RADIO CRAFT

RADIO - ELECTRONICS

HUGO GERNSBACK, Editor

IN THIS ISSUE
Television Power Supplies
Handi-Dandy Transceiver

"FLYING SPOT" TELEVISION TUBE

SEE TELEVISION SECTION

AUG 1948

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CANADA 35¢

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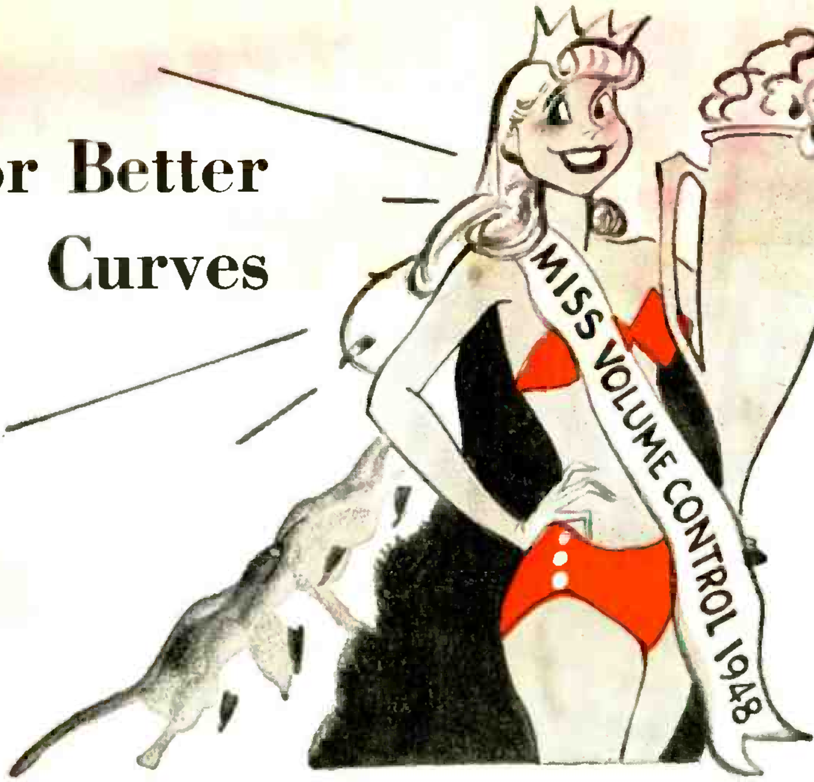

Accurate taper curves prove correct resistance values. When you install a Mallory carbon control, you know that your customer will get the fine, smooth tone gradations that result from tapers that are *mathematically accurate.* Mallory uses an exclusive method of applying the talcum-fine carbon so that the fields of resistance are perfectly feathered for correct attenuation.

Mallory makes the three replacement parts that are used on the majority of your jobs: volume controls, capacitors and vibrators. Into them, Mallory builds design experience that has been acquired by constantly keeping a step ahead of commercial radio-electronic developments — and adds manufacturing skill and repeated quality checks that assure you complete customer satisfaction when Mallory products are used.

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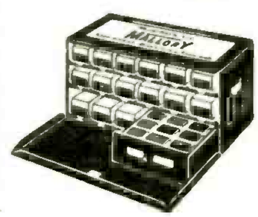
The Mallory 1485 Control Deal

This attractive metal cabinet contains the 15 Controls and 9 Switches that will take care of 90% of your service calls. Its arrangement makes inventory control almost automatic—saves you frequent trips to the distributor's counter. It contains a rack for your Radio Service Encyclopedia. You pay only for the Volume Controls and Switches; the cabinet is included in the deal at no extra cost to you. Check your Mallory distributor on this special offer.



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Check the features — large 5" 5BP1 tube, compensated vertical and horizontal amplifiers using 6SJ7's, 15 cycle to 30 M cycle sweep generator using 884 gas triode, 110V 60 cycle power transformer gives 1100 volts negative and 350 volts positive.

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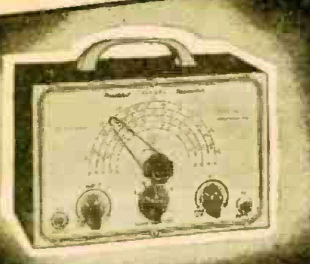
Small portable 9" x 6" x 4¾". Wt. 6 pounds. Ideal for taking on service calls. Complete your service shop with this instrument.

HEATHKIT SIGNAL GENERATOR KIT



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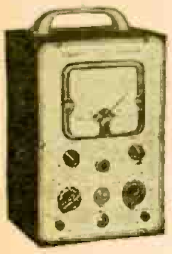

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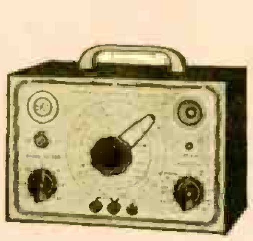

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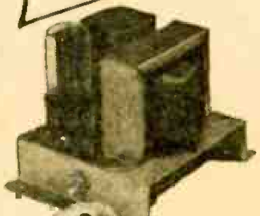

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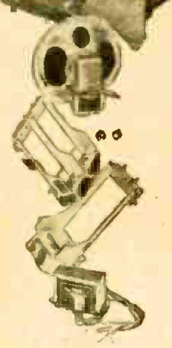

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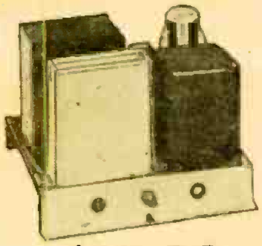

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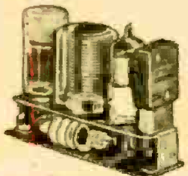

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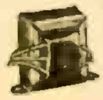

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Push pull 6V6's to 6-8 ohm voice coil excellent characteristics No. 800. 3 for........ **$1.95**

OUTPUT TRANSFORMER

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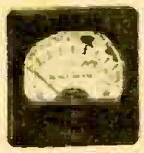

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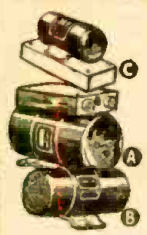

Dynamotor C -- Input 28 volts, output 220 volts at 60 MA. Shipping Weight 6 pounds........ **$1.50**

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Dynamotor B -- Input 6 or 12 volts, output 500 volts, 160 MA. Shipping Weight 30 pounds........ **$5.95**

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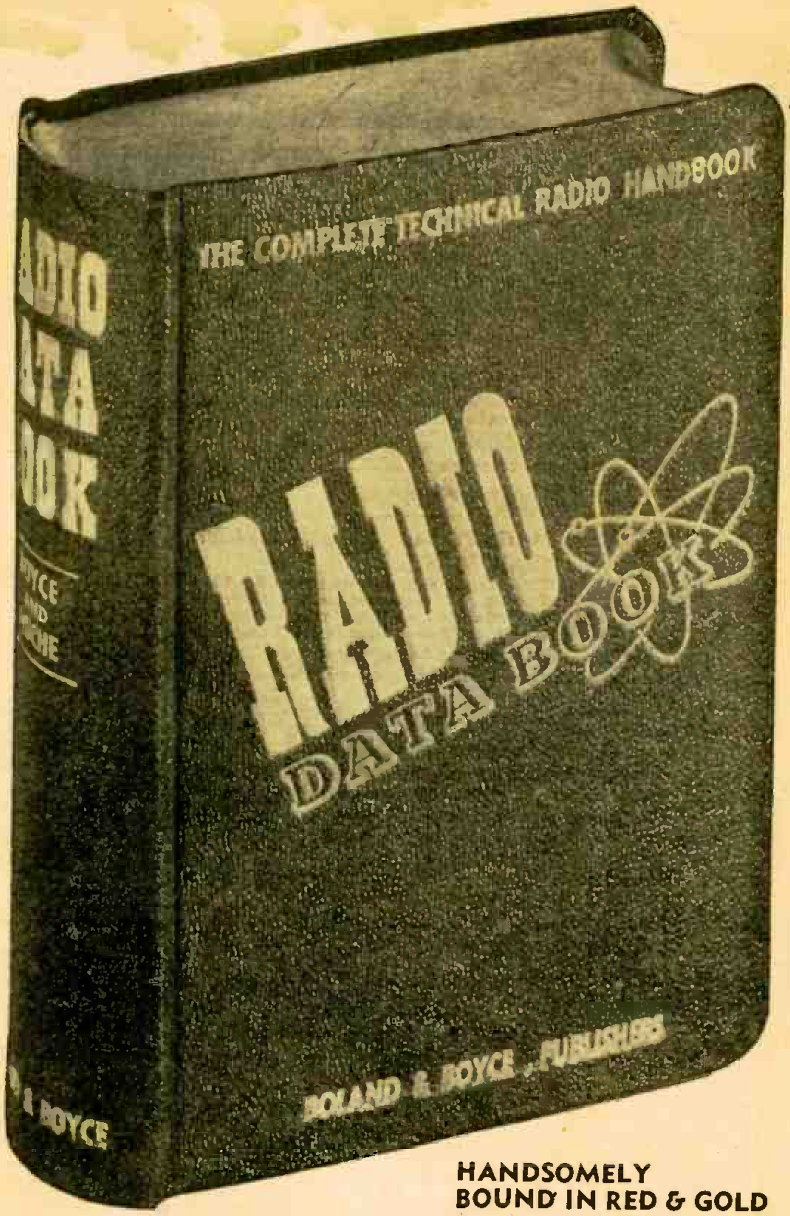

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AUGUST • 1948

RADIO CRAFT

RADIO-ELECTRONICS

Incorporating

SHORT WAVE CRAFT* TELEVISION NEWS* RADIO & TELEVISION

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In an Early Issue

TELEVISION RECEIVER ALIGNMENT
ELECTRONIC MEDICAL RESEARCH
UNIVERSAL TEST INSTRUMENT

On the Cover:

RCA's "flying-spot" television light source. The person in the photograph is L. E. Swedlund, who developed the new equipment.

Chromatone by Alex Schomburg from RCA photo by Gordon W. Hemmerly.

ABC PAID CIRCULATION 6 MONTHS TO DEC. 31, 1947—102,688. (Publishers Statement) PRINTED FOR AUGUST ISSUE—149,000

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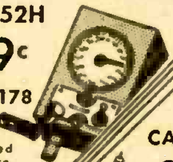
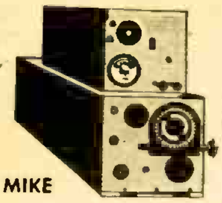


AZIMUTH CONTROL MN 52H

49c

MY 178

Dial calibrated 360 degree face, ideal for antenna rationalizing indicator. 60 to 1 ratio with switch.



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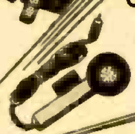
BOTH UNITS ONLY My 105

$9.95



T-17 CARBON MIKE

89c LIKE NEW

MY 160

304TL TUBE 89c

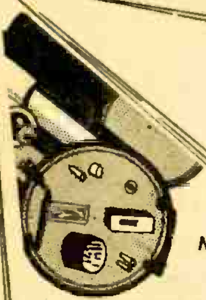
Just the tube for that 1KW final—typical operation 2500 volts at 400 MA. An ideal tube for that induction heater or dielectric heater. Efficient operation at 1500V. to 3000V.

TUBES

815....$1.95	7BP7...$1.49	9004...$ .44	RK60...$ .95
3AP1... 1.95	9LP7.... 2.95	9006... .44	1T4.... .44
3BP1... 1.95	VR150.. .69	50B5... .89	3Q4.... .44
5BP1... 1.95	955.... .65	35W4.. .69	3S4.... .44
5FP7... .95	9002... .44	872A... 1.95	1N5.... .69
5BP4... 1.95	12X3.... .44	1H5....$ .69	VT25 (210).$ .44
		3Q5.... .69	6R7.... .44
		6L6GA.. .95	5W4... .44
		5U4G... .44	2X2.... .95
		6SA7... .44	8016... 1.49

C E PHOTOCELL.....95c
Type used in movie projectors, burglar alarms, etc.

SOCKETS



MY 181

RT 39-A RECEIVER AND TRANSMITTER

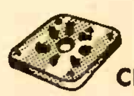
APG 5 contains: (1)829, (1)2C43, (1)2C40, (1)2X2A, (1)Adjustable vacuum shorting gap, (1)1N21B Xtal, (1)5Y3, (2)9-3, (1)VR105, (8)6AK5, (1)6AL5, (1)Blower, IF strip, can be used on television. This equipment brand new and in original sealed carton.

$24.95

My 300

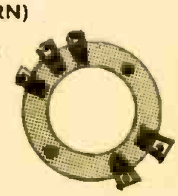
JOHNSON PORCELAIN SOCKET 25W. 4 PRONG

25c



PORCELAIN SOCKET 829-832 ETC.

MY 301 3 for $1



PORCELAIN SOCKET (ACORN)

14c

MY 302

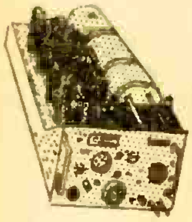
HERSHEL RADIO CO.

5249 GRAND RIVER • DETROIT 8, MICHIGAN

IMPORTANT NOTE

All orders F.O.B. Detroit—Minimum order $2.00—Michigan customers add 3% sales tax—20% payment must accompany all orders.

ULTRA HIGH-FREQUENCY TRANSMITTER AN/APT 5 Brand New!



1500 Megacycle Transmitter, made for U. S. Government, complete with the following tubes: 2-6AC7, 1-6L6, 2-829, 1-931A, 1-6AG7, 1-522 Ultra high freq. tube. Complete with high freq. cavity, 1 Blower to cool the 522, 1 time delay relay, 2 filament trans. cond. and many other component parts for ultra high frequency work. It has a frequency checker, complete Lecher wires, with slider and sensitive bulb for checking the wave length. The Lecher wires are so calibrated that the setting of the slider may be read directly in Centimeters. Operates on 115V. AC for filaments only. Does not include any plate supply. The tubes alone are worth many times more than what we are selling the complete transmitter for. Packed in original case—contains instruction book. Wgt. 118 lbs.

ONLY 49.95 MY 450

HERSHEL RADIO CO.

5249 GRAND RIVER • DETROIT 8, MICHIGAN

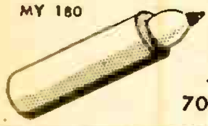
IMPORTANT NOTE

All orders F.O.B. Detroit—Minimum order $2.00—Michigan customers add 3% sales tax—20% payment must accompany all orders.

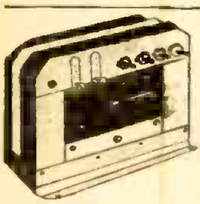
FM RADIO AND TRANSMITTER BC-620-A

20 MC TO 27.9 MC — $9.95 MY 400

This Xtal controlled FM set has 13 tubes and has dual Xtal controlled channels. It also contains built-in Fil. and Plate Meter. Tubes used: (4)1LN5, (1)1LC6, (1)1LH4, (2)1291, (4)1299, (1)1294. Ideal for communication between trucks, boats, etc. Used, in good condition. Less power supply. Wt. 38 lbs. Complete with carrying case and diagrams.



MY 180 — STANDARD BRAND CONDENSERS .1 MFD 7000 VOLTS — $1.95



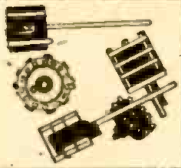
1 KW MODULATION TRANSFORMER

$14.95 MY 111

LIMITED QUANTITY

RCA Modulation Trans. conservatively rated at 550W. audio to modulate that new KW rig. Audio Watts—550, Sec. 1; 450 mils, Sec. 2; 80 mils turns ratio—Pri: Sec.1; 1:1, Pri. Sec. 2 Tap 25:1. Impedance ratio—Pri: 1-1:1 Sec. Pri: Sec 2-25:1 Pri: Sec. Tap 625:1. DC Resistance—Pri: 135 ohms, Sec #1—112 ohms, Sec. #2—99 ohms. Transformers insulation tested: Pri.—8000V. Sec. #1—11,000V. Sec. #2—2000V. to the rest of the coils and core. Primary center-tapped for Class "B" Modulators. Sec. #2 will carry 80 mils to modulate screens of beam power or screen grid tubes. Primary will match any Class "B" tubes up to 10,000 ohms plate to plate, such as 810's, 751's, 8005's, ZB120's, 203's, HY51Z's, 813's, 828's, 805's, 203Z's. Size: 9½x7½x7¼". Heavy channel iron mounting brackets. Wt: approx. 40 lbs.

WAFFER SWITCHES



MY 154 — KIT OF TEN SWITCHES — $1.85

DUAL VARIABLE COND.

89¢ MY 430

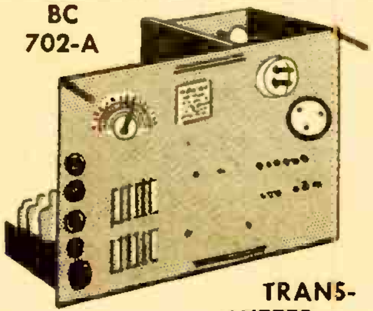
IGNITION COILS FOR STANDARD BRAND Photo Flash Tubes

MY 401 — $1.29

Primary: 150V. condenser discharge. Secondary: 15,000V. can also be used on model airplanes.

WRITE FOR FREE BULLETIN!

BC 702-A



TRANSMITTER ENCLOSED IN A METAL CASE

(4) 2X2 tubes, (1) Squirrel cage blower, 12-24V., .02-8000V., 25 MA 2" meter. 2-.01 at 5000 VDC. .001 at 9500V.

MY 179 — $9.95

CONDENSERS

Cap MFD	VOLT	Your Cost
2	1000 oil	89¢
1	1000 oil	44¢
8	600 oil	95¢
4	600 oil	69¢
2	600 oil	49¢

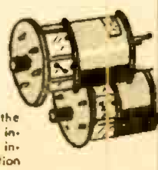
COAXIAL FITTINGS

5¢	25¢	35¢	20¢
HOOD	SOCKET SO-239 83-IR	PLUG PL-259 83-ISP	ANGLE-ADAPTER M-359 83-IAD

POTTER & BRUMFIELD OVERLOAD RELAYS — $1.95 MY 161

Potter and Brumfield. Relay #1—5000 ohms, coil current 10 MA. Relay #2—110V. 60 Cy., AC coil, SPDT.

SELSYN MOTORS



TWO FOR $3.95 — MY 402

The ideal way of indicating the position of Rotary beams, wind indicator, etc. Line chord and instructions for 110 AC operation furnished on request.

SPERTI R.F. VACUUM SWITCH

9200 Volts peak 8 amps. Used as antenna switch. — 95¢ MY 403

Discharge resistor Thyrite type 5F 130V. AC or DC 95c
Resonance ind. neon bulb and alligator clip...... 19c
Paper Cond. .05., 05., 05, 300VDC—round can. 1"x1". Dozen........ $1.00

30 MC-1F SILVER-SLUGGED — MY 412 — 29¢

No. MX16 Cross pointer 3½" Meter. Two 200 microamp movements. Brand new........ $2.95
500 ohm to grid matching transformer #B1749........ 69c
Ceramic Silver Padders Dual 3 to 12 MMFD or 5 to 20 MMFD..... 19c
Ceramic mica Padder single 5 to 20 MMFD........ per doz. 50c
Choke—300MA 20HY. Insulated for 5000V. Heavy Porcelain Insulators. Very conservatively rated. Idle for KW rig........ $8.95

REMOTE POSITION INDICATOR

6-12V. 60 Cy. 5" Indicator with 0-360 Degree Dial. — $2.45 MY 405

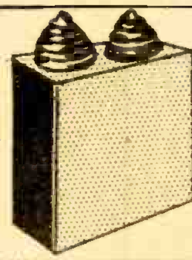
3 HY-5MA-325 OHMS

1⁹⁄₁₆" d. x 1¼" h. — MY 406 — 19c

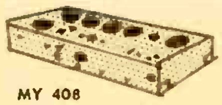
PAPER OIL CAPACITATORS

1 MFD 6000 V. — MY 407 — $4.95

2 MFD 6000 V. — MY 417 — $8.95



CHASSIS



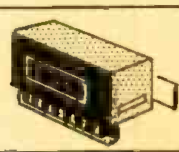
MY 408 — Size: 9¾ x 4 x 1½" — 19c EA. 6 FOR $1.00

INVERTER

AUTOMATIC CHANGE-OVER RELAY

115 V. 400 CY. A.C. 26 V.D.C.

MY 409 — $1.49



ATTENTION! — 500,000

Assorted type plugs and connectors too numerous to mention!! Send in your requirements for our extra special, rock-bottom prices!

NEW BC 223 AX TRANSMITTER

MY 109 — $29.95

801 Oscillators and 801 power amplifiers, 2-46 modulators and 1-46 speech amplifier 4 Xtal frequencies and master oscillator on selector switch. 10 to 30 Watts output. Tone voice or C.W. Mod. Ideal for 80 meter band. Comes with 3 coils TU 17A 2000-3000 Kc. TU 25 3500-5250 Kc. Black crackle case. Includes two separate cases to store extra coils. Frequencies chart and tubes included, packed in original cases, less crystals at this low price.

RADIO RECEIVER BC733D $9.95

A part of aircraft blind landing equipment manufactured by WE. Operates on any one of its predetermined Xtal controlled freq. in the range of 108-120MC. Contains 10 tubes, 3 of which are WE 717A's and Xtals. Ideal receiver for conversion to 144MC Ham Band or mobile telephone bands. For 24VDC operation. 14½ x 7 x 4⅝". Complete with tubes. MY 170

DYNAMOTOR UNIT $2.95

Duo output Dynamotor input voltage 12 to 24V., output voltage 400V. at 135 MA. 800V. at 20 MA. and 9V. at 1.1 amp.

SIGNAL CORPS KEY 39c MY 430

A good sturdy key for those who still prefer to "pound brass." Shorting switch, heavy contacts, fully adjustable gapping and spring pressure.

PYRANOL CAPACITOR

1 MFD, 5000 VDC, Size: 4x4½x3¾" MY 132 $2.95

CHASSIS $1.95 MY 150

Containing: 6V. AC relay. 3 miniature sockets with tube shields. 5 condensers and 6 res. Size: 3x5x1".

INVERTER - MG 149-F

24 V.D.C. Dual output 26V. 60 Cy., 250 volt amperes. 115V. 400 Cy. 500 volt amperes. Single phase. MY 410 $14.95

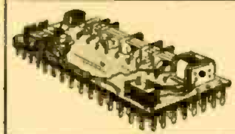
WILL OPERATE WITH RADIO COMPASS SCR 269-F

BRAND NEW AUTOMATIC DIRECTION FINDER

RADIO COMPASS MY 100

SCR 269-F COMPLETE WITH COMPONENT PARTS **$75.00**

The Radio Compass SCR269F was designed to be the primary radio navigation compass for the United States Army and Navy Air Forces. Constant reception is possible day or night so that fixes can always be made to establish the ship's or plane's position. Plotting fixes is accomplished by selecting two or more stations and plotting these on the navigation map. The point of intersection of these lines indicates the location of the craft. This equipment comes complete with 17 tubes and superheterodyne receiver which is tunable from 200 to 1750 KC in three bands. A complete instruction book for operation and maintenance accompanies this equipment.



BK 22 K RELAY MY 110 $2.95

Used in conjunction with SCR269F, change-over contains 28V. step relay 5 deck, 6 position switch. 12V. DPST.

MICA CAPACITATOR MY 166

002. MFD.—3000 W.V.D.C. **69c**

DETROLA RECORD CHANGER MY 311

Handles 12—10" records or 10—12" records. Automatic changer. **$12.45**

FILAMENT TRANSFORMER

110V., 60 Cy. Sec. 1; 4V. at 16 amps, Sec. 2; 2.5V. at 1.75 amps, insulated for 5000V. Ideal for 2X2 and 826 tubes. Hermetically sealed. Size: 6x3½x4½L. MY 145 **$1.95**

ANTENNA DUPLEXER

Originally used on BNIFF equipment to allow the use of a common antenna for receiver and transmitter. 156 to 187 MC..........$5.95

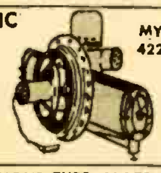
ANTENNA

2 meter antenna: 157-187 MC. Originally used with BNIFF equipment—successfully used on 144 MC as a non-directional antenna........$5.95

BOTH UNITS ONLY **$9.95** MY 310

A-5 AUTOMATIC PILOT—$4.95 MY 422

Servel—100 foot pounds max., to use as a steering device, or compass control on ships.



STANDARD BRAND TYPE HE 49c

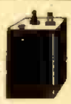
100W. Bleeder consisting of 5 sections; 750 ohms, 23 ohms, 23 ohms, 7500 ohms, 3000 ohms, Total—11,296 ohms. MY 147

PLATE SENS. RELAY $1.49

5000 ohm, coil contact D.P.S.T.

TELEPHONE TYPE, PLATE SENSATIVE RELAY MY 421 **$1.95**

7000 ohm, coil contact, S.P.D.T., S.P.S.T.



IF TRANSFORMER 95c

Mounted in aluminum shield can. 5 MC with air trimmer, impedance coupled type. DISCRIMINATOR TRANSFORMER TO MATCH....................95c MY 115

MODULATION TRANSFORMER AND DRIVER TRANSFORMER

BOTH UNITS ONLY **$4.95** MY 302

RC 1206 modulation transformer. 815 Class AB2, 56W. audio. RC 1205 driver transformer, 6SN7 to 815, Class AB2—Companion to RC 1206.

SCOPE TRANSFORMER

MY 104 **$3.95** Primary 110V. 60 Cy. Sec; 4000V. at 10 MA. Size 6x4x3½".

THORDARSON CHOKE $2.45

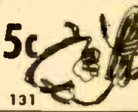
At 200 MA. Shelled case. 10 HY or 15 HY at 150 MA. MY 152

TOGGLE SWITCH 39c

DPST. 30 amps, in Bake-a-lite case. MY 151

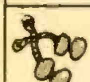
LIP MIKE 95c

WITH HEAD BAND AND CORD MY 131



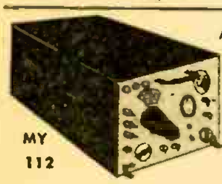
HIGH-SPEED PHOTO-FLASH TUBE $5.95 MY 156

12,000,000 lumens light output. Stops all action, Ignition coil included on back of bulb. 10,000 flashes. Diagrams furnished on request.



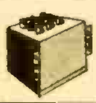
CORONA BALLS MY 116

Grid and plate connections for VT 127-250 TH etc. Ball Type. Heat dissipating silver plated. 10c EA. $1.00 Doz.



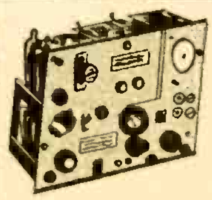
ARR7 AIRBORNE VERSION OF HALLICRAFTER SX 28A MY 112 **$129.00**

With 3 RF stages. (One re-readiation suppressor R.F.) 12 tubes. Motor and manual tuning. S-meter. F-selectivity control, Crystal Filter. AVC, phasing control, ANL, etc. Also furnishes video output for scope, and panoramic output for scanning. Complete with tubes and Xtal, but without power supply. Power requirements, 270V. at 135 MA. New, in sealed cases.



TRANSFORMER 95c

Audio oscillating transformer with output and feedback winding. MY 148

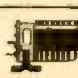


BC-654A PORTABLE RECEIVER AND TRANSMITTER

$14.95 MY 114

The frequency range of both transmitter and receiver is continuous from 3700 to 5800 kilocycles; all stages gang tuned by anti-backlash worm gear dial mechanisms. The BC654-A is 18" wide, 14" high, and 9½" deep. Weight—44½ lbs. Power required for receiver—1.5, 45, and 90V. Power required for transmitter—1½, 6, 51, 84, Volts DC and 500. Volts DC at 160 MA. Used.

VOLTAGE REGULATOR—95c



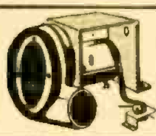
Carbon pile, magnetic type, coil current, 105 MA. Load max. 5 amps at 18.25V MY 141

DON'T MISS THESE SPECIAL SAVINGS!

Powdered iron, ⅜ slug	my118	10c
Jacks for PL55, or PL68	my119	10c
Ass't mica condensers—per 100	my120	$ 1.95
Pin straightener for miniature tubes	my122	25c
Ear phones, 2000 ohms, used	my124	95c
SCR625 Mine detector, used	my127	$39.50
75,000-ohm 200 watt Bleeder Res.	my413	95c

SQUIRREL CAGE BLOWER $7.95 MY 169

2" outlet, 110 AC, 60 Cy. Silent Oil lite bearing motor, with mounting bracket.



SILVER CERAMIC CONDENSERS

500 W.V.D.C. 12c ea. 10 for $1.00

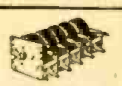
Available capacity (MFFD's), 2, 3, 4, 5, 7, 8, 8½, 10, 11, 12, 15, 24, 25, 40, 45, 50, 51, dual 60, 70, 72, 75, 80, 81, 95, 100, 120, 470, 500, and 1000.

CERAMIC INSULATORS

HIGH VOLTAGE FEED THRU **$1.00** DOZ. MY 103

COPPERWELD WIRE

3000 FEET MY 150 **$2.95**



5-GANG VARIABLE CONDENSER

MY 149 **$1.95**

5 Gang approx. 50 MMFD per section with individual air-tuned padders. 18 to 1 vernier drive. Shielded.

HERSHEL RADIO CO.

5249 GRAND RIVER • DETROIT 8, MICHIGAN

All orders F.O.B. Detroit—Minimum order $2.00—Michigan customers add 3% sales tax—20% payment must accompany all orders.

The Future of Radio and Television

A Radio Authority Looks Ahead

By R. C. COSGROVE, *Guest Editor*

IT AFFORDS me genuine pleasure to cede this space this month to Mr. R. C. Cosgrove, Vice-President of the giant Avco Manufacturing Corporation and General Manager of its Crosley Division—one of the foremost radio manufacturing corporations in this country. Mr. Cosgrove recently delivered an address: "The Present and Future of the Radio, Television, and Appliance Business," before the National Electrical Wholesalers Association Convention at Buffalo.

From this address I have excerpted the major portion of his remarks. Coming from an expert, they will be, not only of great interest, but highly inspiring as well, to all readers.

—*H. Gernsback*

"More than 31 million radio sets were produced from the end of the war to January 1, 1948. More than half of these (about 19 million) were produced in 1947 alone—a record year for the industry. Thirty-seven million, or more than 90% of American homes have at least one radio receiver, and many have three or four. Five million automobile radios and millions of portables are in use. Altogether Americans currently own more than 65 million receivers. (Latest figures would run to more than 75 million.—*Editor)*

"Now, it is misleading to look at these figures and say that the market for radios is becoming saturated. On the contrary, any business that enjoys such universal appeal with the buying public should constantly provide a ripe market if it is a turnover business, and radio definitely is a turnover market. There are millions of console radios and radio phonographs in use today that are from six to ten years old. This replacement market is untapped.

"Hundreds of thousands of new homes are being established this year. Somewhere I have noted that a million and a half marriages will take place. Based upon our 93% figure, this should mean a market for a lot of new radios. Also, the radio industry's campaign for a radio in every room is making definite headway, opening up markets for additional millions of sets. We estimate that, with a free flow of materials, at least 14 million radios will be produced in 1948.

"The broadcasting industry is continuing to serve as a major stimulus to radio sales. New stations going on the air since the end of the war have raised the total to over 1,700—almost twice the number in operation before the war. Construction permits and pending applications represent another 300 stations, which will mean more than 2,000 in operation in the near future.

"We have developed radio to a fine point. No other industry has achieved greater scientific success. But by no means all the frontiers of radio have been opened. We have yet to develop, for instance, a truly personal radio. I mean one that you can carry on your wrist, in your purse, or in your vest pocket. When a dependable receiver of this kind is placed on the market—and it will be—you will have another new untapped source of sales.

"Another development of promise is very small radio equipment for two-way conversation between individual users. Almost all technical hurdles in this field have been cleared. 'Transceivers,' as they are called, which weigh only two and one-half pounds and are no bigger than a camera, have been approved by the Federal Communications Commission. With a transceiver of this type you can talk back and forth with another party as much as eight miles away. It is the 'walkie-talkie' principle made usable for the public. It is a part of your future in radio.

"Before the war, about 4,000 television receivers were made and sold. Attesting to the reliability of the industry, even in its earliest public step, is the fact that most of these 4,000 receivers are still giving good service.

"In 1946, 6,500 television receivers were produced. In 1947, 175,000 were produced. Now, here is an indication of the expansion taking place today. In the first four months of 1948, more than 160,000 television receivers were built, or almost as many as for all of 1947. We expect at least 600,000 sets to reach the market this year.

"By the end of this month, 29 television stations will be operating in 19 cities. Seventy more permits to build stations have been issued by the Federal Communications Commission, and 192 applications are pending in 96 cities. By 1949, stations will be operating in 40 cities—supplying programs to areas representing 60% of the nation's population.

"Great strides have been made in the past 60 days in television programming. As a result, you are going to see a sharp upswing in demand for home receivers. Some newsreel companies have arranged to furnish daily newsreels to television stations. NBC is photographing its own newsreels of world events. And many local stations will televise local news by the same means.

"For some time, a network of stations here in the East has been telecasting historic events from Washington and New York. Millions have experienced by television the rare thrill of watching the President of the United States deliver major addresses to the Congress. Already, more Americans have seen President Truman by television in one day than saw Lincoln in public appearances during his entire term.

"Network facilities are moving along briskly, but the job is tremendous and can't be done overnight. Seven thousand miles of facilities are now installed or under construction. Another 7,000 miles will be started as soon as possible. Coaxial cable will reach as far west as St. Louis by the end of 1948. Other tie-ups between cities are being made by microwave relay. The West Coast should be linked with the East Coast by mid-1949. Meanwhile, the West Coast stations are not standing still. They, too, are linking themselves together for improving the shows they put on the air.

"*Television is not for the few—it is for the many.* It is destined to become as much a part of the American household as radio has become. Surveys have shown that television is by no means a 'rich man's toy.' Three separate, impartial surveys in the nation's major television area—New York and its boroughs—have proved that by far the largest percentage of television sets are owned by families with middle, and lower middle, incomes.

"The latest survey showed that 73½% of sets in the New York area were owned by families in the average income group. 26½% were owned by those in the high income group.

"Sets on the market today range from those with 7-inch picture tubes, which give a picture some 4 x 6 inches, to projection-type receivers giving a picture as big as a newspaper page. Prices range from less than $150 for small table sets, to $2,500 or more for large, opulent consoles.

(As we go to press, Pilot Radio Corporation announces a $99.50 television set with 3-inch tube.—*Editor)*

"What we are now experiencing in television is not a 'boom,' as some have called it, but a logical and stable expansion. Barring defense emergencies, television for years to come will be a rapidly growing, major business. Most estimates on the retail value of annual receiver production by 1952 run around $675,000,000. In the next five years, I expect to see television at least a billion-dollar industry."

THE MOON AFFECTS radio transmission, according to a report last month by Dr. A. G. McNish of the National Bureau of Standards. It is well known that propagation is affected by the sun, but recent observations show that the moon is also a factor at certain times in certain parts of the world.

At Huancayo, Peru, where the effect is very pronounced, maximum usable short-wave frequencies averaged 1.7 mc lower three or four days after new moon than after the first or last quarter.

Dr. McNish explained that just as the moon raises tides in the ocean, it produces tides in the atmosphere and in the ionosphere. This explanation, however, is not deemed sufficient by itself and more investigations are under way.

STRATOVISION tests conducted last month by Westinghouse engineers from a high-flying B-29 were highly successful. With television transmitting and receiving equipment installed aboard the plane, pictures and sound sent out by ground stations in Baltimore, Washington, and other cities were picked up and rebroadcast from the bomber.

With the aircraft at altitudes up to 10,000 feet, the rebroadcast signals (sent out on channel 8) were received at surprising distances with excellent picture and sound quality. The engineers say that it will be possible to get good reception within a radius of 200 miles from the transmitting craft.

The first stratovision experiments were made over 2½ years ago, the recent tests proving conclusively the capabilities of the system. Westinghouse is developing it as a television relay method in competition with co-axial cable, unattended relay stations, and other systems.

ULTRASONIC VIBRATIONS force the evolution and growth of new kinds of plants and insects, *Science Service* reported last month.

The vibrations were produced at 400 kc by electrically driven crystals. They were used on three different kinds of plants and on young fruit flies. Subsequent growth showed genetic changes in the plants and insects and alterations in the heredity-carrying chromosomes.

JOHN F. RIDER, well-known publisher of radio books, received a silver plaque last month from New York's radio repairmen, acting through their organization, the Associated Radio Servicemen of New York, Inc. The plaque, presented at a regular meeting of the association attended by 1700 servicemen, was "in grateful appreciation of his meritorious achievements in behalf of the radio service industry during the years 1921-1948."

President Max Leibowitz of ARSNY presents a plaque to author and publisher John F. Rider.

ELECTRONIC PUSH BUTTONS are used in a new elevator call system announced last month by Otis Elevator Company. The push buttons at each floor resemble the ordinary type, but do not move when pressed. Instead, the presence of the passenger's finger causes a current flow in a small electron tube located in the plastic button housing. The current makes the elevator stop when it comes to the floor. The tube lights up to indicate the call.

The new control simplifies elevator system installation by doing away with about 40 relays in a typical 20-story building, as well as reducing the necessary wiring. Elimination of many mechanical parts cuts down failures.

RADIO RECEIVER SALES dropped sharply in the New York area during the summer, according to dealer reports. Practically the only sets selling well were the portables.

TV COMMERCIALS have obstructed any merger between television and the motion-picture industry, according to a statement made last month by Howard Dietz, vice-president in charge of advertising and publicity of M-G-M. He predicted that ultimately movies and TV would get together, but not as long as programs were sponsored.

Mr. Dietz warned that television was about to repeat the errors of radio by presenting only programs which can sell goods. He advocated a system where viewers would pay for programs or some method of keeping the advertising separate from the program material.

WATCH FOR THE NEW, IMPROVED RADIO-CRAFT

COMMENCING with the September issue RADIO-CRAFT will appear in a new dress. It will not only be printed on high-quality paper assuring good reproduction of illustrations, but it will also have color on a number of editorial pages. A number of other eye-appealing improvements will also be made in the magazine, including better printing.

In addition to all this the magazine will be increased in size to 100 pages, thus giving the readers more interesting and valuable editorial material.

Don't miss the coming issues of the new improved RADIO-CRAFT for up-to-date information in the radio and television field.

HIGH-FREQUENCY TV plans were announced last month by RCA. The company will construct an experimental television transmitter in Washington, D. C., to operate just above 500 mc to permit gathering information on u.h.f. video transmission.

Radiating on a channel of 504-510 mc, the station will have an output of 25 kw. It will duplicate programs of WNBW, Washington NBC television outlet, so that picture quality and reception conditions on the 500-mc band can be compared directly with those on the 66-72-mc channel on which WNBW operates.

The station will be installed at the Wardman Park Hotel where the WNBW transmitter is located.

45-MINUTE RECORDS containing entire symphonies on two sides were demonstrated last month by Columbia Records. The new discs are made of vinylite and are played at 33 1/3 r.p.m. instead of the usual 78.

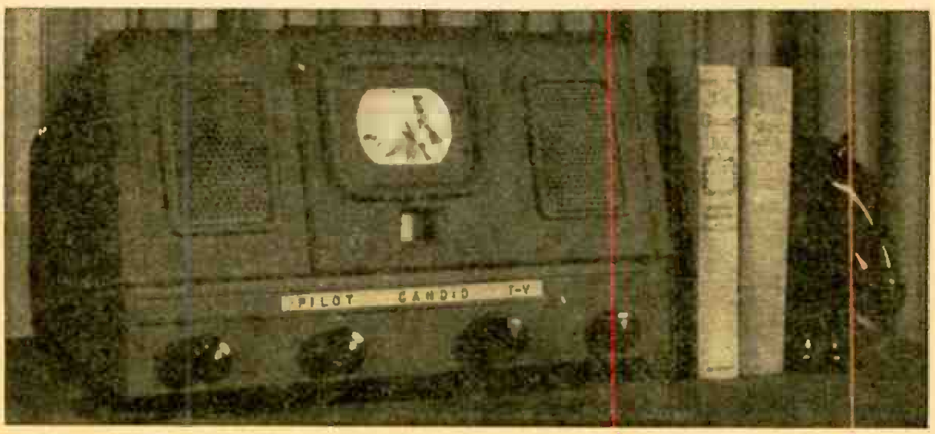
Known as Columbia LP (Long-Playing) Microgrooves, the records are made with pitches of 224 to 300 grooves per inch, in contrast to the maximum of about 100 on present records. The high cutting pitch, together with the slower speed, provides the long playing time.


Dr. Peter C. Goldmark, Engineering Director, CBS, inspects a gold-sputtered master.

Although the discs cannot be played with standard pickups, present home radio-phonographs can be equipped to reproduce them with a small, inexpensive player. This contains a slow-speed turntable and a pickup. The pickup is a newly-developed type of Rochelle salt reproducing cartridge with a semi-permanent stylus of one-third the tip radius of standard needles. The needle pressure is only one-fifth ounce—far lower than that of any previous pickup. In conjunction with the frequency curve used in making the records, it will produce high-fidelity, wide-range response when connected to a flat amplifier. The player was developed by Columbia and Philco.

A PERSONAL TV RECEIVER retailing for less than $100 was demonstrated last month by Pilot Radio Corporation. The set, called the Candid T-V, contains a 3-inch picture tube. The aluminum cabinet measures 14 x 9½ x 13½ inches, and it can be carried from room to room (a leatherette carrying case may be obtained). The small viewing screen makes it especially suitable for personal use, since the viewer can sit close to the set.

Twenty-one tubes are used and all 13 channels are covered. A switch changes tuning from the low to the high television band, and tuning on each band is continuous. Though the manufacturer has furnished no details, the tuner is said to use variable condensers, heretofore not used in v.h.f. television tuning circuits.



The new "personal television receiver" which provides a picture for one or two viewers.

PHILO T. FARNSWORTH, Utah-born major figure in television development, was honored last month by the University of Utah and Brigham Young University. A medal from the University of Utah was accompanied by a citation "for outstanding achievement in the field of science." At Brigham Young University he was guest of honor at a special "Farnsworth Day" celebration.

