr. Brewer suggests that the volume control be insulated from the utility box with fiber washers and then grounded through the secondary of the output transformer.

He points out that if the control is not insulated there is a tendency for the amplifier to oscillate at some settings of the volume control.

Readers who have built this unit and have experienced difficulty with oscillation will be glad to know that they have not made a mistake in wiring. Insulating this control will clear up the difficulty completely. —30—

For the clearest picture of campaign progress...

Rauland PICTURE TUBES

Man, what a year for TV—and TV service profits! The richest menu of regular attractions ever offered to viewers . . . PLUS the party conventions, the campaign, the elections and inauguration! When viewers need replacement picture tubes, they'll want them fast—*and good.*

So remember that Rauland alone offers these replacement profit advantages:

- The *most complete* line of replacement picture tubes . . . a far better supplement for your regular tube line than a second line of receiver tubes.
- The faster, *surer* installation adjustment made possible by the patented Indicator Ton Trap.
- The dependable, uniform *extra* quality that so many smart service men depend on for assured customer satisfaction.

• • •

Remember, Rauland research has developed more "firsts" in picture tube progress since the war than any other maker. And this leadership pays off . . . in your customers' satisfaction.

THE RAULAND CORPORATION

Perfection Through Research

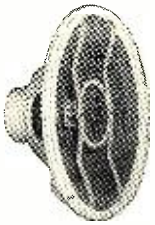
4245 N. KNOX AVENUE • CHICAGO 41, ILLINOIS

New Super-Quality 15-inch COAXIAL SP A R Only $24.95

BUY YOUR WIDE-RANGE COAXIAL SPEAKER AT McGEE

NEW 1952 MODEL
12" COAXIAL P.M.
$12.95
WHY PAY MORE?

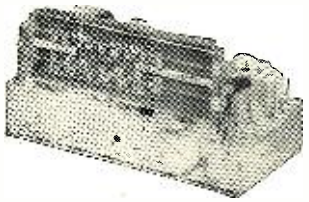
McGee offers its new 1952 model 12" coaxial PM speaker. The finest that we have ever offered. Quality you would put in your finest sets if you were a manufacturer. Genuine Alnico V magnet 6.8 oz. in the 12" woofer. The tweeter is coaxially suspended inside the 12" and has a metal diffusor attached. The high pass filter is concealed under the pot cover, leaving only two wires to connect to your radio or audio amplifier. Why, buy an ordinary speaker, when you can have a 12" coaxial PM for only $12.95? Input 8 ohms with 18 watt peak and 10 watts average. Shipping weight 8 lbs. Response from 30 to 17,500 cps. McGee's finest speaker value. Stock No. CU-14Y. Sale price, **$12.95** each.



15" COAXIAL P.M. SPEAKER
$19.95

Only $19.95 buys a full 15" 20 watt coaxial PM speaker, with built-in high pass filter. Hook to any 8 ohm output on radio or amplifier. Response below 20 to above 17,500 CPS. Good bass response. A lucky purchase makes this price possible. Full 32 oz. magnet in the woofer. 5" tweeter. Model P15-9. Ship. wt. 11 lbs. Sale price, **$19.95.**

New Versatile Espey 12-TUBE FM-AM CHASSIS $64.50



★ BUILT IN PRE-AMPLIFIER FOR G.E. VARIABLE RELUCTANCE PICKUP
★ WIDE RANGE AUDIO
★ MAY BE USED WITH A CRYSTAL MIKE AS A HOME P.A. SYSTEM

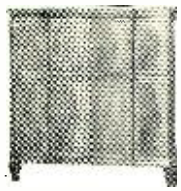
McGee's new 1951 model 12 tube FM/AM chassis. Latest design with phono inputs for all types of record players, crystal or G.E. variable reluctance. Receives standard broadcast 550 to 1700 KC and FM 88 to 108 MC. Wide range audio response (push-pull 7C5) and bass boost tone control. Loop antenna for broadcast and 300 ohm line type antenna, may be stapled in cabinet. Attractive lighted slide rule dial. Chassis size, 13½x9" high and 9" deep. Shipping weight 20 lbs. **Stock No. 7-CX.** Made to sell at a much higher price. McGee's sale price is **$64.50**, less speaker (output matches 8 ohms). **7-CX** chassis with our 12" coaxial PM, CU-14Y, both **$74.50.** Espey 7-C chassis, 12" coaxial PM speaker and 3 speed VM changer with G.E. variable reluctance cartridge, **$104.95.**

HALLICRAFTERS S-78
11-TUBE FM-AM CHASSIS

ONLY **$89.50** LESS SPEAKER
WITH 12" COAXIAL SPEAKER **$99.50**

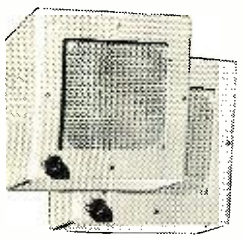
★ PUSH-PULL WIDE RANGE AUDIO

Hallicrafters S-78, 11-tube AM-FM radio receiver chassis, with push-pull 6K6 high fidelity audio system. A new model chassis for custom installation. Full range tone control, with bass boost. Input for automatic record changer. Output transformer has 3.2 ohm and 500 ohm connections. Chassis size, 12¾" x 10" x 7¾" high. Knobs and escutcheon plate are furnished. Receives standard broadcast and FM, 88 to 108 mc. Shipping weight, 25 lbs. Model S-78, priced less speaker at **$89.50** net.
S-78, 11-tube AM-FM chassis with our 12" coaxial PM speaker, both for **$99.50.**
S-78 with 15" coaxial PM speaker, both for **$107.95.**
If you want a record changer, see our special listing below.



DELUXE CAPEHART CABINET $99.95
MADE FOR A $1100.00 RADIO-PHONOGRAPH

Beautiful, top quality, walnut combination radio-phono cabinet. 42" high, 42" wide and 22" deep. Made for Capehart's finest combination. Highly polished matched walnut panels. Cabinet top is 1⅛" thick. This cabinet weighs approximately 180 lbs. Both the radio and changer compartments and speaker grill have hinged doors. Radio compartment on the right-hand side is 14" high and 11½" wide. Made to mount chassis vertically. The changer compartment is 14" high and 26½" wide. Large enough to hold any record changer or recorder mechanism. Front 10" of top over the changer compartment is hinged to fold back for easy access to the changer. Both radio and changer compartments come with uncut panels. Speaker baffle is cut for a 12" speaker and the compartment is completely enclosed. Shipping weight, 275 lbs. Stock No. K-275, Capehart combination cabinet. Net price, **$99.95.**



8" EXTENSION SPEAKER
FOR TELEVISION SETS RADIO SETS—AND P.A. SYSTEMS—

$7.95 EACH

★ HAS VOLUME CONTROL
★ LEATHERETTE BAFFLE
★ HEAVY 8" PM SPEAKER

Just imagine all the places you could use an extension speaker, such as: connected to a TV set or radio, or in a recreation room. It's easy—just clip on 2 connectors to the speaker voice coil and your extension speaker is ready to play.

Loudness of the extension speaker may be controlled right at the extension speaker. You may put speaker on the wall or just set it down. Speaker is housed in a leatherette-covered wood case with volume control and 20 ft. of extension wire. Speaker may be run up to 50 ft. Extra speaker wire, **1½c** per ft. TV-Radio extension PM speaker, Stock No. ID-52, **$7.95** ea.; two for **$15.00.**

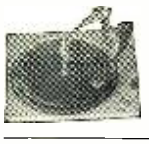
100 Molded Plastic Bypasses $9.95

100 molded plastic tubular by-pass condensers. All 600 volt. And all by the same nationally known mfgr. Regular dealers' net is over two and one-half times our 20th Anniversary sale price. You'll chuckle when you look these over. Here's what you get: 10—.001, 10—.002, 20—.005, 20—.01, 20—.02, 10—.05 and 10—.1. Our big deal No. RN-202. 100 plastic tubulars. Shipping weight 2 lbs. Net price, **$9.95.**

100 600 VOLT TUBULARS $6.95

100 top quality 600 volt tubular by-pass condensers. Made this year by a famous condenser factory. Don't confuse these with grab-bag surplus. McGee's deals are guaranteed to please you. Here's what you get: 10—.001, 10—.002, 20—.005, 20—.01, 10—.02, 20—.05 and 10—.1 600 volt condensers. Our big deal No. RN-203. Shipping weight 2 lbs. Net price, **$6.95.**

3-SPEED CHANGERS ON SALE AT McGEE



WEBSTER CHICAGO MODEL 100-2 ONLY $26.95

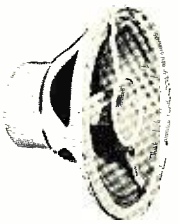
For the first time we offer the world famous Webster-Chicago, model 100-2. Features a newly designed spindle, that drops the records flat; air-cushioned to the turntable. Pickup arm sets down automatically after the last record plays. Plays all records automatically, 33⅓, 78 and 45 rpm. New balanced tone arm with Electro-Voice Tilt-A-Matic cartridge with dual needles. Ordinarily cost over **$37.00.** McGee offers them for only **$26.95** each. Base size 12"x12¾". Shipping weight 14 lbs.

V.M. 3-SPEED MODEL 406 $22.95

VM model 406, deluxe 3 speed automatic record changer. Plays them all. Intermixes records of the same speed. Equipped with a flip over crystal pickup with twin needles. Base size, 12¼x13". Shipping weight 12 lbs. VM-406. Net price **$22.95.**

G.I. 3-SPEED CHANGER WITH G.E. VARIABLE RELUCTANCE TURN-ABOUT CARTRIDGE $22.95

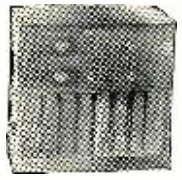
Another tremendous McGee Scoop! Brand new General Instrument 3-speed automatic record changers. Complete with RPX-050 G.E. variable reluctance cartridge with turn-about stylus. Plays all 3 speeds automatically: 7", 10" or 12" records. Has reject button. Repeats last record. Base size, 12"x12⅞". Shipping weight 14 lbs. Stock No. 700-GE. Scoop price, **$22.95.**



NEW SUPER QUALITY 15" COAXIAL SPEAKER 5" TWEETER 21 OZ. ALNICO V MAGNET
THE FINEST COAX WE HAVE EVER OFFERED
$24.95 TWO FOR $47.95

This is the finest 15" coaxial PM speaker value that we have ever offered. New 1952 production, of a famous manufacturer of fine speakers. The 15" speaker has a 21½ oz. Alnico V magnet; equal to 68 oz. of the Alnico 3 type magnet. The cone is free floating, of one piece construction. Will reproduce low frequencies down to 20 cps. The 5" tweeter is coaxially suspended and has a ridged cone to reproduce only the high frequencies. It will respond up to 17,500 cps. The high-pass filter is concealed under the pot cover, leaving only two wires to connect both the tweeter and woofer to any 8 ohm output transformer of a radio, or high fidelity music lovers' amplifier. Stock No. P15-CR, shipping weight 13 lbs. Net price, **$24.95;** 2 for **$47.95.**

RADIO-PHONO CABINET
CUT TO FIT ESPEY CHASSIS OR WITH BLANK PANEL $79.95



Buy this cabinet with Espey chassis and the VM changer listed above and have a fine radio-phono combination for less than the value of the cabinet alone. This beautiful cabinet was intended for a Capehart $800.00 combination. It is the finest possible furniture quality cabinet workmanship. 37" high, 40" wide and 21" front to back. Hinged top lifts in two sections. 25½" lid covers the changer compartment and 14½" is the width of the radio compartment. Changer mounting panel is furnished blank. Radio panel is shipped ready cut to fit the 7-C Espey chassis. Baffle is cut to hold 2 12" speakers. Made of top quality walnut veneer. ⅞" material used throughout. Shipped via truck, rail or express only. Shipping wt., 160 lbs. Stock No. C-175, with panel cut to fit Espey 7-C, **$79.95.** Stock No. B-175B, with blank changer and radio panel, **$79.95.** Buy 2 12" 32 oz. Alnico PM speakers for use in this cabinet for only **$15.00 ($7.50** each).

SENSATIONAL 50 WATT BOOSTER AMPLIFIER

ONLY **$39.95**
2 MIKE PRE-AMP **$12.95** EXTRA

50-WATT BOOSTER A sensational value, 50 watt booster amplifier with push-pull parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X Pre-amp to add the use of 2 mikes and one low level input. The booster amplifier has one input jack and with 1 volt input gives 50 watts of audio. Booster has a 6 lb. potted case high fidelity output transformer, matches speaker with 4-8-16 ohm voice coil, also 60 ohm and 250 ohm line. Booster has a 225 mill power supply with 5U4 rectifier. Price includes tubes: 4 6L6, 7N7 and 5U4. The two variable controls are for master volume control and bass boost tone control. Size 8 x 6½ x 14½. Stock No. PA-55X. Shipping weight 26 lbs. Sale price **$39.95** ea.

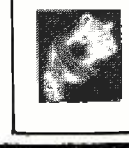
2-MIKE PRE-AMP. Pre-amplifier plugs in directly to the PA-55X Booster amplifier. It enables use of 2. Crystal or Dynamic Mikes plus one low level input. Furnished with 4 foot cables and plugs for remote control of the 55 watt Booster Amplifier. Small chassis size 5 x 3¼ x 4". Stock No. PR-2X, with tubes 7F7 and 7N7. Net price **$12.95.**

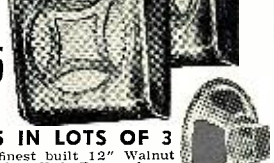
TERRIFIC VALUES IN SPEAKERS AND BAFFLES

8" PM AND LEATHERETTE BAFFLE $4.95
$4.75 IN LOTS OF 10

The finest Leatherette Baffle we have ever offered. New self-supporting plastic grill material, baffle is covered tan with matching grill. Offered with a good heavy duty 8" Alnico V PM speaker with 3.2 ohm voice coil. Stock No. 818. Speaker and Baffle, **$4.95** ea.; lots of 10, **$4.75.** 8" Baffle only. Stock No. NV-8, **$2.29** ea.; 10 for **$19.95.**

High impedance dynamic mike with 12 ft. of cable for use preamp. No. 4-DT, **$9.95** ea. 2 Section floor stand, **$5.88** extra.





12" PM AND WALNUT BAFFLE $9.95
$8.95 IN LOTS OF 3

The finest built 12" Walnut plywood wall baffle we know of. Factory cost of the famous juke box manufacturer exceeds $7.00, we offer with a 12" PM for little more. You pay only **$9.95** in single lots, or **$8.95** in 3 lots for both a 12" Quam Alnico V PM with 3.2 ohm voice coil and the beautiful wall baffle, 12" Speaker Baffle combination. Stock No. BS-12Q. **$9.95** ea.; lots of 3, **$8.95** ea. 12" Baffle only, #SEG-12, **$4.95** each.

McGEE RADIO COMPANY

Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER
1422 GRAND AVE., KANSAS CITY, MISSOURI

★ RED HOT VALUES IN T.V. TUNERS ★

STANDARD COIL CASCODE TUNER $19.95

The Cascode Circuit of the Standard Tuner offers a new development of this famous TV front end assembly which affords a 2-to-1 improvement in gain and a 35% to 50% reduction of noise over the pentode tuner. Other advances include: easy conversion to UHF reception by interchange of channel inductors; increased sensitivity for TV sets in fringe areas; elimination of booster use; and a high profit item for the serviceman as a replacement unit sale. Brand new factory cartoned. Series TV-2000 TV tuner, complete with tubes 6BK7 or 6BQ7 and a 6J6. Scoop price, **$19.95** each.

RCA 201E1 T.V. TUNER $7.95

Terrific buy on this RCA tuner. We have a limited quantity of the famous original 201E1, 13 channel completely wired and tested TV front end tuners. Ready to connect to your TV video I.F. strip. Offered at a sacrifice. Price was $44.00. Now only **$7.95** each, with tubes. Each tuner in good condition but has been repaired. Stock No. RCA-13P, TV front end tuner. Convertor coil type for separate sound as used in the famous 630 chassis. Complete with 3—6J6 tubes, **$7.95.** Specify shaft length desired, either 2" or 4".

GENERAL INST. T.V. TUNER $7.95

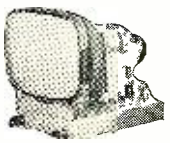
This popular General Instrument TV tuner has been used on thousands of late model TV sets. It has built-in fine tuning and 12 channel selector control. This tuner differs from other tuners in that it is built around a tuning condenser instead of a coil switching arrangement. A convertor coil is not mounted on this tuner. Priced complete with 3—6J6 tubes. Shipping wt., 3 lbs. Stock No. GI-WT3, with tubes. Net price. **$7.95.** Specify shaft length desired, either 1¾" or 7".

$2.95 SPECIAL. GI-312, same as above GI Tuner only less tubes and in repairable condition. 1¾" and 7" shafts available.

3-TUBE SARKES-TARZIAN T.V. TUNER $9.95

This popular Sarkes-Tarzian Type 3 tuner is widely used. 13 channel rotary type switch with individually tuned coils. Price is complete with diagram and three tubes: 6C4 osc., 6BH6 R.F. and 6AG5 mixer. Regular factory cost is twice our price. Each tuner is wired ready to hook up to a video and sound IF strip. May be used with either inter-carrier or separate sound IF circuits. Has built-on convertor coil, built in fine frequency control. Sarkes-Tarzian TV tuner, with 3 tubes. Net price, **$9.95** each. Specify shaft length, either 2⅞" or 4¾".

COMPLETE 17" TO 20" T.V. KIT



★ AC-TRANS-TYPE
★ CONVENTIONAL CIRCUIT
★ READY WIRED 12 CHANNEL T.V. FRONT END
★ 70° DEFLECTION ★ CERAMIC FLYBACK
★ KIT OF TUBES EXCEPT KINE $16.95 ★ 20HP4 $27.95 EXTRA

$59.95 LESS TUBES

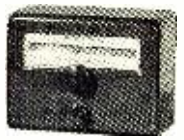
A complete kit of parts to build an AC transformer operated television chassis for use with a 16, 17 or 20 inch rectangular picture tube. The 12 channel Sarkes Tarzian tuner is ready wired. The 4 tube video IF strip is also wired. Circuit is of the conventional accepted design, with latest ceramic type flyback high voltage supply. Chassis is ready punched. Warning: Do not buy this kit unless you understand Television and electronics. It is difficult to wire. We furnish schematic and photos. Kit model WH 20 ship weight 40 lbs., less all tubes **$59.95.** Kit of 19 tubes but less picture tube **$16.95** ext. 17 inch 17BP4A **$21.95** ext. 20HP4 **$27.95** ext. 20CP4 rect. tube **$37.00** ext.

GENUINE STANDARD COIL T.V. BOOSTERS

NOT SURPLUS—BUT RIGHT FROM THE FACTORY—ONLY $11.95 EACH—TWO for $22.00

Latest Model B-51 Standard Coil Television Booster. McGee makes another lucky purchase and as usual, passes the saving on to you. The famous Model B-51, 12 Channel Standard Coil TV booster, which lists for $35.00, is offered to you for only **$11.95** each. Brand new, factory cartoned and fully guaranteed by McGee. This top quality single stage booster utilizes printed high frequency circuits, for improved performance on all channels. Uses 6AK5 tube. Average gain, 6 to 7 volts on low channels and 5 or 6 on high channels. No distorting of picture or sound. Has extremely low noise factor. Continuous one-knob tuning and channel selector control switch for off-on and by-passing 300 ohm lead-in to set. Modern design, dark brown plastic cabinet, 8"x4¼"x4½". Made for 110 volt, 60 cycle AC operation. Shipping weight 5 lbs. Model B-51, Sale price, **$11.95** each, or buy 2 for only **$22.00.**

T.V. FRINGE AREA DEALERS—ATTENTION FM AND TELEVISION BOOSTER SALE



ANOTHER McGEE SCOOP **$10.95**

WHY PAY MORE?
NOT A KIT BUT A FACTORY-BUILT BOOSTER

Sensational value. Continuously variable inductance type tuner, from channel 2, including the FM band, through channel 13. This booster is self powered for 110 volts AC operation. Incorporates a 6J6 tube. Input for 300 ohm TV line and 300 ohm output to the TV set. Single knob tuning. Attractive plastic case. Mahurdle-Silver Super Sonic TV-FM booster, Stock No. GB-6B. Shipping weight 5 lbs. McGee's terrific sale price, **$10.95** each, two for **$20.00.**

NOW YOU CAN CONVERT TO A 17" OR 20" PICTURE TUBE WITH ELECTRO STATIC FOCUS

The 17HP4 and 20HP4 are 17" and 20" black face picture tubes of the electromagnetic deflection electrostatic type of focusing. Focusing is accomplished by a 5 meg. pot connected as a bleeder between ground and the cathode of the damper tube. The arm of the focus pot connects to pin 6 of the CR tube, to apply a focus voltage of from 0 to 300 volts. This new type tube is called low voltage electrostatic focus. Very simple to use and operates from 8.5 KV to 14 KV. Most set makers are using this new tube in several models. The trend is almost completely to this type gun.

20" CONVERSION KIT $32.95

The new 20HP4 blackface picture tube operates from 10 to 14KV, high voltage. It is the conventional 20" rectangular shape A standard 70° yoke and single ion trap are required. Focusing is accomplished by electro-static means, applying from 0-300 volts on the focus anode, pin No. 6. All other connections and characteristics are similar to a 20CP4. (No focus coil or focus magnet is needed.) You get the 20HP4 tube, a 20" rectangular plastic safety mask with gold trim, plus tube characteristics, all for **$32.95.** Stock No. HPM-20, shipping weight 40 lbs.
77J1-X, Universal flyback with connecting instructions, **$3.95.** 70° Deflection Yoke, **$2.95.** Width Coil, **69c.** 5 meg. focus control, **59c.**

17" CONVERSION KIT $24.95

The new 17HP4 blackface picture tube operates from 8 to 14KV, high voltage. It is the conventional 17" rectangular shape. A standard 70° yoke and single ion trap are required. Focusing is accomplished by electro-static means, applying from 0-300 volts on the focus anode, pin No. 6. All other connections and characteristics are similar to a 17BP4. (No focus coil or focus magnet is needed.) You get the 17HP4 tube, a 17" rectangular plastic safety mask, with gold trim, plus tube characteristics, all for **$24.95.** Stock No. HPM-17. Shipping weight 30 lbs.
77J1-X, Universal Flyback with connecting instructions, **$3.95.** 70° Deflection Yoke, **$2.95.** Width Coil, **69c.** 5 meg. focus control, **59c.**

LOOK AT McGEE'S 10-TUBE ALL-PURPOSE RADIO KIT—ONLY $29.95

10-WATT HIGH FIDELITY AMPLIFIER KIT $14.95

★ MIKE INPUT ★ PHONO INPUT
★ BASS AND TREBLE BOOSTER

A complete kit of parts, including tubes, diagram and instructions, to build a 10 watt high fidelity twin tone control audio amplifier, with bass and treble boost. Inputs for radio tuner, crystal mike and crystal phono pickup. Output transformer matches 8 ohms. Use with our 12" coaxial PM speaker, or any good PM and have a beautiful sounding, yet low cost amplifier. Response from 50 to 15,000 cps. Chassis is ready punched and a ventilated cover is furnished. A straight forward circuit with twin triode gain stages and 2-50L6 tubes in push-pull. New twin 150 ma. selenium rectifier voltage doubler; television type power supply. Price includes tubes; 12AX7, 12AU7 and 2-50L6, plus rectifiers. A good quality kit with matched parts. Size, 5¼"x10"x5⅝" high, including cover. Stock No. AP-10R, shipping weight 8 lbs. Sale price $14.95 each. 12" coaxial PM speaker, $12.95, extra.

MODEL ME6-2 $14.95

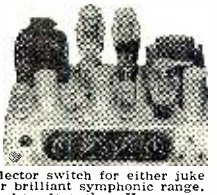
NEW MODEL 6-TUBE, 2-BAND RADIO KIT
A FULL 2-GANG SUPERHET KIT
RECEIVES 550-1600 KC PLUS 6-18 M.C.

McGee's new 1951, 6 tube; AC-DC 2 band radio kit. Receives broadcast, 550 to 1600 kc and short wave, 6 to 18 mc. A straight forward superhet circuit with 2 gang tuning condenser, 456 kc I.F. transformers, etc. 5" speaker illuminated slide rule dial. Everything furnished, including tubes, 12SK7, R.F., 12K8 mixer, 12SK7 I.F., 12SQ7 detector, 1st audio, 35L6 output, 35Z5 rectifier, diagram and a photo showing view of underside of completely wired chassis. The chassis pan and dial parts are factory production. With this kit, you can build a commercial looking and factory quality 2 band radio, housed in a streamlined plastic cabinet. Size: 13 x 6¾ x 6¼". Stock No. ME6-2, shipping weight 10 lbs. Net $14.95.

SELF POWERED AC Broadcast Tuner Kit. 3-Gang Tuning. Complete Kit, $12.95

A self-powered, 3-gang superhet tuner kit with R.F. stage. When wired according to our diagram will make a top quality broadcast tuner (550 to 1650 kc), for use with any amplifier. Don't class this with ordinary tuners; this has its own power transformer. This complete kit is furnished with a diagram, photos and tubes, 6AU6 R.F., 6BE6 oscillator R.F., 6AU6 I.F. detector, 6AL5 diode, AVC, plus rectifier. Connect to any audio amplifier. Ideal for use with our S-2020, TM-16 or 7X5 amplifier kits. Chassis size, 9½x4x 4¼" high. Shipping weight, 7 lbs. Broadcast tuner kit Model BT-38X. Net price, **$12.95.**

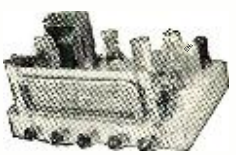
8-TUBE 22 WATT Wide Range Amp. Model 7x5 Kit Only $37.95



A complete kit, including tubes (3-7E5, 2-7F7, 2-6A3, plus rectifier), diagram and photos. All triode circuit makes for minimum harmonic distortion. Inputs for radio tuner any kind of phono pickup (crystal or G.E. variable reluctance) and either crystal or dynamic mike. Output transformer matches 8 ohm voice coil. Twin electronic tone controls, bass and treble with range selector switch for either juke box quality with heavy bass response or brilliant symphonic range. The best quality amplifier kit we know how to make. Has a very wide range output and heavy power transformer. Response 18 to 20,000 CPS. 8 tube all triode amplifier kit, complete with tubes. Weight 25 lbs. Net **$37.95.**

10-TUBE RADIO KIT $29.95

3-GANG TUNING
MIKE INPUT
12 WATT
HI-FI AUDIO
BASS-TREBLE
BOOST



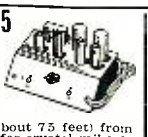
A NEW 1952 ALL-PURPOSE RADIO KIT
ALL-PLATED CHASSIS PARTS

10-Tube Broadcast (550 to 1700 kc) Radio Kit for custom builders. Features 3-gang superhet circuit with A.V.C., high gain IF circuit, 8" slide rule dial. Chassis size 12½" long, 10" front to back, 6½" high. Audio inputs for a crystal or dynamic mike, and record changer or player. Tone compensation for standard crystal pick-up or General Electric variable reluctance. Push-pull 6V6 output tubes, shielded high fidelity output transformer matches 8 ohm PM speaker, husky power transformer, 2 tone controls for separate bass and treble boost. A complete kit, including tubes 6SK7 R.F., 6SA7 mixer, 6SK7 I.F., 6H6 detector, AVC, 6SQ7 1st audio, 12AX7 variable reluctance and mike amplifier, 12AX7 phase inverter, 2-6V6 outputs, plus rectifier, diagram and instructions. Shipping weight 18 lbs. Stock No. BK-R10. Net price **$29.95.** 10" PM speaker, **$6.95** extra. Crystal mike and desk stand, **$4.95** extra. 12" coaxial speaker **$12.95** extra.

5-Tube Broadcast SUPERHET RADIO KIT $12.95

Model RS-5 tube AC-DC superheterodyne radio kit. Has loop antenna and 2 gang condenser, with lighted slide rule dial and attractive plastic cabinet. Receives broadcast, 550 to 1650 kc. Full size dynamic speaker, matched 456 I.F.'s, automatic volume control. This is a complete radio kit. Everything furnished, including diagram, photos and tubes: 12K8 mixer, 12SK7 I.F., 12SQ7 detector, 1st audio, 50L6 output, 35Z5 rectifier. Shipping weight 7 lbs. Stock No. RS-5. Net price **$12.95.**

Build Your Own Phono-Mike Broadcaster $7.95



Kit Model DE-6R. With this simple kit, you can build a 3-tube phono oscillator that also has a mike input. Will broadcast over any radio, within your home, (about 75 feet) from 1000 to 1500 kc. Inputs for crystal mike or crystal phono pickup. Fader control fades from mike to record. Ideal for a home P.A. system, baby listener and home entertainment. A complete kit of parts including tubes. Kit Model DE-6R. Net price, **$7.95.** DE-6RWT, wired and tested. Net price, **$9.95.** Crystal mike and desk stand, **$4.95** extra. Concealed microphone unit, only 1" in diameter and ¼" thick. Specify hidden mike when ordering. Stock No. T-001. Net, **$3.95** extra.

3-WAY PORTABLE KIT $15.95

A NEW '52 MODEL

New 1952 Model 3-way personal portable radio kit. Operates on 110 Volts AC-DC or 67½ B plus 1½ volt self-contained batteries. Leatherette covered case size, 5½x5¾x 8". Receives broadcast 550 to 1650 KC. A conventional 2-gang superhet circuit with 456 KC iron core IF's. Incorporates the new super gain stick loop antenna. All plated chassis. Lab. approved circuit—matched parts. Price includes all parts, tubes, diagram, Alnico V PM speaker. A factory quality kit. Stock No. PN-4T, shipping weight 7 lbs. The complete kit. Less batteries **$15.95.** 67½V. B, **$1.59,** 1½V. A, **39c** extra.

Magnetic Tape and CBC

(*Continued from page 38*)

particularly heavy at Winnipeg as time-zone delayed-scheduling is handled at that point for broadcast material which feeds from both west to east and east to west.

In 1950, three additional channels were added to this installation and about 350 hours of recording and reproducing are handled by this equipment during each four week period on the air.

By using magnetic tape, *CBC* will save approximately $100,000 in the fiscal year 1951-52 in recording materials (*i.e.,* the cost of discs which would have had to be used if tape were not available). However, this must be weighed with the fact that the conversion to magnetic tape has led to a considerable increase in the recording load.

For an average month, approximately 900 hours of tape recorded material is used on the air by the *CBC*. Thirty million feet of tape per year runs through the *CBC* tape recording and playback machines. Tape is used at *CBC* for: (a) News event recording; (b) Delayed broadcast recording; (c) Auditions; (d) Air checks; (e) Reference recording; (f) In certain locations, where the station is mainly a network outlet, tape has been installed at both studio and transmitter. Evening operations originate from tape or at the network transmitter. Station calls, announcements, and programs are taped ahead of time; (g) Shortwave receiving stations use tape for off-the-air recording, monitoring, etc. Considerable *BBC* material, such as news and commentaries, is obtained in this manner.

