HUGO GERNSBACK, Editor

RADIO — ELECTRONICS

formerly RADIO CRAFT

UNUSUAL TECHNIQUES IN SOUND RECORDING

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MAY 1950

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CONTENTS — **MAY, 1950**

ON THE COVER: The new Fairchild Tape recorder beside one of the standard record cutters in the master recording room of Reeves Sound Laboratories. *Posed by Bobbie Shaw for a Kodachrome by Avery Slack.*

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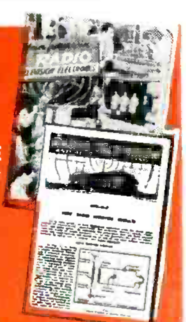

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NOW... the RCA TV Isotap WP-25A—

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Only $16.50 Suggested User Price.

The answer to safe, accurate and speedy servicing of TV receivers ... the RCA WP-25A TV Isotap provides *normal line voltage* for testing sets against manufacturer's rated specifications ... *high line voltage* to show up all the intermittents and faulty components ... *low line voltage* to test receivers under conditions similar to those found in some customers' homes ... *line isolation* to prevent shorts, shocks, and damage to test equipment ... *line matching*, from 105 to 130 volts, in 5-volt steps ... 500 *volt-amperes continuous output* from autotransformer winding; or 275 volt-ampere load from isolated secondary winding.

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RCA WG-263 CRYSTAL PROBE

Converts VoltOhmyst* Meters 163, 165, 165-A, 195, 195-A, WV-65A, WV-75A, and WV-95A into VHF voltmeters for use up to 100 Mc; also used with Chanalyst* Analyzers Types 162, 162-A, 162-B, 162-C and 170-A. Can be used for relative readings to 175 Mc. Price: $8.95.

*Trade Mark, Reg. U. S. Pat. Off.

RCA WG-275 DIODE PROBE

Designed to operate with RCA VoltOhmyst* Electronic Meters WV-75A or WV-95A, for reading rms or peak-to-peak voltages at frequencies from 30 cycles to 250 Mc. The probe fits coaxial "T" connectors, and permits direct measurement of voltages in coaxial lines. Price: $30.00.

*Trade Mark, Reg. U. S. Pat. Off.

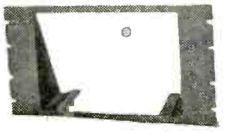
RCA WG-265 MINIATURE TESTPOINT ADAPTER

Makes your trouble-shooting faster, easier, safer by making tube-base connections accessible on the tube side of the chassis. Pins on one end of the adapter fit a 7-pin miniature socket, and socket facilities on the opposite end accommodate all types of 7-pin miniature tubes. Tabs project for easy probe contact. Price $1.50.

RCA ISOTAP WP-24A FOR RADIO SERVICING

Eliminates shock hazard between ac/dc chassis and ground, speeds detection of receiver faults with high-low line tests, and facilitates testing at 117-volt design-center value. Has six-position primary switch and three secondary receptacles. Price: $8.95.

RCA WS-18A RACK-ADAPTER PANEL



For mounting any of the matched RCA Test Instruments in standard 19-inch relay racks. Dimensions, 10½" high, 19" wide, ⅛" thick. Price: $9.50.

TV Exec Cites Need for More Skill in TV Servicemen

Service Manager for Chicago Firm Warns "Old-Timers" that Youngsters are Better Prepared

Adequate test equipment and knowledge of its use are as important to TV technicians as X-ray machines are to surgeons.

AT a recent meeting of the Philadelphia Radio Servicemen's Association, Tim Alexander, service manager of Motorola, Inc., Chicago, and chairman of the Radio Manufacturers' Association Service Committee, as quoted in *Radio & Television Weekly*, warned the old-timers among the radio servicemen that the "youngsters" coming into the business, fresh out of colleges and technical schools, would be taking their jobs away from them unless they take the necessary steps to make themselves as "competent as their new competition."

He pointed out that the "screwdriver and plier" serviceman has no permanent place in television, and that adequate test equipment and knowledge of its use are as important to the television technician as the X-ray machine is to the surgeon.

Mr. Alexander said, "If you are a mediocre television man who can repair a set only by slow, plodding, tenacious work—watch out. Pretty soon one of those 'youngsters' will open a store across the street from you. By virtue of his better training and greater skill, he will be able to do the job in one-quarter of the time. He will be paid twice as much per hour as you get, but the customer will still get off at half-price."

He advised the men to go to school again for latest methods and servicing information.

* * *

ELECTRONIC HOTFOOT is given to pigeons who come to roost in the columns of the State Education Building in Albany, New York. The entrance to the building was once a favorite bombing range until the electronic eliminator was installed.

The eliminator consists of a series of porcelain terminals strung on wires and placed on ledges and overhanging cornices. An r.f. pulse is sent through the wires which sets up a magnetic field around the terminals. When a bird enters the field, he gets a jolt which is harmless but nevertheless very uncomfortable.

SIGNAL CORPS achievements will be displayed on May 13 at Ft. Monmouth, N. J., in an all-day program for delegates to the national convention of the Armed Forces Communications Association to be held at N. Y. C. on May 12. Leaders in the communications and electronics fields and high-ranking officers from all branches of the armed services will be present.

The program will feature elaborate displays from the Signal Corps Engineering Laboratories, the Armed Services Electro-Standards Agency, and the Signal School of Ft. Monmouth; parachute drops by the 82nd Airborne Division; wire laying demonstrations by helicopter and bazooka; and a combat communication problem in which the airborne troops will figure if the weather is good.

CONDUCTIVE GLASS is a recent development of the Corning Glass Works. The glass has a transparent skin of a metallic oxide about 16 millionths of an inch thick which conducts electricity but has enough resistance to heat the glass up to 660° F.

In the first field tests heaters made of flat panels of the new glass were used to keep baby chicks warm in brooders, to dry textile yarns, and to dry lacquer on plastic playing cards. A coffee percolator of electric glass is being developed. The coffee maker will rest on a plastic base, and electrodes will carry current to the electric skin on the bottom of the pot.

The new material might also be used as wall panels in a bath room or to keep ice from forming on windshields. The glass can produce a wide range of temperatures, depending on the resistance of the film and the voltage used.

SOLAR ENERGY may be the answer to the coal crises which come dangerously close to upsetting our economy. Dr. Dean Burk of the National Institute of Health told the finalists of the ninth annual Science Talent Search at a meeting in Washington, D. C., that vast quantities of hydrogen, a highly useful fuel, could be made available if man could master photosynthesis, the process by which plants use solar energy. If this could be done, man could merely direct the sun to decompose water to oxygen and hydrogen.

INCOME TAX returns are being checked by electronic robots this year in New York and four other cities. The Bureau of Internal Revenue has installed fifteen electronic brains, each of which can check all of the involved computations of a 1040 tax return at the rate of 800 returns a minute.

When a tax return is processed, all of the pertinent data is abstracted on an electric card punching machine. The cards are then fed to the robot which traces all of the taxpayers calculations in a seventieth of a second. It finds each mistake and shows where it is. If a refund is due, it is noted; and if an assessment is needed, the machine takes care of that, too. If the taxpayer comes within a dollar of being balanced with the government, the machine calls it quits.

These machines and other work-speeding devices are being used by the bureau to get refunds back to the taxpayer before the interest accumulates.

ALUMINUM MIRROR is used to reflect TV signals in a studio-transmitter link of WNBF-TV in Binghamton, N. Y. Such links are usually provided by special land lines or by a line-of-sight microwave beam. In this case, the transmitter building was on the far slope of a wooded hill about 3½ miles from the studio and a land line up the hill would have been very expensive.

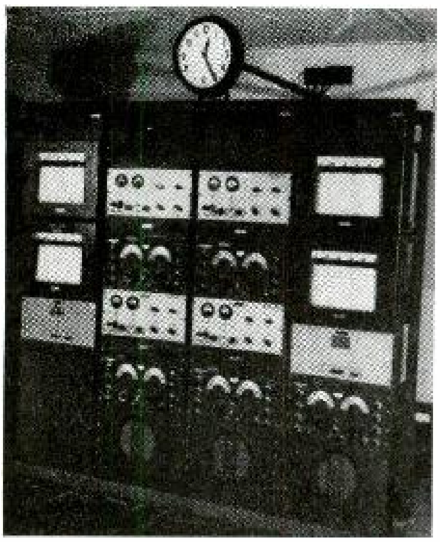
Although the transmitter building has no line-of-sight path to any of the tall buildings in the city, it did have a 384-ft. antenna tower which rose well above the crest of the hill. Engineers placed a 7-foot square sheet of aluminum about halfway up the tower to reflect a microwave beam from the top of the local telephone building to a dish antenna on the roof of the transmitter building.

This is believed to be the first case in which a reflector such as this is used in a television studio-transmitter link, and it required careful planning. Weather men were consulted to find out how much the tower could be expected to sway in the wind. With the mirror halfway up the tower, transmission is not disturbed by any windstorm. A swath had to be cleared through the woods on the hill to get a line-of-sight path from the equipment in the city to the mirror on the antenna tower.

GUIDED MISSILES may be guided to their targets by robot "saboteurs" planted in enemy cities. This was hinted in a *Glossary of Guided Missile Terms* published last month by the Defense Department's Research and Development Board. The reference was to a "semiactive homing guidance" by which the guided bomb homes on a target "illuminated from a source other than the missile."

In practice the missile would follow a radio beam either located in the enemy city, smuggled there by secret agents, or by a beam pointed at the city from outside it and reflected from it on an angle.

FIELD STATION to make continuous measurements of radio waves reflected from the upper atmosphere has been established at Fort Belvoir, Virginia, by the National Bureau of Standards. The Belvoir Field Station is one of a system of fourteen stations operating under the supervision of the Bureau's Central Radio Propagation Laboratory and is part of a world-wide network of over 50 radio observatories.



Some of the equipment at Fort Belvoir.

The station has four separate buildings designed for ionospheric and geophysical measurements. Equipment includes the latest in field intensity recorders, ionospheric recorders, and visually-recording magnetographs. Data gathered at the new station will be used to make predictions three months in advance of the best frequencies for short wave radio communication as well as warnings of sudden radio disturbances.

The Belvoir Field Station serves as a training center in the techniques of ionospheric and field intensity measurements. It is also a testing ground for new measuring equipment and procedures that are proposed for use at all of the Bureau's field stations.

INTERFERENCE from local oscillators in television receivers is a very serious problem according to Chairman Wayne Coy of the Federal Communications Commission. (See January, 1950 issue, page 36.) The FCC hopes to get away from this problem by opening up the u.h.f. range to television broadcasting.

Mr. Coy told a House subcommittee that the oscillators of some television receivers put out enough power to put out of commission all the receivers within a 1-mile radius. He said that the Boston-Providence area is bothered with this trouble and that there are 32,000 receivers in this area which cannot get either channel 11 broadcasts from Providence or channel 7 broadcasts from Boston because of it.

DEATH RAYS that will kill fruit flies and other insects which contaminate food are being used in experiments by the U. S. Bureau of Entomology and Plant Quarantine.

The rays are produced by a 2½-million-volt machine which shoots electrons at the insects in blasts that last for 1 microsecond. At a range of 12 inches, the electrons kill insects over a 14-inch square.

The machine is called a capacitron and was first used for sterilizing and preserving foods. The experiments in killing insects were begun at the request of agricultural experts in Hawaii who were worried about fruit flies in food exported from the islands.

So far, the rays have killed mosquitoes, fruit flies, carpet beetles, flour beetles, and other kinds of insects. They also work on insects in the egg or larva stage.

AIR SAFETY equipment is being purchased by the Civil Aeronautics Administration in a 4-million dollar order, the largest ever made by the CAA.

The order calls for 450 "distance measuring equipment" ground stations for use with a nation-wide network of omni-directional radio ranges. The new D.M.E. transmitters, as the units are called, are part of an air navigation system developed by the Radio Technical Commission for Aeronautics and approved by Congress for installation. It will require about 15 years to complete the system.

Aircraft now can follow direct courses between the CAA's omni-ranges, or they can follow courses parallel to the airways by taking periodic cross-bearings on more than one such station. The D.M.E. units will be installed on top of existing omni-range stations and will give the airmen an exact mileage "fix" on the course they are following. This will eliminate the need for estimating how far they have travelled between ranges.

FRINGE COMMUNITIES in Wisconsin are investigating the dangers of large private television antenna towers in order to enact control ordinances. Residents in cities as far as 100 miles from Milwaukee have erected towers upwards of 60 feet high in an effort to receive programs from Milwaukee and even Chicago.

TEN DEVELOPMENTS in radio which were the most outstanding during the first half of the twentieth century were listed last month by Dr. C. B. Jolliffe, executive vice-president in charge of RCA Laboratories. They are:

1. Wireless communications;
2. The electron tube;
3. Radiotelephone communication;
4. Radio broadcasting;
5. All-electronic television;
6. Facsimile-type transmission;
7. Radio navigation aids;
8. Radar;
9. Remote radio control;
10. Microwave relays.

the 1950 PARTS DISTRIBUTORS CONFERENCE AND SHOW

Remember . . . May is Market Month!

"The only all-industry sponsored Conference and Show in Electronics"

MAY 22-25 1950 • STEVENS HOTEL • CHICAGO

The annual Parts Distributors Conference and Show will be held this year at the Stevens Hotel, Chicago from May 22-25. Approximately 175 manufacturers, merchandising their products through parts distributors, have either reserved booths in the Exhibition Hall or will show their products in display rooms throughout the hotel. Many of the manufacturers will have both booths and display rooms. The Show committee is sponsoring many innovations in this year's program, and attendance in the Exhibition Hall will be restricted exclusively to distributors. All other members of the manufacturing industry will have access to display rooms in the hotel. From all indications, there is every reason to believe that the 1950 Conference and Show will be the most successful and best attended in history. Following is a list of exhibitors who have reserved space in either the Exhibition Hall or in display rooms at the Stevens for their displays.

List of Exhibitors in
THE 1950 PARTS DISTRIBUTORS
CONFERENCE & SHOW

COMPANY	EXHIBITION HALL BOOTH	DISPLAY ROOM
Aerovox Corporation	404	
Aircraft Marine Products, Inc.	124	610
Alliance Mfg. Co.	222	
Alpha Wire Corp.	516	
Altec Lansing Corp.	302	
American Microphone Co.	503	
American Phenolic Corp.	614	550A-551A
American Radio Hardware Co., Inc.	109	
American Television & Radio Co.	420	
Amperite Company	110	
Anchor Radio Corp.	2	
Approved Electronic Instrument Corp.	10	
Astatic Corp.	317	
Atlas Sound Corp.	417	521A
Audio Devices, Inc.	611	602A
Barker & Williamson, Inc.	422	
Belden Manufacturing Co.	405	501A
Bell Sound Systems	514	524A-526A
David Bogen Co.	407	505A
British Industries	301	
Brush Development Co.	106	658-659
Bud Radio, Inc.	206	
Burgess Battery Co.	221	
Camburn, Inc.	129	
Carter Motor Co.	601	
Centralab Div.	509	
Chicago Transformer Division	606	656A-657A
Cinch Manufacturing Co.	413	
Clarostat Manufacturing Co.	320	
Cleveland Electronics, Inc.	204	542A
Columbia Wire & Supply Co.	619	
Condenser Products	418	
Consolidated Wire & Assoc. Companies	7	
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Cornish Wire Co.	613	
Crescent Industries, Inc.	115	557
Crest Transformer Corp.	607	
J. W. Davis & Co.	103	
Drake Electric Works	518	637
Dumont Electric Co.	101	
Duotone Company	521	
Eckstein Radio & TV Co.		612
Electric Soldering Iron Co.	310	
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Electro Products Labs.	219	
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Espey Manufacturing Co.	406	
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Gee-Lar Products Co.	5	
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Hallicrafters Co.	605	530A-532A
Hammarlund Mfg. Co.	7	
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Hickok Electrical Instrument Co.	318	544A
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House of Television, Inc.	14	
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Indiana Steel Products Co.	116	504A
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Jackson Industries	604	
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Jensen Manufacturing Co.	402	504-505
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La Pointe Plascomold Corp.	26	
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Littlefuse, Inc.	313	560A
P. R. Mallory & Co.	121	
Markel Electric Products	602	609A
Merit Transformer Co.	621	
James Millen Mfg. Co.	217	
M. A. Miller Mfg. Co.	211	
National Company, Inc.	306	
National Union Radio Corp.	117	
Newcomb Audio Products Co.	119	521
Nicholas Equipment Co.	8	
Oak Ridge Products	11	
Ohmite Manufacturing Co.	612	
Oxford Electric Corp.	515	507A
Park Metalware Co.	319	
Par-Metal Products Corp.	209	
Pentron Corp.	4	656A
Permoflux Corp.	603	533A-534A
Permo, Inc.	25	
Phalo Plastics Corp.	3	
Philmore Mfg. Co., Inc.	213	535A-536A
Phoenix Electronics, Inc.	618	549
Pickering & Co., Inc.	12	619
Potter & Brumfield	123	553A
Precision Apparatus Co.	303	522
Premax Industries Division	135	
Presto Recording Corp.	207	613A
Pyramid Electric Co.	502	
Quam-Nichols Co.	510	501
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Recoton Corp.	321	
Rek-O-Kut Co.		557A
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Howard W. Sams & Co.	308	
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Walter L. Schott Co.	214	
Hermon Hosmer Scott, Inc.	1	614A-615A
Sheldon Electric Co.	201	632
Shure Brothers, Inc.	512	519A-520A
McMurdo Silver Co.	21	
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Mark Simpson Mfg. Co.	609	605-607
Herman H. Smith, Inc.	316	
Snyder Manufacturing Co.	125	
Sola Electric Co.	513	
Spirling Products Co.	225	612A
Sprague Products Co.	403	
Standard Coil Products Co.	13	
Standard Transformer Corp.	401	512A-513A
Stephens Manufacturing Co.		622A-623A
Supreme, Inc.	311	
Sylvania Electric Products	615	
Talk-A-Phone Co.	410	610A-611A
Technical Appliance Corp.	304	
Thordarson Electric Mfg. Div.	409	
Triad Transformer Mfg. Co.	408	
Tricraft Products Co.	216	
Trimm, Inc.	128	
Triplett Elec'l Instrument Co.	315	520
Tung-Sol Lamp Works	104	613
Turner Co.		509A
Ungar Electric Tool Co.	309	
Unimac Products Div.		533-534
United Transformer Co.	305	
University Loudspeakers, Inc.	506	660
Vaco Products Co.	507	
James Vibrapower Co.		611
V-M Corporation	23	528A
Waldom Electronics Co.	223	
Ward Leonard Electric Co.	220	
Ward Products Corp.	312	537A
Webster-Chicago Corp.	210	
Weller Manufacturing Co.	215	
Weston Elec'l Instrument Corp.	419	
Wilcox-Gay Corp.	102	600
Wincharger Corp.	126	
Workshop Associates	105	601A

PUBLICATIONS

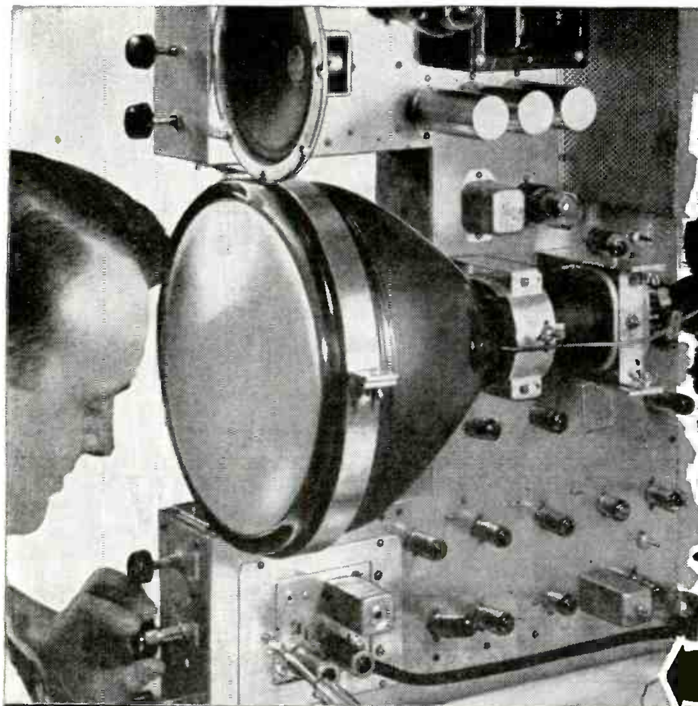
COMPANY	DISPLAY ROOM
RADIO-ELECTRONICS	6[illegible]
Boland & Boyce, Inc.	635A
Bryan-Davis Publishing Co.	561A
Caldwell-Clements, Inc.	604
Cowan Publishing Corp.	618A-619A
Electronic Publishing Co.	603A
FM-TV Magazine	638A
Jobber News	537
Parts Jobber	630A
Radio & TV Journal	655
Radio & TV News	629
Radio & TV Weekly	614
United Catalog Publishers	603-609

The Association of Electronic Parts and Equipment Manufacturers, Chicago, in their February meeting, authorized its publicity committee, to prepare a program on brand names.

The publicity committee consists of HELEN STANILAND QUAM, of Quam-Nichols Co., Chicago, chairman; JEROME J. KAHN, Standard Transformer Corp., Chicago; and RALPH BRENGLE, Potter & Brumfield Co., Princeton, Indiana.

"The parts industry is spending millions of dollars on advertising schedules to acquaint the distributor and the consumer with its products and the only way it can protect that investment is to take effective steps against the substitution of unbranded, surplus, dumped, and distress merchandise," Mrs. Quam told the members.

"The eclipse of individual trade names would invite regimentation of the parts industry and ultimately reduce the manufacturer to the status of an anonymous supplier," she added.

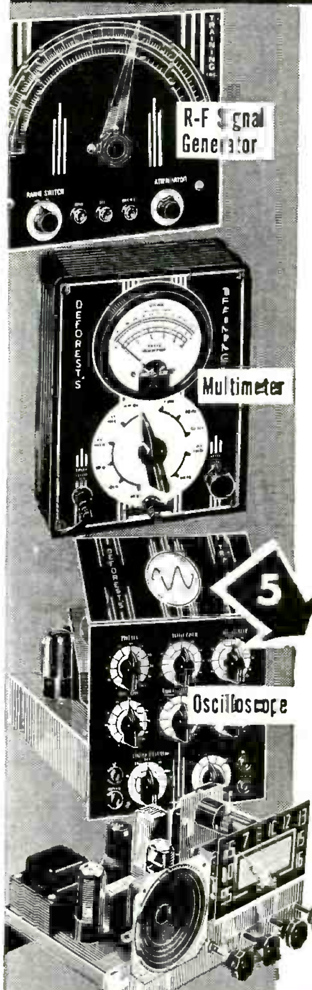


Only D.T.I. offers you the "BIG 5" TELEVISION

RADIO-ELECTRONICS Laboratory Type *HOME TRAINING*

1 { OPTIONAL FEATURE }

Build and Keep 10, 12½ or 16 inch Picture Tube Quality TELEVISION RECEIVER as you prepare for a Profitable Future



Here is *everything* you need to prepare you at home for FASCINATING WORK, GOOD MONEY and a THRILLING FUTURE in one of America's most promising fields.

This includes the opportunity to build and keep the top quality Television Receiver shown above—with choice of a 10, 12½ or 16 inch picture tube that gives big, bright, sharp, steady pictures. Get the complete facts. This is an optional feature — available when you complete your training described below. See how D.T.I.'s wonderfully practical "BIG 5" method meets industry's needs. No previous experience needed. Mail coupon today!

16 Big Shipments of Parts — Plus Lessons

Work over 300 electronic experiments and projects from 16 big shipments of parts. This includes building and keeping all test equipment and radio set shown at left side of page. Modern easy-to-read lessons with handy fold-out diagrams simplifies your entire training.

You Also Use Home Movies

D.T.I., alone, includes the modern, visual training aid . . . MOVIES to help you learn faster, easier at home. See electrons on the march and other fascinating "hidden action"—a remarkable home training advantage that speeds your progress.

EMPLOYMENT SERVICE

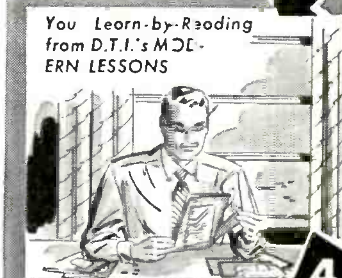
When you complete your training, our effective Employment Service helps you get started toward a real future in Television-Radio-Electronics.

Modern Laboratories

If you prefer, you can get ALL your preparation in our new, Chicago training laboratories . . . one of the finest of its kind. Ample instructors ... modern equipment. Write for details!

2

3



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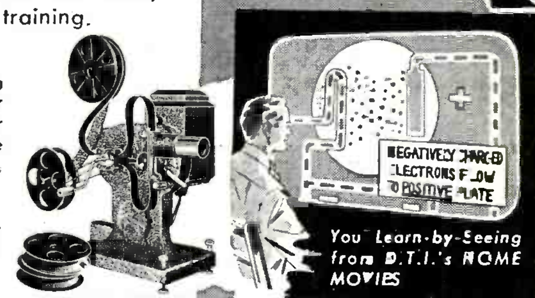

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Chicago 14, Illinois
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Without obligation, give me complete facts showing how I may make my start in Television-Radio-Electronics.

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• STRENGTH • RIGIDITY • SENSITIVITY

SUPERSEDES THE BM 312 FAN FLECTOR SERIES

• LOWER PRICES
• SMALLER BOX
• SUPERIOR PREASSEMBLY

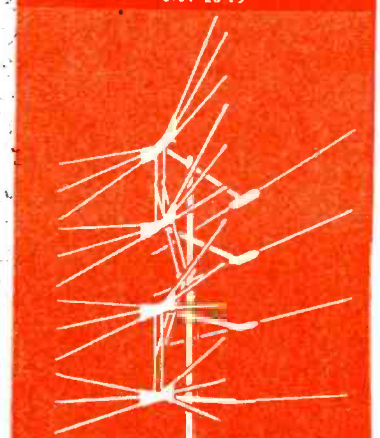
HOWLPROOF BREAKPROOF

The Super-Fan series are the most sensitive broad band antennas, stack for stack, commercially available. Their 150 ohm impedance permits efficient low loss tie-in to all standard transmission lines. Safety engineered with solid aluminum inserts, and howl proof sealed ends, these antennas withstand ice loads and high winds silently and without breakage.

These models also feature *Swing-Lock-Action*, the patented preassembled feature of all Channel Master antennas. Just swing out elements and lock them in place — as easy as that.

BM 313 SUPER-FAN LIST 12.19

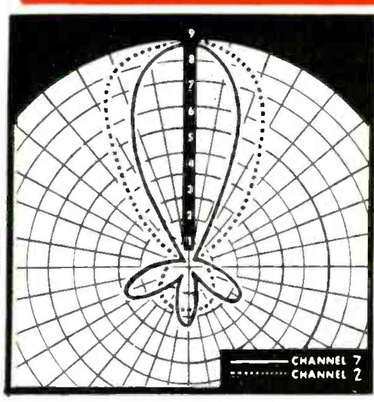
BM 313X2 STACKED SUPER-FAN LIST 26.25



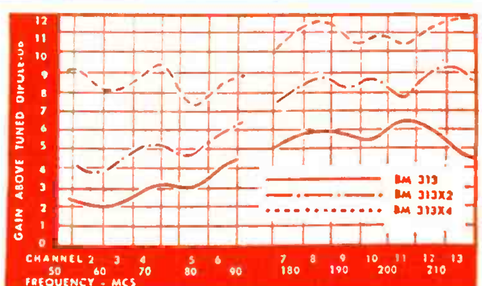
BM 313X4 DOUBLE STACKED SUPER-FAN LIST 57.10

A TELEVISION SET IS NO BETTER THAN ITS ANTENNA
THERE IS NO BETTER ANTENNA THAN THE SUPER-FAN

GAIN OF THE SUPER-FAN SERIES



HORIZONTAL POLAR DIAGRAMS



GAIN CURVES

CHANNEL	2	3	4	5	6		7	8	9	10	11	12	13
313	2.1	2.2	3.0	3.0	4.0		5.5	5.8	5.8	5.7	6.5	6.0	4.7
313X2	4.8	5.0	6.1	5.7	6.8		9.0	9.7	9.3	9.4	8.8	9.8	10.0
313X4	9.0	8.2	9.0	7.5	8.5		11.0	11.4	10.6	10.8	10.3	11.3	11.9

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☐ Name of nearest Channel Master Distributor
☐ Technical data and literature

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MORE QUALITY in *1950 Heathkits*

The NEW V-4 *Heathkit* VACUUM TUBE VOLTMETER KIT

Features

- Meter scale 17% longer than average 4½" meter.
- Modern streamline 200 ua meter.
- New modern streamline styling.
- Burn-out proof meter circuit.
- 24 Complete ranges.
- Isolated probe for dynamic testing.
- Most beautiful VTVM in America.
- Accessory probes (extra) extend ranges to 10,000 Volts and 100 Megacycles.
- Uses 1% precision ceramic divider resistors.
- Modern push-pull electronic voltmeter circuit.
- Electronic AC circuit. No current drawing rectifiers.
- Shatterproof plastic meter face.

The new Heathkit Model V-4 Vacuum Tube Voltmeter has dozens of improvements. A new modern streamlined 200 microampere meter has Alnico V magnet for fast, accurate readings. The new electronic AC voltmeter circuit incorporates an entire new balance control which eliminates contact potential and provides greater accuracy. New simplified switches for quicker assembly. New snap-in battery mounting is on the chassis for easy replacement.

The Heathkit VTVM is the only kit giving all the ranges. Check them — DC and AC full scale linear ranges of 0-3V, 0-10V, 0-30V, 0-100V, 0-300V, 0-1000V and can be extended to 0-3000V and 0-10,000V DC with accessory probe at slight extra cost. Electronic ohmmeter has six ranges measuring resistance accurately from .1 ohm to one billion ohms. Meter pointer can be offset to zero center for FM alignment.

The DC probe is isolated for dynamic measurements. Has db scale for making gain and other audio measurements.

The new instruction manual features pictorial diagrams and step-by-step instructions for easy assembly. The Heathkit VTVM is complete with every part — 110V transformer operated with test leads, tubes, light aluminum cabinet for portability, giant 4½" 200 microamp meter and complete instruction manual.

Order now and enjoy it this entire season. Shipping weight 8 lbs., Model V-4

$24.50

Accessory: 10,000V high voltage probe, No. 310, $4.50.
Accessory: RF crystal diode probe kit extends RF range to 100 Mc., No. 309, $6.50.

New 1950 VERNIER TUNING R.F. *Heathkit* SIGNAL GENERATOR KIT

$19.50

Features

- New 5 to 1 ratio vernier tuning for ease and accuracy.
- New external modulation switch—use it for fidelity testing.
- New precision coils for greater output.
- Cathode follower output for greatest stability.
- 400 cycle audio available for audio testing.
- Most modern type R.F. oscillator.
- Covers 150Kc. to 34Mc. on fundamentals and calibrated strong harmonics to 102 Mc.

The most popular signal generator kit has been vastly improved—the experience of thousands combined to give you the best. Check the features in this fine generator and consider the low price $19.50. A best buy for any shop, yet inexpensive enough for hobbyists. Everyone can have an accurate controlled source of R.F. signal voltage.

The new features double the value—think of being able to make fidelity checks on receivers by inserting a variable audio signal. Internal 400 cycle saw-tooth audio oscillator modulates R.F. signal and is available externally for audio testing. The new 5 to 1 ratio vernier drive gives hairline tuning for maximum accuracy in scale settings. The coils are already precision wound and calibrated. Uses turret type coil and switch assembly for ease of construction. The generator is 110 V. 60 cycle transformer operated and comes complete in every detail—cabinet—tubes—coils—beautiful two color calibrated panel and all small parts—new step-by-step pictorial diagrams and complete instruction manual make assembly a cinch even for novices. Why try to get along without a signal generator when you can have the best for less than a twenty dollar bill. Better order it now. Shipping weight 7 lbs. $19.50

CONVERSION KIT FOR G-1 GENERATORS

Conversion kit for G-1 generators for vernier tuning and external modulation includes new high band coil for greater output. Gives all the features of new G-5 listed above. Order G-5 Conversion Kit No. 316 .... $4.50

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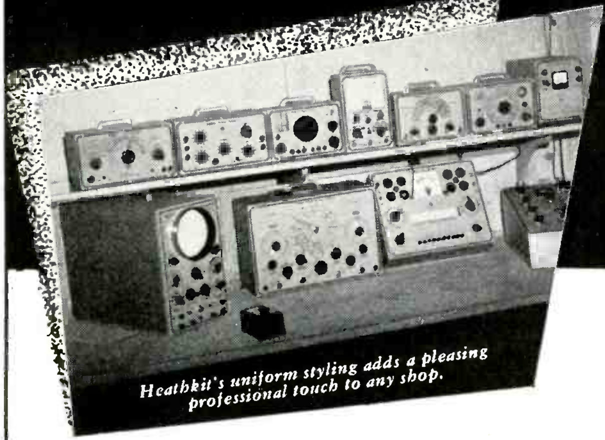
The HEATH COMPANY
... BENTON HARBOR 20, MICHIGAN



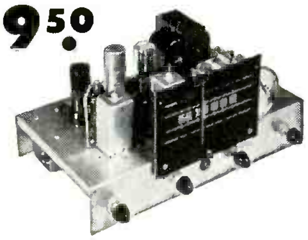
Heathkit's uniform styling adds a pleasing professional touch to any shop.

Heathkits PROVIDE PROFESSIONAL LABORATORY APPEARANCE

New Heathkit BROADCAST AND 3 BAND SUPERHETERODYNE RECEIVER KIT

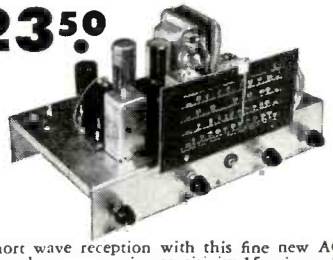
BROADCAST MODEL BR-1
550 to 1600 Kc.

$19.50



3 BAND MODEL AR-1
550 Kc. to 20 Mc.

$23.50



Two new Heathkit Superheterodynes featuring the best of design and material. Beautiful six inch slide rule dials — 110 V. 60 cy. AC power transformer operated—metal cased filters—quality output transformers, dual iron core metal can IF transformers — two gang tuning condenser. The chassis is provided with phono-radio switch—110 V. outlet for changer motor and phono pickup jack. Each kit is complete with all parts and detailed instruction booklet. Pictorial diagrams and step-by-step instructions make assembly quick and easy.

Ideal AC operated superheterodyne receiver for home use or replacement in console cabinet. Comes complete with attractive metal panel for cabinet mounting. Modern circuit uses 12K8 converter, 12SH7 input IF stage, 12C8 output IF stage and first audio 12A6 beam power output stage. 5Y3 rectifier. Excellent sensitivity for distant reception with selectivity which effectively separates adjacent stations.

The husky 110 V. cased power transformer is conservatively rated for long life.

The illuminated six inch slide rule dial is accurately calibrated for DX reception. Enjoy the pleasure of assembling your own fine home receiver. Has tone, volume, tuning and phono-radio controls. Chassis size 2¼" x 7" x 12½" Comes complete with all parts including quality output transformer to 3.4 ohm voice coil, tubes, instruction manual, etc. (less speaker). Shipping Wt., 10 lbs. No. BR-1 Receiver $19.50.

No. 335 Communications Type Table Model Metal Cabinet.................. **$4.50**
No. 320 High Quality 5" PM Speaker for above.................................. **2.75**

Enjoy the thrill of world wide short wave reception with this fine new AC operated Heathkit 3 band superheterodyne — amazing sensitivity 15 microvolt or better on all bands. Continuous coverage 550 Kc. to over 20 Mc. Easy to build with complete step-by-step instructions and pictorial diagram. Attractive accurately calibrated six inch slide rule dial for easy tuning. Six tubes with one dual purpose tube gives seven tube performance. Beam power output tube gives over 3 watts output.

Separately assembled coil turret with band switch eliminates difficult construction. Conservatively rated 110 V. power transformer supplies full operating voltages to all tubes for maximum reception. Has band switch, tuning, volume, tone and phono-radio controls. Chassis size 2¼" x 7" x 12½" — supplied complete — punched chassis — tubes — controls — transformers (quality output to 3.4 ohm voice coil) — all small parts — hardware and instructions (less speaker). Shipping Wt., 10 lbs. No. AR-1 Receiver $23.50.

No. 335 Communications Type Table Model Metal Cabinet.................. **$4.50**
No. 320 High Quality 5" PM Speaker for above.................................. **2.75**

Heathkit PUSH-PULL HIGH FIDELITY AMPLIFIER KIT

$12.50

Build this high fidelity push-pull amplifier and save two-thirds the cost—has two pre-amplifier stages, phase inverter stage and push-pull beam power output stage. Comes complete with six tubes—quality output transformer (to 3-4 ohm voice coil) tone and volume controls—varnish impregnated cased 110V. power transformer and detailed instruction manual and all small parts. Six watt output with output flat within 1½ db between 50 and 15000 cycles. Build this amplifier now and enjoy it for years. Shipping Wt. 7 lbs. Model A-4

12" PM Speaker for above.......... **$6.95**

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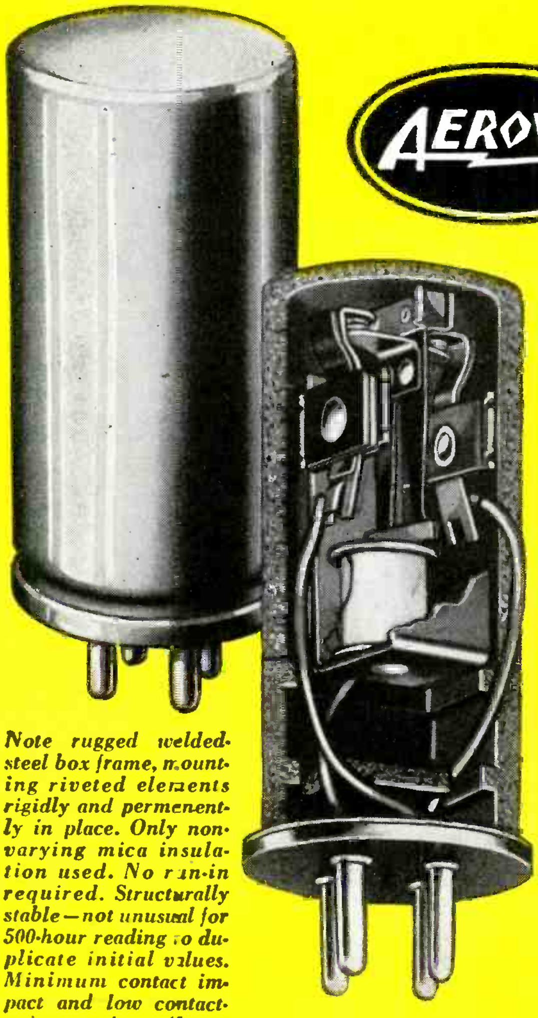
. . . BENTON HARBOR 20, MICHIGAN

Quiet as a mouse



AEROVOX

VIBRATORS

● So very quiet! You'll doubt the Aerovox Vibrator* is running until you've turned up the volume control.

Here's *the first postwar vibrator*. Radically new design—outcome of systematic engineering effort to eliminate annoyances experienced with vibrators. Provides brand new performance thrill with any auto-radio or other vibrator-powered equipment. Definitely another milestone in vibrators.

Just compare!

Yes sir, comparative tests are invited. Literature on request. Let us collaborate on your vibrator problems and needs.

**U. S. Patents Pending*

Note rugged welded-steel box frame, mounting riveted elements rigidly and permanently in place. Only non-varying mica insulation used. No run-in required. Structurally stable—not unusual for 500-hour reading to duplicate initial values. Minimum contact impact and low contact-point erosion. Almost impossible for unit to close or stick. Heat generation low enough to sustain operation at 185° F.

Standard and special types. Also Universal Replacements serving greatest number of auto-radio models with minimum inventory. For the best in replacements, insist on the "Quiet Mouse" yellow - and - black carton vibrator stocked by Aerovox distributors!

AEROVOX

VIBRATORS

FOR AUTO-RADIO • POLICE RADIO • AVIATION RADIO • LABORATORY AND OTHER POWER PACKS • MARINE RADIO • PORTABLE RADIO • FARM RADIO • INDUSTRIAL ELECTRONICS • ETC.

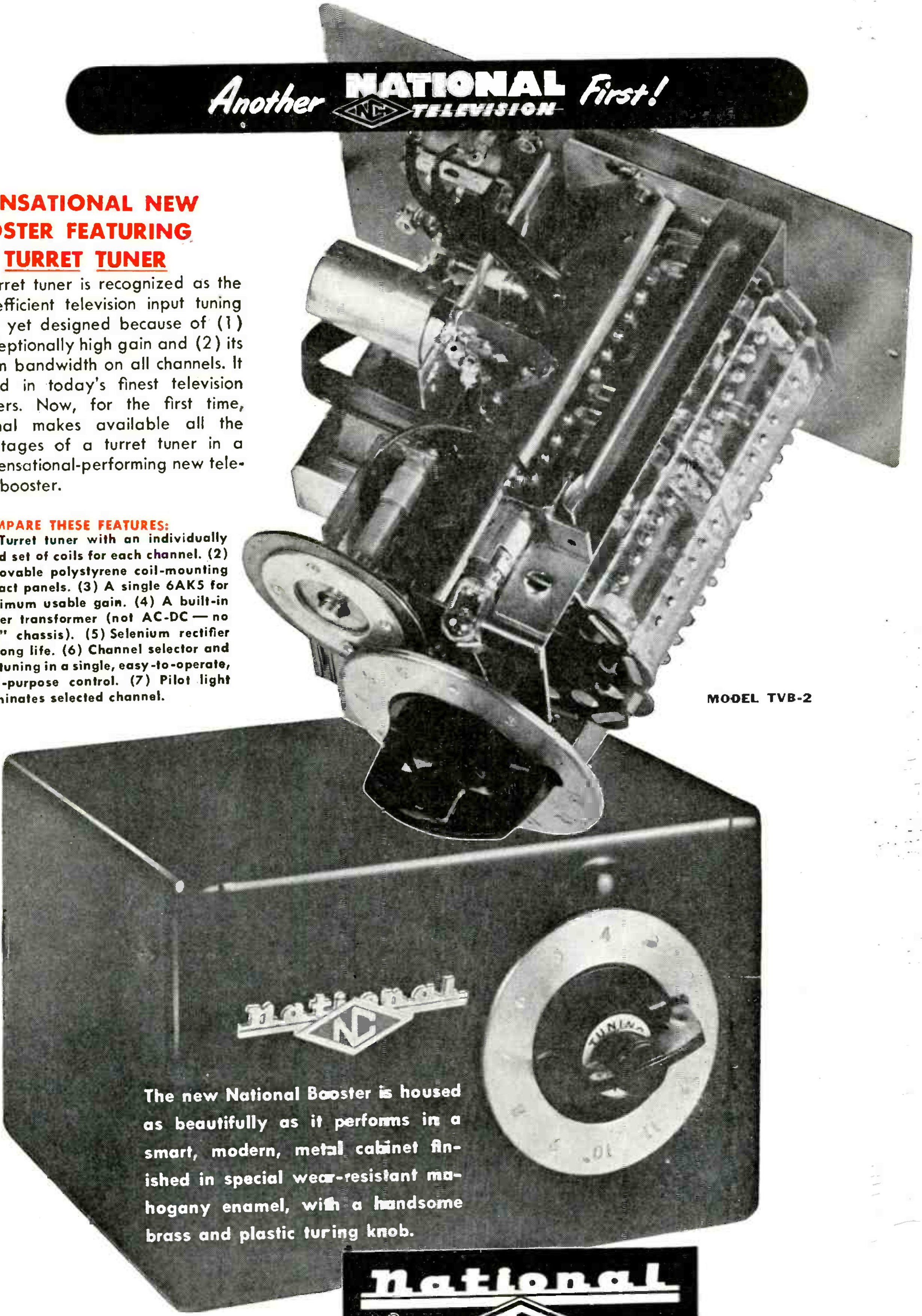
AEROVOX CORPORATION • NEW BEDFORD • MASSACHUSETTS

Another NATIONAL TELEVISION First!

A SENSATIONAL NEW BOOSTER FEATURING A TURRET TUNER

The turret tuner is recognized as the most efficient television input tuning device yet designed because of (1) its exceptionally high gain and (2) its uniform bandwidth on all channels. It is used in today's finest television receivers. Now, for the first time, National makes available all the advantages of a turret tuner in a truly sensational-performing new television booster.

COMPARE THESE FEATURES:
(1) Turret tuner with an individually tuned set of coils for each channel. (2) Removable polystyrene coil-mounting contact panels. (3) A single 6AK5 for maximum usable gain. (4) A built-in power transformer (not AC-DC — no "hot" chassis). (5) Selenium rectifier for long life. (6) Channel selector and fine tuning in a single, easy-to-operate, dual-purpose control. (7) Pilot light illuminates selected channel.



MODEL TVB-2

The new National Booster is housed as beautifully as it performs in a smart, modern, metal cabinet finished in special wear-resistant mahogany enamel, with a handsome brass and plastic turing knob.

$39.95
list price

P.S. No other booster has a turret tuner!

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THESE LEADING SET MAKERS

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BENDIX RADIO
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Sparton
GAROD
CROSLEY
Sentinel
TRAV-LER
air king

Seen these Hytron firsts in popular new TV sets? The prominent TV set makers shown are using them. And the list is growing.

DuMont, for example, now uses the 1X2 and 6BQ6GT. You'll see many more of these famous tubes. And many more new Hytron types designed for low-cost TV for the mass market. When you buy these Hytron firsts, follow the leading set manufacturers. Buy the original. Buy Hytron!

choose one or more of THESE HYTRON TV FIRSTS

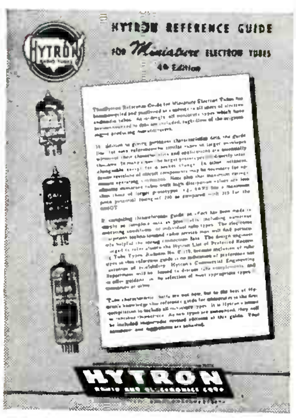
HYTRON TV FIRST
1X2 compact, high-voltage TV rectifier.

HYTRON TV FIRST
6U4GT high-perveance damping diode.

HYTRON TV FIRST
6BQ6GT, 25BQ6GT extra-performance deflection amplifiers.

HYTRON TV FIRST
12BH7 twin-triode sweep amplifier with superior efficiency.

HYTRON TV FIRST
16RP4 original rectangular TV picture tube.



NEW 4th EDITION

Hytron Reference Guide for Miniature Electron Tubes

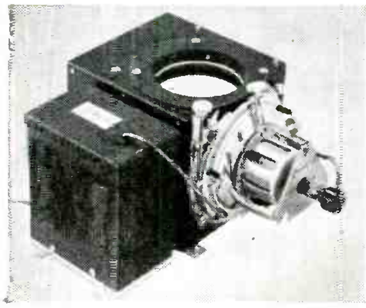
Miniature types are multiplying fast. You need this Hytron Reference Guide. Originated by Hytron, it is unique. Lists all miniatures to date, regardless of make. Six pages of pertinent data. 132 miniatures — 41 of them new. 70 basing diagrams. Lists similar larger prototypes. Free from your Hytron jobber. Get your copy of this old friend brought up to date — today.

OLDEST MANUFACTURER OF RECEIVING TUBES
HYTRON
RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

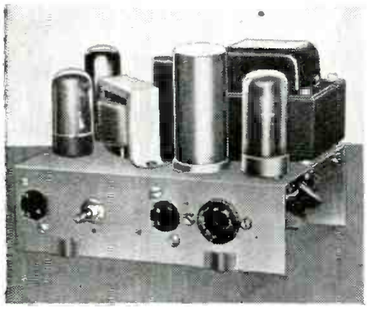
16" Sets to BIG PICTURE TV

PROTELGRAM



PROTELGRAM UNIT

Projection box measures only 8½"x 9"x 13", contains optical system and alignment assembly, is designed for quick easy service and adjustment. The 2½" 3NP4 projection tube is long-lived, extremely low in cost. Compact 25KV high-voltage unit is only 8½" x 4½" x 7".

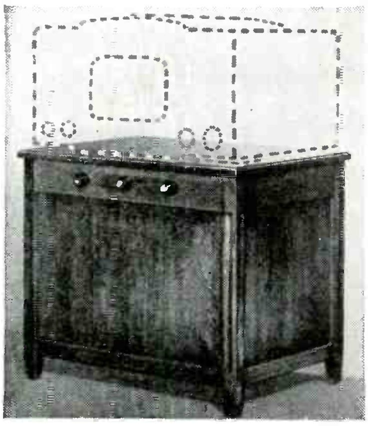


AUXILIARY CHASSIS

New auxiliary chassis fills additional electrical requirements essential to adaption of TV chassis to PROTELGRAM; makes change-over quick and easy. Measures only 8" x 12" x 4".