JOHN MILLS, inventor, author, and retired Bell Laboratories executive died June 14 at the age of 68. Mr. Mills, originally a teacher at the Massachusetts Institute of Technology and Colorado College, wrote the pioneering text on radio, widely used by the Signal Corps during the first World War. He was instrumental in developing the magazine *Bell Laboratories Record*, and was the author of books on atomic physics as well as on radio subjects. Two of his most recent books were *Electronics Today and Tomorrow*, and *The Engineer in Society*.

BLIND RADIO TEACHER and amateur, Robert Gunderson, W2JIO, was honored last month at a luncheon tendered him by the Association for the Education of the Blind on completion of his 13th year as a radio teacher.

The blind radio teacher has trained several hundred sightless radio repairmen and has helped over seventy to prepare for FCC amateur exams. His amateur activity is intense—he is operating four stations in New York and New Jersey at the moment—and he is also a radio inventor and consultant.

McMURDO SILVER died at his home near Hartford, Connecticut, June 18, 1948. Forty-five years old at the time of his death, Silver was known to all radiomen as a veteran designer, constructor and engineer as well as a manufacturer of high-grade radio components and more recently of test equipment. He was head of McMurdo Silver Co., Inc.

Always a pioneer and never an imitator of others, many of his original developments were adopted and became standard over the whole radio field.

McMurdo Silver's first contribution to the radio art was the design of circuits which made the superheterodyne practical. Early superhets used a low intermediate frequency (30 kc). Silver conceived the idea of using a much higher frequency and avoiding the difficulties inherent in what were actually supersonic frequency amplifiers. The Haynes-Griffin superheterodyne, using coils designed by Silver, had an i.f. of 100 kc and was the first of the modern supers.

In the mid-twenties, he combined with a distant relative to produce the famous Silver-Marshall line of high-grade radio receivers and later manufactured a line under his own name. These *Silver Masterpieces* were multiband radios which combined the features of high-class broadcast sets with communications receivers.

More recently he was connected with Guthman Co. and with Fada Radio, of which company he was for a time vice-president. At the time of his death he was manufacturing test instruments for the radio repairman.

Besides radio, McMurdo Silver's hobbies included yachting, polo and old guns. His collection of the latter was extensive, and he was an authority on the history of the Colt revolver. He was a member of the IRE and the Radio Club of America.

HAMS of the West Gulf Division, ARRL will hold their 18th annual convention in Houston, Texas, August 20, 21, and 22. ARRL headquarters representatives and members of the FCC, Army, Navy, and research departments of several universities will speak.

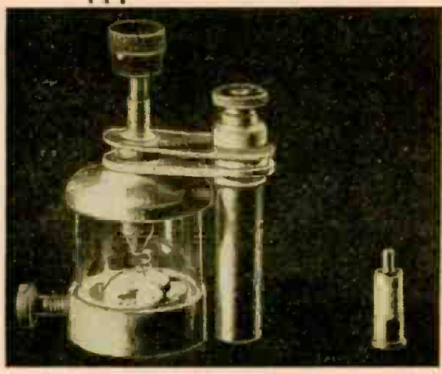


Fig. 1—Compare the 1N21 and its early predecessor with adjustable catwhisker.

The Crystal Detector

Part II—Crystals developed for radar are the results of experiments over many years

By JORDAN McQUAY

MODERN crystal cartridges—now widely used for detecting, mixing, rectifying, and other functions—had their inception in the historic but simple crystal detectors (Fig. 1) that were once a part of every radio receiver. Development of the vacuum tube ended the crystal era, and by 1934 galena and carborundum detectors were toy novelties. The efforts of early experimenters were all but forgotten. With vacuum tubes of greater efficiency, there was no need for crystal detection in receivers operating at ordinary radio frequencies.

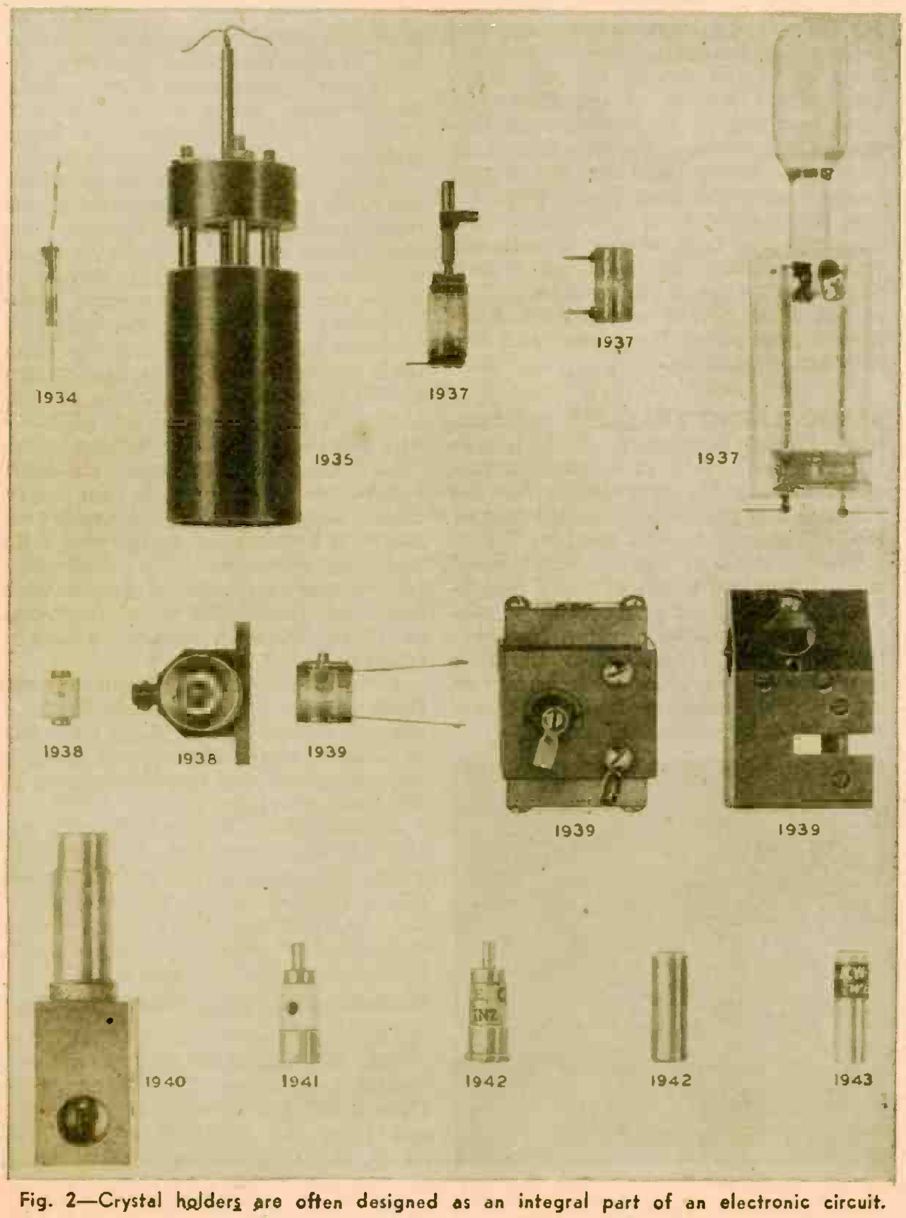


Fig. 2—Crystal holders are often designed as an integral part of an electronic circuit.

In 1934, Bell Telephone began experiments at their Holmdel, N. J., Laboratories to explore the possibilities of using microwaves for communication purposes. Results of these early investigations clearly indicated that it might be possible to raise the upper limit of usable radio frequencies. Evidently, many new operating techniques would be required for microwave reception. In particular, *detection* posed a problem.

Because of limitations imposed by interelectrode capacitance and electron transit-time effects, vacuum tubes would not function adequately at frequencies above 5,000 mc, and thus could not be used to detect microwave signals.

Since transit-time effects as well as capacitance effects are negligible in contact rectifiers, the merits of the almost-forgotten crystal detector were reconsidered. It proved to be the only satisfactory means of detecting extremely high-frequency radio waves.

This 1934 search for suitable materials was somewhat simpler because of the exhaustive investigations conducted by Pickard and other pioneers at the turn of the century[1]. Engineers of the Bell Laboratories examined and tested over 100 materials and metalloids, but only silicon and iron pyrites were found suitable for microwave detection. A point contact hard enough to prevent formation of large contact areas under normal contact pressure was required. The metals finally chosen for the point contact were a platinum-iridium alloy and a fine tungsten wire—sometimes coated with a gold alloy.

Subsequent experiments were concerned with improving the rectifying material, the rectifying surface, the point contact, and the method of mounting or housing the crystal detector.

Many kinds of crystal rectifying devices were designed and used successfully at the Bell Laboratories during the following years. An indication of the wide variety of types and structures is

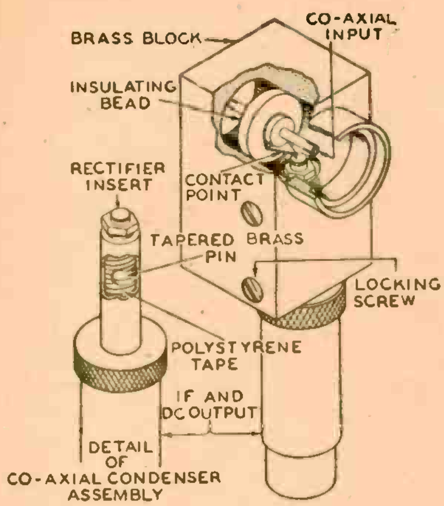


Fig. 3—Early crystal converter assembly.

given in Fig. 2. Designs were generally dictated by the requirements of laboratory apparatus. Often the crystal housing was an integral part of some electrical circuit. Other structures took the form of replaceable cartridges.

Mounting blocks

An outstanding development of the Holmdel Laboratories, prior to 1940, was a crystal detecting arrangement consisting of a rectifier insert and a point contact, both of which were demountable and standardized. When used with a device known as a crystal mounting block (Fig. 3), the arrangement functioned as a mixer (or first detector) in the frequency-converting circuits of microwave receivers. In this way, a comparatively simple crystal rectifier alone provided i.f. signals within practical range of the u.h.f. superheterodyne receivers.

The rectifier inserts consisted of small wafers of silicon or iron pyrites, about 1 mm in diameter and 1 mm in depth, soldered directly to brass studs. Silicon gradually replaced pyrites, since silicon inserts showed less effects of frequency.

By about 1939, knowledge of silicon metallurgy was sufficiently advanced so that a uniformly active contact surface could be produced, and patient searching for active spots was no longer necessary.

These crystal mounting blocks were used in many centimeter-wave experiments prior to 1940. Somewhat similar apparatus was employed by Southworth and King in their celebrated experiments with 25 electromagnetic horns[2].

The demountable rectifier inserts and associated contact points also were used as straight detectors, as rectifiers for u.h.f. test and measuring instruments, and for other purposes. But the ability of crystal rectifiers to function as frequency converters in microwave superheterodynes was the chief reason for their development during the war years which followed.

An urgent war need

The outbreak of war greatly accelerated a vast national program of research and development of microwave radar equipment. There was an urgent need for a standard type of highly sensitive crystal rectifier, to be used for frequency conversion in radar superheterodynes at wave lengths of only a few centimeters.

Earlier in 1941, the British had developed for their radar receivers a small cartridge-type silicon mixer-detector[3] which pronouncedly influenced the shape and size of the first crystal cartridges developed in this country. The trend of American design was toward a more stable and sensitive silicon detector in cartridge form, with the rectifying contact adjusted and fixed during manufacture, so that crystal cartridges could be interchanged and replaced easily. Also, simplicity of construction was desirable for mass production.

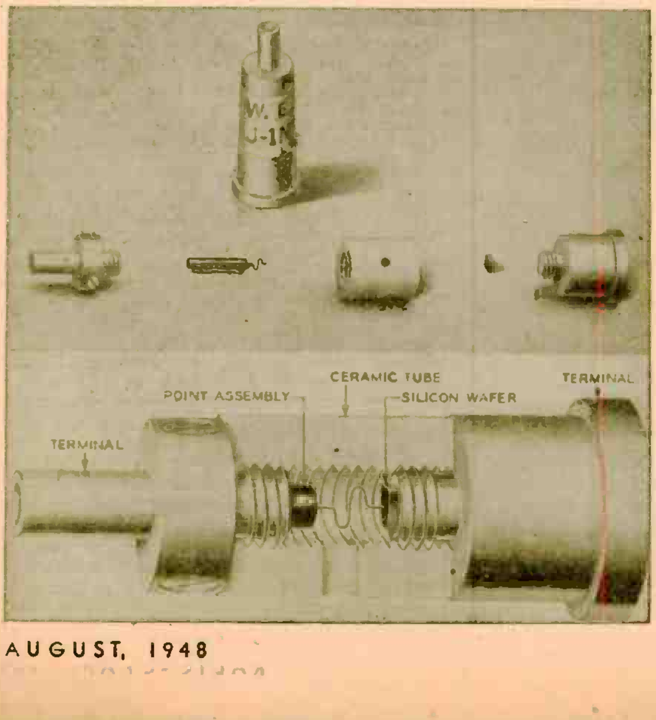
Following these general specifications, work was begun by a number of development organizations, including the Radiation Laboratory of the Massachusetts Institute of Technology and the Bell Laboratories.

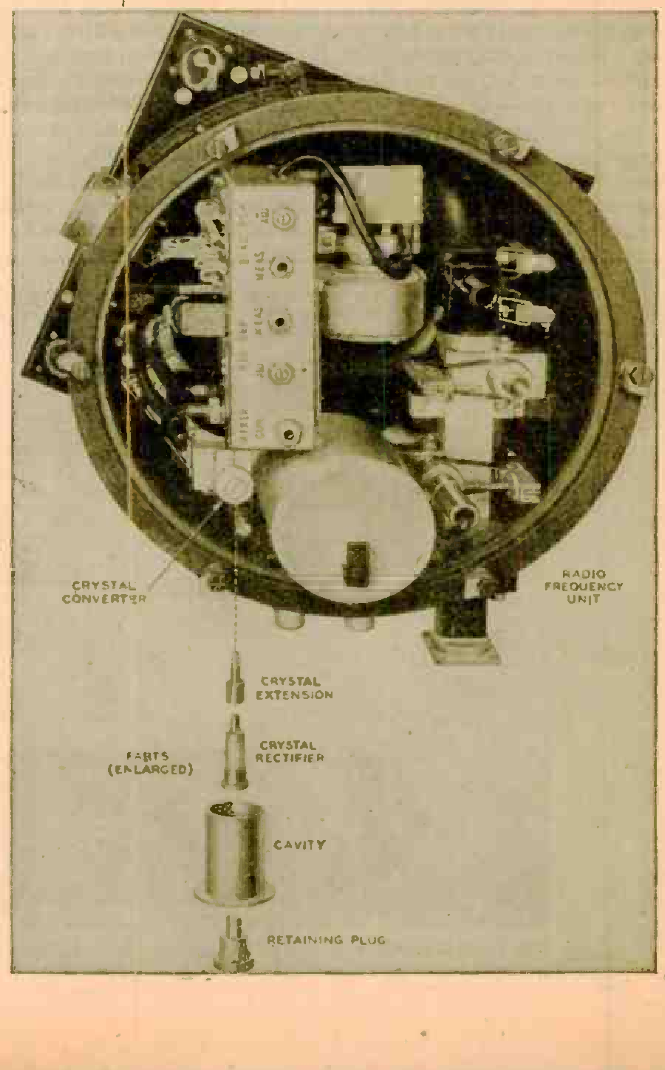
In the work at Bell, the shape and external features of the British cartridge were retained, but considerable changes in process and design were introduced to improve performance and simplify manufacture.

Important changes included the substitution of fused high-purity silicon for the "commercial" silicon of the British detector, to obviate any need for searching for active spots on the contact surface and to improve general performance; use of diamond saws to cut the rectifying element from silicon ingots, and subsequent preparation of the contact surface by careful polishing and etching; and development of a special impregnating compound to protect the cartridge from moisture and mechanical shock.

The result was the ceramic rectifier cartridge[4], which was soon standardized

Fig. 4—(Below) Cutaway and exploded views of a ceramic rectifier cartridge. Fig. 5—(Right) Crystal detectors were used as frequency converters or frequency changers in radar systems for bombing and navigation in B-29 bombers.





and is substantially the same today as when first manufactured nearly seven years ago.

Ceramic rectifier cartridge

Components of the ceramic rectifier cartridge (Fig. 4) include two metallic terminals separated by a ceramic insulator. The rectifying element is a small wafer of silicon soldered to the lower base terminal. The contact spring is attached to a cylindrical brass pin which is locked in position by setscrews. This spring is made of gold-plated tungsten wire formed into an S. The free end of the wire contacts the polished surface of the silicon, and the tip is formed electrolytically. The point usually is cone-shaped to maintain a contact of small area.

After assembly, the rectifying contacts are adjusted for optimum operation. The crystal cartridge is then impregnated with a special *gel* filler, consisting of a wax dispersed in a hydrocarbon oil. This compound prevents mechanical changes in the contact point due to temperature contraction. Since it excludes moisture, the compound also prevents electrical changes and serious point corrosion due to high humidity.

As a final stage in manufacture, the efficiency of a crystal cartridge is improved by striking the side of the cartridge sharply with a small hammer. This simple procedure, known as *tapping*, also reduces high-frequency conversion loss and noise. However, the tapping operation is not a haphazard search for a better rectifying contact, for, with a given material, the reaction is regular and reproducible.

Despite their apparently delicate construction, ceramic rectifier cartridges have high resistance to mechanical and thermal shock. For example, production tests include dropping the unit 3 feet onto a wooden surface, immersing it in water, and rapid heating from subzero to high temperatures. *None of these tests impairs the quality of the rectifier.*

Use of the cartridge

As a mixer or frequency converter, the crystal rectifier has no competition at frequencies above 3,000 mc. It has a frequency response hundreds, and sometimes thousands, of times wider than that of vacuum tube or other dry rectifiers, and requires no heater or plate supply voltages.

In application, the rectifier cartridge produces a difference (intermediate) frequency between the r.f. signal and the local oscillator, which is then amplified and detected in later stages of the superheterodyne.

A typical use of the ceramic rectifier cartridge as a frequency converter in an airborne radar system is shown in Fig. 5. This equipment was used in all B-29 bombers for navigation and for radar bombing.

Similar types of crystal cartridges were used as low-power rectifiers in wave meters, probes, and other test equipment. Special types were developed for direct detection of the video envelope of r.f. signals at low power levels. They have a distinct advantage over selenium rectifiers, since they require no appreciable time to establish blocking action.

Some types for use at frequencies up to 100 mc have a current-carrying capacity from two to three times greater than the 6H6 vacuum tube. These crystal rectifiers are used as second detectors in superheterodynes, clippers, limiters, diode modulators, and for many functions normally accomplished by diode tubes.

Although used widely and successfully in many applications, ceramic cartridge rectifiers have certain limitations. In particular, they are susceptible to damage by discharge of static electricity through the point contact. Also, during manufacture, necessary close control of mechanical dimensions is extremely difficult. To eliminate or minimize these limitations, the shielded rectifier cartridge[4] was developed.

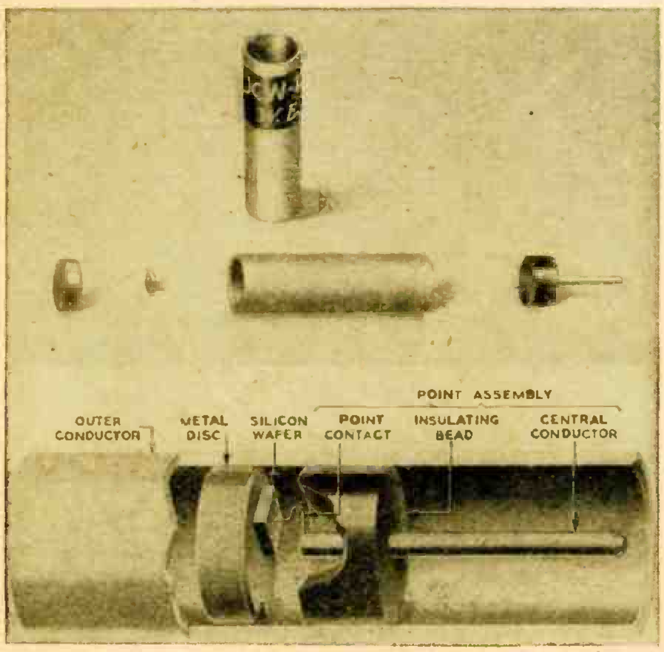


Fig. 6—This rectifier is protected against static by outer conductor.

Shielded rectifier cartridge

Components of this improved crystal cartridge are shown in Fig. 6. The rectifier terminates a small co-axial line. The rectifying material is soldered to a small brass disc, which is fixed in position and connected to the sleeve or outer conductor of the co-axial line. The central conductor—insulated with a bakelite cylinder—terminates in a tungsten wire .002 inch in diameter and formed into a spring. The cone-shaped free end of this spring is in contact with the polished surface of the rectifying material.

The contact point being inside the outer conductor, it is effectively protected from accidental static damage as long as the outer conductor is grounded. The sleeve also shields the rectifying contact from stray radiation.

Although developed in 1942, the shielded rectifier cartridge was not produced and used on a large scale until much later in the war, when its advantage over the ceramic type was demonstrated conclusively. It is likely that most future crystal rectifier cartridges will be shielded.

As the result of research initiated at Purdue University and continued by various laboratories, shielded cartridges using germanium as the rectifying material are available for relatively high-power operation. These rugged types are used for power rectification, d.c. restoration, modulation and demodulation, pulse generation, and other heavy-duty purposes. Further development in this field will eventually produce crystals capable of superseding all diode vacuum tubes and other rectifying devices.

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Image Magnifier Amplifies Light

A STEP TOWARD the long-dreamed-of electron telescope is the image amplifier tube recently developed by the X-ray Division of Westinghouse at Baltimore. This tube is intended to brighten the fluoroscopic images used in X-ray examinations.

Fig. 1 shows how the magnifier tube works. X-rays which have passed through the patient's body, just as in a standard fluoroscope, strike a fluorescent screen. Behind this screen, on which is produced the image of the patient's organs, is a layer of photoelectric material. Each point on the photoelectric surface emits electrons in direct proportion to the brightness of the segment of the fluorescent screen facing it.

The electrons emitted by the photoelectric surface are accelerated and focused by the electronic lenses, to which a high potential is applied. They strike a second fluorescent screen at the small end of the tube. Here the image is much brighter than on the original fluorescent screen for two reasons. First, the acceleration of the electrons has caused them to strike the small screen with great force. This gives a brightness gain of 20 times.

Second, reduction of the image on the small screen to one-fifth the size of that on the large screen increases the brightness. Since the same number of electrons strike the small screen as come from the large, their confinement to a smaller area increases the brightness of any given area. The brightness increases inversely as the square of the image size. Since in this tube, the image size is reduced by a factor of 5, the brightness is increased by the square of 5, or 25.

Combining the two increases in brightness—20 due to electron acceleration and 25 due to size reduction—the total brightness gain is 500. By using an ordinary optical magnifying lens system to examine the small screen, the physician sees the image effectively in its original size.

The present development is by no means a telescope since it *reduces* the size of the image to increase brightness. However, television scanning techniques could be used to break the picture down into a series of elements which could be amplified to any extent.

Limitations of the optical magnification that can be obtained without loss of brightness make it unprofitable to reduce the electron image to less than one-fifth the size of the X-ray image in the present design. The electrostatic acceleration has been held to a gain of 20 times to keep the tube's length down.

The conditions that confront the physician in present day fluoroscopy are even worse than those encountered in finding a seat in a movie after leaving bright sunshine. He has to dark-adapt his eyes for twenty minutes to see the fluoroscopic image. Even then with the low brightness available in difficult cases, such as a large abdominal thickness where the brightness may be as low as .00005 millilamberts, a separation of ¼ inch is necessary before contours can be distinguished. Furthermore this ¼-inch figure applies only in measurements where the contour lines separate regions with a contrast of 100%, as in contours between black and white. While this is an extreme case it compares with 30 millilamberts brightness and .001 inch contour separation as normal conditions for observing X-ray plates. A brightness of .001 millilamberts with a required contour separation of 1/32 inch is the center of the fluoroscopic range.

With the image amplifier tube attached to his equipment the physician will step into his dark room and see at once an image almost as bright as on a movie screen. He may still have to dark-adapt his eyes, though for only three or four minutes, before he can see all the details. What he sees after that will be a clear, easily discernible feature presentation of his patient's organs at work.

The future possibilities for amplified fluoroscopy are impressive. Both patient and doctor will save time and cut down on the period during which they are exposed to direct and scattered X-rays. Even televising fluoroscopic images may well become practical. The physician will be able to perceive objects at present indiscernible.

The image amplifying system is just emerging from the research stage. Westinghouse engineers warn that many months of perfection and design engineering remain to be done before the device is commercially available. The research has, however, irrefutably proven that it is practical and important.

Lenses and screens revealed in cross-section.

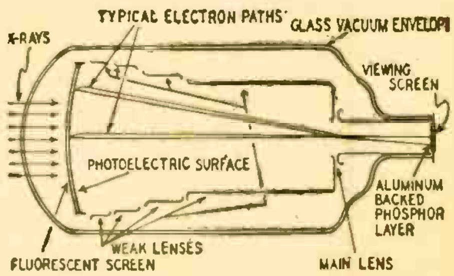
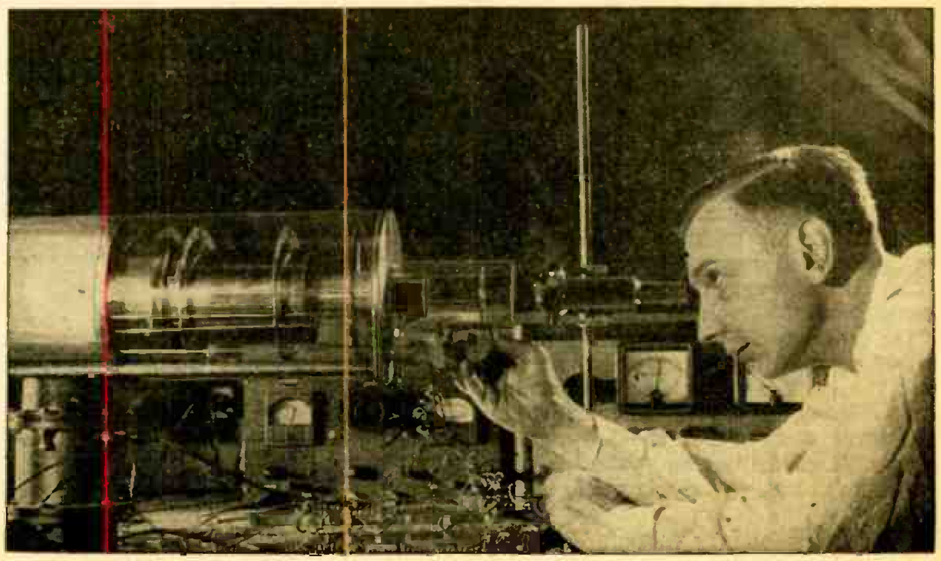


Fig. 1—X-rays strike the fluorescent screen, releasing electrons which are accelerated by the lenses, striking the smaller screen with great velocity and making a brighter image.



Dr. J. W. Coltman of the Westinghouse Laboratories adjusts the focus with a magnet.

Television Power Supplies

Receivers now on the market may have any one of several high-voltage supplies that differ in principle as well as in detail

By E. J. BUKSTEIN

THE availability of cathode-ray tubes on the war surplus market and the expansion of television broadcasting have emphasized the need for obtaining the high d.c. potentials required for C-R tube operation. The potential required depends on the size of the tube: it may vary from 1,000 volts for the small 2-inch tubes to 30,000 volts for the tubes used in projection television receivers. There are several problems which do not exist in low-voltage supplies. Transformer insulation and inverse peak voltage ratings of the rectifier tubes are the most important.

Since the beam current of a cathode-ray tube normally runs well below a quarter milliampere, the need is for a high-voltage, low-current supply. This reduces the problem of filtering, because the amount of filtering necessary is a function of current drain. Since current requirements of the cathode-ray tube are very small, the filter condensers used in the high-voltage supply are considerably smaller in capacitance than those used in low-voltage supplies. However, the voltage ratings of these condensers are of great importance; they must be adequate to prevent voltage breakdown.

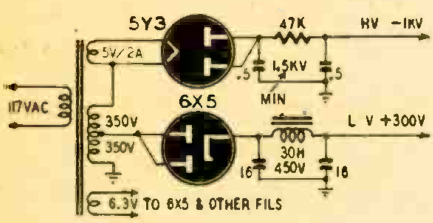


Fig. 1—A supply for a 2- or 3-inch C-R tube.

The supply shown in Fig. 1 utilizes an ordinary receiver-type power transformer and can develop approximately 1,000 volts. It is satisfactory for 2- or 3-inch cathode-ray tubes in television receivers or oscilloscopes.

The transformer used in Fig. 1 delivers about 350 volts r.m.s. each side of the center tap. Since the high-voltage secondary winding is grounded at one end, 350 volts is available at the center tap. The center tap is connected to a half-wave rectifier for the low-voltage supply. A good filtering system is necessary to reduce the ripple voltage sufficiently.

The *total* secondary value is 700 volts r.m.s., which is fed into a half-wave rectifier for the high-voltage supply. Note that the a.c. is fed into the *cathode* of the rectifier tube, resulting in a negative output from the high-voltage supply. This is quite conventional, as cathode-ray tubes are often operated from negative (grounded positive) power supplies. Because the cathode-ray tube will draw only a small amount of current, the voltage output is equal to almost the full *peak* value of the 700-volt input, or approximately 1,000 volts. Also, since the current drain is small, an R-C filter employing 0.5-μf condensers is adequate.

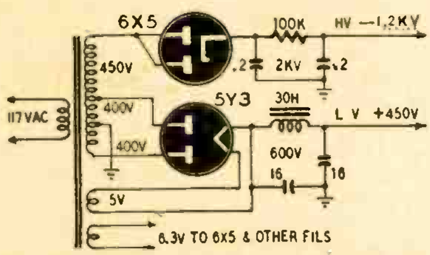


Fig. 2—Dual supply with special transformer.

The supply shown in Fig. 2, typical of those found in commercial oscilloscopes, requires a special power transformer. The high-voltage secondary winding is conventional except that it is continued at one end to give an additional 450 volts. The conventional portion of this secondary winding (400 volts each side of center tap) is connected to an ordinary full-wave rectifier circuit for the low-voltage supply. Here again the filtering should be adequate.

The top of the secondary is connected to a half-wave rectifier. The cathode is 850 volts (400 plus 450) above ground. Because of the small current drain, the output voltage is approximately the full peak value of 1,200 volts.

Five-inch cathode-ray tubes such as the 5BP1, 5CP1, 5CP7, 5UP11, etc., require high-voltage power supplies delivering approximately 2,000 volts. This voltage may be obtained from an ordinary receiver-type power transformer used in a voltage-doubler circuit (Fig. 3). Note that the center tap of the high-voltage secondary winding is not used. This permits use of the full end-to-end voltage, which will be in the order of 800 volts r.m.s.

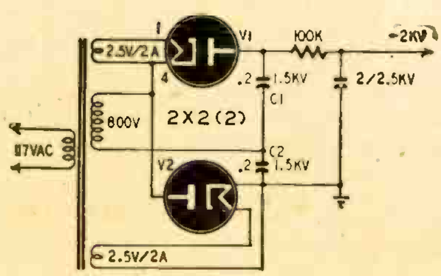


Fig. 3—A voltage-doubler gives 2,000 volts.

As the diagram shows, one end of the high-voltage winding is connected to the cathode of one rectifier tube and to the plate of the other. When this end of the winding is negative, tube V1 conducts, charging condenser C1. When it is positive, tube V2 conducts, charging condenser C2. Thus C1 charges on the negative alternations and C2 on the positive alternations. These condensers charge to the peak value of the a.c. input; and since they are connected in series, the total voltage across both of them is over 2,200.

A type of high-voltage supply increasingly popular in television applications is shown in Fig. 4. This is the r.f. power supply. It is equally useful for oscilloscopes. The only basic difference between this circuit and a conventional power supply is that r.f. is being rectified, rather than the usual 60-cycle line voltage. As shown in Fig. 4, the output of the r.f. oscillator is stepped up by an r.f. transformer. This high-voltage r.f. is then rectified and filtered in the usual manner. The magnitude of the output voltage is determined primarily by the design and turns ratio of the r.f. transformer. These transformers are commercially available in ratings as high as 50,000 volts. Filtering is comparatively simple. Since the ease of filtering depends on frequency, and since the ripple frequency in this power supply is equal to the oscillator frequency, small filter components can be used with a saving of money and space.

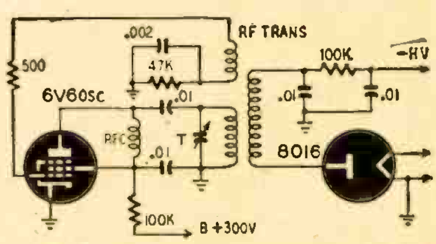


Fig. 4—R.f. supply needs little filtering.

Another very common type of power supply, the inductive kick-back type, was very fully described in RADIO-CRAFT in January, 1948, and will not be further discussed here.

COVER FEATURE

"FLYING SPOT" C-R TUBE

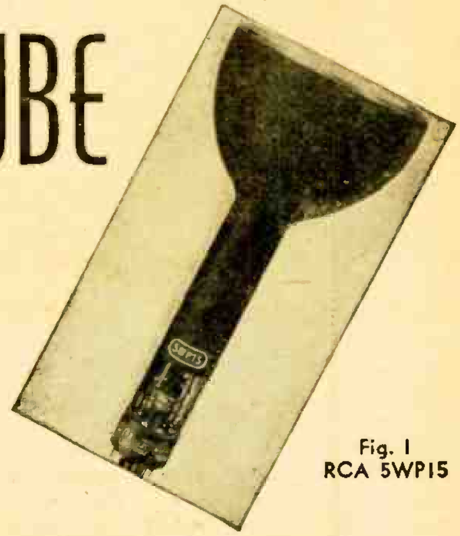


Fig. 1
RCA 5WP15

A new lantern for many television chores

TELEVISION station call letters, test patterns, and pictorial program material may be broadcast, without using expensive and elaborate studio cameras, with the help of the recently designed "flying-spot" cathode-ray tube shown on our cover. Any transparent or opaque slide can be transmitted with the half-tone fidelity of photographic film.

The new tube is not a camera tube, but is a source of light, and is very much like an ordinary cathode-ray picture tube. The extremely intense spot of light which travels over its face is projected through a transparent slide containing the picture. As the spot scans the slide, the light variations produced by the picture are picked up by a multiplier phototube and transmitted as video signals.

The tube, designated 5WP15 by its makers, the Radio Corporation of America, is shown in Fig. 1. It is about 11½ inches long, and the flat fluorescent face is 5 inches in diameter.

Fig. 2 shows how the tube is operated to transmit the picture from a transparent slide. The spot travels just as in the standard television system—525 lines interlaced, 30 frames per second.

The flying spot is focused on the slide, over which it travels, by the objective lens. As the spot passes through each portion of the slide, the transmitted light varies with the density of that portion of the picture. The light strikes a multiplier phototube type 931-A, whose output corresponds at every instant to the intensity of the portion of the slide picture being scanned. This phototube output is the video signal which is then sent to the transmitter for radiation.

RCA's Carolyn Tufts adjusts the tube's height.

The flying-spot principle is not new—it was one of the first systems of television transmission used in experiments. A rotating disc and light source produced the flying spot. It is, of course, much simpler and less expensive than an iconoscope. Until the development of the new 5WP15, however, an all-electronic flying spot was not used, due to several operating difficulties.

One of these troubles was "trailing." When a cathode-ray tube is made with most ordinary phosphors, there is an appreciable time delay in the buildup and decay of light. When the electron stream strikes a particular spot on the screen, a certain time is required for visible light to appear. If this held true in a flying-spot scanning system, the phototube would not receive the full amount of light as soon as the spot moved from a dark to a light area of the slide. The light would build up only gradually, and the received picture outlines would be blurred—the black areas would trail over into what should be a white area.

Decay of the light on a particular spot of the tube face also took time with the old-style cathode-ray tubes. If that were true in this system, the phototube would still be receiving some light after the spot had passed from a white to a black area of the picture. The white in the received image would then tend to trail over into the black. The trailing in previous systems could be remedied to a large extent by high-frequency equalization in the video amplifiers following the phototube. However, complex and costly equalizers would have to be used.

The new flying-spot tube uses a phosphor known as P15, which has extremely short persistence, to reduce trailing. In addition, most of the light emitted is near the ultra-violet region, in which persistence is much shorter than in the visible region. This reduces the trailing further. To achieve the maximum benefit, an optical filter is used to screen out all rays except the ultra-violet. This filter is shown between the condenser lenses and the phototube in Fig. 2. With this arrangement only one inexpensive high-frequency equalizer need be used in the amplifier to give a clear picture and an excellent signal-to-noise ratio.

This month's cover shows an actual system using the flying-spot tube. The engineer is adjusting the knob which sets the height of the tube for proper focusing of the spot on the slide, which is in the projector-type housing just above it. The phototube is mounted behind the slide, instead of the lamp which would be there in a slide projector.

On the same chassis as the slide housing is a video amplifier into which the output of the phototube is fed. Above that is a chassis containing a 20,000-volt power supply for the flying-spot tube and a scanning amplifier. Controls are provided for vertical and horizontal frequency, size, centering, linearity, and electrical focus of the spot.

At the top is equipment for synchronizing signal amplification and a 900-volt regulated supply for the phototube. A 350-volt supply is in the bottom of the rack. Ordinarily, this 7-foot rack, which contains everything necessary for operating the flying-spot transmission system, is covered with steel panels.

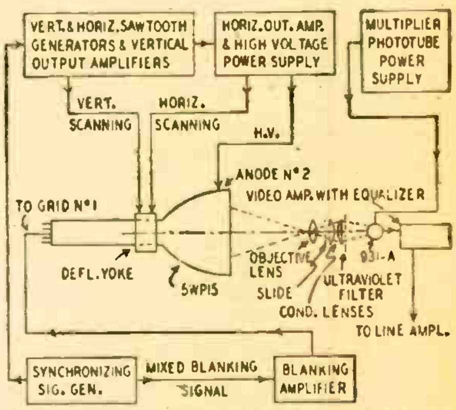


Fig. 2—Block diagram of flying-spot system.

When opaque pictures are to be transmitted, operation of the system is very similar to that used with transparent slides, except that the phototube picks up the light reflected from the picture instead of that passing through it. With opaque pictures, the signal is not quite as strong as with transparencies.

Interesting effects can be obtained using flying-spot scanning for pictures or titles used as program material. One picture, for example, can be superimposed on another. To do this, the flying-spot tube, instead of giving a constant-intensity light spot, is modulated by a picture signal. The light caused by this first picture, which appears on the tube face, is then transmitted through the slide to the phototube. The phototube output contains both signals, one superimposed on the other.

Radio-Frequency V. T. V. M.

Sloping-panel mounting improves appearance.

A valuable instrument for amateurs, radio servicemen, and constructors

By A. A. GOLDBERG

MANY radio measurement problems can be solved efficiently with an r.f. vacuum-tube voltmeter. For those who build their own receivers, the voltmeter makes accurate stage-gain measurements possible. It will show instantly if the local and beat oscillators are operating and with what efficiency.

Transmitter power output can be determined by measuring the voltage across a 75-ohm noninductive resistor connected to the output terminals. The power is then calculated by the formula:

$$W = E^2/R.$$

Adding a pickup stub or tuned circuit converts this voltmeter to a very sensitive field-strength indicator.

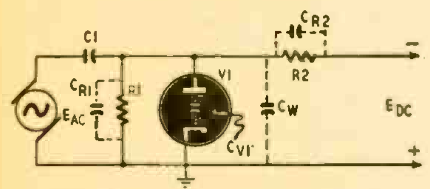
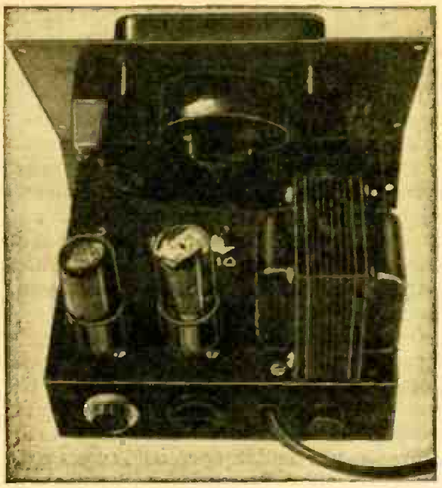


Fig. 1—Problems of h.f. voltage measurements.

The instrument is an a.c. voltmeter which reads accurately between two frequency limits. The low-frequency limit is determined by the input resistance-capacitance time constant, while the high-frequency limit is determined largely by the input shunt capacitance.

In Fig. 1, alternating voltage E_{AC} causes diode V1 to conduct on the positive half cycles only. During the negative halves, capacitor C1, charged to approximately peak voltage of E_{AC}, discharges through resistor R1. The time constant of R1 and C1, however, is so high that C1 loses very little of its charge before the next positive half cycle recharges it.

The longest R-C time constant consistent with the lowest frequency to be used is desirable since variable voltage at 60-cycles a.c. is usually the handiest



Rear view. The probe is connected at left.

available. Ordinary a.c. voltmeters (which are most accurate at 60 cycles) may be used as calibration standards. The R-C time constant is therefore made long enough to prevent excess charge from leaking off C1 to cause inaccuracies at 60 cycles.

Certain limitations prevent using a very large capacitor and resistor to make the R-C time constant extremely long. First, the capacitor must have very little leakage, which precludes the use of electrolytics and the larger paper capacitors. The physical size of the large paper capacitors also causes more shunt capacitance which reduces the high-frequency limit.