The latest *CBC* studio installation is the *CBC* Radio Canada Building in Montreal. The master control for this location is set up to accept 26 inputs and can feed these to 14 output lines. A total of 28 studios are housed on the first 2 floors of this building. The recording room, when completed, will comprise 10 disc and 10 tape channels with space for expansion.

Remote-control facilities for the tape recorders and playbacks are available in all studio-control rooms and transmitter booths.

Headquarters for the International Service and the French Network together with the National Engineering Headquarters Department and various executive offices are located on the remaining ten floors of the same building in Montreal.

The Engineering Headquarters comprises the office of the Director General of Engineering, the Plant, Architectural, Transmissions and Development, Operations and Engineering Projects, and Services Departments of the network.

CBC has proved to its own satisfaction that magnetic tape pays off handsomely in improved operations and reduced maintenance costs. —30—

THE possibility of pre-recorded magnetic tape eventually replacing the disc in broadcast, industrial, wired music, educational, and home entertainment applications has been a subject for wide discussion among professionals and audio enthusiasts for the past two or three years. The proponents of the "disc" have continued their research and development during the past few years. They show no signs of slowing down their efforts to make discs better and better. In its present stage of development, the long playing Microgroove disc represents a formidable obstacle to the *rapid* development of a broad market for pre-recorded tape. It is an accepted fact that as a basic medium for master recording, magnetic tape is in a class by itself. Without it, the rapid growth of the long playing disc would never have been possible. Time and time again, the question has arisen: Why not bypass the expensive and complex disc process entirely and make direct tape duplicate recordings available on a mass production basis? This is a legitimate question, an important one, too. But the steps toward its solution are not easy.

Perhaps one of the basic difficulties in advancing pre-recorded magnetic tape is the sale price, necessitated primarily by the high cost of magnetic tape stock (relative to the cost of materials used in a record pressing). However, this is somewhat a case of the "chicken and the egg" in the basics of economics: supply-demand-mass production-sales price. Perhaps when the demand has been created or when it comes about naturally and mass production can be reached, the cost of magnetic tape stock purchased in huge quantities will cause the basic stock costs to plummet downward, enabling a reflected drastic reduction in the retail price of pre-recorded magnetic tapes. This would cause a new cycle of increased demand, increased production and, perhaps, the wider adoption of pre-recorded magnetic tape libraries.

Another factor which has to be overcome by the proponents of "tape" is the issue of the relative *difficulty* in handling magnetic tape. It is claimed by some that the simplest tape machine is a more difficult mechanism to operate than is a three-speed automatic record changer. Here we find that people differ widely in this matter. Perhaps the opinions frequently vary because of confusions in the points which are sometimes considered to add weight to the "anti-tape" attitudes. We must talk about things on the same levels. If we refer to tape recorders, we must refer to disc recorders. If we refer to

tape players, we must refer to disc players; not a "tape recorder-playback" *versus* a "record changer." Examine the respective equipment in that correct light and come to your own conclusions as to the "difficulties" of handling.

* * *

Tapes of the Month

A-V #101 (MUSICAL VARIETIES)

Wait and See—I Didn't Know What Time It Was—You Are Too Beautiful—It's A Big Wide Wonderful World—Linda Mujer—Crinoline Days—Laura—I Love You So Much It Hurts Me—Sleepy Lagoon—Jungle Lament.

(Available in 7.5" single-track; 7.5" double-track; or 3.75" double-track)

A-V #304 (MOMENTS IN MUSIC)

The Gondoliers, Patience, and Iolanthe (Gilbert & Sullivan)

(Available in 7.5" single-track; 7.5" double-track; or 3.75" double-track)

A-V #303 (MOMENTS IN MUSIC)

Come To Me, Bend To Me—Every Day—Song of India—I'll Remember April—More Than You Know—Intermezzo from L'Arlesienne Suite (Bizet)—Minuet in G—Minute Waltz (Chopin)—Gopak (Moussorgsky).

(Available in 7.5" single-track; 7.5" double-track; or 3.75" double-track)

According to the company's catalogue description of Reel #101: "Select ensembles play the music that has become a part of the American dancing and singing scene; truly classically popular melodies. This series is very much a favorite in the tape library."

According to the same catalogue, Reels #303 and #304 are "a charming potpourri of music for listening or reading; salon and symphonic groups. These program-reels form an excellent background for friendly conversation."

The artists who performed on these reels are not identified in the *A-V Tape Libraries*' catalogue and are probably a "pickup" group which regularly plays for some well-known publisher or conductor and who augment their incomes by "free lancing" such jobs. The performances are charming, the type of music one is used to hearing over the wired music systems. Tonal reproduction is adequate—not impressive, just adequate. The Gilbert and Sullivan excerpts contain no vocals, as is presently customary on all *A-V* reels. One might have some fun with this reel if one obtains the libretto to follow along with the tape.

A-V #1001 (CONCERT HALL)

Faust Ballet Excerpts (Gounod)
Nutcracker Suite Excerpts (Tchaikowsky) including Overture Miniature, Marche, Danse Arabe, Danse De Mirlitons

(Available in 7.5" single-track; 7.5" double-track; or 3.75" double-track)

This reel was the first "Concert Hall" release in *A-V's* catalogue. Here again, no artists are listed and the brief catalogue description bills it as a "professional performance perfectly recorded." The performance is mediocre stuff, something that one *has* to have in a catalogue from the standpoint of music titles.

A-V #1004 (CONCERT HALL)
Part 1. Overtures to Die Fledermaus, Gypsy Baron, and Waldmeister
Austrian Symphony Orchestra,
Max Schonerr and Felix Guenther, conductors
Part 2. Strauss Medley including Annen Polka, New Wein, Acceleration Waltz, Intermezzo, Tik Tak Polka
Austrian Symphony Orchestra
(Available in 7.5" single-track; 7.5" double-track; or 3.75" double-track)

This reel of Johann Strauss music has a good deal to offer, for the music is played with the authentic Viennese *lilt* and *brio*. The timing of the selections is not given. This may become a necessity when broadcasters adopt pre-recorded magnetic tapes for direct broadcast and programming.

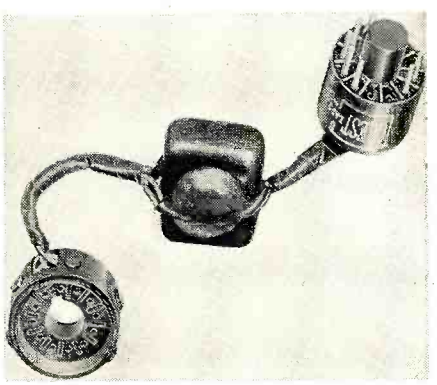
(Each package should be fully labeled with copy taken from the *A-V* catalogue—Editor)

—30—

What's New in Radio

(*Continued from page 77*)

age of the directly-connected filaments of the cathode-ray tube are fed through the transformer and boosted. This additional voltage is sufficient to give weak tubes their original emission characteristics and restore normal



brightness. The reactivating voltage is low enough to preclude any damage to the filament.

Distribution of this new unit is through regular jobbers but additional details may be obtained from the company.

SCOPE PROBE

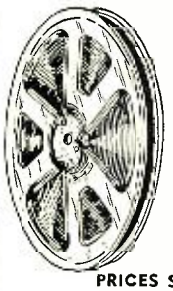
Scala Radio Co., 2814 19th Street, San Francisco 10, California is announcing three new oscilloscope probes for TV servicing applications.

Designed to be used with any oscilloscope, these new units come complete with coaxial leads and complete operating instructions. The signal tracing probe (B.Z.1) can be used to locate dead i.f. stages, mark ratio detector curves, calibrate a marker generator, adjust video amplifiers, check the output of a sweep generator, view the response of a single i.f. stage, etc. This unit is useful up to 225 mc.

The second probe is a low capacity unit, the B.Z.2, which makes possible the tracing of video, sync, or sweep waveforms through high impedance

MAKE UP YOUR ORDER IMMEDIATELY AND MAIL TODAY!

PLASTIC BASE RECORDING TAPE



Get the buy of your life. Save up to 64% on high quality RECORDING TAPE. A large manufacturer had to sell his inventory and he unloaded the whole deal. Olson now offers you this high grade recording tape at prices which defy competition. Standard ¼" wide, 1200 ft. long. Frequency response 50 to 8,000 cy. Plastic Reel included with each.

600 Ft. Reel	1200 Ft. Reel
Stock No. X-275	Stock No. X-249
Single, ea. $1.49. LOTS OF 10, EA...	Single, ea. $2.19. LOTS OF 10, EA...
$1.29	$1.99

PRICES SLASHED ON EMPTY PLASTIC REELS
Finest Clear Plastic—Will Not Warp

5" Diameter—600' Size No. X-250 Single, ea. 39c. LOTS OF TEN, EA..... **29¢**

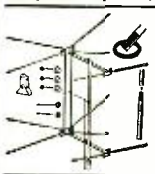
7" Diameter—1200' Size No. X-251 Single, ea. 49c. LOTS OF TEN, EA..... **39¢**

STANDARD COIL TV BOOSTER

★ Latest Model ★ Brand New
★ Reg. List Price $30.00
★ While they last. Model No. B-51. **$10.95 Ea.**

Just connect one of these Standard TV Boosters to your receiver and get brighter, snappier pictures and less "snow" and interference. Easy to attach. Works on all TV sets. An amazing deal—you can cash in—save money—Order Today. Tunes all 12 channels. Uses a 6AK5 tube and a selenium rectifier. Complete. Operates on 115 V. A.C. Shpg. wt. 6 lbs.

COMPLETE TV ANTENNA



Stock No. AU-23
$8.99 Complete Set

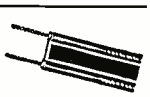
A complete stacked array. Made by a famous manufacturer whose name and brand is on every factory sealed carton. Look what you get: 2 Six-element conical bays, 1 pair "Q" bars, 2 Five-foot mast sections, 60 ft. 300 ohm twin line, 5 Standoff insulators, 1 mounting base, 1 guy ring, 1 clamp, hardware. Elements are highest quality aluminum. Reg. list price is $31.95. Shpg. wt. 15 lbs. Express only.

OPEN WIRE TV LINE ★ Use in Place of 300 Ohm Line

Ideal for fringe area installations. Not affected by moisture or sun. Made of #18 copperweld wire with genuine polystyrene insulators spaced 6" apart. Tensile strength 400 lbs.

Stock No. W-78.	Stock No. W-79.
100 ft. coil. Shpg. wt. 4 lbs...	250 ft. coil. Shpg. wt. 9 lbs...
$5.95	$14.50

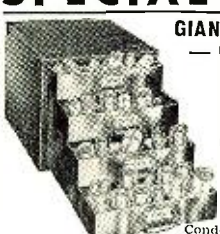
TWIN LINE—300 Ohm Poly Twinline



High quality, low loss. For all TV and FM installations. Shpg. wt. 2 lbs.
Stock No. W-73. 100 ft. coil. LOTS OF 10, EA..... $1.99
Single, ea. $2.99

SPECIAL

1000 Ft. Spool Twinline Stock No. W-99..... **$12.95**



GIANT CONDENSER KIT — 69 PIECES — 4-DRAWER CHEST

FREE OF EXTRA COST

Olson's Price AS-20 **$16.95**

You get $51.60 list worth of "Akrad" Condensers plus the 4 drawer steel cabinet **FREE**, size 10"x 11½"x10". Shpg. wt. 11 lbs.

42 "AKRAD" By-Pass Condensers

Qty.	Cap.	Volts	List ea.	Total
2	.001	600	$.25	$.50
2	.002	600	.25	.50
2	.005	600	.25	.50
5	.01	600	.30	1.50
5	.02	600	.30	1.50
10	.05	600	.40	4.00
10	1	600	.45	4.50
2	.005	1600	.55	1.10
2	.008	1600	.55	1.10
2	.01	1600	.60	1.20

Also 27 "AKRAD" Electrolytic Condensers

Qty.	Cap.	Volts	List ea.	Total
2	10	25	$1.00	$2.00
2	25	25	1.00	2.00
5	20	150	1.20	6.00
5	40	150	1.35	6.75
4	20-20	150	1.65	6.60
5	8	450	1.25	6.25
4	16	450	1.40	5.60
69	Value			$51.60

Stock No. RA-66 **$18.95 Ea.**

3-TUBE AMPLIFIER

Limited Quantity

While they last Olson offers these amplifiers which are ideal for window demonstrations, record playing, announcing, etc. Here's what you get: A three-tube amplifier with tubes, 6" PM speaker, and a two-tone leatherette covered case 5½"x8"x 10". Has input for either phonograph or crystal mike. Operates on 115 V, AC, 60 cy.

NOTICE—RADIO MANUFACTURERS

● Olson Radio has established a tremendous market among radio servicemen, amateurs, universities and industrials all over America as well as principal foreign countries. Our famous rapid mailing service is the talk of the trade.

If you have any good, clean surplus radio material which you wish to dispose of, contact Olson at once. We can use: radios, amplifiers, condensers, chassis, phono motors, pickup arms, volume controls, test equipment, speakers. In fact any radio or electronic part or piece of equipment.

Here is your opportunity to turn idle inventory into cash. Write, wire or call Olson, the popular name in radio.

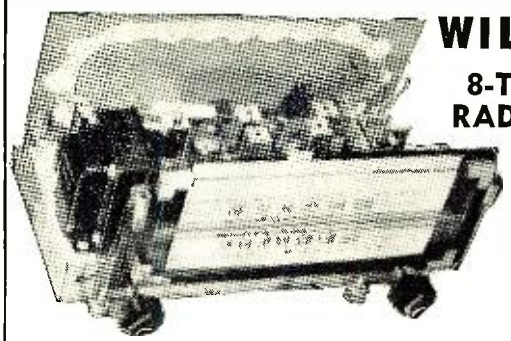
SEND FOR OLSON'S BRAND NEW BARGAIN CATALOG. GET NATIONALLY FAMOUS RADIO PARTS AND SUPPLIES AT BIG DISCOUNTS

CLEVELAND, OHIO
2020 Euclid Ave.
If you live in or near Cleveland visit our store, get these and many more bargains.

CHICAGO, ILLINOIS
623 W. Randolph Street
If you live in or near Chicago visit our store, get these and many more bargains.

MAIL ORDERS SHOULD BE SENT TO AKRON, OHIO

SPECIAL PURCHASE SCOOP!



WILCOX-GAY 8-TUBE AM-FM RADIO CHASSIS

$44.95 EA.

Stock No. RA-52

Complete: Tubes, Loop Antenna, Escutcheon, Knobs, etc.

Latest Model—Newest Features

This is not a kit or a tuner. It's a real high-powered AM-FM Radio Chassis that will pull in distant stations with amazing volume and brilliance of tone. Makes a perfect custom installation in existing cabinets, book-cases, walls, etc. Servicemen and Experimenters: Make money installing these for friends and customers.

The circuit is modern and employs 8 tubes (12AT7, 6BE6, 2-6BA6, 6AL5, 6AV6, 6V6 and 5Y3). The entire R. F. assembly and the 4-section tuning condenser is rubber mounted. Tuned R. F. stage plus two I. F. stages give this set terrific FM sensitivity. Separate FM oscillator tube for extreme stability, and triode R. F. and mixer circuits plus radio detector assure noise free, high fidelity FM reception.

Two modern dual knobs control on-off, volume and tone plus AM-FM, phone switch. Equipped with two panel lamps and edge lit dial. Phono input socket and AC receptacle at rear of chassis. Chassis size 13" wide, 7½" deep, 7¼" high. Cut out in cabinet requires 8x3¼. Output impedance 8 ohms operates on 110-125v AC. 60 cycles. Shpg. wt. 20 lbs. In factory sealed cartons.

COMBINATION DEAL

You get the above Wilcox-Gay Chassis exactly as described PLUS a 12" CO-AXIAL Speaker (Stock No. S-160) PLUS a VM 2-Speed Changer (Stock No. RA-99) as shown in our ad on opposite page.
Deal No. AS-61..... **$74.95**

THIS COSTS YOU NOTHING—NOT A RED CENT

Just to get the ball rolling and to get your order coming our way—Olson is going to send you a handy all-rubber RADIO TUBE PULLER. Made of soft rubber. Easily pulls from stubborn sockets all regular glass tubes, metal tubes and 7 and 9 miniatures. Protects you from burns, shocks, and cuts. All you need do is to make up an order for $10.00 or more from Olson's ad—use handy order blank below. We will ship your order at once (Olson's quick service is famous from Coast to Coast) and include the RADIO TUBE PULLER—FREE.

IT'S EASY TO ORDER FROM OLSON'S

How to order: Order directly from this ad. For convenience use this order blank. Fill in columns below with quantity desired, stock number, description and price. You may send remittance with order (include enough for postage or parcel post shipment), or if you prefer SEND NO MONEY. Olson will ship C.O.D. and you may pay mail or expressman for merchandise and postage.

MONEY BACK GUARANTEE: *Everything you order from Olson is guaranteed as advertised. If you are not more than satisfied, you may return merchandise for cash refund.*

Please Minimum Order $3.00

QUANTITY	STOCK NUMBER	DESCRIPTION	PRICE EACH	TOTAL

NAME _____ TOTAL

ADDRESS _____ ADD POSTAGE

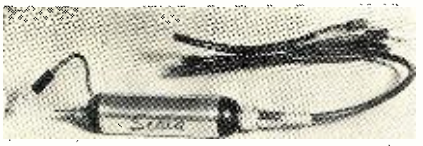
CITY _____ ZONE ____ STATE ____ TOTAL AMOUNT

RN 652

OLSON RADIO WAREHOUSE • 275 E. Market St., Akron 8, Ohio

circuits without causing waveform distortion due to circuit loading. It cuts the effective input capacitance of the scope by a factor of 10 and gives an attenuation of 10 to 1.

The B.Z.3 is a 100:1 voltage divider probe which is useful in troubleshooting horizontal sweep circuits. It may



be applied directly to the plate of a horizontal output tube or at the plate of the damper tube to check the operation waveforms and to measure their peak-to-peak voltages without impairing the waveshape or jeopardizing the oscilloscope.

NEW CONICAL ANTENNA

Kay-Townes Antenna Company, 1511 Dean Avenue, Rome, Georgia has recently introduced the Model C-2 conical type antenna which has been especially designed to provide maximum gain on Channels 2 through 13.

The antenna is constructed of 7/16" aluminum tubing with double-plate dipole holders. Oak dowel pins are used in the construction and the mast clamps are of cast aluminum. This mast clamp assembly will take 1" to 1¾" o.d. mast or pipe.

The high-frequency dipoles work in conjunction with the long dipoles for the highest possible gain on the high band. Both low band reflectors act as shields to the high band from the rear and add to the forward gain.

On the low band, the long receiving elements and reflectors offer a steady, strong signal. The low-band reflector is spaced a full quarter-wave and reflects the signal back to the receiving elements.

A data sheet on the Model C-2 is available without charge from the company.

ELECTRONIC VOLTMETER

The Daven Company, 191 Central Avenue, Newark 4, New Jersey has an-

nounced the availability of a new and improved electronic voltmeter, the Type 170-A.

This portable instrument is especially suitable for general laboratory and production use. The amplifier section and power supply section are separate sub-assemblies, a design feature which facilitates servicing. The amplifier is completely shock-mounted, reducing microphonic effects to a minimum. The amplifier and power supply are electrostatically and magnetically shielded from each other and from external fields.

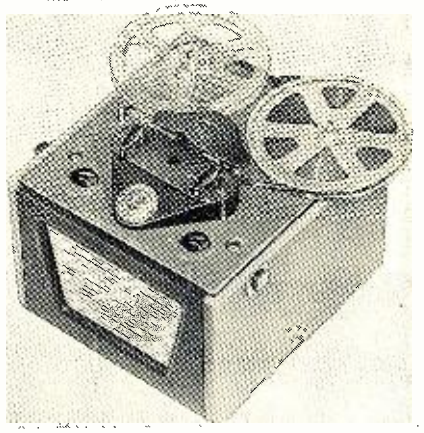
The unit is designed to measure a.c. sinusoidal voltages over a frequency range from 10 to 250,000 cycles and a voltage range from .001 to 100 volts. Its accuracy is ±2% over the entire frequency range.

Complete detailed catalogue information is now available from the company.

LOW-COST TAPE PLAYER

Pentron Corporation, 221 E. Cullerton St., Chicago 16, Illinois is now marketing a new tape player which retails in the low price class.

Designed to play back magnetic recordings made on standard tape recorders at either 3¾ or 7½ inch-per-second speeds, the new unit is available either as a self-contained unit



with speaker and amplifier or with preamp only ready to plug into any existing amplifier, radio, or TV set. Both models feature double track operation and two speeds.

The company will supply full details on either or both of these models. The player with preamp only has been designated as the PB-1 while the complete player is the PB-A2.

WOW-METER

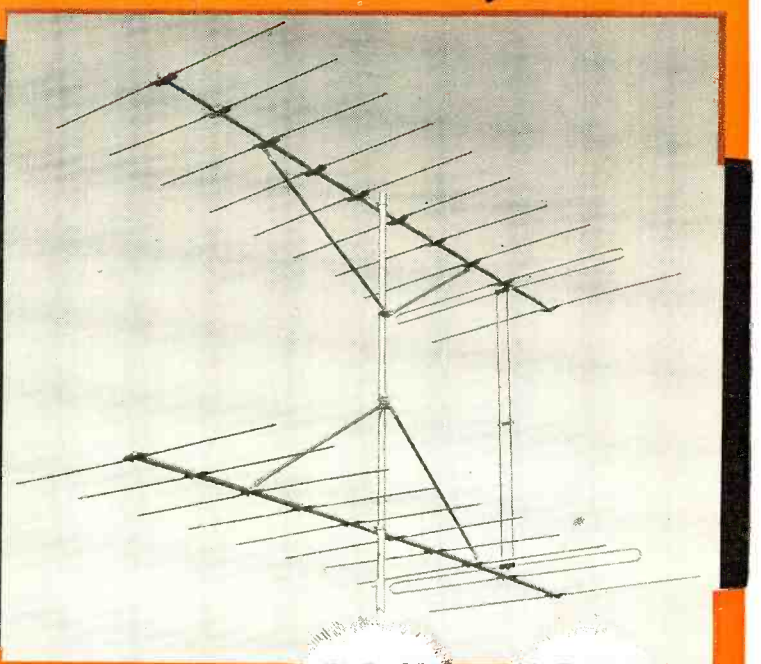
The Minnesota Electronics Corporation, 47 West Water Street, St. Paul 1, Minnesota is now marketing a wow-meter which measures both frequency variation and the center frequency of an audio signal direct.

The Type 152A is designed to measure wow in the center frequency range 800 to 1250 cycles while the built-in frequency meter is calibrated in the range from 600 to 1500 cycles. Other corresponding ranges may be obtained, on special order, to cover frequencies as high as 10,000 cycles with appropriately higher wow ranges.

Three wow spectra are available, ½ to 10; ½ to 120; and 10 to 120, with appropriate damping for each range and a meter reset switch for use on the

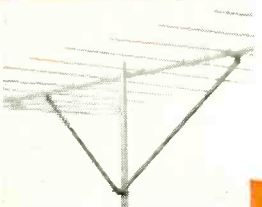
the BIG 10 is terrific!

CHANNEL MASTER'S fabulous new 10 ELEMENT YAGI



Highest Gains In TV History — 12 DB single — 14½ DB stacked

COMPARE these 10 Terrific Features:

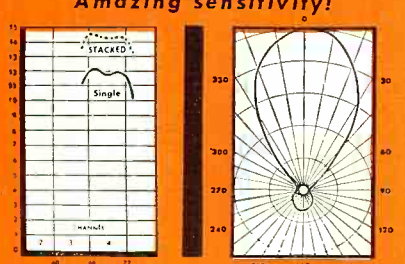


BOOM BRACING
Another original Channel Master development. Eliminates crossboom "bounce" — provides steadier pictures.

1. 10 Elements—more signal, less noise, less rear pickup.
2. Highest gain of any Yagi ever developed.
3. Over 30% more gain than any 8 element Yagi.
4. This antenna **can be stacked,** with 78% additional gain over single bay.
5. Includes the famous Z-Match system.
6. You don't pay for stacking bars.
7. Excellent 300 ohm match in all installations.
8. "Boom Braced" to prevent crossboom "bounce" which causes picture flicker.*
9. Two piece "Swej-Lok" crossboom for simplified stocking, handling, and installation.*
10. Completely pre-assembled.

*Low Band only.

Amazing sensitivity!



Channel 4 gain curves and polar pattern.

List Prices — channel 7-13 $13.88 — channel 2 or 3 $31.94 — channel 4 or 5 28.47 — channel 6 25.69

Write for name of your authorized distributor and complete technical literature.

FIRST IN PREASSEMBLED ANTENNAS

CHANNEL MASTER CORP.

NAPANOCH ROAD, ELLENVILLE, N. Y.

MEMBER — NNA — ANUFACTURERS ASSOCIATION

more highly damped ranges. Outputs are provided for independent monitoring of frequency and wow, allowing connections to recording equipment to

record the center frequency and the wow continuously, and the attachment of a spectrum analyzer or oscilloscope to examine the waveform of the frequency variation.

MOBILE AMPLIFIER

Newcomb Audio Products Co., 6824 Lexington Avenue, Hollywood 38, California has added a new phono-top mobile amplifier to its line of sound equipment.

The Model E-25MP has been especially designed for sound trucks, outdoor meetings, resorts, carnivals, parades, etc. It has inputs for two microphones and one phono input. It

consumes a minimum current per watt output. A standby switch increases the battery life and keeps tubes warm for instant use.

The amplifier has separate power and turntable switches with heavy-duty *Jones* plugs and receptacles providing dependable power connections. The entire unit is housed in a two-tone gray baked enamel cabinet with an etched metal panel.

DIRECT-DRIVE AMPLIFIER

Stephens Mfg. Corp., 8538 Warner Drive, Culver City, California has developed a new 500-ohm direct-drive amplifier and matching 500-ohm voice coil speaker system for high-fidelity sound reproduction applications.

The new "Tru-Sonic" 500D direct-drive amplifier eliminates the output transformer, thus removing all distortion introduced by transformers. Hum and noise are 90 db below full output. Frequency response is ±¼ db from 20 to 70,000 cps. Distortion is less than one-half of one per-cent at a full 20 watts of audio.

The amplifier measures 7¾" wide,

15¼" long, and 7" high. It weighs 20 pounds.

Technical specifications and performance details can be obtained from the company direct.

CONTINUITY TESTER

An inexpensive, compact continuity tester which has been designed for radio-TV-electrical servicing has recently been introduced by *Howard Sales Co.*, 539 Atlantic Avenue, Brooklyn, N. Y.

The "Lumometer" measures 1¼" x 2¾" x 3¼" and weighs just 11 ounces. It will test for opens, shorts, and continuity in radios, amplifiers, TV sets, a.c.-d.c. receivers, radio and television tubes, transformers, speakers, condensers, etc.

The unit will also check a.c. or d.c. voltages from 70 to 750 volts without switching.

A catalogue sheet describing the new unit in detail is now available from the manufacturer... —30—

International Short-Wave

(*Continued from page* 48)

Huambo, 9.705, is now heard to 1600 when closes with "A Portuguesa"; good signal lately. (Machwart, Mich.)

CR6RD is now on 7.093, heard opening "evening" session 1235; high level in parallel with the 9.705 outlet. *Radio Clube de Benguela,* CR6RB, 5.042, is on this *new* channel in parallel with 9.165; latter is best level at 1230 opening; closes 1930A. (Ridgeway, South Africa) The 9.165 outlet noted in Ohio with native musical program 0030-0100 sign-off. (Sutton)

Argentina—LRA, 17.720, good level in Arizona 1600 with news. (Earl) *Radio El Mundo,* Buenos Aires, is using LRX, 9.660, 7 kw., and LRX1, 6.120, 6 kw., to relay LR1, 1070 kc., 50 kw., daily in Spanish 0530-2235.

Australia—Perth, 9.610, noted with good signal around 0630-0745. (Ferguson, N. C.)

DX sessions of *Radio Australia* (on *Sundays*) are to British Isles and Europe 0215, 9.580, 11.760; to Western North America 0030 on 15.200, and to Africa on 21.540; to Eastern North America 0902 on 11.810, to South and Southeast Asia on 11.880, and to Africa on 9.580.

Bechuanaland—ZNB, 8.230, is scheduled 1200-1430 weekdays; 1300-1400 Sun. (*Short Wave News,* London) Noted in Britain 1325 with popular waltz music. (Catch)

Belgian Congo—OTC2, 9.767A, Leopoldville, is good level in Florida around 1830-2315. (Sherman) OTM2, 9.380A, noted with identification by woman 1500 and continuing with recordings; schedule must be extended *after* 1500 now. (Machwart, Mich.) Heard 0100-0120 with what seemed to be news in Flemish, then music. *Radio Congo Belge,* 11.720, heard around 1330 onwards. (Kary, Pa.)

Brazil—ZYP23, 5.045, Petropolis, noted with fair to good level to 2059

sign-off; has QRM from phone carriers. (Ferguson, N. C.) This one has had several DX programs lately arranged by Flavio Serrano, *ISW Dept.* monitor in Rio de Janeiro, who voiced the *English*-language portions.

Bulgaria—Radio Sofia, 9.705A, still excellent evenings around 2000-2030. (Golden, Mass.) Noted opening 1315, preceded by interval signal; foreign language used; *English* noted 1500-1515 is now over 7.671A. (Ridgeway, South Africa)

Canada—VED, 7.320, Edmonton, Alberta, operates daily 0900-0200 (irregularly some days runs longer when has special programs for Northwest Territories); 5 kw. (WRH) VE9AI, 9.540, Edmonton, noted 2015-2030 with fine signal in Calif. (Flynn)

Cape Verde Islands—Kary, Pa., flashes that Praia has been noted on 7.135A from sign-on 1530 to closedown 1702.

Ceylon—Radio Ceylon, 11.975, noted with fair to good signals to 1145A sign-off. (Brown, N. Y.; Kessel, Quebec; Fuller, R. I., others) Noted on 17.730 with religious broadcast 0545; on 15.120 at 2100 with BBC news relay. (Sanderson, Australia)

Chile—Punta Arenas, 9.197A, opens 1900 with march; should sign off 2200. (Stark, Texas) CE1190, 11.900, Valparaiso, noted around 2105-2200 or later; announces "La Voz de Chile para todo America." (Ferguson, N. C.) CE1515, 15.150, Santiago, heard at fair to good level around 1930 in Spanish. (Brown, N. Y.)

China—Radio Peking noted on 15.060 beginning transmission 1700 with news. (Rosenauer, Calif.) Heard in *English* 0400-0425 on 6.100, 11.685, 15.060, 15.170, and at 0830-0900 on 11.685, 15.060. (Huntsman, Burma) *Radio Harbin,* 15.130, heard in Chinese relaying *Radio Peking's Home Service* around 1752. (Winch, Calif.)