CONVERSION CABINET

Console cabinet measuring 22" x 27¾" x 46½" provides space for installation of customer's 630 Type TV chassis, comes equipped with complete PROTELGRAM system, auxiliary chassis, cabinet mirror and viewing screen.



NORELCO DUO-VUE

Beautiful cabinet contains PROTELGRAM unit. Only 23½" high. 20" x 26" top holds most any 10" or larger direct-view table model. Concealed ball-bearing casters make it easy to pull out from wall for 3' x 4' viewing on external screen. Offers customers choice of two picture sizes for small and large group viewing.

FOUR-WAY Profit Plan

Sell PROTELGRAM to the man who builds his own!

Thousands of TV kits have been sold to the man who likes to build his own equipment. These handymen are ripe for PROTELGRAM, because they can combine it with a TV chassis, get life-size TV at a reasonable cost.

Sell PROTELGRAM to custom set buyers

Clients who want built-in installations in walls or cabinets are perfect prospects for PROTELGRAM. Huge picture size, plus compactness and flexibility, makes it the answer for this type of user.

Sell PROTELGRAM to trade-in customers

PROTELGRAM sells itself to customers who want bigger pictures, but are reluctant to take a trade-in loss. You can now use their present TV chassis, connect it with PROTELGRAM in a cabinet such as shown at (3) left. They get a 234 square-inch picture, 13½" x 18".

Sell NORELCO DUO-VUE for largest home-TV pictures

Only with NORELCO DUO-VUE can you offer both direct-view and 3' x 4' movie-size TV . . . and at a reasonable price. This is the newest *thing in television* for your customers who want the best. Lots of sales opportunities in bars, clubs, institutions and hospitals, too.

CONTACT YOUR DISTRIBUTOR OR SEND COUPON TODAY

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Gentlemen: Please send full information as checked

☐ PROTELGRAM SYSTEM
☐ NORELCO DUO-VUE unit
☐ PROTELGRAM SYSTEM with auxiliary chassis
☐ PROTELGRAM SYSTEM for conversion console

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Check here for Dealer Information on
☐ Norelco Electric Shaver ☐ Lady Norelco Electric Razor

The Future of Electronics

. . . The greatest art in History is still in its infancy . . .

By HUGO GERNSBACK

MOST of our human activities during the next half century will be affected in increasingly greater impact by electronics than by the peacetime uses of atomics and atomic energy, according to William C. White, scientist of General Electric Research Laboratories.

In a paper delivered recently at Rochester, N. Y., before the Institute of Radio Engineers, Mr. White declared that the world is embarking on a technological revolution which will be equivalent in its impact to the Industrial Revolution of the past century.

Here are a few highlights of Mr. White's address:

"The industrial revolution made muscle power obsolete while the technological revolution now under way, wherein routine work is being taken over by electronic machines, will make unnecessary jobs where a person performs repetitious operations as a mere reflex, without thought.

"Electronic-science now has at its disposal all elements needed to make machines capable of doing non-thinking jobs.

"As a prime example of such a job, take mail-sorting. If a system of addressing letters with certain code markings were adopted, an electric eye could scan mail. Then signal sorting machinery would route pieces of mail to their proper slots—even into the mailbag of the proper mailman.

"Routine jobs now done by human beings couple one or more of the senses with muscular reflexes. Electronics provides quick and accurate responses, controlling machinery with precision. Moreover, every day brings news of new instruments which can duplicate, and usually excel, human senses.

"The social implications of this trend are, of course, tremendous. It is something humanity will have to adapt itself to, for it cannot easily be stopped.

"Ultimately, it will mean more freedom for mankind, just as the industrial revolution made men more free. Unquestionably, this revolution, well on its way, will have a much greater effect on our ways of life than peacetime uses of atomic energy."

Mr. White's thought-provoking observations of course only scratch the surface of the future of electronics. There is no visible end to the magic of the young art—the more electronics expands the greater the vistas it reveals.

For those who have not followed closely the intricate and complex mazes of electronic developments—even now on the engineering and designing boards—we may add the following:

Manless robot factory. Certain factories where work has been standardized will in the near future be run practically without human workers. There will be only a few technical supervisors to check the output of the machines and see that the quality is up to par. The raw material comes in at one end of the plant, the finished product—packed in boxes, barrels, or other suitable containers—leaves at the other side of the factory. No human hands touch the product. The machines, controlled by electronics, do all the intricate work, better, faster and more efficiently than humans.

There are indeed such plants in existence even today, but they are specialized ones. New and more complex robot factories are coming into use continually. It is even possible today to run huge printing plants, that print magazines such as the one you are reading now, in manless robot printing establishments. While the money investment to build such a plant is formidable, the cost per finished magazine would be almost halved. The reason: cost of labor today is over half the total cost of a magazine.

Electronicked Automobiles. The human can no longer cope adequately with his high-speed car. His reactions are now far too slow to prevent the majority of accidents. By the time he has perceived the danger and decided to circumvent it, ¾ second has elapsed. During that time the car has traveled over 75 feet, (at 68 mph) and the usual crash has occurred.* Electronics, it is believed, could do away with over 75% of all accidents. A combination of radar, *capacity effects between cars*, plus photo-electric cells could automatically steer cars to prevent most collisions. Electronic "perception" has practically no time lag—in moments of danger an electronic robot would take over the steering and brakes, thus preventing most collisions. Obviously all cars would have to be electronicked to make autoing reasonably safe.

Electronic Fishery. The world's population now increases faster than at anytime in history, yet our greatest source of food—the ocean—is hardly touched. Fish is still expensive albeit our most abundant and healthful food. The reason is we still are catching fish as they were caught by the Phoenicians 5,000 years ago—with prehistoric nets (one of the oldest of man's inventions). Recently—using sonar and other electronic means—we have learned how to catch fish efficiently—not by waiting for the fish to come to the fishing vessels, but by going to where the fish congregate in schools by the thousands, often by the millions. But we catch only a puny few with our small nets—our effort compares to catching with a butterfly net the billions of locusts that swoop down on us during a plague. Clearly, specially engineered ships of a fairly large size—over 15,000 tons—*that use no nets* are needed. Instead such a ship would have heroic sized extensible telescopic tubular scoops which could reach down over one hundred feet below the ocean's surface. Huge powerful pumps would then suck up water and fish into the ship's hold where electronic instruments would automatically assort and classify the various types and sizes of fish, then store them in large tanks. On a single trip such a "fish-factory" could catch from 5,000 to 7,500 tons of fish—against the few tons of the present-day fishing vessels. This would bring down the cost of fish to a fraction of what it is at present, yet leave the operators a high profit.

*The *average* reaction time for a healthy driver is about ¾ second. A few drivers show a reaction time down to ½ second, but if the traffic problem ahead becomes complicated, his reaction will take longer.

Review of TV Boosters

Preamplifier units often improve weak stations and reduce much interference

MANY TV set owners within the service areas of TV stations fail to receive acceptable pictures because of inadequate antennas or poor receiving locations. Others live in fringe areas where signals are too weak to produce good pictures. Under such adverse receiving conditions, a booster or preamplifier used in conjunction with the best possible antenna increases the possibilities of reliable reception.

In addition to improving the signal-to-noise ratio, a good booster will minimize or eliminate adjacent-channel interference; fundamentals, images and harmonics from amateur, commercial, FM, and public service transmitters; and spurious radiations from nearby TV and FM receivers. Regardless of the design of the TV receiver, its performance depends largely on its proximity to TV broadcast stations and on the efficiency of its antenna system. Because the booster is connected between the antenna and the set, it can be considered as part of a good antenna system.

A number of boosters are available to the consumer. Nine of these have been reviewed and are discussed in this article. A number of features are common to most of them. All have filament or power transformers which must be operated from 117-volt, 60-cycle lines. The booster which does not have a selenium rectifier and a 6AK5 amplifier tube is a rare one. Unless noted, the boosters do not have direct connection to the a.c. line.

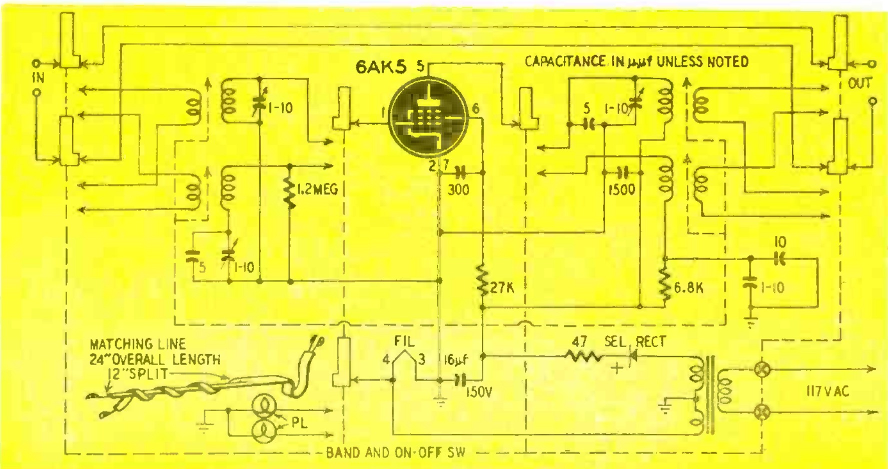


Fig. 1—The Anchor ARC-101-50 is permeability tuned on high and low bands.

Anchor ARC-101-50

The circuit of this preamplifier (Fig. 1), is similar to that used in several boosters to be described. It covers the TV spectrum in two bands. Permeability-tuned input and output circuits are changed by a bandswitch.

The input and output circuits have 300-ohm impedances. A novel impedance-matching device is supplied with the unit. It consists of a 24-inch length of 300-ohm ribbon split 12 inches down the center. The unsplit end is connected to the antenna posts on the receiver. The split ends are wrapped around each other for one or two turns, then connected to the output posts on the booster.

The number of turns to be used is determined by tuning the set and booster to channel 7 or 8 and adjusting the matching line for the best picture. Tune the booster and set to channel 13. If dark bars appear, the booster is oscillating and turns must be taken off the line until oscillations cease. When the booster is matched to the receiver, it will not oscillate on channel 13. There will be a noticeable gain when both units are returned to channel 7 or 8. The matching line is shown below the schematic in Fig. 1.

The ARC-101-50 has a brown, leatherette-covered, metal cabinet 8½ inches wide, 4 inches high, and 4½ inches deep. A single tuning control is ganged to separate slide-rule dials for each band. The dial in use is illuminated by a pilot light.

Astatic AT-1

Called Channel Chief, the Astatic AT-1 booster has more tubes than any of the others. This unit, shown in Fig. 2, uses two cascade-connected 6AK5's for *each* band. Separate ganged controls are used in the grid circuits of the first and second amplifiers. The plate circuits are broad-banded. Bandswitch and power switch are combined. The unused amplifiers are turned off by removing voltage from their screen grids. Gain is controlled by varying the screen voltage on the tubes in use. The chassis is connected to one side of the a.c. line so it may be hot under some conditions. However, it is almost impossible to touch the chassis while it is enclosed in its cabinet.

The Channel Chief is built into a mahogany-finished, slope-front, wooden cabinet 8½ inches wide, 6½ inches high, and 7⅜ inches deep at the bottom. The neon-type pilot lamp is visible through a small aperture in the front panel.

Jerrold Model TV-FM (Series B)

The series B TV-FM booster is similar to an earlier model described in the article "Television Accessories for Improved Reception" in the March, 1949, issue. The principal difference between the models is that the later one has a built-in impedance-matching device called the *Match-A-Trans* which matches the output impedance of the booster to the input impedance of the set. The plate circuit of the series B is peaked by varying the position of a slug inside one of the coils instead of using a trimmer capacitor as in the earlier model.

The series B is a single-ended 6AK5 amplifier having switch-tuning in the input and output circuits. A trimmer type tuning capacitor is in the grid circuit for fine tuning. The tuning switch has one position for each low-band channel, one for FM, one for channel 7, and three positions for channels 8-9, 10-11, and 12-13, respectively. It has no pilot light, so the user may forget to turn it off when it is not in use.

This booster is in a brown, plastic case, 7 inches wide, 4½ inches high, and 6½ inches deep overall.

Masco MTB-13X

This booster has separate 6AK5 amplifiers for high and low bands. Both tubes are used in circuits which are neither triode or pentode connections. See Fig. 3. Note that the screen voltage is taken from the plates through 4,700-ohm resistors. Inductive coupling is used between the antenna and grid coil on the low band and capacitive coupling is used on the high band. A high-band fine-tuning control peaks the permeability-tuned plate circuit. The low band does not have a fine-tuning control.

The input and ouput impedances are not given. The manufacturer states that if the booster does not improve performance of the set on the low band, it may be necessary to reverse the leads at the output terminal of the booster. To improve reception on the weakest high-band channel, instructions are to grasp the antenna lead-in close to the booster. Observe the picture as you slide your hand along the line. There will be two points at which there is no change in the picture. Measure the distance between these points and shorten the lead-in by this much. Use the same procedure on the line between the booster and set.

Although one side of the a.c. line is connected to the chassis, there is little danger of shock so long as the unit is in its cabinet. Two metal screws recessed into the back cover are hot and should be avoided. It is reported that these are insulated in later models.

The MTB-13X is in a walnut-finished wooden cabinet 5½ inches wide, 5½ inches high, and 5 inches deep. A neon-type pilot lamp is used.

Regency DB-213

The Regency DB-213 (Fig. 4), is the only booster reviewed which uses triode amplifiers. A 6J6 is used as a neutralized, push-pull, r.f. amplifier on each band. Capacitive coupling is used between the antenna and grid circuits of each amplifier. The input and output

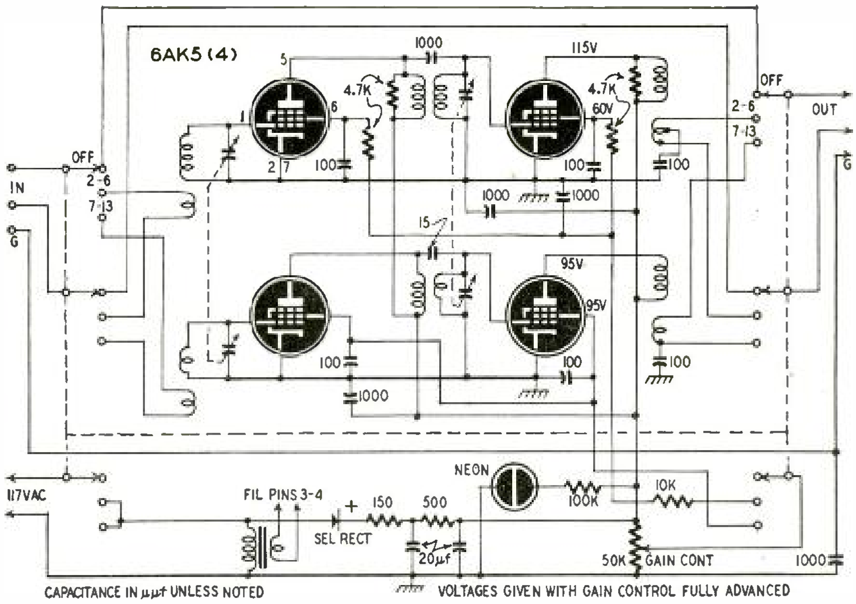


Fig. 2—The Astatic AT-1 has two separately tuned 6AK5's for each band.

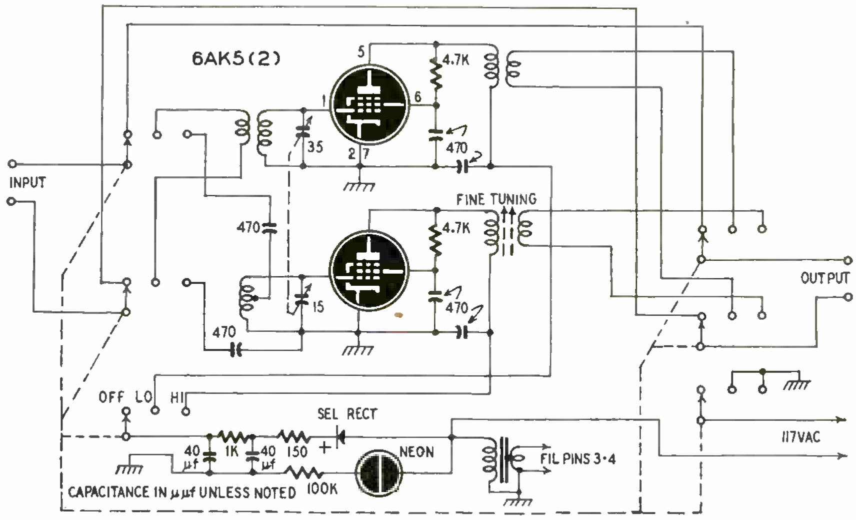


Fig. 3—High-band fine-tuning control peaks the permeability-tuned plate circuit.

circuits of each amplifier are tuned by varying the position of a slug inside the coil forms. Tuning slugs for each band are ganged and brought out to a separate control on the panel. Provisions are made at the input and output for balanced 300-ohm lines or 72-ohm coaxial cables.

The DB-213 is housed in a gray, hammer-tone-finished, metal cabinet 5¼ inches wide, 4 inches high, and 3¼ inches deep. There is no pilot light so it may be left on by mistake.

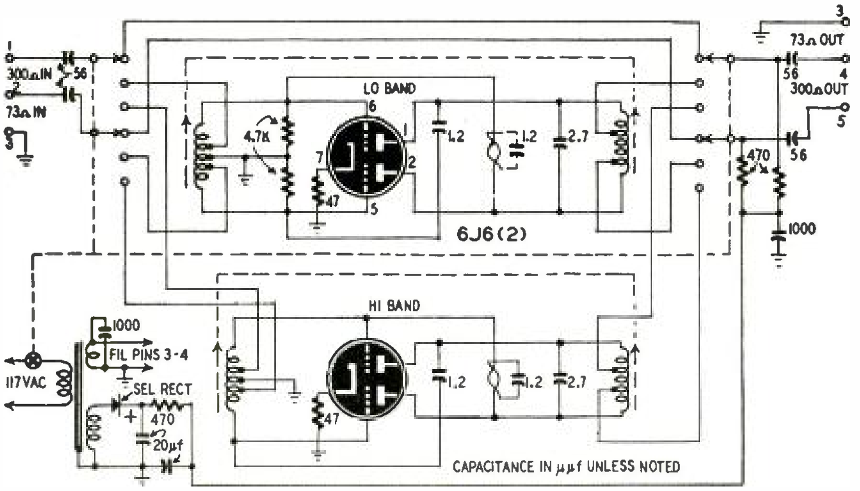


Fig. 4—The Regency DB-213. The 1.2-μf capacitors are simply twisted wires.

RMS SP-4

This is a single-tube, bandswitching, permeability-tuned booster having a circuit and physical construction similar in many respects to the Anchor ARC-101-50 shown in Fig. 1. The input and output impedances are 300 ohms. The manufacturer supplies a strip of metal foil which is to be wrapped around the lead-in and line between booster and set at points where the best picture is obtained on the weakest channel.

The SP-4 has an illuminated slide-rule dial on the front of an oak-finished wooden cabinet, 8 inches wide, 6½ inches high, and 4 inches deep.

Standard B-50

The model B-50 is one of the more unusual of the boosters examined. It tunes from channel 2 through channel 13 without manual switching. The plate and grid circuits are tuned by a wiper which contacts printed-circuit inductors in the input and ouput circuits. A metal vane, ganged to the wiper, acts as a variable capacitor between sections of the inductor, thus providing a fine-tuning action. The circuit of the model B-50 is shown in Fig. 5 and the printed-circuit tuning elements are shown in Fig. 6.

A novel feature of this booster is that it has a receptacle on the rear for plugging in the TV line cord. The control switch is marked OFF—SET—ON. When the switch is off, the set and booster are disconnected from the power line. When it is turned to SET, the booster filament is lighted and the antenna connects to the televiser. Turning the control to ON puts the booster in operation by applying plate voltage, and connects the amplifier between the antenna and receiver.

Input and ouput connections shown in the diagram are for 300-ohm lines. For 72-ohm output or input impedances, cut the jumper between the eyelets. Connect jumpers between the eyelets and screw terminals. Connect the center terminal of the coax to terminal 1 and the shield to terminal 2. A separate ground lead connects to the chassis of

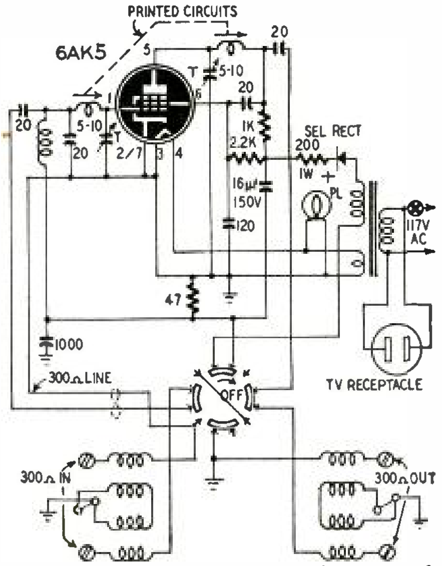


Fig. 5—The Standard B-50 is unusual.

sets having isolation transformers or to ground on transformerless sets.

The B-50 is housed in a brown, hammer-tone-finished metal cabinet 8 inches wide, 4½ inches high, and 5 inches deep. Its illuminated slide-rule dial is calibrated for channels 2 through 13.

Super Sonic IT4

This is the only booster which features continuous tuning over both TV bands and the FM band without switching. The tuning elements are spiral-wound coils which are rotated by the tuning control. As the coils rotate, spring sliders move along them to short out turns as the frequency is raised. Both coils are resonated by the combined tube and wiring capacitances. The coils and tuning control are ganged to an illuminated slide-rule type dial. See Fig. 7. The unit uses a 6AK5. A diode-connected 6C4 is the rectifier for the unit.

Telekit

This booster, like most of the others, uses a 6AK5 pentode. It has a switch-type tuner with a capacitor-type fine-tuning control. This is the only one-tube model which has an r.f. gain control. Sensitivity is controlled by varying the screen voltage.

No provisions are made for bypassing the booster when it is not being used. It must be used at all times that the set is in operation or the antenna will have to be connected directly to the set.

The input and output circuits are loaded with 300-ohm resistors to provide a match for 300-ohm lines. One side of the a.c. line is tied directly to the chassis. Two large holes in the back of the 8¼ x 6¾ x 4¾-inch wooden cabinet present a shock hazard whenever the unit is moved while it is plugged in.

Facts about boosters

Some boosters may have lots of gain and comparatively narrow bandwidth while others may have wide bandwidth and not so much gain. The booster to be selected will depend on the receiving location. If usable signals are obtained without a booster, a wide-band, low-gain unit will probably give the best results because it will amplify the signal enough to produce an acceptable picture without loss of definition. In locations where the signal is so weak that the sound is received without the picture, or the picture is full of snow and so weak that almost any interference will show in the picture, a high-gain, narrow-band booster may be the best bet. The narrow bandwidth will aid in attenuating interference while bringing the signal up to an acceptable

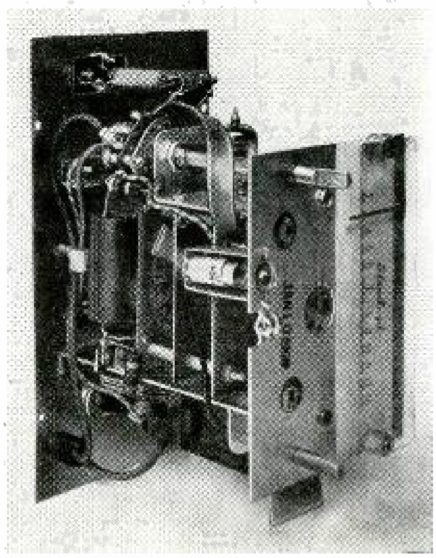


Fig. 6—The B-50 printed circuits can be seen to the left of the pilot light.

level. The loss in definition due to side-band clipping will not be too objectionable in instances where the picture is not acceptable without a booster.

One manufacturer pointed out that most boosters have switches which bypass the lead-in around the booster when it is off. These switches result in a mismatch which may result in con-

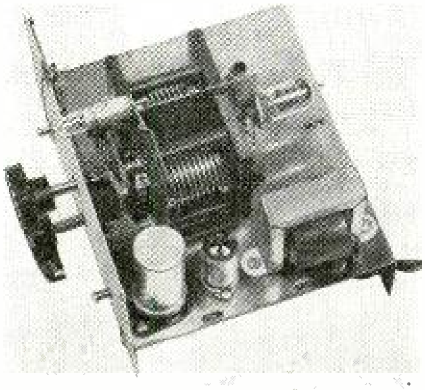
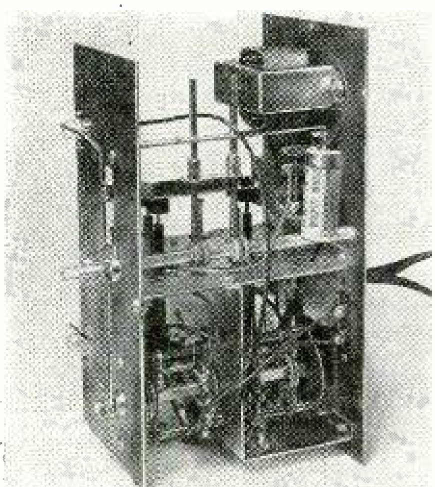


Fig. 7—Spiral-inductance tuned booster.

siderable insertion loss when the booster is off. Therefore, in comparing boosters, the operation should be carried out by comparing the picture with the antenna connected directly to the TV receiver with that obtained with the booster operating between the antenna and set.

In the instruction sheets, manufacturers almost universally recommend the following steps in obtaining optimum performance from a booster:

1. The length of line between the set and booster—including the line from the antenna terminals to the tuner in the set—is critical. In most instances, the over-all length of the line should be a multiple of 2 feet. Try different lengths of line for the best picture on the weakest high-band station.
2. The input and output leads should not cross nor should they be closer than 6 inches apart.
3. Try reversing the leads to the output posts on the booster.
4. Tune the set for the best *sound.*



Two boosters use this smooth tuning system. Backlash is prevented by attaching the pointer direct to the tuning slugs.

Spot-wobble Improves TV

By RALPH W. HALLOWS

RECENTLY I enjoyed two hours of the most pleasing television that I have yet seen. The set was one of those giant affairs with a 20-inch picture tube. With some friends who had come with me, I sat about 7 feet from the screen.

"Far too close," say the experts. "The proper viewing distance for a screen that size is about 12 feet. You don't give the set a chance when you sit so close. The quality of the image is ruined by the horizontal lines."

The facts are that we *did* sit at about half the "proper" distance, and there was not the faintest trace of lines in the image.

The reception was so pleasing because we could view such a large screen at close quarters. If you obey the experts and watch the screen of a standard television set from what they say is the correct distance, two things happen: the first is that you are no longer actively conscious of the lines; the second is that in losing the lines by increasing the viewing distance, you also lose some of the detail of the image. If the screen can be made free from these lines, a short-range view of the image is very pleasing.

The process of freeing the set from lines is so simple that I have been taking running kicks at myself for not having thought of it first. Called spot-wobble, the name describes what it does. Instead of moving in straight lines from side to side of the screen, the scanning spot is given an up-and-down movement of very small amplitude but of very high frequency.

As we took our places, I was given a small box connected to the televiser by a length of cable. An ordinary toggle switch was mounted on the box. In the "on" position, the line removal circuit was in action; turning the switch to "off" cut it out. At 7 feet, the lines are usually very marked on a 20-inch screen, especially in the near-white parts of the image. With the switch at "off", they certainly were; but the lines disappeared completely when the switch was turned to "on".

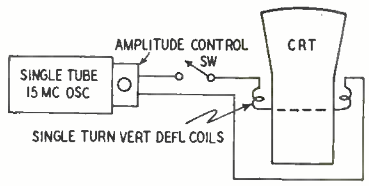
It was particularly interesting to throw the spot-wobbler in and out of action when the image had such things as clouds in the sky, light-colored backgrounds, or open books, letters, and so on in which the lines are usually most evident. The familiar dark lines show up most when the viewing distance is short and the wobbler is out of action, but they disappear completely the instant it is cut in.

To add spot-wobble to a receiver, nothing is needed but the simple arrangement shown in the diagram. I don't give circuit constants—or even circuits in detail—first because I had no opportunity to dig into the bowels of the receiver and note the values of the parts; and second, because the setup is so simple that nearly every reader of RADIO-ELECTRONICS can work out the details himself. I can guarantee the correctness of the general layout shown. The circuit requires no sync, but oscillates independently and requires only one additional tube.

In the British system, there are 405 scanning lines and 25 frames a second. A 10-mc signal was super-imposed on the vertical deflecting field to give the line about 1,000 wobbles per line. In the American system with 525 lines and 30 frames per second, the oscillator frequency would have to be about 15 mc to give a similar number of spot-wobbles per line.

Two points are very important. First, it is necessary to have a switch to cut the wobbler in and out of action. This is required because the set should be focused with the wobbler off. Second, it is most important to be able to control the amplitude of the wobble. If it is too great, there is distortion and a loss of vertical definition. If it is too small, it will not eliminate the lines.

This system is especially noteworthy



Spot-wobble can be applied very easily.

because it is applied to the output stages of the receiver. If it were applied at the transmitter, it would require a considerable increase in the modulation frequencies. If it were applied to the r.f. or i.f. circuits of the receiver, it would require much greater passbands. As it is, it can be applied to *any* receiver.

The British patent covering this remarkable improvement in TV reception dates back to 1938. It is the property of Cintel Ltd., the J. Arthur Rank subsidiary which is concerned with the development of large-screen television for use in movie theaters. For the demonstration described I am indebted to the research department of the BBC, which is now exploring the possibilities of spot-wobble in black-white, color and stereoscopic television.

Anything Can Happen in TELEVISION

By MARTIN CLIFFORD*

WAY back, somewhere around 1923, when the public mind seethed with the mystery and wonder of radio broadcasting, there were some amazingly weird tales about the new entertainment miracle. For example, there was the chap who claimed he could hear broadcast music with his teeth. Seems that he had a silver inlay in one of his bicuspids adjacent to a gold crown protecting the remnants of a molar. These two dissimilar metals in a slightly acid solution, the saliva, generated a small voltage. With the aid of this "cell" he was able to "hear" stations. It never was made clear how he managed to get the sound—probably a loose filling vibrating at an audio rate. There was also the story of the woman who lived practically next door to a broadcast station. Nothing wrong with that except that her stove gave out with music and commercials. She didn't mind since it didn't interfere with her cooking. The only thing she couldn't figure out was how to tune the darn thing.

We don't make any claim whatsoever that these two stories are true. They might have been, for all we know, but you'll have to do what most everybody did . . . believe them or leave them. However, now that television has become everybody's fancy, some very unusual tales have started cropping up. Like the story of channel 2 and the vase.

The story begins over at Pilot Radio Corporation where our good friend Ed Wollman, service manager, had just received an unusual complaint. Some woman, resident in the lush Park Avenue section of Manhattan, was annoyed that her receiver could get all channels —all, that is, except channel 2. Ed rushed over with the woman's plaint, "I wuz robbed," ringing in his ears.

* Instructor—Pierce School of Radio & Television, New York, N. Y.

Concealed front end in a flower vase?

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Will be paid by RADIO-ELECTRONICS for each authenticated report of freak television reception, similar to those described here. Cases must be original and interesting.

Send entries to:

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When he arrived, he found the woman watching . . . you guessed it . . . channel 2. Ed could have gone back to the factory and grabbed himself sóme credit for quickly fixing a toughie, but not Ed. He's intellectually honest, and what's more important, curious. He questioned the customer. All he could find out was that channel 2 had come on by itself. Ed decided to investigate. He turned the receiver catty-corner so that he could peek in at the inside works, being very careful in the meantime to remove a very heavy, decorative vase from the top of the receiver. As he did so, he noticed that channel 2 had disappeared. Just like that. He put the vase back on the receiver, and channel 2 came right back. On again, off again. It happened every time. Ed took the flowers out of the vase. They made absolutely no difference. All that set wanted was to have the vase sitting topside in order to get channel 2. The other channels came in the way they were supposed to, vase or no vase. Ed was a wee bit perturbed. How would you like to go back to your boss and tell him that, in the future, a flower vase would have to become part of a TV front end, and should be shipped with all new receivers?

Ed did the only thing he could do. He examined the vase. Maybe there was a concealed front end in it? At the bottom of the vase he found a big lead ring used as a support and weight to keep the top-heavy vase from killing itself. Ed had found the answer. The metal ring was picking up channel 2 and re-radiating it.

You have every right to ask "why", and here's the best answer we've been able to think of, to date. Sometime ago we were measuring the Q of various broadcast coils on a Boonton Q-Meter. By using polyiron slugs and polyiron shells and Litz wire on a low-loss form, we were able to get a Q of about 200. We happened to have a metal ring from an old cable, and just out of wild impulsiveness decided to check the ring for its Q. It was fantastic. That old metal ring had a self-resonant frequency at umpteen-umpteen megacycles and its Q was so great that the meter needle tried to climb out of the case.

Now think of that ring in the bottom of the vase. It was probably self-resonant to channel 2, and with a very high Q (hence high gain) it was re-radiating channel 2 with a vast amount of enthusiasm. We don't say this is the correct solution, but if you've got a better one, we'd certainly like to hear it.

The next case we ran into was the story of the disappearing channel 4. This story comes from Al Friedman, television instructor at the Pierce School of Radio & Television, New York City. Al has a hobby. No, not television. He gets enough of that all day long. Al is wild about antennas, especially TV antennas. Don't ask us why. It's one of those queer foibles that any of us can have.

One of Al's customers, a woman for whom he had done some very fancy indoor antenna work, called him on the phone with a very curious complaint. She wasn't angry, just sort of wondering. Was it customary, she wanted to know, for channel 4 to go off the air every day, promptly at four o'clock. Right in the middle of a program, too! And didn't Al think it was sort of strange, especially when no other receiver in the building did just that?

Al went over that set with a fine-tooth comb. He also used test instruments. There was nothing wrong. The receiver was perfect and so was the special fixed indoor antenna he had installed. He uprooted the antenna and it went into every conceivable location and into every possible position in that apartment. It worked best where he had placed it originally, with this one very sad exception. Promptly at 4 p.m., channel 4 took off like a frightened rabbit. Disappeared. Vanished.

The mystery began to dissolve when Al happened to look out of the window. It seems that the occupant of the apartment immediately across the court had raised her venetian blinds. This fact, although it seemed to have no connection with the case, stuck in Al's mind, and what is better, bothered him. Was it a coincidence that the blinds were raised at the same time that channel 4 had disappeared? He decided to investigate. Sure enough, next day, at exactly the same time the

No venetian blinds, no channel 4 pix.

blinds were raised, channel 4 disappeared.

Al made an arrangement with the owner of the receiver. "I want you to stand by the window," he told her, "and raise your hand every time channel 4 vanishes." Then he trotted over to the apartment across the way, and got permission from the astounded housewife to raise and lower one of her venetian blinds. That was it, sure enough. His customer waved her hand every time he re-adjusted the blinds. The blind was down all day to keep the sun off the furniture and rug. It was raised at 4 p.m. every day by a very methodical housewife, in order to get more light and air into the apartment.

And now, what is the solution to all this? Simply that the venetian blinds were made of aluminum and were reflecting channel 4 with sufficient gusto to enable it to be picked up. This explanation may be too simple for complicated minds, but there it is.

There are quite a number of things which we must take for granted, otherwise life would become much too complicated. For example, we confidently expect the sun to rise every morning. When we walk down a street, we certainly expect buildings or other large structures to remain the way they are, and not to change their shapes. And what has all this philosophical meandering got to do with television? Let's investigate the mystery of the increasing and decreasing television signal, told by a chap who prefers to remain anonymous.

The trouble was very simple. The owner of the receiver was very irritated. "I wish," he told the serviceman, "I wish that the operators of channel 11 would make up their minds. Sometimes I get them swell and sometimes they don't come in at all. What've they got? Women engineers, huh." As events proved, this last remark showed a definite phobia about women and should be disregarded.

It was just as the customer had said. Sometimes channel 11 came in so strongly that the contrast control had to be backed way down. And at other times? Well, channel 11 was there if you had a good imagination and 20-20 vision. And, as usual, the $64 question —why? Why should channel 11, normally well-behaved and self-respecting, behave in such a flipperty-gibberty fashion? Especially when the receiver was in top-notch operating condition and the antenna installation could be used as a model for all technicians. Nevertheless, the technician in this case gave the roof antenna a thorough checking over. Nothing wrong there, he decided, shoving one foot on a roof ledge and gazing moodily out into space in the general direction of the TV station. He noticed a gas tank somewhat in his line of vision, but since the tank was too small to obstruct the signal, paid little attention to it.

Our hero didn't get the set fixed that day. Nor the next. Nor the next. Finally, in desperation he decided to go in for a completely new type of antenna. He had to do something. During his meanderings around the roof, he noted that the gas tank had apparently doubled its size! This was too much! Now he was seeing things. Perhaps it would be better to admit defeat, give the customer back his money, and go into a nice safe business, like plumbing maybe. Anything, anything would be better than this. Imagine a gas tank increasing in size! Perhaps the best thing to do would be to sit down and wait patiently for the little man with the white jacket.

It was somewhat in the "I know I'm crazy for doing this, but can't help it" spirit that he invested a nickel and called the gas company. "I know this may sound silly to you, but your gas tank has changed size." The gas company wasn't surprised. Seems they had been doing it for a long time. The manager of the gas company thought it was funny. "We regularly get calls about it. Our tanks move up and down, depending on the volume of gas we have stored. Lots of gas . . . big tank. Little gas . . . small tank. Clever, huh?"

Our hero didn't think so. Short of blowing up the gas tank there was nothing he could do. On successive times during the day, he and the set

Dotted line shows minimum tank height.

owner went up on the roof to watch a tank that couldn't make its mind up as to what size to be. Oh, yes. The reason why channel 11 did or did not come in? Simple! When the tank was big enough, it blocked the signal. When the tank was small, the unobstructed signal sped through the air with the greatest of ease. What is it that textbooks say about high-frequency r.f.? Quasi-optical? Maybe those books could stand a re-reading.

If you've stayed with us this far, you're in a good position to solve the problem in this last story. Complaint? Set works fine for three, maybe four, days, and then about half of the channels become so weak and emaciated that it's nothing short of pitiful. And then, apparently shaking itself out of the doldrums, the set decides to work swell for several days. This would be fine, if it would only last, but it doesn't. The set sulks, and snow or just a plain raster takes over where good pix are supposed to be. Very discouraging. What would you do, if every check and test of which you know proves conclusively that the set is working right and that the antenna installation is a dream. Go into some other business, maybe, or sniff around to see if something unusual is in the wind. The text book don't give all the answers, you know.

The technician in this case found the answer. Not too quickly, mind you, but he found it. Seems that the set owner lived near a large pier. Once a week a big ship would come in and tie up at said pier. That big mass of iron and steel soaked up TV signals like a sponge that hasn't had a drink for a month. If you want to go "engineering" on us, you can say that the ship disturbed the normal field-strength intensity pattern, that it radiated a signal whose angle was out of phase with the original signal, thus causing cancellation at the antenna. We like our own answer because every time that ship took off for parts unknown, that little receiver worked right.

Master Television Antenna Systems

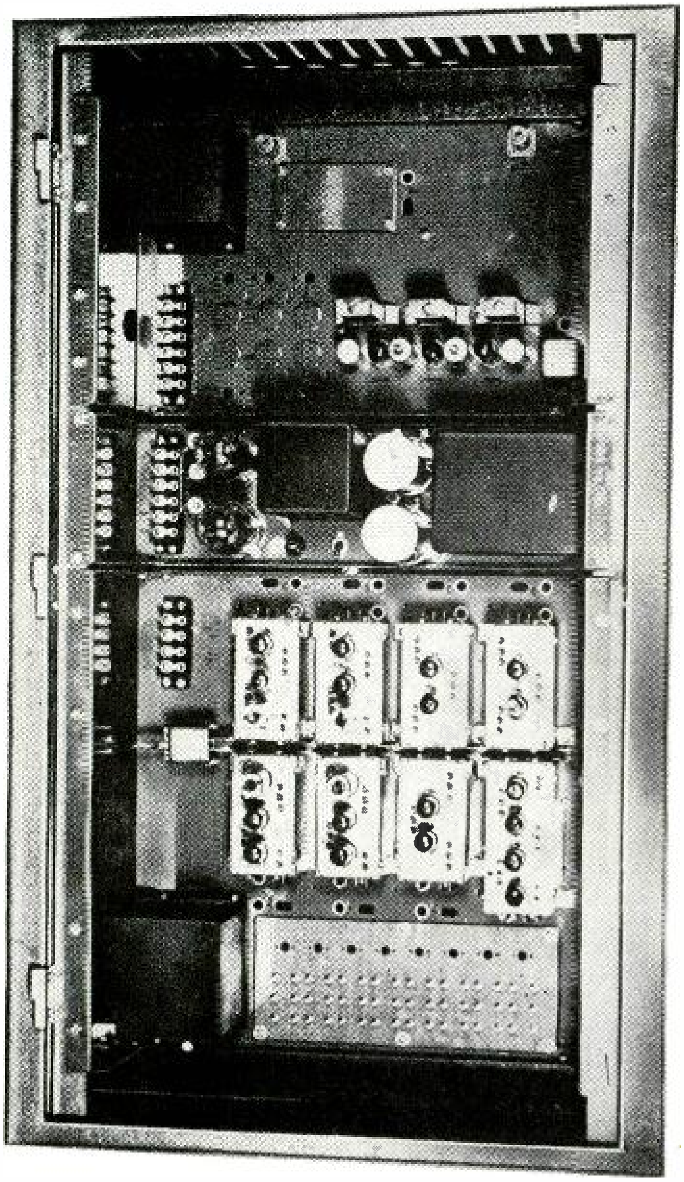


Fig. 1—In this installation an amplifier is used for each channel.

Final answer to multiple-dwelling antenna problems

By IRA KAMEN*

TELEVISION signals are quasi-optical (having qualities similar to light) and cannot be made to pass through steel structures in spite of the best engineering skills of the greatest sales and advertising managers in the field. For this reason, master television antenna systems in fire-proof (steel-wall) buildings are necessary when a large number of TV sets are to be installed. A master antenna system must solve five problems in urban installations. To demonstrate these problems, the author will review a specific installation of the RCA Antenaplex master antenna system at the Hotel Commodore in New York City.

The Hotel Commodore is at 42nd Street and Lexington Avenue, and six New York TV stations are received from six different directions. Therefore, the first problem is to receive ghost-free signals from each of the stations. Tests were made on the roof of the Commodore with an individual directional array for each television channel. The six locations were found, and three-, four-, or six-element Yagis installed. The locations were found by two men and a good 400-line-definition television receiver. Tests began in the most practical locations for a television antenna, but sometimes the best picture can be found only in less desirable parts of the roof. The search for pictures does not stop until a good signal free from ghosts and interference is found. Reflected signals from solid steel buildings are dependable, but reflected signals from palisades, cliffs, and hills cannot be considered a stable source of signal. The presence of ice and snow on these earth-type structures may completely change the character of the reflected signals.

The second problem is to get strong signals of not less than 3,000 microvolts for each television receiver in the system to overcome or swamp any signals from external sources.

An amplifier shown in Fig. 1 with a pretuned booster for each television channel is installed. Antennas for each channel feed their signals to the amplifier unit, and the individual pretuned boosters increase the signal level to approximately 1 volt for each channel. A mixer network in the amplifier combines the outputs of the six boosters so they can be distributed over a single cable.

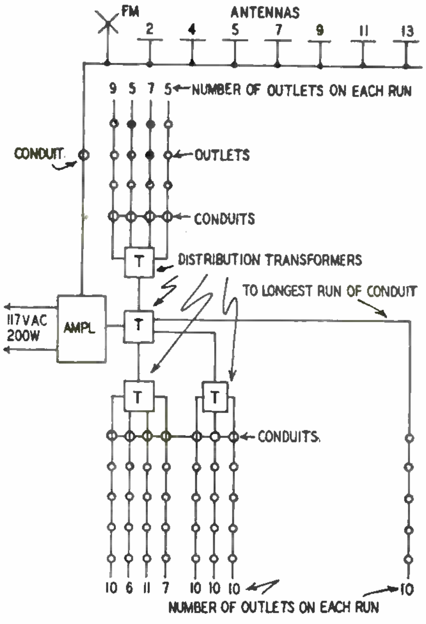


Fig. 2—A typical distribution system.

*Manager, Television Dept., Commercial Radio Sound Corp., N.Y.C.

Distribution of the television signals to feed many outlets is the third problem. In the Hotel Commodore installation, facilities were desired for television in both public places as well as in private rooms.

The amplifier output is fed through a 72-ohm coaxial cable to an r.f. (50-220 mc) distribution transformer

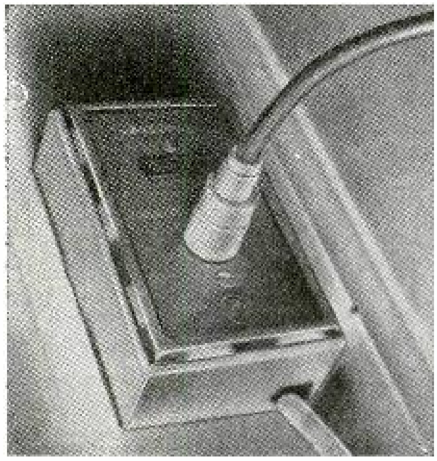


Fig. 3—Appearance of receiver outlet.

which provides four 72-ohm outputs from its one 72-ohm input. The four outputs of the first distribution transformer can then be fed to four other transformers which in turn can feed a total of 16 outlets. This method can be expanded to many more outlets.

When all the outlets can be one next to the other, the best method of distribution is to tap the coaxial lines from the first distribution transformer. It is also possible to combine the two methods of distribution when the layout of the building is suitable. Fig. 2 shows how this is done. Notice that the longest runs of cable go directly from the first distribution transformer, while shorter runs can be distributed further.

Radiation from the local oscillator of the front end of the television receiver is the fourth problem. Television receivers in New York are tuned to channels 2, 4, 5, 7, 9, 11, and 13 and their local oscillators radiate to some extent on channels 5, 11, and 13.

The outlets on either the transformer or tap distribution system are isolated from each other partly by resistive networks within the outlet and partly by attenuation in the coaxial cable between the outlets. The coaxial cable losses may be appreciable in the transformer distribution method. In the Hotel Commodore installation there is more than 500 feet between some of the outlets, adding 20 db to the loss in the system.

Connecting all types of television receivers to the outlets without altering the outlet or the television receiver is the last problem.

A coaxial fitting on the front plate of the outlet (Fig. 3) offers the television signal at an impedance of approximately 72 ohms, which can be connected directly to the input of nearly all the television receivers which use Inductuners, elevator transformers, or other input coil arrangements which allow direct connection to coaxial cable. For early model television receivers which require a balanced input, there is a special transformer which converts the unbalanced coaxial signals to signals balanced to ground which match a 300-ohm input.

In either system, it is important that the coaxial cable be terminated with the proper impedance. Fig. 4 shows the receiver outlet circuit for both types. In the transformer system, each outlet provides the proper 50- or 72-ohm impedance to the line; but in the tap system, only the last outlet on the line has the required terminal impedance, and all other outlets present a high impedance to the line. Both outlets have a high-pass filter (40-mc cutoff). AM and shortwave signals are taken directly from the coaxial cable through a 1,000-ohm series resistance which prevents the AM receiver from loading the cable.

FM may be added to the master antenna system, and an additional channel 13 from Newark may also be added if it can be received with adequate signal strength. All Antenaplex amplifiers

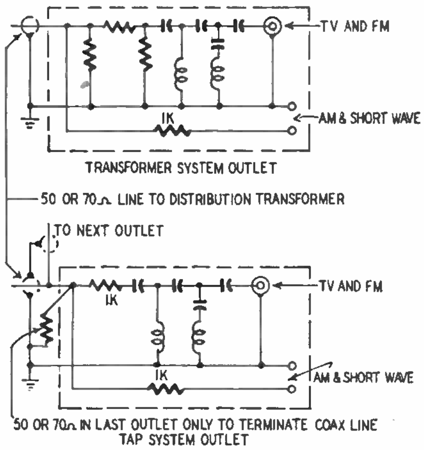
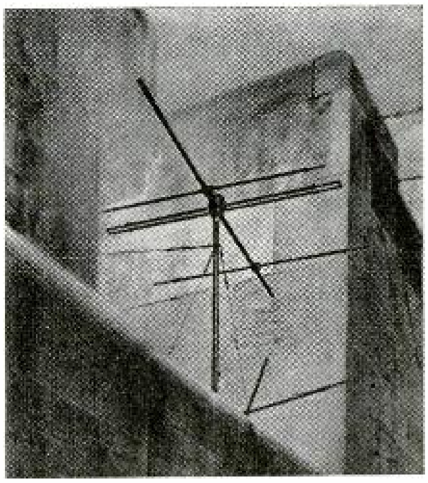


Fig. 4—Networks at receiver outlets.

are designed for continuous operation of the tubes.

