RADIO CRAFT

RADIO-ELECTRONICS

HUGO GERNSBACK
Editor

IN THIS ISSUE
Tele Camera Preamplifiers
Double-Bridge Voltmeter

THE ELECTRONIC NOSE

SEE ELECTRONICS SECTION

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JULY
1948

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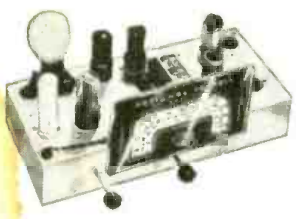

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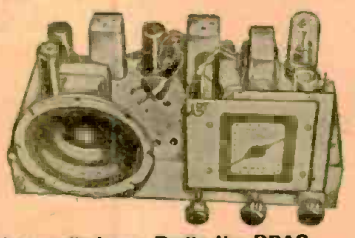

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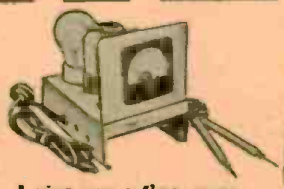

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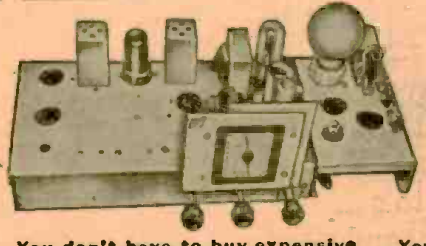

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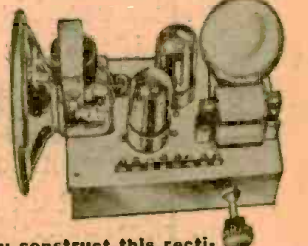

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ESSE Specials!

In this July issue of Radio Craft magazine, we are omitting our ads except for this page. Esse Radio Company, having been one of the first companies to enter the surplus sales field, has accumulated, over the past few years, odds and ends of all different kinds of electronic surplus gear and now, during the month of July, is going to hold its retail store open Monday through Friday from 9 AM to 5 PM and on Saturday from 9 AM to 3 PM and we cordially invite anyone to our store and will promise that, if you do come, you will see the most sensational bargains ever offered anywhere. We suggest that, if you have never been in our store, that you should come alone or invite your friends and all of you come as a group. Esse will go through all of its warehouses and bring to the sales floor, the largest assortment of electronic gear that has ever been assembled in one sales room. We want to clear our shelves of small quantity lots, obsolete equipment, too large a stock of items and we want to become personally acquainted with our mail order customers so we are putting prices "Down", "Down", "Down" until our customers will hardly be able to believe what they see when they enter our door.

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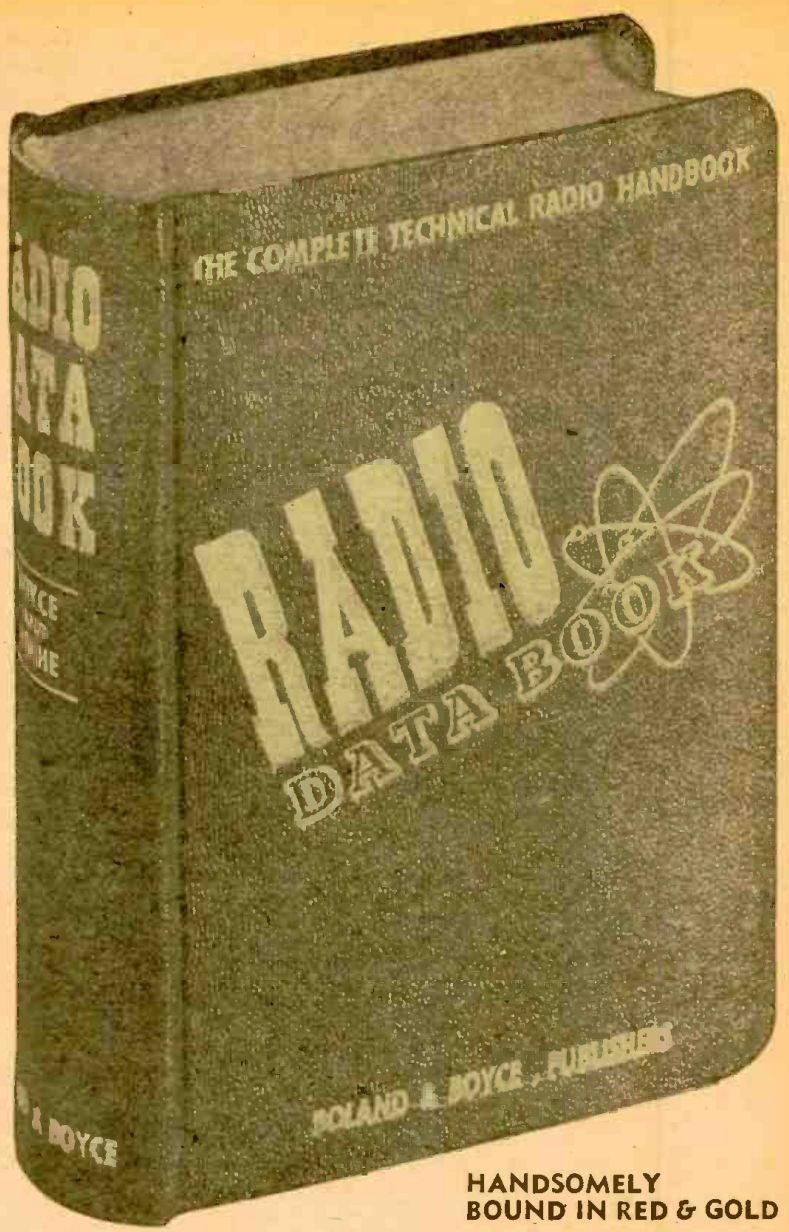

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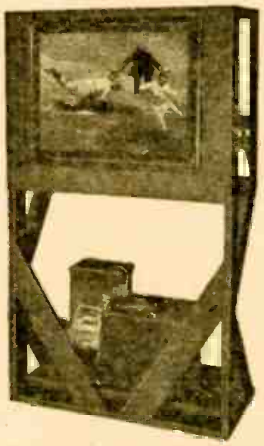

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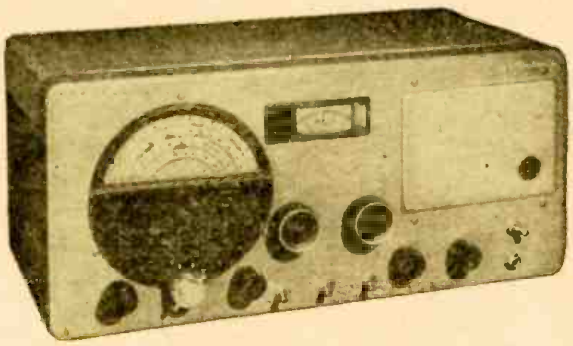

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JULY • 1948

RADIO CRAFT

RADIO-ELECTRONICS

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RADIO & TELEVISION
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In Our Next Issue

TELEVISION POWER SUPPLIES
HANDI-DANDY TRANSCEIVER
"HIGH-FIDELITY" HUM

On the Cover:

The "electronic nose" is a device which detects gases in the air. It is operated by Jane Barstow, of the General Electric Co., Schenectady, New York.

Chromatone by Alex Schomburg from G-E photo by James O. Burns.

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

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How to Pass FCC Commercial Radio Operator LICENSE EXAMS

GET YOUR F C C TICKET IN A FEW SHORT WEEKS

Get your license easily and quickly and be ready for the $3000 to $7500 jobs that are open to ticket holders. CIRE training is the only planned course of coaching and training that leads directly to an FCC license.

IT'S EASY WITH CIRE COACHING AND TRAINING

Your FCC ticket is recognized in all radio fields as proof of your technical ability. Employers often give preference to license holders, even though a license is not required for the job. Hold an FCC "ticket" and the job is yours!

I can train you to pass your FCC License Exams in a few short weeks if you've had any practical radio experience — amateur, Army, Navy, radio servicing or other. My time-proven training plan can help put *you*, too, on the road to success—

EDW. H. GUILFORD, Vice-President.

Let me send you FREE the entire story

Just fill out the coupon and mail it. I will send you, free of charge, a copy of "How to Pass FCC License Exams," plus a sample FCC-type Exam and Catalog A, describing opportunities for you in Radio Electronics.

Get All 3 FREE Send Coupon Now!

Look what these students say:

"Thanks to this course, I now have a very good job in a local power plant's test department. I couldn't have obtained this job without the math and basic electrical theories in the first part of Section 1 of this course." Stud. No. 2893N12

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"You may be interested to know that I am employed at the local broadcast station, where I am a transmitter operator. I took and passed the FCC examinations last February." Stud. No. 2754N12

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
RC-7 Terminal Tower **Cleveland 13, Ohio**

Approved for Training under "G. I. Bill of Rights"

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
RC-7 Terminal Tower, Cleveland 13, Ohio

I want to know how I can get my FCC ticket in a few short weeks. Send me your FREE booklet, "How to Pass FCC License Examinations" (does not cover exams for Amateur License), as well as a sample FCC-type exam and Catalog A, describing opportunities in Radio-Electronics.

NAME .....

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☐ Veterans check for enrollment information under G.I. Bill.

NO OBLIGATION—NO SALESMEN.

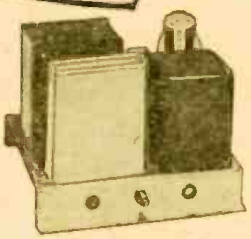
COMMAND SET ACCESSORIES

BEST OF KITS

TRANSMITTER POWER SUPPLY KIT

For BC-645, 223, 522, 274N's, etc. Ideal for powering military transmitters. Supplies 500 to 600 Volts at 150 to 200 MA plate, 6.3 C.T. at 4 Amps, 6.3 at 4 Amps and 12V at 4 Amps. Can be combined to supply 3-6-9-12 or 24 Volts at 4 Amperes. Kit supplied complete with husky 110V 60 cycle power transformer, 5U4 rectifier, oil filled condensers, cased choke, punched chassis, and all other parts, including detailed instructions. Complete — nothing else to buy.

TRANSFORMER ONLY $9.50



$14.50

110V RECEIVER POWER SUPPLY KIT

With 24 volt filament, no wiring changes inside set, punched chassis and volume control **$5.95**

5" PM SPEAKER

With output transformer, matching Headphone output **$2.80**

Dual receiver rack FT277A with connecting plugs **$1.00**

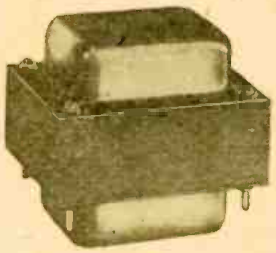
Single transmitter rack FT234A **$1.00**

MILITARY CONVERSION POWER TRANSFORMERS

Convert your military receivers without rewiring the filament. "A" type supplies 500 VCT at 50 MA, 5V at 2A and 24V at ½A. "B" type supplies 500 VCT at 50 MA, 5V at 2A and 12V at 1 amp.

State whether A or B type desired **$2.95**

POWER TRANSFORMER *Specials*



A wonderful buy in a new production heavy duty power transformer. Primary 117V 60 cycle. Secondaries supply 746 V.CT at 220 MA, 6.3V. at 4.5 A., and 5V at 4 A. An ideal transformer for high quality amplifier modulator, small transmitter or quality radio. Will handle 13 tube radio receivers. Supply is limited, order early.

$3.95 . . . 3 FOR $9.95

INPUT AND OUTPUT TRANSFORMER

Two units in one case carbon microphone input and output from 155 to 150 ohm load used in Handie Talkie No. 744 special 4 for **$1.00**

Filter Choke 15 henries at 60 MA cased type hermetically sealed No. 643, each **$1.00**

OUTPUT TRANSFORMER

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

OUTPUT TRANSFORMER

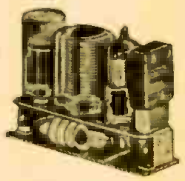
Couples, 6C4, 6J5, etc. to 500 or 5,000 ohm line No. 716. 2 for **$1.00**

MIDGET AMATEUR TRANSMITTER KIT

Complete kit to assemble a 1 Watt battery operated amateur 80 meter transmitter, including tube and crystal. Range up to 500 miles. Only accessories needed are sending key and batteries. Complete instructions supplied. Add postage for 2 lbs.

ACCESSORIES

Key (add postage for 2 lbs.) $1.00
Kit of batteries (add postage for 4 lbs.) 3.25



$3.95

AN/APN1 RADIO ALTIMETERS

Brand new, complete with tubes, dynamotor, antennae, indicator, switch, plugs and instruction manual. Consists of 420 MC transmitter and receiver. Converts into excellent boat radar indicating in feet, or amateur 420 MC rig. In original crate.

$34.95

T32 TABLE MICROPHONE

One of the Army's best. Built by Kellogg, ideal for factory call system, public address, amateur use. Brand new in original cartons, add postage for 5 lbs. **$2.95**

METER *Special*

Brand new DeJur Model 312 0-800 M.A. D.C. Square 3" 0-10 M.A. basic meter with built in shunt. Probably the best buy ever offered in a surplus meter. Shipping weight 1 lb. **$2.95**

HEARING AID HEADPHONES

The Army's best — eliminate flat ears and outside noise. Complete with transformer for conversion from low to high impedance. With cord and plug complete. Add postage for 1 lb.

$1.00

DYNAMOTORS

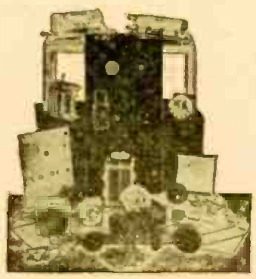
Consists of electric motor operating generator on same shaft. Many applications — operating radios from storage battery - using as motor.

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

Dynamotor A — Input 12 volts, output 1000 volts at 350 MA. Shipping Weight 72 pounds. **$5.95**

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

LOOK AT THE PARTS IN A GENERAL ELECTRIC BC-375 TUNING KIT



FOR *Only* **$2.49**

A beautiful aluminum case ideal for building a receiver or transmitter. Three variable condensers, transmitting coils, transmitting mica condensers, ceramic switches, National Velvet Vernier dial, ceramic insulated couplings, 10 banana jacks, RF chokes, etc. The parts in this unit will be useful for years.

This is truly the greatest buy in surplus — better order one while still available. We include plans for converting to an 80 meter transmitter receiver all for $2.49. Specify TU26B (200-500 KC.) or TU10B (10 to 12.5 MC.) Shipping weight 20 lbs.

HEATHKIT 3-TUBE ALL-WAVE RADIO

110-volt AC operation

$8.75

An ideal way to learn radio. This kit is complete ready to assemble, with tubes and all other parts. Operates from AC. Simple, clear detailed instructions make this a good radio training course. Covers regular broadcasts and short wave bands. Plug-in coils. Regenerative circuit. Operates loud speaker. Battery model for use where no AC house current is available. Add postage for 3 lbs.

Heathkit Beginners' Radio 110-volt type $8.75
Heathkit Beginners' Radio, battery type (2 tubes, no rectifiers) $8.75
Headphones for either type HS 30 per set $1.00
2½" permanent magnet loudspeaker for either type $1.95
Batteries, complete kit for battery type set $3.25

INTERPHONE 2-WAY CALL SYSTEM KIT

Ideal call and communication system for homes, offices, factories, stores, etc. Makes excellent electronic baby watcher, easy to assemble with every part supplied including simple instructions. Distance up to 1/5 mile. Operates from 110 V.A.C. 3 tubes, one master and one remote speaker. Shipping Weight 5 pounds.

$14.50

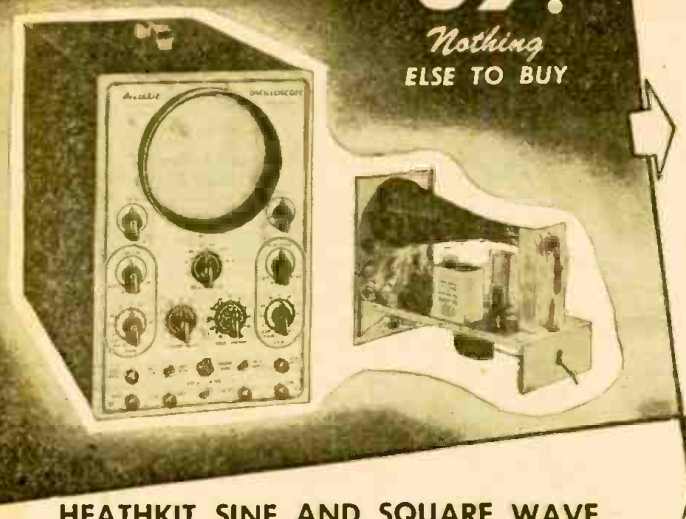
The HEATH COMPANY

DEPT. C . . . BENTON HARBOR, MICHIGAN

Build YOUR OWN TEST EQUIPMENT

NEW 1948 HEATHKIT
5" OSCILLOSCOPE KIT

$39.50
Nothing ELSE TO BUY



A necessity for the newer servicing technique in FM and television at a price you can afford. The Heathkit is complete, beautiful two color panel, all metal parts punched, formed and plated and every part supplied. A pleasant evening's work and you have the most interesting piece of laboratory equipment available.

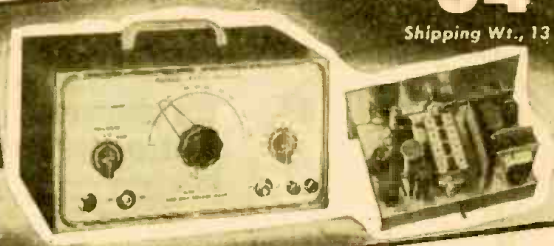
Check the features — large 5" 5BP1 tube, compensated vertical and horizontal amplifiers using 6SJ7's, 15 cycle to 30 M cycle sweep generator using 884 gas triode, 110V 60 cycle power transformer gives 1100 volts negative and 350 volts positive.

Convenient size 8½" x 13" high, 17" deep, weight only 26 pounds.

All controls on front panel with test voltage and ext. syn post. Complete with all tubes and detailed instructions. Shipping weight 35 pounds.

Order today while surplus tubes make the price possible.

$34.50
Shipping Wt., 13 lbs.



HEATHKIT SINE AND SQUARE WAVE
AUDIO GENERATOR KIT

The ideal companion instrument to the Heathkit Oscilloscope. An Audio Generator with less than 1% distortion, high calibration accuracy, covering 20 to 20,000 cycles. Circuit is highly stable resistance capacity tuned circuit. Five tubes are used, a 6SJ7 and 6K6 in the oscillator circuit, a 6SL7 square wave clipper, a 6SN7 as a cathode follower output and 5Y3 as transformer power supply rectifier.

The square wave is of excellent shape between 100 and 5,000 cycles giving adequate range for all audio, FM and television amplifier testing.

Either sine or square waves available instantly at a toggle switch. Approximately 25V of sine AC available at 50,000 ohm output impedance. Output +1 db. from 20 to 20,000 cycles. Nothing else to buy. All metal parts are punched, formed and cadmium plated. Complete with tubes, all parts, detailed blueprints and instructions.

$19.50
Nothing ELSE TO BUY

HEATHKIT SIGNAL TRACER KIT

Reduces service time and greatly increases profits of any service shop. Uses crystal diode to follow signal from antenna to speaker. Locates faults immediately. Internal amplifier available for speaker testing and internal speaker available for amplifier testing. Connection for VTVM on panel allows visual tracing and gain measurements. Also tests phonograph pickups, microphones, PA systems, etc. Frequency range to 200 Mc. Complete ready to assemble. 110V 60 cycle transformer operated. Supplied with 3 tubes, diode probe, 2 color panel, all other parts. Easy to assemble, detailed blueprints and instructions.

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

$19.50
Nothing ELSE TO BUY

HEATHKIT SIGNAL GENERATOR KIT

Every shop needs a good signal generator. The Heathkit fulfills every servicing need, fundamentals from 150 Kc. to 30 megacycles with strong harmonics over 100 megacycles covering the new television and FM bands. 110V 60 cycle transformer operated power supply.

400 cycle audio available for 30% modulation or audio testing. Uses 6SN7 as RF oscillator and audio amplifier. Complete kit has every part necessary and detailed blueprints and instructions enable the builder to assemble it in a few hours. Large easy to read calibration. Convenient size 9" x 6" x 4¾". Weight 4½ pounds.

$24.50
Nothing ELSE TO BUY

THE NEW HEATHKIT VACUUM TUBE
VOLTMETER KIT

The most essential tool a radio man can have, now within the reach of his pocketbook. The Heathkit VTVM is equal in quality to instruments selling for $75.00 or more. Features 500 microamp meter, transformer power supply, 1% glass enclosed divider resistors, ceramic selector switches, 11 megohms input resistance, linear AC and DC scale, electronic AC reading RMS. Circuit uses 6SN7 in balanced bridge circuit, a 6H6 as AC rectifier and 6 x 5 as transformer power supply rectifier. Included is means of calibrating without standards. Average assembly time less than four pleasant hours and you have the most useful test instrument you will ever own. Ranges 0-3, 30, 100, 300, 1000 volts AC and DC. Ohmmeter has ranges of scale times 1, 100, 1000, 10M and 1 megohm, giving range .1 ohm to 1000 megohms. Weight 8 lbs.

$19.50

HEATHKIT
CONDENSER CHECKER KIT

A condenser checker anyone can afford to own. Measures capacity and leakage from .00001 to 100 MFD on calibrated scales with test voltage up to 500 volts. No need for tables or multipliers. Reads resistance 500 ohms to 2 megohms. 110V 60 cycle transformer operated complete with rectifier and magic eye indicator tubes.

Easy quick assembly with clear detailed blueprints and instructions. Small convenient size 9" x 6" x 4¾". Weight 4 pounds. This is one of the handiest instruments in any service shop.

The HEATH COMPANY
DEPT. C . . . BENTON HARBOR, MICHIGAN

Wonderful NEW 3/4 RPM Motor $2.95

Ideal for a beam rotor, plenty of power. Originally designed for 24 volt DC operation, but easily converted, 110 volts AC. Complete instructions included. Excellent for other uses too. Brand new, surplus, guaranteed.
(Add 40c each to cover postage and handling)

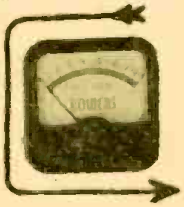
PLUS

24 Other Bargains!!!

"Meter Specials"

77¢

Brand new [redacted], 3-0-3, DC voltmeter 2" round case. Meter has 450 ohms resistance (150 ohms per volt). (Add 15c each to cover postage and handling.)



Brand new Bowers D.C. Volt meter 0 to 9 volts in 2" case with 2 3/4" Flange ..... each .99c

Brand new Bowers D.C. Anmeter 0 to 100 amp scales (600 ma. movement with 100 amp shunt) same case as volt meter each .99c

Add 20c each to cover postage and handling

Stock Up

WILLARD 2 VOLT BATTERIES ONLY $1.25 each

Brand new. Compact, spill proof. Built-in hydrometer. Group several together for higher voltages. Uses Standard Electrolyte Guaranteed. Add 35c to cover postage and handling

500' $2.95

3 CONDUCTOR TELEPHONE WIRE

3 conductor Braided insulated copper & steel telephone wire. It is made of copper for conductivity, and steel for strength. Worth at least 3c per ft. Yet due to an exceptional buy, we can now offer it at less than 1c a ft.

Shipped Express Collect

Radio Compass

NOW $14.95

RS/ARN7 or 433G, either of these Radio Compass Receivers complete with tubes. Ideal for conversion for home reception. Used but good. A real buy at only $[redacted].

(Shipped express collect)

Tubes!

3 CP 1 (Ind. Screen)	.95
3 DP 1-A (Ind. Screen)	.95
3 FP 7-A	1.35
3 HP 7	1.45

(add 25c each to cover postage and handling)

5 FP 7	1.75
5 CP 1	1.95
5 BP 1	2.45
5 HP 1	2.45

(add 35c each to cover postage and handling)

7 BP 7	2.65
7 CP 1	3.25

(add 40c each to cover postage and handling)

9 GP 7	3.50

(Shipped express, charges collect).

1300' Rubber Covered Wire

ONLY $18.00

New 4 conductor 16 gauge rubber covered cable. Color coded. Used by United States Government as Field Telephone Cable. 1300 feet on steel reel. F.O.B. Our warehouse Shipped motor freight or express shipping charges collect.

LOOP ANTENNA

A NEVER AGAIN BUY $3.95

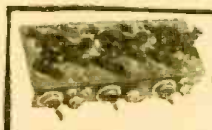
Used primarily on aircraft & Marine ADF Systems, Loop LP-21-A contains an electric motor and selsyn. These loops have been removed from salvage aircraft, but are guaranteed to be in excellent working condition.

Shipped Express Collect

PHANTOM ANTENNA

85¢

A transmitting antenna, for use on approximately 450 MC. Complete with standard coax connector. A weatherproof unit. (Add 25c to cover handling and postage).



BC 450 CONTROL BOX

Triple remote control box for Command Receivers (SCR 274 N Series). Equipped with 3 tuning dials, 3 volume controls, and 6 selector switches. Used, but in excellent condition, a steal at only $1.50 ea. (Add 25c to cover postage and handling.

ZA-1 LOCALIZER SIGNAL CONVERTER

CDE-20109 ONLY $1.95

Contains 2 tubes 6F8G and 6C8G, several carbon resistors, 2 wire wound resistors, 2 precision resistors, 3 transformers, 3 set volume controls and other valuable parts. Add 40c to cover handling and postage.

NOTE — Due to customs regulations which require excessive paperwork and packaging complications, we cannot accept orders for shipment outside the United States or its possessions.

IMPORTANT!

Continuity Tester with 12 extra penn light cells..... $1.95
Add 15c to cover handling & postage

Throat Mike, complete with cord and switch..... $ .95
Add 15c to cover handling & postage

CHECK THESE VALUES

All merchandise subject to prior sale, minimum order $2.00, No C.O.D. orders accepted. Michigan residents must add 3% State sales tax.

N. SILVERSTINE CO.

6532 EAST McNICHOLS ROAD DETROIT 12, MICHIGAN

"Seven Acres of Surplus"

SLASHED PRICES DOWN

TUBES

GREATEST SELECTION IN COUNTRY
LOWEST PRICES
NEW—STANDARD BRAND—Min. Order $5.00
QUANTITY PRICES ON REQUEST

0A4G	$1.06	3C6	1.28	6N7	.88	12DP7	14.95	50	1.56	832A	2.95
00	.50	3C24	.69	6N7GT	.88	12F5GT	.59	50A5	.88	833A	39.50
0Y4	.88	3D6	.89	6P5GT	.88	12H6	.59	50B5	.72	836	1.15
01-A	.50	3E29	2.95	6Q5G	.98	12J5GT	.54	50L6GT	.59	837	2.50
0Z4	.88	3LF4	1.06	6Q6G/6T7G	1.06	12J7GT	.72	50X6	.88	838	4.95
1A3	.72	3Q4	.72	6Q7	.72	12JP4	60.00	50Y6GT	.59	841	.69
1A4	.88	3Q5GT	.88	6R7	.88	12K7GT	.59	53	.88	843	.69
1A4P	1.28	3S4	.72	6S7	.88	12K8	.88	55	.72	845	4.95
1A4T	1.28	4-65A	14.50	6S8GT	.88	12Q7GT	.59	56	.59	860	3.00
1A5G	.88	4-125A	27.50	6SA7GT	.59	12SA7	.59	57	.72	861	50.00
1A6	1.06	4-250A	37.50	6SC7	.72	12SC7	.72	58	.72	864	.69
1AB5	1.06	5BPI	1.49	6SD7GT	.72	12SF5	.59	59	1.06	866A	.89
1B4	1.28	5BP4	4.95	6SF5	.59	12SF7	.72	70L7GT	1.56	868	1.95
1B5/25S	1.06	5CP1	3.95	6SF7	.72	12SG7	.72	71-A	.72	872A	1.95
1B7G	.72	5FP7	3.95	6SG7	.72	12SH7	.72	75	.59	874	1.95
1B25A	4.95	5JP1	9.95	6SH7	.72	12SJ7	.72	75TL	2.95	876	4.95
1A7G	.88	5R4GY	1.29	6SJ7	.59	12SK7	.59	76	.59	884	.98
1B27	4.95	5T4	1.29	6SK7	.59	12SL7GT	.88	77	.59	902	4.95
1B38	4.95	5TP4	20.00	6SL7GT	.88	12SN7GT	.88	78	.59	920	2.95
1C5G	.88	5U4G	.54	6SN7GT	.88	12SQ7	.72	79	.88	950	1.06
1C6	1.06	5V4G	.88	6X4	.54	12SR7	.98	80	.42	954	.49
1C7G	1.06	5W4	.88	6SR7	.59	12X3	.88	81	1.28	955	.49
1D5GT	1.28	5X4GT	.60	6SS7	.72	12Z3	1.06	82	.88	956	.75
1D7G	1.06	5Y3GT	.38	6ST7	.88	14A4	1.56	83	.88	957	.49
1D8GT	1.28	5Y4G	.50	6T7	1.06	14A5	.88	83V	.88	958A	.69
1E5GP	1.56	5Z3	.60	6U5	.72	14A7	1.10	84/6Z4	.59	959	.49
1E7G	1.28	5Z4	.88	6U6GT	.72	14B7	.88	85	.72	991	.50
1F4	.88	6A3	1.06	6U7G	.59	14B6	.88	89	.72	1613	.95
1F5G	.88	6A5G	1.56	6V6	1.06	14C5	.88	99V	1.56	1614	1.75
1F6	1.28	6A6	.88	6V6GT	.72	14C7	.88	99X	1.56	1616	1.39
1G4GT	.88	6A7	.72	6V7G	.72	14E6	.72	100TH	12.95	1619	.29
1G6GT	.88	6A8	.72	6W7G	.88	14E7	.88	114A	.69	1622	1.75
1H4G	.88	6AB5/6N5	.88	6X4	.55	14F7	.88	117L7GT	1.28	1624	.98
1H5GT	.72	6AB7	1.06	6X5	.54	14H7	1.06	117M7GT	1.28	1625	.49
1H6G	.60	6AC5GT	.88	6Y6G	.88	14J7	1.06	117N7GT	1.28	1626	.49
1J6G	1.06	6AC7	1.06	6Z7G	1.28	14N7	1.06	117P7GT	1.28	1627	7.95
1L4	.72	6AD7G	1.06	6ZY5G	.72	14Q7	.88	117Z3	.72	1629	.59
1LA4	1.06	6AF6G	.88	7A4	.72	14S7	1.06	117Z6GT	.88	1642	4.95
1LA6	1.06	6AF8	.88	7A5	.72	14R7	.88	120A	12.95	1851	1.25
1LB4	1.06	6AG5	1.06	7A6	.72	14W7	1.06	121A	2.65	2050	.89
1LC4	1.06	6AG7	1.06	7A7	.72	14X7	1.06	205B	4.50	2051	.49
1LC6	1.06	6AJ5	.99	7A8	.72	14Y4	.88	211	.98	5514	3.95
1LE3	1.06	6AK5	.99	7AE7	.72	15AP4	110.50	215A	3.00	5516	5.95
1LD5	1.06	6AK6	.88	7AF7	.72	15E	1.50	217C	7.50	5562	10.00
1LH4	1.06	6AL5	.72	7B4	.72	19	1.06	250R	7.95	7193	.39
1LN5	1.06	6AL7GT	1.06	7B5	.72	20	1.56	250TH	19.50	8005	4.95
1N5G	.88	6AQ5	.72	7B7	.72	20AP4	270.00	252A	4.95	8011	2.95
1P22	11.50	6AQ6	.72	7B8	.72	22	1.28	259A	4.95	8012	4.95
1P5GT	.88	6AT6	.60	7BP7	2.95	23D4	.49	304TL	1.98	8016	1.95
1Q5G7	.88	6AU6	.72	7C4	1.06	23D6	.98	310	4.95	8020	5.95
1R4	1.06	6B4G	1.06	7C5	.72	24A	.72	307A	6.25	8025	3.95
1T4	.72	6B6G	.72	7C6	.72	24G	.69	310	.89	9001	.89
1T5GT	.88	6B7	1.06	7C7	.72	25A6	1.06	316A	.89	9002	.69
1U4	.72	6B8	1.06	7E5/1201	1.06	25A7GT	.88	350B	4.95	9003	.49
1U5	.88	6BA6	.72	7E6	.72	25C6G	1.06	394A	4.50	9004	.49
1-V	.72	6BE6	.72	7E7	.88	25L6GT	.59	417A	19.95	9005	.98
2A3	1.06	6BG6	2.40	7EP4	17.95	25Y5	1.28	450TL	24.95	9006	.49
2A5	.72	6C4	.60	7F7	.88	25Z5	.54	531	49.50	CEQ72	1.95
2A6	.88	6C5	.60	7F8	1.06	25Z6	.72	701A	4.95	CK1005	.39
2A7	.88	6C6	.72	7G7	1.06	26	.59	703A	7.50	CK1006	.69
2API	2.95	6C8G	1.06	7GP4	19.40	27	.54	705A	2.95	EF50	.79
2B7	.88	6D4	1.95	7H7	.88	28D7	.75	707A	24.95	EL225	1.95
2C22	.69	6D6	.60	7J7	1.06	30	.72	709A	9.95	FM-1000	1.56
2C26A	.75	6E5	.72	7K7	1.06	31	.88	713A	1.65	GL434	4.95
2C34	.98	6F5	.60	7L7	.88	32	1.06	715B	19.95	KL446A	2.60
2C40	2.60	6F6G	.72	7N7	.88	32L7GT	1.28	717A	1.65	HF100	3.95
2C43	2.60	6F6	.72	7Q7	.72	33	1.06	721A	3.95	HY69	2.95
2C44	1.75	6F7	1.06	7R7	.88	34	1.06	723AB	5.95	HY75	1.25
2D21	1.69	6F8G	1.06	7S7	1.06	35/51	.72	725A	12.50	HY615	1.25
2E5	.88	6G6G	.88	7V7	1.06	35A5	.72	750TL	49.50	HEY1148	1.25
2E22	1.50	6H6	.60	7W7	1.06	35L6GT	.59	800	2.25	RK12	1.95
2E24	4.37	6H6GT	.60	7X7	.72	35W4	.46	801A	1.10	RK22	4.95
2E25	3.95	6J4	3.95	7Y4	.72	35Y4	.88	802	2.95	RK60	.79
2E30	2.25	6J5	.54	7Z4	.72	35Z3	.72	803	8.95	RKR72	3.50
2J B5I	4.95	6J5GT	.54	10BP4	34.95	35Z4GT	.59	805	4.95	RK73	9.95
2V3G	1.10	6J6	1.06	10CP4	42.20	35Z5GT	.46	807	1.25	T20	1.95
2X2	.69	6J7	.72	10HP4	49.50	36	.88	808	2.95	TZ40	2.95
3A4	.72	6J7GT	.72	10Y	.69	37	.59	809	1.95	V70D	6.95
3A3GT	1.92	6J8G	1.06	12A6	.89	38	.72	810	7.95	VR75	.98
3API	2.95	6K5GT	.88	12A7	1.06	39/44	.59	811	1.95	VR78	.75
3B7	1.06	6K6GT	.54	12A8GT	.72	41	.59	812	2.95	VR90	.75
3B22	4.95	6K7	.60	12AH7GT	.88	42	.59	812H	6.50	VR105	.75
3B23	4.95	6K8	.88	12AT6	.59	43	.59	813	7.95	VR150	.75
3B24	1.95	6L5G	.88	12AU6	.72	45	.59	814	5.95	VT127A	3.00
3B25	.98	6L6	1.29	12AU7	.88	45Z5GT	.59	815	2.50	VU111	1.50
3BPI	2.95	6L6G	1.06	12BA6	.72	46	.88	826	1.25	WE532A	4.95
		6L7	.88	12BE6	.72	47	.88	829B	4.95	Z225	1.95
				12C8	.89	49	.88	830B	5.25		

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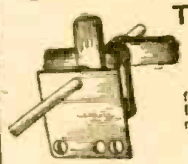

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Weight 10 lbs.
Your cost **$2.49**

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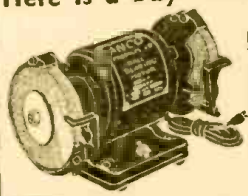

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RUBBER RECIPE

Rubber compounds to the tune of some 35 million pounds a year go into Bell System plant. Each compound must meet many requirements for resistance to humidity, oxygen, ozone, light and abrasion. The right properties depend on skillful selection and compounding of ingredients; this is one of the jobs of Bell Laboratories.

Sulphur, one essential ingredient of rubber, can also be corrosive. That seemed to rule out rubber on telephone cords. But Bell chemists found that if they held sulphur to the bare minimum, corrosion ceased. Now your handset cord has long life, is less susceptible to moisture as, for example, from a wet umbrella.

Connecting your home to the telephone wire on the street is a "drop" — one hundred feet or more of rubber-insulated wire. Once this wire was protected from ozone, light and abrasion by an impregnated cotton braid; but water leached the impregnant, and the braid rotted. Bell chemists tested scores of synthetics, and selected neoprene as an exterior covering with many times the life of braid.

Rubber is only one of many types of insulation developed by the Laboratories for the Bell System; insulation is only one of the Laboratories' problems in providing a quick, economical path for your voice.

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RADIOVISION

Radiovision instead of Television expresses the new art more logically . . .

By HUGO GERNSBACK

"TELEVISION and the Telephot" was the title of an article which I wrote in the December, 1909, issue of my former magazine, MODERN ELECTRICS. This, to the best of my knowledge, was the first technical article to appear in print which used the term "television."

The word "television"—a mongrel word—is composed of the Greek "tele," which means far, and the English word "vision." "Telephot"—a purer term—uses two Greek words: "tele" (far), "photos" (light). In other words: far light.

The 1909 article in MODERN ELECTRICS discussed the German inventor Ruhmer's selenium-cell television experiments, in which a number of light-sensitive cells were arranged into a transmitter of 25 squares. Each of the 25 cells operated a sensitive relay when exposed to light. This sent an alternating current over a wire line. At the receiving end were 25 similar relays which operated incandescent lamps made into a square like that at the transmitter. This, of course, was a very crude type of television, but nevertheless a beginning that actually gave some, if crude, results.

At that time we still used the word "wireless"—the termination "radio" had not as yet appeared on the scene. Moreover, the article concerned only wire transmission and reception of television, when and if it came about. No progress to speak of had been made at that time in translating light impulses into electrical ones, while all inventors would have been very happy indeed to transmit television *via* wire.

Later on when crude television made its debut it was still by wire. It was many years later that television impulses finally were sent through space *via* radio.

Now that sending images by radio is more common than sending them over wire, the term "television" (cognate with "telegraphy" and "telephony") is no longer entirely appropriate.

In one of my former radio magazines I suggested (in July, 1928) the term "radiovision," a word which exactly describes the present video transmission through space. I am of the opinion that this more modern expression should be applied to the new and rapidly growing art now called "television," for a number of reasons:

We must always be conscious of the fact that seeing over a distance will be done in the future in a twofold manner: one way by wire, cable, etc., the other by radio.

The Bell Telephone Laboratories—always in the vanguard of television research—have been prominent in this endeavor for one important reason. That is primarily to link television with the telephone. When and if the problem shall have been solved—and it won't be in a too distant future—we will have *true* television applied and integrated with the telephone. Then when you pick up your phone it will be possible for the distant subscriber to see and be seen over the telephone wire.

In the future, also, we will have a good deal of commercial nonbroadcast television over wires, such as in department stores, in manufacturing plants, in atomic plants, for controlling distant gauges, in banks for verifying checks, etc. Indeed, the two latter applications now are already in use. *The field of wire television will be a vast one.*

But, what concerns us at the present is the far greater application of video: broadcasting through space, which is, of course, radiovision. This term is far more logical, because radio broadcasting should logically remain in its own domain whether it is audio or video. I can easily see many complications and much confusion in the future if the new terminology is not adopted soon.

There is no reason why the word *radiovision* cannot be sold immediately to the public, *before* the video art has become established throughout the land and has become more firmly imbedded in our consciousness.

The regular terminology now used in television can be used with equal facility in radiovision. For instance, we now use the word "telecast." Its counterpart in radiovision, of course, would be "radiocast." A term such as "televise" would have for its counterpart "radiovise." While such words may sound strange at first, they are no stranger than the old terms were when they first came into use.

To us it seems that the radio industry should adopt the term *radiovision* immediately. Once the country has been thoroughly equipped with video stations and when tens of millions of video receivers have been installed, it will then be too late to make a change. Today it can be effected without great difficulty, if and when the radio industry gets behind it. It would appear that the *radio* terminology, as applied to video for this reason, would be most advantageous.

Let us never lose sight of the fact that in the not too distant future we probably will no longer have sound broadcasting alone. Most far-seeing radio engineers today foresee the time when there will be only one kind of radio in this country, namely: sound plus sight. In this coming development the word *Radiovision* will uphold the radio tradition.

DR. J. HOWARD DELLINGER, chief of the Central Radio Propagation Laboratory of the National Bureau of Standards, retired on April 30 after 40 years of government service.

He is the discoverer of the simultaneous occurrence of solar eruptions and radio fadeouts, known as the Dellinger Effect.

Dr. Dellinger joined the Bureau of Standards in 1907, working first on

standards of conductivity for copper. National and international standards were later based on his work. The scientist initiated radio research in the Bureau and was made chief of the Radio Section at its start in 1919. In the early 1920's he began the standard radio frequency broadcasts of WWV.

Author of over 200 technical papers, Dr. Dellinger is the radio editor of Webster's Dictionary and holds many posts of importance in American and foreign technical organizations.

DISABLED VETERANS in New York City were aided by television last month in obtaining jobs. Representing the first major public service program presented by a TV station, WNBT's "Operation Success" offered two veterans an opportunity to demonstrate their skills to the home viewers. One, victim of a foot injury, and trained by the Veterans' Administration as a draftsman, demonstrated his ability by completing before the camera, a working drawing of a house. The other veteran showed his capabilities as an automobile mechanic by repairing part of a racing car.

Immediately after the broadcast, station telephone lines were jammed with calls. 35 positive offers of jobs were made and the Veterans' Administration expects many additional inquiries.

Further broadcasts are planned along the same lines.

FM SETS IN BUSES will furnish riders in Scranton and Wilkes-Barre, Pa., with music and news from station WIZZ. Installation of the receivers has already been started. The arrangement is a commercial tieup between the station and the bus company.

STEREOPHONIC SOUND, produced by multiple recording on magnetized tape, was announced last month by Armour Research Foundation. It is produced by recording three sound tracks from microphones placed at different points.

The three tracks are then amplified through individual amplifiers whose speakers are so located as to give the sought-for two-dimensional effect. Music from such a system seems to "surround" the listener, according to the Foundation.

SMALLER TV STATIONS will be furnished with the best in program fare by a new system of "networking" demonstrated for the first time last month by the Allen B. Dumont Laboratories. In somewhat the same manner as transcriptions are made of sound broadcasts, a film record, known as a tele-transcription, is made of the TV program as it is broadcast, and prints of the film are sent out to other stations.

The process involves receiving the program on a standard kinescope and photographing the image from the face of the tube. It was necessary to develop a special shutter for cameras used in preparing teletranscriptions.

Although the demonstration indicated that very little picture quality is lost in the teletranscription process, its chief advantage is said to be financial. Programs of large city stations, whose expenses are already underwritten, may be syndicated with no extra talent cost. Filming them from a C-R tube saves the expense and trouble of keeping motion picture cameras on hand in the television studios.

ELECTRON TRACKS have been reported seen for the first time with the aid of a new photographic emulsion, Eastman Kodak Laboratories announced last month.

Electron tracks in emulsions were reported from the University of Montreal in 1946, but the new Eastman tracks, first obtained in the company's laboratory at Harrow, England, and later in Rochester, N. Y., are long enough to remove all doubt as to their identity. The number of developed silver grains in a track on the emulsion ranges from six to a maximum of twenty-eight. The length of the path in an emulsion is about two thousandths of an inch, so that a microscope must be used to see it.

MAGNETIC STORMS which blanket out radio communications may now be predicted dependably to within 15 minutes, research engineers of the Radio Corporation of America announced last month.

The new accurate predictions are due to the discovery of a "critical zone" on the face of the sun. Sunspots in this area are the ones responsible for radio "black-outs." Composition and polarity of these spots are also factors that determine their effect on radio communications.

150-KILOWATT broadcast station will be operating by December 1 at San Luis Potosi, Mexico, near the American border. The decision made recently by the Mexican government to license the station on the new 540-kc channel was protested by the National Association of Broadcasters, which contends the authorization contravenes the regulations made at last summer's international conference in Atlantic City. The regulations widened the broadcast band to include 540 kc but forbade use of the channel without a regional agreement.

Though no decision has been made in the U. S., there has been much discussion of reserving the frequency for regional use. The Mexican grant would make this impossible in a large area of the United States.

MILITARY TV can be a substantial aid to victory in any future war, according to David Sarnoff, president and chairman of the board of RCA. Mr. Sarnoff, who is also president of the Armed Forces Communications Association, cited a demonstration of airborne television by the Navy two years ago. He also listed remote control and direction of pilotless bombers and crash boats, military spotting, gun control, and the guidance of bombs, flying torpedoes, and other guided missiles.

"The day may come," predicted Mr. Sarnoff, "when the Commander-In-Chief in Washington will be able to watch distant military activities, even overseas."

NEW RECTIFIER TUBE greatly increases the power-carrying capacity of electrical transmission lines by making possible the use of d.c. on long-distance lines. The new tube, a multi-grid thyratron, has a theoretically infinite power-handling capacity, according to a recent statement by Dr. A. W. Hull of the General Electric Laboratories.

The maximum a.c. which can be carried on a line is limited by the insulation required to handle the peak voltage. It is, however, the r.m.s. voltage—which amounts to only 70.7% of the peak value—which determines the useful energy available. Thus, a line insulated sets for 100,000 volts can do only 70,700 volts worth of work.

Since d.c. voltage does not fluctuate, the same line could handle 100,000 volts of d.c., and 100,000 volts worth of energy would be carried.

Tubes capable of handling the transmission of current generated at Boulder Dam to the west coast at almost 300,000 volts can be built. If the power industry needs them, even larger tubes are possible.

DR. WILLIAM WILSON, former assistant vice-president of the Bell Telephone Laboratories in New York, died last month at his home in Raleigh, N. C. He was an important contributor to the development of the vacuum tube. At the time of his death he was professor of physics at the University of North Carolina.

NEW TELEVISION STUDIOS were leased last month by the National Broadcasting Company in New York City. Three of the RKO-Pathe motion picture sound studios on upper Park Avenue will be used for TV originations. The main studio, measuring 97 x 54 feet, will be the world's largest television studio, according to NBC.

When the new center goes into operation on July 1, the network will have a total of five New York studios. The other two are located at NBC headquarters in Rockefeller Center.

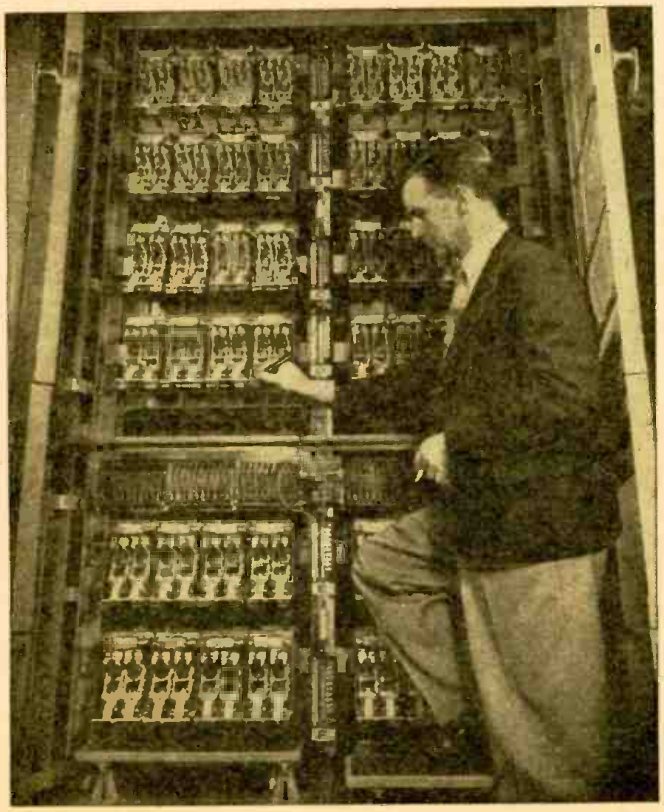
STUDY OF THE 216-500-MC band to determine its usefulness for television will be conducted by a joint committee of the RMA and the IRE, it was announced recently. The project follows a suggestion made by Chairman Wayne Coy of the FCC to the IRE. The study will be of a general nature, to enable the committee to advise the FCC on the practicability of extending commercial television to 500 mc. The present band, according to Mr. Coy, is likely to prove inadequate.

