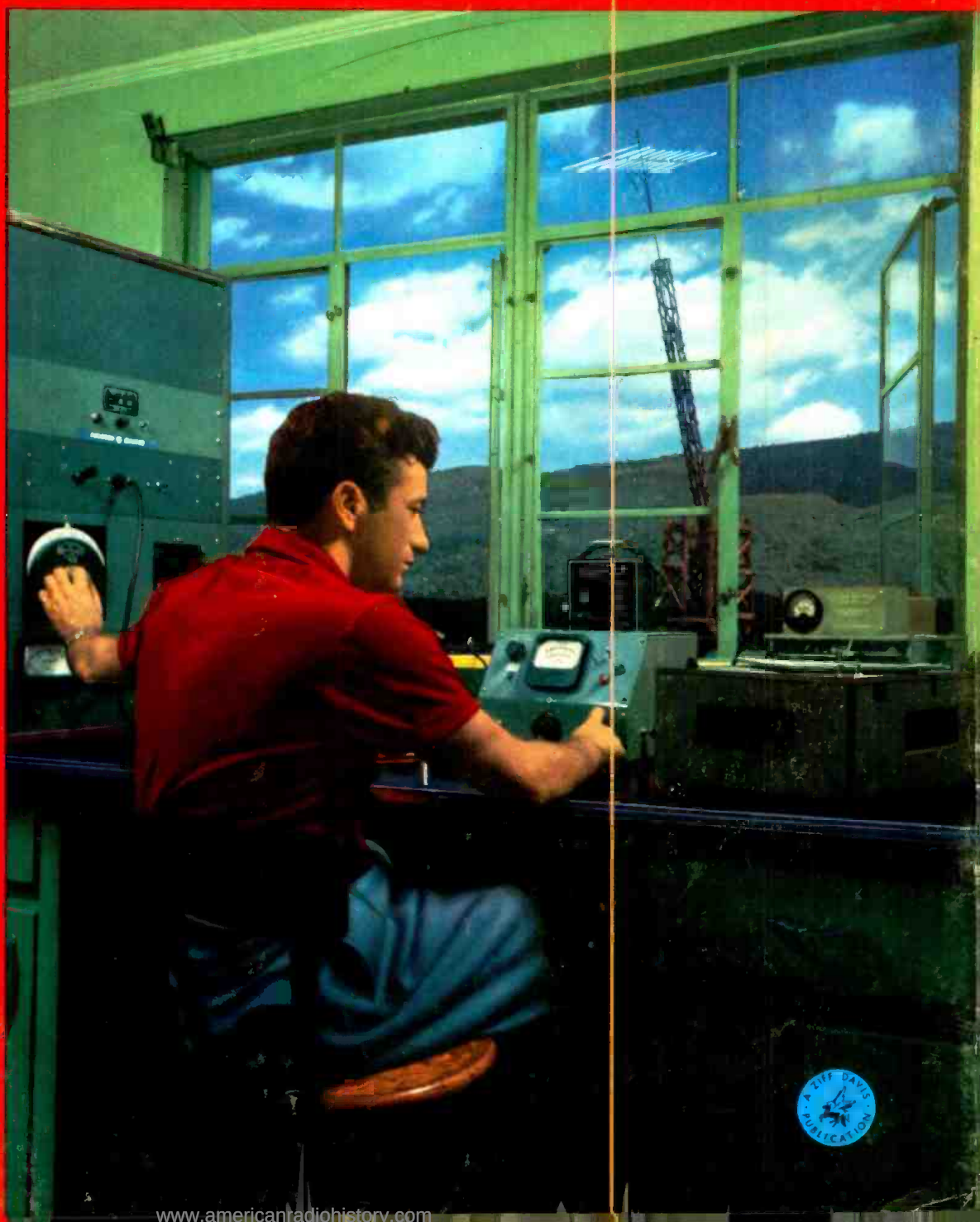
RADIO-ELECTRONIC ENGINEERING EDITION

RADIO & TELEVISION NEWS

APRIL
1953

IN THIS ISSUE



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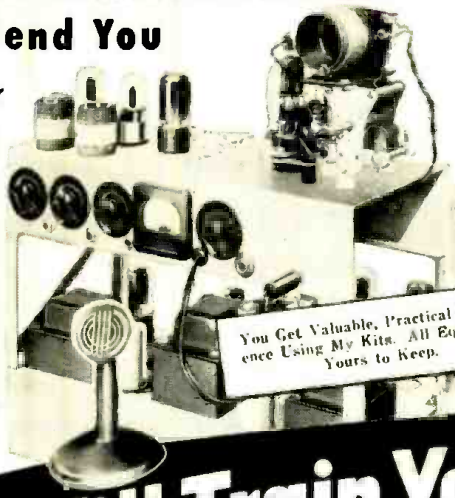

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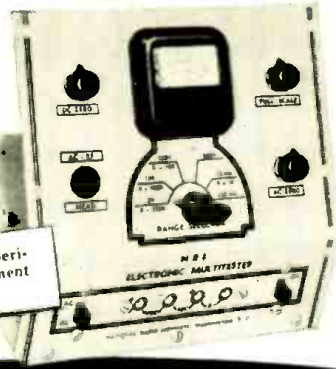

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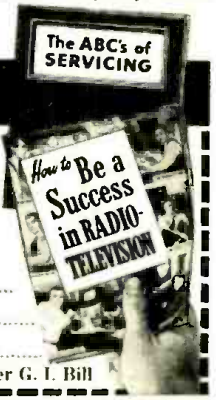

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APRIL, 1953

DEPARTMENTS

ZIFF-DAVIS PUBLISHING COMPANY
Editorial and Executive Offices
366 Madison Ave., New York 17, N. Y.
VOLUME 49 • NUMBER 4

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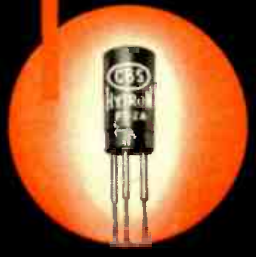
CBS-HYTRON TRANSISTORS

CBS-HYTRON
PT-2A



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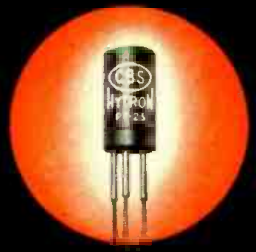

CBS-HYTRON
PT-2S

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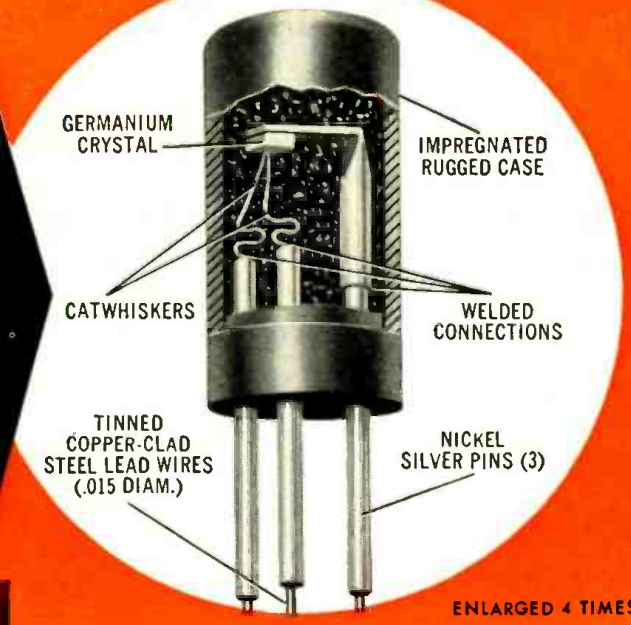
- Sturdy triangular basing
- Polarized base connections
- Auto-electronically formed
- Thoroughly stabilized
- Operate up to 55° C



AND YOU CAN BUY THEM NOW!

Already a major producer of germanium diodes, CBS-Hytron now offers you prompt delivery of transistors: Point-contact CBS-Hytron PT-2A (for amplifying) and PT-2S (for switching). Both have stable characteristics and are guaranteed moisture-resistant. Note flexible leads welded to base pins. You may solder flexible leads into circuit. Or snip them to use stiff base pins in CBS-Hytron type T-2 socket.

Triangular arrangement of base pins is stronger . . . avoids bent pins. Easy-to-remember basing layout simulates basing symbol (see diagram). Polarization makes socket connections foolproof. You are assured of uniformly optimum characteristics by electronic control of pulse forming. Thorough aging achieves maximum stability. You may operate these transistors up to 55°C. And you can order both CBS-Hytron PT-2A and PT-2S for immediate delivery.

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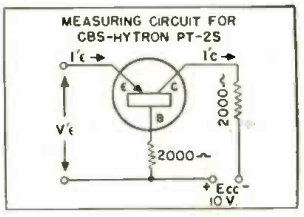
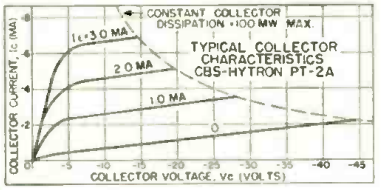
1. Single-ended construction gives maximum mechanical stability.
2. Rugged triangular basing design resists shock and vibration.
3. Dual-purpose connections permit use of flexible leads or stiff plug-in base pins.
4. Direct soldering of germanium wafer to base support guarantees positive contact, avoids flaking.
5. Glass-filled plastic case and high-temperature impregnating wax assure moisture-resistant, trouble-free operation.

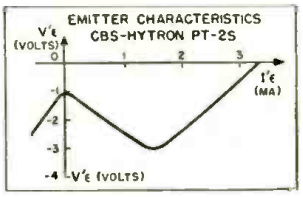
BASING AND SOCKET

Transistor Symbol | Basing Diagram (bottom view) | CBS-Hytron T-2 socket

Note similarity of pin layout to that of transistor symbol. CBS-Hytron type T-2 transistor socket features groove to guide pins into socket. Also anti-burn-out design to insure that base connection of transistor will always be made first.







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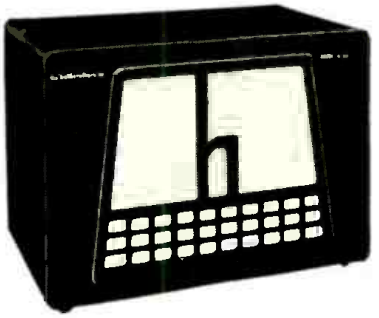

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For the RECORD

BY THE EDITOR

CONELRAD AND AMATEUR RADIO

AS EVERYONE knows by now, *Conelrad* (*Con*trol of *El*ectromagnetic *Rad*iation) is an FCC project to prevent the use, by enemy forces, of the nation's r.f. sources as navigation aids in an attack. While *Conelrad* has so far been publicized in its application to commercial broadcasting, every radio service will have to have its own *Conelrad* plan in the near future.

At a recent conference we attended in Washington, amateur representatives sat down with officials of the FCC, the NCDA, and the military to devise a way to apply *Conelrad* to the amateur service.

The particular systems of *Conelrad* developed for commercial broadcasting obviously cannot be applied to the entire Amateur Radio Service, although something similar will be worked out for stations in *RACES* (Radio Amateur Civil Emergency Service). *Conelrad*, for the hams, will involve flashing a "Radio Alert" to all operating amateur stations, so that all transmissions can be shut down with minimum delay, to prevent their use for direction-finding or homing.

It was the avowed intention of the FCC to adapt *Conelrad* in ways that would be the least burdensome to the amateurs. We hams were not called in to listen to proposed rules and make comments. Instead, the problems were handed to us and we were asked to provide the proposed rules. The usual FCC "Notice of Proposed Rule-Making" will be issued, and all hams and amateur groups will have the right to file comment. Keep in mind, however, that the National Security Resources Board and the Department of Defense will have to pass on *Conelrad* plans, and they may demand something more stringent than what the FCC proposes.

Basically, it will be required that all active amateur stations be able to receive the same Radio Alert that will trigger *Conelrad* for the broadcast stations. This, as far as FCC is concerned, can mean anything from a fancy "autocall" gadget to an ordinary a.c.-d.c. set always tuned to a local broadcaster. Most ham households have at least one of these "midgets" around. If an enemy attack is imminent, the Radio Alert will be given over all broadcast stations in the affected region by keying the carrier, in a simple way, for fifteen seconds, and sending a 1000-cycle tone for fifteen seconds. This sequence can be used to trip an alarm or simply to attract the listener's attention. Following a brief Civilian Defense announcement, the station will move to its *Conelrad* frequency. As proposed, it will *not* be necessary for the ham to monitor a broadcast station twenty-four hours a day, but only while he is operating, and even intermittent checking (before each amateur transmission) of the broadcast carrier will be satisfactory. If the carrier isn't there, the ham can check to see what happened to it, and act accordingly.

The Commission does not at present prescribe how an amateur shall receive the alert. It will require him to be able to receive and act on it; how he does it will be up to him. No ham will be forced to own any gadget.

The question of getting the amateurs back on the air after the "all-clear" came up for discussion. *Conelrad* itself could do this effectively, but the amateurs themselves suggested that normal operation should not be resumed until "affirmatively authorized" by the FCC. Except for pre-announced drills, *Conelrad* will not be used unless the chips are really down. In that case, ordinary amateur operation would have to cease, as it did after Pearl Harbor. There would only be chaos if *Conelrad* triggered the hams back on the air while FCC was trying to implement an order to shut them down. In the unlikely event of a "false alarm," FCC could at once authorize normal activity. *RACES* will continue in any event.

The problem of providing every amateur with a cheap, foolproof alerting device is a challenge to the tremendous inventiveness of the amateur body. Many simple automatic-alarm circuits have been developed, and we plan to publish late designs. It seems to us that transistors would be ideal in this application. A continuously-running transistor monitor could be run off a couple of dry cells, would seldom overheat, burn out, or lose its power source in an emergency, an important consideration from the standpoint of family protection.

The various government experts, present at the conference, cited the amateurs' past record of cooperativeness and expressed confidence that the hams would, as always, act in the national interest. It was heartening indeed for us to participate in the discussions and to observe the FCC's reluctance to burden the amateurs unduly; its refusal to seek the "easy way out" by shutting them down prematurely, its procedure of letting the hams present work out solutions and proposed rules, and the friendly cooperation and unanimity on final decisions. The FCC is to be congratulated on their approach to the problem. . . . . O. R.

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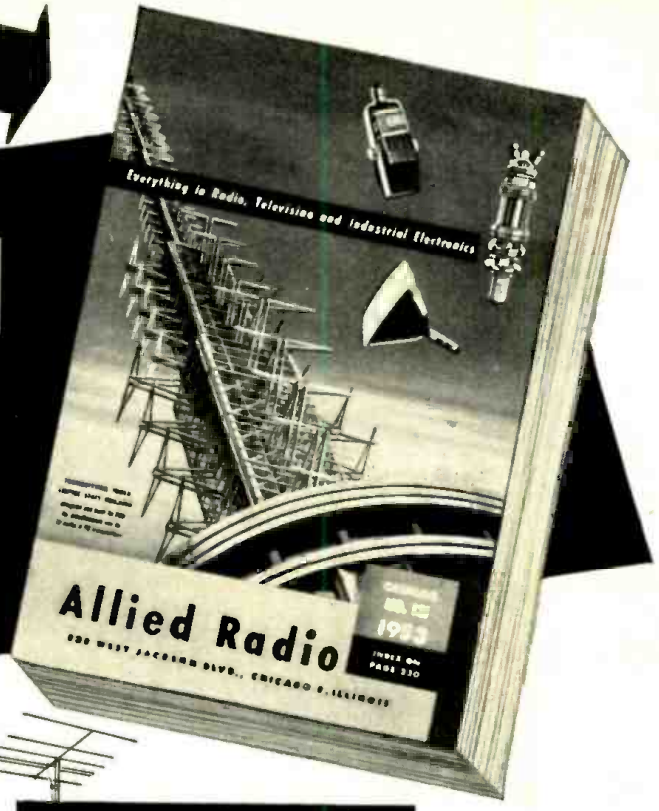

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C	8	6	62
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E	8	4	67
F	8	5	42
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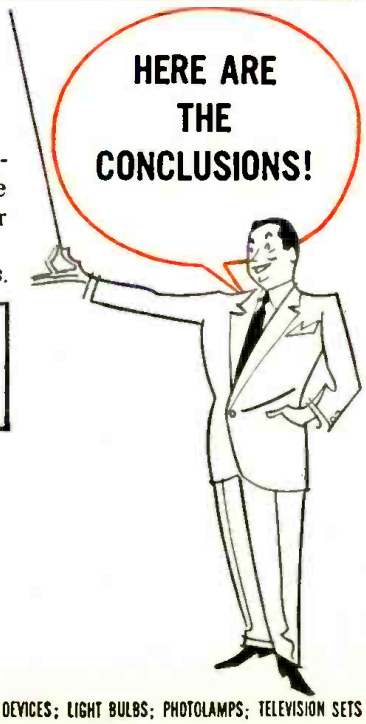

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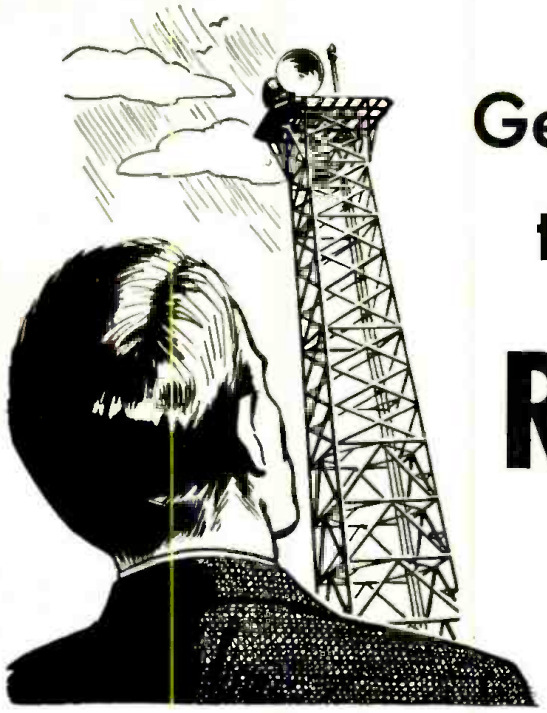

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There is absolutely nothing to compare with the brilliant, full-bodied, "live" tones of the Classic 25 by Newcomb, its unique "Audi-balance" feature or its beautifully finished complete remote control with the "Adjusta-panel" to extend shafts for easy cabinet mounting. **All eight models have this exclusive "Adjusta-panel" feature.** A crossover selector simplifies attainment of correct playback response, includes foreign and domestic frequencies as well as the A.E.S. recommended curve. **The A.E.S. standard is provided on all eight models.** "Fletcher-Munson" compensated volume control maintains perfect aural balance **on all eight models.** The tremendous range of the Classic 25 power amplifier extends from below 10 to over 100,000 cycles, a by product of perfection through-out the audible range from 20 to 20,000 cycles. Response is flat from below 10 to above 30,000. All eight models feature **frequency response ±1 db from 20 through 20,000 cycles or better.** All models but one include a built in, compensated pre-amplifier to meet needs of wide variety of magnetic and crystal pickups.

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Exclusive Newcomb features make all eight of these new amplifiers easier to install and make possible savings in cabinetry and labor often greater than the cost of the amplifier itself. Investigate all the many advantages of these superb new custom home amplifiers. Send for detailed information and installation diagrams in catalog of all 8 models priced from $39.50 to $269.50 audiophile net.

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*T. M.

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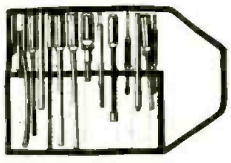
G-C DUPLEX TUBE PIN STRAIGHTENER

Handiest tube pin straightener you ever saw! Straightens pins on both miniature and jumbo miniature tubes, both 7- and 9-pin types. Precision made steel dies molded in durable plastic.

No. 8655 List $2.50



G-C DELUXE TV ALIGNMENT TOOL KIT

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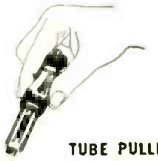
No. 8280 List $12.90



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For No. 4 and 6 studs, color coded for easy identification. Spring steel recessed tips.

No. 8722 List $1.05

G-C TELEVISION 2-IN-1 9" LONG-REACH DUPLEX ALIGNER

For hard-to-get-at No. 4 and 6 studs. Spring steel recessed tips, color coded. Unbreakable plastic.

No. 8721 List $1.25

G-C "SHORTY" TV ALIGNMENT SCREWDRIVER

Only 2" long overall, gets into cramped spots, under tubes, etc. Fits No. 4 and 6 studs. Unbreakable plastic, spring steel tips.

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Specially made for K-Tran I.F. Transformer tuner slugs. Bone fibre with plastic handle. 6½" long.

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NEW G-C- LONG ARM TV TOOL

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TV ANTENNAS

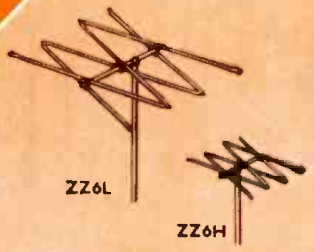
SUBURBAN MODELS

Models ZZ4A and ZZ6A give you all-channel (2 thru 13) reception in ONE SINGLE BAY ANTENNA. The Model ZZ4A has excellent gain and is designed for suburban areas. Model ZZ6A has even greater gain and provides excellent all-channel reception in near fringe areas.

From ultra-ultra fringe to metropolitan areas, the sensational new TRIO ZIG-ZAG TV Antennas are providing clear, enjoyable TV pictures.

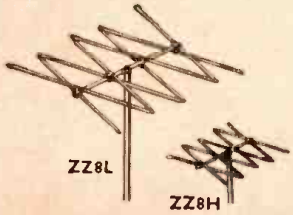
Enthusiastic reports are pouring in from across the nation, testifying to the high efficiency of the new, exclusive TRIO ZIG-ZAG TV Antenna design.

Yes, results — not mere claims — have made the TRIO ZIG-ZAG America's most wanted TV antenna!



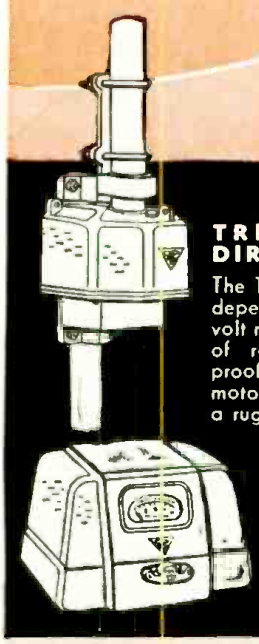
NEAR FRINGE MODELS

For near fringe area reception, the Models ZZ6L and ZZ6H are recommended. Model ZZ6L covers Channels 2 thru 6, Model ZZ6H is for Channels 7 thru 13. Both antennas offer high gain with patterns and front-to-back ratios similar to cut-to-channel yagis.



FRINGE MODELS

Models ZZ8L and ZZ8H were designed for normal fringe area reception and provide clear, snow-free pictures. Forward lobe patterns and front-to-back ratios are similar to a good single channel, multi-element yagi.



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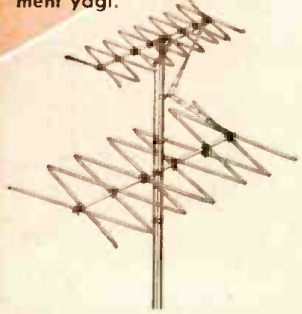
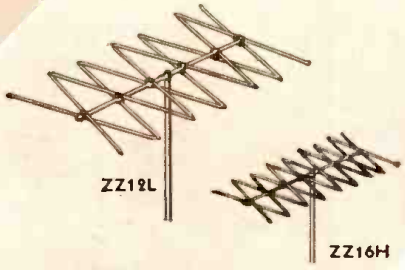
The TRIO Rotator is America's most dependable — has two powerful 24 volt motors — one for each direction of rotation. Absolutely weatherproof, permanently lubricated. All motors, shafts and gears mounted on a rugged, one-piece casting for true alignment, strength and longer life. Every TRIO Rotator fully guaranteed for two years! Beautiful Direction Indicator has "finger tip" control — no need to hold knob for rotation. A touch of the finger starts it — a touch stops it!



ZZ12L and ZZ16H are stacked for all VHF Channel Reception



ULTRA FRINGE MODELS

The extremely high gains of the ZZ12L and the ZZ16H models provide unequalled reception in ultra-fringe areas. Model ZZ12L covers Channels 2 thru 6 and Model ZZ16H, Channels 7 thru 13. These two models when stacked, are fed with only one 300 ohm line and provide ALL VHF CHANNEL RECEPTION. Line match is excellent and front-to-back ratios are unusually high.

** To provide even greater strength, TRIO Antennas now have stamped steel element clamps.*

TRIO

TRIO MANUFACTURING COMPANY • GRIGGSVILLE, ILLINOIS

Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE WASHINGTON REPORT on the state of communications in the nation, prepared annually by the Commission and its able staff, this year reveals a host of startling facts. For the first time, we are told, the number of radio authorizations on the FCC books has exceeded the 1-million mark.

Noted, too, is the fact that there are now forty-five times more nonbroadcast stations than there are broadcasters. More than 200,000 authorizations are now held by public agencies and by private industry and individuals, as compared to less than 5000 in the broadcasting camp. And the nonbroadcast figures do not indicate the actual number of transmitters involved, since a single authorization, as in the case of a police or fire department, railroad company, and so on, can cover many portable or mobile transmitters. Thus, it was said, the safety and special radio services collectively represent nearly 540,000 transmitters operating on the land, on the sea, and in the air.

The safety group with nearly 80,000 authorizations, covers the use of nearly 190,000 transmitters by the aeronautical (42,000 transmitters), marine (35,000), police (81,000), fire (11,000), forestry-conservation (14,000), highway maintenance (4200), special emergency (1900) and state guard radio services (140). The industrial group, the record shows, has nearly 14,000 authorizations, covering the use of more than 90,000 transmitters by the power (51,000), petroleum (15,000), forest products (5200), special industrial (15,000), low power industrial (2300), relay press (nearly 450), motion picture (nearly 200), agriculture (10) and radio-location services (11). In the land transportation group, nearly 6500 authorizations are indicated, covering the use of about 145,000 transmitters: by the railroad (9000), urban transit (1700), intercity bus (400), taxicab (125,000), highway truck (3200), automobile emergency (1500) and citizens radio (3000). More than 113,000 authorizations covering about the same number of transmitters, have been awarded to hams.

In addition, more than 800,000 official radio-op authorizations are outstanding; these include 679,000 commercial grants and the 113,000 to amateurs.

Reviewing the effectiveness of the public safety radio services, the report notes that one of the most progressive new facilities has been the highway maintenance setup. The use of radio by highway departments has made it possible to dispatch promptly equipment to clear road obstructions such as wrecked autos, fallen rocks, road and bridge washouts. By equipping the mobile highway vehicles with radio it has been possible to direct their operation very closely to insure maximum service. Through the use of radio, the FCC noted, many licensees have been able to demonstrate that the total cost of such installations can be recovered in from one to two years, through improved supervision and utilization of road construction equipment and personnel.

According to the Commission, interference complaints required more than 10,000 field investigations during '52 or almost 500 over the '51 figure, with most of the problems revolving about TVI; specifically 6800 cases were reported. Illegal radio stations were another source of trouble, with 114 spotted. The growing problem of interference has prompted an intensive campaign to curb radiations, which have become particularly troublesome because of their effect on TV chassis. Devices found to be especially annoying have been arc welders, garage-door openers and similar remote control devices, electric razors, heating blankets and pads, fluorescent lights, auto ignition systems, and even oscillating record players. At Blountville, Tennessee, the Commission noted, a homemade record player radiated so strongly that aircraft 15 miles away picked up the disturbance.

To stop potential radiation at the source, the Commission has established standards for some devices (diathermy and industrial heating) and suggested means of control for many types of equipment. The former can be submitted to the federal agency for *type approval* and other equipment can be offered for *type acceptance*, the report indicated. This program, it was felt, should serve to eliminate many of the basic and most troublesome types of interference.