Capacitance is the most important high-frequency limitation. Any shunt capacitance appears as a reactive component in parallel with the normal input resistance. Since capacitive resistance decreases with frequency, a point is reached where the total input impedance becomes low enough to introduce considerable error. It is therefore im-

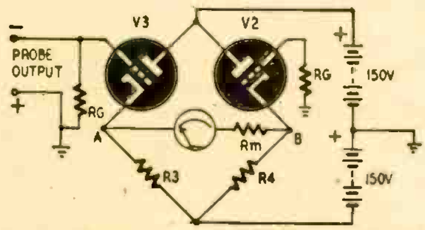


Fig. 2—Fundamental circuit of v.t. voltmeter.

perative to reduce the shunt capacitance to a minimum. These capacitances are the inherent resistor capacitance C_{R1} and C_{R2}, diode plate capacitance C_{V1}, and wiring capacitance C_w. The first two are minimized by using the smallest metalized resistors available. Using the 6AL5 miniature twin diode keeps capacitance C_{V1} small. Capacitance C_w can be kept within tolerable values only if extreme care is used in the construction of the probe.

The probe's voltage output can be fed only into an electronic d.c. voltmeter. An excellent circuit for this purpose is the balanced-bridge type, Fig. 2. The cathode-current drop across R3 and R4 causes the static cathode potential to be +5 with respect to ground. Since the grids are at ground potential, the resultant grid bias is 5 volts negative.

Under static conditions, the bridge is balanced and the voltage between points A and B is zero. If the probe output voltage is 100, the grid of V3 becomes 100 volts negative with respect to ground. This decreases the V3 cathode current until the voltage at A becomes —95 with respect to ground. As point B is still +5 volts, the difference between A and B will be 100 volts. If resistor Rm is 600,000 ohms, a 200 μa meter will read full scale.

The bridge circuit has several advantages: It is independent of plate-supply voltage variation. It is independent of tube aging, due to circuit degeneration. It protects the meter, if Rm is too small. Full voltage cannot build up across points A and B.

The actual circuit used is shown in Fig. 3. The second section of the 6AL5 is used to balance out contact potential on one grid of the 6SN7 by applying an equal contact potential to the other grid. Although it is not absolutely necessary, a contact-potential zero control has been provided. This control has a screw-driver adjustment and is mounted below the chassis.

The 6.8-megohm probe resistors are isolation resistors. The resistor between the plates of the 6SN7 prevents any possible parasitic oscillations.

The power supply delivers exactly 300 volts output. If any other power transformer is used, the 6,800-ohm resistor should be adjusted until the output is exactly 300 volts. Two 100,000-ohm 2-watt resistors divide the output into +150 and —150 volts.

There are five voltage ranges: 0-1, 3, 10, 30, and 100. These ranges suffice for most work in which an instrument of this type is used. Multipliers for each range are a combination of approximately 80% fixed and 20% variable resistors. The large variation range permits recalibration in case of tube changes and aging of parts. An a.c. outlet is provided at the rear of the chassis for use by other instruments.

Constructing probe and chassis

Instrument efficiency depends largely upon good engineering of the probe. This probe (Fig. 4) requires some lathe work, but the appearance and performance make it well worth while. For those who have no machine tools at their disposal, any local machine shop will turn out for a nominal sum the two simple parts required.

The body of the probe is made from a 3½-inch length of 1-inch outside diameter, thin-wall, dural pipe. Square the ends and remove the burrs. The plastic end is machined from a 2-inch length of 1-inch round polystyrene rod. Drill a No. 28 hole through the center of the plastic for a 6-32 brass screw. Measure the diameter of the .03-μf, 400-volt paper capacitor and bore half way through the polystyrene from the flat end to provide a snug fit when the capacitor is inserted. The rear plug is also made from polystyrene. It may be machined for a press fit into the dural tube to eliminate holding screws. Make sure the hole through which the cable passes is a snug fit.

Insert the front polystyrene part into the dural tube and drill three No. 42 holes, 120 degrees apart, through the dural and plastic. Remove the plastic and tap it for 4-40 screws. Enlarge the holes in the dural to clear the screws. The cable is triple-conductor with shielding braid and rubber covering over all.

A polystyrene socket is used with the 6AL5 tube to eliminate the inconvenience and danger of cracked glass. Solder the resistors as close to the socket as possible, but take care to prevent melting the plastic. Arrange the resistors and leads to support the tube coaxially with the metal probe shell.

The v.t.v.m. is built into a metal 8 x 8 x 8-inch, sloping-front cabinet which accommodates a 7 x 7 x 2-inch chassis. All components are placed for the shortest leads consistent with good wiring practice. The probe receptacle is in the rear directly behind the 6SN7-GT tube. A surface-mount-type power transformer eliminates the need for cutting a large rectangular hole in the chassis. The power transformer is placed as far as possible from the sensitive meter to avoid demagnetizing it.

Arranged across the middle of the chassis are the five multiplier potentiometers. The fixed-resistor portions of the multipliers are mounted on terminal strips.

The 4-inch square meter has two scales marked 0-10 and 0-30. These are for the 10-, 30-, and 100-volt ranges. The 1- and 3-volt ranges being nonlinear, corrected scales must be used with these two ranges for greatest accuracy. Although these scales can be drawn on the meter face, the author found it more convenient to mount separate correction curves on the front panel. The dial plate and correction curves were reproduced photographically.

Calibration

Calibrating the r.f. vacuum-tube voltmeter is simple. Any step-down transformer, Variac, or resistance voltage divider connected across the a.c. line can be used as a source of voltage. One convenient source of low voltage is a universal tapped output transformer. Before starting calibration, obtain a 6SN7 tube with close-matched triode elements, for a better-balanced bridge circuit. Also make sure that the cathode-heater leakage is low in both elements. One way to determine this is to measure the (hot) cathode-heater resistance at the tube socket with an ohmmeter.

Actual calibration is done as follows:

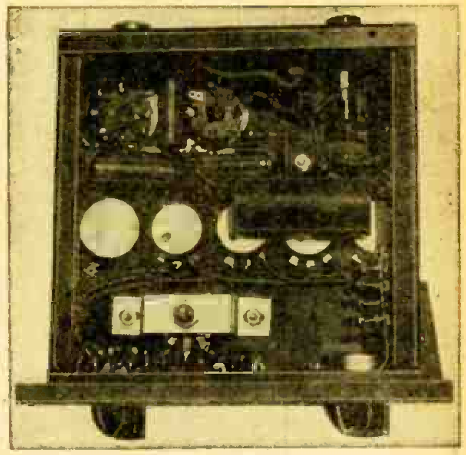
(1) Set the meter needle to zero with the meter-zero screw.

(2) Turn the instrument on and allow about 30 minutes for warm-up.

(3) Disconnect the probe from the chassis, and temporarily connect a 20-megohm resistor from the pin No. 4 grid of the 6SN7 to ground.

(4) Set range switch on 1-volt scale and zero the meter with the front-panel zero control.

(5) Reconnect the probe and remove temporary grid resistor.



Bottom view shows how the parts are placed.

(6) With the contact-potential zero control beneath chassis, zero the meter once more. This adjustment balances the diode contact potential.

(7) With range switch set at 100 volts, feed approximately 80 volts to the probe input. Adjust the calibration control until meter reads correctly. Calibration at the 80% point is the best compromise for any possible error.

(8) Calibrate the 30- and 10-volt scales in a similar way.

(9) Because of nonlinearity in the 3- and 1-volt ranges, plot a correction curve of voltage input versus meter reading. This curve may later be transferred to the meter scale, if desired.

(10) Place a dab of coil cement on the multiplier potentiometer shafts to prevent accidental turning.

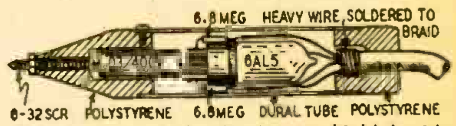
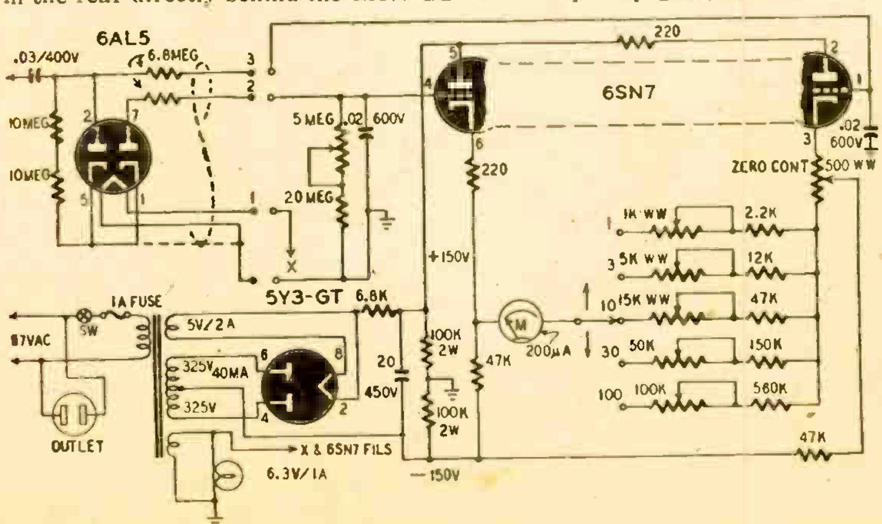


Fig. 4—Ground dural tube to shield braid.

The input capacitance of the probe is 8 μμf. This capacitance may become bothersome at very high frequencies. One way to lower it and raise the input impedance is to connect a 390-ohm metalized resistor in series with the probe. This impairs accuracy slightly, but where the meter is used solely as a peaking device little is lost.



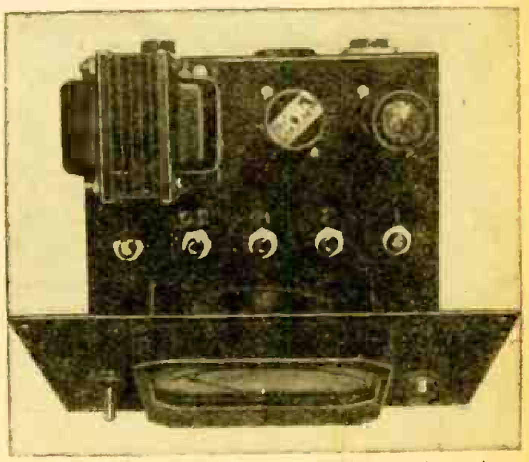
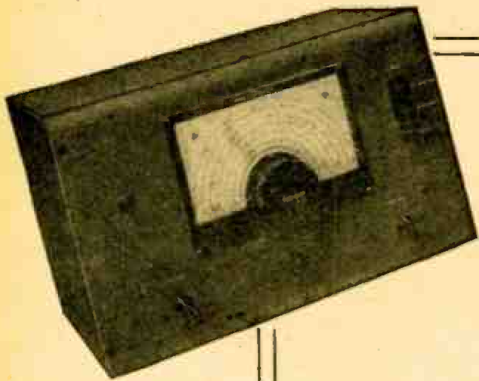


Fig. 3—Complete schematic of the r.f. instrument. Probe connections are 1, 2, 3, and ground.

Top view. The pots are screwdriver-adjusted.



AUDIO OSCILLATOR HAS SINGLE CONTROL

By RICHARD D. HENRY

THIS audio test generator is simple to operate, easy to build, and inexpensive. It is tuned with a single variable resistor, rather than the usual ganged capacitors or potentiometers. No accurately-matched fixed resistors or capacitors are needed. Only two tubes are used, in addition to the power-supply rectifier. Output level is constant within 2 db from 40 to over 12,000 cycles. Wave form is as pure as that of the best R-C oscillators, which means that almost perfect sine waves are produced.

The circuit, adapted from one published in *Wireless World*, a British magazine, uses a modified parallel-T frequency network. Instead of the special lamps used as cathode resistors in most R-C oscillators to keep output constant, this model employs an amplifier for the purpose.

The diagram is given in Fig. 1. The 6SN7 is a 2-stage feedback amplifier. The frequency-determining components are shown within the dashed box. A 3-circuit 2-position switch selects one of two ranges. The lower covers 40 to 850 cycles, and the higher 850 to over 12,000. R1 is the frequency-control potentiometer and R2 is a trimmer used to adjust the ranges so that they overlap. R1 is a standard audio volume control. Do not use a control with a linear taper, as this will crowd the high end of the scales. The four capacitors used in the frequency network and the two 22,000-ohm resistors need not be matched; they need be only roughly equal to the values shown.

The coupling method used between the two sections of the 6SN7 is interesting. The right-hand grid is grounded for audio through a 0.1-μf capacitor. The 5200-ohm cathode resistor (common to both cathodes) is unbypassed. Audio voltage appears across this as the result of audio changes in the plate current of the left triode.

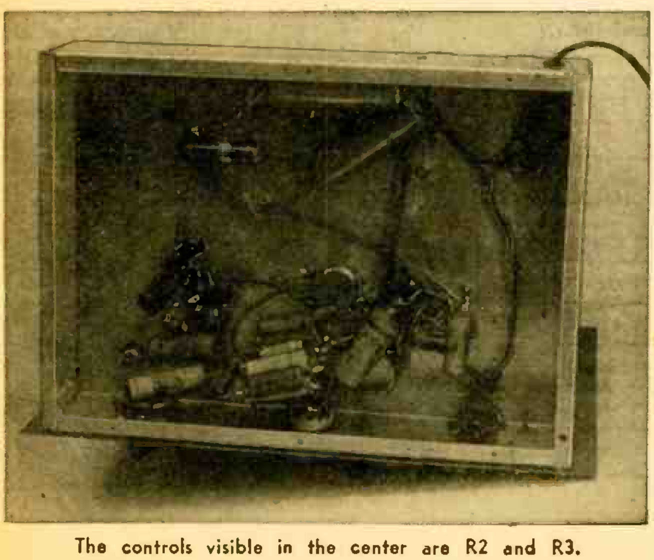
All that is required to modulate a tube is an audio voltage between its grid and cathode. Usually the voltage is placed between the grid and ground, with the cathode grounded for audio. Here the cathode-resistor voltage appears between the right grid and cathode, but the *grid* is grounded. Such grounded-grid amplifiers are often used today, but usually at v.h.f. and u.h.f.

If the 3,000-ohm variable resistor R3 were reduced to zero, both plates would be at ground potential for audio, due to the bypass capacitor C1. Increasing the resistance of R3 places the right-hand plate slightly above ground, allowing a small output voltage to appear between the plate and ground. This voltage is returned to the frequency-determining network as positive or regenerative feedback. The resistor value is increased until just enough feedback voltage is created to cause oscillation. Too much feedback would spoil the waveform. The amplifier is then kept at the same output by the large grid and cathode resistors. To help equalize the gain of the two triodes, most of the grid resistance is common to both.

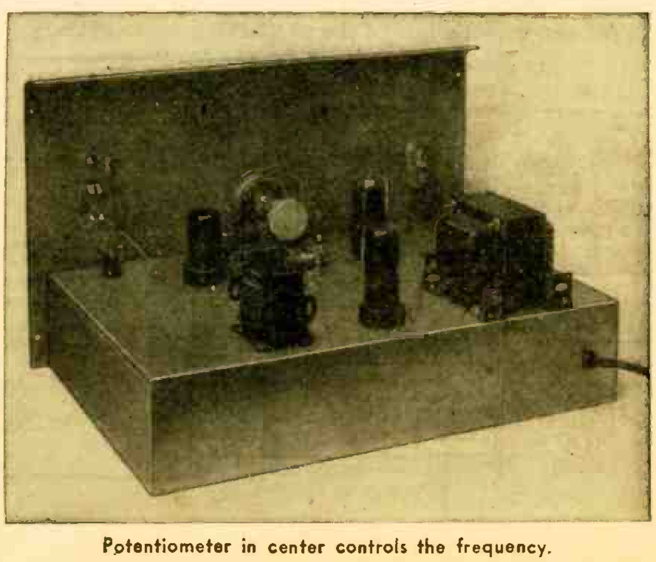
Output is taken from the same plate that supplies the feedback. The two 10,000-ohm resistors are a voltage divider, and the voltage taken from between them is R-C-coupled to an ordinary 6J5 amplifier. Although useful output can be taken directly from the 6SN7, the 6J5 prevents a low-impedance load (or one that is not entirely resistive) from having any effect on the oscillator. It also gives a larger output voltage. The output side of the 6J5 is conventional, but it adds the convenience of a low-impedance tap. R4 is the output volume control.

Construction details

The 15 x 11-inch metal cabinet was on hand, so a 3-inch-high chassis to fit it was procured. This is really much bigger than necessary; a smaller housing and chassis would give plenty of



The controls visible in the center are R2 and R3.



Potentiometer in center controls the frequency.

room for the few components, yet leave more room on the test bench for such other essential items as the amplifier or receiver under test.

The chassis-top view shows the tube layout. The 6SN7 is at the front of the chassis on one side and the 6J5 is on the other. At the rear are the rectifier tube, the power transformer, and the filter choke. If a smaller chassis is used, be sure to separate the two inductors as much as possible from the 6SN7, since the oscillator will tend to lock in with the power supply frequency if there is any hum pickup. The tuning resistor, R1, is mounted on an angle bracket about two inches behind the panel. R3 is beside R1, R2 behind it. Both of these are screwdriver-adjusted.

The under-chassis view shows the parts layout. There is nothing critical here although if leads are too scrambled there may be some instability or undesired oscillation. In the model, the leads from the range switch (which is concealed by the resistor-capacitor mounting board in the photo) were scrambled, but a 100-μμf capacitor, C2 in Fig. 1, stopped all trouble. This capacitor may not be necessary in other models. Use no shielded leads.

The dial is a National ACN, again because it happened to be on hand. It poses a slight problem, since it provides for only 180 degrees of rotation, while the tuning potentiometer, of course, has a 270-degree range. This problem is solved as shown in the following paragraphs.

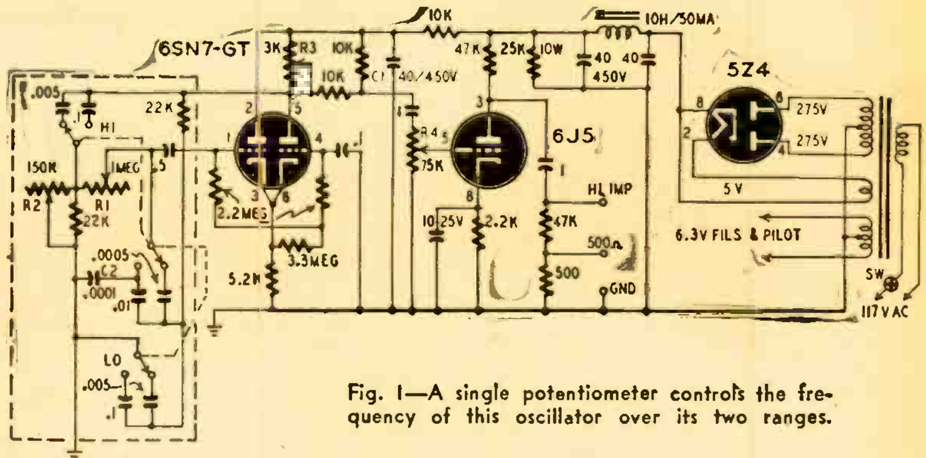


Fig. 1—A single potentiometer controls the frequency of this oscillator over its two ranges.

Adjustment

After the unit is built and voltages are checked, let it warm up for a few minutes, then set the range switch for the low frequencies. Set R1 in the middle of its range, then slowly increase the resistance of R3 until a tone is heard. Rotate R1 over its range with the switch in both positions. Advance R3 until oscillation is smooth at all times and until an a.c. voltmeter placed across the high-impedance output terminals shows that the ratio of minimum to maximum voltage output at the lowest- and highest-level points does not exceed about 1:1.25 (2 db).

R1 should be connected so that frequency rises with counter-clockwise rotation to take advantage of the taper and spread out the high frequencies. If the ACN or some other 180-degree dial is used, set the switch on the low range and turn the pot slowly to the left. Notice that during the last several degrees of rotation, there will be very little change in frequency. Leave the potentiometer set at the point where the frequency change becomes very slow. Set the dial to the left end of the scale, then tighten the setscrew.

Now see if the lowest note of the top range is lower than the highest note of the bottom range. If not, note the lowest note of the top range, retune to the highest frequency of the low band, and decrease the value of R2 until the frequency is high enough to give overlap. R2 will not have much effect on the lower frequencies of each band, but will extend the highest frequencies. In effect, therefore, it extends the coverage of each range. Do not make R2 any smaller than necessary for adequate overlap. It may be necessary to readjust R3.

Calibration

Calibration is best done with the aid of a borrowed oscillator with accurate frequency markings, and an oscilloscope. Feed one oscillator to the vertical input of the scope and the other to the horizontal input. Set the borrowed oscillator to 50 cycles, then slowly adjust the new one until a stationary O appears on the scope, indicating that the two oscillators are tuned to exactly the same frequency. Mark this frequency on the dial scale, then go through the rest of the range in the same way. Depending on the precise phase relationship of the two oscillators, the O may be slanting.

If the calibrating oscillator is not continuously variable, the known and unknown frequencies can be fed into the scope and the resulting Lissajou's patterns used to determine the harmonic relationship existing between the two oscillators. Adjust the oscillator to be calibrated so the oscillographic pattern stands still. Count the number of peaks or loops touching the vertical and horizontal axes. The ratio of the numbers is the same as the ratio of the two frequencies.

Calibration by ear is not too accurate, especially at the higher and lower frequencies. In a pinch, however, it can be done. If another oscillator is not available, a piano can be used for a rough calibrator. Middle A is 440 cycles and each octave doubles the frequency.

A scope can be used, of course, without another oscillator, to give multiples of the line frequency.

Impedance Measuring Methods

By RUFUS P. TURNER

A WELL-KNOWN arrangement for measuring impedance requires only a decade resistance box (or calibrated variable resistor), high-impedance a.c. vacuum-tube voltmeter, audio oscillator, and s.p.d.t. switch. The connections for the test circuit are shown in Fig. 1.

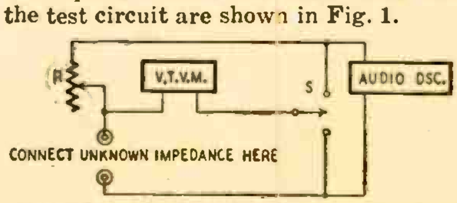


Fig. 1—A standard impedance-measuring setup.

The test procedure is to throw the change-over switch S back and forth, at the same time adjusting the calibrated resistor R. When the meter deflection shows no change as the switch is thrown from one position to the other, the unknown impedance is equal to the resistance of R and may be read directly from the resistor dial.

This scheme is widely used, and presents no difficulty when either the voltmeter or the oscillator is battery-operated. However, when both of these instruments are a.c.-operated (and especially when they are bypassed internally to the power line), difficulties arise because different points in the test circuit are effectively at ground potential. This has the effect of placing a shunt loop around either the unknown impedance or the calibrated variable resistor.

The circuit shown in Fig. 2 overcomes this difficulty by providing a single ground point which is common to both instruments and to the test circuit. The test procedure when using this circuit is somewhat different. Throw switch S back and forth, adjusting the calibrated resistor R. Stop the adjustment when the voltage read with the switch at position A is exactly one-half the voltage at position B, and read the unknown impedance value from the dial of the calibrated resistor.

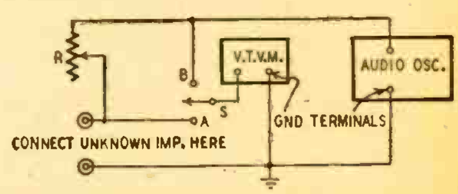
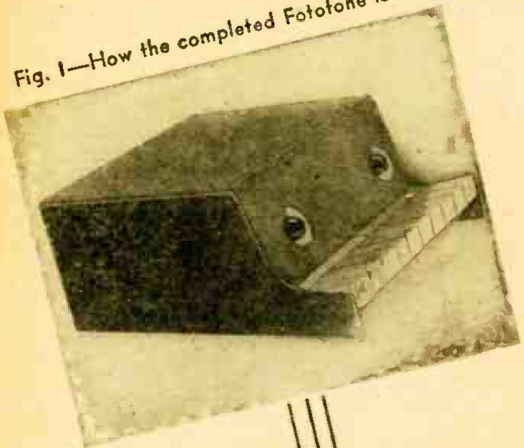


Fig. 2—Improved impedance-measuring method.

Fig. 1—How the completed Fototone looks.



Electron Music With the Fototone

A ten-keyed instrument which uses tone wheel and photoelectric tube

By LYMAN E. GREENLEE

THE Fototone is an unusual musical instrument which—as its name implies — uses the photoelectric principle to produce tones. It is shown in Fig. 1. This case contains the keys, the mechanism, the photocell, and two controls—tuning and volume.

Fig. 2 illustrates the principle by which the instrument operates. A tone disc (shown in the photo, Fig. 3) consists of 10 concentric rings of black diamond-shaped spots. The spots are equally spaced within each ring, but the number of spots—and the spacing between consecutive spots—in each ring is different.

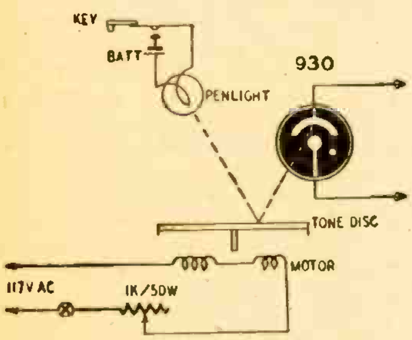


Fig. 2—Reflected light excites phototube.

To return to Fig. 2, the disc is rotated by a motor. The spot of light from a small flashlight lamp is centered on one of the concentric rings. A photocell is placed where the reflection of the light will hit it. When the disc revolves, the reflection of the light from the disc will not be steady; each time a black spot comes under the light spot, there is no reflection. The reflected light pulsates, the pulsation frequency depending on the number of black spots passing under the light spot in a given time.

The photocell picks up these pulsating reflections. Output of the cell is amplified and fed to a loudspeaker, where the pulsations appear as audio tones.

The tone disc is designed so that if the light spot is centered on the inner ring and motor speed is adjusted so that the note produced is C, the succeeding rings will give succeeding notes of the C-major scale. Since there are 10 rings, the highest note will be E of the next octave. If motor speed is changed so that the lowest note is D, for example, the other notes will form a D-major scale, ending at F-sharp.

In the actual instrument there are 10 separate lamps, each positioned to beam a small spot of light on one of the concentric rings of black spots. The photocell is so placed that all light reflections from the disc will reach it. The tone produced then depends on which lamp is lighted. The keyboard holds 10 keys, each of which is a momentary-contact switch connected to one of the lamps.

Fig. 4 shows the top of the Fototone with the cover removed. The vertically-mounted chassis at the rear contains the preamplifier and wireless oscillator (described later). On its front are the oscillator-rectifier-amplifier tube socket (left) and the phototube socket (right). The lamps are mounted, five in each of two brass holders, so that their light will shine down through the oblong hole on the tone disc revolving underneath.

At front center the motor is mounted upside down so that its shaft goes through the Masonite base. The tone disc is attached to the shaft just under the base with the spots facing up. At the front left is the rheostat which controls motor speed, and at the right the volume control.

> A tone-wheel cannot be printed without some distortion due to the curved plates used in printing any large magazine. Therefore the authors have arranged to supply accurate discs at a cost of $1.00. A complete set of blueprints will be supplied with each disc. Address Lyman Greenlee, c/o RADIO-CRAFT, 25 West Broadway, New York 7, N. Y., enclosing a $1.00 postal note.

Layout for each of the lamp holders is given in Fig. 5. The metal used is thin sheet brass. After drilling the holes accurately, nick them as shown with a small file or hacksaw, and then roll the corners of the nicks in opposite directions to form a rudimentary thread,

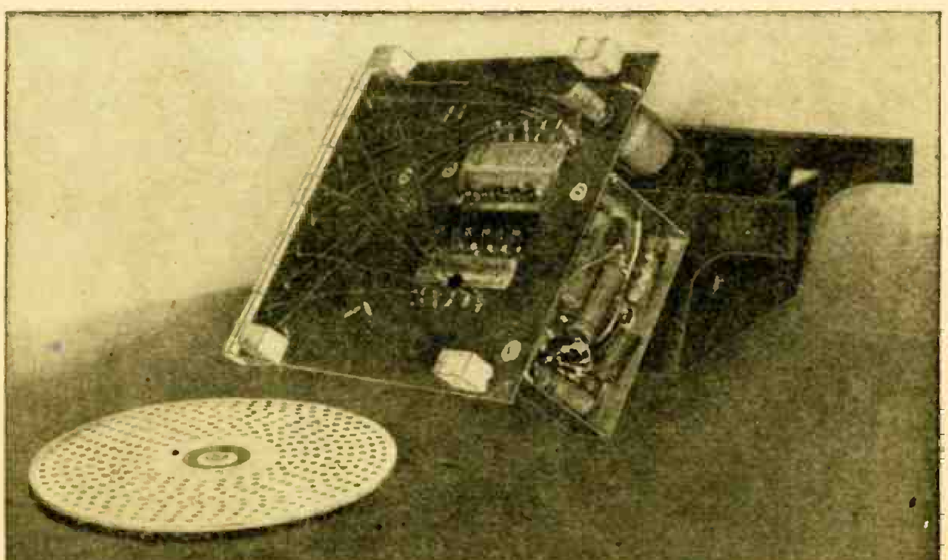


Fig. 3—Bottom view of the Fototone, with the tone disc shown in the left foreground.

the corners engaging in the threads of the flashlight lamps. Bend the strip of brass in the center along the dashed line. The unpunched half will go under the Masonite base, over the edge of the oblong hole to fasten the lamp holder in place.

The layout for the Masonite base is given in Fig. 6. Reference to Figs. 3 and 4 will show what each hole is for. No holes are shown for the motor, since this will depend on the particular motor used. Any motor whose speed can be varied by a series rheostat is satisfactory. Mounting holes for the chassis are likewise omitted. The lettered holes at bottom are for the 10 key contacts. These are brass rivets or screws, which should be put in place before the keyboard is attached.

Each key is made as in Fig. 7-a. The top is Masonite and the end is wood.

Cut, drill, and slot a piece of bronze weatherstripping, as shown in Fig. 8, to make the key contact strip. Mount it to the base with a ⅝ x 9-inch strip of Masonite to hold down its rear edge.

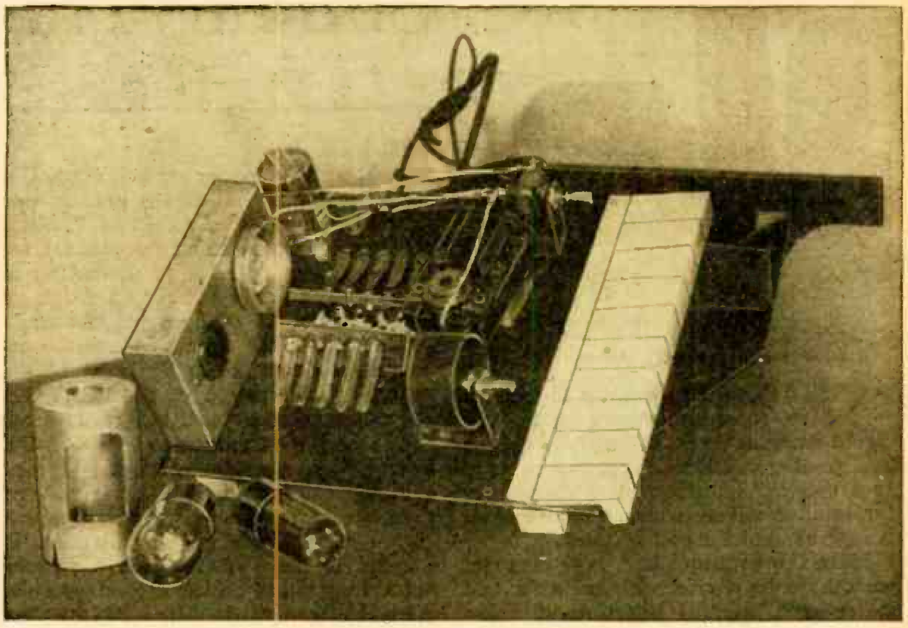


Fig. 4—Top view, showing lamp mountings. Inside of phototube shield should be blackened.

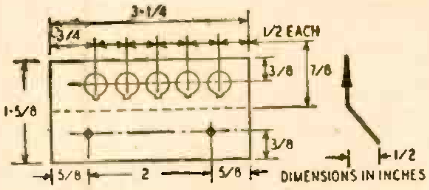


Fig. 5—Each holder takes 5 screw-base lamps.

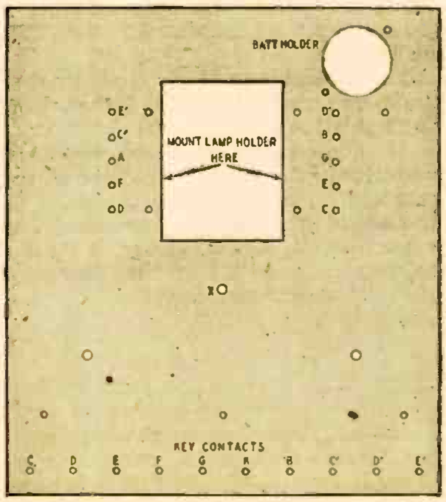


Fig. 6—The motor shaft projects through "X".

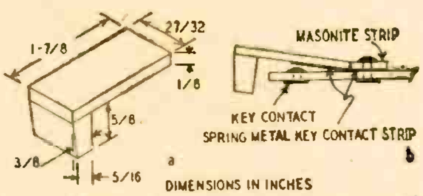


Fig. 7—Keys are constructed as in a and mounted on contact strips as shown at b.

This Masonite strip is shown in a side view in Fig. 7-b. Now bend up each of the 10 projecting strips so they do not touch the key contacts which are on the base. Using Duco or a similar cement, fasten a key to each strip. Refer to Fig. 7-b for the completed arrangement.

Figs. 3 and 4 show how the lamps are mounted in their two brackets. The brackets are a common contact for all the base shells, and strips of spring metal contact the tip of each lamp.

One side of the battery is connected to both brass lamp holders. The other side is wired to the bronze contact strip for the keys. Then each key contact (the rivet or screw mounted under the key on the Masonite base) is wired to the brass strip which contacts the corresponding lamp. Note from Fig. 6 that the lamps are staggered (C on the right, D at left, etc.). The letters indicate the notes for each key and lamp; correspondingly lettered studs and lamp contacts should be wired together. When the lowest key is pressed, the front right-hand lamp should light, and so on.

Now prepare the tone disc. Past experience has shown that this cannot successfully be duplicated from a magazine illustration; the authors will, therefore, supply discs at cost. See box on page 30.

Be very careful not to crease or bend the disc. Get an 8-inch aluminum-base instantaneous-recording disc ("acetate") and remove the black lacquer coating by immersing the disc in warm water for a while before peeling off the coating. The aluminum disc can be cut from sheet stock; but if this is done, the center hole must be very accurately placed.

Paste the photographic print of the tone disc on the aluminum, being extremely careful to match the center of the print to the center hole of the aluminum. Use Duco cement or something similar, but don't use too much. The finished disc *must be absolutely undistorted,* with no lumps, wrinkles, or other variations.

The motor shaft should project down through the Masonite base in the hole marked X in Fig. 6. Disassemble the motor and thread the end of the shaft, either on a lathe or with a die. After reassembling the motor and mounting it atop the base, fasten the disc to the shaft with a pair of nuts. Adjust the entire motor and disc mounting so that the disc will run true without wavering.

Each lamp is coated with black paint except for a small clear spot at the tip.

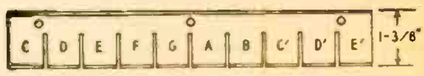


Fig. 8—Cement keys to contact strip.

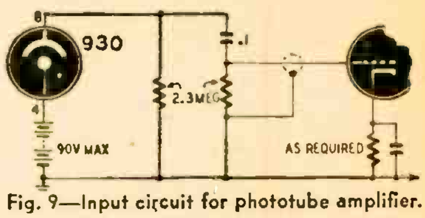


Fig. 9—Input circuit for phototube amplifier.

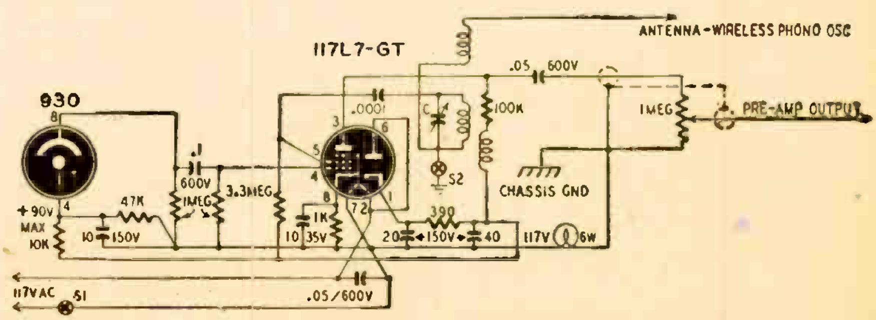
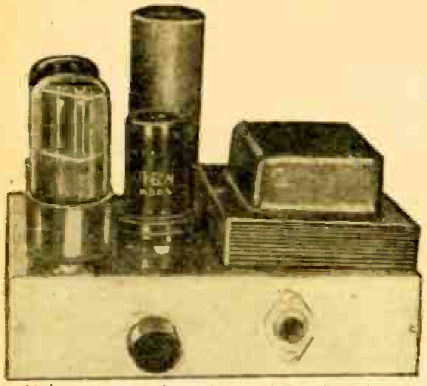


Fig. 10—A standard 3-winding phono oscillator coil is used. Bleeder supplies bias for 930.

Simple Tracer-Amplifier

By HOMER L. DAVIDSON



Volume control projects through cabinet.

CONSTRUCTED primarily to test defective record changers and as a signal tracer, this small utility amplifier has greater possibilities. It can be used as a small PA system, as an amplifier for small receivers when greater output is desired, and for call systems.

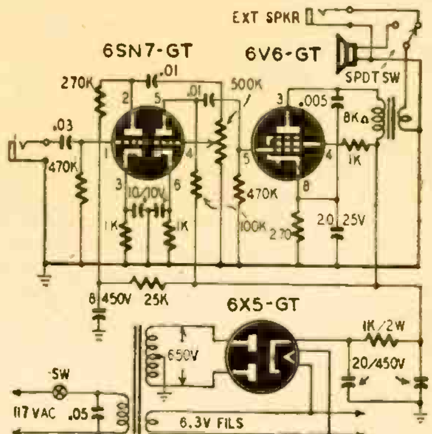
Since the amplifier had to be compact enough to be carried around as a test instrument, careful selection of tubes and parts was necessary. It was constructed on a 4 x 6-inch chassis. The cabinet is 5¾ inches in height, 6⅛ inches in width, and 4½ inches deep. A small 650-volt, 50-ma power transformer with only two secondary windings was used.

Starting with the input (see diagram), a .03-μf paper capacitor couples the incoming signal to the grid of one of the triode units of a 6SN7-GT. Since this amplifier is used as a signal tracer, the blocking capacitor is needed when checking the audio signal in a defective receiver where B-voltages are present.

The amplified signal is resistance-capacitance-coupled to the grid of the second triode section of the 6SN7-GT. A half-megohm volume control is used.

The power output stage is a 6V6-GT beam-power amplifier with the screen-grid operating at a little lower voltage than the plate. An output transformer (8,000 ohms primary impedance) is coupled to the 6V6-GT with a switching arrangement on the secondary side. With this the built-in 4-inch PM speaker can be put in circuit when the unit is used as a signal tracer or small amplifier. For PA work or for testing record players, the secondary is switched to an external 8-inch speaker enclosed in a baffle. There is a phone jack at the rear of the amplifier for the latter.

Surprisingly good results are obtained with the simple R-C power supply filter. Hum is negligible even with the larger speaker. Both sections of the filter capacitor and the 6V6-GT cathode bypass are in the same can, mounted next to the power transformer, as the chassis photo shows, to eliminate overcrowding.

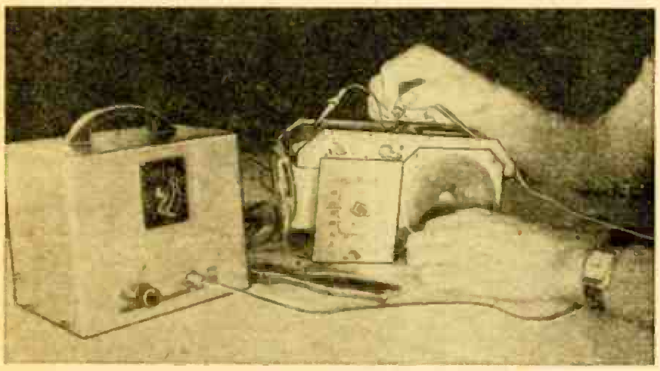


This circuit is simple and easy to build.

The chassis was made from a 7 x 10-inch sheet of aluminum. After corners were cut out and the necessary holes made, the sheet was bent to form a chassis top 6 x 4 inches with sides 1½ inches high.

The cabinet was made from another aluminum sheet 16 x 17⅝ inches, bent to form a bottomless cover.

The audio-tracing test lead consists of a shielded cable with a test prod at the end and an alligator clip connected to the shield for ground connection. The other lead, for signal tracing, is similar to that on page 50 of the February, 1948, issue of RADIO-CRAFT.



The author uses the amplifier to check a small receiver. The built-in speaker is in the top under the handle. Rows of ⅛-inch holes let sound come through. The switch in the center selects the built-in speaker or leads to the external speaker. It is a 2-position switch.

ELECTRON MUSIC

(Continued from preceding page)

Adjust the position of each so that it illuminates only one circle of black spots on the disc. It should throw almost no light on any other ring.

That about completes the mechanical construction of the Fototone. It should be mentioned that when the chassis is made up, its most important mechanical detail is the placement of the phototube socket so that it will position the tube directly over the oblong hole through which the tone disc is visible. See Fig. 4.

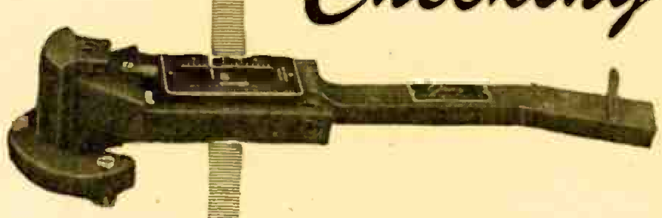
The basic circuit for connecting the 930 phototube to the first tube of an amplifier appears in Fig. 9. If a PA amplifier is used, the microphone channel will be needed, since the phono input will not give sufficient gain. For connection to the a.f. system of a receiver or to a straight phono amplifier, a preamplifier will also be needed. If a special amplifier is built for the Fototone, it should have enough gain to give good results with a crystal microphone. Good results may sometimes be obtained with lower-gain amplifiers, if the lamps are 2.2-volt types and two flashlight cells are used.