Colombia—HJCQ, 11.680, Bogota, noted opening 0700 with woman announcer in Spanish and slogan "Radio Nacional de Colombia." (Ferguson, N. C.) HJKJ, 6.160, is often noted around 2200 announcing "Cadena Nacional;" HJEX, 6.055, Cali, noted with announcement of "Radio Pacifico" and call letters 2230; good signal in Indiana. (Niblack)

HJFU, 4.795, "La Voz del Comercio," is good 2100-2300 sign-off. (Saylor, Va.) HJCQ, 4.955, Bogota, nice level 2245 sign-off. (Gaylord, Washington State) HJCW, Bogota, listed frequency of 4.945 in verification. (Machwart, Mich.) HJCX was *measured* recently on 6.0204 at 1950. (Oskay, N. J.) Noted closing one day at 2330, another day at 0150. (Hoffman, N. Y.)

Costa Rica—TIRS, 11.975A, *Radio Athenea,* San Jose, noted 0215-0235 in Spanish; one-chime interval signal. (Flynn, Calif.) "La Voz de La Victor," 9.617, San Jose, appears to have changed call to TIDCR. (Stark, Texas)

Cuba—COBZ, 9.026, noted 2245-2315 in Spanish; fair signal, in clear. (Baugh, Quebec) COBL, 9.833, Ha-

vana, noted around 2330 in Spanish; fair level. (Lane, Wyo.) COCY, 6.450, noted at good strength 1700-1900 parallel 11.74A. (Boggs, Mo.)

Cyprus—Sharq-al-Adna, 9.650, noted around 0046 with news in Arabic by man; strong signal. (Bellington, N. Y.)

Czechoslovakia—Prague, 11.84, noted with news for USA in progress 0718, fair signal with some flutter and a heterodyne. (Bellington, N. Y.) Heard on 9.504 at 0115 with Spanish news. (Sanderson, Australia)

Prague, 9.55, noted in *English* to North America 1930-2000. (Ferguson, N. C., Kary, Pa., others.) Heard by Pearce, England, on 9.504A with *English* 1400.

Denmark—OZH, 15.180, Copenhagen, fair in Danish 0900-1000; announced in *English* 0900. (Sutton, Ohio) This one logged 0430 with news for Pacific Area. (Sanderson, Australia)

Dominican Republic—HI2A, 9.68, noted signing off 2155 with Dominican anthem; good signal but with heterodyne, probably from XEQQ; some nights has excellent volume. (Bellington, N. Y.) HI1N, 6.042, C. Trujillo, noted around 1925. (Stark, Texas) HI9T, 6.190, Puerto Plata, noted to 1855 when closed with anthem; HI1Z heard on 6.112 with popular recordings around 2239. (Machwart, Mich.) HI2T is currently on *measured* 9.7344V; noted 0710 with news in Spanish; previous measurement was 9.7363. (Oskay, N. J.)

La Voz de Fundacion, 6.150, San Cristobal, noted with identification just *after* 1745; has QRM. (Stark, Texas)

Ecuador—HC2RL, *Radio Quinta Piedad,* 6.633A, is scheduled Tuesdays *only* now 2110A-2330A. (Stark, Texas)

English programs of HCJB, Quito, include "Morning in the Mountains," 0630-0730, 12.455, 9.970; "Quito Calling," 1600-1730, 17.890, 15.115, 12.455, and "Ecuadorean Echoes," 2100-0030, 15.115, 12.455, 9.970, and on 5.995 from 2300. (Van Gilder, Mass.)

Egypt—Cairo, 9.715, is widely reported now opening 1400 with *English* news. Some days continues with *English* and other days uses French. Sign-off is normally 1600 but continues to 1700 on Saturdays.

(*Continued on page* 94)

El Salvador—YSC noted 0001 on 6.075; heard another night from 2345 with marimba music; continues past 2400 most days; YSWW, 5.977A, Santa Ana, heard 2236 with music; YSUA, 6.100, heard 2321 when man announced "YSU, Radio Mil Cincuenta" (YSU is m.w. call); continued with news in Spanish. Runs to 2400; opens 0700. (Stark, Texas) YSO, 7.3142, fair 2200-2210 with music. (Lane, Wyoming, others)

Ethiopia—ETAA, 15.047 *(measured)*, Addis Ababa, noted 1235 to 1300 sign-off; mostly native (Amharic). (Ferguson, N. C.) In verifying for Kary, Pa., Bellington, N. Y., station listed channels of 15.054, 9.610, 6.419. Ridgeway, South Africa, says 15.047 is heard now rather irregularly from 1145 in parallel with 9.624A and 6.422A; stations leave air 1800.

Finland—A Finnish station is audible on 5.930 around 0530 in parallel with Helsinki on 6.120. Helsinki has *English* for Europe on 9.555, 15.190, and 17.800 at 0715-0725, and in French 0750-0800. (Radio Sweden) The *English* is scheduled for repeat to North America 2200 on same channels.

French Morocco — Radio Maroc, 6.006, Rabat, heard 1800 with call, news in French; usually signs off 1800, but one day recently ran to 1900. (Pearce, England)

French West Africa—Radio Dakar has ceased its *English* program (weekdays 1400). A *new* station in this country is *Radio Abidjan* on the Ivory Coast, scheduled weekdays 0145-0230, 0715-0800, 1400-1530; Sundays 0215-0300, 0715-0800, 1400-1545, using 7.210, output 1 kw. (WRH) *Radio Dakar*, 11.896A, is still noted closing with "La Marseillaise" 1800. (Niblack, Ind.) Some sources report 9.71A as a *new Radio Dakar* channel used in parallel with the 11.896A outlet.

Radio Dakar's 15.345 outlet is weak but improving throughout the 1410-1523 sign-off period with popular recorded music. (Lane, Wyo.)

Germany—WRH says RIAS, 6.005, Berlin, is now broadcasting 24 hours a day; power is 20 kw. However, Bellington, N. Y., has noted this one still has some "breaks."

Stuttgart, 15.28, noted at strong level, slight QRM, 1415-1515. (Baugh, Quebec) Nordwestdeutscher Rundfunk now has an additional short-wave transmitter, located in Berlin, 6.270A, heard to 0500. (Radio Sweden) *Radio Free Europe* has been heard on many channels in various bands lately; must be experimenting. (Bellington, N. Y.; Pearce, England; Oskay, N. J., others)

Gold Coast—ZOY, 4.915, Accra, has been heard 1100-1145 with popular music and *English* announcements; announces 61.04 m.; starts to fade around 1145; has aircraft QRM. (Flynn, Calif.) In verifying, listed this channel as in use 0945-1300. (Pearce, England)

Greenland—Gronlands Radio, 7.094A, Godthaab, noted to 1858 sign-off (one day to 1938). (Kary, Pa., Saylor, Va.) Heard signing on 1630; has musical notes for a few minutes prior to sign-on (Pearce, England) Bellington, N. Y., notes that according to *Short Wave News*, London, Godthaab, capital of Greenland, means "Good Hope."

Guadeloupe — The French-speaking station noted on 7.445A, signing off 2004A with "La Marseillaise" is believed to be Pointe-a-Pitre. After "La Marseillaise" has a short interval of guitar theme. (Kary, Pa.) Noted fading in around 1810. (Stark, Texas) May be same station Oskay, N. J., hears mornings on 7.4446 around 0615 to 0630 closedown.

Guatemala—TGNA is using *only* 9.668 and 11.850 for the *English* session nightly 2200-2230 (Wed. to 2300A). (Boice, Conn., Flanagan, N. Y.)

TGWB has been "wandering" around 6.180-6.390 lately; is listed 6.440. (Stark, Texas) TGLA, 6.295, noted 1949-2018 with marimba band music; All-Spanish.

Haiti—4VM, 6.005, Port-au-Prince, noted with call in *English* 1825, then with program of recordings. (Ferguson, N. C.)

Holland—Radio Nederland, Hilversum, hopes to have its new 100 kw. transmitter in operation next year (1953). (van Eekeren, Oregon-Holland)

(*Continued on page* 125)

Spot Radio News

(*Continued from page* 18)

zone. For instance, in zone I, encompassing the states of Massachusetts, Rhode Island, Connecticut, New Jersey, Maryland, Pennsylvania, Delaware, District of Columbia, Ohio, Indiana, Illinois and parts of Maine, New Hampshire, Vermont, New York, Virginia, West Virginia, Michigan, and Wisconsin, the co-channel assignment separations are 170 miles for the 2 to 13 stations, and 155 miles for the upstairs TV stations. In zone II, the separations were increased to 190 miles for the low-band stations and 175 miles for the 14 to 83 stations. This zone includes Kentucky, Tennessee, North Carolina, South Carolina, Missouri, Iowa, Minnesota, Arkansas, Kansas, Nebraska, Oklahoma, North Dakota, South Dakota, Utah, Idaho, Arizona, New Mexico, Montana, Wyoming, Nevada, Colorado, Oregon, Washington, and California, and parts of Maine, New Hampshire, Vermont, New York, Virginia, West Virginia, Georgia, Alabama, Mississippi, Louisiana, Michigan, Wisconsin, and Texas. A further increase in separation appears in zone III, which includes Florida and parts of Georgia, Alabama, Louisiana, Mississippi, and Texas. Here the very-high channels have been spaced 220 miles and the ultra-highs, 205 miles apart.

Some states were very fortunate in the allocation schedule, receiving quite an allotment of channels. California won 84 channels; Illinois over 100, and Texas around 150 in 117 communities. In contrast, New York found itself with only 60 channels in 35 areas.

It had been assumed that the educational stations would only receive channels in the higher bands. However, because of the striking campaign waged by the educators, a healthy slice of the very-high band was also set aside for them. Specifically, 80 v.h.f. channels are now available for schools and over twice that many or 162 u.h.f. channels can also be used for instruction. The assignment of the lower bands for the educators has irked many. In Boston, where Channel 2 was assigned for teaching, stormy protests have been made. During the hearings, *CBS* had opposed the reservation of the channel for educational use, stating that the scholastic interests were not ready to proceed with the construction of a television station, and the educators were not interested in a mass audience and thus would readily use an ultra-high channel for their minority type audience. Supporting the need for the channel for teaching, the members of the Lowell Institute Cooperative Broadcasting Council of Boston, consisting of Boston College, Boston University, Harvard University, Lowell Institute, MIT, Northeastern University, Tufts College, and the Boston Symphony, declared that it has had extensive experience in the fields of radio, through its FM station WGBH, and television, and was prepared to meet the responsibilities of television broadcasting. They indicated that they were more than confident that they would be able to secure the necessary funds to operate a station and they could provide programs that would be of interest to a wide audience. The plea of the council was soundly supported by such personalities as Senators Henry Cabot Lodge, Jr., and Leverett Saltonstall, as well as Congressman Christian A. Herter. The City of Boston and the Commonwealth of Massachusetts also echoed support for the proposal.

In New York, criticism of the educational assignments has also appeared, although no low bands were set aside for that purpose. The strong plea made by the Board of Regents of the University of State of New York won quite a block of attractive channels: 14, 17, 21, 23, 25, 43, 46, 66 and 83. The Board noted that they proposed to utilize the resources of more than 8000 state educational and cultural institutions to afford educational opportunities to more than 91 per-cent of the population of the state. It was also indicated that a television network would be established at a cost of $3,855,540, with an annual technical operating cost of $2,273,941, based on 16 hours of operation Monday through Friday, and 12 hours on Saturday and Sunday. Programming would be apportioned among public and private institutions under state supervision, with costs being borne by participating institutions supplemented by state aid.

THE REPORT was harshly criticized by Commissioner Jones, who in a dissenting opinion struck out at the Com-

mission's power-antenna plan, the fixed inflexible allocations and coverage predictions.

The power-antenna values, which are to be used by broadcasters everywhere from New York City to Goldfield, Nevada, with a population of only 336, warned Jones, means that . . . "there is a million-dollar entry fee for every broadcaster to guarantee the Commission plan's efficiency." He felt that the plan throws the heaviest financial burden upon those least able to pay. The "u.h.f. transmitters cost more to construct and operate," he said, "and u.h.f. receivers cost more." Initially, he pointed out, the u.h.f. receivers will not be as good as the very-high receivers and more complicated and more expensive receiving antennas will be needed to pick up a usable ultra-high signal.

"The Commission's plan will make the television broadcasting business a million-dollar blue chip game, as a result of the powers and antennas chosen for its level of efficiency," Jones added. In his opinion, the . . . "corollary of this philosophy is that those powers and antenna heights require abnormally, if not unreasonably wide separations. The wider the v.h.f. separations are, the less channels there are in any given city. In short, if the Commission is creating an artificial scarcity of v.h.f. channels . . . The Commission thinks it has eliminated . . . the contest between cities (it has not eliminated them at all) by incorporating this firm, fixed, and final allocation plan into its rules. But it has created a bigger Frankenstein with this artificial scarcity of channels than it is trying to avoid. Where the prospect of million-dollar returns are at stake in major markets, more applicants will be seeking a scarce number of channels. When many applicants compete for an unconscionably few v.h.f. channels with the lucrative return on investment provided by this plan (inordinately v.h.f. service areas), it will take years before the Commission can judge the merits on the kind of contests that will surely ensue."

Declaring that the mileage separations cited in the plan, were not . . . "based upon engineering principles at all . . . but on a policy decision . . . for specific size areas for television stations," the critical Commissioner noted that . . . "all of the engineering for this plan is subordinate to and complementary to this non-engineering policy decision."

Berating his fellow Commissioners for their views on coverage, Jones said: "The Commission blows hot and cold on two sides of the same proposition. On the one hand, it says that maximum rural coverage is obtained with wide spacings and on the other hand, it says that if you have a large number of cities close together, you can get larger rural coverage by the use of many stations on different channels because . . . 'there would be an overlapping of service contours and

a multiplicity of alternative services.' The question unanswered by the Commission is: Why did it persist in wide spacings in constructing the zone I portion of the table? As a matter of fact, from the standpoint of efficient channel coverage, there is no answer because the actual assignments have moved toward maximum single station efficiency instead of total maximum channel efficiency. Therefore, this firm, fixed, and final allocation plan, shrinks the available seven high-band channels used at the median spacings of 280 miles actually employed in constructing the table, and gives no more coverage than three of the same group of channels if 155 miles optimum spacing were employed."

In a concluding seething commentary on the defects of the plan, Jones said: "Efficient distribution of channels and the provision of maximum number of television stations have been sacrificed to achieve a misleading appearance of simplicity of administration. The public interest, convenience, and necessity have been abandoned to the theoretical convenience of the Commission. The small communities are to be subjected to rules drawn upon considerations applicable primarily or wholly to larger cities. The apparent simplicity of administration is an illusion that will disappear as soon as the number and complexity of conflicting applications under the standards emerge."

Madame Commissioner Frieda Hennock also felt that the sixth report was improperly drawn in many respects. She viewed that the granting of increases in power and height . . . "unduly and unnecessarily enhanced the v.h.f. at the expense of the u.h.f." Calling the u.h.f. a new and experimental portion of the spectrum containing the bulk of the TV channels, with its use so necessary to a national system, she said that the . . . "Commission should not hinder its development by adding to the advantage held by the already highly developed v.h.f." In her opinion, the Commission should encourage u.h.f. ". . . in every way possible so as to aid in its development, establishment and eventual growth into an integral part of a truly nation-wide television system."

The one-year reassignment plan was also censured by Miss Hennock who felt that with the . . . "anticipated heavy demand for frequencies, the equal right of all parties to petition . . . for these channels and particularly the lack of any definite criteria under which the Commission could withhold them against such demand, it is likely that most unassigned channels will be preempted by larger cities which already have multiple television assignments." She did not believe that . . . "we should so encourage the early appropriation of these channels at the expense of smaller communities, which may in time be able and eager to support a local television station."

The alarm over the inequities, appearing in the report, expressed by Commissioners Hennock and Jones, did not seem to disturb many, who viewed the assignments and standards as a plausible and intelligent approach to an extremely difficult problem. The consensus was that both the very-highs and ultra-highs will prosper and on a nation-wide equitable basis.

A FEW DAYS before the sixth report appeared, Washington and the communications world at large were saddened by the death of former Senator Wallace H. White, Jr., who co-authored the 1927 act, which not only set up the old Federal Radio Commission, but was the basis for the Communications Act of 1934. His passing shocked many, particularly broadcasters who will be forever indebted to him for his leadership in preparing the basic laws that have served the broadcasting world and the public so well for over twenty-five years. The striking growth of broadcasting and TV, too, is stirring testimony to his vision and conception of the long-range requirements of the listeners and viewers of the nation. Everyone will miss his friendly smile and constantly helping hand. . . . . L.W.

Loudspeaker Enclosures

(*Continued from page* 55)

reflex has the advantages of being simpler and less expensive to construct, and can be tuned over a certain range by adjusting the vent opening.

Corner Folded-Horn Cabinets

A type of loudspeaker cabinet which is becoming widely used because of its good low-frequency response is the folded-horn cabinet. In this type of cabinet the sound is radiated from the front of the speaker cone at high frequencies and through a horn coupled to the back of the cone at low frequencies. For home use, it is generally designed to be placed in a corner of the room so that the walls and floor form part of the horn.

The horn is used in loudspeaker applications because it is the acoustical equivalent of the electrical transformer. Since at low frequencies the air represents too low an impedance for proper coupling to the loudspeaker cone, the horn can be used to transform this low impedance to a higher impedance which permits more efficient energy transfer. Generally a volume of air is maintained between the loudspeaker and the entrance to the horn, to act as an acoustic capacity which bypasses the horn at higher frequencies so that all the high-frequency sound radiation is from the front of the speaker. With the use of properly designed corner folded-horn cabinets, frequencies as low as 20 to 30 cps can be reproduced using standard commercial loudspeakers in cabinets of practical sizes.

The details of construction of a typical corner folded-horn cabinet are shown on the "Data-Print." Practical

dimensions are given for the construction of such cabinets for use with commercial 12-inch and 15-inch loudspeakers. No dimensions are given for use with smaller speakers, since the major usefulness of the horn is with speakers that are capable of producing the very low frequencies at which the horn coupling to the air is most useful.

General

In the construction of the various loudspeaker cabinets which are described on the "Data-Print," a number of precautions must be taken to obtain proper performance:

1. In assembling cabinets, all mating joints should be securely glued and screwed together. Cracks or holes should be filled with plastic wood.

2. Large surfaces of the cabinet should be stiffened on the inside to prevent low-frequency vibrations. Stiffening braces should be fastened to such surfaces to eliminate any low-frequency resonances. When surfaces are tapped, only highly-damped high-frequency vibrations should result, and various sections should have different resonant frequencies.

3. Interior of cabinet should be padded to prevent standing waves from being set up. Absorbing material should be placed directly behind the loudspeaker, and one of each two opposing surfaces should be covered over most of its area with absorbing material.

4. Grille cloth should be as light weight and porous as possible, for minimum loss of high frequencies.

For the experimenter who does not have extensive woodworking facilities at his disposal, some of the cabinet types which have been described are available in commercial kits whose dimensions are very similar to those given on the "Data-Print."

The cabinet dimensions which are given in the tables may be changed to suit individual space requirements, provided certain precautions are taken: in the infinite baffle cabinet, the total internal volume should not be decreased. In the bass reflex cabinet, the over-all dimensions may be changed, but the internal volume and the vent area must be kept the same. In the labyrinth, the cross-section and length of the resonant tube must be kept the same. In the corner folded horn, the cross-sections of the horn must be maintained.

If the loudspeaker is placed in the proper cabinet, constructed according to the information given in this article, and the proper precautions taken in the construction of the cabinet, the good sound quality which the loudspeaker is capable of producing will be obtained. There will be no resonances in the frequency response and the cone will be properly damped for best transient response. With a good electronic system, such a loudspeaker system will be capable of a naturalness and clarity of reproduction which could otherwise be attained only by expensive commercial systems.

—30—

RADIO-TV Service Industry News

AS REPORTED BY THE

TELEVISION TECHNICIANS LECTURE BUREAU

MOST of us are inclined to gloss over statistics of potential business volume on a national scale because we can see no direct relationship between the millions of units or dollars that represent the total market and the few thousands of dollars of that market that we manage to get as our share of it. We feel that these fabulous figures are probably all right for big manufacturers but hold no real meaning for helping us to manage our small businesses. But sometimes the application of a little simple arithmetic in connection with some of these national statistics will provide some very useful information, particularly helpful in gauging how our particular business compares with the average business of its kind.

Recently, the *General Electric* Tube Department released some very interesting statistics that were developed in one of the broadest surveys ever made of the market for replacement tubes for television sets and home and car radios. For instance, this survey indicated that the receiving tube industry is about to pass a major landmark. More than 950,000,000 receiving tubes are now in operation in television receivers and home and car radios, and the total is expected to pass the one billion mark within the next few weeks.

Well, a billion sockets which will require replacement tubes at varying intervals represent a lot of sockets. And they also represent a big potential market for replacement tubes and associated service. In terms of individual service shops, it means that if the maintenance of these electronic circuits was evenly divided among all of the service shops now estimated to be in business, each shop would have a total of more than 28,000 sockets to maintain.

The survey showed that about 1,100,000 picture tubes worth $44,000,000 will be sold this year as replacements. On the basis of the number of TV service businesses that are currently estimated to be in operation this replacement business, if evenly divided among them, would sell one hundred tubes at a gross volume of $4000 per shop during this year.

The replacement market for receiving tubes this year is said to be 110,000,000 tubes worth $220,000,000. In terms of radio and television service shops, this would provide an average potential of 3100 tubes per shop during 1952. This represents an average of 60 tubes per shop per week for a total weekly gross income of $120.00. On the basis of technicians now working on maintaining electronic equipment, this potential would represent an average of thirty tubes per week for each technician.

Figures like these show the tremendous business potential that is available to service shops that will merchandise and sell the maintenance and service facilities they have available. It is highly probable that if, on a national scale, the service industry aggressively sought to repair the crippled radios and other electronic devices that are in use in homes, the market for replacement receiving tubes would exceed the estimates shown in the *General Electric Company* survey.

New TV Stations

Now that the three-and-one-half year freeze on TV station construction has been lifted, manufacturers are turning their attention to the development of u.h.f.-v.h.f. combination receivers that will receive both the present 12 v.h.f. channels and the 70 new u.h.f. channels that have been provided. A number of manufacturers have announced that they are going into production on u.h.f. tuners which will enable the present owners of 16 million v.h.f. TV sets to receive u.h.f. programs on their present receivers.

In lifting the freeze, the Federal Communications Commission announced that it would not start to

A COMPLETE Directory of Service Associations, together with the names and addresses of their present officers, is being prepared for publication in late summer. All service associations are urged to write to: Service Editor, RADIO & TELEVISION NEWS, 366 Madison Ave., New York 17, and send a complete list of officers.

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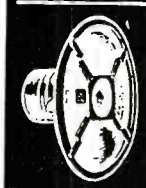
Quantity		Quantity		Quantity		Quantity		Quantity		Quantity	
0Z4	59c	6AB7	$1.15	6J5GT	$ .54	7A6	73c	12BE6	$ .65	35B5	72c
0Z4G		6AC5GT	1.31	6J6	1.04	7A7		12BF6	.59	35C5	
1A5GT	.65	6AC7		6J7G	.79	7A8		12BH7	1.08	35L6	.59
1A7	.99	6AG5	1.19	6J8G	1.15	7B4		12C8	1.15	35W4	.45
1B3GT	.95	6AG7	1.44	6K5GT	.87	7B5	.73	12F5GT	65c	35Y4	99c
1B5	29c	6AH6	1.40	6K6GT	.59	7B6	.73	12H6		35Z3	
1C7G		6AK5		6K7GT	.79	7B7	.73	12J5GT	.54	35Z4	54c
1E7		6AK6	1.08	6K8GT	.87	7B8	.73	12K7GT	.79	35Z5	
1H6		6AL5	72c	6L5G	.95	7C4	1.30	12Q7GT	.65	35Z6G	.95
1H5GT	.65	6AQ5		6L7	.87	7C5		12SA7GT	.72	35/51	.79
1H6G	1.15	6AQ6	.81	6N6G	1.40	7C6	73c	12SC7	.79	41	72c
1J5GT	.95	6AR5	.74	6N7GT	1.08	7C7		12SF5GT	72c	42	
1L4	.59	6AT6	.54	6P5GT		7E6	.89	12SF7		43	
1LA4	1.19	6AS5	.90	6Q7GT	.65	7E7	1.07	12SH7GT	.79	45	
1LA6		6AU5GT	1.45	6R7GT	.95	7F7	.89	12SK7GT	.72	45Z5	.59
1LC5		6AU6	59c	6S4	.65	7F8	1.47	12SL7GT	.87	46	1.04
1LC6		6AV6		6S7GT	1.15	7G7	1.07	12SN7GT	.99	47	
1LD5	.95	6B4G	1.44	6S8GT	.95	7H7	.81	12SQ7	.54	50A5	1.21
1LE3	1.19	6B5		6SA7GT	.72	7J7	1.07	12SQ7GT	.59	50B5	72c
1LH4	1.19	6B6G	.79	6SC7	99c	7K7		12SR7GT	.79	50C5	
1LN5	1.19	6B8GT	1.15	6SD7GT		7L7		12Z3	.95	50C6G	1.04
1N5GT	.72	6BA6	.65	6SF5	.59	7N7	.89	14A7	.89	50L6	.59
1P5GT	95c	6BA7	.87	6SF5GT	.65	7Q7	.86	14AF7	.93	50X6	.79
1Q5GT		6BC5	.72	6SF7	.72	7R7	.89	14B6	89c	50Y6	.59
1R5	72c	6BC7	.79	6SH7GT	.79	7S7	1.07	14B8		70L7	1.40
1S5		6BD5GT	1.15	6SJ7	81c	7V7		14C5	1.07	71A	.87
1T4		6BE6	.65	6SJ7GT		7W7		14C7	.98	75	1.10
1U4		6BF5	.99	6SK7GT	.58	7X6	.89	14F7	.89	77	
1U5	.65	6BF6	.59	6SL7GT	.87	7X7	1.07	14F8	1.30	78	
1X2A	.95	6BG6G	1.73	6SN7GT	.79	7Y4	73c	16SJ7GT	.81	80	.61
2A3	1.15	6BH6	72c	6SQ7	.54	7Z4		19BG6G	2.15	83	1.45
2A5	.79	6BJ6		6SQ7GT	.58	12A7	1.15	19T8	1.04	85	.79
3LF4	1.19	6BN6	1.44	6SR7GT	.65	12A8	.79	20	1.40	117L7	1.40
3Q4	.79	6BQ6	.85	6SS7	.72	12AH7	1.45	24A	.79	117N7	
3Q5GT	1.08	6BQ7	1.58	6T7G	1.15	12AT6	.54	25AC5GT	1.04	117P7	
3S4	72c	6C4	59c	6T8		12AT7	1.04	25BQ6GT	1.15	117Z3	.54
3V4		6C5GT		6U5	1.10	12AU6	.72	25L6GT	.59	117Z6	1.08
5T4	1.40	6C6	.79	6U6GT	79c	12AU7	.65	25W4GT	.72	807	1.55
5U4G	.59	6C8G	1.15	6U7G		12AV6	.54	25X5	1.04	813	8.95
5V4G	.87	6CB6	.72	6V6GT	.59	12AV7	1.15	25Z6GT	.79	1294	29c
5W4	59c	6CD6G	1.69	6W4GT	.65	12AW6	.95	32L7GT	1.15	1299	
5W4GT		6D6	.79	6X4	.54	12AX7	.87	35A5	.99	1619	.45
5X4G	.65	6D8G	1.15	6X5GT	.68	12BA6	.65			1629	.29
5Y3GT	.45	6E5	.79	6Y6G	.87	12BA7	.87			2050	2.00
5Y4G	.54	6F5GT	59c	7A4	.81					2051	1.15
5Z3	.81	6F6GT		7A5	.89					7193	.87
6A3	1.15	6F8G	1.15							VT51	29c
6A7	1.21	6G6G	.95							VT52	
6A8GT	.99	6H6	.59								
		6H6GT	.65								



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Very best quality—NATIONAL BRANDS Individually Packed

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4"	1.36	10"	5.10
5"	1.59	12"	6.54
6"	Special Price		$1.59 ea.

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50 asst.—$2.95

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BEST BRANDS at BEST PRICES

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3S4, 1T4, 1S5, 1R5.
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1U4, 3S4, 1S5, 1R5. List Value $7.80.
All Four Tubes for . . . **$2.39**

3V4, 1R5, 1S5, 1T4.
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117Z3, 1U5, 3V4, 1R5, 1T4.
AC-DC Portable Kit. All for . . . **$2.89**

12AT6, 12BA6, 12BE6, 35W4, 50B5.
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50L6GT, 35Z5GT, 12SQ7GT,
12SK7G, 12SA7G. 5 Tubes for . . . **$3.22**

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12LP4	$18.95	16JP4	$29.95
12LP4A		16RP4	$23.95
14PB4	$22.95	16TP4	
7JP4	$16.95	17BP4A	24.95
16AP4	$29.95	19AP4A	$39.95

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High Gain, Best Pictures Possible . . . complete with 300 ohm line, insulators, guy wire, hardware, full size antenna with double length 9 ft. mast . . . **$7.95** complete

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6-FOOT LINE CORD

UL approved, cord and plug—
10 for . . . $1.95

Get our special sales bulletins . . . write TODAY!

3 speed G. I. CHANGER complete, ready to install . . . **$24.95**

TV INLINE FOLDED DIPOLE ANTENNA
At this price we cannot mention manufacturer's name, complete with mast, ind. boxed. **$6.95** each
6 for $6.29 each.

TERMS: 20% DEPOSIT with order, balance C. O. D. $1.00 handling charge for orders less than $5.00. All shipments F.O.B. Chicago. Our parts and tubes are warranted to be 100% replacements for the prototypes in the listings above. Prices are subject to revision without notice. SATISFACTION GUARANTEED. Illinois residents add 2% sales tax. ORDER TODAY!

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process applications until July 1. This is to allow time for the filing of new applications and the refiling of pending applications on newly devised forms. This process will have the effect of putting all competing applicants, new and old, on the same footing when their bids are considered. The Commission emphasized that when it starts processing the applications on July 1, it is going to give first attention to those areas without any present TV service, and to those communities that will be strictly on u.h.f.

The big question mark now, of course, is how many stations will be built and put on the air during 1952 and where will they be located?

Some indication of the number of stations that may go on the air during 1952-53 may be gained from a review of the information contained in a report issued recently by the RTMA about the findings of its "task force" committee which has been studying the effect of the lifting of the station construction freeze on the national defense program.

Material requirements for transmitters, studio equipment, and antennas through the middle of 1953 can be met from manufacturers' inventories and current allocations of materials without asking for increased allocations. The report indicates there are 28 TV transmitters already delivered to prospective broadcasters, 20 in manufacturers' stock, and 154 in process, for which materials are assured.