TRAVEL RESERVATIONS may be made automatically by Intelex, an amazing electrical brain which continually keeps track of available airplane or railroad accommodations, granting space to travellers if it can be had or denying requests when facilities are sold out.

The new machine, demonstrated last month by the International Telephone and Telegraph Corporation, can be compared to a dial telephone system, but it is much more complex. Clerks at transportation offices send a coded teleprinter message to the Intelex asking for a reservation. The machine determines whether one is available for the particular journey desired, then automatically sends a message of confirmation or denial to the clerk. Only one Intelex is needed for a transit system; it will deal with offices from coast to coast.

One-way or round-trip journeys may be scheduled, as well as more complicated routings. If the desired reservation cannot be had, the mechanism suggests alternative ones. A "broadcast circuit" will inform all offices as soon as space is sold out.

The device is also applicable to inventory control and bookkeeping.



The Intelex, a new electronic device for making train reservations.

DELETION OF CHANNEL 1 from the band assigned to television transmission was announced last month by the FCC. At the same time, the commission ruled all sharing services off the other 12 video channels and called for a public hearing on the whole television allocation problem. Both black and white and color TV will be studied at the hearing, which will be held in September.

Repeating its statement of 1945 that "there is insufficient spectrum space below 300 mc to make possible a truly nationwide and competitive television system," and that such a system must "find its lodging higher in the spectrum where more space exists," the FCC proposed to look into the status of transmitting and receiving equipment for the 475 to 890-mc band.

UN AMATEUR STATION began operation last month from United Nations headquarters at Lake Success. Using the call K2UN, two 1,000-watt transmitters will operate in the 10-, 20-, 40-, and 80-meter bands. Complex beam antennas will assure maximum range of transmission and reception.

The station will make it possible for more information to be spread throughout the world on UN activities, and will afford contact with individuals, to answer queries and to carry messages to and from delegates' families.

Housed in a glass-enclosed booth at one side of the main public lobby, the equipment and the semi-circular control table will be in plain view of UN visitors. Operation will be handled by members of the UN Amateur Radio Club.

A MICROWAVE TOWER "to bring into the laboratory the facilities of the field" was dedicated by Federal Telecommunications Laboratories last month at Nutley, New Jersey. Rising 300 feet from its base and 358 feet above sea level, it will make possible the carrying on of many experiments right at the best point for a radiator.

The tower, made of steel and aluminum, has three main floors which can be used for research purposes. These are directly under the top. There are also several interior platforms for the installation of experimental microwave equipment. At present work with search radar is being carried on in the top section (the parabolic antenna may be seen above the tower) and the one below is being used for experimental television transmission on the high-frequency television band.

One of the new developments shown was a two-color radar. Planes equipped with responders reply to radar challenge with strong signals, which are shown in green on one C-R indicator, while another indicator shows the weaker standard radar reflections from all planes in the area in yellow.

The two indicators are suspended above a mirror so that their images are superimposed and the viewer sees what appears to be a single indicator. Advantages are that the much stronger signals from responder-equipped planes appear plainly in many cases where the natural radar reflection is obscured entirely by ground clutter, yet the duplex indicator can be watched as easily by the operator as a single screen.

The Crystal Detector

How Dr. Pickard developed the first popular radio receivers

By JORDAN McQUAY

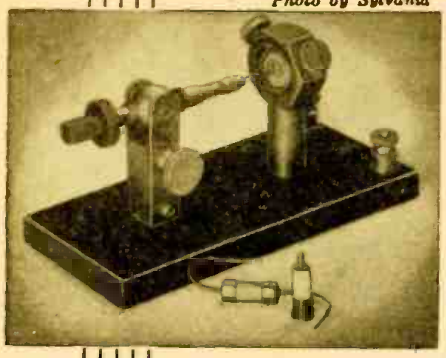


Photo by Sylvania

Fig. 1—Crystal detectors, the old and new.

MODERN development of crystal cartridges has led to countless new uses of crystals for detecting, mixing, and rectifying. With improved manufacturing processes and the use of germanium, these tiny crystal rectifiers may ultimately replace practically all diode vacuum tubes.

The origin of modern crystal cartridges lies in the familiar and historic crystal radio detectors (Fig. 1) of nearly a half century ago.

Not so familiar, however, is the true story of the discovery and development of the first crystal detectors. The supposed date of the discovery of the original crystal or mineral detector has long been generally accepted as 1906, when the first patent was issued. Actually, discovery of the first crystal detector occurred four years ealier in 1902 when Dr. Greenleaf W. Pickard quietly began his initial experiments in wireless detection. There was no publicity, and no patent was applied for; but sufficient evidence has been found to substantiate this early research.

Early detectors

A suggestion that certain minerals possessed unilateral characteristics was advanced as early as 1874 by Braun[1] of Germany, but his experiments dealt only with the conduction—not detection—of electric waves. Beginning about 1891, Branly[2] used combinations of two dissimilar metals as contact rectifiers of very low-frequency waves, with only fair results. Except for occasional speculation in the technical press of the period, the vast possibilities of crystal and mineral detectors remained virtually unexplored.

At the turn of the century there were five principal methods of detecting wireless signals: (1) the metal-filings coherer, (2) the liquid barretter or electrolytic detector, (3) the de Forest responder or anticoherer, (4) the delicate carbon-steel microphonic detector, and (5) the intricate magnetic detector. Although sometimes suitable for low-speed code reception, these detectors were usually unstable and inefficient; they required a battery and were critical to adjust.

During the summer of 1902, a young American radio engineer became keenly interested in the need for a simpler and more efficient means of detection. On May 29, while conducting experiments at Cape May, New Jersey, with a carbon-steel detector and a telephone receiver, he discovered accidently that messages could be received extremely well *when the battery was switched out of the detector circuit.* This was contrary to the accepted theory of the time, and indicated that the telephone diaphragm was being operated entirely by radio energy. Determined to investigate and develop solid-contact detectors which embodied this new principle, from that day in 1902 on, Greenleaf W. Pickard—then a young man of 25—turned his attention to studies of mineralogy and chemistry.

Fig. 2—Dr. G. W. Pickard, still active at 70.

While leading radio engineers and experimenters (such as Marconi, Fessenden, de Forest, Lodge, Stone, King, Collins, Pierce, Vreeland, Taylor, and others) were concerned with the relative merits of the barretter and coherer, young Pickard returned to Boston and quietly began his experiments in search of suitable rectifying substances. These experiments continued without substantial interruption for well over a decade.

The first mineral detector

"At first it was a case of trial and error," relates Dr Pickard, now 70 years old and still active as a consulting radio engineer (Fig. 2).

"After building my own test instruments, I began experiments in the summer of 1902. I started with a typical carbon-steel detector using a local battery, and tried all possible variations to improve reception. One day, I obtained the best results," recalls Dr. Pickard, "when I used an oxidized steel surface, instead of carbon, in contact with a steel needle." This occurred on July 25, 1902.

After exhausting the possibilities of the carbon-steel device as an efficient rectifier, Pickard was ready to explore further the field of minerals.

Recalling his fair results with an oxidized steel surface (essentially an oxide of iron, or layer of magnetite), Pickard obtained a small quantity of lodestone or natural magnetite. "For my experiment," states Dr. Pickard, "I used a fragment of lodestone about 1/10 inch thick, placed on a piece of tinfoil to provide a large contact area. A copper wire served as the second member of the contact."

On October 16, 1902, this combination was used successfully for the first time as a detector without a battery in a simple receiving circuit. Despite only fair results, this was actually the first use of a mineral-type contact detector for the reception of radio waves. Although Pickard made no attempt to patent his discovery of the magnetite detector, the date of this experiment precedes by four years the issuance of the first detector patent[6] and by at least three years the activities of any other

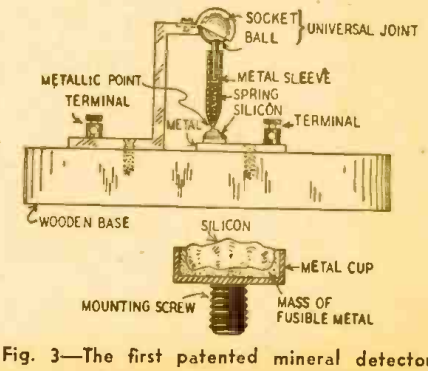


Fig. 3—The first patented mineral detector.

experimenter engaged in similar work. This is substantiated by Pickard's notes and other data[3] on file in the U.S. Patent Office. Subsequent experiments with magnetite proved it to be fairly efficient and capable of withstanding sub-

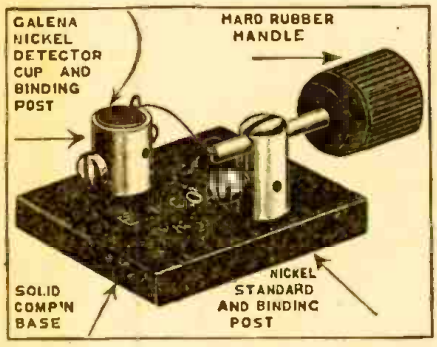


Fig. 4—E. I. Co. crystal detector, designed by H. Gernsback in 1912, orginally sold for 10c for the complete detector. Probably the most widely sold detector at any time. Over 250,000 of these detectors were sold.

stantial electrical overloads, but not very sensitive[4].

In September 1903, the first intelligible speech was received with a carbon-steel rectifier, and the experiments were repeated shortly after with the magnetite detector[3]. (Transmission was by high-frequency spark, incidentally!) Using a modified form of the device, Pickard found that the presence of a local battery did not affect the rectifying action of the detector. However, the use of another substance was required for more sensitive and efficient detection.

Early investigations

Beginning in 1903 and continuing for over seven years, Pickard conducted an exhaustive investigation of all known minerals and crystals to determine those most suitable for the detection of radio waves. The experiments consisted of practical listening tests of code stations in the vicinity, which included the Marconi station at South Wellfleet, Cape Cod (about 80 miles distant), the Navy Yard station at Boston (about 40 miles), and the Fessenden station at Brant Rock, Mass. (about 70 miles).

Minerals were graded on their relative sensitivity when in contact with a nonrectifying conductor and with various other rectifying materials. After testing all minerals available locally and regionally, in 1905 Pickard began tests of new and rarer types from chemical supply companies.

Much of his early work was concentrated on metallic oxides. Of the thousands tested, zinc oxide and lead oxide were identified as highly sensitive materials early in 1905. Also in that year, the merits of galena and iron pyrites were recorded by Pickard. Thereafter, his work was largely concentrated in the study of crystalline materials.

The enormous scope of Pickard's experiments during these years included not only solid chemical elements, but chemical compounds of the various classes—such as oxides and sulphides. During the course of these experiments, Dr. Pickard discovered *more than 250 distinct types* of material which exhibited pronounced properties of rectification. Since these materials were tested in contact with a nonrectifying conductor and then in contact with other materials, actually more than 30,000 different combinations of rectifying materials were tested and classified. This spectacular accomplishment represents one of the most detailed technical investigations in the history of radio.

During the latter part of 1905, occasional references to Pickard's experiments began to appear in the technical press. Then, for perhaps the first time, many engineers and experimenters realized the potential importance of mineral rectifiers and detectors. Austin, Pierce, Round, Fleming, and others began independent experiments.

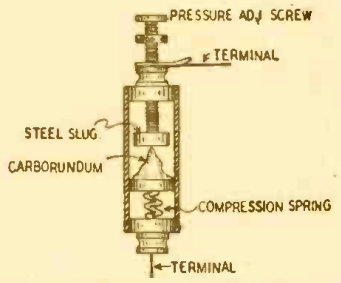


Fig. 5—Dr. Pickard's holder for carborundum.

The silicon detector

Although he had found no detector with extreme sensitivity by the fall of 1905, Pickard continued his investigations, knowing the characteristics of materials most likely to provide efficient and satisfactory rectification. He knew a mineral with a high specific electrical resistance was required.

In November, 1905, Pickard read[5] of a new electric-furnace product known as silicon, which had not only a high specific resistance but a considerable degree of hardness and a high melting point. A sample of silicon was received and tested by Pickard on Aug. 13, 1906. When suitably mounted, with a flat surface of the silicon in contact with a steel hair wire (later known as a catwhisker), the detector proved extremely sensitive despite critical adjustment.

Satisfied with his results, Pickard applied for a patent covering his use of silicon in a special holder. This was finally granted[6] on Nov. 20, 1906. It was the first patent[7] issued for a contact-type mineral detector; it is shown in Fig. 3.

Other types of crystals

During 1906, another contact detector using carborundum was devised by H. H. C. Dunwoody, a retired Signal Corps general.

Carborundum, an electric furnace product, was somewhat of a novelty at that time, and Dunwoody conceived the idea of using it as a detector in a large number of wireless applications. He applied for a broad patent for his device, but before the patent was granted[8] Dunwoody sold his idea of a carborundum detector to the American de Forest Wireless Telegraph Company.

Convinced of the possibilities of carborundum but unable to operate the detectors properly, the de Forest Company employed G. W. Pickard—by then a recognized authority on mineral detectors

Fig. 6—The first crystal holders were offered in 1908 by the Electro Importing Company.

—to explain the proper adjustment and operation of the detectors to de Forest engineers and technicians. Pickard soon introduced new crystal holders (Fig. 5) for the carborundum, and later designed holders for carborundum detectors used with the de Forest Type 8 receiver.

The carborundum detector was rugged and stable[9], and it became fairly popular with commercial operators. Considerable contact pressure was required for efficient operation, and a local battery and potentiometer were necessary for varying the sensitivity. However, the detector did not require frequent adjustment.

In May of 1906, L. W. Austin proposed that contact detectors could be made of *any* material or combination of materials, so long as the two contact elements were brought together with sufficient pressure. However, his attempt to patent a holder[10] met with failure. Continuing his activities, Austin developed a unique detector consisting of tellurium and silicon arranged in a thermocouple. Although patented[11], the device had little practical application.

Later developments

Continued popularity of the silicon detector was assured by the middle of 1907, but Pickard did not abandon his search for more sensitive rectifying materials.

He developed an improved silicon detector[12], more rugged and with higher sensitivity, which was subsequently adopted as standard by the Army Signal Corps.

Expanding his earlier experiments with zinc oxide, Pickard perfected a sensitive contact rectifier known commercially as the "perikon" detector[13]. The unilateral element of this device consisted of a combination of zinc oxide and copper pyrites.

By this time, many experimenters had become interested in contact detectors, and the majority believed that the action was entirely thermoelectric in nature. Despite the firm beliefs of engineers and experimenters such as de Forest[14], Acheson[15], Pierce[16], Tissot[17], and Fleming[18], Pickard proved conclusively that the action was not thermoelectric but a true rectifying action.

Subsequently, Pickard was successful in producing oscillations with a crystal detector circuit, so that the circuit could be operated as a beat receiver.

Later, Pickard developed and patented a molybdenite detector[19], an improved zincite-chalcopyrite detector[20], and the "pyron" detector composed of iron sulphide.

During this period, a number of other materials such as galena, iron pyrites, and pyrolusite, were perfected for use as contact rectifiers. In particular, the galena detector (Fig. 4) proved extremely popular because of its high sensitivity.

Heyday of crystal detectors

Public interest in crystal detectors, beginning in 1909, had a profound effect on the popularization of radio and, eventually, broadcasting.

The first commercial crystal holder (Fig. 6) was advertised by Hugo Gernsback's Electro Importing Company of New York in its *Catalogue 5* and in the technical press[21] in the fall of 1908.

There was no vast radio industry at that time; but to meet the increasing demands of amateurs, and later, the general public, more and more firms turned to the manufacture and sale of crystal detectors and receivers from 1910 to about 1920.

All this came to an end with the development of the vacuum tube which, at that time, proved a far more efficient detector and rectifier than any mineral substance. Today, only memory serves as a reminder of the heyday of crystal detectors, but the early work of Dr. G. W. Pickard remains a monumental achievement of historical importance.

Dr. Pickard believes today that many of the useful radio and electrical possibilities of minerals and crystals have yet to be explored and developed.

"Any contact which doesn't obey Ohm's law can be used to produce oscillations," states Dr. Pickard. "If it can be made to oscillate, a crystal rectifier can also be made to amplify—although the simple contact must be changed to something more complex."

And in the light of highly successful experiments which are now in progress at the laboratories of several universities, the eventual use of certain minerals and crystals for amplification is a distinct probability.

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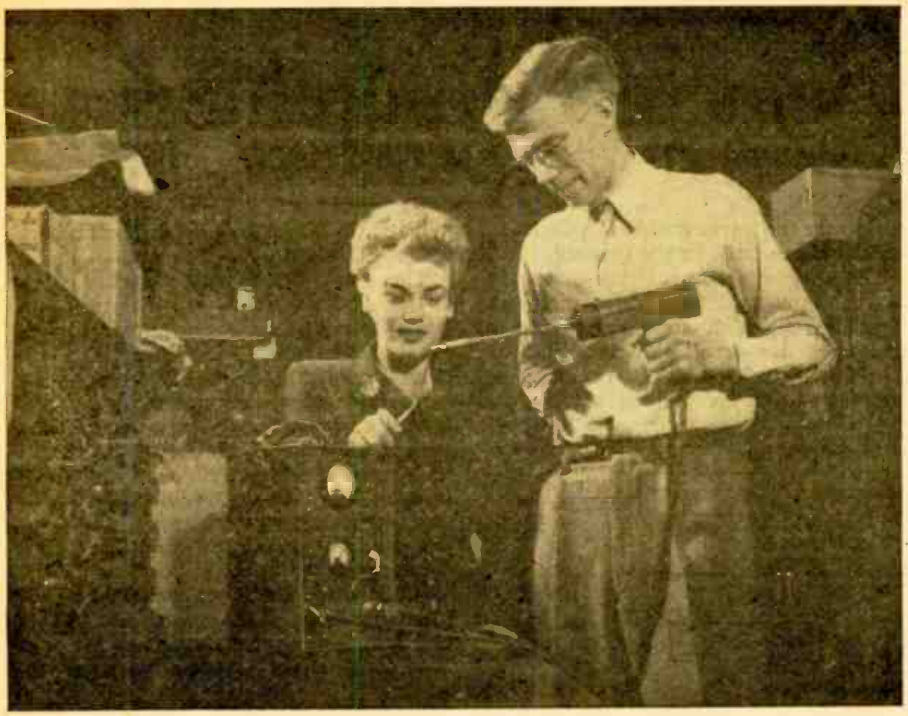
PHOTOELECTRIC EYE PROTECTS SUNBATHERS

THE science of electronics, in addition to performing such varied chores as arousing sleepwalkers and opening garage doors, has invaded still another sphere of activity. Bathing beaches, formerly associated with bathing beauties, playboys, and escapists from the oppressive heat of cities, may now be the proving grounds of science. The all-seeing photoelectric eye will scan sun bathers and ration the amounts of suntan.

Tourists to Florida beaches next winter may be seen carrying, in addition to their usual luggage, a device resembling an overgrown portable radio, with a knob on top. Inside the wooden container is a photoelectric tube which controls a flow of current in direct proportion to the intensity of the light entering the box. The unit uses standard equipment for correlating light intensity and exposure time, as is done in making exposures for photo engravings. In measuring sun-tan, the device automatically fixes the period of time in relation to the amount of light—thus preventing undesirable sunburn.

Where breathes there a man with skin so immune that he has not at some time lain overlong under a deceptively hazy sky and gone home with a burning, itching, tortured hide? Some light-complexioned individuals even refuse to go to a beach at all because they know that no matter how much they may enjoy their revels in the surf and their gambols on the sand, the next week's agony may be small recompense. For these unfortunates, electronics come to the rescue.

Fair, sensitive skins of blondes, for instance, cannot tolerate more than twenty minutes of bright sunlight, without inviting a painful lobster red. Hazy days with intervals of cloudiness and brightness, are even more problematical to sensitive skins. On such days, the all-seeing and scientifically accurate photoelectric eye can dole out proper doses of sunshine to sun bathers. The indicator on the dial of the General Electric gadget is set on the desired duration of time, assuming bright sunlight, say 20 minutes. A switch is flipped, and the electronic tube passes electric current in proportion to the intensity of the light actually present. An indicator on the dial slowly moves back to zero at a speed depending on tube current. When the dial registers zero, the desired amount of suntan has been obtained, and either a bell rings or a light flashes a visual warning. Net results—scientific sun bathing!



Above—The halogen-sensitive element used in the electronic nose. Left—The burning driftwood splinter releases halogen smokes which are drawn through the "pistol barrel" to the sensitive element. Upper meter shows presence and concentration of vapor or gas.

The Electronic Nose

ONE of the latest developments in the application of electronics to industry is an "electronic nose" capable of indicating the presence and the strength of an odor. The instrument adds the sense of smell to the other human functions which can be duplicated by science—

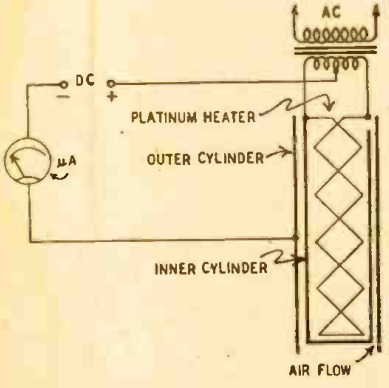


Fig. 1—Gas leaks are found with this circuit.

hearing (the microphone), speaking (the loudspeaker), sight (the photoelectric tube), and touch (simulated by special instruments).

The new device, born recently in the General Electric Laboratories, is expected to be most valuable in detecting the presence of harmful smokes and gases.

Emission of electrons is a commonplace in radio. Vacuum tubes are based on this. That *positive ions* can also be emitted by the action of heat is not so well known. The polarities of the vacuum tube must be reversed: the cold anode is made negative and the heated cathode positive. Ion emission can take place in air, unlike electron emission, which requires a near-vacuum.

This device makes use of the ion emission, which increases when the cathode is struck by vapors of the halogen family. This includes bromine, iodine, fluorine, chlorine, and their compounds. It is especially sensitive to chlorine compounds such as carbon tetrachloride, chloroform, and Freon.

Fig. 1 shows the structure of the "electronic nose." The platinum wire heater heats the inner cylinder or cathode. D.c. is applied between the outer cylinder and the cathode. The negative charge on the outer cylinder attracts positive ions emitted by the cathode, and a current flows through the meter.

A flow of air is maintained through the spaces between anode and cathode. When the air contains chlorine vapors, the stream of ions flowing from cathode to anode increases. The resulting increased meter reading indicates the presence and relative concentration of these vapors in the air.

Increased ion-flow also takes place when certain types of solid particles are added to the air. The nose will "smell" smoke produced by burning of any substance containing iodides, chlorides, bromides, and fluorides.

In its present form, the elements become corroded after too much exposure to vapors, and they must be replaced; there is promise, however, that more research will enable the "electronic nose" to maintain its sensitivity for longer periods.

Practical uses for the device are manifold. It can be used, for instance, to detect gas leakages. In one refrigerating system using Freon gas, the air intake nozzle is moved around near places where the Freon is suspected to be leaking. If it is actually leaking some of it will get into the spaces between cathode and anode of the detector and the rising meter reading will indicate the leak.

Fig. 2 shows another interesting method for making the unit indicate the presence of vapors. The speaker transformer, condenser, and glow-discharge tube form a relaxation oscillator. The current through the d.c. circuit (controlled by the emission of the cathode) builds up a charge across the condenser. When the charge is high enough the glow tube breaks down and shorts the condenser, which then starts charging again. Each time the glow tube breaks down a click is heard in the speaker. As the amount of vapor in the air increases, ion emission increases, the condenser charges more quickly and the clicks in the speaker speed up.

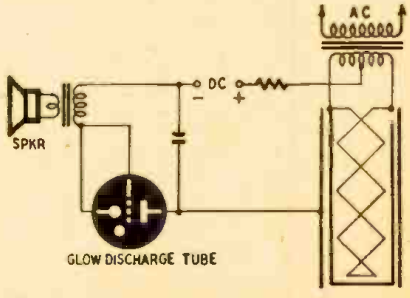


Fig. 2—A gas leak sounds audible alarm.

Television Camera Preamplifiers

By EDWARD M. NOLL

CAMERA preamplifiers are used to bring up the very weak output of the camera tube to a level suitable for transfer through a co-axial cable to the main video amplifiers. Generally, four or five stages are necessary. To keep the signal above the noise level, the preamplifier is placed near the camera tube. Even with the preamp mounted close to the camera a number of unusual precautions must be taken to keep the signal-to-noise ratio high and to amplify linearly a band of frequencies extending from 30 cycles to 4 or 5 mc.

A block diagram showing the main components of the camera circuit appears in Fig. 1. Not all of these components are a part of the camera proper, but they are essential for proper operation. Only the parts within the dash-line rectangle are built in the camera.

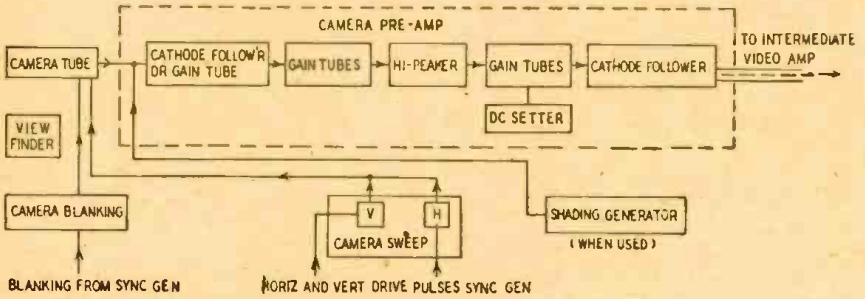


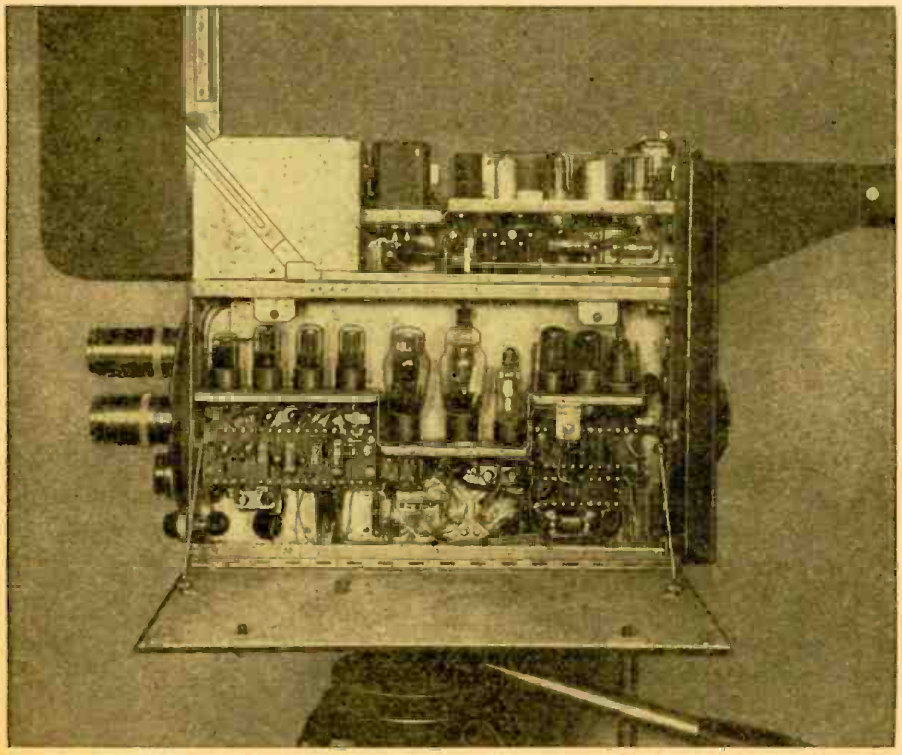
Fig. 1—Blanking and sync voltages are usually generated at the master control.

The three major problems in the design of a preamplifier are: maintenance of a high signal-to-noise ratio with an extremely low-level signal; obtaining the proper band width to amplify all components of the picture signal; and proper shielding to prevent hum and the introduction of spurious signals.

Since output from the camera tube is so small, noises which are considered insignificant in other work, such as thermal and tube shot noises, seriously affect a camera circuit.

Thermal agitation in the output resistor of the camera tube contributes a considerable amount of noise. The amplitude of this noise rises as the square root of the resistor value, while signal output rises directly as the resistance value. Consequently, the best signal-to-noise ratio is obtained with the highest value of resistance.

There is a limit to the possible value of the output resistor. While output and signal-to-noise ratio do improve with greater resistances, the distributed capacitance of the camera and tube circuits does not allow the high-frequency output to increase at the same rate as output at middle and low frequencies. The maximum permissible resistor value is limited by the allowable amount of high-frequency loss, which must be compensated for in a later stage (the high peaker) of the preamplifier. Located at a point where the signal reaches an appreciable level, it attenuates the middle and low frequencies until they reach a level comparable to that of the highs.



The preamplifier is in the lower section of this RCA image orthicon camera unit.

Frequency response

The over-all frequency response of the camera preamp must be linear over a wide range. To follow an abrupt change in brightness along one line of the picture requires a very fast change in voltage, or good high-frequency response; to follow a very slow change requires good low-frequency response.

The high-frequency response is restored by special series or shunt peaking systems. Every possible precaution is taken to keep distributed capacitance at a minimum, particularly in the camera-tube output circuit. If the circuit capacitance is held at a minimum, the output load resistor can be made higher, and more gain can be obtained. Miniature tubes, with their low input and output capacitances and high gain, have greatly improved and simplified camera preamplifiers.

A cathode follower is often used in the input stage because of its lower input capacitance. Cathode followers are used in output circuits as impedance transformers, to obtain the low-impedance signal necessary to match the co-axial transmission line without high-frequency loss.

The good low-frequency characteristic and the high gain of the preamplifier make microphonics and hum pickup important. The preamp must be properly shielded, very carefully decoupled at the power supply point, and must use non-microphonic tubes. Wiring must be done carefully to prevent hum and low-frequency oscillation (motorboating). In most units, d.c. is applied to the heaters.

In some cameras, special clamping circuits are used to sustain low-frequency response. When this system is used, the earliest stages have relatively poor low-frequency response, and, therefore, are not susceptible to microphonics and hum. In a later stage the low-frequency components and the d.c. black-level signals are re-inserted by means of the clamping circuits.

The camera tube is well shielded. This prevents hum pickup from motor-driven focusing and view-finder systems.

Special compensating circuits must be used to remove spurious signals inserted into the camera output during the beam retrace period, when relatively high-voltage transients are generated in the deflection coils.

High-frequency peaking

The equivalent output circuit of the camera tube is shown in Fig. 2-a. Resistor R1 represents the output resistance, and capacitor C1 represents the

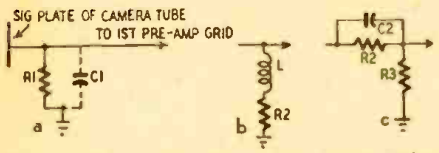


Fig. 2—H.f. compensation for camera tube.

total distributed capacitance in shunt with the resistor. As in all amplifiers, the capacitance shunting the output resistance reduces the net impedance at high frequencies. In the case of camera tubes, where the signal passing through the resistance is extremely weak, the resistance must be kept as high as possible to develop an appreciable voltage. But, as the value of the resistor increases, the high-frequency loss becomes more serious. To obtain appreciable output voltage from an iconoscope circuit, the output resistor must be approximately 300,000 ohms. Obviously, high-frequency loss is great. In a typical example, the output impedance consists of 300,000 ohms shunted by an effective 8-μμf capacitor. With this combination the output is reduced to 70.7% of the mid-frequency level at 67,000 cycles. A good deal of compensation is necessary to obtain linear response up to 5 mc at the preamplifier output.

Two basic compensating circuits are shown in Figs. 2-b and 2-c. In Fig. 2-b a simple inductor-resistor combination is used. Its rising impedance with frequency compensates for the decreasing impedance of the camera-tube output circuit. If the time constants of these two networks are made equal, the high-frequency loss and phase shift will be compensated for.

With the capacitor-resistor combination of Fig. 2-c a similar relationship exists, where the time constant of R1-C1 and R2-C2 must be equal for proper compensation. With this method, C2 prevents the transfer of the low and middle frequencies to R3, while it readily passes the high frequencies.

Amplifiers following the high-peaker network must have a linear response over the entire range. The combination of the output impedance of the camera tube, the high-peaker stage, and the following linear amplifiers, produces a camera preamplifier with a linear response over the entire video range.

Typical preamplifiers

A typical iconoscope preamplifier is shown in Fig. 3. It uses the R-L method of high peaking, as in Fig. 2-b. The peaking circuits are adjustable and are set when aligning the camera. In practice, the high peaker is set to give the best horizontal resolution without the appearance of transients in the picture.

The preamp of Fig. 3 uses a cathode-follower input stage, followed by a linear amplifier and the high peaker. Another amplifier follows the high peaker and feeds the output tube.

The normal input capacitance of the 1851 is 16 μμf; by connecting the tube as a cathode follower, the effective input capacitance becomes only 2 μμf. This

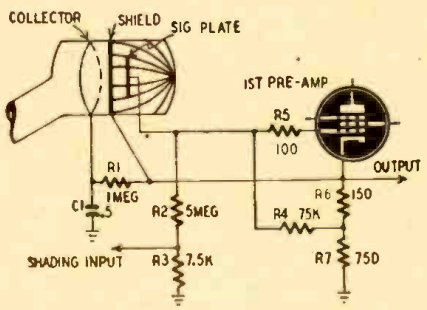


Fig. 4—Detail of first amplifier stage, Fig. 3.

permits the use of a higher-value load resistance with an attendant increase in camera output voltage and signal-to-noise ratio.

The iconoscope output circuit and video input stage are shown in detail in Fig. 4. The actual resistive load on the iconoscope consists of R4 in series with R7. Although these are only 75,000 and 750 ohms, respectively, the resistive load on the iconoscope is actually 300,000 ohms because of the effective increase in input resistance when the tube is used as a cathode follower.

R6 and R7 in series form the cathode output resistance. The grid return is at the junction of these two resistors to obtain the proper bias. R5 is a parasitic suppressor.

Since the average emission from the iconoscope increases when the collector ring is operated at a slightly positive potential with respect to the signal plate, a positive voltage is taken from the cathode of the input stage and passed through R1 to the collector. The a.c. variations are effectively filtered to produce a d.c. voltage across C1, which makes the collector ring slightly positive with respect to the signal plate, which is at the d.c. ground potential. This circuit does not affect the a.c. output variations across R6 and R7.

The shading signal is introduced through a voltage-divider network to keep it at the same low level as the camera-tube output signal. R3 serves as a termination for the shading generator. R2 is very large and effectively isolates the capacitance of the shading generator circuit from the iconoscope output.

The wire screen often placed around the iconoscope near the mosaic and signal plate keeps the capacitance of the signal plate to ground constant.

Bifilar winding

The third stage of the camera preamp in Fig. 3 uses a high-peaker network with an electrical equivalent of the series R-L combination of Fig. 2-b. In the high peaker, the requirement is that the quotient of L/R be equal to the time constant of the iconoscope output circuit. However, the value of L is limited by the distributed shunt capacitance of the high peaker stage itself. For example, assuming a certain shunt capacitance value, the value of L must be chosen to produce a linear frequency response up to about 5 mc. The variable quantity is the resistance. If, as is usually true, there must be substantial compensation, the resistor value becomes extremely low. In the preamp of Fig. 3,

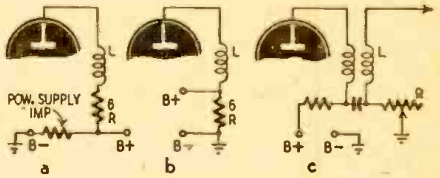


Fig. 5—High-peaking for plate circuits.

it is about 6 ohms. If a conventional video amplifier output circuit is used, as shown in Fig. 5-a, the 6-ohm value of R is much lower than the power supply impedance. The load on the high peaker stage is not, therefore, really 6 ohms.

An effective 6-ohm load can be placed on the high peaker by placing the resistor across the power supply, as in Fig. 5-b, but this would call for a mammoth B supply to furnish the tremendous current the resistor would draw. The solution to the problem is the bifilar winding (Fig. 5-c).

A bifilar winding consists of two very closely spaced windings with unity coupling and a uniform transfer over a very broad band. The 6-ohm load is placed between the low side of the secondary winding and ground. For the a.c. signal, the load is the series impedance of L and R; the d.c. power supply has been effectively isolated.

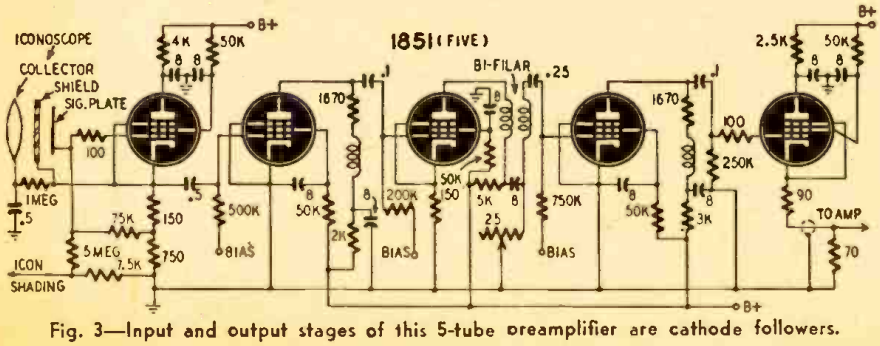


Fig. 3—Input and output stages of this 5-tube preamplifier are cathode followers.

TELEVISION COUNTERS

Television pictures are stabilized with differentiators and integrators.

By ROBERT W. EHRLICH

INTEGRATING and differentiating circuits are among the most useful of those employed in present-day electronic developments. It would have been almost impossible to develop telemetering systems, radar, high-speed counters and television to their present state of perfection without them.

The differentiator or "peaker" is a high-pass filter designed to produce sharp pips of short duration when rectangular voltage waves are applied to its input terminals. It consists of a capacitance and resistance in series across the voltage source. The leading edge of the wave causes the voltage across the resistor to rise sharply to maximum and then decay as the charge builds up on the capacitor. When the capacitor is fully charged, the voltage across the resistor drops to zero and remains there until the lagging edge of the input pulse comes along. Then the condenser discharges through the resistor to produce a voltage pip in a negative direction. The pips are sharpest when the time constant (R x C) of the resistance-capacitance combination is shortest.

The integrator circuit is physically the same as that of a differentiator. But it is designed as a low-pass filter and the output voltage appears across the capacitance. The output voltage waveshape follows the gradual rise and fall of the capacitor charge. This circuit is often used ahead of triggered oscillators and gating circuits when they must respond only to input pulses of comparatively long duration. The time constant of the circuit should approach or equal the duration of the operating pulse.

In the television receiver, there are two sweep circuits that must be synchronized with those of the transmitter. One sweeps the beam horizontally at the rate of 15,750 times per second; the other sweeps it vertically at the much slower rate of 60 times per second. Synchronization is accomplished by superimposing a number of rectangular pulses on the picture signal as it is sent out from the transmitter. The receiver must interpret these pulses, feeding one pulse every 1/15750 second to the horizontal sweep circuit and one every 1/60 second to the vertical sweep circuit. The trick is that the 1/15750 second pulses must continue all the time, even during the relatively long period each 1/60 second when vertical synchronization is to be applied.

A portion of the series of synchronizing pulses as they are included in the video signal is shown at *a* in Fig. 1. During most of the 1/60 second "field" period, narrow pulses are sent out at such rates as to synchronize the 15,750-cycle horizontal sweep oscillator frequency. During the interval when the vertical synchronization is to take place, high-rate pulses are still sent out but they are made very much wider.

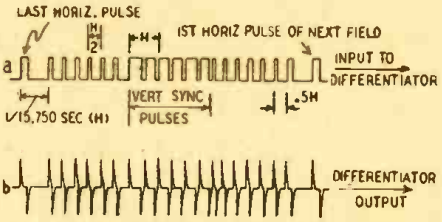


Fig. 1—The leading and trailing edges of the rectangular pulses produce sharp pips.

When the synchronizing signal of *a* is applied to the differentiation circuit, Fig. 2, the output of the latter is a number of extremely sharp positive pulses which correspond to each sudden rise in synchronizing voltage, as well as sharp negative pulses corresponding to each drop in synchronizing voltage. These pulses are shown at *b* in Fig. 1. The polarities in the circuit are such that the sharp positive pulses will cause synchronization of the local sweep oscillator, whereas the negative ones are clipped off in the grid circuit of the following tube and so have no effect. It will be noted that the positive pulses appear at the differentiator output at a constant rate during this period, irrespective of the width of the corresponding synchronizing impulse from the transmitter. The horizontal sweep circuit is then locked in with the transmitter at all times, even while the wide pulses are being transmitted.

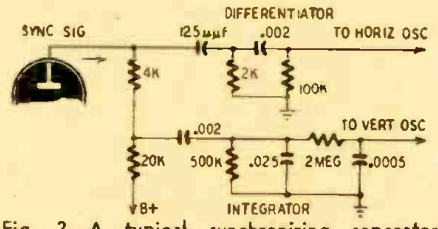


Fig. 2—A typical synchronizing separator designed for use in a television receiver.

The same sync signal is applied to an integration circuit, Fig. 2. Here the narrow horizontal pulses cause only a small integrator output, which is too small to affect the vertical oscillator circuit. However, shortly after the end of the field, the wider vertical impulses allow a greater charge to accumulate on the integrating capacitor, and the output of the integrator is then the broad pulse shown in Fig. 3-b.

You may feel that this broad pulse is not sufficiently sharp to accurately synchronize the vertical sweep oscillator. Remember that the period of this oscillator is relatively long, 1/60 second. When Fig. 3-b is redrawn to show a complete vertical cycle, these pulses are seen to be relatively short compared to the entire cycle.

Separation of horizontal and vertical synchronizing pulses is only one of many applications for these versatile circuits. Even in the same television receiver, integration is often used again for another purpose. In many of the low-cost television receivers, the pulses of Fig. 1-b are rectified to cut off the negative pulses and clipped to flatten the tops of the positive pulses. The resulting series of short, flat-topped pulses is then integrated to produce a sawtooth waveform. The sawtooth wave is amplified directly and used to drive the scanning spot horizontally across the face of the cathode-ray tube.

Both the designer and the serviceman must be familiar with the principles of integration and differentiation circuits. This necessity for the designer is obvious, but the serviceman must also recognize these functions when they appear in the circuit diagram of some equipment. On a diagram the R-C type of differentiator looks like a standard audio coupling circuit in which the capacitor need only be large enough to pass the lowest audio frequency concerned. On the other hand, the time constant of a differentiator circuit must be set at an exact value. Replacement with an incorrect component or failure to replace a capacitor or resistor that has changed value will completely destroy the effectiveness of the circuit and of the apparatus in which it is employed.

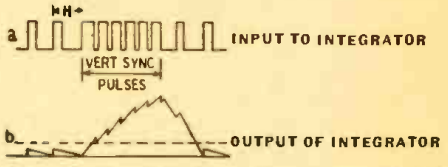


Fig. 3—The broad vertical pulses build up a charge on the integrating condenser.

Tiny Signal Tracer

By RUFUS P. TURNER

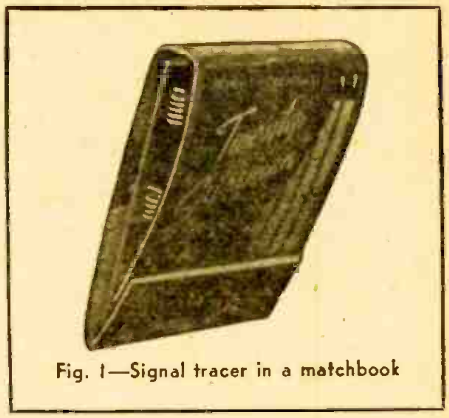


Fig. 1—Signal tracer in a matchbook

A PRACTICAL signal tracer that takes no more room in the serviceman's pocket than a book of safety matches is almost a believe-it-or-not item. Yet, here is one that actually *is* built inside a book-match cover. We believe this is the ultimate in compact signal tracers.

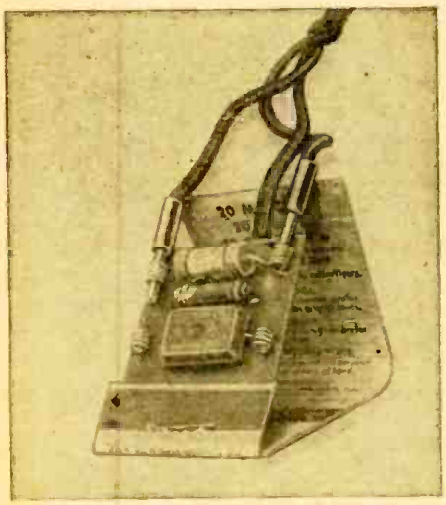


Fig. 2—Parts are mounted on thin fiber card.

The vest-pocket signal tracer described in this article definitely is not a toy. Its essential components are a crystal diode, coupling capacitor, and load resistor—the same parts used in all modern, batteryless probes. Its small size makes it exceptionally easy to carry.

In spite of its tubeless design, this signal tracer has sufficient sensitivity to give a good headphone signal right down to the antenna and ground terminals of a receiver. It may be used on both a.f. and r.f. signals. And it can be used as an a.f.-r.f. probe for a d.c. vacuum-tube voltmeter. It cannot be damaged by d.c. voltages in the set under test.

Circuit details

The circuit schematic of the signal tracer given in Fig. 4 will be recognized as the standard shunt diode rectifier circuit employing a 1N34 crystal. The coupling capacitor C serves also to isolate the tracer circuit from d.c. voltages. R is a 1-megohm load resistor across which the output voltage is developed.

Signals as high as 30 volts r.m.s. may be applied continuously to the input terminals without damaging the crystal. Somewhat higher voltages may be applied momentarily. This will be satisfactory in most signal-tracing operations. If a 1N38 crystal is employed, much higher signal voltages may be handled.

Figs. 2, 5, and 6 show constructional details of the signal tracer. All parts are visible in the photographs (Figs. 2 and 3) and in the layout drawing (Fig. 5).

The parts are mounted on a thin card of fiber or stiff cardboard measuring 1¾ x 1 7/16 inches. The pigtail leads of the crystal, resistor, and capacitor are pushed through pinholes in this card so that all connections may be made on the reverse side of the card. After the parts are mounted and the wiring completed, the card is stapled into the match folder in place of the matches. A regular desk stapler may be used.

Small-sized components are employed throughout. R, for example, is the smallest ½-watt carbon resistor, and C is an Aerovox type 1469 miniature mica capacitor.

The input and output terminals are small coil springs wound with No. 20 bare solid hookup wire. These springs may be made by close-winding 4 or 5 turns of the wire around the thin end of a standard phone tip, then slipping off. The two ends of each coil are passed through pinholes in the mounting card and soldered together, for support, behind the card, as shown in Fig. 6. Headphone cord tips may be inserted directly into the two output spring terminals

Fig. 3—A straight pin is used as test prod.

(see Fig. 2). Wire leads may be pinched between turns of the two input spring terminals. In Fig. 3, a straight pin is shown pinched into the input spring terminal A to be used as a simple test prod. Input terminal spring B must be connected to the chassis or B-minus terminal of the radio or amplifier under test.

The folder may be closed as easily as any ordinary book of matches (see Fig. 1), and the closed signal tracer fits comfortably into a vest or shirt pocket. A miniature hearing-aid phone may be tucked away in the vest pocket along with the tracer.

Using the tracer

When tracing signals through a radio receiver, a modulated r.f. signal must be fed into the receiver. Headphones then may be employed with the tracer, and tests may be made in any stage in the set.

Fig. 4—Schematic diagram of the tiny tracer.

Clip the exploring prod into input spring terminal A, as shown in Fig. 3. Connect input spring terminal B to the chassis of the receiver by means of a short, flexible lead.