Fig. 10 is a combination preamplifier and wireless oscillator which may be used. With it, either photocell output can be picked up on a nearby broadcast receiver or the receiver's audio system can be connected directly. The oscillation can be stopped by opening S2. S1 is mounted on the preamplifier volume control. The 6-watt lamp is a safety device; if the preamplifier is connected to an a.c.-d.c. receiver and the lamp lights, reverse the a.c. plug of either the receiver or the Fototone.

After making up whichever variety of circuit is desired—oscillator-preamplifier or a complete amplifier—mount the chassis on its side at the rear of the Masonite base. The phototube shield shown in Fig. 4 may or may not be necessary, depending on the hum present. It does no harm in either case because it also shields the tube from any unwanted light. Paint the inside of the shield black, using a flat paint.

The rheostat used to control motor speed in the original model was as shown in Fig. 2, but, depending on the motor used, it may be different. In the model, this rheostat allowed speed variations from about 50 to 1200 r.p.m., which was enough to give a range of five octaves, more than enough for any purpose.

The cover and music rack can be designed to the builder's taste. It need only be a box of Masonite with the right dimensions to allow it to be slipped over the completed instrument. Those who wish to duplicate the original model exactly will be able to use the blueprints which the authors send with the tone disc.



Courtesy Gray Research & Development Co.

Checking Performance of Phono Pickups

By RICHARD H. DORF

FEW sound men can deny that for many years the reproduction of phonograph records has been a very haphazard affair. Following the usual procedure, the constructor walks out of his distributor's store with any one of the crystal pickups available for under ten dollars, connects its two leads to the phonograph input of his amplifier or receiver, and starts listening to records.

The results are generally far from ideal from the standpoints of frequency response, record wear, and distortion, among other things. In commercial home radio-phonograph combinations, the reason for this lack of perfection is principally that each extra penny spent in production counts. In specially built equipment it is a lack of knowledge. In this article, we hope to supply much of that knowledge from a practical standpoint.

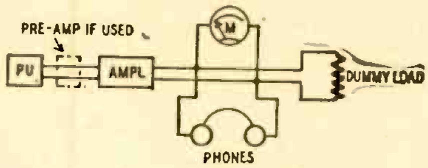


Fig. 1—Setup used in checking phono pickups.

First let us scotch the rumor that "phonograph records don't contain anything above about four or five thousand cycles anyway." The more recent records of the better manufacturers have a very usable response up to at least 8,000 cycles, and, in very many cases, records are good up to a full 10,000 cycles. The response is smooth within this range, and, with proper equalization of one of the modern pickups, performance approximating a live FM broadcast may be expected. Even surface noise will be almost unnoticeable.

The frequency response of records is not uniform throughout this range. This is not a fault, but, rather, a technical necessity.

During recording, stylus travel is greatest at the low frequencies. Volume at the low end of the range must, therefore, be reduced to prevent the stylus from cutting over into adjacent grooves. That makes some bass boost necessary in playback.

Most surface noise or scratch is in the high-frequency range. Record makers boost the highs during recording to get a favorable music/noise ratio. To restore the proper balance the highs must be reduced during playback. While restoring the musical balance, this reduction of highs brings the surface noise down, too.

The equipment necessary for measuring and adjusting a phonograph system includes:

1. Frequency test records. Several are available, but for purposes of discussion we shall use the Columbia 10003-M and 10004-M discs.
2. An output meter (a.c. voltmeter) of good frequency characteristics, preferably, but not necessarily, calibrated in decibels.
3. A supply of semilogarithmic graph paper, 3 cycles by 10 divisions.

The amplifier should be a good one with flat frequency response and low

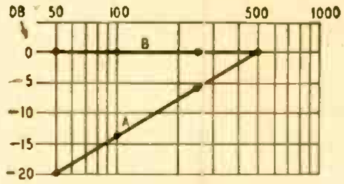


Fig. 3—Ideal *vs.* curve of magnetic pickup.

distortion. The pickup arm should be adjusted if possible to the recommended stylus pressure. No change should be made in stylus pressure after measurements are completed, since any change will alter the high-frequency response of the system. (Usually, the greater the pressure, the less the high response.) The loudspeaker should be replaced with a dummy load resistor equal to the output impedance of the amplifier. Connect the output meter across the resistor. High-impedance headsets for listening to the test record may be connected across the resistor also. The setup is shown in Fig. 1.

The low frequencies

In American-made recordings, the low-frequency band extends from about 50 cycles up to a turnover frequency of about 500 cycles. American records should be equalized with the Columbia 10004-M tone record, which has a 500-cycle turnover. In European discs, the low range ends at about 300 cycles. They should be equalized with the 10003-M, which has a 300-cycle turnover. Use of the American characteristic and the 10004-M disc is recommended, at least at first; the final complete equalizer can be made variable to accommodate both types of record.

Set the needle on the 500-cycle band. Adjust amplifier gain until the output meter gives a reading on some even division. Make a note of the reading. (We assume that the meter is calibrated only in volts.) This reading is now known as the *reference voltage*. It corresponds to zero decibels on the graph to be made.

Starting at the 500-cycle band, play the remainder of the record, the frequencies from 500 down to 50 cycles. As the meter comes to rest for each frequency, make a note of the reading. Then convert these voltage readings to decibels in the following manner:

If, for example, the reading for 250 cycles was 3 volts, and that for 500

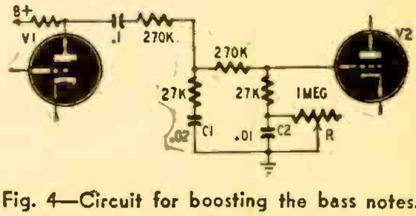


Fig. 4—Circuit for boosting the bass notes.

cycles (the reference voltage) was 6 volts, divide the larger number by the smaller. 6/3 equals 2. The 2 is the *voltage ratio* between the reference reading (at 500 cycles) and the 250-cycle reading. Find the number 2 under "Voltage Ratio" Fig. 2. Opposite it, in the decibel column, is the number 6. This indicates that the system output at 250

Voltage Ratio	Db	Voltage Ratio	Db	Voltage Ratio	Db	Voltage Ratio	Db
1.06	0.5	1.58	4.0	3.55	11	7.94	18
1.12	1.0	1.68	4.5	3.98	12	8.91	19
1.19	1.5	2.00	6	4.47	13	10.0	20
1.26	2.0	2.24	7	5.01	14	12.6	22
1.34	2.5	2.51	8	5.62	15	15.8	24
1.41	3.0	2.82	9	6.31	16	20.0	26
1.50	3.5	3.16	10	7.08	17	25.1	28

Fig. 2—The table of voltage-decibel ratios above is sufficient for pickup measurements.

cycles differed by 6 db from that at 500 cycles. It was, of course, lower, so place a dot at —6 db on the graph paper at the 250-cycle division, as in A of Fig. 3. The dot on the zero-db line at 500 cycles indicates the reference voltage, corresponding to zero decibels.

After determining the decibel equivalent for each of the frequencies, and placing corresponding dots on the graph, connect the dots with a pencil line. A in Fig. 3 shows the resultant curve from a perfect magnetic pickup through a perfect amplifier. Notice that the volume level decreases as the frequency gets lower. Bass boost will have to be used to bring up the lows.

The B curve of Fig. 3 shows output from the same record, using the same procedure but with a perfect *crystal* pickup. Because crystals have different characteristics from magnetics (they

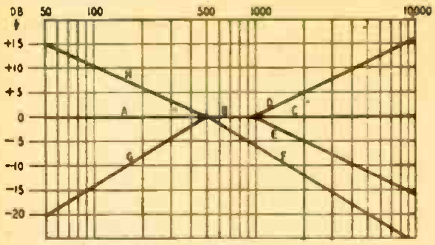


Fig. 5—Recording and compensating curves.

work exactly opposite), the bass will be reproduced properly, but the highs will need boosting.

No matter what type of pickup is used or how the original curves turn out, the object is to get flat output at the low end of the range. After equalization, a curve taken on the system should look like B (Fig. 3).

Output from most pickups will be very much like the curves shown, except that arm effects may be present. The arm in which the pickup is mounted is very important. Like any solid object, it has a mechanical resonant frequency which causes a large "hump" in the curve. Unfortunately, nothing can be done about it except to buy one of the better arms with a resonance frequency below audibility. If that is not possible, then equalization must be adjusted for a compromise.

The next step is to insert equalizer circuits to correct whatever deficiency is shown in the graph. For the magnetic-type pickup of A (Fig 3), for instance, bass boost must be used to counteract the drop shown. Fig. 4 shows a typical bass-boost equalizer. C1 and C2 determine the frequency at which the boost begins (the turnover frequency). The 270,000- and 27,000-ohm resistors control the approximate amount of boost. R is used for fine adjustment of the amount of boost. The circuit values shown will be about right to compensate for American records played with a good magnetic-type pickup. In effect this is a bass-boost equalizer, but it really does its job by reducing the middle and high frequencies. Inserting it in an amplifier will reduce the total gain of the amplifier considerably, and an extra stage will probably be necessary.

Often when using a crystal pickup nothing need be done about the low frequencies. If adjustment is needed, the load resistance into which the pickup works can be changed. Increasing this gives more bass; decreasing it reduces bass.

It is not possible to correct the middle range, except with very involved circuits, without also affecting the high range. Ideally, output in this range should be flat. Magnetic pickups may be flat, but crystal pickups will usually not be.

The high frequencies

In making the graph for the range between about 1,000 and 10,000 cycles, the 500-cycle reference voltage should be retained to represent zero decibels.

A preliminary run of the 10004-M disc on a perfect magnetic pickup will show a practically flat output. However, to minimize noise, almost all commercial records are made with a boost or *pre-emphasis* in the high range.

No two manufacturers agree on the amount of pre-emphasis, and often two records from the same manufacturer will be different. A certain curve has been arrived at by engineers of the National Association of Broadcasters for use on broadcast transcriptions. Most good modern American phonograph records adhere more or less closely to this curve. Conformity to the NAB characteristic is neither universal nor

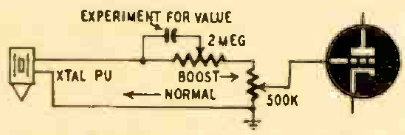


Fig. 6—Typical circuit for crystal pickups.

accurate, but as a compromise for adjusting a playback system, it is useful.

Curve GBD of Fig. 5 shows the NAB characteristic used in making recordings. (Notice that the low-frequency section corresponds to A in Fig. 3.) The records have a high-frequency pre-emphasis reaching +16 db at 10,000 cycles. The playback system must counter this rise with attenuation while boosting the bass at the same time. The entire playback equalization is shown in curve HBE.

The test record has the same bass drop G as standard records, so the actual bass response wanted from the system when using the test disc is curve A. But it should be clearly understood that *the test record includes no treble boost*. Therefore, the output from it after equalization should look like curve ABE.

When using a good magnetic pickup, equalization must be added to the circuit to reduce the high-frequency response to approximately that of curve E. A condenser across a grid resistor will reduce highs. Experiment with condenser values.

A crystal pickup initially showing a response like AF must be boosted to reach the desired curve E. Fig. 6 shows a suitable high-boost circuit for crystal pickups.

Many systems are good up to a certain frequency, but will not go as high as 10,000 cycles. With these systems, curve ABE should still be obtained as far as the system will go. Boosting intermediate frequencies to compensate for the lack of highs will result only in poorer sound.

High-frequency equalization should be either variable or (preferably) adjustable in steps by a rotary switch. Different amounts of equalization can then be used for records which do not sound right when played with the NAB curve. Some foreign-made records do not have as much high-frequency pre-emphasis as the American ones; a curve like AB in Fig. 7—not having so much de-emphasis—is useful for these. Very noisy records may require a sacrifice of fidelity for the sake of quietness. Additional de-emphasis, for instance that of curve AC, can be used. Another help with very bad discs is a cutoff at around 5,000 cycles, as shown in ADF. (The response of most inexpensive crystal pickups cuts off between 4,000 and 8,000 cycles, anyway).

So far we have been using the Columbia 10004-M test record to equalize for American recordings. It is a good idea to provide for European records too. To do this, simply use the Columbia 10003-M disc and re-equalize the low range for flat output. The equalization used should be included on a switch position, so that it can be cut in when necessary. Rather than adding a complete separate equalizer for European records, it is easier to use the same equalizer used for American records and simply to vary the single component—usually just a resistor—which regulates the *amount* of bass boost, without changing the components which determine the *frequency* at which the boost starts. R is used for this purpose in Fig.

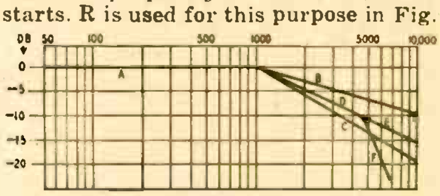


Fig. 7—Special-purpose compensation curves.

4. The result will not be quite as accurate as with the more complicated method, but it will relieve the excessive boominess heard when European records are played on an American system. To save the investment in an additional test record, the adjustment can be made by ear while playing European records.

The equalizer diagrammed in Fig. 4 can be used at almost any point within an amplifier. However, depending on the output of the pickup used, it may be necessary to add extra amplification to offset the loss (about 40 db) in the equalizer. If that is the case, V1 and V2 may be the two sections of a 6SC7, with the tube being used as a preamplifier ahead of the main amplifier.

Other equalizer circuits will be found in RADIO-CRAFT. Any one of these, if it has the proper frequency characteristic, can be used to correct the pickup response.

Church Bell Records

New method of engraving sound tracks in steel makes records of great durability

Fig. 6—Setting the bells for desired time.

A NEW method of recording and reproducing the sound of church bells has been devised by G. Chancenotte, a French inventor. The recordings consist of engraved sound tracks on tapes or cylinders of magnetic material; the sounds are reproduced magnetically. The special virtue claimed by the inventor is the durability of the recordings.

The sound is recorded first on a strip of motion picture film, using the variable-area method. When the film is developed, the sound track looks like Fig. 1. Several of the tracks are recorded side by side on one strip of film. The film is then used to make a photoengraving on a steel tape or cylinder.

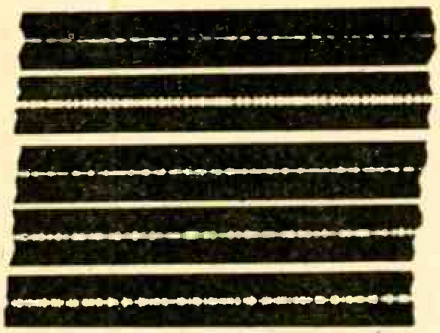


Fig. 1—Several typical sound-track specimens.

A section of the track engraved on the steel is shown in Fig. 2. Whether the tape or the cylinder is used, the ends of the track are joined to create an endless-belt effect. Therefore the bell sounds may be played for as long a period as desired.

The reproducing head is made of a piece of mu-metal bent into the shape of a square U. One arm has a beveled end; on this arm a low-impedance winding is placed. A permanent magnet is placed on the other arm. As Fig. 3 shows, the head is placed so that the magnetic flux passing from the magnet to the winding must pass through the sound track. As the track moves, the varying width of the raised track varies the permeability of the steel path at audio rate. The flux reaching the coil therefore varies, and the induced coil current is amplified and fed through speakers to produce the sound.

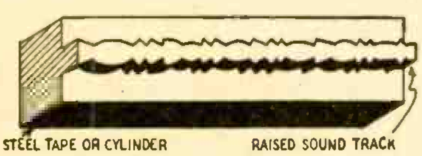


Fig. 2—How the track is engraved in steel.

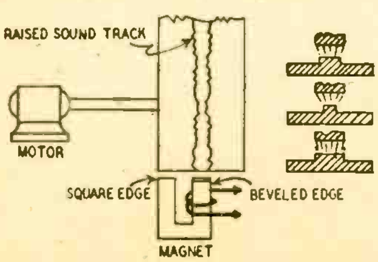


Fig. 3—Detail of the track and pickup system.

The playback head does not actually touch the sound track, so there is no problem of wear. Demagnetization of the sound track is not a factor, because the track is not magnetized in the first place.

Several sound tracks and playback heads are placed on each of two cylinders in the unit used in churches. Each track contains one of the desired bell sounds and cylinder rotation speed can be varied to produce still other tones. Speeds for the cylinders are normally 30 r.p.m. for the one containing the higher-pitched sounds and 20 r.p.m. for the other, which contains the bass bells. Each cylinder is about 3 feet in diameter.

A complex system of relays and cams has been devised by the inventor to play certain selections automatically and to produce various effects by mingling sounds from the two cylinders and varying the speed of each. The cams and one of the cylinders appear in Fig. 4. Note the six sound tracks on the cylinder (bottom of picture).

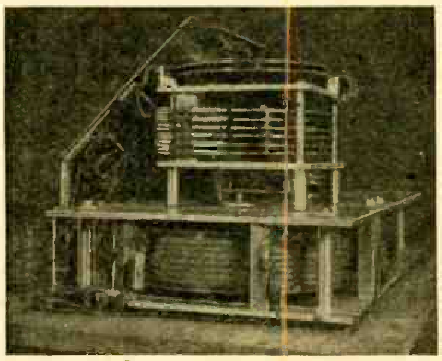


Fig. 4—A complete set of relays and tracks.

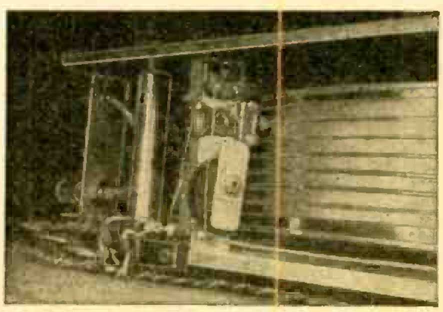
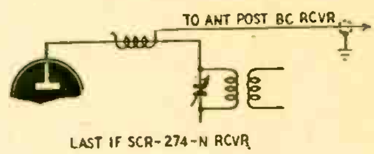


Fig. 5—A closeup of sound tracks and pickup.

Fig. 5 is a closeup of the playback head used for the topmost track. The other photograph shows the control panel of the electronic bell system. The clock is set to start the bells automatically at certain times and the other controls provide for ringing them "manually" or setting up the various possible special effects.

LOUDSPEAKER RECEPTION

It is difficult to attach a loudspeaker directly to the outputs of surplus SCR-274-N command set receivers because the impedance is incorrect and the level too low. The circuit shown illustrates a method of obtaining the advantages of speaker reception and increasing selectivity and gain.



An insulated wire is wrapped around the lead which connects the plate of the final i.f. stage in the receiver to the i.f. transformer. The wire is connected to the antenna terminal of an ordinary broadcast set. Since the i.f. of the 3-6-mc receiver is 1415 kc, the broadcast set, when tuned to that frequency, will pick up the signal from the surplus receiver, convert, amplify, and detect it, and feed it through the loudspeaker. The two receivers become one double superheterodyne.

If the broadcast set is an all-wave type, the 40-meter receiver from the SCR-274-N may be used in the same manner. Its i.f. is 2830 kc.

FRANK BODINE, W4JVZ,
Fort Wayne, Ind.

THE HI-FI EXPERT TRACKS DOWN HUM


The author communes with his soul, but the hum buzzes merrily on.

Hum is one of the trickiest troubles known to the sound engineer. Mr. Langham relates a hum-filled adventure with a tuner-amplifier.

By JAMES R. LANGHAM

THE worst case of hum I ever saw or heard was one of my own. Naturally. Nobody else I know uses such screwy circuits or makes such dumb mistakes. Whenever I use standard circuits, I get satisfactory—if uninteresting—results; but when I improve on circuits—brother, that's a humdinger!

The time I'm thinking of wasn't that deal with the preamplifier on one of the XYL's ice trays. ("We Learn the Hard Way," RADIO-CRAFT, Jan., 1944.) This one involved a simple tuner-and-amplifier combination.

I had built the amplifier first and it sounded pretty good—a pair of 2A3's in class A1 with fixed bias—so I threw together this simple little t.r.f. tuner, just one r.f. amplifier feeding an infinite-impedance detector. I lined it up strictly by ear, and it sounded pretty nice over the headphones. So I hitched it up to the amplifier.

Man! That thing had a terrific hum level. The XYL cocked an eyebrow. "What, again?" That ice-tray deal still rankled a little.

I coughed delicately. "Must have popped a filter." I disconnected things and pulled off the bottom plate of the amplifier. Then I realized that rasp was no filter—I must have mucked up the ground circuit; so I put it back and connected it right, ground side to chassis, hot side to grid, and flipped the switch on.

The hum was still there, so I flipped the switch off again without looking in the XYL's direction. This time I took down the amplifier and started prodding around among the filter condensers. They all seemed to be O.K., so I turned off the amplifier and connected the tuner directly to the speaker.

The program came through—faint, but clear of hum—so I tied the amplifier to the speaker instead and cranked the gain way down to avoid offending the XYL's ears. No hum. Upped the gain a bit, then more, and then all the way. Very, very slight hum at full gain with a lot of tube hiss mixed in.

"Hmm. Intermittent?" I banged individual condensers, popped light switches, and finally started tapping a screw driver against the amplifier itself.

"Here, try this." But I scorned the hammer the XYL held out to me.

"You don't hear any hum now, do you?" I demanded, turning the gain wide open.

She shook her head. "It was probably my imagination before. You know me."

I didn't trust it, but I hitched it all up again the way it had been and then turned the switch on.

That hum was terrific, but instead of switching it off right away I went through my routine of tapping and banging at the tubes and filter cans.

"On second thought," the XYL shouted at me, "maybe I do hear a little hum at that."

I put one hand to my ear. "How's that?" I shouted back.

I flipped the switch as she repeated it and her last words echoed all around the whole neighborhood.

I raised my eyebrows. "There's no occasion," I said stiffly, "for you to raise your voice like that to me." Then I dodged and she missed.

I turned it all on again and started in earnest. I cranked the gain down, and the hum went down too. It was about 2 or 3 db less than the program level. I paralleled each condenser with a known-to-be-good one. No change. I listened with phones at practically every spot on that chassis. The B-plus was clear and free all along the line, and so was the fixed-bias line. My grounds were all fine and bright. Everywhere there was a signal there was also that hum. Right back to the input.

Aha! I switched off the tuner—the hum and signal died together. "Barking up the wrong tree, hunh?" The XYL spoke from behind my shoulder.

I nodded and put the amplifier back together and then back on the shelf and pulled the little tuner down in front of me. I opened it up, and it was so simple that I couldn't see where there could be any trouble in it. Heck, it didn't even have a.v.c.

I prodded around inside with headphones. No hum there at all. I had the XYL listen. Then I tied it into the amplifier and turned it on and, HMMmmm, there it was again. I tracked it up to the detector itself, and filters didn't help at all.

I turned off the whole shebang and sulked. It didn't make sense to me. Either one alone was free of hum, but together they hummed.

"Maybe it's the broadcasting station," the XYL suggested.

I shook my head. "It was KFI. They wouldn't have anything like that." I pulled down Terman and began studying. Then I pulled down Reich. Then Henney. Then the Hambook.

After awhile I turned it all on again.

I turned the plugs in the wall socket. I put little condensers across the line as filters. Nothing did any good.

Could it be some appliance in the house? I wondered. I began turning lamps and stuff on and off. Then I turned the volume up so I could hear while I went out to fiddle with the fuses in the kitchen. Out there I heard both signal and hum go off and come back and go off again.

Hum on carriers only

I raced into the room to find the XYL twisting the tuning condenser. "Look," she said. "I think it is the station at that."

Tuning off the station killed hum as well as signal and left silence.

Then she turned to another station and there was the hum again. All over that dial there was hum wherever there was a signal, but no hum in between. "Are they all humming?"

"No, we're modulating the carrier ourselves some way." I knew that much.

I went back to the books again and studied. After a while I ripped out the filament wiring in the little tuner and rewired it with 2-conductor shielded cable. No change. Then I got drastic and heated the tubes in the tuner with 6 volts of flashlight battery.

Still that hum. So I got discouraged and we listened to Jack Benny on the other little radio and then went to bed.

I don't know now how long I played around with that outfit before I got on to the deal, but I do remember listening to a musical program on the little radio and turning on the big amplifier to play some of our records afterward. As the amplifier warmed up, here came that same hum out of the little radio. Terrific hum.

I turned off the amplifier and the hum died. Turned it on again and there it was. Well, instead of playing records that night, I fooled around the inside of that amplifier with every trick I knew or ever heard of. I hooked in potentiometers to the transformer windings that were supposed to be center-tapped to ground and grounded the pots so I could move my ground from side to side to compensate for any unbalance in the transformers. I raised the level of my filament string from zero to as high as 20 volts. I paralleled all the electrolytics with paper condensers. I did everything I could think of, humming all the while.

After I had tried all the things I could possibly imagine any reason for, I began doing things without knowing why I was doing them or how they could possibly help. The same idea as beating a tin pan to chase the devils away, I guess.

I was fooling around with a small paper condenser when the hum suddenly stopped. I stopped daydreaming and looked. What I had done was tie this small condenser from plate to filament of the 5Y3-GT rectifier of the bias supply. It killed it. No hum. I took it off, and there was hum.

I couldn't figure out just what I was doing and why it should stop hum but I wired the condenser in. Then it popped itself out—began smoking—so I replaced it with a regular buffer condenser. Higher voltage. (See Fig. 1.)

You see, I still believed in class A1 then, and I liked the fixed bias so I had a separate bias supply for the 2A3's. Well, not wanting to have that fail and leave B-plus on my plates and so burn up my tubes and output transformer, I had installed a relay. I used the relay coil as a filter choke for the bias supply

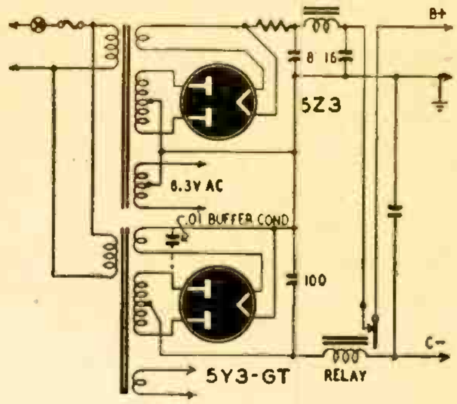


Fig. 1—The buffer condenser cured the hum.

and had some whacking big condensers (low-voltage ones) as filters along with it. That must have been the trouble. I had some very funny reactances there, and it was putting out a peculiar field that would modulate any neighboring r.f. Putting that buffer condenser across it upset those reactances and resonances and killed the deal.

The XYL heard the outfit playing and came in to see how I'd fixed it. I couldn't tell her how or why it worked, but I showed her that it did. She asked so many questions, though, that I blamed it all on the guard-relay circuit and redesigned it, as shown in Fig. 2.

I used a different switching circuit and arranged to flip the tubes over to self-bias when the fixed bias failed. I told her that was better and showed her how and why. I snowed her under with words and until she reads this she hasn't known that I didn't know what I was doing then.

Since then I have run into the same modulated-hum trouble in other outfits. On three occasions I cured it the same way—right first try out of the box—and the owners thought I was a fine engineer to have diagnosed the trouble so easily. On the other occasion an a.c. line really was causing the hum. We found that out by unscrewing fuses from the household box.

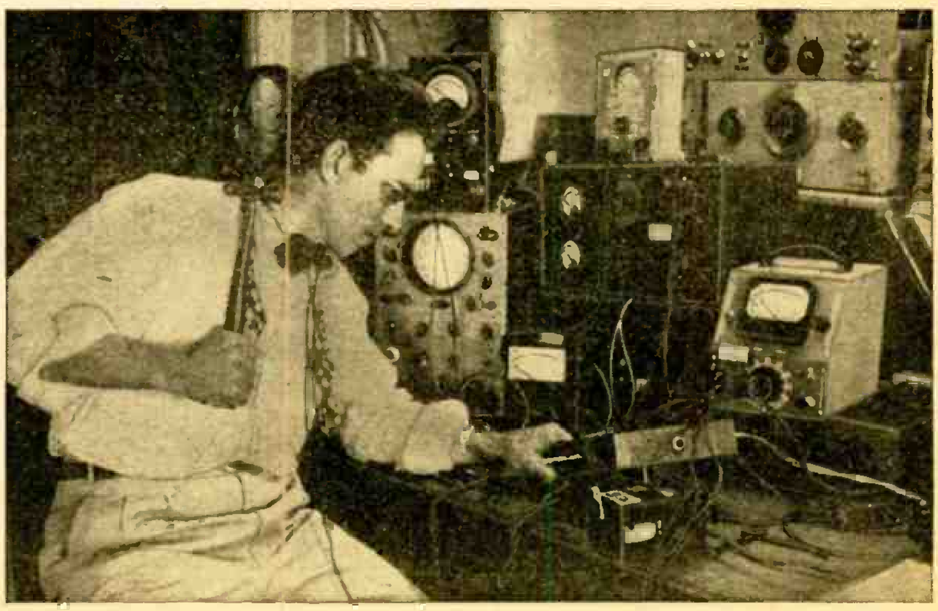
As for unmodulated hum, the ordinary kind, it's usually caused by insufficient filtering. Obviously. When it's a high gain job, I always suspect the ground circuit. Ground loops can do strange things. I like to run my ground as a lead and tie it to chassis at just one spot. I generally pick that spot experimentally, sometimes near the power tube and sometimes near the lowest level. Theoretically it should be either at the point of highest current or lowest level. I am never sure which, and I'm not sure there is an arbitrary standard. I've seen amplifiers built with over 100-db gain and with all grounds made to chassis at the handiest points. Some of them have been quiet and a lot have been terrible.

Sound engineer's credo

I believe all shielding should be grounded at one end—not both—and grounded to chassis. I believe the No. 1 pins on tubes should be tied to chassis. I believe signal grounds should be kept separate from chassis grounds and B-minus except at one point. That point should be either at the output tube or the input tube.

I also like to parallel electrolytics with small paper condensers, but that's more to prevent oscillatory trouble than hum.

One case I remember was a PA system where the preamplifier tube hummed terribly. The trouble was ground loops. We didn't have time to



A smart hammer blow is one way to stop hum but the author does not recommend it—very often.

rewire the whole outfit, it was one of those deals where the wiring is laced and then varnished. Lovely to look at, but oh, that hum! It had to be used that afternoon. It had a 6SJ7 input, and the final was a pair of 6L6's. I pulled

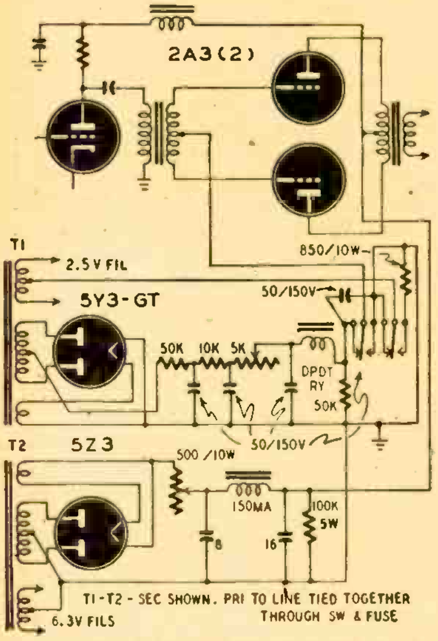


Fig. 2—This is the redesigned guard circuit.

out the 6SJ7 and substituted a 12SJ7 and then ran a d.c. filament by wiring it in series with the B-minus. The circuit appears in Fig. 3. The total drain was close to 150 ma, which just lit the 12SJ7 nicely. The 6L6's didn't seem to miss the lost 12 volts from their plate voltage, and the hum was way, way down. Later the owner rewired the amplifier with more attention to ground loops and cleared up the situation. You could argue that the trouble there was filament induction rather than ground loops, and you might be right. I do know, however, that it was cured by (1) d.c. filaments, (2) rewiring the ground.

All the high-gain amplifiers I have fooled with since 1939 have had potentiometers across their filament supplies with the center arm grounded. If they didn't have them when I got them, they had them when they left me, because I've run into a lot of transformers whose centertaps haven't been in the center, electrically speaking. That little trick with a potentiometer—100 ohms or so, it's not critical—will give at least a 5- to 7-db hum reduction on the average outfit and considerably more on some.

I've often heard of curing hum troubles by raising the whole filament supply several volts above ground, but I've never succeeded with one of those cases myself. I've tried it—oh a dozen times—on hummy amplifiers, and not once have I seen it work. It might help on the millions I never tried, but I can't confirm that.

The best solutions are (1) watch your layout; (2) watch the grounds—separate grounds for chassis, signal, and B-minus; (3) use metal tubes or tube shields in low-level stages; (4) use a 100-ohm potentiometer across the filaments and ground the center tap; (5) use a hot iron. This last is most important. It's amazing how many otherwise smart radio men will keep their irons too cool. Cold joints are nasty things.

Also important is to tighten potentiometer nuts and use star washers under them. I lost a star washer when I was putting together our present unit so I left it out. Presently the set hummed from time to time. The XYL humbled me by stopping it—she put a book on top of the knob. The pressure made the contact good enough to cure the hum. It was one of those silly things I should have known better about. Finally, of course, I got a star washer and put it in, but the XYL still brings it up in conversation with other radio men; and I daresay she'll remember and tell about it when I'm 83.

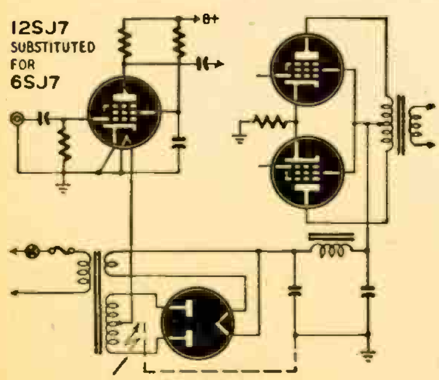


Fig. 3—A change of tubes stopped hum here.

HEARING AID HAS PICKUP COIL

A NEWLY developed hearing aid uses a magnetic microphone, which is unaffected by temperature and humidity, in place of the more common crystal type. Another important feature of the unit is an inductive pickup coil (Fig. 1) for use when telephoning which is built into the front of the plastic case. In use, the telephone receiver is held near the front of the case, and the amplifier input is switched from the microphone to the pickup coil.

Inductive coupling through the magnetic field of the telephone induces a voltage in the pickup coil.

While the crystal microphones in hearing aids do give good results, their efficiency is reduced at the operating temperatures normally encountered (90 degrees F), and they may be ruined in time by either humidity or dryness.

The magnetic microphone used in this hearing aid is made almost entirely of metal. It consists of a thin aluminum diaphragm cemented to the edge of an aluminum case (Fig. 2). An aluminum-alloy driving pin soldered to the center of the diaphragm transmits vibrations to a smaller diaphragm and armature made of nickel-iron. As the armature vibrates, it induces a voltage in the bipolar magnet coils spaced beneath it.

A resonance tube connects the air behind the aluminum diaphragm with the outside to give a considerable increase in low-frequency response. Closing the

Courtesy E. A. Meyers & Son

Fig. 1—Inductive pickup coil is in case front.

tube with a small screw results in a reduction in low-frequency amplification.

The hearing aid amplifier has three stages, with an over-all voltage gain from the first grid to the last plate of about 20,000. Tubes are of the subminiature type: two CK512AX voltage amplifiers and either a CK522AX or a CK507AX as output tube. The microphone and pickup coil are transformer-coupled to the input, and the output is transformer-coupled to the air- or bone-conduction receiver. Self-bias on the output tube results in stable performance.

The frequency range of the hearing aid is deliberately limited to approximately 300 to 3,500 cycles to minimize the effects of noise and nonlinear distortion. A noise control reduces amplification on frequencies below 1,000 cycles and above 2,000 cycles.

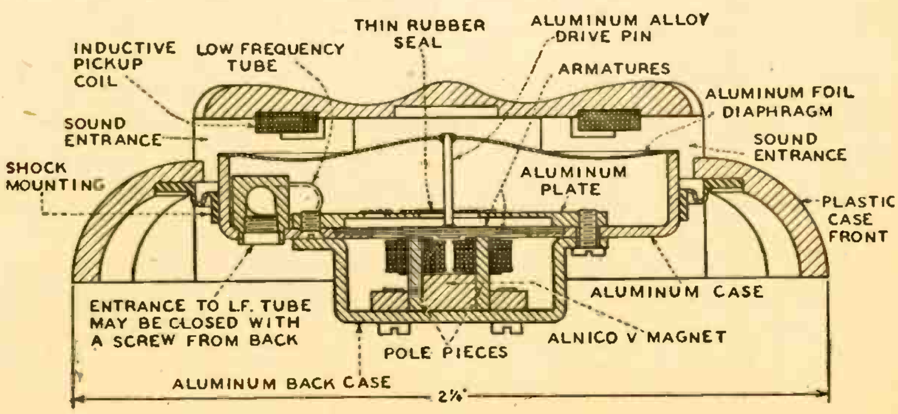
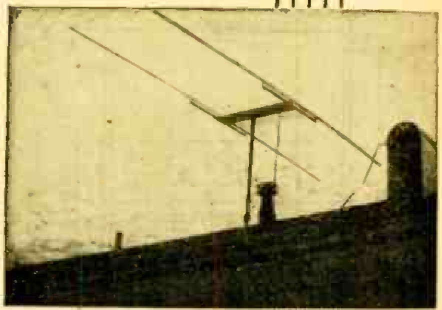


Fig. 2—Cross-section of microphone, showing inductive pickup and the resonance chambers.

A Folded Dipole 10-Meter Antenna

By A. B. KAUFMAN



Directional dipole in its place on the roof.

THE folded dipole has become very popular for FM and television antennas and, recently, for use on even the lower-frequency bands by amateurs. Usually, the antenna is made of 300-ohm ribbon line.

This 10-meter beam uses the folded dipole, but adds a reflector to it. The front-to-back signal ratio is 10 to 15 db, and the gain is about 5 db over a single half-wave antenna. The beam is rotated by a surplus gun mount. Construction is less difficult than for the usual rotatable beam.

A two-element beam was chosen for several reasons. First, it will work efficiently over a much broader band of frequencies than will an antenna of three or more elements. It is certainly easier to build, and the supports and rotating motor have less of a load to carry.

A reflector was used as the parasitic element rather than a director because its spacing is much less critical. A reflector can be spaced farther from the radiating element than a director, and yet give the same gain without cutting down radiation resistance so much.

A folded dipole was used as the driven element because of its high radiation resistance and its broad tuning. The reflector brings this resistance (normally 300 ohms) down to between 60 and 150 ohms. A 70-ohm line can be used to feed the antenna, though even 300-ohm twin lead will work satisfactorily.

The folded dipole and the reflector are made of dural or brass tubing to the dimensions given in Fig. 1. The driven element is made in three pieces, one 16 feet long and the other two about 7 feet 11 inches each. Tubing clips are used at the ends of the assembly to hold the rods together and to short them electrically. It is not a good idea to drill the tubing, since this weakens it. The reflector is 16½ feet long.

Additional tubing clips are used to hold the folded dipole rods together near the center. At this point, however, the rods must not be shorted to each other, so a tight-fitting piece of fiber tube is placed over each rod and the clip clamped over the fiber.

The element support is made of knot-free wood which is not likely to split. As Fig. 2 indicates, the main support is a piece of ¾-inch-thick wood 4 x 10 inches. Attached crosswise to each end is a 4-foot length of 1 x 1. It is to these crosspieces that the elements will be mounted.

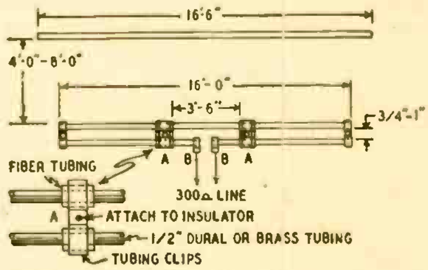


Fig. 1—Dimensions of the radiating element.

Five stand-off insulators are used for mounting the folded dipole: one at each of the fastenings *A* (Fig 1), one at each point *B*, and one at the center of the unbroken dipole rod. The insulators are attached to the *A* points as shown in the detail drawing of Fig. 1, and the others are fastened to the rods directly with tube clips. The insulators are then screwed to one of the wooden crosspieces.

The reflector rod is fastened to the other crosspiece with tubing clips and insulators in the same manner. Three insulators are sufficient.

The vertical pole supporting the beam is made of dural, brass, or thin-wall steel tubing about 2 inches in diameter. Do not use water pipe, it being too heavy and not sufficiently rigid. A flange welded to the top of the pole holds the wooden beam support.

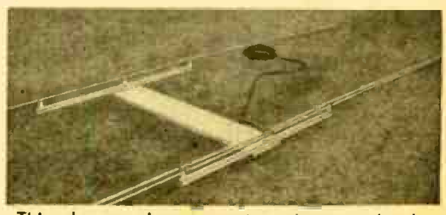
Fig. 3 shows how the beam is mounted. The rotating mechanism (details later) is on the floor of the attic. The pole goes through a hole in the side of the sloping roof. At this point, a short length of pipe is used as a bearing. Its inside diameter should be enough larger than the outside diameter of the pole to allow the pole to turn freely, but not so much larger that there is excessive play.

The bearing pipe is attached to the roof by a flange. Since the roof slopes, the flange must be welded to the bearing pipe at the proper angle to make the pipe exactly vertical. To determine this angle, use a protractor and a liquid level, the kind employed by carpenters. Fig. 3 shows how the protractor is held on the roof. The level is adjusted to center the air bubble, and the roof-slope angle is read from the protractor scale. Be sure the flange is welded to the bearing pipe at exactly this angle.

The flange itself need not be round, but it should be large enough so that it can be screwed to two of the shingle support boards. To make the assembly rigid put long machine screws right through the shingle support boards and the flange and tighten nuts on the ends, using big washers under the nuts.

To prevent water from dripping down the antenna pole and through the hole in the roof, cut one end off a large tin can, and then in the other end cut a hole equal in diameter to the antenna pole. Slip the can over the pole with the open end down, so that the open end is over the upper end of the bearing pipe. Calk and tar the hole in the other end so that the can will stay in position on the pole and no water will get through the hole. To keep the can in place it may be necessary to use setscrews as indicated in Fig. 3.