The committee reported that on a "realistic schedule" construction permits for 140 new television stations would be issued by the Federal Communications Commission by the end of 1952 and 190 more by the end of 1953. It was estimated that half of these would be for u.h.f. transmitters, and the remainder for v.h.f.

The prediction was made that 22 new v.h.f. stations, but no u.h.f. stations would go on the air during 1952, 21 of them in cities not now served with television. During 1953, according to the committee, 171 new stations would go on the air with 64 in the ultra-high-frequency range.

Using both "optimistic and pessimistic" projections, the committee estimated that consumer demand for television receivers would be increased between 750,000 and 1,660,000 sets in the second half of 1952 and the first half of 1953 by the lifting of the "freeze."

According to the report of the RTMA "task force" committee, 48 finished television transmitters are available for immediate installation—28 already delivered to prospective telecasters and 20 in manufacturers' stock. Of these 48 available transmitters, they expect 22 to be on the air by the end of 1952. Twenty-one of these transmitters will be operating in cities not now served by television. Since these are all v.h.f. transmitters this means that 21 new areas of opportunity for television servicing businesses will open up during the latter half of 1952 with the initial requirements for installations to receive a channel in the present range. But, since there probably will be u.h.f. channels assigned to these new video areas, prospective set purchasers will have to be convinced that their new receivers will bring in u.h.f. programs when they are available.

New Service Business Opportunities

It is the considered opinion of the editors of this department that the renewal of television station construction with the addition of 70 channels in the ultra-high-frequency region of the spectrum will mark the beginning of a new era in radio-television service as a business activity. It has been proved that good, reliable service is the very keystone of good television reception. Television set owners have demonstrated that they do not want cheap service—they want dependable, reliable service. They will willingly pay the price for this good service if they know what they are buying and can be shown that it is worth what they are paying for it.

Hundreds of independent television servicing contractors and many receiver retailers have proved through the success of their own businesses that reliable, competent television service can be given to set owners. They have also shown through the success of their own businesses that this kind of service can be given at a profit. But in all cases, these successful service businesses have been managed as *businesses* and not as *technical laboratories.*

Consumer television service in these new areas will be greatly benefited by the experience of seasoned, successful service businesses in present telecasting areas. Some radio service operators in these new video regions will be able to expand their businesses to become successful television installation and service contractors. But the majority of one-man radio service shops will find the television service business very complex and very confusing. Radio technicians in these new TV areas will do well to carefully study the six basic features of television service as a business as they were outlined for members of the Philadelphia TV Contractors Association by Paul V. Forte, their executive secretary:

1. "Television, consisting of an integrated group of complex electronic circuits, requires considerably more test equipment than radio. Such equipment is costly and far beyond the financial resources of the old-time radio mechanic. In addition, it is delicate, sensitive and in some instances, bulky—it can't be trundled from home to home on service calls. It must be intelligently installed on a bench in a shop where it can be effectively used. That means you have to have a *service shop.*

2. "In order to handle service calls on television you have to have a panel

truck or specially fitted car. In it must be carried a supply of tools, equipment, and spare parts that are in most common need. When a TV set can't be repaired with these facilities, the car or truck must be suited so that a chassis and/or cabinet can be brought back to the shop for bench work. Such vehicles cost money and represent another investment on the part of the service contractor.

3. "Since there are, roughly, about eighty different makes of television receivers and thousands of models, the effectively-operating contractor must have a complete library of diagrams, schematics, and service notes. These things cost money, and taking care of them, adding to them, and using them costs time and money. Without them no man can claim that he is ready to service television.

4. "A service operator cannot function properly unless he has records of all service calls. These are not things he keeps in his mind or in his wallet. He's got to have files and forms and he's got to have somebody work on them to keep them up to date. That means he has to have an office and someone in it to handle service requests and to dispatch them properly, and promptly. These things cost money, a cost that cannot be borne by one man working alone.

5. "He must have special equipment and facilities for installations which include the erection of antennas. This, definitely, requires a truck. Yes, he can contract the antenna installation to someone else but that is hardly a good way of conducting a business. Trucks, too, cost money and are an integral part of the investment that must be put into a television service operation, as well as into the cost of service.

6. "Since he is dealing with expensive equipment in the customer's home, he has to carry Public Liability and Property Damage insurance. He has to carry other insurance on his vehicles, test equipment, parts stock, and other facilities. It costs more money!"

Since most television contracts, installation, and service work originate with the dealer who sells the receiver, the set dealer's requirements are usually the governing factor in what service company gets the business for his customers. Where antenna installations are involved, the average dealer will give his business to the service contractor who has complete facilities for installation and service. It is doubtful whether these new TV areas will witness the frenzied boom in receiver sales that marked the early days of TV in major centers, when television installation and service contracts were dished out to service operators without any regard to their ability to fulfill the long term contract commitments for service.

Future of Radio Service

A recent report from RTMA revealed some interesting statistics on

radio receiver production. The report showed that the production of home sets has dropped consistently since 1947, with the exception of 1950, as a per-cent of the total radio output. In 1947, 14,082,662 home radio units were manufactured, accounting for 70 per-cent of total production, while in 1951 only 6,751,452 units were produced or 53 per-cent of the output.

An interesting feature of this report is in the growth of automobile set production from 3,459,061 in 1947 to 4,542,920 in 1951. Auto set production rose from 17 per-cent of the total radio output in 1947 to 36 per-cent in 1951.

The effects of the constantly dropping production of home radio receivers on the future of radio servicing may be interpreted in two ways. It definitely indicates a sagging interest in radio for home entertainment. No doubt the AM radios are still used in most TV homes but since the entertainment interest is primarily centered in television there is a tendency to hang onto the old radio receivers and not trade them in on new models. This situation would indicate a larger market for service on AM radios as age and use take their toll in tubes and component parts.

On the other hand, if the dropping interest in home radios means that AM radio listening has been practically abandoned in a large percentage of TV homes, then the market for service on conventional radios is gradually drying up. This would presage a rather dismal future for businesses that specialize in home radio service.

Association Developments

Last January, when the city fathers of Sheboygan, Wis., were contemplating a city ordinance and licensing bill to control the television service business in that city, Bob Mullen, the only NARDA member in Sheboygan, appealed to the Association's Chicago headquarters to have them present the CTIS (Certified Television Installation and Service) program to the council to avert the passage of the bill.

A group of Sheboygan dealers joined forces to adopt the CTIS program and to prepare a cooperative advertising program to bring the merits of the program to the attention of the public.

Two weeks later their newspapers carried an ad reading: "Look, Mr. and Mrs. Sheboygan, Can You Afford an Accident? Remember, when you hire a sideline operator to erect your TV antenna, he may not be carrying adequate protection for you. *You are the employer* when you hire someone to work on your premises, and if injuries or loss of life result, *you are liable!* . . . CTIS dealers carry the insurance necessary to protect you as a customer. For your protection, insist on Certified Television Installation and Service."

Included in the same ad—indicating a major victory—this appeared: "In cooperation with the City Inspection Department and City Electrical Department."

Now the Sheboygan dealers plan to

extend CTIS throughout their county to clean up and/or avoid any undesirable TV practices.

New Middlesex County, New Jersey, Association

The Television Technicians Association of Middlesex County, New Jersey, is looking for an alignment with a State or National Association of technicians. This recently organized group is composed of 75 members all of whom are actively engaged in television service. Contacts with other organizations are being handled by Ray Viglioni of *Ray's Television,* 276 Washington Street, Perth Amboy, N. J.

Hawaiian Group to Form Association

Radio technicians in the Honolulu area are forming a service association and want information from other associations about activity programs that will be useful in their organization. E. A. Piety of *Puuloa Sales and Service,* whose address is CHA 3, Honolulu 18, T. H., is contacting associations for information.

New Pittsburgh, Pa., TV Service Association

The Television Service Association (Tri State Area) was recently organized in Pittsburgh, Pa., with Robert Laneve of *Pittsburgh Radio, Sound and Television Labs* as its first president. Other officers elected to serve with Mr. Laneve are: Milton J. Reich of *Allegheny Television, Inc.,* as vice-president; Thomas Ulrich of *Penn Television,* as secretary; and L. C. Reed of *Moree Television Service* as treasurer. Penny Martin, public relations counsellor, was selected for the post of executive secretary.

The first edition of the TSA's monthly Newsletter is one of the most effective association bulletins that has come to the attention of the editors of this department.

The association's address is: Penny Martin, Executive Secretary, Television Service Association, 414 Bessemer Building, 104 Sixth Avenue, Pittsburgh, Pa. —30—

HAM CONVENTION

The twenty-second annual ARRL West Gulf Division Convention, sponsored by the Gulf Radio Club, will be held at the Robert Driscoll Hotel in Corpus Christi, Texas, on June 28th and 29th.

There will be a pre-convention get-together on Friday evening at the K.C. Hall for those who arrive early.

The committee has planned an interesting program which includes talks, contests, special group meetings, a dance, and a banquet.

FCC ham examinations will be given on Saturday morning for those who wish to get started with a new license or advance to a higher grade.

Special activities, including a style show, a tea, and a boat ride, have been planned for the XYL's.

Registration for the convention is $8.00 per person. Pre-registration and requests for reservations should be sent to the Gulf Radio Club, P.O. Box 2073, Corpus Christi, Texas.

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Interpreting TV Patterns

(*Continued from page* 61)

defective. They may perform satisfactorily in another receiver of the same model. Other remedies include adjusting the drive control (an eighth to a quarter of a turn of the drive control may eliminate Barkhausen interference effects in the picture), horizontal width, or horizontal linearity. When substituting pulse amplifier tubes, the drive control should be readjusted after each substitution. When the methods previously described fail to eliminate this interference, an ion trap magnet may be placed over the top of the 6BG6 tube and rotated for satisfactory results. If all methods fail, then an anti-Barkhausen 6BG6 tube should be obtained. Anti-Barkhausen 6BG6 tubes are produced by various tube manufacturers and are currently available.

Fig. 6 represents improper distribution of the picture in the horizontal direction. This condition is generally due to improper adjustment of the horizontal linearity control. The proper adjustment procedure for correctly setting the linearity control is to first adjust the drive control properly and then set the horizontal size control until the picture fills the screen horizontally. Adjust the horizontal linearity control until the best possible horizontal distribution is obtained. If reasonable linearity is not obtained, readjust the drive and linearity controls for the best compromise.

If the linearity control does not respond to adjustment or has very little effect, check the damper and pulse amplifier tubes, the linearity coil itself, the condenser in parallel (C_{106}) and the boost or boot-strap electrolytic (C_{115} in Fig. 8). This condition may also be due to magnetic influences either compressing or pulling the sides of the picture. Check for foreign material such as iron hardware on the ion trap or on the focus magnet.

The most common cause for drive bars appearing as shown in Fig. 9 is the misadjustment of the horizontal drive control. The drive control varies the amount of drive voltage to the grid of the pulse amplifier tube and is therefore a critical adjustment. An incorrect adjustment may damage the pulse amplifier tube and/or the horizontal output and high voltage transformer. The drive control should be adjusted in the following manner: adjust size until picture fills the screen horizontally, and the linearity control for the best possible horizontal distribution. Turn drive control until a drive bar or foldover appears in the center or left portion of the picture. Turn the control in the opposite direction until all traces of the drive bar disappear and then turn the control an additional one-eighth or one-quarter turn. This will compensate for various circuit conditions and line voltage fluctuations. An increase in line voltage may produce a slight reappearance of horizontal drive bars. A simple method of checking the drive control adjustment consists of rotating the brightness control from maximum to minimum while observing the face of the picture tube. If the drive control is adjusted properly the drive bar will not reappear.

If the drive control fails to respond to adjustment, check the pulse amplifier tube, the drive control itself (C_{109} in Fig. 8), the condenser in parallel (C_{111}) and other components such as L_{26}, C_{106}, R_{98}, and C_{113}. Also check the oscillator plate load resistor (R_{92} in Fig. 7). Voltage measurements may help to quickly determine the defective component. However, the following simple facts should be kept in mind during voltage measurements. Voltage readings specified by receiver manufacturers are correct only under certain conditions. Such conditions as line voltage, signal and no-signal operation, control settings, and the internal resistance of the voltmeter will affect the readings obtained.

The condition illustrated in Fig. 10 is usually caused by a weak or defective damper tube. Complete failure of the damper tube may result in a loss of the raster. Check the damper tube, boot-strap electrolytic (C_{115} in Fig. 8) for open, and continuity of deflection transformer leads to the terminals and linearity coil. Also check condenser C_{106}.

A loss of the raster or the complaint of no brightness on the face of the picture tube is best analyzed in the following manner: First determine whether the sound is functioning normally. A "no raster-no sound" condition can generally be traced to the low-voltage power supply. If the sound is normal then proceed to check or measure the second anode or high voltage. If the high voltage is normal the trouble is probably due to one of the following defects: ion trap magnet incorrectly positioned, yoke plug not in place or loose, broken or loose CRT socket, defective brightness control circuit, or a defective picture tube. If, however, there is insufficient or no high voltage, check the high voltage rectifier, pulse amplifier, damper and horizontal oscillator tubes. If tube substitutions do not correct the "no raster" condition, measure the drive voltage. This measurement will determine whether the horizontal oscillator is functioning normally. If an incorrect drive voltage reading is obtained, check for defective oscillator components by means of a scope or voltmeter. If a correct reading is obtained check between the grid of the pulse amplifier tube and the output of the high voltage rectifier for defects.

The condition of poor focus as illustrated in Fig. 11 is generally caused by improper adjustment of the focusing control. Similar conditions may be due to a defective high voltage rectifier or pulse amplifier tube, gassy damper tube or picture tube, astigmatic picture tube, partially shorted

high voltage condenser, defective H.V. deflection transformer, leaky drive trimmer, arcing in yoke, open CRT first anode, low "B+", line voltage change or a defective or weak focus magnet. If a magnet is used to provide focusing, a non-magnetic tool should be used for the adjustment (brass or stainless steel). Magnetic material will alter the flux density of the focusing assembly and a correct adjustment cannot be obtained. If the adjustment does not provide proper focusing across the entire picture, substitute focus magnets or deflection yokes or remove the ion trap magnet and replace after an 180 degree rotation. Readjust the focusing control until the best average focus is obtained. If a focus concentration is at the center only, reduce the flux gauss to the tube; if only at the edges, increase the flux for balanced distribution.

Fig. 12 illustrates a miscentered and improperly aligned picture. This is generally due to a misadjusted centering control and a tilted yoke. Loosen the wing nut or yoke supporting brackets and rotate the yoke clockwise or counterclockwise until either the sides of the picture are vertical or the top or bottom is horizontal. Properly recenter the picture and the shadow should disappear. If the shadow remains, check the forward position of the deflection yoke and the ion trap magnet setting. The yoke should be as far forward as the shape of the picture tube will allow. The ion trap magnet should be positioned until maximum illumination and minimum tube shadow are obtained. Many receiver manufacturers supply a limited amount of d.c. current through the horizontal winding of the deflection yoke. This d.c. current compensates for circuit differences and moves the entire picture to the left or right depending on the direction of the current. This arrangement provides proper centering without tube shadow. If tube shadow persists after the above adjustments prove unsuccessful, check the circuit supplying the d.c. current through the yoke. —30—

FCC AMENDS HAM RULES

THE FCC has announced that effective April 1, 1952 Section 12.111 (a) (4) has been amended as follows:

The former frequency band of 14,000 to 14,400 kc. has been reduced by 50 kc. and is now 14,000 to 14,350 kc. The entire new band is open to A1 type emission. A3 emission and narrow band frequency or phase modulation may be used on frequencies from 14,200 to 14,300 kc. by stations licensed to amateurs holding an Amateur Extra Class or Advanced Class license, only when operated and controlled by an operator holding one of these classes of license.

Effective May 1, 1952 the new frequency band from 21,000 to 21,450 kc. will be opened to amateur operation using type A1 emission only. Operation on this band will be open to any amateur holding a valid operator's license, except those of the Novice or Technician Class. —30—

Crystal Diodes

(*Continued from page 47*)

pulses of equal amplitude and 180 degree phase difference. These are applied to the germanium diode crystals acting as a horizontal phase detector and frequency comparator for comparison with the saw-tooth pulses of the horizontal deflection system. Any difference in phase or frequency permits a small correction bias to be applied to the horizontal oscillator to maintain the correct horizontal frequency.

Field experience has shown that differences in the forward and back characteristics of the germanium crystals used has little effect upon their performance in this circuit. Any pair of diodes would provide satisfactory performance. The load resistances are low in comparison to the back resistance for any voltage likely to be encountered. The substitution of the germanium diodes for the 6AL5 provides more stable operation, more exact circuit balance, and complete freedom from hum difficulties.

Automatic Gain Control

The a.g.c. regulates the gain of the r.f. and the video i.f. amplifier to maintain the same peak amplitude of signal input to the video detector. The a.g.c. operates on strong, medium, and weak signals, but it has no effect on very weak signals. The gain of the r.f. and i.f. amplifiers is controlled by varying the negative grid bias for some or all the tubes in these amplifiers. The controlling voltages are provided by the a.g.c. system.

This system furnishes negative bias voltages ranging up to about —15 volts, for controlling the gain of the r.f. and video i.f. amplifiers. The magnitude of the control bias voltage depends upon the amplitude of the video signal fed to the a.g.c. circuit. The input signal for the a.g.c. system is usually obtained from the video amplifier.

Fig. 5 shows a typical direct-coupled a.g.c. circuit which develops a d.c. voltage proportional to the peak amplitude of the video signal. When this voltage is applied to the r.f. and i.f. stages of the receiver it helps to maintain essentially constant picture contrast, regardless of normal changes in carrier level, by virtue of its automatic gain control feature.

The a.g.c. bias is made to vary with settings of the contrast control. The output of the video detector increases as the gain of the video amplifier is increased, and decreases as the gain of the video amplifier is reduced; this effectively increases the range of the contrast control.

The a.g.c. detector component is a germanium diode crystal CR_1; the anode is direct coupled to the video amplifier output. The diode acts as a peak rectifier of the video signal and conducts only during the sync interval. A positive d.c. voltage proportional to the peak amplitude of the sync pulse is produced across the diode load resistor. This voltage is filtered through an RC network and applied to the grid of the a.g.c. amplifier pentode V_2. The degree of control afforded by the circuit may be increased by reducing the value of the isolating resistor at the cathode of the a.g.c. detector diode.

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TV IN SCOTLAND

A NEW British television station was opened in mid-March linking Scotland with London and providing the longest television relay system in Europe.

The new station is situated at Kirk o'Shotts, midway between Glasgow and Edinburgh and is designed to provide television service over a wide area in Scotland.

At first the service will be on an experimental basis since only the medium power transmitters are in use. When the high-power transmitters are put into operation later in the year, the potential audience for the station will reach 4,000,000. British television will then extend to a total of 70 percent of the country's population.

Under the present set-up, programs can be transmitted in both directions over all three sections of the network. The net uses coaxial cable, narrow-band coaxial cable, and, finally, microwaves.

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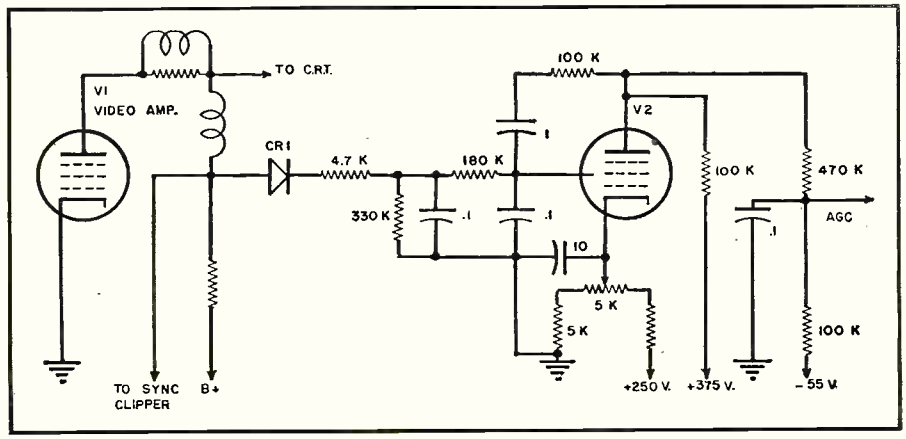
Fig. 5. Circuit of an a.g.c. peak detector and amplifier. CR_1 may be either a 1N34 or 1N48 type crystal diode. V_1 is the video amplifier, V_2 the a.g.c. amplifier tube.



—or so it seems—keeps me standing around for an hour or so while he putters around doing a lot of things that could just as well be done later. If he would just take five minutes to give me his order, I could be out of his way and on the road; but instead of doing that, he makes phone calls, works on sets, and so on while I stand around chewing my pencil."

"How about the guy who returns about five times as many 'faulty' parts as anyone else?" Dick wanted to know. "Some of these birds even insist on returning tubes with burned out filaments. Art and I both want to have parts returned when there is really something wrong with them; but it begins to look like a racket when one or two technicians seem to get about eighty per-cent of these bad parts."

"Yeah, and he's got a twin who orders the wrong parts and then tries to blame this mistake on the salesman," Art said. "Another cute little trick of his is to order new equipment, which he does not have the remotest idea of buying, just to see what it looks like; then he refuses to take it. The same lazy bird will not make the simplest of repairs on an item, say a booster, that is still in guarantee, but insists on returning it to the manufacturer. We'd be more than willing to furnish any parts needed rather than go to the trouble and expense of having to box up the booster and return it, and I should think the technician would rather perform the simple operation of replacing a rectifier or adjusting a thermal switch rather than deprive his customer or himself of the use of the booster for a month to six weeks."

"The Chiseler is another salesman's curse," Dick interrupted. "He is the sort who is always saying, 'I'd really like to buy from you, but I can get things so much cheaper from Blank Company that I just can't afford to.' He's always trying to beat down your prices by saying that he can buy it at such-and-such a price from your competitor, but he never comes up with any price sheets or receipted bills to prove what he says."

"Hold it!" Mac broke in. "Your *Cokes* are getting warm while you talk, and so are you. While you two catch up with the rest of us, I'll point out a few things technicians wish salesmen wouldn't do:

"Number One is to carry tales from one shop to another. I like to hear how service business in general is going over the area, but I certainly do not want a salesman coming in here and telling me how many sets one of my competitors is getting back, what a sloppy workman he is, how slow he is about paying his bills, and so on, for this merely convinces me that the salesman will be tattling my affairs at the next shop on his list. By the same token, I don't want to hear him

knocking other salesmen, or the companies they represent. You'd think by now everyone had learned the wisdom of that hoary old adage about not knocking your competition, but some parts salesmen still refuse to practice it.

"Another fellow I can't stand is the one who butts into conversations between me and my customers. Almost as bad is the salesman who hangs around and wants to chat when I'm covered up with work. I'm glad to chew the fat with you fellows when I have the time, for you give me a lot of information about new products that are just out, what items are becoming hard to get, what TV antennas are moving fastest in this area, and so on; but both of you have the good sense to get your order and be on your way when you see I'm really busy.

"Still another salesman who rubs me the wrong way is the one who tries to high-pressure me into stocking up heavily on items I do not want and do not need in large quantities—and no amount of hinting about what large quantities of this item a competitor has ordered will make me change my mind! The same salesman who is so eager to load me up with the stuff he has in over-supply is the one who shows no interest whatsoever in helping me get hold of a badly-needed part that he does not happen to have in stock.

"Finally, it gripes me to have a salesman arrive just as I am going out for lunch or am locking up for the day."

"Well," Dick commented as Mac paused, "all three of us seem to have pretty well got our pet peeves off our respective chests. Now I'm wondering, Mac, if you have any concrete suggestions about what Art and I can do to make things better."

"Suppose first you tell me how life can be beautiful for salesmen," Mac countered.

"That's easy: try to have your orders made up pretty well in advance of our arrival. Order parts by manufacturer and part number, if at all possible; and if you can't do this, give all possible information on model and serial numbers, etc. When we come in, treat us like you would want to be treated. Try to look ahead and give us a little time to supply hard-to-get items instead of waiting until you have to have this article at once."

"And if you are running a small shop, try to place the majority of your orders with two or three concerns instead of half a dozen or so," Art added. "That way your business will be worth-while to the two or three salesmen who call on you, and they will feel like doing their best to keep that business. When your buying is divided into too many parts, none of these parts is worth much effort to the salesmen and, on top of that, you will have that many more salesmen taking up your time."

"And don't make a collector out of the salesman by paying your bill to

him," Dick said. "Send your check in to the company the first of the month. When a salesman has to do the collecting, it upsets the kind of relationship that ought to exist between the salesman and the shop-owner—especially when the shop-owner gets a little behind on his bills!"

"Don't expect the parts salesman to be a consulting engineer on your tough sets. Most of us do not have much of a technical background, and even if we did we could not roll up our sleeves and wade into the service bench at every shop where we stopped," Art cautioned.

"Fine!" Mac said. "That is exactly the kind of material I wanted. And now both of you can jot down these points in your memory book: I want you to bring me all of the promotional material you receive on new electronic equipment as soon as you receive it. If you want me to fix up my orders correctly, make it easy for me to do this. Those special carbon-backed order blanks Dick leaves with me, and the copy of the latest edition of *'Radio's Master'* that Art's company gave me are examples of what I mean.

"I'll appreciate your tipping me off when you see that a popular item is becoming scarce so that I can order that article somewhat in advance of my immediate needs. I also expect you fellows to help me get hold of an occasional special item that I may need even though you do not stock it at the time. If I take your advice and give all my business to you two fellows, I expect, in return, that you will take care of me when parts are scarce."

"Well," Dick commented as he looked out at the sun that suddenly broke through the clouds and was glistening on the wet streets, "it looks as though the atmosphere has been greatly cleared—both inside and out!"

"And remembering what the good man said about wasting his time," Art added as he slid from the bench, "we'd better be making tracks before he throws us out."

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SELF-OPENING PLIERS

By HUGH LINEBACK

BENDING a short piece of rubber tubing and slipping it over the handles of a pair of pliers gives a spring effect that keeps the jaws open until the handles are squeezed. The tubing also gives a better grip on the handles to prevent slipping.

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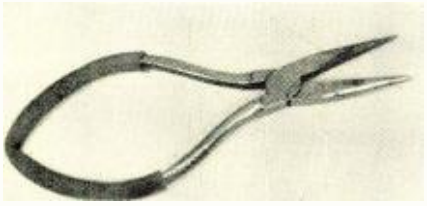
Speed service work with this tool tip.

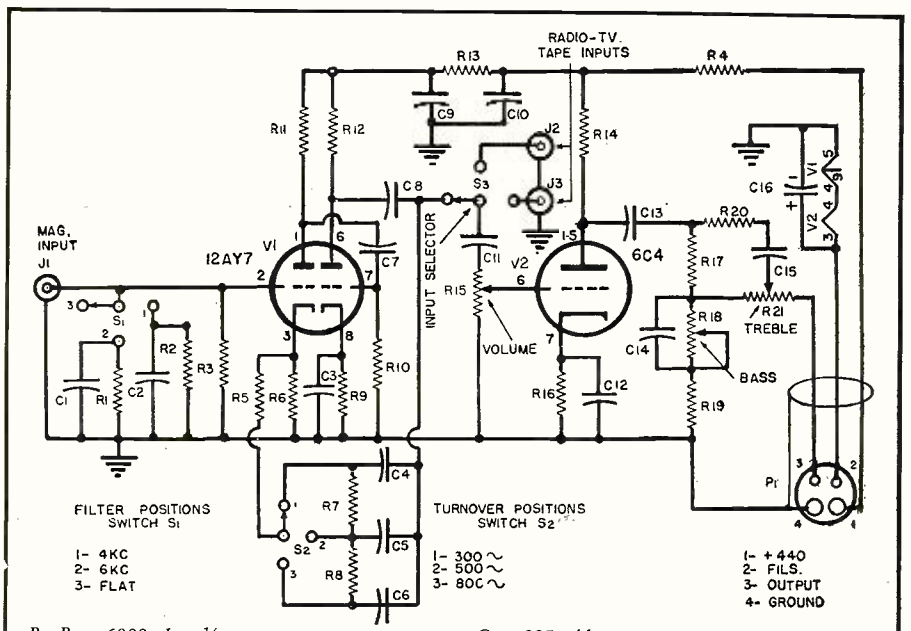


Front End Control Unit

(*Continued from page 41*)

used with other output stages provided that their quiescent current drain is at least 115 ma. For drains larger than about 130 ma. it will be necessary to shunt the heaters with a suitable resistor. For amplifiers that do not have the minimum output stage drain, but draw that much total current, the filaments can be wired in the center tap of the power transformer's high voltage winding. This will necessitate a floating ground, but difficulty can be avoided by heavily bypassing the heaters. The filter condensers should be returned to the center tap.

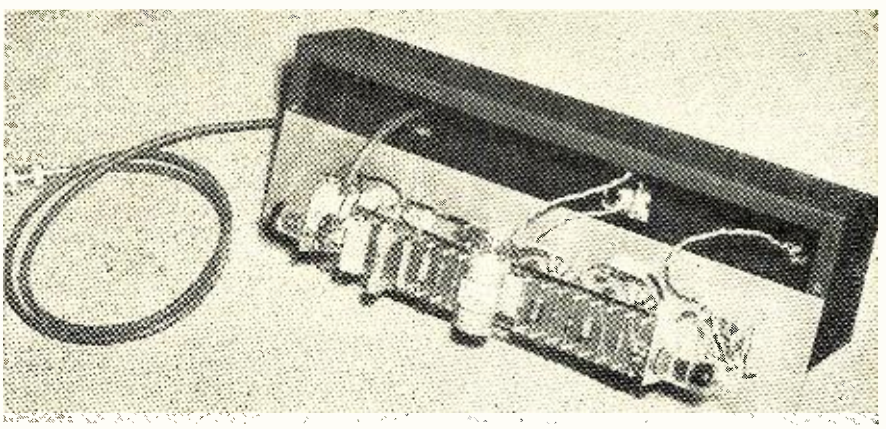
When the unit is placed in operation, the listener will immediately recognize the advantages of d.c. heater operation and use of wirewound resistors by the completely hum-free output and lack of noise. If the magnetic pickup introduces hum, the connections and shielding to the cartridge should be checked for ground loops and improper orientation of the turntable. Be sure that both sides of the a.c. line are bypassed to the amplifier chassis. A mechanical ground system that connects the pickup arm, motor frame, and all amplifier chassis to a water pipe will do much to eliminate any induced hum. Some turntables have proven themselves unfit for high



R_1, R_{19}—*6800 ohm, ½ w. res.*
R_2—*4700 ohm, ½ w. res.*
R_3—*27,000 ohm, ½ w. res.*
R_4—*47,000 ohm, 2 w. res.*
R_5, R_{17}—*100,000 ohm, ½ w. res.*
R_6, R_9, R_{16}—*2200 ohm, ½ w. wirewound res.*
R_7, R_8—*10 megohm, ½ w. res.*
R_{10}—*470,000 ohm, ½ w. res.*
R_{11}, R_{12}, R_{14}—*100,000 ohm, ½ w. wirewound res.*
R_{13}—*56,000 ohm, 1 w. res.*
R_{15}—*500,000 ohm linear taper pot.*
R_{18}—*1 megohm audio taper pot.*
R_{20}—*10,000 ohm, ½ w. res.*
R_{21}—*100,000 ohm linear taper pot.*
C_1—*.005 μfd., 400 v. cond.*
C_2—*.01 μfd., 400 v. cond.*
C_3, C_{12}—*25 μfd., 25 v. elec. cond.*
C_4—*.0035 μfd., 400 v. cond.*
C_5—*.002 μfd., 400 v. cond.*
C_6—*.0015 μfd., 400 v. cond.*
C_7—*.02 μfd., 600 v. cond.*
C_8, C_{11}, C_{13}, C_{14}—*.05 μfd., 600 v. cond.*
C_9, C_{10}—*20 μfd., 450 v. elec. cond.*
C_{15}—*150 μμfd. mica cond.*
C_{16}—*50 μfd., 50 v. elec. cond.*
S_1, S_2, S_3—*S.p. 3-pos. shorting-type rotary sw.*
J_1, J_2, J_3—*RCA-type phono jack*
V_1—*12AY7 tube*
V_2—*6C4 tube*

Fig. 9. Preamplifier with simplified filter and "boost only" bass and treble controls.