The tracer may be used also as an a.f.-r.f. probe for a d.c. vacuum-tube voltmeter. Connect the negative meter

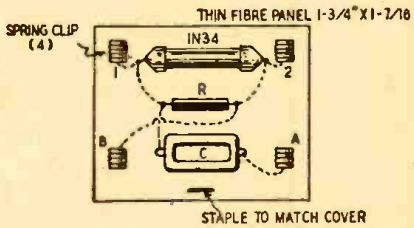


Fig. 5—Dotted lines show wiring under card.

terminal to tracer output terminal 1, and the positive meter terminal to terminal 2. The meter reading will indicate the *peak* value of the voltage being measured, that is, 1.414 times the r.m.s. value, except on the 0-3 volt scale of the meter where the reading will be somewhat lower than the peak value.

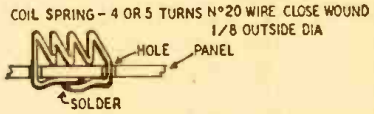


Fig. 6—Attachment of the spring terminals.

As a probe, the tracer also may be employed with an audio amplifier when loudspeaker operation is desired. In this application, connect the input terminals of the audio amplifier to the two output terminals of the tracer, and use the tracer in the usual manner.

Double-Bridge V.T. Voltmeter

By I. QUEEN

MODERN radio, television, and other electronic circuits often have resistance loads of 1 megohm and higher. A meter of exceptionally high resistance is needed when measuring voltages across such high values. For example, an 11-megohm voltmeter reads about 15% lower than actual value when connected across 2 megohms. The error is reduced by increasing the resistance of the meter.

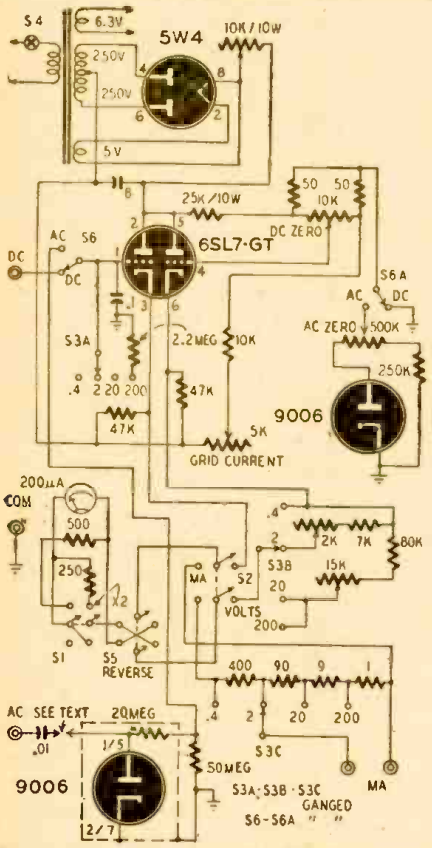


Fig. 1—Complete schematic of the instrument.

The instrument shown in the accompanying photographs was designed for negligible loading of high-resistance circuits. On low d.c. voltages its input resistance is approximately 2,500 megohms. On the higher ranges, it is about 22 megohms. It can measure a.c. and r.f. voltages with unusually low loading effect. The several ranges are individually adjusted for accuracy. Each range is provided with a separate potentiometer to calibrate it whenever necessary.

There are eight voltage ranges. The full-scale readings are: 0.4, 0.8, 2, 4, 20, 40, 200, and 400 volts. This gives plenty of overlap and covers values used in most work. Ordinarily, eight ranges require an 8-position switch. Only a 4-position switch is necessary in this instrument. The number of ranges is doubled by S1, "x 2" switch.

Another switch, S2, converts the instrument into a high-precision milliammeter. The current ranges are the same as the voltage ranges.

Front panel and chassis views are shown in the photographs. The metal cabinet measures 9 x 6 x 5 inches. The a.c. zero control is at lower left, the d.c. zero control in the center, and the range switch at lower right.

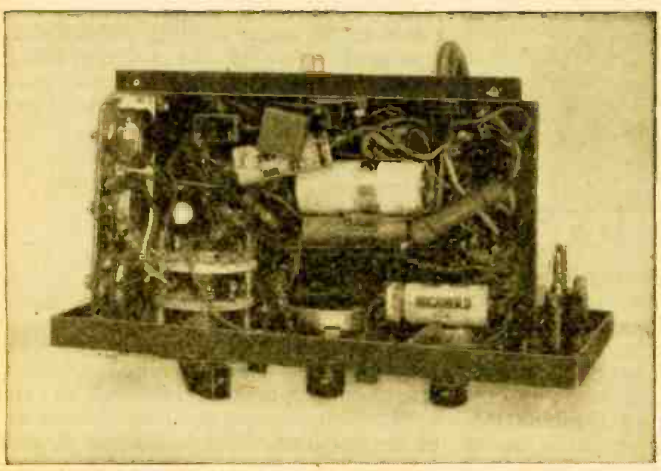
The complete schematic appears in Fig. 1. The power supply is a simple one using an R-C filter. The adjustable 10,000-ohm, 10-watt resistor is varied until the voltage across the filter condenser measures about 220. The B-minus is not grounded.

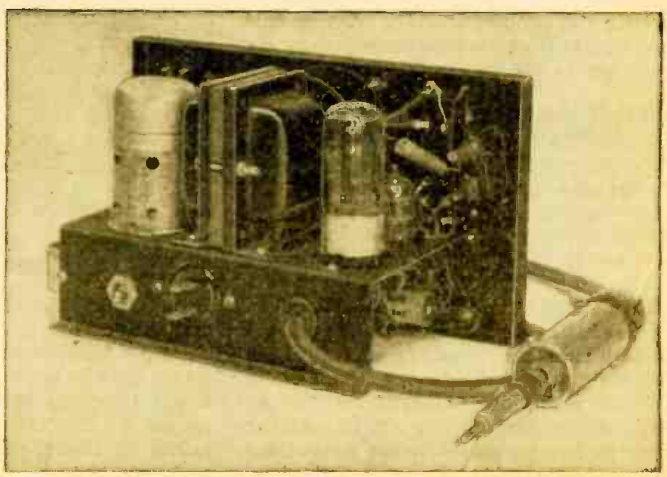
Two bridge circuits are used for measuring d.c. volts. The first is a conventional double-triode bridge which cancels fluctuations in plate and filament voltage. One of the control grids has constant potential and takes no part in measurements. The second grid is connected to the voltage being measured.

The other bridge balances out grid current. A simplified schematic is shown in Fig. 2. Internal resistance between the control grid and each of the other tube elements is drawn as an equivalent resistance. Actual resistor values depend upon such factors as tube gas, leakage, and grid emission. If the tap on the potentiometer is adjusted to balance the bridge to ground, no current will flow through the center arm no matter how much resistance is present in the circuit.

When grid current is low, the input resistance to the tube is extremely high. With complete grid-current balance this particular voltmeter reaches an input of about 2,500 *megohms* on the low d.c. voltage ranges. This is practically an open circuit which cannot load any circuit normally encountered in shop or laboratory. Consequently, we can use an isolating resistor of as high as 20 megohms right in the negative d.c. probe. This resistor completely isolates the v.t.v.m. from the circuit being measured even if the circuit is a sensitive one.

The d.c. voltage ranges are the first to be calibrated. S2 is thrown to the "volts" position and the range switch S3 is





Bottom and rear-chassis views. Isolating condenser is shown plugged into probe for r.f. measurement.

rotated to the "200" range. The instrument is then plugged in and the power switch S4 (at rear) turned on. Allow about 3 to 4 minutes warm-up time.

The d.c. leads are inserted into the banana jacks at the bottom center of the panel. It is necessary to watch their polarization only on higher voltage ranges. S5 is used to reverse polarity on the lower ranges without reversing the leads themselves.

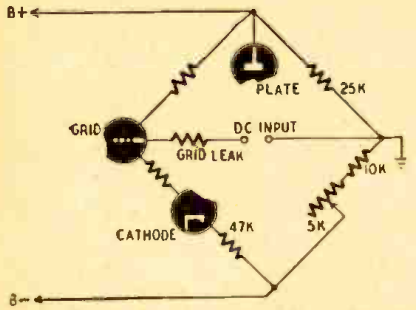


Fig. 2—Fundamental circuit of the voltmeter.

After several minutes for complete warm up, the prods are shorted together. The range switch is rotated to the lowest range and the d.c. zero is set. This setting will need very little attention after the first few minutes.

The grid current control is now adjusted. Separate the d.c. leads and watch the meter. There will probably be a gradual drift away from zero in one direction or the other. Allow about 5 or 10 seconds since the drift is very slow. Keep adjusting the grid current control until the meter remains at zero whether the d.c. leads are shorted or separated.

Don't shake the leads or move them about during the calibration since this induces a very small voltage and causes an incorrect meter reading.

A drift of about one or two small divisions on the lowest range can be tolerated. This reading is equivalent to about .02 volt and will be negligible on higher ranges. It becomes zero when the prods are shorted or when a measurement is made across a reasonably low resistance (like 25 megohms!).

The three low-voltage d.c. ranges are individually calibrated by comparison with a standard meter and are checked for linearity at several points on each scale. A dry cell or other d.c. power supply with a potentiometer across it will provide a convenient calibrating voltage.

The accuracy of calibration will depend primarily upon the accuracy of the standard meter.

The 200-volt range has no separate calibrating potentiometer, but is adjusted after the a.c. voltage ranges are calibrated.

If the calibration points are not near the centers of the potentiometers, try other resistors of nearly the same values until satisfactory ones are found.

A.c. voltages are measured by using a tube rectifier to feed the d.c. voltmeter. The type 9006 diode used is effective to well beyond FM frequencies. The tube is within an aluminum probe 1 inch in diameter and 3 1/16 inches long (Fig. 3). A circular piece of bakelite drilled to accommodate the 9006 socket is wedged in the probe with the socket pins toward the front end. The front is closed by a circular piece of ¼-inch thick polystyrene with a banana jack mounted in the center.

The other end of the probe is fitted with a 4-prong socket. Two leads are for the 9006 filament, one for ground (shell of the probe), and one comes from the 9006 plate (through a high resistance). A 4-conductor cable of convenient length connects the removable probe with the instrument.

Calibration is carried out at 60 cycles. A variable-tap toy transformer is good for low voltages. For highest accuracy use a reliable a.c. standard voltmeter to monitor the voltage at the terminals. The a.c. adjustment is governed by the 50-megohm fixed resistor. Too much resistance causes a high reading. The a.c. scales will correspond to the d.c. scales with the correct value of resistance.

The a.c. zero control is a potentiometer in the plate circuit of a second 9006. This tube is used only to cancel the initial velocity reading of the other 9006. Without it there would be an a.c. reading even before the application of input voltage. It may be necessary to transpose these diodes to get proper zero control.

Voltage range adjustment

Adjustment of the voltage ranges should be made in order according to Table 1.

TABLE I

Step	Range	Adjustment
1	0.4 v d.c.	basic circuit design, especially the cathode feedback resistors and the plate voltage
2	2 v d.c.	2,000-ohm potentiometer
3	20 v d.c.	15,000-ohm potentiometer
4	2 v and 20v a.c.	20-megohm resistor (actual value is correct when it makes a.c. scales read correctly with previous d.c. calibrations)
5	200 v a.c.	2.2-megohm grid leak (actual value is correct when this range reads correctly)
6	200 v d.c.	20-megohm resistor in neg. probe (choose value which makes this range read correctly)

It is usually convenient to measure low-frequency voltages at a panel jack. In this case, the probe is plugged into a connector at the rear of the panel. A fixed condenser connects this rear-panel plug with the a.c. jack at the left of the front panel. This plug is in the upper right-hand corner behind the panel. A short screw through the side of the cabinet fits into the probe to hold it in the cabinet.

For intermediate- and high-frequency measurements the probe is taken out of the cabinet and applied right at the point of measurement. An isolating condenser is soldered to a banana plug which can be plugged into the probe. The free end of the condenser is the lead actually applied to the r.f. circuit. For frequencies of 100 mc or higher, use a 100-μμf ceramic or silver mica condenser. A .01-μf condenser is suitable for lower frequencies.

D.c. milliamperes

The values indicated for the current shunts shown apply only to the particular meter used here—200 μa full scale, and 500 ohms internal resistance. (Other meters may require different values.) The shunts are individually wire-wound on a form which is later mounted above the chassis near the 6SL7. Taps from the shunts lead to the range switch. For high accuracy the shunts should be measured on a reliable bridge.

To eliminate the possibility of damage to the meter, the milliampere jacks are of the phone type (banana plugs are used for the voltage jacks).

This instrument will be found as easy to build as it is to use. The meter is a 200-μa instrument with four main scale divisions and 40 subdivisions. Therefore the ranges 2, 20, 200 volts or milliamperes are direct-reading except for the decimal point, which is supplied mentally almost at once. The very low range is also practically direct-reading. Each small division represents .01 and each main division is 0.1 volt or ma. A mental multiplication by 2 is required on any scale when the range-doubling switch S1 is thrown.

The meter deflection is very sluggish on the lower-range voltage measurements. This is due to the open grid, high capacitance across the grid, and the large isolating resistor. The slow downward travel can be used to advantage. After the two prods are removed from the circuit, there is still plenty of time to note the reading. The grid is discharged more rapidly to zero when the prods are shorted or connected across a resistor.

Other adjustments

The only adjustments which may occasionally have to be made are to the grid current control and the two d.c. range potentiometers. These three are mounted on an aluminum strip at the right side of the instrument and their screw-driver adjustments can be reached through holes in the cabinet.

The high resistance of this voltmeter can be shown by a simple experiment. Switch it to the 2-volt range and connect it across a dry cell. Use the a.c. lead (without isolating resistor) instead of the negative d.c. lead and note the reading. Now take the measurement with the regular d.c. negative lead. This value will be only about .01 volt lower than the previous one. The addition of 20 megohms in series with the voltmeter resistance has produced an added drop of little more than .01 volt. A simple Ohm's law calculation shows an input resistance of approximately 2,500 megohms.

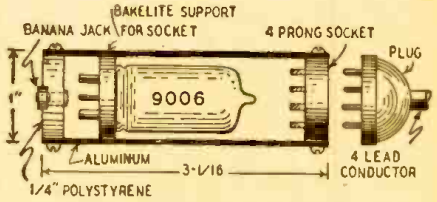
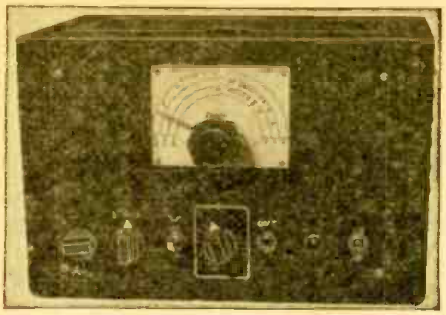


Fig. 3—Mounting details of the r.f. probe.



Front panel shows the home-made tuning dial.

Audio Generator

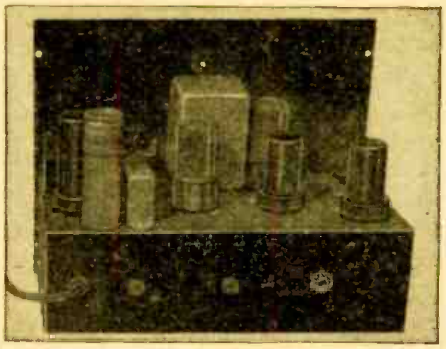
A sine- and square-wave source

By JAMES C. McGUIRE

VARIABLE-FREQUENCY a.f. oscillators and square-wave generators have innumerable applications which make them useful to the serviceman or experimenter. This combination sine- and square-wave generator is simple and can be duplicated with little effort. Its parts are not critical and most of them can be taken from the spare-parts box.

The sine-wave output from this device (20 to 20,000 cycles in three ranges) is useful in running a.f. response curves, checking speaker resonance points, and a.f. signal tracing. The high harmonic content of square waves makes them useful for visual checking of frequency response and for r.f. signal tracing.

The output of V2 is fed back to the grid of V1 through C3, C1, and P1, producing an oscillatory circuit which without P2 would be a free-running multivibrator. If S1 is closed and P2 inserted, the strength of oscillation and the output wave shape can be controlled by adjusting P2. Decreasing its resistance reduces the feedback to the No. 1 grid of V1 and increases the degenerative feedback current through the lamp in the cathode circuit, automatically controlling the output of the oscillator. The output approaches a perfect sine wave when P2 is adjusted correctly. When the resistance of P2 is too low, oscillations are erratic or stop altogether. Once the correct adjustment is found, it need not be changed unless the lamp burns out. To produce a square wave, open S1 and adjust P3 till the output approximates the desired wave shape. The square wave will not be perfect, but P3 can be adjusted to produce a wave form which is usable for checking amplifiers or speakers. The unit delivers about 1 watt and can be matched to a speaker through an 8,000- or 10,000-ohm output transformer.



P1 is mounted in the metal box at the center.

Calibration is easy

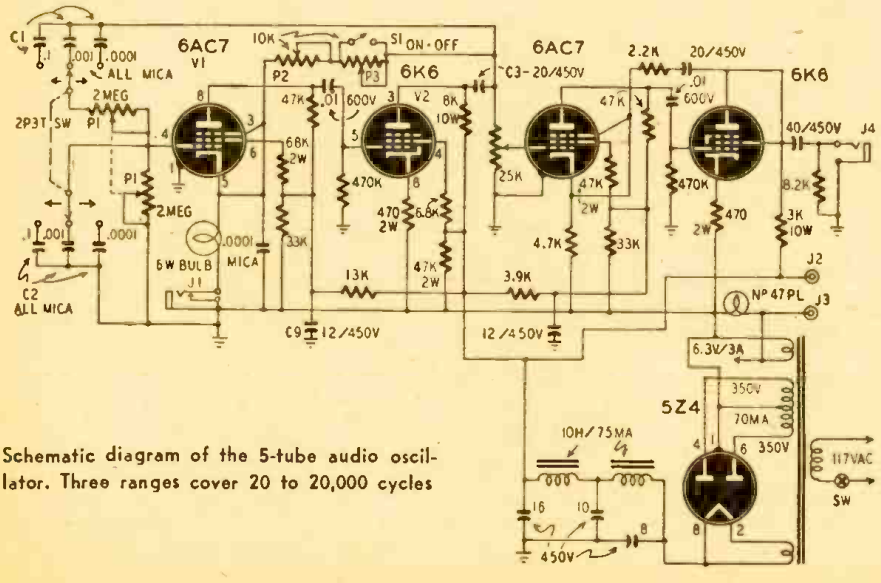
An oscilloscope and calibrated oscillator are needed for calibration. Connect your uncalibrated oscillator to the vertical input of the 'scope and the calibrated oscillator to the horizontal input posts. Lissajou's figures can be used to determine the ratio between known and unknown frequencies. It is simpler and easier to adjust the oscillators to zero beat for each calibration point. This condition is indicated by a stationary circle, ellipse, or diagonal line, depending on the phase and amplitude of the known and unknown signals.

Connect the output of the new oscillator to one input of the oscilloscope, and the output of the standard generator to the other. Set the standard to the desired frequency, then rotate the dial of the new unit until the oscilloscope shows one of the given patterns. Usually the circle or ellipse will be seen, the diagonal line less often. When the pattern is stationary, mark the dial.

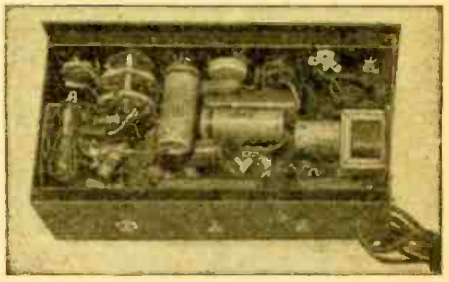
Calibration on the author's unit was not correct for square waves; but the difference was equal for all bands, so square-wave calibration was marked with red dots on each band.

Construction

The complete unit was built on a 9½ x 5 x 3-inch chassis and placed in a small metal cabinet. The tuning dial is home-made and hand-calibrated. The pointer is made by drilling a small hole in a fluted knob and cementing a piece of steel wire in it. The dial scales were drawn on a piece of white cardboard and protected with a sheet of 1/16-inch Plexiglas. Each band was calibrated from 2 to 20 and the multipliers inked in below.



Schematic diagram of the 5-tube audio oscillator. Three ranges cover 20 to 20,000 cycles



The stabilizing lamp is under chassis at left.

Two insulated pin jacks, J2 and J3, on the back of the chassis, provide plate voltages for other purposes. The closed-circuit jack J1 is also on the rear of the chassis. It is used for keying the oscillator when necessary. Keep all grid leads out of a.c. fields. Shield the leads if they are long. Mount the control potentiometers P1 (IRC Type No. 33-3939) in a metal shield box to prevent unwanted feedback and hum pickup.

A 4-Tube Reflex Superhet

Continuous coverage from 200 meters to 13 meters with this novel reflex circuit.

By T. W. DRESSER

SINCE the inception of short-wave broadcasting the t.r.f. receiver has been deservedly popular. There can be few enthusiasts who have not built one at some time. One reason for this popularity is that the t.r.f. has a low noise level.

It has the additional advantage that it can be built easily and cheaply. This is so important that many builders tend to overlook the potentialities of a cheap superheterodyne with modern tubes and a modern circuit. The superhet, while possessing a signal-to-noise ratio equal to that of the t.r.f. receiver, is far superior from the point of view of selectivity; and with the short-wave bands as crowded as they are today, this virtue is essential.

The writer decided to design a superhet with all the good qualities of the t.r.f. as far as cheapness, ease of construction, and low noise level were concerned.

It sounds fairly easy; just take a standard broadcast superheterodyne and adapt it for short wave. But it's not quite as simple as that. The majority of broadcast superhets, regardless of the number of bands they cover, follow a similar pattern: they begin with a triode-hexode converter, followed by one stage of i.f., a double-diode triode for demodulation, a.v.c., and audio amplification, and finish with a high-gain pentode. Occasionally the converter is preceded by an r.f. stage. The more expensive sets, of course, include an extra i.f. stage and a better audio output section.

There are serious objections to this standard setup for short-wave listening. The sensitivity of such a receiver on high frequencies is apt to be poor compared with that on the broadcast band, and in an effort to remedy this failing regeneration is employed in either the r.f. or i.f. stage, or a pre-amplifier with one or two r.f. tubes is added.

If regeneration is used ahead of the converter, the additional tubes are largely unnecessary; if a regenerative i.f. stage is used, the selectivity curve is sharpened to such a degree at resonance that severe "top cut" is inevitable.

The desired receiver is now beginning to take shape. The points made so far are the desirability of a high-signal-to-noise ratio without the necessity for an additional r.f. stage, the need for a reasonably flat a.v.c. curve to give better control of weak signals, and a good-quality output stage.

Fig. 1 is the diagram of such a receiver. A reflex circuit is employed, reducing the cost considerably and at the same time giving a.v.c. on the first audio as well as on the r.f. stages.

A 6K8 was selected as the converter. This tube has proved quiet and efficient in operation as well as practically non-microphonic, a big advantage. This is followed by a 6B8 for i.f. amplification, demodulation, a.v.c., and first audio amplifier. The output stage is a 6F6. There is nothing complicated either in the circuit or in the construction. On test, this receiver proved to be outstanding. Selectivity was adequate and the quality on broadcast above average for a short-wave job.

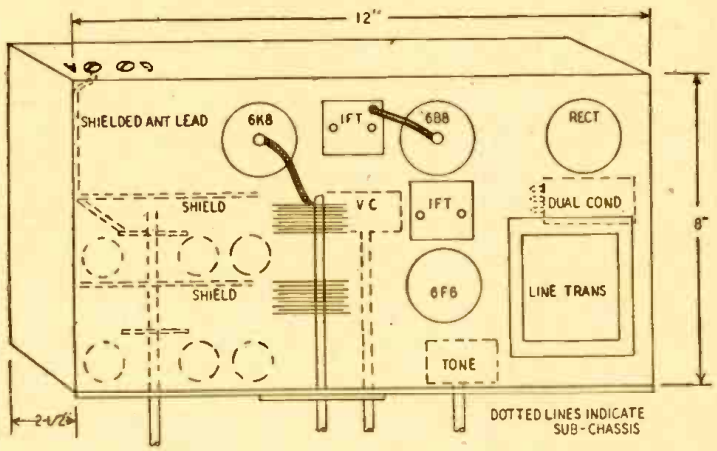


Fig. 2—Note the placement of parts. The oscillator and antenna coils are shielded.

Construction should be quite simple. Fig. 2 shows a suggested layout, and the table gives all the necessary coil-winding information.

Some figures may be of interest. Average sensitivity is 8 μv on all bands, selectivity 45 db down 10 kc off tune, and harmonic distortion at full output is 6.2%.

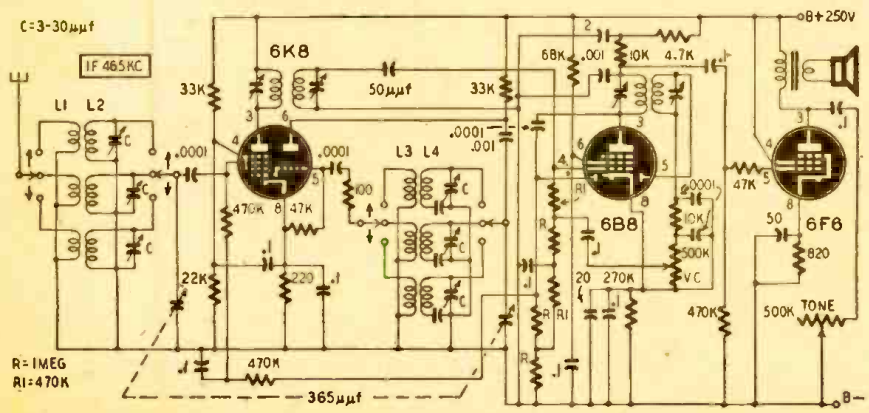


Fig. 1—The pentode section of the 6B8 amplifies intermediate and audio signals.

COIL DATA

Band (Mc)	Coil	Turns	Length	Wire size	Osc. padder (μf)
1.5 to 4.5	L1	9	c.w	24	.001
	L2	34	1½"	18	
	L3	10	c.w.	24	
	L4	31	1½"	18	
	L1	5	c.w.	24	.003
	L2	14	1½"	18	
3.8 to 11	L3	3½	c.w.	24	
	L4	12	1½"	18	
	L1	4	c.w	24	.01
	L2	6	1½"	18	
8.5 to 23	L3	2½	c.w.	24	
	L4	6	1⅜"	18	

All coils wound with enamel wire on 1½-inch forms. L1 and L3 are ⅛ inch from ground end of L2 and L4. Close-spaced windings indicated by c.w.

Circuits Needed Most

You asked for these circuits. Perhaps you will find the one you wanted among them.

WE received many favorable comments on the article *Most-Needed Circuits*, in the April 1948 issue. Most readers expressed desires to see more control circuits but none gave any suggestions as to the type of control circuits they would like to see. The problem of selecting circuits for this article was again left up to your editors who hope their selection of material will prove both interesting and useful.

Converting the BC-929 scope

The BC-929 is one of the smaller radar indicator scopes available on the surplus market. It has a 400-cycle power supply and 8 tubes including a 3BP1 cathode-ray tube. It can be converted to a neat little oscilloscope for experimental work or radio and sound equipment servicing. The conversion diagram is shown in Fig. 1.

Remove the original power transformer and replace it with a 60-cycle transformer or transformers delivering the proper operating voltages. Suitable 60-cycle components are available on commercial and surplus markets. The original transformer has all windings on one core. It may be necessary to use two or more small units to replace it. Before purchasing replacement transformers, be sure that they have adequate insulation between windings and core and that you have space on the chassis for them. Mount the intensity, focus and centering controls on an insulated sub-panel and use insulated couplings between their shafts and control knobs. Shield the amplifiers from the magnetic field surrounding the transformer and chokes.

The vertical and horizontal amplifiers in this circuit have sufficient gain and bandwidth for most purposes. If wideband amplifiers are desirable, they can be built on a separate chassis and connected to the deflection plates through the terminal board. An amplifier passing up to 2 mc is shown on page 44 of the December 1946 RADIO-CRAFT.

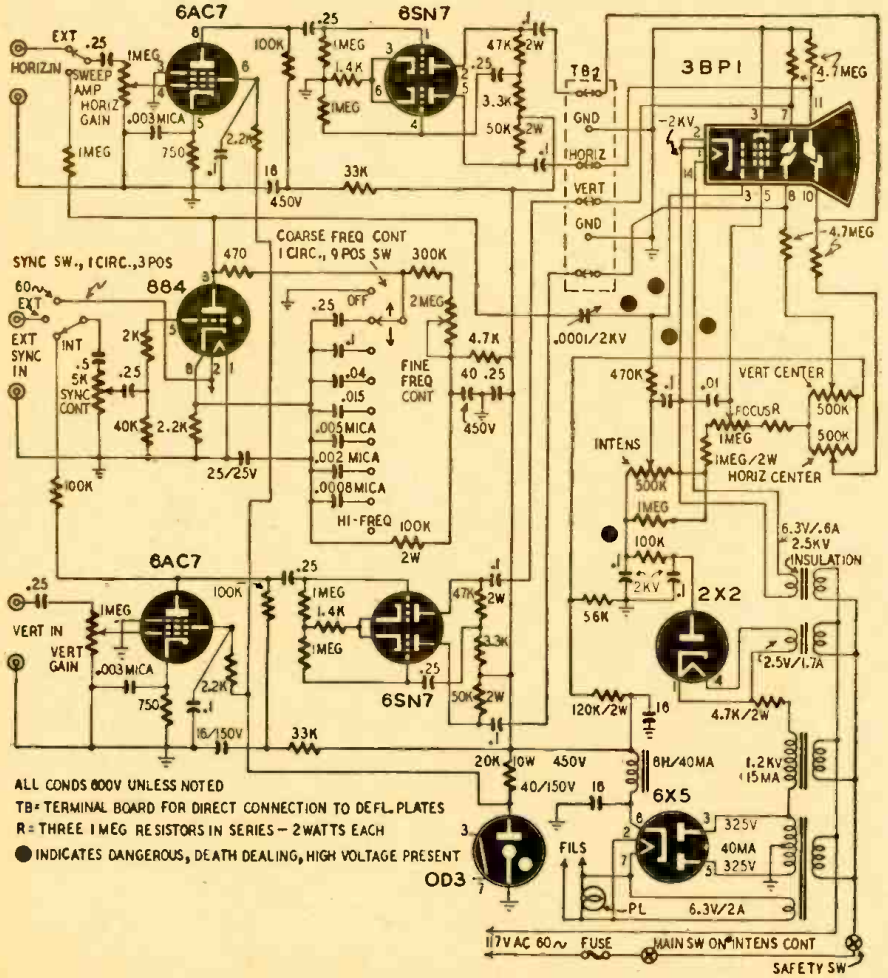


Fig. 1—Ground the junction of the grid and cathode resistors in the lower 6SN7 amplifier.

The vertical and horizontal amplifiers in this circuit have sufficient gain and bandwidth for most purposes. If wideband amplifiers are desirable, they can be built on a separate chassis and connected to the deflection plates through the terminal board. An amplifier passing up to 2 mc is shown on page 44 of the December 1946 RADIO-CRAFT.

Amplifier for talkies

Many home-movie enthusiasts have trouble finding a suitable phototube amplifier after converting their silent movie projectors to handle sound film. Fig. 2 shows a typical phototube amplifier using a gas-filled tube. The CE-3 is shown but other tubes like the 868 and 918 can be used. The amplifier circuit can be changed to use some of the new miniature tubes.

The value of the phototube load resistor R depends on the desired signal level and permissible distortion. Signal voltage and distortion increase with increasing load resistance.

A variable voltage supply

A power supply that will deliver any voltage between 50 and 400 and that will supply up to 200 ma at any voltage setting is a very valuable piece of service equipment.

This unit—described by RCA in *Ham Tips*—is a conventional full-wave rectifier except that it uses a pair of thyratrons instead of the usual high-vacuum diodes. The thyratron is a gas-filled tube with one or more grids. The ones used here are 2050's.

As the diagram, Fig. 3, shows, grid voltage is furnished to the 2050's by T2 through T3. C1 and P1 constitute a phase-shifting network for the grid voltage. P1 varies phase relationships between grid and plate voltages, thus controlling the percentage of the cycle during which the tubes will conduct, and therefore the output voltage of the supply.

A capacitor input filter is used, with a resistor (R3) limiting current through the input capacitor. High-voltage is available at screw terminals.

P1 is so arranged that adjusting it for maximum resistance will give minimum output. It may be necessary to interchange either the primary leads of T2 or the tube grid leads.

S1 is used to turn on all filaments, and S2 is included for separate control of

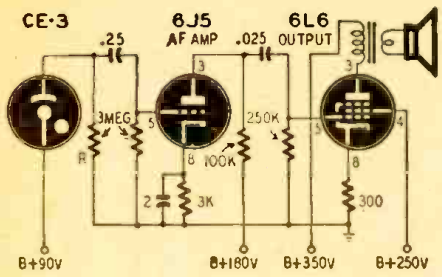


Fig. 2—Amplifier for sound-on-film movies.

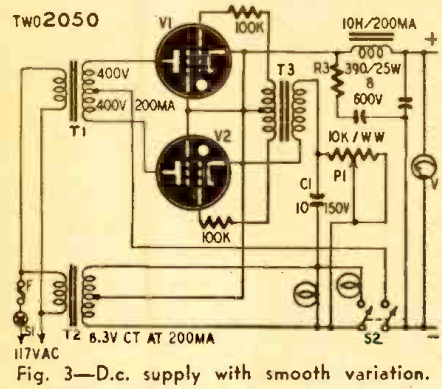


Fig. 3—D.c. supply with smooth variation.

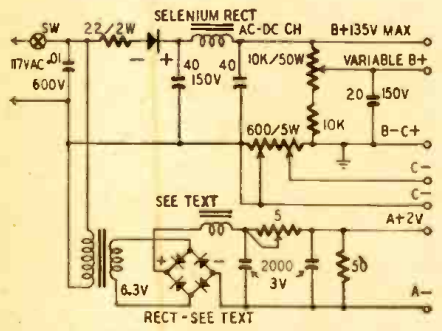


Fig. 4—Battery eliminator for portables.

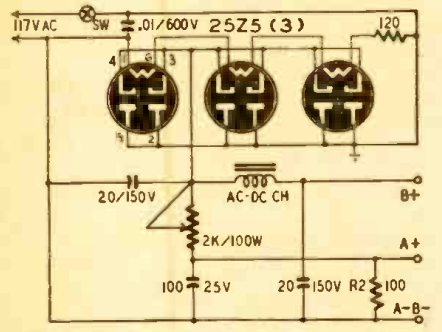


Fig. 5—This eliminator uses vacuum tubes.

the high voltage. Always operate S1 first, then wait about ½ minute before turning on S2.

It is somewhat difficult to design a compact universal A-battery eliminator for battery portables and farm radios because of the wide variety of filament voltages and currents encountered. There is seldom any problem in supplying B- and C-eliminators.

The supply shown in Fig. 4 is designed to deliver A, B and C voltages to 2-volt farm radios. Plate and bias voltages are obtained from a conventional high-voltage supply using a selenium rectifier. About 12 volts can be developed across the 600-ohm resistor in the negative return lead. Use as many sliders as necessary and adjust each for correct operating bias. If fixed bias is not required from the pack, the bias resistor can be omitted or shorted out.

The A-supply delivers 2 volts at up to 1.5 amperes—more than enough for most 2-volt sets. A dry rectifier such as the Mallory 1B8R or equivalent should be used. It is supplied from a 6.3-volt filament transformer rated at 1.5 amperes or more. Adjust the 5-ohm resistor in the A-plus lead so the supply delivers 2 volts with the filaments lighted. A suitable A-choke is made by winding as many turns of No. 22 enamel wire as possible on the core of a discarded a.c.-d.c. choke.

The supply shown in Fig. 5 can be used with sets having 1.5- or 6-volt filament supplies. Three 25Z5's or 25Z6's are used with plates in parallel as are the cathodes. A- and B-voltages are taken from the cathodes. The B-supply is conventional. A-voltage is dropped to the correct value by the 1,000-ohm resistor. This eliminator is useful only with sets having common A and B negative leads. If the set has a biasing resistor in the negative lead, use the circuit in Fig. 4.

The filaments of battery tubes blow out easily. Adjust filament dropping resistors to full value and connect a d.c. voltmeter across the filament terminals before turning on the power. Then adjust the resistor so voltage is correct.

GERMAN IONOSPHERIC EXPERIMENTS ON 3.6 mc.

By DR. WILHELM OBURGER

DURING the past war, the German Army found it necessary to determine the frequencies which would permit long distance communications with good reception at different hours of the day. Since shortwave communication depends upon the appearance, altitude, and other features of the ionospheric layers, the measurement and recording of these layers became an important phase of research.

One problem of this research was to develop a very small receiver which could amplify the incoming signal enough for use with a registering device. The device consisted of a modified oscillograph and an electrically driven camera.

The superregenerative receiver seemed to be best for this application. It is capable of great signal amplification and can also demodulate the signal—all in one tube. It also has a large band width, is very sensitive to weak signals, and its inherent a.v.c. action eliminates fading.

A receiver with a separate quench oscillator was decided upon since the quench frequency does not vary with signal frequency.

The circuit of the final receiver is shown in Fig. 1. The operating frequency was 3.6 mc, and the quench frequency was 20 to 30 kc. Special powdered-iron-core r.f. and quench oscillator coils were used in the original model, but standard permeability-tuned short-wave and quench-oscillator coils may be substituted. An equivalent tube for the type originally used is the 6SJ7.

The pulses from the 3.6-mc transmitter were in the form of a steep-sided trapezoid, of .0001-second duration, and were transmitted at the rate of 50 per second. The ground wave directly from the transmitter, together with the reflection from the ionosphere (Fig. 2), was picked up by the receiver, fed into the registering device, and recorded on film.

A section of film record made with this receiver is shown in Fig. 3. G is the trace of the ground wave from the transmitter. F is the reflection from the first layer, and 2F is the reflection from the second. The record, started at 8:00 am, shows that reflections have begun to disappear at about 9:30. Long-distance communication at 3.6 mc, therefore, was possible only till this time on the day of recording. The marker points on the film show heights of approximately 125 miles.

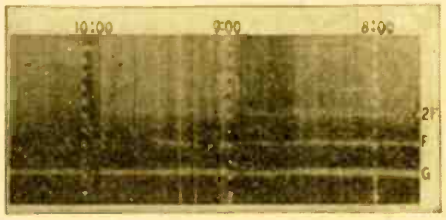


Fig. 3—Reflections vary with time of day.

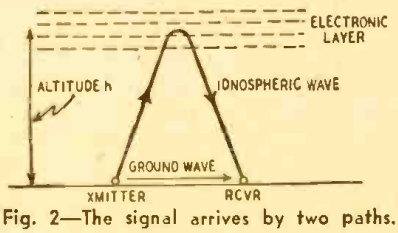


Fig. 2—The signal arrives by two paths.

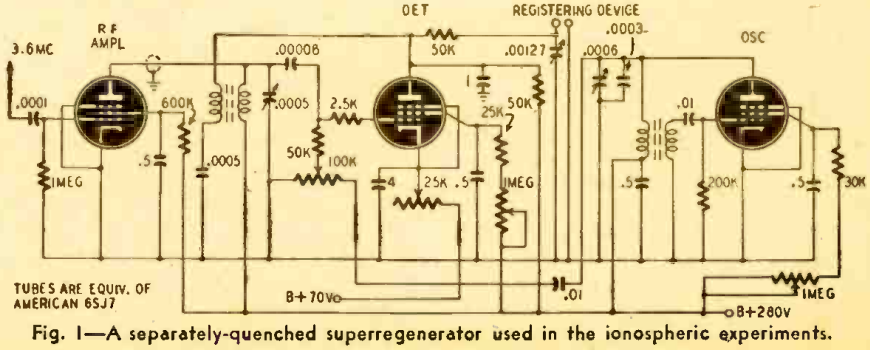


Fig. 1—A separately-quenched superregenerator used in the ionospheric experiments.

Phase Inversion Circuits

Part II — The R-C coupled phase inverter

By JOHN W. STRAEDE*

ONE of the earliest types of resistance - capacitance - coupled phase inverters is the *paraphase*. The signal from an amplifier tube is taken from a tap on either its plate resistor or the grid resistor of the output tube it feeds (usually the latter), and applied to a phase-inverter tube. This tube reverses the polarity of the signal.

Because the phase-inverter tube also amplifies, only a portion of the first tube's signal is applied to it, and its output goes to the grid of the other output tube. The modern version of the paraphase circuit is shown in Fig. 1.

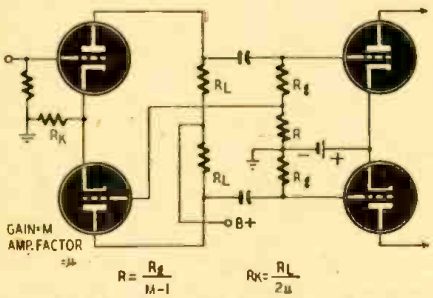


Fig. 1—A modern paraphase phase inverter.

The voltage-divider constants Rg and R are critical, and resistors with closer than 10% tolerance are required. Aging of the phase-inverter tube reduces its output and results in unbalance.

Automatic near-balance is obtained in the floating paraphase circuit (Fig. 2).

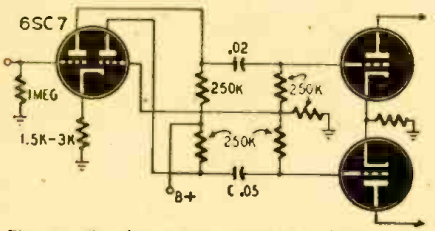


Fig. 2—The driver tube must have high gain.

The signal for the inverter section depends upon the lack of circuit balance. The greater the gain of this tube, the nearer is true balance approached; therefore, a high-gain tube such as a 6SC7 is commonly used.

A still closer approach to true balance can be obtained by making the plate and grid resistors in the inverter section just a trifle larger than those in the voltage amplifier.

Unbalance at low frequencies is due to extra phase shift caused by the lower coupling condenser C. This condenser should be much larger than the top one.

If a large amount of negative feedback is to be used over the phase-inverter stage, the straight paraphase circuit is preferable, since accurate balancing is important.

*Lecturer in electronics and electro-acoustics, Melbourne Technical College, Australia.

In the split-load inverter (Fig. 3), output voltage from a tube is divided by placing half the load impedance between cathode and ground. The voltage at the cathode is then out of phase with the voltage at the plate. Half the load in the cathode circuit also results in half the load being in the grid-to-cathode circuit and gives a negative feedback factor of one-half. Stage gain is therefore very low; in practice it is usually about 0.9 (from grid of phase inverter to grid of one output tube).

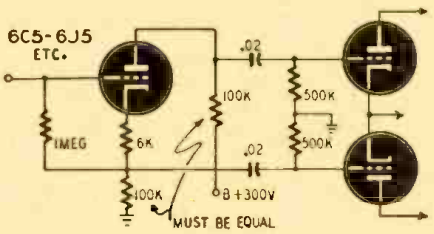


Fig. 3—Stage gain is low with this circuit.

This circuit, popular in Australia, is sometimes known as the *kangaroo* phase inverter.

Accuracy of balance depends solely upon the equality of the load resistors and the following grid resistors. Because of degeneration, the cathode resistor does not require bypassing (unless a low-gain tube is used), and the coupling condenser to the grid of the phase inverter can be smaller than usual.

Cathode-Drive Inverters

If push-pull tubes share a common unbypassed cathode bias resistor, an interesting phenomenon occurs if the signal is removed from one tube. Instead of the output dropping considerably, there is only a slight lessening of volume and the output continues to come from both tubes, though there is a distinct lack of balance. The undriven tube is actually being driven by the other one through the common cathode impedance. One example of this is the Barnes "mystery" circuit of Fig. 4.

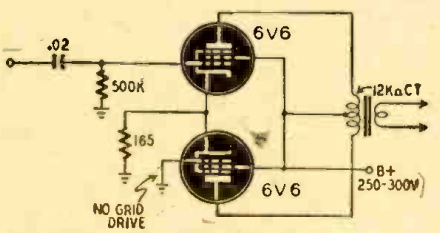


Fig. 4—The upper tube drives the lower one.

The greater this common cathode impedance in comparison to the load impedance, and the greater the stage gain, the more nearly perfect is the balance. If two push-pull voltage amplifier stages are used with no signal on one tube of the first stage, very good balance is obtained at the output of the second stage. This amplifier (Fig. 5) is sometimes known as the "long-tailed" amplifier.

If very good balance is desired, the size of the common cathode resistor is increased and tapped to give the correct grid bias, as in Fig. 6.

Accuracy of balance depends on the similarity of the tubes and the equality of the plate load resistors.

Fig. 7 shows a 2-stage direct-coupled amplifier with cathode-drive phase inversion. It responds to d.c. voltages as well as to a.c. Balance is not as good as in resistance-coupled amplifiers, but the unbalance is limited to a difference in amplitude. There is no unbalance due to phase shift at different frequencies.

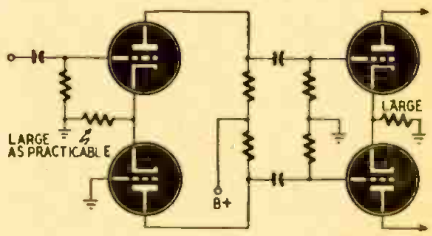


Fig. 5—The long-tailed push-pull amplifier.

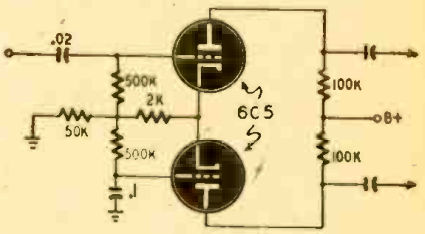


Fig. 6—Similar driver tubes improve balance.

Unusual phase inverters

Besides the more commonly used circuits, there are some unique variations of the split-load and paraphase circuits.

Fig. 8 is a simplified split-load inverter in which the inverter tube is directly coupled to the preceding tube. Gain is higher than might be expected, since part of the *load* for the first tube is actually amplified by the inverter. There is noticeable reduction in the number of

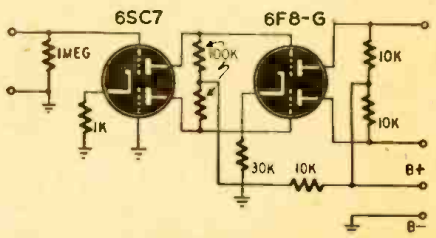


Fig. 7—A two-tube direct-coupled amplifier.

parts, and the output voltages are sufficient to drive 6V6's.

To obtain gain from the actual phase-inverter stage, the preceding tube must be a pentode and the load is amplified by a split-load inverter. The extra gain is due to load amplification and practically disappears if the preceding tube is a triode.

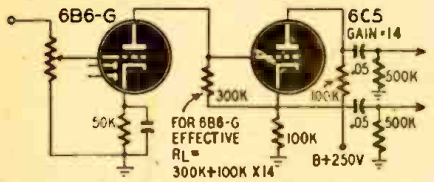


Fig. 8—Split-load direct-coupled inverter.

A version of this circuit is shown in Fig. 9. Over-all gain from the 6J7 input to one output tube grid is about 700, and each output is about 40 volts peak.

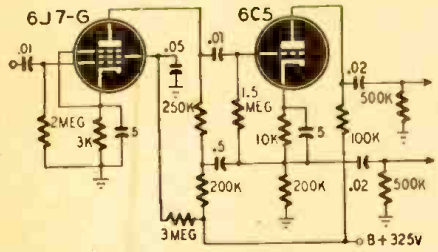


Fig. 9—This inverter provides high gain.

To economize in the use of tubes, attempts have been made to use one of the output tubes as a paraphase-type phase inverter. Part of the output voltage is applied to the grid of the other output tube. The output load impedance varies with frequency, so perfect balance is obtained over only a narrow band.

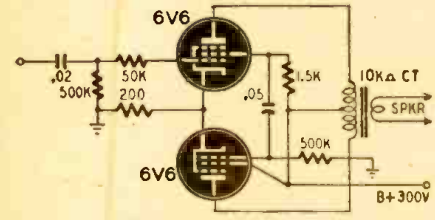


Fig. 10—One 6V6 is a paraphase inverter.

When pentode or beam tubes are used, the signal is usually obtained from the screen grid across a 1,000- or 2,000-ohm load resistor. The results are disappointing—in practice the circuit does not seem to function better than a pair of tubes in parallel or the Barnes mystery circuit of Fig. 4. One of the better circuits is shown in Fig. 10.