IN ANOTHER FCC REPORT, issued in accordance with the revised Communications Act (provided in the McFarland Act), it was disclosed that

SERVICEMAN'S DIARY....by Ben Grim

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A LOOK INSIDE PROVES WHY

Sprague *dry* molding keeps the high purity paper and foil windings uncontaminated during manufacture.

Enlarged cut-away view of Sprague Telecap.

This exclusive hollow eyelet terminal permits OIL impregnation *after* the capacitor is molded.

Solder-seal construction formerly used only in costly, large metal-encased capacitors.

BLACK BEAUTY TELECAPS® ARE TOPS!

★ Molded *dry* into their tough non-flammable Bakelite phenolic cases, Sprague Black Beauty Telecaps are mineral-oil* impregnated through a tiny metal eyelet under high vacuum *after* molding—the same as expensive metal-encased oil-filled jobs! No dust or moisture can contaminate the capacitor sections. This exclusive Sprague *dry assembly process* assures maximum insulation resistance, superior capacitance stability and capacitance retrace†, plus l-o-n-g life under high heat (185°F) and humidity.

★ More than 250 million Black Beauties are on the job today! Used in the most critical TV and radio circuits, they have an unprecedented failure-free service record.

★ Ask for these Black Beauty Capacitors by name and accept no substitute. *There is no other capacitor "just as good."*

★ Do you have the new Sprague TV Replacement Capacitor Manual? If not, write today to: Sprague Products Company, 51 Marshall Street, North Adams, Massachusetts.

*All units from 600 to 12,500 volts are mineral-oil impregnated.
†Only Sprague Black Beauties consistently return to the same capacitance at the same temperature time after time.

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WORLD'S LARGEST CAPACITOR MANUFACTURER

SPRAGUE PRODUCTS COMPANY IS THE DISTRIBUTORS' DIVISION OF SPRAGUE ELECTRIC COMPANY

at the end of '52, 1000 broadcast applications were still pending, and some of the station requests were becoming really ancient items. In 1944, KARM of Fresno, California, asked permission to change its frequency from 1430 to 1030 kc. Because of the still-pending decision on the seven-year clear-channel and daytime sky-wave case, this request and 77 others, too, are still waiting for action. WOWO, in Ft. Wayne, who asked for permission to use 50 kilowatts with a directional antenna about six years ago, is also waiting for a decision, delayed because of an anti-trust investigation of the station's licensee, and a review of the proposed antenna tower and its possible air hazard height and location.

WITH OVER 200 new TV authorizations now on the books, and a surge of grants on the way, it appears as if the early summer may see as many as 500 approvals recorded. During the first few weeks of the new year, the active hearing group sent out OK's for nearly 100 stations, and this record will be broken soon.

As this column is being written, all but two states (New Hampshire and Vermont) have TV and they'll probably have video-facility grants soon, too. The continued broad distribution of new TVers is strikingly illustrated in the listing appearing on page 74 of this issue. It will be noted that many western states without any TV are now among those in the approved column; Montana, to illustrate, has received three standard-band grants for Channels 4, 5, and 8. New Mexico will have a Channel 2 station, and Wyoming is now scheduled to be the home of a Channel 5 transmitter. An ultra-high station (26) has been alloted to Chicago, and in Fargo, North Dakota, a Channel 6 station will be placed on the air soon.

A BUDGET OF OVER $8-MILLION, to run the Commission during the fiscal year of '54, was submitted by former President Truman just before he left office. More than $1.5-million of the funds were said to be for radio-monitoring and direction-finding. For the broadcast division, $1,667,074 is being sought; for applied technical research and frequency allocation activities, nearly $500,000; for safety and special radio services, over $700,000; and for executive staff operation, over $1-million and a half. A boost of nearly $500,000 appears in the broadcast request to take care of the additional examiner teams that will be required to process the new station applications; such a team consists of an attorney, engineer, accountant, clerical help, and the examiner. Currently there are 10 examiner teams; the additional funds should make it possible to hire another 10 teams.

TV was described as a key medium,

(*Continued on page* 138)

RADIO-ELECTRONIC Engineering SECTION

RADIO & TELEVISION NEWS

Reg. U. S. Pat. Off.

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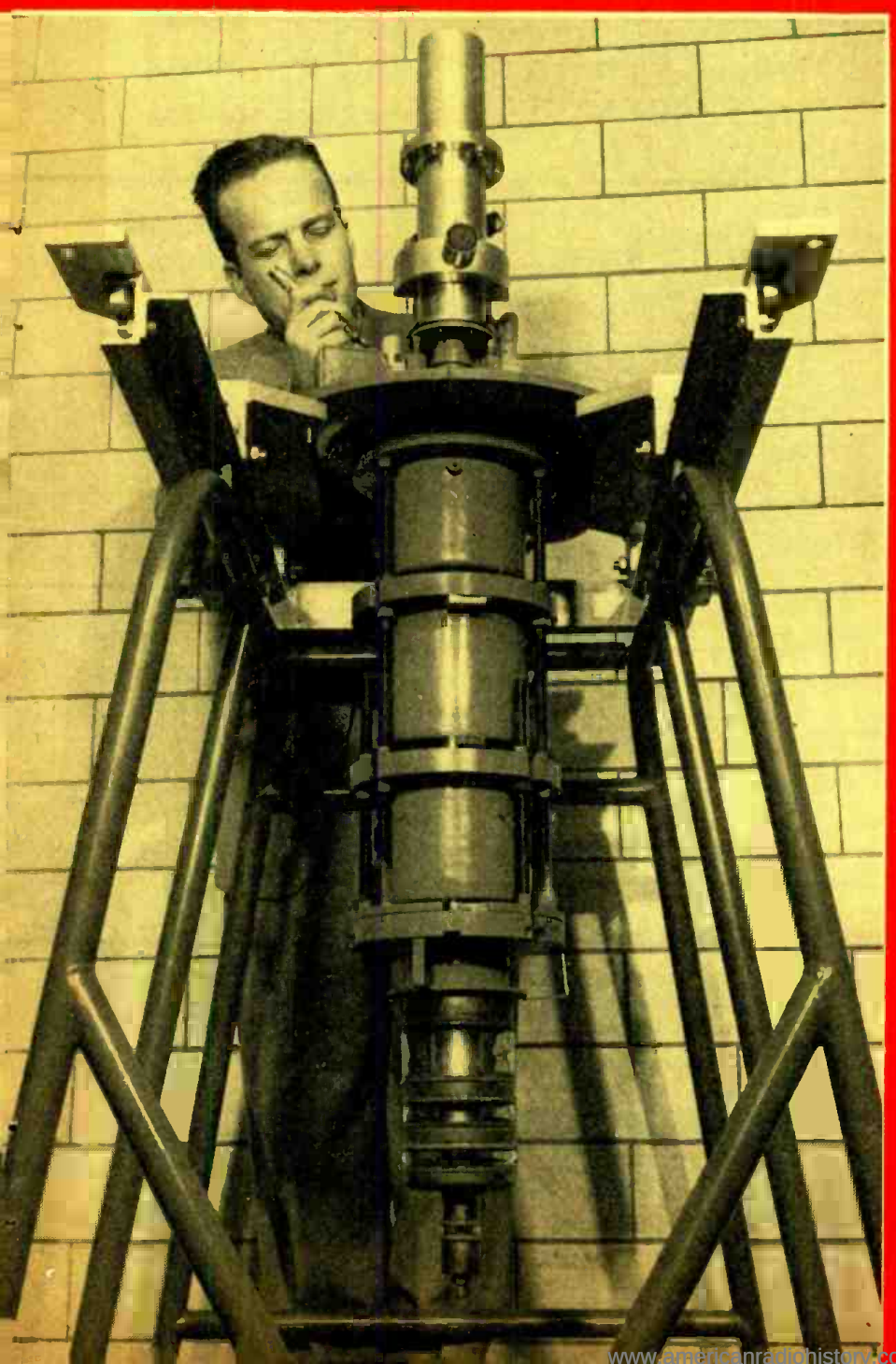

APRIL, 1953

RADIO-ELECTRONIC ENGINEERING is published each month as a special section in a limited number of copies of RADIO & TELEVISION NEWS, by the Ziff-Davis Publishing Company, 366 Madison Avenue, New York 17, N. Y.

Edited by H. S. RENNE

and the Radio & Television News Staff

This 15-kw. klystron for u.h.f. TV was developed for the General Electric Company by Varian Associates, Inc., to supply the power for WHUM-TV in Reading, Pa.

for *Stock* Hermetically Sealed Components

For over fifteen years UTC has been the largest supplier of transformer components for military applications, to customer specifications. Listed below are a number of types, to latest military specifications, which are now catalogued as UTC stock items.

RCOF CASE

Length 1 25/64
Width 61/64
Height 1 13/32
Mounting 1 1/8
Screws ..... 4-40 FIL.
Cutout ..... 7/8 Dia.
Unit Weight ..... 1.5 oz.

MINIATURE AUDIO UNITS...RCOF CASE

Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	DC in Pri., MA	Response ± 2db. (Cyc.)	Max. level dbm	List Price
H-1	Mike, pickup, line to grid	TF1A10YY	50,200 CT, 500 CT*	50,000	0	50-10,000	+ 5	$16.50
H-2	Mike to grid	TF1A11YY	82	135,000	50	250-8,000	+21	16.00
H-3	Single plate to single grid	TF1A15YY	15,000	60,000	0	50-10,000	+ 6	13.50
H-4	Single plate to single grid, DC in Pri.	TF1A15YY	15,000	60,000	4	200-10,000	+14	13.50
H-5	Single plate to P.P. grids	TF1A15YY	15,000	95,000 CT	0	50-10,000	+ 5	15.50
H-6	Single plate to P.P. grids, DC in Pri.	TF1A15YY	15,000	95,000 split	4	200-10,000	+11	16.00
H-7	Single or P.P. plates to line	TF1A13YY	20,000 CT	150/600	4	200-10,000	+21	16.50
H-8	Mixing and matching	TF1A16YY	150/600	600 CT	0	50-10,000	+ 8	15.50
H-9	82/41:1 Input to grid	TF1A10YY	150/600	1 meg.	0	200-3,000 (4db.)	+10	16.50
H-10	10:1 single plate to single grid	TF1A15YY	10,000	1 meg.	0	200-3,000 (4db.)	+10	15.00
H-11	Reactor	TF1A20YY	300 Henries-0 DC, 50 Henries-3 Ma. DC, 6,000 Ohms.					12.00

RC-50 CASE

Length 1 5/8
Width 1 5/8
Height 2 5/16
Mounting 1 5/16
Screws ..... #6-32
Cutout ..... 1 1/2 Dia.
Unit Weight ..... 8 oz.

COMPACT AUDIO UNITS...RC-50 CASE

Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	DC in Pri., MA	Response ± 2db. (Cyc.)	Max. level dbm	List Price
H-20	Single plate to 2 grids, can also be used for P.P. plates	TF1A15YY	15,000 split	80,000 split	0	30-20,000	+12	$20.00
H-21	Single plate to P.P. grids, DC in Pri.	TF1A15YY	15,000	80,000 split	8	100-20,000	+23	23.00
H-22	Single plate to multiple line	TF1A13YY	15,000	50/200, 125/500**	8	50-20,000	+23	21.00
H-23	P.P. plates to multiple line	TF1A13YY	30,000 split	50/200, 125/500**	8 BAL.	30-20,000	+19	20.00
H-24	Reactor	TF1A20YY	450 Hys.-0 DC, 250 Hys.-5 Ma. DC, 6000 ohms . . . 65 Hys.-10 Ma. DC, 1500 ohms.					15.00

SM CASE

Length 11/16
Width 1/2
Height 29/32
Screw ..... 4-40 FIL.
Unit Weight ..... 8 oz.

SUBMINIATURE AUDIO UNITS...SM CASE

Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	DC in Pri., MA	Response ± 2db. (Cyc.)	Max. level dbm	List Price
H-30	Input to grid	TF1A10YY.	50***	62,500	0	150-10,000	+13	$13.00
H-31	Single plate to single grid, 3:1	TF1A15YY	10,000	90,000	0	300-10,000	+13	13.00
H-32	Single plate to line	TF1A13YY	10,000****	200	3	300-10,000	+13	13.00
H-33	Single plate to low impedance	TF1A13YY	30,000	50	1	300-10,000	+15	13.00
H-34	Single plate to low impedance	TF1A13YY	100,000	60	.5	300-10,000	+ 6	13.00
H-35	Reactor	TF1A20YY	100 Henries-0 DC, 50 Henries-1 Ma. DC, 4,400 ohms.					11.00

The *impedance ratings* are listed in standard manner. Obviously, a transformer with a 15,000 ohm primary impedance can operate from a tube representing a source impedance of 7700 ohms, etc. In addition, transformers can be used for applications differing considerably from those shown, keeping in mind that impedance ratio is constant. Lower source impedance will improve response and level ratings . . . higher source impedance will reduce frequency range and level rating.

* 200 ohm termination can be used for 150 ohms or 250 ohms, 500 ohm termination can be used for 600 ohms.

** 200 ohm termination can be used for 150 ohms or 250 ohms, 125/500 ohm termination can be used for 150/600 ohms.

*** can be used with higher source impedances, with corresponding reduction in frequency range. With 200 ohm source, secondary impedance becomes 250,000 ohms . . . loaded response is —4 db. at 300 cycles.

**** can be used for 500 ohm load . . . 25,000 ohm primary impedance . . . 1.5 Ma. DC.

United Transformer Corp.

150 VARICK STREET • NEW YORK 13, N. Y.

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BETA RADIATION GAUGING METHODS

By **GEORGE B. FOSTER**
Technical Director
Industrial Nucleonics Corporation

The weight-per-unit area of a material made in a continuous process can be accurately measured and controlled by means of beta radiation gauges.

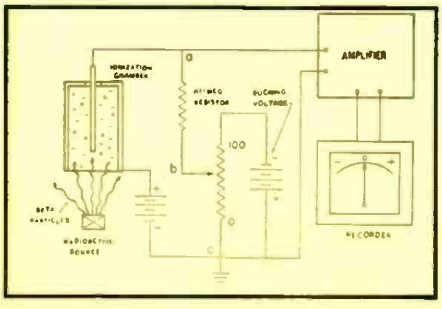
Fig. 1. Consoles which house the electronic circuitry for dual beta gauge installation.

THE manufacturer in a continuous process industry faces a serious problem today. His costs are made up of raw material, labor, overhead and taxes; his income is directly affected by the prevailing price level. In today's situation, with costs rising generally, it is a disturbing fact that the price level has not moved correspondingly. This situation has resulted in higher "break-even" operating levels for more and more industries. In examining ways and means of reducing costs, the manufacturer finds that he has no control over taxes, and little control of overhead and labor. The one quantity which can spell the difference between profit and loss is the cost of his raw material.

Virtually all of the raw materials entering into the manufacturing process are purchased on a weight basis, but the majority of finished goods is sold on a unit basis. Thus, control of the weight per unit becomes a vitally important factor. Since a unit—whether it be a filing cabinet, a plastic table cloth or an automobile tire—is finished to a given dimension, it constitutes a fixed area of material used in its fabrication. Thus, the finished weight is a direct function of the weight-per-unit area.

The availability of radioisotopes, which are essentially a by-product of the nation's atomic energy program, has opened up a whole new field of instrumentation. These radioactive materials have the property of extreme stability in the nature of their radiations. This means that it has become possible for the first time to construct noncontacting instruments which read the quantity "weight-per-unit area" directly. The use of beta radiation in a suitably designed gauge will give the same information that is obtainable by cutting out a sample of material, determining its area, and weighing it in a chemical balance. The importance of the information obtainable from measurements with a balance is readily apparent in plastic film and coated fabric industries. In many instances, a festooning stack has been installed to give the machine operator time to die out a sample of the material which he then places in a balance to determine the square-yard weight. The machine operator makes adjustments in accordance with the information obtained from this sample. His conclusions concerning the adjustments required are about as effective as predicting the outcome of a presidential election after interviewing one thousand voters. This is because the operator has no way of knowing at what point on the normal cyclical process variation he cut his sample.

Fig. 2. Basic elements of a beta radiation gauge. Material being measured is interposed between the radioactive source and the radiation detector.



The use of a gauge which reads the weight-per-unit area continuously, immediately, and at any point across the sheet permits control of the process to tolerances which are dictated only by the limitations of the machine. To achieve this control a continuous record of the material weight, as produced, must be available. In order to have meaning, this record must be both accurate and reliable. It must not rely upon the skill or memory of a machine operator to make adjustments at periodic intervals. The accuracy of the instrument must be independent of plant environment or gauge operating conditions. In particular, it must not be dependent upon an instrument technician who is required to insert standard samples, or adjust "zero set," "calibrate control," or "deflection sensitivity" controls.

In determining the operating characteristics which would meet the requirements of the continuous process industries, beta gauge designers spent a great deal of time interviewing engineers, production men and quality control managers who would be concerned with the results of an improved instrumentation program. Their experience with contacting, capacitance, and magnetic-reluctance gauging equipment all pointed to the necessity for reliability, accuracy and trouble-free operation. These objectives have been achieved. There is now available to industries processing sheet materials an instrument that will measure and record their products on direct-reading scales, and with automatic standardization which maintains an accuracy of 1%.

Figure 2 shows the basic elements of a beta radiation gauge. A source of

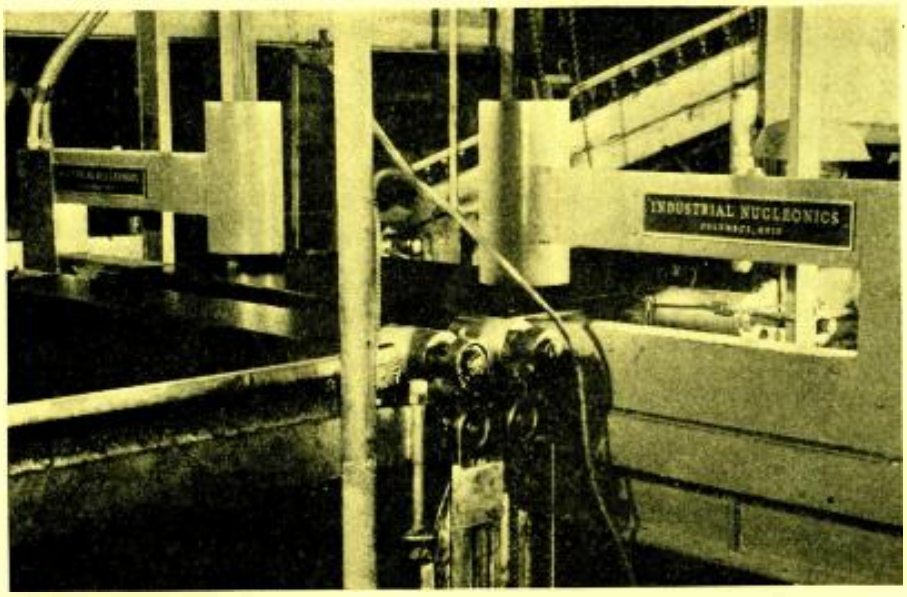


Fig. 3. Typical dual installation on a coated textile calendering machine. Source and detector are mounted on a transverse carriage.

radiation shines upward toward the detector. The amount of radiation reaching the detector is a function of the weight of material interposed between the detector and the source. Within certain limitations, the nature of the material does not affect the reading of the basic quantity, weight-per-unit area. This permits calibration of the instrument in discrete increments of weight, as opposed to "deflection from zero" presentation. The latter depends upon the machine operator's judgment while the former constitutes a measurement standard.

An instrument of this type, which is capable of giving direct readings of square-yard weight, is useful only to the extent that its readings can be trusted for their accuracy. No matter how useful the information may be, if it cannot be relied upon 100% of the time, such an instrument has only marginal utility. An analogy might be drawn between this type of instrumentation and the operation of a calculating machine. It would not matter how easily and rapidly the solution to complex accounting problems could be obtained with such a machine unless it could be relied upon to give correct answers every time. If it gave correct answers *almost* all of the time, such a machine would not be employed in the computation of balance sheets or important accounting information. The answers would be worked out in longhand, however laboriously, in order to insure their reliability. Errors in an instrument employed for continuous process control cannot be tolerated any more than they would be permitted in the accountant's calculating machine. The results would be equally costly.

Fig. 4. The absorption characteristic typical of beta-emitting radiosotopes.

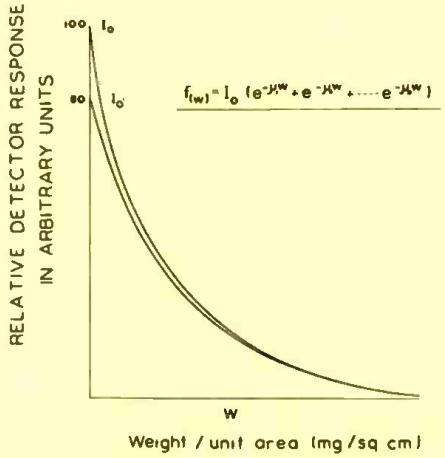


Figure 4 shows the absorption characteristic typical of beta-emitting radioisotopes. The function of the relative absorption of the beta particles vs. absorber weight is peculiar to the isotope used and is determined solely by the energy spectrum resulting from the decay scheme of the parent element. Strontium 90, one of the industrially useful beta emitters, is particularly attractive beause of its long half-life and good penetrating ability. This isotope, with a half-life of 25 years, will provide measurements of plastic material up to a thickness of .2" and up to .030" of steel. While the absolute level of the radiation is decreasing continually at a rate determined by the half-life, the function of the relative absorption vs. sample weight remains a constant. This relationship is expressed:

$$I = I_0\ (e^{-\mu_1 w} + e^{-\mu_2 w} + \ldots + e^{-\mu_n w})$$

where I represents the response in the detector of radiation at any weight-per-unit area w, I_0 represents the response in the detector with no absorber between the source of radiation and the detector, and μ_1, μ_2 . . . μ_n represent absorption coefficients peculiar to the isotope employed. Through the use of suitable instrumentation, readings of the ratio of the absorbed to the unabsorbed radiation may be obtained independently of the absolute level of the radiation. Since the terms e and μ are constants, the readings become a function only of w, the weight-per-unit area, which is the quantity being measured. The response of the detector is shown to have been reduced to a quantity of 80% that of the initial value in the second curve of Fig. 4, with this unattenuated response designated I_0'. Such an attenuation could have occurred, for example, through the natural decay of the isotope used. Suitable circuitry must be provided to effect the compensation necessary to cancel these changes in amplitude as they affect the instrument readings.

A typical dual installation on a coated textile calendering machine is illustrated in Figs. 1 and 3. The use of two gauging elements provides continuous indication of the levelness of the sheet as produced. Readings from each detector are combined on a two-pen strip chart indicator-recorder. Use of different colored inks provides differentiation between the traces. Gauging elements are mounted on a traversing carriage supported by a heavy beam structure. The operator may select at will the point across the web which he desires to measure. This traversing feature also makes it possible to obtain information on the profile of the sheet.

A typical trace from a dual installation shows good operation of a calendering process through routine use of beta gauge instrumentation. The absence of sample holes, which is particularly noticeable on such a chart, represents a considerable saving in material which was formerly wasted in cutting samples.

The single-pen chart trace in Fig. 6 was taken from a tire fabric calender by using the beta gauge as an indicating device only, and not as a controlling instrument. A wide cyclical variation occurs shortly after restarting the calender following a period of shutdown. The sharp swing to light weight, which shows up shortly after restarting, is due to the squeeze that was exerted on the section of material left in the pinch between the rolls during the shutdown. The wide bandwidth of repetitive variation was determined to have been caused by roll eccentricity resulting from temperature distortion of the rolls while stopped. It is apparent that this bandwidth slowly narrows as a more even circumferential temperature distribution is achieved. A residual bandwidth remains due to residual roll eccentricity and bearing run-out. The difficulty which a machine operator

would have in controlling the process illustrated, if he were to rely upon cutting out samples, can be readily appreciated. He would have no way of determining whether the sample was cut at the peak of a "zig" or a "zag" or at the average weight.

Improvement in the operation of a machine process is readily apparent in the frequency distribution curves of Fig. 5. The curve of operation prior to beta gauge control showed that material was produced as much as .16 pounds per square yard below specification.

The foregoing illustrations have shown the utilization of this instrumentation in the plastics, textile and tire industries. Emphasis has been placed on readings of square-yard weight as a process control parameter. However, this same technique may be applied with equal effectiveness to those industries in which thickness is the traditional specification. It is a fortunate coincidence that the metal industries are processing materials of essentially constant density. A calibration of the beta gauge in terms of thickness is both practical and accurate, provided the material being measured is of a known and constant density. Thus, instruments are currently being used for the control of precision-rolled metal foils to an accuracy of 20 microinches. The extension of beta radiation gauging methods to the volum production of cold-rolled steel strip stock will find wide application in the steel industry with the first signs of a buyer's market. Commercial tolerances of $\pm 10\%$ will not sell steel when $\pm 2\%$ is attainable.

In many ways, the technique of manufacturing a wide variety of products must be considered an art today. One of the more spectacular applications of beta radiation gauges to process control may be seen in the coated abrasive industry. This process involves the application of "maker" glue to a paper or fabric base, the deposition of an abrasive grit, a drying sequence, and the application of sizing glue. The operation is characterized by the term "100% scrap." This means that if the control of the process is inadequate at any point along the line, the total investment in material and machine time is lost. The cost of the cloth base is not only augmented by the amount of the glue and grit applied but a rejected roll will not even burn satisfactorily; the reject roll must be stored until someone can be obtained and paid to remove the debris from the premises. Beta gauges applied at every point in the process have afforded spectacular savings both in improved quality and reduction of scrap material. These gauges have, in effect, projected the art and experience of the machine operator onto direct-reading scales. It is no longer necessary to wait for Old Gus to put his finger into the glue pot before making proper machine adjustments. The first gauge reads the weight of the base fabric. The second gauge reads the weight of the base fabric after the application of the glue coating. A subtracting recorder indicates directly in pounds per ream the weight of glue applied. Further down the line, a gauge measures the weight of this combination after a drying process is used and a subtracting recorder reads the drying rate. A fourth instrument, reading the finished weight after the application of sizing glue, provides the information required to obtain a reading of the sizing glue alone. The availability of continuous records has provided management with a precision tool for the control of the process and an accurate measure of the costs.

Several basic questions must be answered before this new measurement technique can logically be applied to process control by the manufacturer. There must be a recognition of the fact that the variations in his product are of sufficient magnitude to constitute a serious limitation to the standards of quality which he can maintain. In those companies which have followed a consistent program of quality control, there are records which can demonstrate the existence of significant problems in process control. In other companies, this evidence has been made available only indirectly in the form of customer complaints and the rejection of material. A further consideration is the necessity for any instrumentation program to be able to assure accurate and reliable information on the process. Strip chart records of production must be accepted as the measurement standard not only by the machine operator but also by the production, accounting, quality control and sales departments.

The most important factor to be considered is the ability of this new measurement technique to assure the production of a better product at lower cost. In a process in which the machine characteristics require the setting of a nominal specification 15% above the minimum acceptable weight-per-unit area, this percentage can be reduced by accurate instrumentation. Take the case of a machine with a normal cyclical variation of $\pm 5\%$, a 5% safety factor, and a gauging accuracy of 5%. An immediate reduction of 4% in the specification can be achieved with a gauge of 1% accuracy. When applied to a process involving an output of several million dollars annually, this saving rapidly mounts into hundreds of thousands of dollars. Experience in the rubber, plastics, abrasive and steel industries has shown that such savings are not merely projected or theoretical but are being achieved on a month-to-month basis.