Fig. 10. Preamplifier with simple filter, built according to schematic of Fig. 9. An aluminum sub-assembly forms the basis for the mounting of resistor boards and tubes.



quality work. Even with their motors suspended 10" below the turntable, the magnetic field is still strong enough to cause hum. The solution is to replace the turntable unit with one of better quality.

There is wide latitude for satisfying individual preferences and applying recommended compensation in the finished unit. The turnover selector is set for the particular record in use, then the variable equalizers are adjusted to suit the listener's taste. Usually, the bass and treble will have to be boosted at lower volume levels and run flatter as the loudness increases. The treble control will compensate amply for any pre-emphasized recordings if the de-emphasis circuit is not used. Coincidental use of the scratch filter and the treble control will bring a balance between record noise and highs. The best procedure is to start with the treble flat and adjust the filter to the point where scratch is reduced noticeably. Then by advancing the treble until the scratch is just barely heard, the balance is effected and the maximum permissible amount of highs will be present without the annoyance of record noise. Use the filter with discretion and in the highest possible position.

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U.H.F. Conversion

(*Continued from page* 58)

the frequency of operation. Consequently, if the signal can be introduced to the first vacuum tube at a low frequency a better ratio can be obtained. Inasmuch as the signal output is so very low at the crystal mixer (and crystal mixing has not added a high noise level), the signal-to-noise ratio of the tuner is set by the first i.f. tube. A satisfactory ratio can be obtained because of the lower applied frequency. If an r.f. amplifier stage or vacuum tube mixer were employed it would be more difficult and more costly to obtain a comparable ratio because of the much higher signal frequency.

To summarize, a higher signal-to-noise ratio per cost factor can be obtained by introducing a lower frequency signal to the first vacuum tube circuit. Thus vacuum tube amplification or mixing in the u.h.f. range is not used. Instead, a low noise crystal mixer is used to reduce the signal frequency before it is introduced to the first vacuum tube circuit at a much lower frequency. To obtain the very best signal-to-noise relation with this system the i.f. stage must be designed with care to keep hum and noise level at a minimum. The new cascode type amplifier with its low noise content and effective shielding will be almost universal in u.h.f. converters.

Local oscillator radiation is not as trying a problem as in the v.h.f. band despite the absence of an r.f. amplifier stage. The crystal mixer in addition to its attenuation characteristic also requires much less local oscillator

excitation than a corresponding vacuum tube mixer. Furthermore there is a greater frequency separation between the signal and local oscillator frequency and the local oscillator component is not as likely to pass out through the frequency selective input circuits to the antenna.

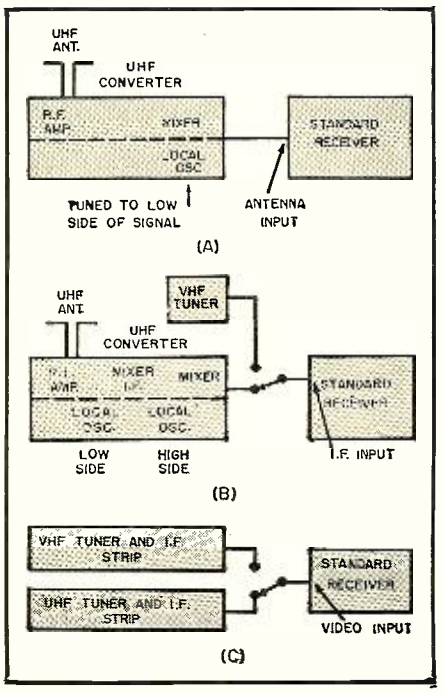
Output and Switching Systems

Output signal frequency of the u.h.f. converter will be in the channel frequency range of the present v.h.f. receiver so the converter is attached to the receiver in much the same way as we attach a booster today. The antenna or antennas are attached to the converter while the output of converter is applied to the antenna input terminals of v.h.f. receiver. The most common output frequency range will be over the Channel 5 and 6 spectrum with Channels 2-3 or Channels 12-13 output ranges a possibility for some few converters.

Two adjacent channels are chosen in order that in a given area converter output frequency can be set to whichever channel of two adjacents is unused. For example in New York with a Channel 5 station in operation, the converter output would be set on Channel 6; in Philadelphia, with a Channel 6 station in operation, the converter output would be set on Channel 5. The receiver is set on this predetermined channel whenever u.h.f. reception is desired.

A switch is included to switch the converter output to the receiver antenna terminals when u.h.f. reception is desired. At the same time, the u.h.f. antenna is attached to the input of the converter. The same switching arrangement removes the converter output from the v.h.f. receiver antenna terminals and applies the v.h.f. antenna system to these terminals for normal v.h.f. reception.

Fig. 9. Additional conversion possibilities.



Other possibilities for u.h.f. converters, Fig. 9, are to use an r.f. amplifier preceding the crystal or a vacuum tube mixer for more expensive types. Amplification in the u.h.f. range requires more critical design and expensive components and the problem at the moment is to reduce higher costs.

If more sensitivity, selectivity, and image rejection are desired, the second method is preferred. This system, using a double superhet technique, has a first mixer-oscillator that reduces the signal frequency into the 150-250 mc. range. The signal is then amplified in the selective multi-stage i.f. strip before presentation to a second mixer-oscillator. The output of the second mixer has the same frequency range as the low video channels (2-3) or the i.f. range of the v.h.f. receiver. For the latter arrangement, actual v.h.f.-u.h.f. switching would be done at the input of the i.f. strip of the v.h.f. receiver, keeping the v.h.f. and u.h.f. tuners separate from each other. This system might at first appear elaborate but with small component parts the unit can be mounted on a sub-chassis that can be attached to the main chassis of a v.h.f. receiver. A converter of this type was constructed by *RCA* and attached to their "Anniversary" model receivers for field checks.

Still another possibility would be to have a complete u.h.f. tuner and i.f. strip assembly and do the switching at the input to the receiver video amplifier. These latter two systems are likely to be common in factory-built combination v.h.f.-u.h.f. model receivers.

In the final article, we will discuss additional tuners, test equipment needed for u.h.f. work, and proper alignment procedures.

(*To be continued*)

A new and improved portable field telephone set has been developed by the Bell Telephone Laboratories for the Signal Corps. Basically, the new unit has been modeled after the new Bell System 500-set which has recently gone into production. The field set incorporates a number of special military features. It has a shaved earpiece end so it can fit comfortably beneath a battle helmet and a special "press to talk" switch that can be operated by a soldier wearing Arctic-type mitts.

CAN YOU PAY YOURSELF A SALARY?

By HAROLD J. ASHE

Is your service business providing you with an adequate return for capital and time invested?

THE self-critical radio-television service shop owner may very well ask himself whether, in fact, he is a success in his business. Self-esteem may dictate an affirmative answer even though an objective analysis might indicate a contrary conclusion.

While there are many ways in which business success may be evaluated there is one acid test that is paramount. This test is: can the shop owner pay himself a salary out of business earnings, and one commensurate with his value to the shop?

Few people are in business for their health, and service shop owners are no exception. There is not much point in taking on the heavy responsibilities of shop ownership unless there is an adequate financial reward. Nevertheless, there is considerable evidence that a large number of radio-television shop owners are *making less for their time than their highest paid employees.* This means they are making nothing on their capital investment.

How much should a radio service shop owner make to equal the wage or salary of his highest paid employee? If the shop owner's top employee is paid $60 for a 40-hour week, the hourly rate is $1.50. To be equally well compensated, the shop owner must pay himself an annual salary of between $5148 and $6177.60 for his time! And this will only put him on a par with his highest paid employee. This is not a typographical error. Yet, many radio service shop owners fail to net such a return for both personal services and capital, let alone for their services only plus an additional return on capital.

How is such a shop owner's salary arrived at? The thing to remember is that while the employee earns $60 for 40 hours service, the shop owner, on the other hand, devotes 60 to 72 hours or more a week to his business. He gets to the shop early and he leaves late. If he keeps the shop open one night a week, he is the one person most certain to put in a night shift. In addition, he is likely to spend nights in the shop going over his accounts and doing necessary paper work, taking physical inventory, etc.

So, assuming the shop owner values his time as being worth at least as much as his highest paid employee getting $60, he must pay himself far more than that. On a 66-hour week basis his salary should be $99. That's not all. Employees have certain fringe benefits in addition to their pay checks. The shop owner covers them with workmen's compensation, unemployment insurance, old-age social security and sometimes, life insurance policies, and may give yearly bonuses. These add real value to the pay check. Thus, another 10 per-cent should be added to the $99 to compensate for these other valuable considerations obtained by employees. This brings the shop owner's salary to $108.90 a week or at an annual rate of $5662.80.

This $5662.80 still does not provide any reward for the special management skills and responsibilities of the shop owner that distinguish him from even his most valued employee. Neither does it provide for a fair return on his capital. Nor does it give a margin to offset the risks peculiar to the business and which are inherent no matter how sound the management.

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Table 1. Owner's annual salary as compared with compensation paid to employees.

Highest Paid Employee's Salary (40-Hour Week)	Owner's Time Devoted to Business		
	60 Hours	66 Hours	72 Hours
$50.00	$4290.00	$4719.00	$5148.00
60.00	5148.00	5662.80	6177.60
70.00	6006.00	6606.60	7207.20
75.00	6435.00	7078.50	7722.00
80.00	6864.00	7550.40	8236.00
90.00	7722.00	8494.20	9266.40
100.00	8580.00	9438.00	10,896.00
125.00	10,725.00	11,797.50	12,870.00

NOTE: To the foregoing salary should be added an amount representing the fair value of the owner's services over and above the value of the highest paid employee. In addition, there is still an amount to be earned as a return on capital investment.

Small-Town Television

(*Continued from page 34*)

gally, technically, and financially qualified, and that operation of the proposed station would be in the public interest, convenience and necessity."

After application filing is closed, the FCC must then tackle the tremendous job of ruling on whom shall receive the coveted construction permits. In cities where there are more applications than available channels, hearings must be held to judge the best qualified applicant.

This, as you can guess, is an involved, legal proposition. To make matters worse, the FCC has only seven hearing examiners for the entire United States. This handful of already hard-pressed authorities must make these difficult rulings in addition to their normal work load.

Small wonder that the Commission has already warned applicants not to expect any whirlwind processing of their applications. In fact, George E. Sterling, a member of the FCC, has bluntly stated that " . . . even if we are in a position to process TV applications during April, May, and June, the number of grants we could hope to make within these three months with our present staff would be a small number. The applications will come in a flood—but the output will be but a trickle."

This is indeed another strange example of government economy in a period of unprecedented waste. Mr. Coy said he could only hope " . . . to be dramatically rescued through greatly increased appropriations."

Yet, despite this involved legal procedure, it can be safely assumed that new station owners, and especially those in small towns, will be moving ahead rapidly with plans for actually building their stations once permits have been granted. Fortunately a wealth of valuable information is available to the prospective owner as a guide to the design, construction, and programming of his station. Much of this is to be found in material prepared by equipment manufacturers and in experience reported in trade and technical journals.

This review by RADIO & TELEVISION NEWS is not intended as a substitute for all this information. It would undoubtedly take a shelf of books to begin to blueprint all the aspects of small-town television. More practical in this space is a summary of high points that will help to familiarize prospective station personnel, TV technicians, and studio crews with the vast scope of the operation in which they are about to take part.

The logical jumping off spot of any survey is in the area of equipment. For some time now, announcements have been made warning that equipment for new stations will be so scarce as to jeopardize actual construction plans.

Yet, in one of a series of exclusive interviews for this article, an official of *RCA* denied this situation.

He said, in part, " . . . availability of v.h.f. equipment offers no problem today. Most manufacturers can supply this in quantities sufficient to keep up with the number of new stations licensed by the FCC." He added, however, that " . . . u.h.f. equipment will probably be scarce this year, but the outlook is good beginning in 1953."

When one gets into the subject of station equipment, the first impression is that you've walked by mistake into a discussion of taxes or foreign loans. The talk all starts with five figures and generally moves up from there. There's no mistake, though. Television transmitting and studio equipment costs a lot—far more than either AM or FM gear ever did in their plushest times. Yet this is only relative to the size of revenue.

Manufacturers point out that the owner of a new station will actually find some costs lower and availability greater than he would have four years ago. This is true for several reasons.

Greater production of tubes, for example, has brought their cost down. What's more, the tubes of today give longer life at less cost of operation than did the early models. Circuits, too, are more stable and greatly improved. Lastly, the equipment is easier to operate, generally smaller in size, and thus easier to service. A 5 kw. v.h.f. transmitter cost $88,500 in 1949 whereas a 10 kw. model sells today for only $79,000.

Still many other specific items and services have gone up as much as 15 to 20 per-cent. Greatest increases will be found in towers, transmission lines, and studio equipment with physical costs connected with installation and construction varying with the section of the country.

Cost comparisons between v.h.f. and u.h.f. transmitters are rather difficult to make since u.h.f. gear is nowhere near full production. The v.h.f. transmitters have come down in price during their development and it is expected that u.h.f. gear will do the same. But for the time being, u.h.f. models cost more than v.h.f. units of comparable power.

Probably the greatest advantage a new station owner has today is the availability of commercially-built transmitters. In 1949, virtually all equipment was custom-made. That meant that the owner had to pay much higher prices for his equipment and even so faced frequent expensive readjustments.

Today *RCA,* as a typical manufacturer, offers a complete line of ready-made transmitters that includes seven different models. An owner can step up and buy outright a 500 watt, a 2 kw., 10 kw., 25/20 kw., and 50 kw. v.h.f. transmitter. In antennas, he can select turnstiles in combinations of 3-bay, 5-bay, and 12-bay.

The u.h.f. channel transmitters come in 1 kw. and 10 kw. with standard u.h.f. antennas. Power gains from 3 to 12 are provided and an owner can get effective radiated power up to 200 kw. on any channel from 2 to 83. These again are all standard items that can be selected to best serve the individual requirements of an owner.

As a gauge of costs, here is the price tag on some typical items of equipment—not including land, buildings, or supporting tower for antenna—for a typical small-town station. A 2 kw. v.h.f. transmitter putting out a radiated power of 10 kw. on Channels 2 or 3 is $44,200. A five-section superturnstile antenna for the same transmitter runs about $33,000. Eleven hundred feet of 3⅛-inch transmission line is $9200. Frequency and modulation monitors are $2900; film equipment (including two projectors, film camera, and control equipment) is $28,900. Audio-video equipment including sync generator, amplifiers, power supplies, etc., is $15,300; test and measuring equipment, $4000.

The total: $137,500. This again is basic transmitting equipment only for a station having just film or network operation. For a complete two camera-equipped studio, including switching facilities, monitors but not including lights, air conditioning, etc. add on another $65,585. Then if you are thinking about remote shows, better set aside another $27,765 for microwave and mobile units.

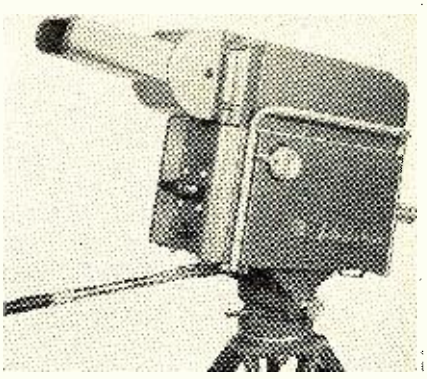
You're getting close to a quarter of a million dollars there—and it's still only a 2 kw. rig.

A 1 kw. u.h.f. transmitter putting out a radiated power of 20 kw. on Channels 14 to 83 starts at $64,700 for the transmitter and ends up with a bill for $145,200 covering the complete set-up, less, of course, cameras and other live pick-up gear.

Up in the big money brackets is a 10 kw. u.h.f. transmitter putting out 200 kw. radiated power on Channels 14 to 83. It comes to $230,500 for just the transmitting and monitoring apparatus without any studio equipment at all!

The requirements of every small-town owner will naturally call for different combinations of transmitters and antennas but the consulting services of all major manufacturers are available. Taking advantage of this professional skill in the early planning

RCA's new image orthicon TV camera.



stages will certainly save much time and money later on.

As a general rule of thumb, though, there are certain recommended minima that will meet the requirements of a small town. In terms of transmitter equipment, here are some suggested basics for carrying out film and network operations. (The manufacturers usually consider a TV studio as simply another signal source. Thus the studio arrangement can be planned entirely separately from the transmitting and film facilities.)

In each transmitter room, four major components will be found.

(1) Transmitter, including vestigial sideband filter, antenna diplexer, and dummy load.

(2) Rack equipment consisting of:

(a) Sound and visual frequency and modulation monitors as required by FCC.

(b) Synchronizing generator.

(c) The d.c. power supplies for operation of video amplifiers, master monitors, etc.

(d) Audio input equipment such as preamplifiers, limiting and monitoring amplifiers.

(e) Video input equipment such as stabilizing amplifiers, video jacks, monoscope camera, and test equipment.

(3) Audio-video control desk—designed to handle the switching and fading of six video signals and their corresponding audio counterparts.

An example of the progress made in station design is the unique "package" TV stations now available. These are actually entire TV stations which will go on the air with a minimum investment in equipment and technical manpower.

The unit sold by *RCA* is called the "Basic Buy" and includes all facilities necessary to handle TV shows received from the network with local station identification. In addition, local revenue is provided by having equipment that will take local shows and commercial announcements on films or slides.

The "Basic Buy" station includes these units, which again reflect the facilities that most small-town operators will need:

(1) A transmitter and an antenna.

(2) Monitoring equipment.

(3) Film and slide equipment.

(4) Monoscope camera (for reproducing a test pattern).

(5) Control console (one-man operated).

How much physical space is required to house a station is another question pertinent at this time. This element is obviously affected by your technical facilities but, in general, there are five things to consider when planning your station building. These are:

(1) Size and power of the transmitter.

(2) Particular floor arrangement of individual units.

(3) Space or clearance between units.

(4) Number of rooms desired.
(5) Plans for future expansion.

There is certainly much room for individual decisions in this area. Yet it is surprising just how little actual floor space is required for on-the-air operation. A 1 kw. u.h.f. station can be comfortably housed in one large room measuring 900 square feet. A typical floor plan permits the broadcaster to enclose the film projectors, multiplexer, and film camera if he desires, but this involves only a partition and not any additional space. The announcing studio may likewise be set off from the control room by the conventional booth arrangement.

A 10 kw. u.h.f. or v.h.f. station can be accommodated in about 1100 square feet, again with variations that include the separate announcing booth, engineering work shop, closed off film room, etc.

Designers retained by the major manufacturers have done considerable research into the subject of floor plans and suggested layouts down to the placement of each microphone, console, and chair are available as a guide. These can greatly assist a local station owner in simplifying his own building problems.

As indicated earlier, live studios can be considered apart from the transmitting room and so may actually be located in a different part of town. In some cases, it might be more economical to have the live-talent studio on another floor of the same building or merely as an extension of the transmitter and control room. In any case, it's well to repeat that studios can be added efficiently to a station set-up at any time.

There are, once again, certain minima that must be met. These include the following:

(1) Studio camera, control unit, and power supplies.
(2) Metal tripod, friction head, and dolly.
(3) Microphone boom stand.
(4) Rack containing power supplies.
(5) Microphone.

If more elaborate programming is planned or if the studio is remote from your control facilities, additional equipment will be needed. This includes more studio cameras, switching gear, and "on-the-air" monitor, audio consolette, sync generator, and turntables.

No discussion of small-town television is complete without something more than a nod in the direction of WTTV in Bloomington, Indiana—a town of 28,000 people. There the nation's first small-town TV station was founded in the fall of 1949 by Sarkes Tarzian, an enterprising local businessman and manufacturer.

For almost four years, this station has stood as the prototype of things to come in community TV. Bloomington still remains the smallest community in the U.S. to have a TV station.

Mr. Tarzian had to pioneer at every step of the way from building the

transmitter to programming the broadcast schedule. But his experiences have given prospective owners a vast amount of practical operating knowledge. One industry executive said that WTTV had literally saved small-town television five years of experimentation.

First of all, it is agreed that small-town television is commercially sound. After one year on the air, WTTV was "in the black"—certainly an encouraging note for all new owners. Then his novice crews, many totally inexperienced, showed how local personnel could be trained to present top quality shows.

Interested radio station owners and businessmen "bitten by the TV bug" have visited WTTV regularly for years now, studying every phase of its operation from sales to camera techniques and from script writing to transmitter maintenance. As a result, information that could be had only through trial-and-error is available to the entire industry.

Many improvisions made by Tarzian's staff prove that ingenuity can help offset some of the high costs of TV equipment. Bathroom fluorescent light fixtures and amateur photographic flood lamp reflectors double as studio lights; paper-maché hamburger meat cartons serve as sound proofing; a microphone boom was made from old pipe for $29.30, and a studio pick-up camera was actually built for $400 worth of parts!

On the other side of the ledger, Tarzian wanted to bring in network shows but was not in line with existing facilities. So he built, at a personal expense of $110,000, a two-tower radio relay network to pick up the signals from Cincinnati.

This, admittedly, is not the usual answer to the next problem before a new station owner, *i.e.,* his position in regards to the networks. In many cases, the contractual agreements between TV stations and the networks are patterned closely after those in radio. But other aspects of the relationship are very different.

If there is only one TV outlet in a city, it may, for example, carry programs of all four networks—*NBC, CBS, ABC,* and *Du Mont.* This arrangement generally finds the town's only TV station serving as a "primary affiliate" of one network. As such, the station agrees to carry a certain volume of commercial network programming. This is known as "network option" time.

Other than this time, the station can draw upon the schedule of other networks or use the time for himself, *i.e.,* as "local option" time. Obviously this permits even a small station to have some of the best fare available for its listeners.

Details of contracts between a network and any given primary affiliate are generally secret but they all call for the local outlet to give the network a specified discount from the card rate for time. It, in effect, sells its time to

the network which, in turn, bills the commercial sponsor at a figure above that cost for coverage in the area. Conversely, the network will offer sustaining shows to the station which can be broken into with local commercial spot announcements.

There are several methods of getting the network signals and these will vary according to local facilities. The most common way to bring in network programs is via the radio relay system as operated by *American Telephone & Telegraph Company.*

Through this system of beamed microwaves, the network shows are carried along "highways" made up of relay stations generally about 30 miles apart. Stations along the way can be hooked into the system via parabolic "dishes" that beam the microwaves to their transmitter towers.

This service is obtained by paying line charges to *AT&T* and not to the network. If a microwave link or coaxial cable line isn't available, a station may also construct a single relay on some high point and put in, at its own expense, an automatic relay. In this case, the station arranges to pick up the signal from a nearby station with network affiliations.

Thus the TV station in Grand Rapids, Michigan, gets its programs from WNBQ in Chicago which sells its services to Grand Rapids.

The third option is exercised if a station wants to build its own relay system (as was done by WTTV) or to order one as was done by WTMJ-TV in Milwaukee, Wisconsin. It has a seven-tower relay system bringing in all network shows from Chicago.

Officials of the Long Lines Department of the *AT&T* are quick to point out, however, that the relay networks which carry TV shows are not built for this purpose at all. They are first and foremost a means of carrying telephone communications.

For that reason, both coaxial cable and radio relay systems will, of necessity, follow the route of the heaviest load of telephone traffic. Because of the tremendous backlog of telephone equipment orders and the expense of putting in such relay nets, *AT&T* will undoubtedly not build lines to remote areas in the near future.

However, there are 86 TV stations in 46 cities now served by *AT&T* relay systems and this number will jump as soon as new routes are completed. A quick glance at the cost sheet of such equipment will show why expansion is generally limited. The coast-to-coast hook-up now in operation cost upwards of 40 million dollars.

What does this mean in terms of small town TV? Well, the picture isn't as bleak as it might seem. *AT&T* is rapidly extending its radio relay system which will bring programs to many new locations.

Also, a small station can effectively use kinescopes of network programs which was the basic means of presenting name shows on the West Coast for several years. These filmed versions

are quite adequate for anything except exceptionally timely material and the rapid transportation of kinescopes from source to station can help bridge this time gap.

It is apparent that the owner of a new TV station has, from the start, an eager viewing public. The nation is certainly sold on TV and will readily take to almost any program schedule. Even so, it is economically important that a concerted effort be made to build a substantial audience as soon as possible.

This is necessary in terms of revenue since rates charged for local and network programs reflect a careful analysis of the listener area. A sizable audience must be presented to the network before it will be interested in buying local time.

Unlike radio in its early days, television cannot afford a slow, gradual build up. In rapid succession, programming must be prepared that will cultivate a good, loyal audience. Since the original costs and operating charges connected with TV are so high, the outlay must be met rather quickly to bring about the sound development of the station.

Despite the huge investment involved, the TV industry admits that big money is there to be made—and in a comparatively short time. Most stations can look for a profit after the first year, officials indicate.

One of the secrets of this success lies in programming. The local station manager has within his power the ability to make or break a station. Program costs can easily skyrocket far out of proportion to the income derived if not carefully watched. That's why the industry looks to small town stations for an entirely new format for shows.

"There is no reason why small stations should put out big money for expensive variety shows," explained one network official. "A station with network affiliation can offer its audience some of the nation's finest dramatic and variety personalities.

"Why then should a local manager try to compete with these and waste his capital. It's far wiser—and much better programming sense—to develop shows that have an exclusive local appeal, ones that can't be done by anyone else. County fair coverage, for example, high school sports, band contests, county agriculture demonstrations and talks, local festivals . . . all are absolutely perfect for TV. The appeal of such programs is universal and balance wonderfully well with the more lavish but impersonal network shows."

Again, Bloomington's WTTV gives some concrete examples of this advice. "Meet Your Teacher" is one of their low budget shows that has an excellent following. "Call To Order" is a public service program that sets the style for this important type of presentation. The town's mayor is moderator and city officials come before the cameras to answer questions put

to them by representatives of church, social, and civic groups.

In the Quad City area of Rock Island, Moline, East Moline, Illinois and Davenport, Iowa, WHBF-TV has done an outstanding job in community program development. The staff of this enterprising station gained tremendous local prestige this spring when they carried the semi-finals and finals of the Illinois State Basketball Tournament direct from Champaign, Illinois.

The tourney play, by far the most popular state-wide sporting event of the winter, originated with a telecast by WENR-TV, Chicago. Since Champaign is on the St. Louis-to-Chicago coaxial cable, the program was carried to Chicago by direct line. Then, in Chicago, it was fed back via *AT&T* radio relay facilities to Rock Island and WHBF-TV.

The same "feed" technique was used for the Iowa-Illinois basketball games which were originated by WGN-TV in Chicago and put out on the radio relay link to Ames, Iowa, via Rock Island.

Another locally-produced show is one that utilizes the talents of the faculty and students from Augustana College. This is a forum-type program that demonstrates the excellent use that can be made of nearby colleges and universities as talent sources.

As this article has indicated, the development of small-town television will be neither easy, inexpensive, nor especially rapid. It's going to take much hard work and huge capital outlays to bring these community stations into being.

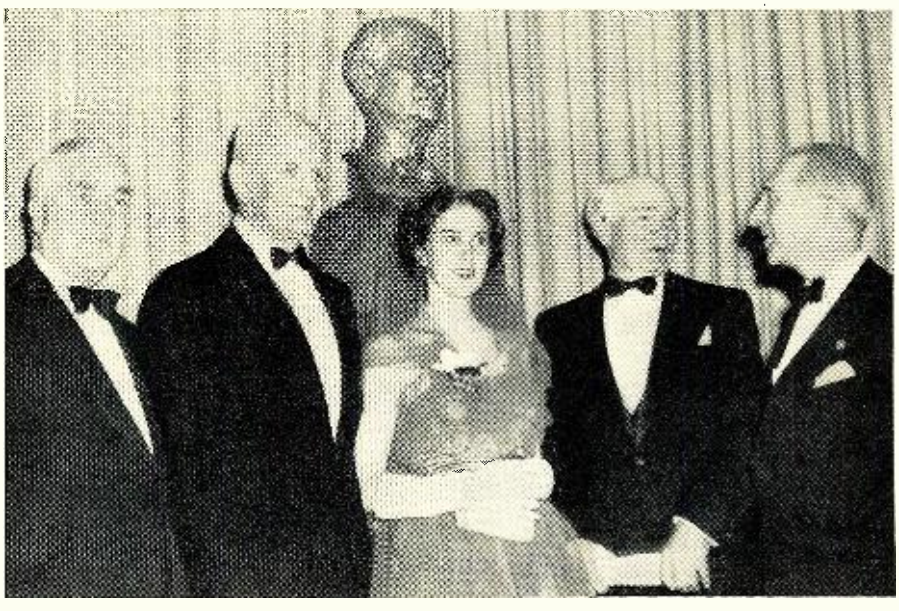
Yet it is an amazing tribute to the industry that there has been no shortage of willing backers or any lack of public support. The entire scope of the move is best appreciated when one considers several historical facts.

Radio broadcasting began in 1920 and today there are 2300 AM and 640 FM stations on the air. Television got underway only four years ago. Yet already it has a target of 2000 stations to be built and booming within another year or so!

No one can even begin to predict what impact this nation-wide system of video broadcasting will have on our national life. It is sufficient to note that the readers of this page will witness—and probably take an active part in—the greatest sweep of mass communications that this nation has ever seen or will be likely to be repeated in our lifetime.