Note that the control grid of one 6V6 is coupled to the screen grid of the other through a .05-μf condenser. When a signal is applied to the upper tube, its screen current varies and develops a voltage across the 1,500-ohm resistor. This voltage has the correct magnitude and polarity to excite the lower tube.

References

RADIO-CRAFT, April 1946 (Amplifiers with Paraphase and with Split-load Inversion).
RADIO-CRAFT, November, 1944 (Amplifier with Paraphase Inverter).
RADIOTRON TUBE MANUAL RC 15 (Pages 222 and 223).
RADIOTRON DESIGNER'S HANDBOOK.

MAGNETIC RECORDERS

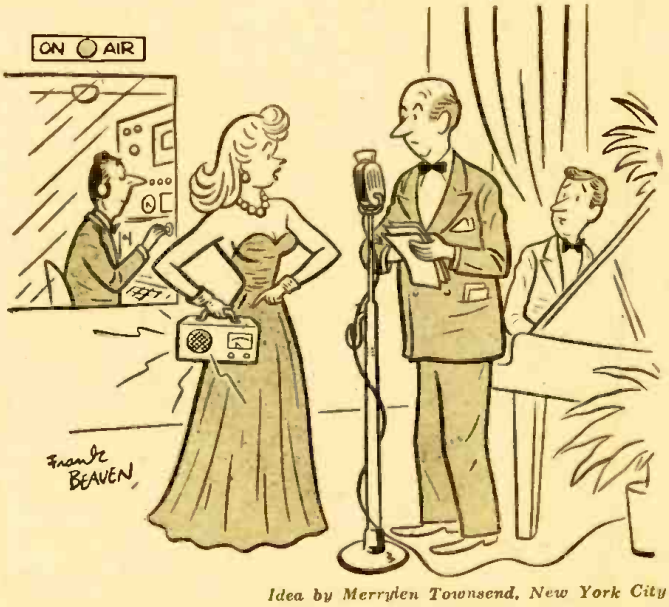
The impetus given during the war to magnetic recording has resulted in a number of consumer models using both tape and wire. The table below lists the important data on most currently available models. It was originally published in the *Saturday Review of Literature* as part of an article by James E. Jump.

All statements in the table are factual, except for the fidelity ratings, which are the author's personal opinions.

COMPARATIVE TABULATION OF AVAILABLE MAGNETIC RECORDERS

Manufacturer	List Price*	Cost Per Hour**	Fidelity	Appearance	Recording Time	Portability	Indexing Feature	Rewind Time	Modulation Indicator
WIRE:									
Brush									
Model BK-303	$795.00	$8.25	excellent	suitcase	30, 60, 120 180 min.	yes 50 lbs.	yes	2, 4, 8, 12 min.	eye
National Polytronics	$79.50	$4.50	fair	table model	10 min.	yes 20 lbs.	no	5 min.	ear
Pierce	$424.00 (3)	$9.00	good	professional	66 min.	yes 40 lbs.	yes	15 min.	eye
Powell	$225.00 (3)	$7.50	good	suitcase	60 min.	yes 26 lbs.	yes	7½ min.	lamp
Webster	$149.50	$5.00	fair	suitcase	15, 30, 60 min.	yes 28 lbs.	no	2, 4, 8 min.	lamp
Air King									
Model A-750	$129.50	$4.95	fair	suitcase	to 60 min.	yes 33 lbs.	no	10 min.	lamp
Model 4700	$239.50	$4.95	fair	walnut-finish console	to 60 min.	no	no	10 min.	lamp
Precision-Audio Products (Wire Master)	$295.50 (7)	$5.00	excellent	suitcase	15, 30, 60 min.	yes 45 lbs.	no (8)	2, 4, 9 min.	2 lamps
TAPE:									
Amplifier Corp. of America									
Model 800-A	$239 net	$5.00	good	table model (4)	30 min.	yes (4) 40 lbs.	optional (4)	½ min.	eye
Model 800-B	$263 net	$5.00	good	table model (4)	30 min.	yes (4) 40 lbs.	optional (4)	½ min.	eye
Model 800-E	$312 net	$2.50	fair	table model (4)	60 min.	yes (4) 40 lbs.	optional (4)	½ min.	eye
Model 800-F	$322 net	$10.00	excellent	table model (4)	15 min.	yes (4) 40 lbs.	optional (4)	½ min.	eye
Model 800-G	$401 net (5)	$10.00 (5)	excellent	table model (4)	15, 30, 60 min. (6)	yes (4) 40 lbs.	optional (4)	½ min.	eye
Brush									
Model BK-401	$229.50	$5.00	excellent	table model	30 min.	yes 40 lbs. (1)	yes	1 min.	eye
Model BK-403	$375.00	$2.50	excellent	suitcase	30, or 60 min. (2)	yes 50 lbs.	yes	¾ min.	eye

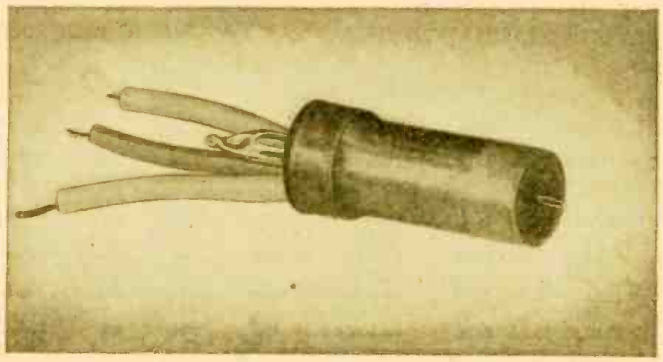
*Includes microphone, amplifier, speaker and recording mechanism unless otherwise noted.
**Cost per hour of wire or tape at nominal speed, whether 60-minute reels available or not.
(1) Carrying case with handle supplied for $16.50 extra.
(2) At 4½ inches per second. At 7½ inches per second for maximum fidelity the running time is proportionately less.
(3) Recorder and playback mechanism only—no microphone, speaker or playback amplifier provided. Faster rewind device available at $40 extra.
(4) Similar portable models available for $42.00 extra. Other optional features include indexing device at $11.90 extra and automatic program timer at $28.80.
(5) Includes 3 capstans ($25.00 each) but may be purchased with only 1 or 2 capstans. Tape cost $2.50, $5.00, $10.00, depending upon fidelity desired.
(6) Based on 3 capstans.
(7) Microphone not included — suitable ones recommended on request. (Price range from $24.00 to $62.00.)
(8) Automatic timer may be used.



Idea by Merryden Townsend, New York City

"I bought it so I could listen to myself when I sing over the air."

Vacuum Tube Is Phono Pickup



This photo of the mechanoelectronic pickup tube is larger than life.

THE Radio Corporation of America has developed an electronic phono pickup and a microphone which operate on a principle entirely different from conventional types. Its operation, as described recently to the Audio Engineering Society by its designer, Dr. Harry F. Olson, is based upon the use of a mechanoelectronic transducer. In this new system, voltage is developed by the motion of one or more elements *inside* an electron tube. Advantages are: (1) the transducer can be made very small to have a low mechanical impedance; (2) electrical power output is not obtained from the actuating source.

The fundamental problem involved in design of such transducers is transfer of controlled vibrations to the tube elements through a vacuum-tight shell. The specific problem was to design a vacuum-tight link that would operate with forces of less than one-millionth of a pound and yet withstand a static air pressure of 15 pounds per square inch.

One type of transducer tube, shown in Fig. 1 and the photo above, is a metal triode about 1 inch long and ¼ inch in diameter. Leads from the elements are brought out through a glass seal at one end. The flexible metal diaphragm at the other end permits transfer of external motion to the movable anode.

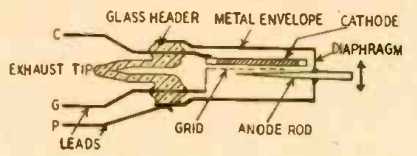


Fig. 1—The transducer tube's plate moves.

Fig. 2 is a cross section of an electronic phonograph pickup. The needle is attached to the transducer tube's actuating rod.

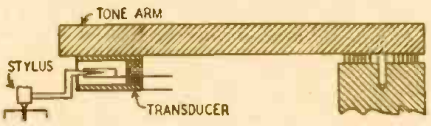


Fig. 2—How the tube is used in a pickup.

The electronic microphone (Fig. 3) has its diaphragm attached to the flexible metal diaphragm on the transducer tube. A microphone of this type has the high sensitivity of a carbon microphone, but without its accompanying high distortion, carbon packing, and variation in response with orientation.

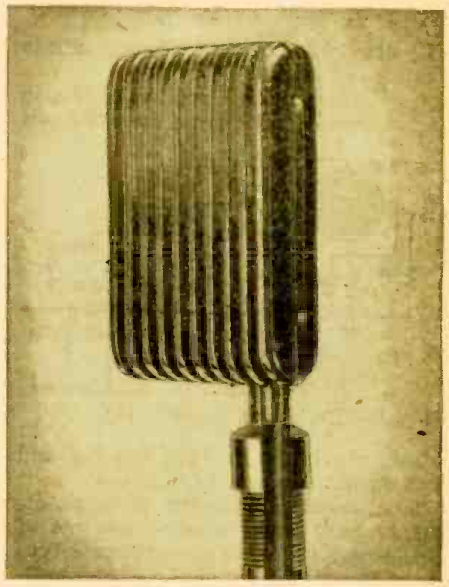
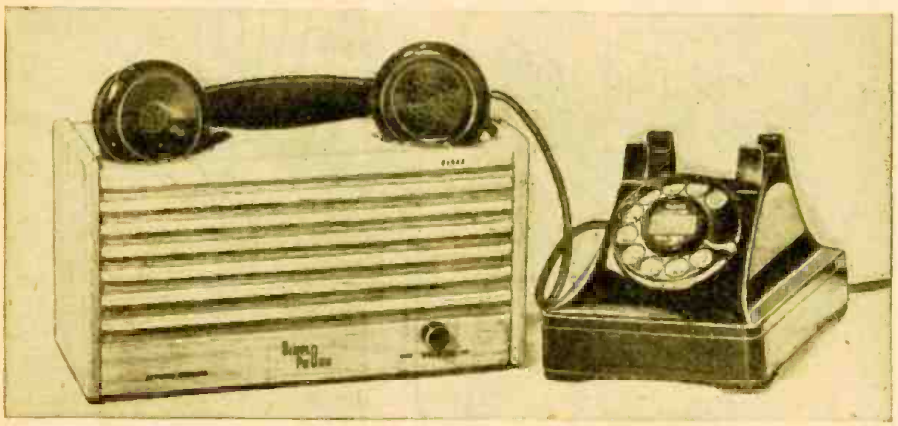


Fig. 3—A tube transducer type microphone.

The model in the photograph is a general-purpose microphone, suitable for public address and paging systems and outside broadcast pickups. The diaphragm is a molded paper cone 2 inches in diameter.

Amplifier Makes Telephone "Speak Up"

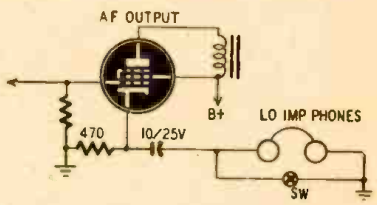


Courtesy Intercontinental Inventions Management Corp.

This amplifier allows the user to telephone without having to hold the instrument, leaving hands free for writing or typing. The telephone handset is placed atop the cabinet, as the photo shows, with the microphone and receiver resting in small depressions. Amplification is sufficient to allow the listener to hear perfectly at distances of a few feet and to permit several other people to listen to the call or take part in the conversation.

Low-impedance Phones

I recently bought a pair of surplus headphones and found they were low impedance instead of high. By using the hookup shown in the diagram I was able to avoid buying a transformer to convert the phones to high impedance:



The switch across the phones cuts them out and restores normal operating conditions to the tube when the phones are not used.

R. P. Balin,
Miami, Fla.

(The same result might have been obtained by connecting the phones across the speaker voice coil. Most of the surplus 300-ohm phones are recognizable by the red plug at the end of the cable. —*Editor*)

Crystal FM Deviation Circuits

BECAUSE of the difficulty of modulating crystals, wide-band FM transmitters generally rely on self-excited master oscillators, but, to maintain a constant center frequency, elaborate stabilizing networks must be added (see RADIO-CRAFT, May-June, 1946).

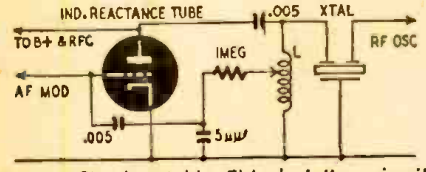


Fig. 1—Simple, stable FM deviation circuit.

However, many laboratories are currently working on this problem, and several new types of crystal oscillators have been developed recently that can be modulated over a relatively wide band without loss of control and with good linearity. The frequency is varied by changing the total reactance in the crystal circuit.

The simplest frequency change is made by adding a small capacitance across the crystal, but the effect is limited since shunt capacitance already exists due to the holder or plated surfaces

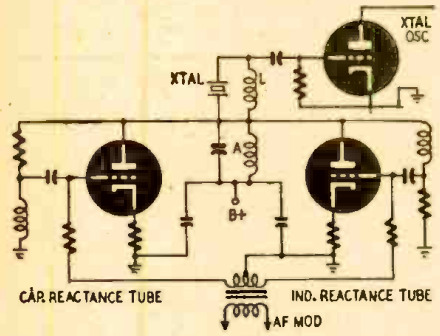


Fig. 2—Improved circuit for more deviation.

of the crystal. Adding a coil is a better method because it balances out the holder capacitance. Then the circuit operates with low reactance, and deviation is more easily produced. In addition, inductance produces better linearity over a wider frequency range.

A circuit invented by Warren P. Mason (Bell Telephone Labs, U.S. patent 2,424,246) is shown in Fig. 1. The modulator and oscillator stages are coupled only through the crystal which is mounted in a split holder. This reduces shunt capacitance and reduces amplitude modulation of the oscillator by the modulator. As a matter of fact, the oscillations continue even when the modulator end of the crystal is short-circuited.

A low-impedance triode is used as an inductive reactance tube across coil L. The combination of tube, coil and crystal is designed for low inductive reactance over the oscillator band. The tube reactance varies with the a.f. voltage impressed upon its grid and with the change in oscillator frequency. A total frequency change of 0.7% can be attained. For best stability and linearity, it should be limited to about .07%, however.

The more complicated circuit illustrated in Fig. 2 was invented by Paul D. Gerber (RCA, U.S. patent 2,438,392). In the unmodulated condition the two reactance tubes are biased to cut-off. When a.f. modulation is applied to their grids in push-pull, the tubes conduct alternately. During half of each a.f. cycle, one tube introduces inductance. During the other half, the other tube introduces capacitance. If the reactance of the parallel circuit A is approximately equal to that of the crystal element, the oscillator frequency will deviate widely as the reactance tubes become effective. The coil L is added across the crystal for greater deviation with low distortion.

The connection of reactance tubes in push-pull provides greater frequency deviation. A total change of about 1.5% can be accomplished with good linearity. Each reactance tube is responsible for half of this change.

ROLLING RADIO STUDIO COVERS OKLAHOMA

The photograph shows WKY's new bus for relaying outside broadcasts to the main studios. It is in reality a broadcasting station on wheels. The inset reveals the equipment. A 200-watt AM transmitter, monitor speakers, studio speech console, transcription tables and recording equipment, and 3 receivers, for AM and FM, are just behind the driver's compartment.

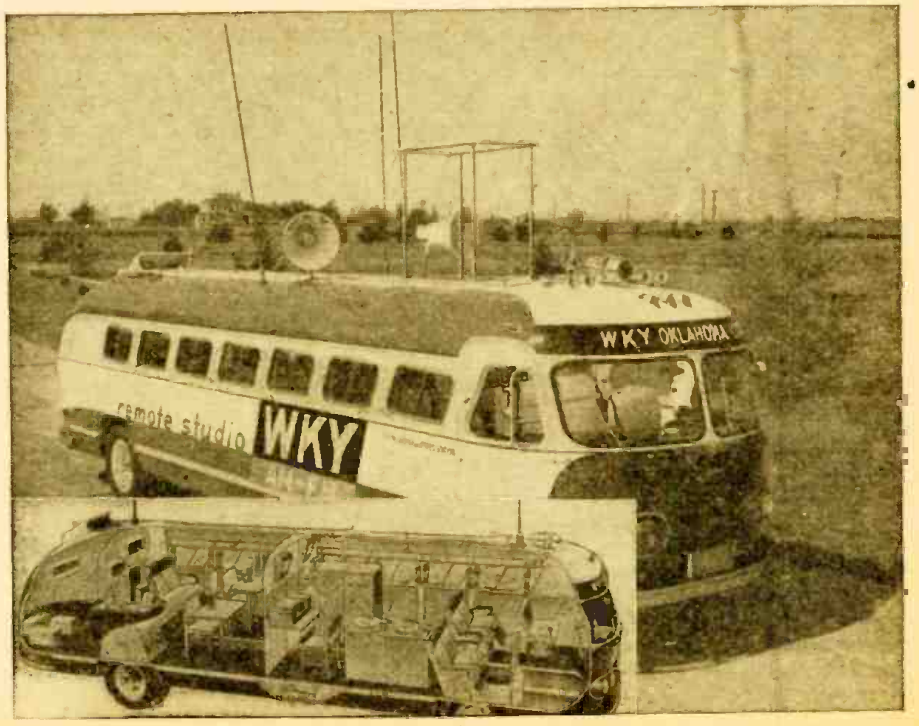
Since runs of 150 miles or more to cover an important event are commonplace, the design of this bus considers comfort of personnel more than many such installations. Seating space is provided for carrying the driver, two or three engineers and any other persons who may be needed for special events.

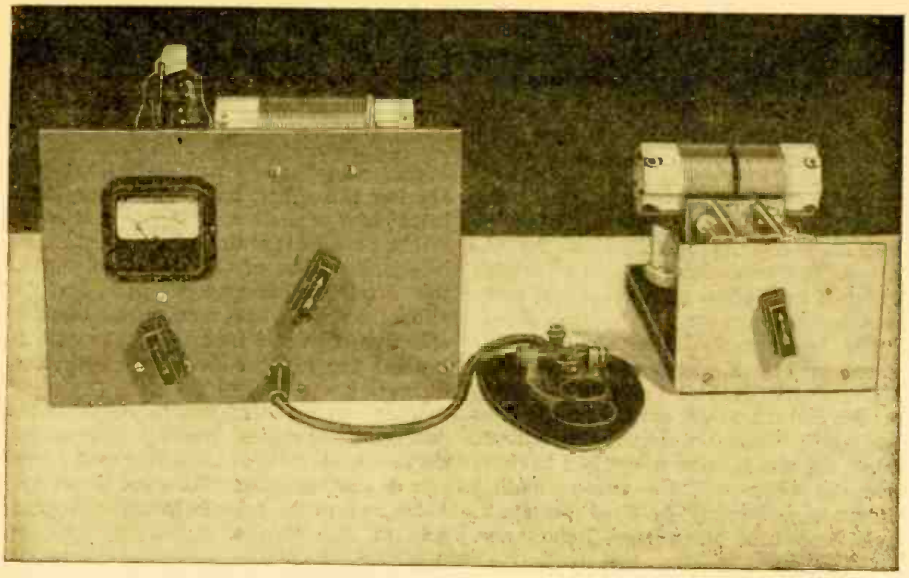
Transmitting facilities include an RCA ACT-150 relay transmitter (1600 to 2800 kc) and a pack transmitter (30 to 40 mc). Space has been reserved for a 150-mc FM relay transmitter.

The studio, behind the control room, is entered through a glass-paneled door. Tables, with microphones on them, are fastened to the floor.

The rear compartment includes a Bell System radio telephone for calling the studio, a PA amplifier (note the speakers on the roof of the bus), an antenna tuning unit, police receiver, and 2-kw 60-cycle Onan gasoline generator. This power unit has proved to be extremely dependable under all extremes of temperature.

Three whip-type receiving antennas are visible in the photo. A 35-foot transmitting antenna and a 25-foot receiving antenna are used for stationary operation. The railed-in announcer's stand enables him to work above large crowds.





Carry this little 35-watter along on your summer vacation. The antenna tuner is an extra feature

Vacationer's 35-Watter

By CLINTON CLARK, WIKLS

LESS than ten dollars is the cost of this transmitter! With the exception of the low-priced milliammeter and a few small parts obtainable for less than a dollar, all the components are surplus items. Thirty-five watts input to the 807 crystal-controlled oscillator was found sufficient for many enjoyable contacts and good R-S-T reports. Even the heavy evening QRM can be conquered with the rig.

Wiring, Fig. 1, is simple and direct. No metal cutting or drilling is necessary, as the chassis is plywood. Most of the parts may be salvaged from one of the surplus BC-375 tuning units. In addition to the parts for the transmitter, the builder will find use for the tuning unit cabinet and the two vernier dials, one of these a right-angle, worm-driven dial of very high ratio.

Before proceeding with construction it will be necessary to dismantle the tuning unit. From it the builder will obtain the two coil and condenser combinations, L1, C1 and L2, C2, a heavy-duty switch for shorting out the milliammeter, two r.f. chokes, three knobs, a flexible coupler, coil mounting strip, and small hardware.

The selection of a tuning unit (they may be obtained in several frequency ranges) is up to the builder. The plug-in coils in the plate and antenna circuits allow operation on several bands with a transmitter built from the parts of any one of the tuning units. Extra coil forms may be purchased and easily wound to cover extra bands. Surplus forms bearing the name Alsimag and the number 7462683 are correctly drilled to match the holes in the coil mounting strip. This is cut from the long strip found in the tuning unit. It has a row of banana jacks, two of which are spaced to fit the coil forms. The terminals of the coils are replaced by standard banana plugs which may be screwed into the holes left by the terminals. A small alcohol torch will supply enough heat to melt the solder with which the terminals are coated.

After preparing one of the coils the point at which they will fit into the terminal strip is found. The strip may then be cut to size, about 4½ inches long. Remove the unneeded jacks. Two of the holes plus a couple of porcelain standoffs (supplied by one of the switches in the tuning unit) will solve the problem of mounting to the panel.

Two pieces of ¼-inch thick plywood 7 x 10 inches, are used for panel and sub-panel. The wooden strips which raise the sub-panel 1¼ inches are ¾-inch stock. To do a neat job, first place all parts in position and drill the necessary mounting holes. Remove the parts, sand the chassis smooth and give it two coats of paint. Battleship gray is suggested. Against this background the black meter case and bar knobs give a pleasing contrast.

All of the top deck parts are shown in the photograph except the crystal socket, which is mounted between the 807 tube and the front panel. A 5-prong socket with grid and cathode terminals shorted will take both ¾- and ½-inch spaced crystal holder pins. The plate connection is common for both sizes. This socket and the tube socket are mounted ½-inch above the sub-panel.

Construction of the antenna tuning unit is very simple. In this unit two of the non-surplus items are used. These are the insulators into which the antenna coil is plugged. Equipped with banana jacks, the standoffs are 1½ inches high. Antenna coils fitted with standard banana plugs, as described for the plate coil, facilitate coil changing. A baseboard for the unit may be made of ¾-inch pine, 5 x 8 inches. For the panel use a piece of Masonite 4 inches high and 5 inches long.

To connect the transmitter with the antenna tuner, Amphenol 300-ohm line or ordinary twisted lamp cord may be used. Length of the line is not important but it should be sufficient to allow placement of the antenna tuner as near the window or lead-in point as possible.

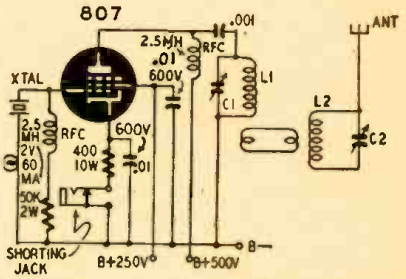


Fig. 1—Try a ground at the low end on L2.

The antenna coupler described is designed to feed a Hertz end-fed antenna. Its length may be any odd number of quarter waves. Since for 80-meter operation a quarter wave is 66 feet long, the length may be determined by the space available.

An alternate method of antenna coupling, Fig. 2, is very effective for loading

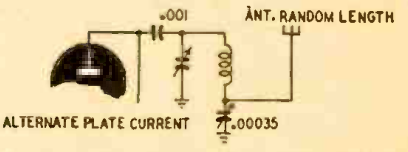


Fig. 2—A pi coupler for short antennas.

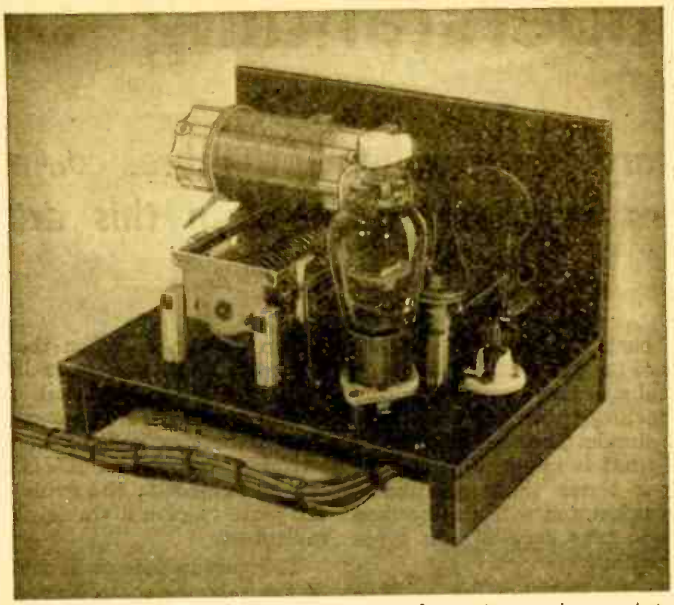
an odd length of wire. It requires some change in the physical layout. Either use a longer panel or mount the 350-μμf condenser close to the transmitter.

With the transmitter completed and

connected to a 550-volt power supply, tune up as follows: Open the meter switch and apply plate voltage. Tune immediately for greatest dip of the milliammeter. At this point a pickup loop and bulb will be found helpful as an r.f. indicator. Placed over the tank coil, it indicates resonance by the brightest glow of the bulb. With antenna attached, tune the antenna tuner to resonance. This will be shown by a noticeable decrease in the brilliance of the bulb in the pickup loop. Remove the loop and place it over the antenna coil. Tune here for *maximum* brilliance. For stable operation avoid trying to draw all of the r.f. energy from the plate circuit—loosen the coupling a little!

With the alternate method, antenna tuning is a matter of tuning the two condensers to the proper ratio. A small bulb in series with the antenna makes an excellent and sensitive r.f. indicator. This bulb may be shorted out of the circuit when the point of maximum output is reached.

If the builder wants to vary this design or does not wish to purchase a BC-375 tuning unit, it will be helpful to know that the condensers (C1 and C2) are approximately 100-150 μμf. Old broadcast condensers may be cut down and double-spaced to approximate this value, or commercially manufactured coil and condenser combinations may be used.



The major components in this rig are from the surplus market.

The meter is a 150-ma d.c. unit with a shorting switch across its terminals. It may be placed in the 500-volt B-plus lead or in the cathode circuit between the frame of the jack and ground. In the latter position, it reads the sum of the plate, screen and control grid currents. Be sure that the meter you use has adequate insulation between its movement and case.

Adjust the tuning and antenna loading so the plate current is about 65 ma at resonance when loaded for 35 watts input.

AM and FM Share Same Carrier

SIMULTANEOUS transmission of FM and AM over the same carrier is entirely practical and not difficult, John J. O'Brien told the IRE convention last March. There is no saving in spectrum space, since the resulting channel is as wide as the sum of a standard FM plus a standard AM channel, but the advantages of having an additional signal channel on a given carrier may be great. For example, AM speech might be used for control purposes on an FM relay channel.

Reception is not as simple, but is also entirely practical, and some interesting circuits were developed to separate the two types of signals.

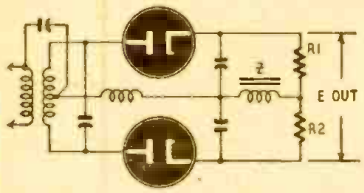


Fig. 1—The simplest discriminator-detector.

No particular problem is presented in transmitting AM and FM simultaneously, Mr. O'Brien stated. Any reasonably constant-amplitude FM signal can be made to drive a class-C final amplifier, which can be plate-modulated by the AM signal at the same time. The class-C final stage must be broad enough to have a practically flat response over the frequency-deviation range, and powerful enough to handle the AM peaks.

There are several ways to solve the more complex problem of separating FM and AM signals in the receiver. Simplest of these is to use a Foster-Seeley discriminator with a high impedance in the center connection (Fig. 1). This amplitude-modulation output impedance Z should be high at all audio frequencies, as compared with R1 and R2. Other constants in the circuit may be kept to standard values, unless it is desirable to reduce R1 and R2 for better ratio with Z. The impedance may be a large inductance or a "constant-current" pentode.

Fig. 2 is a pentode discriminator. Triodes can be used in a similar circuit. This is an improvement over the diode circuit because of its higher input impedance. Cathode resistors should be high enough to make the tubes work as plate detectors.

Self-balance and correction for discriminator misalignment — characteristic of the triode or pentode discriminator—are increased by placing the impedance Z in a common cathode degenerative return circuit, as in Fig. 3. With this circuit it is possible to substitute a large resistor (compared to R1 and R2) for the constant-current impedance Z. Any remaining frequency modulation in the output voltage across the cathode resistor may be eliminated by connecting a bypass capacitor of large capacitance between the two plates.

These discriminators, with their advantages of high input impedance and appreciable amplification might be well worth study by the straight FM constructor as well as the experimenter with hybrid circuits. Circuit constants will have to be determined experimentally, but in general will follow standard practice. Modifications may be desirable in some cases. For example, if a large resistor is used as cathode impedance in Fig. 3, the idea of tapping it and bringing the grid return back to a point of correct bias arises immediately. The possible variations—and varied possibilities—of these circuits are many.

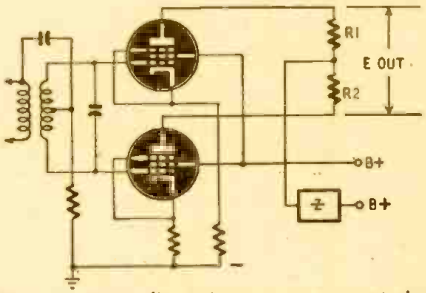


Fig. 2—This discriminator uses pentodes.

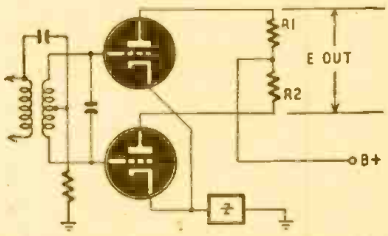


Fig. 3—Triode type; AM output from cathode.

Understanding Tube Checkers

Theory and operation of the three common types are fully described in this article

By SOL D. PRENSKY*

IN THE past few years, new tube types have poured forth by the hundreds, and still they come. The problem of testing this wide variety of tubes is not simple. The technician must understand what is required so that he can choose a tester that will handle present-day tubes and will also be flexible enough to take care of new types as they come along.

There are three main classifications of tube tester in wide use. (a) the *emission* type, (b) the *direct-reading mutual-conductance* type, and (c) the *relative-reading mutual-conductance* or *dynamic* type.

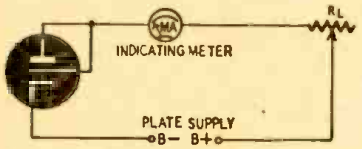


Fig. 1—How the emission-type tester works.

Any of these types can be satisfactory to the serviceman. None of them will predict tube performance infallibly in every possible application. In most cases the emission-type tester is reasonably effective in spotting bad or doubtful tubes; but there are many cases where the circuit requirements of particular tubes require a more demanding test. An emission test might indicate GOOD, and yet the tube might not give satisfactory performance in some particular circuit.

In these cases, the tester should be able to test the tube under conditions as close as possible to actual operating conditions. For this more demanding test, the mutual-conductance tester—either the direct-reading or the relative-reading type—is more desirable.

There are, of course, special cases, where nothing but an actual performance test will do. Then a new tube must be substituted in the actual circuit. As simple and effective as this test is, it would be impractical to use it at all times, considering the many tube types likely to be encountered, to say nothing of the possibility of more than one tube being bad in the equipment under test.

Emission testers

The circuit required for measuring the amount of electron emission from a heated cathode is quite simple. It is shown in Fig. 1. When the cathode is heated to its normal operating temperature, the normal amount of emission should give a certain meter reading. To adjust the circuit for various tubes, a variable load resistor RL is included in the plate circuit; the grids are tied to the plate to give a stable plate current indication.

To show up defects in the positioning of the tube elements, the emission test is supplemented by other tests designed to indicate shorted elements or leakage between elements. Usually, a sensitive neon-tube indicator is used.

Although the emission tester does not test the normal functioning of the grids, it is practical within its limits, since most tube failures result from reduced emission or shorted elements. It is effective in most cases where a tube should be replaced in an ordinary receiver, but it does not give a complete picture of the worth of the tube. The emission tester is most desirable where low cost and simple operation are important. A typical emission tester is pictured in Fig. 2.

Direct-reading gm testers

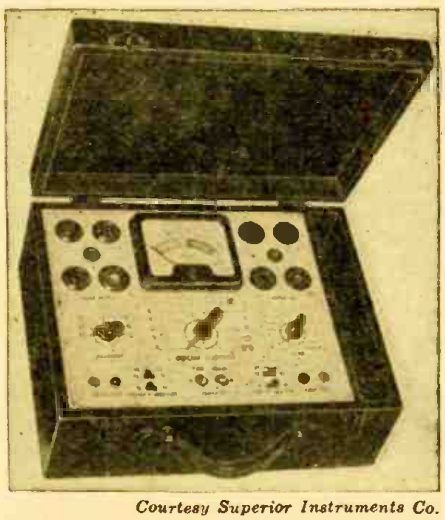
In the direct-reading mutual-conductance tester, the tube is placed in a circuit which allows measurement, not only of the plate current, caused by cathode emission, but also of the *change* in plate current caused by application of a signal to the tube's control grid. The amount of change in plate current is an indication of the mutual conductance of the tube, according to the formula:

$$gm = \frac{\text{change in plate current}}{\text{change in grid voltage.}}$$

If plate current is in milliamperes and grid voltage in volts, the gm (mutual conductance or transconductance) will be in micromhos.

To make this measurement, it is necessary to supply the tube with normal heater, plate, and screen voltages, and then to apply a constant a.c. signal to the control grid. By arranging the plate meter to read zero for the resting value of plate current and to deflect upward in proportion to the change in plate current caused by application of the grid signal, it is possible to calibrate the meter scale to read directly in micromhos.

For analysis of this type of circuit, the Hickok model 532-P is selected as an example. A simplified circuit diagram is given in Fig. 3.



Courtesy Superior Instruments Co.

Fig. 2—Standard emission-type tube checker.

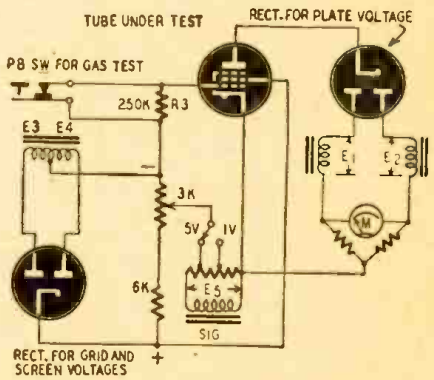


Fig. 3—Fundamental circuit of gm checker.

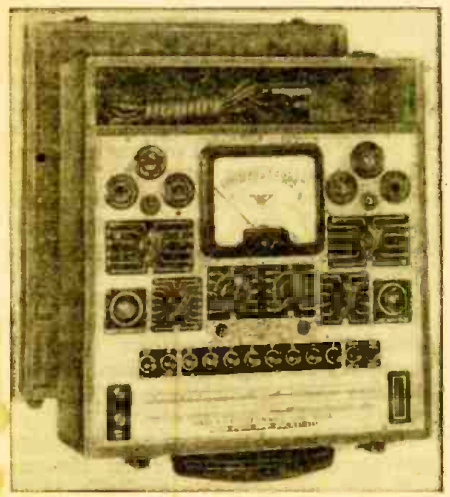
Two rectifier tubes are used: an 83 mercury-vapor tube for the plate voltage, and a 5W4 for grid and screen potentials. The voltages supplied to the tube all come from *secondary* windings of the same transformer. They are marked in the diagram as follows: E1 and E2 for the plate supply, E3 and E4 for the screen and fixed bias supply, and E5 for the a.c. grid signal voltage. Since these voltages are all derived from the same transformer, they are all in phase.

When no signal voltage is applied to the grid of the tube, the unfiltered pulsating d.c. plate voltage from the 83 rectifier causes plate current to flow on each half cycle. Equal amounts of this plate current, of opposite polarity, are alternate-

*Instructor, Brooklyn Technical High School. Some of the material here is taken from the forthcoming book "Electronic Maintenance and Test Equipment."

ly shunted through the meter; as a result of the inertia of the meter movement, which prevents it from swinging 120 times per second, the needle remains motionless.

With the proper amount of a.c. signal E5 applied to the tube grid, the grid becomes more negative on one-half of the a.c. cycle and less negative on the other half. The current tending to push the meter to the right is then greater than that tending to push it to left because, during the positive pulse of plate current, the grid becomes positive, allowing the tube to conduct, while, during the negative plate current pulse,



Courtesy Precision Apparatus Co.

Fig. 4—Relative-reading, or dynamic tester.

the grid is negative, reducing its conductance. The average current through the meter now being positive, the meter pointer will deflect upward. This deflection represents the gm of the tube, and the meter can be calibrated directly in micromhos. In accordance with the gm formula, a plate current change of 1 ma for a grid signal of 1 volt represents a transconductance of 1,000 micromhos, and a plate current change of 2 ma for the same grid signal would mean a gm of 2,000 micromhos. By allowing for sufficient variation of the supply and signal voltages, the manufacturer usually provides direct-reading ranges of 3,000, 6,000, and 15,000 micromhos. A GOOD—?—BAD scale is often included for quick checking, and tests for shorted elements, noise, and gas are usually added.

Modified gm testers

Between the two extremes of the simple emission tester and the fairly complex direct-reading gm instrument there is another tester, usually known as the *dynamic* type, which uses a modified gm-testing circuit. Its purpose is to indicate tube condition by a relative gm reading, without using a direct-reading scale to give the absolute value. Its price range falls between those of the other two instruments. It has won wide acceptance because it is relatively easy to use and quite reliable.

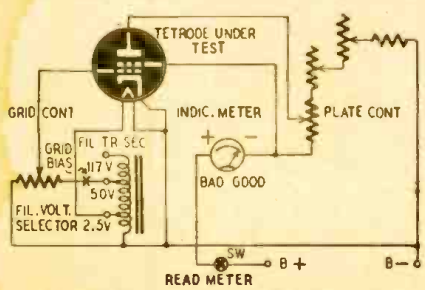


Fig. 5—Working principle of dynamic tester.

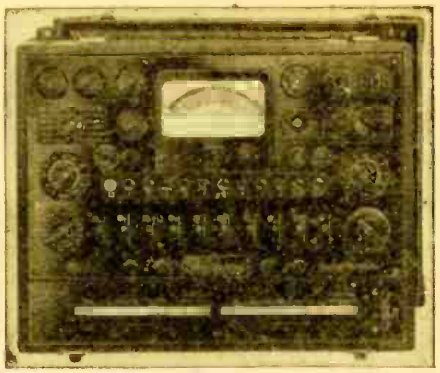
The dynamic tester, like the last type described, makes a grid voltage change indicate merit in terms of the resulting plate current change. The a.c. grid voltage causes plate current to vary symmetrically above and below its resting value. Due to meter inertia, this would cause no change in the reading. One method employed to cause the meter to indicate is to use an a.c. meter of the type which responds to both steady d.c. value and the a.c. component. Where the more sensitive d.c. meter is to be retained, the tube can be operated as a plate detector, rather than a class-A amplifier. Partial rectification takes place, causing d.c. plate current to increase as the grid voltage increases.

The photograph of Fig. 4 shows a dynamic tester. The meter gives an indication of *relative* gm, an indication that is dependent upon gm without reading directly in micromhos.

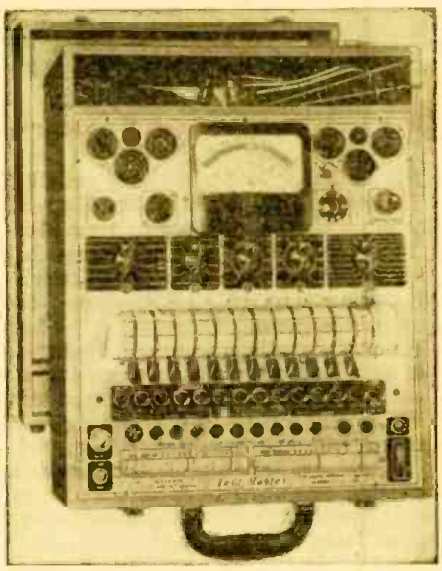
The functional diagram of this tester (Fig. 5) shows how an a.c. signal is applied to the grid, causing a plate meter indication which varies with values of grid voltage. Note that the tube, in this circuit, is being operated under conditions quite similar to those encountered in actual use. Element potentials are adjusted so that the meter reading, for a good tube, will fall on the GOOD portion of the scale. This instrument also tests cathode leakage, inter-element shorts, filament continuity, and noise.

Combination testers

Figs. 6 & 7 show two of the latest types of testers, in which the tube tester is combined with a multimeter to produce a combination instrument usually called a *set-tester*. Note that, in both of the units



Courtesy Simpson Electric Co.



Courtesy Precision Apparatus Co.

Figs. 6 and 7—Two tube tester-multimeters.

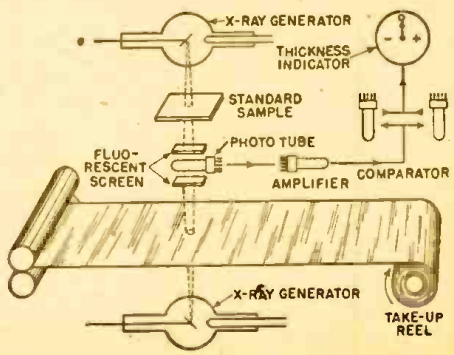
pictured, the multimeter functions occupy very little extra space, though they provide many ranges. It is also interesting to note the trend toward multiple lever selector systems to provide for circuit elements beyond the capacity of the common 4- to 8-pin socket. With such a system it is possible to accommodate the newer-type tubes, such as the 9-pin miniatures and others coming into wide use as v.h.f. amplifiers.

X-RAY INSTRUMENT MEASURES STEEL THICKNESS

Better quality sheet metal is being made with an X-ray thickness gauge now in operation. The gauge consists of two X-ray sources and a phototube pick-up device. Radiation from one X-ray source is directed up through the sheet being gauged so that the transmitted rays will strike the pick-up. X-ray from the upper source is directed through a standard sample of correct thickness; to strike the same pick-up tube. The two sources emit radiation 180 degrees out of phase so that their rays strike the pick-up alternately.

The pick-up device consists of a photo-multiplier tube surrounded by a fluorescent screen and enclosed in a light-proof cover. Absorption of X-radiation by the fluorescent screen causes visible luminescence which is picked up by the photoelectric cell and converted into current pulses, which vary in amplitude according to the thickness of the material. The pulses are amplified and the differences checked by a comparator.

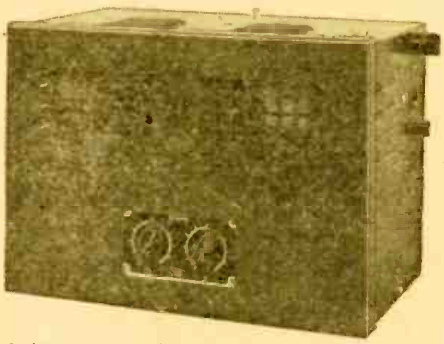
Any disparity in the intensities of X-rays from the two sources hitting the pick-up is registered on the indicator instrument. When the thickness of the material is out of gauge, the indicator needle is fully deflected.



Radio Set and Service Review

Langevin Model 122 Amplifier

By RICHARD H. DORF



Only two controls appear on the front panel.

INTEREST in high-fidelity sound reproduction has heightened greatly since the end of the war. New phonograph pickups and cartridges have been developed and records—particularly some foreign makes—have been greatly improved. Increase in the number of FM stations and their duplication of standard programs have contributed much to high-quality radio transmission. FM tuners are being offered to give listeners optimum reception. Adding to the development of high-fidelity systems, speaker manufacturers have added several excellent dual and co-axial units to their lines.

Probably the least attention has been paid to amplifiers. Usually, audio sections of standard receivers are used with phonographs and tuners. The results are often far from ideal because the a.f. system of the average receiver is not particularly good.

The Langevin Model 122 Amplifier was developed especially for home use. Basically, it is simply an 8-watt amplifier. But, unlike most commercial units with living-room-size power outputs, its frequency characteristic is flat within 1 db from 30 to 15,000 cycles and harmonic distortion is kept down to 3% over the entire range. A laboratory check confirms the manufacturer's rating on the frequency response; although no harmonic distortion measurements were made, the amplifier sounded exceptionally clean when used for records and live FM programs.

The amplifier is interesting because of its flexibility. There are two input channels with separate gain controls. Microphones, pickups, tuners, and lines with impedances of 30, 150, 250, or 600 ohms may be used. High-impedance devices may be worked into a 1-megohm load.

The tube lineup includes a 6SL7 preamplifier in channel 1 and a 6SJ7 preamplifier in channel 2. Use of either is optional, depending on the gain required. A 6SJ7 voltage amplifier drives a 6V6-GT (triode connected) phase-inverter. The output stage consists of a pair of 6V6-GT's in push-pull (Fig. 1).

The basic gain of the amplifier is set by either including a preamplifier in one or both of the input channels or leaving it out of the circuit. For tuners, crystal pickups, and lines, about 69 db is the overall gain. Using the built-in preamplifiers, 107 db is available for microphones and modern magnetic-type pickups.

Variable low-frequency equalization can be inserted for use with crystal pickups; a fixed equalizer (plus the necessary extra gain) is added for such pickups as the Pickering, GE, and others.

Output impedances of 3.2 to 16 ohms are provided for voice coils; 150- and 600-ohm taps are also available on the output transformer.

No line cord is provided. A.c. must be connected to the power supply through a small plastic knockout to terminals on the right rear of the chassis. A convenience outlet is provided at the side of the case. Fig. 2 shows a rear view of the amplifier with the hinged cover swung down. Mounting the chassis on its side, rather than on its bottom allows easy access to the circuit components. "Dish-mounting," as this is called, is very common in broadcast equipment, where testing and maintenance must be done without wasting time.

Four keyhole slots are provided for wall-mounting the amplifier. To do this, the terminal board on the hinged rear cover is removed and remounted with spacers, so that the terminals will not hit the wall. Small knockouts are built into the bottom of the case, so that leads may be brought in.

The way in which the amplifier is adapted for the various uses to which it can be put is interesting. Rather than including the required number of variable controls to change impedances, gain, and equalization, the designer has furnished only two controls for ordinary use. These are the gain controls for the two input channels. They appear on the front panel in the photo above. If a permanent gain setting is desired, the knobs and extension shafts can be taken off and the knobs placed directly on the potentiometers, within the cabinet.