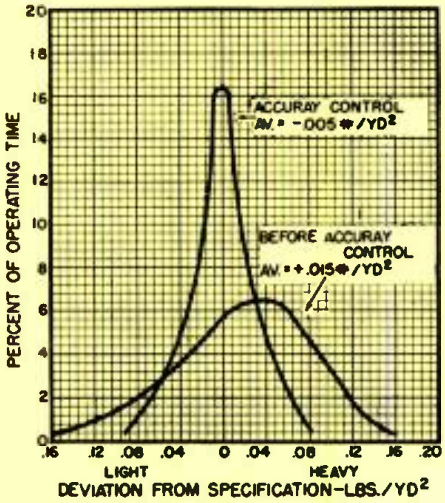
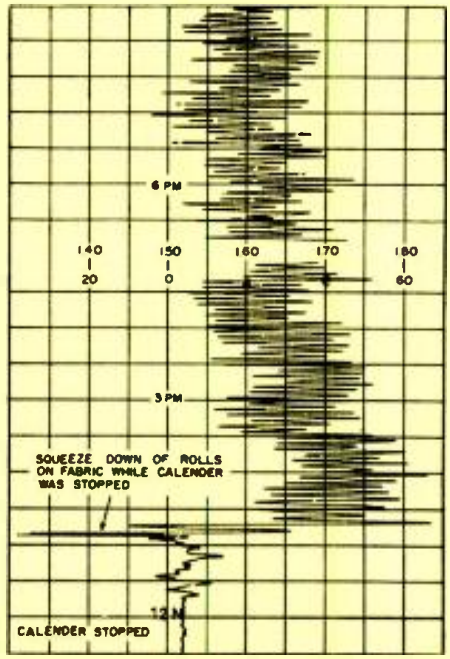


Fig. 5. Frequency distribution curves showing the close process control attainable with beta radiation gauging.

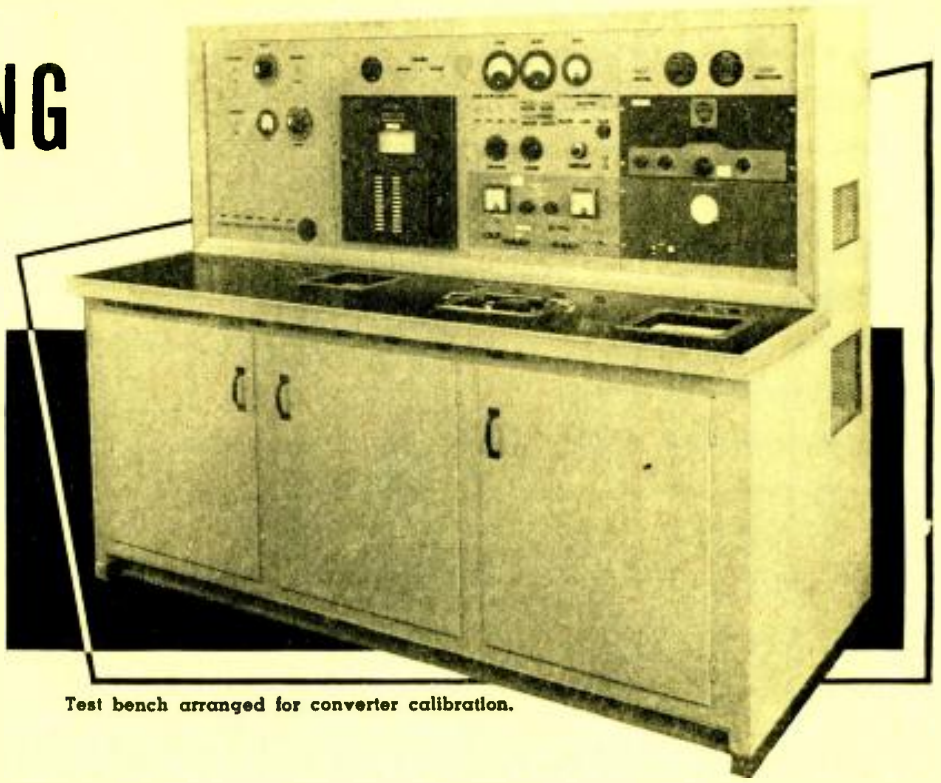
To measure means the ability to control, and automatic process control has been achieved through the use of beta radiation gauging. It is a serious step to entrust the control of one's process to a gauge which supplants the twenty years' experience of the machine operator. Standards of reliability and accuracy required of an instrument that is to perform the function of automatic process control are very high. The beta gauge has met these standards.

Fig. 6. Single-pen chart trace taken from a tire fabric calender using the gauge for indication only, not for control. The upper portion shows decreased cyclical fluctuations due to more even temperature distribution in rolls after calender was started.



TELEMETERING CONVERTER CALIBRATION

By
EDWIN N. KAUFMAN



Test bench arranged for converter calibration.

Equipment and techniques which are used in converter calibration, and the accuracy which can be achieved.

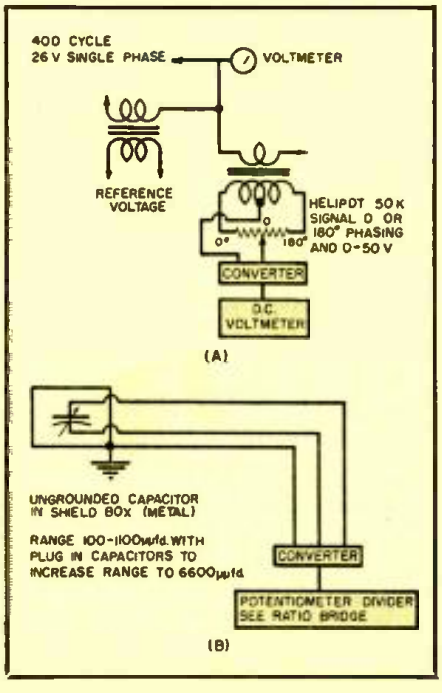
A TELEMETERING converter is a device that receives the output of a transducer and converts it into a d.c. signal which varies from 0 to 5 volts over the operating range. Such a converter is usually electronic, and is used with transducers which are incapable of providing the 0 to 5 volts d.c. necessary to frequency-modulate the center frequency of a subcarrier oscillator.

There are six types of converters in general use:

The *thermocouple converter* either produces a direct output of 0 to 5 volts or mechanically positions a potentiometer divider which in turn is placed across a stabilized supply of 5 volts, providing an output proportional to the input signal.

The *frequency type of converter* is insensitive to voltage amplitude over a wide range but produces a d.c. output voltage proportional to the input frequency. It is used either with fuel flow transducers, which produce an a.c. frequency in proportion to fuel flow, or with a.c.-producing tachometer generators.

Fig. 1. (A) Voltage and direction-sensing converter. (B) Capacity (fuel quantity) converter calibration.



The *strain gauge converter*, sometimes called a carrier system, is sensitive to a.c. voltages, the amplitude of which cause a proportional d.c. output voltage. It is used for many purposes from fluid and gas pressure measurements to strain measurements of the missile frame and airfoil.

The *voltage and direction-sensing converter* is used in conjunction with autopilot systems and with rate gyros. A rate gyro is a device that provides a signal proportional to the speed with which it is rotated; it can be used to indicate missile roll, pitch, and yaw. The output voltage also shifts phase in reference to a reference voltage, and this phase shift is detected to provide a "sensing" or direction-of-motion signal. Instead of ranging between 0 to 5 volts d.c., the converter output ranges about a center point of 2.5 volts. Changes in the rate of rotation cause the voltage to rise or fall. Normally, clockwise motion produces a rising voltage while counter-clockwise motion produces a falling voltage. It can be seen that the output voltage indicates the direction as well as the rate of motion.

The *capacity converter* transfers a function such as fuel quantity into potentiometer divider motion. The capacity transducer is an "air" capacitor placed in a fuel or oil tank. As the fuel or oil level decreases, the dielectric constant of the condenser decreases, thereby lowering the capacity of the condenser; thus, the level of oil or gas in the tank can be measured as a capacity function.

The *potentiometer divider* converts mechanical motion into a change of potentiometer slider position.

In dealing with these converters, it is necessary to establish the accuracy of calibration that is desired, and then to consider the cost of calibrating to this accuracy. In many cases, the standard of accuracy will be relaxed when the cost of equipment is determined, and the fact is recognized that the over-all typical telemetering system accuracy is only rated ±4%.

Calibration of these converters can best be explained by discussing each converter individually.

The *thermocouple converter* requires, for the input, an accurately known source of d.c. millivolts. This can be obtained by one of two methods. The first, which the author employed, is to use a Helipot potentiometer and series resistor across a 1.5-volt dry cell, and to use an indicating millivolt potentiometer to show the input voltage accurately. This will provide an input accuracy on the order of ½ to 1%, depending on the indicating potentiometer. A less expensive way is to use a *General Radio* Microvolter (Model 546). However, if this

is done, the meter on the Microvolter cannot be used. Instead, a 1% d.c. voltmeter must be used to adjust the input voltage accurately. It will provide an over-all input accuracy of 3%. It should be realized that the total accuracy of measurement will be approximately the input accuracy squared, added to the output accuracy squared, and the square root taken. Thus, for example, if the input and output accuracies are 5%, the over-all accuracy will be very close to 7%.

Output voltage, if directly produced, can be measured with a 200,000 ohms/volt voltmeter. The one used by the author was a *Weston* Model 622, having a range specified as 0 to 5 volts d.c., with a five-microampere movement. This meter is rated at ½% accuracy. If the output of the converter is mechanical motion, as in a potentiometer divider, an accuracy of ½% can be obtained. Potentiometer dividers will be covered more fully later in this article.

The *frequency converter* requires an audio oscillator whose range depends upon the application, an EPUT (events per unit time) meter to measure the input frequency accurately, and the *Weston* 200,000 ohms/volt meter to measure output voltage. The converter input and output loading should be as close as possible to the actual circuit loading. As the converter output feeds into a 500*K*-ohm resistor, the output measuring voltmeter does not "load" the circuit due to its high resistance. If desired, a 500*K*-ohm resistor can be shunted across the converter output. Most audio oscillators are rated in the range of 2% dial accuracy. If 2% accuracy is satisfactory, the EPUT meter can be eliminated; if not, the EPUT meter will provide an input accuracy of much better than ½%. This meter should have a ten-second time base for use in measuring frequencies below 100 cps. The input can be checked to make sure that the amplitude of the signal does not cause a change in the output by varying the input amplitude over a known range.

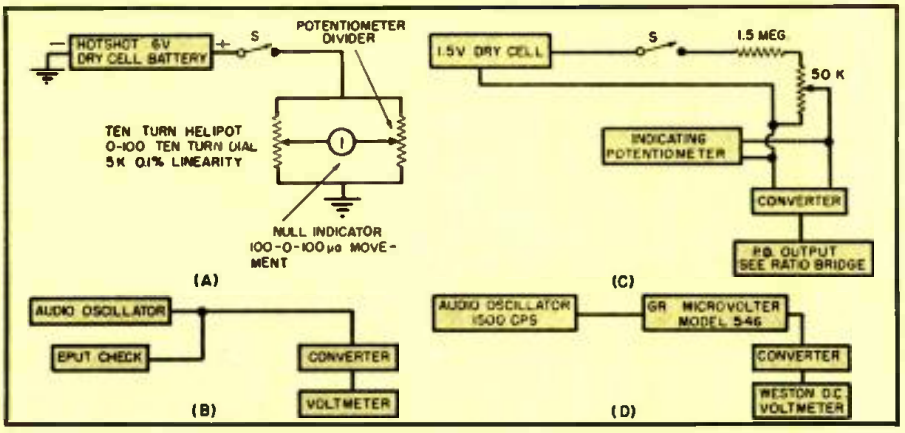


Fig. 2. (A) Ratio bridge for potentiometer dividers. (B) Tachometer converter. (C) Thermocouple converter with potentiometer divider output. (D) Strain gauge converter.

A *strain gauge or carrier converter* requires an a.c. millivolt input signal. This can best be obtained from an audio oscillator to provide the proper a.c. frequency (most carrier systems operate on between 1000 to 3000 cps), and a *General Radio* Microvolter to reduce the audio oscillator voltage to the millivolt range. The converter d.c. output voltage is again indicated by the *Weston* voltmeter. Over-all accuracy is about 3%. As measurements of this type are often critical, higher calibration accuracy may be desired. Accuracy can be increased by using a precision laboratory dynamometer voltmeter rated at ½% to replace the rectifier type of meter used in the Microvolter. The Microvolter can then be calibrated to better than 1% if it is used in an air-conditioned laboratory. However, two important points should be noted. One is that an audio oscillator cannot supply the 3 to 8 watts of meter power consumption necessary, but will require an audio power amplifier following it. The second is that meters of this accuracy are expensive. It is impossible to buy vacuum tube voltmeters which will indicate in the a.c. millivolt range with an accuracy of better than 2%. For this reason, and because of the simplicity of the circuit and the lack of vacuum tubes, the Microvolter is considered superior.

As the *voltage and direction-sensing converter* requires a.c. voltages of various ranges, use of a rate gyro having an output of 0 to 4 volts is recommended. Besides providing a voltage of 0 to 4 volts for the input to the converter, it must provide this voltage in-phase or 180° out-of-phase with the line (or reference) voltage. This can be

(*Continued on page* 31)

Table 1. Characteristics of various types of converters, and methods of calibration.

Type	Input	Input Supply	Output	Calibration
Thermocouple	0-50 d.c. millivolts	1.5-volt battery and Helipot—range checked by indicating potentiometer	Potentiometer divider	Ratio bridge
Tachometer (frequency type)	10-1000 cps	Audio oscillator checked by EPUT meter	0-5 volts d.c.	*Weston* 200,000 ohms/volt voltmeter (Model 622)
Strain gauge	0-100 a.c. millivolts 1500 cps	Audio oscillator and *GR* Microvolter	0-5 volts d.c.	*Weston* 200,000 ohms/volt voltmeter (Model 622)
Voltage and direction-sensing	0-50 volts a.c. in-phase or 180° out-of-phase	Transformer and Helipot arrangement for phasing —VTVM for voltage range	0-5 volts d.c.	*Weston* 200,000 ohms/volt voltmeter (Model 622)
Capacity (fuel quantity)	Capacity (above ground)	Special variable capacitor	Potentiometer divider	Ratio bridge
Potentiometer divider	Mechanical motion	Mechanical motion	Potentiometer divider	Ratio bridge

NEGATIVE RESISTANCE IN GERMANIUM DIODES

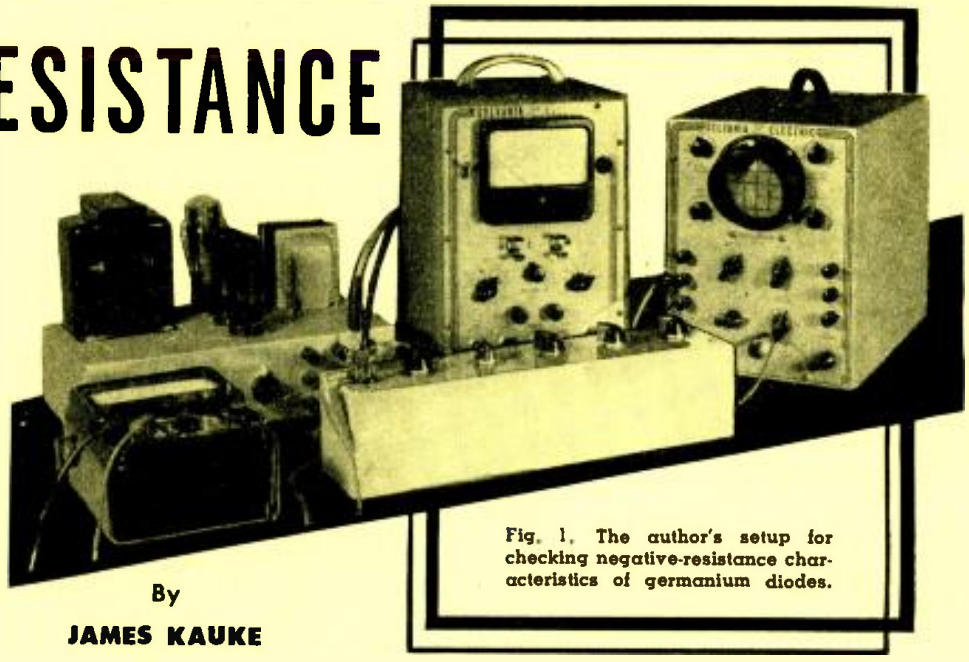


Fig. 1. The author's setup for checking negative-resistance characteristics of germanium diodes.

By
JAMES KAUKE

Simple oscillator, amplifier, and trigger circuits can be based on diode negative-resistance characteristics.

IN THE familiar point-contact germanium diode, negative resistance is a somewhat obscure and presently unexploited characteristic. Most applications of this effect currently are in the laboratory stage, but they merit more than academic interest.

Germanium diodes show negative resistance at reverse voltage values somewhat higher than rated continuous reverse working voltage. Negative resistance also shows up at high values of forward voltage, but diode burn out usually occurs quickly after the forward level is reached. This article is concerned, therefore, only with the negative resistance of the reverse characteristic.

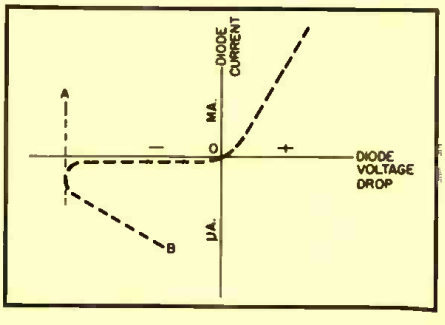
Figure 2 shows the static characteristic of a typical germanium diode. From this plot, the following is evident: as the reverse current is increased slowly from zero, the reverse voltage drop across the diode increases rapidly and finally reaches point A; as the current is increased further, the diode voltage drop begins to decrease, as between A and B. The latter portion of the characteristic curve thus has a negative slope.

The reverse voltage at point A is listed in germanium diode tables under the heading "Reverse Voltage for Zero Dynamic Resistance." For simplicity, this voltage will be referred to here as E_p, since it is often called "peak voltage" by diode engineers. It is at the E_p point (voltage A in Fig. 2) that the dynamic resistance, dE/dI, does become zero; and from A to B, dE/dI changes sign to negative. Table 1 compares E_p with percentage overload over continuous rated working reverse voltage for a number of germanium diode types.

The negative-resistance region of the reverse characteristic is very often encountered accidentally in checking the back conduction of germanium diodes, and it is puzzling to the operator who is unacquainted with it. As the applied d.c. voltage (anode negative) is increased, the resulting current increases slowly but remains small, being of the order of a few microamperes. However, as point A (Fig. 2) is reached, the current suddenly jumps to a value of many milliamperes, giving the erroneous impression that the diode has short-circuited. Reducing the voltage and repeating the test shows that no breakdown, in the common sense of the term, has occurred.

All negative resistances show this decrease in voltage drop as current through them is increased. The reverse is also true. A common (real) resistance consumes power, and therefore is a source of loss. Negative resistance in a circuit, on the other hand, consumes no power; in fact, it may be viewed as a generator of power. An interesting property of a negative resistance is its ability to cancel an equal positive resistance shunting it. Thus, a negative resistance in parallel with a tuned circuit comprises an oscillator. Under certain conditions of operation, a negative resistance will also provide amplification in a simple circuit. Practical demonstrations of both phenomena, oscillation and amplification, are described in this article.

Fig. 2. Static characteristic curve of typical germanium diode.



To date, semiconductor engineers have offered no simple, widely accepted explanation of the negative-resistance phenomenon. However, there has been some accounting for the effect in the complex mathematical language of solid-state physics. There is no denying that internal heating in the diode is in some way responsible. Unlike conventional resistors and conductors, semiconductors have a negative temperature coefficient of resistance. It is possible, therefore, that as the temperature of the diode rises with increased current flow, the resistance decreases, thereby lowering the voltage drop. The writer checked E_p values for a number of diodes at room temperature and at 10-degree intervals to —50°, noting that E_p (and the back resistance at all applied voltage levels) became higher as the temperature was lowered. The converse was also found to be true; negative resistance is reached much sooner in diodes heated above ambient temperature. With the diodes immersed in liquid nitrogen, E_p could not be located at all, even at applied voltages of —300 volts. Restoration to room temperature re-established original characteristics.

The property of negative resistance has been used several times as the basis for experimental crystal diode oscillators[1, 2, 3, 4, 5]. It has been utilized for

voltage regulation[1, 2, 3], as well and gives promise of application in special-purpose trigger and switching circuits. Nothing has appeared previously on the direct use of the germanium diode as a negative-resistance amplifier, although Dowell[6] and Becker, Green, and Pearson[7] have called attention to the application of another semiconductor device —the thermistor—as a negative-resistance amplifier.

Applications

Several interesting and provocative applications of the negative-resistance phenomenon, and of effects in and around the region of zero dynamic resistance, are possible. Figures 3 to 6 illustrate some of the possible applications.

Sawtooth Oscillator

In this application, the diode occupies the same position as a gaseous tube in the conventional *RC* relaxation oscillator circuit. See Fig. 3A. With a 1N34, the d.c. input voltage *E* is adjusted to a value between 100 and 125 volts, depending upon the individual diode, whereupon oscillation begins suddenly. In a test setup of the circuit, current *I* was 30 ma. The circuit constants shown in Fig. 3A gave a frequency of 3000 cycles.

The circuit must operate into a high impedance (100,000 ohms or more). As the insert in Fig. 3A shows, the sawtooth wave is positive-going, but is not linear. A peak voltage of 20 volts was obtained in the test setup.

Sine-Wave Oscillator

See Figs. 3B and 4. This unit was built originally as a tone modulator, for intermittent use, to be included in a special r.f. signal generator. Transformer *T*, shown in Fig. 4, is a surplus "Ouncer" transformer for coupling a 200-ohm microphone or line to push-pull grids. The secondary winding *(G* to *G)* has a measured inductance of 6 henrys.

Using a 1N54 diode, and with the d.c. voltage *E* set to approximately 100 volts, fairly clean sine-wave output was obtained at 180 cycles and 1 volt r.m.s. open circuit. Higher output voltage would have been obtained if the transformer had not had a stepdown turns ratio. Loading of the oscillator must be kept light; otherwise high distortion and lowered output voltage result.

Figure 3B is the circuit commonly employed in diode sine-wave oscillators. Air-core components are substituted for the iron-core transformer *T* when r.f. operation is desired.

Output of the sine-wave oscillator drops rapidly at frequencies higher than 10 kc. The author seldom has obtained other than sporadic and feeble operation above 100 kc., although 1-mc. oscillation has been reported by occasional researchers.

Voltage Amplifier

Amplification is a curious phenomenon exhibited by the germanium diode when functioning as a negative resistance. In this application, the diode is connected in series with a load resistance and is d.c.-biased to the negative slope of the diode's reverse conduction curve. An a.c. signal applied in series with this bias causes the circuit current to fluctuate periodically about the bias current level as a mean value. A current increase produces a voltage rise across the load resistance and a voltage fall across the diode. Under satisfactory conditions of bias voltage level, signal voltage amplitude, and load resistance, the a.c. voltage across the load resistance will be higher than the a.c. signal voltage, thus producing voltage amplification. The law of conservation of energy is not violated in this case since the d.c. bias source supplies the "local" power.

Figure 5 shows a test circuit for studying this effect. The adjustable d.c. voltage source must have as low an output impedance as is practicable and should be automatically regulated. The signal input transformer *T* must have very low secondary resistance to avoid introduction of appreciable resistance in series with the diode and load resistance.

Input and output signal voltages (E_i and E_o, respectively) are read with a.c. vacuum tube voltmeters, and the output signal is monitored with an oscilloscope to check waveform. If transformer *T* has a 1:1 turns ratio, the input v.t.v.m. may be transferred to the primary input, a more desirable point of operation for this meter.

The d.c. bias voltage, a.c. signal voltage, and load resistance are each made adjustable. There are numerous combinations of each which will operate the circuit, but only one optimum combination of the three will give appreciable amplification with an individual diode. Some diodes show good amplification with low signal voltage levels (i.e., under 1 volt r.m.s.), while others require as much as 10 volts of signal with proper adjustment of d.c. bias and load resistance.

Using types 1N34 and 1N54 diodes, the author has obtained voltage amplifications of 2 to 4 at 1000 cycles with input signal levels between 0.5 and 5 volts. In each instance, the waveform has been fair but stability poor, amplification often ceasing suddenly with a complete readjustment of the circuit required to restore it. Furthermore, some brand-new diodes exhibited no amplification whatever, showing at best a gain of 1 in the circuit.

The author has been unsuccessful in obtaining amplification at frequencies higher than 5000 cycles, but is continuing experiments in this direction. It would appear from preliminary tests that the germanium diode, like the thermistor, is adaptable only to low frequency use as a negative-resistance amplifier. Three disadvantages of the diode amplifier appear to be: (1) the high input signal level required, (2) relatively low impedance input, and (3) lack of isolation between input and output circuits.

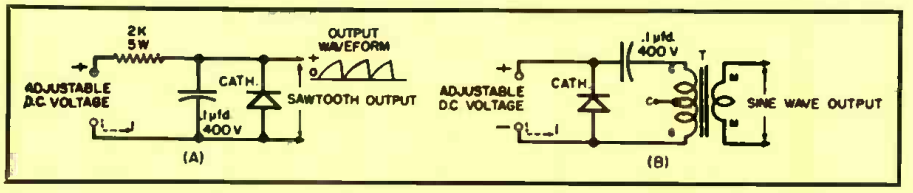
Germanium Diode Type	E_p for Zero Dynamic Resistance	Overload Represented by E_p (%)
1N34, 34A	75	25
1N35	75	50
1N38, 38A	120	20
1N39	225	12.5
1N48	85	21.4
1N51	50	25
1N52	85	21.4
1N54	75	46.5
1N54A	75	50
1N55, 55A	170	13.3
1N56, 56A	50	25
1N58, 58A	120	20
1N60	30	20
1N63	125	25
1N65	85	21.4
1N69	75	25
1N70	125	25
1N75	125	25
1N81	50	25

Table 1. Percentage overload for various diodes when operated as negative resistances.

Lock-In Circuit

In the region of the peak back voltage E_p of a germanium diode, the reverse current jumps suddenly from a few microamperes to many milliamperes as the applied reverse voltage is increased in a small step. High current then continues to flow, even when the applied voltage is decreased drastically.

Fig. 3. (A) Diode sawtooth oscillator. (B) Diode sine-wave oscillator.



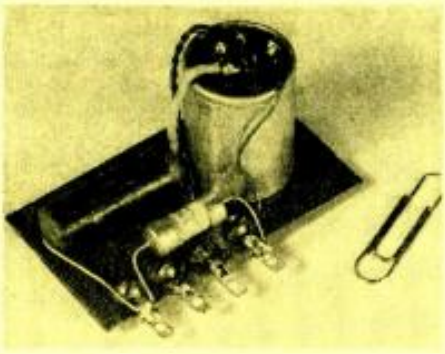


Fig. 4. Germanium diode sine-wave oscillator. See Fig. 3B.

If the circuit is interrupted temporarily, however, at a reduced voltage, the current drops again to a few microamperes. This behavior is somewhat analogous to the action of a thyratron.

This effect is utilized in the circuit of Fig. 6A to obtain simple "lock-in" conduction as the result of the application of a momentary voltage increment.

The adjustable d.c. voltage biases the diode to a potential slightly less than that required to "strike" the diode—i.e., to cause high current flow. The resting circuit current will be of the order of microamperes. If a small a.c. or d.c. voltage (equal to the difference between the bias and the diode E_p, with due consideration for the drop in the load device) then is applied to the signal input terminals, the current level will hold to that value even when the incremental voltage is removed. This high current will continue to flow until the circuit is interrupted momentarily by opening switch S. When the switch subsequently is closed, the circuit again will be ready for operation.

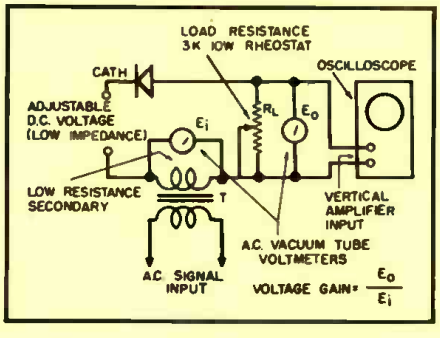


Fig. 5. Circuit diagram for germanium diode negative-resistance amplifier.