Large dealer establishments and department stores can use similar systems to solve their demonstration prob-



One Hotel Commodore antenna location.

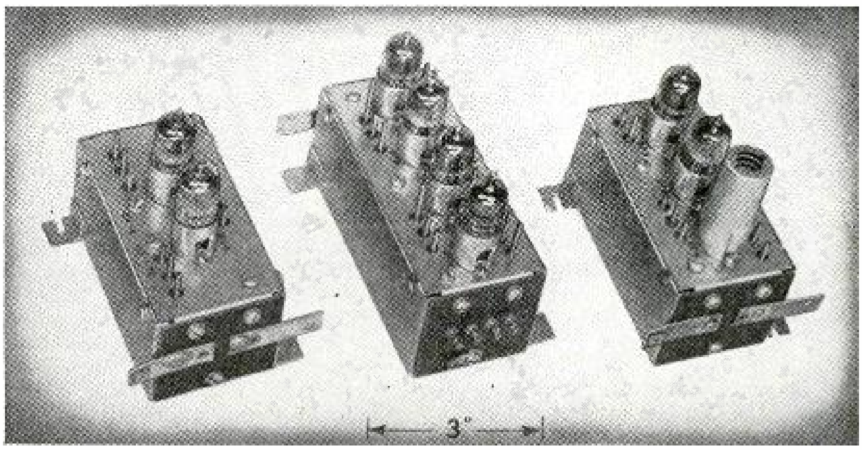
lems, enabling all receivers to operate under common conditions. The customer can make a fair analysis of all the television receivers and pick the one which performs to his liking. At present, many customers make unfair comparisons between receivers operating from separate and often quite different antennas.

While new construction jobs are confined to the electrical contractors in most areas, the servicing dealer and television installation companies can install master systems in existing buildings.

In some localities the dealer will aid in financing antenna system installations to open new markets for television receivers.

Business organizations who finance installations of master antenna systems in buildings operate like telephone companies and make an initial connection charge and a monthly service charge to the tenants in the building. Systems for this type of financing are usually installed so that the antenna service can be disconnected without entering the tenant's apartment.

The cost of installing a system depends on the quality of local reception, the number of outlets and their location, and the accessibility of conduits and shaftways in the building.



Left to right—Amplifier for channels 2-6, FM amplifier, unit for channels 7-13.

A DeLuxe Televiser

Part V—Alignment and adjustments of the video and the sound i.f.'s

By
CHARLES A. VACCARO

IF YOU have constructed the deluxe televiser described in the January, February, and March issues, you are now ready to align the video and sound i.f. strips. Refer to the complete schematic in Fig. 17 (March issue) for the frequencies of the coils and transformers and for the location of the tuning slugs.

There are a number of preliminary adjustments which must be made before alignment is begun. The table gives settings for the various controls, the resistance being measured between the arm (center terminal) and one of the numbered outside terminals or to another point in the circuit.

After making the adjustments, turn the adjusting screws approximately halfway into each end of the automatic sync discriminator transformer. Screw the core of the width control in approximately halfway. Set the D.S.C.-A.S.C. switch in the A.S.C. position. Now install the picture tube and its socket. *Always hold or support the tube by the cone. Never allow any pressure to be exerted on its thin neck.* Adjust the deflection coils until the assembly is tight against the cone and adjust its mounting so the grounding springs are bearing lightly on the external conductive coating of the tube.

Adjust the mountings so the focus coil is about ⅛ to ¼ inch from the deflection coil and centered about the neck of the tube. If you are using a tube that requires an ion trap, install the trap so the magnets are over the flags which can be seen through the neck of the tube. The large magnet must be toward the base of the tube. When a 10FP4 or 12KP4 is used, the ion trap is not required. Connect all cables, plug the linecord into a convenient outlet and turn the chassis on its side so that it rests on the high-voltage supply box. Put a book between the mounting ring and table if there is any tendency toward wobbling.

Turn the TV-OFF-RADIO switch to TV position and measure the voltages between 225- and 400-volt power supply terminals and receiver chassis. DO NOT measure to the power supply chassis as these values will be different. If there is much variation from 225 and 400 volts, check to see that all tubes are in and review the power supply data in the March issue if trouble is encountered.

Make sure that the line voltage is about normal (117 volts) before making any of these changes. The closer the subject voltages are to 225 and 400, the easier it will be to compare circuit voltages on the schematics.

Now there should be some indication of a raster on the screen. If an aluminized screen tube such as the 10FP4 is used, vary the focus control and adjust the focus coil to obtain fine horizontal lines focused as evenly as possible over the entire raster. If a tube such as the 10BP4 is used, move the ion trap back and forth and from side to side until a position is found where the intensity of the raster is maximum without being shadowed on either side. Readjust the focus coil and focus control if necessary to obtain evenly focused horizontal lines. The raster can now be centered by tilting the focus coil. Finish the horizontal centering by adjusting the horizontal centering control on the rear of the chassis.

Aligning the video i.f.

If you yielded to the temptation of seeing a station come in, turn the channel selector switch to the blank position between channels 6 and 7.

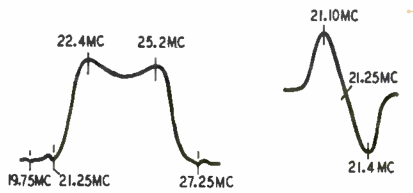


Fig. 20, left—Response for video i.f.
Fig. 21, right—Response for sound i.f.

This cuts off the oscillator and prevents r.f. from coming through the front end.

Turn the adjusting screws approximately three-fourths of the way into the 19.75- and 21.25-mc traps and the screws on the other coils all the way out. *The video i.f. adjustments are on the bottom and the trap adjustments on the top* of the strip. Now connect an oscilloscope, output meter, or a v.t.v.m. between the junction of the 6AC7 video peaking coils and ground. Connect a .05-μf capacitor and 10,000-ohm resistor in series with the inner conductor of a low-capacitance shielded cable if the indicator does not already incorporate a capacitor.

Connect the signal generator to the grid of the mixer and to chassis ground using approximately 200 μμf in series with the hot r.f. lead.

Turn on the internal modulation. If it is adjustable, turn it up to about 50%. Set the dial to 25.0 mc and increase the output until a slight increase is noted on the output indicator. If there is no increase turn up the contrast control until wide black and white bars appear across the raster. Screw in the core of the last i.f. coil, tuning for a maximum indication. Note occasionally if the black and white bars are getting too black. When the entire raster is black, it indicates the video amplifier and possibly the i.f. amplifiers are being overloaded and the signal generator output and the contrast control, or both, should be reduced. Adjust the signal generator output and the contrast control when necessary so the black bars appear slightly gray or about the same width as the white bars.

After adjusting the 25.0-mc coil, set the signal generator at 25.3 mc and adjust the core of the next coil forward to give a maximum output indication. Repeat with the next stages working toward the mixer, retuning the signal generator and tuning the coils to maximum output at the frequencies indicated on the schematic.

Now set the generator to 21.25 mc and advance its output control and the contrast control of the receiver until a good deflection is noted on the indicator. Adjust the *top* core on the first i.f. coil to obtain a minimum deflection. Still at this setting, adjust the core in the cathode trap to a further minimum. It may be necessary to move the signal generator to the grid of the first or second i.f. amplifier to see a good indication of a minimum response from the cathode trap.

Set the generator to 19.75 mc and reconnect it to the grid of the mixer if it was changed in the last step. Adjust the core of the 19.75-mc trap to minimum and repeat the procedure for the 27.25-mc trap. There being some interaction between cores on the same forms, touch up the adjustments of the video i.f. coils by repeating the alignment and making sure that each is tuned for maximum output at its proper frequency. *Make sure that this section of the alignment is followed closely, as a poor job done at this stage will impair the quality of the final picture.* The alignment can be checked by rotating the generator dial slowly from 18 to 28 mc and comparing the output indications with the response curve in Fig. 20.

The output should show an increase following the upward slope of the curve and remain fairly flat across the top and decrease as the slope decreases at the right side. A closer comparison can be made by plotting the output indications versus the frequency at several settings of the frequency dial. If a large difference is noted in the curves, check the values of the grid and plate resistors and change any that are off more than 5%. If any of the cores on the i.f. strip do not have enough range to tune to both sides of the maximum point, remove them and check them against the dimensions given in Fig. 4.

Aligning the sound i.f.

Set the signal generator frequency to 21.25 mc and check that the *minimum* response of the *video* i.f. amplifiers at 21.25 mc agrees with this setting. Now, without touching the signal generator, adjust the *audio* i.f. transformer cores to obtain maximum output from the speaker. This can be done by ear, using a low level of audio or connecting the indicator previously used across the 6V6 audio amplifier. Now adjust the bottom (primary) core of the discriminator transformer for maximum output. The peak will be broad. Next adjust the top (secondary) core of the transformer to obtain a null. When the null is found, the amplitude modulation can be cancelled out completely with further careful adjustment. Detune this core about one quarter turn or until sound is heard again and readjust the other cores again for maximum sound from the speaker. Then retune the top core of the discriminator transformer to the null position or minimum sound. Now tune the generator first to approximately 21.35 mc and then to 21.15 mc, noting the audio output. The output should be as nearly equal as possible at these two points. (See Fig. 21.) Touching up of the audio i.f. transformer and discriminator primary adjustments will help to make these equal.

Additional adjustments

Remove the output indicator and the signal generator and we will proceed to bring in a picture. The antenna should be temporarily placed so that it is about broadside to the direction of the transmitters and should be connected to the receiver with 300-ohm line.

Turn the intensity control to obtain a good visible raster and turn the contrast control about halfway. Now switch the station selector switch to a channel where the station is known to be on the air. If the coils were spread to the dimensions indicated in Fig. 14 and the wiring of the front end was followed exactly, some sort of signal or picture should be seen on the screen. If nothing is seen, turn the contrast control up higher and repeat the switching. If the raster goes black, it is an indication of excessive signal and the contrast control setting should be reduced.

If the preliminary adjustments were made as outlined earlier, you probably have a pattern on the picture tube screen with black and white diagonal or nearly horizontal bars or lines. Adjust the primary core of the sync discriminator transformer that protrudes from the rear of the chassis. As the adjustment is brought closer to resonance, the diagonal lines will become more and more vertical until the picture becomes synchronized. Adjust the vertical hold control on the front panel if the picture is slipping up or down. At this point don't worry if the sound cannot be found or the picture quality is poor. Turn the contrast control down until retrace lines are visible and then advance it to a point just beyond that at which the white retrace lines disappear.

Preliminary Adjustments for Aligning.

Control	Setting
Intensity	100,000 ohms to No. 1
Contrast	400,000 ohms to ground
Volume	One half rotation
Vert. hold	140,000 ohms to No. 1
Tone	One half rotation
Horiz. Lin. No. 1	60,000 ohms to pin No. 3 or 6 of 6AS7-G
Horiz. Lin. No. 2	82,000 ohms to No. 1
Horiz. centering	6 ohms to ground
Focus	200 ohms to No. 3
D.S.C. Horiz. hold	85,000 ohms to No. 3
A.S.C. Horiz. hold	38,000 ohms to pin No. 5 of 6F6 osc.
Vert. Lin. No. 1	7,000 ohms to pin No. 8 of 6V6 vert. output
Vert. Lin. No. 2	5,300 ohms to pin No. 8 of 6V6 vert. output
Height	950,000 ohms to No. 3

If a test pattern is being received well enough, the linearity adjustments of the receiver can be made at this time. Return to this after the r.f. alignment if the test pattern cannot be received well enough.

Assuming that the controls were preset as outlined in the table, very little additional adjustment will be required. The vertical linearity control No. 1 expands the upper and contracts the lower section of the test pattern when turned in one direction and vice versa in the other direction. Vertical linearity control No. 2 mainly affects the top edge of the picture. Moving past the correct setting in one direction will result in squeezing of the top few lines and in the opposite direction of the control they will be spread apart. The height control and the vertical linearity control affect each other slightly, so it may be necessary to readjust the vertical linearity No. 1 and then the vertical linearity No. 2 control if the height control is changed. Adjust these so the top and bottom sections of the test pattern are equal in size. The horizontal linearity and width controls affect the picture in the horizontal direction and are a little more critical than the vertical controls. Adjust the horizontal linearity control No. 1 until the picture is as wide as possible without squeezed or expanded sections (vertical bars lighter or darker than the rest of the raster), and until the test-pattern wedges on both sides are the same size. Repeat with control No. 2 which keeps the lighter or darker bars out of the left side of the raster. Adjust the width control by screwing in the core to increase the width of the raster.

The direct sync control (d.s.c.) system should be adjusted before the r.f. alignment is started. Temporarily short out the tuned circuit in the cathode of the horizontal multivibrator with a jumper across the coil. Switch the A.S.C.-D.S.C. sync control switch to D.S.C. position and, if necessary, readjust the d.s.c. horizontal hold control (on the back panel) to bring the picture back into horizontal synchronization. (Note that when the switch is thrown, it will be necessary to readjust the focus and contrast controls slightly as the plate supply currents from the power supply have been decreased.) adjust this horizontal hold control accurately and make sure the picture stays synchronized in this position. Lack of low-frequency response may make it unstable because the front end is not yet aligned. It can be made more stable by trying a different position of the fine-tuning control. When you are sure that no better adjustment of the hold control can be made, remove the jumper from across the tuned circuit and adjust the core of the coil until the picture is again synchronized and the test pattern is fully on the screen. Do not touch the horizontal hold control while making the core adjustment. Once this core is set it usually requires no further adjustment during the alignment procedure.

Proper alignment of the video i.f. stages is extremely important for good pictures. The details of the picture are contained in the higher frequencies of the picture signal, and if there is any attenuation of these frequencies, the picture will have poor horizontal detail, as can be seen on a test pattern.

If the sound trap is not adjusted correctly, the sound signals can mar the picture. The sound signal will beat with the picture signal, and if the beat frequency is less than 1 mc, horizontal bars may appear in the picture.

Another type of sound interference is caused by the FM signal being converted to an AM signal by the sloping response of the video i.f. If this occurs, the sound signal is coupled to the video amplifier and will also appear as bars in the picture.

Voltage Multipliers in Television

Basic multiplying circuits that are often found in TV receivers

By C. W. PALMER

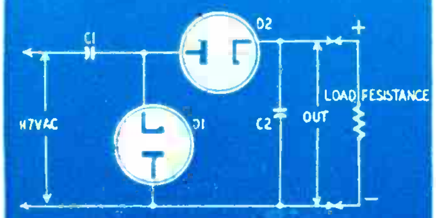


Fig. 1—The simplest form of doubler.

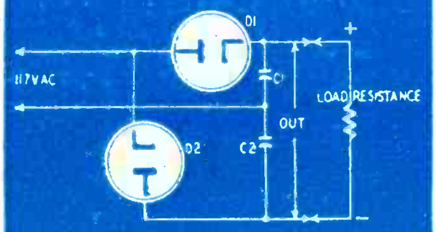


Fig. 2—Widely-used full-wave doubler.

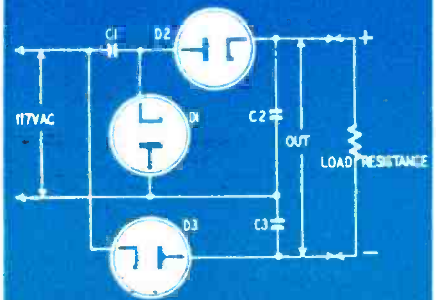


Fig. 3—Another diode makes a tripler.

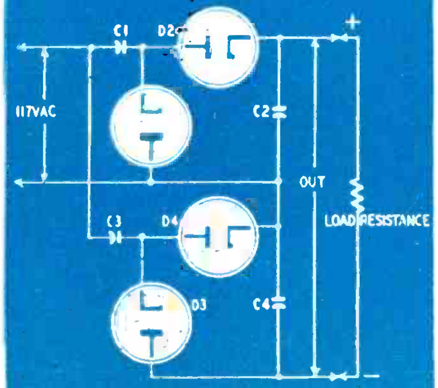


Fig. 4—Two doublers make quadrupler.

KNOWN for many years, voltage multiplying circuits have been used in a variety of ways to step up and rectify line voltage without using power transformers. The midget radio receiver brought voltage doublers into wide use.

The voltage doubler, tripler, and quadrupler have now found new utility in television receivers where space and weight are important considerations. Voltage multipliers are employed in both low- and high-voltage supplies in some of the latest TV sets.

Because of this trend, it will be of value to the radio and television technician to review the basic principles of these multipliers and to look at a few of the current TV receiver circuits in which they are used.

The simplest form of voltage doubler and the one most widely used consists of two diodes and two capacitors C1 and C2 as shown in Fig. 1. In this circuit, when the voltage from the a.c. line is of such polarity that the rectifier D1 plate is positive, current passes through this rectifier and capacitor C1 is charged to a voltage equal to the peak voltage of the a.c. line (1.4 times the r.m.s. voltage) minus the voltage drop through the tube D1. During this time, rectifier D2 is not functioning, as its plate is negative.

When the polarity of the a.c. line reverses at the end of the half cycle, the voltage on C1 is added to the line voltage and the total is applied to rectifier D2, thus charging capacitor C2. This capacitor, being connected to the load, immediately starts discharging through the load, so that its charge never quite reaches the peak voltage of the line plus capacitor C1 voltage. For this reason, the voltage impressed on the load is not quite twice the peak a.c. line voltage.

The larger the capacitance of C1 and C2, the nearer this voltage approaches twice the peak line voltage. On 60-cycle lines, the capacitors should be not less than 16 μf.

This circuit has all the characteristics of a half-wave rectifier of standard design except that the regulation (the change in output voltage with a change in load) is not as good. This poor regulation is characteristic of voltage multipliers and is one of the limiting factors of this type of circuit. In circuits that are sensitive to voltage change, some form of voltage regulation must be added to compensate for the poor regulation.

A voltage doubler popular in midget radio sets is the full-wave doubler shown in Fig. 2. Here diode D1 charges capacitor C1 when the plate of D1 is positive. On the other half cycle, capacitor C2 is charged by diode D2. Since the load is across the two capacitors in series, the voltage applied to the load is the sum of the charges on the two capacitors and is nearly twice the peak line voltage. It does not quite reach twice the peak line voltage, because one of the capacitors starts to discharge into the load through the other as the line polarity changes. To say this another way, the two capacitors are charged separately to the same d.c. voltage and are discharged in series to the load. Here again, the size of C1 and C2 determines the output voltage and the regulation.

As in standard half-wave and full-wave rectifiers, the ripple frequency of the full-wave doubler rectifier is twice the line frequency, while that for the half-wave doubler rectifier is equal to the line frequency. For this reason the full-wave type is much easier to filter, requiring smaller values of inductance and capacitance than the half-wave type.

The voltage multiplying action explained above can be carried beyond that of doubling. Practical power supplies have been made using up to 12 doubler stages in cascade. This is an extreme case, and in most TV sets the multiplying action is not carried beyond the quadrupler stage.

A voltage tripler is shown in Fig. 3. Three diodes in a half-wave rectifier combination are used. Diodes D1 and D2 with capacitors C1 and C2 are a half-wave doubler applying twice the line voltage across C2. This is added in series with the voltage across C3 which is charged by diode D3. The result is a voltage across the load resistance almost three times the applied voltage. D3 carries twice the current of D1 and D2.

The ripple frequency of the voltage tripler is the same as that of a half-wave rectifier because of the unbalanced arrangement. Capacitors C1, C2, and C3 should be at least 16 µf as in the previous doublers. The voltage regulation of the tripler is better than that of the doublers described above because, while the voltage has been tripled, only one multiplying action is present so that the "straight-through" rectifier D3 adds a stabilizing action to the complete circuit.

Fig. 4 shows a voltage quadrupler consisting of two half-wave doublers connected in cascade. The action here is the same as in the half-wave doubler, and the sum of the two doublers is discharged through the load in series. This same action can be cascaded by adding as many doublers as needed.

The regulation with varying loads of typical doublers, triplers, and quadruplers is shown in Fig. 5. A single 25Z6 connected as a half-wave rectifier is used as a comparison with the voltage multipliers. The 25Z6 dual-diode is used in all the circuits, the individual diodes being combined to keep the number of tubes at a minimum. The regulation of the voltage tripler is better than that of either the doubler or quadrupler and is almost as good as a single half-wave rectifier of like size.

The Emerson model 571 TV receiver uses a voltage quadrupler in the low-voltage power supply composed of five 25Z5 tubes arranged as shown in Fig. 6. A filament transformer for certain tubes in the set has an autotransformer primary supplying 125 volts to the voltage quadrupler and to the five 25Z5 filaments in series. Tubes V23 and V24 make a half-wave doubler with two pairs of diodes paralleled to increase the power output of the rectifier. The positive terminal of this

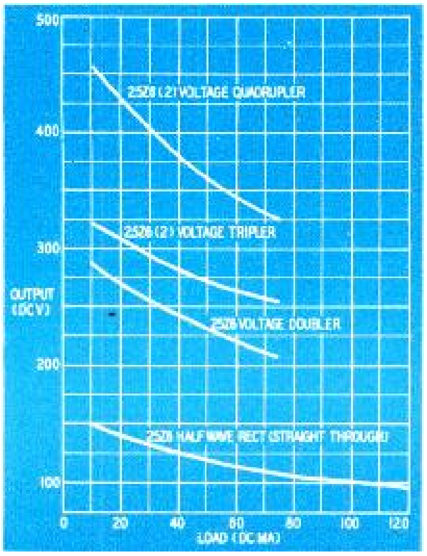


Fig. 5—Multiplier regulation is poor.

rectifier is grounded to the chassis. Tubes V20, V21, and V22 form another half-wave doubler with three pairs of diodes in parallel. The negative terminal of this rectifier is grounded.

By connecting terminals 1 and 3 to an ungrounded load (with 1 as the negative and 3 as the positive terminal) a voltage quadrupling action for the sweep circuits is achieved.

The Motorola model VT-71 receiver uses two selenium rectifiers in a half-wave doubler circuit. Some of the tubes of the receiver are connected in series across the power supply to act as the voltage divider for the power supply. The circuit of the doubler for this set is shown in Fig. 7.

A voltage doubler and tripler are used in the low-voltage supply of the Hallicrafter model T54. As shown in Fig. 8, the selenium rectifier with one half of the 25Z6 tube forms a half-wave doubler, supplying a voltage at 1 equal to the line voltage minus the rectifier and filter drop and at 3, a voltage equal to almost twice the line voltage. The output of this doubler is fed to a half-wave tripler consisting of a 6X5 tube and condenser C57B, giving over 300 volts at 5.

The circuit is slightly different than the one in Fig. 3. When the top line of the a.c. input is positive, the selenium rectifier conducts and C60A is charged to almost line voltage. When the line polarity reverses, this voltage, in series with the line voltage, is applied to C58B through the 25Z6, charging it up to twice line voltage. At the next alternation, the line voltage is applied to the 6X5 in series with the voltage across C58B, tripling the original voltage.

The second side of the 25Z6 V15 is a straight half-wave rectifier with positive ground which added to the tripler provides a total voltage step-up equal to almost four times line voltage.

These circuits are representative of the multiplier circuits used in the low-voltage B-supplies of some of the modern TV sets. Variations of these circuits are found in many other makes and models, but all are based on the fundamental circuits shown in Figs. 1 to 4. A study of these basic circuits will be valuable to the technician in isolating power supply failures.

Several manufacturers have used voltage multiplication in the high-voltage power supplies. The Philco model 48-2500 TV receiver is an example, applying some 20,000 volts on the TP400 projection type tube with a voltage tripler.

The horizontal sweep output of the set is applied to an autotransformer which steps up the positive pulse developed by the horizontal retrace to about 7,000 volts. This is applied to a tripler consisting of three diodes as shown in Fig. 9. The output is the sum of the voltages developed across C100, C101, and C102, each of which is approximately 7,000 volts.

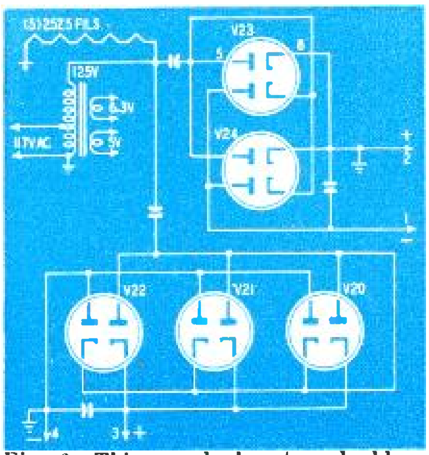


Fig. 6—This supply has two doublers.

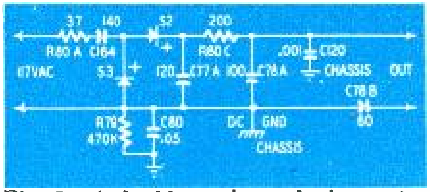


Fig. 7—A doubler using selenium cells.

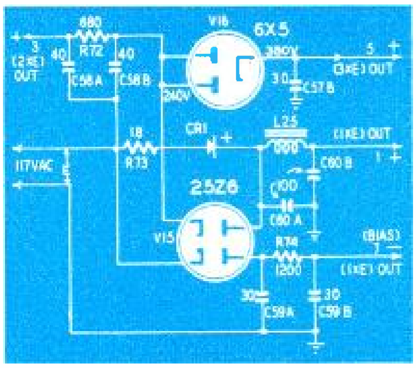
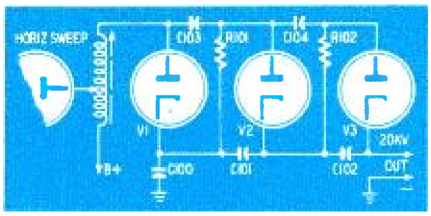


Fig. 8—This supply has four outputs.



ALL CAPACITORS VALUES IN µf UNLESS NOTED

Fig. 9—A 20,000-volt tripler supply.

The action is as follows: The positive going pulse from the horizontal sweep circuit is applied to the autotransformer and is stepped up to approximately 7,000 volts. This causes diode V1 to conduct and charge capacitor C100 to 7,000 volts. At the same time, the plates of V2 and V3 are also made positive to approximately 7,000 volts through condensers C103 and C104 because of the positive pulse applied to these circuits. This charges condensers C101 and C102, which are in series with the cathodes of V2 and V3, to approximately 7,000 volts. C100, C101, and C102 being in series, they discharge in series through the load. The action repeats on each positive retrace pulse, thus maintaining the voltage on the TP400 tube at some 20,000 volts.

Television Dictionary

(Continued from page 33 of the April issue)

By ED BUKSTEIN

Monochromatic
Single-color.

Monoscope
A tube used to generate a fixed television image, usually a resolution pattern. It is used primarily for test and adjustment purposes.

Mosaic
A photosensitive surface consisting of a large number of individual caesium-silver globules. (See Iconoscope.)

Multiple scanning
The process of scanning an image in two or more individual fields, each containing a fraction of the total picture information. It is also referred to as interlaced scanning or multiple interlace.

Multiplier
A short name for the electron multiplier tube.

N

Negative image
A reversed television image in which the dark portions of the televised scene appear bright, and the bright portions appear dark.

Negative transmission
Modulation of the picture carrier in such a manner that the dark portions of the image cause an increase in radiated power, and the bright portions cause a decrease.

Nipkow disk
A rotating disk containing a series of openings or windows and used for mechanical scanning.

O

Odd-line interlace
A scanning system in which each field contains an extra half line. In the standard 525-line picture, each field contains 262.5 lines.

Orthicon
A type of television pickup tube using a low-velocity scanning beam to reduce secondary emission from the caesium-silver globules. (See Shading.)

P

Panning
Scanning a field of view by moving the camera in a horizontal plane.

Pedestal
A pulse, such as the blanking pulse, used in television systems. (See Blanking pedestal.)

Persistence
The afterglow of the screen chemical of a cathode-ray tube. (See Afterglow.)

Persistence of vision
The ability of the eye to retain the impression of an image for a length of time after the image has disappeared from view. It is this property of the eye which enables it to fill in the dark intervals between successive images and to produce the illusion of motion.

Phosphor
The chemical coating deposited on the face of a cathode-ray tube. This chemical produces light when bombarded by electrons. Various chemicals are employed in practice to produce different colors.

Phosphorescence
Light given off by a phosphor after the exciting light or electron stream has ceased to act. The same as persistence and afterglow.

Photocell
A device for converting variations of light intensity or color into equivalent electrical variations.

Photoconductive
The name applied to a substance which changes its electrical conductivity under varying degrees of illumination. Selenium, for instance, has approximately eight times as much resistance in the dark as in the light.

Photoemissive
The name applied to a substance which emits electrons when struck by light. Caesium and rubidium are examples.

Photosensitive
The name applied to a substance which exhibits photoelectric properties, that is, converts light variations into electrical variations.

Photovoltaic cell
A type of photocell which produces an electromotive force when struck by light. Photovoltaic cells, also called barrier-layer cells, find their greatest application in light measuring devices.

Pickup tube
A tube used in the television camera for the purpose of converting the optical image into its electrical equivalent. (See Camera and Iconoscope.)

Picture frequency
The same as frame frequency. In standard practice the picture frequency is 30 per second.

Picture tube
The cathode-ray tube used in a television receiver. As the spot sweeps across the fluorescent screen, the incoming video signal varies its intensity and produces the dark and light portions of the image.

Positive transmission
Modulation of the picture carrier in such a manner that the bright portions of the televised scene cause an increase in radiated power, and the dark portions cause a decrease. Positive transmission is also called positive modulation.

Principal axis
An imaginary line extending from the center of a lens or mirror and passing through the focal point. (See focal length.)

Prism
A piece of glass having a triangular cross section. White light, in passing through a prism, is separated into its component colors. (See Dispersion.)

Progressive interlace
A system of interlaced scanning in which the first line of the picture is scanned as the first line of the first field, the second line is scanned as the first line of the second field, the third line is scanned as the first line of the third field, etc. (See Sequential interlace.)

Projection-type receiver
A television receiver in which the image is optically projected from the cathode-ray tube to a special viewing screen.

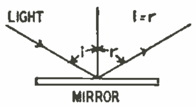
Q

Quadruple staggered interlace
A system of interlace in which each frame consists of four fields, and in which the fields do not follow in a progressive order. In this system, line one is the first line of the first field, line three is the first line of the second field, line two is the first line of the third field, and line four is the first line of the fourth field.

R

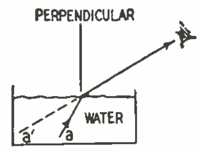
Raster
The rectangular area scanned by the electron beam in the picture tube.

Reflection
The throwing back of images or waves by an object; for instance, the light returned from a mirror. The law of reflection states that the angle at which a ray of light is reflected from a mirror is equal to the angle at which it strikes the mirror. In other words, the angle



of reflection is equal to the angle of incidence.

Refraction
The bending of a ray of light as it passes from one medium to another of different density. Because of such refraction, an underwater object appears to occupy a position other than that which it really occupies. In passing from a more



dense to a less dense medium, the light is bent away from the perpendicular. (An object at a appears to be at a'.) In passing from a less dense to a more dense medium, the light is bent toward the perpendicular.

Reinserter
A circuit for establishing the d.c. level of a waveform. (See Clamping.)

Resolution
That quality of a television image which enables an observer to distinguish fine detail.

Resolution chart
A test pattern containing a number of converging lines. The point on the screen where these lines seem to merge into one, determines the maximum resolution of the image. Resolution is normally indicated as the number of lines which can be distinguished as individual.

Resolution pattern
Same as resolution chart.

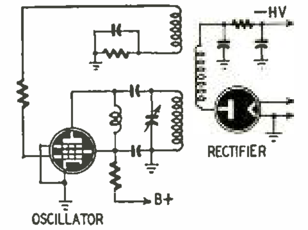
Retentivity of vision
The ability of the eye to retain the impression of an image after the image has disappeared from view. (See Persistence of vision.)

Retrace
The return trace of the spot after it sweeps across the fluorescent screen. Also called flyback.

Retrace ghost
An image produced during the retrace period. It may be due to improper blanking of the iconoscope at the transmitter.

Return period
The time required for the spot to return after each sweep. It is also referred to as return time.

R.F. power supply
A type of high-voltage power supply sometimes used in television re-



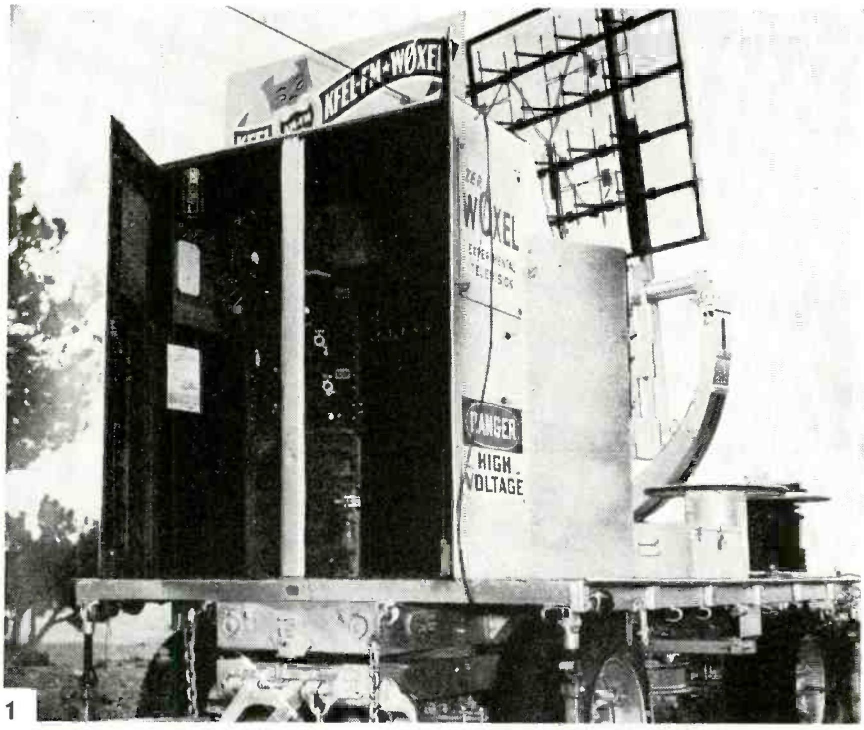
ceivers. It consists of an r.f. oscillator whose output is fed through a step-up transformer to a rectifier. The output of the r.f. power supply can be filtered with relatively small values of filter components. This ease of filtering results from the low current drain and the high frequency of the ripple. Oscillator frequencies generally used are from 30 to 500 kc. Voltages as high as 5 to 10 kv are obtained directly with this type of supply.

S

Sawtooth
A voltage or current waveform which rises linearly to its peak value and then drops rapidly back to its starting level. The sawtooth waveform is used extensively for sweep or scanning in oscilloscopes and television equipment. If the sawtooth is not linear, the spot will move across the fluorescent screen at a varying rate and the pattern will appear to be crowded towards one side. (See Linearity control.)

(To be continued)

KFEL TESTS SITE



1

By EUGENE A. CONKLIN

KFEL, DENVER, faced the problem of selecting the best possible site for its proposed new television station. Height especially was necessary for a large service area—long line-of-sight path. Freedom from surrounding buildings was also a major goal, to help reduce possibilities of ghost reception. The final selection was Lookout Mountain, 7,000 feet above sea level and about 2,000 feet above Denver.

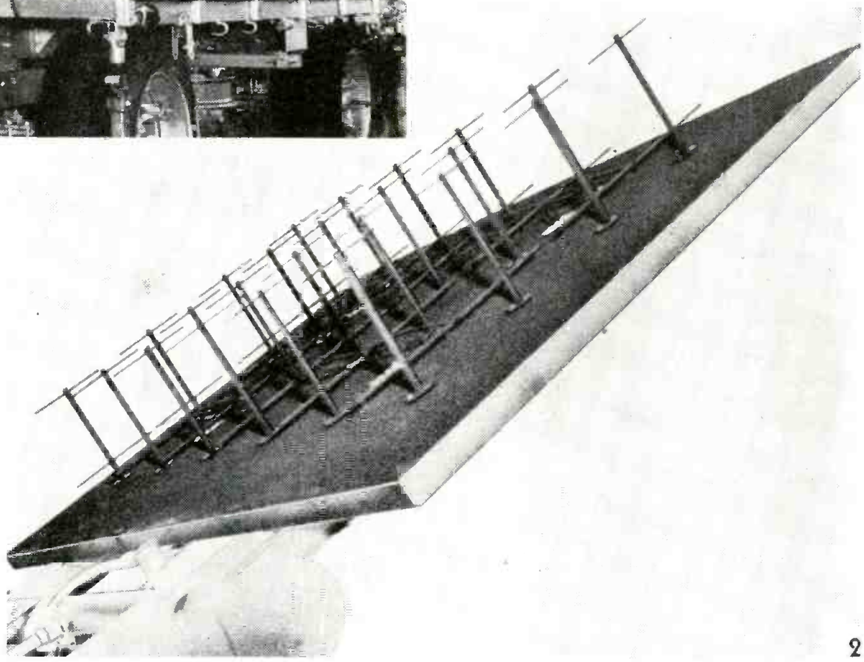
The height of the site has another advantage in that a high tower is not necessary. Aside from the economy in cost, that means a long transmitter-to-antenna transmission line, with its losses, will be avoided.

To survey all the possible sites, KFEL used a mobile "test set" mounted in a motor truck. This mobile test station (Photo 1) includes, among other components, a surplus SCR-533 500-watt radar transmitter (capable of generating up to 200 kw on peaks).

Photo 2 is a closeup of the antenna. It has 48 elements and is mounted on a rotating support.

Photo 3 was taken from the doorway of the radio trailer and shows the components of the SCR-533. The transmitter is at the left, the monitor scope and antenna controls in the center, and the power supply and monitor receiver at the right (partially hidden by the doorpost).

If and when the FCC authorizes the use of directional antennas, KFEL will be ready, for they already have such an antenna plotted. It will beam the signal north, south, and east, and will prevent wasteful scattering of power into the unreceptive Rocky Mountains.



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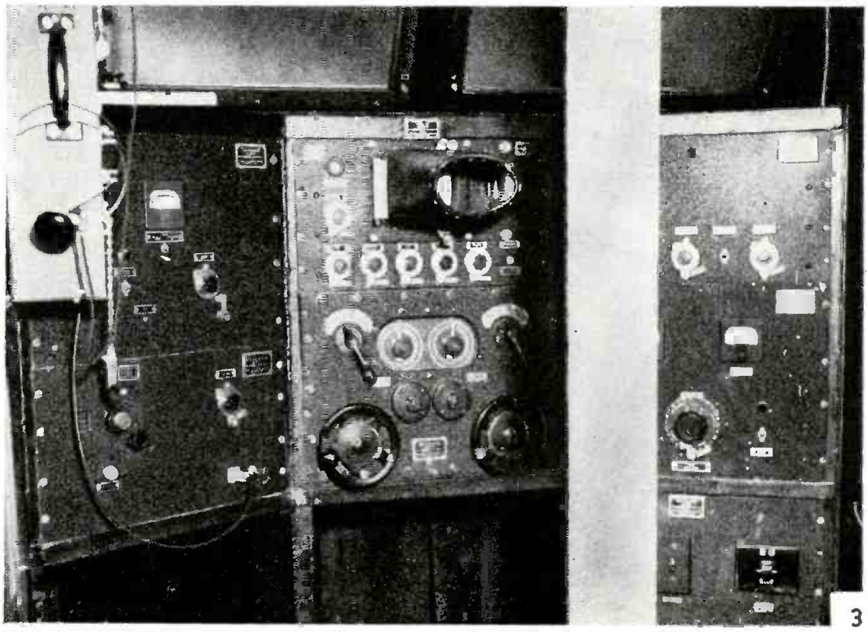
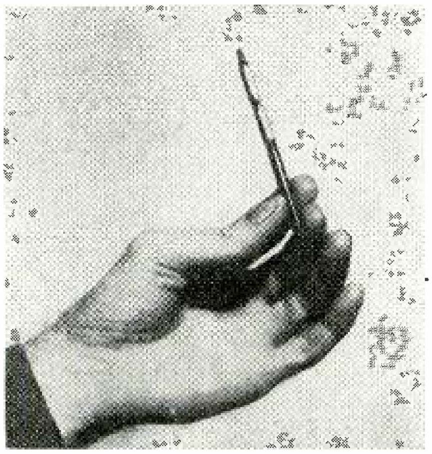


3

IRE "Accents The New"

New principles, new equipment and new methods revealed at meeting of the Institute of Radio Engineers

NEW super-low-loss waveguides that look like—and are—ordinary pieces of enameled magnet wire, a new portable-radio speaker eight times as efficient as present types, practical magnetic amplifiers, a miniature magnetron to work on voltages between 80 and 120, and a new crystal triode called a fieldsistor, which uses a genuine grid surrounding the emitter electrode with a concentric ring of points but not touching the collector—these were the highlights of the IRE convention and exposition at New York the first week of March.



The little tube is a genuine magnetron.

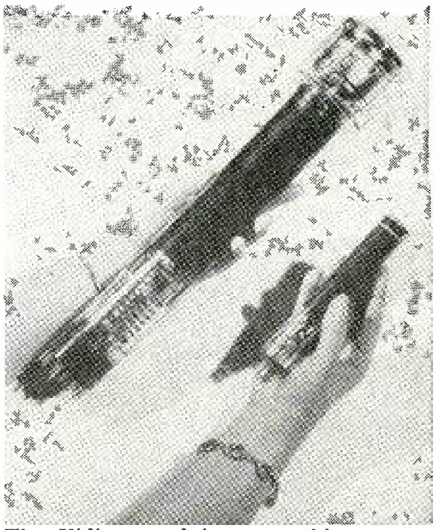
RCA's new miniature television camera.

Other developments were almost as exciting, and some may have been even more important. The world's most powerful radio tube—a 500-kw "beam triode"—was on display. Two industrial television systems were demonstrated—both alike in that they operate on closed circuits, but otherwise vastly different. Du Mont's industrial color television system is designed to a specification of 18 mc bandwidth, 525 lines, at 180 fields per second, producing a color picture with nearly four times the definition of standard black-and-white. RCA's Vidicon system produces black and white pictures comparable in definition to those obtained on standard television receivers. Its features are miniaturization of the equipment and the Vidicon tube which makes it possible. The Vidicon is like an ionoscope in that it uses a mosaic coated on one side of a nonconducting layer, the other side of which is maintained at a steady positive voltage. This layer in the Vidicon is nonconducting only in darkness, and if an image is focused on it, the light portions become "leaky" and permit part of the positive charge to be placed on the particles of mosaic opposite the light portions of the image. The mosaic is scanned in standard fashion. The sensitivity of the tube makes multipliers unnecessary and permits great simplification of equipment.

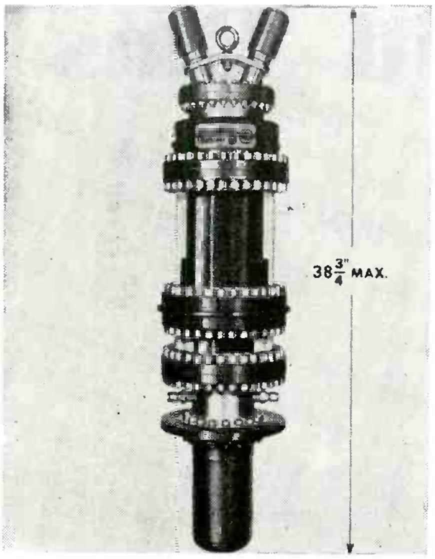
The Army Signal Corps' surface-wave transmission line is, as the photograph shows, simply a piece of wire. It is coupled to a source of ultra-high frequency with a small horn, and carries it with approximately 10% of the losses of similar lengths of coaxial cable. The action, so strangely different from that of an ordinary conductor carrying current, is due to the dielectric (enamel) on the wire's surface, which reduces the velocity of the waves and tends to "bind" them to the wire. With ordinary sizes of wire and reasonable dimensions of matching equipment at the ends, the system is practical for frequencies from 300 mc upward.

Another approach to practically the same result was made by Bell Telephone Laboratory scientists in a paper which described artificial dielectrics in waveguide-like structures. In its fundamental form a row of metal discs strung on a rod or wire, this waveguiding device may become a longitudinal row of short transverse dipoles. Corrugated or threaded rods used for the same purpose were described by the Air Force Research Laboratories. Although the exact type or mode of wave transmission may not be identical for each of these structures, the underlying principles appear to be the same, and they all represent a hitherto-unknown way of carrying electricity on a wire, with possibly startling possibilities in future communications, television and other applications.

The portable-set speaker was described by Dr. Harry F. Olson of RCA. Intended to compensate for the low power output of the battery portable, the horn principle was used for its greater efficiency. But a horn of the reduced dimensions necessary in this case would have a higher cutoff fre-



The Vidicon and image orthicon compared.



The super-powerful 500-kw beam triode.

quency than could be permitted, even on a portable. So the bass-reflex principle was used to increase the low-note response. In one of the experimental models, a vent was made in the case, and in another V-shaped cutouts in the side of the horn help to keep up the low-note output. A small cone with an air-gap of high magnetic intensity powers the unit.

The 500-kw tube (RCA-5831) is in effect a circle of 48 triodes mounted in slots in a beam-forming cylinder. Thoriated tungsten rod filaments in each of these sends a beam of electrons between two grid rods to the anode. The plate current of this tube is over 20 amperes at 10,000 volts, and the 6-volt filament draws 2,220 amperes.

At the other end of the bigness scale is the *fieldsistor* developed by the Air Force. A crystal triode, its grid element consists of a cylinder of wires surrounding the catwhisker. Their points approach—but do not quite touch—the crystal surface to which the catwhisker is welded. The field created around these points acts as a control over the output, the unit resembling both a transistor and a triode radio tube. It is a crystal like the transistor, but the control signal is applied in a manner more reminiscent of the action of a triode vacuum tube.

To obtain the extremely small spacing required, the wires are placed in small glass capillary tubes. The tubes are then heated and drawn, reducing the spacing between the wires while retaining the same proportional thickness of wire and insulation. Spacings of almost microscopic dimensions have been achieved by this method.

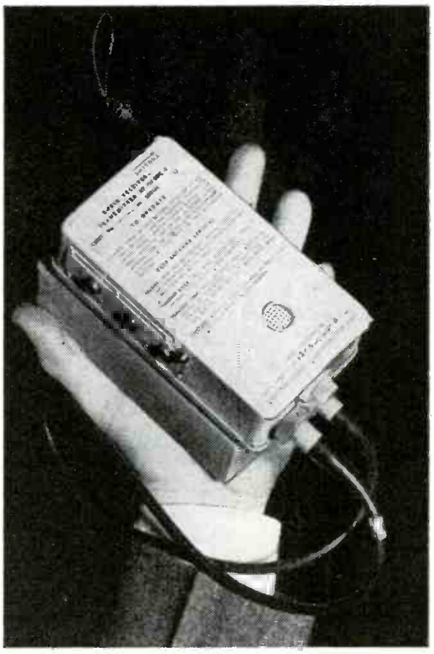
The magnetic amplifiers exhibited by the Navy received a tremendous amount of attention. Plastic boxes smaller than most midget radios, they have extremely high gain and require no attention nor maintenance throughout their life. While applicable chiefly to such circuits as servos, gun directors and other control devices, it was stated that a magnetic amplifier, powered with a 50-kc a.c. supply, has been used to amplify music, with results which might be described as encouraging, though hardly satisfactory from the standpoint of the high-fidelity enthusiast.

A new miniature transmitter-receiver for air-sea rescues has been developed by the Air Materiel Command's laboratories at Wright Field, Ohio.

Known as the URC-4, the midget set is not much larger than a ration kit and can be held in one hand. It operates with a range of up to 80 miles on a v.h.f. and a u.h.f. channel and can be switched from one to the other instantaneously. Power is supplied by a mercury-type battery in a separate unit. A rubberized cable attaches the battery to the transmitter-receiver section, and the cable is long enough so the battery can be kept in a pocket when the set is in use.