The distance between the attic floor—the lower support for the pole—and the bearing pipe determines how high the antenna pole can be. The leverage should be not greater than 4 to 1. That means that with a floor-to-roof height of 5 feet, for example, the pole should be not more than 20 feet above the roof, giving a maximum total pole length of 25 feet. This is a rather dangerous maximum, however, and preferably the pole should be much shorter. At W6YOV



This closeup shows rotating element clearly.

the pole extends 8 feet above the roof.

A surplus K7 gun mount, sold by many radio stores for just this purpose, supports the bottom of the pole and at

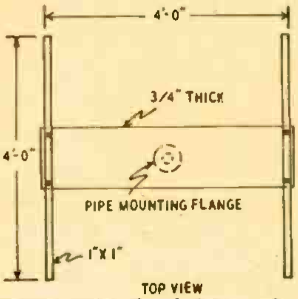
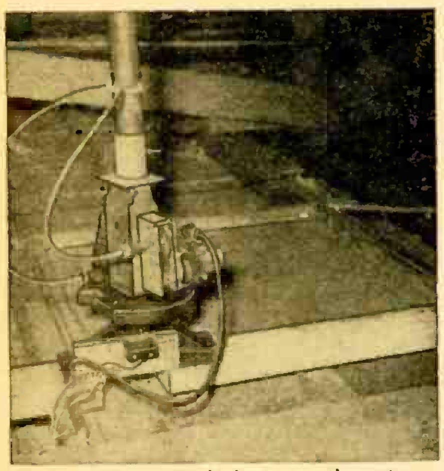


Fig. 2—Some details of the rotating member.

the same time provides a means of rotating it. Remove all excess parts and gearing, and bolt the gun mount securely, base down, to the attic floor. To its top secure a piece of tubing just large enough to receive the base of the antenna pole. A single 8-32 bolt passed through this tubing and the pole base will hold them together.

Mount a small motor (some 24-volt d.c. surplus motors can be operated intermittently from the 117-volt a.c. line) on the rotating framework and attach the flexible drive cable from the gun mount to the motor shaft.

If the antenna is allowed to rotate continuously more than 360 degrees, the leads to the motor (which rotates with the gun mount) and to the antenna will eventually be pulled out by the roots. Slip-ring arrangements are possible, but a good deal of trouble. It is better to limit total rotation to about 330 degrees



The K7 gun mount which rotates the antenna.

and make the motor reversible. Orient the antenna so the dead spot is in the least useful direction.

The limiting is done with microswitches mounted in a small box or attached to some part of the gun mount support. A small piece of metal or wood attached to the rotating mechanism should be adjusted to ride over one of the switches at each end of the rotation swing. Be sure to arrange matters so that, if the antenna coasts after the power is off, the microswitches will not be ruined!

Two wiring diagrams for the rotating motor are shown in Fig. 4. In Fig. 4-a the motor has two leads for the armature and two for the field. A 6-wire cable is run from the attic to the operating desk. A d.p.d.t. switch controls the direction of rotation, and a push-button operates the motor. The microswitches are normally closed units. If the motor does not go off when a microswitch opens, reverse the field connections.

If the motor has a center-tapped field, only three wires and a s.p.d.t. switch will be necessary, as shown in Fig. 4-b. If the microswitches do not operate properly, reverse field connections.

If the motor used is a 24-volt d.c. unit, a line-dropping resistor or a tungsten lamp will have to be placed in series with the 117-volt a.c. line. These motors will overheat on continuous duty. Probably a 117-volt a.c. motor would be best, though perhaps a little more expensive.

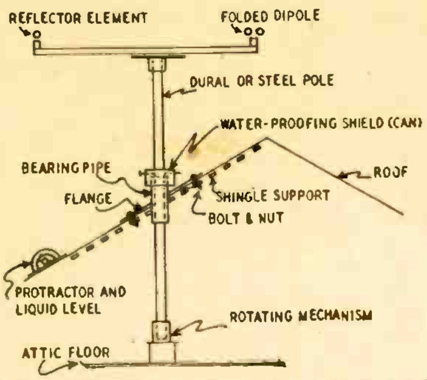


Fig. 3—How the mast goes through the roof.

The motor should be geared down so that the antenna does not rotate faster than about 1-4 r.p.m. This holds true, whether the K7 gun mount or any other worm-gear-and-pinion arrangement is used. It may be necessary to bypass the motor with a 0.1- to 1-μf capacitor to eliminate noise pickup in the receiver.

There is no reason why this antenna could not be used on higher-frequency bands.

The dimensions given for the lengths of the elements were figured roughly for the high end of the 10-meter band. For any other frequency on any other band, use the following formulas: For the folded dipole, the length in feet from end to end equals 955/frequency in mc. Length in feet of the reflector equals 492/frequency in mc. Spacing between elements should be between one and two tenths wave length, but this is not too critical. Minimum spacing will give the best match for a 70-ohm transmission line; maximum will be best if 300-ohm ribbon is to be used.

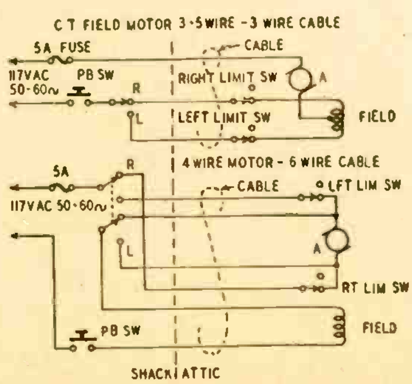


Fig. 4-a, below—Motor connections; b, above—connections for a center-tapped motor field.

SURPLUS CONVERSIONS

By MILTON KALASHIAN

Many articles have been published in the past couple of years on conversion of surplus equipment for ham use. This index of these articles enables the owner of a piece of surplus gear to find all the available information quickly.

Symbols used are RC (Radio-Craft), RN (Radio News) and RH (Radio Handbook, 11th edition, Editors and Engineers, Santa Barbara, Calif.)

150-B Transmitter....QST Sep 47 p. 22
  Improving c.w. operation of....QST May 48 p. 69
APS-13, 420-mc operation of....QST May 48 p. 57
ARC-5 (see SCR-274)
ART-13 Transmitter....RN Dec 46 p. 50
  CQ Feb 47 p. 33, Nov. 46 p. 13
  Speech amplifier....RH p. 437, CQ Dec 47 p. 19
BC-191 as modulator....RH p. 436
BC-221 Frequency Meter
  as c.w. monitor....RN Apr 48 p. 160
  Modulation of....QST May 48 p. 68
  Power supplies for....QST May 47 p. 72
  CQ Apr 47 p. 30, Jan 48 p. 28
  as v.f.o.....RH p. 445, QST Mar 47 p. 43
BC-312 Receiver
  A.c. power supply for....RC Jan 48 p. 74
  Conversion....RH p. 431
BC-342 Receiver, conversion....QST Sep 46 p. 42
BC-348 Receiver
  Conversion....QST Jan 47 p. 19, Nov 47 p. 66,
  CQ Apr 48 p. 25, RH p. 435
  Dial backlash elimination....QST Feb 48 p. 59
  S-meter for....RN Apr 48 p. 68
BC-375 Transmitter
  Conversion....QST Dec 46 p. 38
  as Modulator....RH p. 436
BC-406 Receiver....CQ Feb 46 p. 18
BC-412 Oscilloscope....RC July 46 p. 70
  Oct. 46 p. 18
  as Television receiver....RN Aug 47 p. 45
BC-453, 454, 455, 457, 458, 459 (see SCR-274)
BC-610 Transmitter (see SCR-299)
BC-624, 625 (see SCR-522)
BC-645 Transmitter-Receiver, 420-mc operation....QST Feb. 47 p. 15
BC-652, 653 (see SCR-506)
BC-654 (see SCR-284)
BC-696 (see SCR-274)
BC-746 Tuning Unit as pocket c.w. transmitter....QST Jan 48 p. 62
BC-779-A Receiver, improving stability....CQ May 48 p. 32
BC-946 Receiver, conversion....RC Feb 48 p. 26
BC-1068-A Receiver
  2-meter operation....CQ Jun 47 p. 25, RH p. 442
  as Television receiver....RC Jan 48 p. 57
BC-1284 Preselector....CQ Mar 47 p. 32
CAY 47150 Tuning Unit as carrier-current transmitter....RC Oct. 47 p. 24
CW-3, F-3 Receivers, FM and NFM conversion....QST Apr 48 p. 48
LM Frequency Meter
  Modulation of....QST May 48 p. 68
  Power supply for....RH p. 445
  as V.f.o.....QST Aug 46 p. 34
PE-110 Power Supply, conversion....RH p. 441
Propellor pitch changer as beam rotator....CQ Apr 48 p. 38
SCR-211 (see BC-221)
SCR 274
  Receivers....CQ Nov 47 p. 24, RC Feb 48 p. 26
  BC-453 as Q-5er....QST Jan 48 p. 40
  Connections....RC Mar 48 p. 44
Transmitters
  BC-459, 40-, 20-meter operation....CQ Mar 48 p. 31
  Mobile use....CQ Jan. 48 p. 22
  as V.f.o.....CQ May 46 p. 18, RN Mar 48 p. 57
SCR-284
  Mobile installation....CQ Mar 47 p. 26
  Portable use....CQ Oct 46 p. 28
SCR-522
  Receiver (BC-624)
  2-meter operation....CQ Jul 47 p. 27
  RC Sep 47 p. 24, RN Oct 46 p. 35
  Bandpass converter....QST Mar 48 p. 34
  as FM receiver....RC Jun 48 p. 38
  Output increase....CQ May 48 p. 22
  Transmitter (BC-625)
  2-meter operation....CQ Jul 47 p. 27
  RC Apr 47 p. 35, RN Nov 47 p. 35
  6-, 10-meter operation....RN Apr 48 p. 50
  QST May 48 p. 58
SCR-536 Handie-Talkie....RC Jul 46 p. 684
TBY-7 Transmitter-Receiver, 6-, 10-meter operation....RN Oct 47 p. 39
TS-47/APR Test Oscillator....RN May 46 p. 32

Fig. 1—The author transmits from his bicycle.

Handi-Dandy Transceiver

A 144-148-mc portable-mobile phone that uses only four dry-cell tubes

By WILLIAM E. PIKE, W1KMW

THE "Handi-Dandy" is a compact battery - operated transmitter - receiver for the 144-148-mc ham band. This versatile little rig, entirely self-contained, is just about the same size and weight as a portable radio. It may be carried and operated practically anywhere. It may be used as a monitor in the station or as an emergency transmitter, and is fine for hunting hidden transmitters on ham field days or other mobile work. In this latter case it was used on a bicycle (see Fig. 1).

The entire unit, including batteries and a 5-inch PM speaker, is housed in a metal cabinet only 7 x 10 x 6 inches.

The circuit (Fig. 2) is conventional. Operating efficiency and economy were kept in mind when selecting tubes. Two 957's were chosen for the detector and oscillator. A 1G4-GT triode and a 1C5-GT pentode are used in a common audio circuit which is employed as a modulator when transmitting and as an audio amplifier driving the 5-inch PM speaker when receiving. The chassis is made from a piece of 6 x 6½-inch aluminum 1/16 inch thick. Dimensions for bending and for locating socket holes may be seen in Fig. 3. The front panel is also made from a piece of 1/16-inch thick aluminum 7 x 10 inches.

Placement of parts isn't too critical, although the oscillator and detector circuits are located at the rear of the chassis to reduce hand capacity.

The oscillator circuit is located on the left rear of the chassis. The detector components are on the right rear. The detector and oscillator coils L2 and L4 are each 4½ turns, ½ inch in diameter, of No. 14 wire. They are about ⅞ inches long. With these coils there should be about 40 to 50 degrees of band spread on the dial. The coils are soldered directly to the tuning condensers with all leads kept as short as possible.

The tuning condensers are mounted on small angle brackets made of polystyrene and are connected to the National Velvet Vernier dials with flexible couplings and ¼-inch insulated tuning shafts.

A small feed-through insulator is mounted at one side of each of the 957 tubes to support RFC1 and RFC2 and also to serve as a connection to the underside of the chassis. The tube sockets, raised from the chassis, are supported by ¼-inch bushings. The 1C5-GT is located at the left front of the chassis, while the 1G4-GT is at the right.

A bottom view of the chassis is shown in Fig. 5. A 4-terminal strip is mounted

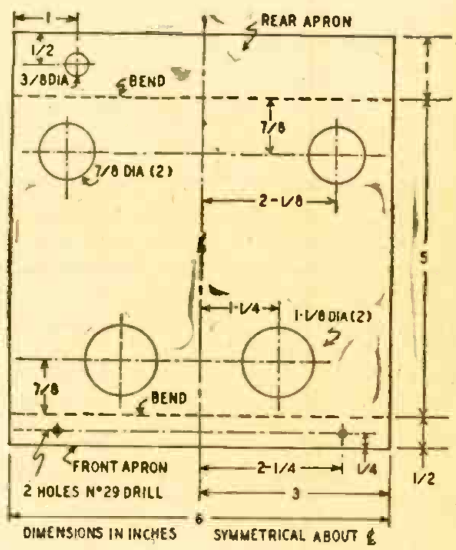


Fig. 3—The chassis is made of sheet aluminum.

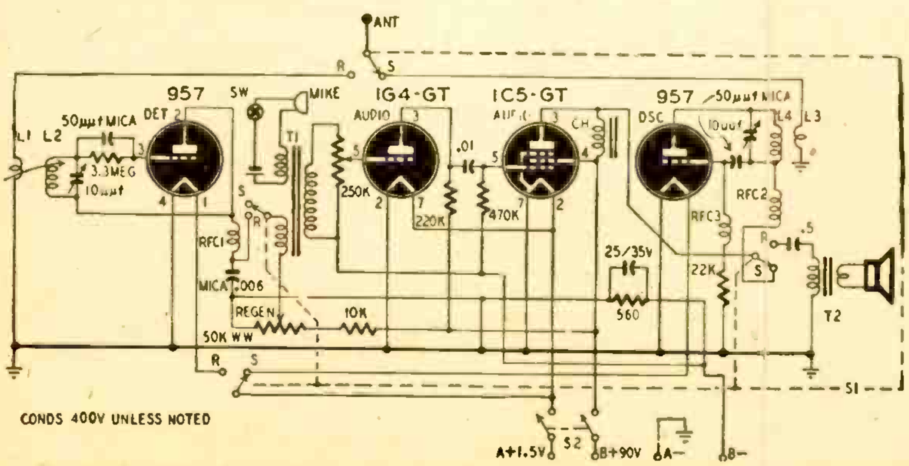


Fig. 2—The 957 at left is the superregenerator. The transmitting oscillator is at right.

on the rear apron of the chassis for battery connections. S2 is also mounted here.

T1 is located at the left in Fig. 5; the send-receive switch S1 is located in the center and mounted on the front panel. T2 is mounted on this switch. The audio choke CH is at right. Regeneration control is mounted on the front panel. Two small jacks are mounted on the front panel underneath the chassis. One is used for the microphone, and the other may be hooked up for a pair of headphones if desired.

Note that the filaments of the 957's are wired to the send-receive switch S1 so that only one is on at a time. This conserves the batteries.

The antenna coupling coils L1 and

L3 are each 2 turns, ½-inch diameter, No. 14 wire. The oscillator coupling is fixed, and the coil is supported by a small stand-off insulator mounted on the side of the cabinet. It is spaced about ⅛ inch from the plate end of the oscillator coil. Experiment to determine the exact spacing between the two coils L3 and L4. If the coupling is too tight, the 957 will pop out of oscillation.

The variable coupling for the detector is made by drilling two holes the

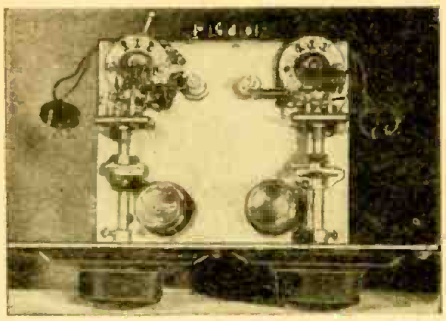


Fig. 4—Top view of the Handi-Dandy chassis.

size of the No. 14 wire into a ¼-inch polystyrene shaft about 6 inches long. The wire leads of L1 are passed through the holes and secured in place with a couple of drops of sealing wax. A bracket for supporting the shaft on the coil end is made by drilling a ¼-inch hole through the center of a piece of ¼-inch-thick polystyrene 1 inch square. This is secured to the side of the cabinet. The front end of the shaft protrudes through a bushing on the panel. The antenna coils aren't secured in place until the set is in the cabinet.

The cabinet is 7 x 10 x 6 inches. It is made of 1/16-inch aluminum, held together with small angle irons and 6-32 screws. A handle is fastened to the top. The 5-inch PM speaker is mounted on the inside top of the cabinet. Several holes were drilled in the top of the cabinet to make a grill.

The antenna is a piece of ⅛-inch brass rod 38 inches long. This is one-half wave for the 2-meter band. A quarter-wave antenna 19 inches long will work just as well. The rod is soldered into a small banana plug, which is plugged into a jack on the rear right of the cabinet top.

Two 45-volt portable batteries in series are used for the B-supply, and a 1.5-volt hearing-aid battery is used for filament supply. A 4.5-volt battery furnishes microphone voltage. The B-batteries are located one on either side of the chassis, between the chassis and side of the cabinet. The filament and microphone batteries are underneath the chassis, secured to the bottom of the cabinet. Standard battery plugs and short cables are used to connect the batteries to the terminal strip.

With these batteries, several months' service may be expected, using the unit a couple of hours a day.

Little or no difficulty should be encountered in getting the equipment into operation. An absorption-type wavemeter, or a couple of stations of known frequency, can be used for "spotting" the band.

Reliable contacts over several miles can be expected under normal conditions, but of course location and height play a major part in the performance of v.h.f. equipment.

While there are no restrictions on

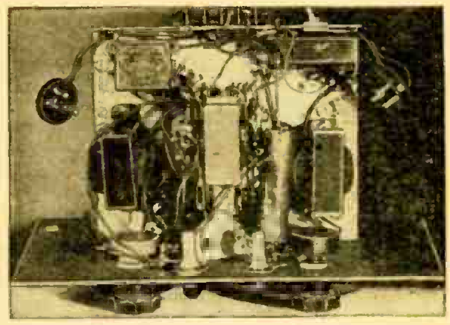


Fig. 5—Transformers are under the chassis.

building and experimenting with radio equipment, a federal license is required to put a transmitter on the air, regardless of its size or power.

Amateur licenses are issued free of charge to any United States citizen and are obtained upon taking an examination at any of the radio inspectors' offices throughout the country.

An S-Meter for Your Receiver

By H. HATFIELD

MANY hams have been searching for a simple and accurate S-meter to measure the strength of incoming signals and to provide visual tuning.

This S-meter will operate with any

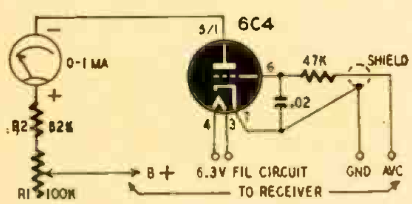


Fig. 1—This is the 1-tube S-meter amplifier.

broadcast or short-wave receiver having a.v.c and a 6.3-volt or a 0.3-amp. series filament supply. In sets having a 12.6-volt filament supply, a 12AT6 may be substituted for the 6C4. The B-supply may be either 100-165 or 225-350 volts.

The circuit, Fig. 1, shows that this S-meter works on the principle of a vacuum-tube voltmeter. A change in signal strength causes a change in the a.v.c. voltage, which is used to bias the 6C4. The resulting variations in plate current actuate the 0-1-ma meter, which is calibrated as in Fig. 2.

Use R1 to set the meter to zero signal (full scale) on any quiet spot on the band.

If the meter does not read 30 db on a powerful local station, reduce the B-voltage supply to the S-meter by connecting to the screen supply of the set or by any other convenient means. The resistance of R2 may have to be reduced.

The socket for the 6C4 and a 4-lug

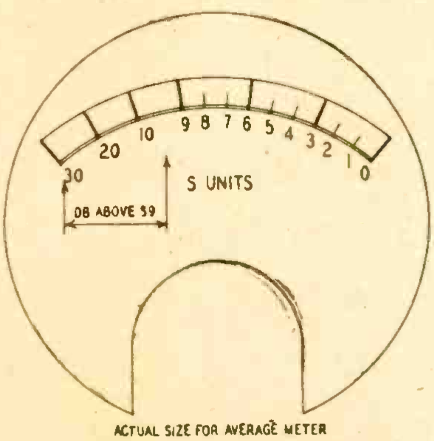


Fig. 2—Make a new meter scale as shown here.

terminal strip are fastened to a small metal chassis used to mount all components, including the meter. The a.v.c. wire must be shielded, and the shield is used for ground return to receiver.

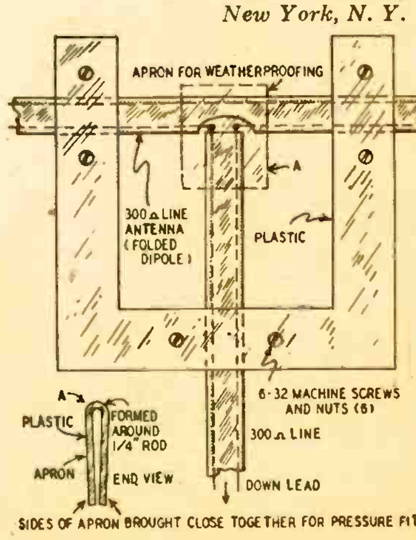
ANTENNA DOWNLEADS

I use a 40-meter folded dipole made of 300-ohm ribbon line. After the wind had torn the down lead from the antenna several times, I cut two pieces of light-weight plastic (Plexiglas was handy) and drilled small holes in them as shown.

After connecting the transmission line to the center of the antenna, I clamped the ribbon between the two pieces of Plexiglas, passed screws through the holes, and tightened nuts on them.

The plastic apron protects the connections from the weather. The system weathered a windy winter and is still in good condition.

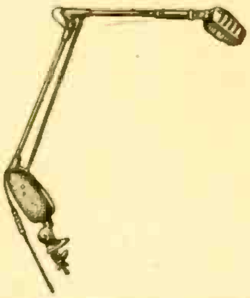
RICHARD HENRY,
New York, N. Y.



MICROPHONE STAND

Dazor Manufacturing Corp., St. Louis, Mo.

The Floating Arm is an adaptation from the desk lamp brackets made by the same manufacturer, the lamp being removed from the end and a standard threaded microphone holder substituted.



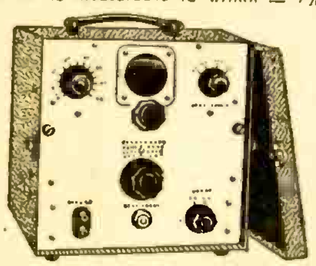
An advantage of the arm is that the microphone can be placed in any position—raised, lowered, or moved sideways—without the necessity of adjusting setscrews. The microphone will stay in any position in which it is set, according to the maker, because of a patented enclosed spring.

Much less bulky than the usual boom stand used for the same purpose, the Floating Arm may be obtained with a floor pedestal or with a universal mounting bracket permitting it to be clamped or screwed to any surface.—RADIO-CRAFT

BATTERY VTVM

Hewlett Packard Co., Palo Alto, Calif.

The 404A vacuum-tube voltmeter is housed in a metal carrying case and uses standard flashlight cells and 45-volt B-batteries as a power source. A.c. measurements from 2 to 20,000 cycles are accurate to ± 3%, with frequencies to 50 kc measurable to within ± 7%.



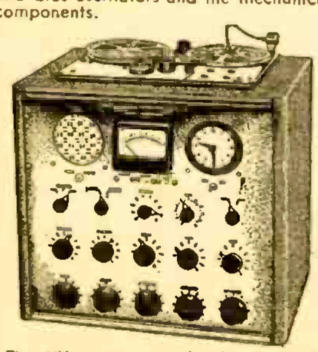
The range which may be measured with the 404A extends from .001 to 300 volts. Input impedance consists of 10 megohms shunted by 20 μμf.

Audio measurements are facilitated by the decibel scale. Continuous readings from −62 to +52 db may be taken. The instrument may also be used as a high-gain a.f. amplifier.—RADIO-CRAFT

TAPE RECORDER

Amplifier Corp. of America, New York, N. Y.

The Model SP850 Magnetape Recorder is a high-fidelity unit, designed for professional and semi-professional use. Recording, monitoring, and playback amplifiers are contained within the rack-type cabinet, as well as the erase and bias oscillators and the mechanical components.



The VU meter, provided principally for visual monitoring, is also used to measure bias and erase voltages. An automatic timer permits the user to preset the unit to begin and end recordings at any time up to 12 hours in advance.

Three tape speeds are possible: the slowest affords an hour's recording time, and the fastest 15 minutes with frequency range to 12,500 cycles. Five input channels accommodate microphones, tuners, phonographs, and lines. The playback amplifier gives 15 watts output with less than 1% distortion. Variable equalizers are included.—RADIO-CRAFT

TV SIG GENERATOR

Hickok Electrical Instrument Co., Cleveland, Ohio

Model 610 Television Generator replaces the usual sweep generator, used with marker generator, trap alignment generator, and crystal calibrator. It permits the technician to align any of the 13 channels, i.f. stages, and traps, and to insert an accurate marker at any point on the i.f. response curve. Self-contained marker frequencies are directly calibrated on the instrument's dial.

The generator also provides crystal controlled signals from 1 mc to the top TV band.—RADIO-CRAFT

FUSE-RESISTOR

International Resistance Co., Philadelphia, Pa.

Type OWA resistors consist of small-diameter resistance wire well-spaced on an insulating core. The wire is bare and the winding is not coated.

Under normal conditions in the circuit, the resistor functions as usual, but if an overload occurs, the wire opens. The heat creates no smoke or fire hazard, since there is no inflammable material in contact with the wire.

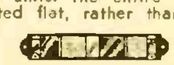
These fuse resistors are useful in complying with underwriters' requirements in a.c.-d.c. receivers, as well as in protection of other types of equipment.

Resistance values from 15 to 150 ohms are available.—RADIO-CRAFT

SELENIUM STRIPS

Standard Arcturus Corp., Newark, N. J.

Kotron rectifiers are thin half-wave selenium units. The entire rectifier is constructed flat, rather than in usual



pile-up fashion. Cooler operation results, since heat can be dissipated directly, instead of being passed from one plate to the next.

The Kotron rectifiers employ no more than four rectifying elements, giving minimum voltage drop. They are available in 75-, 100-, and 200-ma. ratings.—RADIO-CRAFT

PROTECTIVE TUBING

Walter L. Schott Co., Beverly Hills, Calif.

Walsco Protecto-Tube is a flexible synthetic tubing designed for insulating the handles of pliers, screwdrivers, test prods, and similar tools.

The kit contains several sizes of tubing and a bottle of "expanding solution." To insulate a tool, the user selects tubing of a slightly smaller diameter than the tool. Dipping the tubing into the expanding solution swells it, so that it can be slipped over the tool. After drying, the tube shrinks, making a tight fit.—RADIO-CRAFT

COIN RADIO

Tradio, Inc., Asbury Park, N. J.

Described by the manufacturer as the smallest coin-operated radio in the world, the 6-tube Tradio-ette is 7½

inches square and 5 inches deep. Designed to be placed in booths in restaurants and bars, the receiver has an r.f. stage, and a squelch circuit to silence interstation noise.

Installation requires only plugging in to the power line; a built-in antenna is provided. The aluminum cabinet contains the coin box. Playing time can be adjusted by the owner from 7½ minutes to one hour. Maximum volume is preset to avoid annoyance to other patrons.—RADIO-CRAFT

TELEVISION BOOSTER

Jerrold Electronics Corp., Philadelphia, Pa.

The Jerrold Booster is a preamplifier which incorporates a selector switch to provide amplification on any of the 13 TV channels. With a minimum gain of 25 db on each channel and a full 6-mc band width, the unit makes good re-

ception possible in areas of low signal strength. Multiple receiver installations, such as those in dealers' showrooms, apartment houses, and hotels, are also improved by the extra gain. In cities, the booster often eliminates the need for an outside antenna.

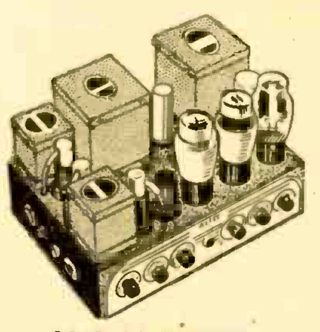
The unit is contained in a furniture-style walnut plastic cabinet whose dimensions are 7x4x4 inches. Built-in power supply operates from the 117-volt line.—RADIO-CRAFT

PA AMPLIFIER

Altec Lansing Corp., New York, N. Y.

The Model A-324 portable amplifier is rated at 15 watts output with flat frequency response from 20 to 20,000 cycles. Two low-impedance microphone inputs are provided, each with 95-db gain and a separate volume control. Two low-gain inputs permit phonograph and tuner connection.

Variable bass and treble equalizers are included.—RADIO-CRAFT



V-O-M METER

Triplett Electrical Instrument Co. Bluffton, Ohio

The Model 2405-A is a volt-ohm-milliammeter with a sensitivity of 20,000 ohms per volt on the d.c. ranges and 1,000 ohms per volt on a.c.

Voltages up to 1000 on a.c. and d.c., 50 μa to 10 amps on d.c., and 500 ma to 10 amps on a.c. are included in its 35 ranges. The ohms range is from 0-40 megohms in 4 steps. A condenser is in series with the output voltage jack, and the ranges are the same as for a.c. volts.

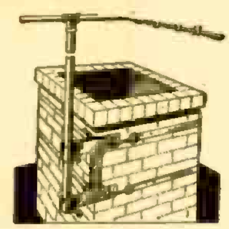
ANTENNA MOUNT

South River Metal Products Co., South River, N. J.

The Chimney Mount antenna base is used to fasten FM and television antenna masts to chimneys. Two galvanized steel bands are passed around the chimney to hold the mount in position. The mast is inserted into the two vertical rings and held with setscrews.

Installation is said to take only a few minutes. Marring the brickwork by drilling holes in it is unnecessary.

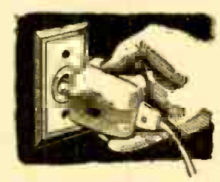
The hardware furnished is rust-resistant, and the steel bands have a combined tensile strength of 3,000 pounds.—RADIO-CRAFT



POWER INVERTER

Electronic Specialty Co., Los Angeles, Calif.

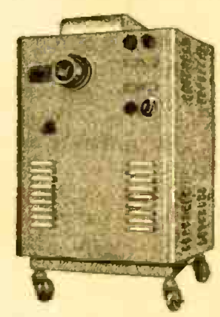
The Ranger Inverter converts 117-volt a.c. line voltage to d.c. Originally designed for use with vibrator-type electric shavers, which operate best on d.c., the inverter may be used in any application requiring 15 watts or less.—RADIO-CRAFT



TELEVISION PROJECTOR

Cortley Television Corp., New York, N. Y.

This projection televiser can furnish a picture as large as 12x16 feet. Operation is said to be as simple as that



of a home movie projector; only four operating controls are furnished. A special plastic screen eliminates glare. Front or rear projection is controlled by a switch.

The metal cabinet, 35 inches high and 22½ inches long, is mounted on rubber-tired wheels.—RADIO-CRAFT

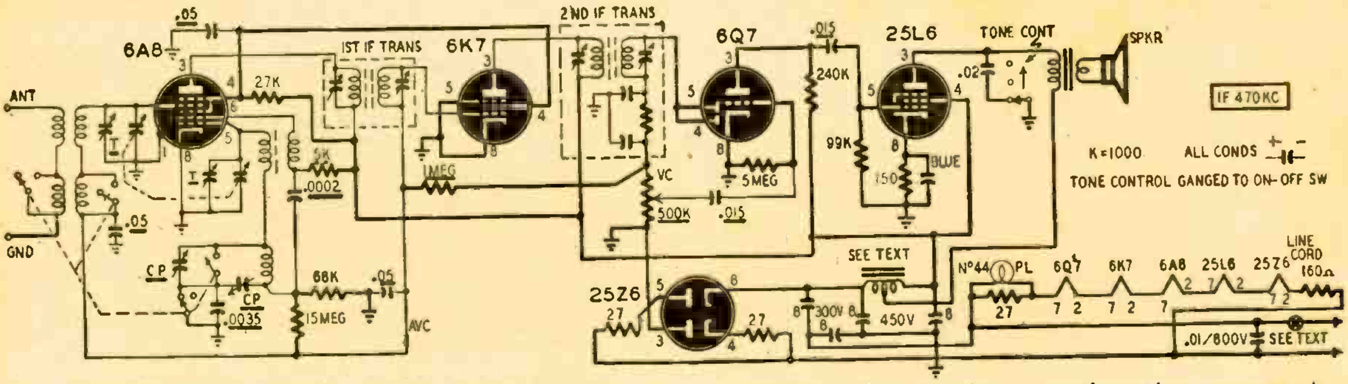
AUTOMATIC KEY

Electric Eye Equipment Co., Danville, Ill.

The Mon-Key is an electronically timed automatic key that makes dots and dashes spaced in relation to their length. Also, it is a monitor, producing a tone that can be regulated as to volume or cut out entirely as may be desired.

Regardless of the speed to which the key is set (8 to 45 words per minute), dashes are always three times as long as dots. The spaces between successive dots or dashes are always equal to the dot length.

The Mon-Key is activated by a lightweight aluminum paddle-type key. It is not affected by vibration. The unit is basically a multivibrator, and does not operate on the adjustable-weight principle but is completely electronic.—RADIO-CRAFT



The battery tubes of the Philco Model 38-38 were replaced with those more suitable for operation from a transformer-less power supply.

Converting Farm Sets For A. C.

An opportunity for rural servicemen

By ALFRED SHORTCUT

SLOWLY but surely the Rural Electrification Administration is bringing power to localities where it was totally unavailable a few years ago. Most of the radios in these areas were operated from storage batteries or combinations of storage and dry batteries. Many of these sets are still in use in recently-electrified areas. The cost and inconvenience of battery charging and replacement can be overcome by converting them to a.c. operation. The Philco Model 38-38 is a typical 2-volt farm radio. The diagram shows how it was converted to a.c. operation using parts costing less than $8. The *heavy* lines show circuit changes or new wiring. The portions of the circuit shown in *light* lines are not changed. Values of parts already in the set are underlined.

An a.c.-d.c. circuit was selected for economy and easy installation. The 1C7-G, 1D5-GT, and 1H4-G (second detector) sockets were rewired for the 6A8, 6K7, and 6Q7, respectively. The 1H4-G driver was replaced by a 25L6, and the 1J6-G by a 25Z6. The 1E5-GP socket was not used.

The first step is to rewire the filament pins in series with the 160-ohm line-cord resistor in the order shown in the diagram. Wire up the power supply, using the 25Z6 in a voltage-doubler circuit. B-drain is low so you can use the old driver transformer as a filter choke. If the primary is open—it usually is if the set has been out of service for a while—use the secondary. It will filter well and still carry the load. Take care when wiring the switch into the power line. One set of its contacts shorts to ground. If you use this section, you will short one half of the rectifier to ground. Use an ohmmeter and be sure.

The oscillator circuit requires little rewiring because the elements of the 1C7-G and 6A8 have corresponding pin numbers. Tie the screen grids of the 6A8 and 6K7 together and connect them to B-plus through a 27,000-ohm dropping resistor. The original .05-µf screen bypass stays in use. (Better make sure it's good.) The 1C7-G oscillator anode voltage was supplied through a filter network consisting of a 4-µf condenser and 5,000- and 2,000-ohm resistors in series. Remove the 2,000-ohm resistor and the condenser, and connect the 5,000-ohm resistor to B-plus. Replace the 120,000-ohm oscillator grid resistor with a 68,000-ohm unit. The high side of this resistor is connected to the a.v.c. line through a 15-megohm resistor to supply fixed bias for the 6A8 and 6K7 control grids. This permits operating their cathodes at ground potential.

A.v.c. is taken from the high side of the volume control and filtered through a 1-megohm resistor and a .05-µf condenser. A 5-megohm resistor supplies contact bias for the 6Q7.

The power amplifier is the only stage with cathode bias. This is developed by a 150-ohm, 1-watt resistor. Connect the *blue* terminal of the original electrolytic condenser to the cathode of the 25L6. Replace the output transformer with one having a 3,000-ohm primary.

Disconnect the bottom end of the antenna primary from the chassis and connect it to the ground terminal so a doublet antenna or outside ground can be used. Realign the set.

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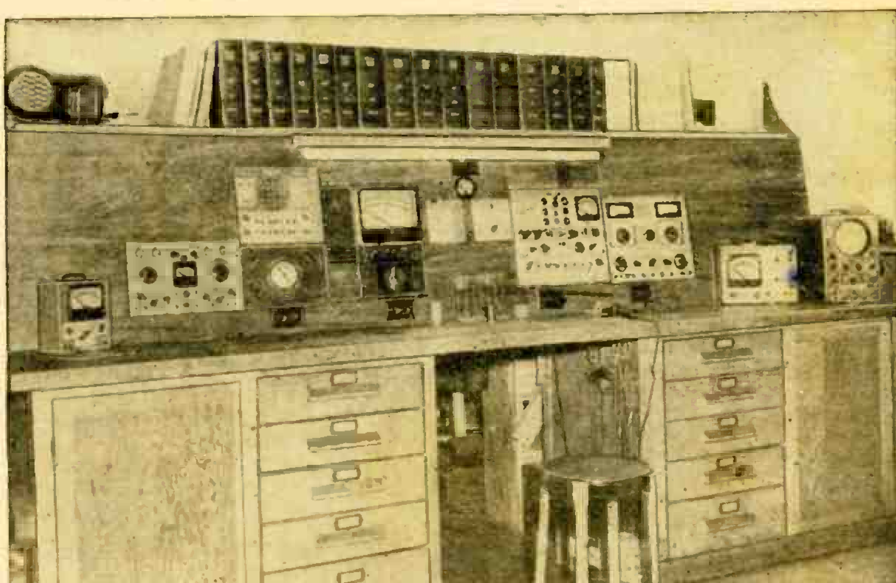

The service bench of Hambrick & Crecente, radio technicians of Moultrie, Georgia, has two complete sets of equipment that can be used simultaneously. Eight a.c. outlets and one 6-volt d.c. outlet provide operating voltages for a.c. and auto radios. Drawers and compartments provide ample storage space for spare parts, tools, wire, and public address equipment.

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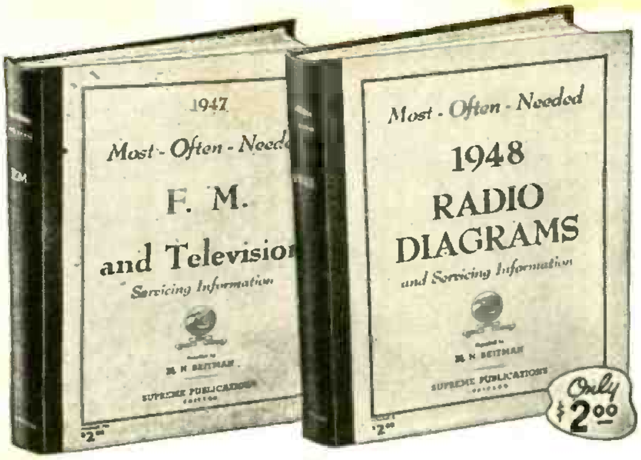

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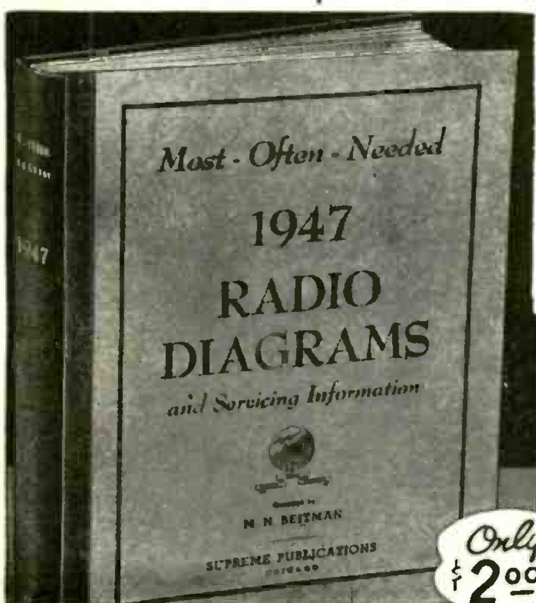

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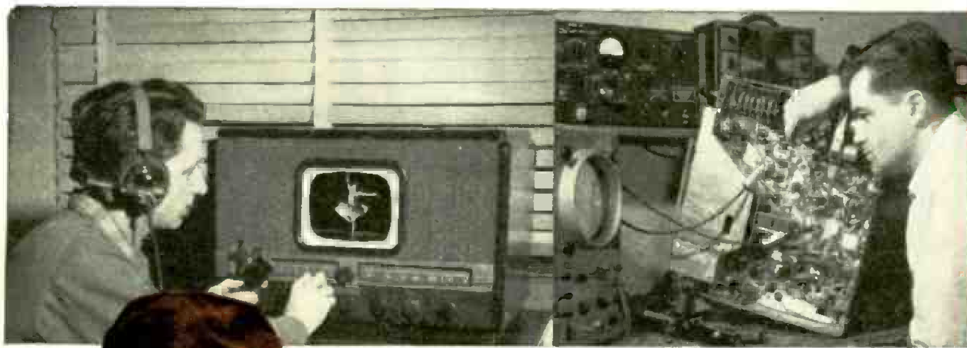

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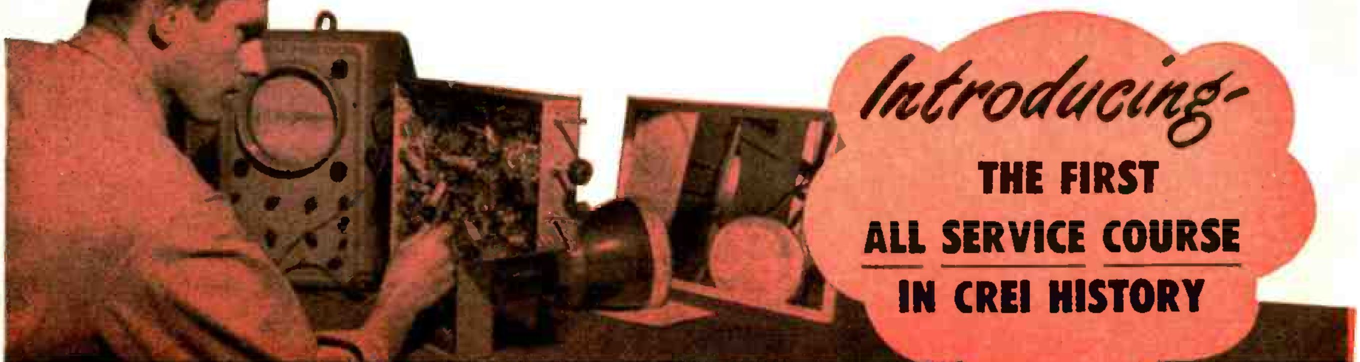

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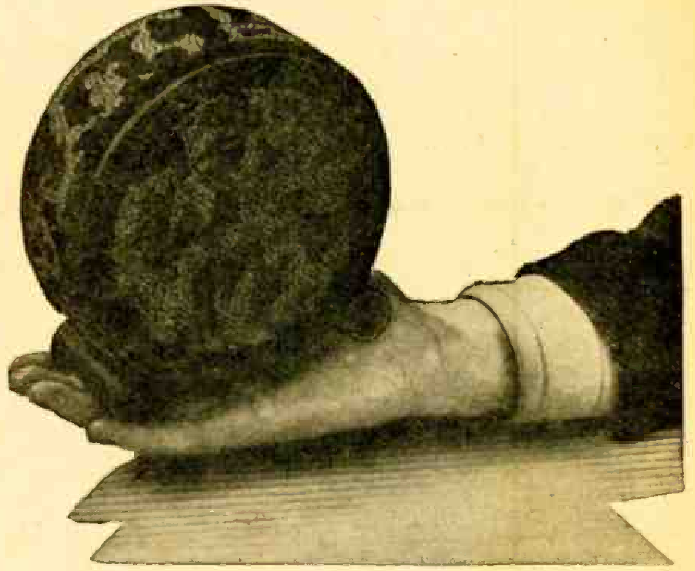
Compact Radio From Holland

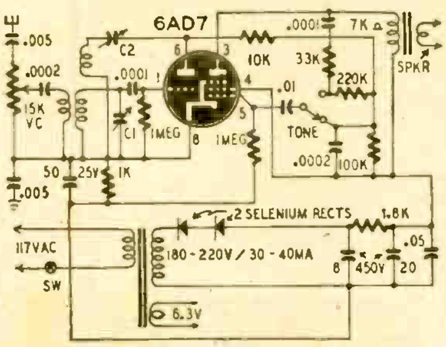


The little radio is built around and behind its own speaker.