Thus, the circuit is locked-in each time a current pulse of proper amplitude is applied to the signal input terminals. The load device indicated in Fig. 6A might be a d.c. relay, low current signal lamp, or similar component.

How close to the diode E_p voltage level the bias voltage may be held without self-striking occurring depends upon the individual diode used. With some of the units tested in the circuit, the bias could be held within 5 volts of the striking point; with others, 15 to 20 volts was as close as a stable setting could be made.

Since internal heating in the diode results from this type of operation, there is a tendency for the striking point to move downward in voltage in direct proportion to the length of time of high current conduction. A number of closely spaced operations will also temporarily lower the striking point voltage. With pronounced heating, the gap between the bias and E_p voltage values soon closes and the circuit fires itself. For that reason, it is desirable to reduce the bias voltage and use larger signal (trigger) amplitudes when long operating periods are planned.

Voltage Divider

Figure 6B shows a circuit in which a voltage divider (potentiometer) is set up with a germanium diode and a 1000-ohm resistor in series. Output voltage E_o is taken across the latter.

The d.c. voltage E_i is adjusted to the E_p value of the diode (plus, of course, the drop across the 1000-ohm resistor) or slightly higher. It will be noted that E_o then is a fraction of E_i, indicating that the voltage divider is operating correctly. If E_i is raised by an increment, say 10 volts, E_o will increase by the same voltage. And if E_i is decreased by a certain amount, E_o will drop by the same amount. This action is contrary to the behavior of a conventional potentiometer which would divide the increments as well as the initial voltage.

If, instead of a d.c. voltage increment, an a.c. voltage is superimposed upon the steady d.c. voltage E_i, the a.c. voltage appearing across the 1000-ohm resistor will have the same value as the applied a.c. voltage, indicating zero dynamic resistance for the diode.

The negative-resistance phenomenon in germanium diodes is temperature-dependent. Elevated temperature depresses the negative-resistance characteristic to a lower reverse voltage level. Also, operation of the diode in the negative-resistance region generates internal heat in the crystal.

Presently available diodes are overloaded when operating as negative resistances. Table 1 shows the percentage overload for various types and would seem to indicate that the types which might be used with the most safety are 1N39, 1N55, 1N55A, 1N38, 1N38A, 1N58, 1N58A, and 1N60.

In numerous tests performed by the author and by other researchers, germanium diodes have occasionally been operated as negative resistances for long periods without untimely impairment or destruction. Records indicate, however, that prolonged operation at the E_p level and along the negative slope reduces life. This means that all applications involving negative resistance in present point-contact diodes must be regarded as intermittent.

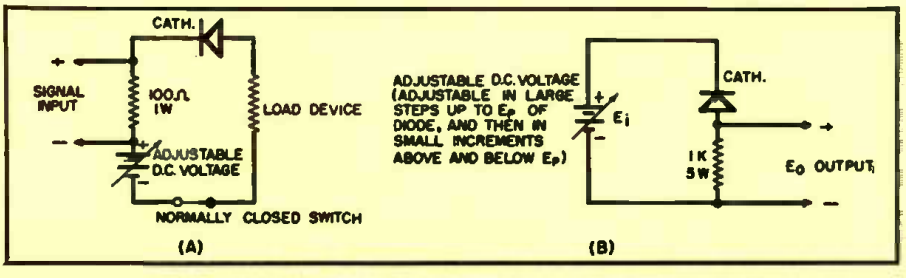
It is believed that new diode designs and construction, especially those involving area conduction in junction type diodes, might lead to more rugged operation at the high reverse current and voltage levels at which negative resistance appears.

It is difficult to operate germanium-diode negative resistances in parallel or in push-pull because of the poor matching of E_p values and negative slopes.

The negative-resistance oscillator or amplifier cannot deliver appreciable power to a load unless the negative resistance is evident over a considerable range of applied voltage.

Some objection undoubtedly will arise to the use of germanium diodes as negative resistances in many applications because of the relatively high currents necessary for their operation in this manner. However, if these components can be ruggedized for negative-resistance operation, their use will be justified in many applications, alone and with tubes, where simplicity and compactness outweigh power requirements.

Fig. 6. (A) Lock-in circuit. (B) Voltage divider with zero dynamic loss.



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DECAY CONSTANT IN VIBRATING SYSTEMS

By
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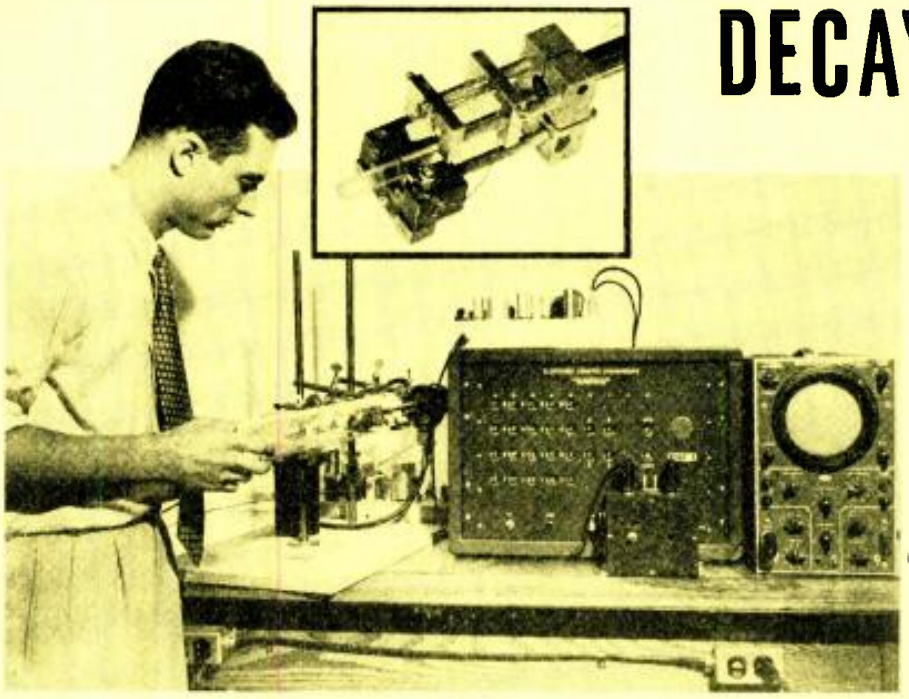


Experimental apparatus used to study the internal losses in quartz and relaxation effects in alkali halide and other crystals. Inset shows low-loss crystal mounting.

Technique developed at NBS for determining losses in vibratory systems by measuring decay constant.

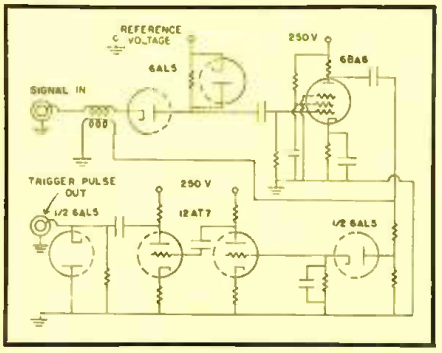
IN mechanical and electrical vibrating systems, a certain proportion of the oscillating energy is lost because of the natural damping properties of the device in motion. An electronic instrument recently developed at the National Bureau of Standards' Solid State Physics Laboratory measures the time of decay of these systems—a quantity representative of the lost energy. The instrument has a wide range of application to vibratory systems and can measure decay times from 5 seconds to 5 milliseconds or less with an accuracy of one-half per cent.

The NBS instrument was designed specifically to study the internal losses in quartz as a function of temperature and relaxation effects in the alkali halide and other crystals. The need for such experiments arose when crystals were observed to exhibit anomalous losses at elevated temperatures. An x-cut quartz crystal bar, especially prepared and cut at NBS, was heated to high temperatures in an evacuated chamber. The crystal was supported at a vibrational node in a low-loss mounting consisting essentially of a pair of knife edges and a spring clip. A thermocouple in contact with a second bar of quartz provided close temperature control during the experiments. After a signal generator initiated oscillations in the crystal, the output of the freely vibrating crystal was impressed on the decay-constant measuring instrument. The experimental results indicated that the quartz crystal exhibited high-loss characteristics between 200 and 350°C, with the maximum losses occurring at 250°C.

The instrument may be used to study mechanically vibrating systems by attaching an electromechanical transducer, such as a quartz plate resonator, to the device to convert from mechanical to electrical energy. By using auxiliary equipment, further applications are possible for the measurement of the time constant of phosphors, photocells, and other phenomena involving exponential decays.

The time decay measured by the NBS instrument is actually the time increment corresponding to any two selected voltages of an exponential waveform.

Voltage comparison circuit used to control passage of triggering voltages to a precision counter chronoscope.



The transient condition—an exponential decay—may be represented by:

$$V(t) = V_0 e^{-\alpha t}$$

where V_0 is the initial amplitude of the decaying voltage, $V(t)$ is the amplitude at any later time t, and α is the damping coefficient associated with the particular circuit or device. The lost energy resulting from the external and internal damping is determined from the value of α. This quantity may be computed from the solution of the above equation for any two times t_1 and t_2 corresponding to known voltages V_1 and V_2:

$$\alpha = \ln (V_1/V_2) / \Delta t$$

Thus, if it is possible to measure the time, Δt, required for the voltage to fall from V_1 to V_2, a determination of the energy lost in a vibrating system is reduced to the division of a fixed number by a varying time.

The NBS method for determining the decay constant of a vibrating system utilizes the principle of voltage-amplitude comparison, in which the time required for the exponential waveform to pass from one known voltage to another is measured. A pair of identical circuits amplifies, differentiates, and shapes the decaying voltage into pulses that are used to trigger a precision counter chronoscope. The two circuits are alike except for different reference voltages controlling the time of initiation of the triggering pulses through each circuit. One reference voltage controls the starting pulse, which is passed through the circuit to the chronoscope when the input voltage reaches a selected value. The other reference voltage passes the stopping pulse on to the chronoscope when the input voltage has decayed to the second selected value.

(*Continued on page* 30)

U.H.F. MAGNETIC ATTENUATOR

By
FRANK REGGIA
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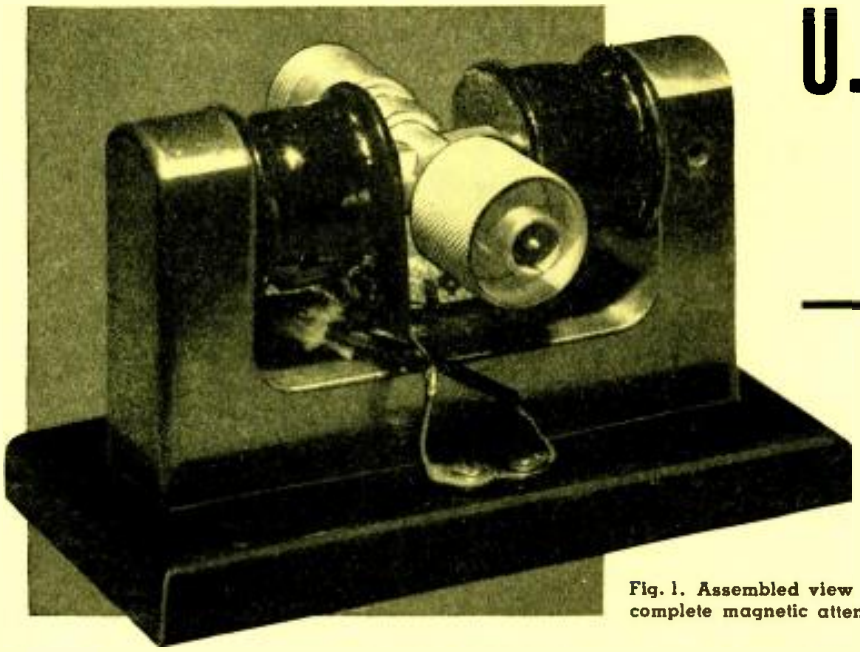


Fig. 1. Assembled view of the complete magnetic attenuator.

Varying the magnetic field through a section of coax containing a ferrite material varies the attenuation.

ONE OF THE more recent developments to emerge from the microwave standards program at the National Bureau of Standards[1] is an electrically controlled variable attenuator for u.h.f. This device, a distinctly different type of variable attenuator, utilizes a magnetic field to obtain instantaneous changes in attenuation, and is known as a magnetic attenuator.

Conventional variable attenuators for microwave frequencies use metalized glass or mica strips, and powdered carbon film on glass or bakelite strips as their r.f. dissipative elements. These elements, which are fragile and usually machined to close tolerances, are moved in and out of narrow slots in the walls of coaxial lines or wave guides to obtain attenuation changes. The mechanical displacement of two coupling loops inside a section of circular wave guide operating below its cutoff frequency is also used to effect an attenuation change. Such a device is sometimes called a mutual inductance type attenuator. Both types are characterized by movable parts and mechanical linkages to the attenuating elements. Also, use of the complex mechanisms which are necessary to insure a high degree of precision and fineness of control usually results in bulky, hard-to-handle controls at substantially increased costs.

On the other hand, the u.h.f. magnetic attenuator is a mechanically static device which is physically small and simple in construction. It requires no mechanical controls, slots in a transmission line, or movable parts, and can be operated either manually or automatically from a remote position.

Description and Operation

If a small slug of magnetic ferrite[2] material is placed in a section of coaxial transmission line in the same way that an insulating bead is inserted in the line, some of the r.f. energy passing through the material is attenuated by dissipation, being transformed into heat. Now, if a small magnet is brought near the section of line containing the ferrite material, the loss characteristics of the r.f. dissipating material change considerably. Or if the section of line containing the ferrite material is placed between the poles of an electromagnet and the current through its field coils is changed, the result is a simple, electrically controlled, variable attenuator.

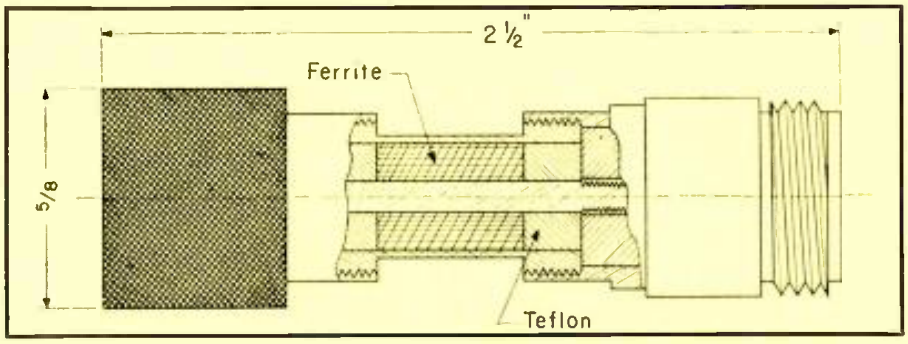
Such a magnetic attenuator for a section of coaxial line consists of two principal parts, the transmission line section (as shown in Fig. 2) containing the ferrite material, and an electromagnet used to supply the external magnetic field.

The section of line containing the r.f. dissipative material is approximately 2½" in length. An axial hole is put through the ferrite slug to pass the center conductor. Teflon beads are placed at the ends of the slug. The whole assembly is encased in a metal sheath with a standard male and female type N connector at the ends.

The electromagnet unit consists of two low-current field coils, pure iron pole pieces and yoke, and a bakelite mounting base. Field strengths as great as 2000 gauss have been measured at the center of the ⅜" air gap with solenoid currents up to 25 ma.

Shown in Fig. 5 is the section of transmission line containing the ferrite dissipative material. The end connectors were designed to unscrew from the line section, thus permitting quick removal of the dissipative material inserts.

Fig. 2. Cross section of coaxial transmission line housing the magnetic material.



Magnetic Ferrites

Magnetic ferrites contain no metallic particles. They are substances compounded from various metallic oxides[3] which make them very poor conductors of electricity. They are characterized by high volume resistivity (10^6 ohm cm.), relatively high permeabilities

(5000), and Curie point* occurring above 150°C.

Although ferrites were developed primarily for use as low-loss core materials in high frequency transformers and inductors, investigations of these materials at microwave frequencies have revealed other interesting applications. The most common of these applications include use in matched load terminations, fixed attenuator pads, r.f. chokes, magnetic attenuators, microwave switches, and control devices for amplitude-modulating or automatically stabilizing the power output of microwave generators.

Attenuator Characteristics

As previously mentioned, when a section of coaxial transmission line containing an r.f. energy-dissipating ferrite is brought within the proximity of an external magnetic field, a sharp drop in the loss properties of the material is observed.

The phenomenon which can be seen in Fig. 4 shows the attenuation characteristics of the magnetic attenuator using two different ferrite materials. As shown for Ferramic H, Fig. 4, the r.f. attenuation** was at its maximum value of 16.5 db when no external magnetizing field was used. As the direct current in the coils of the electromagnet was increased, the r.f. losses in the ferrite material decreased until magnetic saturation of the ferrite was reached, and the minimum value of attenuation was about 2 db. This minimum value (residual loss) is partly due to the reflective component of the attenuation. As also shown in Fig. 4, the use of a slug of Croloy No. 20 ferrite material in the attenuator resulted in a maximum (zero field) loss of approximately 14 db. As the external d.c. field was increased, the attenuation decreased to a value near zero db as the material became saturated. The input VSWR of the attenuator at saturation was approximately 1.06.

The family of curves in Fig. 3B shows the attenuation characteristics of another ferrite material (XE2826) over the entire u.h.f. band. A larger electromagnet (shown in Fig. 6) capable of handling currents up to several amperes was used for these measurements to insure complete magnetic saturation of the ferrite material.

Several interesting observations can be made from the data in Fig. 3B. First, the initial (zero field) attenuation increases rapidly with frequency.

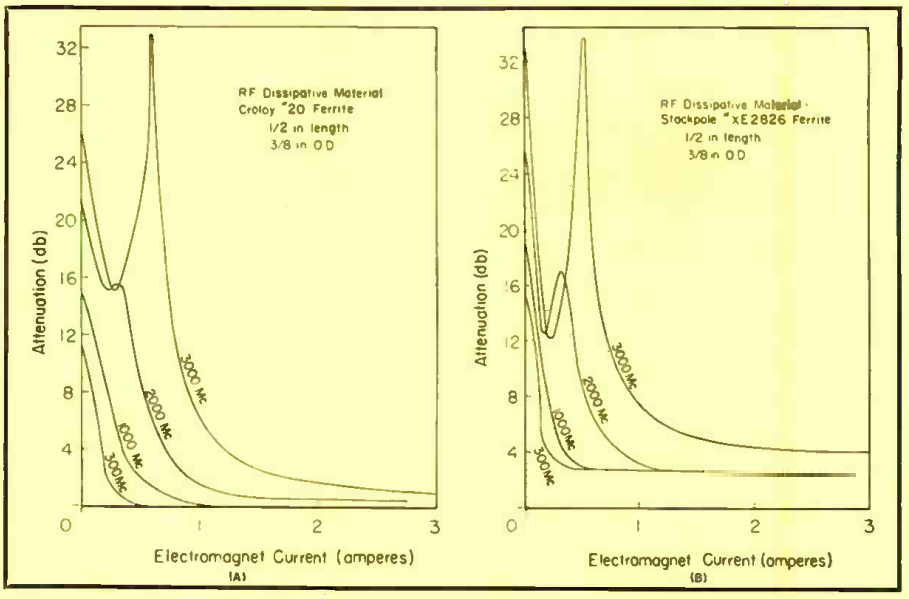


Fig. 3. Attenuation vs. electromagnet current for two dissipative materials.

Also, the sensitivity (db/amp.) of the material varies with frequency and the d.c. magnetizing field applied. Below 2000 mc., the material behaves very similarly to the previously described ferrites. However, above this frequency, a resonance phenomenon occurs which causes the normal direction of the attenuation change to reverse itself, climb to large values of attenuation, and decrease again as the d.c. field is increased. This phenomenon is characteristic of all ferrites investigated by this author at frequencies near 3000 mc.; an explanation of it is beyond the scope of this article.

Figure 3A shows another family of curves which characterizes the attenuation properties of Croloy No. 20 fer-

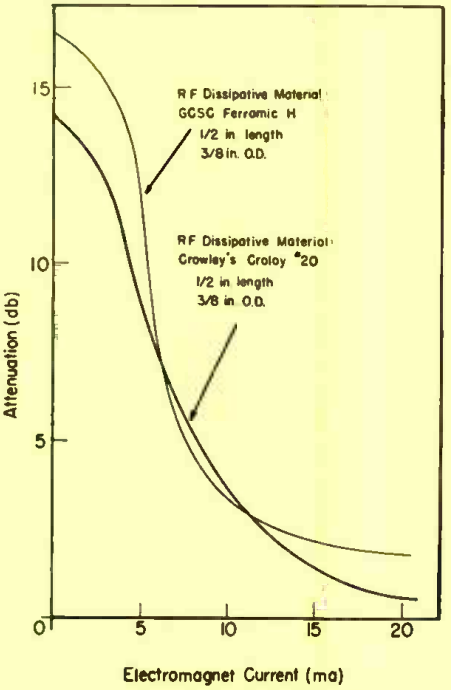
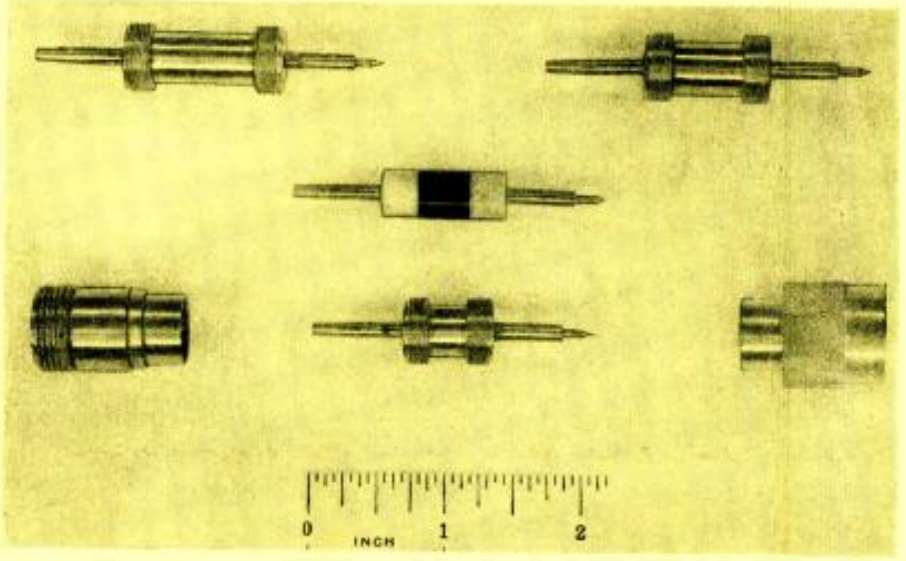


Fig. 4. Attenuation vs. electromagnet current at 500 mc. for two materials.

Fig. 5. Short section of transmission line showing end connectors, ferrite material, and three sizes of housings.



Magnetic transition temperature (Curie point) of a ferromagnetic material is the temperature at which, with increasing temperature, the transition from ferromagnetic to paramagnetic properties appears to be complete.

**The insertion loss when the attenuator is placed in a matched, 50-ohm coaxial transmission line system having type N connectors.*

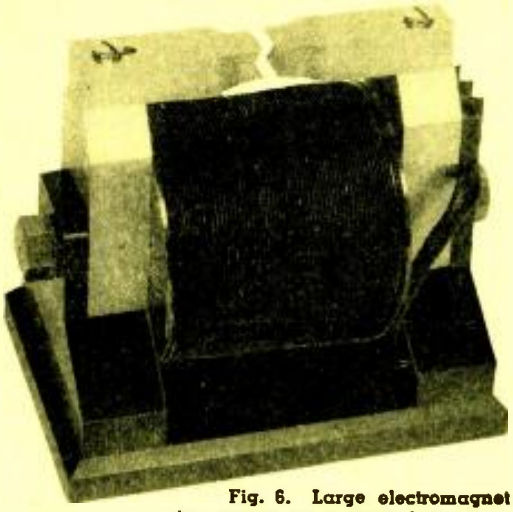


Fig. 6. Large electromagnet for currents up to several amperes.

rite material at u.h.f. These curves are somewhat similar to those of Fig. 3B except that lower values of residual losses were obtained. This is partly due to the low input VSWR of 1.06 when the ferrite material reached magnetic saturation.

Additional data exhibiting ferromagnetic resonance is shown in Fig. 7A for the Croloy No. 20 ferrite material. Resonance may be seen to occur at higher magnetic field strengths as the frequency is increased. The highest observed absorption peak occurs at a frequency of approximately 3200 mc.

In some cases, rotating the coaxial line section containing the ferrite material with respect to the electromagnet produces a change in attenuation. The effect is quite small or absent in most cases except when ferromagnetic resonance occurs. This phenomenon is shown in Fig. 7B for a particular attenuator using a Ferramic B ferrite. It is to be presumed that the particular sample of dissipative material used is anisotropic.

Effects of dimensions, power level, temperature, and hysteresis on the attenuation characteristics are summarized briefly in the following paragraphs.

The attenuation at zero electromagnet current generally increases linearly with the length of the insert. The diameter of the insert and the relative diameter of the inner and outer conductors have their principal effect on the input impedance. The insert chosen for the u.h.f. magnetic attenuator was of such a size as to give a fairly good impedance match and efficient control of attenuation with most materials used.

At power levels up to 10 watts, some heating was observed but no noticeable change in the attenuation characteristics was observed. At 2000 mc., and with no external magnetic field applied, an attenuator using a Ferramic H ferrite as the dissipative material was heated to a temperature above 105°C and no noticeable change in its attenuation characteristics was observed. One hour was required for a complete heating cycle.

There was practically no noticeable hysteresis effect from increasing or decreasing the external magnetic field.

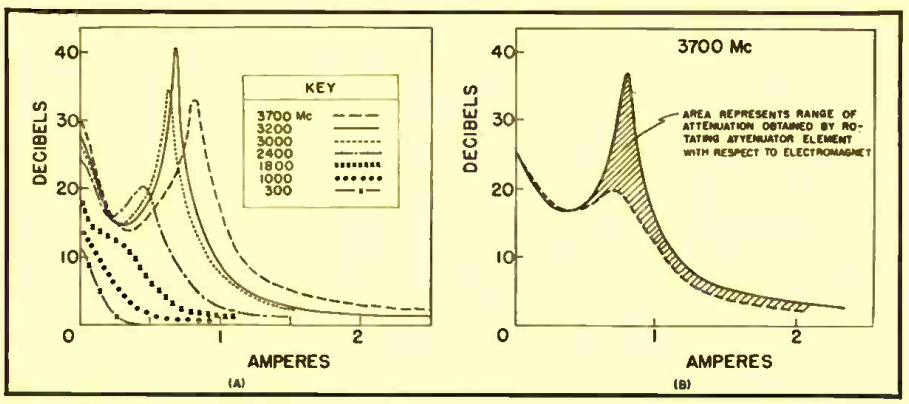


Fig. 7. (A) Attenuation vs. electromagnet current (showing ferromagnetic resonance) for Croloy No. 20. (B) Effects of rotating the magnetic field near resonance.

Table 1. List of ferrite materials, with attenuation at 1000 mc., and manufacturers.

Dissipative Material		Zero Field Attenuation (db/in.) at 1000 mc.	Manufacturer
Ferramic	B	22	General Ceramic and Steatite Corp., Keasbey, N. J.
"	G	19	
"	H	35	
Croloy	20	29	H. L. Crowley & Co., Inc., West Orange, N. J.
"	70	40	
"	BX113	22	
Lavite	F27	35	D. M. Steward Manufacturing Co., Chattanooga, Tenn.
"	F15	34	
"	F4	72	
XE2826		38	Stackpole Carbon Co., St. Marys, Pa.

Application

Electric control of the loss characteristics of ferrite materials in wave guides and coaxial lines immediately suggests some interesting engineering applications. As previously mentioned, an electrically controlled variable attenuator with low minimum loss for obtaining a smooth output control of u.h.f. and microwave generators can be constructed. A control device for amplitude-modulating or automatically stabilizing the output of r.f. and microwave generators may also be assembled.