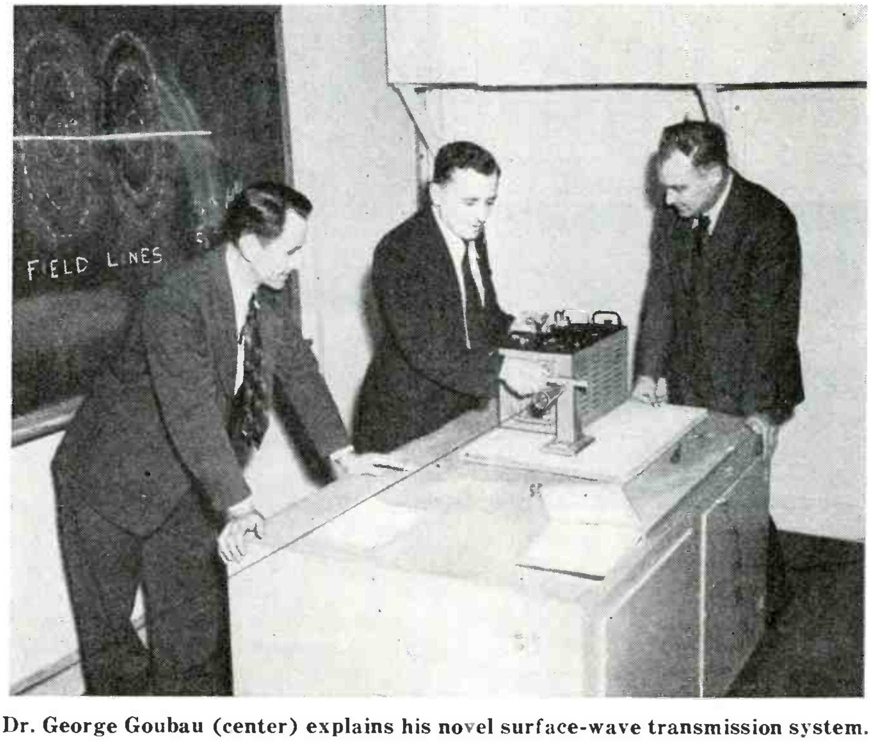
The entire unit is impervious to salt water and it will stand temperature extremes from −50 to +169° F. The set is designed for ruggedness, and its engineers claim that nothing short of a drop from an aircraft at 10,000 feet is likely to damage it.

These were the highlights of the show as seen by one observer. Another might consider the transistor transmitter more interesting than any of the items mentioned above. In the more than $7 million worth of equipment exhibited, there was meat for all types of technical minds, and at least one reporter came back with a story of little else but new television test equipment, oscilloscopes, and interference-chasing apparatus.



The URC-4 midget rescue transceiver.

The Olson speaker on an RCA portable. V-shaped cutouts act as reflex ports.



Dr. George Goubau (center) explains his novel surface-wave transmission system.

Vacuum-tube Grid Bias

Variety of grid bias circuits that will improve vacuum-tube operation

By H. B. DAVIS

AN ELECTRON tube can operate properly only when the relation between the element voltages is correct. Frequently the only difference between two circuits performing unlike functions is the values of the bias voltages on the grids. The importance of the correct bias voltage is not always appreciated. Effects of wrong bias voltage may appear as distortion, low power output, low voltage gain, overheating, and inefficient detection, to list but a few.

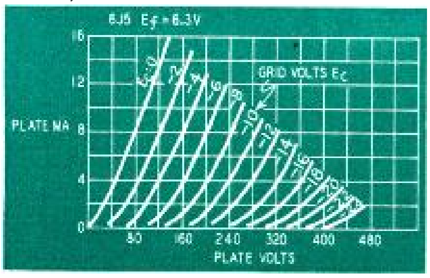


Fig. 1—Curves show relationship between tube's grid voltage and plate current at various plate voltages.

Choice of a bias method may be controlled by the circuit for which it is designed. For example, if plate-supply voltages are low, cathode bias is undesirable, because it lowers the plate voltage still further. The bias methods described here are useful in a variety of circuits. Extremely simple in themselves, they may suggest new answers to otherwise difficult problems.

In Fig. 1 is a family of curves of the plate characteristics of the 6J5. These curves show the plate current that will flow for different plate and grid voltages.

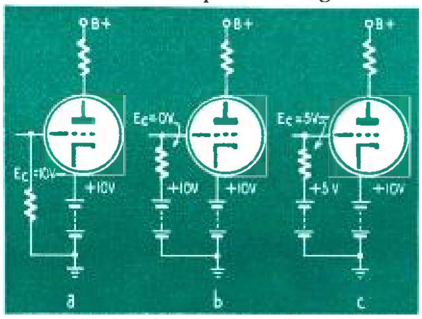


Fig. 2—Bias depends on grid-return point and not grid-to-ground voltage.

The point often overlooked is that the plate voltage is the voltage between the plate and the *cathode* of the tube and that the grid voltage is the voltage between the grid and the *cathode*. The cathode-to-ground voltage may or may not be the grid bias, depending upon the point to which the grid is returned. For example, in Fig.

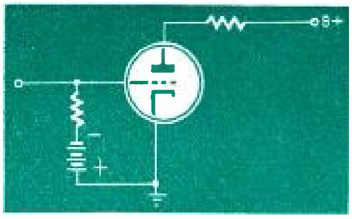


Fig. 3—Elementary type of battery bias.

2-a with the cathode 10 volts above ground and the grid returned to ground, the grid bias is –10 volts because the grid is 10 volts negative *with respect to the cathode*. In Fig. 2-b, however, the bias on the tube is zero because the grid and cathode are at the same potential. In Fig. 2-c the bias is –5 volts, the grid being 5 volts lower in potential than the cathode.This can be an advantage when the grid must be directly coupled to a point having a d.c. voltage above or below ground.

There are two general methods for obtaining bias voltage: using a separate voltage source or applying to the grid

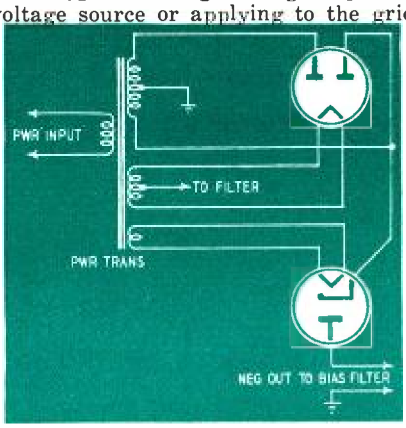


Fig. 4—Separate rectifier supplies bias.

the voltage drop developed across a portion of the circuit.

Separate Bias Sources

In the early days of radio a common system of bias was that shown in Fig. 3. The cathode or filament was returned to ground, and a battery was connected to make the grid negative with respect to the cathode. This bias method is still used in some circuits today, usually with miniature bias cells in circuits in which no grid current is expected. The same bias would be obtained by putting the bias battery in the cathode circuit, making the cathode positive with respect to ground as in Fig. 2-a. This is not done, however, because the cathode impedance of the tube would increase with use due to battery aging and the battery ages faster because it carries the entire plate current.

A common method of obtaining bias from the power supply is shown in Fig. 4. With this circuit the negative voltage is determined by the voltage of half the transformer secondary winding. This is usually too high for bias use and must be reduced by a voltage divider or other means, resulting in loss of power in heat.

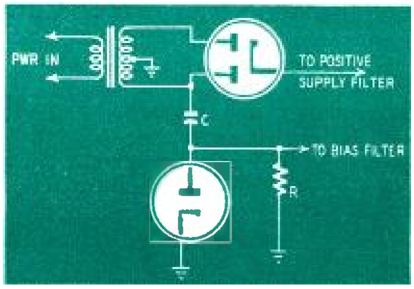


Fig. 5—Shunt diode reduces heat losses.

A system offering several advantages is the shunt-diode circuit. With the circuit of Fig. 5[1] a voltage divider is formed by the R-C circuit, allowing the desired output voltage to be delivered without the high heat loss present in dropping resistors. C is made only large enough to deliver the desired voltage. The excess voltage appears as a drop across the capacitive reactance, which does not produce heat. Low-voltage components may be used in the

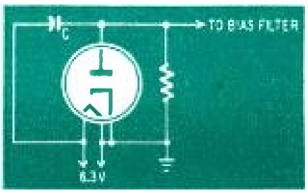


Fig. 6—Filament supply furnishes bias.

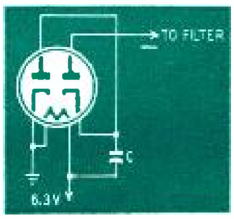


Fig. 7—Voltage-doubler bias arrangement that provides up to 18 volts.

filter, and the heater may be supplied from the winding serving the other tubes.

The shunt-diode system may also be used as shown in Fig. 6 to provide up to 9 volts bias from the 6.3-volt heater supply. A voltage-doubling arrangement such as that shown in Fig. 7 may be used for voltages up to 18 volts from the 6.3-volt supply.

A clever circuit for developing a fixed bias voltage, patented[2] in 1945, is shown in Fig. 8. The bias is developed by rectifying the heater voltage with the diodes in the tube itself. The bias voltage appears across R and is filtered by C. This circuit has the advantages of providing a bias voltage independent of the signal level or tube current and of requiring no more parts than are

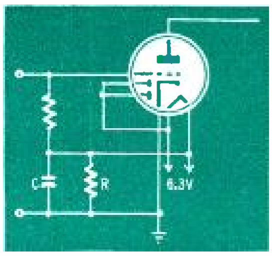


Fig. 8—Internal diodes rectify the bias.

required for conventional cathode-bias systems. No part of the filament-transformer winding should be grounded.

Self-bias systems

One of the most popular circuits utilizing the second general method of developing a bias voltage is that of Fig. 9. In this circuit the bias voltage is developed by the plate current of the tube flowing in the cathode resistor R. The current flow is in such a direction as to make the cathode positive with respect to ground. The tube is then biased in the same manner as was

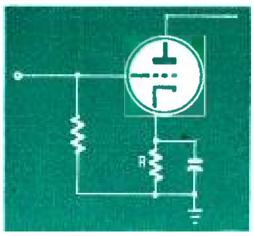


Fig. 9—Common variety of self-bias.

shown in Fig. 2-a. The capacitor from cathode to ground is necessary to prevent the cathode resistor from introducing degeneration. The bias voltage E_c is $E_c = RI_p$, where I_p is the total cathode current. Bias derived from the cathode current is satisfactory only when the average cathode current is constant, as in class-A amplifiers. In push-pull class-A circuits it must be remembered that the I_p of the equation becomes the total quiescent current of two tubes, since both tubes operate simultaneously.

In class-C amplifiers or grid-leak detectors (Figs. 10-a and 10-b) there is initially no bias. The tube draws grid current on the positive half-cycle of the input signal. The positive grid swing causes current to flow in the grid-cathode circuit, through the grid resistor in such a direction as to develop a negative voltage at the grid and charge the grid capacitor sufficiently to maintain the bias during the negative half-cycle of signal swing. This circuit was very popular years ago when grid-leak detection was used almost exclusively.

A system, sometimes known as the back-bias method, for developing bias voltage for the output stage of battery amplifiers is shown in Fig. 11. Bias for

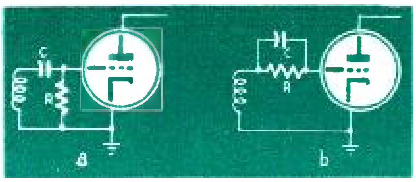


Fig. 10—Two circuits for grid-leak bias.

the grid of the tube is provided by the voltage drop across R. Bias for preceding stages may be taken from appropriate points along R.

In some circuits the bias voltage is developed by floating the negative power supply lead below ground and grounding the bleeder resistor at the point necessary to give the proper bias voltage. A circuit of this type is shown in Fig. 12.

The plate voltage of the tube is reduced by the amount of the bias voltage whenever self-bias is used. That is why separate bias supplies are often used where large bias voltages are required.

A system which does not reduce the

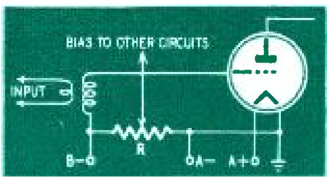


Fig. 11—Total B-current develops bias.

plate voltage is shown in Fig. 13. The bias is obtained by placing the filter choke in the negative d.c. lead and utilizing the voltage drop across the filter choke. The voltage developed is equal to the product of the choke's resistance and the total load current. R and C form a hum filter, necessary because the grid is returned to an unfiltered point in the power supply.

Frequently the grid of a tube must be operated at a relatively high d.c. voltage with respect to ground. A commonly used method of obtaining the proper bias is shown in Fig. 14. If –5 volts bias is required for a tube operat-

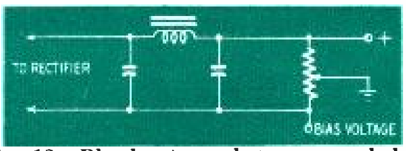


Fig. 12—Bleeder tapped, tap grounded.

ing with its grid at 20 volts above ground, a bleeder network R1-R2 may be used to bring the cathode to 25 volts above ground. The grid is then 5 volts negative with respect to the cathode. Capacitor C is the usual cathode bypass.

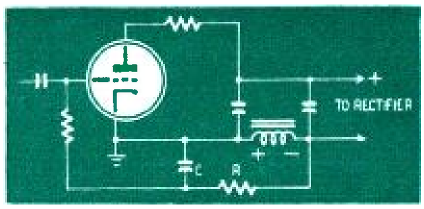


Fig. 13—Choke placed in negative lead.

Although the circuits shown have assumed tubes using cathodes, the same circuits may be used on filament tubes operating from filament transformers by assuming the centertap of the transformer to be the cathode. For example, the circuit of Fig. 9 would become that of Fig. 15. The two capaci-

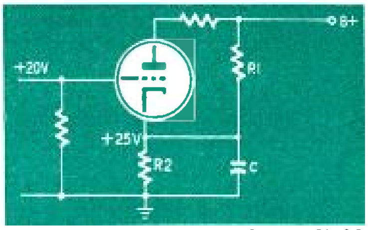


Fig. 14—R1 and R2 are voltage divider.

tors across the filament bypass the signal currents across the inductance of the transformer winding.

Some battery portables have the filaments connected in series across a 6-volt battery; by connecting the grids at desired points along the filament line, from zero to nearly 6 volts may be applied to such grids as require bias. A variation of this system is occasionally found in some three-way sets. The plate current through the output tube used for a.c. operation is used to supply filament current for the other tubes. Thus their filaments become the cathode resistor (or part of the cathode resistor) of the output tube. A few

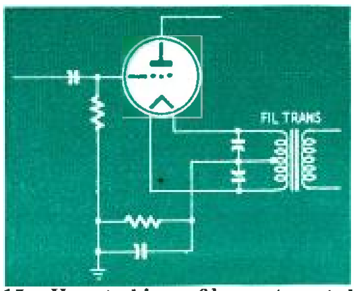


Fig. 15—How to bias a filamentary tube.

battery portables have used bias from the oscillator tube for the output tube. The oscillator of a superheterodyne uses a circuit like that of Fig. 10, and a small current flows through R. By making part of R the grid leak (or part of the grid leak) of the output tube, bias may be obtained without robbing the B-battery as would be necessary if the circuits of Figs. 11 or 14 were to be used.

References

1 "Use of Shunt Diode for Supplying Bias Voltage," *Electronics*, September, 1945.

2 Patent No. 2,375,877 issued to Orville I. Thompson, assigned to DeForest Training, Inc.

This combination unit provides versatility at low cost.

A Signal Tracer and V.T.V.M. Combined

By HARRY HATFIELD

A VACUUM-TUBE voltmeter and a signal tracer are probably the best instruments for tracking down intermittents quickly, measuring gain and distortion, and making many tests.

This instrument traces a signal from the antenna to the voice coil, detects hum, distortion, and feedback. It measures d.c. and a.c. voltages, resistance, and capacitance. Lightweight and portable, it costs not more than $35 to construct. The entire circuit appears in Fig. 1. The signal tracer is a three-tube audio amplifier with a self-contained speaker. The output tube is a 6V6 that delivers about 2½ to 3 watts. Biasing the 6V6 is a 500-ohm potentiometer, the bias being used as a d.c. source for the ohmmeter.

A 6SF5 tube is used for the voltage amplifier, having a stage gain of 50. The grid lead should be short and run direct to the signal-tracer volume control. It must be kept away from the heater and power wires, as it is sensitive to hum pickup. A closed-circuit phone jack (labeled LOW GAIN in Fig. 1) is used for most signal tracing.

When the probe is not in the LOW GAIN jack, a high-gain 6J7 amplifier is automatically switched into the circuit. The 6J7 plate and grid leads should be very short and kept clear of (and if necessary shielded from) any hum, feedback, or noise-producing circuits. The grid is run to a closed-circuit jack (labeled HIGH GAIN) which grounds the grid when the probe is not inserted. By using the HIGH GAIN input, signals down to 100 μv or less may be traced.

The probe consists of a shielded lead from a phone plug to a large test prod. A blocking capacitor and a 1N34 crystal-diode detector are placed inside the test prod. A piece of test-lead wire with a clip on one end is soldered to the shield of the probe inside the test prod, and brought out. The clip connects to the chassis or the B-minus lead of the set.

At a and b in Fig. 2 are two variations of a signal-tracer probe. The author has used both arrangements satisfactorily. It is recommended that both arrangements be tried, and the preferred one assembled permanently.

The v.t.v.m.

A 6SN7-GT is used in a bridge-type vacuum-tube volt-, ohm-, and capacitance-meter circuit. It measures a.c. and d.c. volts with little or no effect on the circuit under test. It will measure inductance also, if allowances are made for the resistance of the coil.

If the v.t.v.m. is built from standard radio parts, it may be accurate to about 8%; but by using 1% resistors, ceramic switches, etc., the error can be reduced to approximately 4 or 5%.

The nine voltage-divider and ohmmeter-comparison resistors are mounted on the 11-position rotary selector switch. The values are based on a 3-volt grid swing in the first (top) triode of the 6SN7-GT. All the ranges are given in the Range Table.

The 6SN7-GT cathodes are connected together and grounded through an unbypassed cathode resistor. The change in plate current in one triode produces a potential change across the common cathode resistor which changes the bias on the other 180 degrees out of phase with the grid change in the first. The balanced-bridge output is affected little by B-supply variations, since such changes do not affect the amplification factor of the tube; being in phase and of equal amplitude on each triode, they cancel out. The one-megohm grid resistor is used only to equalize grid input impedance over all ranges, except the 3-volt, 10-megohm range, where some variations will be expected.

The 33,000-ohm resistors are the loads for the 6SN7-GT and the remaining two arms of the bridge (the tubes themselves are the first two arms).

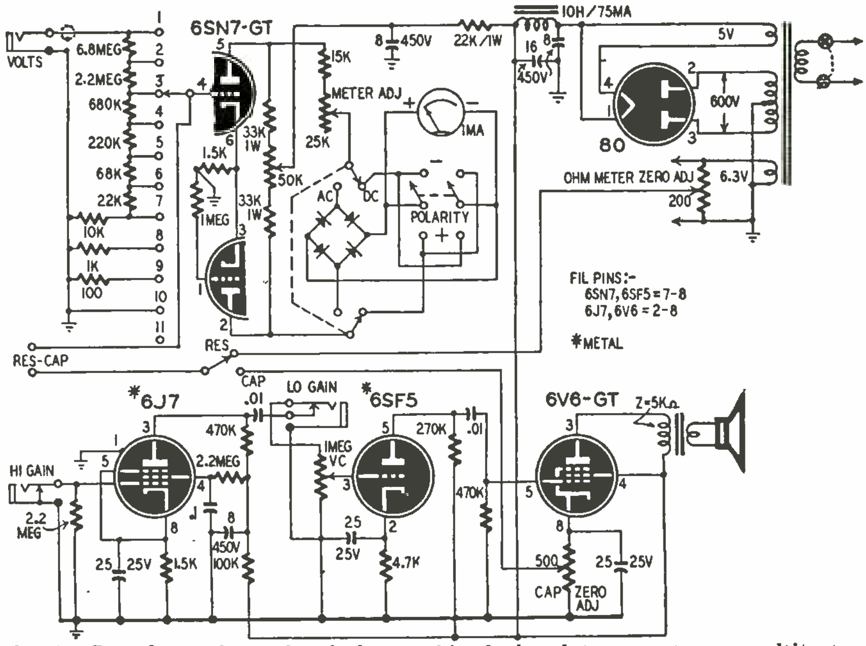


Fig. 1—Complete schematic of the combined signal tracer-v.t.v.m. multitester.

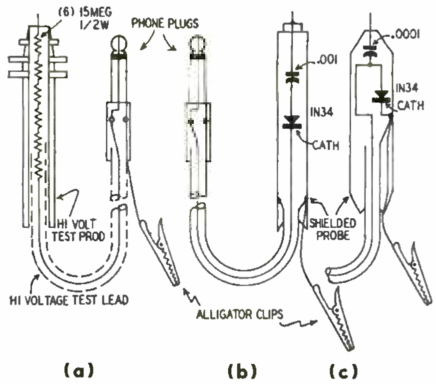


Fig. 2—Probes for tracer and v.t.v.m.

RANGE TABLE

Range	D.c. volts	A.c. volts	Ohms Min.	Ohms Center	Ohms Max.	Capacitance Min.	Capacitance Center	Capacitance Max.
1	2.5	3	0.2 meg	10 meg	100 *meg	stray	.00013	.001
2	6	9	—	—	—	—	—	—
3	30	30	20,000	1 meg	50 meg	.0001	.0013	.01
4	100	100	—	—	—	—	—	—
5	300	300	2,000	0.1 meg	5 meg	.001	.013	0.1
6	1000	1000	—	—	—	—	—	—
7	—	—	200	10,000	0.5 meg	.01	0.13	1
8	—	—	20	1,000	50,000	0.1	1.3	10
9	—	—	2	100	5,000	1	13	100
10	— GROUNDED —				GROUNDED —			

*—Higher values unreadable.

The bridge equalizing potentiometer (50,000 ohms) is adjusted so that the two plate potentials are equal indicated when the meter is at zero. The meter is connected between the plates of the 6SN7-GT in series with the variable 25,000-ohm meter calibration resistor and a fixed 15,000 ohms.

The AC-DC switch places a bridge-type meter rectifier into the circuit for the a.c. and capacitance ranges. The polarity switch permits the reading of either positive or negative direct voltages. The 8-μf capacitor and 22,000-ohm resistor form a decoupling network to prevent interaction between the v.t.v.m. and other circuits.

To obtain an a.c. voltage for capacitance, and inductance measurements, a 200-ohm potentiometer was connected across the 6.3-volt filament winding, with one side grounded. The arm is connected to the RES-CAP switch, which selects either an a.c. voltage from the filament potentiometer or a d.c. voltage for measuring resistance from the cathode bias resistor of the 6V6. The conventional power supply requires no explanation.

A high-voltage test probe is constructed as shown in Fig. 2-c. The prod is a large, long, high-voltage insulated test prod with 90 megohms resistance enclosed in the form of six 15-megohm, ½-watt resistors in series. A high-voltage-insulated, shielded test lead connects the prod to a phone plug for insertion into the voltmeter jack. A piece of test-lead wire tipped with an alligator clip is connected to the ground terminal of the phone jack to connect to the low voltage side of item being tested. This probe multiplies all voltage ranges given in the Range Table by 10.

The parts are laid out on the chassis so that the sensitive input circuits of the v.t.v.m. and the 6J7 high-gain signal-tracer tube are far removed from the rectifier and power transformer The 25,000-ohm v.t.v.m. adjustment needs changing only if a tube or meter is changed; therefore, it is mounted on the chassis inside the cabinet. Copy the meter scale of Fig. 3 or paste it on your meter if it will fit.

Calibration

To calibrate the meter, turn the 25,000-ohm v.t.v.m. adjustment to maximum resistance and turn on the power. Set the RES-CAP switch to RES, the AC-DC switch to DC, and the meter polarity switch to +. Set the ohmmeter zero adjust to minimum. Balance the bridge by adjusting the bridge balance control until the meter reads zero. Set the range switch to position 3 and short the ohmmeter terminals.

Connect an accurate multimeter to the RES-CAP jacks and adjust the ohmmeter zero control until the multimeter reads 3 volts. Set the meter adjustment for maximum meter movement (full scale).

Turn the AC-DC switch to AC, RES-CAP switch to CAP, and capacitance zero adjust to minimum. Short the RES-CAP jacks and connect a multimeter as before. Turn the capacitance zero control for full-scale meter deflection. The multimeter reading should be 3 volts. If it is only slightly off, set the meter adjustment for a satisfactory compromise between d.c. and a.c. readings. Seal it with speaker cement.

Remove the test leads from the RES-CAP jacks. Insert the v.t.v.m. probe into the voltmeter jack; set the AC-DC switch to DC, and the RES-CAP switch to RES. Turn the range switch to position 1. Insert the v.t.v.m. probe tip into the jack that connects with the ohmmeter zero adjustment. Place one multitester test prod on the chassis and the other on the probe tip. When the ohmmeter zero settings are varied, the readings of the two meters should agree on the 2½-volt meter scale.

Turn the range switch to the next position and check the 6-volt range. The lower ranges will read slightly different from the "3" and "10" scales of the higher ranges due to space-charge effects in the 6SN7-GT.

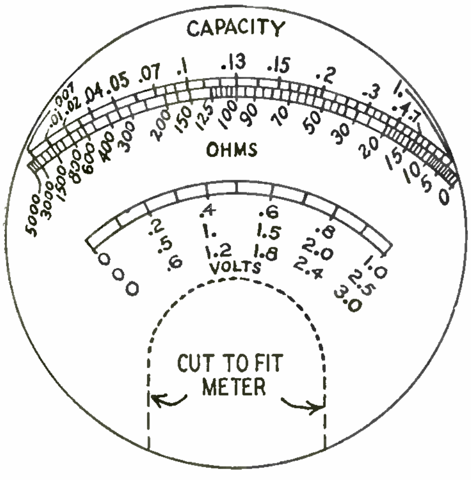
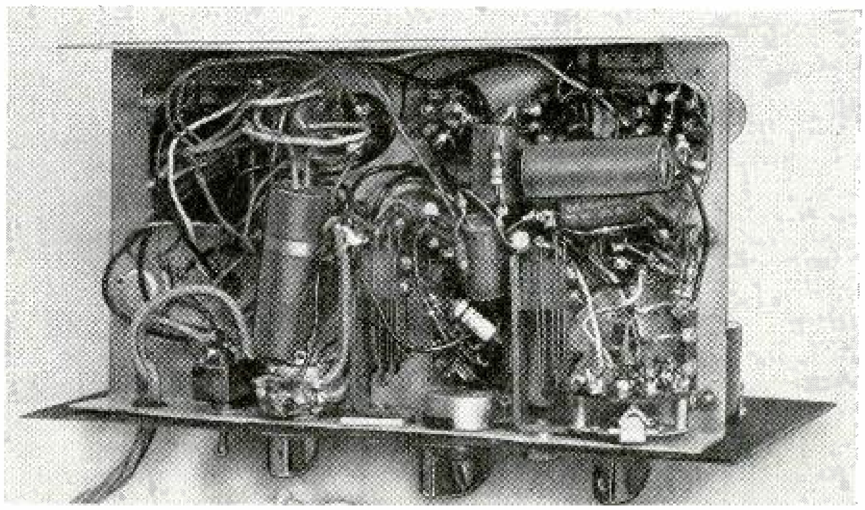


Fig. 3—Cut-out for the meter face.



Under the chassis. Wiring is point-to-point, with low-level a.f. shielded.

Fundamentals of Radio Servicing

Part XV—Sound and Loudspeakers

By JOHN T. FRYE

"The music goes 'round and 'round,
And it comes out here!"

NEVER do I hear the words of that song of a few years back without grinning and thinking they might well be a beautifully brief description of the whole complicated business of radio.

Certainly the music *does* go 'round and 'round from the moment it enters the microphone of the broadcast studio and is transformed into a weak audio-frequency current.

By the time the signal reaches the receiving antenna, it is so enfeebled by its journey that once more it must be nursed back to health before it is ready for the operation of being separated from the carrier. Nurses R.F. Amplification, Conversion, and I.F. Amplification have charge of this building-up process; and Doctor Detection performs the operation. After that, the audio signal must still be passed through the audio amplifier of the receiver before it "comes out here."

The "here" that actually releases the captive sound from the magic spell of electricity is the *loudspeaker*. It might be called a microphone in reverse, for, just as a microphone is a device for changing sound waves into electrical currents, a speaker is a device for changing electrical currents back into sound waves. The speaker is at the very end of the whole process of radio reception, in which it has the very last word. So it stands to reason that it is a most important piece of apparatus. Unless it does its job well, the good work of all the other units goes for nothing.

Brief review of sound

Since a loudspeaker is a sound device, let's review briefly some of the properties of sound before examining its operation:

Sound is "the sensation produced by a stimulation of the auditory nerves by vibrational energy." Suppose we strike the tuning fork of Fig. 1 and start it vibrating. As a prong of the fork moves back and forth, it alternately causes the molecules of air next to it to be pushed together and to be spread apart. These *compressions* and *rarefactions* travel through the molecules of air. To understand *how*, imagine that we have several croquet balls lined up in a shallow trough and separated by equal lengths of large-diameter coil spring. If we strike a ball at one end of the trough, it will compress the spring between it and the next ball. That ball will pass this shove along to the next, while the first ball is being thrust backward by the first compressed spring. In this manner the motion originally given to the first ball will travel through the whole string, causing each ball first to move closer to its neighbor and then to spring away from it.

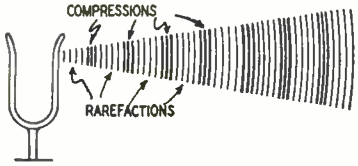


Fig. 1—Vibrating fork sets up waves.

In exactly the same way, the thrusts that the tuning fork gives to the surrounding air is transmitted to the ear, and these tiny variations in pressure cause the eardrum to move back and forth with the tuning fork. In that instant, vibration becomes sound.

A compression and an accompanying rarefaction make up a *sound wave*. If we could see these waves moving from the fork to the ear, we would notice that, when the fork vibrates slowly, only a few waves pass in front of us in a given space of time; so we might say that the *frequency* or *pitch* of the sound is low. Moreover, we would notice that the distance between two adjacent compressions is quite great, or that the sound wave is *long*.

On the other hand, when the fork vibrates rapidly, the number of waves passing before us is greatly increased. We say that the sound now has a higher frequency or pitch. At the same time, the wavelength would be noticeably shorter.

When the fork vibrates violently, it gives much stronger shoves to the air molecules than it does when moving through a small arc. The varying amount of energy thus imparted to and contained in the sound waves is referred to as the *intensity* or *amplitude* of the sound. The ear recognizes this difference in intensity as a variation in the *loudness*.

The current that is delivered to the speaker is an *electrical* reproduction of the *physical* sound that fathers it. This current is alternating in nature, but the frequency is not monotonously fixed as it is in the 60-cycle light mains. Instead, it is free to vary from instant to instant so that the electrical cycles per second are exactly equal to the number of sound waves per second striking the microphone. At the same time the power of the alternating current goes up and down in accordance with the intensity of the sound waves. A weak 1,000-cycle tone will produce a weak 1,000-cycle alternating current at the output of our receiver; but a loud 5,000-cycle sound will produce a powerful 5,000-cycle current at the same place.

The dynamic speaker

Now we are ready to see how a loudspeaker changes this alternating current back into sound. Take a look at Fig. 2, a drawing which illustrates the elements of a loud speaker mechanism.

The *field coil* consists of thousands of turns of wire wound in many layers in a doughnut form that fits snugly around the cylindrical soft-iron *pole piece*. This pole piece is firmly fastened to the rear of the heavy, soft-iron *frame* and projects through the exact center of a hole in the front of this frame, leaving a small space between the pole piece and sides of the hole. A tube of paper with a coil of wire wound in two or four layers around it is slipped over the pole piece and rests in

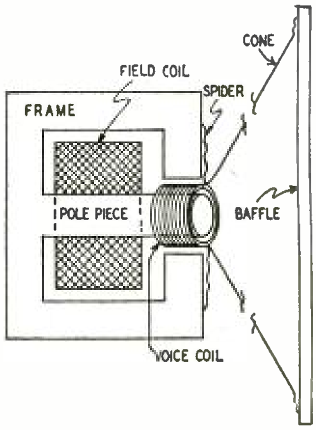


Fig. 2—Cross section of a loudspeaker.

this space. This is the *voice coil.* It must not touch either the pole piece or the frame; therefore, a flexible brace, called the spider, holds the voice coil centered in the narrow space, allowing it to move freely backward and forward on the pole piece. A paper *cone* is cemented to the voice coil, and the outer edge of this cone is also flexibly supported so that it may move back and forth with the voice coil.

Suppose we pass a direct current through the field coil. From our study of magnetism we know that this will magnetize the pole piece. The lines of force of its field will flow out the front end of the pole piece cross the gap between it and the frame and then return to the rear of the pole piece through the soft-iron frame. There will be a very concentrated steady magnetic field in the small air gap in which the voice coil rests.

Suppose we pass another current through the turns of the voice coil. This current will produce a magnetic field of its own, and we shall have two different sets of magnetic lines of force. The interaction between these two magnetic fields will cause the voice coil to move back or forth on the pole piece. The direction of movement will depend upon the direction of current flow through the voice coil, and the amount of movement will depend upon the strength of the current.

Stopping right here, can't you guess what will happen when we connect the output of our radio receiver to the voice coil? Remember this output is an alternating current whose frequency varies with the pitch of the sound producing it and whose power reflects the loudness of the original sound. Since the direction of movement of the voice coil depends upon the direction of current through it, an alternating current will cause it to move back and forth, exactly in step with the frequency of the reversing current through the coil. Here we have a *vibrating* object that can produce sound! A stronger current will cause the coil to have a greater movement than a weak current; thus a *violent* swing of the tuning fork will produce a *loud* sound that will result in a *strong* current that will cause a *violent* movement of the voice coil and cone and produce a *loud* sound.

The whole thing sounds rather like a dog chasing his tail, but it establishes the point that the sound from the speaker is almost exactly the same as that in the broadcast studio—and that is our goal.

A comparatively recent tendency in this *field-coil dynamic* type of speaker has been to get rid of the field coil. This coil was needed only to create a strong magnetic field in the space in which the voice coil works. (However, radio engineers made a virtue of a necessity and also used the field coil for a filter choke.) In the last few years we have learned how to make powerful, compact, permanent magnets many times stronger than formerly believed possible. When a permanent magnet is used to replace a section of the pole piece, the speaker works just as it did with the field coil; but a great saving has been made in cost and weight, and we no longer need a source of field coil current. Such speakers are called "permanent-magnet dynamic speakers" or, less formally, "PM speakers."

The human ear cannot hear vibrations of all frequencies. Any frequency between 15 and 20,000 cycles is called an audio frequency, but the range of hearing of most people is probably between 30 and 16,000 cycles per second. What is more, the response of the ear is similar to the spelling of Ohio: "round on the ends and high in the middle," as is shown in Fig. 3. Sounds of equal actual intensity seem much louder in the range between 500 and 3,000 cycles than when pitched either above or below this range.

Low-note difficulties

If the ear is to hear low-pitched tones at all, the speaker must move a considerable mass of air to produce the necessary changes in pressure with the comparatively slow-motion movement of the voice coil. That is why the cone is attached to the coil. It acts like a piston and allows the voice coil to set a large quantity of air into motion.

Even this advantage is largely lost at low frequencies without the use of a baffle. As the cone moves forward, it compresses the air in front of it and lessens the pressure behind it. At low frequencies, this cone movement is comparatively slow, and the pressure being built up in front simply slides over the edge of the cone and reduces the partial vacuum we are trying to create behind. It is like trying to use a 3-inch piston in a 4-inch cylinder: most of the pressure simply escapes past the sides of the piston, and the net result is very little change in pressure front or back.

The remedy is to lengthen the path the pressure or sound wave must travel in going from in front of the cone to the back so that by the time it gets there all ready to do its dirty work, the cone has started back and the arriving pressure wave actually contributes to the pressure the backward-moving cone is starting to build up behind the speaker. The name *baffle* is given to the means used to lengthen this path; and the whole baffling subject is discussed at some length in the article by A. G. Sanders on page 31 of the December, 1949, issue of RADIO-ELECTRONICS.

While a large cone and voice coil help to reproduce the low frequencies, the increased mass of these items seriously interferes with the reproduction of high frequencies. If you have trouble in understanding *why*, just reflect on how much easier it is to flutter a handkerchief than a bed quilt! By making the cone out of flexible material we can help the situation, for then the whole cone will move back and forth at the low frequencies while just the inner portion will follow the rapid vibrations necessary for high-frequency reproduction.

The best solution is the use of two speakers: a small "tweeter" especially designed for the highs, and a large "woofer" that is intended to reproduce the low frequencies. Both of these speakers are often contained in a single unit. A device known as a crossover network separates the frequencies below the crossover frequency—usually somewhere between 400 and 2,000 cycles—from those above it and feeds each set of frequencies to the speaker which is best able to reproduce them.

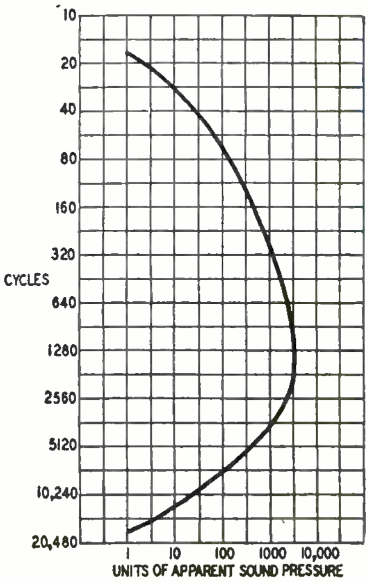


Fig. 3—Apparent sound pressure curve.

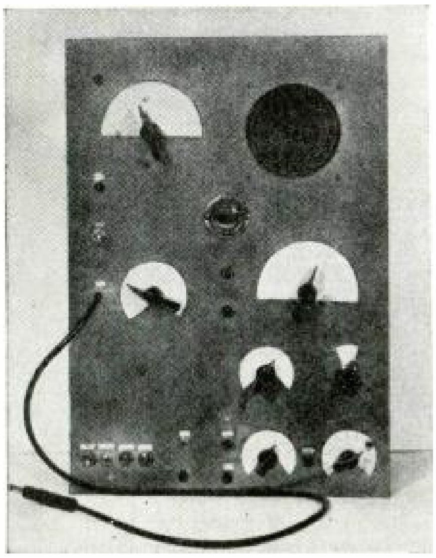
Repair problems

Most of the troubles which appear to originate in the speaker of a receiver are actually in the output transformer usually attached to the speaker. A burned-out primary is responsible in nine out of ten cases, and can easily be detected by checking with an ohmmeter. A red-hot screen in the output tube is another indication of an open plate lead and points unerringly to the burned-out transformer primary.

Real speaker troubles consist of shorted or open voice and field coils, of voice coils that are not properly centered and so rub on the pole piece or frame, of breaks in the flexible leads that connect the output transformer to the voice coil, and of cracked, worn, and warped speaker cones. Good speakers have provisions for recentering the voice coil by shifting the spider. The best repairs for the other faults mentioned is simply to replace the defective parts. Small faults in the cone can be repaired with speaker cement; but extensive use of this expedient will result in a cone that is not uniformly flexible and cannot perform as intended. A new cone is a much better repair.

All in all, speakers that have not been excessively abused give very little trouble and in no way deserve the suspicion that radio owners always direct at them when their sets go dead.

Compact Unit Tests Everything



Front view of the instrument. Pointers are used with hand-calibrated scales.

Signal tracer, capacitor tester, signal generator and tuner on one panel.

By WESLEY NEELANDS

RADIO repairing started as a hobby with me. My radio repair equipment consisted of a simple one-tube regenerative rig for a signal generator. When radio repairing had become a part-time occupation, it still didn't justify expensive equipment, but something more elaborate obviously was needed to turn out better work in less time. I leafed through the last two years' copies of this magazine and found that most testers were either too complicated or too simple to suit me, but I picked up some good ideas and put them together.

The test panel devised contains four units: a simple tuning unit, a capacitor tester, a signal tracer, and a signal generator. Fig. 1 shows the complete circuit.

The tuning unit is exceedingly simple. It brings in local stations with good volume and is very dependable and useful for providing music in the work shop; for checking the output of the signal generator (with a dead radio on the bench one sometimes wonders if the generator *is* operating); and for checking distortion.

The tuning unit will pick up the output of the signal generator. The r.f. or i.f. signal is heard in the speaker and can be adjusted for modulation and pitch. Distortion is checked by feeding a good voice or music program to the tuning unit and applying the output of the tuning unit to the first audio stage of the signal tracer. The output of the signal tracer then provides an audio signal to use for distortion checks.

The capacitor tester provides a test for all capacitors commonly used. Insert the capacitor between the neon bulb and B-plus. One flash when contact is made and another (on the opposite neon element) when the capacitor is grounded indicates a good unit. No flash shows an open, and a steady glow a shorted or leaky capacitor. For low voltage capacitors, use a voltage divider inserted between B-plus and ground.

The signal tracer is a simple audio amplifier that needs little explanation. The combination of a 6SQ7 and a 6V6 gives very good sensitivity for a triode-pentode combination, having a high-mu triode and a beam-power output. Use shielding as indicated, short leads in plate and grid circuits, no crowding, and adequate filtering in the B-supply. The result is a quiet, stable amplifier.

Two probes, shown in Fig. 2, are required. One a simple shielded probe with an alligator clip for picking up audio signals. For example, it can be clipped to one side of the voice coil with the other side grounded. The tracer then acts as an output meter. The other probe contains a 1N34 germanium crystal. With it, signals can be traced from the aerial to the detector stage. No provision is made in this probe for a return r.f. path and the circuit itself must provide a path or a more elaborate probe is required. The speaker can be switched off to avoid confusion between the output of the test speaker and that of the radio under test. A short circuit switch for the output transformer is needed when the speaker is out or enough signal will leak across the switch to be troublesome.

The 6E5 eye is valuable for alignment, output tests, and comparison of gain from stage to stage. For the latter, it is helpful to set up a chart using different types of good radios that come to your shop. The point on the tester volume control at which the eye closes should be noted as the tracer is put on each test point. The simplified diagram shown in Fig. 3 may be used and the test positions, as numbered, incorporated into the chart.

The signal generator has no plug-in coils and no coil switching. The complete audio range, from a few cycles per second to the inaudible frequencies,

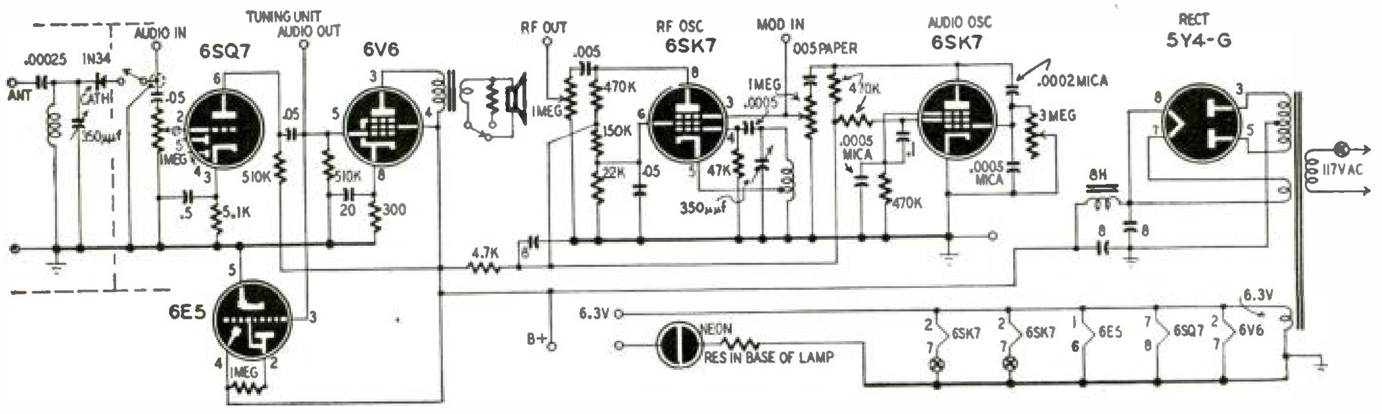
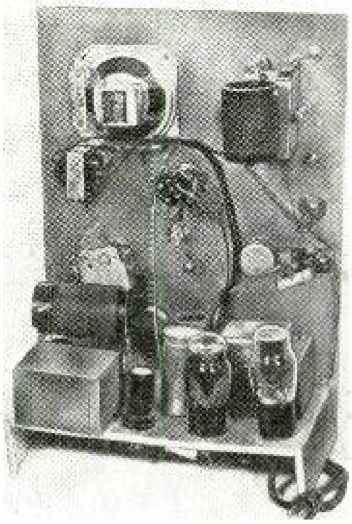


Fig. 1—There are three units—tuner-tracer, sig gen and power pack. Pin jacks permit many tests and supply various voltages.



The instrument as viewed from the rear.

is available at the turn of a knob. The r.f. and i.f. range covered is from 456 to about 1450 kc. The r.f. can be modulated with any desired audio note at any desired percent modulation. The r.f. or i.f. can be modulated by the output of the 6SQ7 or from an outside source. When this is done, the filament of the audio generator is switched off and the a.f. output jack becomes the modulation input jack.

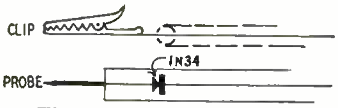


Fig. 2—The r.f. and a.f. signal probes.

One fault with this generator is that the audio signal from this type of oscillator is a sawtooth wave and is difficult to interpret on an oscilloscope. For all other purposes it is just as good as a sine wave. The stability and range of the audio wave are affected by the values of the plate to grid capacitor, the screen resistor, and the screen to suppressor capacitor. The values given should prove satisfactory.

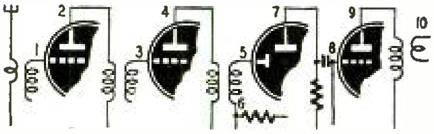


Fig. 3—Rough signal tracing procedure.

To cover the required i.f. and r.f. frequencies, I had intended to switch in a small trimmer capacitor and made provision for this on the panel. I was surprised to find it possible to wind a coil that covers from just below the required i.f. of 456 kc. to almost the top of the broadcast band. Thus all the commonly required frequencies are available with one twist of the wrist. The tuning coil is 85 turns of d.c.c. copper wire wound to nearly 2 inches on a 2-inch form, and the oscillator coil has 104 turns of d.c.c. wire occupying 2½ inches on a 2-inch form with the cathode tap at 38 turns above ground. No. 26 d.c.c. wire is roughly correct without noticeable spacing. I plan to use the switch for switching in short wave coils if needed.

The large, heavy aluminum panel effectively shields a radio from signals radiated directly from the coil, but, with a probe inserted, a strong signal is radiated. If used close to other radios, it might cause interference. The circuit of the r.f. generator is the familiar Hartley electron-coupled oscillator. Too large a grid leak may cause instability. That is, the oscillator may squeal at certain settings because of grid blocking. The screen voltage must be kept at a moderate figure.

It may pay to experiment with the location of the tap on the coil. Do not be satisfied until you have a signal which is inaudible until modulation is added or the signal beats against some other r.f. signal. In either case the signal should be quite loud.

Most of the layout can be seen from the photograph of the panel. Coils are mounted on the backs of the capacitors and the output transformer is on the speaker. The chassis is 11 x 7 x 2½ inches, allowing plenty of room for the power transformer, tubes, can-type filters, and the filter choke. The panel is 12 x 17 inches.

The only other equipment necessary to repair radios even on a part-time basis is a volt-ohmmeter (a.c.-d.c.), a tube tester, and a thorough knowledge of radio.

Capacitance Measurement with Signal Generator

CAPACITANCES below .0005 µf cannot be measured accurately with ordinary bridge circuits. A signal generator in connection with a standard radio solves the problem simply and accurately with no extra drain on the pocket.

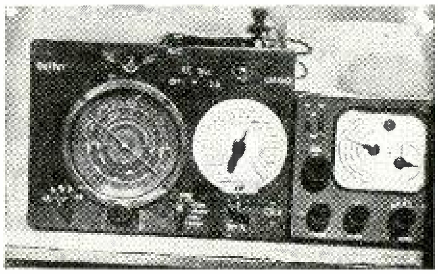
Nearly every radioman has this instrument and one who has not may construct one.

A problem arose concerning some nonstandard coded micas of low capacitances obtained from war surplus stores. With no further waste of time and money, I thought of a way to use my signal generator to solve the difficulty. I connected a .0005-µf linear-type variable capacitor in parallel with a signal generator log-type tuning capacitor with the shortest possible plug-in leads so that the original calibration would not be affected when this extra unit is disconnected. There being 100 divisions on the linear unit dial, the signal generator dial was marked for each degree by spotting the signal on the radio receiver in turn with the calibrating capacitor and the signal generator's own. In this way the signal generator capacitor was calibrated in terms of the linear one.

The capacitance for each division marked will be .0005 µf divided by 100. The calibration, of course, will be crowded on the low-frequency end of the dial and may be marked for convenience. With a big dial, the task will be easy and more accurate.

To test a given capacitor, set the signal generator variable capacitor for minimum capacitance and plug in the capacitor under test. Tune in the signal on the radio receiver on the appropriate band. Unplug the capacitor and leave the radio receiver as tuned. Tune the signal generator in to spot the signal on the radio. The pointer on the signal generator will now directly indicate the value of the capacitor under test. Care should be taken to distinguish fundamentals from harmonics when measuring a capacitor by this method.