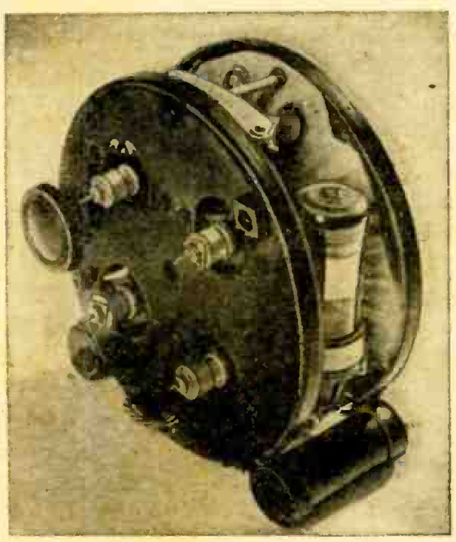
THIS little receiver is of Dutch origin and in its original form was about five inches in diameter by less than two inches deep. As described in *Radio Bulletin* (Bussum, Holland) it was constructed around the smallest of the Philips loud speakers, with all controls at the back.

Available American tubes and parts may make such extreme miniaturization impossible here, but the circuit is adaptable to standard U. S. equipment and might repay an experimenter for the time spent on it.

The set is a 1-tube, 2-stage receiver with a regenerative detector and resistance-coupled audio amplifier, including degenerative feedback. The 6AD7 is the only U. S. tube adapted to this circuit. (Original was a UCH21 or ECH-21.) An interesting feature is the antenna resistor used as a volume control.



Modified schematic of the original receiver.



This back view shows the switch and trimmers.

This could be omitted and the regeneration control used to control volume as well. In that case, the antenna could be attached directly to the 200μμf condenser connected to the antenna coil primary.

The original constructor used an ingenious switching arrangement which permitted tuning to three important stations on different wave bands with two coils and three sets of trimmers. The American constructor will probably prefer continuous tuning, either one band with a single coil, or with plug-in coils if the set is to be a short-waver.

In the upper position, the tone control switches in a feedback network to reduce highs. The small series capacitor limits feedback to the higher frequencies, so that the gain of the pentode is reduced more at the high end of the range than at the low end. In the lower switch position (as shown in the diagram) highs are attenuated slightly by the 200μμf capacitor from grid to ground. This is done to prevent oscillation in the pentode.

Standard 3-winding broadcast or short-wave coils may be used. For broadcast use only, the antenna coil may be wound on a 1½-inch form with approximately 100 turns of No. 28 enamelled wire; the tickler coil may consist of 30 turns of No. 32 to 34 enamelled wire wound next to the ground end of the secondary; the primary can be 20 to 30 turns of the same wire wound in a close doughnut just small enough to slip *inside* the form, where it may be moved to provide best coupling.

For broadcast use, C1 may be 365μμf and C2 160μμf. For short-wave reception these may both be 140 to 160μf. Short-wave coils may be wound or standard coils obtained. Either commercial or homewound coils will require some experimental adding or subtracting of turns to fit each individual receiver. Suitable coil constants are:

Band Meters	*Pri Turns*	*Secondary Turns*	*Spacing*	*Wire*	*Tickler Turns*
10-20	2	6	1 in.	No. 18	4
20-40	4	12	1 in.	No. 18	6
40-80	8	20	own width	No. 23	10
80-160	16	40	close	No. 23	18

The ticklers of the 10-20- and 20-40-meter coils are woven between the turns of the primary. The others are close-wound about ⅛ inch from the ground end of the secondary. Primaries may be ¼ to ½ inch away on the same form or wound inside as described for the broadcast coil. All primaries and ticklers may be wound with No. 32 or 34. All forms are 1½ inches in diameter. Although there are three windings, one terminal of each is common, so four-prong coils may be used. The usual reversing of the tickler is indicated whenever the set fails to oscillate.

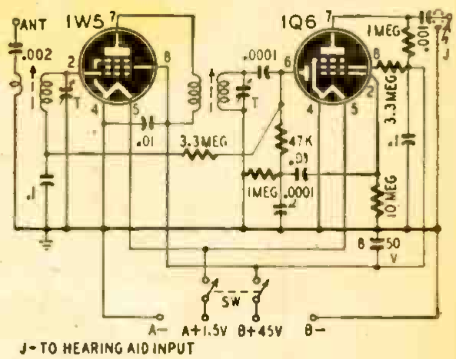
Variations on the power supply are possible. Where miniaturization is not desirable, a full-wave rectifier with a tube might be used. A.c.-d.c. operation is not recommended, because of the high filament current of the 6AD7. However, the entire circuit could be adapted to dry-cell use with a 1D8-GT.

AM TUNER

Here is a small AM tuner using a permeability tuning unit. The tubes are made by Sylvania, and are the type used during the war in proximity fuses. Except for size, the 1W5 is like the 1T4 and the 1Q6 is similar to the 1S5.

This particular tuner was made very small so that it could be hooked to a hearing aid. A small switch is installed in the aid to cut out the microphone and cut in the tuner.

CURTIS HILL,
Jackson, Mich.



REMOTE CONTROLLED COIN INSERT AND SPEAKER BOX

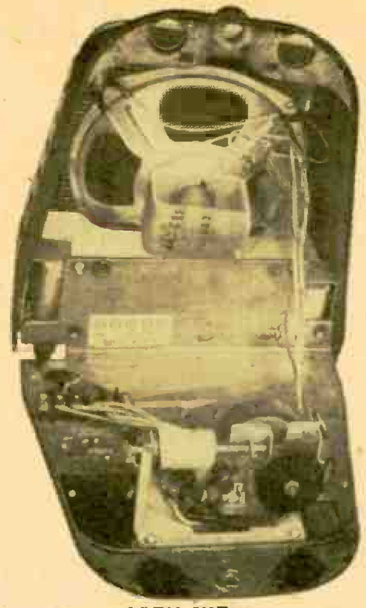
A

A CLOSED VIEW

Made by Solotone Corp., Los Angeles

24 Volt operated, fused
Size of base 5½" x 8" x 10" high
Weight 11 lbs.
Front grill is sloping, illuminated by two pilot lights
PM speaker 6" size with matching transformer, screen and felt protective grills
Will accept 5c or 10c coins
Each 5c coin gives equivalent of two phonograph records
Has Haydon Mfg. Co. timer
Has lock installed in top. (with key.)
Coin box readily removable, size Ɛ½" x 7¼" x 1¾" deep
Finished in attractive blue crackle metal, red plastic with chrome plated grill
Easily mounted on a wall or a flat base
This unit could be used to house coin operated radio

Original cost and selling price of this unit was several times our price.
BRAND NEW **$4.75**



A OPEN VIEW

REMOTE CONTROLLED COIN INSERT AND SPEAKER BOX

B

B CLOSED VIEW

Made by Personal Music Corp., Newark, N. J.

Model F
24 Volt operated, fused
Weight 6½ lbs.
Size 4¾ x 7½ x 5½" high
Sloping front
P M Speaker 5" size
Has 2 Pilot Lights for illumination
Finished in chrome metal and grill with red plastic
Accepts 1 to 6 nickels
Each 5c coin gives about two phono records of music
Should be mounted on a flat base
Has Haydon Mfg. Co. timer
Lock installed in top. (with key.)
Easily removable coin box, size 6" x 3½" x 1½"
Requires 4 wires from power unit

A beautiful piece of equipment that could be built to house coin operated radio

Worth several times our asking price. Price brand new **$4.95**

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ADAPTER-AMPLIFIER

Made by Solotone Corp., Los Angeles

Model 2
115 Volts, 60 Cycles, fused
125 Watts input
15 Watts output
Tube line up 6J5, 6SL7, 2-6L6G's, 5 U4G
Crystal, Magnetic or 600 ohm line inputs
Individual volume, treble and bass controls
15 ohm output
Size 10½" x 15½" x 8½" high
Weight 30 lbs.
Chassis size 10½" x 15½" x 3¼" high
Has meter to determine number of plays
Has 24 V AC output for the remote speaker boxes, fused
Toggle switch turns remote speaker boxes off and on
Black Crackle finish
Well ventilated
Built for continuous night and day service

Originally sold for several times our asking price. Price Brand New **$24.75**

$24.75

MASTER POWER SUPPLY UNIT
for Measured Music System

Made by Personal Music Corp., Newark, N. J.

Model F
110 V 60 cycle, input 300 Watts, fused
15 Watt output
Has high-low AC input line switch
Tube lineup: 2D21, 6AL5, 6SJ7, 6SN7, 2—6L6G's, 5U4G
Size 11½" x 17¼" x 10"
Chassis size 11½" x 17½" x 2½"
Has Vernier volume, master volume, treble and base controls
Gray crackle finish
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External handles for carrying it
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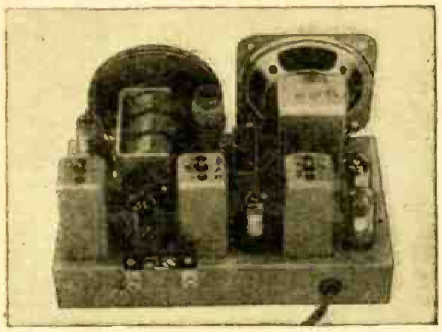
A Six-Tube Dry-Cell Superhet

A 1.5-Volt Radio For Use in Rural Areas

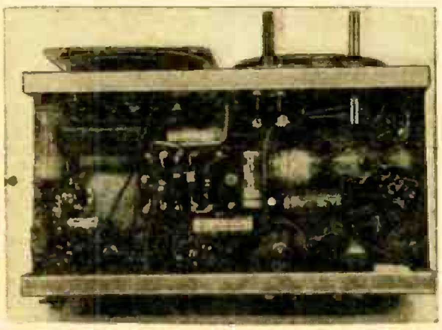
By EDWIN BOHR

An r.f. stage and two stages of i.f. are found in this receiver, its size has been kept down by the use of miniature button-base tubes which also increase efficiency.

Most battery-operated portables are designed for local reception only and are unable to pull in the weak stations. A logical step for increasing sensitivity is to add an r.f. stage. The use of two i.f. stages on the broadcast band is not generally necessary, but, by using two stages and applying a.v.c. to only the first, the second can be made to function as an a.v.c. amplifier. This gives more satisfactory a.v.c. action.


Though not a portable, set is very compact.

An orthodox circuit consisting of a 1T4 r.f. amplifier, a 1R5 converter, two 1T4 i.f. stages, a 1S5 second detector and first audio amplifier, and a 1S4 in the output is employed.


Underchassis photo shows placement of parts.

The chassis should be cut and punched before mounting the parts: a slip of a drill may ruin a speaker or tuning condenser.

Grid leads should be pressed close to the chassis to reduce stray fields and troublesome oscillation. Use light, flexible hookup wire because the socket lugs are delicate and can be damaged easily. The difficulty of grouping parts around these tiny sockets makes terminal strips necessary. The holes in the centers of the sockets were made to be used in case future tubes had exhaust tips on the bottom. They serve admirably as ground lugs. The antenna coil should be mounted above the chassis, and the r.f. coil below. By using the center section of the tuning condenser for oscillator tuning, a source of feedback trouble is avoided.

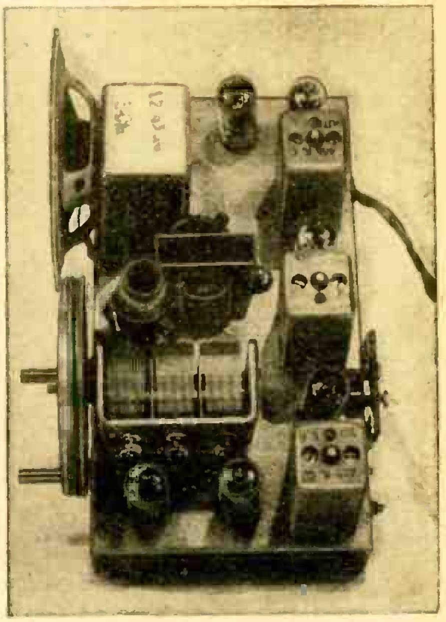
A 4,700-ohm resistor and a .01-μf condenser decouple the i.f. and r.f. stage B-supplies. This is necessary to prevent i.f. voltages from feeding back to the r.f. stage when the set is tuned to the low end of the band. The 1S5 plate is bypassed with a 100-μμf capacitor to reduce high notes and noise as well as to add to the r.f. filtering.

The speaker is mounted on the chassis by the bracket intended for an output transformer, instead of by the flange. This mounting method helps assure a microphonic-free radio. The speaker is a heavy-duty unit with a heavy magnet which contributes to the set's efficiency.

The tuning condenser used will tune to 1600 kc with a set of standard broadcast coils. The receiver is aligned in the usual way. Use the size padder the manufacturer specifies for the coils.

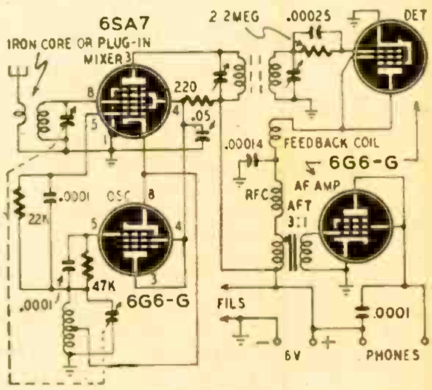
The 67½-volt B-battery was chosen because it could be placed in the bottom of the cabinet built for the set.

With suitable coils the receiver performs well on the short-wave bands.

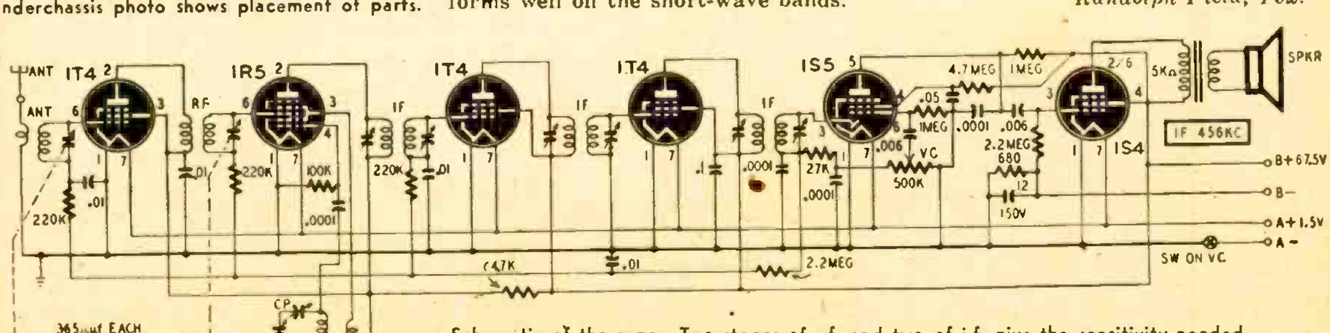

The six-tube superheterodyne is well laid out.

6-VOLT RECEIVER

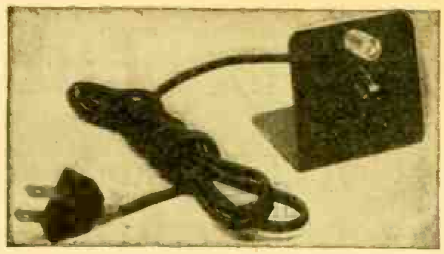
Only a single 6-volt battery is used in this receiver for both filament and plate supplies. The tuning capacitor is a 365-μμf-per-section unit and standard broadcast coils may be used. The i.f. transformer may be a standard unit with a regeneration winding or the extra winding may be added to an ordinary transformer.



JAMES C. SOUKUP,
Randolph Field, Tex.



Schematic of the super. Two stages of r.f. and two of i.f. give the sensitivity needed by many dry-cell sets, which are often used in rural areas far from broadcast stations.



The neon lamp used as a photoelectric eye.

NEON LAMP EXPERIMENTS

By HAROLD PALLATZ

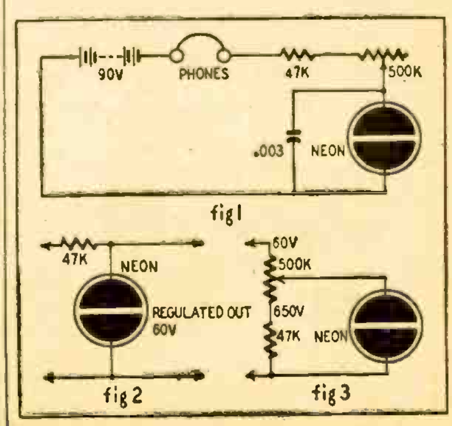
MANY interesting and useful devices may be built from the ordinary fluorescent light starter, the type of starter containing a neon lamp. (Any ¼-watt neon bulb will also work.) Remove the metal can and the capacitor from the starter.

Also needed are a 47,000-ohm, 1-watt resistor, a .003-µf capacitor, and a 500,000-ohm linear potentiometer. A source of 90 volts d.c. will be required for the oscillator experiment. This may be obtained from two 45-volt portable radio batteries or by tapping the voltage from an a.c.-d.c. receiver. If voltage from a receiver is used, be careful to avoid shock. It is a good idea to make sure the receiver chassis is connected to the grounded side of the power line. If a 117-volt lamp wired between chassis and ground lights, reverse the power plug.

Audio oscillator

Connect the components as indicated in Fig. 1. A tone should be heard in the headphones, and adjustment of the control will change its pitch. If the neon is lit but no tone is heard, interrupt the supply voltage momentarily.

This is a relaxation oscillator, a type used in early oscilloscopes. The capacitor takes a certain length of time to charge. When it has charged to about 60 volts, the neon in the lamp ionizes or "breaks down," discharging the capacitor. Again the capacitor starts charging and again it is discharged by ionization of the neon. As a result, current through the headphones varies at a rate determined by the capacitance



Figs. 1, 2, 3—Schematics for three of the experiments with fluorescent lamp starters.

and resistance in the circuit and the breakdown voltage of the lamp.

Voltage regulator

A neon bulb tends to maintain a constant voltage across its terminals, changing its resistance to compensate for any voltage changes. The voltage regulator in Fig. 2 will maintain a constant 60 volts regardless of line voltage fluctuations. Similar regulators were used in army radar equipment and are often employed in test equipment and in television.

Voltmeter

A neon-bulb voltmeter, wired as shown in Fig. 3, will measure a.c. and d.c. voltages with fair accuracy. From 60 to 650 volts can be measured. A scale may be made of cardboard and pasted on the panel to indicate the voltage.

Start at the 650-volt side and advance the control until the bulb just lights. Do not advance the control past the point where the bulb just glows as the bulb may burn out. Calibrate with an ordinary voltmeter, a.c. or d.c. (or both) as desired.

Photoelectric eye

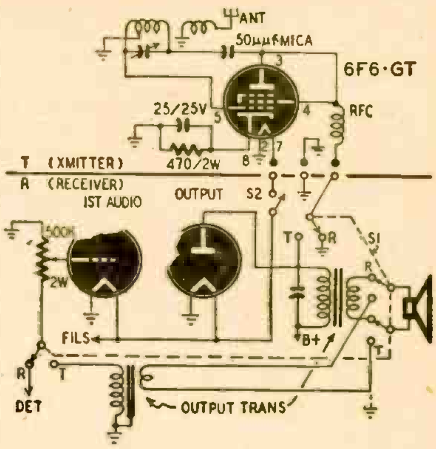
For the electric-eye experiment, simply connect the voltmeter just described to the 117-volt a.c. power line. Shade the bulb. Carefully adjust the control until the bulb is just about to glow. Then bring a strong light close to it. This will make the bulb light. The light obtained is the result of the proximity of another and stronger light.

The operation of neon bulbs as light detectors is somewhat critical and care is necessary in finding the right adjustment. The action is due to ionization of the gas in the tube by the light, possibly coupled with photoelectric action by the plates. The experiment is somewhat similar to the famous one of Hertz on the breakdown of a spark gap by light. In his experiment a spark gap was used and just slightly less than breakdown voltage applied. Application of light ionized the air and permitted the spark to jump.

If desired, headphones may be inserted in series with the neon bulb; a click will be heard each time the light is interrupted.

CONVERSADAPTOR

This *Conversadaptor* is a cheap and compact method of adding a transmitter



to a standard receiver so as to make it a transceiver.

The section labelled T in the diagram is an ultraudion oscillator built on a 4½ x 3 x 1-inch chassis. The section labeled R is the audio portion of the receiver to be used.

Subchassis holds the transmitting oscillator.

The PM speaker is used also as a microphone. With the 4-gang switch S1 in the receiving position as shown in the diagram, the audio input tube is connected to the receiver's detector and the speaker is connected to the audio output. Plate voltage is removed from the 6F6-GT oscillator tube.

With S1 in the transmitting position, the first audio grid is fed by the speaker as a microphone, and the oscillator is plate-modulated by the audio output tube.

The values of the oscillator coil and condenser will depend on the band used.

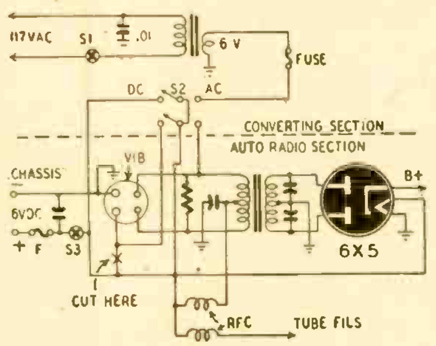
THEODORE S. GEORGILADAKIS,
Crete, Greece

AUTO RADIO CONVERSION

The advantage of this converter circuit for an auto radio is that very few changes are necessary in the receiver, and the receiver can still be used on d.c. at any time. All new parts can be mounted on the cover of the metal receiver cabinet. To use the radio on a.c., disconnect the battery and plug the receiver into the line. Close S1, and throw S2 to the a.c. position.

It may be necessary to replace the speaker with a permanent-magnet type if a.c. hum occurs.

E. L. RAYNAUD,
Mexico, D.F.



SMALL SHIELD CANS

Shield cans for small coils and miniature tubes can be made from the casings of old flashlight batteries.

Some of these have metal jackets in place of the cardboard ones. Straighten the flanges at top or bottom with long-nosed pliers, and slip the casings off the batteries.

The zinc outside of an ordinary cell can be removed by sawing off the top and bottom with a hacksaw, then removing the insides of the battery with a hammer and a large nail. Clean the inside of the zinc thoroughly with soap, water, and a small bottle brush. Try not to get the sticky material from inside the battery on your hands.

Solder small right angles to opposite sides of one end. Slide the shield over the coil or tube, then screw or solder the angles to the chassis.

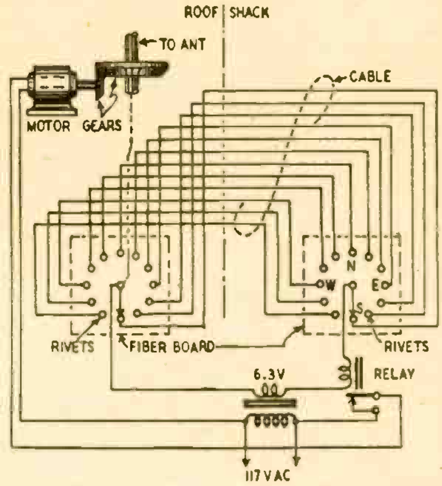
When shielding coils, the zinc will often be better than the steel casings; they will lower the Q less.

K. E. FORSBERG,
Sauk Centre, Minn.

DIRECTION INDICATOR

Aside from the antenna assembly and motor, this direction indicator for a rotatable antenna requires only a pair of square fiber boards, a couple of old volume controls, a 6-volt relay, and a few copper rivets.

The volume controls, mounted in the center of the fiber squares, are used only as bearings, so their "innards" should be removed. Around each control, in a circle, drill 15 accurately spaced holes. Mount a round-headed copper rivet in each hole. Attach a piece of spring brass to each of a pair of old knobs and bend it so that when the knob is placed on the shaft, the brass contacts each rivet in turn. Now mount the fiber squares on boxes so that they form the tops.



Mount one box in a convenient position under the antenna, and couple the antenna pole to the rotating contact, so that when the antenna rotates the contact will revolve in step with it.

Place the second box on the operating desk, and connect the studs of the two boxes with a cable. Be sure that each rivet of one box is connected to the corresponding rivet of the other.

In series with the power line to the antenna motor, place the contacts of a normally closed 6-volt relay. Connect one end of the relay coil to a 6-volt supply (a filament transformer will do) and the other to the rotating contact of the box in the shack. The other end of the 6-volt supply goes to the rotating contact of the box at the antenna.

To make the antenna point south, for example, place the rotating contact in the shack on the rivet contact which represents south (marked S in the drawing). Since the antenna motor's power circuit is complete (through the relay contacts), the antenna will rotate and the contact on the antenna box will go around with it. When this contact hits the "south" rivet, the 6-volt circuit will be complete and the relay will open. This will interrupt the supply of current to the motor; the antenna will stop.

If the antenna turns too freely, some kind of clutch may be necessary to prevent its coasting past the contact. If finer positioning is necessary, a greater number of rivets may be used in each box.

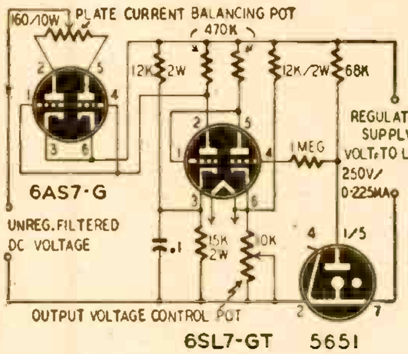
W. H. GIBSON,
St. Catherines, Ontario

REGULATED SUPPLY

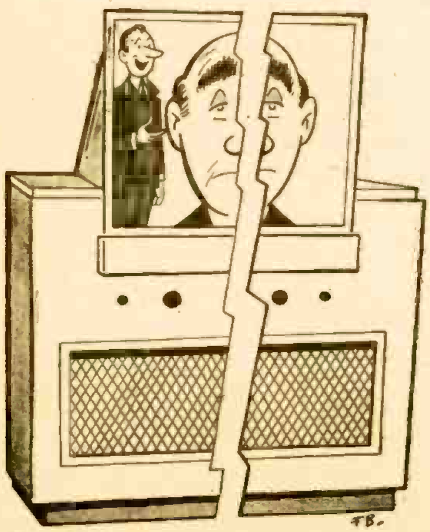
This regulated power supply uses the new RCA 5651 miniature voltage-reference tube. The circuit of the power supply is described in the tube's data sheet.

The grid of the right-hand section of the 6SL7-GT is furnished by the 5651 with a constant reference voltage.

When the load on the supply decreases, the output voltage increases. This increases the plate voltage on the right triode. The left grid, being tied to the right plate, also becomes more positive, and the left triode plate current increases. This makes the left plate—and the 6AS7-G grids tied to it—more negative. Plate resistance of the 6AS7-G rises; and since the cathode-plate circuit of the 6AS7-G is in series with the positive side of the supply line, the supply's output voltage decreases.



At an output of 250 volts, variation is less than 0.2 volt for load currents of 0-225 ma.



Suggested by:
Grego Banshuck, New York City

"This is the split personality type!"

PHONO ADAPTER

The photograph shows a good method for making an extension for a phonograph pickup cable or an adapter.

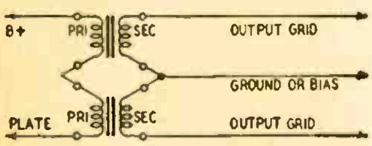
The receptacle housing is made from the shell of an old fluorescent lamp starter. The ears on the starter shell were lengthened by filing down the wall between them, then bent over the edge of the receptacle and soldered to the grounding connections. Shielded wire runs through a hole in the top of the shell.

This solves the problem of making a neat connection to a standard phono jack while preserving the shielding throughout.

JACK D. SELLERS,
Detroit, Mich.

INTERSTAGE TRANSFORMER

The driver transformer may burn out in old sets in which they were used. If no audio unit with a push-pull secondary is available, two single-ended transformers can be used.



Connect the primaries and secondaries in series. Hook the primaries to the driver output as shown in the diagram.

Connect the secondary to the push-pull grids, using the junction between the two transformers as the center tap. If operation is not ideal, reverse the connections of one of the secondaries.

ORREN REYNOLDS,
Dupont, Ohio

TINNING IRONS

During almost every soldering job little drops of solder melt from the iron and fall on the bench, the chassis or even (the XYL doesn't like this) on the solderer's pants. When brushing off the bench, don't throw away these little solder chips. Collect them in an aluminum shield can.

After the collection has attained some bulk, put the can on the stove and let the solder melt. When it hardens, it will form one solid piece. To tin an iron, first file away the corrosion and then clean the tip with steel wool. Then dip the tip into the shield can, twisting the point around so that all parts are immersed in the solder. Take it out of the can, wipe quickly with a piece of heavy cloth, and note the brightly tinned surface.

Tinning the iron this way is not only cheaper but also more efficient than using new solder from a spool.

RICHARD HENRY,
New York, N. Y.

RESISTANCE WIRE

While constructing a multimeter I needed some resistance wire to make shunts for the current ranges. I broke open an old tube and carefully unravelled the grid and screen wires.

One four-foot piece of this wire had a resistance of 200 ohms. Another was 2½ feet long and measured 5 ohms. Dividing 200 ohms by 4 feet told me that the first piece had a resistance of 50 ohms per foot; the other, 2 ohms per foot.

Knowing the resistance per unit length, it was an easy matter to cut exactly the length needed.

S. P. BRUNTON,
Kingston, Ontario

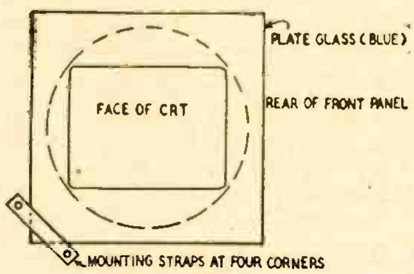
TV GLARE FILTER

Eye fatigue resulting from watching television programs is often due to the glare. To eliminate this, I fastened a piece of blue-tinted plate glass behind the front panel of the set, between the kinescope tube and the cabinet aperture. The glass is fastened to the rear of the panel by straps at the corners.

As well as eliminating glare, the glass improves contrast, permits viewing in a well-lighted room, and gives added protection to the tube.

Blue-tinted plastic, available at art stores, will work as well as glass, but if there is no protective glass in the cabinet, the plastic may be scratched.

ANTHONY DUTKOWSKI,
Bayonne, N. J.



AIR-CONDITIONED RECEPTION

When I was younger, my friend and I used to have fun talking from room to room through the furnace pipes. Recently, I made practical use of this idea when people in several rooms wanted to hear the same radio program.

I turned up the volume of my receiver and put it, speaker face down, on the cool-air intake in the living room. The program was heard clearly all over the house, and the cold-air intake does the radio no harm.

In the summer, when the furnace is turned off, the radio could be fed through any outlet in the house.

Although the fidelity probably suffers, the volume is entirely sufficient.

ARTHUR TRAUFFER,
Council Bluffs, Iowa

TIGHTENING GRILL CLOTH

A number of receivers that come into the shop for repair have sagging grill cloths.

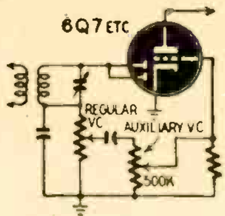
A simple way to tighten them is to sprinkle or spray them lightly with water, and then let them dry overnight. The cloth shrinks and becomes taut.

Since water is distinctly unhealthy for speaker cones, it is a good idea to remove the speaker before sprinkling.

G. J. MACHEAK,
San Pedro, Calif.

PRESET VOLUME

A preset volume control can be a blessing where loud radios are annoying. Children can be prevented from upsetting mother's nerves by running the volume up on the more blood-curdling programs.



The auxiliary control, wired as shown, is placed in any convenient position away from prying fingers. It may be screwdriver-set. Sets using variable bias as a volume control may be preset with a variable 3,000-ohm resistor placed in series with the regular control.

FRED G. WILLMAR,
Maywood, Ill.

6N6 SUBSTITUTE

The 6N6 tubes I needed for replacement in an old receiver are no longer available. 6K6's placed in the 6N6 sockets worked fine without any rewiring.

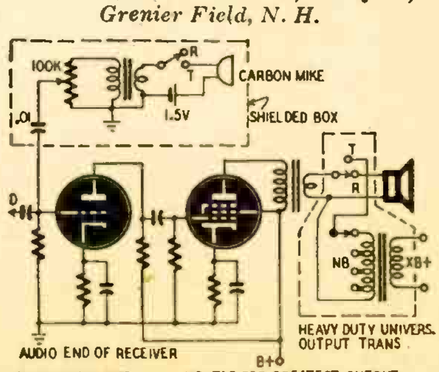
ERIC LESLIE,
New York, N. Y.

MODULATOR

Here is a method of modulating a flea-power rig when a modulator is not available.

A carbon mike is switched to the grid of the first audio tube of a small receiver. The low-impedance secondary of a plate-to-voice-coil transformer is placed across the receiver output, and the primary of the transformer is used to plate-modulate the transmitter.

S/SGT. BENEROGE, W1QYU,
Grenier Field, N. H.



D= FROM 2ND DET NB-TAP FOR GREATEST OUTPUT
XB+-INSERT IN B+ LINE TO BE MODULATED

SCREW SIZES

If you own a small set of taps and dies, you can make a handy device for measuring screws. It will tell you what size tap to use to accommodate a certain screw or, if you keep your screws separated according to size, it will tell you which box a particular screw belongs in.

Drill and tap several threaded holes in a small oblong block of metal. There should be one hole for each size tap in the set, and the holes should be made from left to right in order of size. Use a block at least ¼-inch thick. The handle of an old ten-cent-store dinner knife was handy in my case.

To determine the size of a screw, try fitting it into the holes. Screw it all the way in to make sure the pitch is correct. The block can be marked with sizes, but, since it is hard to mark metal, simply counting the holes from smallest up will tell you the size.

HENRY HOENIGSBERGER,
New York, N. Y.

MOUNTING SHUNTS

When shunts are needed, to convert a meter for a greater current range, resistance wire is often used.

An easy way to make such shunts is to wind the wire on the outside of an insulated resistor. Use one with a resistance high enough not to interfere with the shunting. Wind the wire tightly about the resistor, then solder it to the pigtail leads.

Duco or similar cement may be used to hold the turns in place. The completed shunt may be mounted wherever it is needed, using the resistor leads for connection.

A. D. DENTON,
Herts, England

USEFUL OLD FILE

An old three-cornered file with the sides ground down to sharp edges makes a good tool for stripping wire, scraping, and other operations.

The end of the file can be ground to a chisel shape. The end of the handle can be ground to a rounded point and will be useful for prying up wires which are being unsoldered.

EMIL EPP,
Carrot River, Saskatchewan

ISOLATION TRANSFORMER

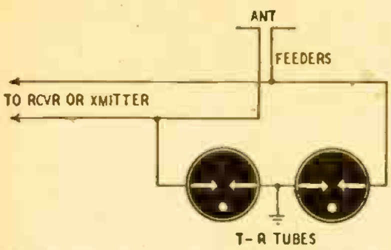
When servicing a.c.-d.c. receivers, isolate the set from the power line to prevent shocks. An inexpensive isolation transformer can be made by hooking two identical filament or toy transformers back to back. The primary of one goes to the a.c. line, the two secondaries are connected together, and the remaining primary feeds the receiver.

Be sure to use transformers with high enough wattage ratings. To determine this, multiply the rated secondary voltage by the rated secondary current. A 6.3-volt, 3-amp. transformer, for example, would be rated at roughly 18 watts.

CHARLES E. COHN,
Chicago, Ill.

LIGHTNING ARRESTER

Surplus T-R radar tubes, such as the 721, 1B25, 1B24, 1B27, or 702B, are used in this lightning arrester. If lightning strikes the antenna, it causes the tubes to break down and lead the charge to ground.



For maximum safety, the ground wire should be run in the same direction as the feeders from the antenna and should have no sharp bends. The lead-in from the tubes to the receiver should come from the arrester circuit at right angles to the antenna and ground leads.

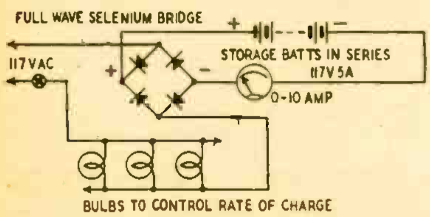
This arrester may be used with transmitting antennas if it is inserted at a low-voltage point in the feeders.

CHARLES KNOOP,
Saginaw, Mich.

BATTERY CHARGER

After building some portable equipment, I discovered I had no way to charge the 12-volt storage batteries. Here is my inexpensive charger.

Two selenium war surplus rectifiers rated at 120 volts, 5 amperes, were purchased. As the diagram shows, they were arranged into a bridge circuit.



Up to three 12-volt batteries may be connected in series for charging. When using the charger, first connect the batteries, then insert a 25-watt lamp into one of the sockets, leaving the other two empty. After plugging into the 117-volt a.c. line, read charging current on the meter. If it is too low, change to a higher-wattage lamp, or add other lamps in the parallel sockets. The lamps act as line-dropping resistors; the higher their wattages and the more of them connected in parallel, the higher will be the charging current.

DAVID SIMON,
Montreal, Quebec

CRYSTAL RECEIVER

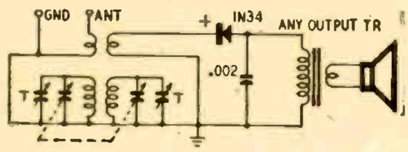
Here is a crystal set which gives good results with a loudspeaker on strong local stations.

The two identical coils for the tuned circuits are 90 turns of No. 20 enameled wire on forms 1⅝ inches in diameter and 3½ inches long. After each coil is wound, cover it with a piece of wrapping paper and wind 30 turns of the wire over the center.

The set was constructed breadboard-style. The coil forms are mounted vertically 1/32-inch apart to give proper coupling. The 2-gang, 500-μμf-per-section broadcast tuning capacitor is attached to the base with wood screws. Fahnestock clips serve for antenna and ground connections.

To line up the receiver, tune in a strong signal, remove the speaker from the circuit, and connect a 1-ma meter in its place. Tune the trimmers for highest meter reading.

G. J. MACHEAK,
San Pedro, Calif.



PHONO AMPLIFIER

This amplifier uses a cathode-follower output stage. The triode-connected 6L6's give about 8 watts without any measurable distortion. They can be driven to about 11 watts, but distortion will appear. The output transformer need not be a high-fidelity unit, but it should be of reasonably good quality with a rating of about 15 watts.

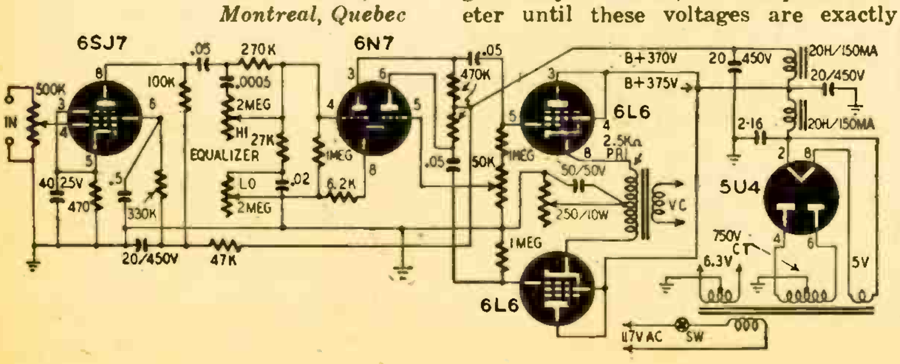
The normal frequency response is uniform from 40 to 15,000 cycles. The equalizer circuit allows highs to be boosted about 6 db at 8,000 cycles, and the lows to be boosted about 7 db at 50 cycles.

It is very important that the 470,000-ohm plate resistors of the 6N7 phase inverter be well-matched. The power supply output voltages must be within 5 volts of those shown. Some adjustment of the voltage can be made by trying different values for the filter input condenser. Adjust the 6L6 cathode resistor until the tubes draw 110 ma.