The magnetic attenuator may be used to amplitude-modulate a u.h.f. generator. It is simply inserted into any part of the transmission line network, and when an a.c. field is applied to the electromagnet windings, an amplitude-modulated wave results. To eliminate distortion in the modulated wave and to increase the sensitivity of the attenuator, a d.c. biasing field must be used.

The significance of the d.c biasing field can be understood by referring to Fig. 4. It can be seen that approximately 50 per cent of the curve is linear. Therefore, to minimize distortion in the modulated wave, it is necessary to operate over the linear portion by proper biasing. Moreover, the sensitivity of the attenuator to external fields is greatest in this region, in this instance being approximately 4 db per ma. of electromagnet current.

Modulation frequencies from d.c. to above 10,000 cycles have been used successfully with the attenuator assembly shown in Fig. 1. Using a single attenuator unit, amplitude modulation has been obtained over the frequency range of 10 to 10,000 mc.

The magnetic attenuator has also been used as a control device in a degenerative feedback network to stabilize power output of a u.h.f. generator. Automatically a small amount of r.f. power taken from the coaxial transmission line is detected, amplified, compared against a d.c. reference voltage, and used to control the output voltage of a regulated power supply which, in turn, controls the r.f. power level through the attenuator.

It can be seen that the magnetic attenuator offers excellent possibilities as a transmission switch. When no external d.c. field is applied, the device offers its maximum attenuation. When the ferrite dissipative material in the wave guide is saturated with a d.c.

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COAXIAL CAVITY TUNING ELEMENT FOR U.H.F.

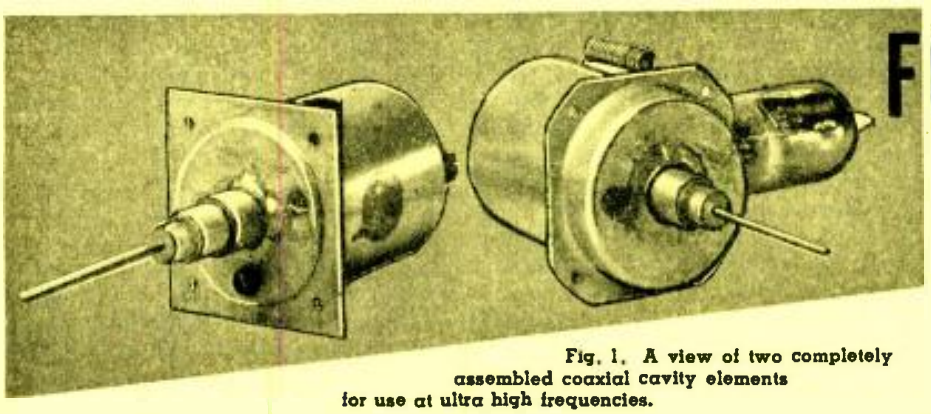


Fig. 1. A view of two completely assembled coaxial cavity elements for use at ultra high frequencies.

By
the Engineering Dept.
Granco Products Inc.

This element, which may be used in TV tuners and test instruments, covers the 470-890 mc. TV band.

THE announced intention by the FCC of opening up the u.h.f. band of frequencies to television broadcasting prior to the Korean War was the go-ahead signal for one of the most intensely competitive developments in electronic history—the development of a commercially feasible front end or tuner to cover this new u.h.f. band. Every interested company of any consequence was relatively well staffed with competent engineering talent; each was armed with microwave techniques gleaned from war development radar contracts. This experience, coupled with prior radio and v.h.f. television experience, appeared to be quite adequate to cope with the practical problems posed by the new u.h.f. band. But just as FM and v.h.f. television forced the radio engineer to re-examine all of his experiences based on lumped parameters, so did the new u.h.f. band force television and microwave engineers to acclimate themselves to a new band of frequencies that was too high for lumped constants, too low for true cavities, and too wide for transmission lines because of their clumsiness.

Basically, the problem was one of cost. U.h.f. techniques had already been developed so that the "know-how" for doing the job was in the public domain. This "know-how" included awareness of the solutions that were possible through the use of sliding contacts on lines, plunger type variable frequency cavities, and many variations of the same technique. These solutions proved to be quite satisfactory for the elaborate military equipment on which they were used, but for home television receivers, components requiring costly machining operations and precision moving contacts and the like become prohibitively expensive. Thus, the problem was as much mechanical as it was electrical.

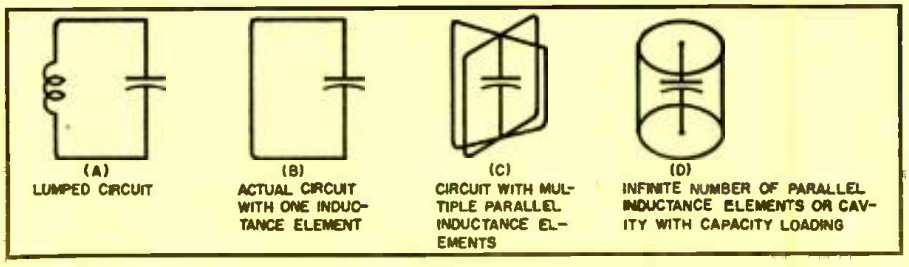
Television manufacturers were further confronted with a dearth of suitable test equipment to cover this new band. Not one completely satisfactory u.h.f. sweeper was available. Existing grid-dip meters and wavemeters stopped at 400 mc., the end of the lumped constant range, and signal generators were available only in limited numbers and were extremely costly. Nine out of ten television manufacturers are even today without adequate u.h.f. equipment, and, of course, virtually no television technician has any u.h.f. equipment.

Coaxial Cavity Development

Development of new equipment to meet the industry's requirements represented a major undertaking because a considerable part of the development lay in devising a suitable resonant tuned circuit capable of being tuned over the 470-890 mc. range of frequencies. Sliding contacts on transmission lines were tried as the first approach to the solution of this problem as far back as 1947; this approach has resulted in tuners that are now commercially available in limited quantities. Tuning elements have also been developed that use lumped constants as the variable elements. For some time now the members of the engineering staff of *Granco Products Inc.* have been involved in this development and have thoroughly investigated a large variety of circuit arrangements to accomplish satisfactory tuning over the frequency range. The circuit arrangement chosen as the optimum design is one that can be thought of either as a lumped circuit, or as a cavity. The tuning element is shown in Fig. 1. It is evolved by starting with a simple lumped parallel-tuned circuit, as shown in Fig. 2, and then reducing the inductance by adding more inductive elements until they completely enclose the capacitor. The inductance consists of a metal cylinder, and a coaxial conducting sleeve broken at the center acts as the variable capacitor of the parallel-tuned circuit. Inside these two sleeves, separating and supporting them, is a precision low-loss dielectric tube. A metallic plunger rides in the dielectric tube and acts as the tuning member of the tuned circuit.

As the plunger rides inside the smooth precision-bored dielectric, the capacitance is varied from C_{min} to $C_{min} + C/2$ where C_{min} and $C/2$ are self-defined in Fig. 4. Effective ratios of $C_{min} + C/2$ to C_{min} better than 5 to 1 are possible, including trimmer capacitance when the cavity is used as a passive preselector tuned circuit, or tube capacitance when

Fig. 2. Various steps in the evolution of the tuning element.



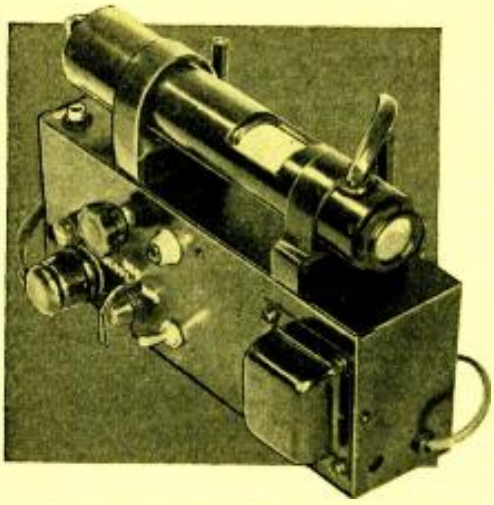


Fig. 3. The grid-dip meter. Top portion may serve as a wavemeter.

it is used as the tank circuit of an oscillator. This provides more than adequate range to cover the less than 2:1 frequency range required by the new 470-890 mc. u.h.f. band.

Inductance of the cavity is varied by rotating a brass fin in the cavity field. This fin acts as a shorted turn and represents a convenient way of trimming the inductance of the tuned circuit.

The practicability of this device lay in the ability to manufacture the dielectric sleeve with sufficient accuracy. Should the plunger have lateral motion in the dielectric once its position is set, the unit would be susceptible to microphonics and backlash, thus proving quite unsatisfactory for use in a u.h.f. tuning element. Production techniques for realizing almost unheard of accuracies have been developed exclusively for this application, making the device commercially feasible at a reasonable cost.

Advantages

The question now arises as to why this particular arrangement was finally chosen as the ideal u.h.f. tuning element for the new band of frequencies.

Most important is (1) that the construction is simple, and the severe close tolerances required by u.h.f. are easily held. Then, (2) there are no moving electrical contacts. This results in a long, noise-free life, with no contact finger or plunger wiper wear. The fact that there are no moving electrical contacts also results in a considerably higher Q tuning element than would otherwise be possible.

Extremely high Q's are attainable using this configuration (3); Q's of 1000 or more have been achieved. The use of high Q circuits for the tuner element insures low noise figure and high gain. Also, trimming and padding of the unit is easily achieved (4), thus assuring three-point tracking.

Rigid construction (5) assures excellent frequency stability. As a matter of fact, the unit lends itself admirably to virtual self-compensation of thermal drift. The completely shielded construction makes the unit independent of its environment (6) since its field is internal; and outside motion, such as hand capacitance, has practically no effect on resonant frequency. This construction also keeps radiation from the tuning element to a minimum.

The reasons given above were all considered important in arriving at the choice of a tuning element. There is, however, another very important reason for its choice which is (7) that the whole unit lends itself admirably as a generic element for a line of u.h.f. test equipment.

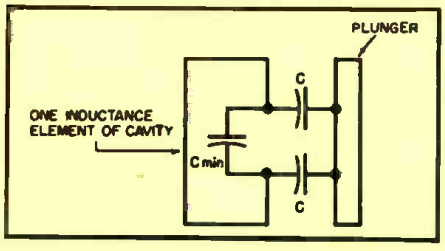


Fig. 4. Capacitance tuning of cavity.

The following u.h.f. equipment is required in a well-equipped laboratory working to develop u.h.f. television receivers and associated products:

1. Signal generator
2. Sweep generator
3. Wavemeter
4. Grid-dip meter
5. Composite picture, sound and sync signal generator

These instruments have recently been developed by *Granco Products Inc.* to fill its own growing need for laboratory and production instruments in the development and production of u.h.f. television products. The top unit in Fig. 3 shows the wavemeter design using the tuning element described. A small plug-in coupling loop is brought out at one end of the "cavity" for use as a probe. The signal is rectified by a 1N72 crystal and the detected current read on a compact meter conveniently mounted in the end of the instrument. Provision is also made to plug in a more sensitive meter when required. Because of the high Q of the cavity, this wavemeter is unusually sensitive, and extremely weak signals can be detected with negligible reaction on the circuit under observation. The instrument as presently constituted has a 13" dial scale with accurate individual calibration from 380 to 1000 mc. This unit is particularly useful in the design of any oscillator both as a wavemeter and relative power output meter. It can be used in the latter function by being placed in a fixed position relative to the circuit under test, making the meter reading a function of the power output of the oscillator.

By converting the wavemeter into an oscillator, capable of either external or internal amplitude modulation, the versatile grid-dip meter (shown in Fig. 3) was developed. A switch is provided to turn off the oscillator for operation similar to the wavemeter. The addition of the oscillator has greatly extended the instrument's utility. Because of the accurate frequency dial, high output and stable operation, it may be used as a compact u.h.f. signal source for numerous applications — for example, as a marker source when sweeping a television receiver, as a probe for detection of parasitics and in determining the self-resonant frequency of circuit components. Provision is also made for earphones or other types of detection facilities.

The power cable to the oscillator has been so designed that it will plug directly into the power connector of the *Measurements Corporation's* popular megacycle meter, thus extending the range of this instrument from 400 mc. through 1000 mc.

A small, compact sweep generator covering the u.h.f. television band, and having a sweep width of approximately ±80 mc., is shown in block diagram form in Fig. 5. This instrument uses a resonant cavity circuit mounted so that the cavity rides on a smooth rod, the position of which is controlled by the center frequency knob. As the cavity is moved, a plunger moves in to the cavity to change its frequency. This plunger

(*Continued on page* 30)

Fig. 5. Diagram of sweep generator.

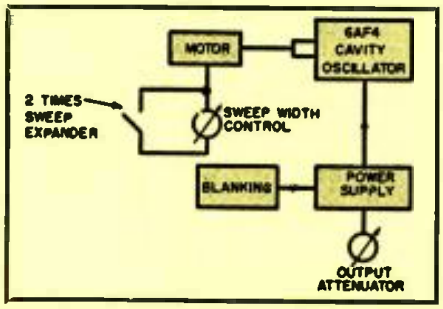
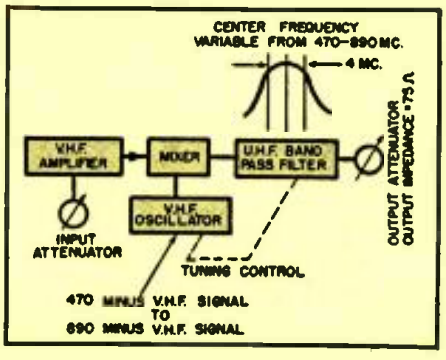
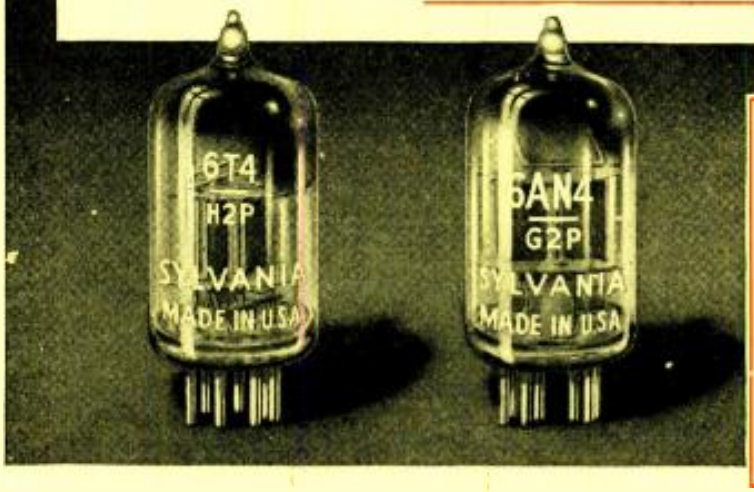


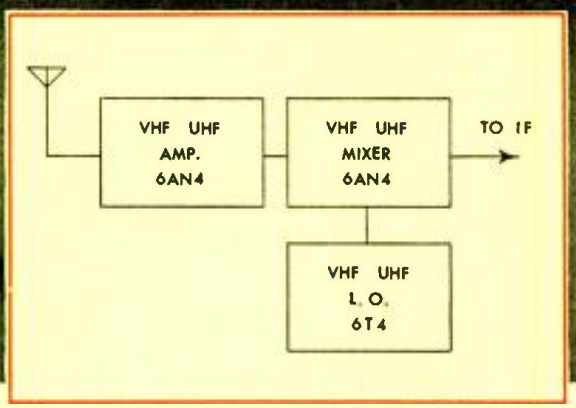
Fig. 6. Block diagram and waveforms for the picture signal generator.



Make your UHF circuits as simple as VHF designs...

Use these two New Sylvania Tubes in tuners and converters





Representative block diagram of combination VHF-UHF tuner using the new Sylvania 6AN4 as rf amplifier and mixer, and the 6T4 as local oscillator.

Equipment Manufacturers! Simplify design of combination VHF-UHF tuners, UHF converters for TV! Two new Sylvania-developed tubes permit adaptation of conventional amplifier-mixer-local oscillator circuit to the new frequency bands—completely eliminate complicated switching arrangements or stage duplication. Leading Tuner Manufacturers have adopted these types for current tuner production.

- Short Bulb T-5½ 7-pin miniature construction
- Requires no special socketry
- Designed for use at frequencies up to 1000 mc
- Double plate and grid leads
- Uniformity at high frequency means lower cost and better availability

THE SYLVANIA 6T4 is designed for use as a local oscillator at frequencies up to 1000 mc. Used as the companion tube to the 6AN4, it makes possible the design of extremely simple combination tuners and UHF converters.

THE SYLVANIA 6AN4 can be used both as an rf amplifier and as a mixer. Its performance in the VHF band is equal to or better than previously existing types of tubes, and in UHF tuners it gives comparable performance to VHF tuners.

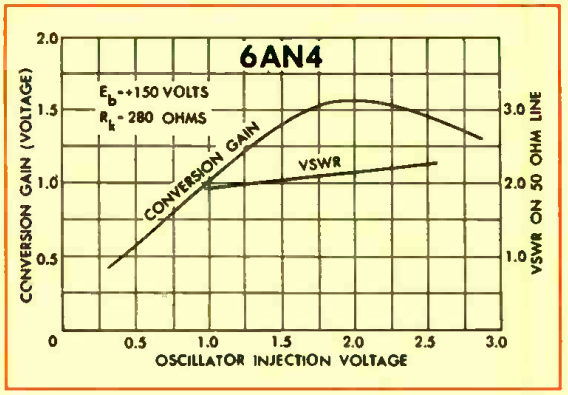
The 6AN4 is designed for both high g_m and high mu. Under representative operating conditions as a Class A amplifier, the transconductance is 10,000 micromhos and the amplification factor is 70.

When used as a mixer, the 6AN4 offers the advantages of a conversion gain and of relatively low oscillator drive requirements.

Complete technical information on operating characteristics, including performance curves, is included in the manual, "Sylvania's UHF Story." A copy is yours for the asking. Write to: Sylvania Electric Products Inc., Dept. 3R-1003, 1740 Broadway, New York 19, N. Y.

COMPARATIVE PERFORMANCE OF THE 6AN4 AT VHF AND UHF

CONDITIONS		VOLTAGE GAIN	NOISE FIGURE
Single tube in Channel 13 booster	VHF	5	9.2 db
Two tubes in cascode in Channel 13 booster	VHF	11.1	8 db
Single tube in open half-wave tuned amplifier at 450 mc.	UHF	12 db	13 db
Single tube in open half-wave tuned amplifier at 900 mc.	UHF	10 db	15 db



Curve shows representative relationships between conversion gain and input VSWR of the 6AN4 when used in mixer service, plotted against oscillator injection voltage.

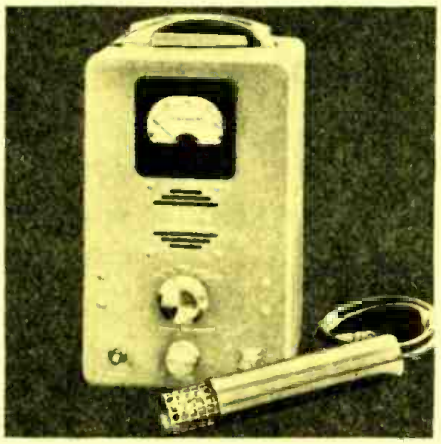
SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT LAMPS, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

NEW PRODUCTS

COUNT RATE METER

Now being manufactured by the *Berkeley Scientific Division* of *Beckman Instruments, Inc.*, 2200 Wright Avenue, Richmond, Calif., is a general-purpose

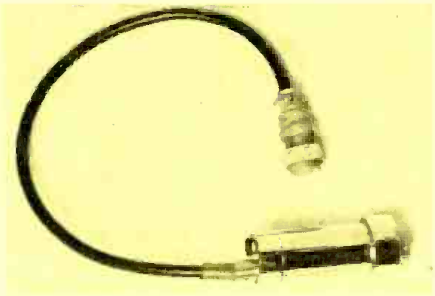


count rate meter with provision for a visual and/or aural indication.

The new *Berkeley* laboratory monitor Model 1800 is accurate to approximately ±5%. A front panel control permits the selection of five different meter ranges: 300, 1000, 3000, 10,000 and 30,000 counts per minute. Power requirements are 117 volts ±10%, at approximately 35 watts. The instrument may be obtained with a *GM* tube and probe.

PRESSURE TRANSDUCER

Rapid transient pressure surges and high frequency pressure pulsations can be measured easily and accurately with the Type 4-301 pressure transducer announced by *Consolidated Engineering Corporation*. Type 4-301 may also be used for measuring static or slowly



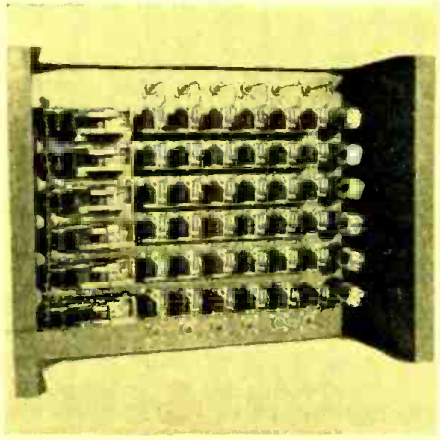
varying pressures over a wide temperature range in both gaseous and liquid systems.

A high safety factor is incorporated in this transducer, and overloads many times its full-scale rated pressure range will not cause mechanical failure.

Complete data and specifications are contained in Bulletin CEC-1532, available on request from *Consolidated Engineering Corporation*, 300 N. Sierra Madre Villa, Pasadena 8, Calif.

VIDEO AND AUDIO MONITOR

General Communications, Fort Atkinson, Wisconsin, is introducing a video and audio dial-operated monitor system to the broadcast industry. Each of the monitoring points in the six-



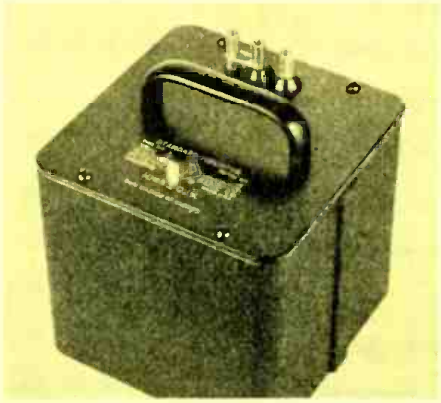
station unit is provided with a dial mounted in a desk top housing; selection of the monitor circuit desired is made by dialing the appropriate numeral.

Both video and audio monitor circuits are switched simultaneously. Audio is switched by two levels of a rotary stepping switch, the third level of which operates the corresponding video relay associated with the audio circuit. The video output of the relay bank is fed to a cathode follower which provides complete isolation of the monitor from the source. Audio switching is across low impedance program monitor buses with bridging monitor inputs, thus minimizing circuit disturbance.

The CDMS-1 system is also available in a three-station unit.

STANDARD INDUCTORS

Replacements for the Type 106 inductors have been announced by the *General Radio Company*, 275 Massachusetts Avenue, Cambridge 39, Mass. The Type 1482 standard inductors are symmetrically wound toroids, having a much higher degree of astaticism than existed in the adjacent pair of D-shaped coils



used in the older type. They have essentially no pickup from a moderately uniform electromagnetic field and, when energized, they produce no such field in their vicinity.

With no external magnetic field, these toroidal units can be housed in a metallic case and thus given an electrostatic shield with no complicated frequency correction of inductance due to eddy current reaction. The Type 1482 inductors are offered in 1-2-5 unit values, permitting a precise direct comparison between them on a unity-ratio bridge. Inductance values extend from 100 μh. to 1 h. inclusive.

CARRIER-CONTROLLED RELAY

The carrier-controlled relay recently developed by *Haller, Raymond and Brown, Inc.*, State College, Pa., was designed for use in conjunction with a radio receiver to develop a control signal which coincides in time with the reception of an r.f. carrier wave. Only one connection between the CCR (Model

3801) and the companion radio receiver is required; that connection supplies the CCR with a small portion of the radio receiver's i.f. signal energy.

Two of the several possible applications for this instrument are (1) use in a radio repeater system, for turning on a transmitter which is normally on standby service, and (2) in a receiver-

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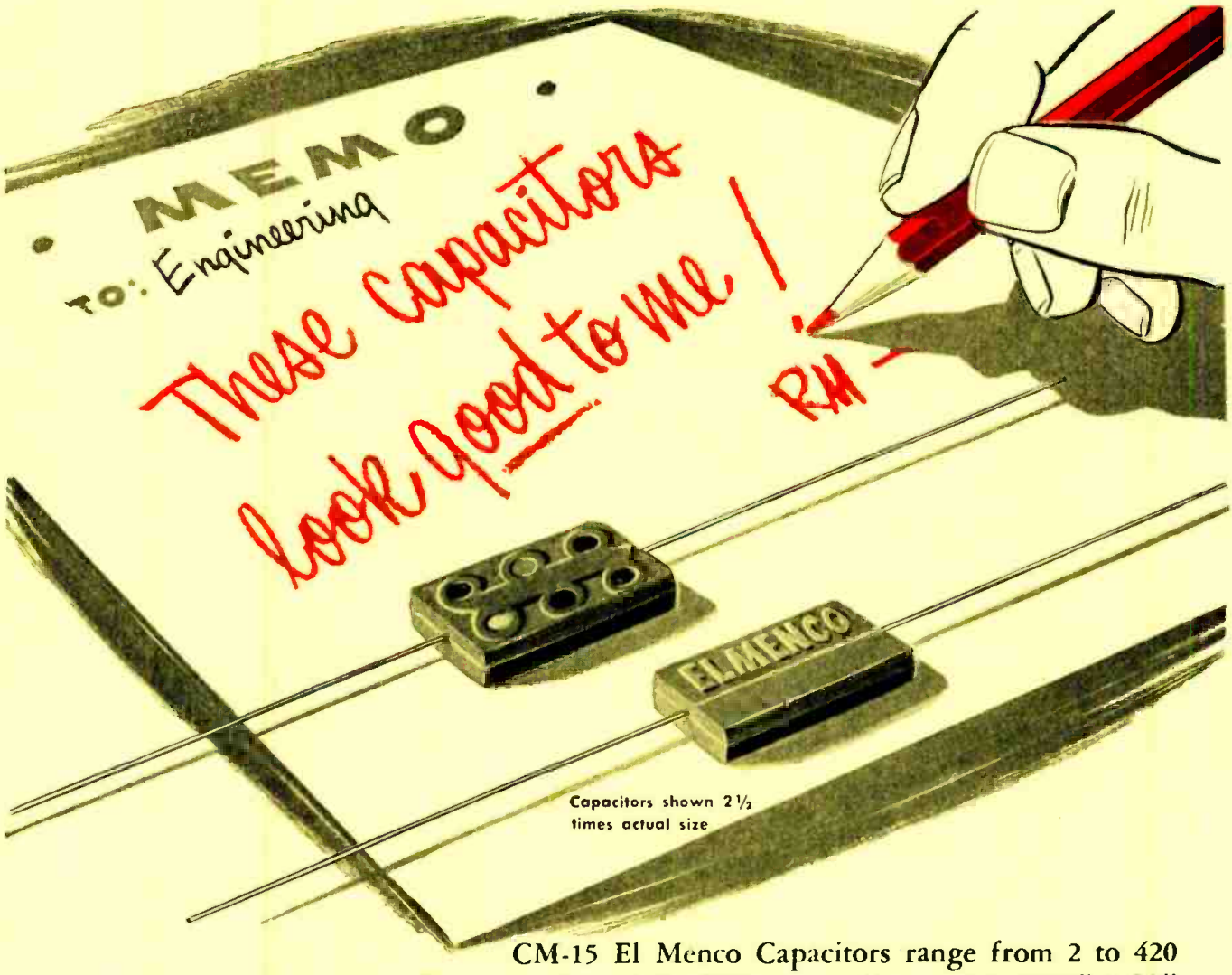

CM-15 El Menco Capacitors range from 2 to 420 mmf. at 500 vDCw . . . measure only 9/32" x ½" x 3/16" . . . but they're

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ALL fixed mica El Menco Capacitors are *factory-tested at double their working voltage.* So, you can be sure they'll stand up. They also meet all significant JAN-C-5 specifications. This means that you can specify them with confidence for all military or civilian electronic applications.