—30—

The 45th anniversary of the invention of the 3-element vacuum tube and the 50th anniversary of its inventor's entrance into wireless telegraphy were celebrated recently at a testimonial dinner given in honor of Dr. Lee de Forest at the Waldorf-Astoria in New York. At the affair a bronze bust of Dr. de Forest was presented to Yale University, his Alma Mater. Many of the pioneers and leaders in radio and television were on hand to pay tribute to "The Father of Radio," and to hear former-Governor Charles Edison of New Jersey (who described himself as an "Edison Effect") and Rear Admiral Ellery W. Stone (both shown at the left) extol the past and present contributions of the 79-year-old inventor, who is at present at work on transistor improvements. Former President Herbert Hoover, one of the guest speakers at the dinner, ranked Dr. de Forest alongside of Faraday, Edison, Morse, and Bell as the "outstanding men of genius who have transformed the mysteries of science into those great inventions which have shaken civilization into new channels." In the early days of radio development, Dr. de Forest often used the pages of RADIO & TELEVISION NEWS (or "Radio Amateur News" as it was then called) to describe his new inventions. "The Audion and The Radio Amateur" was written by Dr. de Forest for this magazine in 1919, and is one of the first authoritative articles on the applications of triodes. Shown wih Dr. de Forest in the photograph (in addition to Mr. Edison and Admiral Stone) are Mrs. Catherine Allaben, and Frederic Allen Williams who sculptured the bust of Dr. de Forest.



International Short-Wave

(*Continued from page 94*)

Honduras—Radio Monserrat, HROW, 6.675, noted signing off 2304; fair level with some QRN, QSB. (Oestreich, Washington State) Soon should have (recorded) *English* announcements. (Serrano, Brazil)

Hong Kong—ZBW3, 9.525, is seldom heard but occasionally comes through shortly before 1031 sign-off. (Gay, Calif.)

India—Current schedules of *All-India Radio,* just received via airmail, are—To East and Southeast Asia, Australia, New Zealand 1930-2000, 15.290, 11.850; 2030-2200, 15.160, 17.740; 0200-0320, 21.700, 15.190; 0600-0815, 17.705, 15.190; 0830-0945, 17.705, 15.380. To Middle East, Central Europe, United Kingdom, Burma, Philippines 0200-0330, 21.700, 15.190; 0230-0330, 17.740, 15.160; 0600-0700, 17.705, 15.190; 0830-0945, 17.705, 15.380. To China, Japan (Sat., Sun. *only*) 0530-0600, 17.740, 15.160. To East and South Africa, Mauritius 2300-0010, 11.850, 9.670; 1045-1215, 11.710, 9.550. To West Indies 1830-1930, 15.290, 11.850, 9.720, 7.170. To Burma 1945-1955, 9.720, 7.170; 0615-0600, 17.740, 15.160. To China 0430-0545 (to *only* 0530 Sat., Sun.), 17.740, 15.160. To Indonesia 1745-1800, 11.790, 9.550; 0700-0730, 17.740, 15.160. To East and Southeast Asia 1930-2000, 15.290, 11.850; 2030-2200, 17.740, 15.160; 0200-0320, 21.700, 15.190; 0600-0815, 17.705, 15.190; 0830-0945, 17.705, 15.380. To Fijis 0200-0320, 21.700, 15.190. To West Pakistan 2230-2245, 11.710, 9.630, 7.290; 0945-1000, 5.960, 4.870. To Afghanistan 2215-2230, 7.290, 5.960; 0030-0130, 9.670, 7.170; Fri. *only* 0845-0930, 4.870; 1130-1230, 7.170, 5.990, 4.940. 3.945. To Persia, Afghanistan 1230-1330, 7.260, 7.170, 5.990, 4.940. To Saudi Arabia, Egypt, Lebanon, Syria, North Africa, Trans-Jordan, Sudan 2315-0015, 11.760, 9.720; 1230-1455, 7.125, 5.960. To Europe 1400-1515, 5.990, 9.720, 7.170; 0230-0330, 17.740, 15.160; 0830-0945, 17.705, 15.380. *English* news periods are listed 1400-1410, 9.720, 5.990, 7.170; 1930-1945, 11.850, 15.290; 2310-2320, 11.850, 9.670; 0300-0310, 17.740, 15.160; 0830-0840, 17.705, 15.380, and 1045-1055, 11.710, 9.550.

Bombay noted with news 2130 on 6.150, at 0300 on 9.550, at 0730 and 1030 on 4.840; Calcutta heard with news 2130 on 7.210, at 0730 on 6.010, at 1030 on 3.30 (Huntsman, Burma)

Indo-China (Vietnam) — Radio France-Asie, Saigon, tried 9.720 recently for a few days, then returned to 9.752A; noted 0930 with all announcements in French. (Rosenauer, Calif.) Heard on 11.924 with bi-lingual programs 0800-1030 (UNESCO news Tue. 1015-1025); news in French 1030-1040 when leaves air after "La Marseillaise." (Ridgeway, South Africa) Heard on measured 15.440 with news 0500. (Hutchins, Sanderson, Australia) Pearce, England, notes that the 11.920 and 9.752A channels vary in

sign-off between 1030-1100 now. The 11.920 outlet has news 0900, reports Rosenauer, Calif.

"The Voice of Vietnam," 7.089A, Saigon, noted 0830 with *English* session; news 0845, off 0900. (Ridgeway, South Africa, others)

Iran—Radio Tabriz, 6.090, sent letter by registered mail; said now broadcasts *English* lesson at 2045-2100 Teheran time (1245-1300 EST) on Mon., Wed., Sat. (Pearce, England)

Radio Teheran is again using EPB, 15.100, for news 1500; has news in Russian 1515. (Kary, Pa.)

Iraq—HNQ, 11.724A, Baghdad, was logged recently at fair to good level around 0445-0600; Arabic; had this one once around 1000 but with much QRM. The 11.724 outlet is now scheduled 2330-0100, 0430-0600, 0830-1500. (Radio Sweden) Heard 1415-1500 closedown with program in *English* called "A Date With Baghdad;" ended with Iraqi National Anthem. (Pearce, Catch, England)

Israel — 4X4EA, 6.728, is heard through bad CWQRM in parallel with 9.010A from 1300 onwards; not as good as latter channel; has news 1430-1445. (Ridgeway, South Africa) Tel-Aviv, 9.010A, now begins *English* session ("Voice of Zion") at 1615. (Robertson, Mass.) Usually closes around 1715. Pearce, England, says announces *English* for 0645 on 6.830.

4XB24, 8.170, Haifa, noted 1530 with news in native and music for local listeners. (Sanderson, Australia)

Italy—Rome has been noted on a *new* channel of 9.708A with *English* for North America daily 2145-2200; North American transmission begins 1900. (Baitzel, N. J.) Rome, 15.402, has fair to good level some days around 0430 with news in Italian at slow speed; woman announcer. (Saylor, Va.) Noted with news 0320 on 15.400A, 15.120; at 0435 was parallel on 11.905, 15.120, 15.400A with news in Italian at dictation speed. (Bellington, N. Y.) On Sundays, Rome, 11.905, has "Weekend Journal" in *English* 1400-1415. (Schroth, Mass.)

Rome heard 0615 on 15.400A; 1030 on 17.800; 1508 calling South Africa on 17.800; 9520 to 1545 sign-off on 15.400A; 15115 on 11.90, and 1900 on 9.780; all with *English* and at good level in Mass. (Golden) Noted on 11.905 with news 1400A. (Niblack, Ind.) Heard well on 9.57A ending news 1920. (Bishop, Ohio, others)

Italian Somaliland — Mogadishu, 7.380A, noted with good signal lately; signs on 1000 in Arabic; Italian at 1200 (Italian news 1225A); is heard to 1300 usually—but sometimes extends session to 1400 when leaves air with a lively tune in dance tempo; on extended schedule usually plays operatic records 1300-1400; some days is not heard at all. (Ridgeway, South Africa)

Jamaica—Radio Jamaica was noted recently on *measured* 12.056 at 1730 with special sports broadcast; signed off 1740; strong signal in Calif. (Ballou) Robertson, Mass., reports this

special broadcast as on approximately 11.950, heard from 1600.

Japan—The British Commonwealth Occupation Force outlet at Kure, 6.105, is now known as the *Britcom Base Broadcasting Station.* (Hutchins, Radio Australia)

Radio Japan noted to North America 0000-0100 over JOA3, 11.705 (announced JOB, 6.069, in parallel); includes news in *English,* commentary in *English,* Japanese classical music, news and commentary in Japanese; still asks for reception reports to International Broadcasting Section, Radio Japan, Tokyo, Japan. (McPhadden, Calif., others) JOB2, 11.705, and JOA2, 9.675, noted in transmission to Philippines, Indonesia 0900-1000; high level on 9.675 also 1030-1130 to India. (Ridgeway, South Africa)

Lebanon—Beirut, 8.036A, noted with *English* program opening 1002; at 0955 was in Arabic. (Pearce, England)

Liberia—ELBC, 6.028V, was recently *measured* on this channel at 1645 when had music; previous measurements were 6.023, 6.025. (Oskay, N. J.) Closes 1845. Noted at press time with *English* newscast 1815 (was on a Saturday, may not be daily (?).

Madagascar—Radio Tananarive sent schedule of 9.515, 6.172, 3.205, 1550 kc., in French daily 2230-0030, 0400-0600, 1000-1430, and Sundays 2300 (Sat. *EST*)-0245, 0330-0600, 0915-1430; on 7.374, 9.693 with Malgache daily 2230-0000, 0320-0530, 0900-1200, and Sundays at 2300 (Sat. *EST*)-0045, 0330-0530, 0900-1200. (Pearce, England)

Malaya—Radio Malaya, 4.825, Singapore, is again coming through with fine strength; has news 0900; should be parallel 7.200. (Rosenauer, Calif.) Heard on 6.135 at 0630 with news. (Sanderson, Australia)

BFEBS, 7.120, Singapore, noted 1120 with music to India-Pakistan; some QSB and CWQRM. (Flynn, Calif.) Has *replaced* 15.300 with 15.435, noted there 0900 with relay of "Radio Newsreel" from BBC; closed down on 15.435 at 0915, but re-opened at 1100 on 15.435 with news relay from BBC; at 1115 announced 17.755, 15.435, 11.955, 7.120; closed 1145 with "God Save the Queen." (Pearce, England; others) Noted on 9.69 at best level around 0930-1030; also heard on 15.435 and 11.955 at 0600-0915. (Boggs, Mo.)

The 15.435 channel noted in Calif. signing off 0827 with "God Save the Queen." (Winch)

Mexico—"La Voz de Mexico" (relaying XEX) has been noted evenings (*EST*) on 6.065; seems parallel 11.900; opens 0800A. (Stark, Texas) Cushen, N.Z. says *new* call of *Radio Morelia,* 6.030 is XESF; formerly was XEKW; heard signing off 2330 and asking for reports. (ISWC, London)

Monaco—Radio Monte Carlo, noted 1033-1037 with accordion music; 1043-1059 with popular music; announced "Ici Monte Carlo" at 1100; heard only at 0930. (Lane, Wyo.)

Mozambique — Lourenco Marques, 11.764A, noted around 0000 in *English.* (Lund, Iowa) Is again audible on West Coast, signing on week-days 2300. (Rosenauer, Calif.) The 31-m. channel used for *English* programs afternoons (*EST*) seems to have settled down on approximately 9.760; noted to 1600 when signs off after Ted Lewis' "Goodnight Song" and "A Portuguesa." (Boice, Conn., others) Noted Sundays signing off 1600. (Losee, N. Y.) Runs to 1700 Saturdays.

Heard with Portuguese on 15.287A around 1230; noted same day in Portuguese to 1630 sign-off on 9.635A. (Stark, Texas) Station lists CR7BG now as on 15.285. (Radio Sweden) The 4.932A channel is audible some days just prior to 1600 sign-off (1700 on Sats.). (Kary, Pa.) Parallels 9.760A. Pearce, England, flashes he now notes the 15.287A channel signing on in Portuguese 1100.

The 31-m. outlet for Portuguese programs is still "wandering"—more recently noted on 9.79A at 0012; at times is as high as 9.85A. (Bellington, N.Y.)

New Caledonia — *Radio Noumea,* 6.034, noted signing off 0530A with "La Marseillaise;" good level in Kansas. (Dary)

New Zealand — ZL10, 15.22, noted parallel with ZL4, 15.28, around 0100; good level; 15.28 is best; ZL3, 11.78, is at high level in the 1300-1545 session. (Ridgeway, South Africa) ZL3, 11.78, noted signing on 0200, usually at

good level. (Niblack, Ind.) ZL2, 9.54, beamed to Pacific, and ZL3, 11.78, beamed to Australia, are used parallel 0200-0545; ZL3 has best signal. (Stein, Calif.)

Nicaragua—Radio Mundial, 6.465A, announces call of YNWA. (Stark, Texas) Should sign-off 2400. Patterson, Ga., reports YNVP, 6.760, Managua, at 1750-1815. YNDG, Leon, has now moved again and seems settled down around 5.935; noted often evenings (*EST*) with native music, announcing "Radio Colonial." YNHB, 6.550, heard 2310-2343 identifying as "Radio Panamericana en Managua, Nicaragua, Centro America." (Machwart, Mich.)

Nigeria—Radio Nigeria, Lagos, is now *testing* on 4.990 at 1145-1700; on 6.100 at 0000-1115; asks for reports. (Radio Sweden, others) Still heard on 7.255 to 1715A closedown; usually has African music last 15 minutes; signs with "God Save the Queen." Normally takes relay of BBC's GOS from 1500-1700; news 1500. (Pearce, England)

North Korea—The North Koreans reported on 6.235A and 4.400A are constantly on the move; are hard to keep up with; heard mornings (*EST*). (Rosenauer, Calif., others)

Pakistan—Radio Pakistan, 15.620, Dacca, noted with news 0330-0340, 0340-0400 in native, then talk in *English,* followed by recordings to closedown 0430. (Pearce, England) Heard on 15.325 with news 2130; on 7.010 with news 1530. (Sanderson, Australia)

Panama—HOLA, 9.505, Colon, heard ending *English* session; starting another *English* period 2100. (Baitzel, N. J.) HORT, 6.030, noted 0700; HOJA, 9.645, heard with music 1800; HOQQ can now be heard evenings (*EST*) on 6.140, noted 2045-2120 with native music. (Machwart, Mich.) Measured 6.139 recently at 1925; is in clear since TGJA moved. (Oskay, N. J.)

Peru—OAX4T, 9.560A, Lima, noted good level 0750 and closing down 0800. (Ferguson, N. C.) This one heard to 2308, fair level but in QRN. (Oestreich, Washington State) OAX4X, 15.105A, Lima, noted 1841 with identification "Transmitiendo Radio El Sol desde Lima, Peru;" continued with native music; OAX1A, 6.157, Chiclayo, noted 2340-0013; OAX4G, 6.091, Lima, heard 2200. (Machwart, Mich.) OAX4Z, *Radio Nacional del Peru,* 5.887, Lima, sent QSL card, in Spanish. (Patterson, Ga.)

Philippines — DZH7, 9.73, Manila, noted regularly 1000 in *English.* (Gaylord, Washington State) Heard 1630-1645 in *English,* then Russian. (Flynn, Calif.) Pearce, England, notes DZH8, 15.300, strong 1015; DZH7, 9.730, at 1120; and DZH9, 11.85A to closedown.

DZH3, 9.500, noted 0430 with musical session. (Sanderson, Australia)

Poland—Radio Warsaw noted with *English* for North America on 15.120 at 0715-0800. (Mast, N. Y., others) Announces other *English* periods for North America currently as 1700-1800, 11.740; 1930-2000, 9.570; 2315-2345, 0030-0100, 7.205. (Kary, Pa.)

Pablo Acquerino, native musician, plays the one-stringed "Eng-Eng," which he constructed himself. His music is heard on the "Call of the Orient" broadcasts which originate over the facilities of the Far East Broadcasting Company in Manila, P. I.

Portugal — CSA38, 6.360, Lisbon, noted recently to 1900 sign-off; closed with clock striking and "A Portuguesa;" all-Portuguese. (Ferguson, N. C.)

Portuguese India — WRH reports *Radio Goa* now on the air 2030 (Sat. from 2130)-1230 on 3.529, 6.025, 9.610; news in Portuguese 0300, 0930.

Roumania — Radio Bucharest, 9.252A, has news now 1400 by man and woman; fair signal but with heavy QRN in South Africa. (Ridgeway)

South Africa—SABC has *experimental* transmissions in *English* over 15.230 on Tue., Thur. 0330-0715, and Sat. 0330-1045; over 11.937 on Tue., Thur., Sat. 1100-1505. (ISWC, London) Noted by Pearce, England, on 11.937 with news 1200; service in Afrikaans 1230-1330.

The South African noted from around 2300 on 4.945 is believed to be "Springbok Radio." (Patterson, Ga.) Heard identifying as such. (Stark, Texas) SABC, 4.895, Johannesburg, noted 0010 with setting-up exercises in Afrikaans. (McPhadden, Calif., others) SABC, 9.679A, noted 2345-0030A fade-out; news 0000. (Stark, Texas) Believed Johannesburg. Rosenauer, Calif., notes the SABC transmitter on 9.615 coming through from around 1000-1130.

Spain—Cadiz, 7.200, noted 1750 announcing "Radio Nacional de Espana" (may have been relay); signed off 1759 with march; fair level in N. C. Madrid, 15.526, noted with program in Spanish for Canary Islands 1145-1157; good level. (Ferguson) Madrid, 9.363, is coming through better now in Iowa with *English* to North America 1800-1840. (Lund) *Radio Juventud de Murcia,* 7.100, noted strong 1700 with call followed by light music. (Pearce, England)

Surinam—PZC, 15.405A, has *English* each Sat. 2030-2040. (Niblack, Ind.) Is parallel over PZH5, 5.752A. Noted by Winch, Calif., on 15.405A with music and Dutch announcements around 1930.

Sweden—Radio Sweden noted in *English* 2300-2315 on 11.705, 15.155; best on 11.705. (Leary, Calif.) Heard on 15.155 with news 1015; on 11.705 at 1805 tune-in when had *English*. (Niblack, Ind.)

Switzerland—Summer schedules for the monthly DX session from SBC, Berne, during the first week of the month, are—*To United Kingdom and Ireland*—Tuesday 1405, HEU3, 9.665; HER2, 6.055. *To North America*—Tuesday 2050, 2235, HER5, 6.165; HEI3, 7.210; HER4, 9.535; HEU3, 9.665; HER5, 11.865. *To E. Australia and New Zealand*—Wednesday 0235, HER5, 11.865; HER6, 15.305; HER7, 17.784 (last two are beamed to W. Australia, Far East). *To Southern Asia and Japan*—Wednesday 0805, HER6, 15.305; HER5, 11.865; HER7, 17.784. *To India and Pakistan*—Wednesday 1005, HER5, 11.865; HER7, 17.784. *To South Africa*—Wednesday 1005, HER6, 15.305. *To Middle East*—Wednesday 1205, HER5, 11.865; HED7, 15.120.

Syria—Damascus, 11.913A, noted signing on 1530 in French; started *English* session 1630; was QRM'd by VOA at 1700A. (Ferguson, N. C.) Still closes 1730; noted with news 1716-1722. (Bellington, N. Y., others)

Tahiti—Radio Tahiti, 6.135, Papeete, has nice signal around 0000-0100. (Flynn, Calif.)

Taiwan—BEC26, 10.065A, heard 0915 with dance music; another day noted 0845 with music, news in Chinese 0900. (Pearce, England)

Tangier—Pan-American Radio noted near 7.300 with Spanish, French, *English* at sign-off 1800; the well-known "La Cucaracha" interval is now orchestral instead of music-box rendition as formerly. (*Short Wave News*, London)

Thailand—Bangkok, 6.24, noted with *English* identification now when signing off 1025; announces 6.240, 7.104, 11.910, and (probably) 15.910; the *English* session is heard on 6.240 as early as 0530 and concludes 0625; 7.104 is heard as early as 0530 also but is *not* parallel with 6.240; these channels do parallel from 0625, however, with native session. (Rosenauer, Calif.) Heard in New Jersey on *measured* 7.1062 with excellent signal 0640 in native, parallel 6.240, which was very weak. (Oskay)

Turkey—The (Sunday) Mailbag session is again noted 1845 over TAT, 9.515, in the North American beam. (Boice, Gates, Conn., others) Still has Spanish session for Latin America daily 1730-1800 on that channel. (Bellington, N. Y.)

In verifying, *Radio Ankara* listed available channels as TAN, 6.000; TAM, 7.240; TAP, 9.465; TAK, 11.760; TAQ, 15.195; TAD, 17.720—all 20 kw. TAS, 7.285; TAT, 9.515; TAU, 15.160, and TAV, 17.830—all 100 kw. (Mast, N. Y.)

Radio Izmir, 6.485, Smyrna, is on the air daily 0800-1500; call is "Burasi Izmir Radiosu." (Bluman, Israel, via WRH)

Uruguay—Radio Sweden says

CXA19, 11.835, Montevideo, now broadcasts news in *English* 1715.

USI (Indonesia)—Radio Angkatan Udara, 11.940, Djakarta, is on the air daily 0430-0630 but remains 0700-0730 on Fri., Sat. (Radio Sweden) Opens with "Repaz Band March." (Sanderson, Australia) YDP, 4.930, Medan, Sumatra, noted closing 1130. (Catch, England)

USSR—Radio Moscow noted with news 2100 on 7.200, 7.245A. (Tonsi, Wisc.) Moscow, 11.75, noted signing on 2100 in Home Service; still heard 2230, fair to good level; noted on 9.66 in parallel with 9.545, 6.11, 6.05 to China 0400; on 11.88 with news 0000, fair level. (Balbi, Calif.)

Alma Ata is radiating on 9.340 and 9.380 in parallel 1915-2130, 2300-1100. (WRH) Khabarovsk, 6.02, noted parallel Soviet on 7.18 at 0027 with setting-up exercises. (Bellington, N. Y.) *Radio Tashkent,* 6.825, noted with *English* to India-Pakistan 1000-1030, 1115-1130. (O'Sullivan, England) *Malmo DX-aren,* Sweden, lists this one also on 7.710, and says *Radio Erevan,* 7.150, Armenia, is heard 1100-1300.

Flanagan, N. Y., lists summer schedules for *English* broadcasts from *Radio Moscow* as (to North America) 0800-0830, 17.83, 15.12, 11.96, 11.91; 1820-1930, 15.23, 15.155, 9.7, 9.67, 9.57, 9.55, 7.24, 7.20; 1930-2030, 15.23, 15.11, 9.67, 7.24, 7.20; 2030-2300, 15.23, 15.11, 9.7, 9.67, 9.57, 9.55, 7.24, 7.20; 2300-0100 (for Pacific Coast), 11.88, 9.56, 7.24, 7.20.

Vatican—Vatican Radio broadcasts in *English* daily 1000 on 9.646, 11.740, 15.120; 1315 daily on 5.968A, 9.646, 11.740; Tue. *only* 1030 on 11.740, 17.840 (to India, Ceylon, South Africa). (Boice, Conn.) Pearce, England, recently noted *Vatican Radio* on 7.270 with interval signal 1500, followed by call and talk in Spanish.

Venezuela—YVQV, "La Voz de Los Pueblos," *Radio Carupano,* is a *new* station heard on 3.320 relaying YVQP, m.w., and signing off 2200. (Radio Sweden) YVMO, 4.989, Barquisimeto, noted 1810 with music, good level in Britain. (Catch) Noted back on *measured* 4.990 at 0600 recently. YVKM is currently back on 5.0293, heard 0608. (Oskay, N. J.)

Yugoslavia—Radio Yugoslavia, Belgrade, is now scheduled on five channels using 10 kw. each, but by this time may have started operation of its projected 100 kw. outlet. Schedule includes *English* 0215-0230, 11.895; 1130-1145, 7.240; 1400-1415, 7.200. French 0200-0215, 11.895; 1345-1400, 7.200; 1700-1715, 1800-1815, 6.100. Spanish 0130-0200, 11.895; 1500-1530, 6.100; 1815-1845, 6.255. (WRH)

* * *

Press Time Flashes

The Commercial Service of *Radio Goa,* Portuguese India, has been heard by Pearce, England, on 17.900A around 0315 with "Listeners' Request" session; gave schedule as 0300-0430 for this session; also reported by Cushen, N. Z., closing 0430.

Newspaper dispatches some weeks

ago indicated that *Vatican Radio* soon would double power. (Gay, Calif.)

Indonesia is to replace transmitters at Surakarta, Medan, Jogjakarta, and Djakarta with higher-powered jobs shortly. (ISWC, London)

Cushen, N. Z., reports an unidentified station on 3.720 at 1300-1400 fadeout; says at 1300-1315 is in *English;* he believes it may be located in the Near East. A Swede believes this to be a Greek Armed Forces Station which parallels 6.340.

PRL7, 9.720, Rio de Janeiro, was heard recently at 2045 in *English* with a program "from the Midnight Room of the Copabana Palace Hotel;" followed with airline commercial announcement. (Robertson, Mass.)

AAH, Seattle, Washington, Alaskan Communications System, heard testing on 11.995A at 2015; good level in N. C. (Ferguson) Is noted some Sundays testing around 1100-1200A.

Paris lists overseas programs as to Antilles, Guyane, St. Pierre and Miquelon, 1830-2030, 9.560, 9.675. To Madagascar, Comores, Cote Francaise des Somalis, Reunion, 2300-2330, 11.845. To Tahiti, Iles Marquises, 0030-0130, 9.550, 17.850. To Fr. West Africa and Fr. Equatorial Africa, 0145-0245, 17.850, 15.240. To New Caledonia, New Hebrides, 0245-0315, 17.850, 15.240. To Antilles, Guyane, St. Pierre and Miquelon, 0530-0600, 17.850. To Indo-China, 0815-0830, 17.850, 15.400. To Madagascar, Comores, Cote Francaise des Somalis, Reunion, 1115-1215, 17.850, 15.350, 11.845. To Fr. West Africa and Fr. Equatorial Africa, 1500-1630, 11.700, 15.240, 9.540. To Indo-China, 1730-1800, 9.680. All transmitters in the Overseas Service are listed 100 kw. (Bishop, Ohio)

Radio Pakistan has been noted with *test* program to Indonesia 0630-0715 on 17.835, 15.270 (announced); had all-native music, songs. (Pearce, England) *Radio Algerie,* Algiers, broadcasts on 6.145 at 1330-1500 in Kabyle on Mon., Thur., Sat., and in Arabic other days; in French on 7.280 daily at 1500-1800. (Radio Sweden)

In a letter direct from Radio Tokyo, current schedules were listed—To North America, JOB, 6.069, 0000-0100; to North China, JOB, 6.069, and JOA, 7.180, 0600-0700; to Central China, JOB, 6.069, and JOA, 7.180, 0700-0800; to Philippines and Indonesia, JOB-2, 11.705, and JOA-2, 9.675, 0900-1000; and to India, JOB-2, 11.705 ,and JOA-2, 9.675, 1030-1130. However, West Coast DX-ers were hearing the 0000-0100 North American beam on 11.705 regularly; may be "alternating" between 6.069 and 9.675 in parallel with 11.705 for this transmission for "test" purposes. (Worley, Balbi, Rosenauer, Calif., others)

Saylor, Virginia, reports a *new* outlet in Brazil heard irregularly evenings (*EST*) on 5.597AV; announces as *Sao Francisco* and may not be on daily.

Verification from HOLA, 9.505, Colon, Panama, lists *English* for 0900-1100, 1600-1800, 2100-2200. (Saylor, Va.)

Hamburg now operates on two *new* channels beamed to Southeastern Europe—6.270 at 2300-0600; on 9.735 at 1100-1900. *Radio France-Asie*, Saigon, Indo-China, now *tests* on 15.430 at 1035-1100 in French, *English;* asks for reports. (Radio Sweden)

Catch, England, flashes summer schedules in *English* for Paris are daily 0315 on 7.240, 6.145; daily 1345 on 6.200; daily 1500-1600 on 6.200; Mailbag program is Wed., Sat., during the 1500-1600 transmission.

Radio A.E.F., Brazzaville, French Equatorial Africa, is now scheduled 0630-0815, 6.025, 9.570, 17.840; 1230-1505, 6.025, 9.970, 15.595. (Bluman, Israel, via WRH)

At press time, WRH reported that the Community of the German Broadcasting System has decided to begin an International Short-Wave Service in about two months. It is planned to radiate at first only five programs in German directed to German listeners throughout the world. This Overseas Service is being arranged by Nordwestdeutscher Rundfunk, Hamburg, and is to be transmitted by *all* German shortwave stations (presumably "all" refers to Western Zone.—K.R.B.).

At press time, the short-wave transmitters aboard the *Courier* were being heard at good level throughout the United States, testing on (*announced*) KU2XAJ, 6.110, 9.690 (and 1510 kc. m. w.) on a schedule of 1700-2300, with announcements in Spanish and *English*; location was given as Canal Zone waters, and reception reports were requested to P.O. Box 2016, Balboa, Panama Canal Zone.

* * *

Acknowledgement

Many thanks for the fine reports. Please keep them coming to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. . . . . K.R.B.

DELIVERIES SPEEDED

HESS BROTHERS of Allentown, Pa. has put into operation a two-way radio communications system linking the store directly with its fleet of more than 30 delivery and service trucks and cars at all times.

Station KGC209 is the first radio communications station to be licensed in the U. S. for the exclusive use of a department store. The station is authorized to operate on a 24-hour-a-day basis on a frequency of 35.94 mc.

In addition to expediting deliveries in the store's 60-mile radius trading area, the new installation is expected to effect substantial savings in the consumption of gas, oil, and tires. The company also anticipates a reduction in the number of packages which are undeliverable because of errors in addresses, etc., as such errors can be queried by the driver and corrections made without having to return the delivery to the store for correction and re-routing. This should also result in a saving of time.

—30—

Technical BOOKS

"SIMPLIFIED RADIO SERVICING BY COMPARISON METHOD" by M. N. Beitman. Published by *Supreme Publications,* Chicago. 92 pages. Paper bound.

This is a simple and practical approach to the problem of servicing radio receivers. The beginner will find this manual as understandable as the technician with experience. The author has not assumed previous knowledge of the subject of radio and has launched his discussion with the most elementary principles regarding electricity, components, the use of circuit diagrams, vacuum tube operation, etc. A radio tube characteristic chart has been included so that this data is at hand and other reference books are not required. After a brief discussion on how a radio operates, and an outline of some of the possible circuit faults that develop in receiver circuits, the author discusses the comparison method of receiver servicing.

Various types of AM and FM radio receiver circuits are covered along with circuit diagrams and instructions on how such circuits are to be serviced.

* * *

"THE RADIO AMATEUR'S HANDBOOK" by the ARRL Staff. Published by *The American Radio Relay League,* West Hartford, Conn. Twenty-ninth Edition (1952), 784 pages. Price $3.00. Paper bound.

The ham fraternity will welcome this newly-revised edition of the "Handbook" which has been brought up-to-date and contains a wealth of practical material.

Like its predecessors, the emphasis is on the practical aspects of ham radio. Four chapters are devoted to the history of amatuer radio, electrical laws and circuits, vacuum tube principles, and data on high-frequency communications. The balance of the book is devoted to a discussion of high-frequency transmitters and receivers, power supplies, auxiliary ham equipment, antennas, operating techniques and procedures, etc. The text material contains information of interest to hams of all classes from the "Novice" through "Amateur Extra."