Fig. 3 shows the front of the amplifier with the cover removed. Note the two empty octal tube sockets at bottom of the chassis on each side. One or more

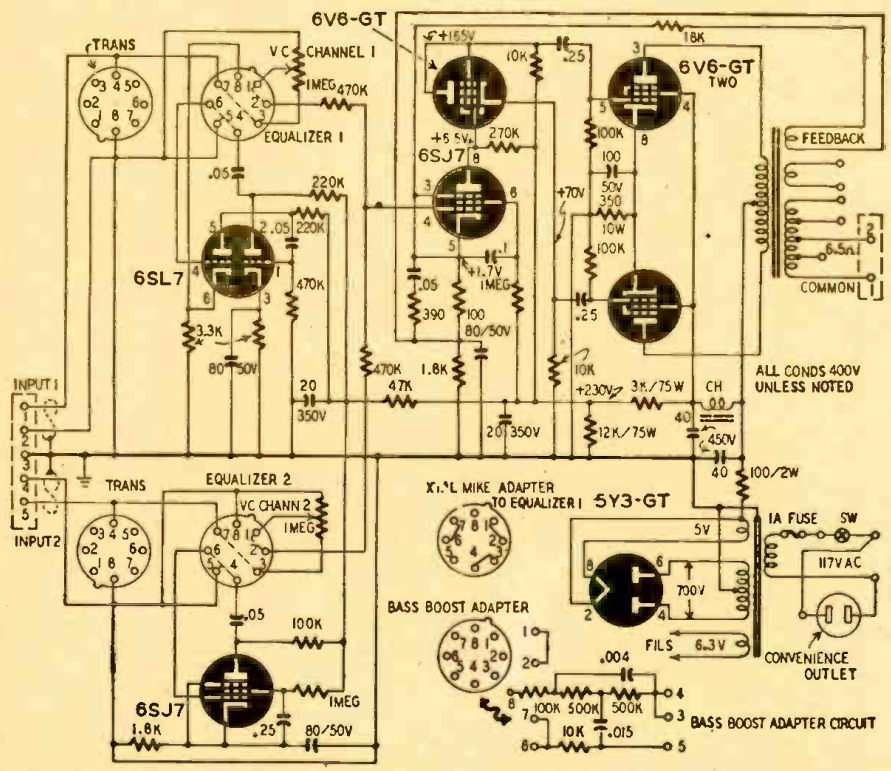


Fig. 1—The schematic. Dotted lines in the equalizer sockets indicate red-covered jumpers.

of the plugs which appear in front of the amplifier in the picture may be inserted into these sockets to give the desired amplifier characteristics. Some of the plugs are connected as jumpers and others are equalizer circuits. One impedance-changing transformer is furnished. This appears at the left in the photo.

The second and third adapters from the left in the photo are variable bass boosters. Using them, maximum bass boost in channel 1 is about 18 db at 20 cycles, in channel 2, about 10 db at 50 cycles. The next adapter provides fixed bass boost for use with magnetic pickups.

One of the small plugs at the right is strapped in the same manner as the original strapping on the equalizer sockets (shown in dotted lines in Fig. 1). It is inserted in the socket to reconnect the strapping, if that should be desired, after the original red-covered wires have been cut by the user. Two more are adapters for crystal microphones, cutting the appropriate preamplifier tube into the circuit for extra gain. The last is a voice filter.

All the adapters are to be plugged into the equalizer socket of the channel to be used. The transformer plugs into one of the transformer sockets.

The schematic diagram, Fig. 1, shows the amplifier as furnished, with all tubes in place, but without plugs in the equalizer or transformer sockets. The dotted connections in the equalizer sockets indicate jumper connections which must be clipped off if plugs are to be used. Jumpers are covered with red spaghetti for easy identification.

For channel No. 1, terminal 2 at the input board on the left is grounded, and terminal 1 is the "high" side of the line. This lead goes to pin 7 of the equalizer socket, through the dotted jumper and pin 3, to one end of the channel 1 gain control. The other end of the control is grounded. The variable arm leads through pins 1 and 2 and a 470,000-ohm isolating resistor to the grid of the 6SJ7. Notice that the 6SL7 is bypassed.

The 6SJ7 is direct-coupled to the 6V6-GT triode phase inverter, which uses its cathode circuit to obtain an out-of-phase voltage for the grid of the bottom power-output tube. The voltage markings show how the proper polarities are maintained with the direct coupling. Though the 6V6-GT grid operates at +64 volts, the cathode is at +70; since the cathode is more positive than the grid, the net grid-to-cathode potential is negative.

The output transformer is tapped for the required impedances; as furnished, the 6.5-ohm taps are brought out to the terminals, but the user can change this by soldering the proper leads to the terminal board. Taps are also provided at the transformer secondary for 13 db negative feedback. The feedback voltage is returned to the cathode of the 6SJ7.

As shown, the amplifier is suitable for high-level devices, such as tuners or crystal pickups. Its frequency response is flat and neither of the two preamplifier tubes is in the circuit. To adapt the unit for other uses, the dotted jumper connections must first be cut away from the equalizer sockets. Plugs are provided, as mentioned previously, to re-make these connections.

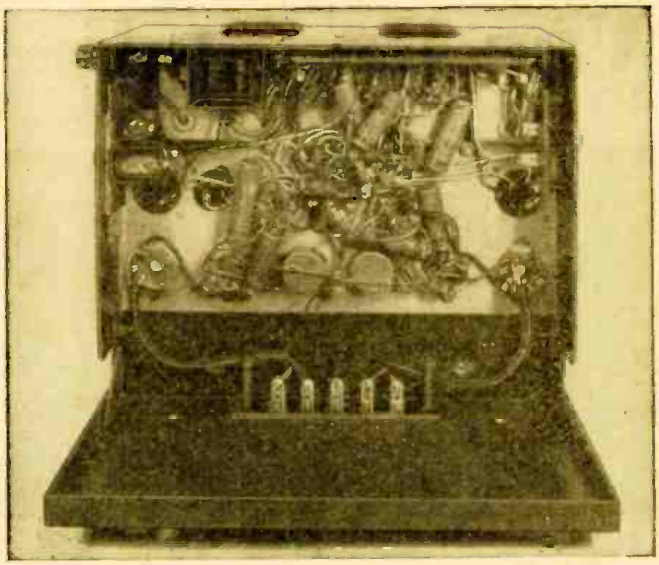


Fig. 2—Opening the hinged rear cover gives access to the parts.

The extra gain of a preamplifier tube is needed if a crystal microphone is to be used. For channel 1 the adapter shown in lower center of the diagram is furnished. It makes the proper connections for adding the 6SL7 to the circuit when inserted into the equalizer socket. Tracing the channel 1 input with this adapter in the top equalizer socket, terminal 1 (the "high" side) leads to pin 7, through the adapter jumper to pin 6, and thence to the left grid of the 6SL7. The left plate is coupled to the right grid, and the signal from right plate passes through its .05-μf blocking condenser to pin 4 on the equalizer socket. The adapter jumper carries it to pin 3, one end of the volume control. The arm of the control is connected to pin 1, and the adapter jumper carries the signal through pin 2 to the 6SJ7 grid. The 6SL7 is thus connected into the circuit as a preamplifier. Similiar operation is obtained in channel 2 if the crystal microphone adapter is placed in the other equalizer socket.

The bass-boost adapter used with magnetic-type pickups contains, in addition to necessary jumpers, an R-C equalizer circuit which gives a 6 db-per-octave bass rise. The adapter circuit is shown in Fig. 1. The original design for this adapter left the high-frequency end of the range flat, but a roll-off will probably be added in future production to compensate for the pre-emphasis existing on most records.

Adding to the amplifier's versatility, a voice filter is furnished. When plugged into an equalizer socket, it emphasizes frequencies in the 2,000-cycle region.

A multi-tap input transformer with an octal plug base can be inserted into a transformer socket to accommodate low-impedance microphones, pickups, or lines. Jumpers must be soldered to the transformer socket to give the desired impedances.

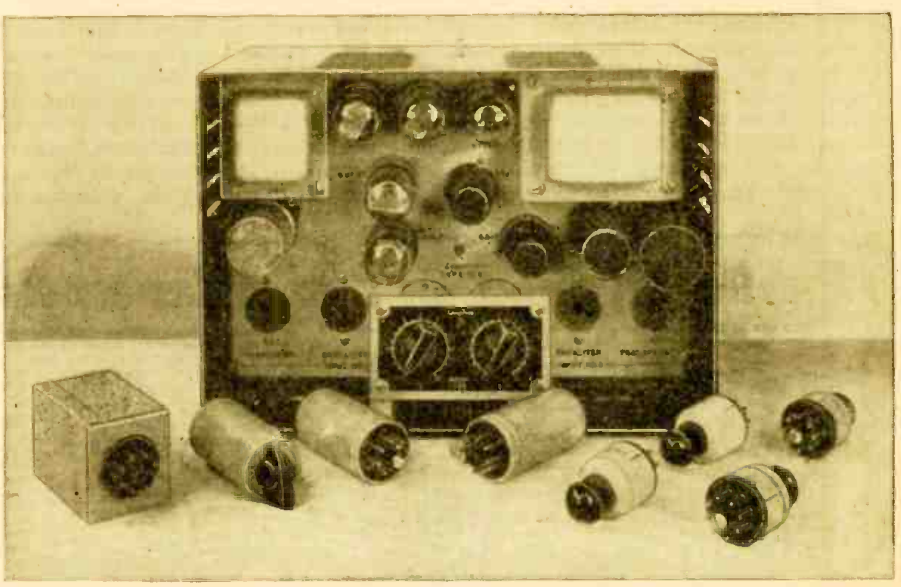


Fig. 3—The adapters shown in front of the amplifier may be plugged into the empty sockets.

War On Radio Repairmen

Servicemen organize to fight gyps and unfair surveys

By FRED SHUNAMAN

Members of Pittsburgh's Better Business Bureau show racketeering with prepared chart.

"THE War on Servicemen" is on again, with Pittsburgh its latest battleground, as witness the photo on this page. The same "investigation" and "gimmick" weapons have been brought into play, and the same eager press has hurried to join the manhunt: "Radio Racketeers Dupe Public," screams the *Pittsburgh Press*, while the *Sun-Telegraph* informs: "Two out of three radio repair shops in Pittsburgh are gypping the public . . ." The attacking forces, incidentally, have a new ally—the serious and cautious Better Business Bureaus.

The Pittsburgh attack was by no means unprovoked. George Dennison, secretary of the Better Business Bureau, reports that no less than 51 complaints from radio owners were received. Attempts made to contact 41 of the shops complained of resulted in such negative co-operation that an investigation and exposé was deemed the only way to correct the situation.

Unhappily, the discredited "gimmick" was again pressed into service. Artificial faults of a type not found in a genuinely defective radio were introduced — an open connection, two wires pressed together, an open audio circuit—and the "gimmicked" set shopped around various radio shops. Not only were the faults atypical; they were trivial. After spending his time locating the trouble, the radioman did not find a genuine repair job for which he could make a charge. This probably accounted for the two-out-of-three overcharge rate, so much out of step with results of investigation where genuine faults are "planted" in the set.

The BBB, or other laymen, cannot see this point. "A 13-year-old boy discovered the loose wire in three minutes," reports Mr. Dennison. It is useless to argue to laymen that with such unlooked-for faults a 13-year-old boy might have an advantage over the skilled repairman. He might conceivably have an advantage over a Better Business Bureau in a parallel case—say one in which a company is not answering complaints because of a crack in its mail chute. Better Business Bureaus are not geared to look for such faults as leaky mail chutes—nor do radiomen look for short circuits as an initial procedure.

The very real abuses of the Pittsburgh situation must not be obscured by any shortcomings of the investigation. Each of the 51 complaints represented either dishonesty on the part of some radio technician, or ineptness in selling his services. The question is not: "How could the survey have been improved," but "What are we going to do about it?" What can be learned from the Pittsburgh investigation?

First and most unhappy lesson is: *Look out for gimmicks!* More and more agencies, newspapers and independent investigators are being stirred up by the various exposés to check up on their local repairman. Look over all radios for something out of the ordinary—especially if standard tests do not show up the fault immediately! A dead audio circuit may mean that phono jack contacts are squeezed together. No i.f. may be caused by a nonfunctioning oscillator—or by a cut wire. Use your eyes—remember the old slogan "The Customer Will Gyp You If You Don't Watch Out" (RADIO-CRAFT, April 1942, Page 477).

Stop the abuses!

The second and harder lesson is—the abuses must be stopped. And nobody is

(*Continued on page* 49)


Public 'Gypped' in Radio Repair Racket, Bureau Says

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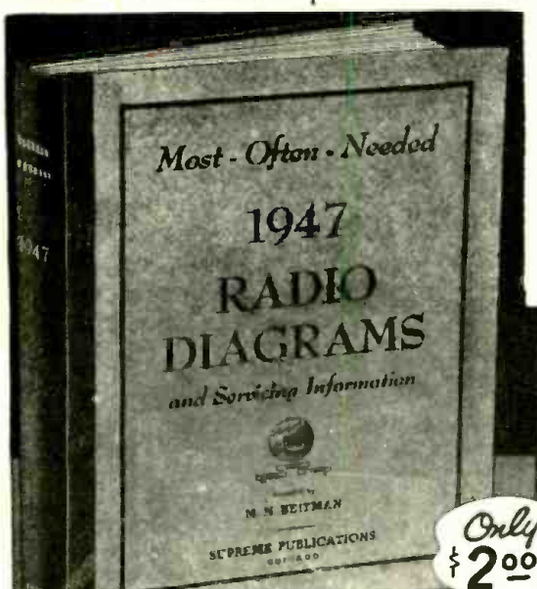

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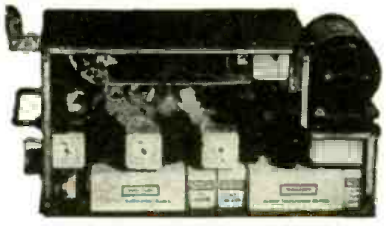

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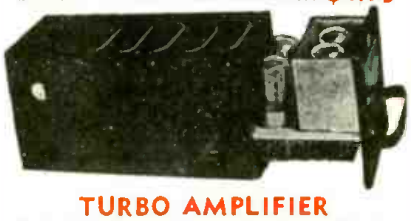

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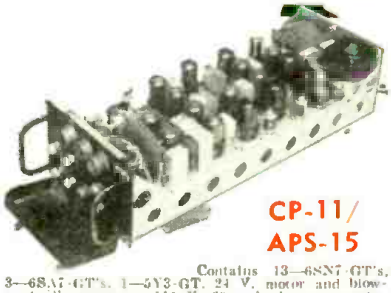

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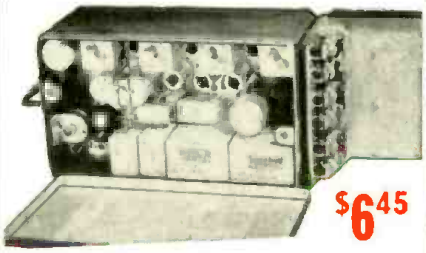

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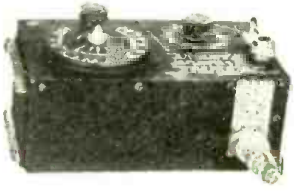

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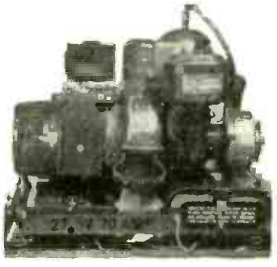

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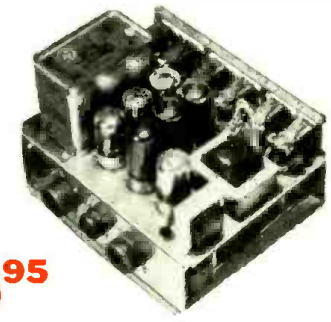

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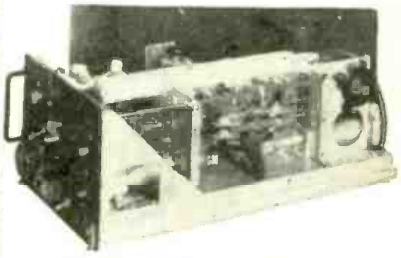
Were used to control operation of Servo units, causing them to move the control surface of airplane in one direction or the other in response to signals received. The complete amplifier includes one rect. 7Y4, 3—7F7's for amplification and control, 3—7N7's for signal discrimination, 1 power transformer, 6 relays, 4 control pots, chokes, condensers, etc. Convert for use on radio controlled models, doors, etc. Operates from 24 V. DC. Size 9¼ x 6¼ x 7⅝". Complete.



T-39/APQ-9 RADAR TRANSMITTER

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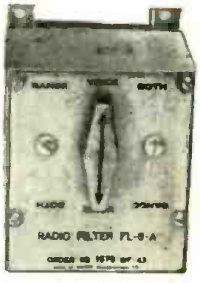

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INSULATED PLATFORM

When working with power tools or metallic devices using power from the 117-volt line, it is a good idea to make sure your feet are not grounded. A concrete floor is an especially good conductor and an insulating platform should always be placed on it.

I made such a platform cheaply by using a piece of wood about 18 inches long, 12 inches wide, and ⅞ inch thick, and four old plug fuses with Pyrex bodies.

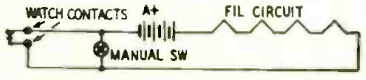
One-inch holes were drilled about 1¼ inches in from the corners of the platform, and the brass-threaded ends of the fuses were pressed into the holes. This keeps the platform about ½ inch from the floor and thoroughly insulates it.

OSCAR E. MALECH,
San Francisco, Cali.

RADIO TIMER

I often listen to the radio while in bed, and several times I have fallen asleep without turning it off. To avoid running down the batteries, I constructed a timer to turn off the receiver after a stated length of time.

The hour hand is removed from a cheap pocket watch and a small strip of spring bronze soldered to the watch face in the position shown. In the center of the spring is a silver contact.



Immediately above the contact, on the plastic watch-crystal material, is bolted another contact, so that the two touch when the minute-hand is away from the assembly.

When the minute hand gets to the spring, it pushes it down, breaking the contacts and turning off the radio.

Because of exposed contacts, this timer should be used only on battery sets. A shorting switch, across the contacts, cuts out the timer for normal radio operation.

STANLEY A. OLLENDORF,
Oak Park, Ill.

CRYSTAL MOUNTING

Here is a convenient way to mount crystal diodes which do not have pigtail leads.

The large end is held in a miniature fuse clip, and the small end in a hearing-aid-battery jack. Clip and jack may be mounted on a bakelite or fiber base for convenience in placing the assembly on a chassis.

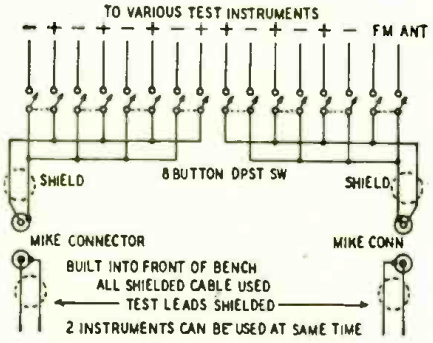
JOSEPH PATAY,
Toledo, Ohio

TEST LEAD SWITCHING

To eliminate the tangle of wires that results from a number of test instruments on the bench, I use this system of switching two pairs of test leads to various instruments.

The leads are connected to any of several meters or antennas by d.p.s.t. push buttons. Using a Mallory #2100 8-button assembly, two pairs of leads can each be switched to any of four instruments.

EDWARD L. SPEAL,
South Paris, Me.



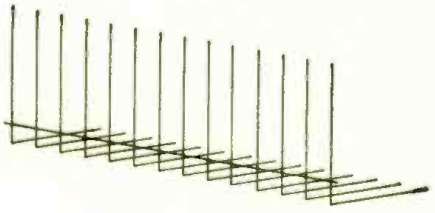
MOTORBOATING CURE

On small receivers there is often motorboating at one end of the band. Frequently, it is due to electrostatic coupling between the glass i.f. tube and the loop antenna.

To prevent this, I use a static shield made of horizontal strips of stiff copper wire. The strips are laid out on the bench, in the pattern shown by the drawing, and a right-angle piece of the same wire is laid across as shown. Spots of solder at each point where one wire crosses another hold the assembly together.

The shield is installed so it resembles a fence between the tube and the antenna. The right-angle strips are soldered to the chassis.

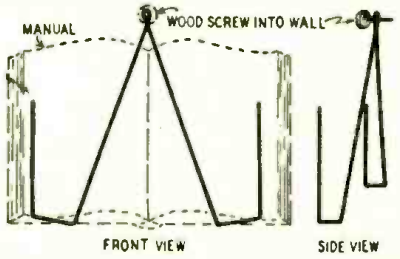
JOHN W. COOK,
Waynesboro, Va.



BOOK HOLDER

Books that are in use while a set is being serviced can be kept clean and out of the way by holding them to the back of the bench with a wire holder made from a wire coat hanger.

The hanger is cut in the center of the horizontal wire, and the hook is removed. A small loop is made in the wire just under the hook, and a woodscrew and washer serve to fasten the loop to the wall. The remainder of the hanger is bent as shown in the drawing.



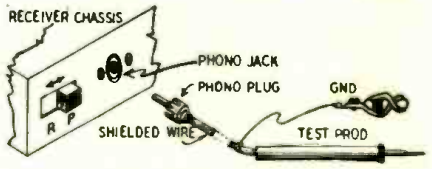
N. H. SILVERMAN,
Los Angeles, Calif.

SIGNAL TRACER

When no regular signal tracer is at hand, almost any receiver having a phono jack can be used for the purpose. Make up a shielded cord with a probe on one end and a phono plug on the other. A short length of wire attached to the shield ends in a small alligator clip to make the ground connection on the receiver under test. This setup is fine for audio signal tracing.

To trace r.f. signals, another similar assembly should be made up, but a crystal diode should be connected in series with the hot lead and, if possible, placed within the probe. Several such probes have been described in RADIO-CRAFT recently.

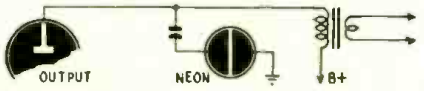
R. W. EUBANK,
Lexington, Ky.



MUSICAL LIGHT

I obtained an interesting effect by making a neon lamp glow in synchronism with the sound coming from my receiver.

The neon lamp is connected in series with a condenser between the plate of the output tube and ground. The intensity of the glow varies with the loudness of the voice or music.



With 265 volts on the final tube plate of my receiver, I found that a 20-μf electrolytic condenser worked best, with a General Electric NE-57 lamp (its starting voltage is 55 a.c. and 70 d.c.). A.c.-d.c. sets would probably require a lamp with lower starting voltage, and a different size condenser.

JOHN E. LOVETT,
Denver, Colo.

DENTAL MIRROR AID

Many points in the crowded space under the chassis of small sets are hard to examine. I use a dental mirror to get into these places. To insulate the handle of the mirror, a coating of tape is wrapped around it.

FRANK M. WANLASS,
Ogden, Utah

(Though this is a very old trick, RADIO-CRAFT makes no apology for republishing it. We feel servicing aids like this ought to be repeated at intervals, to inform beginners and remind the old hands.—*Editor*)

going to do that but the radio technician himself. This was the happiest feature of the whole Pittsburgh investigation. During the week of the exposé, six stories on the investigation were printed in Pittsburgh papers—*and 11 on efforts by the repairmen to clean up the situation.* The press there is strongly behind the reputable majority of the repairmen. The old repairmen's association, under the veteran repairman Bert Bregenzer, reorganized under the new name of Radio and Television Servicemen's Association, and pledged itself to the fight for reputable radio repair in Pittsburgh.

How can organization help the situation? Many report that dishonest repairmen simply do not join associations, or drop out as soon as they are criticized. The answer (discovered years ago by the Philadelphia Radio Servicemen's Association) is that the organization can be responsible for *all* radio repair, whether by members of the organization or not. The association acts as a bureau to receive *all* complaints from radio owners. It then gets in touch with the repairman and asks him to contact the owner. In most cases an adjustment is made immediately. If not, a committee inspects the set and makes a decision. Actually dishonest repairmen or equally dishonest or over critical customers will heed such decisions—they will not take a chance on going to court against such expert witnesses. Where the difficulty is due to a misunderstanding between repairmen and customer, it is usually easy to settle it.

Improved public relations

Organization is even more helpful in improving the reputation of the good radio technicians than in checking the bad. The experience of the new Associated Radio Servicemen of New York (City) is a striking case in point. Born under the worst possible auspices (a move to license all radio repairmen, with a $30 annual license fee) the organization found itself compelled to defend the city repairmen from another "investigation" and attacks from a half-dozen radio commentators. Several newspapers joined in the hue and cry. The situation could hardly have been darker.

Hopelessly, president Liebowitz and secretary Edel started calling broadcast stations to protest unfair treatment. To their utter surprise, they were offered time to answer the charges, and even in some cases to face their attackers at the microphone. What followed was even more surprising. Without exception, the radio commentators were so impressed with the new association and its program that they swung behind it wholeheartedly. Today men like Paul Dennis, John McCaffrey, Lyle Van and J. Raymond Walsh are the strongest backers of the ARSNY.

These men have told their listeners—over the air and through their newspaper columns—to take their radios to shops which display the ARSNY decal in the window (see illustration) for fair treatment. These shops give itemized bills, stand back of their work, and can

RADIO REPAIRMEN
(Continued from page 44)

be checked up on immediately through their own organization.

Meanwhile the clamor about radio repair frauds and overcharging died quietly. The Grievance Committee of the ARSNY broadcast notice of its willingness to take up any customer's complaint, whether against a member or non-member, and *received only 19 complaints* during the first two weeks of its existence. Four-fifths of these were settled immediately by phone.

This 12 by 4 inch decal window display is the identifying symbol of members of ARSNY.

Technical improvement possible

The radio technician has as much to gain through organization from a technical point of view as from that of public relations. This point was startlingly brought out by the General Electric FM Travelling Workshop, a series of lecture and demonstration sessions designed to spread information on servicing FM receivers. The Workshop discovered that *"except in those few communities where a strong radio servicemen's organization is in operation* (our italics) . . . the average serviceman, through no fault of his own, does not have . . . the technique to service FM receivers properly." The conclusion is all the more important because it was totally unexpected by the promoters of the Workshop. So struck were they that the first recommendation on their report is:

"One, and perhaps the best, way to correct the conditions we encountered on this tour is the creation of strong radio servicemen's organizations throughout the country. *Such* organizations, the report states, can:

Disclose new ways of doing better work, and new tools to work with.

Set qualifications and standards for their membership to keep servicing procedure at a high level.

Set up rules and regulations governing the conduct of radio work.

Set up schools for teaching radio service to prospective members.

Carry on local publicity campaigns.

All these methods have been proved effective by the older organizations (RADIO-CRAFT, March, 1948) and by the newer ARSNY. Other associations now springing up throughout the country will find them equally valuable. Both from a business and a technical standpoint, organization is the way out and up for the radio repair technician.

Time-Saving Repair Tips

By W. G. ESLICK

ONE would think that the average serviceman would know the simple quick tests and trouble-shooting methods described below, but to my surprise and disgust, too many don't. I have been manager of a large service shop and have worked in or visited many others, so know whereof I speak.

A headache in a.c.-d.c. radios may sometimes be due to intermittent filaments which won't show on the tube tester unless one stands over it for some time. Usually one can see the pilot light go on and off or off and stay off! Simply take one of the little neon testers advertised for around fifty cents and place it across each filament. Because of the minute current required to light the neon bulb and the complete series circuit (except the intermittent tube) the neon bulb placed across the faulty tube will light when the filament opens. Most men sweat over the tube tester to find the tube. (An a.c. voltmeter placed across each filament will often show a bad tube. Its resistance may be much higher or lower than normal, causing an abnormal voltage drop.—*Editor)*

To find a leaky coupling condenser coupled between a plate and grid: set your voltmeter on a 300-volt range or more and place between grid and chassis ground or the common ground circuit, then keep decreasing the voltage selector on your tester till a reading can be had. (Place positive prod on grid and negative prod to common ground or point from which grid bias is obtained. Leakage will cause the meter to show the small positive voltage on the grid. It varies according to leakage. This method catches the intermittent and I like it better than an ohmmeter test.

Here is another not-too-well known fact. Your voltmeter can be used as a resistor. Suppose you find the 6SQ7 plate voltage nil. With the voltmeter set on a high range (at least as high as the voltage in the radio for safety) touch the negative prod to the plate of the tube and the positive prod to B-plus. If the set plays, replace the resistor. This just saves time. The meter is already in use, so why hunt up a resistor and shunt it across the suspicious carbon stick when you have a resistor in your hands.

(Continued on page 55)

Servicing Farm Radios

Trouble in Silvertone Model 4722

By HARRY LEEPER

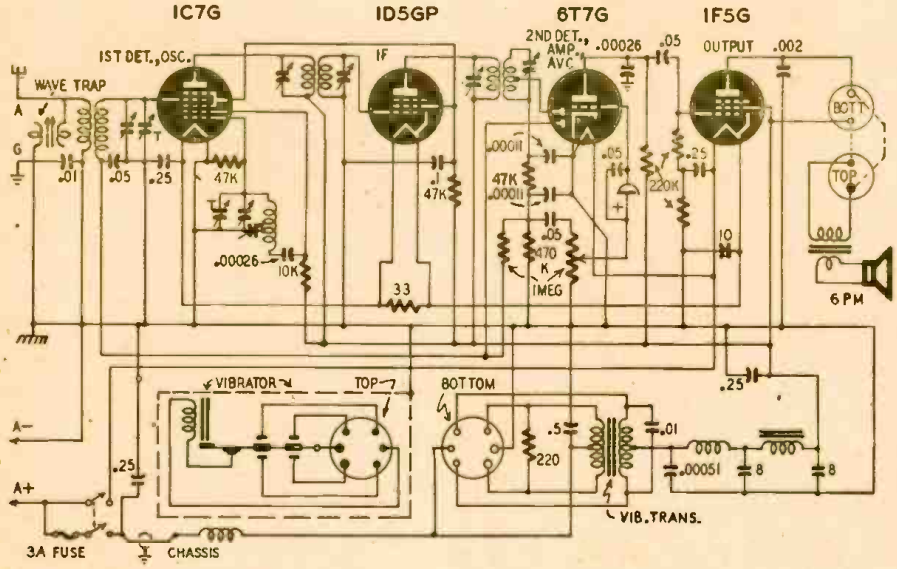


Fig. 1—Battery drain is reduced by using 2-volt tubes in mixer, i.f. and output stages.

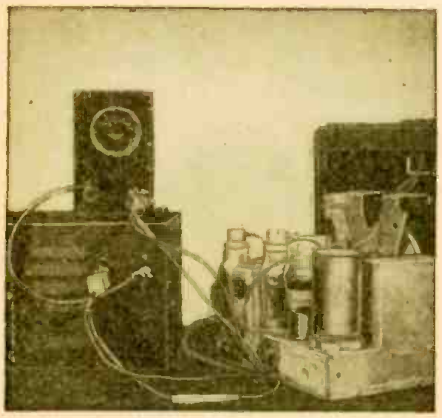


Fig. 2—Ammeter checks current used by set.

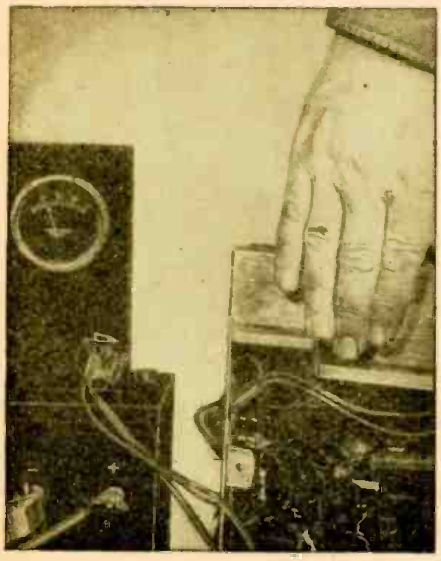


Fig 3—Unusual heat shows trouble in set.

OCCASIONALLY the serviceman gets a farm radio which uses a vibrator and operates from a 6-volt battery. In testing such sets certain problems are encountered which are somewhat different from those found in the conventional a.c. home radio.

A receiver of this type is the Silvertone Model 4722, chassis 100.179, which uses three 2-volt tubes in series and one 6-volt tube, as Fig. 1 shows.

There were several complaints on one of these sets. When it worked, short circuits occurred when the battery leads touched, and there was noise when the radio was jarred. When brought into the shop, the set was no longer operating.

A battery eliminator made to test car radios was used as the test power supply, and an ammeter inserted in the d.c. circuit as in Fig. 2 showed about 12 amperes—entirely too much current for a radio of this type.

The vibrator could be heard in operation and after being connected for a few minutes, the metal cover over the bottom of the transformer terminals and the buffer condenser became warm. See Fig. 3.

The transformer buffer condenser—a .01-μf unit—was suspected. It was disconnected, and an ohmmeter reading across this unit, shown in Fig. 4, revealed that it was shorted.

With this condenser disconnected and the eliminator turned on again, the ammeter reading dropped to around 4 amperes, as Fig. 5 indicates.

The defective condenser was replaced with one of like value rated at 1,600 volts.

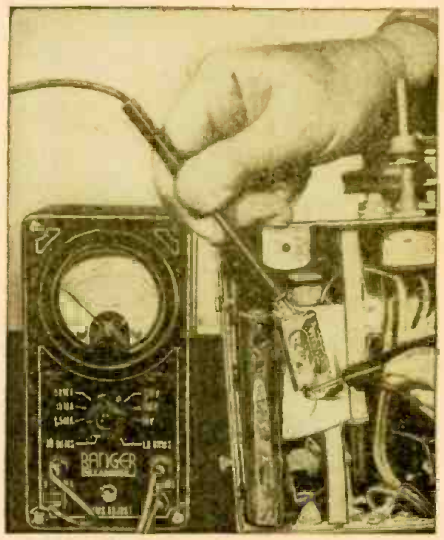


Fig. 4—Shorted buffers are troublesome.

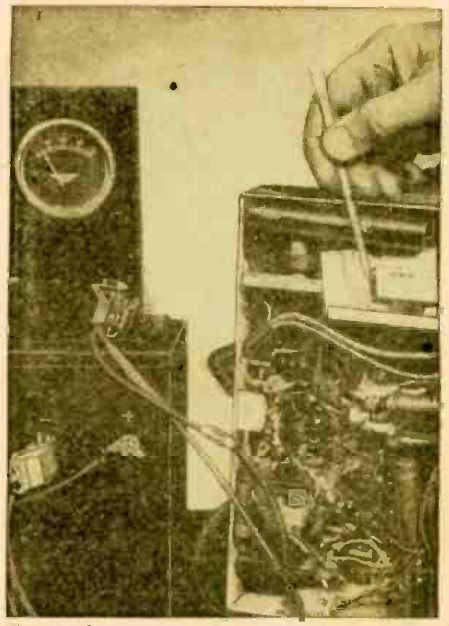


Fig. 5—Current is normal with the new buffer.

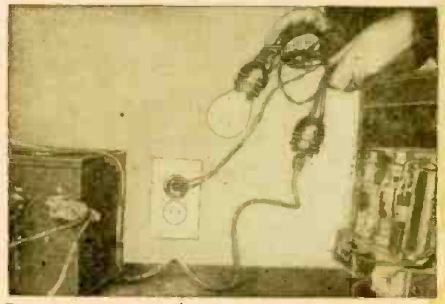


Fig. 6—A series lamp drops input voltage.

The radio would now operate, but the vibrator noise seemed louder. A check of the tube filament voltage showed 9 volts instead of 6.

The eliminator was designed to furnish 6 volts for auto sets drawing a fairly heavy current, and the higher voltage here was due to the lighter current requirements of this farm radio.

In order to reduce the filament voltage to a safe value, a 25-watt, 115-volt lamp was placed in series with the eliminator transformer primary as shown in Fig. 6.

The secondary voltage was then 5 volts. Other lamp combinations would have been possible, but, since the radio operated satisfactorily on 5 volts, the 25-watt lamp was used for further tests.

The complaint of battery leads shorting was then investigated.

An ohmmeter test from the metal fuse holder to the battery clip on the same lead, which was the insulated lead of Fig. 7, showed a short circuit, indicating that the fuse was touching the metal holder.

Further check revealed that the fiber insulator which ordinarily insulates the fuse from the holder was missing: when the fuse holder touched the other uninsulated lead, a short circuit occurred.

A piece of fiber sleeving was placed over the fuse, as illustrated in Fig. 8, and this trouble was eliminated. As further protection, the battery leads were taped at the point of entrance to the cable sheath (Fig. 9).

The battery clips, corroded from chemical action, were cleaned by dipping them in a solution of water and baking soda (Fig. 10). Vaseline was applied to the clips to slow down any future corrosion.

The noise heard when the set was jarred was cleared up by tightening the speaker plug receptacle under the chassis. (Note the method in Fig. 11.) This plug, being only a 2-prong one, is not held in place as firmly as plugs having four or five prongs.

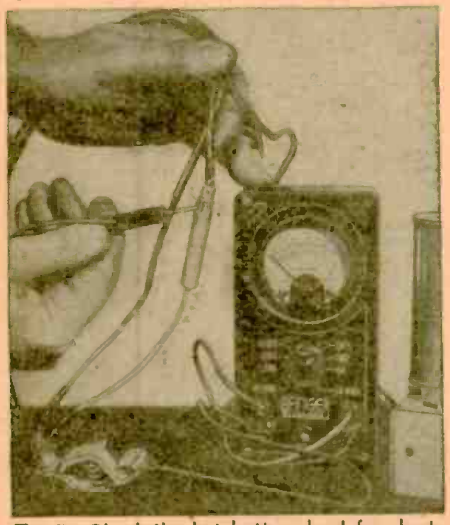


Fig. 7—Check the hot battery lead for shorts.

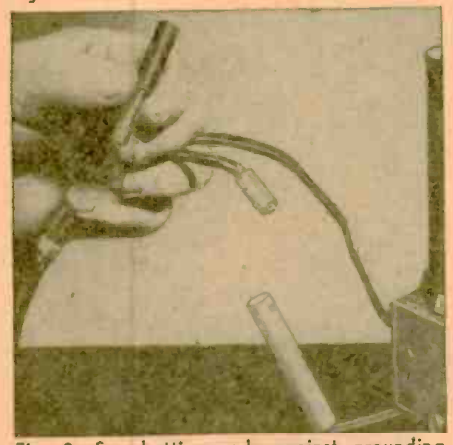


Fig. 8—Spaghetti guards against grounding.

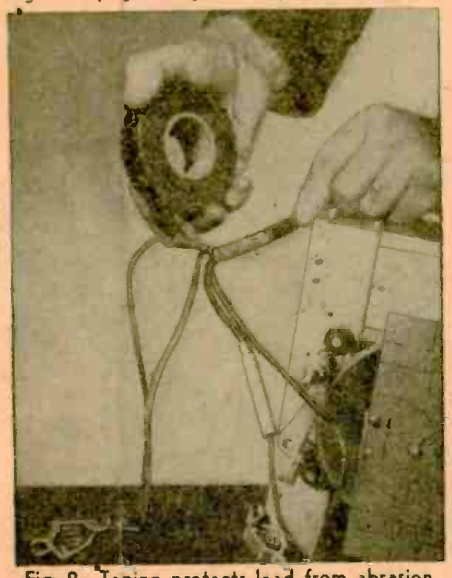


Fig. 9—Taping protects lead from abrasion.

Fig. 10—Baking soda removes the corrosion.

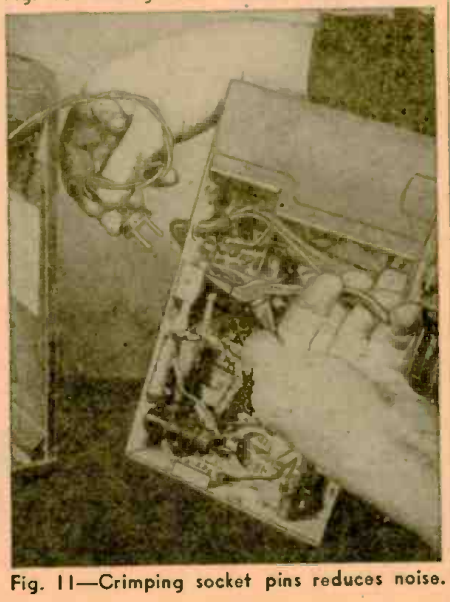


Fig. 11—Crimping socket pins reduces noise.

Pedro's Inductant Reasoning

By GUY SLAUGHTER

"The old blister was back again, only this time she brought two cops along with her."

I'M working on an FM job when the dame first comes into the shop, so Pedro waits on her. Pedro is a little Mexican kid who works for me. He doesn't know much radio but he comes in handy sometimes.

"Good morning, Senora," says Pedro, "Something I can do?"

I can hear the dame sniff clear back at the bench. She has a voice like a buzz saw.

"I wish to see the proprietor," she buzzes. "At once!"

I get up from the bench with a sigh. "Yes, lady," I say when I reach the counter. "I'm the proprietor."

"This radio," she gurgles, slamming it down on the counter. "I bought it here. I want it fixed." She stabs me with an accusing glare.

"All right lady," I say. "What's the matter with the set?"

"Everything," the old girl barks. "There's so much noise I can't hear the music." She's still glaring at me. "You ought to be ashamed young man, selling things like that!"

"But lady," I say. "Wait a minute. That set is four years old. Have you had any trouble with it before?"

"I should hope not," she buzzes. "I paid nearly twenty dollars for it, and I expect to get my money's worth!"

"Absolutely right, Senora," pipes up Pedro. "Should be good for years yet."

"I'll be back tomorrow morning," she breaks in. "Fix it so I won't have any trouble with it ever again, or I'll call in the Better Business Bureau!" She leaves, slamming the door and muttering to herself.

Pedro breaks into a gay little laugh, but his grin fades as I give him the eye.

"What's so funny?" I demand.

"Uh . . . nothing, Herk," he says, grabbing a rag and going to work on the dust atop the counter.

"And lay off the 'Herk' stuff, see? From now on in it's Mister Newton, with the accent on the 'Mister'."

"Yes MISTER Newton," says Pedro glumly.

I finish tracking an FM job, and plug the dame's set in on the bench to warm up. After 30 seconds or so the little job starts pouring out music, and the noise level is practically zero.

"Fixed already MISTER Newton?" Pedro says, coming back to the bench with his dust cloth. "What was wrong?"

"Must be an intermittent. We'll have to wait for it to act up." I cover it with a box I keep for the purpose, wanting it to get hot quick, and go on with my next job, ready to check it the minute it starts to noise up. But it doesn't, and when I close up that evening, it's still going strong.

Next morning about nine o'clock the old dame comes in. She stops at the counter, and stands there, tapping her foot and looking sour.

"Good morning, Senora," Pedro says. "You're bright and early, no?"

"Never mind that," says the dame. "Where's my radio?"

I have it back on the bench, of course, and it's still going strong. I pull the plug, do the line cord up into a neat hank, and carry it out front, thinking up my speech as I go.

"Good morning," I say, before she gets a chance to start talking. "There's nothing wrong with your radio. It must . . ."

"I should hope not," she breaks in. "I've given you nearly 24 hours to get it fixed. And this time it better stay fixed!" She grabs it out of my hands and departs, slamming the door.

"Huh," says Pedro, laughing. "Guess she is in a hurry."

"Yeah," I say. "I guess she is. But she didn't give me a chance to say I didn't have to fix it. And she didn't ask me what the charges were either."

"Oh well," says Pedro. "No work, no pay."

I go back to work after that, but in about an hour I hear the door open and close, and Pedro hollers back at me, all excited like.

"Hey Herk," he shouts. "I mean MISTER Newton. Guess who?"

So I rise wearily and go out front to find the same old dame again. This time she's got a cop with her. He's carrying the radio and looking rather stunned.

"Hello," I manage weakly. "I see you're back."

The dame has been silent up to now, but with that she opens up.

"Arrest him, officer," she screeches. "That's the man, arrest him!"

"What's it all about, mister?" the cop asks, and before I can get a word in, the old blister starts up with her routine again. This goes on for about five minutes, and all the time the dame gets

more and more insistent and screechy.

Finally Pedro snatches the radio from the cop's arms, sets it down on the counter, and plugs it in. And just as she strikes an all-time high in indignant squeals, music pours from the speaker. The old girl breaks off yelling, stops waving her arms, and gradually her sour puss assumes a look of enraptured pleasure.

"Well," she gurgles. "It works." And I throw a look of gratitude at Pedro.

The cop senses the crisis is past, and starts sneaking for the door. The old crone stops him with a look that would melt solder.

"Where are you going?" she demands. "Come back here!"

"I . . . I figured everything was okay, so I'd get back to my beat. The radio plays, doesn't it?"

"Yes," the old girl bleats. "It plays here." The accent is on the "here," and the implication is that it doesn't play elsewhere. That's my cue to speak up.

"Look, lady," I say. "A radio is a radio. If it plays here it'll play there . . ."

"Never mind the Gertrude Stein," she says, impaling me with a look. "I know a radio is a radio. But it won't play at my house. Nothing but noise comes out."

The cop looks weary now. "What's the score here?" he asks. "Did you gyp the lady like she says?"

"No!" I say, getting mad now. "This woman brings in a four-year-old radio and gives me the devil because it's noisy. I try it out and it works fine. She picks it up and the next thing I know she's back here with you. The radio plays, so tell her to take it home and leave me alone!" With that I head for the back room and dive into a five-band job with a burned-up bandswitch.

I hear voices out front for a while. Finally the door opens and closes, and I heave a deep sigh of relief.

"MISTER Newton," Pedro says, coming back and leaning on the bench. "MISTER Newton, you've got to be pretty smart to be a radio man, don't you?"

"Yeah, Pedro," I say. "I guess you do."

"Kind of like being a detective, ain't it?" says Pedro, dreamily.

I don't get it, and say so.

"I mean you got to find a clue, and then you figure what's wrong by inductant reasoning," says Pedro. "And then you fix it."

"Yeah," I murmur, trying to shove a ⅜-inch shaft through a 5/16-inch hole. "Yeah, I guess so."

"Well I got a clue," says Pedro, starting out front. "And the Senora will be back again."

"Whattya mean?" I holler, pulling my head out of the chassis. "If that old bag comes back again, tell her I've left for Pomona!"

I finally get my bandswitch wired up, and start out with the truck to make my weekly pick-ups and deliveries.

When I get back Pedro greets me very formally.

"MISTER Newton," he says, smiling a knowing, superior smile. "The lady was back again, and this time she brought two cops. Her radio still doesn't work, and she said to tell you she was swearing out a warrant for your arrest."

"Oh no," I groan. "Why does everything have to happen to me?"

"She is charging you with 'fraudulently obtaining money under false pretenses'," Pedro reads from a scrap of paper on which he has taken notes. "She claims you sold her a radio for twenty dollars, that said radio carried a guarantee, that she has returned it to you three separate times to have some adjustment made, that you have persistently and stubbornly refused to give her any satisfaction, and that you have, before witnesses, insulted her and practically thrown her out of your shop."

"Pedro," I say, giving him the old eye. "Are you giving me the business?"

"No, MISTER Newton. That's what she said. Can she do it?"

"Of course not," I groan. "But she can try, and that's almost as bad. An old bag like that can cause trouble."

"I stalled her off," Pedro goes on, smiling beatifically. "She won't do anything until tomorrow."

"How come?"

"I told her if her radio didn't work right by tomorrow we'd give her a new one. That Stromberg-Carlson in the window." Pedro beams at me as if he's just done me a big favor.

"What?" I shout. "Were the cops here when you told her that?"

"Sure," says Pedro, calmly.

"That's fine," I say, slapping my fore-

head. "Witnesses yet!" I sink into a chair, and begin to twitch.

"How do you mean, witnesses?" asks Pedro.

"You know what that Stromberg-Carlson is worth?" I croak.

"Oh don't let that worry you, Herk . . . MISTER Newton," says Pedro. "She only gets that if her radio isn't fixed by tomorrow."

I just glare at him, speechless.

"The thing is," Pedro says, "we fix it before then."

"But there's nothing wrong with it!" I holler, finding my voice. "How can you fix something when there's nothing wrong with it?"

"She says it makes noises," Pedro goes on calmly. "And I got a clue."

"What kind of a clue?" I mumble.

"Well," he says, thoughtfully, "a radio that works here should work any place unless something is different. Right?"

"Yeah," I say, absently, wondering how many friends the old girl has, and how much business I'm able to lose. "Something different."

Pedro looks a little disappointed.

"Well," he says, "I know what's different there. She's got an outside aerial."

"That could be it!" I begin to see light. "Maybe it rubs against a rain pipe or something."

"Fire escape," says Pedro. "It rubs her fire escape."

"How do you know?"

"I sneaked over to her house and looked," says Pedro, a bit apprehensively. "While you were out. I wasn't gone but a minute. She lives in the next block."

"Even so," I say, "why should it start making a lot of noise all of a sudden?"

"She just started using it a couple of days ago," Pedro says. "Her nephew hooked it to the aerial for her. She told me about it this morning when you beat it back to the bench."

"Get her on the phone for me, Pedro," I say, taking off my coat and hanging it up.

He dials a number and hands me the phone. I recognize the voice at the other end when she answers it.

"Look, lady," I tell her, "if you'll take the aerial off your radio you won't get all that noise. Lady, believe me . . . The hell with your nephew, lady. Just take . . . Hello . . ." I hang up disgustedly. You can't talk to a dead wire.