Our Type CM-15 silvered mica capacitors reach 525 mmf. at 300 vDCw. Our other types — silvered and regular — provide capacities up to 10,000 mmf. Want samples for testing? *The Electro Motive Manufacturing Co., Inc., Willimantic, Conn.*

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CAPACITORS

Foreign and Electronic Manufacturers Get Information Direct from our Export Dept. at Willimantic, Conn.

THE ELECTRO MOTIVE MFG. CO., INC. **WILLIMANTIC, CONNECTICUT**

NEWS BRIEFS

"OARAC" COMPUTER

"OARAC" is an electronic computer which has one of the largest "memories" yet incorporated in any computing device. A serial, decimal, single-address machine with magnetic tape input and output, it was built by the *General Electric Company* at Syracuse, N. Y., for use by the U. S. Air Force at its Flight Research Laboratory, Wright Air Development Center, Dayton, Ohio, in solving complex problems involving air-

craft design, guided missiles and ballistics.

The brain of the computer is a metallic drum (shown in photograph) which can hold pulses representing 10,000 ten-decimal numbers on its magnetized surface until the numbers are called into use. Operations can be performed upon instructions as well as on numbers. OARAC can make as many as 100 calculations per second.

IRE TECHNICAL CONFERENCE

On April 18 the only national IRE technical conference entirely devoted to television will be held in Cincinnati, Ohio. This is the Seventh Annual Spring Technical Conference, sponsored by the Cincinnati Section of the Institute of Radio Engineers.

Subjects of the papers to be delivered include: "Television and the Bell System," "A High Powered UHF-TV Broadcast System," "The Design of TV Receivers Utilizing Non-Synchronous Power," "Approach to Mechanized Assembly of Electronic Equipment Applicable to TV Receivers," "The Selection and Amplification of UHF Television Signals," and the latest developments in color television.

COMPONENTS SYMPOSIUM

The American Institute of Electrical Engineers, the Institute of Radio Engineers, the Radio-Television Manufacturers Association, and the West Coast Electronic Manufacturers Association are cooperating in the presentation of the 1953 Electronic Components Symposium to be held at the Shakespeare Club in Pasadena, Calif., on April 29, 30 and May 1.

This symposium is one of a series of national meetings on electronic component parts being held annually for the purpose of bringing together all those who share an interest in the development, design, performance, and future of electronic component parts.

MAGNETIC MEMORY UNIT

Employing both electronic and new magnetic techniques, a fast-access memory unit which stores and releases numbers at the rate of 50,000 per second has been designed and constructed for the U. S. Army by the Research Division of *Burroughs Adding Machine Company*. *Burroughs* was commissioned to build the apparatus by the U. S. Army Ordnance Corps to speed the work of its electronic digital computer, ENIAC, in the Ballistics Research Lab-

oratory at Aberdeen Proving Grounds, Maryland.

ENIAC previously could "remember" a maximum of 20 numbers in its internal vacuum tube memory. The *Burroughs* unit, with a capacity of 100 numbers, is expected to increase ENIAC's memory power six-fold. The heart of the new unit consists of 4100 individual memory cells, which are small doughnut-shaped cores of magnetic metal encased in plastic.

TELEPHONE "RECOGNIZER"

An electronic telephone device which can understand and intelligently react to spoken numbers has been built at *Bell Telephone Laboratories*. Named "Audrey," a contraction of "automatic

digit recognizer," the special circuit automatically determines which of ten numbers, from "1" through "0," has been spoken into an ordinary telephone, and responds by flashing an appropriate light.

When this device is adjusted for best performance with a particular speaker, it is said to operate with remarkable accuracy. The "recognizer" was the subject of a technical paper published in the January issue of the Journal of the Acoustical Society of America by K. H. Davis (shown in photograph), R. Biddulph and S. Balashek, members of the *Bell Laboratories* technical staff who worked out its intricate details.

ENGINEERS WANTED

According to Mr. T. A. Marshall, Jr., executive secretary of the Engineering Manpower Commission of the Engineers' Joint Council, 40,000 jobs are waiting to be filled in the engineering profession today. At a press meeting held by The Advertising Council to introduce its new public service advertising drive for more engineering students, Mr. Marshall warned that the current engineering shortage was "critical" and "a threat to our national security." He explained that of the 23,000 new engineering graduates expected in 1953, the ROTC will take 6800, leaving 16,200 for industry—which will need some 30,000 a year for many years to come. The Advertising Council's campaign to help alleviate the shortage has been undertaken at the request of the Engineering Manpower Commission.

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RADIO CORPORATION of AMERICA

LOOKING at TUBES

By WILFRID B. WHALLEY

Adjunct Professor of Electrical Engineering
Brooklyn Polytechnic Institute

The development of the vidicon pickup tube.

IN THE February issue of RADIO-ELECTRONIC ENGINEERING, the development of the *image orthicon* was discussed. This is the most used type of pickup tube for both outdoor and studio entertainment television at the present time.

While the image orthicon has high sensitivity, good resolution and reasonable contrast range, it is admittedly quite complex and requires correspondingly complicated associated apparatus. Due to its many internal parts, and the careful processing required, the tube is quite expensive. Occasionally also, there can be added spurious patterns due to variations in the secondary emissivity over the surface of the first dynode, so that the number of secondary electrons varies with the angle of arrival of electrons returning from the mosaic.

Therefore, a great deal of effort has gone into the development of lower-cost and simpler pickup devices. To satisfy the requirements for industrial operation, a pickup tube should preferably contain only a light-sensitive target and an electron gun.

Transfer Methods

Until recently, all pickup tubes commercially available have made use of photoemission. These include the *iconoscope*, the *image iconoscope*, the *orthicon* and the *image orthicon*. In all four types, the electrical signal depends upon the light energy releasing electrons from a suitably treated surface. However, many experimenters had tried other light-to-electric transfer methods, such as thermoelectricity, photovoltaic cells and photoconductivity.

The thermoelectric effect is well known in the use of thermocouples. It could be of value in the infrared rather than the visible light region. Some experiments were performed with films of germanium made of vapor deposition on mica, but the reported sensitivities were low.

Photovoltaic cells made, for example, with cuprous oxide on copper having a translucent film of silver to make contact to the oxide surface have shown useful variations in potential with light intensity. Such construction is not appropriate for pickup tubes since both surfaces are good conductors. Also, the changes in voltage are very small compared to the voltage of an electron scanning beam.

Photoconductivity shows up in some materials as a variation in resistance with light intensity. Among others, H. Iams, H. Miller and J. W. Strange demonstrated tubes using photoconductive surfaces nearly twenty years ago.

Photoconductivity

It was expected that photoconductivity could provide higher sensitivity than photoemission, since the photons could interact more completely during penetration into the volume of the material. Photoconductive cells had shown high sensitivity in light intensity meters. The first experiments for television use were made with selenium films mounted on graphite, but these showed very long recovery times. Resistance would decrease with light, but recovery was too slow to take care of the scene motion. Selenium was difficult to process, due to the high rate of evaporation at the usual tube bake-out temperatures.

To be suitable, a material must have sufficient "dark" resistivity so that thin layers can be comparable to the effective resistance of the scanning electron beam of a pickup tube. The layer should not be thicker than required to absorb the light completely; this entails resistivities of more than 10^{13} ohm cm. Also, the material must recover its dark resistivity quick enough to avoid "smearing" in rapidly moving objects. Then the decrease in resistance, due to light, can produce useful changes in output voltage.

Early targets were made with aluminum oxide and zirconium oxide treated with caesium vapor. Later materials consisted of various sulphides, oxides and selenides.

The Vidicon

Figure 2 illustrates the basic principle of a *vidicon* tube, the first commercial tube to use a photoconductive target. The electrons moving from the cathode to the photolayer cause a varying current through the load resistor, as the resistance of portions of the photoconductive layer is changed by the focused light from the scene.

Figure 1 shows the construction of the target in detail. The inside surface of the tube face is coated with a transparent conducting metallic film extending to the embedded kovar metal ring. This ring provides the external signal terminal. The photoconductive film, which is only about two ten-thousandths of an inch in thickness, is deposited upon the glass.

Figure 3 shows the essential parts of a complete tube. Located some distance behind the target is a fine mesh wire screen which is used to maintain a uniform electric field over the inner face of the target. An electron gun similar to that used in other pickup tubes, but with a very small limiting aperture. is positioned at the other end of the tube. Deflection of the electron beam is accomplished by magnetic fields from a yoke similar in design to that used with the image orthicon. The tube and deflection yoke assembly is immersed in an axial d.c. magnetic field produced by the focusing coil. As in the orthicon and image orthicon, the axial field

(*Continued on page* 27)

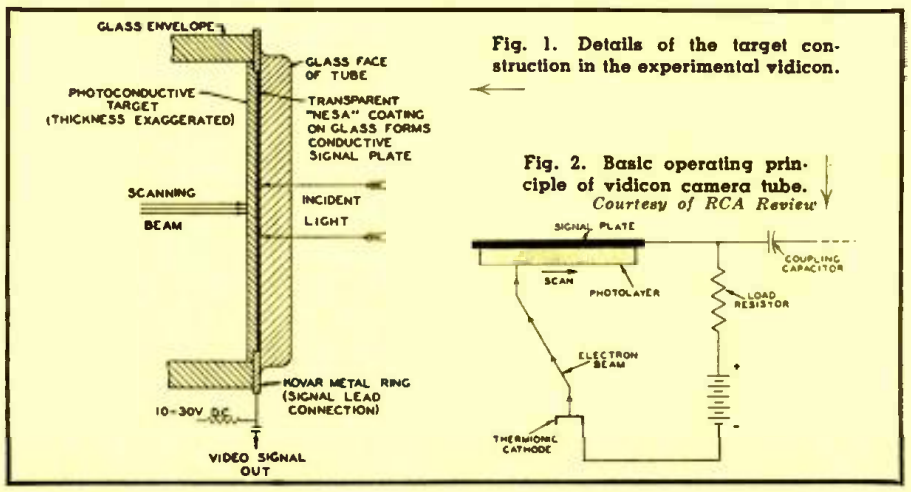

Fig. 1. Details of the target construction in the experimental vidicon.

Fig. 2. Basic operating principle of vidicon camera tube. *Courtesy of RCA Review*

FREQUENCY CONTROL FOR MILITARY APPLICATION

MIL CRYSTAL UNIT	BLILEY CRYSTAL HOLDER	FREQUENCY RANGE MEGACYCLES	OPERATING TEMPERATURE RANGE (Centigrade)	FREQUENCY TOLERANCE OVER OPERATING RANGE
CR-15	AR2[illegible]	0.080 - 0.19999	—40° to +70°	± .01%
CR-16	AR23W	0.080 - 0.19999	—40° to +70°	± .01%
CR-18	BH6A	0.8 - 15.0	—55° to +90°	± .005%
CR-19	BH6A	[illegible]	—55° to +90°	± .005%
CR-23	BH6A	10.0 - 75.0	—55° to +90°	± .005%
CR-24	BH7A	15.0 - 50.0	—55° to +90°	± .005%
CR-27	BH6A	0.8 - 15.0	[illegible] to +80°	± .002%
CR-28	BH6A	[illegible]	+70° to +80°	± .002%
CR-29	AR23	0.080 - 0.19999	+70° to +80°	± .002%
CR-30	AR23W	0.080 - 0.19999	+70° to +80°	± .002%
CR-32	BH6A	10.0 - 75.0	[illegible] to +80°	± .002%
CR-33	BH6A	[illegible]	—55° to +90°	± .005%
CR-35	BH6A	0.800 - 20.0	+80° to +90°	± .002%
CR-36	BH6A	0.800 - 15.0	+80° to +90°	± .002%
CR-37	BH9A	0.090 - 0.250	[illegible] to +70°	± .02%
CR-42	BH9A	0.090 - [illegible]	+70° to +80°	± .003%
CR-44	BH6A	15.[illegible] - [illegible].0	+80° to +90°	± .002%
CR-45	BH6A	0.455	—40° to +70°	± .02%
CR-46	BH6A	0.2 - 0.500	—40° to +70°	± .01%
CR-47	BH6A	0.2 - 0.500	+70° to +80°	± .002%

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BULLETIN NO. 43 CONTAINS A QUICK REFERENCE INDEX FOR MILITARY TYPE CRYSTAL UNITS---SENT UPON REQUEST

Bliley CRYSTALS

BLILEY ELECTRIC COMPANY
UNION STATION BUILDING, ERIE, PA.

Personals

JOSEPH N. BENJAMIN has been appointed vice-president of the *Pilot Radio Corporation*, 37-06 36th Street, Long Island City, N. Y. A graduate electrical engineer, Mr. Benjamin has been associated with the *Pilot Radio Corporation* since 1946, first as production manager, then as works manager, and recently as manager of the Government Contract Department. He served as a major in the Signal Corps in World War II.

RAUL H. FRYE, formerly director of research and engineering for the *Raytheon Television and Radio Corporation*, has been named general manager of the newly formed Special Products Division. He will supervise all planning, research and production. Shortly after his appointment, Mr. Frye named Robertson Gannaway, formerly *Raytheon Television's* chief technical engineer, as director of research and engineering for the new division.

KARL B. HOFFMAN has been elevated to the office of vice-president in charge of TV planning and operations at the *WGR Broadcasting Corporation;* he became associated with the *Buffalo Broadcasting Corporation* (*WGR*'s predecessor) as technical director in 1933. In the radio-TV-electronic field since 1921, Mr. Hoffman was for many years a member of the engineering staff of the *General Electric Company's* Station WGY at Schenectady.

DR. RUSSELL R. LAW is now assistant to the vice-president in charge of manufacturing and engineering at *Hytron Radio & Electronics Co.*, a division of *Columbia Broadcasting System, Inc.;* in this capacity he will serve as adviser on special technological problems. During the last 18 years, Dr. Law has been with *RCA* at Harrison and Princeton, N. J. He holds B.S. and M.S. degrees from Iowa State College and a D.S. degree from Harvard University.

JOHN E. NELSON, appointed product manager for industrial and transmitting tubes by the *General Electric Company*, Schenectady, N. Y., will direct the planning of *G-E* tube product development; he has served as acting product manager since March, 1951. Mr. Nelson was with the U. S. Department of Agriculture for nine years before joining *G-E* in 1942. He received his master's degree in electrical engineering from the University of Illinois.

DR. GORDON K. TEAL, well known for his work in the semiconductor field, has joined *Texas Instruments Incorporated*, of Dallas, as assistant vice-president and director of the Materials and Components Research Department, Engineering Division. Prior to joining *Texas Instruments*, Dr. Teal was associated with *Bell Telephone Laboratories*, where he had charge of a group responsible for the development of transistor and varistor materials.

Magnetic Attenuator

(*Continued from page* 14)

magnetizing field, minimum attenuation is obtained. Both the minimum and the maximum values of attenuation are determined by the operating frequency, the ferrite material and lengths used in the device, and the impedance matching of the attenuator.

Conclusion

From the data already presented, it can be seen that if an efficient magnetic attenuator is to be constructed, consideration must be given to the range of frequencies over which operation is desired, and a careful selection of ferrite materials should be made. A certain amount of trial and error may be necessary to find the best material for a given application. In some applications, operation of several units in cascade may be necessary to obtain the required attenuation range. Impedance-matching the device can be done by conventional methods of undercutting, tapering, or stepping the section of ferrite material.

Since the physical properties of these r.f. dissipative materials closely resemble those of glass and ceramics, special machining techniques[5] are needed to shape the materials to the desired dimensions. Diamond-surfaced grinding wheels and drills are required throughout. Copper mandrels with diamond dust—approximately 60 microns in size—impregnated upon the tip were the most successful for drilling small holes. A recent type of dental drill, consisting of a steel mandrel with diamond particles electroformed on the tip, can also be used. Such drills can be conveniently obtained in many shapes and sizes from most dental manufacturing companies.

A list of commercially available ferrite materials suitable for use in the u.h.f. magnetic attenuator is shown in Table 1. The approximate attenuation at 1000 mc. when no external magnetic field is applied is shown for each material, together with the manufacturer's name and address.

The author wishes to thank Mr. R. W. Beatty for his assistance and helpful discussions throughout the development of the magnetic attenuator.

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1. *"NBS Magnetic Attenuator," National Bureau of Standards, Technical News Bulletin, Vol. 35, No. 8, pp. 109-111, August,* 1951.
2. *Snyder, C. L., Albers-Schoenberg, E., and Goldsmith, Harold A., "Magnetic Ferrites," Electrical Manufacturing, Vol. 44, No. 6, pp. 86-91. December,* 1949.
3. *Snoek, J. L., "Non-metallic Magnetic Materials for High Frequencies," Philips Technical Review, Vol. 8, December,* 1946.
4. *Standley, K. J., "Ferromagnetic Resonance Phenomena at Microwave Frequencies," Science Progress, Vol. 38, No. 150, pp. 231-245. April,* 1950.
5. *Feldman, A. A., "The Machining of Powdered Iron Materials and Ferromagnetic Ferrites," National Bureau of Standards, Report No. 1530.*

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Seven out of the ten leading television set makers are today using Sylvania Picture Tubes. Why this overwhelming popularity? Much of the credit will be found in the splendid quality and scientific purity of Sylvania's Tungsten and Chemical Components. And NOW, these products, based on 15 years research and special skills, are offered to you! *For example:*

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SYLVANIA

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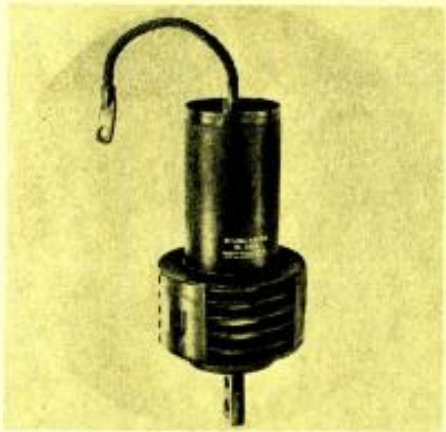
NEW TUBES

AIR-COOLED IGNITRON

National Electronics, Inc., Geneva, Ill., has recently developed a 56-ampere ignitron which does not require water cooling and is electrically similar to the 5551 Size B ignitron tube. Elimination of water cooling is expected to permit the use of ignitron tubes in



fields where their application has previously not been feasible.

Designated as NL-1005, this tube is designed for forced air cooling, but it may be used at reduced ratings with free ventilation. It is capable of controlling maximum r.m.s. demand current of 2400 amperes at 250 volts a.c. or 1200 amperes at 500 volts a.c. Maximum average anode current rating is 56 amperes d.c. When used for welding control, the NL-1005 is the approximate equivalent of a 300-ampere magnetic contactor.

Complete technical data are available from the manufacturer.

PICTURE TUBE REPLACEMENT

The addition of the type 16K/RP4 to *Du Mont's* picture tube replacement line has been announced by the Cathode-Ray Tube Division of *Allen B. Du Mont Laboratories, Inc.*, Clifton, N. J. It is a glass rectangular type employing magnetic focus and deflection.

Production of this tube, which is already under way, will provide the service industry with a complete *Du Mont* line of round and rectangular glass picture tubes for replacement.

GERMANIUM DIODES

Amperex Electronic Corporation announces the addition of a line of seven germanium diodes of the hermetically sealed glass variety which are not affected by atmospheric conditions of humidity, altitude and extremely low temperature.

Types 1N34A, 1N38A, 1N54A and 1N58A are electrically interchangeable with the well-known standard types. New types include: 1N86—a general purpose diode, 1N87—a video detector diode, and 1N88—a d.c. restorer diode.

Complete technical data are available on request from *Amperex Electronic Corporation*, 230 Duffy Avenue, Hicksville, L. I., N. Y.

X-BAND ATR TUBE

Designed for operation in the X-band at a frequency of 9280 mc., the Type 6276 ATR is electrically but not mechanically interchangeable with such types as the 1B35 and 1B35A. Introduced by *Microwave Associates Inc.*, 22 Cummington Street, Boston 15, Mass., it features a braid gasket flange type of mounting located near the window instead of a resonant choke-mounted seat. Because of this, lower values of normalized equivalent con-

ductance and freedom from arcing at high power operation are achieved.

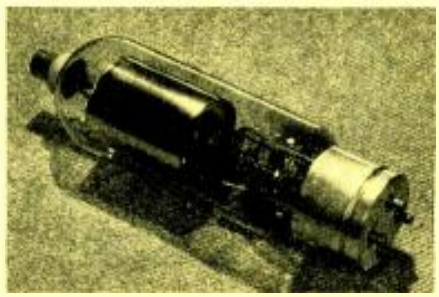
The Type 6276 is completely silver-brazed, resulting in electrical and mechanical uniformity. It is small and compact in design, having an over-all length of only one inch. The tubulation is located on the narrow side of the wave guide body, thus providing greater clearance for associated equipment.

HALF-WAVE RECTIFIER

A half-wave rectifier designed for high-voltage rectifier circuits has been added to *General Electric's* industrial tube line. It is intended for use in radio and television transmitters, industrial heating oscillators, and other applications where high voltage d.c. is required.

The GL-4B32 is an inert-gas-filled tube which will operate over a wide temperature range—from -55 to 70 C. Use of an inert gas instead of mercury permits the tube to be mounted in any position.

Maximum ratings include a peak maximum cathode current of 5 amperes, an average maximum cathode current of 1.25 amperes, and a max-



imum peak inverse anode voltage of 10,000 volts. Further information may be secured by writing to the *General Electric Company*, Tube Department, 1 River Road, Schenectady 5, N. Y.

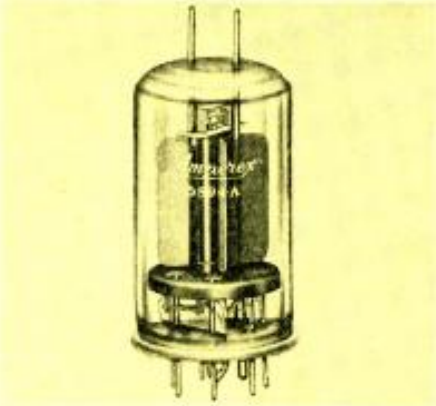
VERTICAL DEFLECTION AMPLIFIER

Now in production at the Radio Tube Division of *Sylvania Electric Products Inc.*, at Emporium, Pa., is a miniature, high perveance, double triode, vertical deflection amplifier designated as Type 12BH7.

This unit consists of two completely independent medium-mu triodes in a T-6½ envelope. One section may be used as the sawtooth generator while the other section serves as the vertical deflection amplifier. Both sections are designed to withstand the high pulse voltages normally encountered in vertical amplifier service. For certain applications where the plate supply voltage must be kept low, parallel connection of the two sections may be used.

TWIN TETRODE

Designed for wide-band operation as an r.f. amplifier, modulator, frequency doubler or a tripler, the new *Amperex*



u.h.f. and v.h.f. twin tetrode is a smaller, mechanically and electrically improved version of the *Amperex* AX-9903/5844 tube. Improved h.f. performance is possible with this new tube,

known as the 5894-A, because the cathode and grid structure is supported at the top as well as the bottom of the tube. Being held in exact vertical alignment with the plates, the two sections of the tube are in closer electrical balance.

The *Amperex* 5894-A employs a new type of construction which enables the tube to withstand greater shock and vibration. The anode seal strength has been increased by replacing the top section of the tube with a powdered glass seal. For further information, write to *Amperex Electronic Corporation*, 230 Duffy Avenue, Hicksville, L. I., N. Y.

HYDROGEN THYRATRONS

Plans for the production of hydrogen thyratrons at the Scranton, Pa., plant of the *General Electric Company* have recently been announced. These tubes will be used in the radar fence being built by the U. S. Air Force—a series of radar detector stations to guard the country's shorelines and borders against sneak attack—and will also be used in Army and Navy radar equipment.

Hydrogen thyratrons are vital to the operation of high power radar units. First developed during and following World War II, they have been in short supply due to manufacturing difficulties —the hydrogen gas inside the tubes is extremely active chemically and the tubes are subject to voltages considerably higher than those used in standard industrial thyratrons. *G-E* now expects to produce several million dollars' worth of these hydrogen units annually.

SHARP CUTOFF PENTODE

Intended particularly for use in electronic computers, the Type 6145 sharp cutoff pentode amplifier is suitable for applications where long life under cutoff conditions, low supply voltage and high plate current at zero bias are required. It has just been announced by the Radio Tube Division, *Sylvania Electric Products Inc.*, 1740 Broadway, New York 19, N. Y.

Advantages of the 6145 include: T-9 lock-in construction for compactness, shielding and secure socketing; and unusually low interelectrode capacitances.

Looking at Tubes

(*Continued from page* 22)

keeps the low voltage electron beam in focus during travel from the gun to the target. Another coil is placed over the gun to control alignment of the electron beam on entering the main focusing field.

In operation, the electron beam brings each portion of the surface to

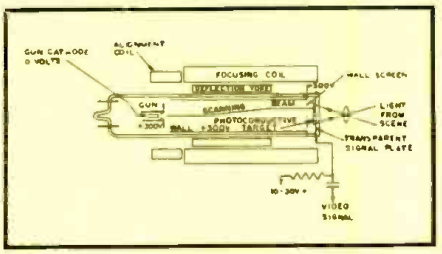


Fig. 3. Cross-sectional diagram of an experimental vidicon pickup tube.

cathode potential. When light is falling on a portion of the surface, the potential difference between that part of the surface and the signal plate changes during the scanning interval, and the electron flow from the beam on the next scan (to return the surface to cathode potential) causes a voltage drop across the load resistor. This voltage is proportional to the change in resistance caused by the illumination.

The vidicon is much smaller than other types of pickup tubes, being approximately one inch in diameter and six inches long. Its sensitivity is quite high, and it operates satisfactorily with standard types of photographic optical lenses. Due to its small size, low voltage requirements, and simplicity of adjustment, it is particularly well suited to industrial television.

NEW LITERATURE

DIESEL ELECTRIC SETS

Actual operating experiences with "Caterpillar" diesel electric sets throughout the United States and Canada are featured in an eight-page bulletin published by *Caterpillar*, Peoria, Ill. Entitled "Power Guards for Communications," it emphasizes the need for uninterrupted service in the many fields of communications—and the important part that a dependable power source plays in making this service possible. Specifications for ten different diesel electric sets are included.

POWER CONVERSION UNITS

A two-color booklet describing the complete *G-E* line of metallic rectifier power conversion units is available from the *General Electric Company*, Schenectady 5, N. Y.

This illustrated eight-page bulletin, GEA-5658A, contains design features, performance characteristics, circuits, applications and advantages of the *G-E* line. A chart of the dimensions, ratings and weights is also included, together with guide form specifications.

RCA TUBE TYPES

The Tube Department of *Radio Corporation of America* recently issued a revised edition of its list of preferred tube types for new equipment design. The revisions involve changes resulting from technological advances in tube design and application.

A copy of this latest issue of the *RCA* list can be obtained on request from Commercial Engineering, *RCA* Tube Department, Harrison, N. J.

OTS PUBLICATIONS

PB 111051

How to build aircraft electronic equipment so as to eliminate operational disturbances (natural static and interference from other equipment) is explained in a report entitled "Design Techniques for Interference-Free Operation of Airborne Electronic Equipment." 459 pages. $11.50. Orders for PB 111051 should be addressed to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., accompanied by check or money order payable to the Treasurer of the United States.

PB 107274

"The Sleeve Antenna" describes an improved type of short-wave antenna — a coaxial cable in which the inside central rod is made to extend beyond the outside cylinder forms an effective "sleeve" type antenna for radiating short-wave energy. 141 pages. On microfilm, $5.75; in photostat form, $18.75. Orders for PB 107274 should be addressed to the Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, D. C., with check or money order payable to the Librarian of Congress.