The tube data, which has always formed an important section of this manual, has been brought up-to-date and is presented in the most concise and compact manner possible.

A large catalogue section and a 13-page topical index complete the book.

* * *

"MUSICAL ENGINEERING" by Harry F. Olson. Published by *McGraw-Hill Book Company,* New York. 357 pages. Price $6.50.

To quote the subtitle of this book, this is "an engineering treatment of the interrelated subjects of speech, music, musical instruments, acoustics, sound reproduction, and hearing."

The text has been prepared with a

rather diversified audience in mind, ranging from the music teacher, the advanced musician, the musically-inclined layman, and the sound reproduction enthusiast to the engineer whose work is closely allied with the musical fields.

The book is divided into nine chapters which cover: sound waves; musical terminology; musical scales; resonators and radiators; musical instruments; characteristics of musical instruments; the properties of music; theater, studio, and room acoustics; and sound-reproducing systems.

This definitive work should find an enthusiastic audience among audio engineers and those whose vocation or avocation is the reproduction of music.

* * *

"MANDL'S TELEVISION SERVICING" by Matthew Mandl. Published by *The Macmillan Company,* New York. 417 pages. Price $5.50.

This is a practical how-to-do-it book for the radio technician entering the television field for the first time, or for the old timers in the TV game who want to brush up on the newest circuits and servicing techniques.

From long experience both in teaching and practicing television servicing, the author has arranged the text material for maximum utility. The first two sections of the book deal with television receiver fundamentals which apply to the various systems, the third section explains how circuit troubles can be localized, while the balance of the book deals with the specific service fault encountered. There are chapters on the picture tube and associated components; the r.f. mixer-oscillator stages; the sound section; the video i.f., video amplifiers, video detector, and d.c. restorer; the sync separator stages; the vertical sweep system; the horizontal sweep system; the power supplies; repairing and improving the antenna system; projection television; and v.h.f.-u.h.f. servicing problems.

A separate section on test equipment and color receivers concludes the book. The appendix contains a listing of TV station frequencies, the TV transmission pulse standard, the frequency spectrum, and data on typical TV picture tubes.

This book should prove of value to the TV technician when confronted by those elusive and time-consuming service faults.

—30—

"Darling, maybe we'd better call one of those 'gyp-artists' after all."

Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

"Z-MATCHBOOKS"

Complete technical and sales details on the company's "Z-Match" yagi antennas are told in a unique promotion giveaway just released by *Channel Master Corp.* of Ellenville, New York.

The "Giant Z-Matchbook" measures 3⅜" x 4¼" closed and fully illustrates and describes how the "Z-Match" yagi eliminates mismatch and why it always matches 300-ohm transmission line, single or stacked. Diagrammatically, it shows how, in stacking, the impedance of the 300-ohm single "Z-Match" yagi is adjusted automatically so that a perfect 300-ohm match is provided for the entire stacked array.

Each individual match, 3" long, is imprinted with a specific sales message, including the fact that no stacking bars are required for these antennas.

"Z-Matchbooks," printed in 3 colors, are available to technicians, dealers, and installation men from the company's distributors.

RELAY CATALOGUE

Relay Sales, 833 W. Chicago Avenue, Chicago 22, Illinois has issued a handy catalogue which lists hundreds of relays which the company has in stock for immediate delivery.

Listed in this 1952 catalogue are standard telephone relays, short telephone types, midget units, dual-telephone relays, slow acting relays, aircraft contactors, rotary relays, *Western Electric* type "E" units, keying relays, sealed units, voltage regulators, differential relays, and special types of relays.

Copies of this catalogue, which lists these units by stock number, voltage, ohmage, contacts, manufacturer, and price, are available without charge upon request to the company.

TV SERVICE GUIDE

The second edition of *General Electric Company's* television receiver service guide is now available to distributors, dealers, and technicians.

New information has been added to the 80-page publication which is said to increase its usefulness to the industry. The original 17 x 11 inch size, the fingerprint and dirt-resistant paper, and the special binding have been retained in this second edition.

Like the first edition, the new service guide contains accurate information on 102 *General Electric* chassis, schematic diagrams with circuit symbol numbers, tube locations, top and bottom views, and cabling diagrams on each model. It also carries information on ten r.f. tuners used in these chassis. The picture section, identifying every postwar *G-E* television set, including the 24 inch; resistor, and ceramic and molded mica condensers color code charts have also been retained.

The new edition has been priced at $1.00 a copy and is currently available from the company's distributors.

ANTENNA TOWERS

Alprodco, Inc., Kempton, Indiana has issued a colorful new four-page catalogue which fully illustrates the company's antenna towers as well as all of the components used in erecting these towers.

Details are given on the economy "Tower-Pac" as well as on the various commercial accessories in the company's line.

NEEDLE CHART

Permo Inc., 6415 Ravenswood Avenue, Chicago 26, Illinois has recently published a needle correlation chart for use by dealers and distributors.

The new chart gives a cross reference of special type replacement needle stock numbers to "Fidelitone" stock numbers.

The needle chart is only one segment of the company's complete merchandising program which includes 110 different needles, special packaging for accurate replacement, installation tools and accessories, individually-colored identification labels on each package for different size needles, an automatic inventory and re-order system, etc.

Full details on the new merchandising program are available from "Fidelitone" distributors as are copies of the needle correlation chart.

"POWERSTAT" BULLETIN

The *Superior Electric Co.,* Bristol, Conn. has published a bulletin providing complete information on its new Type 10 "Powerstat" variable transformer.

Known as Bulletin P252, the new publication includes photographs, outline dimensions, ratings, and other descriptive material on the new Type 10 which provides a variable a.c. voltage control for low wattage applications.

Copies of Bulletin P252 are available without charge by writing to R. F. Grenne at the company.

RCA PARTS CATALOGUE

The Tube Department of *Radio Corporation of America* has issued a comprehensive parts catalogue designed to expedite the service dealer's parts-ordering activities.

The new catalogue lists more than 16,000 parts contained in *RCA Victor*

television receivers, radios, and phonographs, as well as a cross reference of replacement cabinets.

Parts are listed in numerical order by stock numbers and each listing includes a description, package quantity, and suggested list price. The catalogue will be revised and reissued periodically to keep it up-to-date.

Radio and television service dealers may secure copies of this publication by contacting their *RCA* parts distributors.

HI-FI REPRODUCTION

A 31-page technical treatise on the subject of high-fidelity reproduction has just been released by the *General Electric Company* and is currently available at the company's dealers.

Designed for audio fans, engineers, and service technicians, the booklet was written by three of the company's audio engineers, Mark Woodworth, Norm Cromwell, and Roy Dally. The booklet contains 19 illustrations and 18 charts or diagrams and covers a wide range of subjects within the field of high-fidelity reproduction.

Entitled "Why Variable Reluctance," the publication is divided into five sections containing information on the theory of operation of the variable reluctance cartridge, preamplifiers and equalization circuits, diamond and sapphire stylus comparison, converting to high fidelity, and a section devoted to data sheets, stylus and cartridge replacement charts, etc.

The booklet is available in limited quantities at 25 cents per copy.

BLILEY CATALOGUE

Of interest to hams, purchasing agents, and design engineers is the new Bulletin #43 recently released by *Bliley Electric Company,* Union Station Building, Erie, Pennsylvania.

The new 16-page catalogue, printed in two colors, contains much valuable data regarding performance, dimensions, frequency ranges, etc., of the complete *Bliley* line of crystals.

The bulletin also carries a two-page military section which gives a specification index for military crystal units in tabular form.

A special information section provides data on frequency temperature characteristics, drive levels, and processing procedures employed on special order crystals.

Copies of this new catalogue are available without charge by writing direct to the company.

SIMPSON CATALOGUE

The Simpson Electric Co., 5200 W. Kinzie Street, Chicago, Illinois has prepared a condensed four-page catalogue and price list especially for dealers.

The new publication contains illustrations of all the company's test instruments and panel meters including the new Model 276 oscilloscope calibrator which is currently being introduced to the trade.

All specifications, ranges, and other pertinent information such as weights

and dealer's net prices are arranged so that they can be seen at a glance.

Copies of Form 2052 can be obtained from Mel Buehring at the company address or from the company's representatives.

"PRODUCT INDEX"

P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind. is now distributing copies of its "Product Index" which provides specific information, in condensed form, on its electrochemical, electromechanical, electronic, and metallurgical products.

The catalogue includes a brief description of the specifications, features and applications of the complete line of *Mallory* batteries, condensers, contacts, rectifiers, resistors, switches, vibrators, metals and ceramics, tuners, and resistance welding supplies.

TEST EQUIPMENT

Precise Development Corporation, Oceanside, New York has released the first in its new series of catalogue sheets covering its line of test equipment.

Among the units illustrated and described in this two-color publication are the Model 630 r.f.-a.f.-TV marker generator; the Model 909 v.t.v.m.; the Model 907 deluxe v.t.v.m.; the Model 635 universal a.f. sine, square, and pulse generator; the Model 912 r.f. probe; and the Model 999 high voltage probe.

Requests for copies of this catalogue sheet should be addressed to the company.

SOLA CATALOGUE

Sola Electric Co., 4633 West 16th Street, Chicago 50, Illinois has issued a new constant voltage transformer catalogue, the "Number CV-142."

This 22-page booklet is an up-to-date cross reference covering the company's line of constant voltage transformers. It covers both standard regulators and four new types which have been added to the line since the publication of the previous catalogue.

The new publication includes photographs, schematic diagrams, and dimensional drawings of every unit offered. It also includes performance charts, harmonic analysis, electrical and mechanical specifications.

Copies are available on letterhead request. Please specify Bulletin P-100-CV 142.

MOBILE ANTENNAS

Ward Products Corp., 1523 East 45th street, Cleveland 3, Ohio has released two new mobile communications bulletins covering its Models SPP-143 and SPPB-71.

The first bulletin describes the Model

Through an inadvertent transposition of type, copies of Tru-Ohm Products' new resistor catalogue were listed at 45 cents each in the item appearing on page 98 of the May issue. These catalogues are available without charge from the company. Address your requests to the firm at 2800 N. Milwaukee Ave., Chicago 18, Illinois.

SPP-143, an antenna with a single hole mounting that can be installed in the same place as a standard auto aerial. The Model SPPB-71, described in the second bulletin, is designed to have the same outward appearance as a standard auto aerial, while operating on regular mobile frequencies.

Free copies of these two sheets may be obtained from *Ward* distributors or from the company direct.

FUSE PRICE LIST

Littelfuse, Inc., 1865 Miner Street, Des Plaines, Illinois has issued a completely illustrated list price sheet covering its line of fuses.

The new four-page sheet contains actual-size drawings of 25 fuse types and lists blowing characteristics. By matching the blown fuse to the illustration, the jobber counterman or service technician can determine, quickly and accurately, the replacement fuse needed. —30—

V.H.F. FIELD DAY

THE Purple Glow V. H. F. Club of Albuquerque has announced that it will man six- and two-meter stations on Sandia Crest, 10,600 feet up, overlooking the New Mexican desert during the V. H. F. Field Day, June 7th and 8th.

A 40-meter rig, operating on 7155, will be used for local schedules and liaison work. All aetivity will be under the call W5RFF/5.

Address all communications regarding schedules or other details to A. David Middelton, W5CA, at Tijeras, New Mexico. —30—

OPPOSES 29,640 KC. OPERATION

EGYPTIAN Radio Club, Inc. of Granite City, Illinois has voiced its opposition to use of 29,640 kc. as a "calling" frequency only and urges all emergency corps in various cities in the U. S. to continue present use of this frequency as a local net operating frequency and to contact their directors and insist that ARRL discontinue its proposal of a national calling frequency only on 29,640 kc.

The Club points out 29,640 kc. was chosen by the group as an operating net frequency. The net includes mobiles in the entire St. Louis area. Actual drills are held regularly on this frequency or monitored for contacts with other mobiles in the area in case the band is not open.

The members contend that by building up interest in this frequency operation they found that when disaster struck they were able to be on the scene in a matter of minutes. So far they have encountered little interference from other stations. In cases where a distant station came in on the frequency, a call to them would clear them and, in most cases, they would stand by on the frequency to help keep it clear of interference.

The Club believes that 29,640 kc. is not intended to be used for long haul traffic and should be used as a local ground wave frequency.

The Club is asking other emergency nets operating on this frequency to join them in protesting its use as a calling frequency. —30—

Factors Influencing Hi-Fi
(*Continued from page* 66)

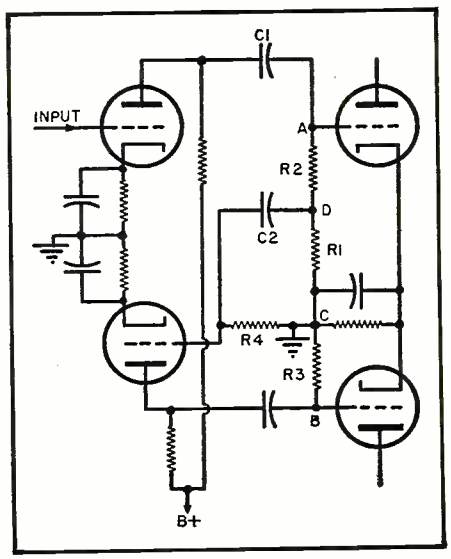
poorly regulated supply source for the screen. Where the voltage must be dropped for the screen, it is advisable to use a heavy voltage divider with a large amount of bypass capacity. At least 10 μfd. should be used, with 20 μfd. or 30 μfd. to be much preferred. Voltage regulating tubes connected across the screen supply next to the screen take-off are quite effective.

5. *Power Supply Regulation*—The regulation of the power supply is directly related to low distortion. A good amplifier operated off a poorly regulated power supply will have excessive distortion. This is especially true of the low audio frequencies where the power supply becomes a source of degeneration even though the amplifier is operating strictly class "A" throughout. This means low series resistance in the power supply, *i.e.*, low resistance chokes and good size rectifier tubes.

The output section of the filter condenser should be large; not merely for its filtering qualities but to furnish a low impedance path to ground for audio frequencies.

6. *Balancing of Phase Inverter*—Experience indicates that all too often too little attention is given to balancing of the phase inverter where this type circuit is used to replace a push-pull transformer. Fig. 7 illustrates probably the most widely used phase inverter circuit. With the amplifier running at near its maximum output with a sine wave input, the audio voltage from points *A* to *C* and *B* to *C* should be compared. This may be measured with an oscilloscope or high impedance a.c. v.t.v.m. The two voltages should be within 5%, preferably closer. If they are not, R_1 should be either increased or decreased, as the case may be, until the two voltages are equal. It should be noted that defective tubes may result in the same unbalance and

Fig. 7. Balance check points on phase inverter. Audio voltages from points A to C and B to C should be approximately equal.



this possibility should be eliminated before changing the value of R_1.

A balance may be obtained at 400 or 1000 cycles, but due to phase shift caused by R_1 and C_2, be unbalanced at low frequencies. To avoid this, C_2 and R_1 should be as large in value as possible.

7. *Coupling Condensers*—In order to extend the low frequency response, the coupling condensers should be quite large. Large values, however, are disadvantageous for two reasons. The likelihood of leakage increases with the large values of coupling condensers. Leakage tends to put "B+" on the negative grid of the following stage. Secondly, large coupling capacity may cause blocking of the next stage grid, especially if its grid return resistor is of a large value.

A rough guide to follow here is to select condensers by means of a sensitive ohmmeter for extremely low leakage and to use as low a value of grid resistor in the next stage as possible when the coupling capacity is large.

Frequency Response

With present day components, frequency response from 30 cycles to 15,000 cycles ±1 db is relatively easy to obtain. Practically all the audio equipment of broadcast stations and the better recording studios, as well as a good many sound systems, meet or approach this response.

1. *Transformers*—Perhaps the most important components in wide range amplifier design are the transformers. Regardless of the quality of the other components, the input and output transformers become the limiting factors in the response curve. These must be selected for the highest and lowest responses desired and must be capable of this response at the desired input and output levels.

The manufacturer's literature must serve as the guide here. Even here a bit of conservatism on the buyer's part may pay dividends as many commercial units are a bit on the shy side in actual usage. The actual response as taken in the supplier's laboratory may easily meet the response specifications when measured with pure resistive loads; yet under actual loads encountered, they may fall off sharply in response. This is particularly true of input transformers.

2. *Low Value Plate Load Resistors*—Low values of plate load resistors are necessary to prevent drop-off of the high frequencies. Values above 100,000 ohms are seldom encountered in the higest quality audio equipment. In fact, an inspection of broadcast equipment of modern vintage will disclose plate load resistor values of 82,000, 56,000 and even as low as 24,000 ohms.

The lower the value, the less shunt effect the tube interelectrode capacities and wiring capacities have on the high frequencies.

3. *Large Value Coupling Condensers*—The low frequency response is dependent on the value of coupling

condensers between stages. If this value is too small, the low frequency response will fall off sharply. This is due to the increase of the condenser reactance as the frequency decreases.

To preserve low frequency response, coupling condensers must be large. This is particularly true if the grid return resistor is small. Typical values of coupling condensers for broadcast equipment are .1 μfd. and .25 μfd.

4. *Screen Bypass Condensers*—The size of the screen bypass condenser influences the low frequency response. Too small values tend to decrease the low frequency response. This is largely due to a degenerative action at the low frequencies which reduces the gain at these frequencies. Values as high as 10 μfd. are not uncommon for wide response commercial amplifiers.

5. *Cathode Bypass Condensers* — Cathode bypass condensers can also cause a drop-off in low frequency response if they are too small. This is due to the same degenerative action as discussed previously. A good rule here is to keep the reactance of the bypass condenser at the lowest frequency to one-tenth of the cathode bias resistance value. Common values found in commercial equipment run from 10 to 50 μfd.

6. *Decoupling Condensers*—The isolating or decoupling condensers between stages can be a source of frequency discrimination, particularly at the lower frequencies. These should be as large as economically feasible. Typical values for low level resistance amplifier stage decoupling are 10 and 20 μfd.

7. *Low Capacity Grid Leads*—The high frequency response may be seriously impaired by the use of grid leads having high capacity to ground. Use of ordinary shielded wire for grid cap leads, etc. should be avoided for this reason. Shielding for grid leads should consist of a small inner conductor to reduce this shunt capacitance. The smaller the inner conductor and the greater its spacing from its shield, the less the capacity will be. Commercially-made grid leads are available which have very low capacity. These are usually well worth the few cents they cost.

8. *Low Grid-to-Ground Impedance* —In input stages low grid-to-ground impedance should be maintained if transformer input is used. Low impedance values, while perhaps resulting in lower gain, prevent excessive high frequency drop-off due to shunt capacity and Miller effect. As a general rule, 60,000 ohms or less is to be preferred for extended high frequency response.

In resistance-coupled stages low values of grid return resistors can result in loss of low frequency response if the coupling condenser is of fairly low value. Typical grid return resistor values are 220,000 and 470,000 ohms and occasionally 100,000 ohms if a large coupling condenser is used.

9. *Gain Control Compensation* — Often it will be found that the response

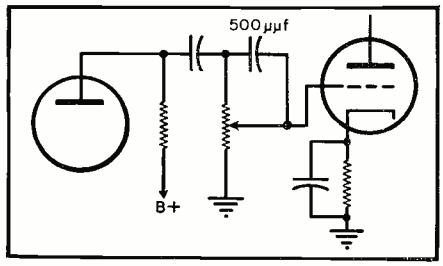


Fig. 8. Compensating condenser used to correct frequency discrimination caused by different settings of the gain control.

of an amplifier changes with the position of the gain control. At full gain setting the response will be flat but when turned to say the half-way point, the high frequency response at 10,000 or 15,000 cycles will drop off two or three db. A small condenser connected as in Fig. 8 will compensate for this frequency discrimination. An often used value is .0005 μfd. The actual value, of course, depends on the particular amplifier components.

10. *Negative Feedback* — Negative or inverse feedback may be used to straighten out the response curve and is often employed specifically for this purpose. No attempt will be made here to cover such a lengthy and comprehensive subject. One thought should be injected here at this point. Even when feedback is used, detailed attention must be paid to all the foregoing points if long time stability is to be maintained as each of the points mentioned affect the phase response as well as the frequency response.

-30-

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ERRATA

The photograph appearing on page 54 of the April issue ("Microwave Klystron Oscillators") was captioned incorrectly. The picture actually shows a Sperry 41OR klystron. A recent version of this same tube is known as the 3K30 oscillator amplifier. It operates on a wavelength of 10 cm (3000 mc. band).

* * *

In Fig. 2, page 53 of the April, 1952, issue, there should be a connection from the junction of C_5, C_6, to the top end of RFC_1.

In the parts list accompanying the schematic diagram, the reference to the substitution of a single .001 μfd. condenser in place of C_5, C_6, should be eliminated.

With this minor correction the Clapp oscillator circuit will operate in the correct manner.

Resonance Indicator

(*Continued from page 45*)

bles and smaller loops. Conversely, if the instrument is desired for v.h.f. use, longer cables would serve the same purpose by shifting the dead spot to a frequency lower than the lowest frequency desired for measurement. In any event, it will be found that for all frequencies other than that of the dead spot, operation is very stable. There is no meter variation as the frequency is changed and resonance is indicated by a pronounced deflection.

It is important to select a 12AU7 containing balanced sections if full advantage of the intended feature of this instrument is to be obtained. The potentiometer, R_2, is provided for the compensation of minor and unavoidable unbalancing effects. Once adjusted, it need not be touched again, except occasionally due to the aging of tubes and components. However, it must not be employed to zero the meter when there is gross unbalance from unmatched 12AU7 sections. Under such circumstances, the meter will not remain stationary as the oscillator is tuned.

Calibration of frequency may be performed by listening to the oscillator with a communications receiver with the beat-frequency oscillator turned on. Allow at least ten minutes warm-up time for both the instrument and the receiver. Disconnect the antenna from the receiver and merely move the resonance indicator within five or six feet from the receiver. The receiver frequency at which zero beat occurs is then the frequency corresponding to the particular dial setting of the resonance indicator. It should be ascertained that the receiver is not tuned to harmonic frequencies of the resonance indicator. —30—

HAM CLUB PICNIC

THE Starved Rock Radio Club will hold its annual hamfest and picnic at Camp Ki-Shau-Wau near Starved Rock State Park, Illinois on June 8th.

A diversified program has been planned for the hams, their XYL's, and the kids.

Listen on 3940 kc. for up-to-the-minute news on this annual event or contact G. E. Keith, W9QLZ, Utica, Ill.

—30—

Two-Way Radio

(*Continued from page 63*)

the same frequency, can be used as a radio-telephone system. Portable and fixed units can be intermixed in any combination. They may also be tied into more powerful FM two-way radio systems such as those used by the police, fire departments, railroads, public utilities, etc. When the "Littlefone" units are used to increase the efficiency and flexibility of a higher powered fixed system and the central station antenna is approximately 200 feet above the ground, the one-watt portable unit can, in most cases, talk to the central station over distances of approximately ten miles. When this same portable low-powered equipment is used in a cruising plane at 2000 feet above the ground, the equipment will operate reliably over distances of 40 miles.

These units are comprised of a crystal-controlled, double-superheterodyne receiver and a crystal-controlled, phase-modulated FM transmitter. Two different frequency ranges are covered by these units, the first being 25 to 50 mc. (11 to 6 meters approximately), and 150 to 174 mc (2 meters approximately). The receiver sensitivities for 20 db quieting are 3/10 of a microvolt in the low frequency range and 1 microvolt or under in the high frequency range. The power outputs of the models differ depending on the power supply selected and the operating frequency. On the low band (25 to 50 mc.) the power output ranges from .75 watt with the dry battery supply to 2 watts in the high powered rechargeable wet cell models. The high frequency models vary from ½ watt output on the dry cell units to 1 watt in the high powered rechargeable storage battery models.

The central station desk or wall-mounted model employ the same compact r.f. section which is interchangeable with the hand-carried units of the same frequency range but which obtains its operating power from a transformer-rectifier system. The central station equipment also incorporates an additional one-watt audio amplifier and a self-contained loudspeaker.

—30—

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Range Max. 100 Mi. Min. .25	P.R.R. 200 Per Sec.
Azimuth Mech. 360° Automatic 360° Accuracy ±3°	Pulse Width 2 Micro Sec.
Scanning Manual Automatic	Beam Width 3° Horiz. 13° Vert.
Presentation 7" P.P.I. 5" A Scope	
I.F.F. not provided but has provision for. Frequency 1074-1086 Mcs.	Power Input 1100 W at 115V 400 Cyc. and 180 W at 27V D.C.
Power output 150 K.W.	Weight: 1,518 Lbs.

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AN/APT-5 300-1500 mcs. xmitter cavity oscillator using 3C22 lighthouse tube. Power output 30 watts. Noise modulated. Excellent condition. Complete with all tubes $169.50

SK-1M Radar Receiver Indicators. Freq. 195 mcs. 2 R.F. stages, 3 IF stages. 1 video, etc. New condition $97.50

SCR-522 VHF Airborne Command Equipment. Freq. range 100-156 mcs. in 4 channels receiver and transmitter. Crystal controlled. Complete equipment. Consists of trans/rec, control box BC-602, dynamotor PE-94, AN104A antenna, plugs, etc. Power input with PE-94 in 28v. We can supply PE-98 dynamotor for 12v input at additional cost.

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Secret Transmission Receiver for reception of double modulated carrier. Will receive 235-258 mcs signals that have been modulated by a 600-750 KC signal. When carrier is heard on a standard receiver no modulation is heard on the carrier when actually speech is being transmitted. 12V DC input.

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JUNE 1952

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TVI-Proof Transmitter

(*Continued from page 37*)

made on the 80-meter band. With the v.f.o. connected, filaments on, and 360 volts applied to the 6L6, the driver was tuned to resonance with the drive control set at maximum. Under these conditions it was possible to obtain a grid current of around 25 ma. on the 813. This is much higher than necessary or desirable, so the drive control was then adjusted to give a final grid-current reading of 12 ma. Then, using a sensitive wavemeter, the 813 neutralizing condenser was adjusted until there was no indication of radio frequency current in the final tank at any setting of the final tank condenser. After neutralization the final plate voltage was applied and the 813 plate circuit quickly tuned to resonance. Using a dummy load, the variable link was adjusted to give normal 813 operating plate current. With the dropping-resistor method of obtaining screen voltage it is recommended that the 813 always be operated in a loaded condition and with grid drive held to rather close limits. Previous stages may be keyed, however, as the 6Y6 will reduce the 813 screen voltage to a low level with loss of excitation.

With the transmitter delivering full power into a dummy load, and a ground connection made to the r.f. chassis, it was impossible to get any indication of radio frequency leakage from the cabinet or in any of the leads.

After connecting the rig to an antenna through a low-pass filter and an antenna coupler, checks were made with a neighboring television receiver. No disturbance was noted on any channel. A distance of about 50 feet separates the end of the author's transmitting antenna from the nearest TV antenna, which is a 4-section conical.

Under normal operating conditions, operating constants for highest efficiency were as follows: 6L6 plate voltage, 360; 6L6 plate current, 20 ma.; 813 screen voltage, 375; 813 control grid voltage, —120; 813 control grid current, 12 ma.; 813 screen current, 35 ma.; 813 cathode current, 250 ma.; 813 plate voltage, 1250.

Below the radio frequency unit are mounted two more sections of identical size which contain the speech amplifier and modulator units. The tube lineup of the speech amplifier, which utilizes low-level clipping and inverse feedback, is as follows: 6SJ7 and 6J5 voltage amplifiers, 6SN7 clipper, 6SN7 two-stage voltage amplifier, pair of 6L6's in the output stage. Power requirements are furnished by a 5Z3 rectifier, which also supplies plate voltage for the 6L6 r.f. driver stage.

The modulator utilizes a pair of 811 tubes in class B, with about 850 volts on the plates. The power supply for the modulator stage is built on the same chassis and incorporates a pair of 816 tubes as rectifiers. —30—

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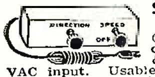

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550VCT/150MADC, 5V/3A, 6.3V/5A.	3.49

TABOGRAM

WRITE FOR IT

WE STOCK LARGE VARIETY OF COMPONENTS. TELL US YOUR NEEDS. SELL US YOUR TUBES & EQUIPMENT.

"TAB" THAT'S A BUY

DYNAMOTORS

DM37C in 28V/9.2A out 625V/225ma.	$9.98
DM4 12&24V out 225V/100ma, 440V/200ma	11.98
DM53A 28V1.45A out 220V80ma	3.59
DA3A 28V/10.5A out 300VDC/260ma, 150VDC/10ma, 14.5/vdc/.5A	6.75
PE94 W/DYNA DA3A, (SCR522)	8.98

SELSYNS

2JIHI GE Selsyn	2 for $6.98
2J1F3 GE BrandNew115V/400cy.	ea. 9.75
C78249 Sync.Diff. 115V/60cy.	2 for 25.00
C78248 Sync. Trans 115V/60cy.	2 for 29.95
Synchro Repeater 115V/60cy Type 11-4 Brand New @ $13.95.	2 for 25.00
Bendix Autosyn AY1 & AY5	2 for 4.95

TAB "SUN-FLASH" LAMPS

"Tab" No.	Replaces	W-Sec. Max.	Each
U10	GE FT114	100	$ 9.98
No. 1	AMGLO 5804X	100	10.98
23ST	GE FT210	200	10.98
53GT	GE FT403	500	16.98
VA	SYLV. 4330	200	11.98
23MT	FT214	250	10.98
22ST	FT110	200	10.98
353GTQ	FT503	5000	54.98

Power Packs External Light and Complete Line of Accessories. Write for Data.

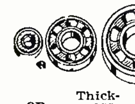
FILAMENT XFMRS

6.3vct/4A (gud 6.5A) H'Sld HVins. $2.69
6.3vct/1A $1.98 2.5v/2A .79
6VCT/5A, 6V/5A, 5VCT/5A 5.95
5V/60A $13.98; 5V/115A 16.95
7.5vct/12A 15Kvins, $10.98; 24v/6a. 4.98
24v/1.25, $1.98; 2.5vct/10A 5Kvins. 3.59

LINE FILTERS

10Amp/130vacdc Csd0.1to1000Mc's. $1.29
30Amp/250vacdc Csd0.1to1000Mc's. 3.98
50Amp/600vdc/250vac. Fltrs both sides of line. SOLAR "Elim-O-Stat" New $9.98; 100Amp/usable 110 vacdc GE 2 for $1.98

BALL BEARINGS



Mfr.	ID	OD	Thickness	Each
ND-R3	12/64	32/64	10/64	$0.64
38KDD	10/64	40/64	12/64	.75
200KDD	25/64	1 11/64	22/64	1.00
Norma 305	63/64	2 28/64	42/64	1.80
B546	19/64	2 56/64	16/64	2.10
S12/12R	1 24/64	2 32/64	27/64	1.89

Write for Complete Listing

OIL CAPACITORS

600wvdc		1000wvdc		2000wvdc	
.1	.64	.45	.79	1	1.89
.25	.71	1	1.09	2	2.98
.5	.75	2	1.69	3	3.69
1	.85	5	2.98	8	9.49
4	1.89	15	4.98	3000wvdc	
5	2.29	1400wvdc		2	4.49
6	2.69	.25	1.29	3	6.98
10	3.29	.5	1.39	4	7.98

HIGH CURRENT MICA CNDSRS.