Adjust the phase inverter by feeding a constant tone into the amplifier and (with a vacuum-tube voltmeter) measuring the audio voltage at each 6L6 grid. Adjust the 50,000-ohm potentiometer until these voltages are exactly equal. This adjustment should be repeated periodically, since aging of the 6N7 may cause unbalance.

Despite the 6SJ7 voltage amplifier, the unit will not have enough gain for most microphones. The 6SJ7 merely restores gain lost in the equalizer network. The amplifier will, however, work well with a good phonograph pickup.

WILLIAM D. JOHNSON,
Oakland, Calif.

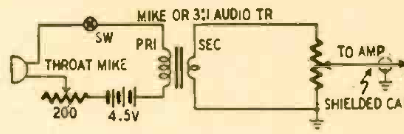


CONTACT MICROPHONE

A surplus T-30 throat microphone makes an excellent contact microphone for amplifying musical instruments. These small carbon units, which can be fastened to the instrument with Scotch tape, work best when the back of the microphone, rather than the rounded front, is against the wood.

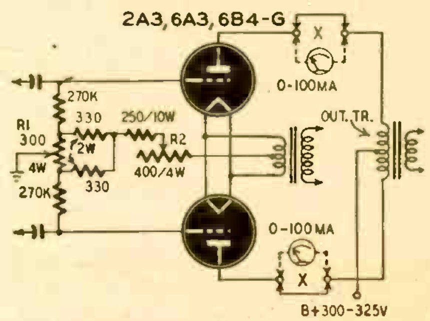
The connection to the amplifier is shown in the diagram. If no carbon microphone transformer is on hand, a 3-to-1 audio interstage unit can be used. Adjust the 200-ohm variable resistor so that satisfactory operation is obtained with the greatest possible amount of resistance in the circuit. Don't forget to open the switch when the assembly is not being used.

KENNETH S. FERRIN,
Fort Wayne, Ind.



BALANCING POWER TRIODES

A.f. power triodes, such as the 2A3, 6A3, and 6B4-G, are very susceptible to unbalance when used in push-pull. The circuit shown corrects this.



R1 is adjusted until the plate currents of the two tubes—measured by a milliammeter inserted at the points marked X—are equal. Then R2 is varied until the total plate current for the stage is of the proper value.

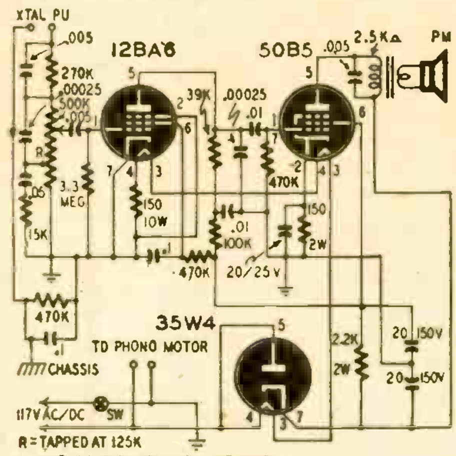
In this arrangement, each triode grid is above ground for d.c. The phase inverter which drives the power stage must be so connected that this d.c. does not appear on its grid. There will be no trouble if the split-load type is used; but if a voltage is tapped off the grid resistor of one of the power tubes to obtain the out-of-phase signal, a capacitor should be inserted to block the d.c. from the inverter grid.

M. HARVEY,
Westfield, N. J.

A.C.-D.C. PHONO AMPLIFIER

When a 6-inch PM speaker is used on this a.c.-d.c. amplifier, it has enough output for comfortable room volume. Since it reproduces frequencies only up to about 5,000 cycles, it is not a high-fidelity unit, but it will please juke-box enthusiasts with its good bass reproduction. Of course, the speaker must be properly baffled. It should be a good-quality speaker with a large magnet.

Notice in the diagram that the ground wire is for the circuit ground only. Between this wire and chassis are a 0.1-μf capacitor and a 500,000-ohm resistor. The arm of the pickup should be connected to chassis—not to the circuit ground—to avoid shocks.

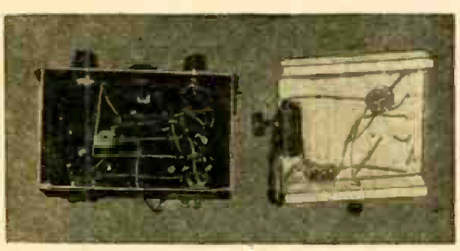


The parallel .005-μf capacitor and the 250,000-ohm resistor in series with the pickup raise the high frequencies somewhat. Different capacitor values can be tried to get varying treble response. Increasing the value of the .01-μf capacitor across the output transformer primary will vary the bass.—*W. G. Eslick*

SIMPLE TRANSMITTER-RECEIVER

This transmitter and receiver operates with a plate potential of only 6 volts for the receiver and 12 volts (often less) for the transmitter.

The receiver has 2 stages, a regenerative detector followed by an audio amplifier. Although the usual filament voltage for these tubes is 6, 3 to 4 volts has

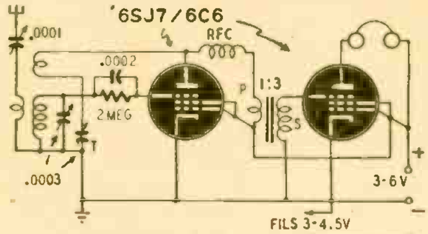


The wiring of both units is extremely simple.

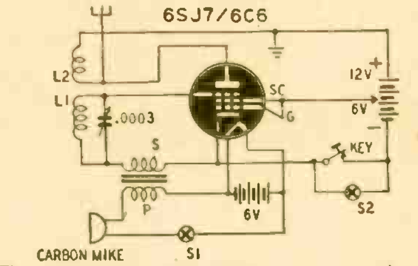
The transmitter (left) and receiver (right).

been found sufficient with this type of circuit.

The transmitter hookup is conventional and several good contacts have been made with it. The receiver brings



The 2-stage receiver uses only 6 plate volts.



The transmitter can operate on c.w. or phone.

in numerous foreign stations, especially on short wave. Any desired band may be chosen by suitable plug-in coils.

This little station has been used as an interhouse communication system with excellent results.

The increased electron emission due to the positive voltage on the control and screen grids enables these tubes to operate efficiently on such low voltages.

P. T. NARASHIMAN,
Tambaram, South India

(This equipment could be adapted to use dry-cell tubes, which would make it much more portable.—*Editor)*

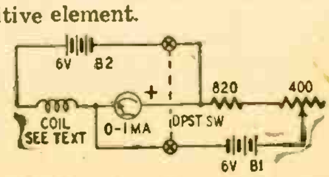
REMOTE THERMOMETER

The temperature of a remote point is indicated by this electrical thermometer which works on the principle that the resistance of copper changes with temperature. It can be made entirely from old radio parts.

The circuit shows a 0-1 milliammeter drawing current from B1 through a fixed resistor and a rheostat. If the meter is connected as shown, this current will cause it to read in the usual direction.

The current from B2 is oppositely polarized, however, causing the meter to read backward. The difference in the two currents will be the actual reading of the meter.

The resistor labeled "coil" is actually an old loudspeaker field coil or any homemade coil of copper wire with a resistance of about 1,150 ohms. It is the sensitive element.



In winding the coil, a fairly small size of wire will be best in order to keep the finished product down to reasonable dimensions. A core should be used for convenience in winding. Any wood or paper tube will do, since the coil is not required to act as an inductance. Scramble-winding is easiest and quickest.

If the coil is placed in the location whose temperature is to be measured, its resistance will change as the heat present varies. The resulting change in B2 current through the meter will cause a change in reading corresponding to the change in temperature.

To calibrate the unit, place the coil in a location which is as cold as the lowest desired scale marking. (The original unit went down to —10 degrees.) Note the reading of a good mercury thermometer in the same location, then mark this reading on the lowest point of the meter scale. Adjust the 400-ohm rheostat until the needle points to the marking.

Now increase the heat and mark other points on the scale, leaving the rheostat alone.

The sensitive coil may be located at any reasonable distance from the rest of the instrument. It should be dipped in paraffin for weatherproofing, but allow excess paraffin to drip off. Do not remove the coil from the circuit until the batteries are turned off. To conserve batteries, turn on the unit only when taking readings.

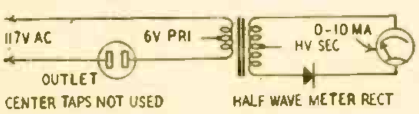
RUSSELL B. GARRETT,
Hanover, Pa.

A.C. WATTMETER

This "wattmeter", which shows the amount of power drawn from the a.c. line by any receiver or amplifier, is very useful for detecting excessive power consumption which might be caused by shorted filter capacitors or by other bad parts.

Current through the transformer primary is determined by the amount of current drawn by the set under test, which is plugged into the a.c. outlet. The current in the secondary is determined by that in the primary. Secondary current is rectified by the small dry-disc rectifier and read on the 10-ma meter.

The transformer has a 6-volt primary. It was the power transformer of an old auto radio. Other meters may be used, or higher wattages may be measured by shunting the meter.



Open the meter and turn the dial scale over. On the white under surface mark the wattage calibrations. Plug in a 25-watt lamp, note meter reading, and mark the scale "25". Other lamps will give other calibration points.

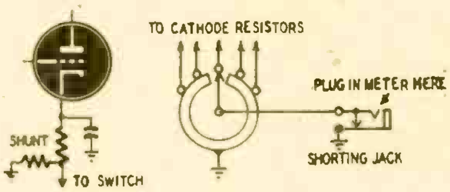
After its initial calibration on 117 volts a.c., the wattmeter will be incorrectly marked for other voltages. However, for the normal variations between 110 and 120 volts, the error will not be important.

J. T. RODGERS,
Bandera, Tex.

PLATE CURRENT CHECKS

Wherever it is important that equipment remain in service at all times, such as in a recording or broadcasting studio, this circuit should be valuable.

Disconnect all cathode resistors from ground, but leave the bypass capacitors grounded. Connect each resistor to one contact of a meter switch, as shown in



the diagram. (This is a Centralab type G wafer.) The almost circular rotor grounds all contacts except one. This one is led to a jack into which milliammeter leads are plugged. Cathode current of the tube associated with that contact will be read on the meter.

If all tubes in an amplifier are to be checked, determine the reading for the tube with the lowest normal current. Then insert a shunt, as shown, on each tube, to bring the meter reading to about the same point. The shunts will not affect the bias values.

Condition of each tube can be checked once a day or as required by plugging in the meter and rotating the switch. Any meter reading that is not normal indicates a tube that will probably fail. If it is replaced immediately, no more than a few seconds of operating time, if that, will be lost.

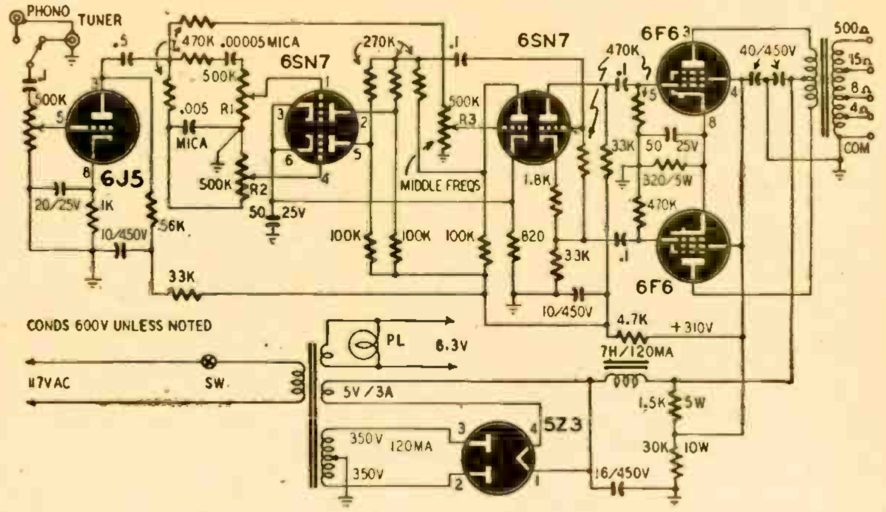
The jack is a shorting type so that, even if the plug is not in, the tube which is switched to the meter will continue to operate.

RICHARD HENRY,
New York, N. Y.

PHONO AMPLIFIER

? *Please design an amplifier suitable for a phonograph or tuner, and having separate channels for bass and treble.—R.R.P., Lakewood, Ohio*

A. In the circuit shown, the first 6SN7 and the left section of the second are used to amplify high, low, and middle tones, respectively. R1, R2, and R3 give separate control of each, as indicated. The right-hand section of the second 6SN7 is used as a cathode-follower or split-load phase inverter for the 6F6's.

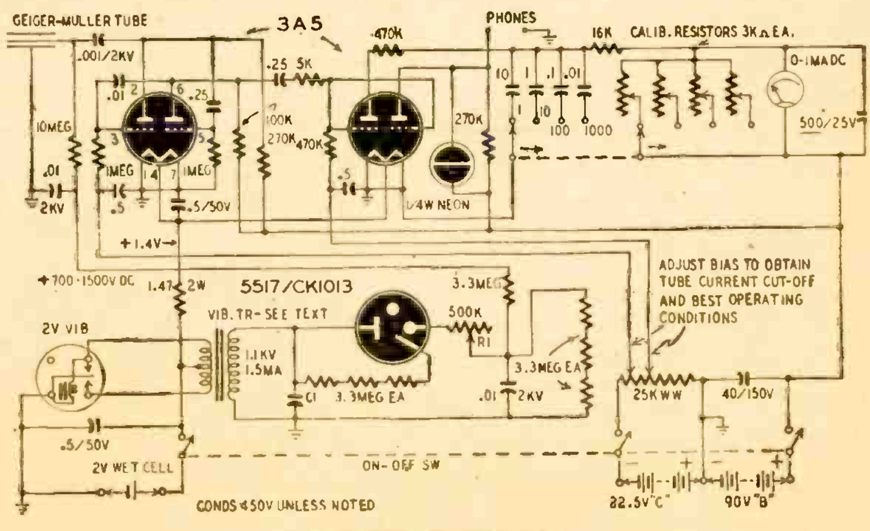


PORTABLE G-M COUNTER

? *Please print a circuit of a portable Geiger-Muller counter giving visual and audible indications. Headphones and a neon lamp are to be used in the indicator circuit. For more exact measurements, I want to use a 4-range meter for indicating 1, 10, 100, and 1,000 counts per second.—K.E.S., Syracuse, N. Y.*

A. In the portable counter circuit shown, dry cells supply operating voltages for the 3A5's. A 2-volt storage battery supplies the filaments and the vibrator pack. The vibrator transformer used is a special item and may have to be wound to order. However, it may be possible to use one of the transformers designed for portable photoflash units. The Thordarson type T-22R43 delivers the necessary voltage and current in the secondary circuit. It has 117-volt a.c. and 4-volt vibrator primaries, and can be used by using a dropping resistor and operating the 3A5 filaments in series.

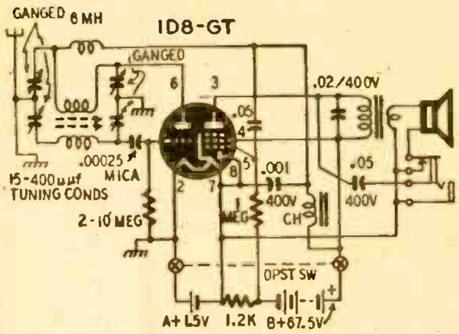
Adjust C1 to obtain the lowest battery drain. Its rating is approximately .0005 μf at 2,500 volts. The G-M tube is used in a self-quenching circuit. Adjust R1 for most stable operation of the tube and set the taps on the 25,000-ohm biasing resistor for best operation of the tubes. (Additional material on G-M counters will be found in RADIO-CRAFT, February, 1944; *Electronics*, January, 1947; *Sylvania News*, May, 1947; *Electrical Counting*, by W. B. Lewis.)



1-TUBE RECEIVER

? *Please print a diagram adapting the receiver described in the August, 1947, RADIO-CRAFT, for use with one tube.—R.W.H., Atlanta, Ga.*

A. The complete receiver, revamped for use with one tube, is shown. Make the variometer of two concentric cardboard or fiber hoops about 5¾ inches in diameter, wound with six turns of No. 24 or 28 wire each. The 400-μμf tuning condensers add to the frequency range, which will be almost 10 to 1.



PORTABLE AMPLIFIER

Please give me a diagram of a portable amplifier. It should have about 6 watts output, and should operate from dry batteries or from a 6-volt vibrator supply.—E.C.B., Streamstown, Alberta

A. The amplifier diagrammed will satisfy these requirements. While 2-volt tubes might require a smaller A-battery, a larger number of stages would have to be used. The 6-volt tubes have the advantage that they may be operated directly from the storage battery used to drive the vibrator supply. When using the vibrator, adjust the value of C for lowest battery drain. RFC is 55 turns of No. 12 wire close-wound on a 1-inch form.

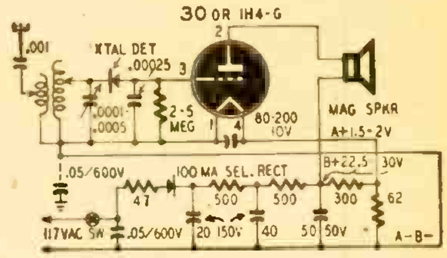
A dynamotor giving 180 to 250 volts output at 50 ma or more from a 6-volt input could also be used. The filtering shown is more than sufficient for a dynamotor.

1-TUBE CRYSTAL SET

Please give a diagram for a crystal receiver using a type 30 tube for audio amplification and a selenium-rectifier power supply.—L.G., Pilot Grove, Mo.

A. Here is the circuit you requested. The rectifier is a 100-ma selenium unit. If B-voltage is too high, R may be increased. L1 and L2 are not critical, since only the desired portion of each is selected by the tap. L1 might be about 30 or 40 turns and L2 around 300 turns, both on a 1- to 2-inch diameter form.

Unless an isolation transformer is used between the a.c. line and the power

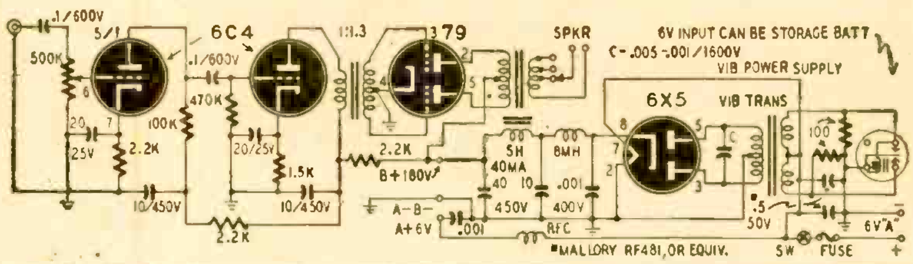


supply, be very careful about touching components. It is advisable to enclose the set in a cabinet.

REMOTE ANTENNA

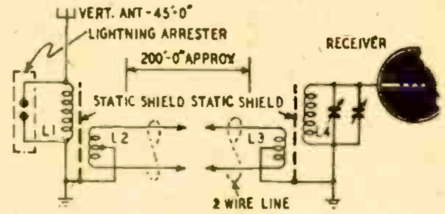
I am about 150 miles from the nearest broadcast station and in a very noisy location. I have set up a 30-foot pole and placed a 19-foot whip antenna atop it at a spot about 300 feet from my house where noise is at a minimum. How can I run a transmission line to my receiver, picking up least possible noise along the way?—J. H. H., Inyokern, Calif.

A. The schematic shows location of the coils necessary. Wind L2 with 24 turns of No. 24 d.c.c. in a single layer on a



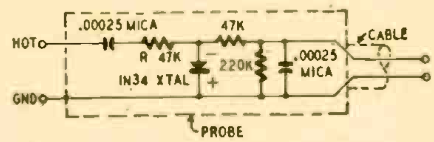
1¼-inch diameter form. Over it place a strip of lead foil as a static shield. To avoid the effect of a shorted turn, insulate the ends of the shield from each other and ground the foil. Over this pie-wind L1 with 30 turns of No. 30 d.s.c. Make the pie about ⅛-inch wide. Be sure the center tap on L2 is accurately placed.

L3 and L4 are handled in the same manner. L3 is 44 turns of No. 36 close-wound, and L3 is 124 turns of the same wire pie-wound, ⅛-inch wide. Vary the turns on L4 to allow good tracking in the receiver.



CRYSTAL PROBE

? *Please print a diagram for a probe I can use with the signal tracer-injector described on page 31 of the September, 1947,* RADIO-CRAFT.—*E. F., Tampa, Fla.*



A. The probe shown is what you want. It uses a 1N34 crystal. It will work well with any signal tracer. Loading effect exists, but is slight.

Resistor R may be any value from 20,000 to 100,000 ohms, whichever works best for you. The probe is suitable for almost all i.f. and r.f. frequencies found in ordinary repair work.

CRYSTAL PICKUP CABLE

? *Will a 10-foot cable between my crystal pickup and the amplifier cut high frequencies appreciably? — R.H., New York, N. Y.*

A. The capacitance of the cable across the pickup will not cut highs because the crystal is itself capacitive. It may, however, reduce overall level.

COIL DATA

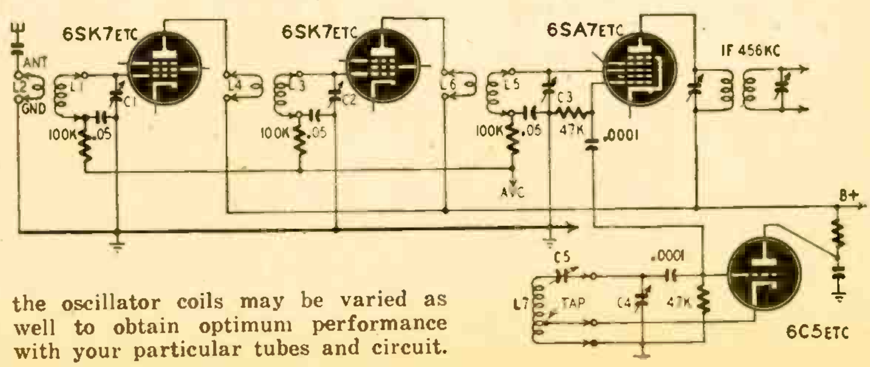
? *I am building a superheterodyne to cover the broadcast band and 80, 40, 20, and 10 meters. I am using a 4-gang, 140-μμf tuning capacitor with 4- to 30-μμf trimmers. The i.f. is 465 kc.*

Please supply me with data for winding the coils, and give values for the necessary padding capacitors. — L.I., Compton, Calif.

A. The coil table shows the data you require. To get all the coils to track, it may be necessary to adjust the turns or lengths slightly, as well as the padder values. Taps on the oscillator coils may be varied as well to obtain optimum performance with your particular tubes and circuit.

BAND (mc)	COILS	TURNS	TAP FROM GROUND END (turns)	PADDER C5 (μf)
Broadcast 0.55-1.6	L1, 3, 5 L2, 4, 6 L7	145 35 115	— — 34	— — 0-.00018
80 meters 3-5.7	L1, 3, 5 L2, 4, 6 L7	24 8 21	— — 6	— — .0011
40 meters 5.4-10	L1, 3, 5 L2, 4, 6 L7	13 6 12	— — 4	— — .0012
20 meters 9.5-18	L1, 3, 5 L2, 4, 6 L7	8 5 7.5	— — 3	— — 005
10 meters 15-30	L1, 3, 5 L2, 4, 6 L7	4 3 4	— — 2	— — none

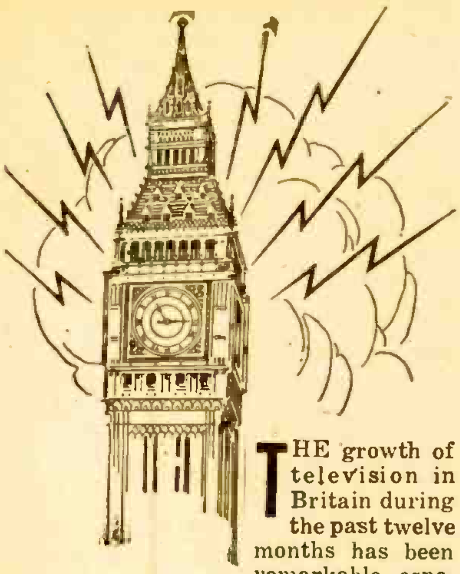
All coils wound on 1½-inch diameter forms. All L2, 4, 6 coils spaced approx. ¼ inch from ground ends of L1, 3, 5 coils. All wire No. 24 enamelled except broadcast band coils which use No. 32. All coils close-wound except L1, 3, 5 on 80, 40, 20, and 10 meters, which are spaced to 1 inch.



Report From Britain

By Major Ralph W. Hallows

RADIO-CRAFT EUROPEAN CORRESPONDENT



THE growth of television in Britain during the past twelve months has been remarkable, especially when you consider that reception is still confined to the London area, that (owing to restricted output from the factories) televisers haven't always been easy to come by, and that many homes in some parts of London have unsuitable power supplies. British standard current is 230-volt 50-cycle a.c.; but at the moment the word "standard" is more of a pious hope than a reality. Actually you may come across a.c. with queer frequencies like 30, 40, 83 (!) and 100 cycles. In the London area you may find houses on one side of a street with d.c. at 100, 200, 205, 210, 215, 220, 230, or 240 volts and those on the other side with 100, 105, 200, 205, 210, 220, 230 or 240 volts of a.c. All this would have been ironed out before now if it hadn't been for the war. Thus by no means every home can accommodate a televiser.

In spite of that, the number of sets in use has risen from just over 18,000 a year ago to more than 45,000 now, an increase of 250 percent. It would have been much greater than that if radio manufacturers could obtain all the raw materials that they need. Meantime, work on the second television transmitter at Sutton Coldfield near Birmingham is going ahead fast. When it comes into action in the fall, television will get another big boost. If only our radio factories could get the materials, I believe that there would be half a million or more televisers in use by this time next year.

For several reasons England is probably peculiarly well situated as a country for the quick development of television. Geographically the territory is small: you can't find two places in Britain which are more than 800 miles apart; over 80% of the population can be covered by half a dozen television transmitters, each having a service area with a radius of about 40 miles; the majority of the great sporting and other events which have the biggest of all appeals to televiewers take place within easy co-ax or radio link range of these six centers. Further, there is no handicap of large time differences between the eastern and the western parts of the country. An interesting event in any part of Britain can be televised to any other part without calling on some viewers to sit up far past their usual bedtime or on others to rise at uncanny hours if they want to see what's going on.

Man-made static

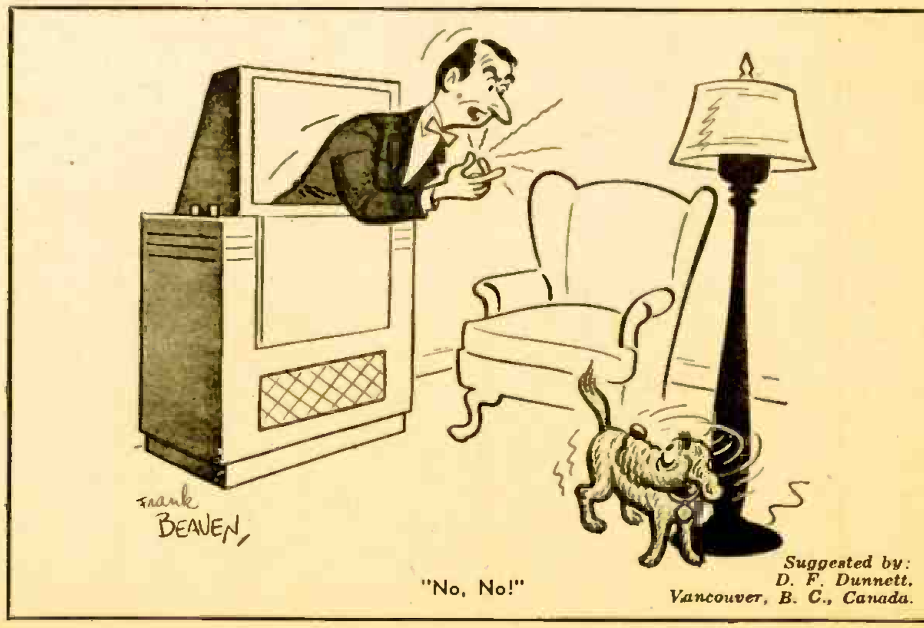
Whatever kicks in the pants Mother Nature may deal out to radio enthusiasts in the form of static, blackouts and fading, she confines mainly to frequencies below 30 mc. Above that point the human race unhappily devises sources of man-made static which easily beat all Dame Nature's efforts on the lower frequencies. One of man's worst efforts so far has been automobile and truck ignition systems. This produces the worst kind of radio interference above about 40 mc and almost the only sort beyond 90 mc. Research has shown that this interference can easily be suppressed by a 10,000-ohm resistor in the main distributor lead. All vehicles ought to be so fitted before they leave the factory, but that hasn't come about yet, in Britain at any rate. The General Post Office, the radio trade associations, and some other concerns are having all their vehicles fitted with suppressors; but there remains one offender who is still giving a lot of trouble—the private car owner. For his special benefit a 10,000-ohm resistor gadget is sold for about 30c. A threaded tip for the distributor lead screws into a socket in the distributor. There's another type available for the "push-in" lead. Thus for a low price and little effort the private car owner can get the greater part of the advantages of complete suppression.

High-frequency laundering

Sometime ago Sir Edward Appleton, Director of the National Physical Laboratory, announced, as the result of a series of experiments, that it would shortly be possible to extract the dirt from soiled fabrics by the use of supersonic vibrations. Further experiments have been carried out by the Mullard Company and a recent demonstration was most striking. The instrument used is called a transducer. It converts the energy from an oscillator into pressure waves in water. Two very dirty laboratory overalls, one soaped and the other unsoaped, were put into separate tanks of water, each provided with a transducer. The unsoaped overall came out a little less white than the other, though it was perfectly clean. There is still a good deal of work to be done before the first radio-electronic laundry is opened. It has been shown that clothes can be washed without soap, but some way of whitening them has to be found. And there's a great deal to be discovered about the right frequencies for use with different fabrics. Too low a frequency means that some dirt remains; if the frequency is a good deal too high, not only is the dirt shaken out, but the fabric itself may be shaken to pieces.

Olympic PA

An interesting PA system for the Olympic Games is being installed at the Wembley Stadium by the Philips Company. One of the difficulties about ensuring that announcements are clearly heard by members of a big crowd is that their clothes and bodies absorb the higher frequencies. Unless something is done about it the higher sound of



"No, No!"

Suggested by: D. F. Dunnett, Vancouver, B. C., Canada.

speech may be so completely lost that little but a series of unintelligible "woomphs" is heard from the loudspeakers. Here's how the problem has been tackled. The 24 main loudspeakers are arranged in pairs on 12 standards. These are 25-watt 12-inch cone speakers. Immediately above each main speaker is a 12-watt high-frequency unit with a triple square-section horn. Between these and the amplifier is a bass-cut circuit. The control of both volume and frequency range is quite independent of the main loudspeakers. Thus the tonal balance can be adjusted as may be necessary to suit the size of the crowd at any time. The denser the crowd the greater the treble boost needed.

Vest-pocket B-supply

A British battery-making company has just produced what must be about the smallest high-voltage dry battery going. Weighing 7½ ounces and measuring 3 29/32 x 2 19/32 x 2 7/64 inches, it has an output of 300 volts. It is intended primarily for photographers' repeating gas-filled flash tubes, but other ideas for its use concern radioactivity meters, insulation testers and portable television receivers. It certainly packs a punch! Connect a few of these midgets in series and you're up in the thousand volts region. Yet you could carry the lot in a pocket.

German scientists have organized the Max Planck Society for the Advancement of Science to replace the war-ruined Kaiser Wilhelm Society. The organization, named for Prof. Max Planck, who won the 1918 Nobel prize in physics, for his development of the quantum theory, held its first meeting recently in Goettingen.

Purpose of the Society is to foster free research in Germany.

New Canadian bands and modes of operation are: Eighty-meter band; A1—3.5 to 4.0 mc, A3—3.75 to 4.0 mc, FM—3.8 to 4.0 mc. Forty-meter band: A1—7.0 to 7.3 mc. Twenty-meter band: A1—14.0 to 14.4 mc, A3—14.15 to 14.35 mc, FM—14.15 to 14.25 mc. Eleven-meter band; A1—27.16 to 27.43 mc, A3—27.16 to 27.43 mc, FM—27.16 to 27.43 mc. Ten-meter band; A1—28.0 to 29.7 mc, A3 and FM—28.2 to 29.7 mc. Six-meter band; A1, A2, A3 and FM—50.0 to 54.0 mc. Canadians interested in obtaining licenses write to Room 2212, No. 3 Temporary Bldg., Ottawa, Ont., Room 403 Youville Place, Montreal, P.Q., or the nearest District Radio Office.

Canadian amateur radio operators are required to operate c.w. exclusively for a period of six months or more prior to applying for permission to operate radio-telephone stations in the 10- and 11-meter bands. After operating an active station for one year or more, they must pass an examination in advanced radiotelephone theory and operation and a 15-word-per-minute code test to qualify for an operating permit on the 80- and 20-meter bands.

RADIO IN LATIN AMERICA

By E. A. CONKLIN

SEVERAL noteworthy radio-electronic developments are taking place in Central and South America.

In Costa Rica all radio servicemen must appear for a 3-hour oral technical examination before a Wireless and Electronics Commission, composed of three radio servicemen who have been in the servicing business for five years. Each candidate is asked 15 questions concerning circuits and servicing techniques. Passing score to obtain a servicing license is 86%. Licenses remain valid for 3 years, after which a new examination must be taken. The license costs about $100 a year.

In Nicaragua police are using television to conduct criminal line-ups. Eleven TV transmitters have been erected in communities about 75 to 100 miles apart. Pictures of criminals caught in any of these communities are televised to other communities in the chain for identification.

In Venezuela experimentation is being carried out in the use of radio facsimile by the public. A number of offices have been set up in key Venezuelan cities and citizens may transmit messages which include drawings. At present, rates are approximately $5.00 for a 200-word message plus 1 drawing 2¼ x 4¼ inches.

In Lima, Peru, a complete wing of a recently built hospital is devoted to electronic and radio surgery. Short-wave diathermy equipment, electronic knives for bloodless surgery, and other electronic apparatus is being used. Experimentation with ultrasonics in the treatment of tumors and cancerous growths is being performed. Under a new plan doctors in Peru will be given a 90-day course in electronics and radio as applied to surgery.

In La Paz, Bolivia, radio servicemen are being supplied with screens which can be mounted over their service benches, and slide projectors. Each month 6 slides are issued, each a blown-up schematic which the repairman can consult as he goes about his receiver analysis.

In Bogota, Colombia, automatic radio control equipment is being experimented with in helicopters. In the same city table-model television receivers are being installed in restaurants, diners, and cabarets, where, for the equivalent of 50 cents in American money, 1 hour of televised entertainment is offered. Receivers are installed in booths so only booth occupants can see and hear.

In Buenos Aires, Argentina, a new short-wave transmitter is beaming transmissions in one-hour periods to each of 16 other Latin-American countries. Each day's hourly program is devoted to news of the world, discussions on Argentinian culture, Argentinian music and drama. Multilingual announcers speak Portuguese, Spanish and other languages.

In Chile, airlines are being equipped with recorders so that businessmen may dictate letters as they travel. Chilean airport restaurants are now using electronic grills which can prepare sandwiches, steaks, and chops in a few seconds.

In Risbanba, Ecuador, trucks are being equipped with radar to eliminate collisions with each other in the heavy native rainstorms. Ecuadorean radio servicemen are now renting juke-boxes to private families. The radioman installs an automatic phonograph in the home and calls once a month with an assortment of 30 new records. He picks up the old records and leaves them at another home.

A. F. C. STOPS DRIFT

It can be added to existing radios.

By L. S. WECKER

MOST FM and television set owners soon realize that these units are much more difficult to tune than the broadcast sets to which they have become accustomed. Many of these sets must be *retuned* (at least once) during the warm-up period because of drift in the oscillator and other tuned circuits.

Some manufacturers have made tuning easier by using slow-motion dial drives and tuning indicators. Attempts have been made to stabilize receivers completely by using temperature-compensating capacitors and regulated voltages in the oscillator circuit.

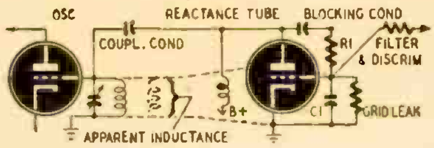


Fig. 1—This circuit adds apparent inductance.

These measures are, in most instances, but a partial solution to the problem. Automatic frequency control (a.f.c.) can be added to the average FM or television set to compensate further for drift and to make tuning simpler. This addition costs little and is easy to make.

An a.f.c. circuit consists of a controlled oscillator, a discriminator, and a reactance modulator or reactance tube as they are called in control circuits. Since almost all FM and television sets have an oscillator and discriminator, a.f.c. can be added to them simply by installing a reactance tube.

How reactance tubes work

In FM transmitters and signal generators, a reactance tube shifts the oscillator frequency in response to modulation. In a.f.c. circuits, the oscillator is shifted to its correct operating frequency whenever the receiver or transmitter drifts.

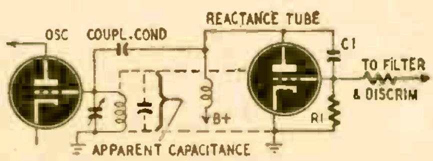


Fig. 2—Here the reactance tube is capacitive.

When a reactance tube is connected across a tuned oscillator circuit, it can be made to appear as added inductance or capacitance by causing its grid voltage to lag or lead the oscillator tank voltage by 90 degrees.

Fig. 1 is the circuit of an inductive-reactance circuit. The reactance tube is connected to the oscillator through a coupling condenser with low reactance at radio frequencies. Grid voltage for the reactance tube is taken from a point on a phase-shifter network consisting of R1-C1. The resistance of R1 is much larger than the reactance of C1. The reactance of the blocking condenser is so low, and the grid-leak resistance so high, that neither affects the phase-shift network. The current through this network is in phase with the r.f. tank voltage. Since voltage lags current 90 degrees through a capacitor, the grid voltage lags the tank voltage by 90 degrees. In a vacuum tube the plate current is rising and falling with the grid voltage, so the plate current is lagging the r.f. tank voltage by 90 degrees. This lagging plate current is drawn through the tank circuit, giving the effect that an inductive reactance has been connected in parallel with it. This produces an increase in the resonant frequency of the oscillator.

In a capacitive-reactance circuit (Fig. 2) the positions of C1 and R1 have been reversed and the reactance of C1 is much larger than the resistance of R1. In this circuit, the grid voltage leads the tank voltage by 90 degrees and produces a plate current leading the tank voltage by an equal phase angle.

The magnitude of the apparent reactance is controlled by the d.c. bias on the grid of the reactance modulator. This control bias is developed by a discriminator in a.f.c. circuits.

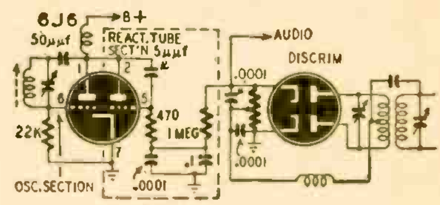


Fig. 3—Diagram shows complete a.f.c. circuit.

The discriminator converts frequency variations into voltage variations. When we tune it to the center frequency of a carrier, no voltage is developed across its output. However, should we move the carrier higher or lower, we would get either a negative or a positive voltage developed across the output of the discriminator. By the same token should the local oscillator, i.f. amplifiers, or the transmitter deviate from mean center frequency, the discriminator develops a negative or positive voltage that can be filtered and used to bias the reactance tube grid.

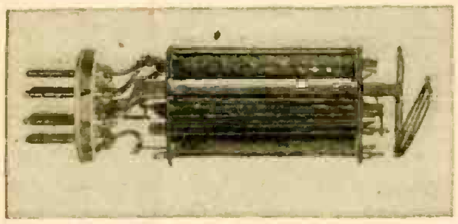
A.F.C. for FM or TV receivers

Fig. 3 is the circuit of an a.f.c. circuit that can be added to many existing FM and television sets. A 6J6 is shown as a combination oscillator and reactance tube. In sets using a separate triode oscillator, the oscillator socket can be rewired to take a double triode such as a 7F8 or 6J6. One triode is wired into the oscillator circuit and the other used as the reactance tube. When a single tube is used as oscillator and mixer, an additional socket can be mounted for the reactance tube. A 6C4 is a good choice since it shouldn't be hard to find space near the oscillator to mount it in almost any receiver.

Control voltage is taken from the a.f. output circuit of the discriminator and passed through a filter network consisting of a 1-megohm resistor and .0001- and 0.1-μf condensers. This filter removes a.f. and residual r.f. voltages. The r.f. choke in the plate lead prevents r.f. voltages from flowing through the power supply. This may be a standard v.h.f. choke or may be about 28 turns of No. 24 enameled wire close-wound on a ¼-inch form.

MULTI-ELEMENT FM TUBE

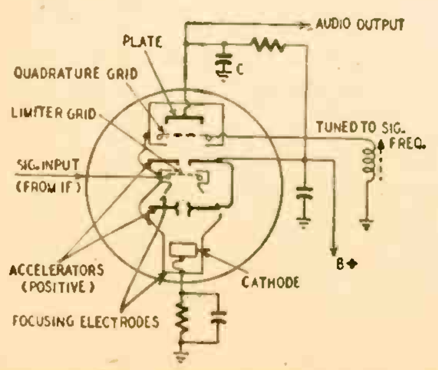
LIMITING and detection of FM signals in a single tube is made possible by a recent development by Dr. Robert Adler of Zenith Radio Corporation. The new tube, simple, though unconventional in design, does the dual job with the aid of only one tuned circuit and without any problems of critical transformer coupling.



Structure of the new FM limiter-detector tube.

The diagram shows the tube schematically. Electrons emitted by the rectangular cathode are focused into a narrow beam by the lower focusing electrode which is connected to cathode. The beam passes through the slit in the lower accelerator, to which a positive potential is applied.