INDUSTRIAL CONTROLS

Complete information on *Barber-Colman* industrial controls is now available in Catalog F-3941-2. Products covered include thermostats, a proportioning pressure switch, humidity controls, motor-operated and solenoid valves, temperature regulators, control motors, relays, and electrical accessories.

Address your request for a copy of F-3941-2 to the *Barber-Colman Company*, Rockford, Ill.

INTEGRATOR

Instron Engineering Corporation, 2 Hancock Street, Quincy 71, Mass., announces the availability of a bulletin describing the *Instron* integrator—an electromechanical device for obtaining the time integral of a varying input signal.

Included in this bulletin are the various possible applications of the integrator, a general description of the device, its principle of operation, input requirements, and specifications.

MICROWAVE INFORMATION

Economic aspects of multichannel operation of telephone and telegraph circuits over microwave radio links are emphasized in the new *Lenkurt* Bulletin 72A-P16. Entitled "Microwave in the Telephone Toll Plant," it may be obtained from the *Lenkurt Electric Company*, County Road, San Carlos, Calif.

Among the subjects discussed in this publication are: the investment required for microwave equipment; the revenue possibilities which microwave provides; and the way in which the use of microwave affects such problems as future system growth.

COOK BROCHURE

Bulletin R-10 is a 47-page brochure containing information on the latest facilities and services of the new *Cook Research Laboratories* in Skokie, Ill., a division of the *Cook Electric Company*. It will be mailed to anyone interested in research, development and instrumentation in the fields of nuclear physics, servomechanisms, upper air research, weather reconnaissance, radar, sonar, guided missiles and general electronics. Write to *Cook Electric Company*, 2700 Southport Avenue, Chicago 14, Ill., for your copy.

TECHNICAL BOOKS

"FILTER DESIGN DATA FOR COMMUNICATION ENGINEERS" by J. H. Mole. Published by *John Wiley & Sons, Inc.*, 440 Fourth Avenue, New York 16, N. Y. 252 pages. $7.50.

This book is concerned mainly with the Zobel filter. Brief accounts of a number of recent extensions to the Zobel theory have been included.

Heretofore. textbooks on filters have concentrated on theoretical principles and have given comparatively little attention to the needs of the practical designer; the present work is an attempt to supplement such textbooks by providing in a convenient form charts, tables and formulae selected or constructed so as to lighten the labor of calculation as much as possible. With their help, it should be possible to design filters in a small fraction of the time otherwise needed.

Derivations of formulae have been omitted except where they clarify the presentation, and attention has been confined to the statement of results and the explanation of design methods. It has been assumed that the reader has an elementary knowledge of the principles of line transmission and of filters.

"PROCEEDINGS OF THE NATIONAL ELECTRONICS CONFERENCE"—1952—Volume 8. Published by the National Electronics Conference, 852 East 83rd Street, Chicago 19, Ill. 835 pages, including charts, diagrams and tables. Case bound. $5.00.

Included in this volume are all of the papers which were presented at the Eighth National Electronics Conference held in Chicago on September 29, 30 and October 1. A program of the three-day session is also given.

Topics covered by the 97 technical papers include: electronic research, development, and application; antennas; the assembly and measurement of components; audio; circuits; coding and recording techniques; computers; delay lines and h.f. test equipment; electronic instruments; engineering management; industrial measurements; magnetic amplifiers; memory tubes; radar; radio navigation; reliability of components and equipment; semiconductors; servomechanisms; television; transistors; and wave guides.

The appendices contain a catalog of the various exhibitors at the 1952 Conference and contents of previous issues of the Proceedings. Copies of Volumes 2, 4, 5, 6 and 7 may also be obtained for $5.00 a copy.

New Products

(*Continued from page* 18)

tape recorder combination, where the CCR turns on the tape drive mechanism only when there is a signal to be recorded.

FERRAMIC CORES

Production of a new line of ferramic cores for use in digital computers is under way at the *General Ceramics and Steatite Corporation*. These cores are molded of Ferramic MF 1118, a soft magnetic material featuring square hysteresis loops, high volume resistivity and a low loss factor.

As the response time of Ferramic MF 1118 is about 40 times faster than that of other magnetic materials, the new cores have a switching time of less than one microsecond. They are available in three sizes. Complete data will be supplied promptly on request to: *General Ceramics and Steatite Corp.*, Keasbey, N. J.

DECADE RESISTOR

Type 245S, a new 1-watt precision wire-wound resistor for decades and other applications requiring low resistance values with close tolerances, low temperature rise, and low inductance, has been announced by the *Shallcross Manufacturing Company*. It can be calibrated to a tolerance of ±0.1% or better and is available from 0.1 to 1000 ohms. The Type 245S resistor is 1⅛" long by ⅜" in diameter.

A single layer bifilar winding protected by a moisture-resistant lacquer coating is used for all-values. The Steatite bobbin and axial wire leads at the same end make it easy to mount this resistor directly on decade switch decks or other similar equipment. Further details may be secured by letterhead request to *Shallcross Manufacturing Company*, Collingdale, Pa.

ULTRASONIC DELAY LINES

A series of fused quartz ultrasonic delay lines for radar and electronic computer applications has been developed by *Andersen Laboratories, Inc.*, West Hartford, Conn. These solid delay lines are available in bandwidths of 12 mc. or greater, and feature an extremely low ratio of spurious to desired signals—as low as -50 db for special requirements. Insertion losses are also kept to a minimum, 34 to 50 db being characteristic, depending on the terminating impedance necessary.

Andersen Laboratories is prepared to offer advice and engineering help to customers on all types of ultrasonic delay line problems.

Decay Constant

(*Continued from page* 11)

The decaying waveform, which must be essentially d.c. in character, is impressed on one of the cathodes of a 6AL5 twin diode through the primary windings of a pulse transformer. The anode is maintained at a selected potential supplied by a battery external to the circuit. As long as the cathode potential exceeds that of the anode, no conduction can take place. When the cathode and anode potentials become equal, a small current flows and a voltage appears across a differentiating circuit in the grid of a 6BA6 high-gain pentode amplifier. This voltage, initially a small pulse, is amplified and its phase is inverted by the pentode. The amplified pulse is impressed upon the cathode of the diode through a capacitor and the secondary of the pulse transformer. The combination of tube- and transformer-phase inversion drives the cathode voltage lower and increases the difference in potential between it and the anode. This action forces heavy conduction in the diode within a very short time after the small initial pulse appears. It is also cumulative and becomes oscillatory in a time determined by the reactances in the regenerative circuit of the 6BA6. Thus, within a very short time after the reference voltage on the anode and the "signal" voltage on the cathode have become equal, a sharply rising oscillatory wave is generated.

The impedance level at the anode of the 6BA6 pentode is high, and any loading of the circuit would adversely influence the speed of response of the complete circuit. Therefore, the circuits following this type of regenerative voltage comparator convert the waveform into a single pulse at an impedance level suitable for triggering a precision counter chronoscope. A diode rectifier —one-half of another 6AL5—of short time constant is connected to the anode of the pentode amplifier to convert the input oscillations into a step function containing only a slight ripple. This impulse waveform is amplified in a two-section rise-rate triode amplifier (a 12AT7) that further increases its speed of rise. Another differentiating circuit and an overshoot diode clipper complete the output section.

At the instant the decaying waveform is applied to the circuit described above, it is also impressed on a similar circuit. The second circuit is identical to the first except that the reference voltage on the anode of the comparison diode prevents the circuit from functioning until the input voltage has decayed to a lower value than in the first circuit, usually 22½ volts. The output pulse of the second circuit is then used to stop the chronoscope. The time difference between the 45 volt-triggering and the 22½ volt-stopping pulses is a measure of the damping coefficient of the vibrating system.

The accuracy of the NBS decay-constant measurement method was determined by using precision *RC* networks, the time constants of which are simply calculated. The error in measuring the time increment was found to be proportional to the length of the increment. Thus, for a 3-second increment, the error is 3%; and a 0.2 second increment has an error of less than ½%.

Stability over long periods of time is insured by compensating the comparator diodes for thermal drift due to heater aging and temperature variations. The drift voltages are cancelled by using two diodes in the same envelope. In measurements of decay time in the region of 0.15 second, the compensation maintains the drift to 1 part in 1500 for periods of several hours.

Coaxial Cavity Element

(*Continued from page* 16)

is attached to a small driving motor which frequency-modulates the output. A 60-cycle sweep source, whose phase is adjustable for proper phasing of sweep and swept signal on the viewing scope, is also provided. Two versions of the unit have been designed: one provides an output of approximately 2 volts into 72 ohms unbalanced, which is capable of being attenuated approximately 30 db; and a second provides an output of approximately 1 volt into 72 ohms unbalanced, with an output capable of being attenuated over 100 db. Provision for internal and external modulation is made on the latter unit, so that it may be used as a combination sweep and signal generator.

In order to fill the need for final testing of converters, it was found necessary to have a source of u.h.f. television signals covering the entire u.h.f. band, since—unlike v.h.f.—no area has more than one or two stations. To cover this deficiency, a relatively low-cost composite picture, sound, and sync signal generator using the video and sound signals of existing v.h.f. stations was designed. A block diagram of the picture signal generator is shown in Fig. 6. The unit is provided with a piston attenuator capable of a maximum output of approximately 1 volt into 75 ohms and over 100 db attenuation. It has level-set meters and controls for both input and output signals, and is capable of external modulation by means of a monoscope and synchronizing generator rack. The generator makes it possible to provide a composite picture at any u.h.f. channel. In effect, it is a miniature u.h.f. station wired directly to the receiver being tested. It may be used for u.h.f. demonstrations, interference studies, hum modulation and microphonic investigations, and other applications.

PHOTO CREDITS

PAGE	CREDIT
3, 4	Industrial Nucleonics Corp.
11, 12, 13, 14, 32	National Bureau of Standards
15, 16	Granco Products Inc.

Converter Calibration

(*Continued from page 7*)

done easily by using a center-tapped transformer with a 50,000-ohm Helipot across the plate leads. The center tap of the transformer and the Helipot slider provide the signal leads. With the potentiometer slider centered, zero output voltage will exist. Moving the slider in either direction will cause a voltage to appear; but in one direction the voltage will be practically in-phase with the line voltage, and in the other direction it will be practically 180° out-of-phase. When a transformer is used, a phase shift of about 2° will occur between the input and output voltages. The output voltage can be read directly from a calibrated dial on the Helipot, provided that the input voltage to the transformer is adjusted, using a *Weston* Model 622 voltmeter (1%), a vacuum tube voltmeter (3%), or a laboratory dynamometer voltmeter (½%). The converter output of 0 to 5 volts d.c. can be read by the *Weston* 200,000 ohm/volt voltmeter.

It might be well to note here that converters of this type can be very tricky to design, build, and calibrate.

Calibration of the *capacity converter* (Fig. 1B) consists of connecting known capacitors to the input of the converter to simulate different capacities, indicating—for example—different fuel levels. The converter output is fed to a potentiometer divider, placed across a stable 5-volt supply. Proper voltage is then provided by the slider. The calibration capacitor is a special capacitor arrangement whereby both the stator and rotor are above ground, and ground is the shielded box surrounding the variable capacitor. Plug-in fixed capacitors increase the total capacity range. This results in a three-wire arrangement which makes possible a system free from errors due to changes in temperature or moisture content of cable insulation. Fuel gauge accuracy is also independent of cable lengths or capacity. Accuracy is approximately 1%.

The *potentiometer divider* converts mechanical motion into a change of potentiometer slider position. The best method of calibration of this device is through the use of a ratio bridge (Fig. 2A). A potentiometer divider generally consists of a 5000-ohm potentiometer, and is arranged in a bridge circuit with a Helipot having a ten-turn dial, also rated at 5000 ohms. Voltage is applied across the dividers and a null indicator (D'Arsonval microammeter) is placed between the two sliders. The actual voltage across the two parallel potentiometers is not critical, i.e., the voltage can vary over several volts—say, between 4 to 6 volts—because the ratio bridge is a null device. The Helipot is adjusted for a null and its dial indicates 0 to 1000, which can conveniently be reduced to 0 to 100. Therefore, the input to the potentiometer divider can be plotted against 0 to 100% motion. This method of measurement is widely used because it eliminates the necessity for measuring and maintaining 5 volts d.c. to better than 1% and then reading the divider output voltage to 1%. The overall accuracy of a ratio bridge circuit can be ½%.

Equipment in a converter calibration bench is also suitable for testing and calibrating subcarrier oscillators. A subcarrier oscillator is frequency-modulated by applying a signal between 0 and 5 volts d.c. The a.f. output deviates from the center frequency ±7.5%, with 2.5 volts d.c. causing the subcarrier oscillator to oscillate at center frequency. Thus, the EPUT meter can measure the subcarrier output frequency and the *Weston* d.c. voltmeter can measure the input voltage accurately.

The calibration bench requires power supplies of 400 cycles, 115 volts a.c. and 26 volts a.c., single-phase; several hundred volts d.c.; 6.3 volts a.c. or d.c.; and 28 volts d.c. Most of these power requirements can be supplied by commercial power supplies.

CALENDAR of Coming Events

MARCH 23-26—IRE National Convention, Waldorf-Astoria Hotel and Grand Central Palace, New York, N. Y.

APRIL 11—New England Radio Engineering Meeting, University of Connecticut, Storrs, Conn.

APRIL 18—Spring Technical Conference of the Cincinnati Section, IRE, Engineering Societies Bldg., Cincinnati, Ohio.

APRIL 23-24—International Symposium on Non-Linear Circuit Analysis, organized by Polytechnic Institute of Brooklyn, Engineering Societies Bldg., 33 W. 39th St., New York, N.Y.

APRIL 27-30—Spring Technical Meeting, sponsored jointly by the U.S.A. National Committee of the International Scientific Radio Union and the IRE Group on Antennas and Propagation, National Bureau of Standards, Washington, D. C.

APRIL 29-MAY 1—Electronic Components Symposium, sponsored by the AIEE, IRE, RTMA and WCEMA, Shakespeare Club, Pasadena, Calif.

MAY 7-9—Acoustical Society of America, 45th Meeting, featuring Sound Reproduction, Warwick Hotel, Philadelphia, Pa.

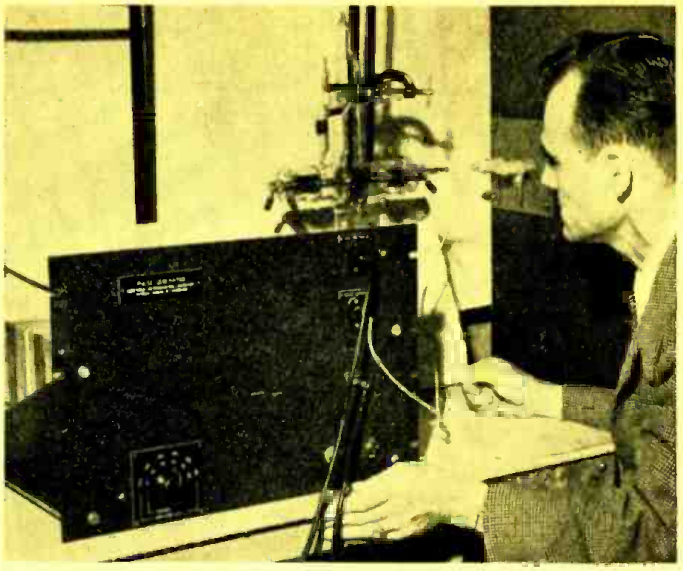
MAY 11-13—National Conference on Airborne Electronics, Hotel Biltmore, Dayton, Ohio

AUGUST 19-21—Western Electronic Show and Convention, Civic Auditorium, San Francisco, Calif.

A HIGH-POWER PULSE GENERATOR

By
W. E. WILLIAMS, JR.
National Bureau of Standards

Pulses of nearly square waveform at voltages up to 1200 volts at several amperes and at six frequencies are provided by this generator.



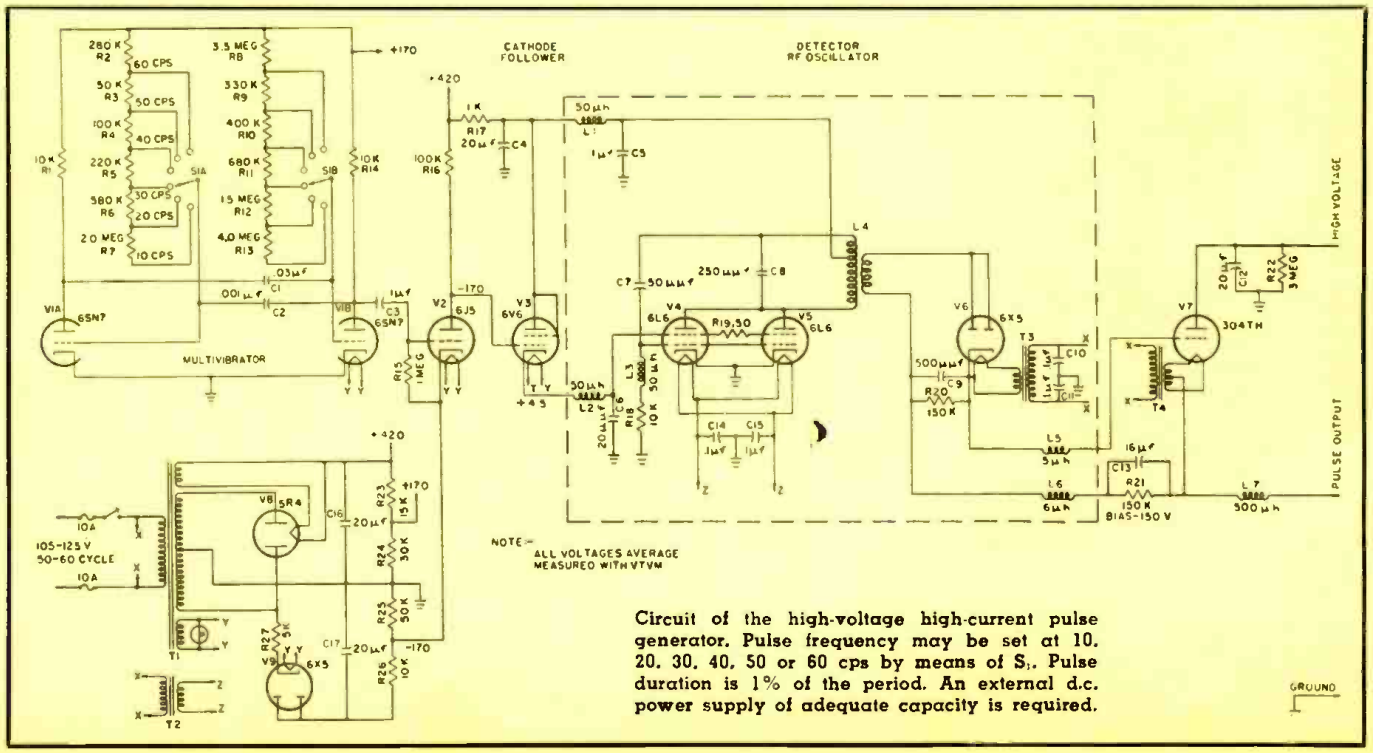
The generator being used to supply current pulses to a vacuum tube.

AN ELECTRONIC pulse generator has recently been developed at the National Bureau of Standards to supply heavy pulses required in an NBS study of cathode emission.

Output of the pulse generator is taken between ground and the cathode of a high power 304TH triode switch tube. The plate voltage of the 304TH is supplied from an adjustable external source of up to 2000 volts. When the switch tube is receiving no pulse excitation, its grid is biased to cutoff, and its cathode is at ground potential. When a pulse drives the 304TH grid positive with respect to cathode (about 130 volts are used), the output voltage rises to a value determined by characteristics of the external power supply and load.

The novelty of the NBS pulse generator lies in the means by which the exciting pulse is supplied to the grid of the 304TH. The most obvious method might seem to be to couple a pulse-forming circuit to the 304TH by means of a pulse transformer. But the transformer would need to be insulated to withstand the high voltages involved, and it would be difficult to construct such a transformer having good response at the low repetition rates as well as good insulation. For this reason, a circuit was adopted in which a keyed r.f. oscillator and rectifier take the place of a pulse transformer.

Pulses are generated initially by a twin-triode 6SN7 vacuum tube in an unbalanced multivibrator circuit. Output of the multivibrator is amplified by a single 6J5 triode and coupled by a 6V6 cathode follower to the screen grids of a 4.2-mc. r.f. oscillator using two 6L6's in parallel. By this arrangement the oscillator is keyed on for the duration of each pulse. The oscillator output—a 4.2-mc. carrier with 100% 10-to-60-cycle near-square-wave modulation—is inductively coupled to a 6X5 rectifier, and the positive-pulse output of the rectifier is applied to the grid of the 304TH output tube. Necessary high voltage insulation between the two windings of the oscillator coil is readily provided.



Circuit of the high-voltage high-current pulse generator. Pulse frequency may be set at 10, 20, 30, 40, 50 or 60 cps by means of S_1. Pulse duration is 1% of the period. An external d.c. power supply of adequate capacity is required.

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Corner Reflector No. UHF400

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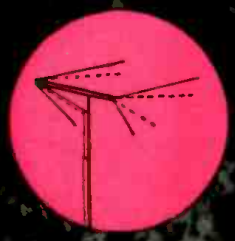

Ultra V-Beam No. UHF500

YAGIS No. UHF300 Series for Channels 14 to 83

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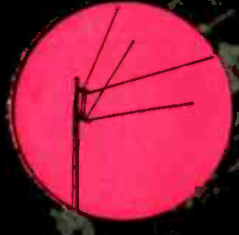

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Two ALL NEW Complete Kits for Every High-Fidelity Need

FM Tuner Kit **$55**

The FM-11 tuner is available in kit form with the IF Amplifier mounted in the chassis, wired and tested by us. You mount the completed RF Tuning Unit and power supply, then after some simple wiring, it's all set to operate. 11 tubes: 6J6 RF amp, 6AG5 converter, 6C4 oscillator, 6BA6 1st IF, (2) 6AU6 2nd and 3rd IF, (2) 6AU6 limiters, 6AL5 discriminator, 6AL7-GT double tuning eye, 5Y3-GT rectifier. Sensitivity 6 to 10 microvolts, less than ½ of 1% distortion, 20 to 20,000 cycle response with 2DB variation. Chassis dimensions: 12½" wide, 8" deep, 7" high. Illustrated manual supplied. Shipping weight 14 lbs.

Each Collins Tuner Kit is complete with punched chassis, tubes, power transformer, power supply components, hardware, dial assembly, tuning eye, knobs, wire, etc., as well as the **completed** sub-assemblies: FM tuning units, AM tuning units, IF amplifiers, etc., where applicable. Since all these sub-assemblies are wired, tested and aligned at the factory, Collins Pre-Fab Kits are easily assembled even without technical knowledge. The end result is a fine, high quality, high fidelity instrument at often less than half the cost — because you helped make it and bought it direct from the factory. Bring your present reproducing system up to date with a new Collins Tuner.

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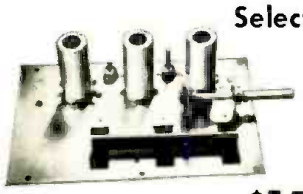
The original 15 tube deluxe FM/AM pre-fab kit redesigned on a smaller chassis. The tuner now measures 14" wide by 12" deep by 7½" high. This attractive new front and dial assembly opens up new applications where space is at a premium. Kit includes everything necessary to put it into operation—punched chassis, tubes, wired and aligned components, power supply, hardware, etc. Kit comprises FMF-3 tuning unit, IF-6 amplifier, AM-4 AM tuning unit, magic eye assembly and complete instructions. All tubes included. Shipping weight 19 lbs.

Selected Basic Components For Special Applications

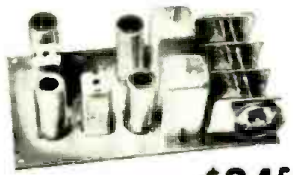


FMF-3 Tuning Unit **$15.25**

The best for FM. The most sensitive and most selective type of "front end" on the market. 6 to 10 microvolts sensitivity. Image ratio 500 to 1. 6J6 tuned RF stage, 6AG5 converter, 6C4 oscillator. Permeability tuned, stable and drift-free. Chassis plate measures 6½"x4½". In combination with the IF-6 amplifier, the highest order of sensitivity on FM can be attained. Tubes included as well as schematic and instructions. Draws 30 ma. Shipping weight FMF-3: 2½ lbs. Dial available @ $3.85

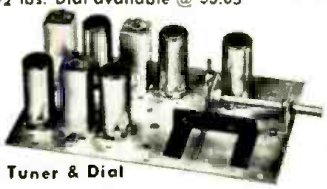
IF-6 Amplifier **$19.75**

A remarkable value! 6 tubes are used in the IF amplifier: 6BA6 1st IF, (2) 6AU6 2nd and 3rd IF's, (2) 6AU6 limiters and 6AL5 discriminator. High gain, wide-band response (200 KC) for highest fidelity. 20 to 20,000 cycles. Distortion less than ½ of 1%. Draws 40 ma @ 220 volts. Chassis plate dimensions: 11-5/16"x2½" Shipping weight: 3 lbs.



AM-4 Tuning Unit **$24.50**

Tops in AM superhet performance! A 3-gang tuning condenser gives 3 tuned stages with high sensitivity and selectivity. Assembly is completely wired, tested and aligned ready for immediate use. Frequency coverage 540 KC to 1650 KC at a sensitivity of 5 microvolts. Tubes 6BA6 RF amplifier; 6BE6 converter; 6BA6 IF amplifier and 6AT6 detector. Draws 30 ma @ 220 volts. Mounts on a chassis plate measuring 4"x7⅜". Shipping weight 2½ lbs. Dial available at $3.85.



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The COLLINS RD-1C FM tuner chassis is unique in the field. A whole, compact FM tuner and dial that fits in the palm of your hand. Convert AM sets to FM/AM receivers for only a few dollars! Unlimited applications where space is at a premium. Use in conjunction with your phonograph amplifier. Full frequency response to 20,000 cycles. Sensitivity 20 microvolts, permeability tuned. Tuning unit and IF amplifier on the same chassis plate. Draws 40 ma @ 100 volts. Tubes: 6AG5 converter, 6C4 oscillator, (2) 6AU6 IF amplifiers, 6AL5 in new ratio detector circuit Shipping weight tuner and dial 5 lbs

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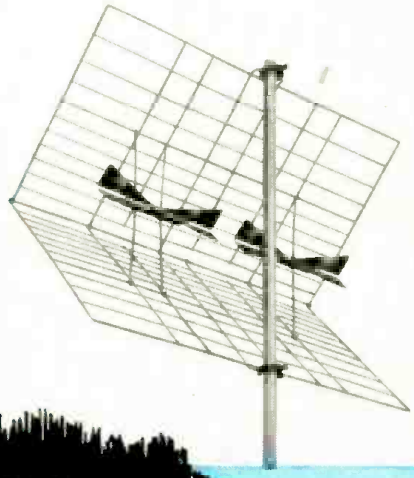
beats 'em all on UHF!



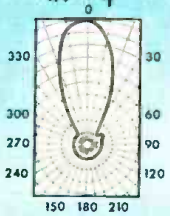
CHANNEL MASTER'S TWIN CORNER REFLECTOR

Model No. 406

Gives the brilliant performance of **2** antennas!

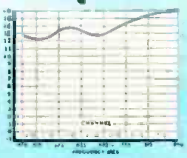
up to 16 db gain

THE MOST SENSITIVE UHF ANTENNA EVER DEVELOPED!