I have a couple of calls next morning, and it's after ten o'clock when I get back to the shop. I enter apprehensively, making sure the Stromberg-Carlson is still in the window.

"Hi Herk," says Pedro, when I come in the door.

"What?" I say.

"I mean MISTER Newton," he says, smiling broadly.

"That's better," I say. "Heard from the old bag this morning?"

"Yup," says Pedro happily, producing a huge cake from beneath the counter. "She brought us this." There's a large wedge missing, and crumbs of

icing about Pedro's mouth show its hiding place.

"Huh?" I say, staring blankly. "Who did?"

"The old blister," says Pedro, handing me a piece of cake. "She baked it for us because we fixed her radio last night."

"Huh?" I say. "We did?"

"Sure," says Pedro. "I told her we fixed it by remote control, and she's very happy." He shoves a slice of cake into his mouth all at once.

"Yeah," I stammer. "But . . . but . . . how . . . ?"

"Easy Herk," he says, through his cake. "Figured it out by inductant reasoning. I climbed her fire escape last night, cut out a hunk of aerial lead-in, and tied a piece of brown twine in its place." He licks his fingers. "She'll never know the difference, and now her radio works."

"Nice work, kid," I say, eyeing him reverently. "Good work, Pedro!"

"Senor Pedro," he says sternly. "With the accent on the 'Senor'."

"Okay, SENOR Pedro," I say, laughing. "You win, SENOR."

"Good cake, Herk," says SENOR Pedro. "Have some cake, Herk!"

REPAIR TIPS

(Continued from page 49)

When the set has distorted tone, set the voltmeter on a high range shunt meter between output tube grid and ground. If tone clears up, replace grid resistor. To check whether a tube or bias resistor is wrong, set meter on the 20-volt range and place across resistor. A normal reading for that tube usually means that both tube and bias are O.K. A full-scale reading (against the peg) means the resistor is bad. If plate voltage is O.K., a low bias reading means a bad tube (or shorted bypass or tone-control condenser).

When the radio distorts on locals and sounds O.K. on distant stations, place meter (250,000 ohms or more on 250-volt or higher range) between chassis and a.v.c. lead of r.f., antenna and i.f. coils. If tone clears up, there usually is an open series or a.v.c. load resistor. You can think of more tests of this nature. Remember, unless you are sure, to set meter range to correspond to B-plus voltage of radio.

I don't think 10% of the servicemen use an output meter. Try this to convince yourself that one is necessary. Align a radio by ear, then hook output meter and touch up the trimmers. You can still make the meter climb a little more, can't you? Another thing some servicemen don't use is a series condenser when aligning r.f. and antenna stages. Remember the test oscillator puts a load on the input tuned circuit and the alignment will be off. Use a small (250 μμf) mica condenser with coil inputs. Hook the oscillator to a small loop and place it close to radio loop for sets with loops or hook the oscillator to something that isn't connected to the radio and the loop will pick signal up without being loaded.

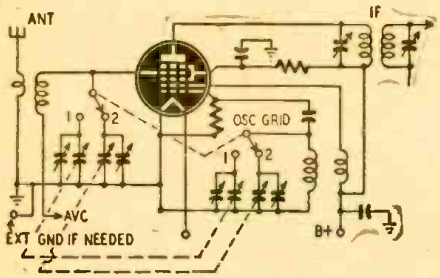
A little carbon tet or cleaning agent used on the variable condenser at each end of shaft and on the shaft that turns pointer and gang condensers will clear up those tuning rasps and noises. Squirt a few drops in the volume control and clean contacts on wave band switch and phono-radio switch with a small brush. This takes out a whole lot of unwanted noise. Never use sandpaper on these contacts—it ruins them.

Here's a simple trick I've showed several servicemen. To find out where and what plates in the variable condensers are shorting, they used a magnifying glass and an ohmmeter and usually got nowhere. Unhook all wires from the stator plates and connect one stator to the B-plus in the radio. Turn shaft and look for sparks and there is your short. Don't keep a short on B-plus too long. (Better put a resistor in series.—*Ed.*)

In one instance I had a small Westinghouse which had been to four radio shops and then sent to the distributor to cure a hum. All condensers were replaced and the hum was still bad. I placed a 'scope on the grids of the two push-pull 25L6's and a hum pattern was seen. The coupling condensers were unhooked and a pattern was still seen at the grids. Both 25L6's had cathode-to-heater short! These tubes had been checked many times. I checked them on a Precision, Sylvania, Supreme and a Superior and they didn't show the short. *Use your 'SCOPE IF YOU OWN ONE. It's no good AS A DUST CATCHER.*

STATION SWITCHING

Sometimes, when I am listening to a radio program, someone else wants to listen to another station for a few seconds to catch a time signal or a weather report. I made the change shown in the diagram to avoid retuning the receiver.



An additional tuning condenser, just like the one already in the receiver, is added, with a d.p.d.t. switch to choose the desired condenser. One condenser is tuned to each station. To change from one station to the other, simply throw the switch.

A rotary wafer switch is best, and leads should be as short as possible.

GILBERT RUST,
Evanston, Ind.

VACUUM-TUBE VOLTMETER

The vacuum-tube voltmeter illustrated here uses few parts and is simple to build It has five d.c. voltage ranges at an input resistance of 11 megohms and five a.c. voltage ranges at a sensitivity of 5,000 ohms per volt. Maximum voltage on both scales is 800. There are also five resistance ranges up to 5 megohms. A single 1.5-volt flashlight cell is used for all resistance measurements.

The instrument is a.c.-operated and uses a 6SN7 as the indicator tube and a 6X5 as the rectifier. A VR-105 regulator tube prevents voltage fluctuations and improves the stability of the circuit.

The zero-adjust and ohms-adjust potentiometers are mounted on the panel, but the calibrating potentiometer R is mounted at the rear of the chassis. This control has a lock nut to prevent the calibration from being changed accidentally.

The v.t.v.m. is calibrated by setting it to the 2-volt d.c. scale and then touching the d.c. probe to the positive terminal of the internal dry cell. R is then adjusted till the meter reads 150 microamperes. The meter is now ready for use.

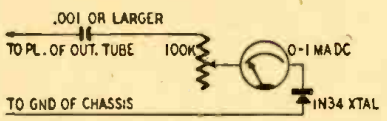
F. STUMPF,
West New York, N. J.

CRYSTAL OUTPUT METER

Here is an audio output meter which can be put together quickly. A 0-1 d.c. milliammeter and a crystal rectifier (many obtainable as surplus) are the only necessary items, besides a paper condenser and a potentiometer from the junk-box.

While the diagram shows a 100,000-ohm potentiometer, any value near this can be used. The condenser may be of any value from about .001 μf up.

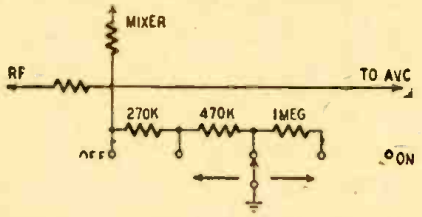
After connecting the assembly between the plate of the output tube and ground, set the potentiometer for maximum resistance. Then turn the receiver on, apply the signal and adjust its level. Next, decrease the value of the variable resistor slowly until a meter reading is obtained. Be careful not to decrease resistance too fast—a burned-up meter (and crystal) may result.



SAMUEL E. MCKINNEY,
Folcroft, Pa.

A.V.C. CONTROL

I have found that the ability to control the a.v.c. voltage in my communications-type receiver is a decided advantage when receiving certain types of signals, when the a.v.c.-manual switch alone does not give the desired effect.



The switch in the diagram shows an on and off position for the a.v.c. with two intermediate steps, but any desired number of steps could be added. A 2-megohm potentiometer might be used in place of the switch to give continuous control.

A. C. COGGON,
Mahone Bay, Nova Scotia

MIKE CONNECTION

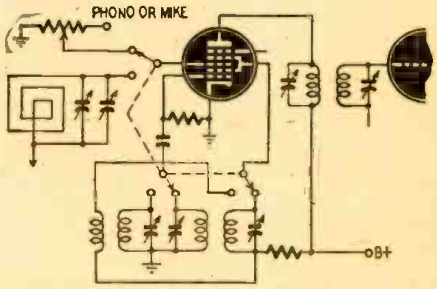
I tried to connect a microphone and a phonograph to the audio section of my small superheterodyne, but found there was not enough gain. Rather than add a preamplifier, I used this circuit.

An old i.f. transformer, of the same frequency as the set's i.f., was installed near the oscillator coil. The switch connects this in place of the oscillator coil and substitutes the phono or mike for the antenna coil at the mixer tube.

The oscillator puts out a signal which is modulated by the mike or phono, amplified by the receiver's i.f. system, and detected. Loudspeaker output is very satisfactory.

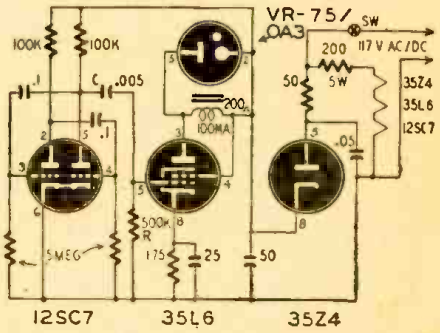
While this system will have enough gain for most phonograph pickups, only high-output microphones will work.

JIM NERISON,
Minneapolis, Minn.



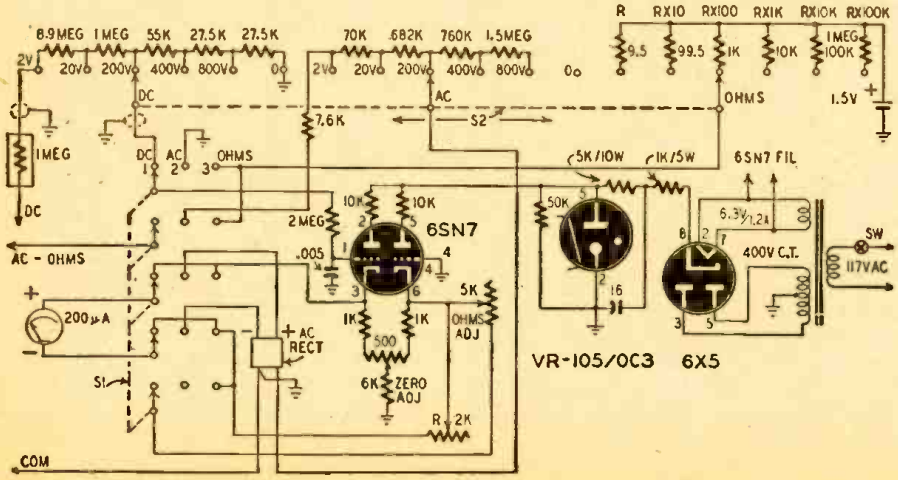
ELECTRONIC FLASHER

This device gives a strong, brief flash of light about once a second. It was designed for a shop window display. A 12SC7 is connected as a multivibrator. The circuit values are chosen to give a low oscillation frequency—about 1 cycle per second. The output is differentiated by the network R and C, and sharp pulses amplified by the 35L6 are developed across the output choke. A neon lamp, or in this case an OA3/VR-75 tube connected across the choke will flash briefly in step with the frequency.



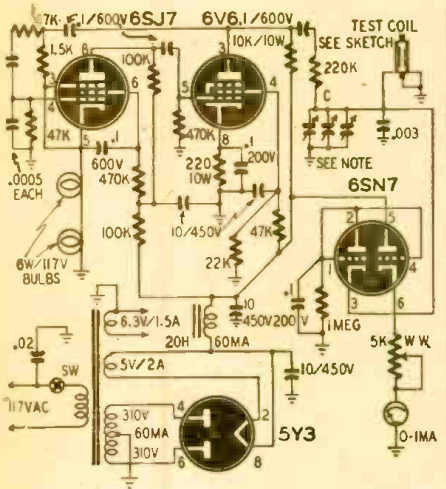
The power supply is conventional, but a selenium rectifier may be substituted for the 35Z4 if the filament-dropping resistor is changed to 460 ohms at 20 watts.

ALFRED HAAS,
Annecy, France



TRANSFORMER CHECKER

Whether the experimenter winds his own transformers or uses commercial types, a shorted section or turn of the inductor can cause a lot of trouble. Using ordinary methods, such shorts are often very difficult to find. With the instrument diagrammed, even one short-



NOTE: C-3 GANG 410 μμf, SLIGHTLY DETUNED FOR MAX. SENSITIVITY

DIMENSIONS IN INCHES

1500 T. N° 30 E NAM. THIN LAYER WOUND ON PAPER INSULATION

ed turn of No. 33 wire is easily discovered.

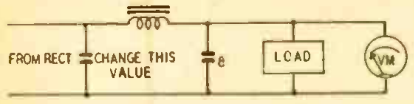
The 6SJ7 and the 6V6, with their associated components, form an R-C audio oscillator. The test coil is connected to the oscillator and is tuned by condenser C to the oscillator frequency.

When an a.f. or power transformer or choke with a shorted turn or section is held close to the test coil, the vacuum-tube voltmeter, composed of the 6SN7 and the 0-1-ma instrument, deflects, showing that the oscillator frequency has been affected.

GUENTER BORCHERT,
Sao Paulo, Brazil

VOLTAGE REDUCTION

Output voltage from a power supply can be reduced without the use of bleeder or series resistors. Change the value



of the input filter condenser until the desired voltage appears across the load. This value usually is between 0.25 and 2 μf.

Any increased hum may in most cases be cancelled by increasing the size of the output filter condenser.

G. N. CARTER,
Nanaimo, B.C., Canada

(Where hum remains high, an additional resistor and condenser may be inserted to filter the supply to all stages before the output. Wattage of the resistor may be much lower than that of one used to filter the whole supply.—*Editor*)

RADIOMEN'S HEADQUARTERS — WORLD WIDE MAIL ORDER SERVICE!!!

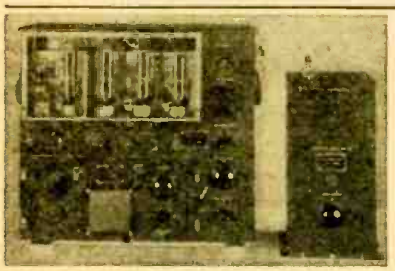
DUE TO POPULAR DEMAND WE REPEAT THESE TERRIFIC BARGAINS

Three assorted new MICROPHONES, including push-to-talk type $1.49
Ten assorted R. F. Chokes including high frequency types ..... $ .35
Five assorted AUDIO or FILTER CHOKES ..... $ .99
One Hundred assorted RESISTORS $1.95
Ten assorted JAN CABLE CONNECTORS, including SCR274,522 and BC375 types ..... $ .99
Six assorted OIL FILLED CAN TYPE CONDENSERS, all with mounting brackets $1.49
Ten assorted METAL & BAKELITE KNOBS—(no wooden knobs) ..... $ .39
Six assorted VARIABLE CONDENSERS, including butterfly types $1.49
Six assorted POWER and AUDIO TRANSFORMERS, all new $1.98
Six assorted isolantite and bakelite R. F. COILS, shielded and unshielded ..... $ .99

The above ten assortments totaling over $12.00 at the unbelievable bargain prices listed can be purchased together as one lot at a super-special total price of only $10.00. All merchandise guaranteed to be as advertised.

BRAND NEW INVERTERS AND DYNAMOTORS

PE 6A: A 24 to 32 V DC input, to 80 V. AC regulated output converter $12.95
PE 19A: A 24 to 28 V DC input, to 80 V AC at 800 cps output $9.95
(We include a stepup transformer with each of the above so that 110 V AC is available from either.)
27 V DC input 285 V DC @ 75 MA output 98c
27 V DC input. Output 300 V @ 150 MA, 150 V @ 15 MA and 12 V @ 5 Amp. $5.95
12 V DC input. Output 300 V @ 150 MA, 150 V @ 15 MA and 12 V @ 5 Amp. $12.00
13 or 26 V DC input. Output 800 V DC, 400 V DC @ 135 MA, and 9 V AC $15.00
(By running on 6 V AC, 60 cycle input, with a small amount of DC for field excitation, the above dynamotor will provide a good source of 12, 24, 400 or 800 V DC.)



GENERAL ELECTRIC 150 WATT TRANSMITTER

Cost the Government $1800.00
Cost to you $44.50!!!!

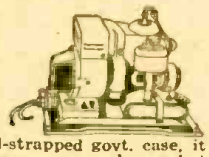
This is the famous transmitter used in U.S. Army bombers and ground stations, during the war. Its design and construction have been proved in service, under all kinds of conditions, all over the world. The entire frequency range is covered by means of plug-in tuning units which are included. Each tuning unit has its own oscillator and power amplifier coils and condensers, and antenna tuning circuits—all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle, and the milliammeter, voltmeter, and RF ammeter are mounted on the front panel. Here are the specifications: FREQUENCY RANGE: 200 to 500 KC and 1500 to 12,500 KC. (Will operate on 10 and 20 meter band with slight modification). OSCILLATOR: Self-excited, thermo compensated, and hand calibrated. POWER AMPLIFIER: Neutralized class "C" stage, using 211 tube, and equipped with antenna coupling circuit which matches practically any length antenna. MODULATOR: Class "B"—uses two 211 tubes. POWER SUPPLY: Supplied complete with either 12 or 24V dynamotor (SPECIFY), which furnishes 1000V at 350 MA. Complete conversion instructions for 10 and 20 Meter bands as well as 110V AC modifications are furnished. SIZE: 21½x23x9¼ inches. Total shipping weight 200 lbs., complete with all tubes, dynamotor power supply, five tuning units, antenna tuning unit and the essential plugs. These units have been removed from unused aircraft but are guaranteed to be in perfect condition.

TERRIFIC VALUE— PORTABLE ELECTRIC DRILL

Sold at less than established factory price so we cannot mention brand name)

Only $19.95 equipped with ¼" Jacobs Geared Chuck and Key.
Not an intermittent duty drill, but a full size rugged tool.
Most convenient type switch, natural grip handle and balance like a six shooter.
Precision cut gears—turbine type cooling blower—extra long brushes.
No stalling under heaviest pressure because of powerful 110 Volt AC-DC motor and multiple ball thrust bearing.
Other bearings self-aligning lifetime-lubricating Chrysler Oilite type.
Made for toughest year-in and year-out service in plant or on construction jobs.
Amazing perpetual factory guarantee assures you of a lifetime of trouble-free use.
25% deposit on C.O.D.'s. Full refund (you pay transportation) if not pleased with drill after trial.

PE-109 32-Volt DIRECT CURRENT POWER PLANT



This power plant consists of a gasoline engine that is direct coupled to a 2000 watt 32 volt DC generator. This unit is ideal for use in locations that are not serviced by commercial power or to run many of the surplus items that require 24-32V DC for operation. **The price of this power plant is only $58.95. We can also supply** a converter that will supply 110v AC from the above unit or from any 16-32V DC source for $12.95.
Due to the fact that the PE-109 comes to us sealed in a heavy steel-strapped govt. case, it is impossible to inspect the individual units to determine if they are new or used, or what the condition is if used. Consequently we must sell them "as is." In general they represent a terrific bargain.

STEATITE VARIABLE CONDENSERS

Ideal for high-frequency applications in receivers and low power transmitter stages. All types have standard ¼" dia. shafts.

10 mmf	$.35	10 for	$2.90	100 for	$23.00
15 mmf	$.35	10 for	$2.90	100 for	$23.00
25 mmf	$.35	10 for	$2.90	100 for	$23.00
35 mmf	$.40	10 for	$3.40	100 for	$28.00
50 mmf	$.45	10 for	$3.70	100 for	$30.00
75 mmf	$.50	10 for	$4.40	100 for	$38.00
100 mmf	$.55	10 for	$4.50	100 for	$39.00
140 mmf	$.80	10 for	$7.40	100 for	$64.00
160 mmf	$1.00	10 for	$8.50	100 for	$70.00
140-140 mmf	$1.60	10 for	$12.50	100 for	$100.00

Screw Driver Adjustment

$.20	10 for	$1.80	100 for	$16.00
$.20	10 for	$1.80	100 for	$16.00
$.20	10 for	$1.80	100 for	$16.00
$.25	10 for	$2.30	100 for	$20.00
$.25	10 for	$2.30	100 for	$20.00
$.30	10 for	$2.70	100 for	$25.00
$.40	10 for	$3.60	100 for	$32.00

Butterfly condensers, rotor has two ball bearings and a ¾" shaft.

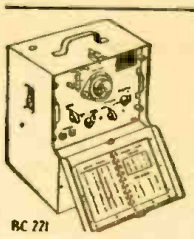
15 mmf. per section $.50—10 for $4.50—100 for $40.00
30 mmf. per section $.60—10 for $5.50—100 for $50.00
50 mmf. per section $.70—10 for $6.50—100 for $60.00

Manufacturers and distributors write for prices on larger quantities.
WE HAVE OVER 250,000 VARIABLE CONDENSERS IN STOCK.
Minimum order $3.00—All prices subject to change—25% deposit with C.O.D. orders

UNIVERSAL MICROPHONE CO.'S latest model recorder platform with high quality recording amplifier complete with all necessary controls for volume, tone, playback, record, and public address applications. Unit features crystal playback and magnetic recorder head attached by special pantographic arrangement for making absolutely linear recordings. Complete with all tubes and matched speaker. Everything supplied but the cabinet for **$46.95**

TUBES—All types in stock, 60% off on all tubes if ordered in lots of 10 or more.
TRANSFORMERS—All types in stock. **AUTO-TRANSFORMERS:** Steps up 110v. or steps down 220v to 110v—$1.95.
FIL. TRANS.: 6.3v, 20 Amps.—$1.98; Universal Output Trans. 8 Watt—89c; 18 Watt—$1.29; 30 Watt—$1.69. **AUDIO TRANSFORMERS:** S. Plate to S. Grid, 3:1—79c; S. Plate to P.P. Grids—79c; Heavy Duty Class AB or B. P.P. inputs—$1.49; Midget Output for AC-DC sets—69c; **MIKE TRANSFORMER** for T-17 Shure microphone, similar to UTC ouncer type—$2.00 Stancor SB or DB mike to line or grid—$1.95.

MIDGET 1 WATT RIG supplied complete with polystyrene coil forms for 3 ham bands. Size overall 3"x1"x2½" high. Includes practically all necessary parts. Details on page 62 of January 1948 QST. Your cost $1.50
Battery pack for the 1 watt transmitter supplying 90 volts "B" and 1.5 volts "A" $1.50
110 V. AC power supply kit for the 1 watt transmitter ... $3.50



BC-221 FREQUENCY METERS with calibrating Crystal and calibration charts. A precision frequency standard that is useful for innumerable applications for laboratory technician, service man, amateur, and experimenter at the give away price of only **$36.95.**

RT-1655—11 tube crystal controlled superhet receiver for 24-28V DC operation. Beautiful chassis and cabinet. Uses latest tube types including 7 miniature 6AJ5's. Tubes and schematic supplied. Only a few available at $14.95

Aluminum gear box 18x8x7 that contains two powerful electric motors and two matched gear-trains, 62 gears in all varying in size from ½ to 4 inches in diameter. This unit is readily converted to rotate a beam antenna or any other similar use..... $3.00

MODULATION TRANSFORMERS—10 watt, metal case 98c; 30 watt, open-type, $1.95; 40 watt, cast aluminum case, $2.95; Class "B" input transformers, cast aluminum case, $1.95; Transceiver audio transformers, 65c; Transceiver modulation transformers, 65c.
MINIATURE PLIERS SET contains one of each of the following: Needle nose, flat nose, parrot nose, standard nose. All contained in a leatherette case. Your cost—$1.98.
SOCKET WRENCH SET consisting of 5 sockets ranging in size from 5/16 to ½" and a handle—79c.
AUTOMATIC WIRE STRIPPERS will strip up to 1000 wires per hour, a handy tool for any service job—$3.52.

GENERAL ELECTRIC RT-1248 15-TUBE TRANSMITTER-RECEIVER

TERRIFIC POWER—(20 watts) on any two instantly selected, easily pre-adjusted frequencies from 435 to 500 Mc. Transmitter uses 5 tubes including a Western Electric 316 A as final. Receiver uses 10 tubes including 955's, as first detector and oscillator, and 3—7H7's as IF's, with 4 slug-tuned 40 Mc. IF transformers, plus a 7H7, 7E6's and 7F7's. In addition unit contains 8 relays designed to operate any sort of external equipment when actuated by a received signal from a similar set elsewhere. Originally designed for 12 volt operation, power supply is not included, as it is a cinch for any amateur to connect this unit for 110V AC, using any supply capable of 400V DC at 135 MA. The ideal unit for use in mobile or stationary service in the Citizen's Radio Telephone Band where no license is necessary. Instructions and diagrams supplied for running the RT-1248 transmitter on either code or voice in AM or FM transmission or reception, for use as a mobile public address system, as on 80 to 110 Mc. FM broadcast receiver, as a Facsimile transmitter or receiver, as an amateur television transmitter or receiver, for remote control relay hookups, for Geiger-Mueller counter applications. It sells for only $29.95 or two for $53.90. If desired for marine or mobile use, the dynamotor which will work on either 12 or 24V DC and supply all power for the set is only $15.00 additional.

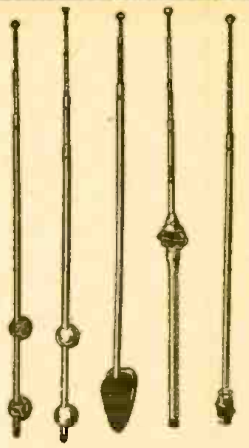
Cable Address: BUFRAD

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. 7 C. BUFFALO 3, N. Y.

RADIOMEN'S HEADQUARTERS — WORLD WIDE MAIL ORDER SERVICE!!!

BUFRAD CAR RADIO ANTENNAS

All of our car radio antennas are made of triple plated Admiralty Brass Tubing, complete with low loss shielded antenna leads and high quality fittings.
SIDE COWL—BR-1, 3 sections extend to 66". Your price—single units—$1.50; in lots of 12—$1.35 ea.
SKYSCRAPER—BR-2 has 4 heavy duty sections that extend to 98". Your price—single units—$2.45; in lots of 12—$2.25 ea.
TILT ANGLE—BR-3, may be adjusted to all body contours. 3 sections extend to 66". Single unit price—$1.50; 12 lot price—$1.25 ea.
VERSATILE—BR-4, single hole fender or top cowl mounting may be adjusted to conform with all body contours. 4 sections extend to 56". Single unit price—$2.90; 12 lot price—$2.75 ea.
THE MONARCH—BR-5, single hole top cowl mounting, 3 sections extend to 56". Single unit price—$1.90; 12 lot price—$1.75 ea.
AFTER SEEING OUR ANTENNAS AND COMPARING, YOU WILL NEVER BUY ANY OTHER MAKE!



BR1 BR2 BR3 BR4 BR5

BENDIX SCR 522—Very high Frequency Voice Transmitter-Receiver—100 to 156 MC. This job was good enough for the Joint Command to make it standard equipment in everything that flew, even though each set cost the Gov't $2500.00. Crystal Controlled and Amplitude Modulated—HIGH TRANSMITTER OUTPUT and 3 Microvolt Receiver Sensitivity gave good communication up to 180 miles at high altitudes. Receiver has ten tubes and transmitter has seven tubes, including two 832's. Furnished complete with 17 tubes, remote control unit, 4 crystals, and the special wide band VHF antenna that was designed for this set. These sets have been removed from unused aircraft and are guaranteed to be in perfect condition. We include free parts and diagrams for the conversion to "continuously variable frequency coverage" in the receiver.

The SCR 522 complete with 24 volt dynamotor sells for only $37.95. The SCR 522 is also available with a brand new 12 volt dynamotor for only $42.95.

FILTER CHOKES: 200, 300, 400, 500 ohm light duty—59c; 200 or 300 ohm heavy duty—99c; 250 ma 35 ohm, made for U.S. Navy, fully shielded—$1.95; 75 ohm 125 ma—25c or 25 for $4.25; "Meissner type" tapped filter chokes—25c; 8 amp. iron core A filter—25c; Choke-condenser combination, ideal to replace any size speaker field when installing PM speaker—79c. **110V. CIRCUIT BREAKERS** of Magnetic type; Following Current Ratings in Stock: 1.25, 3, 4, 8 Amps. Please specify. $1.95 each.

SEVEN ASSORTED I.F. TRANSFORMERS—$1.98: Five Asstd. Oscillator Coils—69c.

METER RECTIFIER—Full wave, may be used for replacement, or in construction of all types of test equipment—$1.25. Half Wave—90c.

FLUORESCENT LIGHT BALLASTS. Single 30 or 40 watt $1.68; Dual 40 watt High Power Factor—$3.75.
HEADPHONES—Highest quality Signal Corps headsets with 12" cord and plug $1.25. 5' rubber covered patchcords with phone plug and socket—45c.
LINE FILTERS—110V—each unit contains two 2 mfd. oil filled condensers and a 15 amp. iron core choke. This filter has innumerable uses such as oil burner line filter, etc. A ten dollar value for 98c.
SELENIUM RECTIFIERS—Dry disc type 1½", 1", 1.2 Amp. maximum, suitable for converting DC relays to AC, for supplying filament source in portable radios, converting DC meters to AC applications, and also may be used in low current chargers—90c.

AUTO RADIO DEALERS! ATTENTION!

Nationally advertised brand of 1948 car radio which will fit practically any car and every pocketbook. Six tube superheterodyne with three gang condenser and 6½" speaker. **$32.20 for sample, or Dealer price $29.97 each, in lots of two or more.**
Here is an item that no serviceman who repairs auto radios should be without. Nationally advertised ATR battery eliminator that supplies perfectly filtered 6 VDC at 14 amps, from 110 AC $36.00

AT LAST YOU CAN AFFORD A LABORATORY STANDARD MICRO VOLTER

The famous Measurements Corp. Model 78E, 5 Tube Laboratory Standard Signal Generator (that sold new, FOB Boonton, N. J., for $310.00 net) is available in perfect condition for 25 to 60 cycle, 115 V AC operation. Until now this is the sort of top-flight lab equipment that discriminating buyers have only vainly hoped would be released at a bargain price. Worth every cent the manufacturer asks, but available FOB Buffalo while our limited supply lasts for only $59.95.
Such companies as Admiral Corp. and John Meck, Inc., have ordered from us and repeated many times on these 78 generators for use in their labs and production line testing.

Model 78-E Standard Signal Generator.

MICROPHONES—All nationally known brands. Bullet crystal—$5.45; Bullet Dynamic—$7.45; Mike Jr.—60c; Handy Mike—90c; Lapel Mike—83c; SHURE T-17 MIKES, with push to talk switch—99c.
20 ASST'D COIL FORMS, including 11 ceramic, 3 polystyrene, and 6 fiber, all useful sizes—50c.
VARIABLE CONDENSERS: 350 MMFD, 5 gang—$1.95; 4 gang—$1.49; 3 gang—83c; 7.5 to 20 MMFD, 1750v spacing, extra long shaft Hammarlund—69c; miniature variables, 25 MMFD—39c; 50 MMFD—49c; 75 MMFD—59c; 100 MMFD—69c; 140 MMFD—79c.
INTERRUPTION FREQUENCY COILS for super-regenerative receivers or the tremendously popular FM adapters for standard broadcast sets. Iron core with a resonant frequency of 50 KC—39c; Air Core, 100 KC—29c.
30 MC IF TRANSFORMERS, double slug tuned—25c.
30 MC VIDEO AMPLIFIER PLATE COILS—Slug tuned—25c.
REMOTE CONTROL UNIT: Aluminum case 4x3x2" containing 2 potentiometers, triple pole switch, 4 knobs, gear mechanism, counter and phone jacks—59c.

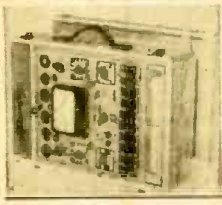
POWER TRANSFORMERS—Half-shell type, 110V, 60 cy. Centertapped 11V winding. Specify either 2.5 or 6.3V filament when ordering.

For 4-5 tube sets—650V, 40MA, 5V & 2.5 or 6.3V	$1.49
For 5-6 tube sets—650V, 45MA, 5V & 2.5 or 6.3V	1.75
For 6-7 tube sets—675V, 50MA, 5V & 2.5 or 6.3V	1.90
For 7-8 tube sets—700V, 70MA, 5V & 6.3 or two 2.5V	2.35
For 7-8 tube sets—700V, 70MA, 5V & 6.3 (25 Cycle)	3.60
For 8-9 tube sets—700V-90MA, 5V-3A, 2.5V-3.5A, 2.5-10.5A	2.85
For 9-11 tube sets—700V, 5V & 6.3V-4A	2.85
For 9-15 tube sets—800V, 150MA, 5V & 6.3V	2.95

CONDENSERS—PAPER TUBULAR 600 WV—.001, .002, .005—8c; .01, .05—9c; .1—10c; .25—23c; .5—35c; **ELECTROLYTICS:** 8mfd 200v—20c; 10mfd 35v—20c; 30mfd 150v—23c; 20/20mfd 150v—35c; 30/20 150v—46c; 50mfd 150v—43c; 8mfd 475v—34c; 16mfd 350v—65c; **OIL CONDENSERS:** 4mfd 600v 49c; 2mfd 600v—29c; 3X.1mfd 600v—29c.

SPEAKERS—These PM speakers are the finest that are available. All have heavy overside Alnico V magnets.

3½"	$1.15	6 for	$6.60
4"	$1.15	6 for	$6.60
4x6 (oval)	$1.95	6 for	$11.40
5"	$1.10	10 for	$9.50
6"	$1.50	6 for	$8.70
7" (Car Radio Size)	$4.50	6 for	$21.50
8" 10 oz.	$3.95	6 for	$20.50
8" 21 oz.	$4.95	6 for	$26.50
10" 21 oz.	$5.50	6 for	$30.00
12" 21 oz.	$7.95	6 for	$42.00



1948 MODEL MUTUAL CONDUCTANCE TUBE TESTER $49.95

No possibility of good tubes reading "Bad" or bad tubes reading "Good" as on dynamic conductance testers or other ordinary emission testers. Attractive panel and case equal to any on the market in appearance. . . . Large 4½" meter. . . . Calibrated micromho scale as well as a Bad-Good scale. . . . Front panel fuse. . . . Individual sockets for all tube base types—voltages from .75 volts to 117 volts and complete switching flexibility allow all present and future tubes to be tested regardless of location of elements on tube base. . . . Indicates gas content and detects shorts or opens on each individual section of all loctal, octal and miniature tubes including cold cathode, magic eye and voltage regulator tubes as well as all ballast resistors. Name of the nationally known manufacturer withheld because of special price offer.
Model "C"—Sloping front counter case $49.95
Model "P"—Handsome hand-rubbed portable case 54.95
Built-in- roll chart with either of above $5.00 extra.

1948 MODEL OUTBOARD MOTOR AT DEALER WHOLESALE PRICE!!

Powerful deluxe twin cylinder outboard motor with automatic starter (no fumbling for a rope), a positive cooling unbreakable water pump, and an improved magneto for sensationally quick starts as well as smooth, efficient operation at slowest trolling speed or with the throttle wide open. Dozens of additional outstanding features are provided, such as corrosion resistant aluminum alloy castings, to protect the engine and give the unit a sleek, streamlined appearance; hardened alloy steel connecting rods with roller bearings, and a rugged perfectly balanced crankshaft. Delivers a full 7.5 H.P. as rated by the Outboard Boating Club of America. Net weight 52 lb. Gross shipping weight including free steel storage stand 100 lb. For a limited time we are selling this motor, which is produced by the world's second largest maker of outboards to sell for more than $30.00 above our Price—for only $139.00, brand new, FOB Buffalo.

SELENIUM RECTIFIERS. All types are rated at 130 V.A.C. Do not assort to make quantity.

25 MA	$.45	10 for $4.00	
75 MA	.70	10 for 6.50	50 for $31.00
100 MA	.75	10 for 7.00	50 for 32.50
150 MA	.80	10 for 7.50	50 for 35.00
200 MA	1.05	10 for 10.00	50 for 47.50
250 MA	1.25	10 for 12.00	50 for 57.50

Cable Address: BUFRAD

CLOSING OUT

THE FOLLOWING DESIRABLE ITEMS AT SACRIFICE PRICES TO MAKE ROOM IN OUR WAREHOUSE FOR INCOMING STOCK

AIRPLANE INTERCOM AMPLIFIER—Complete with 4 tubes in aluminum case $4.95
5" "SO" RADAR P.P.I. SCOPE, complete with 9 tubes, Selsyn motor and self-contained 110 V power supply designed to run on the AC supply on LST and PT boats. Various ranges from 2 to 80 miles. The most satisfactory scope available for navigational radar or panoramic television applications. Nationally advertised as surplus at $100.00 by others. **Our price only $39.95**
AIRCRAFT MARKER BEACON RECEIVER—Complete with dual purpose tubes and sensitive relay to control external circuits from received signals. Just the receiver you have been waiting for to control models, open doors from a distance, etc. **PRICED AT only $6.95**

$9.95 TAKES ALL THREE BIG BARGAINS

1. AUDIO AMPLIFIER Undreamed of value. Uses 6V6's. Has 4 microphone inputs brought to jacks at rear panel. Various output impedances available at rear panel connections. Steel case with chrome handles, 9" long x 9" high x 6" deep. Tubes included. New in original carton. Shipping weight 15 lb. SUPER SPECIAL—$4.95 while supply lasts.

2. RADIO HEADSETS Latest supersensitive type with rubber earpieces. Every pair guaranteed perfect. $.59 per pair OR 3 PAIRS FOR $1.00.

3. HOME WORKSHOP AT BARGAIN PRICE. Accurate and precise 2 speed guaranteed hobby lathe, the essential machine for the home workshop. Sturdy enough for light production work or factory standby service. Supplied with 56" of belting for connecting to any available electric motor or power take-off, such as on a jeep or tractor. Also included in this unbelievable offer are such accessories as a ½" drill chuck with specially hardened tool steel jaws, a 4" electric furnace high speed grinding wheel, a cotton buffing wheel with a large supply of buffing compound and a 4" steel wire scratch brush. Your cost $8.00. Sole export agent.

Satisfaction guaranteed or money refunded if returned prepaid within five days.

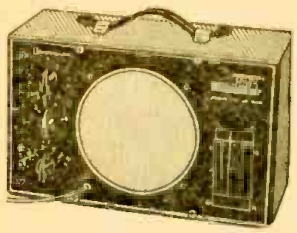
Minimum order $3.00—All prices subject to change—25% deposit with C.O.D. orders

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. 7 C. BUFFALO 3, N. Y.

SIGNAL TRACER

McMurdo Silver Co., Inc.
Hartford, Conn.

The Model 905A Sparx is a sensitive aural dynamic signal tracer incorporating an 18-watt universal output transformer and test speaker which may be used separately. A new vacuum-tube hand-size probe is provided with switchable tip to permit either r.f./i.f. or a.f. signal tracing without the usual single-probe distortion. Frequency range of probe and amplifier is 20 cycles through 200 megacycles for AM, FM, and TV signal tracing. Amplification is so great that loud signals are had from a built-in 6-inch PM speaker on local stations when the probe is connected to small loop antennas. Undistorted power output is 3.4 watts. Two panel switches and a chart provide any of 30 transformer primary impedances from 325 through 70,000 ohms, single tube and push-pull.

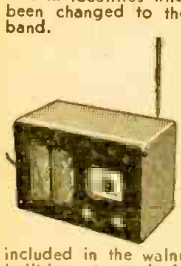


Model 910 is identical to Model 905A except that it does not include signal-tracing functions.—RADIO-CRAFT

FM POLICE RECEIVER

Radio Apparatus Co.
Indianapolis, Ind.

The R.A.C. Policalarm receiver allows police-call fans to listen to police dispatchers sending orders to squad cars in localities where equipment has been changed to the new FM police band.

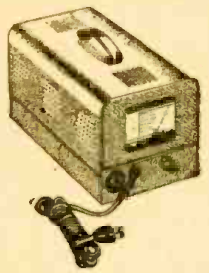


The receiver tunes from 152 to 162 mc, which also includes frequencies used by taxis and others mobile services. A superheterodyne circuit is used, with five miniature tubes and 10.7-mc i.f. A 5-inch speaker is included in the walnut cabinet, and a built-in antenna is furnished.—RADIO-CRAFT

D.C. CONVERTER

Electronic Laboratories, Inc.,
Indianapolis, Ind.

Many would-be television viewers live in areas where only d.c. power is available. The Model 110R15 converter is designed to furnish 15 to 150 watts of a.c. from a 110-volt d.c. line to operate table-model television receivers; the Model 110R30 furnishes 30 to 300 watts for console models.



The converters use vibrators. Output is filtered completely for broadcast, television, short-wave, and FM bands. Regulation is sufficient to obviate the necessity for any external control of voltage.

The autostart feature allows the converters to be placed in whatever location is convenient; operating the power switch of the receiver automatically turns on the converter, allowing the receiver to be used just as it would be if connected to an a.c. line.—RADIO-CRAFT

FREQUENCY STANDARD

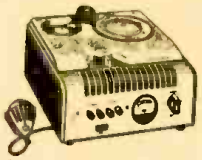
American Time Products, Inc.
New York, N. Y.

Type 2121A uses a hermetically sealed tuning fork as frequency control. It provides an accuracy of one part in 100,000, with a temperature coefficient of less than one part per million per degree Centigrade. Outputs are: 60 cycles, 0-110 volts at 0 to 10 watts (variable); 120-cycle pulses, 30 volts negative; 240-cycle pulses, 30 watts positive and negative. A clock is provided for comparing with time signals. Power input is 117 volts, 50 to 400 cycles at 45 watts.—RADIO-CRAFT

WIRE RECORDER

Webster-Chicago Corporation,
Chicago, Ill.

The Model 78 wire recorder makes use of the familiar Webster chassis containing the wire driving mechanism and the record, erase, and playback heads. The new unit provides a case for the chassis, together with the control switches and a properly calibrated volume indicator. Connections are provided to couple the recorder to the external amplifier or radio receiver necessary for recording and playback. Cords, plugs, and a microphone are furnished as well as a supply of wire.—RADIO-CRAFT



TUBELESS INTERCOM

Pa-Kette Electric Co.
Kearney, Nebr.

Intertalkie is a two-station intercom using no tubes. Power is supplied by three flashlight batteries. Loudspeaker volume is obtained, eliminating necessity for earphones. The unit is enclosed in a plastic case which can be placed on a desk or hung on the wall.

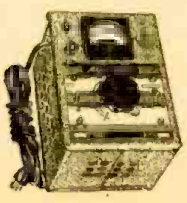
Multitalkie system uses up to seven of the tubeless stations. Each station connected to the system may call any of the others affording maximum flexibility in communication. — RADIO-CRAFT

LINE ADJUSTER

Standard Electrical Products Co.,
Dayton, Ohio

Adjust-A-Volt transformers are variable to give an output of 0-140 volts from a 117-volt a.c. line for test or special purposes or to provide manual regulation in areas where line voltage is unsteady.

The transformers are available with primary and secondary windings for isolation of equipment from mains, and as autotransformers where isolation is not necessary. Both types are available with built-in meters to indicate the output voltage.—RADIO-CRAFT



TV VIEWING LENS

Liquid Lens Corp.
Flushing, N. Y.

The All-Vue lens is made of specially prepared Dupont lucite, liquid-filled and permanently sealed. It is spherically designed to produce a perfect optical vision, and prefocused to eliminate adjustment. The lens enlarges the picture to 2½ times its original size.

Perception of a magnified television picture direct from the coating of the tube rather than from the reflecting and diffusing area between the coating and the front surface of the tube is the new patent principle. Sharper images, better contrasts of blacks and whites, a clearer picture, and increased depth, with reduced glare and eye strain, are obtained. The picture is visible over an angle of 180 degrees.—RADIO-CRAFT

NOISE SUPPRESSORS

Minnesota Electronics Corp.,
Saint Paul, Minn.

Three new Goodell dynamic noise suppressor amplifiers are announced. Each contains the H. H. Scott suppressor circuit.

Model NSA-2 is a 6-tube unit with response to 12,000 cycles and effective noise reduction of over 25 db. Separate phono and microphone inputs are selected by a panel switch. Power output is 10 watts.

Model NSA-1 includes a preamplifier with built-in equalizer for popular magnetic pickups and an electron-ray tube for observation of suppressor gating. Two-chasssis construction is used. Push-pull 807's give 18-watt power output.

Model NSAT-1 is similar to the NSA-1, but has four 6B4 push-pull parallel output triodes.—RADIO-CRAFT

SIX-INCH METERS

Marion Electrical Instrument Co.,
Manchester, New Hampshire

The Model 56 meter, measuring 6½ x 5¼ inches, fills the gap between 4½- and 8-inch meters. It has a 100-degree arc, 5½-inch scale length, and large open face, making it easily adaptable to multiarc dials. It is supplied in a number of current ranges.

The bakelite case is designed with extra heavy cross sections that stand up under the most rugged use. Versatility is augmented through the use of Alnico II magnets in all normal ranges and Alnico V's in the more sensitive microammeter ranges.—RADIO-CRAFT

MINIATURE RELAY

Advance Electric & Relay Co.
Los Angeles, Calif.

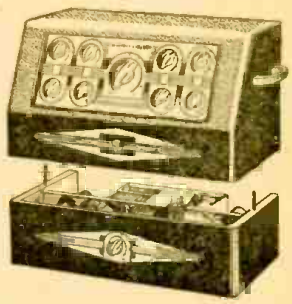
The Tiny Mite relay (type 000) is thought to be the world's smallest relay. Only 0.35 cubic inch in volume, this relay has s.p.d.t. contacts rated at 0.35 amp at 60 volts d.c. or 115 volts a.c. (resistive load). Its average power requirement is from 0.35 to 0.50 watt, but can be made less by careful adjustment. Laminated phenolic keeps contacts above ground. Tiny Mite can be supplied for any coil voltage from 1 to 50 volts d.c.—RADIO-CRAFT

BOOSTER AMPLIFIER

Setchell Carlson, Inc.
Saint Paul, Minn.

Several 25-watt output channels are made available by the PA722 master and the B422 booster amplifiers. The boosters fasten to the master with concealed tie bolts and connect with a simple plug-in.

The master amplifier has one phono and four microphone inputs, each with separate tone control, and 25-watt output with response flat to 8,000 cycles. Each 25-watt booster is flat to 10,000 cycles.—RADIO-CRAFT



MICROAMMETER

Radio Corp. of America
Camden, N. J.

This ultrasensitive electronic microammeter is capable of measuring currents as low as one-billionth of an ampere. A portable, battery-operated instrument, it can withstand overloads of 10,000% without damage to the meter movement.

Use of external multiplier resistors allows the microammeter to be used as a voltmeter with resistance as high as 1 megohm per volt or (with the addition of a 45-volt battery) as an ohmmeter to measure resistances up to 4,500 megohms.—RADIO-CRAFT

PHONO AMPLIFIER

Herman Hosmer Scott
Cambridge, Mass.

The type 210-A laboratory amplifier incorporating a new dynamic band-pass noise suppressor provides a complete phonograph system except for the turntable and loudspeaker. It is supplied with a matched variable-reluctance pickup cartridge.

The amplifier provides 20 watts output with less than 2% distortion. Below 8 watts, the distortion is under ½%. The output transformer is arranged to match speaker impedances between 2 and 500 ohms.

The frequency response of the amplifier exceeds 20,000 cycles—with the dynamic noise suppressor the response is flat to 10,000 cycles and extends to 16,000 cycles. Independent tone controls allow boost or attenuation at either end of the frequency range. A whistle filter is provided for AM reception.—RADIO-CRAFT

TEST LEADS

Koiled Kords, Inc.,
New Haven, Conn.

These test leads are somewhat similar in function to the spring-coiled telephone wires available from the telephone company. The 48-inch lengths in which they are sold can be cut to any size required by the user. In use, the leads, which are colored standard red and black, are pulled out to a convenient length. One foot of coiled lead will extend to 5 feet for use, and, when released, will spring back out of the way. Any type of pin plugs, prods or alligator clips may be attached.—RADIO-CRAFT

MONEY BACK GUARANTEE — We believe units offered for sale by mail order should be sold only on a "Money-Back-If-Not-Satisfied" basis. We carefully check the design, calibration and value of all items advertised by us and unhesitatingly offer all merchandise subject to a return for credit or refund. You, the customer, are the sole judge as to value of the item or items you have purchased.

The Model 88-A *COMBINATION*

SIGNAL GENERATOR AND SIGNAL TRACER

The Model 88 comes complete with all test leads and operating instructions.