When the limiter grid is at a certain minimum negative potential, it turns back few electrons, allowing most of them to pass through it, through the slit in the upper accelerator, and on to the quadrature grid and plate. When the grid potential is somewhat more negative, it turns back a few of the electrons; in an ordinary tube, this would merely result in a proportional reduction in plate current. However, in this tube, the turned-back electrons upset the



Schematic diagram shows how the tube is made.

space charges which allow the beam to pass through the lower accelerator slit. The beam is diffused and many electrons are absorbed by the accelerator. As a result, plate current reduction is very great. With a slightly more negative grid, plate current drops abruptly almost to zero.

The difference in grid voltage required to produce maximum and minimum plate current is very small, since negative grid signals not only limit plate current in the usual manner, but also limit it further by diffusing the beam. As long as the input signal exceeds about 1 volt, a square-wave output is obtained, making any amplitude variations in the input signal ineffective.

Detection is obtained by means of the quadrature grid. This is connected to ground through a tuned circuit which is adjusted to the center frequency of the input signal. The quadrature grid obtains its signals from the electron stream; it then affects the space charge surrounding it. The effect with no audio modulation is exactly 90 degrees out of phase with the input signal. The two 90-degree-out-of-phase or quadrature signals both reach the plate, interacting to produce an output of a certain fixed amplitude.

When the signal is modulated, the frequency swings away from its unmodulated value, at an audio rate. Since at most instants the modulated signal frequency is different from that to which the quadrature grid circuit is tuned, the phase difference is usually not 90 degrees. Therefore, the plate current, which is dependent on the mixture of the phased signals, varies along with the phase difference. Since the phase difference depends at any instant on the a.f. modulation, so does the plate current. Capacitor C filters out the r.f. from the plate circuit and audio is produced across the plate resistor.

The new tube does the work of three or four separate tube sections in the standard FM receiver circuit—one or two limiters and two discriminator diodes. The smaller requirements for parts and tubes will allow important production economies.

COMMERCIAL FACSIMILE

Facsimile Broadcasting on a commercial basis was authorized by FCC to take effect on July 15th. Operation previously has been experimental.

The authorization allows facsimile to be transmitted over standard FM stations by either the simplex or the multiplex method. With simplex transmission, the entire channel is devoted to facsimile while pictures are being transmitted. With multiplex, the regular aural programs are transmitted at the same time as the facsimile.

To avoid interruption of sound-program service, the Commission has limited simplex operation to 1 hour between 7 am and midnight. Multiplex is permitted for a maximum of 3 hours per day between 7 am and midnight. Use of either system between midnight and 7 am is unlimited.

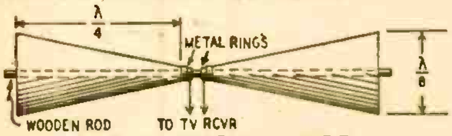
TV ANTENNA

Patent No. 2,440,597
Horace Atwood, Jr., Bellville, N. J.
(assigned to Du Mont Laboratories, Inc.)

This antenna is especially suitable for indoor use, as in an attic. It is effective over a wide frequency band and can be coupled to a low-impedance line.

A metal foil or plated surface covers the area of the two cones which are of hard insulating material. The conducting surface connects to metal rings near the middle of the antenna. The transmission line is soldered to the rings as shown.

A wooden rod through the antenna axis gives the unit a firm support. Its ends may be suspended or supported in any manner.



R-C OSCILLATOR

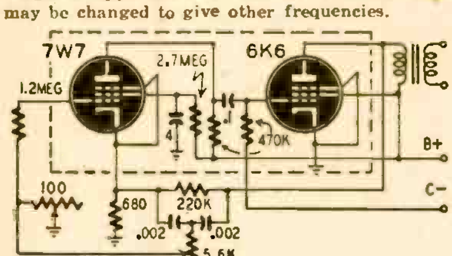
Patent No. 2,439,245
James C. Dunn, Philadelphia, Pa.
(assigned to Philco Corp.)

One form of an improved audio oscillator which is capable of good wave form and wide frequency range is shown in the accompanying figure. It uses only one tuning control, a variable resistor.

The invention consists of a 2-tube amplifier with the second tube coupled to the first through a bridged-T network. Negative feedback takes place through the fixed resistor in this network, and regeneration is obtained through the variable resistor.

As the T network is adjusted, there is one frequency which is balanced out. This frequency depends upon the R and C values of the network. At this frequency there will be almost no negative feedback to the 7W7 cathode, and therefore the circuit oscillates. The 100-ohm resistor in the grid circuit of the first tube is the regeneration control. It is set at the lowest value which will permit oscillation.

The component values given are for a frequency range of approximately 2-20 kc. The capacitors may be changed to give other frequencies.



MAGNITUDE AND PHASE CONTROL

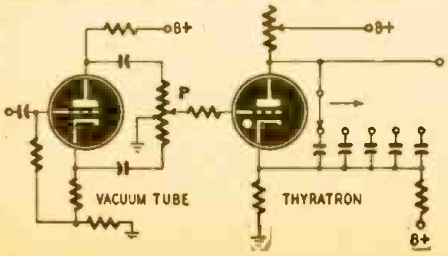
Patent No. 2,441,334
William H. Sayer, Passaic, N. J.
(assigned to Du Mont Laboratories, Inc.)

Only a positive pulse can trigger a thyratron. This circuit can reverse the polarity of a signal so an input pulse of either polarity can be used if its magnitude is great enough.

The middle of the plate load resistor is grounded. Therefore voltage polarity is different on each side. Furthermore the value of this potential increases as P is moved away from ground. The contact is set at the point which provides enough positive voltage to operate the thyratron.

The figure shows how the circuit may be used ahead of an 884 or similar tube to generate saw-tooth waves. If the input signal is positive P is moved towards the cathode end of the potentiometer.

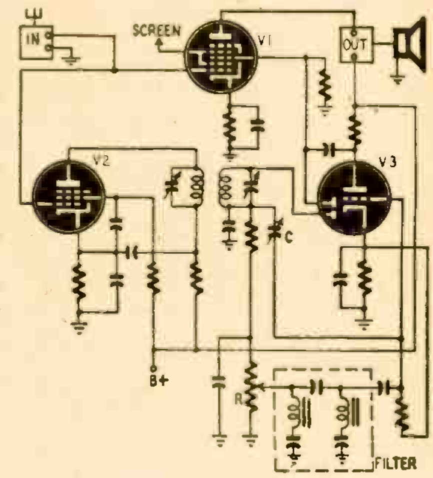
The capacitor-selector switch chooses the capacitor which will give the time-constant desired for the saw-tooth wave generated by the thyratron.



NOISE REJECTOR

Patent No. 2,438,501
Donald L. Hings, Ottawa, Ont., Canada.
(assigned to Electronic Lab., Inc.)

The inventor of this circuit claims that many types of noise are practically eliminated by it. The noise is amplified separately and then mixed with the incoming signal in a pentagrid tube. If the noise level is adjusted correctly, it will oppose the noise in the signal. The result is cancellation of noise without affecting the desired signal.



The signal is applied to the control grids of V1 and V2. The amplified signal (including the noise) is transmitted through the transformer to one diode plate of V3. Here it is rectified, and part of it passes through C to the control grid. The remainder of the r.f. component is filtered out while the a.f. component appears at R. This is followed by a high-pass filter with cutoff at about 3 kc. These higher frequeneies passed by the filter (shown in the dashed box) include most of the noise.

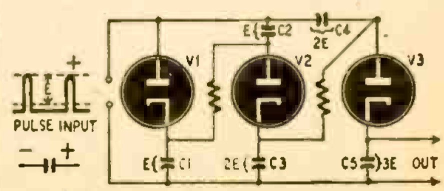
The noise is amplified in V3 and then applied to the grid No. 3 of V1. The noise voltage opposes the signal voltage at grid No. 1. The control R is adjusted for the proper level to produce noise cancellation.

VOLTAGE MULTIPLIER

Patent No. 2,439,224
Winfield R. Koch, Haddonfield, N. J.
(assigned to Radio Corp. of America)

A potential of 25 kv or more must be used for projecting large-screen television. This voltage may be obtained by rectifying the pulses from the scanning circuit and then doubling or tripling as required. The ordinary type of voltage-multiplier is not satisfactory because it uses several condensers in series to bring up the total voltage. Regulation is poor when a series circuit is used. The circuit shown here is a voltage-tripler in a parallel arrangement. Each rectifier is supplied by its own condenser. Regulation is greatly improved.

Each rectifier must be connected with polarity as shown, since the input is not symmetrical. C1 becomes charged to the peak voltage E, and during the next few pulses the charge leaks off and places a voltage E upon C2. During each pulse, V2 is subjected to a voltage 2E, the sum of the potential upon C2 and the pulse voltage.



Therefore C3 becomes charged to a voltage 2E. During the next few pulses this voltage appears across C4 because of the leakage current. V3 is now subjected to a potential 3E, made up of the voltage across C4 in series with the input. Therefore a voltage 3E appears across C5. Output is taken from this point.

Additional stages may be added for still higher voltages. The output remains fairly constant even when the load changes.

SQUARE WAVE GENERATOR

Patent No. 2,440,992
Richard C. Webb, LaFayette, Ind.
(assigned to Purdue Research Foundation)

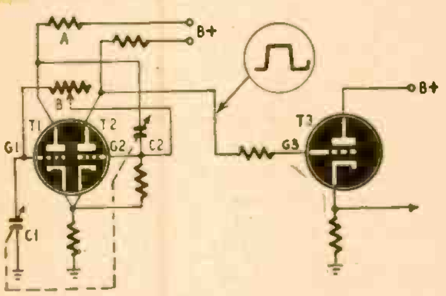
A good square wave generator needs two main controls: pulse width and frequency. Neither should have much effect on the other. These requirements are met in this simple generator. It uses a double-triode tube, such as a 6SN7, and a triode cathode follower.

When power is first turned on, C1 is uncharged so grid G1 is at ground potential. G2 is at high positive potential because it connects to B plus through a condenser. The heavy plate current through T2 produces a large negative voltage drop through its load and this voltage appears at G3.

The large plate current also flows through the common cathode resistor and a large negative bias is placed on G1 to cut off this tube. As the negative voltage leaks off C1 the grid becomes more positive and the other grid (G2) becomes more negative. Now T1 conducts and T2 is cut off. Plate voltage on T2 rises to the full power supply value and it appears on G3 as a high positive voltage.

After a short interval the high positive voltage on C1 discharges. G1 voltage becomes more negative and G2 more positive. As the T1 plate current drops the increasing voltage across its load is transferred to G2 through the condenser C2. Finally G2 reaches a high positive potential and the cycle repeats.

The frequency is determined by the rates of charge and discharge and is therefore controlled by B. The pulse width is determined by the ratio of C2 to C1. These condensers may be controlled simultaneously so that one increases as the other decreases. When C2 equals C1 the square wave is symmetrical.

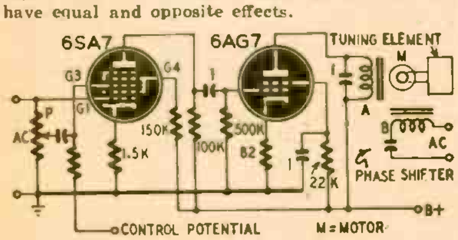


ELECTRONIC MOTOR CONTROL

Patent No. 2,440,600
Murray G. Crosby, Riverhead, N. Y.
(assigned to Radio Corp. of America)

Less than a volt is enough to start or reverse a motor operated by this circuit. The first tube is a mixer. About 0.6 volt at 60 cycles is applied to G1 to modulate the electron stream. The tap at P places about half this voltage on G3.

Some electrons are trapped by the screen which is not bypassed. This produces an a.c. voltage drop across the screen resistor. This voltage is 180 degrees out of phase with the potential applied to G3. P may be adjusted so that the two voltages have equal and opposite effects.



Balance is maintained until amplification due to G3 is changed. This may be done by a d.c. control potential. If this potential is positive the effect of G3 is greater than that of the screen which opposes it. A negative potential will cause the screen voltage to predominate. When the polarity of the control potential is reversed, so is the phase of the plate current.

The motor has two windings. The phase of B is shifted 90 degrees by a condenser. The current through A will then be either in phase or completely out of phase with the input a.c. Therefore it either leads or lags current through B by 90 degrees current. The motor runs in one direction or the other depending upon the polarity of the control potential. This voltage may be taken from a frequency discriminator. It will be positive or negative depending upon whether an incoming signal frequency is too high or too low.

OPPORTUNITY AD-LETS

FM STATION LIST

Next month we are printing a complete FM Station List. Managers and Chief Engineers of FM stations which have come into operation since our June list was published are invited to communicate with us, giving the call, and frequency of their stations. FM observers are also requested to help us keep our list up-to-date.

. . . . VARIABLE CONDENSER CLEANER

When variable condenser plates are too close to clean with a pipe cleaner, put the cleaner in a vise and apply pressure. The new flattened shape will fit easily between most condenser plates.

H. R. NEWELL,
Bradford, N. H.

. . . . RCA MODEL 85T

The tubular condensers in this set usually go bad and cause intermittent reception. It is a good idea to check all these condensers when this set is brought in for repair.

BRIAN BAILEY,
Brownwood, Texas

. . . . RADAIR MODEL 101

If interference and oscillation is very noticeable, the set is probably out of alignment. The i.f. on this receiver is 2 mc, someone may have tried to align it with the signal generator tuned to 456 or 465 kc, since the proper frequency is not indicated on the chassis.

ARTHUR L. JOHNSON,
Hutchinson, Kan.

RADIO-CRAFT wants *Technotes* describing common troubles of well-known receivers or telling how rare or difficult problems were solved. A six-month subscription will be awarded for each unillustrated and a one-year subscription for each illustrated *Technote* published.

. . . . ZENITH MODELS 5R216 AND 5S218

Several of these receivers had the same complaint, low volume with a loud hiss on stations below 650 kc, even with a good antenna attached. Low-frequency stations came in much stronger when the chassis was turned on its side.

The trouble was traced to a shorted antenna coil primary. The improvement in reception when it was on its side was due to the unshielded antenna coil secondary acting as a directional loop antenna.

A universal replacement coil restored the set to normal.

WILLIAM FORD,
Chicago, Ill.

. . . . REDUCING DRAIN

When using an external device, such as a phono preamplifier, which draws its power from the receiver or amplifier, current drain on the filament supply can be reduced by replacing the pilot lamp with one of lower current rating. For 6.3-volt lamps, use No. 40 or 47 (brown bead) to replace No. 44 or 46 (blue bead), saving 100 ma. For 2.5-volt lamps, use No. 42 (green bead) to replace No. 41 (white bead), saving 150 ma.

LEWIS SWANSON,
Toronto, Ontario

. . . . PHILCO 1201 SERIES

If a very loud hum appears (it may show up as an intermittent buzz), regardless of the setting of the volume control, check for a short where the wires to the phono motor switch pass through a metal sleeve.

GORDON S. WEEKS,
High Springs, Fla.

. . . . SPEAKER REPAIR

When a speaker voice coil is rubbing against the pole pieces, find out which side of the voice coil is rubbing by gently prodding the center of the cone with the fingers. Then insert a piece of cotton or a ball of paper between the cone and the speaker frame in such a position that the voice coil no longer rubs. Dampen the cone lightly with carbon tetrachloride. When it is dry remove the paper or cotton. The rubbing will usually have been eliminated.

K. E. STEWART,
Moberly, Mo.

. . . . CONTINENTAL MODEL 6C

A particularly irritating grinding noise in this set sounded like local interference. Noise-reducing methods had no effect. The defect was finally localized in a partially open filter condenser by the use of a condenser analyzer.

BRIAN BAILEY,
Brownwood, Texas

. . . . AUTO SETS

To find out if the vibrator power pack in an auto set is defective, disconnect the B-plus lead and supply the high voltage from an external power pack or dynamotor. The filament voltage is supplied by the battery. If the set now operates, the trouble is in the power supply.

A light current drawn from the battery before the B-plus lead was cut indicates a probably defective vibrator. If the current is excessive, either the buffer condenser is shorted or the vibrator points are sticking.

FRED P. STEINMETZ,
Chandler, Indiana

. . . . PHILCO 41-605

Heating of the power supply voltage-divider resistor was caused by a shorted filter condenser.

Replacing the XXD tube with a 14AF7 caused oscillation at the high-frequency end of the dial. This was cured by replacing the 10,000-ohm oscillator plate circuit resistor with a 5,000-ohm resistor.

TEWS RADIO SERVICE,
Milwaukee, Wis.

. . . . ADMIRAL CHANGERS

A common trouble is failure of the changer to complete its cycle. This is often due to a worn drive wheel (part No. G400 A179). Wear can be detected by running the fingers around its rubber tire. Replace it if it is bad.

Another common difficulty is failure of the set-down assembly (part No. G400 A152). If the adjusting screws will not index properly, the set-down assembly may be slightly bent and scraping against the frame. Straightening it will complete the repair.

EARL E. WEITZ,
Chicago, Ill.

. . . . VIBRATOR REPAIR

When replacement vibrators are hard to get, the technician may repair the old one by filing the contacts. To observe the repaired unit in operation, use a neon lamp as a stroboscope.

The usual frequency of a vibrator is in the neighborhood of 120 cycles. This is a multiple of the 60-cycle line frequency. A neon bulb connected to the 60-cycle line and held near the moving vibrator contacts will make them appear to stand still or slow down. Improper operation can easily be noticed.

For best results, the room should be darkened so that the only light shining on the vibrator is that from the neon lamp.

A. CREMAILH,
Douala, French Cameroon

(Vibrators repaired by filing the contacts often become defective again very soon, and the technician should *replace* worn vibrators except of course in cases like that above, where obtaining a replacement might take many months. *—Editor)*

Edited by ELMER R. FULLER

READERS have noted that this department has skipped a few issues during the past several months. This has been due to the new FM station list. In the future, the Short-Wave Station List will appear in two sections in successive months, and the FM List will appear the third month. A complete world-wide log will be printed in the October and November issues (half in each issue) so be on the lookout for it.

Below you will find something different than we usually print in this department. Here is a list of the least-heard and possibly hardest-to-get stations. We would like to have you do a little dial twisting, and give us a report on any of them that you hear. Most of them have been reported as being received on the east coast, so they are not impossible to get.

A Dx-ers program from Sweden is transmitted every Saturday on 6.065 mc and on 15.155 mc at 0245 EST, with a second transmission on 10.780 mc and on 15.155 mc at 1000, and a third transmission on 9.535 mc and on 10.780 mc at 2000, EST. Reports may be sent to Dx Editor, Radiotjanst, Stockholm.

Radio Monte Carlo is now using 6.035 mc and may be heard from 0230 to 0430, 0700 to 0900 and 1400 to 1815 daily. Reports may be sent to: Radio Monte Carlo, 16 Bd Princesse Charlotte, Monte-Carlo, Monaco.

Freq.	Station	Location and Schedule
3.910	ZQP	LUSAKA, SOUTHERN RHODESIA: 1030 to 1200
4.780		SINGAPORE, MALAYA; 0345 to 1000; 2330 to 0130
4.900	ZOH	COLOMBO, CEYLON; 0430 to 1145
4.940	HJCW	BOGOTA, COLOMBIA: 0645 to 1115; 1600 to 2315
5.880	ZRK	CAPETOWN, SOUTH AFRICA: 2345 to 0130; 1100 to 1600
5.980		ANDORRA; 0600 to 0830; 1300 to 1900
6.040		RANGOON, BURMA: 0915 to 1015
6.060		TETUAN, SPANISH MOROCCO: 0230 to 0300; 1330 to 1500
6.100	VUD3	DELHI, INDIA: 1200 to 1245
6.100		WARSAW, POLAND: 1100 to 1800
6.150	EQB	TEHERAN, IRAN: 0930 to 1400; 2230 to 2315
6.150	CS2WD	LISBON, PORTUGAL: 1330 to 1800
6.200	FK8AA	NOUMEA, NEW CALEDONIA: 0200 to 0400; 0430 to 0500
6.360	HRPI	SAN PEDRO SULA, HONDURAS: 1100 to 1415; 1800 to 2330
6.370	CSX	LISBON, PORTUGAL: 1230 to 1800
6.770		SINGAPORE, MALAYA: 0330 to 1200
7.100		BISSAU, PORTUGUESE GUIANA; 1345 to 1730
7.130	VQ6MI	HARGEISA, BRITISH SOMALILAND: 0800 to 1030; 1200 to 1300
7.290	VUD3	DELHI, INDIA: 0800 to 1100; 1730 to 1825; 2100 to 2300
7.290	ZOY	ACCRA, GOLD COAST: 1045 to 1300
7.570	EAJ43	SANTA CRUZ, CANARY ISLANDS: 0730 to 0900; 1230 to 1700
7.850	ZAA	TIRANA, ALBANIA: 1300 to 1630
7.950		ALICANTE, SPAIN: 0700 to 1000; 1400 to 1800
8.030	FXE	BEIRUT, LEBANON: 0000 to 0115; 0515 to 0800; 1030 to 1600
9.080	CNR3	RABAT, MOROCCO; 0145 to 0500; 1315 to 1900
9.370	EAQ	MADRID, SPAIN: 1330 to 1600; 1830 to 2200
9.460	TAP	ANKARA, TURKEY: 1000 to 1615; Sun. Mon. Thurs. 1530 to 1545
9.500	OIX2	LAHTI, FINLAND: 0100 to 0130; 0610 to 0740; 1000 to 1600
9.520	ZRG	JOHANNESBURG, SOUTH AFRICA; 0900 to 1045
9.520	OZF	COPENHAGEN, DENMARK; 1145 to 1545
9.520	SEAC	COLOMBO, CEYLON: 1930 to 1200
9.700		FORT DE FRANCE, MARTINIQUE; 1730 to 1845; and later
11.040	CSW6	LISBON, PORTUGAL: 1230 to 1530; 1600 to 1800
11.090		PONTA DEL GADA, AZORES; 1500 to 1600
11.730		SINGAPORE, MALAYA: 0325 to 1200
11.830		CONSTANTINE, ALGERIA: 0130 to 0315; 0630 to 0915; 1315 to 1400; 1430 to 1700
15.270		SINGAPORE, MALAYA; 0330 to 1200
15.290	VUD11	DELHI, INDIA: 2215 to 0030; 0125 to 0150; 0200 to 0400; 0500 to 0700
15.300		SINGAPORE, MALAYA; 0330 to 1200
17.770	SEAC	COLOMBO, CEYLON: 2300 to 0730; 1100 to 1200
18.130	PMC	BATAVIA, NETHERLAND INDIES: 1100 to 1130

FM PRODUCTION BOOM

FM will become a $750 million business by the end of this year, predicted "Bill" Bailey, recently. Bailey, executive director of the FM Association, a group composed of FM station licensees, said that over $48 million has already been invested by FM stations, with an additional $54 million investment to be made by the 543 construction permit and conditional grant holders.

More than two million receivers have been produced since the war's end, said Bailey, and an estimated five to eight million will be turned out during 1948. Production during the first quarter of this year was roughly a half million.

Retail value of RMA-manufactured sets in 1947 was over $311 million for the 1,175,000 units made. $500 million is the figure predicted for this year.

According to the FCC, commercial FM stations now on the air total 482, with 543 construction permits and 47 applications pending.

FM HOMES DOUBLE IN YEAR

FM receiver ownership is well over 156,000 in the metropolitan New York area, according to a survey made recently by The Pulse, Inc., radio research organization. This is more than double the number in the area as compared with January, 1947. The area covered by the survey has approximately 2.8 million radio homes. The figures show that the percentage of homes where there are FM sets is about 5.6.

TAX HITS BRITISH RADIO

British radio sales have experienced a serious slump of late, blamed by the makers on the high government purchase tax. The levy has increased to 66 2/3% in the last two national budgets, from its former figure of 33 1/3%.

As a result, over 10,000 of the 55,000 radio factory workers in England have lost their jobs, and two manufacturers have gone out of business.

The Radio Industry Council, representing British radio makers, has appealed to Sir Stafford Cripps, Chancellor of the Exchequer, to reduce the tax to 33 1/3% and to do away with it for television receivers and tubes.

HIGHER POWER FOR WRUL

International shortwave radio WRUL (Boston, Mass.) has applied to the FCC for permission to increase its power to 250,000 watts. This would make it the most powerful broadcaster in the Western Hemisphere.

GE STARTS TV RESEARCH

A new television division has been set up in the General Electric research laboratory, Dr. C. G. Suits, GE vice-president and director of research, announced last month. He explained that in view of the company's large activity in television, it was appropriate that it be in a position to make basic contributions to the art.

$3.00 FOR CARTOON IDEAS

RADIO-CRAFT prints several radio cartoons every month. Readers are invited to contribute humorous radio ideas which can be used in cartoon form. It is not necessary that you draw a sketch, unless you wish.

IDEAS NOT WANTED

No electrical or radio definitions wanted. Some of these were published in the past, but the subject is about exhausted.

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In Gernsback Publications

HUGO GERNSBACK
Founder

Some of the larger libraries in the country still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

FROM THE ELECTRICAL EXPERIMENTER, JULY, 1914

The Speaking Arc Light by *H. Winfield Secor*
Radio Transmission and Weather by *A. A. Taylor*
Progress in Radiotelegraphy
A Vacation Radio Pocket Set by *Harry V. Johnson*
A Novel Detector Switch by *Albert St. Cyr*
A Loop Aerial Switching Scheme by *Thomas Benson*
Experimental Radio Station by *C. F. Hancock*
Poulsen Receiving Sets
Microphone Transmitters

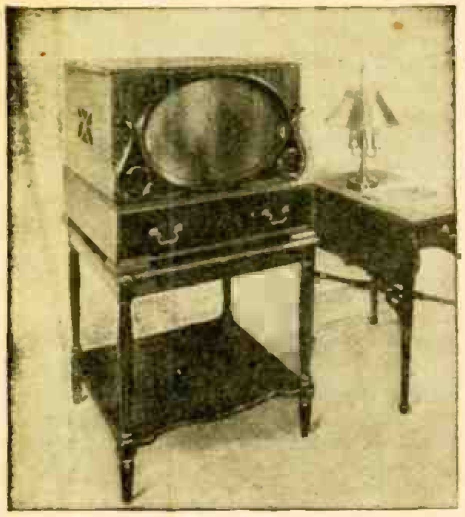
FROM THE AUGUST 1914 ISSUE

An Efficient Wavemeter by *Thomas W. Benson*
Selenium Cells and How to Use Them
Amplifier for Wireless Signals
Wireless Receivers (A Symposium)
A Variable Condenser by *Irving Byrnes*
A Peroxide of Lead Detector by *James L. Green*
A High Frequency Sending Buzzer by *Thomas W. Benson*
Automatic Radio Tuning Device
A New Low Altitude Antenna

SPEAKER DEMONSTRATOR

Output of the receiver at top of this speaker demonstrating board can be channelled to any of the speakers. The board is made by Wright.

TV RECEIVER HAS MIRROR



This Sightmaster receiver looks like a period furniture piece with a mirror when it is not in use. When the false drawer front is folded down, the controls are revealed. The picture on the face of the cathode-ray tube is seen through the mirror which is transparent and acts as a filter to reduce eye fatigue.

NEW TUBE TYPES

Two new miniature electronic tubes, types 6AV6 and 12AV6, have been made available by General Electric. Providing an amplification factor of 100, they are designed for use as combined diode detectors, a.v.c. tubes, and first audio amplifiers.

The tubes are intended to supersede the 6AT6 and 12AT6 and may be substituted directly for them in receivers.

Both types are duplex-diode triodes, having triode sections capable of providing large undistorted output voltages from a small input signal. Heater voltage of the 6AV6 is 6.3 volts, while that of the 12AV6 is 12.6 volts.

NEW PARTS GUIDE OUT

A new parts replacement manual, the Howard W. Sams *Radio Industry Red Book,* will permit the repair technician to find instantly not only the manufacturer's part number for a component, but also a number of alternates. Unlike earlier encyclopedias which showed only one correct replacement, this guide gives the original part number plus three alternates for transformers, four for capacitors, two for controls and speakers, and one for i.f. coils, vibrators, batteries and phono pickup cartridges.

Radar will be installed on all 21 tankers of the Atlantic Refining Co. The operation is expected to take a year and to cost $304,000.

A new optical radar unit is used in surveying. Pulses of light are reflected from the point whose position is to be determined. Distance is measured by the time taken for the light to travel.

Interference to aviation radio on the 6-mc band which was noted from Oregon to Puerto Rico and far east into the Atlantic has been traced to an electronic heater in a Johnstown (Penna.) chair manufacturing plant.

WELL-BALANCED MAGAZINE

Dear Editor:

I don't think you can ever please everybody with the articles you publish. But here is my opinion:

I don't agree with those readers who want RADIO-CRAFT to stick to simple educational material. You can buy any number of books on elementary radio and electronics. I'm completely new in the field, so I want to know how the simple devices work. *But* I also want to know how the more elaborate circuits are made. Print both simple and complex articles, and give newcomers like me a chance to progress.

True, I haven't built the 17-tube FM receiver (RADIO-CRAFT, November, 1947), but I have made a note of it. When I get around to fooling with FM, I will look it over and maybe use all or part of it.

I finished an 18-tube, 4-band AM set about four months ago, and you can bet I got circuits and ideas from RADIO-CRAFT, from both the simple and the advanced articles.

In short, a newcomer always finds plenty in RADIO-CRAFT that he can understand and plenty of material that will allow him to increase his knowledge. I think your magazine is well-balanced for the majority of the readers.

C. O. SUTTON,
Alameda, Calif.

EUROPEAN EQUIPMENT

Dear Editor:

Orchids to Maj. Hallows! It was a great satisfaction to me to read his report that there had been some improvement in European receiver design. During my three war years in the Middle East, I worked on practically every well-known European brand, and I do mean worked. A serviceman must be a mechanical engineer and a jigsaw-puzzle expert to cope with the array of cams, levers, friction clutches, and push-buttons on some of these sets.

Please give us more articles by Maj. Hallows on foreign receivers. Maybe our own manufacturers can get some ideas. We're far from perfect.

EUGENE K. GOODWIN,
Los Angeles, Calif.

IGNITION RUINS FM?

Dear Editor:

I certainly agree that FM is superior to AM in some cases but it is not free from noise caused by automobile ignition systems. Automobile noise in some locations ruins FM reception.

Is anyone doing anything about this? I wish RADIO-CRAFT would print an article on how to solve the problem.

LOUIS ZARATTARO,
Pittsfield, Mass.

(Are many listeners plagued with this problem? Are some locations actually impossible for FM reception or were Mr. Zarattaro's experiences with poor receivers? Reports from other readers on this subject should be interesting, especially if make of receiver is noted, along with details about the antenna location with relation to automobile traffic.—*Editor)*

CONTROLS FOR REPAIRMEN

Dear Editor:

Federal control of radio operators and transmitters has been of great help in assuring operation for the benefit of the public. I do not believe, however, that the government should license radio repairmen.

It would be more constructive to form a union of servicemen. This organization would issue its own technical certificates, based on standardized examinations of prospective entrants into the profession. The standards might be set up by the IRE, for example, as an outstanding independent engineering organization. Several organizations might be set up, if territorial or other reasons should make it desirable, all using the common set of standards. This would certainly help to strengthen radio servicing as a profession, rather than a haphazard affair.

SYLVESTER ROBINSON;
Kansas City, Mo.

SUB-MINIATURE TUBES

Dear Editor:

We were most interested in the electronic stethoscope on page 66 of the June issue of RADIO-CRAFT.

The item stated that a CK510AX could be substituted for the first CK512AX if added gain were desired. We would like to remind constructors that a direct substitution is impossible without certain changes. In the diagram the two CK512AX filaments are in series; since the CK510AX requires 2½ times as much filament current as the CK512AX, this will have to be changed. In addition, a different socket is required if sockets are used.

C. W. MARTEL,
RAYTHEON MFG. CO.,
Newton, Mass.

LIKES THE NEW LOOK

Dear Editor:

Again Gernsback leads the field in foresight and imagination. Your new format is certainly a boon to radiomen. Digging for a particular article will no longer be a chore but a pleasure. That "continued on page . . ." will no longer plague busy technicians. *Congratulations!*

I disagree with one point in Mr. Sanabria's letter published on page 82 of the June RADIO-CRAFT. There is not really a shortage of technicians for FM and TV servicing. The fact is that the industry will not hire inexperienced men.

Radio schools can only train men, not give them experience. If no one will hire them, they will never get experience. It is the old vicious circle: inexperienced men can't get a job, but if they don't work they can't get experience.

It is up to the *radio industry* to give these men a chance. If it does, there will not be a shortage of technicians for long.

PHILLIP SPAMPINATO,
New York, N. Y.

RADIO-CRAFT needs more photos of service shops and service benches. We will pay $6.00 for each 6x8- or 8x10-inch glossy photo accepted. Do not "dress up" your bench, but take a bona-fide photo, preferably with men working.

ADVANCED RADIO SERVICING. Methods and Ideas. A collection of lectures by M. N. Beitman. Supreme Publications. 8¼ x 10½ inches, 224 pages. Price $3.00.

The series is divided into three sections, dealing with the business side of radio servicing, equipment used, and radio circuits and trouble-shooting.

Some interesting layouts of shops appear in the first section. The descriptions of radio equipment, however, form the most interesting part of the book. A large number of modern test instruments are discussed with complete schematics and technical details. The typography is largely typewriter style, though some chapters are printed in standard type.

RADIO DATA BOOK. edited by William F. Boyce and Joseph J. Roche. Published by Boland and Boyce, Inc. 5 x 7 inches, 1148 pages. Price $5.00.

Subject matter is divided into ten sections: basic circuits; test equipment; tests and measurements; antennas; sound systems; sound recording; tube data; formulas, graphs and tables; symbols, codes and standards; circuit diagrams; radio dictionary; and radio books (bibliography).

Most interesting section is the basic circuits, which number nearly 150, ranging from crystal detectors to Klystron oscillators. Possibly equally valuable is the large section of formulas, graphs and tables, which contain much of the reference data every radioman must seek from time to time.

The section on tests and measurements contains basic descriptions of the methods of measuring most electronic quantities. An interesting feature is the fairly large number of oscilloscope patterns. The tube data section lists important transmitting and receiving types.

ELECTRONIC TRANSFORMERS AND CIRCUITS, by Reuben Lee, Advisory Engineer, Westinghouse Electric Corp. Published by John Wiley & Sons, 6¼ by 9¼ inches, 282 pages, cloth covers. Price $4.50.

The author has covered the many new problems confronting the designer of electronic transformers with formulas and graphs, and where necessary has included the associated circuits.

The first sections deal with core materials and windings, dielectric strength of insulating materials, impregnation, and size vs. rating, etc. Then follow discussions on rectifier transformers and reactors, voltage doublers, anode and filament transformers.

The action of polyphase rectifiers and multistage filters is discussed; also tuned rectifier filters, amplifier transformers, anode characteristics and low-frequency response, harmonic distortion, pentode amplifiers, and amplifier transformer design.

Later chapters deal with wave filter principles, modulation transformers, driver transformers, iron- and air-core transformers, grid-controlled rectifiers, saturable reactors, and peaking transformers. Other subjects include pulse and video transformers, design of pulse transformers, saw-tooth transformers, testing technique, etc. A valuable appendix containing useful formulas is included, also a bibliography on the subject and a well-arranged index.—*H.W.S.*

RADIO ENGINEERING, by Frederick Emmons Terman. Third edition. Published by McGraw-Hill Book Co. 6½ x 9 inches, 969 pages, plus prefaces and contents. Price $7.00.

The standard radio engineering text has been revised completely and is in all respects a 1948 work. The older chapter on resonant circuits has been expanded into two—one dealing with lumped and the other with distributed constants. Under Electron Tubes are found such subjects as electron optics and high-frequency and transit-time effects. Amplifiers include the traveling-wave tube. Klystrons and magnetrons are discussed under Oscillators. Frequency modulation, crystal detectors and mixers, and u.h.f. antennas are given space commensurate with their present-day importance and radio navigation aids (chiefly radar) and television receive a chapter each.

APPLIED ARCHITECTURAL ACOUSTICS, by Michael Rettinger. Published by Chemical Publishing Co. Stiff cloth covers, 5½ x 8½ inches, 189 pages. Price $5.50.

In a practical, concise handbook written for both the architect and sound engineer Mr. Rettinger presents material covering the general design of buildings or rooms in which correct acoustical conditions are of prime importance. Theoretical as well as practical aspects have been considered, making this book also suited as a text book.

The first three chapters deal with geometric acoustics, reverberation, and sound insulation. Chapters bear such headings as "Motion Picture Theaters," "Broadcasting Studios," etc.

Applied Architectural Acoustics is a well written volume packed with hard-to-find information that otherwise could be found only by a frustrating search through more voluminous works. Even the nontechnical public address serviceman should find the wealth of rule-of-thumb information invaluable in installing sound systems.—*E.B.*

RADIO TEST INSTRUMENTS (revised edition), by Rufus P. Turner. Published by Ziff-Davis Publishing Co. 6¼ x 9½ inches, 221 pages. Price $4.50.

The author describes the construction of more than 75 separate pieces of radio test equipment including volt-ohm-milliammeters; vacuum-tube voltmeters; watt, decibel, impedance, capacitance, and inductance meters; oscilloscopes and accessories; special-purpose bridges; a.f. and r.f. signal generators; frequency meters; and signal tracers. A few of these devices have been described in past issues of RADIO-CRAFT and RADIO NEWS. Photographs and drawings show parts layouts and mechanical construction of the more complex items. Methods of adjusting, calibrating, and operating the instruments are described.

Errors were noted in three of the oscilloscope diagrams. Cathode returns were omitted from the C-R tube circuits.—*R.F.S.*

ELECTRONIC CIRCUITS AND TUBES, by the Electronics Training Staff of the Cruft Laboratory, Harvard University. Published by McGraw-Hill Book Co. 6½ x 9 inches, 948 pages. Price $7.50.

The material presented was taken from notes prepared for lectures given at the Graduate School of Engineering at Harvard University during the war.

(*Continued on page* 87)

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Oscillators and wide-band amplifiers are covered more fully than in many texts of this type. The well-known but seldom-discussed effects of tightly-coupled tuned circuits on oscillator stability and calibration are described and discussed in Chapter XV. Design data on compensated wide-band amplifiers is complete with practical examples of actual circuits.

Four appendices: Review of Mathematics, Brief Review of Electricity and Magnetism, Description of a Direct-Current Source in Terms of Electrical Constants, and Symbols and Abbreviations are included.—*R.F.S.*

ELEMENTARY MANUAL OF RADIO PROPAGATION, by Donald H. Menzel. Published by Prentice-Hall, Inc. Loose-leaf flat-ring binding with flexible leatherette covers, 8¼ x 11½ inches, 222 pages. Price $7.65.

A complete work describing the methods of calculating propagation paths between radio stations and the theory behind such calculations. Absorption and lowest usable high frequencies are considered as well as the more commonly considered maximum usable frequencies. The book as a whole serves as an advanced text to the person with experience in making calculations from the CRPL charts, as well as a complete manual to the newcomer in the art.

A number of chapters are devoted to calculating the coverage of a given transmitting station. A number of other interesting points, including variability of the sun, problems of broadcast and lower frequencies, and propagation effects deduced from weather conditions, are covered in separate chapters. Two appendices discuss the theory of ionospheric and tropospheric propagation.

ESSENTIALS OF RADIO, by Morris Slurzberg and William Osterheld. Cloth covers: 806 pages; Illustrated. Size 6½ by 9 inches. Published by McGraw-Hill Book Co. Price $5.00.

This book, written for the radioman with a knowledge of simple high-school algebra, is an excellent treatise which covers all branches of the radio transmitting and receiving art, including FM and AM.

One of the opening sections deals with circuit analysis, including the calculation of inductance of coils and the capacity of condensers. The power transformer is described at length. The calculation of circuit constants is carefully explained for both a.c. and d.c. systems, with the necessary simple mathematics. Receiving circuits and vacuum tubes are covered completely. A series of questions and problems and a bibliography appended at the end of each chapter are useful to the student.

This reviewer would like to have seen more space devoted to antennas and transmission lines, especially the effect of standing waves on FM and TV.

The tables include logarithms, sines and cosines, copper wire sizes, letter symbols used in electronics, conversion factors, freq.-wavelength and LC products, receiving tube data and socket diagrams, resistance - capacity - coupled amplifier chart, and other useful information.—*H.W.S.*

TELEVISION TODAY, by Roy C. Norris. Published by Rockliff (Great Britain). 5¾ x 8¾ inches, 249 pages plus index. Price 21 shillings.

Written for the reader with a moderate knowledge of a.c. and d.c. theory, this book gives a "from the ground up" description of how a television system operates.

An English publication, it devotes some space to an interesting comparison of British and American television systems, and presents complete information on all the important details of transmission.

Receivers are covered thoroughly, as well as antennas and antenna theory, large-screen television, color and stereoscopy, and system adjustment and trouble-shooting.

The many diagrams are clearly drawn and are placed so that each drawing is on the same page as the explanatory text.—*R.H.D.*

FINAL ACTS OF THE INTERNATIONAL TELECOMMUNICATION AND RADIO CONFERENCES. Published by the International Telecommunications Union, distributed by the American Radio Relay League. 5¼ x 8½ inches, 426 double pages. Price $1.50.

This book contains the new International Telecommunications Convention, the International Radio Regulations, and all the Appendices, Annexes, Protocols, Resolutions, and Recommendations arrived at during the Atlantic City Conference last year. Representing the work of 79 nations, these documents are detailed and explicit. They provide source material on which international radio regulation will be based for some years to come.

Two official texts of the Convention are given on opposing pages throughout the book, French on one page and English on the facing one.

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INDEX TO ADVERTISERS

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(Pages 86-87)

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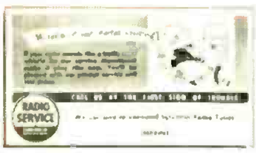

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THIS 4-MONTH ADVERTISING PROGRAM PACKED IN ONE HANDY KIT

Covering the months of September, October, November and December, this hard-hitting sales promotion program is packed in one big kit. You pay only the postage on the government postal cards you mail. Sylvania supplies everything else without charge.

YOU CAN IDENTIFY YOURSELF WITH THIS DECAL

Put this decal on your door, windows and truck. It is reproduced in Sylvania's national ads and identifies you as the radio serviceman described in Sylvania's national advertising.

Learn how you can participate in this Fall advertising program. Write Sylvania Electric Products Inc., Advertising Department, Emporium, Pa., or see your Sylvania Distributor.

SYLVANIA ELECTRIC

RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; PHOTOLAMPS; ELECTRIC LIGHT BULBS