This method also provides a quality test. If the signal cannot be tuned, it may be due to large leakage stopping the signal generator. Should it be open, stray capacitance will deviate the signal very little. (For low capacitances, the h.f. band will be more accurate and convenient.)



Dial is calibrated in capacitance units.

Interelectrode capacitance of tubes also can be measured by this method, and by comparison with good tubes, an open element can be found easily.

I constructed the signal generator (see photo) from an article, "Better Signal Generator" in the 1946 Radio-Electronics Reference Annual. It was supplemented with a capacitance and resistance checker bridge circuit described in the same Annual. By combining two in one, the power supply cost was cut down. Of course, an additional winding of 60 volts on the power transformer for the bridge circuit was required. The 6E5 tuning eye in the bridge is a null indicator and also has been used as a low-range v.t.v.m. and for a.v.c. checking and alignment work.

The instrument also has been used as a Morse code practice set as well as with a receiver to provide modulated signals. Thus maximum returns have been achieved with minimum of cost. Hope that the setup will encourage readers toward home-made test instruments.—*Raojibbai J. Patel*

Servicing Vibrator Power Supplies

Voltage and current waveform analysis simplifies trouble shooting in vibrator-type power supplies

By JOHN LEDBETTER


A full-wave non-synchronous supply.

SERVICING automobile receivers and other equipment with vibrator-type power supplies is no harder than servicing a.c. apparatus, yet many technicians don't like to tackle this type of equipment. They usually feel that extra test equipment and batteries will be required, and that work on vibrator supplies is tedious or tricky.

Neither of these ideas is necessarily true, although a 6-volt storage battery or battery eliminator *is* desirable if much work is to be done on auto receivers or battery-operated PA systems. Servicing both synchronous and nonsynchronous power supplies is quite simple once the underlying principles are understood.

Basic theory

Three general types of vibrators are in use today: half-wave nonsynchronous, full-wave nonsynchronous, and synchronous. The half-wave type is shown in Fig. 1. Voltage applied to the vibrator's series electromagnetic coil makes and breaks the circuit about 85 times per second. The pulsating current thus produced in the transformer primary induces an a.c. voltage in the secondary, which depends on the turns ratio of the transformer and the vibrator frequency.

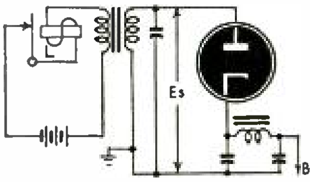
When the vibrator contact points are open, the energy stored in the magnetic field of the primary winding tries to keep the current flowing in the coil. Since the resistance of the vibrator contacts has changed from zero when closed to almost infinity when open, the voltage across the winding rises to an extremely high value (1,000 volts or more) in the attempt to keep the current flowing across the contact gap.

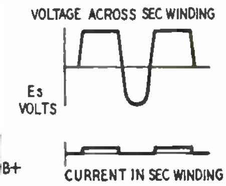
Since this inductive surge will damage the transformer or ruin the vibrator points, a buffer capacitor is placed across the transformer secondary to absorb the voltage peaks. When the vibrator contacts are closed, the capacitor charges. The inductive surge is opposite in polarity to the charge on the buffer capacitor so that it must reverse the charge on the capacitor before it can begin charging in the opposite direction. By this time the inductive surge has been used up or reduced to only a few volts.

The half-wave circuit in Fig. 1 has several disadvantages because of the series vibrator coil and single secondary winding. Since the coil is in series, the current through it depends on the current load placed on the secondary winding. If the current falls below a certain value, the efficiency of the vibrator varies and it flutters or vibrates very feebly. The longer contact periods of the vibrator points cause saturation of the transformer and sparking occurs.

If the secondary current drain is excessive, the vibrator current also is excessive and the vibrator is slated for early failure. Although the secondary winding actually contains a form of alternating voltage, the rectifier tube draws current only if this voltage has a certain polarity. This amounts to forcing pulsating d.c. through the secondary, and the inductance of this winding acts like a choke and limits the amount of current which can be drawn through it. The practical limit is about 30 milliamperes at 180 volts.

The action just described can be understood more clearly by referring to the voltage and current waveforms in Fig. 2. When the square-topped portion of the voltage waveform has the correct polarity to be passed by the rectifier tube, the energy transfer is high. If the rectifier draws power from the *bottom* of the wave, the output is being obtained only from the energy stored in the transformer core. The result is low output and poor vibrator operation. This condition can be corrected by reversing the battery leads.





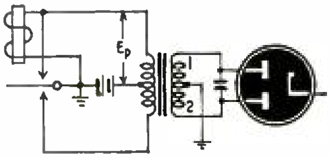
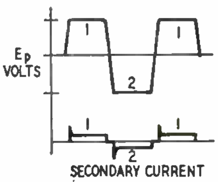
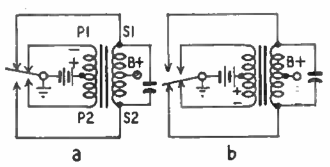


Fig. 1, left—Half-wave vibrator supply. Fig. 2, center—Voltage and current half-wave supply waveforms. Fig. 3, right—Full-wave, non-sync. vibrator.

Full-wave circuits

Full-wave nonsynchronous circuits avoid the above disadvantages (see Fig. 3). Here, the vibrator coil is connected in parallel with the vibrator contacts instead of in series, and draws a constant amount of current regardless of the secondary load. This full-wave circuit is actually two half-wave circuits placed back-to-back so that each alternately supplies half of the output wave. This keeps the output voltage polarity correct, so that each





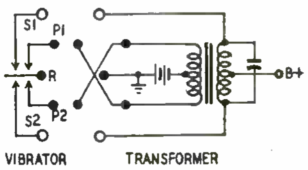
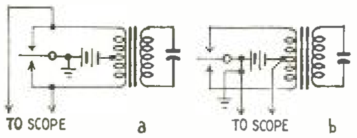
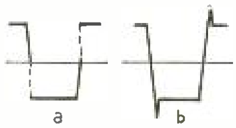


Fig. 4, left—Full-wave supply increases efficiency. Fig. 5, center—Synchronous supply eliminates rectifier. Fig. 6, right—Reversing plug for vibrator.

half of the rectifier conducts, and there is no need for observing battery polarity.

Since one-half of the transformer secondary is always providing d.c. output, the inductive surges in each half balance each other. No d.c. is drawn through the secondary, and the voltage output may be increased as much as desired simply by increasing the turns ratio, the only limit being the eventual overloading of the vibrator if this is carried too far. The increase in efficiency is shown in the voltage and current waveforms in Fig. 4.





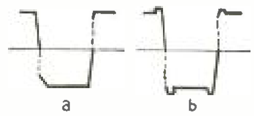


Fig. 7, left—Oscilloscope connections for waveform observation. Fig. 8, center—Non-synchronous supply waveforms. Fig. 9, right—Synchronous waveforms.

The synchronous vibrator supply permits a simpler, more compact circuit arrangement since the rectifier tube and socket are eliminated. In Fig. 5-a, the battery voltage is applied across the primary winding of the power transformer. This voltage is positive at the centertap and negative at P1. The transformer produces a high positive voltage at the secondary centertap and the secondary winding is negative at S1. (The negative return is grounded through the vibrator reed.) When the reed is in the position shown in Fig. 5-b, the primary centertap is again positive, and this time P2 is negative. The secondary voltage still is positive at the centertap, but is now negative at *S2*. Thus the output voltage at the secondary centertap is always positive d.c., regardless of the position of the vibrator reed.

The main disadvantage of this circuit is the necessity of observing battery polarity. The wrong polarity will damage both the vibrator and the filter capacitors if allowed to remain for even a short time. Some manufacturers provide for reversing vibrator polarity in different makes of automobiles by equipping the vibrator with a special six-prong base; polarity is reversed by removing the vibrator from the socket, rotating it 180 degrees, and re-inserting (see Fig. 6). Some of the older receivers did not make such provisions, and polarity had to be reversed by reversing the primary leads of the power transformer.

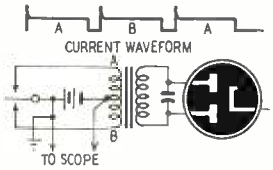
Servicing methods

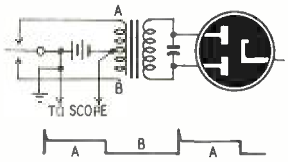
Two good methods of checking a vibrator supply are waveform and voltage and current measurements. Both are simple and take up little time. Useful information can be obtained by observing both the voltage and current waveforms with an oscilloscope. The *voltage* waveform shows the condition of the vibrator itself and whether it is electrically matched to the circuit, and the *current* waveform indicates the condition of the *circuit* and whether the vibrator is correctly connected to it. Oscilloscope connections for observing waveforms are shown in Fig. 7. The voltage wave (7-a) can be checked by connecting the vertical scope leads to any convenient point across the power transformer primary, usually at the vibrator socket. The current waveform (7-b) is obtained by connecting the vertical leads of the scope at any convenient point between the A hot line and ground. (Since the vibrator draws a pulsating current from the battery, the voltage drop in the battery line will have exactly the same waveform as the current.)

The vibrator must operate smoothly both before and after the tubes have warmed up. A full-wave nonsynchronous vibrator should have the waveform shown in Fig. 8-a as soon as the receiver is turned on. This form should not change appreciably when the full load is applied. If it resembles that of Fig. 8-b, either the vibrator is badly worn or the buffer capacitor has insufficient capacitance. The vibrator should not be replaced until the buffer has been checked or replaced. The buffer should be replaced as a safety measure each time a new vibrator is installed, even if it checks good.

A synchronous vibrator in good condition has a waveform across the primary similar to Fig. 9-a before the load is applied. This is essentially the same as Fig. 8-a. When the tubes have warmed up, this waveform has the pips or "ears" seen in Fig. 9-b. These ears are normal, because the secondary points on the vibrator are set wider than the primary points and do not place any load on the vibrator until slightly after the primary points have made contact.

Suppose the vibrator has short life, although it appears to operate smoothly and the current drain is about normal. A check of the current waveform will show whether the load is equally distributed between each set of contacts. In the normal full-wave vibrator, each contact feeds one plate of the rectifier tube and the load is shared by the two contacts. Proper load balance is indicated when the height of each consecutive current pulse (A and B in Fig. 10) is equal.





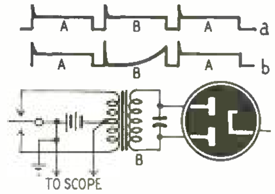


Fig. 10, left—Proper full-wave load balance. Fig. 11, center—Open at B upsets balance. Fig. 12, right—High-resistance joint in secondary unbalances current.

Current waveform tests

In some tests, the current waveform is more helpful than the voltage waveform. For example, suppose half the transformer primary winding is open (Fig. 11). The output voltage waveform may be almost normal, but the fault will be apparent immediately in the *current* waveform. Since no current can flow in contact B because of the open winding, there will be a long "off" period between adjacent current pulses (compare A with B in Fig. 11). This will cause short vibrator life because one set of points is forced to carry the entire load. This same thing can happen if one of the rectifier plates is weaker than the other. The shape of the current waveform in this case will resemble that in Fig. 12-a. Note the decreased height of current pulse B as compared with the pulse A. The same waveform could be caused by a high-resistance joint in the secondary winding or at the tube socket. If the secondary winding is open at B, the waveform will have the slope as shown in Fig. 12-b.

Note the small peaks which appear at the front edge of each current pulse. These are caused by a charging current for the buffer capacitor and should be no higher than two or three times the height of each current pulse under normal load. It is not necessary that each peak be *exactly* the same, but a value higher than normal indicates excessive buffer capacitance and will result in short vibrator life. Excessive charging peaks will also cause hum in the speaker by being induced into the voice coil by way of the field coil of the speaker.

Too large a buffer capacitor will give the voltage and current waveforms shown in Fig. 13. The waveforms in Fig. 14 are usually the result of using a vibrator designed for a high-frequency unit at low frequencies. The waveforms show a saturated power transformer as the result of the vibrator contacts being closed for too long a period. This should not occur if the manufacturer's recommendations for vibrator replacement have been followed.

Current drain

The current drain of the set should be checked against the manufacturer's specifications. If these are not available, check the vibrator current by allowing the tubes to warm up and taking a current reading of the battery with the vibrator in the circuit, then with it removed. The difference in readings is the vibrator current.

Roughly, this current should be 2 amperes for each power tube in the receiver, ½ ampere for the converter tube, and ¼ ampere for each of the other tubes. The rectifier is not included, since it draws no current from the vibrator. If the actual vibrator drain is much more than the above approximations, the various components should be checked.

the trouble is in the vibrator, buffer capacitor, or power transformer. If replacing the first two does not reduce the current drain to normal, the transformer itself is defective and must be replaced.

The input current can be checked without removing the receiver from the car by making up an adapter like the one shown in Fig. 15. This adapter consists of a standard and a clearance-

Fig. 13, left—Too large a buffer capacitor peaks the current. Fig. 14, right—High frequency unit used at low frequencies saturates power transformer.

Most likely causes of trouble are: high leakage in the filter capacitors, leaky or shorted coupling or bypass capacitors in the output stage, defective output tube, or a faulty resistor or capacitor in the cathode bias circuit. Defective parts in other stages may also contribute to the excessive current drain.

In nonsynchronous circuits, the trouble can be isolated quickly by removing the rectifier tube; in synchronous circuits by disconnecting the centertap of the transformer secondary. The current drain through the vibrator under these no-load conditions should be 1 ampere or less. If more,

type fuse holder and plug, a d.p.d.t. switch (toggle or knife-type rated at 6 amperes or more), for reversing the meter, and a d.c. ammeter (0-15 or 0-20 amps).

The current can be measured directly by connecting the adapter in series with the hot battery lead. The current reading should be taken with the car motor off and with no other load on the battery. The battery voltage should be as close to 6 volts as possible when the readings are made.

Vibrator life test

The life expectancy of vibrators which have been in the set for a long time but are still in good condition can be predicted by making the following tests: First, replace the 0Z4, if one is used, with a 6X5 for the tests. Then, with the set operating, but with no station tuned in, check the plate voltage. This should be within 10% of the manufacturer's rating and should vary not more than 4% (this would be ±10 volts at 250 volts plate voltage approximately).

Drop the input to 4 volts by connecting the hot lead across two cells of the battery. Disconnect the set for about 1 second. This allows the vibrator to stop but does not allow the tubes to cool. Then apply battery voltage to the receiver several times in succession. The vibrator should start consistently at 4 volts as long as the

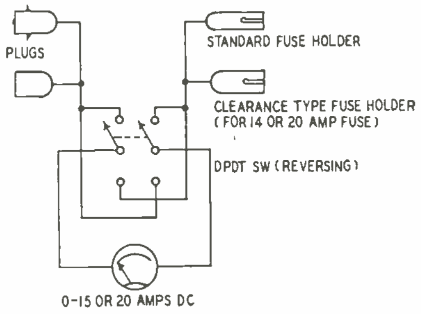


Fig. 15—Adapter for car radio check.

tubes are hot. Failure to do so indicates trouble in the near future with *normal* starting voltage. Although plate voltage with the 4-volt input should be two-thirds normal, the vibrator is still good if the reading is only half normal. In most commercial service jobs, however, it will be safer to replace such a vibrator, as its life is not likely to be long.

Most modern vibrators are treated or hermetically sealed in the can to prevent accumulation of film on the contact points when stored in high humidity for a long period of time.

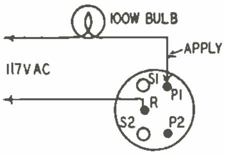


Fig. 16—Circuit for clearing points.

This film often prevents starting under normal conditions. If this happens, turn the set on and allow the tubes to warm up, then snap the switch off and on rapidly several times to start the vibrator. A few minutes' operation should remove the film. If the vibrator will not start, remove it and apply 110 volts a.c. to the points in series with a 100-watt light bulb (see Fig. 16). A half minute of this treatment will clear the film without damage to the vibrator.

Diagrams, material and the photo contained in this article appear in the Radiart vibrator manual and are included with permission of the Radiart Corporation.

CURING MODULATION HUM

WHEN hum in receivers and amplifiers is not produced by faulty filtering, stray a.c. fields, and other common faults, it may be caused by heater-to-cathode leakage in one or more of the tubes.

The easiest method of locating the bad tube is by substitution. However, this method is not too reliable unless two or more of each type tube are available.

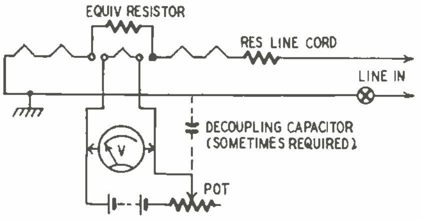


Fig. 1—Series heaters need resistor.

Another method is to disconnect the tube heater from its a.c. supply and use a battery to heat it. The battery should deliver the required voltage and current. A rheostat and voltmeter can be used to adjust the voltage to the correct value. Try this on each tube until the hum disappears. This tube should then be replaced by one of the same type hand-picked for hum-free service.

Fig. 1 shows the connections for a.c.-d.c. type sets having series filament strings. In such sets, the heater string must be completed by a resistor equal to the "hot" resistance of the heater it replaces. The resistance is equal to the heater voltage divided by the heater current in amperes. Fig. 2 shows the connections for making the test on a.c. sets.

If instability is experienced during—or because of—this test, bypass one side of the heater to chassis or B-minus. Use a .001-μf capacitor for r.f. circuits and a .01-μf unit for a.f. circuits.

If the hum is strong, start testing tubes at the front end of the set or amplifier. If it is weak, start at the output stage. Do not overlook the rectifier tube. It can cause this trouble just as easily as the others can. Be extremely careful when testing rectifier tubes.

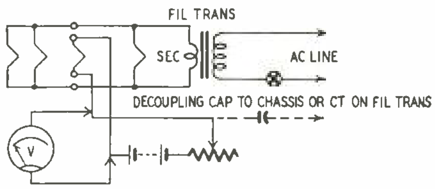


Fig. 2—Rheostat varies the voltage.

This method is especially effective in checking high-resistance leaks between cathode and filament of the power tube in series-filament receivers. The leakage may be so slight as to be undetectable on any tube tester but be very noticeable when it has the whole voltage of the filament string across it.

—*Ludwig Furth*

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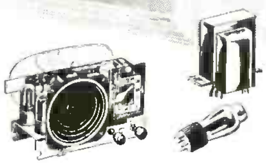

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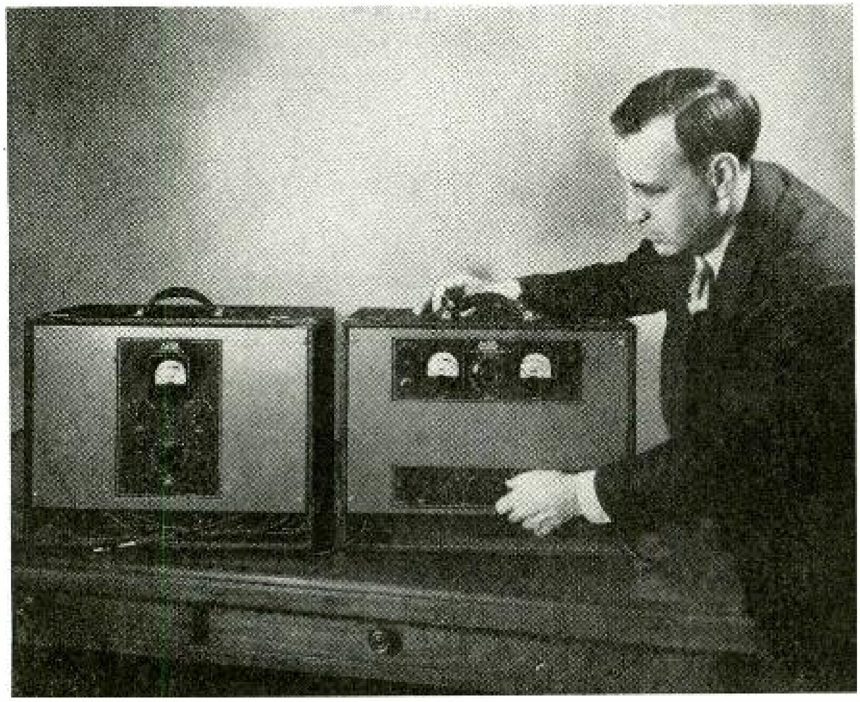

Altec-Lansing's John K. Hilliard adjusts their intermodulation test equipment.

Intermodulation Distortion Tests

How what is possibly the most serious form of audio-frequency distortion is detected and measured.

By CARL N. SHIPMAN*

THERE are three ways of measuring the distortion produced in an audio system. Distortion-factor meters and wave analyzers have been used for some time, but intermodulation analyzers are relatively new. Though no objective measurements have yet been devised that can predict accurately whether or not listeners will like the sound of a particular system (the listeners' ears are, after all, the final criterion), intermodulation tests usually seem to give better clues to hearer acceptance.

Distortion-factor meters are still most common. A single-frequency sine wave is fed into the amplifier and the output is filtered so that the original frequency disappears. The remainder, which consists of any harmonics generated by the amplifier plus whatever noise is present, is measured. The fundamental output is also measured and the harmonics are then figured as a percentage of the fundamental. For good-quality systems 5% is often satisfactory, but nowadays high-precision professional equipment has only 2% or even less.

The wave analyzer works on the same principle; but instead of measuring all harmonics at once, it filters and measures only one at a time, usually by beating an oscillator with the harmonic to be measured and passing the resultant beat frequency through a very selective filter. The advantage here is that the highly selective filter narrows the bandwidth measured so much that most of the noise is excluded. It also tells just which harmonics are most prominent, giving a clue to the fault, if any, in the system.

The trouble with harmonic measurement is that only distortion in the low-frequency half of the spectrum can be measured; if the fundamental is above the mid-frequency point, all the harmonics fall outside the audio band the equipment covers.

The intermodulation method of measuring distortion is based on the fact that the worst offense to the ears is committed when two or more different frequencies being amplified simultaneously interact due to some nonlinearity in the amplifier. While pure harmonic distortion of a single tone merely creates additional frequencies which are exact multiples of the fundamental, interaction between two or more tones produces sum and difference frequencies which may be totally unrelated harmonically to the originals. The effect is a good deal worse than when some members of a musical ensemble play off pitch or wrong notes, destroying the harmonies or chords. Intermodulation measurements, therefore, usually approximate more closely the subjective reactions of a listener and are generally more useful than simple measurements of spurious harmonics.

The intermodulation method employs two tones: one of low frequency—between about 50 and 200 cycles, and one of considerably higher frequency—anywhere from about 1,000 cycles up. Both tones are fed to an amplifier, and an analyzer connected to the output measures the interaction between them.

The signal generator

Fig. 1 is a block diagram of a typical intermodulation signal generator. The two oscillators produce sine waves, 60 and 2,000 cycles in this example. (The 60-cycle signal may be provided by the a.c. power line instead of an oscillator.) The two tones are combined in a network carefully designed for minimum distortion.

The resultant wave is shown in Fig. 1. It is a 2,000-cycle sine wave, with a 60-cycle sine wave as its axis of symmetry. As a more or less standard condition (though no genuine standards have yet been set) the voltage amplitude of the 60-cycle wave is four times that of the 2,000-cycle wave (12 db greater). With this relationship, the intermodulation distortion percentage is usually roughly four times as high as a straight harmonic distortion measurement would be on the same equipment. The exact ratio varies with the cause of distortion.

The output waveform of Fig. 1 illustrates what happens whenever two or more frequencies are combined—the

* University of Hollywood

..this letter speaks for itself!

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lower ones act as axes for the upper ones, a single composite wave being formed. The shape, amplitude, and position of any portion of the wavetrain about the main a.c. axis depend on the original frequencies, amplitudes, and phase relations. To produce undistorted sound output, the composite wavetrain must reach the loudspeaker in exactly the same condition it assumes at the amplifier input. (The exception is that the ear will tolerate a rather large amount of phase change.)

As the composite generator output goes through the amplifier being tested, the low-frequency signal causes relatively large positive and negative grid-voltage excursions at each stage. If every tube operates on a linear portion of its transfer characteristic up to the maximum grid-voltage excursions in each direction, no distortion takes place. But if—as is always the case, since nothing is perfect—a nonlinear region is encountered during the swing in one or both directions, those alternations of the 2,000-cycle superimposed signal which occur while the tube is nonlinear will be either greater or smaller in amplitude than when the tube is operating linearly.

Typical distortion

As an example, suppose one stage in the amplifier is a resistance-coupled 6J5 with a 50,000-ohm plate load resistor, a 50,000-ohm following grid resistor, and 1,000-ohm cathode-bias resistor. Plate supply voltage is 300. According to the resistance-coupled am-

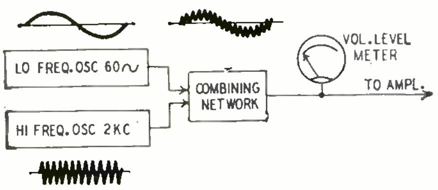

Fig. 1—The intermodulation signal generator combines two basic frequencies.

plifier charts in the RCA tube manual, voltage gain is 13 and maximum a.c. output voltage should be 41. Dividing 41 by 13, we find that maximum signal voltage at the grid should be 3.15.

Assume that the 3.15-volt input maximum is exceeded slightly. On positive input peaks the grid begins to draw current, flattening off the output wave to some extent. Each time the 60-cycle signal reaches a positive peak, therefore, the amplification of the tube effectively decreases somewhat and the 2,000-cycle alternations superimposed on the 90-degree point of the low-frequency wave have smaller amplitude.

It is likely, too, that negative 60-cycle excursions now take the tube into a nonlinear region, especially with such a low tube load resistance. At and about the 270-degree point of the low-frequency wave, therefore, given changes in grid voltage produce smaller changes in plate voltage and again amplification decreases. The result is reduced amplitude of the 2,000-cycle alternations superimposed on the 270-degree region of the 60-cycle wave.

The composite wave now appears like A in Fig. 2. Comparing it with its counterpart in Fig. 1, the distortion is apparent in the reduced amplitude of the 2,000-cycle waves at the 60-cycle peaks.

Fig. 2 is a block diagram of an intermodulation analyzer. The amplifier output wave at A is fed first into a high-pass filter which removes the 60-cycle component from the composite signal. This leaves only the 2,000-cycle signal. Since the amplitude of the 2,000-cycle signal is no longer constant (because of the distortion in the amplifier), it appears at the filter output as a modulated wave (shown at B). Its amplitude is normal or maximum at the points which correspond to the 0-, 180-, and 360-degree regions of the filtered-out 60-cycle wave, and less than normal at the 90- and 270-degree points.

The wave at B is exactly like the familiar r.f. modulated wave (except, of course, for the actual frequency, which is 2,000 cycles) and can be detected and measured in the same way.

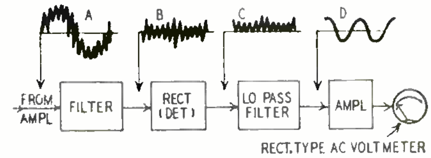

Fig. 2—The analyzer filters the output signal, detects and measures distortion.

It is first rectified (detected) to yield the d.c. wave at C. Then it is fed through a low-pass filter to remove the 2,000-cycle pulsations. The low-frequency modulation envelope remains at D.

Note one important point. The remaining modulation envelope is *not* the original 60-cycle signal. It is the change in amplitude of the 2,000-cycle signal produced by the 6J5 nonlinearities. Since the amplitude was changed twice during each low-frequency cycle (once by the tube's drawing grid current and once by the negative excursion into a nonlinear transfer region), the modulation envelope at D is twice the original low frequency or 120 cycles. If either the negative or positive 6J5 grid excursion alone had caused nonlinearity, that is, a change once per low-frequency cycle, the wave at D would be 60 cycles. Its shape is usually not sine, either, depending on how abruptly the 6J5's characteristic departed from linear.

The wave at D in Fig. 2 is produced solely by amplifier nonlinearity, which affected the relationship between two frequencies. If the amplifier were linear, the 2,000-cycle signal would have remained constant in amplitude as it was originally, and detection of a wave at B would have resulted in pure d.c. Obviously, then, the amplitude of the wave at D is a direct indication of the amount of distortion present. It is measured by an ordinary rectifier-type voltmeter. In some instruments, the circuit is arranged so that the operator can tell whether distortion is greater in the negative or positive direction.

The percentage of intermodulation is equal to the modulation percentage of the "carrier" wave at B. With the analyzer calibrated to present a fixed level to the detector, the meter may be marked directly in percent.

When citing intermodulation figures, the test conditions should be specified. The two frequencies should be given, as well as the amplifier output level. For greatest precision, the amplifier input level and the amplitude relationship of the two frequencies should also be mentioned. Measurements should be made with several sets of frequencies, as the distortion varies somewhat.

An amplifier which has low harmonic distortion ordinarily shows low intermodulation as well. Intermodulation results usually agree more closely with listening tests, however, and give a better indication of performance at high frequencies.

The percentage figure for intermodulation is always higher than that for harmonic distortion, which is why some manufacturers feel it unwise to publish it. A more valid reason is that standards for intermodulation testing have not yet been agreed on, and this may make interpretation difficult.

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Frayne and Wolfe, *Elements of Sound Recording*, John Wiley and Sons, Inc., New York, 1949.

G. W. Read and R. R. Scoville, "An Improved Intermodulation Measuring System," *Journal of the Society of Motion Picture Engineers*, February, 1948.

"Proposed Standards for the Measurement of Distortion in Sound Recording," *Journal of the Society of Motion Picture Engineers*, November, 1948.

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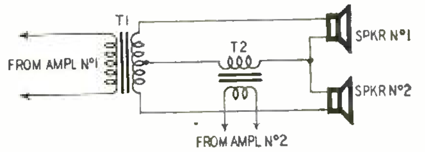

Hybrid connection for two speakers.

and another for paging. In a typical airport installation the speakers common to both amplifiers would be in the waiting room or at the loading gate. Individual speakers for the paging and announcing amplifiers would be located in restrooms, cafeterias, and on the observation deck.

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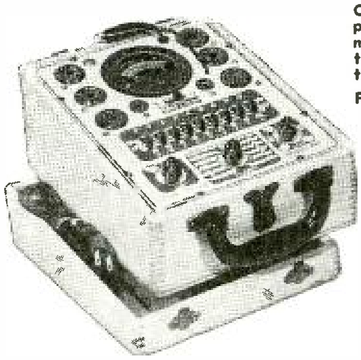

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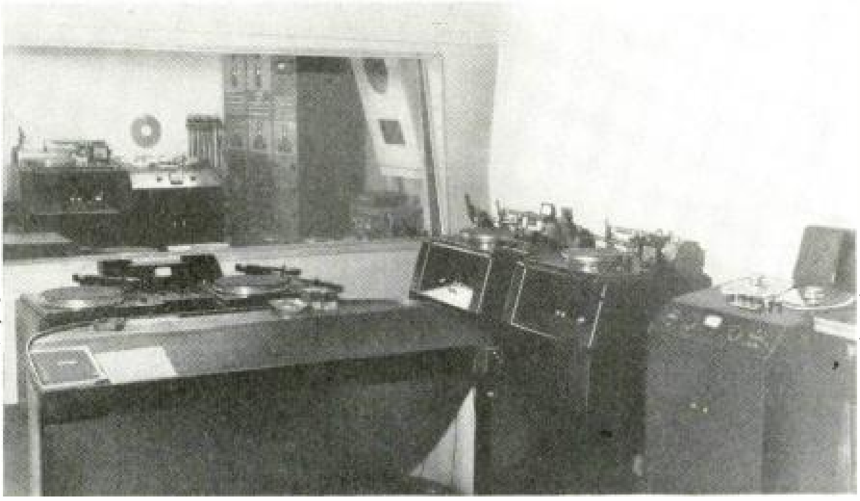

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By
RICHARD H. DORF

LIKE many RADIO-ELECTRONICS readers, I have been greatly interested in amateur sound recording for a long time. When I had an opportunity recently to spend the best part of a day at Reeves Sound Studios in New York, I expected to feel very much like a spectator on an NBC studio tour who appreciates the intricate and efficient setup but finds nothing that is likely to have any real relation to his own work.

That isn't what happened. I saw practices, tricks, and techniques, many of which you or I can duplicate. I then realized that recording can be combined with imagination and ingenuity to produce highly distinctive work, and save time and labor.

As a very simple example, the playback tables used for dubbing are started by a switch on the recorder console permitting one man to do a dub job without having to run back and forth and make long run-in grooves. And even while I was sitting there, one engineer thought of an improvement on that—a spring and solenoid arrangement that eliminates even the second or so delay while the table gets up speed!

Reeves is the largest independent sound recording installation on the Eastern seaboard. Occupying a five-story building, it not only does straight sound recording, but has a big hand in producing sound tracks for motion pictures—television commercials and shorts, government training and information films, almost every conceivable type of movie except regular Hollywood features.

Today over half of the studio's activity is film work, but making discs of all kinds is a very important part of each day's work. The disc recording room (see photos) is a separate entity to which programs are fed from any of the five separate studios in the building. Here are located two tape recorders, four disc recorders, four playback tables, three 6-foot racks full of amplifying, switching, and control equipment, and miscellaneous other devices.

Why tape?

This month's cover is filled mainly with a tape recorder (we'll consider the young lady operator merely as a control device, if you don't mind) and you may wonder what a tape recorder has to do with a disc story. The answer is one reason for the musical perfection of many long-playing records.

No orchestra, quartet, or pianist ever has the good luck to turn in a full 40- or 50-minute performance with every note just the way it ought to be. The first ten minutes may be perfect, but one player may "hit a clinker" in the middle of the 339th bar and the tempo may be off just a shade at the start of the second movement. During a concert-hall performance, these things are quickly forgotten if the work as a whole is good. But a recording will be played back time and time again—and the "clinker" gets worse every time! In the "old days" a bad note during the recording meant doing over again at least one side of a disc, and the work had to be done in segments of no less than about 3 or 4 minutes—the time recorded on one side of a disc.

Then the tape recorder bowed in. The performance is recorded on tape, not on discs. If the conductor doesn't like the way things are going, he stops the orchestra and starts again a couple of bars before the unsatisfactory point. If he isn't sure, he stops and listens to the tape, then makes up his mind. (You can't listen to a disc, then use it as a master for pressing.) Or he may repeat a portion of the music at slightly different tempo, then decide later which is preferable.

The whole performance may be recorded in bits and pieces and not necessarily in the correct sequence. Just as long as all the music gets on the tape somehow and as long as each part has been given a good performance at least once, the job is done. (*Con't on p. 62*)

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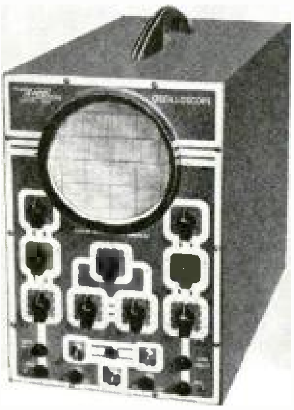

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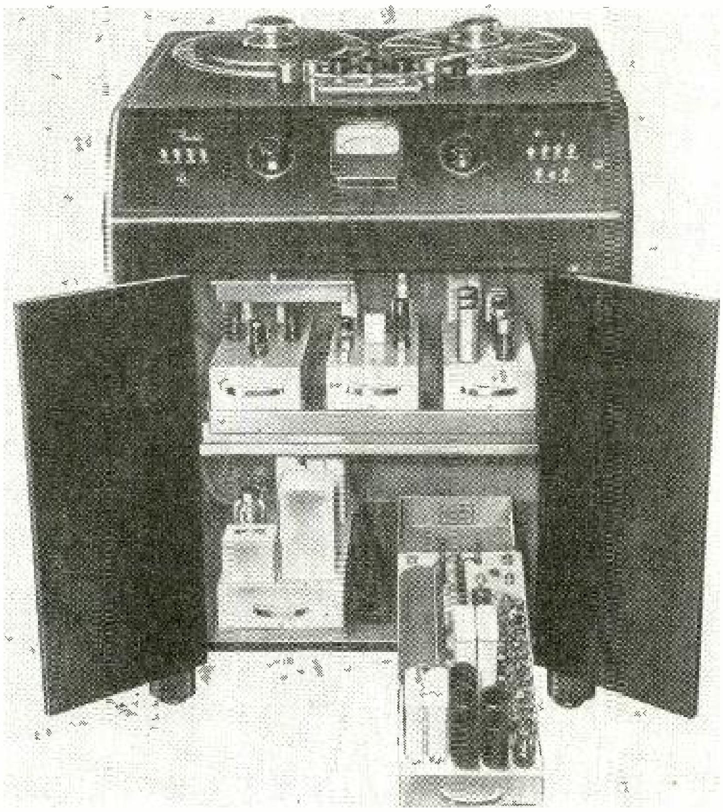


The Fairchild tape recorder produces higher-quality sound than most of the best disc recorders. Amplifiers and relays are housed in the console cabinet. The recorder plays for one hour. Reeves engineers use plastic tape because its thickness is more uniform than that of paper tape. Speed is 30 inches a second.

Then the conductor gets together with the engineers. They listen to the tape with a score in one hand and a pair of scissors in the other. They clip out the best performances of each part of the music—a few bars here, perhaps a single high trumpet note there. Then they splice it all together and throw away the second-rate bits. The result is a complete performance, each note of which is played at its best. The last step is to dub the tape to an LP master. Mercury records are made this way at Reeves and you can hear the result yourself if you happen to own a Mercury LP—one that was made here, not dubbed from European masters. RCA (and probably others) uses tape for its classical master records.

Engineer monitors the cutting of an LP with one hand on pitch control and his eyes on a cue sheet which indicates when the loud and soft passages will appear.

One disadvantage is inherent in LP records—the sound level fed to the cutter must be lower than with standard records to avoid overcutting (having the stylus cut through into adjacent grooves during loud peaks). Another disadvantage common to *all* discs is reduced range between the loudest and softest sounds that can be recorded—for the same reason, even with standard groove spacings.

Bob Fine's invention of the margin control technique has almost completely cured these troubles. It's very close to one of those why-didn't-I-think-of-it-myself ideas. The only time overcutting is a danger is during loud passages, and then only because the adjacent groove is so close.

The answer is to make the next groove not so close! So the control engineer *varies the pitch*—the number of grooves per inch—during the recording, rather than the sound level. In soft passages, the grooves are made very close together to get the maximum playing time. Just before a loud passage, the distance is increased to allow for the greater stylus swing. The total pitch range is from about 320 lines per inch for very soft music to approximately 160 lines for the loudest parts of the music.

The *depth* of the cut also must be varied so that on the loud passages, when the groove swings are wider, the playback stylus will not jump out. The engineer does this with a knob, not by manually adjusting the cutter. The depth control device is still in the developmental stage and details are not available.

The drawings show in a simple way how the pitch of the Fairchild recorder, which Reeves uses, can be varied continuously without changing the lead screw or any pulleys. A flat disc is driven by the motor. Between it and the sleeves fastened rigidly to the right end of the feed screw is a ball bearing which contacts both disc and sleeve. When the disc rotates, the motion is transmitted through the ball to the sleeve, which then rotates axially, carrying the feed screw, which is fixed to the sleeve, with it.

By simple mechanical law. the speed of the feed screw depends on the position of the ball. The direction in which the feed screw rotates depends on whether the ball is to right or left of the center of the disc.

The top-view drawing shows how the position of the ball is controlled. The ball is enclosed in a metal frame (without top or bottom, of course). The frame is moved right and left by a knob, taking the ball with it. A vertical metal plate under the knob is calibrated in lines per inch with separate scales at right and left for outside-in and inside-out.

Interestingly, this scheme was devised long before microgroove records were on the market. It just happened to be adaptable to making LP's, the only change necessary being the addition of calibration marks on the metal plate. The possible pitch variation is from 80 to a theoretical infinity. Actual records have been made at pitches as high as 500 lines.

The volume of work at the studios surprised me. The recording room is in business approximately 90 hours a week making discs for Mercury and other independent companies; radio commercials (including jingles, of course); sound effects for radio programs; frequency test records; and programs for the Department of State and other independent producers.

One of the most interesting and unusual discs was made on special order for an ingenious householder who wanted a burglar alarm. The burglar's entrance turns on a record player which sends the sound of a barking dog to a loudspeaker, then generates a subaudible tone which operates a relay to turn on the lights.

Many recorded slide lectures are made, with an 8-kc tone on the disc to trigger the slide projector automatically at the proper places.

A three-speed dub

Children like stories with elves or fairies, and Golden records try to satisfy them. But the tiny elfin voice is too high for any human to produce. Here's how Reeves did it.

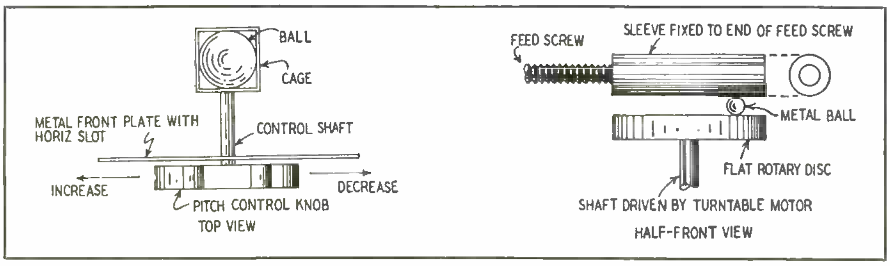
The orchestra was recorded at 78 r.p.m. It was played back at 33 1/3 r.p.m. and the voice sang with the playback. This combination was fed to a recorder at 33 1/3 r.p.m. When the result was played back at 78 onto the final master, the orchestra was returned to its original pitch, but the voice pitch was very much higher—and sounded just like the elf the children want. In another, similar record, *two* elfin voices were wanted, and their pitches had to be different so they could be told apart. That was done by using 33 1/3 for one voice and 45 r.p.m. for the other.

At the moment, Reeves is the only studio other than RCA making 45-r.p.m. masters. To get the new speed, they change the power-supply frequency from 60 to 81.008 cycles and set the Fairchild recording table to the 33 1/3-r.p.m. position. The new frequency is generated by a Hewlett-Packard a.f. oscillator and stepped up by a high-power audio amplifier with 845's in the output stage.

Just about all the recording equipment in use at Reeves is made by Fairchild. The tape recorders are in console cabinets with amplifying equipment inside. Some of it can be seen in the cover photo and more in the picture on these pages. Pushbuttons and signal lights give quick and easy control, essential for accurate recording of tricky material. Response is flat within 1 db from 50 to 15,000 cycles.

While I was at the studio, the engineers made an LP disc master from a tape of piano music. The record was an instructional one, designed to show how the piano developed, and several early and modern pianos and harpsichords were recorded on it. The last selection was played by Edith Weiss-Mann, world-famous harpsichordist, on four different instruments, one quarter of the piece on each instrument. Then the four strips of tape were spliced together and played back. The change of instruments took place, not in musical pauses, but right in the middle of the selection—when the music was going fast. But so perfect was the cutting and splicing job that there was not the slightest falter in tempo when the instruments changed. If Bob Fine, Reeves' chief engineer and inventor of most of the special techniques and gadgets, had not given me his word that it was a splice job, I would have been absolutely sure that four different players had made the recording at the same time.

The Fairchild disc recorders have a frequency response of ±2 db to 8 kc, but they are cut off at around 6 kc when making LP's. Fine says the usual playback stylus simply will not track anything higher than that, especially toward the inner diameter of a fine-groove disc, and he can see no reason why higher frequencies should be put on the record at all. According to him, "psychological" wide range is much more important than what the meter says. If the recording is made in a suitably reverberant studio or hall, if the microphone placements are correct, if there is little harmonic or intermodulation distortion and record noise, the ear thinks the recording is beautiful.



How pitch is varied continuously in the Fairchild disc recorder. Precision ball couples rotary disc driven by motor to feed screw sleeve. Position of ball determines pitch and direction. The knob and cage move ball to the right or left.

Even outside the studio, with portable equipment, standards must be kept high.

Recording For Profit

by FRANK E. FLEMING

RECORDING studios today are in the position photographic studios found themselves when the camera first became practical in the hands of the layman. With the advent of successful home recorders, recording studios are competing with amateurs. Does that mean recording will be confined to a half-hearted sideline in the hands of radio stores? We think not. It does mean that recording studios, like photographic studios, must be able to turn out a better job than the amateur. Some recording studios are doing a professional job; many more could, following certain principles of operation.

As we see it, three requisites are demanded: service, a good-looking product, and a good-sounding product.

The word "service" covers the entire job. It refers to the friendly approach, the effort to put the client at ease, care in musical balance, care in adjustment of the recorder, care in making the record, and a frank warning of the limitations of acetate recordings. These are important ingredients of a successful recording business.

We make a practice, when arranging recording appointments, to advise the client that the job will take considerably longer than actual cutting time of the record: we ask him to time his material carefully. If, as sometimes happens, the recording runs overtime and must be stopped before completion, the onus is on the customer.

We also find out what type of machine the record will be played on. If it is to be used on an old-fashioned acoustic machine with heavy tone arm (there are still considerable numbers in use),

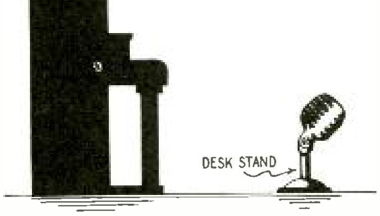


Fig. 1—Microphone on the floor is best for picking up certain kinds of pianos.

we frankly advise against making a record. Only dissatisfaction will result from playing an acetate disc on such a machine, and the customer will feel cheated. Oddly enough, most such people if forewarned, will find a friend with a modern record player, and will make the record anyway. Whatever the outcome, we have kept our reputation intact.

We have already warned our client that the job will take more time than the actual cutting; so we do not have to worry about taking up his time. On the contrary, he is usually pleased at the importance we place on making his record. The extra time is consumed mainly in achieving a correct microphone placement. In speech recording the matter is comparatively simple; in vocal or instrumental work the job can become complicated.

Microphone placement

Even the balance between a single voice and piano requires care, and experimenting with microphone position will pay off. To some extent, balance is a matter of personal preference, but it depends also on the type of voice. Fairly heavy accompaniment can often cover vocal flaws without actually obscuring the voice. It is not advisable to ask either vocalist or pianist to perform more loudly or more softly than they do normally. The more comfortably the artists can perform, the better the results.

This rule does not necessarily apply to piano solos, where the damper ("loud") pedal should be used more sparingly than in ordinary circumstances. If the player finds the "pedal habit" hard to break, however, it is not wise to press the point. In a piano solo, microphone placement can make a tremendous difference to the results. We have found that, in many rooms improperly treated acoustically, a microphone on a desk stand, placed on the floor as in Fig. 1, gives best results. In any case, only experimentation will determine best placement.

Vocal quartets can be exasperating. If voices blend and balance properly to begin with, a microphone placed a few feet in front of them will usually do the job. If some voices predominate, special mike positioning will be necessary. Having achieved correct balance, you may find it disappears in the next line of the song. Nothing can be done, because the singers themselves cannot keep their voices balanced. If critical remarks are passed when the record is played back, it is well to point out the spots where balance is o.k., and indicate diplomatically that the fault lies, not in the recording, but in the quartet.

Obtaining correct balance on an orchestra is often more difficult, but worth the taking of infinitely greater pains. If each member of the orchestra can hear his own instrument on the finished record, chances are he will have a duplicate made for himself. If recording from a band-shell, with little opportunity for rearranging instruments, a great deal of ingenuity may be required to effect a good balance. A highly directional microphone will help.

Most dance bands may be divided into three sections: rhythm, brass, and wood winds. In the rhythm section the average band will have piano, drums, and string bass; in the brass section, several trumpets and a trombone; in the wood-wind section, perhaps three saxes, some players doubling on clarinet. The usual arrangement finds the brass at the back of the stand, with wood winds in the front line. The rhythm section is often subject to wide variations in position, and usually presents the greatest pickup problem. One reason is that the instruments differ widely in the amount of sound each produces: piano, medium to loud volume; string bass, low volume; and drums, high volume.

As a start, the microphone may be placed in front of the band, probably toward the end where the piano is located, and facing more or less laterally across the front of the orchestra as in Fig. 2-a. The string bass may be required to move closer to the mike; but if the bass player is moved too far from the piano, you are looking for trouble, because he depends on the piano, which sets and sustains tempo for the entire band.