ONLY $28.85 NET

The ultimate in signal tracing procedure is achieved by the Model 88, for the use of this model, enables you to use either the broadcast signal itself or the signal injected by the Signal Generator. This is especially useful of course when servicing "dead" or "intermittent" receivers. The Model 88 you will find is the greatest time-saver ever provided for by combining a full range Signal Generator and Signal Tracer into one unit the set up time for interconnecting, etc., is entirely eliminated.

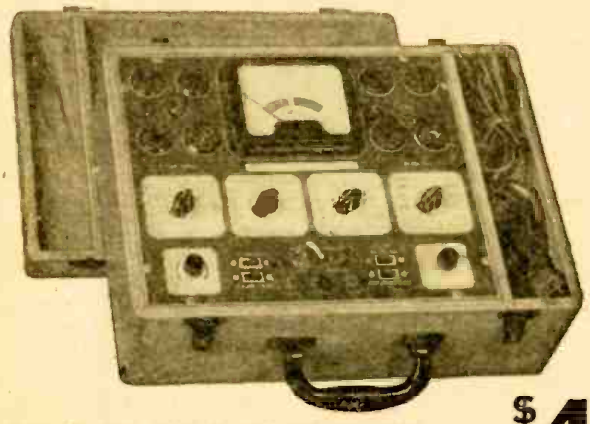
Signal Generator Specifications:

- ★ Frequency Range: 150 Kilocycles to 50 Megacycles.
- ★ The R.F. Signal Frequency is kept completely constant at all output levels. This is accomplished by use of a special grid loaded circuit which provides a constant load on the oscillatory circuit. A grounded plate oscillator is used for additional frequency stability.
- ★ Modulation is accomplished by Grid-blocking action which has proven to be equally effective for alignment of amplitude and frequency modulation as well as for television receivers.
- ★ Positive action attenuator provides effective output control at all times.
- ★ R.F. is obtainable separately or modulated by the Audio Frequency.

Signal Tracer Specifications:

- ★ Uses the new Sylvania 1N34 Germanium crystal Diode which combined with a resistance-capacity network provides a frequency range of 300 cycles to 50 Megacycles.
- ★ Simple to Operate—Clips directly on to receiver chassis, no tuning controls.
- ★ Provision is made for insertion of phones of any impedance, a standard Volt-Ohm Milliammeter or Oscilloscope.

The New Model 606 TUBE & SET TESTER



Model 606 comes housed in a beautiful hand rubbed oak cabinet complete with portable cover, test leads, tube charts, and detailed operating instructions—

ONLY $47.85 NET

A COMPLETE TUBE TESTER

- Tests all tubes including the new post-war miniature loctals such as the 12AT6, 12AU6, 35W4, 50B5, 11723, etc.
- Tests by the well-established emission method for tube quality, directly read on the scale of the meter.
- Tests shorts and leakages up to 3 Megohms in all tubes.
- Tests leakages and shorts of any one element against all elements in all tubes.
- Tests both plates in rectifiers.
- Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.

A COMPLETE MULTI-METER

- 6 D.C. VOLTAGE RANGES: 0 to 7.5/15/75/150/750/1,500 Volts
- 6 A.C. VOLTAGE RANGES: 0 to 15/30/150/300/1,500 3,000 Volts
- 4 D.C. CURRENT RANGES: 0 to 1.5/15/150 Ma. 0 to 1.5 Amps.
- LOW RESISTANCE RANGE: 0 to 2,000 Ohms (1st division is 1/10th of an ohm.)
- 2 MEDIUM RESISTANCE RANGES: 0 to 20,000/200,000 Ohms
- HIGH RESISTANCE RANGE: 0 to 20 Megohms
- 3 DECIBEL RANGES: −10 to +38 +10 to +38 +30 to +58 D.B.

20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS

GENERAL ELECTRONIC DISTRIBUTING CO. DEPT. RC-7 98 PARK PLACE, NEW YORK 7, N. Y.

RECORDING AMPLIFIER

I have built an amplifier from the diagram on page 226 of the RCA Receiving Tube Manual (RC 15). How can I modify the amplifier to use it for recording?—A.V.F., Ottawa, Canada

A. The complete amplifier may be modified as shown. A crystal cutter may be used, as in the diagram, or a 4- to 8-ohm magnetic cutter may be connected in place of the output transformer dummy load resistance R.

A 5-pole, 4-position rotary switch (S1, S2, S3, S4, S5) selects one of the following functions:

Position 1—record from microphone only,

Position 2—record from microphone, and phono,

Position 3—record from phono or tuner,

Position 4—record playback or P.A. amplification.

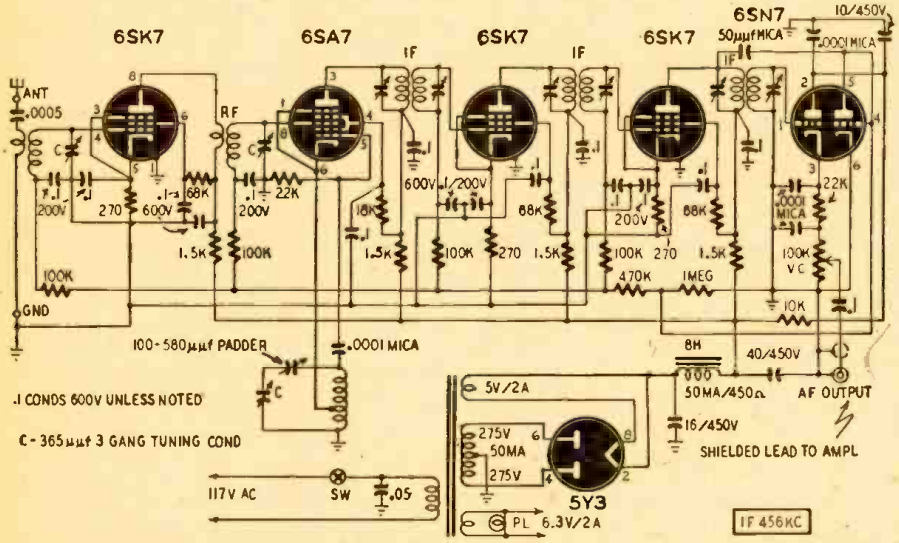
SUPERHET AM TUNER

I would like a diagram of a superheterodyne AM tuner for use with my PA amplifier.—J.A.R., Lawrenceville, Pa.

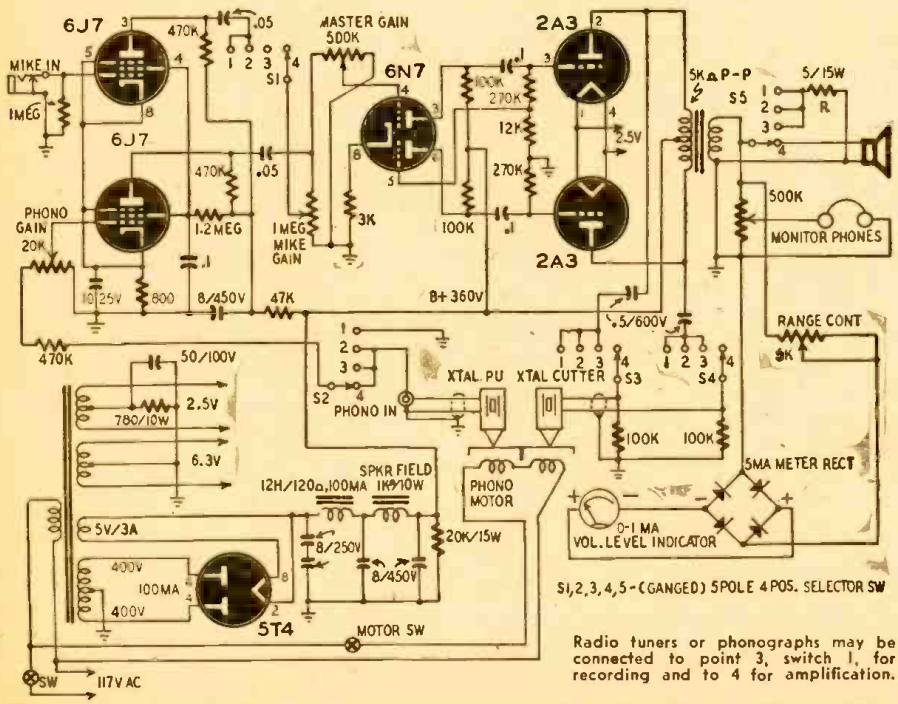
A. Here is a tuner, the output of which can be connected to the phonograph input of a PA amplifier. Although the diagram is complete with power supply, the tuner may take power from the amplifier, provided the amplifier supply has reserve capacity.

Use a shielded lead between tuner and amplifier input. This tuner is designed to use standard broadcast coils. Its range may be extended as desired by using commercially available multiband coils.

The oscillator padder is standard for the broadcast band. If short-wave bands are included, use oscillator padders as recommended by the coil manufacturer for each band.



The output of this tuner may be connected to the phonograph input of any audio amplifier.



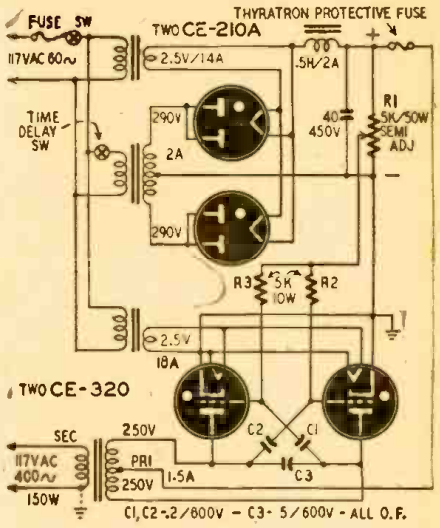
Radio tuners or phonographs may be connected to point 3, switch 1, for recording and to 4 for amplification.

Recordings may be made with either a crystal or magnetic cutter driven by this amplifier.

FREQUENCY CHANGER

Please design a frequency changer with a 117-volt, 60-cycle input and a 117-volt, 400-cycle output, capable of supplying 150 watts.—T.J.K., Gary, Indiana.

A. The unit shown uses Continental tubes or equivalents. Both plates of each CE-210A should be paralleled.



The output frequency depends on the values of R2, R3, C1, C2, and the setting of R1. The value of C3 may have to be changed from that shown.

It may be necessary to add or subtract turns from the output transformer.

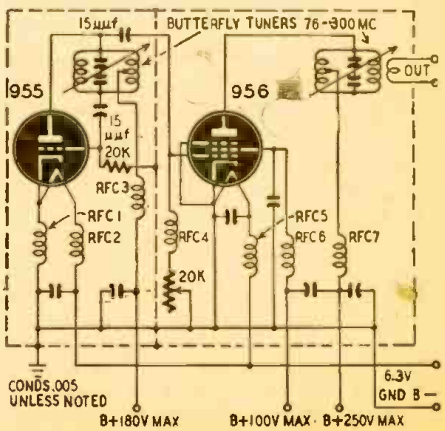
BUTTERFLY TUNER

Please give me a diagram of a v.h.f. signal generator using surplus butterfly tuners and acorn tubes.—J.P.Z., Chicago, Ill.

A. In the diagram, a 955 is used as an oscillator and a 956 as a buffer amplifier to isolate the output from the oscillator. Although a second butterfly tuner is shown in the plate circuit of the 956, this could be replaced by an r.f. choke, which would give somewhat less output.

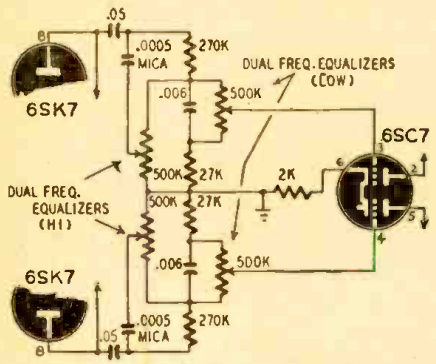
RFC-1, -2, and -5 are 40 turns of No. 24 d.s.c. wire ¼ inch in diameter, close wound; and RFC-3, -4, -6, and -7 are 44 turns of No. 28 d.s.c., ½ inch in diameter, spaced to 1 inch in length.

This setup might be used to drive a 144- or 235-mc amateur transmitter, but great care would have to be exercised to make sure of in-band operation.



TONE EQUALIZER

I have an audio amplifier using a pair of push-pull 6K7's resistance-coupled to a 6SC7. Please show how bass and treble tone controls can be used between these stages. I would like to use R-C circuits if possible.—V.C.C., Cordoba, Argentina.



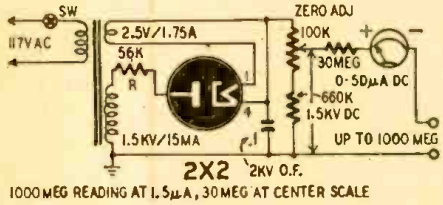
A. This circuit provides high- and low-frequency equalization. The control networks are in the grid circuits of the 6SC7. They are controlled with dual potentiometers.

HIGH-RANGE OHMMETER

I would like to build an ohmmeter which would read up to about 1,000 megohms, using 1,500 to 2,000 volts on the test leads and a 0-1-ma meter. The unit should operate from 117-volt a.c.—D.M., Stockton, Calif.

A. A 0-1 milliammeter would require too high a voltage to give satisfactory results, measuring such high resistances. The circuit shown uses a 50-μa meter.

To make the 660,000-ohm resistor, connect three 1-watt units of 220,000 ohms each in series. To make the 30-megohm resistor, use ten 3-megohm, 1-watt units. The accuracy of the ohmmeter will depend on the accuracy of the 30-megohm resistor, so each of the 10 units used in making it should be of 1% accuracy. The value of R may be changed, if desired, to give the zero set potentiometer suitable operating range.

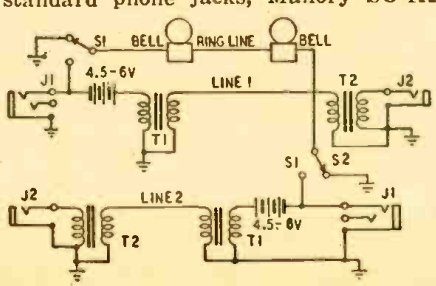


TELEPHONE FROM SURPLUS

I have two TS-13 surplus handsets. Please show how I can connect them as a shop-to-house telephone. — R.H.D., Oreland, Pa.

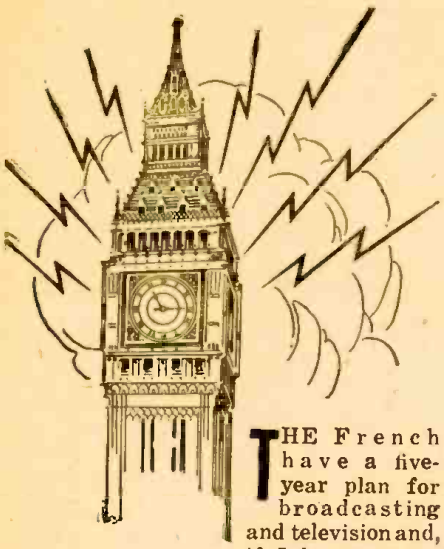
A. The telephone system shown requires three lines and a common grounded return. Two lines are for signal circuits and the other for ringing. The mike transformers T1 are designed to match a 70- or 75-ohm, single-button carbon mike to a 500-ohm line. The output transformers T2 are designed to match a 500-ohm line to a 3,500-ohm load, but you may use an output transformer designed to match a 3,000- or 4,000-ohm load to a 500-ohm line and connect it in reverse.

Mike jacks J1 are for PL-68-type plugs. You can use Mallory SCA-2B or equivalent types. Receiver jacks J2 are standard phone jacks, Mallory SC-1A or equivalent. Switches S1 and S2 are s.p.d.t. push-button type. The normally closed contact is connected to ground. One of the two bells must be of the single-stroke type. It may be made from a standard vibrator type by connecting the line directly to the coils as shown. Do not use two vibrator-type bells.



CORRECTION

In the diagram of the 6AD7 Amplifier on page 25 of the May 1948 issue, the bleeder resistor is shown between two grounded points. It should be placed between the positive side of the power supply and ground. We thank Mr. Paul V. Zeyn, Sr., of Milton, Penna., for this correction.



Report From Britain

By Major Ralph W. Hallows

RADIO-CRAFT EUROPEAN CORRESPONDENT

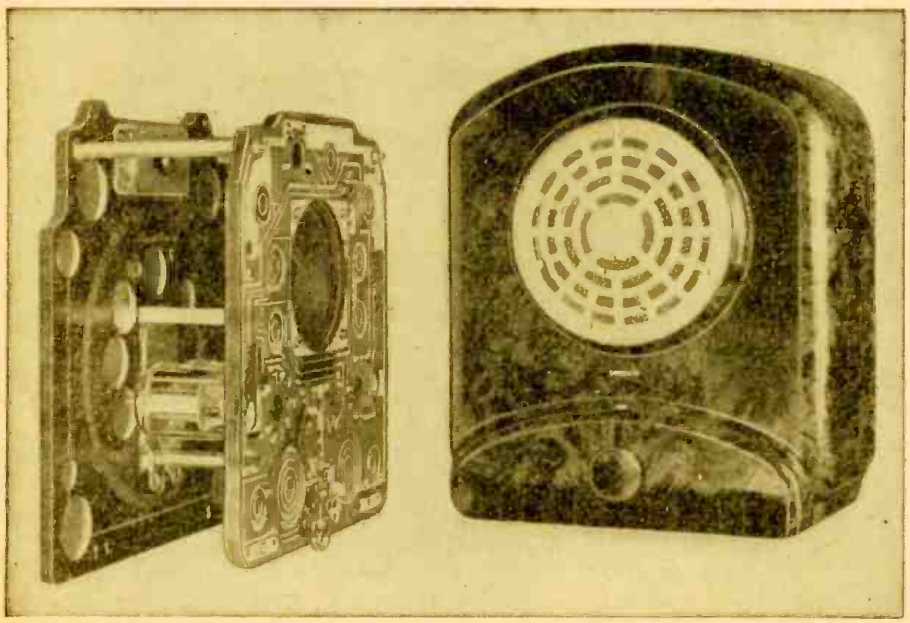
THE French have a five-year plan for broadcasting and television and, if I know anything about their knack of getting things electrical done, they'll have it in operation sometime before the end of that period. The plan includes the reconstruction of the long-wave station at Allouis, which is to have 1,000-kw power output provided by a coupled pair of 500-kw transmitters; the erection of at least five medium-wave transmitters of 100-kw rating; the installation of a colonial chain in France itself and in her colonies, consisting of about a score of 20-100-kw shortwave transmitters; the inauguration of at least fifteen 5-kw FM transmitters; and the completion of television transmitters operating in the neighborhood of 12 mc at Paris, Marseilles, Lyons, and Lille. It seems likely that the definition adopted for these will be of the order of 1,000 lines, since all are intended to work in conjunction with big-screen public television theaters. The authority for this information is the French radio magazine *Le Haut Parleur (The Loudspeaker)*, which generally knows what it is loudspeaking about!

Theater television

I mentioned some time ago that the J. Arthur Rank organization had gone ahead well with its plans for big-screen television in motion picture theaters. The original idea was to have television in several London theaters before the end of last year, but there was a hold-up of some kind and it may now be a month or two before audiences have their first view of it. Both BBC transmissions and special studio transmissions by Ciné Television Ltd., a subsidiary of Rank's, are to be screened. The latter will come from the Crystal Palace, where the late J. L. Baird had his studios. The Schmidt optical system will be used, the aspherical corrector lenses being molded from plastic by the new process developed by Dr. Starkie of Imperial Chemical Industries. I have seen big-screen images reproduced by this system, and they certainly are bright, contrasting, and detailed. I'd say, however, that television in its present form won't be accepted by theater audiences except for sports and spot news, in which the technical imperfections are outweighed by the interest value. I don't think television will become genuine big-screen stuff until *at least* a 1,000-line scanning system is developed—or until, as Mr. Gernsback holds, a revolutionary method of transmission and reception is found which will relegate scanning apparatus to the museums.

Sargrove invents "wireless" radio

I described some months ago the Sargrove method of mass-producing radios by metal-spraying molded plastic blanks. I have one of those little sets working in my house now. The type I am using is intended purely for local use and gives a choice of two stations. It is a 2-tube, a.c.-d.c. receiver. The 55-volt heaters are connected (one can't say "wired," for there isn't an inch of wire in the things) in series; the set can thus be hooked directly to 110-volt lines. Mine are 200-volt, and a resistance winding in the line cord provides the necessary dropping. You'll see from the photograph how simple this set is to assemble, use, and service. Does it work? It certainly does. The nearest stations are 20 miles away, yet with a short antenna I have to use the volume control to prevent the loudspeaker from being overloaded. The quality of reproduction isn't, of course, what you get from a large console radio, but it's quite acceptable. Manufacturing costs of radios of this type must be extraordinarily small, and the sets should go far toward solving the problem of bringing radio within reach of the ordinary man in countries where wage rates are low. As you probably know, Britons call radio "wireless." But I never thought I'd see a wireless set that really *was* wire-less!



Wiring of this British receiver is appliqued. Molded plastic blanks are sprayed with metal.

French televisers

It's good to see a French firm bringing out a whole range of television receivers. The Ontra Company is now marketing no less than six different types. Two sizes of tubes, the 18-cm and the 22-cm, which correspond approximately to 7 inches and 8 inches, respectively, are used in various models. The most ambitious of these televisers is a radio-video console of very neat design; the smallest a 13-tube table model for video only. The sound accompanying the vision program can be received by means of an ordinary broadcast set tuned to 1500 kc. A small converter unit using a 6E8 is connected between the television antenna and the broadcast receiver. This unit, matched to the input impedance of the average broadcast superheterodyne at 1500 kc, delivers the sound signal changed to that frequency. It seems a good method of turning out low-priced televisers, for most viewers already possess perfectly adequate broadcast radios which they are glad to use if it means a saving.

Swedes like radio

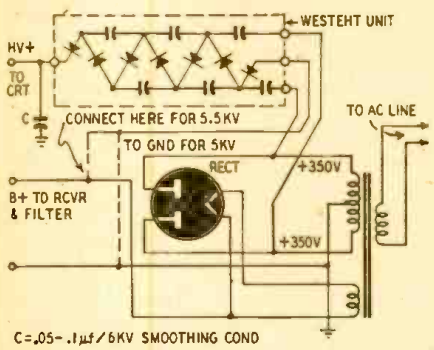
Sweden can claim the honor of being the most radio-minded country in Europe. Before the war 24% of her inhabitants owned radios, and now the proportion is higher. One reason for this progress is no doubt that power lines are available practically everywhere. I remember how impressed I was, when I first visited Sweden as a boy, by finding electric light far more com-

mon in their houses than in ours. The Swedes became electricity-minded years ago, with the result that they were ready to fall for broadcasting as soon as it came along—and fall they did. They soon had an extensive system in action, which has been steadily improved ever since. A new short-wave service of theirs will be of considerable interest to radio fans. This consists of programs specially planned for amateurs and dealing with radio topics. They are sent out three times every Saturday, but only two of the transmissions are likely to be received in the U.S., for the third (at 0745 GMT) is directed southeasterly. The transmissions directed toward America are:

1500 GMT:	SDB2	10.780 mc
	SBT	15.155 mc
0100 GMT:	SDB2	10.780 mc
	SBU	9.535 mc

A new high-voltage supply

Considerable interest has been aroused by a new electronic gadget called the Westeht (short for Westinghouse Extra High Tension) which supplies 5,000 volts or more for the anodes of cathode-ray tubes in televisers and other equipment. It is for use in atom-smashing experiments. It consists of a number of half-wave metallic rectifiers and capacitors. Each unit rectifies and



Novel h.v. supply for scopes and televisers.

stores in its capacitor, the peak voltage developed by the preceding section. The voltage output depends on the number of rectifiers and storage units in use.

The figure shows how the unit is connected to the power pack. This type provides either 5.0 or 5.5 kv at 150-250 microamperes. Other models are available for voltages up to 20,000. This method has several advantages over other high voltage supplies, not the least of which is the small size of the unit. It measures only 2¾ inches in diameter by 9 inches high. Output voltage does not vary more than 7% for a total current swing of 100 microamperes.

Televiewers in the New York City area now have a chance to test their sets above 200 mc. The new station WATV in Newark, N. J., is now operating on 210-216 mc (channel 13).

WATV is being picked up regularly in Brooklyn on an antenna less than 35 feet high. Signals are much weaker than those from the local stations.

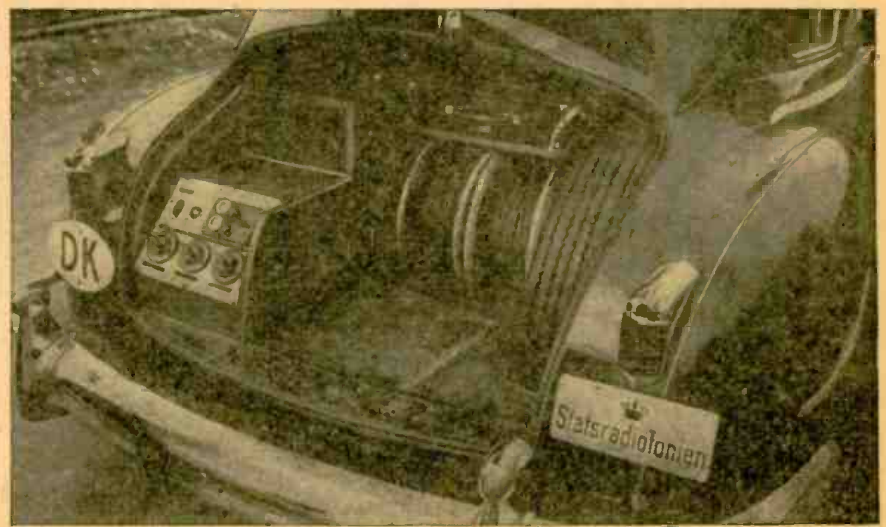
To get the new station at its best, some antenna changes might be advisable, as most of the antennas now in use are designed for the lower band.—*I.Q.*

Radio School in Greece

One of 35 radio service technicians being graduated from the school run by K. Karayannis & Co. in Athens, Greece, is congratulated by Prof. George Athanassiadis of Athens University in the photo above. The course lasts nine months and includes physics and mathematics, as well as servicing techniques. Requirements for entrance are so high that only 80 students were selected from the 450 applicants during the 1946-47 season. This year 100 students are in training. Another school will soon be established at Salonika, and later, correspondence courses will be introduced in Greece.

Below, American radio equipment is demonstrated for the audience at the graduation exercises.

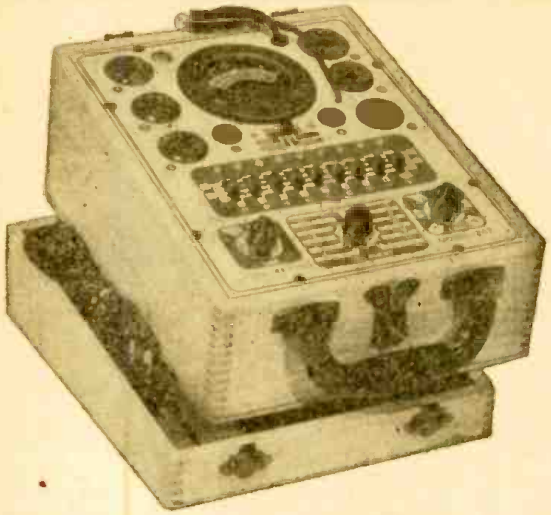
MOBILE BROADCAST RELAY IN DENMARK



Transmitting equipment in rear of one of two standard Chrysler sedans used to relay local events to the Danish broadcast network. One of the cars is even fitted with twin turntables.

A CHALLENGE—Order a model 247. Disregard the unbelievably low price and compare it on the basis of appearance, quality and performance to any other Tube Tester (ANY MAKE, ANY PRICE). If you are not completely satisfied with the model 247 after a 15 day trial, return it to us for full refund—no explanation necessary.

The model 247 is not surplus nor is it a hashed over pre-war model. It is newly designed and incorporates new advances in Tube Tester design. Read the description below and order one today!



The New Model 247

TUBE TESTER

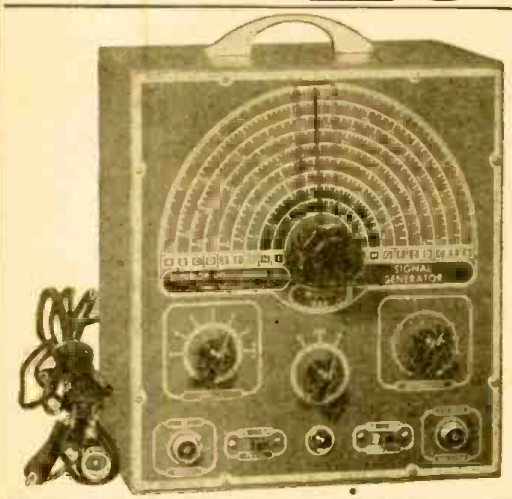
Checks octals, loctals, bantam jr. peanuts, television miniatures, magic eye, hearing aids, thyratrons, the new type H.F. miniatures, etc.

Features:

* A newly designed element selector switch reduces the possibility of obsolescence to an absolute minimum.
* When checking Diode, Triode and Pentode sections of multi-purpose tubes, sections can be tested individually. A special isolating circuit allows each section to be tested as if it were in a separate envelope.
* The Model 247 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.
* One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Model 247 comes complete with new speed-read chart. Comes housed in handsome, hand-rubbed oak cabinet sloped for bench use. A slip-on portable hinged cover is included for outside use. Size: 10¾" x 8¾" x 5¾".

ONLY **$29.90** NET



THE MODEL 650—AN A.C. OPERATED SIGNAL GENERATOR

RANGE: 100 KILOCYCLES TO 105 MEGACYCLES

*RF obtainable separately or modulated by the Audio Frequency.

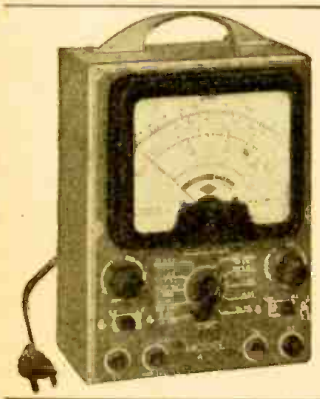
*Audio Modulating Frequency—400 cycles pure sine wave—less than 2% distortion.

*Attenuation—3-step ladder type of attenuator (T pad).

*Uses a Hartley Excited Oscillator with a Buffer Amplifier.

*Tubes: 6J5 as R.F. Oscillator: 6SA7 as modulated buffer and Mixer; 6SL7 as audio oscillator and rectifier.

Model 650 comes complete with coaxial cable, test leads and instructions. Housed in heavy gauge grey crystalline cabinet with beautiful two tone etched front panel. Size 9½" x 10" x 6". ..... NET PRICE: **$39.95**



The New Model 670 SUPER METER

A Combination VOLT-OHM-MILLIAMMETER plus CAPACITY REACTANCE, INDUCTANCE and DECIBEL MEASUREMENTS.

D. C. VOLTS: 0 to 7.5/15/75/150/750/1500/7500.—A. C. VOLTS 0 to 15/30/150/300/1500/3000. Volts.—OUTPUT VOLTS: 0 to 15/30/150/300/1500/3000.—D. C. CURRENT. 0 to 1.5/15/150 Ma.; 0 to 1.5 Amps.—RESISTANCE: 0 to 500/100,000 ohms, 0 to 10 Megohms.—CAPACITY: .001 to .2 Mfd., 1 to 4 Mfd. (Quality test for electrolytics).—REACTANCE: 700 to 27,000 Ohms; 13,000 Ohms to 3 Megohms.—INDUCTANCE: 1.75 to 70 Henries; 35 to 8,000 Henries. DECIBELS: −10 to +18, +10 to +38, +30 to +58.

THE MODEL 670 COMES HOUSED IN A RUGGED, CRACKLE-FINISHED STEEL CABINET COMPLETE WITH TEST LEADS AND OPERATING INSTRUCTIONS. SIZE 5½" x 7½" x 3".

$28.40 NET

Available for Immediate Shipment From Stock—20% Deposit Required on All C.O.D. Orders

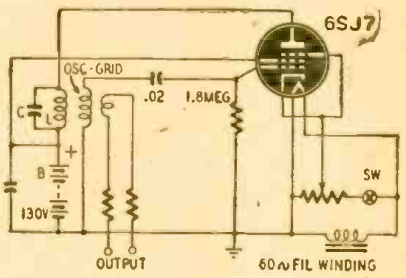
MOSS ELECTRONIC DISTRIBUTING CO. DEPT. RC-7 229 FULTON ST. NEW YORK 7, N. Y.

STABLE OSCILLATOR

Alphons V. Wurmser, Bogota, N. J.
(assigned to Bell Telephone Lab.)
Patent 2,435,262

This generator requires only one tube for the production of modulated signals. Unlike grid-blocking schemes and similar circuits the output is highly stable and of sine-wave character.

The tube may be a 6SJ7 or similar type. Values shown are suitable for an output of 1,000 cycles modulated at 20 cycles, such as is needed in telephone communication. The LC circuit is tuned to the "carrier" or 1,000 cycles. The grid leak and condenser are chosen to have a time constant which emphasizes 20 cycles. They may be determined by experiment.



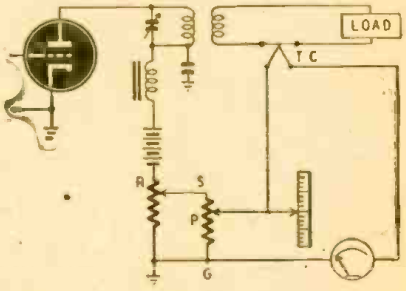
About 1 volt at 60 cycles is taken from the filament transformer and applied to the cathode to vary grid bias. Due to the non-linear tube characteristic the gain varies at 60 cycles and at various harmonics and sub-harmonics of 60 cycles. The 20-cycle sub-harmonic is especially strong because the grid circuit encourages this frequency.

Because of the whole-number ratio between 1000 and 20, these two frequencies lock in and each tends to become as stable as the line voltage injected into the cathode circuit. The modulation is complete and each frequency is practically a pure wave.

EFFICIENCY MEASUREMENT

John R. Boykin, Baltimore, Md.
(assigned to Westinghouse Elec. Corp.)
Patent No. 2,434,544

A transmitter is a circuit which converts d.c. to r.f. power. Efficiency is determined by dividing output power by input power. Ordinarily two separate meters are used, one for r.f. and the other for d.c., and the efficiency is found by dividing these values. Practically any adjustment in the transmitter will affect both readings and requires a new calculation.



This method requires only a single d.c. galvanometer and no calculation to find efficiency. The r.f. power is measured by a thermocouple TC, which produces a voltage proportional to r.f. power. This voltage appears across PG. The d.c. voltage drop across R (and SG) is proportional to input power. The two voltages are connected to oppose each other.

There is some setting of P where the thermocouple voltage exactly equals that portion of the R voltage which appears across PG. At this setting there is no effective circuit voltage and therefore no galvanometer deflection. Then the transmitter efficiency is equal to the ratio PG/SG × 100. The scale may be calibrated directly in terms of efficiency.

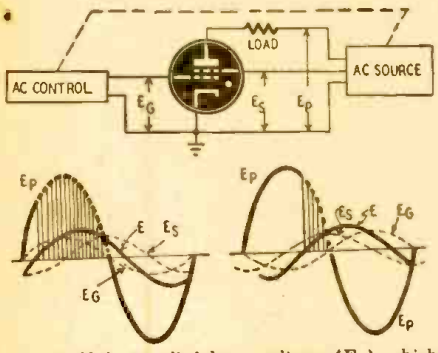
Much time and labor is saved through use of this single, direct-reading dial. Changes in tuning, coupling, etc., produce corresponding changes in the galvanometer reading. In one direction it shows an increase in efficiency, in the other it indicates a reduction. After obtaining maximum efficiency, the dial is adjusted to bring the meter back to zero and the actual efficiency is then observed at once.

VARIABLE-OUTPUT POWER SUPPLY

Frederick A. Russell, Summit, N. J.
(assigned to United States Govt. as represented by the Sec'y of War)
Patent No. 2,438,417

A thyratron power supply has the advantages of low internal voltage drop and high current output. Ordinarily the tube grids are controlled by a variable-phase voltage which is not as easy to obtain as the variable-amplitude voltage used here.

A four-element thyratron, as shown in the figure, is used with a.c. voltages on its elements. The



screen-grid is supplied by a voltage (E_s) which is 90 degrees out of phase with the plate voltage (E_P). This fixed phase difference may be obtained by using an R-C network within the a.c. source. The control grid voltage (E_g) is variable and in phase with the plate voltage.

The thyratron ionizes only when its plate is positive and the total effect of E_s and E_g is positive at the same time. After the tube breaks down, current will continue to flow through the load for the remainder of the positive half-cycle. Output is controlled by causing the break-down to occur earlier or later in the half-cycle.

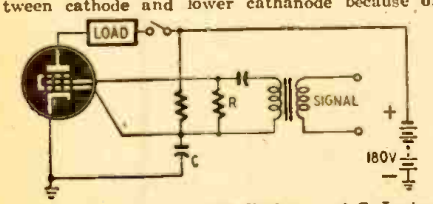
With the basic circuit shown, the conduction period can be varied from zero to the entire positive half-cycle. The graphs show how the conduction period varies with a change in the amplitude of E_g. The shaded portion shows conduction interval. In the graphs E is the total effect of E_s and E_g. When it goes positive it causes the tube to break down. Note that E_g must be "weighted". In other words, if the control grid is 3 times as effective as the screen grid (due to its closer position to the cathode), then the actual value of E_g is multiplied by 3 before drawing its dashed curve.

RELAY TUBE

Paul W. Stutsman, Needham, Mass.
(assigned to Raytheon Mfg. Co.)
Patent No. 2,436,835

This new gas-filled tube is highly sensitive and stable. It can be actuated by less than 1 volt a.c. and requires negligible power input. The tube contains a cathode, an anode, and a control grid surrounded by a "cathanode". As its name suggests, the latter acts both as anode for the tube cathode and as cathode for the tube anode. The lower cathanode is spaced about .04 inch from the cathode. Other elements are spaced by about .015 inch. The tube is filled with inert gas, such as xenon and krypton, at a pressure of 10 mm of mercury.

Normally, sawtooth oscillations take place between cathode and lower cathanode because of



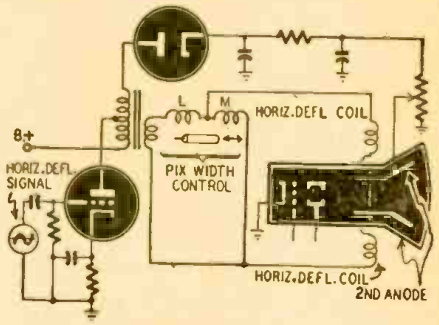
the slow charge and rapid discharge of C. Ionization is localized because a negative bias is built up on the control grid by leakage current flowing through the grid resistor. When a.c. appears on the control grid the local discharge spreads throughout the tube. A current of about 5 ma then flows from cathode to anode through the load until the switch is opened.

The critical signal (for tube breakdown) depends upon values chosen for R and C. Input power is negligible due to the extremely high values of R.

TV PICTURE CONTROL

Patent No. 2,438,359
Richard G. Clapp, Haverford, Pa.
(assigned to Philco Corp.)

The second anode of a television picture tube is usually supplied with voltage from the horizontal sweep circuit. The saw-tooth current induces a very high potential which is further stepped up by autotransformer action and is then rectified by a diode. The low-impedance secondary of the transformer supplies sweep current for the deflection coils. If the picture width is adjusted (by changing the deflection coil current or by other means), the transformer load changes; this affects the high-voltage circuit which does not have particularly good regulation.



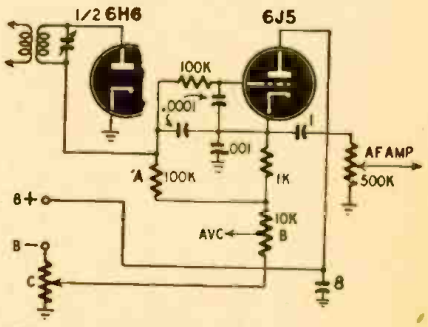
The picture control disclosed here is simple and effective. Two small coils are wound on a single form but separated to obtain negligible coupling. A powdered iron core, controlled by a threaded screw, is placed between the coils so that it approaches one as it moves away from the other. The impedance of both coils in series (see figure) remains fairly constant. As the screw is turned, the picture width varies because of the change of current through the deflection coils. However, the transformer load remains practically constant and does not affect the high-voltage supply.

In a typical control, the form is 2 inches long and ⅜ inch in diameter. L has 70 turns of No. 28 single-silk enamel-covered wire close-wound in three layers. M is wound in two pies separated by 1/32 inch, each having 130 turns of No. 41 s.s.c. In a particular TV receiver having a 340-μh deflection yoke, the picture was varied 20% with negligible change of high voltage. L increased from 37 to 122-μh, while M dropped from 3,200 to 1020 μh during this adjustment.

IMPROVED DIODE DETECTOR

Patent No. 2,437,493
Theodore G. Anderson, Kennett Square, Pa.
(assigned to Hazetine Research, Inc.)

Sharper tuning and higher fidelity are among the advantages claimed for this new circuit. The input impedance of the detector is increased many times without using high resistance in the load circuit.



When a signal is received, diode current flows through the i.f. transformer and load to ground. The load is composed of A, B, and part of C. After filtering, only the a.f. component appears at the triode grid. This tube is used as a cathode follower. The circuits of both tubes are common, resulting in regeneration.

When the diode plate goes positive due to signal, current flows through the load and produces a negative potential at the upper ends of A and B. As the triode current through B is reduced, this resistor has an additional voltage drop which is in phase with the voltage due to the diode. This places additional negative bias on the diode and increases its input impedance.

RADAR *VS.* RAINDROPS

SYNTHETIC raindrops are helping research men to determine the effect of rain and snow on 1.25-cm (K-band) radar. Basis of the work is the assumption that if raindrops reflect or scatter K-band waves, it may be possible to spot storm or hurricane areas many miles away.

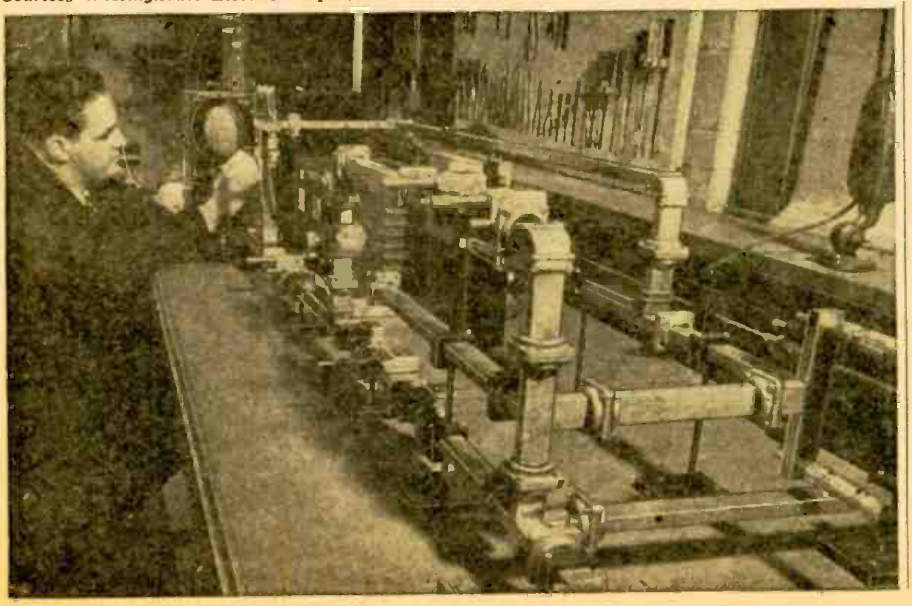
The 3-cm (X-band) radar waves, currently used in commercial marine radar, are not seriously hampered by rain or snow; but with the shorter K-band waves, the quality and range of echo reception varies considerably with the kind and magnitude of the precipitation. This variation has been attributed to absorption and scattering of microwaves by rain, snow, or water vapor.

Artificial raindrops are made in a range of carefully calculated sizes of ceramic powder and carbon black to obtain different electrical characteristics. In the tests a raindrop is fastened to a background that absorbs nearly all radiation not striking the drop. Microwave energy transmitted by a horn-type antenna is directed toward the raindrop, and is reflected into a receiving antenna placed at various distances.

A wave-guide balancing circuit actually measures the amount of scattering from the raindrop. First, microwave energy is transmitted without the raindrop in the field, and the amount of scattered energy received is balanced with a small signal from the transmitter fed into the balancing circuit. The raindrop is then placed in the field, causing a change in the received signal which unbalances the detector. The additional power needed to rebalance the circuit is a measure of the increase of scattered energy. The equipment is shown below.

Aim of the research is to verify two basic "guesses." One is that scattering of microwave energy from raindrops is most intense at certain frequencies. The other is that these frequencies are a function of the diameter of the individual particles of rain.

Courtesy Westinghouse Electric Corporation



.... PHILCO CONDENSERS

The values, number of units, and connections in the old Philco bakelite-cased bypass condensers may be quickly found by checking the list in Rider's Manual, Volume 11, Philco page 14. These units are hard to check without this list.

HARRY A. NICKERSON,
Boston, Mass.

.... REGAL MODEL L-46

My Regal Model L-46 tuned in only one strong station. Turned upside down, it played loudly for a few minutes and then stopped again. I noticed that the tuning condenser was slightly out of line. After I aligned it and soldered the mounting rivets to the chassis, volume was fully restored.

W. F. ONDER,
Arnold, Missouri

.... ZENITH 5678

Volume and tone change intermittently only if the volume is set at a low level. Replace .005-μf condenser connected to the tone tap on the volume control through a 47,000-ohm resistor. Also check other condensers mounted near sources of heat.

JOSEPH FIEDERER,
Worcester, N. Y.

.... HARD-TO-FIND TUBE FAULT

A Stromberg Model 1204H played well on AM, but only intermittently when turned to the FM band. There was also a strong a.c. hum present. The trouble was traced to the 12BA6 i.f. amplifier tube which would momentarily short and then open up. A signal tracer was needed to locate the defective stage as a tube tester did not give any indication of the tube being bad.

HOMER L. DAVIDSON,
Fort Dodge, Iowa

.... ALIGNMENT CHECK

When the maximum a.v.c. voltage of a receiver is given in the service notes, the information can be used to make a quick check of the over-all alignment of the set. The maximum voltage cannot be obtained when the set is out of alignment.

JAMES R. LIMBECK,
Glendale, Calif.

.... MECK 5D7-WL-187

This set is an a.c.-d.c.-battery portable with a circuit that charges the B-batteries while the set is playing on a.c. Be sure to turn the switch to OFF when you have finished testing the set on a.c. If you pull the plug with the switch on, the charging circuit will place a drain of about 1.8 ma on the B-batteries and they will soon go dead.

JOHN GORT,
Rock Valley, Iowa

.... SILVERTONE 6140, 6152, 6153

These and other Silvertone models use bias cells in the grid circuit of the first audio stage. After a period of time, the cells deteriorate and cause a loss in volume. The results are seldom satisfactory when new cells are installed.

Insert a 0.01-μf condenser in place of the cells and ground the grid through a 5-megohm resistor. The volume will increase considerably.

JOHN LISTIAK, JR.,
Warren, Ohio

.... BREWSTER 574 BB

The rivets in one end of the 12BE6 and 12BA6 sockets are used to ground the antenna loop to the chassis. These rivets may make bad connections and cause noisy reception. Since the chassis is aluminum, repair the set by placing a star washer and lug under one of the speaker supporting screws and soldering a lead to the center post of each offending socket.

MAURICE O. WHEELER,
Hudson, Mass.