CYLINDRICAL—SIMILAR TYPE G

Mfd.	Kv	Amps	Mc	Each
.09	1.5	35	1	$14.98
2x.003	1.5	7	1	2.98
.01	10	30	3	49.50
.0025	20	22	3	45.00
.004	20	22	3	45.00
.005	15	30	1	48.00
.0025	12	20	3	28.95
.001	30	30	3	110.00

PHOTOFLASH CAPACITORS

2X.36 Mfd Total .72 Mfd Per Unit.
30 Units/21.6Mfd/1800V/38.8 W.Sec. $5.95
30 Units/21.6Mfd/3000V/64.8 W.Sec. 7.95
Save on Replacements—Write for Details

END EQUIPMENT BUYS

ART13 Spch Amp, New, Less Tubes	$12.98
RM29 Control Unit. BRAND NEW	12.98
PE97 Plate Supply Unit, Less Tubes	9.98
I-108 Range Calibrator. Metal Case.	29.98
I-198 Sig.Gen.Good Cond.Less Tubes	14.95
SCR595 IFF, Less Tubes. As Is	3.98
BC906 Freq. Mtr. exc. cond.	29.95
I-122A Sig. Gen. 115V/60 Cy	149.50
BC221 Sig. Gen. Exc. Cond.	125.00
SCR522A Less/Xtals w/Tubes	69.95
R59/TPS3 Good, As Is Less Tubes	29.98

TV PICTURE TUBES
6 MONTHS GUARANTEE

10" ROUND	$14.95
12" ROUND	17.95
14" RECTANGULAR	20.95
16" ROUND	22.95
16" RECTANGULAR	23.85
17" RECTANGULAR	24.85
19" ROUND	28.50
20" RECTANGULAR	29.95
21" RECTANGULAR	30.45
24" METAL	67.00

Infrared Snooperscope

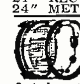


Image-Converter Tube HiSensitivity simplified design 2" dia. Willemite screen—Resolution up to 350 lines/in. Complete data & tube. each $4.98; 2 for $9.49

STORAGE BATTERIES

36 Volt Willard Mini-BRAND. New! 5 oz. Designed Portable Equip. .98c; 4 for $3.00
2V/20AH PLUS 2 Volt Vibrator 2.39
6V/6AH Willd NT6/BB214U 1.98
6V/40AH Willard ER40-6 6.98

RHEOSTATS

2 ohm 500 Ohmite	$2.59
15 ohm 25 W Ward L.	1.98
100 ohm 50W Ohmite	2.25
200 ohm 25W Model D	1.98
250 ohm 25W ea. 1.39; 4 for	5.00
300 ohm, 200W Model P	5.49
350, 500, 5000 ohm slotted shaft 25 watt 79c; 3 for	2.00
1000 ohm 25W Model J	2.19

ALLEN BRADLEY POTENTIOMETERS

1000 ohm Type J 1/4" Flatted Shaft.	$1.45
25K ohm Type J 1/8" Slotted Shaft.	1.25
50K ohm Type J 3/8" Flatted Shaft.	1.45
100K ohm Type J 3/8" Flatted Shaft.	1.45
1 meg Type J 1/8" Slotted Shaft.	1.25
1 meg Type JJJ (Triple) 1 3/8" Shaft	3.69

ATTENUATORS

7470 & 1063 Ohm 12 Step	$3.98
100,000 Ohm 20 Step 3DB/Step	4.98
50,000 Ohm 20 Step 1 1/2DB/Step	3.98

TUBES

"TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE

Tube	Price	Tube	Price	Tube	Price
0A2	$ .98	2E5	1.19	6AF6G	1.33
0A3/VR75	1.23	2E22	1.95	6AG5	.89
0A4G	1.45	2E24	4.69	6AG7	1.99
0B2	1.37	2E25/HY65	5.15	6AH5G	1.49
0B3/VR90	1.09	2E26	3.19	6AH6	1.99
0C3/VR105	1.19	2E30	2.19	6AJ5	1.40
0D3/VR150	.98	2J21	10.69	6AK5	.90
0Y4	2.53	2J21A	9.25	6AK5W	2.98
0Z4	.60	2J22	7.90	6AK6	1.49
C1A	9.75	2J31	29.75	6AL5	.69
01A	.69	2J31A	79.95	6AL7GT	1.29
VS-1	12.49	2J32	59.95	6AN5	2.90
1A3	1.10	2J33	39.39	6AQ5	.59
1A4P	.79	2J34	38.50	6AQ5W	3.98
1A5GT	.79	2J36	120.00	6AQ6	1.00
1A6	1.49	2J37	12.70	6AQ7GT	1.29
1A7GT	1.32	2J38	17.75	6AR5	.79
1AE4	1.80	2J39	49.50	6AR6	2.98
1B3/8016	.83	2J42	250.00	6AS5	.79
1B4P	.89	2J48	28.50	6AS6	2.79
1B5/25S	.99	2J49	39.45	6AS6W	3.20
1B7GT	.99	2J50	27.50	6AS7G	4.35
1B21/471A	2.85	2J52	249.50	6AT6	.82
1B22	2.20	2J55	85.00	6AU5GT	1.49
1B23	9.90	2J56	199.50	6AU6	.69
1B24	17.49	2J61	49.95	6AV5GT	1.29
1B26	2.45	2J62	49.45	6AV6	.59
1B27	14.98	2K25	39.95	6AW6	1.89
1B32/532A	3.90	2K25/723AB	29.00	6AX5GT	.79
1B35	10.98	2K28	34.95	6AX4/6U4	.79
1B37	16.98	2K29	23.95	6B4G	1.59
1B38	29.95	2K33	300.00	6B5	1.19
1B40	4.95	2K48	118.00	6B6G	.89
1B41	49.95	2V3G	1.29	6B8G	1.09
1B42	18.00	2W3GT	.98	6BA6	.79
1B46	1.98	2X2	.69	6BA7	1.29
1B53	49.95	2X2A	1.89	6BC5	.69
1B56	38.50	3A4	.99	6BC7	1.23
1B58	350.00	3A5	1.69	6BD5GT	1.65
1B60	69.75	3A8GT	1.59	6BD6	.89
1B63	50.00	3B4	2.69	6BE6	.79
1B63A	75.00	3B5	.98	6BF5	1.06
ELIC	2.70	3B22	2.70	6BF6	1.49
1C5GT	.89	3B23/RK22	4.95	6BF7	2.55
1C6	.79	3B24	5.40	6BG6G	1.65
1C7G	.89	3B25	4.50	6BG7	1.98
1D5GP	.99	3B26	3.70	6BH6	.89
1D7G	.89	3B28	8.80	6BJ6	.99
1D8GT	.89	3C6/XXB	1.49	6BK7	2.15
1E5	.99	3C22	125.00	6BL7GT	1.45
1E7G	.99	3C23	12.45	6BN6	1.49
1F4	.69	3C31/C1B	3.45	6BN7	1.69
1F5G	.79	3C33	14.98	6BQ6GT	1.29
1F6	.89	3C34/HK24	5.49	6BQ7	2.15
1F7G	.89	3C45	25.00	6BY5G	1.45
1G4GT	.89	3D6/1299	.69	6C4	.60
1G5G	.89	3D21A	2.39	6C5GT	.79
1G6GT	.79	3D22	13.95	6C6	.79
1H4G	.89	3D23	4.90	6C7	1.26
1H5GT	.89	3E29	14.95	6C8G	.89
1H6GT	.79	3Q4	.79	6C21	29.45
1J5G	1.20	3Q5GT	1.29	6CB6	.89
1J6GT	.79	3S4	.85	6CD6G	2.49
1L4	.69	3V4	.79	6D4	2.85
1L6	.98	4-125A	29.95	6D6	.89
1LA4	1.19	4-250A	40.95	6D7G	.89
1LA6	.99	4-1000A	108.50	6D8G	.89
1LB4	1.29	4B23	16.98	6E5	.89
1LC5	.79	4B27	4.98	6E7	1.39
1LC6	1.39	4C25/HK54	5.98	6F4	6.35
1LD5	.99	4C33	S9.00	6F5	.79
1LE3	.99	4C35	28.65	6F6	.99
1LH4	.89	4C36	15.98	6F6GT	.79
1LN5	.79	4E27/257	14.50	6F7	1.39
1N5GT	.99	4J22	148.50	6F7G	1.29
1P5GT	.79	4J31	95.00	6G6G	1.39
1P42	4.75	4J34	194.00	6H4GT	.98
1Q5GT	.89	4J42/700	27.00	6H6	.89
1Q26	69.00	4J47	260.00	C6J	6.95
1R4/1294	1.29	4J47CY	198.00	6J4	7.65
1R5	.79	4J52	350.00	6J5GT	.59
1S4	1.19	4X-150A	45.00	6J6	.89
1S5	.79	4X-500F	85.00	6J7	1.09
1S21	6.90	5AX4GT	.54	6J8G	1.19
1T4	.79	5AZ4	1.35	6K4A	4.75
1T5GT	.99	EL5BHD	16.98	6K5GT	1.09
1U4/5910	.73	5C21/C6J	6.95	6K6GT	.79
1U5	.79	5C22	53.35	6K7	.85
1V	.79	5C30/C5B	3.95	6K8	.99
1V2	.70	5D21	27.45	6L5G	.79
1X2	.99	5D23/RK65	24.95	6L6	2.25
1Y2	6.98	5J29	12.40	6L6G	1.69
1Z2	3.98	5R4GY	1.80	6L6GA	1.69
2A3	1.78	5R4WGY	1.75	6L6GAY	2.29
2A4G	1.19	5T4	2.49	6L7	1.19
2A5	.69	5U4G	.77	6N4	2.39
2A6	.69	5V4G	1.10	6N6G	1.69
2A7	.69	5W4	.89	6N7GT	1.29
2AC15	4.98	5X4G	.79	6P5GT	.89
2AS15	4.98	5Y3GT	.49	6Q7	.89
2B7	.89	5Y4G	.79	6R7	.99
2B22	3.90	5Z3	.99	6R8	1.39
2C21/1642	.67	5Z4	1.29	6S4	.98
2C22/7193	.33	C6A	6.75	6S7G	.89
2C26	.19	6A3	1.59	6S8GT	.99
2C26A	.47	6A4	1.89	6SA7GT	.89
2C33/RX233A	3.49	6A5G	2.39	6SA7GTY	3.37
2C34/RK34	.69	6A6	.89	6SB7Y	1.19
2C39	33.98	6A7	1.32	6SC7	1.39
2C40	9.98	6A8GT	1.09	6SD7GT	.99
2C40 JAN	19.90	6AB4	.79	6SF5	.89
2C43	26.75	6AB5/6N5	1.33	6SF7	.89
2C43/464A	9.49	6AB7/1853	1.39	6SG7	1.39
2C44	1.20	6AC5GT	1.09	6SH7	.99
2C50	3.69	6AC6G	1.49	6SJ7	.89
2C51	6.45	6AC7	.99	6SK7GT	.89
2C52	5.98	6AD6G	.98	6SL7GT	.89
2D21	1.49	6AD7G	1.49	6SN7GT	.79
				6SN7WGT	2.25

Tube	Price	Tube	Price	Tube	Price	Tube	Price	Tube	Price
6SQ7GT	.79	12BD6	1.75	35/51	.89	117L/M7GT	1.59	WL676	39.95
6SR7	.69	12BE6	.89	35A5	.79	117N7GT	1.79	WL677	34.00
6SS7	1.09	12BF6	.85	35B5	.79	117P7GT	1.39	WL686	35.00
6ST7	1.33	12BH7	1.29	35C5	.69	117Z3	.59	701A	5.89
6SU7GTY	3.37	12BY7	1.35	35L6GT	.79	117Z4GT	1.39	702A	3.29
6SZ7	1.05	12BZ7	1.25	35T	6.95	117Z6GT	1.19	702B	5.98
6T7G	.89	12C8	1.39	35TG	5.45	117Z7GT	1.49	703A	5.98
6T8	1.09	12F5GT	.79	35W4	.59	F123A	7.90	704A	.98
6U5/6G5	.99	12H6	.89	35Y4	.69	T125	12.49	705A/8021	1.98
6U6GT	1.09	12J5GT	.69	35Z3	.79	F127A	19.98	707A	7.90
6U7G	.69	12J7GT	.99	35Z4GT	.69	VT127A	3.90	707B	17.49
6V3	1.89	12K7GT	.89	35Z5GT	.59	CV148	4.98	710A/8011	.95
6V6	2.25	12K8	.99	REL36/6J4	.49	150T	14.50	713A	.98
6V6GT	.69	12Q7GT	.79	36	.65	VT158	14.49	NL714	5.95
6V8	1.99	12S8GT	.98	37	.69	FG166	49.00	714AY	5.90
6W4GT	.69	12SA7GT	.89	38	.59	FG172	42.50	715A	6.45
6W6GT	.89	12SC7	1.39	RK39	2.89	182B	1.20	715B	8.90
6W7G	1.33	12SF5GT	.79	39/44	.59	FG190	12.80	715C	29.85
6X4	.69	12SF7GT	.59	CRC40	.59	T200	22.98	717A	1.49
6X5GT	.75	12SG7	1.05	T40	4.29	201A/CX301A	.98	718BY	48.45
6Y6G	1.27	12SH7	1.10	TZ40	3.98	203A	5.98	718CY	48.45
6Y7G	.89	12SJ7GT	.79	40	1.09	205B/VT2	1.69	719A	49.95
6Z7G	.89	12SK7	.89	HY40Z	3.75	CE206	3.15	721A	2.49
6ZY5G	.89	12SL7GT	.79	41	.79	211/VT4C	.45	722A/287	2.45
7A4/XXL	.89	12SN7GT	.89	42	.69	CE215	8.98	723A	11.95
7A5	.99	12SQ7GT	.79	43	.85	RX215	9.95	723A/B	25.00
7A6	.79	12SR7	.98	45	.69	WE215A	.18	724A	3.95
7A7	.99	12X3	.90	45S/VT52	.65	217C	8.75	724B	3.45
7A8	.89	12Z3	.89	45Z3	.69	227A	4.98	725A	8.90
7AD7	1.49	14A4	1.09	45Z5GT	.89			726A	8.45

Use Your Priority for SPEEDY DELIVERY—Extend Your DO & Contract Nos.

Tube	Price	Tube	Price	Tube	Price	Tube	Price	Tube	Price
7AF7	.89	14A7/12B7	.99	46	.89	231	1.20	726B	59.95
7AG7	1.99	14AF7/XXD	1.19	47	.99	242C	3.95	726C	69.95
7AH7	1.19	14B6	.99	48	1.99	244A	4.15	800	1.85
7B4	79	14B8	.89	RK48A	6.85	247A	9.95	801A	.45
7B5	.79	14C5	1.09	RK49	7.50	249B	3.75	802	3.98
7B6	.79	14C7	1.09	49	.83	250R	9.90	803	3.89
7B7	.89	14E6	.99	50	1.19	250TH	22.25	804	11.50
7B8	.89	14E7	1.09	50A5	1.19	250TL	18.50	805	3.90
7C4/1203A	.79	14F7	1.09	50B5	.79	HK254	14.49	807	1.65
7C5	.98	14F8	1.29	50C5	.69	262B	3.98	808	2.98
7C6	.99	14H7	.99	50C6	1.49	274B	3.45	809	2.43
7C7	1.00	14J7	1.19	50L6GT	.69	276A	9.89	810	10.98
7C23	72.00	14N7	1.49	50X6	.89	T300	26.98	811	2.90
7C29	69.95	14Q7	1.09	50Y6GT	.79	304TH	8.90	812	2.70
7E5/1201	1.25	14R7	1.19	50Z7G	.98	304TL	8.90	813	7.83
7E6	.89	14S7	1.09	52	.99	307A/RK75	4.85	814	3.45
7E7	.89	14W7	1.09	53	.69	310A	6.25	815	2.45
7F7	1.25	14X7	1.23	T55	8.79	311CH	10.95	816/866Jr.	1.07
7F8	2.19	15E	1.98	55	1.06	313C	2.98	826	.95
7G7/1232	1.29	15R	.89	56	.85	311CT	10.50	828	11.29
7H7	.89	FG17	3.95	57	.79	311T	10.50	829	11.49
7J7	1.09	18	.98	58	.79	316A	1.49	829B	12.45
7K7	1.29	19	.69	RK59	1.45	323A	24.25	830B	3.49
7L7	1.19	19BG6G	1.79	59	1.78	327A	4.95	832	7.65
7N7	1.19	19T8	1.09	T60	10.49	350A	6.50	832A	9.65
7Q7	.79	19V8	1.62	HY69	4.98	350B	5.90	833A	39.45
7R7	.99	T20/1623	3.79	70A7	1.59	353A	4.65	834	5.95

Top Dollar Paid for Your Surplus Tubes—Send List and Prices

Tube	Price	Tube	Price	Tube	Price	Tube	Price	Tube	Price
7S7	1.09	TUF20	5.19	70L7GT	1.59	HK354	24.98	836	4.75
7T7	1.03	TZ20	3.79	71A	.79	355A	14.15	837	1.45
7V7	1.39	20	1.17	72	.95	368AS	7.75	838	3.98
7W7	1.19	RK20A	8.95	CRP72	1.20	371B	.90	843	.39
7X7/XXFM	1.19	RX21	3.75	CRP73	1.49	380A	.79	845	5.95
7Y4	.69	22	.99	73	1.67	388A	1.49	849	29.45
7Z4	.69	24	.85	NR74	.29	393A	8.90	852	19.98
8DC-15	4.98	24A	1.10	HY75	4.59	394A	4.90	860	4.90
10Y	.43	24G/3C24	1.90	75	.99	FP400	15.98	861	23.95
CV11	5.25	25A6	1.09	76	.79	417A	8.95	864	.39
UXCVII	5.25	25A7	2.98	77	.69	GL434A	29.95	865	1.29
12A	.89	25AC5GT	1.59	78	1.05	446A	1.89	866A	1.50
12A5	1.39	25AV5GT	1.29	79	.89	446B	3.89	868/CE1C	3.49
12A6	.89	25BQ6GT	1.19	80	.69	450TH	44.00	869	36.95
12A7	1.29	25C6	1.18	81	1.69	450TL	52.00	827A	3.29
12A8GT	.79	25L6GT	.69	FG81A	3.90	460/HF200	15.95	874	1.39
12AC7	1.45	25W4GT	.89	82	1.19	WL468	13.95	878	1.95
12AH7GT	1.45	25Y5	.79	82V	1.39	GL471A	2.69	884/6Q5G	1.80
12AK5	1.98	25Z5	.79	83	1.45	GL502A	1.79	885	1.45
12AK5W	2.98	25Z6GT	.99	83V	1.79	RH507	9.98	893A	250.00
12AL5	1.11	26	.79	84/6Z4	.99	GL530	22.00	922	1.85
12AT6	.59	27	.69	85	.79	531	6.98	923	1.00
12AT7	.93	FG27A	8.70	89	.75	WL532	3.98	927/CE25	1.49
12AU6	.89	HV27	10.95	VR92	.25	550P1	19.95	930	1.25
12AU7	.74	RK28A	4.89	FG95	24.85	575A/975	13.75	931A	6.90
12AV6	.69	28D7	1.39	FG98	19.95	WL579	10.49	954	.25
12AV7	1.35	30	.79	100TH	8.89	WL579B	12.98	955	.39
12AW6	1.79	31	.59	102D	2.98	601B	.19	956	.36
12AX4GT	1.20	HY31Z	2.75	102G	2.98	HY615	.25	957	.45
12AX7	.99	32	.49	FG104	37.98	616	37.00	958A	.67
12AY7	2.95	FG32/5558	13.85	FG105	18.98	KU627	18.00	967/FG17	3.95
12AZ7	1.49	32L7GT	1.49	VU111	1.45	WL652	65.00	973	10.75
12BA6	.79	33	.59	HY114B	.75	WL670A	11.98	991	.39
12BA7	.79	34	.69	HY115/145	.79			FM1000	1.50

Tube	Price	Tube	Price
CK1005	.85	CK5678	2.45
CK1006	3.49	CK5697	5.98
CK1007	.89	CK5702	7.45
CK1090	2.98	CK5703	.98
R1100	5.00	CK5704	4.39
R1130	12.00	CK5783	6.69
E1148	1.35	CK5784	7.40
HY1231Z	5.39	CK5829	4.49
1612	1.98	CK5851	4.98
1613	.89	CK5875	1.98
1616	.74	**C'Ray Tubes**	
1619	.25	2AP1	$11.90
1620	6.25	3AP1	10.69
1622	2.69	3AP1A	14.25
1624	1.90	3BP1	7.19
1625	.39	3BP1A	14.98
1626	.39	3CP1	2.20
1629	.29	3DP1	4.85
1630	.97	3EP1/1806P1	4.98
1631	.74	3FP7	1.65
1632	.77	3FP7A	14.98
1633	.73	3GP1	4.70
1634	.73	3HP7	3.85
1636	3.19	3HP14	14.98
1644	.95	3JP7	12.50
2000T	149.50	3JP12	19.95
2050	1.47	3JP14	16.95
2051	1.19	4AP10	4.60
5516	5.98	5AP1	5.98
5517	3.39	5BP1	4.49
5594	6.65	5BP1A	19.95
5608A	5.95	5BP4	4.75
5637	7.15	5CP1	4.75
5638	4.79	5CP7	11.95
5651	3.05	5FP7	1.85
5654	2.95	5HP1	9.75
5656	6.90	5HP4	9.75
5663	1.85	5JP2	24.40
5670	6.98	5JP4	26.75
5684	14.98	5LP1	29.95
5686	3.90	5LP7	19.95
5687	5.75	5MP1	9.75
5692	7.69	7BP1	4.95
5693	7.69	7BP7	6.75
5694	3.65	7EP4	17.98
5718	10.15	7JP4	18.39
5719	12.75	9GP7	14.89
GL5727	4.49	9LP7	5.95
5726	4.39	12DP7	16.89
5744	6.49	12DP7A	49.50
5749	3.39	12GP1	49.98
5751	5.45	12GP7	16.89
5763	1.70	12HP7	16.89
5812	2.99	12JP4	27.00
5814	5.49	12KP4	47.00
5840	12.75	12LP4	21.25
5881	3.29	905	3.49
X6030	4.49	912	89.98
8002R	99.50	913	11.98
8005	7.25	914A	45.00
8008	6.49	**Mazda Pilots**	
8012	2.89	311/28V	$0.15
8013	2.75	313/28V	.15
8013A	6.45	323/3V	.25
8014A	28.95	**Xtal Diodes**	
8020	1.25	1N21	$0.79
8025	5.79	1N21A	1.65
9001	1.65	1N21B	3.45
9002	1.29	1N21C	27.45
9003	1.69	1N22	1.25
9004	.42	1N23	1.35
9005	1.45	1N23A	2.45
9006	.39	1N23B	3.70
Sub-Miniatures Write for Complete List		1N25	7.45
1AD4	$2.95	1N26	9.15
2E31	1.49	1N27	1.65
2E36	2.19	1N29	3.50
2E41	2.39	1N32	24.50
2E43	1.39	1N34	.64
2G21	2.39	1N34A	.98
CK502AX	1.79	1N35	1.95
CK509AX	1.26	1N38	1.65
CK512AX	3.15	1N39	6.15
CK522AX	2.49	1N40	9.98
CK525AX	3.15	1N43	1.69
CK526AX	3.95	1N44	1.21
CK531DX	1.98	1N45	1.39
CK532DX	1.98	1N46	.69
CK533AX	1.39	1N47	9.50
CK534AX	.89	1N48	.59
CK536AX	.89	1N51	.45
CK538DX	.89	1N52	1.85
CK539DX	1.98	1N54	.89
CK542DX	.98	1N55	2.99
CK544DX	.98	1N56	.89
CK546DX	1.98	1N57	.89
CK571AX/5886	4.98	1N58	1.19
CK573AX/6029	4.45	1N60	.60
CK1027	3.35	1N61	2.10
CK1028	9.98	1N63/K63	2.49
CK1089	2.98	1N64	.69
CK1090	2.98	1N67	1.95
CK5672	2.29	1N69	1.98
CK5676	2.29	K34	1.39
		CK705	.77
		CK706	.54
		CK707	1.80

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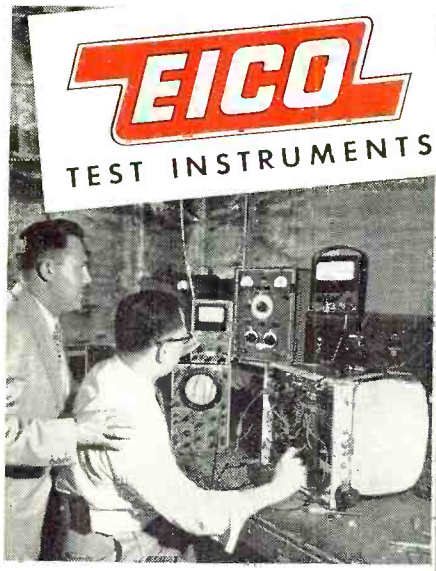
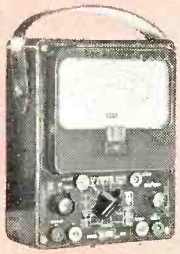


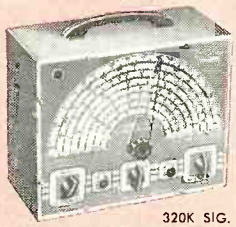
In the CBS-Columbia design laboratories, Al Goldberg takes some important readings with the EICO Model 221 Vacuum Tube Voltmeter and Model 555 Multimeter, as Harry R. Ashley looks on.

Mr. Al Goldberg, Assistant Chief Engineer of CBS-Columbia and Harry R. Ashley, President of EICO, inspecting the use of the EICO Model 221 Vacuum Tube Voltmeter and Model HVP-1 High Voltage Probe at the Sweep Frequency Troubleshooting Position on the CBS-Columbia Television production lines.

KITS
WIRED INSTRUMENTS



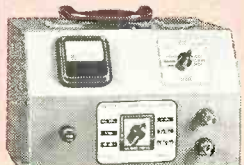
NEW 565K MULTIMETER KIT $24.95 WIRED $29.95. 20,000 ohms/volt



320K SIG. GEN. KIT $19.95. WIRED $29.95

NEW 322K SIG. GEN. KIT $23.95. WIRED $34.95

NEW 950K R-C BRIDGE & R-C-L COMP. KIT $19.95 WIRED $29.95



NEW 1040K BATTERY ELIM. KIT $25.95. WIRED $34.95

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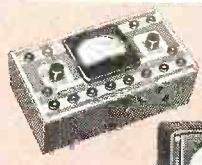
NEW 425K 5" PUSH-PULL SCOPE KIT $44.95. WIRED $79.95



511K VOM KIT $14.95 WIRED $17.95

NEW 536K MULTIMETER KIT $12.90 WIRED $14.90 1000 ohms/volt

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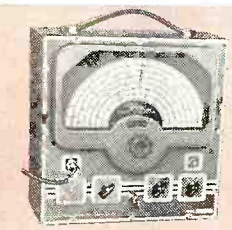

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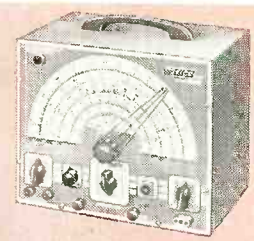

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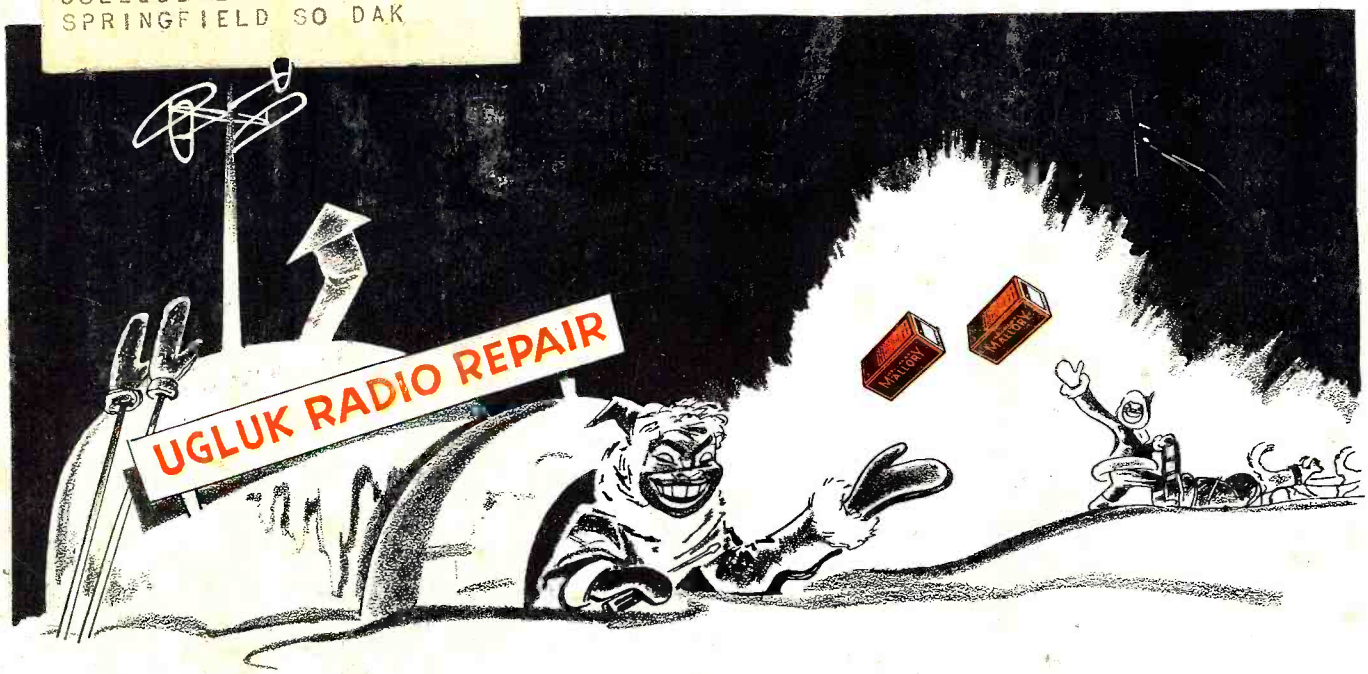

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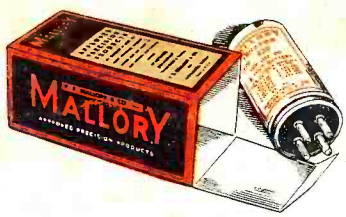

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