No hard or fast rules on the subject

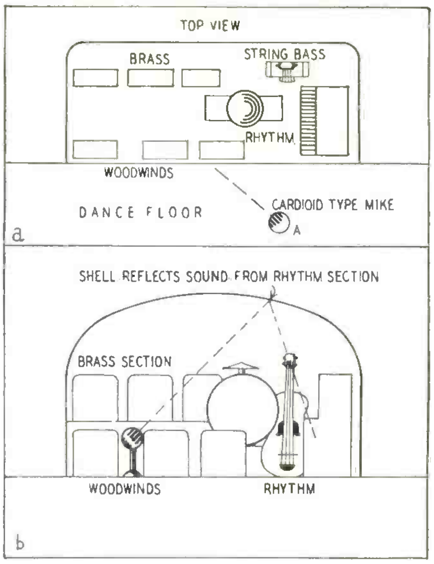


Fig.2-a—Cardioid microphone facing orchestra at angle sometimes does best job. Fig. 2-b—Microphone in woodwind section picks up other instruments by reflection.

can be laid down; each band and each hall presents its own peculiar problems. But *do not* let the band leader dictate the microphone placement. One once gave us a very questioning look when we placed a cardioid mike right between two men in the front line and faced it to the ceiling as in Fig. 2-b. The pickup must have been satisfactory, because everybody in the band bought a copy of the completed record!

We are assuming a one-mike pickup in the foregoing discussions; we are not in favor of multimike pickups. They tend to destroy the illusion of perspective or depth, besides presenting

(Continued on page 68)

a greater problem in maintaining balance and levels.

Making the record

Having obtained what to us is correct balance, we make a test cut on a separate disc. The test is long enough to make sure the recorder is properly adjusted: correct angle and depth of cut, thread throwing properly, etc. We use a sapphire cutting stylus: anyone cutting records professionally cannot afford to use anything less. Sapphires are less expensive in the long run and give lower surface noise and higher fidelity.

Selection of recording blanks is important. Of the numerous makes on the market now, many are excellent. On the other hand, some would be expensive if you got them free! A hard spot in the coating can ruin a sapphire stylus. Moreover, the type of coating determines whether the record will have a long or short playing life. Our own sad experiences with various brands makes us shy away from those which produce a "gooey" thread—the kind that rolls up into a soggy mass. The playing life of such discs is short; they lack brilliance, may produce "echo", and become noisy rapidly.

Having made the test cut, we play it back to our clients. If the balance suits them, we go ahead; if not, we change the microphone placement, and make a further test cut to check the new balance.

In the actual making of the record, control of volume is more important than is sometimes realized. Wide dynamic range (variation in loudness which contributes to musical expression) is desirable from a standpoint of realism, but must be sacrificed to some extent so quiet passages are not lost in needle scratch. A properly cut acetate recording is practically noiseless when new, but successive playings usually add more surface noise than to a commercial pressing. By compressing the dynamic range—increasing volume of soft passages and decreasing volume of loud passages—you can add many playings to the useable life of the record. But it requires considerable skill in handling the volume control. The main trick to be acquired is *anticipating* volume peaks, and reducing gain just *before* the peaks occur. This not only makes for unnoticeable volume changes, but also preserves the *illusion* of greater dynamic range. The method is illustrated in Fig. 3.

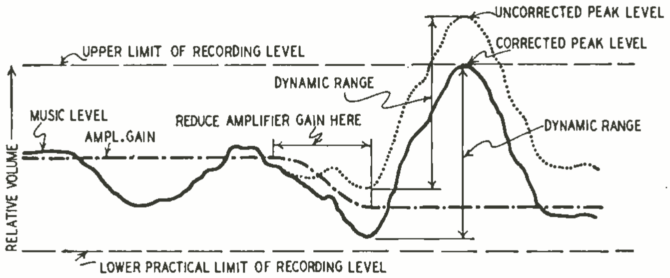


Fig. 3—Reducing amplifier gain before peaks instead of on them preserves the difference between maximum and minimum levels and the original dynamic range.

We make a standard practice of cutting "flat" and playing back the same way. Then we play the record (or part of it) back again with tone compensation set to *bass* (really attenuating the treble), explaining that is the quality most record players deliver. Many people prefer it to the "harsh" reality of flat reproduction. We tone-control the *first* playback on a certain type of singer whose voice has a natural "harmonic distortion" in it. This distortion, coupled with even a slight amount of harmonic distortion in the recorder, is not pleasing—though quite realistic. In this case, a reduction in the treble response will make the client much more pleased with the results.

After the playback is the time to ask if your client wishes duplicates. Explain that duplicates are best made before the record has had many playings. Be prepared to cut the duplicates then and there, if at all possible. We have found duplicates will often turn a little job into a well paying one. Quality of the original record is, of course, the thing that sells "dubs." And if you have a top-quality playback unit, you can make duplicates that cannot be told from the original by the average listener.

The final step is an important one: neatly typing the title onto your *own* printed label, and sticking it on with rubber cement. It's your advertising—so don't use the standard label supplied on the record blank. Our own label appears on all our records.

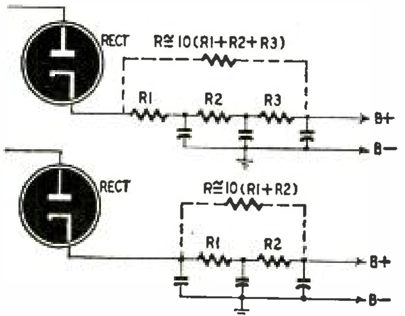
When we had our labels made up, we purposely omitted any dotted lines such as "*Title*......," "*Date*........," etc., which gives the label a "filled-in" appearance. The top half is devoted to the printed name of the studio; the bottom half is left blank, for typing in the details—title of selection, artist, and so on. As we cut all personal recordings outside-in, no special instructions are necessary. (Outside-in cutting gives the record a more professional quality, as it duplicates standard pressings.)

Finally we provide with each record a mimeographed sheet of suggestions outlining proper care and handling. At one corner we affix a "shadowgraphed" playback needle. The instruction sheet proves valuable in forestalling trouble: if a record is damaged by a customer, he can't say he hasn't been warned!

If our repeat recording business is any criterion, striving for perfection pays off!

HUM REDUCTION

Hum can be reduced at the output of R-C filters simply by connecting a resistor R between the rectifier cathode and the output of the filter, as shown in the diagrams. R should equal approximately 10 times the total resistance in the filter.



When R-C filters are used in B-supplies, the ripple voltage across the output capacitor is out of phase with the ripple voltage at the cathode of the rectifier. Resistor R delivers to the output capacitor ripple voltage which bucks out some of the ripple which passes through the filter. The combination of ripple voltages being less than the ripple voltage without R, the hum level is reduced.

A variable resistor may be used to find the best value for R. Adjust it to the point of least hum, measure it with an ohmmeter and replace with a fixed resistor.—*Leon Medler*

$1,200.00 PRIZE CONTEST
RADIO-ELECTRONICS IN THE HOME

Midnight of June 1, **Eastern Standard Time marks the closing of the third month's *Radio-Electronics in the Home* contest. Entries for the June contest must be postmarked before this date. *The closing date for the May contest is midnight, May 1.***

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Prizes will be awarded in accordance with novelty, general importance of the application or device, smallness of cost involved in building it, and practicability.

Any ideas may be submitted. Highest prizes will be awarded to contestants who have actually built the device and submit photographs to prove it. Lesser prizes will be given for "ideas" and entries not accompanied by photographs.

For complete details and rules of the contest see page 35 of RADIO-ELECTRONICS for March.

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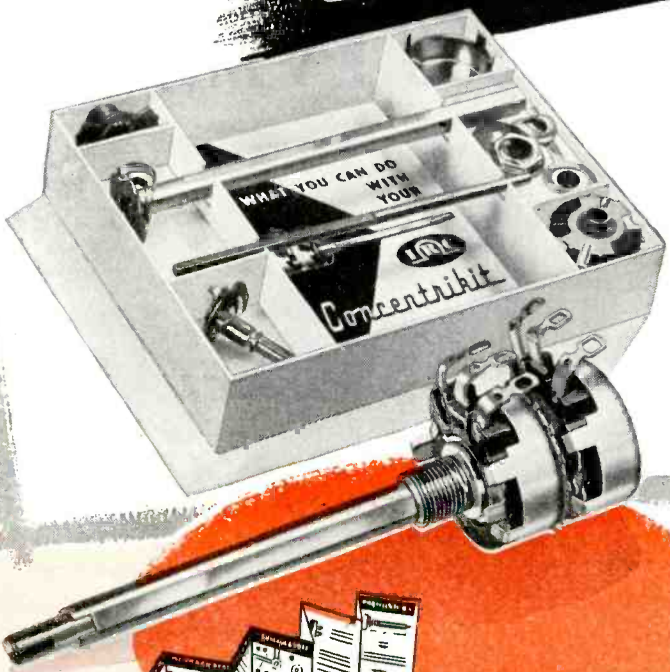

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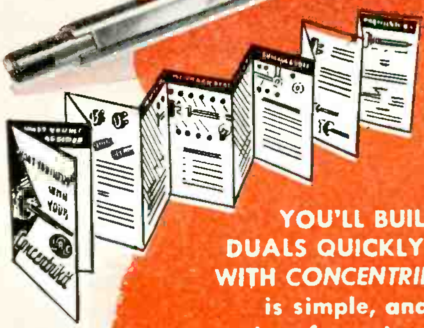

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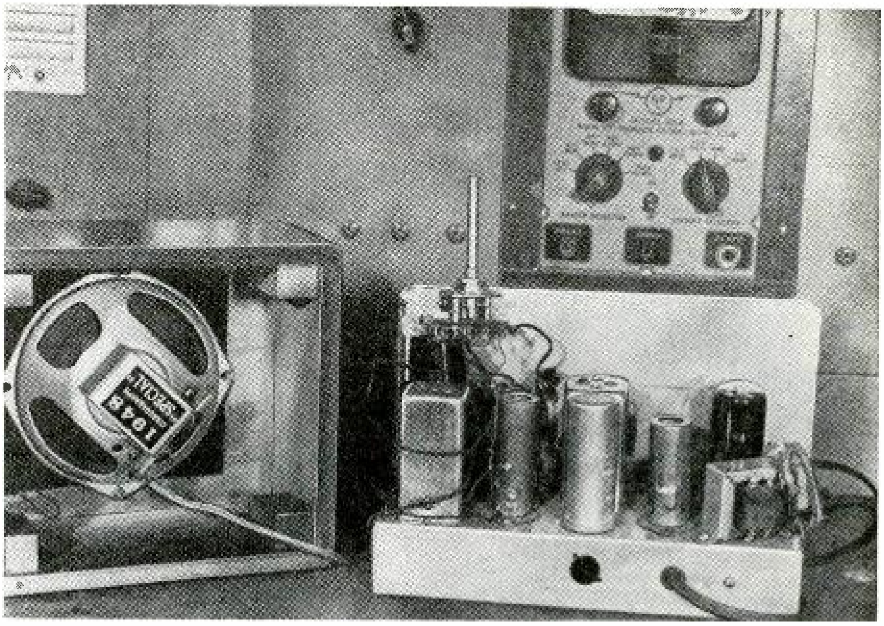


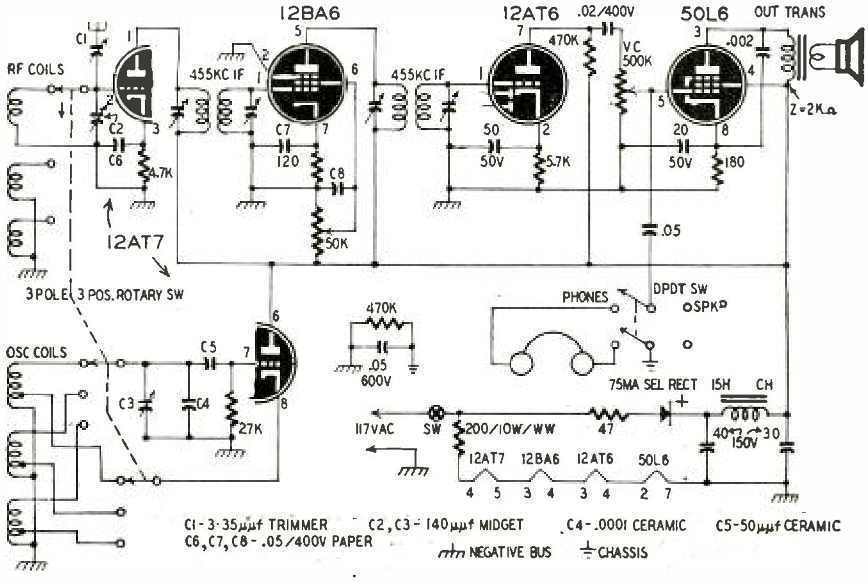
This 4-tube receiver has high performance. Note feedback loop around i.f. can.

A High Performance Short-wave Midget

By HOMER L. DAVIDSON

THIS little 4-tube shortwave receiver has the performance of a six-tube superhet. The mixer and oscillator tube is a high-frequency 12AT7 duo-triode. Half of the triode is used as a mixer connecting through a mica trimmer capacitor to the antenna, and is cathode-biased. The other half is an oscillator tube with a cathode-tapped oscillator coil. This tube is mounted on top of the chassis on its side (at the right end of the chassis, between panel and i.f. can, with its tip pointing outward) to make connections to the coil short.

The coils are wound with No. 28 enameled wire, as shown in the table, on 1-inch bakelite or fiber tubing 4



Schematic. Note that C2 and C3 are connected to negative bus, not to chassis.

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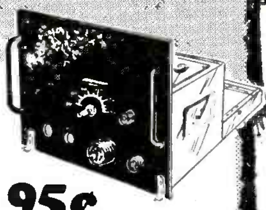

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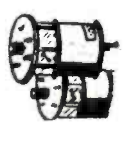

The ideal way of indicating the position of Rotary beams, wind indicator, etc. Line cord and instructions for 110 AC operation furnished on request.

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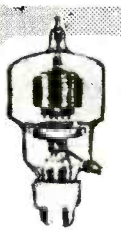

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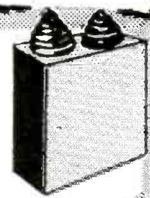

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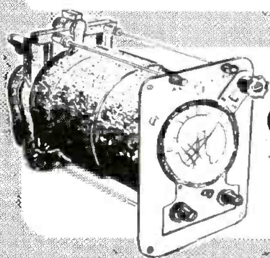

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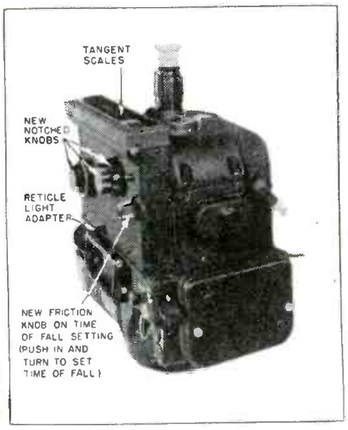

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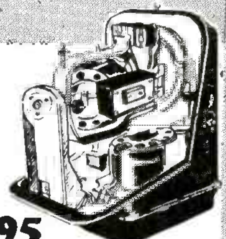


A-5 Automatic pilot Mfd. by A. C. Spark Plug under license of Sperry Gyroscope Co., Inc.

$9.95

HERSHEL RADIO CO.

DEPT. RE. 4

5249 GRAND RIVER
DETROIT 8, MICHIGAN

Write for Free Catalogue

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

A HIGH PERFORMANCE SHORT WAVE MIDGET

(Continued from page 72)

inches long. The three oscillator coils are wound on one tube, and the r.f. coils are wound on the other. These tapped coils are soldered directly to the three-pole, three-position switch before mounting. The coils are wound to ½-inch, except the 80-meter r.f. coil which extends to 1 inch.

To get the coils to cover the bands completely, it may be necessary to add a few turns or to spread or close the turns of wire on the oscillator coils. These coils are vertically mounted between the horizontal 12AT7 and first i.f. can.

The 455-kc intermediate-frequency stage uses a 12BA6 amplifier tube with cathode bias. In this circuit, feedback is used to increase sensitivity. Surprising results are obtained by connecting a wire to the grid of the 12BA6 and wrapping it around the first i.f. can. There are many ways of getting feedback, but this method seemed to fit this receiver best. On 20 meters, the gain is most notable—twice that of the signal without feedback. Only two turns of insulated wire are needed around the first i.f. can to increase the gain tremendously. The 20-meter hams burst through from Maine, California, and the Florida coast at loud speaker volume.

An r.f. gain control is placed in the screen circuit of the 12BA6 i.f. stage. This control is a 100,000-ohm carbon potentiometer to vary the screen voltage on the 12BA6. The gain control works best in this receiver at about three-quarters maximum setting.

The second detector is a cathode-biased 12AT6 miniature audio tube. This tube seems to function best with a 5,700-ohm cathode resistor and a 50-µf, 50-volt electrolytic capacitor in the cathode circuit. Higher values may be tried. The two i.f.'s are identical input type 455 kc i.f. transformers.

A 500,000-ohm volume control varies the audio signal to the 50L6-GT power amplifier tube. It also can be switched to a pair of headphones as well. A d.p.d.t. switch is mounted on the front panel for this purpose. Believe it or not, but the volume must be lowered on all three bands when using the PM speaker. The volume control is almost in the off position when using headphones.

Coil Data Table

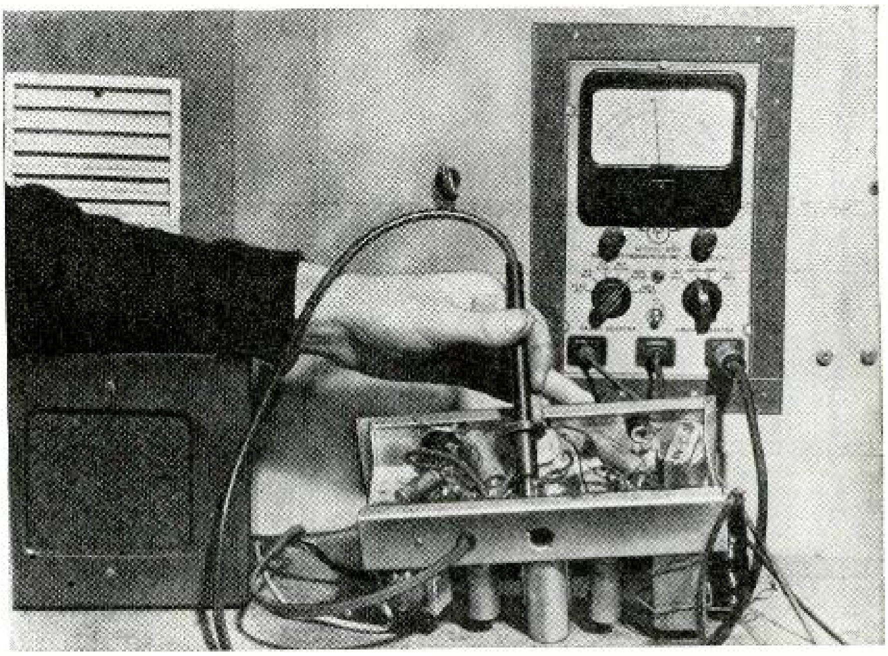
Band	80	40	20
Ant. coil (turns)	27	15	6
Osc. coil (turns)	11	7	4
Cathode tap (turns)	5	3	2

All coils wound on 1-inch tubing.

A 75-ma selenium rectifier is employed, with a standard filter system. With speaker operation, the 60-cycle a.c. hum is nil and on headphone operation can be heard only on the 20-meter band.

All the miniature tubes are wired in an a.c.-d.c. circuit and are in series. The 50L6-GT filament is at ground potential. It has been noted that the 12AT7 lights up brightly at first, but no ill effects have resulted as yet.

The chassis layout is shown in the photographs. Both chassis and panel are aluminum. The front panel was painted with two coats of crackle-finish paint, gray and green. You will notice



The set has adequate power to drive the 5-inch speaker shown on the left.

ESSE

RC-213 ANTENNA EQUIPMENT

This antenna was made to operate in the spectrum of 100-156 Mc. by use of three sets of diapoles furnished (4 diapoles per set). The antenna is continuously rotatable with 18' mast, mounted on ball bearing cones. Has bearing indicator, sense antenna, tuning unit for matching, handwheel for rotating, and coaxial connector to connect to your RG-8/U trasmission line. All rustproof brass and aluminum components except cones and bearings. This unit originally packed in 6 boxes. Shipping wgt. approx. 600 lbs. Close out price—$89.50

BC-406 RECEIVER. New, with tubes . . . **$17.50 ea.**

25¢ TUBES 25¢

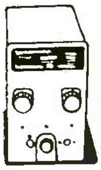
The following tubes are an overstock and are being sold at the ridiculous price of 25¢ to move. All are new JAN tubes, fully guaranteed.
1629, 1625, 12A6, 9003, 955, VT67—Ceramic base type 30.—Choice **25¢**

CR TUBES. NEW, GUARANTEED

5CP1	$3.50
5FP7	2.50
3BP1	3.25

STANDARD MAKE MODEL H 25 watt RHEOSTAT, 150 ohm . . . 35¢ each

$1.75 MARKER BEACON RECEIVERS $1.75



We have a pile of these to move and need space. They were used on aircraft from the 24 V. power supply to provide indication of cone, fan, and approach markers on 75 Mc. modulated at 3000, 1300, 400 cycles. Reception of any of these modulated frequencies to operate 1 of 3 signal lamps connected to the output of the receiver. I have seen many interesting things done with these such as opening and closing garage doors from the car, controlled models, etc. These units sold as removed surplus aircraft. Size overall 3½" x 5¼" x 5½". Price . . . $1.75

★ ★ ★ ★

BC-1033 Same as above but more sensitive type. Has 1 more tube . . . $2.75 ea.

HI-VOLTAGE INDUSTRIAL CONDENSERS

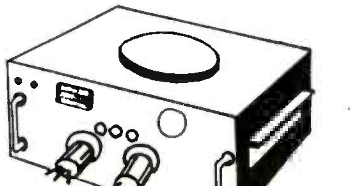
.25 mfd. 20,000 V., Manufactured by G. E. Pyranol, Standard Make, Cornel-Dubilier or Solar. Size on Cornel-Dubilier 8" wide x 4" thick x 17" overall height, 6" insulator. Others vary slightly. These condensers ideal for PF correction on HV transmission lines or in industry. All brand new and guaranteed first quality. At a fraction of original cost . . . $7.45 ea.

$1.75 TU-10-B TUNING UNIT $1.75

Brand new in metal case. Here is a value you cannot afford to pass. Stan said to move them, we need the warehouse space. It contains three HV variable condensers as follows: 1—27 plate 20—120 mmfd., 1—16 plate 15—60 mmfd. and 1—7 plate 7—30 mmfd.; 3—2500 Volt. 0004 mfd. micas; 3—RF chokes; 1—9 turn inductance and 1—7 turn inductance on 2" ceramic form spaced 5 turns per inch. Vernier tuners, knobs, chart frame, etc. Can you pass it at . . . $1.75 ea.

TYPE A-15 OXYGEN MASK

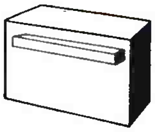
New in original box. Use in aircraft, paint spraying or give the kids . . . **70¢ ea.**
D-2 Oxygen bottle with regulator for attachment to above mask. Used, but like new. Shipped less oxygen due to I.C.C. regulations. The complete outfit ideal for aviators, or to set you back on your feet after a hard night out. Price, D-2 bottle **$4.50** Complete bottle & Mask—**$5.00**



BC-1158-A MODULATOR & TRANSMITTER

Boys, here's one of the nicest pieces of equipment I have ever seen. In fact, we have not had to advertise them before due to the amount of store sales we have had; however, we are trying to move old merchandise for a lot of new coming in. This unit the hams find easy to convert for a super mobile 10-meter rig. It is crystal controlled, uses 4-815's, 10-12SN7's, all included, has motor fan for cooling, and tuning meter for alignment. If you don't know the unit, don't inquire as the small quantity I have will be exhausted before I could answer . . . $19.50

12 VOLT AIRCRAFT BATTERY—NEW— $8.95



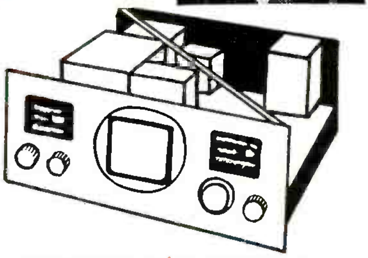
Here is the ideal power source for your surplus equipment. These batteries are new dry-charged—add 1.260 SPG acid and they are ready to go. Rated 12 V. 34 A.H. In metal case with cover to protect other equipment from corrosion. Size, 10¼" wide x 10" high x 5½" deep. Price, New . . . $8.95

METERS—BRAND NEW 3" ROUND—$1.00 each

Hoyt Model 531/L 0-600 DC ammeter. Used, external shunt not furnished . . . $1.00
Hoyt Model 531/L 0-30 amp Ammeter. Internal shunt . . . 2.00
Hoyt Model 531/L 0-40 V. Voltmeter . . . 2.00
Westinghouse-type NT-35 RF Ammeter, 0-5 amps . . . 3.50

723/AB CAVITY OSCILLATOR TUBE OR REFLEX VELOCITY MODULATED TUBE

Used in the local oscillator of radar sets. Operates at 9400 Mc. Shepard-Pierce W.E. mechanical tuning type . . . $12.50



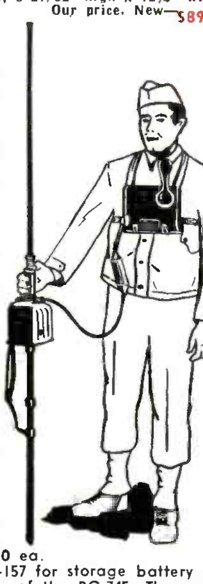
CONTROL UNIT BC-1268-A

Ideal foundation for building yourself a CR scope or TV set. Contains the 5CP1 CR tube with socket and shield. 3—2.5, 2.5, 5 mfd. 600 WV condensers and 1—.2 mfd. 5000 V. condenser, 24 tube sockets. Numerous pots, including 7½" precision, and variable condenser and gear mechanism, etc. These units new with tubes except CR tube removed. $12.50 ea.

RADIO SET SCR-619

The radio set SCR-619 is a low power, 18 tube, crystal controlled, FM voice set consisting of a single unit receiver-transmitter BC-1335, Battery Charger, PE-219, and additional components. The set is designed for portable field operations from a 6, 12 or 24 V. source or self-contained storage battery. Operated in the range of 27 to 38.9 Mc. The average distance range is 5 miles but is greater under favorable conditions. Power output of transmitter 1½ watts. The unit comes complete, brand new, in original packing with above units and batteries, ready to operate less crystals and antenna. We can supply some crystals for $1.00 additional per crystal. These units have been finding favorable use with forestry, police and industrial. For portable or pack, use with other existing 30-40 Mc. FM equipment. Weight of BC-1335, 23 lbs. Size of BC-1335, 6-21/32" high x 12¼" wide x 13-9/32" deep. Our price, New—$89.50

RADIO SET SCR-511



This set is a low powered, portable, AM Radio telephone, transmitter and receiver. Powered by dry or storage batteries. Operates in the frequency range of 2-6 Mc. Operating range is about 5 miles or more under favorable conditions. The set comes complete with new BC-745 transmitter and receiver and new T-39 chest unit only. Add batteries and tuning unit and you are ready to operate. We can supply only a limited amount of BC-746 tuning units in channels 3(3995 Kc.), 4(4845 Kc.), 5(5500 Kc.), 13(5305 Kc.) only, at a $3.50 each additional price. Weight of BC-745 and T-39 approximately 13 lbs. Price New $17.50 ea.
Power supply unit PE-157 for storage battery and loudspeaker operation of the BC-745. These units have self-contained BB54 battery and charging unit. The unit is new; however, speaker is removed and sold as is. Price, complete with battery . . . $6.96

AUCTION SALE! AUCTION SALE! AUCTION SALE!

THE TIME: Saturday, May 13, 1950, starting at 10 AM 'til everything is sold if it takes until midnight.
WHERE: Esse Radio Company, 42 West South Street, Indianapolis, Indiana.
Esse Radio Company will sell, at public auction, new and used surplus and currently manufactured radio electronic gear at your prices. This is a gigantic undertaking. Thousands and thousands of dollars' worth of merchandise will be sold. We invite you to come to this sale and promise it will be of tremendous interest.
Martin P. Maddux, well-known auctioneer, will be in charge of this sale. Terms of the sale are cash. Come early to register. We are going to sell some or all of every item in our store during this sale. We especially want other dealers, who are interested in buying quantity, to attend this sale as well as individuals buying for their own use.
Although this sale, to be held May 13, 1950, will perhaps be the largest auction sale that Esse will hold, Esse will continue to have auction sales the 2nd Saturday of each month; so, if you can't come to our first sale, attend others.
Consign your surplus gear to Esse Radio Company for this sale. Esse will sell your equipment for a 15% commission. If you have anything that is connected with radio such as transmitters, receivers, tubes, test equipment, power supplies, condensers, speakers, amplifiers, modulators, dynamotors, etc., regardless of make, send it, or them, to Esse, transportation charges prepaid, and Esse will sell your merchandise for you on this sale. Your equipment should bring highest prices. Individuals, factories, radio clubs, other dealers, just anybody, send your equipment in to Esse for this tremendous sale. You will be placing your gear in the hands of experts for this sale but with the understanding that the consignment of material is final and without recourse as to the prices that it will bring. Everything sold on the sale goes to the highest bidder regardless of what the bid amounts to; however, we believe that the return that you receive for your gear will be fair. Help make this sale a bigger success. Send in your gear and what-not to Esse (all transportation charges must be prepaid). Within five days after the sale, Esse will send you a check for whatever your gear brings, except for a 15% commission that Esse will charge you for handling. Act today! You must hurry to get your equipment to Esse in time for the sale (you don't need to correspond or contact Esse. Just send the gear in.) If you cannot get your equipment to Esse for this first sale, send it in anyway for the auction sale June 10, 1950. Remember, Esse will hold an auction sale the 2nd Saturday in every month and will accept consignment of merchandise for any sale.

ESSE RADIO COMPANY, 42 West South Street, Indianapolis, Indiana

ESSE RADIO CO., 40 W. SOUTH ST., INDIANAPOLIS, INDIANA

that the front panel is ½-inch longer than the subchassis so the flange will cover the metal mounting cabinet. The 5-inch pin-cushion speaker is mounted separately. Also note in the rear-view photo that the band switch protrudes through the top panel of the metal cabinet. A large slow-motion dial is placed on the oscillator tuning capacitor shaft and small knobs are used on other controls. The phone jack is mounted at the bottom right-hand corner.

In wiring the receiver, all wires should be short as possible. At first, the chassis was used as common ground but results were not too good. It is better to use a common bus bar or wire running from socket to socket. This reduces distributed capacitance as well as hum in the audio sections. Be sure to twist all wires around the prongs tightly and solder them securely with rosin-core solder.

After all parts are mounted and wired, the first thing to do is to peak the i.f. cans. If you have a signal generator, set it to 455 k.c. and use a .05-μf paper condenser to couple the signal to grid prong No. 2 of the 12AT7. Remove the r.f. coil and insert a 100,000-ohm resistor in its place and then align both i.f. units. These coils are set at the factory so very little alignment is usually required. Be sure to go over both i.f. units, peaking them several times so that the first adjustment does not throw the next one off. The r.f. coil is then soldered back into place.

Turn the r.f. gain control full on and do the same with the volume control. In first testing the receiver, it is best to use the 80-meter coil. All the bands should be checked with various stations for correct frequency.

The oscillator tuning capacitor is tuned to a station and the r.f. tuning capacitor C2 is varied until the signal rolls in. On weak signals, C1 is very useful in tuning. C1 should be set so that the r.f. tuning capacitor C2 has a definite effect on signal strength. If C1 is set too tight, C2 has little influence on the tuning of the r.f. circuit. A happy medium should be sought for all three bands. In hunting for stations, tune slowly with the oscillator capacitor C3, and follow with C2. Background noise will tell you when the two circuits are tracking.

In a small set like this with no r.f. stage, it is no trouble to tune the oscillator and mixer capacitors separately, and eliminating the ganged capacitor also eliminates the tracking problem on the three bands.

Materials for Receiver

Resistors: 1—120, 1—180, 1—4,700, 1—5,700, 1—27,000, 2—470,000 ohms, ½ watt; 1—200 ohm, 10 watts, wire-wound; 1—50,000 ohms, 1—500,000 ohms, potentiometers.
Capacitors: 1—50, 1—100 μμf ceramic; 1—.02 μf, 2—.05 μf, 400 volts, paper; 1—50 μf, 50 volts, electrolytic; 1—40, 30, 20, μf, 150, 150, 50 volts, electrolytic, can type; 1—3 to 35 μμf trimmer; 2—140 μμf midget variable.
Switches: 1—3-pole 3-position, rotary; 1—s.p.s.t. on volume control; 1—d.p.d.t. slide contact.
Transformers: 2—455 k.c. i.f.; 1—output, 2,000 ohm primary, multitap secondary.
Miscellaneous: 1—selenium rectifier, 75 ma; 1—15-henry 75-ma choke; chassis, sockets, speaker, headphones, non-shorting phone jack, hookup wire.

A TUNED TONE CONTROL

The tone controls on most radio receivers are insufficient; they merely permit suppression of the high notes, thus relatively favoring the bass. More effective "compensation circuits" become very complex, sometimes comprising adjustable resistors, capacitors, and inductors all in the same circuit.

Here is a variant that is very simple, yet gives excellent results. It is composed of two fixed-tuned, parallel-resonant circuits, with a variable resistor of 500,000 ohms shunted across each. (See Fig. 1.)

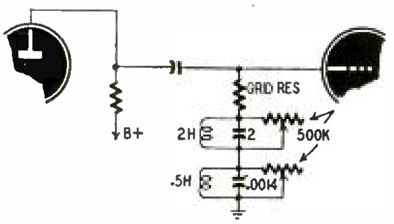


Fig. 1—Tuned circuits provide boost.

The control is placed in series with the grid resistor of the output tube. (If the circuit is push-pull, it may be placed in the grid circuit of the driver or phase-inverter.) The two circuits are tuned to the high and low frequencies at which re-inforcement is required, and their action regulated with the two variable resistors. (With the constants given, the high boost is around 6 kilocycles; the bass boost near 80 cycles.)

With these constants, the resistance in the grid circuit of the output tube appears to rise considerably near 80 and 6,000 cycles, and the signal applied to its grid increases accordingly. Thus these frequencies are amplified more, as indicated in Fig. 2. The frequencies

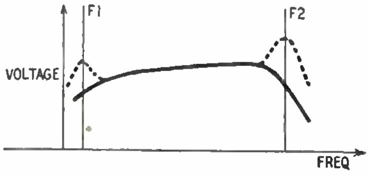
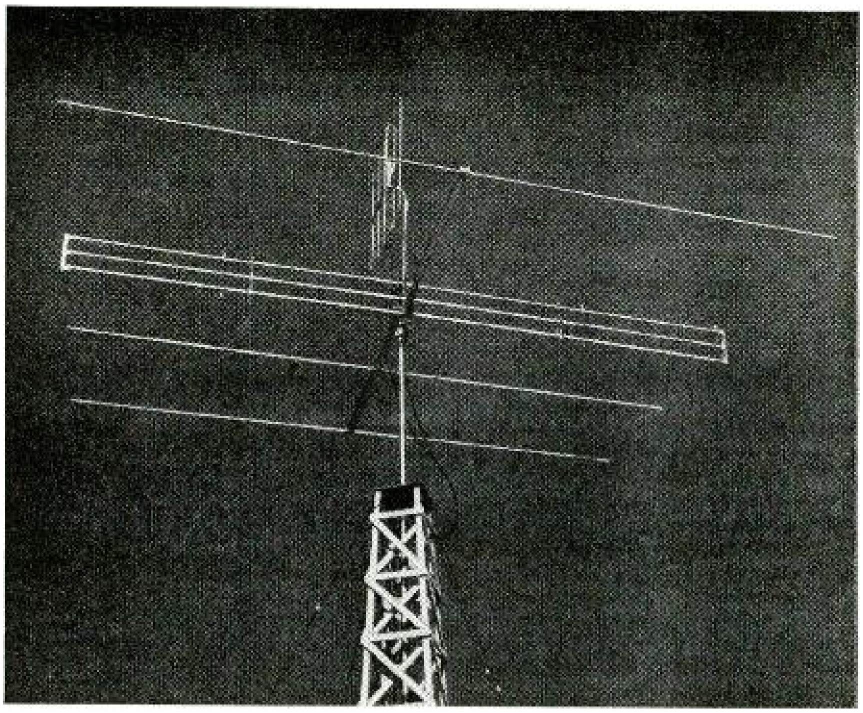


Fig. 2—Dotted curves show boosting.

f1 and f2 can be adjusted to compensate for the deficiencies of any given amplifier by choosing values of inductance and capacitance that resonate in the regions where reinforcement is needed.

The action is, of course, greater as the variable resistors are adjusted to increase the resistance across the tuned circuits, and can be cancelled altogether by reducing the shunting resistance to zero and thus shorting them. The output tube's grid resistor should be kept relatively low—100,000 ohms will probably be found suitable in most cases. If a much smaller value of grid resistance is used, the tone control adjustments may have an undesirable effect on the overall volume of the amplifier.—*P. Hemardinquer*


A view of the completed beam. Note the three conductors in the driven element.

A Beam Antenna to Match 52-Ohm Coax

By LOUIS H. HIPPE, W6APQ

THE greatest possible transfer of energy from transmitter to antenna depends largely upon correct impedance match between the transmission line and antenna. Coaxial transmission line being available as surplus at reasonable prices has created among amateurs a great deal of interest in its possibilities for feeding beam antennas. The most popular of the coaxial cables is that bearing the Army-Navy type number RG-8/U.

RG-8/U coaxial is a medium-size, flexible cable for general-purpose use. The inner conductor consists of several (7/21 AWG) copper wires twisted together and buried in stabilized polyethylene dielectric material having a nominal diameter of 0.285 inch. The dielectric is shielded with copper braid, and the whole is covered with a tough coating of vinylite. The over-all nominal diameter of the finished cable is 0.405 inch. The cable has a nominal capacitance of 29.5 μμf per foot and a maximum operating voltage of 4,000 r.m.s. The rated surge impedance is 52 ohms.

The fact that this particular type of cable is abundant and cheap (about 4 cents a foot), is easily handled, will withstand weather, is flexible (it will wrap around a mast without shorting or breaking), and can be buried is responsible for its popularity. Many people, however, have had difficulty in matching the impedance of the line to the center impedance of beam antennas.

The "delta" has been used, but its adjustment is critical. It is intended more for matching 300- to 600-ohm open-wire transmission lines to the antenna, and considerable time and temper can be consumed in adjustments. If the adjustment is not right on the button, the delta will radiate from the delta yoke.

The "T" match formula is T (inches) = 870/f(mc). The result gives the dimensions of *one section* of the "T" match, from center to one end only. It is based on approximately 6 inches spacing between elements. The "T" is efficient and not too hard to adjust by comparison with the delta. However, inquiries as to dimensions of the "T's" in use have brought a variety of answers.

The arguments pro and con regarding the use of coax aroused our curiosity about an easy method of impedance match *plus* a beam antenna designed so that it could be adapted to the impedance of any transmission line desired, as well as RG-8/U. Research revealed a wealth of helpful and interesting information.

For instance, a four-element, close-spaced beam one full wave above ground with a simple dipole for a driven element has a radiation resistance at its center of approximately 6 ohms. A three-element, close-spaced beam under the same conditions has a radiation resistance of approximately 9 ohms. If we add another conductor to our simple dipole, making it a *folded dipole*, the approximate radiation resistance at center becomes 24 ohms for our four-element beam and 36 ohms for the three-element array.

There is a formula for this change of impedance, radiation resistance = $N^2 \times$ radiation resistance of simple dipole driven element. N = the total number of conductors in the driven element. Thus, if we add two new conductors to the dipole of a four-element beam we get 9 times the original radiation resistance, 54 ohms.

The formula shows that by adding conductors the radiation resistance can be changed to almost any desired useable value. Adjustments are almost unnecessary. This is the easy method of impedance matching between antenna and transmission line. Either antenna wire or tubing can be used for the added driven elements.

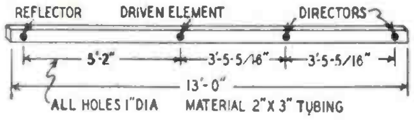


Fig. 1—Boom is made of hard aluminum.

The rest was a problem of versatility so that if it were decided in the future to change the transmission line to one with a different impedance, it could be done without rebuilding the beam antenna from scratch.

Building the beam

When purchasing the beam materials, be sure all parts are of the hard (24ST) aluminum stock to prevent the elements from sagging and blowing about in a high wind or bending under the weight of ice and snow.

The boom was made of 2x3-inch aluminum tubing. The elements are 1 inch outside diameter. The sections which slide onto the driven elements are 1 inch inside diameter. The tubing for the reflector and two directors should be not less than 16½ feet long. The central sections for the driven element are 12-foot lengths, and the end tuning sections are 6-foot lengths.

Since this beam was to have four elements close-spaced (0.1 and 0.15 wave length) and to operate on a frequency of 28.55 mc, the following dimensions were used in spacing the elements: reflector to driven element, 62 inches; driven element to first director, 41⁵⁄₁₆ inches; first director to second director, 41⁵⁄₁₆ inches.

The stock for the boom was laid out and drilled to take the 1-inch elements as in Fig. 1. The reflector and two directors were centered in these holes. A hole for a 10-32 screw was drilled through the top of the boom, through each element, and through the bot-

Italian interest in television is attested by *Televisione Italiana*, a new magazine published in Turin and devoted entirely to technical television subjects.

The first issue carries a story, signed by the editors, discussing the television demonstrations carried on in Turin last October. Two complete transmission systems were set up: one furnished by the French and conforming to the new French 819-line standard; the other installed by General Electric, using a 625-line standard, with typical American circuits. Receivers were scattered about Turin.

tom of the boom. A hole slightly larger than the head of the 10-32 brass screw was redrilled in the top of the boom to allow the bolt head to rest firmly against the top of the element tube. This will prevent the wind from causing excessive vibration of the elements and

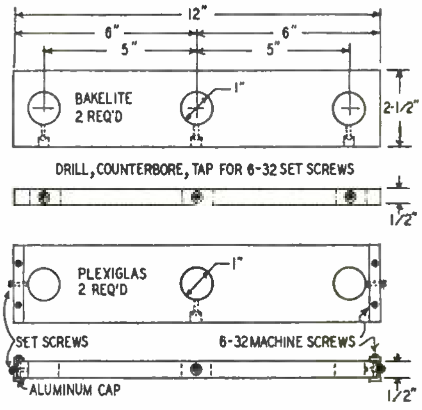
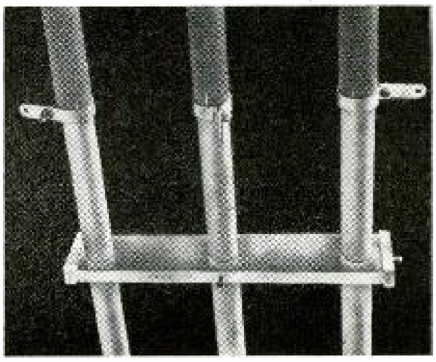


Fig. 2—Spacers for the triconductor.

also prevents sag when the screw is drawn up tight.

Fifty-two ohm coaxial cable for the transmission line necessitated the use of a *three-conductor* folded dipole in order to obtain an impedance match. Therefore two pieces of Plexiglas 12 x 2½ x ⅜ inches and two pieces of Bakelite of the same dimensions were drilled as shown in Fig. 2. The Bakelite, being heavier, was used as the spacing medium at the boom and was securely bolted in place with 10-32 brass screws. The center hole in the Bakelite was carefully aligned with the 1-inch hole drilled in the boom to take the driven element (see photo). Next, the three conductors of the driven element were passed through the holes provided for them and secured with 6-32 setscrews. It is important to note here that the conductor that is to be driven *is not split at this time, but is left intact.* This is to expedite alignment of the three elements so the matching sections on the ends of the triconductor driven section will slide easily without binding.

The Plexiglas spacers are next placed on the three conductors of the driven section. The sliding sections can now be slid over the outer ends of the central triple section. Slide them on at least halfway to give firm support for the end shorting bars (see photo), which



Aluminum caps add strength to spacer.

can now be added to each opposite end of the sliding section. These bars can be shaped to fit snugly on the tube ends. The shorting bar and each of the tube ends are drilled *while in position* to take 8-32 brass screws. C clamps should be used to prevent slippage. Once the shorting bars have been bolted in position and the sliding sections aligned, the unit should be removed and the ends opposite the shorting bars slotted three ways with a hacksaw to a depth of 1 inch. Circular clamps should be placed over the slotted ends and the sliding sections replaced on the triple sections.

The ends of the two directors and the reflector should also be slotted in the same manner and circular clamps placed over them. Inserts about 6 inches long of aluminum tubing of ¾-inch outside diameter are slid into the ends of the two directors and the reflector for tuning. They are held in position with the circular clamps.

The tube that is to be connected to the transmission line is now cut in two and separated by a half inch. Circular clamps placed over these ends serve as connectors for the coax fitting shown in the photo on page 85. This fitting is

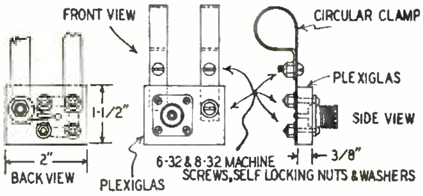
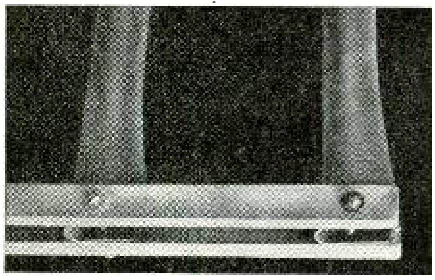


Fig. 3—Dimensions for coax fitting.

easily made from a piece of Plexiglas, a coax connector, and necessary brass screws. Fig. 3 gives all the necessary dimensions.

Tuning the beam

Before the various sections are set to the resonant frequency the parts that fit together by sliding should be *thoroughly cleaned* until they are shiny bright. An efficient way to do this is to purchase two brass wire brushes of the sort commonly used to clean shotguns. One end has a shank threaded to take a ramrod. When these threads are



Detail of shorting bars for the ends.

ground or filed off, the shank fits nicely into the chuck of a ¼-inch hand power drill. With this power-driven wire brush, the inside as well as the outside of the tubes can be cleaned of all aluminum oxide, affording good electrical connections.

The elements can now be adjusted for the frequency upon which you wish to operate. Using the formulas given in handbooks, the element lengths of our own antenna were calculated for a frequency of 28.55 mc. The lengths of the various elements (tip to tip) are as follows: reflector, 17 feet 2¾ inches; driven element, 16 feet 4½ inches; first director, 15 feet 9 inches; second director, 15 feet 1½ inches.

Once the elements have been fastened to the boom and adjusted for length, we can locate the point on the boom at which the antenna will balance perfectly. Mark this point. It is the place to which we will bolt the plate to seat the pipe flange into which the supporting mast will thread.

Measure the diameter of the pipe flange and, adding at least 1 inch on either side, cut a square piece of ⅛-inch 24ST flat stock. Place the center of the flat stock over the balance mark on the boom; drill and bolt the flat piece to the underside of the boom with 10-32 brass or galvanized screws. This will provide a strong, flat base to which the pipe flange can be bolted.

Once the pipe flange has been secured, the beam elements should again be measured and checked. If everything checks perfectly, the sliding section of each of the elements is drilled to take galvanized, self-threading screws. The holes should be slightly smaller than the screws to provide a sharp bite as they cut their own threads. This will insure perfect electrical connections as well as prevent the tuning sections from becoming loose once the beam has been installed where it might be inaccessible. These screws should pass through the circular clamps as well as the elements. If there is any play where the elements pass through the boom, cut small wedges from scrap tubing and carefully tap them firmly into any spaces. It is absolutely imperative there be no scraping parts in the antenna. Metal scraping against metal in any part of the array will cause noisy reception.

Before the antenna is raised to its final position, it should be given an undercoat and a coat of high-grade lacquer. When the lacquer is *thoroughly dried*, the antenna may be raised and installed. While it is in position, four holes should be drilled through the skirt of the pipe flange and through the pipe which screws into it. These holes should be tapped to take brass machine screws. The mast and flange are firmly held together and yet easily disassembled if necessary.

The antenna is now ready for the transmission line to be connected and tests made, as described in any handbook, for standing-wave ratio (see "The Coax Twin Lamp," *QST*, November, 1948). Trim the coaxial line carefully if tests indicate that it is necessary.

For optimum efficiency the lowest permissible height above ground for the antenna is one full wavelength. (See handbooks for the curves on the effect of height.) To tune a beam 6 or 8 feet above ground and then raise it to a height of 32 feet cancels all effort at reaching a point of high forward gain or front-to-back ratio. If it is possible to tune the beam in its working position, the story can be different. However, it should be kept in mind that much time was spent in experiment and tests by engineers with considerably more experience and background on the antenna subject than we are apt to have. The practical formulas were arrived at from observations made for optimum performance at the most efficient height above ground.

These observations conclude that if the antenna can be placed one full wave above ground and fully in the clear away from buildings and trees it is best to build the antenna, calculate the element lengths as per formula, and install the antenna where it will eventually work without further adjustment except on the transmission line.