.... ZENITH FORD GMFO90

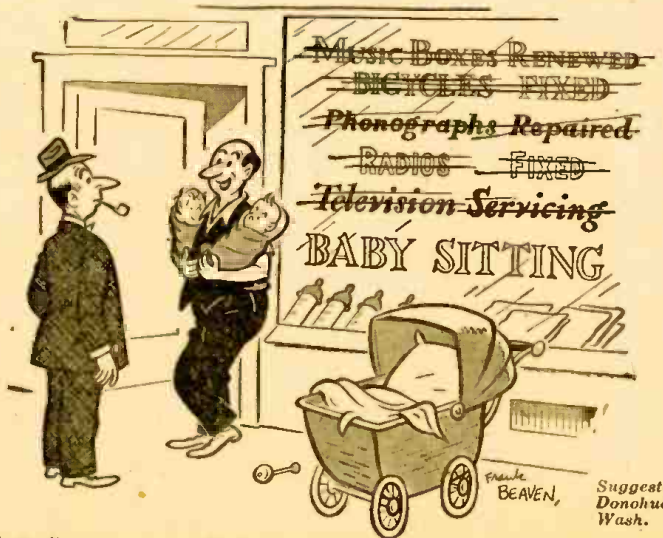
If the tuning dial will not work for manual tuning, but makes a ratchet sound when turned, straightening the fingers on the back of the tuning shaft will fix the trouble.

WILLIAM PORTER,
Lafayette, Ind.

.... 1946-47 HUDSON

If the pilot light seems to have too short life, replace it with a type 55, instead of the 51 installed at the factory.

WILLIAM PORTER,
Lafayette, Ind.



Suggested by: E. R. Donohue, Walla Walla, Wash.

"So finally I says to myself: Brother, you'd better get into something permanent."

. . . . PHILCO 46-1209 AND 46-480

The 7F8 converter of these sets becomes noisy, and in some cases entirely bad, because of the high voltage on the plate of the mixer section. This can be cured by replacing R300, 4,700 ohms, with a 50,000 to 60,000-ohm resistor. Replacing this resistor will raise the voltage on the cathode. This is lowered to its normal value by removing R404, 100,000 ohms, connected between the B-plus line and the mixer cathode.

HAROLD V. GODFREY,
Ft. Worth, Texas

. . . . MOTOROLA TWIN 8

When the volume control was advanced, this auto radio motorboated badly. The 6A4/LA audio output tube was found to be oscillating at about 50 kc, with grid-blocking at an audio rate. The trouble was corrected by replacing the center-tapped driver inductor. The circuit could also have been rewired for a driver transformer, or else a 40,000-ohm resistor could have been connected from grid of the power tube to ground.

RADIO SERVICEMAN,
Worcester, N. Y.

. . . . RECORD DISTORTION

A radio-phono combination showed distortion when playing records, though radio reproduction was normal. The pickup used an Astatic Nylon 1-J crystal cartridge. Examination of the nylon needle showed that it was just touching the side of the spring needle guard. Repositioning the guard (held by two small screws) removed the distortion.

M. H. HARVEY,
Scotch Plains, N. J.

. . . . CROSLEY 56PA, 56PB

To prevent the 3S4 from burning out, remove the wire connecting lug 3 to lug 8 on the 117Z6 socket. In its place, solder a 47-ohm, 1-watt resistor.

Crosley Service Instruction No. 1-03 shows a 140-ohm resistor in the diagram and a 47-ohm resistor in the text. The 47-ohm value is correct.

CROSLEY SERVICE DEPARTMENT

. . . . PHILCO MODEL 42-1006

These sets were either dead or had intermittent reception and fading. The defect was found in the r.f. transformer and was due to a short between the leads of the 15,000-ohm resistor on the secondary winding and the outer turns of the primary coil.

The trouble was eliminated by pushing the resistor away from the primary coil.

J. C. PLOPPER,
Fontana, Calif.

. . . . TUBE PINS AS TIE LUGS

In many receivers the No. 1 pin on some of the tube sockets is used as a tie point for various components. Where the tube used is glass, there is usually no objection; but if a metal tube is substituted at any time, the tube envelope, connected to the No. 1 pin, may touch the chassis and ground the pin. It's a good idea to examine the socket before substituting a metal tube for a glass one.

GEORGE E. HUFF,
Miami, Okla.

. . . . SHORTED AUTO ANTENNA

To make a quick test for a shorted or grounded antenna, disconnect the antenna lead from the receiver and touch it momentarily to an ungrounded lead from the battery. If a spark results, the antenna is shorting to either the auto body or to the shield of the lead-in cable.

RANDOLPH CHAMBERS,
Mobile, Alabama

. . . . RCA MODEL 56X

When the 30-50-μf filter condenser is replaced on these sets, shunt the 50-μf section with a 0.1 tubular condenser to prevent oscillation.

E. W. TEWS,
Milwaukee, Wis.

. . . . PUSH-PULL STAGES

During routine testing of a radio with push-pull output, I obtained readings of 300 ohms from the plate of one output tube to center tap, and 150 ohms from the other plate to center tap. The plate-to-plate resistance was 150 ohms. Upon investigation, I discovered that one plate was connected to the center tap, while one of the plate leads from the transformer was connected to B-plus.

This set was a new production model and the error was due to faulty wiring, but the same fault might also be found in a radio that had been "repaired."

J. L. FILION
Montreal, Quebec

. . . . FREQUENCY DRIFT

Frequency drift or shift on the high end of the broadcast band may be caused by a defective oscillator trimmer condenser. Replacement of the condenser will often cure the trouble.

JOHN R. SIMPSON,
Gainesville, Fla.

. . . . DIRTY VOLUME CONTROLS

I use a hypodermic syringe filled with carbon tetrachloride to clean dirty volume controls. You can usually find an opening large enough to get a needle into, thereby eliminating the removal of the control.

A. W. POWELL,
Rolfe, Iowa

. . . . HALLICRAFTERS MODEL S-11

A slight crackling noise along with the signal was traced to a noisy tone control. A new control eliminated the trouble.

CLAUDE M. PREW,
New London, N. H.

. . . . SILVERTONE MODEL 6421

When retuning is required about every five minutes, check the eccentric rotor of the tuning condenser for any play. It may be necessary to replace the spring from the rotor to the condenser frame.

CLAUDE M. PREW,
New London, N. H.

. . . . NOISY CAR RADIOS

If an auto radio with a whip-type antenna is noisy, check to see if the small ball or bead at the tip is still attached. A missing ball usually causes high-frequency static at speeds over 25 miles per hour.

V. DE ROO,
Dinuba, Calif.

. . . . MOTORBOATING

Motorboating or other instability symptoms noticed when strong signals are tuned in may often be eliminated by bypassing r.f. stage screens or cathodes with high-capacitance electrolytic condensers.

JOHN R. SIMPSON,
Gainsville, Fla.

. . . . ROGERS 900 SERIES

The 89RS/6G7S tube used in some of these models is no longer available. As replacement for this dual-purpose tube, use an 89 as power amplifier and add a selenium rectifier.

R. LEROY BLINN,
London, Ontario

. . . . PHILCO MODEL 67-30

This set faded continually. However, it played fairly well on the local station. All voltages were normal and the tubes tested good. The trouble was traced to a defective antenna coil. After it was replaced with a universal replacement type, the set played perfectly.

The defect in the coil was probably due to a lowered Q caused by electrolysis.

BRIAN BAILEY,
Brownwood, Texas

. . . . PHILCO MODEL 46-1209

Slight distortion occurred on the phono position only. The voltage measured at the No. 6 pin of the 7AF7 preamplifier tube was below normal.

Trouble was traced to the 470,000-ohm plate decoupling resistor which had increased in value.

JOSEPH A. DESLIENS,
Fall River, Mass.

. . . . TUBE REPLACEMENT

A 32L7 tube may be substituted for the discontinued type 25A7. Although the characteristics of the tubes are different, the change in output quality is not noticeable.

The filament dropping resistor in the receiver must be changed to increase the voltage across the 32L7 filament.

ROBERT P. KRAIG,
Olympia, Washington

. . . . RCA U-125

If the phono motor causes interference on this receiver, try grounding the motor frame to the receiver chassis. This should eliminate the trouble.

JAMES R. LIMBECK,
Glendale, Calif.

. . . . A.C.-D.C. SETS

Oscillation in a.c.-d.c. t.r.f. receivers can often be reduced by increasing the value of the bypass condenser from the plate of the detector to the chassis.

JAMES R. LIMBECK,
Glendale, Calif.

. . . . 1946 MOTOROLA

If the 6SA7 seems to be intermittent and a replacement does not help, replace the oscillator coil. Checking oscillator coils is a good idea with all the late Motorola auto receivers, too.

WILLIAM PORTER,
Lafayette, Ind.

. . . . PHILCO 650

Volume was very low. All voltages checked O.K., but an ohmmeter showed a large difference between the resistances of the two halves of the output transformer primary. Replacement of this transformer restored volume to normal.

DONALD A. WEILER,
Metairie, La.

. . . . GE MODEL 304

Checking for intermittent reception on this set, I found that the coil-spring shielding on the lead to the tone control was too long. One end occasionally touched and grounded the connection. After a few turns of the spring were removed, the trouble disappeared.

E. W. TEWS,
Milwaukee, Wis.

. . . . PILOTUNER T-601

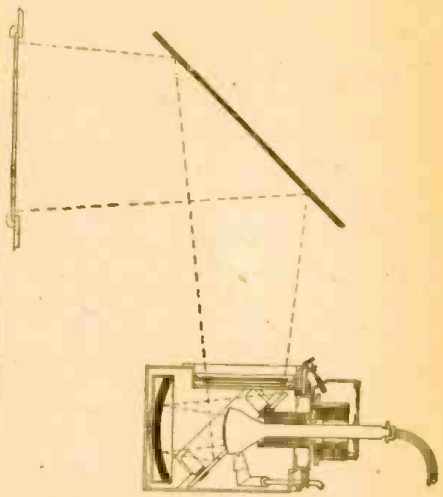
After a few weeks of operation, the pilot light begins to flicker and after a few hours, the set fails. Check the .01-μf condenser between the No. 4 pin of the 6BA6 and ground. This condenser has been found shorted in a number of sets. These were replaced with .01-μf 600-volt units and no further trouble has been experienced.

ARNOLD B. MARGOLIS,
Bronx, N. Y.

RADIO-CRAFT needs more Technotes. Two types are wanted urgently—those which are characteristic of a given set and those which are very hard to find or require special ingenuity to solve. One year's subscription is given for each Technote.

NEW TELE PROJECTOR

A compact and efficient television projector which produces a 12 x 16-inch picture from a 1.4 x 1.86-inch image on the face of a 2½-inch cathode-ray tube has been developed by the North American Philips Company, Inc.

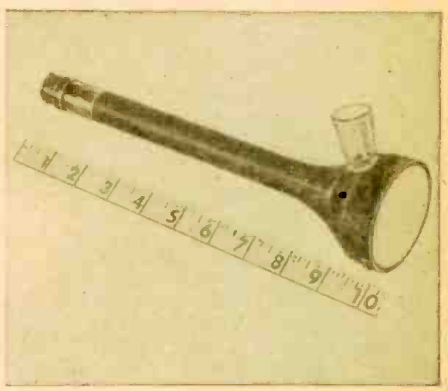


A multi-reflection optical system is used.

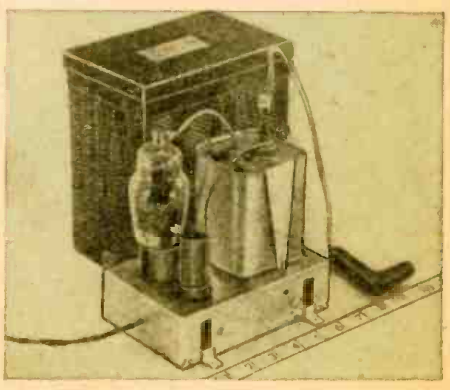
Known as the Protelgram, the system consists of the 3NP4 projection tube, an optical projection box including deflection and focussing coils, and a 25-kilovolt power supply.

The optical elements comprise a modified Schmidt system, mounted in a triangular array inside the projection box, as the drawing shows. A removable alignment assembly fastened to the outside of the box supports the tube and coils.

The 25-kilovolt supply consists prin-

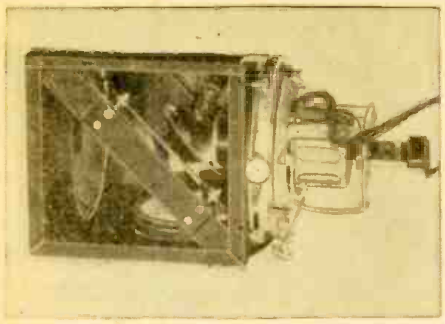


The tube. Cup insulates accelerating anode.



The 25-kilovolt radio-frequency power supply.

cipally of a 6SR7 oscillator, a 6BG6-G amplifier, and a sealed transformer as-



Equipment is compact, due to mirror system.

sembly containing three special rectifier tubes. A cascade voltage tripler circuit is used.

Opportunity In Television

"How can I equip myself to properly service television receivers?" is a question asked by many radio repair technicians. The answer, according to Harry Kalker, sales manager of the Sprague Products Company, is not at all hard to find.

More and more manufacturers are developing training courses, printing literature, and disseminating material to help the repairman to get the information and experience he needs. Television schools and correspondence courses are available to everyone who has the time and initiative to go after the information. Technical books and publications offer comprehensive cover-

age of televjsion, and radio magazines bring their readers up-to-the-minute articles on the latest authentic servicing data.

That time and money spent to acquire television knowledge is well invested is shown in the advertisement above, reprinted from a New York City daily newspaper.

More test equipment will be needed for television servicing, but higher cost of the receivers will justify greater charges than the usual hourly rate; this will pay for the test equipment.

Edited By ELMER R. FULLER

HERE we are again with your shortwave station list, but this month we have something different for you. Our calls listed this month are few in number, but they are the ones most often heard, other than the U. S. stations, which were omitted. The stations listed can be used as check points on your dial because of their regularity of reception.

Several shortwave fans are approaching their receivers for dx reception in an unusual manner. Did you ever try concentrating your efforts on just one shortwave band, and trying constantly for dx on this one band? Try it for a few weeks, and you'll be surprised at the ones you have been missing.

Conditions during the past couple of months have not been very good from the dx standpoint, and things do not seem very promising for the future. Reports have been very few lately, and even the few have not given much dope on schedules or frequencies. Can it be that the stations are maintaining their present schedules? The U. S. stations should be changing soon, but at this date nothing has been received regarding them.

Just how long we will publish this department only every other month is not known at present, but it is hoped that a schedule can be worked out and an announcement made regarding this matter in the next issue. If you have any suggestions for improving this department, please let your editor know of them. They will be greatly appreciated. So until next time, 73!

Freq.	Station	Location and Schedule
3.310	YVIRO	TRUJILLO, VENEZUELA; 1700 to 2130
3.370	YVIRT	MARACAIBO, VENEZUELA; 1730 to 2230
3.380	YV5RY	CARACAS, VENEZUELA; 0930 to 2230
3.390	YV4RK	MARACAY, VENEZUELA; 1800 to 2230
3.400	YV5RW	CARACAS, VENEZUELA; 0530 to 2230
3.460	YV4RP	VALENCIA, VENEZUELA; 1730 to 2130
3.480	YV4RQ	PUERTA CABALLO, VENEZUELA; 1700 to 2130
3.480	ZQ1	JAMAICA, BRIT. WEST INDIES; 1600 to 2200
3.490	YV3RS	BARQUISIMETO, VENEZUELA; 1630 to 2130
3.500	YV5RX	CARACAS, VENEZUELA; 0930 to 1400; 1530 to 2230
3.510	YV6RC	BARQUISIMETO, VENEZUELA; 1800 to 2130
3.530	YV5RS	CARACAS, VENEZUELA; 0530 to 2230
4.100	HCJB	QUITO, ECUADOR; 1800 to 2230
4.750	YVIRV	MARACAIBO, VENEZUELA; 0530 to 2130
4.770	YVIRY	CORO, VENEZUELA; 1600 to 2130
4.780	YV4RO	VALENCIA, VENEZUELA; 1630 to 2130
4.810	YVIRL	MARACAIBO, VENEZUELA; 0530 to 2230
4.810	HJBB	CUCUTA, COLOMBIA; 1700 to 2200
4.820	HJED	CALI, COLOMBIA; 1900 to 2300
4.840	YVIRZ	VOLERA, VENEZUELA; 1630 to 2145
4.850	HJCA	BOGOTA, COLDMBIA; 1900 to 2200
4.860	PRC5	BELEM, BRAZIL; 0600 to 0700; 0900 to 1100; 1530 to 2000 except Sundays
4.890	HJCH	BOGOTA, COLOMBIA; 1800 to 2200
4.920	HJAP	CARTAGENA, COLOMBIA; 0600 to 1300; 1700 to 2200
4.920	YV5RN	CARACAS, VENEZUELA; 0600 to 2230
4.950	HJCQ	BOGOTA, COLOMBIA; 1000 to 1400; 1700 to 2300
4.960	HJAE	CARTAGENA, COLOMBIA; 1600 to 2230
4.990	YV3RN	BARQUISIMETO, VENEZUELA; 1630 to 2230
5.000	WWV	WASHINGTON, D. C.; U.S. Bureau of Standards; continuously day and night
5.870	HRN	TEGUCIGALPA, HONDURAS; 0800 to 1000; 1300 to 1500; 1800 to 2300
5.890	OAX4Z	LIMA, PERU; 1630 to 2330
5.950	HH2S	PORT-AU-PRINCE, HAITI; 0600 to 0815; 1100 to 1300; 1730 to 2130
6.000	ZFY	GEORGETOWN, BRITISH GUIANA; 0545 to 0745; 0945 to 1145; 1415 to 1945
6.010	CJCX	SYDNEY, NOVA SCOTIA; 0530 to 2200
6.020	HJCX	BOGOTA, COLOMBIA; 0700 to 0800; 1400 to 2315
6.030	HP5B	PANAMA CITY, PANAMA; 1800 to 0030
6.040	XETW	TAMPICO, MEXICO; 0745 to 0045
6.070	CFRX	TORONTO, CANADA; 0600 to 0030
6.090	CBFW	MONTREAL, CANADA; 0730 to 1945; 2000 to 2400
6.100	PRE9	FORTALEZA, BRAZIL; 0900 to 1200; 1600 to 1900
6.100	Munich I	MUNICH, GERMANY; European beam, 1415 to 1700
6.160	HJCD	BOGOTA, COLOMBIA; 0700 to 0800
6.160	CBRX	VANCOUVER, CANADA; 0900 to 0200
6.160	HER3	BERNE, SWITZERLAND; 0245 to 0715; 1200 to 1700; 2030 to 2230
6.200	YV6RD	CIUDAD BOLIVAR, VENEZUELA; 1700 to 2315
6.240	HJCF	BOGOTA, COLOMBIA; 1700 to 2300
6.240	HIIN	CIUDAD TRUJILLO, DOMINICAN REPUBLIC; 1600 to 2230
6.280	HCJB	QUITO, ECUADOR; 1800 to 2400
6.310	HIIZ	CIUDAD TRUJILLO, DOMINICAN REPUBLIC; 1600 to 2255
7.290	Munich II	MUNICH, GERMANY; Balkan beam, 1115 to 1700

"He used to work in a restaurant."

Freq.	Station	Location and Schedule
7.300		MOSCOW, U.S.S.R.: 1300 to 1800; 1815 to 2100
7.380	HEK3	BERNE, SWITZERLAND; 1000 to 1045; 1510 to 1530
8.700	COCO	HAVANA, CUBA; 0700 to 2330
8.830	COCQ	HAVANA, CUBA; 0530 to 0030
9.210	HI2G	CIUDAD TRUJILLO, DOMINICAN REPUBLIC; 0530 to 0830; 1300 to 1530; 1700 to 1845
9.270	COCX	HAVANA, CUBA; 0700 to 0030
9.380	OTC	LEOPOLDVILLE, BELGIAN CONGO; 0000 to 0200; 1100 to 1500
9.440	FZI	BRAZZAVILLE, FRENCH EQUATORIAL AFRICA; 0000 to 0130; 1100 to 2020
9.500	XEWW	MEXICO CITY, MEXICO; 0800 to 0200
9.540	VLR	MELBOURNE, AUSTRALIA; 0800 to 0915; 0930 to 1000; 1245 to 1415
9.540	Munich IV	MUNICH, GERMANY; East European beam, 1115 to 1700
9.550		PRAGUE, CZECHOSLOVAKIA; 1215 to 1230; 1315 to 1330; 1400 to 1430; 1445 to 1500; 1515 to 1530; 1600 to 1630; 1645 to 1700
9.550		PARIS, FRANCE; 0000 to 0130; 0715 to 0845
9.580	GSC	LONDON, ENGLAND; 1330 to 1345; 1430 to 1530; 1600 to 1615; 1815 to 2030
9.590	PCJ	HILVERSUM, NETHERLANDS; 2100 to 2200; Sundays and Wednesdays; 2200 to 2300
9.610	VLC6	SHEPPARTON, AUSTRALIA; 1000 to 1115; 1500 to 1615
9.630	CKLO	MONTREAL, CANADA; 1600 to 1800
9.670	TGWA	GUATEMALA CITY, GUATEMALA; 1830 to 2330
9.680	LRA1	BUENOS AIRES, ARGENTINA; 0800 to 2200
9.710		MOSCOW, U.S.S.R.; 2300 to 0730
9.740	OTC	LEOPOLDVILLE, BELGIAN CONGO; 1530 to 1645; 1700 to 2300
9.960	HCJB	QUITO, ECUADOR; 2230 to 2400; except Mondays; Mondays, 2300 to 0300; 0300 to 2150
11.630		MOSCOW, U.S.S.R.; 1930 to 0300; 0600 to 0800; 0830 to 1300
11.700	GVW	LONDON, ENGLAND; 2300 to 0030
11.700	SBP	STOCKHOLM, SWEDEN; 0140 to 0220; 0600 to 0650; 2000 to 2100; Sundays, 0215 to 1100
11.710	VLG3	MELBOURNE, AUSTRALIA; 0245 to 0345
11.710	HEI5	BERNE, SWITZERLAND; Mondays, Tuesdays, Thursdays, Fridays; 0215 to 0330
11.720	PRL8	RIO DE JANEIRO, BRAZIL; 0345 to 0700
11.720	CKRX	WINNIPEG, CANADA; 1000 to 2000
11.750	GSD	LONDON, ENGLAND; 2000 to 0300; 1215 to 1745
11.780		MOSCOW, U.S.S.R.; 0900 to 1000; 2000 to 2130; 2200 to 0100
11.830	CXA19	MONTEVIDEO, URUGUAY; 0600 to 2200
11.840		MANILA, PHILIPPINES; East Asia beam, 0430 to 1005
11.840	VLC7	SHEPPARTON, AUSTRALIA; 2330 to 0045; 1500 to 1615
11.840		PARIS, FRANCE; 0030 to 0130; 0145 to 0300; 1915 to 2245; 0000 to 0015
11.880		MOSCOW, U.S.S.R.; 1820 to 1930; 2000 to 2045
11.890		MANILA, PHILIPPINES; Far East beam, 0400 to 1005
11.900	XGOY	CHUNGKING, CHINA; 0400 to 0530; 0745 to 0830; 0845 to 1045
12.440	HCJB	QUITO, ECUADOR; 1400 to 2230; Mondays, 2230 to 2400
15.110	HCJB	QUITO, ECUADOR; 0500 to 1200; 1330 to 2330
15.140	GSF	LONDON, ENGLAND; 0600 to 0715; 0915 to 1015; 1030 to 1200; 1300 to 1600; 1615 to 2015; 2300 to 0100
15.170	TGWA	GUATEMALA CITY, GUATEMALA; 0730 to 1500
15.190	CKCX	MONTREAL, CANADA; 0845 to 1100; 1820 to 1935
15.230	VLG6	MELBOURNE, AUSTRALIA; 2330 to 0045; 0100 to 0145; 2200 to 2300; Saturdays and Sundays; 2100 to 2300
15.310	VLC4	SHEPPARTON, AUSTRALIA; 0245 to 0345; 0355 to 0750; 0800 to 1045
15.330		MANILA, PHILIPPINES; Indian-Parkistan beam, 0230 to 0345
17.530	FZI	BRAZZAVILLE, FRENCH EQUATORIAL AFRICA; 0000 to 0130; 0445 to 0745; 1100 to 1700
17.820	CKNC	MONTREAL, CANADA; 2345 to 0100; 0845 to 1630; 1820 to 2100

RADIO PRICES DOWN

Receiver prices are down about as far as they will go for this year, large brand-name manufacturers said recently. While some substantial cuts have been made in 1948-model prices as compared to those of 1947 sets, these were ascribed to higher production and increased manufacturing efficiency. From now on, said the makers, operating costs will keep a floor under prices.

One of the factors relieving large companies from worry about competitive price-slashing is the remarkable devotion of consumers to well-known brand names. As a result, sales of the big producers are holding up, while smaller companies are finding difficulty in making ends meet.

$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.

All checks are payable on publication.

Address RADIO CARTOONS, RADIO-CRAFT
25 West Broadway, New York 7, N. Y.

SUGGESTS RADAR X-RAYS

Dear Editor:

The article by Mohammed Ulysses Fips on the Tubeless Homo-Heteradio (RADIO-CRAFT, April 1948) was most interesting. I don't think it is at all impossible to construct such a set.

Here is another idea for Fips to play with. I got the idea before I ever heard of radar, but now that radar is an accomplished fact, it fits in very nicely with my idea. Besides a radar transmitter, my scheme requires a source of X-rays (an X-ray tube), a photo-electric cell, and a television receiver.

Feed the X-rays from the tube into the photocell. Connect a high-gain high-power amplifier to the cell, and feed its output into the radar transmitter. Now train the combined radar waves and X-rays on a distant object, such as an airplane.

The returning waves (the reflections) are received on a radar receiver, using the same antenna as is used for transmitting—just as in standard radar practice. But note that the returning radar waves will contain some X-rays. These X-rays will have penetrated into the distant object to a depth determined by the strength of the rays.

Instead of feeding the received waves to an oscilloscope, channel them to a television receiver. *On the screen will appear an X-ray picture of the inside of the airplane!*

By varying the amplitude of the radar and X-rays (and the proportion in which they are mixed) it would be possible to reproduce on the television screen any object from 3 feet away to a distance of a half mile. Or for objects in the laboratory, the rays could be made to penetrate to the exact depth required, rather than using a fluoroscope, which penetrates the entire object.

There should be countless uses in medicine and in industry for the radar X-ray!

RALPH N. HUSE,
Sumner, Wash.

TREATS ALL SETS AS OWN

Dear Editor:

Unfortunately, there are quacks in every profession; in radio servicing there are a few, but enough to give honest repairmen a black eye. I notice, however, that these men are rapidly going out of business.

The pliers-and-screwdriver era is over. The tinkerer must be replaced by the well-trained professional man who uses the scope, signal tracer, and other precision instruments. I welcome licensing because it will eliminate the quacks and give the real service technician more prestige.

In my own business, my policy is to regard each receiver brought in for repair as my own—I give it my entire interest. Whenever possible, I make exact replacements of parts; and I never use "bargain" materials. I regard myself as a public servant whose mission is to bring music and enlightenment to the homes of my customers by keeping their radios in top condition.

IRVING HOROWITZ,
Niagara Falls, N. Y.

LICENSES FOR PROPRIETORS?

Dear Editor:

Speaking of licensing repairmen, why not license the proprietors of service shops, as well? Many complaints of excessive repair charges are justified because the owner of the shop, while he employs skilled men to do the actual work, is often unskilled himself. When he conforms to the popular practice of giving free estimates, he is forced to do a lot more guessing than if he were as experienced as the men he hires. A good repairman can give a pretty accurate estimate, but an estimator who is not an expert will usually quote a high price just to be safe.

OSCAR SCHECTAR,
Washington, D. C.

LESS COMMERCIALS FOR FM

Dear Editor:

Milwaukee has one FM station, which broadcasts the same programs as its AM affiliate.

FM sets were sold to people who wanted good music and other programs without much advertising. For a while, they got what they wanted; but now they hear soap operas and all the other standard AM programs.

Until we can have good programs, free of too many commercials—a one-minute commercial during each 15-minute program would be all right—FM is a dead issue here.

R. F. LANGNOR,
Milwaukee, Wis.

[FM broadcasting never has been publicized as an advertising-free medium of broadcasting. It *has* been hailed as offering higher fidelity and less interference. We can sympathize with dislike of soap opera and commercials, but we must point out that FM offers advantages even to listeners who enjoy soap operas. (Some people *do* enjoy them, strangely enough.)—*Editor.*]

A TEEN-AGER SPEAKS UP

Dear Editor:

I am writing to congratulate you on your most interesting editorial, *Radio as a Vocation*, which appeared in the April issue. I am studying radio and electricity at a vocational high school. Before reading the editorial I was undecided about taking up radio as a profession because I thought a college education was needed. I understand now that, though college is an advantage, it is not necessary.

I am sure many boys my age (15) have these problems about their future and their education. The problems are great because, in this atomic age, education is of vital importance to youth. Your editorial cleared up most of the problems. We will remember especially one word that you stressed: *specialization.*

DOMINICK BRUSCA,
Brooklyn, N. Y.

WANTS MORE BIOGRAPHIES

Dear Editor:

I have just finished reading the story about C. Francis Jenkins in the January issue of RADIO-CRAFT. May I congratulate you and the author George H. Clark on the manner in which this story was presented? It is a credit to the entire radio, electronics, and television field when author and publisher work together to present to the public this fine résumé of a man's life and love.

I hope to find many more similar articles in future issues of RADIO-CRAFT.

W. B. JARVIS,
The Electrolab
Vida, Oregon

CORRECTIONS

The circuit of the "Dual Test Instrument," on page 40 of the March, 1948, issue shows the pilot lamp connected between pins 3 and 7 of the 35Z5. This connection should be made between pins 2 and 3. The outside heater connections of the 35Z5 in the "Audio Amplifier," on the same page, should be to pins 2 and 7 instead of 2 and 3 as shown. The (unconnected) heater tap is brought out to pin 3.

We thank Mr. R. Privat, of Cloverdale, California, for calling this to our attention.

No values were given for the variable condensers used in the 5-Watt Transmitter, page 31 of the April 1948 issue. Condensers C1 and C2 are 50 μμf and 140 μμf respectively.

We thank Mr. S. J. Osterman of Rockaway Park, N. Y., for spotting this omission.

The Worcester Polytechnic Institute at Worcester, Mass., is having holes cut through doors and stairways for an experiment to measure accurately the speed of light.

Professor William B. Wadsworth who is conducting the experiment said that the speed is somewhere between 185,999 and 186,000 miles per second, but has never been precisely measured.

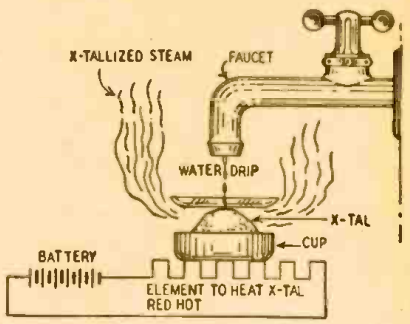
"We propose to find out accurately what it is," he added.

THAT TUBELESS HOMO-HETERADIO!

Dear Editor:

Unless RADIO-CRAFT prints this letter in their next issue, it is very possible that they may have a serious law suit on their hands. In the article by Mohammed Ulysses Fips, I.R.E.I.R.E. the sin of omission has been committed and in this case it is a very serious error. In the diagram at the bottom of page 22 in the April issue the polarity of the battery connections for the Tubeless Homo-Heteradio is not indicated. This is a grave omission.

I have constructed the T.H-H. and have found that when the motor rotates in a counterclockwise position the apparatus functions perfectly. But when the battery connections are reversed and the motor operates in a clockwise direction supersonic vibrations of high intensity are generated along with waves from the 57th and 61st octaves. These waves *may be lethal* to the experimenter. Fortunately, I have a receiver with a crystal squelch circuit in the same room as the T.H-H. The crystal absorbed these vibrations and saved me from a fate that I would rather not discuss. For the sake of the many radiomen who do not have *crystal squelch circuits* available I recommend that RADIO-CRAFT make it very clear



Crystal squelch circuit for Homo-Heteradio.

that the motor of the T.H-H. must be operated in a counterclockwise direction.

HOWARD L. FUNK,
Lynchburg, Va.

P.S. Except for this omission, I think that your magazine is tops.

P.SS. In a second model of the T.H-H. I added one stage of amplification using a 4T1 tube and an electret for a power supply.

HOMO-HETERADIO ERRORS CORRECTED

Dear Editor:

Having been much impressed by the Tubeless Homo-Heteradio in your April issue, some of the boys in the lab decided to construct this fine example of post-war design. After taking the parts to a specially-built laboratory for tryout, we found several discrepancies in Fips' calculations, which caused us no end of trouble. Here are the corrections for the table of vibrations, as verified by several universities and a number of 2500-tube electronic calculators:

The receiver is now operating satisfactorily and many new discoveries have been made. Its most outstanding accomplishment has been the prediction of the name of our next president.

JOHN J. DOE
Willawaa, Iowa

TABLE

Octave	*Original*	*Correction*
20	1,047,576	1,048,576
46	70,368,744,177,644	70,368,744,177,664
47th	140,737,468,355,328	140,737,488,355,328
62nd	4,611,686,618,427,389,904	4,611,686,018,427,387,904

A FEW IMPROVEMENTS ON FIPS

Dear Editor:

Your article on the *Tubeless Homo-Heteradio* by Mohammed Ulysses Fips in the April issue interested me greatly. For the past 20 years I have searched for a perpetual motion machine. Your radio, coupled to such a machine, would be the ultimate in receiver design because it would take no power—not even the siren-driving battery would be necessary. In addition, automatic tuning and a.v.c. might be added to your set by means of a slipping clutch.

I have attempted construction of a Heteradio, following your design but adding some improvements of my own. To avoid frequency drift, I used a synchronous 3600-r.p.m. motor for the siren. Varying the motor speed was obviously impossible, so to tune the set I provided push-button tuning by connecting 5 sirens to the motor through individual gear trains. The largest gear wheel is 23¾ feet in diameter and has 1731½ teeth. The half tooth gives an audible click with each revolution, which could be eliminated by increasing the gear diameter to 47½ feet; I felt, however, that this would be a bit clumsy.

To accommodate the set and the battery-driven crystal-controlled power supply I built for it, I rented an unused airplane hangar, as the house was just slightly too small. For some reason, my wife decided to divorce me at about that time. I have been too busy to ask her just why.

Since increasing the size of the horn should increase the amount of pickup, I based my horn dimensions on the Mt. Palomar telescope lens. I mounted it atop the hangar and connected it to the receiver by means of a long stove pipe. Standard wave guide practice was followed rigidly. I placed several metal lenses in front of the antenna and had to brace the roof. A new assembly of motors and generators was purchased to rotate the assembly.

I find that when I turn on the various

machines, there is so much noise I cannot hear the stations I tune in. This, however, should be cured by acoustic redesign of the rooms.

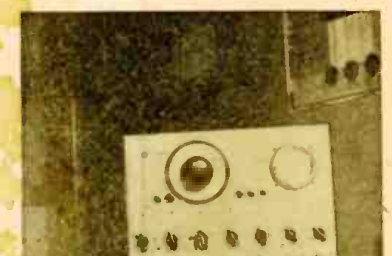
The cost to date is in the neighborhood of $37,000, but I feel I am well on the way to a commercial design. I will keep you informed about my progress and I am sure we can come to an agreement on patent rights which will allow us to follow together the rising star of the Fips Heteradio.

W. G. MURRAY,
Ottawa, Canada

A HOLLAND EXPERIMENTER

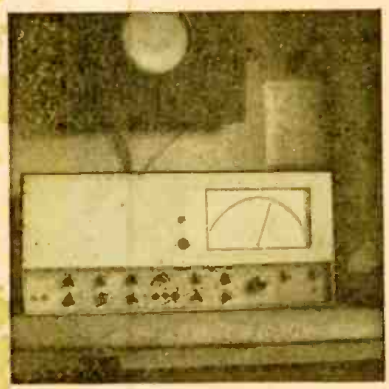
Dear Editor:

Here are pictures of a 12-tube oscilloscope and a 16-tube receiver I built. The scope contains r.f., a.f., and f.m. generators, horizontal and vertical amplifiers, sawtooth oscillator, and 3 rectifiers.



The oscilloscope's panel layout is neat.

The receiver line-up includes r.f. amplifier, mixer and oscillator, two i.f. stages, crystal filter, a.v.c. amplifier,



Receiver uses two separate power supplies.

noise suppressor, a push-pull output stage, and two rectifiers with voltage regulators.

A. A. BOSSCHART,
Delft, Holland

Matched units which would permit a customer to buy a radio-phonograph combination and televiser in two units were announced recently by Admiral Corporation and Hallicrafters. Thus the home radio-televiser can be purchased a piece at a time, as finances become available. The two-unit equipment is also a safeguard against obsolescence, as either the radio or the televiser can be replaced independently.

CLAROSTAT SERVICE MANUAL (7th edition), published by Clarostat Manufacturing Co., Inc. 8½ x 11 inches, 127 pages. Price fifty cents.

Servicemen can refer to this manual when selecting replacement tone and volume controls for receivers. Models are listed numerically in a column under the manufacturer's name. Adjacent columns contain original part numbers, catalog number of Clarostat replacement control and switch if one is used, total resistance in control, application and installation notes including circuit alterations where necessary.

MATHEMATICS FOR RADIO ENGINEERS, by Leonard Mautner. Published by Pitman Publishing Corporation. Stiff cloth covers, 9¼ x 6½ inches, 319 pages plus index. Price $5.00.

More and more radio technicians are beginning to realize that the screwdriver and the soldering iron ought to be backed up by a good theoretical knowledge of the equipment worked on. Especially with today's increasingly complex television and FM receivers, high-frequency heating, and other developments, a mathematical analysis of circuits is highly desirable.

This book takes the reader with a knowledge of basic algebra up through calculus. Designed to be used either as a home-study course for those without previous knowledge of higher mathematics or as a refresher for the graduate engineer, the text presents the work in a step-by-step fashion, and throughout, integrates it directly with electronics by using actual circuits as examples.

The 11 chapters begin with a review of fundamentals, circular trigonometric functions, complex algebra, and hyperbolic functions. From here, the author proceeds to higher mathematics, from differential calculus to the Fourier series.—*R.H.D.*

VIBRATOR POWER SUPPLY DESIGN (Fundamental Principles of). Compiled and published by P. R. Mallory & Co. Flexible fiber covers, 6 x 9 inches, 136 pages. Illustrated. Price $1.00.

Theory and practical description of vibrator power supplies for radio sets, together with design data, formulas, and graphs for the student and engineer are included in this useful handbook. The opening chapters illustrate the circuits and action of vibrator power units, leading up to the basic structure of the vibrator, standard vibrators, and preliminary design considerations.

Basic power transformer characteristics are next discussed. A number of valuable charts are included, among them iron core-loss graphs, wire tables, and d.c. magnetization curves for various grades of transformer steels.

Examples of typical vibrator transformers are given, showing the application of the formulas and tables. Closing chapters deal with timing condensers, with numerous oscillograms to illustrate various adjustments of the vibrator, and the use of different-size condensers; in-

terference elimination; vibrator power-supply connections; inspecting and servicing of vibrators.

Anyone interested in this class of power supply will find this book useful, as it brings into one compact volume the essential data required for a thorough understanding of these often misunderstood devices.—*H.W.S.*

TRANSFORMERS — PRINCIPLES AND APPLICATIONS. By Carl H. Dunlap, W. A. Siefert and Frank E. Austin. Published by the American Technical Society. Cloth covers, 5¾ x 8½ inches, 278 pages. Price $2.75.

A book for the practical man, with sufficient mathematics to provide a thorough understanding of transformers and how they work. The work is divided into three sections: Construction —Theory, Connections and Operation— The Design of Small Transformers. Specially drawn diagrams help to make clear the action occurring in a transformer. Core and shell types are described and the text leads up to an explanation of the current and voltage relations in the transformer. The various iron and copper losses are explained, as well as the means of calculating these losses.

The closing section deals with the design of small transformers, including a 1,000-watt, 110-10,000-volt type, and one of 750 watts, for stepping down 110 volts to 10 volts. A section covers the checking of polarity and phase relations. —*H.W.S.*

BROADCAST OPERATORS' HANDBOOK by Harold E. Ennes. 5½ x 8¾ inches, 265 pages plus index. Published by John F. Rider Publisher, Inc. Price $3.30.

The duties of a broadcast operator are described in this book. Inclusion of studio, field, and transmitter work makes the description rather complete. The writer uses as examples the operation of several of the larger stations. While this adds interest for the reader unfamiliar with broadcasting, the information would be familiar to any technician far enough advanced to be employed by this class of station. The book will suffice to show the novice the problems he will encounter in his future work, but is of less value to the technician of medium experience.—*R.H.D.*

Suggested by: Arthur A. Henrikson

"Just where did you say that needle was lost?"

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THE RADIO AMATEUR'S BEAM POINTER GUIDE, by John F. Rider. Published by John F. Rider Publisher, Inc., 8½ x 11 inches, 32 pages. Price $1.00.

This compilation of tables will help amateur radio operators in this country (as well as several foreign cities) to point a beam antenna "on the nose" at any country or territory with an amateur radio prefix. The tables are corrected for compass deviation to show the bearing to any foreign prefix from 21 cities: Albuquerque, Atlanta, Boston, Buffalo, Butte, Chicago, Cincinnati, Dallas, Denver, Kansas City, Los Angeles, Miami, Minneapolis, New Orleans, New York, St. Louis, San Francisco, Seattle, Washington (D.C.), Buenos Aires, London, and Mexico City.

To use the tables, the operator need only turn to the chart of the city nearest him and read the magnetic bearing next to the prefix.

Minor corrections may be necessary if the antenna is more than 200 miles away from the nearest city listed. The cross index of countries and prefixes is useful in the event that the prefix is not known.—*R.F.S.*

MALLORY RADIO SERVICE ENCYCLOPEDIA (6th Edition), compiled and published by P. R. Mallory & Co., Inc., 8½ x 10⅜ inches, 552 pages. Price $2.00.

The latest edition of this well-known servicing encyclopedia hardly needs an introduction to men in the radio servicing industry. It is prepared along the lines of the earlier editions and contains information on almost all receivers, including some of the latest FM and television models.

The tables list Mallory catalog numbers for replacement tone and volume controls, electrolytic condensers and vibrators as well as the full tube complement, intermediate frequency, and diagram index to Rider's Manuals. A number of diagrams and notes are provided to assist in replacing faulty parts. This type of information is particularly useful when replacing condenser blocks and tapped volume and tone controls.

HIGH VACUA, Principles, Production and Measurement, by Swami Jnanananda, D. Sc., Ph.D., F. Inst. P. Published by D. Van Nostrand Co. Stiff cloth covers, 6 x 9 inches, 310 pages. Price $5.50.

An exhaustive treatise on the subject. The discussions of fundamental theory and measurement are highly technical and mathematical; the description of the various types of pumps and pumping methods is practical and simple. Thus the needs of both the engineer and the operator or maintenance man are met.

RADAR SYSTEM ENGINEERING (Volume I of the M.I.T. Radiation Laboratory Series), edited by Louis N. Ridenour. Published by McGraw-Hill Book Company. Stiff cloth covers, 6½ x 9¼ inches, 748 pages. Price $7.50.

The work of 32 contributing authors, this book presents a broad picture of radar—its theory, development, and applications. Each of its 17 chapters—the work of one or more authors—is divided into a number of subchapters; each complete in itself. Among the chapter titles are: "Properties of Radar Targets," "Limitations of Pulse Radar," "Gathering and Presentation of Radar Data," and "Examples of Radar System Design."

While amply thorough in coverage, the book is surprisingly free from equations and mathematical examples. No special engineering training is required to read it with confidence and understanding. It contains much material on pulse generation and formation, high-frequency and video techniques which is of use to students of electronics and television.

All material is well illustrated with photographs, drawings, and diagrams. In some instances, there are diagrams of radar components now available on the surplus market. Experimenters and engineers may therefore find the book helpful in work on developmental projects with surplus equipment.—*R.F.S.*

MODERN RADIO INSTRUMENTS AND TESTING METHODS, by the Technical Staff of the Coyne Electrical and Radio School. 5½ x 8½ inches, 343 pages plus index. Published by the Coyne School. $3.50.

Beginning with a chapter on the fundamental principles and workings of indicating meters, this book instructs the reader in the care and operation of standard servicing instruments and describes the techniques of making measurements of all types, up to and including oscilloscope tests. Tube testing and signal tracing are included as practical measurement techniques.

The simplest language is used, and the text is well illustrated with drawings and photographs.

RADIO AND THE LAW, by J. G. Moser and Richard A. Lavine. Published by Parker & Co. (Los Angeles). 7 x 10 inches, 386 pages, Price $10.00.

The title is inexact, as with the exception of a few points of basic radio law referred to in connection with broadcasting, the whole book is devoted to broadcast radio and the law. As such, it is complete, covering subjects and quoting specific cases in all fields of broadcasting, including even internal management of broadcast stations.

The Communications Act is printed in full, as an appendix.

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CORRECTION

Silver FM Sweep Generator Model 906

Several specifications on this generator were wrongly given in the article on page 25 of the June issue. The actual range of the Silver Model 906 is from 90 kc to 210 mc; maximum FM deviation range is variable to 1 mc total swing (±500 kc deviation); FM sweep frequency is at twice the power line frequency and amplitude modulation is variable from 0 to 100%. The power supply is not voltage-regulated.

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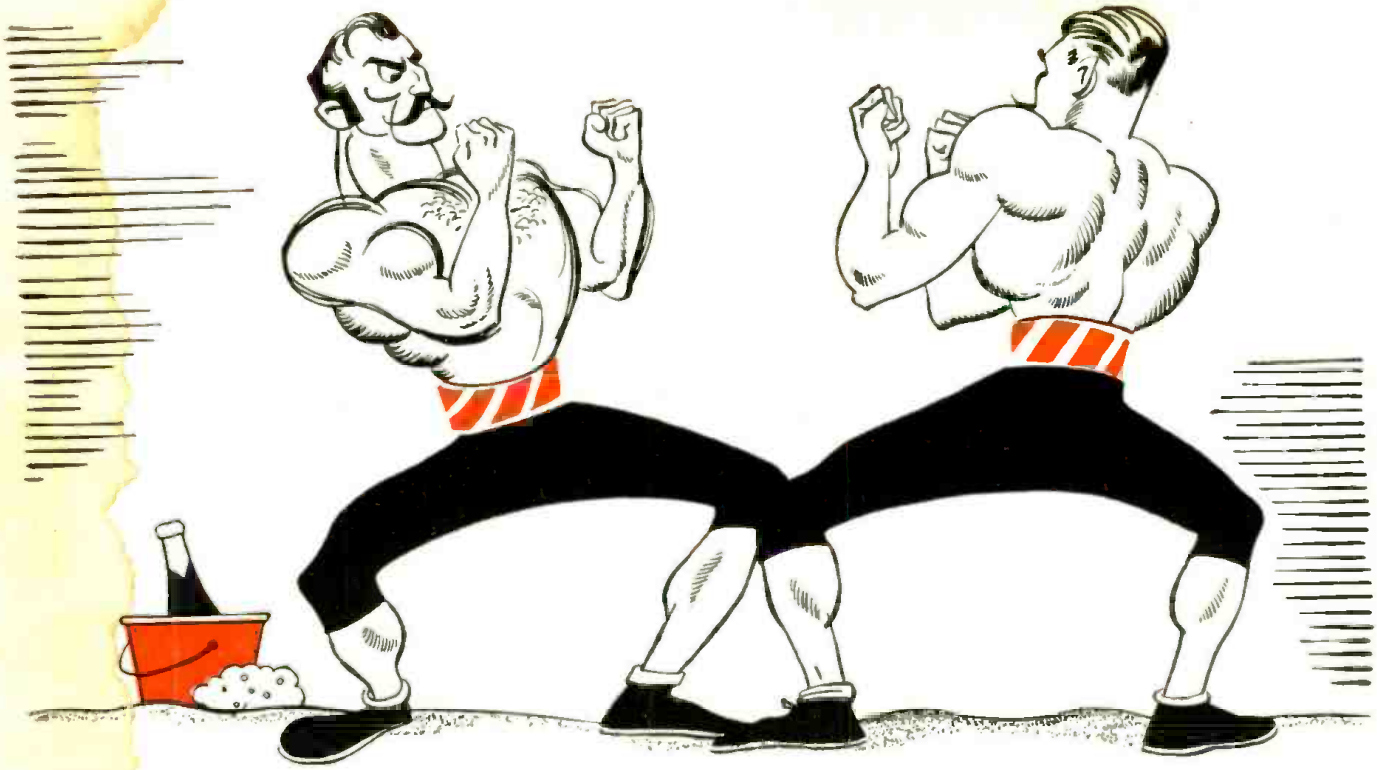

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