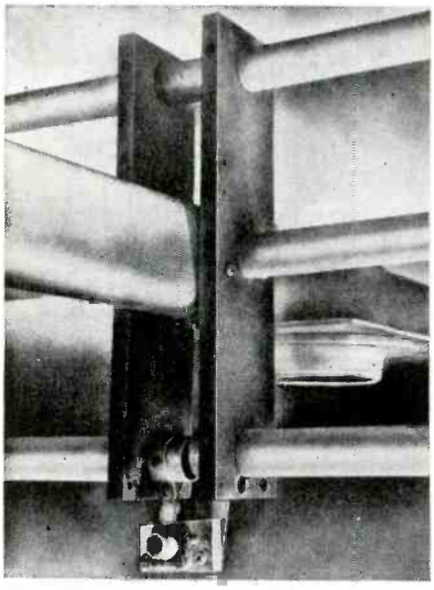
It is interesting to note that according to the available information, a four-element beam one full wave above ground has a radiation angle of approximately 15 degrees. By raising the antenna to a height of two full waves the radiation angle can be lowered to approximately 8 degrees. For most efficient operation in the 10-meter band the angle of radiation should be from 8 to 15 degrees. Approximately 10

BEAM TUNING TABLE

FRE-QUENCY (MC)	REFLECTOR LENGTH	DRIVEN-ELEM. LENGTH	DIRECTOR NO. 1 LENGTH	REFLECTOR TO DRIVEN-ELEM. SPACING	DIRECTOR NO. 1 TO DRIVEN-ELEM. SPACING
28.70	17'2"	16'3"	15'7½"	61½"	41⅜"
28.85	17'¾"	16'2½"	15'7"	61¼"	40 30/32"
28.90	16'11"	16'1¼"	15'6"	61"	40 13/16"
29.15	16'10"	16'⅜"	15'4¾"	60⅝"	40 1/16"
29.30	16'9⅛"	15'11⅛"	15'4"	60⅛"	40 3/32"
29.45	16'8 13/32"	15'10¼"	15'3"	60"	40"
29.60	16'7 13/16"	15'9 19/32"	15'2⅜"	59⅞"	39⅞"
29.70	16'6½"	15'8 17/32"	15'1 7/16"	59"	39⅝"
14.00	35'1¼"	33'4 13/16"	32'1 13/16"	10'6⅜"	7'1"
14.10	34'10 13/16"	33'2"	31'10 13/16"	10'5¾"	6'11"
14.20	34'7¼"	32'11"	31'7¼"	10'4½"	6'10 13/16"
14.30	34'4 13/16"	32'8 13/16"	31'5"	10'3 19/32"	6'9¾"
14.40	34'2 13/32"	32'6"	31'2½"	10'3"	6'9⅝"

degrees is considered best for dx work.

A beam with a multielement driven section[1] is a broadband antenna by comparison with the conventional dipole-driven beam.



Coax line connection to driven element.

In tentative tests with W6MIM and W6HLK, the front-to-back ratio was about 21.6 db.

The Beam Tuning Table gives a list of working frequencies with calculated spacings and element lengths for both 10 and 20 meters. For calculating the length of director No. 2 for a four-element beam, shorten the length given for director No. 1 by 4%. The spacing between the two directors will be the same as that indicated for the space between the driven elment and director No. 1.

(The constructor may find it to his advantage to use zinc-, cadmium-, or nickel-plated steel screws rather than the brass ones used by the author. Strong galvanic corrosion takes place between brass and aluminum when exposed to atmospheric moisture. The result is that the aluminum is eaten away at the junction of the two metals. The beam will become noisy and is likely to fail in a strong wind.

For additional information on the subject, see "Your Beam—Will It Stay Up?," in the October, 1949, issue of *QST*.—*Editor*)

[1]See "Multi-element Radiators in Close Spaced Arrays," *QST*, June, 1947.

SIMPLE KEYING MONITOR

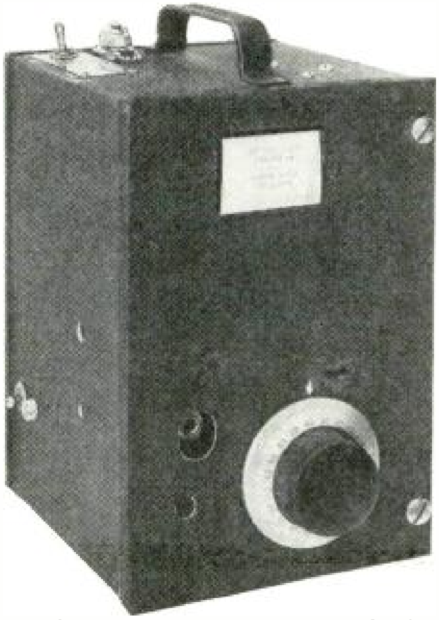
If you use low-impedance phones on your receiver, a low-cost keying monitor can be made by connecting a germanium diode across the phone leads at the receiver. R.f. picked up by the phone leads and circuit wiring in the receiver is rectified and will appear in the phones as hum which is easy to copy.

Connecting the diode across the phones does not affect the volume of received signals.—*Fred Lingel, W2ZGY*

Frequency Control Unit For Citizens Band Tests

"Gold-Plated Special" is a signal source and freqmeter

By I. QUEEN



The double-check frequency control unit.

THE citizens' band is attracting a tremendous amount of attention because it is the only band on which the untrained individual will be permitted to operate without code test, radiophone license, or other test except a probable short examination in traffic rules and the regulations covering his equipment. Thus it will be open to large numbers of persons who would otherwise be unable to use two-way radio.

Designing receivers and transmitters for this u.h.f band is by no means easy. Many technicians and amateurs are attempting to modify Army-Navy surplus units to operate in the 460–470-mc band, so far without real success. The FCC has—correctly—set stiff frequency and stability tolerances for citizens' band operation, and the designer is finding it difficult to stay within the specifications.

The indispensable first step in successful construction or conversion of u.h.f. equipment is a *reliable signal source* and an accurate method for *measuring frequency.* Use of very high harmonics of crystals and v.f.o. units is not practical at such high frequencies. Besides, a crystal is limited to a very narrow range and dozens would be needed fully to cover the band.

This article will be divided into two parts: one will describe the signal source, and the other a method for measuring its frequency.

Signal source

Most readers are aware of the tremendous difficulties awaiting the designer of u.h.f. signal generators. The problem is eased somewhat by using the second (or even third) harmonic of an oscillator. Many technicians now use equipment of this type in television servicing, for example. Such operation is entirely satisfactory and is well justified for work in the citizens' band. Of course building a generator even for 235 mc is a difficult project for the home or small lab.

Fortunately an excellent one is now available for a few dollars on the surplus market—the so-called "gold-plated special," a Navy signal generator putting out a signal in the range 234–258 mc. This is being sold with two type 955 acorn tubes but without batteries. It is housed in a metal box with handle. Its rear compartment has plenty of room for an a.c. power supply.

This portable test set was used by the Navy to align homing adapters and command receivers used aboard Navy planes for picking up homing signals to enable the planes to find their "home" carrier after completing a mission. The homing signal was transmitted in the range between 234–258 mc with amplitude modulation at 710 kc. The homing

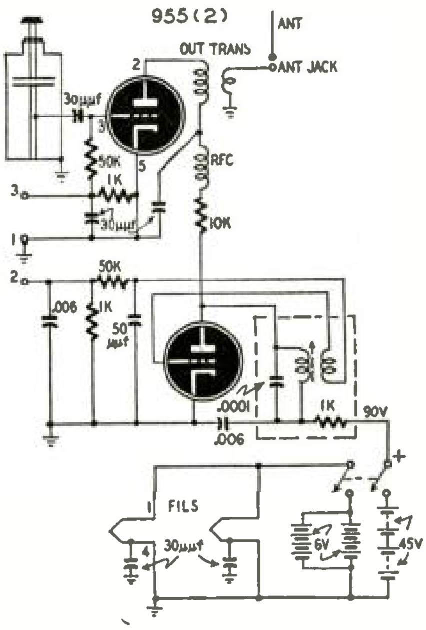
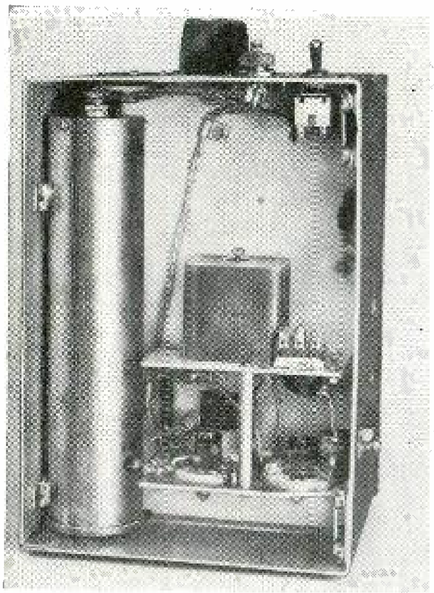


Fig. 1—Schematic of the Navy test set.

adapter picked up the v.h.f., demodulated it and passed the 710-kc signal to the main command set where it was reproduced. The "gold-plated special" is a test oscillator which simulates the actual transmitter and was used to align a group of receivers and their adapters. Obviously the signal is stable, and reliable and has little drift, since the Navy sought and obtained the best instrument possible that could be manufactured. The safety of men, planes, and missions required it.

Possible adjustments

The portable test set has two acorn tubes. (Fig. 1.) One is used in the tuned-grid, tuned-plate v.h.f. circuit. A gold-plated coaxial resonator tunes the grid circuit. The plate is resonated by a small coil without tank capacitor. Because of its very high Q, the resonator largely determines frequency. The plate coil does, however, affect the v.h.f. By compressing it slightly, the lower limit may be reduced so that the second harmonic covers the entire citizens' band. The modulator tube (at the right) may be removed, thus eliminating the modulation. As already mentioned, an a.c. power supply may be built into the rear compartment. No other changes are required or recommended.



High-frequency section, internal view. The gold-plated coaxial resonator is at left and the 710-kc transformer near the center of the case. Below are the two 955 r.f. and a.f. oscillator tubes.

The v.h.f is adjusted by rotating the screw at the top of the coax resonator. This can be done with a special wrench supplied with the instrument. This screw controls a variable capacitor inside the resonator. The tuning is fixed by tightening the locknut.

After the oscillator is tuned and locked in place, we have the equivalent of a "crystal" at v.h.f. The second harmonic signal is stable and can be maintained for long periods with low drift. If an a.c. power supply is to be used, it should be regulated for best results. Of course batteries add greatly to the stability and eliminate radiation through the line.

Frequency measurement

Every signal generator should be checked at intervals by comparing it with a standard, especially at these frequencies. Even if its frequency is known accurately at a given time, possibly a few minutes later the frequency may change for some reason. It is not convenient to compare this oscillator directly with WWV because of its high frequency, but a good frequency meter may be designed for it. Such an instrument may be fixed permanently in the same box as the oscillator and be available at all times for measurements.

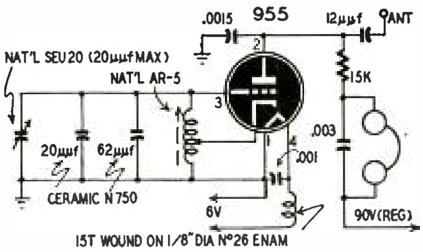


Fig. 2—Frequency meter for the unit.

The standard must be mechanically strong and electrically stable. All parts and the wiring should be rigid to avoid the effects of vibration. High-Q circuits and narrow tuning range are essential.

The calibration unit shown in Fig. 2 uses a single 955 in a Hartley oscillator circuit. The high C stabilizes the oscillator and temperature compensation cuts drift. Tuning range is about 36.7 to 39.2 mc, equivalent to tuning from 440 to 470 mc on the twelfth harmonic. This frequency meter is a combination oscillator-detector. Its fundamental or one of its harmonics may heterodyne a nearby v.h.f. signal (such as from the 230-mc oscillator) and create a beat in the phones. Also, the fundamental may heterodyne a harmonic of some nearby signal (such as from an 80-meter crystal or v.f.o.) to make the audio beat. In any case a beat indicates that a nearby signal has a frequency nearly equal to that of the calibrator, or a multiple of it.

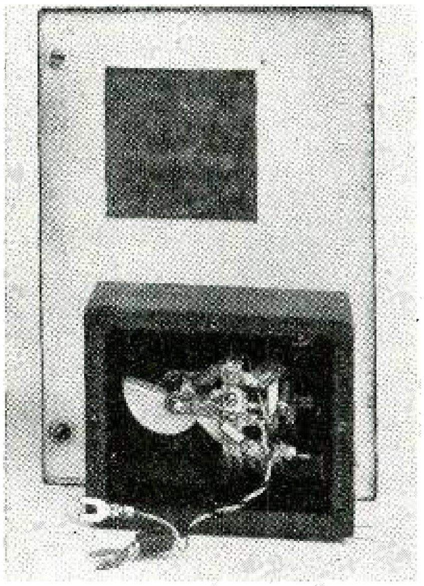
If the frequency of the external signal is known approximately, it can be measured exactly. For example, if the signal is near 230 mc, it is evidently heterodyning against the *sixth* harmonic of the calibrator. Since the calibrator operates near 40 mc, the external signal must be known to less than 20 mc. Unless a major change has been made in the Navy test oscillator its range is about 230–250 mc and no doubt should exist as to the calibrator harmonic which creates the beat. Note that the frequency of the v.h.f. oscillator *increases* as the coax resonator screw is turned counterclockwise (looking down on it). Frequencies near 230 mc are generated when the screw is *down* toward the resonator.

The signal calibrator

The calibrator is housed in a 3 x 4 x 5-inch metal box fixed to the rear cover of the test oscillator with metal spacers. When the cover is closed, the box is screwed down to the base of the portable case. It is necessary to space the rear cover from the calibrator box panel because a velvet vernier dial is used and this cannot be mounted in the usual way.

Essential parts of the calibrator are an acorn tube and socket, a slug-tuned coil, straight-line frequency capacitor, and temperature-compensating capacitors. A type AR-5 (National) coil permits adjusting the frequency range as required. The SLF capacitor was chosen because it has a 270-degree rotation. Actually, a linear frequency variation may be obtained by using semicircular plates but these have only 180-degree rotation. Furthermore it is difficult to obtain a rugged, noiseless unit in the required capacitance range (about 12 μμf minimum to maximum). The SLF capacitor permits allocating nearly 180 degrees of rotation to the citizens' band measurements and leaves room for measuring frequencies down to 440 mc (on the twelfth harmonic, of course). The calibrator frequency chart is shown in Fig. 3. Frequencies between 468–470 mc may be measured to within .01% because of the very wide bandspread. This is the region reserved for class-A stations.

If the v.h.f. oscillator uses the same power supply as the calibrator, no other coupling is required. The beat note will sound rather rough, a convenience because no modulation is required. This is not necessarily a mark of instability. A change of 2 kc out of 230,000 is less than .001%. For the same reason drift will sound very noticeable. However, total drift over a period of 5 hours (but not counting the first 5 minutes) is less than 0.22 mc, about 0.1%. Most of the drift takes place the first 15 minutes or so. In any case the drift is not a serious problem. The v.h.f oscillator is merely a signal source, and we can measure its frequency as often as we wish to determine its exact value.



The low-frequency unit, internal view.

Calibration methods

Calibrating the frequency meter may present a problem. Usually its approximate frequency will be known from the size of the tank circuit. For example, an AR-5 coil tunes to about 38 mc when shunted by about 100 μμf (refer to the manufacturer's chart). If its approximate frequency is still in doubt, proceed as follows:

Keep the calibrator tuning fixed and couple it to a nearby calibrated v.f.o. Tune the v.f.o. for two adjacent beats in the phones of the calibrator (disregard any very weak beats which may be heard). Assume readings of 3.5 and 3.85 mc. Subtract; divide the difference (0.35) into the smaller of the two (3.5). The answer is 10, which gives the harmonic order of the *larger* number (3.85). The calibrator is tuned to 38.5 mc which, of course, is the eleventh harmonic of the *smaller* number (3.5). Knowing the order of harmonic, a number of check points may then be obtained for the calibrator dial. Crystals may be used for highest precision.

The error due to the calibrator itself may be completely eliminated if desired. To do this, tune it to the rough note from the v.h.f. oscillator and simultaneously tune a low-frequency v.f.o. so that one of its harmonics creates a second beat. When the beats are heard simultaneously, the v.h.f. signal can be compared with the low-frequency source with an accuracy of a few parts in a million.

The calibrator unit is not limited to use in the citizens' band. It can measure frequency in any frequency range which is harmonically related to its fundamental. It could be used, for example, to locate and check most of the amateur bands.

The 710-kc modulation is not needed for most measurements. It can be led to a banana jack on the panel and thus be available for experimental measurements, as has been done here. A toggle switch in the filament circuit controls the modulator tube. The tube is switched on only when the low-frequency signal is needed.

With this unit, the experimenter should be able to make excellent frequency measurements on the 460-470 mc band whereas constructing a reliable oscillator for those frequencies might be well-nigh impossible.

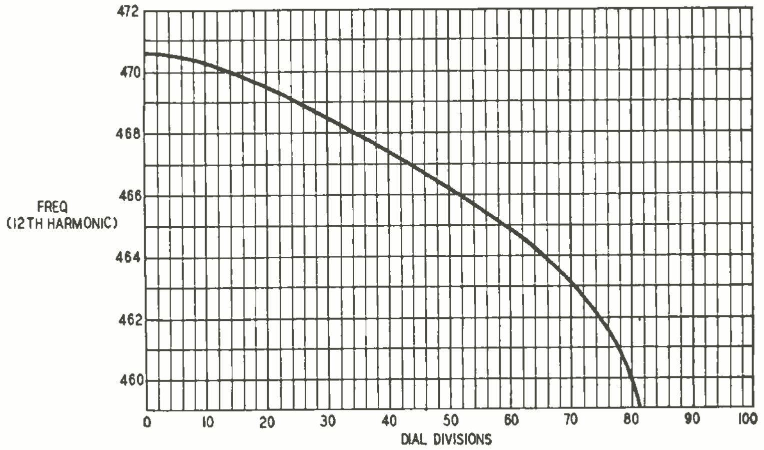


Fig. 3—Frequency chart showing coverage of the instrument. Accuracy at the edges of the band should be good enough to cover class A as well as class B stations.

SIMPLE FILING SYSTEM

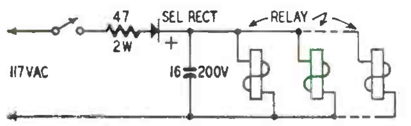
Now that RADIO-ELECTRONICS has departments in its new format, it is easy to take out the articles you want to save and file them for future reference. Remove the staples from each issue so it will be easy to take out the pages. Staple each complete article together and file in an indexed folder. This arrangement saves space and makes it easy to find the information you are looking for.—*N. Schvedman*—

(Why not just file the whole issue, use a card index, and save work? The articles we want to refer to are always the ones we weren't interested in when they appeared, anyway.—*Editor*)

POWERING SURPLUS RELAYS

Surplus high-resistance relays have become fairly common as antenna-changeover relays, and in other low-power applications. However, it is difficult to obtain a suitable d.c. voltage to operate them.

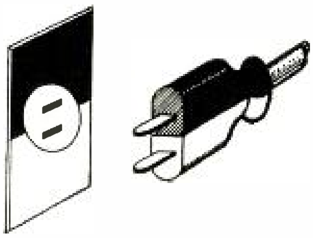
One common type of relay suitable for low-power antenna switching has a resistance of 8,000 to 10,000 ohms and requires a "make" current of about 10 ma. The voltage may be obtained from a simple selenium rectifier circuit. Two advantages of this circuit are that the relay operation is independent of transmitter-receiver voltages, and that no warm-up time is required.



The hook-up is a half-wave rectifier having a single-section capacitor input filter. The relay windings act as both filter choke and load. The voltage developed across the relays is high enough to give good, positive action. No ground troubles are involved since the relay winding and terminals are isolated from each other. Five or six relays may be operated in parallel with a rectifier of suitable current rating before the voltage becomes too low for dependable action. A capacitor of the size shown or larger should be used to avoid any possibilities of chatter.—*Claire E. Shelden, Jr., WØHXN*

POLARIZING LINE CORDS

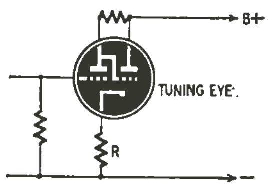
Many a.c.-d.c. receivers and phono amplifiers are wired with one side of the line connected to the chassis. This presents a serious shock hazard when the user touches the chassis or other metal part if the ungrounded side of the line is connected to the chassis. Because most line plugs are not polarized, the user is never certain that the line cord will be plugged in correctly once it has been removed from its receptacle.



To avoid this trouble, plug in the set and turn it on. Take a small 117-volt lamp and connect one side to a radiator, cold water pipe, or outside ground wire; then touch the other lead to the chassis. If the lamp lights, the chassis is hot and the line plug must be reversed. When the correct polarity is found, apply a coat of paint to one half of the plug and to the corresponding half of the receptacle. The set will always be polarized correctly when the plug is inserted so its painted side faces the painted surface on the receptacle.—*Robert P. Balin*

IMPROVING TUNING EYES

To increase the sensitivity of 6E5's and similar electron-ray tuning indicators, insert a resistor R in the cathode circuit of the tube. When a negative voltage is applied to the grid, the triode plate current drops while the target current increases. The increase in target current is much greater than the decrease in plate current so the total cathode current increases. The increase in cathode current through R biases the grid more negative, thus increasing the sensitivity of the tube and making the shadow angle smaller for a given grid voltage.

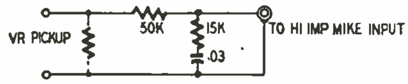


The value of R will probably be between 5,000 and 10,000 ohms, depending on the type of tube. The exact value should be determined by experiment. If R is too large, the tube may oscillate and limit its usefulness as an indicator.—*D. Bosman*

EQUALIZER FOR V-R PICKUPS

It is not necessary to use the 6SC7 preamplifier-equalizer with variable-reluctance pickups when connecting them to conventional public-address amplifiers if you use the simple equalizer circuit shown.

The response with the equalizer is substantially flat. A slight bass boost can be had by replacing the .03-μf capacitor with a .02-μf unit. A slight high-frequency roll-off can be obtained by shunting the pickup with a resistance of 5,000 to 10,000 ohms.

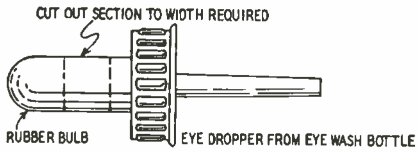


The equalizer components should be placed in a shield can and connected to the amplifier and pickup through low-capacitance, shielded cable.—*T. A. Hildebrand*

REPLACING RUBBER WASHERS

Many of the older receivers use rubber washers in friction-type dial mechanisms. When the rubber rots with age or deteriorates because of oil spilled on it, replacement washers are seldom available.

Being unable to obtain replacement washers for a dial drive, I made them by cutting circles (see drawing) from



the bulb of a medicine dropper of the type which is built into the tops of eye-wash and nose-drop bottles. The rubber used in these droppers is of good quality, has fine grain and is of a convenient size.

If the washers do not fit snugly on the dial shaft, build up the shaft with layers of friction tape before slipping the washer on it. Clean the mechanism with carbon tet to make sure that there is no oily residue to contaminate the rubber.—*J. A. Sabourin*

INDUCTANCE MEASUREMENTS

Multimeters having capacitance scales can be used to measure the inductance of small, low-resistance inductors. Adjust the meter to read capacitance in microfarads, place the inductor between the test leads, then record the meter reading. Measure the d.c. resistance of the inductor. The inductance in henries is found by solving the equation

$$L = \frac{\sqrt{X^2 - R^2}}{377}$$

where X is the 60-cycle reactance of the capacitance indicated on the meter, and R is the d.c. resistance of the inductor. The number 377 is 2π times the frequency of 60 cycles.

For example, assume that a choke has a d.c. resistance of 50 ohms and the meter reads 8 μf. Referring to a capacitive reactance chart, we find that the 60-cycle reactance of an 8-μf capacitor is 340 ohms. Substituting in the equation,

$$L = \frac{\sqrt{340^2 - 50^2}}{377} = \frac{335}{377} = 0.83 \text{ henry.}$$

These calculations were carried out to slide-rule accuracy.—*George McCullough*

TELE DEVICES

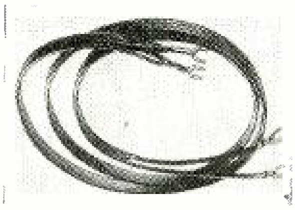
American Phenolic Corporation
Chicago, Illinois

The American Phenolic Corporation announces two items of interest to television technicians and others working with high-frequency antennas.

A low-cost, compact, efficient lightning arrestor, meeting all requirements for indoor and outdoor installation and bearing the Underwriters' Laboratories

stamp of approval is a combination of the gap shunt-resistance types of arrestor. It is easily installed under eaves, on a window sill, or on the wall; it can be used with all types of transmission lines but is primarily designed for use with 300-ohm, flat twin-lead. No stripping is necessary as toothed clamps on the arrestor penetrate the insulation to make contact with the wires in the twin lead.

A new matching transformer, designed to avoid the mismatch and loss of signal which results from use of a folded dipole without matching to 72-ohm coaxial lead, employs Amphenol four-conductor twin-lead specially connected to provide a transformation in impedance from 300-ohms



down to 75. It is particularly useful in matching 300-ohm transmission line to 72- or 75-ohm input television receivers or providing an efficient match between any 300-ohm antenna and a coaxial 75-ohm line such as might be used in an area where the noise level is high.

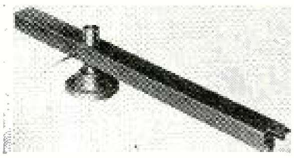
This transformer is a key to the effective application of broadband antennas either to coaxial lead-in or to 72- or 75-ohm receivers. The terminals on the transformer are spade-type lugs at each end of the transformer section, which should be operated fully open or in a very loose coil. Tight coiling is unnecessary.

PICKUP ARM

Pickering & Co.
Oceanside, N. Y.

Features of the Pickering 190 arm include: a low-as-possible vertical-to-lateral moment of inertia; a minimized vertical mass in order to track any record without imposing extra vertical load on grooves so that badly warped records as well as flat ones can be played; absence of spurious arm resonance at any frequency; lower than 3-gram-centimeter pivot friction; rugged and trouble-free bearings; static balancing about the vertical axis to eliminate tendency to jump grooves when subjected to bumping or jarring; an offset head to reduce tracking error to less than ± 2½ degrees; and protection of stylus point.

In addition, the 190 arm includes adjustments for sensitive tracking force, height adjustment for turntables from ½ to 2 inches high, one-hole mounting



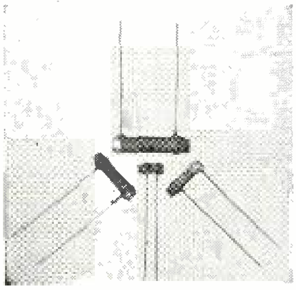
and self-contained leveling screws, plug-in cartridge holder, magnetic arm rest, and a completely visible stylus point for starting and cueing records.

NEW CAPACITORS

Centralab Division
Globe-Union Inc.
Milwaukee, Wisc.

Formerly made in 20 values, the new Centralab BC Hi-Kap capacitors now come in 48 different values and four sizes, with tolerances of 20% from 10 through 2,200 μμf, and guaranteed minimum values from 2,500 through 10,000 μμf.

The BC Hi-Kap capacitors have a low power factor, are designed to withstand high temperatures, and are moisture-proof. The capacitors have No. 22 tinned soft copper wire radial



leads to permit easy, close-coupled connections.

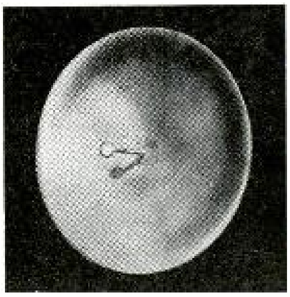
The BC Hi-Kaps are used as replacement capacitors in TV, AM, and FM receivers, and supplant the old-style tubular capacitors in much new equipment.

PARABOLIC ANTENNAS

Workshop Associates
Newton Highlands, Mass.

Five new parabolic antennas to cover the frequency band from 5,925-7,125 mc are now available. These models, together with previously announced models for 940 and 2,000 mc, comprise a complete line of parabolic antennas for commercial frequency allocations.

Each parabola is available in 2-, 4-, 6-, and 8-foot diameters, and mounts are available for all types of installations. The antennas have gains up to 44.9 db, and can be supplied with complete de-icing equipment and junction boxes.



C-R OSCILLOSCOPE

Allen B. Du Mont Labs, Inc.
Clifton, N. J.

The type 250-AH scope employs a DuMont type 5RP-A high-voltage cathode-ray tube. The over-all accelerating potential for this tube, supplied by an external high-voltage power supply, is 13,500 volts. This high potential makes possible the observation and photographing of high-speed signals.

In the type 250-AH, as in the earlier type 250-H, input signals may be applied through an a.c. amplifier, through a d.c. amplifier, or directly to the deflection plates for both X- and Y- axes. The frequency response of the d.c. amplifiers is uniform within 10% to 200,000 cycles, while the response of the a.c. amplifiers is uniform within 10% from 5 to 200,000 cycles.

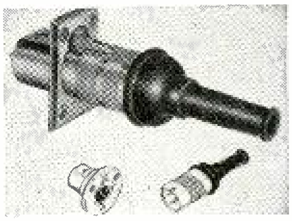
The type 250-A, a low-voltage version of the type 250-AH, is also available. It employs a type 5CP-A cathode-ray tube operated at an over-all accelerating potential of 3,000 volts.

A built-in square-wave voltage calibrator, accurate to within ± 5%, provides outputs of 0.01, 0.1, 1.0, 10, and 100 volts.

AUDIO CONNECTORS

Cannon Electric Co.
Los Angeles, Calif.

The UA series by Cannon Electric consists at present of two plugs and four receptacles, carrying three 15-amp contacts rated at 1,500 volts minimum flashover.



UA plug shells are steel; receptacles zinc. Both are finished in satin chrome. The flattened plug top provides better polarization means than ordinary keyways, having a finger touch design. The safety latchlock device is improved and strengthened; socket contacts are full-floating. All contacts are gold-plated for long life. Cable entry is ½-inch. Insulators are all-purpose Durez; inserts may be removed without screws by pressure on a spring release button. Rubber bushings and cable relief collar protect the connectors from shock and moisture.

PA SPEAKERS

Racon Electric Co.
New York, N. Y.

The COB speakers are designed to cope with the problem of large noisy crowds and to supply a uniform field over a horizontal angle of 120 and

vertical angle of 40 degrees, thus concentrating and beaming the sound for maximum efficiency. Cutoff point is 370 cycles to produce crisp, articulate speech, thus simplifying amplifier requirements considerably.

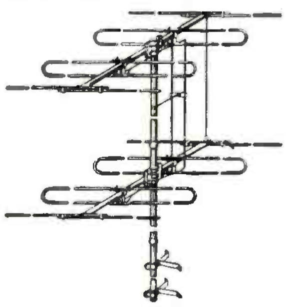
Additional specifications for the COB-2 back-to-back combination: 25 watts operating capacity; 50 watts peak capacity; response 370-6,500 cycles; impedance 15 ohms; sensitivity as bidirectional speaker is 105 db at 4 feet, 1 watt input; sensitivity as single wide-angle speaker is 108 db at 4 feet, 1 watt input.

New Devices

TWIN-DRIVEN YAGI

Technical Appliance Corp.
Sherburne, N. Y.

A new twin-driven Yagi, No. 985—4½, has performance peaks at both channel 4 and channel 5.



With this new design it will now be possible to achieve the gain in the antenna heretofore possible on only one channel. In fringe areas or weak signal locations it will bring in signals and at the same time not require the most height required for comparable signals by other antenna types.

TWO TUBE TESTERS

Sylvania Electric Co.
New York, N. Y.

Features of Sylvania's new testers for portable and bench use include an ohmmeter-type shorts and leakage test, which indicates "Replace" or "Good" directly on the instrument's illuminated meter; direct meter indication for all other tests; an easy-to-operate gas test; and a combined emission and trans conductance test under dynamic

operating conditions, which takes relative tube life into account. Twelve sockets provide for testing four-, five-, six-, seven-, eight-, and nine-pin tubes; octal and lock-in miniatures; subminiature, acorn, and hearing-aid types; mobile and ruggedized tubes; and pilot lamps.

Facilities for unannounced types are included. Control settings are shown on a roller chart which is easily removable from the front panel for adding new tube settings.

RADIO KITS

Meissner Mfg. Division
Maguire Industries Ltd.
Mt. Carmel, Ill.

Meissner announces the addition of five new radio kits to their line (which includes the Signal Shifter kit, broadcast and shortwave kit, and others).

Typical of the kits in this new group is the T8CK, the Meissner FM receptor in easy-to-build kit form. The T4AK is a 20-watt power amplifier kit that can be quickly assembled into a professional looking piece of equipment.

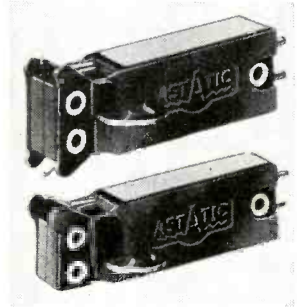
The T2BK 2-tube battery trainer kit and the T3BK a.c.-d.c. trainer kit furnish beginners with instruction and low-cost radio sets. The T6BK 6-tube a.c. superhet kit affords instruction in more advanced receiver design.

IMPROVED PICKUPS

The Astatic Corporation
Conneaut, Ohio

The new units of the AC series have housings of molded Bakelite and metal mounting brackets (which fit standard ½-inch mounting centers) and needle guards. The cartridges use Astatic's special type C Taper-Lock needle, which features ease of changeability without tools.

There are four models in the AC series. Model AC-78 has a 3-mil-radius stylus tip, either precious metal or sapphire, for standard 78 r.p.m. records; model AC, a 1-mil stylus for narrow-groove, slow-speed records; model AC-AG has Astatic's new All-Groove stylus tip, of special design to play 33-1/3, 45, and 78 r.p.m. records; and model ACD is a turnover cartridge with dual needles to play narrow-



groove records on one side and 78 r.p.m. on the other.

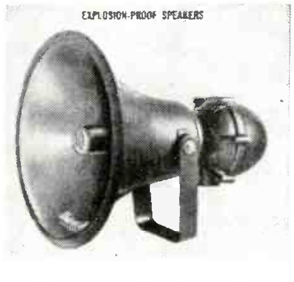
The frequency range of all models is from 50 to 10,000 cycles. Needle pressure of the AC model is 5 grams, while that of the others is 6 grams. Output of all, at approximately 1,000 cycles, is 1 volt, using the Audiotone 78-1 and RCA 12-5-31V test records.

LOUD SPEAKERS

University Loudspeakers Inc.
White Plains, N. Y.

Two complete reflex trumpet speakers with an integral 30-watt driver unit and built-in multitap line matching transformer are announced. Model 7101 is UL approved for class I, groups C and D, which include locations in which flammable, volatile liquids, highly flammable gases, mixtures or other flammable substances are manufactured, used, handled, or stored. Model 7102 is approved for both class I as well as class II, groups E, F, and G, which include those locations in which combustible dust is thrown or suspended in air, producing explosive mixtures, and in places where such dust may collect or settle on motors, lamps, or other electrical devices.

Specifications for both models are as follows: maximum power input, 30 watts; frequency response, 200-10,000 cycles; impedances, 16,500, 1,000, 1,500, 2,000 ohms. The dimensions are: length—19 inches; height—16 inches, and the



mounting is a swivel U bracket with adapter for ½-inch pipe mounting available. Cable entrance is tapped for standard ½-inch conduit, and the net weight is 20½ lbs.

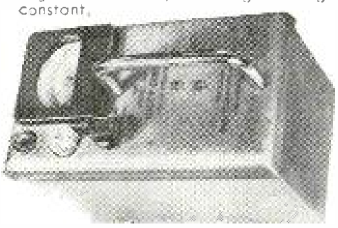
GEIGER COUNTER

Precision Radiation Instruments, Inc.
Los Angeles, Calif.

This instrument has been designed particularly for the prospector.

It detects beta, gamma, cosmic, and X-rays. It includes an earphone as well as a neon flasher and a 3-range meter as indicating means. It is completely tropicalized and weather-proofed. Its 900-volt Geiger tube with a 30-milligram-per-square-centimeter thin window section has a life in excess of 100 million counts. A stainless steel probe is available as optional equipment, although the entire instrument is small enough to be used as a probe.

It has an electronic automatic voltage regulator to keep the high voltage constant.



The specifications are: Size: approximately 3½ x 4 x 6½ inches. Weight: approximately 3½ lbs. Ranges: 20, 2, and 0.2 milliroentgens per hour. Sensitivity: beta and gamma.

8-WATT AMPLIFIER

Minnesota Electronics Corp.
St. Paul, Minn.

This amplifier is an 8-watt unit designed for the inexpensive home installation in which an amplifier is needed for radio, phonograph, and television. Specifications are:

Bass control: Continuously variable. Variation available ± 16 decibels at 40 cycles. Initial boost starts at very low frequencies.

Treble control: Continuously variable. Variation available ± 16 decibels at 10,000 cycles.

Stabilized degenerative feedback: Circuit reduces internal generator impedance to approximately half of speaker impedance.

Output impedances: Selector switch provides choice of 4-8-20-250-500 ohms ganged to simultaneous switching of feedback resistors for optimum performance on each tap.

Inputs: Four-position switch provides radio–78-r.p.m. phono–LP phono–television with automatic equalization inserted for LP and 45-r.p.m. records. Socket provided with power supply for plug-in phono preamplifier.

Frequency response: 20 to beyond 20,000 cycles within 1.5 decibels.

Power output: Conservative rating 8 watts.

Hum level: More than 60 decibels below rated output.

Oscillation: No tendency to oscillate under any load conditions.

Intermodulation distortion: Less than 5% at rated output.

Harmonic distortion: Less than 2% at rated output.

Tubes: 2-6L6, 1-5U4G, 1-6SN7 (dual), 1-12AX7 (dual).

TEST EQUIPMENT

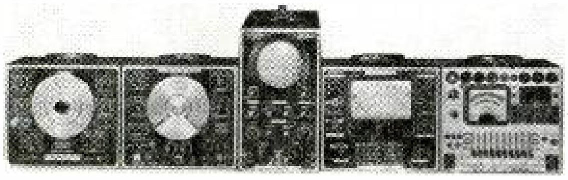
Precision Apparatus Co., Inc.
Elmhurst, N. Y.

A complete basic AM-FM-TV testing and service laboratory, consisting of a set of five matched instruments, is announced.

This combination comprises the complete working facilities for a service technician and is available in various models and styles to suit individual applications in shop or field uses.

It also permits servicemen to round out incompletely equipped labs with additional units which will match the ones they already own.

The equipment consists of: marker-signal generator, sweep signal generator, cathode-ray oscillograph, v.t.v.m.-megohmmeter, and tube tester.

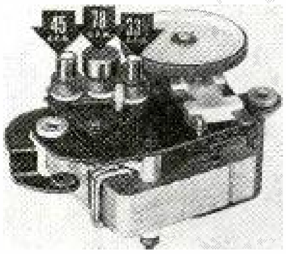


PHONO MOTOR

General Industries Co.
Elmyria, Ohio

This turret-type phonomotor for use in three-speed record changers has turntable speeds of 33⅓, 45, and 78 r.p.m., secured through three separate pulleys mounted on a turret plate. With a simple lever, the desired pulley is brought into contact with the idler wheel.

The entire mechanism is powered with a dynamically balanced two-pole,



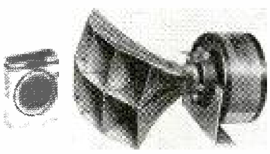
shaded-pole motor. Symmetrical electrical and mechanical design results in minimum stray field and maximum performance for physical size.

HY-SON TWEETER

Stephens Manufacturing Corp.
Culver City, Calif.

The Hy-Son high-frequency reproducer is designed for the 3,500-20,000 cycle range. Specifications are:

Power input above 3,500 c.p.s., 20 watts from program material, 5 watts steady tone. Reproducing range 3,500-20,000 cycles, flat ± 3db to 15,000 c.p.s. Impedance, 16 ohms. Voice coil diameter 1 inch, motor mass 350 milligrams. Weight, unit, and crossover combined, 5½ lbs. Size, driver only, 3½ inches diameter by 2½ inches deep, with 2 x 4, 40° x 80° high frequency horn attached, 7 inches deep overall.



TAPE RECORDER

Berlant Associates
Los Angeles, Calif.

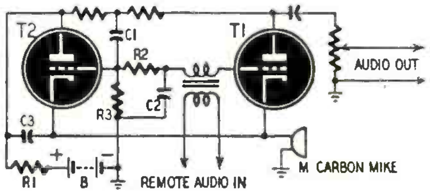
The Concertone is a high-fidelity magnetic tape recorder designed for custom installation in studios, schools, homes, and industrial plants.

The basic recorder No. 401 complies with NAB standards. Among its features are instantaneous monitoring from the tape while recording, separate heads for high-frequency erase, record and playback, forward and reverse high-speed rewind, three dynamically balanced motors, record level indicator, instantaneous choice of 7.5- or 15-inch-per-second tape speed, independent azimuth adjustment for each head, and either standard 7-inch or NAB 10½-inch reels. It is quickly convertible to either a console or portable unit.

VOLUME COMPRESSOR

Patent No. 2,492,707
John C. O'Brien, Rochester, N. Y.
(Assigned to Gen. Railway Signal Co.)

This communication system has facilities for 2 microphone inputs. One is volume-controlled for use by trainmen in noisy locations. Different speech levels give practically constant output. Loud speech reduces the background noise because of the volume limiter. The second microphone input is not controlled.



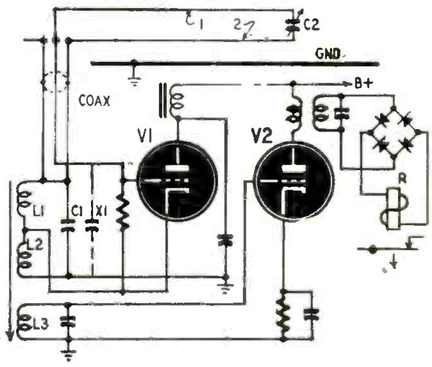
The controlled microphone of the carbon-button type is connected in the cathode circuit of two tubes. T1 is the amplifier and T2 is the control tube. With loud speech input, a high a.f. voltage is fed from the T1 plate to the T2 grid. This is rectified by the grid and appears across R3 as added negative bias on both tubes; therefore, total cathode current is reduced. This cuts the button current and consequently the sensitivity of the microphone so that the output tends to remain constant regardless of speech level.

R2-C2 filters the audio to prevent feedback to the grid of T1. R1-C3 keeps a.f. out of the common B-supply.

AUTOMATIC RAILWAY SIGNALING

Patent No. 2,492,388
Paul N. Martin, Penn Township, Pa.
(Assigned to Union Switch & Signal Co.)

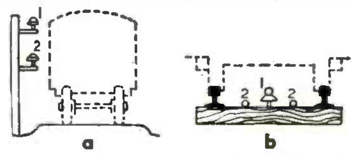
This circuit has special importance in detecting the presence of railway cars on a stretch of track. Other methods often depend upon current flow through rails, but when rails are seldom used, their resistance is apt to become very high. In this case the capacitance of a car operates the circuit.



Car capacitance operates the circuit.

V1 is a low-frequency Hartley oscillator with tank circuit L1, L2, and C1. The upper end of L1 is connected to the grid through C2. Insulated lines 1 and 2 may be suspended alongside the rails as in (a) or they may be in the form of additional rails as in (b). In either case the capacitance between line 1 and ground is normally small. Note that conductor 2 acts as a shield for 1 over the distance between the tank circuit and the section of track. C2 is adjusted to prevent oscillations.

When a car is moved onto the tracks adjacent to the lines 1 and 2 (dotted figures), appreciable capacitance is shunted across C2 and oscillations start. These are transferred to L3 and amplified by V2. The a.c. is rectified for energizing relay R. The relay contacts may be used to throw a rail switch, turn on a danger signal, etc., to prevent the movement of another car onto the same siding.

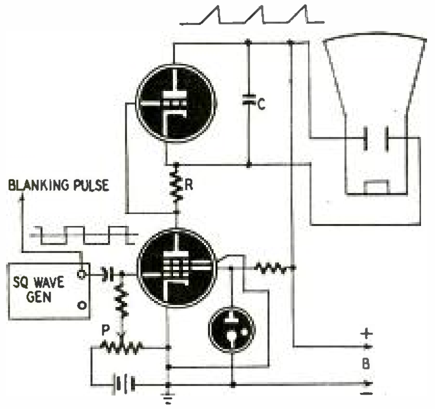


Alternate ways of running the lines.

OSCILLOSCOPE SWEEP

Patent No. 2,489,312
Humbert P. Pacini, Utica, N. Y.
(Assigned to the United States of America as represented by the Sec'y of War)

For precise oscilloscope measurements an accurate sawtooth sweep must be used. The rising portion must be linear and the retrace must be rapid. Both requirements are met with this two-tube circuit. A square wave generator controls the charge and discharge of a capacitor.



The pentode is biased below cutoff to conduct only when the square wave input exceeds its bias. The plate current of a pentode remains constant regardless of plate voltage. The screen voltage exercising considerable control over Ip, a VR tube is used to keep this voltage fixed.

When the square wave is positive, the pentode conducts and the constant Ip flows through R and C. A voltage drop then exists across the resistor and this biases the triode to cutoff. C charges at a linear rate. When the square wave polarity changes, pentode current stops and the bias across R disappears. The triode conducts and discharges C quickly. The next sawtooth wave begins when the square wave swings positive again. The sweep voltage appears across C.

The potentiometer P controls the bias on the pentode and therefore determines the height of the sawtooth (sweep amplitude). Less bias means more plate current and therefore a greater sawtooth voltage. The width and frequency of the sawtooth wave equal that of the square wave generator.

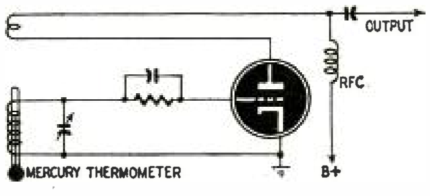
A lead from the square wave generator may be connected to the oscilloscope to blank the pattern during retrace.

MERCURY-CONTROLLED OSCILLATOR

Patent No. 2,491,486
Harold I. Ewen, U.S. Navy
(May be used by the U.S. Government without payment of royalties)

Mercury is a conductor of electricity and therefore affects the magnetic field of a coil. If a mercury thermometer is placed within an oscillator tank coil, the frequency depends upon the height of the mercury column.

As a typical application of this invention, small changes of temperature may be indicated by noting the frequency of an oscillator (which has been previously calibrated in terms of degrees).

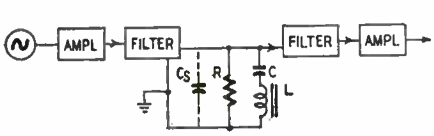


MAGNETIC DETECTOR

Patent No. 2,477,337
William E. Kahl, West New York, N. J.
(Assigned to Bell Tel. Labs, Inc.)

This invention relates to magnetic detectors such as the one illustrated here. The a.c. source is filtered to supply a pure sine current to the magnetometer coil L. Because of saturation, the flux around L and the induced voltage across it becomes distorted. Although the induced voltage is distorted, it remains symmetrical because the exciting current is symmetrical. A symmetrical voltage wave has no even harmonics.

In the presence of an external, unidirectional flux, the field near L is no longer symmetrical. The external flux adds to the coil flux during one half cycle and subtracts from it during the other half. Therefore, the induced voltage across L is asymmetrical and contains even harmonics. The strength of the external field is indicated by the magnitude of the even harmonics, preferably the



second. The output filter passes only second harmonics to be measured or recorded.

This inventor has discovered that, when L is tuned to series resonance (by capacitor C), the magnetometer is less critical to changes in exciting current or distributed capacitance Cs between leads. A resistor R also improves the performance.

MINE COMMUNICATIONS

Patent No. 2,499,195
James A. McNiven, New York, N. Y.

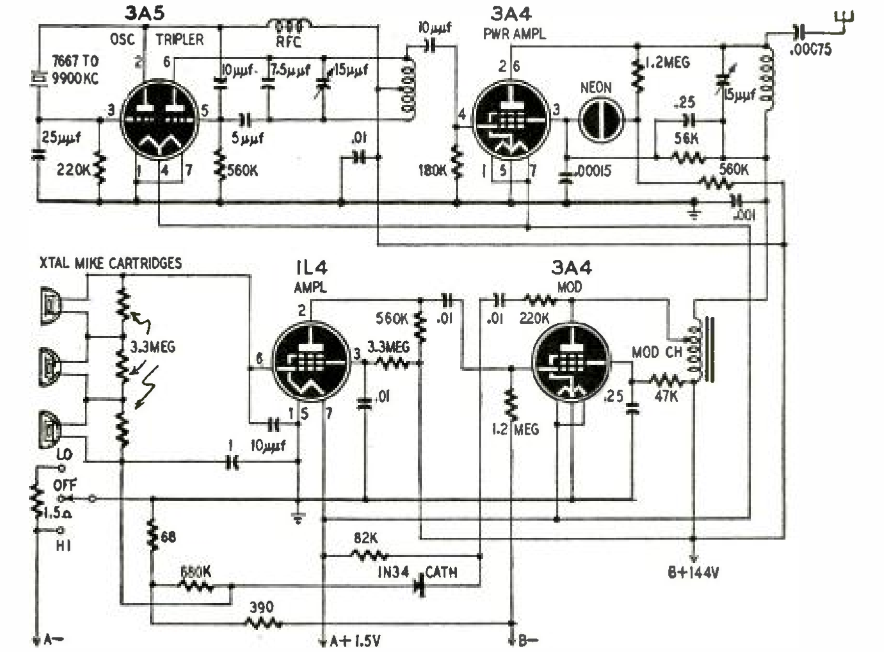
In mine emergencies, such as cave-ins, explosions or fires, miners may be imprisoned in isolated tunnels. Rescue operations could be carried on more efficiently and with a greater chance of success if the miners below could communicate with the rescuers and direct their operations.

This invention describes a frequency-modulation communications system operating on frequencies between 80 and 150 kc. The antenna system consists of probes driven into the roof or sides of the tunnel, as far apart as may be feasible.

The equipment is so designed that it may be operated with power obtained from miners' lamp batteries or a hand-cranked generator.

COMPACT SHORT-RANGE TRANSMITTER

"Radio Mike," a compact, portable, transmitter described in *RCA Review*, was designed for short-range communication in the range between 23 and 30 mc. It is useful for broadcast and telecast relays, emergency services, and portable amateur operation.



speech amplifier is required if a single microphone unit is used.

This circuit incorporates an automatic modulation control. A portion of the output of the modulator is rectified by a 1N34 and applied to the control grid of the 1L4. When the sound input exceeds a preset level, the 1N34 develops a negative voltage high enough to lower the gain of the 1L4.

The r.f. section consists of a 3A5 Pierce oscillator and regenerative—overneutralized—tripler driving a 3A4 power amplifier. The antenna is a 20-inch length of thin aluminum tubing coupled to the transmitter through a spring-type loading coil. Measured output is 250 millwatts.

A neon-lamp tuning indicator and pilot lamp is connected between the plate and screen of the power amplifier. When the switch is off, plate and screen voltages are equal and the lamp does not glow. To tune the transmitter, adjust the tripler tuning capacitor for minimum brilliance, then tune the power amplifier for maximum brilliance.

The audio circuit consists of a 1L4 speech amplifier and a 3A4 modulator. Three crystal microphone cartridges are connected in series so their additive outputs will be sufficient to drive the modulator from the 1L4. An additional

The power switch has three positions. In the LOW position, a 1.5-ohm resistor is inserted in series with the A-minus line to reduce the plate and filament power drains. This resistor drops the filament voltage to 1.1 volts with a new 1.5-volt battery. When the battery begins to drop off, the switch is thrown to HIGH. Battery drain will be reduced if reliable contacts can be had with the switch in the LOW position.

The transmitter and batteries are in an aluminum case 4½ x 3⅜ x 10 inches. Entire unit weighs six pounds.

Suggested coil data for 10- and 11-meter operation is as follows:
22 turns of No. 20 d.c.c. tapped at the center for the 3A5 tripler, and 13 turns of No. 20 d.c.c. for the 3A4 final amplifier. Both coils may be wound on ¾-inch forms.

OSCILLATOR CIRCUITS USING TRANSISTORS

The circuit of an audio oscillator (Fig. 1) using a Raytheon CK-703 transistor is reprinted by courtesy of Cornell-Dubilier Electric Corp. It is a Hartley-type oscillator using the primary of a microphone transformer as the feedback winding. The primary is tuned to the desired frequency by selecting a suitable value for the capacitor across the secondary. The 1,000-ohm resistor in the cathode or germanium base return should be adjusted to give the greatest stability with least distortion.

Be sure that the battery polarity is as shown on the diagram. The collector C will burn out if polarity is reversed.

Fig. 2 is a diagram of a transistor-type crystal-controlled r.f. oscillator demonstrated by the Signal Corps at

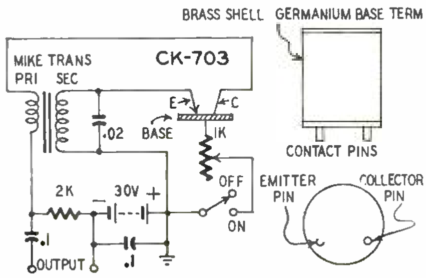


Fig. 1—Transformer supplies feedback.

the recent Radio Engineering Show in New York. Power input to the collector is approximately 60 milliwatts, and

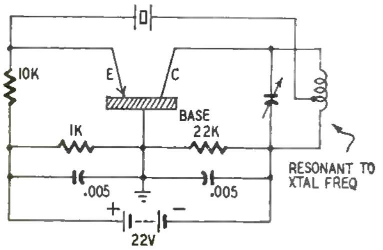
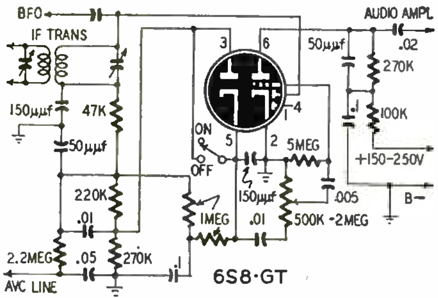


Fig. 2—Crystal controls the frequency.

output is 10 milliwatts. The circuit oscillates on a frequency close to the series-resonant frequency of the crystal. The coil and capacitor are selected to tune to the crystal frequency.

6S8-GT IN AMATEUR RECEIVERS

The diagram shows how a 6S8-GT can be used as second detector, a.f. amplifier, series noise limiter, and



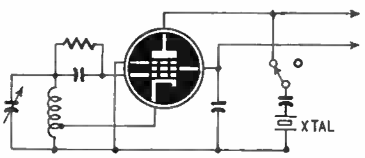
source of a.v.c. voltage in amateur, portable, and mobile 6-volt receivers. The triode section is—for all practical purposes—equivalent to that of a 6Q7 or 6SQ7. A 6H6 will work as the noise limiter but it requires an extra socket and draws an additional 300 ma from the heater supply. A 1N34 could be used in the noise limiter circuit, but we have found that it will not work well on strong noise pulses and its bias voltage is critical. The a.n.l. components have been selected to have the circuits work at levels above 95% modulation.

This circuit can be added to many existing receivers. If the set has a 6H6 detector, its socket can be rewired for the 6S8-GT. The a.f. amplifier socket can be rewired for an additional i.f. stage, b.f.o., or secondary frequency standard. A 6SS7 or similar 150-ma tube will effect a saving in heater current. A 12S8-GT can be used in a.c.-d.c. equipment.—*L. H Trent*

CRYSTAL ABSORPTION METER

Because of its high Q, a crystal makes a very selective absorption meter. The crystal can absorb a considerable amount of r.f. energy from a nearby tank coil. One terminal of the crystal may be grounded and the other left free. Alternatively, the crystal may be coupled to the circuit through a small capacitor. In either case, the r.f. energy dips sharply as the circuit is tuned to the frequency of the crystal.

The figure shows how a crystal is used to check the calibration of a v.f.o. As the tank is tuned through crystal resonance, there is an abrupt loss of excitation to the following stages. A grid or plate meter in the final will indicate when this occurs. If two or three crystals are available, it is easy to calibrate the v.f.o. at several points without using a crystal standard and a receiver or more elaborate calibrating equipment.—*W2OUX*



Hi-Volt Electrostatic Generators

TWO new electrostatic generators, developing 20,000 and 6,000 volts, respectively, and weighing only about 10 pounds each, were disclosed by the Army Engineer Research and Development Laboratories at Ft. Belvoir, Va.

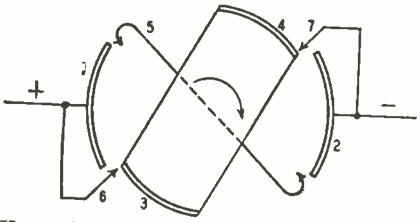
Designed for use as a high-potential power supply for electron image tubes, the generators are driven by a spring motor with a manually operated governor. The 14-1 gear ratio between the generator and the driving motor makes possible continuous operation for 19 minutes on a single winding.

The generators consist of a spring motor driving a rotor made up of plastic laminated with metal foil. As the rotor turns between stator plates (already given an initial charge), a voltage is built up by induction on the metallic foil. At the proper moment, the voltage is picked off the foil by means of brushes and is transported to the stator plates.

The figure shows how the generators work. The two insulated metallic stator plates are designated 1 and 2. Metallic rotor segments 3 and 4 are mounted diametrically on a Lucite rotor blade. If stator plate 1 is given an initial positive charge and rotor segment 3 is caused to approach stator plate 1, the electrons in this rotor segment are attracted to the side of the segment facing the stator plate 1 and leave the other side of the same segment positively charged.

Simultaneously, the charges on rotor segment 4 are segregated in the same way by the influence of stator 2. If at this instant the rotor segments come in contact with electrically interconnected brushes 5, electrons will flow from segment 4 to segment 3, thus leaving segment 3 negatively charged and segment 4 charged positively.

When the rotor is caused to rotate 180 degrees, negatively charged segment 3 moves toward negative stator plate 2, while positively charged segment 4 moves toward positive stator plate 1. As the segments approach this position, they are respectively dis-

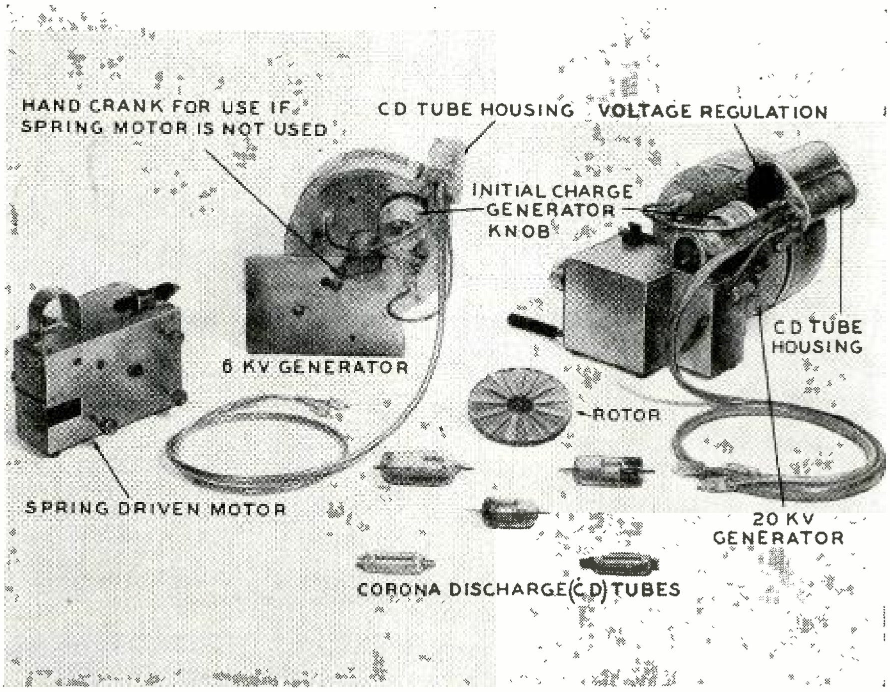


How the static charges are built up.

charged by brushes 6 and 7 which transfer the charges to the stator plates. The rotor segments then contact the interconnected brushes 5 and again assume influence charges because of their proximity to the charged stator plates.

By continuously turning the rotor, this cycle is repeated and stator plate 1 becomes increasingly positively charged while stator plate 2 becomes increasingly negatively charged. If several pairs of rotor segments are put on the rotor, the rate of building up the charge on the stator plates is increased for a given speed of the rotor.

The initial charge is placed on the plates by a manually operated friction-type electrostatic generator which appears as a small knob on the side of the generator housing. After the initial charge, the process of building up the voltage and transporting it to the plates is continuous as long as the rotor



These portable generators supply high voltages for low-current applications.

is in motion. The charges accumulated on these plates are the source of the high voltage.

Availability of new insulation materials, new plastics, and new techniques of hermetic sealing made the development of these generators possible. A "pressure-tight transmission" permits the application of a rotary motion into a pressurized generator housing.

A concurrent development, the corona discharge regulator tube, makes possible excellent voltage regulation without the use of power-consuming resistance-type voltage dividers. This tube acts as a kind of safety valve by limiting the voltage and thus maintaining it at a specified value.

ULTRASONIC SOLDERING

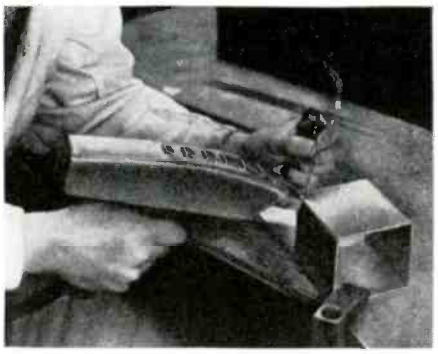
AN ULTRASONIC soldering gun has been developed that will successfully solder aluminum and other metals and alloys which form oxide films under normal atmospheric conditions and will not respond to ordinary soldering methods.

The new soldering gun has the normal type of copper tip heated in the usual manner by a resistance winding. The copper tip is secured to a brass block which in turn is held in firm contact with the nickel core of a magnetostriction transducer. A winding around the transducer provides the excitation.

In application, the tip of the gun is allowed to heat to the operating temperature. The transducer is then energized and the tip is tinned by applying a soft solder. The tip is applied to the work and solder is fed in the usual way. It is essential to keep a good liquid contact between the tip and the work for maximum acoustical efficiency.

The effect of the ultrasonic vibration is to destroy the oxide surface temporarily and leave a clean surface for the solder.

The power needed to supply the magnetostriction unit is supplied by an



electronic amplifier that operates directly from the a.c. lines. The output frequency is obtained by feeding back the resonant frequency of the vibrating element to the amplifier input by means of a coil on the element. The operating frequency is chosen well above the normal audible range so that no discomfort is experienced by the operator.

The ultrasonic soldering gun was developed in the Mullard Research Laboratories in London.

ELECTRONIC LITERATURE

Any or all of these catalogs, bulletins, and periodicals are available to you if you write to us on your letterhead (do not use postcards) and request them by number. Send coin or stamps where cash is required. We will forward the request to the manufacturers, who in turn will send the literature directly to you. This offer void after six months.

My-1—GASOLINE GENERATOR BOOKLET

An eight-page booklet has been issued by D. W. Onan & Sons describing their complete line of gasoline-driven electric plants ranging from 260 to 35,000 watts, in all standard voltages, frequencies, and phases. Special accessories, including automatic controls, fuel tanks, remote stations and wires, and two-wheeled dollies and trailers, are also listed. A model guide has been included which points out the different types of models and gives instructions for choosing the proper type, size, and starting method. An additional four-page booklet gives information on diesel electric plants. —*Gratis*

My-2—STANDARD TUNER DATA

Standard Coil Products Company, Inc., has issued a four-page bulletin giving schematic diagrams, mounting dimensions, and alignment procedures for the Standard TV tuners TV-101 and 201. A supplementary sheet gives data on tuner TV-250.—*Gratis*

My-3—TV VIEWING TUBE BOOKLET

This 20-page booklet details television picture tube and general-purpose cathode-ray tube characteristics, replacement tube data, base diagrams, suggestions for tube handling, and a concise description of cathode-ray oscilloscopes used in TV servicing. Published by the Radio Tube Division, Sylvania Electric Products Inc.

A new viewing tube replacement chart lists 120 tube types and shows interchangeable types, changes required for tubes of different face size and over-all lengths, service data for TV sets designed for obsolete tube types, and data for kit builders wishing to increase picture tube size. A total of 165 tube types ranging from 2 to 20 inches in size and using both electrostatic and magnetic deflection systems are covered by the booklet.—*Gratis*

My-4—TEST EQUIPMENT

A 12-page catalog issued by the Precision Apparatus Company describes their line of test equipment including signal generators, oscilloscopes, tube checkers, vacuum-tube voltmeters, and volt-ohmmeters.—*Gratis*

My-5—SYNCHRONOUS GENERATORS

Bulletin GEA-5415 of the General Electric Company describes high-speed synchronous generators for standby, portable, and prime source power. The 8-page booklet gives construction features and performance data of the generators which have ratings from 12½ kva to 1250 kva and speeds from 1800 r.p.m. to 514 r.p.m.—*Gratis*

My-6—TV AND FM COILS
An eight-page catalog issued by the Stanwyck Winding Co. describes their TV and FM coils. The catalog contains replacement data as well as circuit diagrams in which the coils are used. —*Gratis*

My-7—RUGGED INSTRUMENTS
A 12-page booklet put out by the Marion Electrical Instrument Co. describes their "ruggedized" electrical instruments. The booklet gives in detail the construction features which make the instruments rugged and describes performance tests which the instruments must undergo.—*Gratis*

My-8—GE HAM NEWS
Ham News, bimonthly publication of the General Electric Company, is now available on a yearly subscription basis for those who find it difficult to obtain each issue. Subscription blanks are obtainable at any G-E tube distributor. *Ham News* will still be available on a free basis if picked up at a distributor's headquarters.—*Rate $1.00 per year.*

My-9—PRECISION RESISTOR CATALOG
A catalog of 36 pages with information on their line of precision wire-wound resistors and resistive devices for sound equipment has been issued by the Cinema Engineering Co. An interesting feature is a kit for making wire-wound resistors up to 5% tolerance without the use of instruments. —*Gratis*

My-10—TV TUBE GUIDE
A 56-page television receiver tube complement book, listing by make and by model the number and type of receiving and picture tubes used in more than 620 sets, has been issued by Sylvania Electric Products, Inc. The book contains a chart showing the percentage of each of 136 receiving tube types used in TV sets distributed by 85 manufacturers and also a list with names and addresses of 80 TV set manufacturers. Replacement data is given for 120 TV picture tube types. —*Price 75¢.*

My-11—TRANSMISSION LINE
Bulletin No. 5 of the Andrew Corporation describes their Type 450 rigid transmission line and accessories for AM and FM. An accompanying bulletin, No. 49, is a price list for the equipment.—*Gratis*

My-12—TV INSTRUMENTS
Signal generators, a field strength meter, TV and FM tuners, a custom built TV receiver, and other equipment is described in a 12-page catalog issued by the Approved Electronic Instrument Corp. Included are a signal generator kit and an FM and TV sweep generator kit.—*Gratis*

My-13—TEMPERATURE REGULATOR
An electronic temperature regulator for aircraft cabins and other uses in high-speed aircraft is described in a bulletin of the AiResearch Manufacturing Co. The device anticipates the rate of change of temperature.—*Gratis*

My-14—CONNECTOR CHART
The 1949 Cannon desk chart gives the insert arrangement of all type K connectors. Measuring 19 x 24 inches it contains 211 layouts with wire, contact, and clearance data. Major shell types and styles are shown with exploded views.—*Gratis*

My-17—DUAL CONTROL DATA
A 20-page manual containing replacement data for concentric dual controls has been put out by the International Resistance Co. The manual covers only those dual controls on which rear and panel sections are operated independently by concentric shafts. The listings are comprehensive, covering early prewar concentrics for home and auto radios and continuing up to television receivers appearing in the fall of 1949.—*Price 25¢*

ANIMATED WINDOW DISPLAY

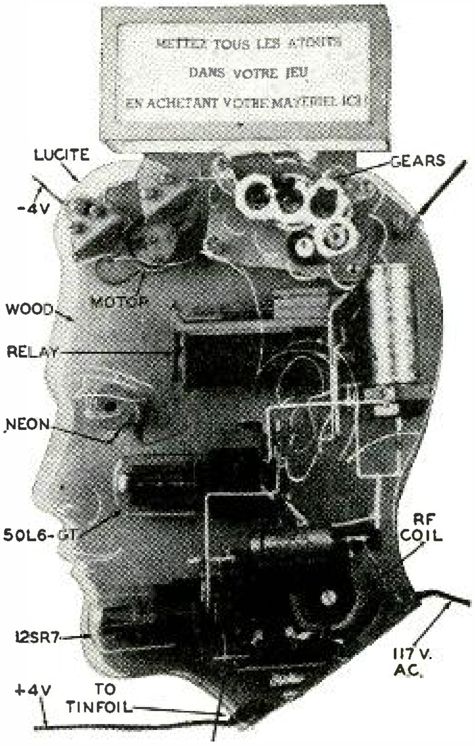
The photograph shows a novel attention-getter installed in the window of my radio shop in Brussels. The mounting for all the components is a piece of wood cut in the shape of a man's head. Over the parts is a second head silhouette made of Lucite.

The device is capacitance-operated. When a passerby approaches the window, a light goes on, illuminating the advertising text ("Put all the trumps in your game by buying here"); a toy motor turns a train of four gears, to each of which is attached a playing-card symbol; and a movable piece of wood uncovers the head's eye, giving the effect of a wink.

The diagram shows how it is done. The triode section of the 12SR7 is an oscillator, the coil of which was made from an old 55-kc i.f. transformer. Almost any other frequency can be used, but steer clear of those in the broadcast band. A 7-inch square of tinfoil glued to the window makes the tube stop oscillating when a person approaches.

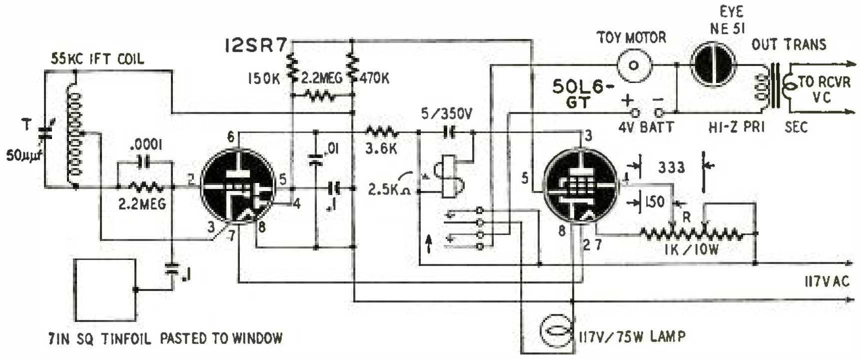
The plate current of the 12SR7 is rectified by the two diode plates in parallel and applied to the grid of the 50L6 relay-control tube. When the 12SR7 stops oscillating, the 50L6 grid voltage becomes more positive, increasing the 50L6 plate current and closing the relay. The relay contacts light the 117-volt incandescent lamp which illuminates the sign and starts the motor which whirls the playing-card symbols.

A piece of wood, shaped as in the photo, is attached to the relay armature. When the relay closes, this piece,



This elaborate capacity-actuated window display always attracts attention.

leads will be eliminated. Resistor R, in addition to dropping the line voltage for the series filaments, is tapped for 50L6 screen voltage. The tap is adjusted so that the relay opens when the oscillator is running and closes when it is not.



Body capacitance stops the oscillator to allow the 50L6 to operate the relay, which causes the Lucite figure's eye to wink, actuates a display and lights a sign.

normally between the neon lamp and the eye hole, is withdrawn so that the eye appears to light up.

The power supply is unrectified a.c. line voltage. A 4-volt battery (external) runs the motor; but, if a 117-volt motor is used, the battery and a pair of

The 117-volt and 4-volt leads are used to hang the head.

This display can be varied widely, of course, to suit different types of customers, but the human head idea seems to be a sure attention-getter.

—*V. Fastenaekels*

CORRECTIONS

The power transformer for the audio amplifier at the bottom of page 37 of the March issue is listed as 650 volts at 60 ma in the parts list. It should be 700 volts at 120 ma.

We thank Mr. James McDaniel, of Rosell, N. J., for this correction.

Substitute the letter I for the numeral 1 in the equation for finding the capacitance of an input capacitor in "Power Pack Design" in the February issue. This equation is in the fourth line, third column, of page 44 of that issue.

Our thanks to Mr. Perry Booker, of Lyons, Kansas, for calling this printer's error to our attention.

Radio Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK
Founder

Modern Electrics	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931
Wireless Association of America	1908

Some of the larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

May, 1916, ELECTRICAL EXPERIMENTER

Locating Vessels at Sea by Radio and Sound Waves
Modern Concepts of Electricity, by Samuel Cohen
Latest Radio Telephone Apparatus
Wireless Aids Uncle Sam to Catch Villa
A Novel Mounting for Oscillation Transformer, by Philip C. Platt
Magnetic Wireless Detector, by Frank Cusack
A Cheap Hot Wire Ammeter, by Francis A. Pray
Designing Spiral Aerial, by George L. Bowman
Easily Adjusted Detector Stand, by Francis R. Pray
Electrical Losses in Radio Transmitting and Receiving Sets, by James L. Green
Use and Construction of a Wireless Telephone Set, by Milton B. Sleeper
How to Make a Simple Electrolytic Interrupter, by Clyde G. Sykes

TECHNICIANS REORGANIZE

An important announcement by the (former) Philadelphia Radio Service Men's Association informs us that they have reorganized as an entirely new type of organization for electronic technicians.

The new Association, known as the Electronic Technicians Guild, will include in its membership independent radio technicians, employees in larger radio and television service establishments, radio and television dealers and distributors and their sales personnel. Shops will be classified and wage rates set, working conditions regulated and grievances between employers and employees arbitrated.

Committees will examine and grade all members. Attendance at meetings and technical lectures (or a technical school) will be compulsory until the Master Grade is reached. Attendance at meetings will continue to be required, so that the operating procedures of the organization will remain strictly democratic.

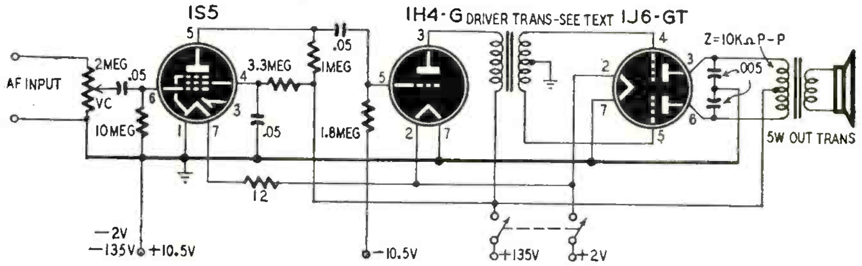
The new type of organization will be tried out in the metropolitan Philadelphia district, and if successful will be extended to other member groups of the Federation of Radio Servicemen's Association of Pennsylvania.

The step, taken by one of the oldest radio technicians' associations of the country, is very important and will be watched with great interest by organized radio service technicians all over the country.

BATTERY-POWERED PUBLIC ADDRESS SYSTEM

? *I would like to have a circuit of a battery-powered public address system which will deliver at least 1.5 watts. Please design the circuit to use a 1J6-G, 1H4-G, and a 1S5.—Wm. H. W., Maplewood, N. J.*

A. The amplifier shown in the diagram will deliver 2 watts. The 1J6-G operates class B and is transformer-coupled to the 1H4-G driver stage. The ratio of the primary to half the secondary of the driver transformer should be approximately 2.4 to 1. The filament drain being heavy, a small 2-volt storage battery is recommended for the filament supply to save on battery expenses.

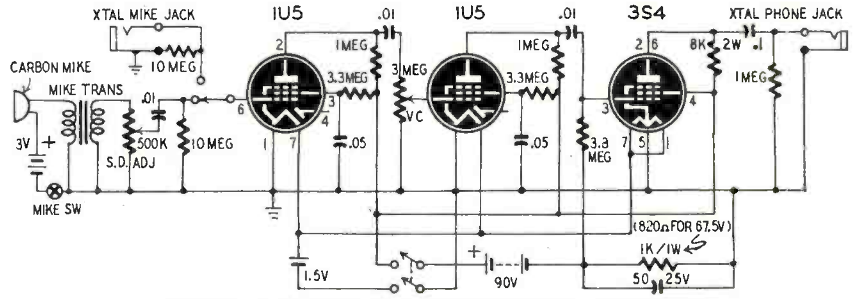


PORTABLE AMPLIFIER FOR DICTAPHONE

? *Please print a circuit of a portable battery-powered amplifier which I can use as a dictaphone. The amplifier should be designed for use with crystal or carbon microphones. I plan to use crystal headphones with the unit.—T. C. B., Coronado, Calif.*

A. The amplifier shown in the diagram should do the job for you. The grid of the first 1U5 speech amplifier can be switched to the crystal or carbon mike at will. If you are planning to run the microphone cables more than 50 or 60 feet, replace the microphone transformer with a line-to-grid transformer in the grid circuit of the 1U5. Install a mike-to-line transformer at each microphone. Select transformers made to match each microphone. Mount the batteries for the carbon microphone close to it.

Adjust the pre-set control for the carbon microphone to avoid overloading the amplifier on loud signals. A separate switch cuts out the carbon mike.



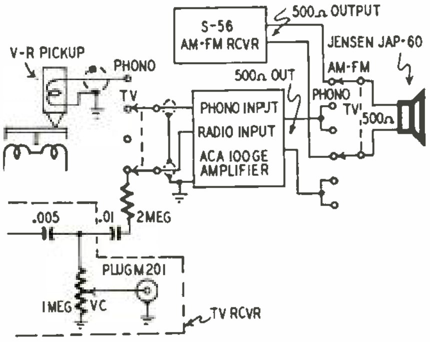
RADIO-PHONO-TV SWITCHING CIRCUIT

? *I have a 500-ohm, 15-inch coaxial speaker, Admiral 30A16 TV receiver, a record changer with variable-reluctance cartridge, S-56 Hallicrafters AM-FM receiver, and an ACA 100GE amplifier with a built-in equalizer and preamplifier for variable-reluctance pickups. Please show how these units can be interconnected by switches so the speaker—and amplifier, if necessary—can be used with all units.—P. L. P.—Philadelphia, Penna.*

A. One switching circuit is shown. Separate switches are used in the input and output circuits. A single multi-circuit switch could have been used; however, feedback is likely because of coupling through the switch

The a.f. signal from the TV receiver

is tapped off the top of the volume control and fed to the radio input jack on the amplifier through an R-C network and one side of the TV-PHONO switch. The TV volume control can be turned down or plug M201 removed from its jack while the amplifier is in use. The

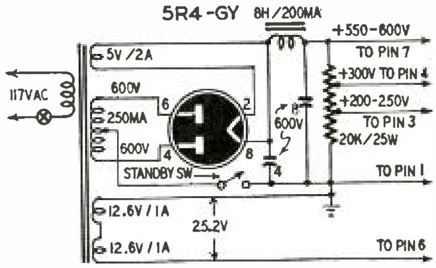


variable-reluctance pickup is connected to the phono input jack on the amplifier through the second pole on the TV-PHONO switch.

The S-56 has a high-fidelity amplifier with 500-ohm output terminals which can be used to feed the speaker without further amplification.

POWER SUPPLY FOR BC-696

? *Please print a diagram of a power supply for a BC-696 transmitter. I have a power transformer which has a 1,200-volt center-tapped, 250-ma, high-voltage winding; two 12.6-volt filament windings; and a 5-volt, 3-ampere filament winding. I also have an 8.5-henry, 200-ma choke which I want to use.—T.F.M., Sybial, W. Va.*



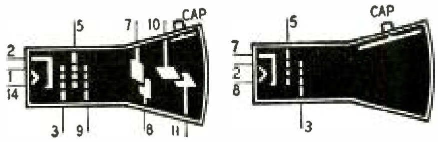
A. The components which you have should make an efficient power supply for the BC-696 or any of the other receivers in the SCR-274-N and ARC-5 command sets. The diagram is shown. The oscillator voltage may be reduced to 150.

Leads from the power supply connect to the numbered pins on receptacle J64 on the transmitter.

C-R TUBE BASE CONNECTIONS

? *I have surplus 12DP7 and 12GP7 C-R tubes which I want to use in remote viewers as described in your January issue. Please print base connections for these tubes.—A. A. P., Brooklyn, N. Y.*

A. Base connections for these tubes are shown.



12GP7. 12DP7

MINERVA TROPIC MASTER

A Tropic Master model W-117 was dead with only 25 volts being delivered by the B-supply. All filters and bypass capacitors checked perfect. A check showed no electrical contact between a .01-μf coupling capacitor and a grid of one of the 50L6 output tubes. The soldered joints looked perfect; but, when a hot iron was applied, we found that the joint had crystalized and was insulated from the socket pin by a wax-like substance. All other joints were checked and also found to be crystalized —a condition probably caused by the use of wartime solder of low tin content.

The entire underside of the chassis had been sprayed with a waxlike substance in the tropicalization process. Evidently, when the set warmed up, the wax melted and seeped into the pores of the soldered joint and completely isolated some components from the electrical circuit. All joints were cleaned and resoldered to restore the set to normal operation.

PHILCO LP PICKUPS

Low output from Philco LP pickups can be caused by the cartridge's not being properly seated in its holder. Make sure that the old cartridge is firm in its holder before replacing it with a new one.—*C. R. Lutz*

DIFFICULT I.F. ALIGNMENT

If you cannot peak the i.f.'s in some of the new inverted-chassis models, look for wax around the trimmers on the i.f. transformers. This trouble usually occurs in small, poorly ventilated sets. The wax melts and runs down into the trimmers, making it impossible to align the set. Replace the transformers with wax-free units to avoid a repeat of this difficulty.—*Alan McFarlane*

ZENITH 12-A-58

This model motorboated loudly when operating on the high end of the broadcast band or on shortwave. Comparing its circuit with those of later models, we found that the oscillator anode (pin No. 6 of the 6A8) was fed through an 11,000-ohm resistor in the set we had while 20,000 ohms was used in later models. Replacing the anode load resistor with 20,000 ohms cleared up the trouble.

When the volume was advanced above a certain level, the power amplifier tubes drew more current and lowered operating voltages throughout the set. This slight drop in voltage was sufficient to detune the oscillator and tune out high-frequency stations. With the oscillator detuned, the signal to the power amplifiers dropped off, they drew less current, voltages returned to normal, and the cycle began anew.—*Baron von Huene*

PHILCO 48-250

Oscillation in the i.f. amplifier of this and similar models can often be cured by placing a .05-μf capacitor between B-plus and the chassis to decouple the i.f. stage from the power supply.—*E. R. Crowder*

ADMIRAL RECORD CHANGERS

Distorted reproduction from crystal cartridges can often be traced to one of two sources. Crystal deterioration is usually recognized by a reduction in output accompanied by distortion. It can be cured by replacing the cartridge with a fresh one.

Motor noise is a common type of distortion produced when motor vibrations are transferred to the crystal. This is most noticeable on 33 1/3-r.p.m. records. It can sometimes be cured by tightening the motor mounting. If this does not help, replace the motor.—*Service Division of Admiral Corp.*

ADMIRAL 19A1 TV CHASSIS

If the picture and sound cut out intermittently, the trouble may be caused by a bad 6J6 oscillator-mixer tube, dirty turret contacts, or cold-soldered joints in the tuner. Any or all of these troubles may occur simultaneously, so check all of them and avoid another service call for the same complaint.—*William Porter*

TUNABLE HUM IN A.C.-D.C. SETS

The G-E model GD-62 and most other a.c.-d.c. sets have .01-μf molded paper capacitors across the a.c. line to bypass noise and line modulation. A .01-μf capacitor is not large enough to stop strong line modulation which produces tunable hum on some stations. Replace this capacitor with a high-grade, 600-volt capacitor of at least .05 μf.

As a preventive measure, use the .01-μf molded capacitor to replace the coupling capacitor between the plate of the a.f. amplifier and the grid of the power amplifier. The original coupling capacitor is a potential source of trouble in the form of low-resistance leakage, open circuits, and intermittents. A molded capacitor is less likely to fail in this circuit than the original capacitor.—*John T. Bailey*

TRACKING SUPERHETS

Some inexpensive sets do not have low-frequency padders or adjustable slugs on the oscillator coil. To improve tracking, construct a wire loop slightly larger than the circumference of the oscillator coil. Place the loop over the coil and ground one side to the chassis. For tracking, vary the inductance of the coil over narrow limits by adjusting the coupling between loop and coil.—*Charles Buscombe*

MOTOROLA VT-105, VT-107, VK106

Greater i.f. sensitivity for improved fringe-area reception can be had by replacing the 6BA6 third video i.f. amplifier with a 6AG5. Remove all connections from pin No. 2 of the 6BA6 socket and move the i.f. transformer ground to the ground point on the socket of the second i.f. amplifier. Bypass the cathode resistor with a .001-μf ceramic capacitor. Install a 6AG5 and realign T7 and T8 to complete the job.—*Edward G. Tanrath*

DE FOREST GETS CREDIT

Dear Editor:

In Part X of "Fundamentals of Radio Servicing" (page 50 of the December, 1949, issue) the author talks about "the early engineers" inserting a grid in the diode and inventing the triode. As was pointed out in the January, 1947, de Forest anniversary number of your own magazine, the inventor of the three-element tube was Dr. Lee de Forest. Dr. de Forest was by no means an ordinary "engineer" and he certainly was not plural. I would like to be sure that the newcomers Mr. Frye's articles are designed to reach do not go away with the idea that a basic, world-changing invention like the triode just "grew." It was the product of Lee de Forest, the father of modern radio.

T. JON GIBBS

Long View, Wash.

(The editors and Mr. Frye are equally red in the face, all the more so as we published the article referred to by our correspondent, in which the development of the triode audion was traced step by step. We of all people should know that the triode is not a diode with an extra element inserted in it, as was commonly claimed during the days of the Fleming-de Forest patent suits. Strange as it may now seem, the triode is more closely related to the coherer than to the Fleming valve, as was proved by the January, 1947, article.—*Editor*)

A CONSTRUCTOR REPORTS

Dear Editor:

About four years ago I built the Omnichecker described in your July, 1945, issue, and a year later I constructed the Transigenerator detailed in the July, 1946, issue. I tested the resistors for the checker on a radio-school bridge and redesigned the generator somewhat to include a cathode-follower stage.

Mr. Altomare, author of both the articles, might be interested to know that both instruments are still in daily use.

WILFRED J. LENNOX

Wiarton, Ont.

RADIO-COOLED HOUSE?

Dear Editor:

Here is the queerest service problem I have had in my whole career. A customer called me with the complaint that every time he used his radio, the house would get cold within an hour. (He didn't heat the house with electricity, but steam!)

What he didn't tell me was that he had a thermostat-regulated oil burner. I found the thermostat right behind the radio, which was placed in a corner. Moving the radio cooled the thermostat down and permitted the house to heat up.

FERNAND LEPAGE

Montreal, Canada

RADIOMAN'S WIFE SPEAKS

Dear Editor:

I am a technician's wife, not a radio technician. After 12 years of listening to nothing but ham talk and radio and having nothing but radio magazines around, I find your articles on TV most interesting.

In fact, when I have time to read, I find them every bit as interesting as fiction stories because TV is new, growing, and surely here to stay.

My husband thinks about the future just as any service technician should in an area where there is still no TV shown, and now he is one of the best TV service technicians in the city.

MRS. GENEVA B. MINDER
Akron, Ohio

LIKES NEW INFORMATION

Dear Editor:

I think you are doing a fine job in giving us the round-robin system of up-to-date technical information. Most of us who are serious about electronics like a "lift" to clear up foggy points, and I have often benefitted by your technotes while at my job.

I don't think you are wasting space at all by printing experimental circuits of Geiger counters, medical tips, etc. It is a good thing to know what's going on in the electronic world, and it's usually the below-average person who refuses to see future possibilities any further ahead than his own not-too-long nose.

CHARLES W. BATES
Washington, D. C.

HAS COLOR TELEVISION

Dear Editor:

On Tuesday morning, February 14, we watched the CBS color transmission from 11.15 a.m. to 11.35 a.m. The program consisted of a couple doing the rhumba and models demonstrating color fabrics, flags, and maps in diverse colors.

To watch the transmission in color, we used a 3-inch color disc attached to the end of a 10¢ miniature egg-beater which was turned by hand at a slow speed. The horizontal hold control was set for black-and-white reception which, of course, produced four images on the screen. The vertical hold was adjusted until the pictures stopped rolling vertically. With this arrangement, the color pictures were similar to 16 mm Kodachrome projected on a home screen.

It's surprising how easily color pictures remain in synchronization when using hand power at a slow speed.

MICHAEL L. TORTARIELLO
Newark, N. J.

(While the above device is very interesting and shows what a little ingenuity can do, readers are advised not to bother constructing similar devices, as CBS has discontinued its color transmissions for an indefinite period.—*Editor*)

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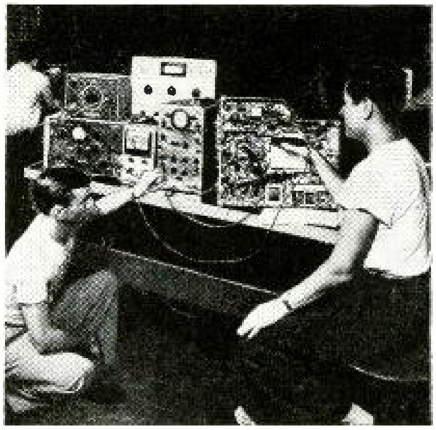

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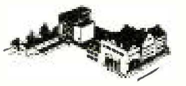

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RADIO OPERATING QUESTIONS AND ANSWERS, tenth edition, by J. L. Hornung. Published by McGraw-Hill Book Co., Inc., New York. 5 x 8 inches, 588 pages. Price 5.00.

This new edition has been prepared to cover the new questions recently released by the FCC for the radiotelegraph and radiotelephone operators' license examinations. The new questions have been revised and expanded both in theory and practice and many mathematical problems have been included.

A new feature of this text is a special problem section of 45 questions and answers of more advanced problems in general theory, radar, and loran.

FOUNDATIONS OF MODERN PHYSICS (second edition), by T. B. Brown. Published by John Wiley & Sons, Inc., N. Y. 6 x 9¼ inches. 318 pages plus index. Price $5.00.

Written in clear, easy-to-understand language, this book contains no higher mathematics, although equations are given where helpful. The author fully discusses wave mechanics, relativity, quantum and kinetic theories, radioactivity, nuclear physics, and other topics. Numerous diagrams and photographs illustrate the experiments.

Each chapter is followed by problems and suggested reading lists. Three appendices are devoted to physical tables and units. Others reveal interesting facts dealing with relativity and radioactivity. This is an excellent text to supplement older books on physics.

—*I.Q.*

TELEVISION TUBE LOCATION GUIDE. Published by Howard W. Sams & Co., Inc. 5½ x 8½ inches. 96 (unnumbered) pages, 219 diagrams. Price $1.50.

Service technicians have been waiting for this handbook which gives television receiver tube complement layout charts. The charts give the type and function of the tubes, so that often repairs on a set can be made in a matter of minutes if a tube is at fault by referring to the proper chart and replacing the tube.

Suggested by J. B. Lalley, Red Bank, N. J.

Ah! Here's your trouble, grid leak

ADVERTISING INDEX

RADIO OPERATOR'S LICENSE Q & A MANUAL, by Milton Kaufman. Published by John F. Rider Publisher, Inc., New York. 5½ x 8½ inches, 608 pages. Price $6.00.

This book is not only a text, but a valuable reference for the student and operator. Questions and answers to pass FCC exams are listed in order, and many of the answers are supplemented with a follow-through discussion to present a clear understanding of difficult technical questions.

The first six chapters cover the six elements of the FCC Commercial Radio Operator Examinations. The material is based on the latest study guide and other recent FCC releases and includes such topics as frequency-shift keying, marine radar, and loran.

A complete section of the book is devoted to the Amateur Radio License questions and answers, and rules and regulations. Cross references are made to answers and discussions in the Commercial license section.

VACUUM EQUIPMENT AND TECHNIQUES, edited by A. Guthrie and R.K. Wakerling. Published by McGraw-Hill Book Co., New York. 6½ x 9½ inches, 264 pages. Price $2.50.

This book compiles the results of studies and developments in high-vacuum equipment and practice as made by the personnel of the University of California Radiation Laboratory. The opening chapter covers the fundamentals of vacuum practices and the rest of the book is a practical discussion of vacuum systems, gauges, leak detection equipment, and techniques, with many diagrams and circuits. This work will be a useful reference to anyone working with high-vacuum equipment.

ELECTRON-TUBE CIRCUITS, by Samuel Seely. Published by McGraw-Hill Book Co., New York. 6½ x 9½ inches, 529 pages. Price $6.00.

As a new addition to the McGraw-Hill Electrical and Electronic Engineering Series, about half of this volume is of a radio engineering character, and the rest covers circuits used extensively in radar, television, pulse communication, and general electronic control.

The author presents the various classes of circuits with no attempt to cover all the aspects of any one class, but rather to present an analytical approach to the study of vacuum-tube circuits. A knowledge of calculus is assumed by the author, although much of the book will be of interest to non-engineering readers.

Of particular interest is a chapter on computing circuits which describes methods for electronically performing such mathematical operations as addition, subtraction, multiplication, squaring, etc.

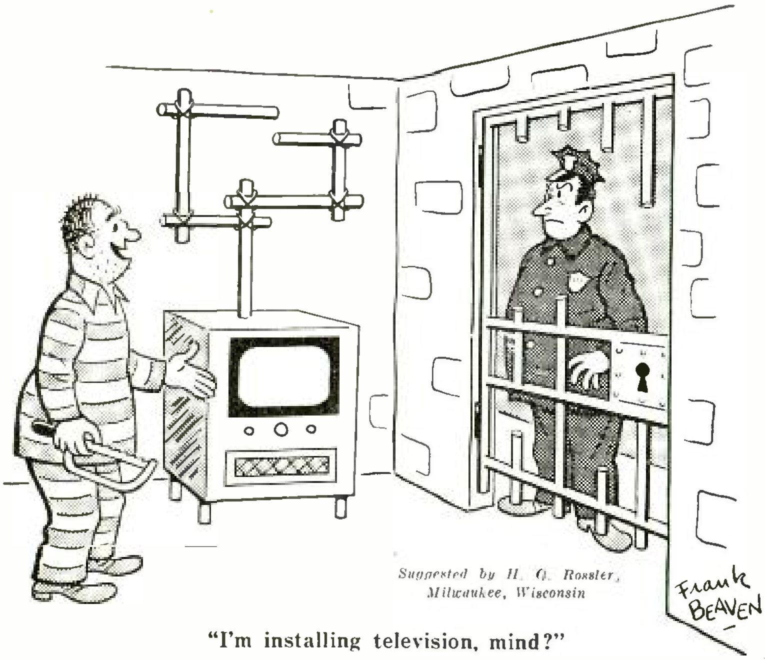
SOUND REPRODUCTION by G. A. Briggs. Published by Wharfedale Wireless Works, Bradford, England. (Distributed in the United States by British Industries Corporation, New York, N. Y.) 5½ x 8½ inches, 143 pages. Price $2.25.

This book contains much valuable information on the home reproduction of sound. Nearly half is devoted to loudspeakers with much concise data on size and shape of cabinets, materials for making baffles and cabinets, frequency ranges, and speaker locations.

The rest of the book is a discussion of recording systems, records, pickups, and other material of interest to audio enthusiasts and technicians.

KEY AND ANSWERS TO NEW RADIOTELEGRAPH EXAMINATION QUESTIONS, compiled, edited, and published by Alexander A. McKenzie, Hackensack, N. J. 5½ x 8½ inches, 62 pages. Price $1.

This book is a study guide for prospective FCC licensees based on the July, 1948, revision of FCC study material and on mimeographed Supplement No. 4. It includes Element 1, questions 233 through 296 of Element 5, and questions 226 through 295 of Element 6.—*R. H. D.*



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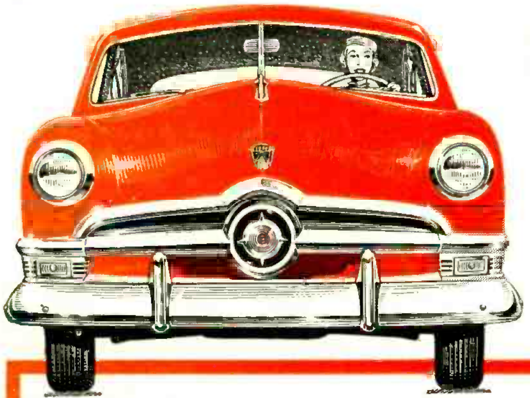

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6th Prize $260 Kaufmann Travel Luggage (4 matched pcs.)
7th Prize $233 Kroydon Golf Clubs & Bag
8th Prize $145 Kaufmann Travel Luggage (2 matched pcs.)
9th to 15th Prizes—$100 Longines Wrist Watches
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