Twice the gain of the BEST standard UHF Corner Reflector

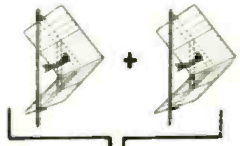
Extremely narrow forward lobe, with no side lobes and negligible rear lobe



Excellent 300 ohm impedance match over the entire UHF range, provided by built-in, pre-cut matching harness

because Channel Master's Twin Corner Reflector really is **2** antennas . . .

stacked side by side into one simple structure

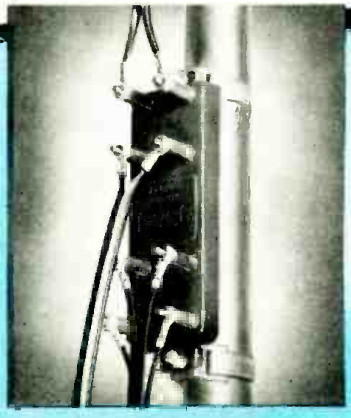


exclusive **DUBL-DIPOLE** design

- 2 antennas, electrically
- 1 antenna, mechanically
- One simple structure . . . one simple installation . . . highest gain, all-channel UHF coverage!

In any area you pick, the Twin Corner Reflector will out-perform any other antenna available today!

Ties together all 3 TV reception bands!



"Free space" terminals. Impossible for dirt or rainwater to accumulate between the terminals, which can short out the picture. Assures you of brilliant, steady reception in ANY KIND OF WEATHER!

SINGLE LEAD • NO SWITCHING

ELIMINATES INTER-ACTION • NO SIGNAL LOSS ON VHF OR UHF

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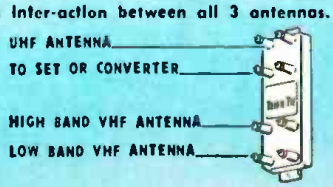
TRIPLE-TIE model no. 9035

electronic inter-action filter

Combines up to 3 antennas with only 1 lead to the set.

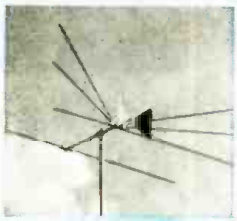
1. Low Band VHF
2. High Band VHF
3. All UHF (Broad Band or Yagi)

Eliminates inter-action between all 3 antennas.

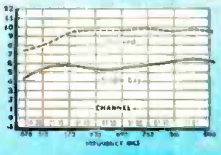


Designed to adapt all HI-LO VHF installations to UHF — quickly and economically

ULTRA FAN series — Complete VHF-UHF coverage



single bay — model no. 413

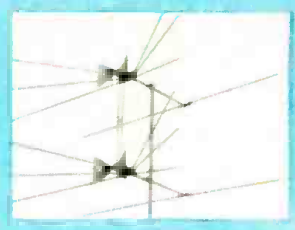


Today's most sensitive All-VU* antennas! The Ultra Fans actually operate on *three* separate electronic principles — automatically:

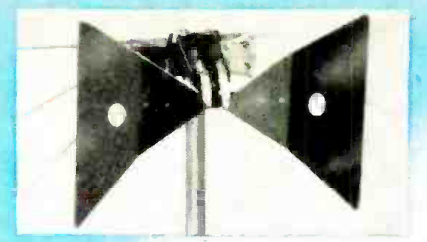
1. Low Band VHF (Channels 2-6) . . . *Conical antenna with parasitic reflector*
2. High Band VHF (Channels 7-13) . . . *Large diameter V antenna*
3. UHF (Channels 14-83) . . . *Triangular dipole with sheet reflector*

One set of All-VU* stacking rods provides highest VHF and UHF gain. Each Ultra Fan has its own 2-stage inter-action filter, so that only one transmission line to the set is required.

*All VHF, all UHF



stacked — model no. 4132



ULTRA DAPTER

model no. 414

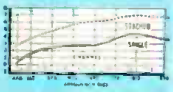
Instantly converts all Channel Master Super Fans into high gain, all-channel, VHF-UHF antennas. *Features a built-in inter-action filter.*

Your best bet for UHF!

CHANNEL MASTER Ultra-Tennas

America's most complete — most effective — UHF antenna line.

Channel Master's advanced engineering pays off again! While rain caused hundreds of UHF antennas to FAIL recently in Portland, *not one Channel Master antenna dimmed or shorted out a picture!* The facts speak for themselves: Rain or shine, Channel Master antennas outperform all others.



ULTRA BOW

model no. 401

The basic UHF antenna for primary signal areas, and the outstanding member of the bow-type antenna family.

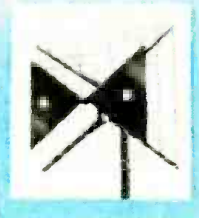
Only Channel Master Antennas are designed to eliminate the "TWIN TERRORS" OF UHF RECEPTION:

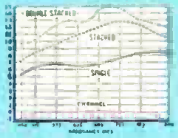
- **Vibration, which causes picture flicker.**

  Eliminated by Channel Master's Ultra-Rigid construction and advanced mechanical design.

- **The accumulation of dirt or moisture around the antenna terminals, which dims and eventually shorts out the TV picture.**

  Eliminated by Channel Master's sensational "free-space" terminals which prevent the accumulation of foreign deposits at the feed points.



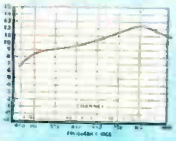


ULTRA BOW

with SCREEN REFLECTOR

model no. 403

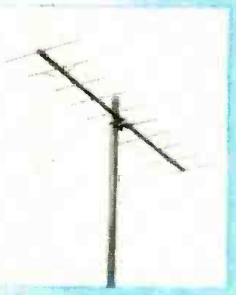
Can be stacked in 1, 2, and 4 bays. High, all-channel UHF gain, excellent front-to-back ratio.



ULTRA VEE

model no. 404

- Good UHF gain
- Low VHF gain
- The most rigid UHF antenna of its type and size.

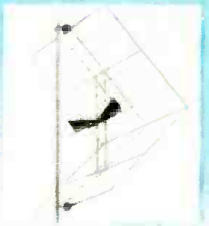


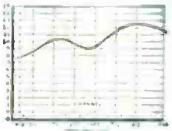
Gain: 11 DB, single
14 DB, stacked

DELTA WELD

Wide Band 10 Element UHF Yagi

Custom-designed for full coverage of your specific area! Brilliant high gain performance across as many as *23 different channels.*





CORNER REFLECTOR

model no. 405

The outstanding all-channel UHF FRINGE antenna.

MEMBER

ANTENNA MANUFACTURERS ASSOCIATION

MADE IN UNASSEMBLED ANTENNAS

Sold through the nation's leading distributors

CHANNEL MASTER CORP.

ELLENVILLE, N. Y.

Write for complete technical literature

ULTRA-TIE model no. 9034

Electronic Inter-Action Filter

JOINS separate antennas into a single VHF-UHF antenna system, for use with a single transmission line.

SEPARATES VHF and UHF signals at the set or converter where separate inputs are provided.

The only filter with "free-space" terminals.

Within the INDUSTRY

AEROVOX CORPORATION is building a condenser plant in Monrovia, California to provide components for West Coast electronics manufacturers. Production is expected to start early this summer . . . **K. C. BURCAW & CO.** has moved to new offices in Suite 207, 22128 Grand River Ave., Detroit 19. The company represents several well-known electronics manufacturers . . . **PCA ELECTRONICS, INC.** has recently moved into a new plant at 2180 Colorado St., Santa Monica, Calif. . . . Construction has been started on an extensive addition to the existing **TECHNICAL APPLIANCE CORP.** plant in Sherburne, N. Y. This is the fourth such addition since the firm moved to Sherburne in 1948 . . . The Rectifier Div. of **SARKES TARZIAN, INC.** is adding a two-story structure to its present plant in Bloomington, Ind. . . . **RAYTHEON MFG. CO.** will erect a 100,000 square foot plant adjacent to its present receiving tube plant on Centre Street in South Quincy, Mass. . . . **HICKOK ELECTRICAL INSTRUMENT CO.** has completed a new assembly plant at 10626 Leuer Ave. in Cleveland . . . **AUDIO & VIDEO PRODUCTS CORP.** has opened a new office in Washington, D. C. at 100 Indiana Ave., N.W. R. E. Hadahay will continue to direct the Washington operation . . . **PEERLESS RADIO DISTRIBUTORS** has added a complete new wing to its present warehouse at 92-32 Merrick Rd. in Jamaica, N. Y. . . . **PACKARD-BELL CO.** has broken ground for a new factory addition at 12333 W. Olympic Blvd. in Los Angeles. The new building will provide 95,000 sq. feet of production facilities.

* * *

ROBERT C. SPRAGUE has resigned as president of *Sprague Electric Co.*, according to an announcement made by Julian K. Sprague, spokesman for the company's board of directors.

Mr. Sprague founded the company in Quincy, Massachusetts in 1926. The firm has now grown until it operates nine plants in six different cities. Details of Mr. Sprague's future plans will be announced at a later date

The board of directors elected Julian Sprague to the post of president, succeeding his brother. The new president has been with the firm since shortly after its founding.

* * *

RTMA has promoted two men and added a member to the staff at its Washington headquarters.

Peter H. Cousins, who has been information director of RTMA for several years, has been appointed special assistant to the technical products division.

Tyler Nourse, who served as assistant information director under Mr. Cousins, has been promoted to the post of editorial director in charge of RTMA publications.

Herbert Francis Hodge, Jr. of Silver Spring, Md., formerly in government information service, has joined the RTMA headquarters staff as an editorial assistant to Mr. Nourse.

* * *

MONTE COHEN has been elected president of *General Instrument Corporation*, radio, television, and electronic component manufacturer.

He was formerly executive vice-president of the company and president of the *F. W. Sickles Division*, a wholly-owned subsidiary since March 1951. He is now president of both companies.

Mr. Cohen has been in the radio industry since 1916 and has since been identified with several well-known firms. He is a former director of RTMA and a member of the IRE and VWOA.

* * *

WALTER LEFEBRE is the new director of new television market development for the radio and television division of *Sylvania Electric Products Inc.* . . . *Motorola Inc.* has named **WALTER SCOTT** to the post of vice-president in charge of manufacturing in the consumer products division and **JOHN SILVER** vice-president in charge of operations for the communications and electronics division . . . **DEMPSTER McINTOSH** has resigned as president of *Philco International Corp.* to open his own export offices in New York. **SYDNEY CAPELL**, vice-president and general manager of the company's Canadian operations, has been named to fill the post . . **PAUL DYE** has been named to the newly-created post of general sales manager of *Admiral Corporation*. He has been with the firm since 1946 . . *Brush Electronics Co.*, formerly *The Brush Development Co.*, has made two new appointments of interest to the industry. **ROBERT P. LEON** is the new manager of the tape recorder department while **D. L. DALE** has been named to an executive sales post with the same department . . . **JAY J. GREENGARD** is now the general manager for *Waldom Electronics, Inc.* of Chicago . . . *Airborne Instruments Laboratory, Inc.* has appointed **MATTHEW T. LEBENBAUM** as supervisor of the newly-formed applied electronics section of its research and engineering division

Leonard C. Lane, B.S., M.A.
President of Radio-Television Training Association. Exec. Dir. of Pierce School of Radio and Television.

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Set up your own home laboratory with the 15 BIG TV-Radio kits we send you. You build AND KEEP your own complete BIG SCREEN TV RECEIVER, Super-Het Radio Receiver, R.F. Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Receiver, AC-DC Power Supply. Everything is furnished complete, including all tubes, plus big TV picture tube.

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LEARN MORE!

EARN MORE!

THOUSANDS OF NEW JOBS IN TELEVISION

I PREPARE YOU AT HOME IN YOUR SPARE TIME

MORE TRAINING TO FIT YOU FOR THE BETTER PAY JOBS

Thousands of new jobs will open up right in your own state, now that the government has lifted restrictions on new TV stations. My simple, successful methods have helped hundreds of men — most of them with NO PREVIOUS TRAINING — find places in America's booming TELEVISION and Electronics industries. You too can get the success and happiness you always wanted out of life within months . . . studying at home . . . as I train you to become a full-fledged TV TECHNICIAN. Many of my students make as much as $25.00 a week repairing Radio-TV sets in their spare time while learning . . . pay their entire training almost from the very beginning from spare time earnings . . . start their own profitable service business.

But I don't stop after I qualify you as a TV Technician . . . although right there you can choose from among dozens of fascinating careers! I continue to train you — AT NO EXTRA COST — to qualify for even better pay in the BETTER JOBS that demand FCC licenses, with my . . .

MORE VALUE!

YOU GET A ROUND TRIP TO NEW YORK CITY AT NO EXTRA COST

FROM ANYWHERE IN THE U.S. OR CANADA — I pay your way to New York and return, PLUS 2 FREE weeks, 50 hours of advanced instruction and shop training at the PIERCE SCHOOL OF RADIO & TELEVISION. You use modern electronics equipment, including student-operated TV and Radio stations. You go behind the scenes of New York's big Radio-TV centers, to study first hand. And I give you all this AT NO EXTRA COST! (Applies to complete Radio-TV course only.)

Only RTTA makes this amazing offer.

I GET MY GRADUATES GOOD PAYING JOBS

"Thanks to your training, I qualified for a good job as a Receiver Tester at Federal Telephone and Radio."
— **Paul Frank Seier**

"I'm making good money in my own business, repairing and installing radio and TV sets — thanks to your training."
— **Irwin Polansky**

"Your excellent instruction helped me get my present job as an airport radio mechanic for American Airlines. — **Eugene E. Basko**

"I'll always be grateful to your training which helped me get my present fine position as Assistant Parts Manager."
— **Norman Weston**

Many others working at NBC, RCA, CBS, DuMont, Philco, Emerson, Admiral and other leading firms.

FREE FCC COACHING COURSE

PREPARES YOU AT HOME FOR YOUR FCC LICENSE.
THE BEST JOBS IN TV AND RADIO REQUIRE AN FCC LICENSE.
Given at NO EXTRA COST after TV Theory and Practice is completed.

NOW! ADVANCED FM-TV TRAINING

If you have previous Armed Forces or civilian radio experience—my ADVANCED COURSE can save you months of training. Full theory and practical training . . . complete with kits, including BIG SCREEN TV RECEIVER and FREE FCC License Coaching Course.

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My vocational adviser will help you obtain a good-paying job in the locality of your choice.

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MY SCHOOLS FULLY APPROVED TO TRAIN VETERANS UNDER *NEW* G.I. BILL! If discharged after June 27, 1950 — CHECK COUPON BELOW! Also approved for RESIDENT TRAINING in New York City . . . qualifies you for full subsistence allowance up to $160 per month.

MAIL COUPON TODAY!

BOTH FREE! New Illustrated Book and Sample Lesson. Learn How My Simple Methods Make Success Easy!

NO SALESMAN WILL CALL!

Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION
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Dear Mr. Lane: Mail me your NEW FREE BOOK and SAMPLE LESSON that will show me how I can make BIG MONEY in TELEVISION. I understand I am under no obligation and no salesman will call.

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City _____ Zone _____ State _____

I am interested in: ☐ Radio-TV ☐ Advanced FM-TV.
VETERANS: If qualified under new G.I. Bill, check your choice: ☐ Home Study ☐ Resident Study.

RADIO-TELEVISION TRAINING ASSOCIATION

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LICENSED BY THE STATE OF NEW YORK

. . . **RAY ROBINSON,** formerly eastern regional sales engineer for *Philco,* has joined *Jerrold Electronics Corp.* as general manager . . . **BENJAMIN M. PINZ,** formerly with *Harrison,* is now managing director of *Orfeo Music Studios.*

* * *

JOHN H. HAUSER has been appointed renewal tube sales manager for *Hytron Radio & Electronics Co.,* a division of *CBS.*

He has had wide experience in distributors sales with *Sylvania.* He served as assistant sales manager of the distributor sales department and more recently as midwest regional manager of distributor sales.

In his new post he will devote his time to the distributors.

* * *

THE LAPOINTE PLASCOMOLD CORPORATION has changed its name to **LA POINTE ELECTRONICS INC.** to better reflect the company's role in the electronics industry . . . **KEYSTONE PRODUCTS COMPANY** has been incorporated under the laws of the state of New Jersey. The firm, which has offices at 904 Twenty-third St., Union City, N. J., manufactures aircraft and special purpose transformers and magnetic amplifiers. The company was established in 1946 . . . **GRANCO PRODUCTS, INC.** has been formed to design, manufacture, and distribute u.h.f. converters and u.h.f. measuring instruments. The company has headquarters at 36-17 Twentieth Ave., Long Island City, N. Y. . . . **GUIDED MISSILES, INC.** is the newly-formed subsidiary of **RESDEL ENGINEERING CORP.** It will handle the production phases of missile contracts and will specialize in electronic guidance and tracking systems. The plant will be near that of the parent company in Los Angeles . . . Douglas H. Carpenter has established the **SUMMIT ENGINEERING COMPANY** at 3324 Main St. in Hartford, Conn. The firm is in production on a line of television antennas and other electronic equipment.

* * *

LESLIE NORDE has joined *Hammarlund Mfg. Co., Inc.* of New York as chief receiver engineer after nearly five years at the *Northern Radio Corp.* where he was senior project engineer.

In his new position, Mr. Norde will act as supervisor and technical consultant for the design of the company's commercial and amateur radio receivers. He is a senior member of the IRE, an associate member of AIEE, and a member of Tau Beta Pi.

* * *

RTMA's board of directors has accepted the principal recommendations

(*Continued on page* 149)

*A **Transistor** of point-contact type. Two hair-thin wires control current flow in germanium metal.*

It's helping to win the Battle of the Watts

*Laboratories engineer examines **Transistor** oscillator. It is used in Englewood, New Jersey, where 10,000 subscribers can personally dial distant cities. **Transistors** generate the signals which carry the dialed numbers to other towns and cities. Other uses are in prospect.*

When you keep down the power needed to send voices by telephone you keep down the special equipment needed to supply that power. A great new power saver for telephony is the ***Transistor,*** invented at Bell Telephone Laboratories, and now entering telephone service for the first time.

Tiny, simple and rugged, the ***Transistor*** can do many of the things the vacuum tube can do, but it is not a vacuum tube. It works on an entirely new principle and uses much less power than even the smallest tubes. This will mean smaller and cheaper power equipment, and the use of ***Transistors*** at many points in the telephone system where other equipment has not been able to do the job as economically.

It's another example of how Bell Telephone Laboratories makes basic discoveries, then applies them to improve telephone service while helping to keep its cost down.

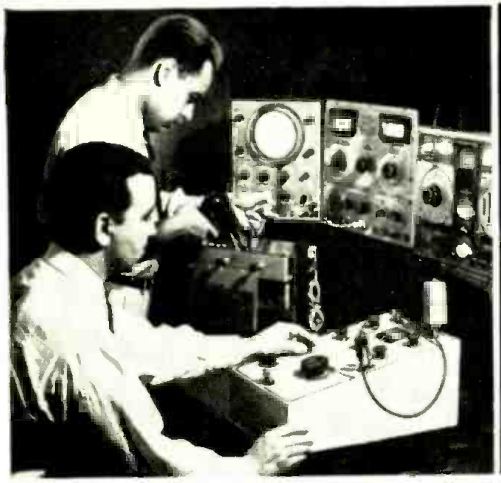
TRANSISTOR FACTS

Created by Bell scientists. First announced in 1948.

Has no glass bulb, requires no filament current or warm-up period. Operates instantly when called upon. Uses no energy when idle.

BELL TELEPHONE LABORATORIES

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



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AS A NATIONAL SCHOOLS GRADUATE THERE'S A PLACE FOR *YOU* IN THIS EXPANDING INDUSTRY...*Never before* such a demand for *you!* For *never before* such a *growing* industry as today's Television, Radio and other Electronic fields. This industry needs *you* . . . TODAY . . . and it needs you as a *trained* man . . . the kind of man you will be as a National Schools graduate. So don't wait. Start your National Schools training NOW...and enjoy big money, job security, SUCCESS!

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Ready to use. Easy to operate. Light enough to carry on service calls.

DRAFT AGE? National Schools training helps you get into special service classifications—get higher grades, better pay!

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Let National Schools –a *resident* technical trade school for nearly 50 years–train you at home for today's unlimited opportunities in Radio-TV.

All yours at no extra cost!

YOU GET ALL THE PARTS INCLUDING TUBES for this superheterodyne receiver... and lots of other equipment...to keep!

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NEW SPECIAL PAYMENT PLAN

Finest, Most Up-to-Date Testing Instruments Ever Produced!

APPLIANCE TESTER • MODEL 5007

This new Philco Appliance Tester Model 5007 permits complete analysis of over-all performance of refrigerators, air conditioners, ranges and household appliances. It provides accurate temperature measurements in degrees Fahrenheit from —30° to 600° on a large 6" meter. Ascertains power requirements of appliances up to 6 kilowatts, and includes an AC voltmeter for measuring voltages up to 260 volts. Gives positive check for shorts or open circuits on appliances. Equipped with all necessary "pick-up" elements for temperature determination.

Size: 12" W. x 8" H. x 6" D. **Weight: 9 lbs.**

MUTUAL CONDUCTANCE DYNAMIC TUBE CHECKER

MODEL 7052. A companion piece to Philco Model 7051 Emission Type Tube Checker. This model 7052 checks all tubes from sub-miniature to low power transmitting tubes. Checks shorts and leakages between elements of tubes. Determines noise characteristics. Ascertains gas content. Gives mutual Conductance readings directly in microhms. Permits forecasting remaining tube life. A portable or counter type tester with a beautiful blue leatherette finish. Operating Voltage: 105-130 Volts AC.

Size: 17" W. x 15" L. x 12" D. Weight: 22 lbs. (Shipping Wt. 34 lbs.)

VISUAL ALIGNMENT GENERATOR • MODEL 7008

FEATURES: AM Generator (and Marker): 3.2-250 mc. • FM Generator: 4-120 mc., and 145-260 mc. • Sweep-frequency width to 15 mc. (Flat to within .2db/mc.) • Audio Generator: 400 cycles • Only one input and output connection • Special oscilloscope circuits • Vertical-deflection Sensitivity: 25 millivolts/inch (with amplifier) • Swiveled cathode-ray-tube housing for compact carrying size • Telescoping light shield • High-frequency probe for signal tracing • Crystal calibrator to provide check points for marker generator.

FILL OUT AND MAIL THIS COUPON . . . OR SEE YOUR PHILCO DISTRIBUTOR TODAY!

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☐ I am interested in the Philco Test Equipment shown here. Please send me details of your SPECIAL PURCHASE PLAN for obtaining these units.

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BUY TEST EQUIPMENT
ON THIS RADICALLY NEW
TIME PAYMENT PLAN

NO INTEREST!! - NO CARRYING CHARGES!!

USE CONVENIENT TIME PAYMENT ORDER BLANK BELOW

Superior's New Model 770

VOLT-OHM MILLIAMMETER

Sensitivity—1000 ohms per volt

Uses latest design 2% accurate 1 Mil. D'Arsonval type meter. • Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range. • Housed in round-cornered, molded case. • Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

SPECIFICATIONS:

6 **A.C. VOLTAGE RANGES:** 0-15/30/150/300/1500/3000 Volts.
6 **D.C. VOLTAGE RANGES:** 0-7.5/15/75/150/750/1500 Volts.
4 **D.C. CURRENT RANGES:** 0-1.5/15/150 MA. 0-1.5 Amps.
2 **RESISTANCE RANGES:** 0-500 Ohms. 0-1 Megohm.

Model 770 is an accurate pocket-size V.O.M. Measures only 3⅛"x 5⅞"x2¼".

$14.90 NET The Model 770 comes complete with self-contained batteries, test leads and all operating instructions.

Superior's New Model TV-11

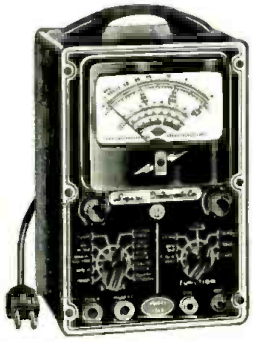
TUBE TESTER

• Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary. • Uses no combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket. • Free-moving built-in roll chart provides complete data for all tubes. • Phono jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose external connections.

Operates on 105-130 Volt 60 Cycles A.C. Hand-rubbed oak cabinet complete with portable cover ..... **$47.50 NET**

Superior's New Model 670-A

SUPER-METER



A *COMBINATION* VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts.
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OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
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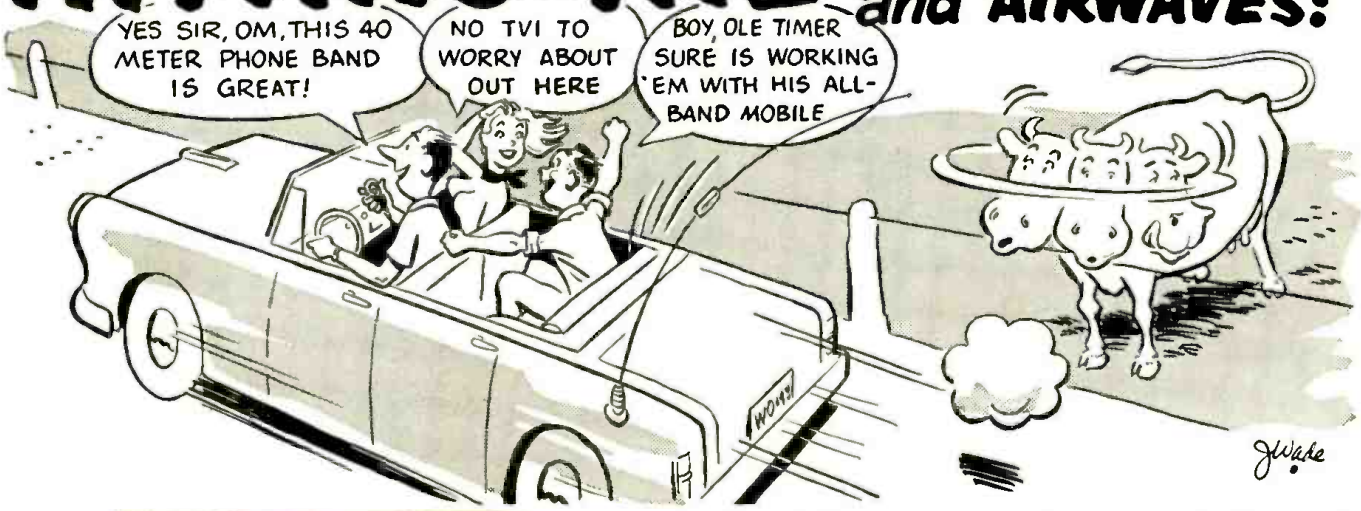

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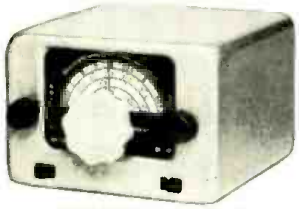

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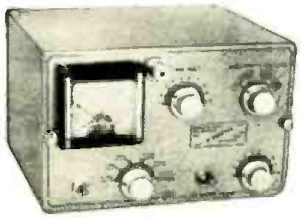

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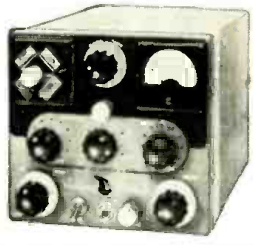

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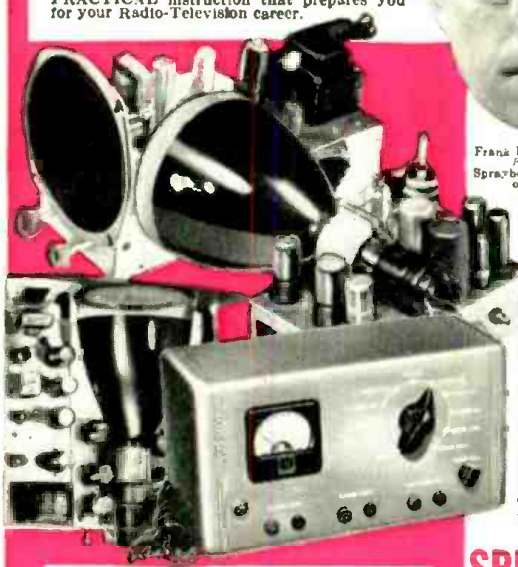

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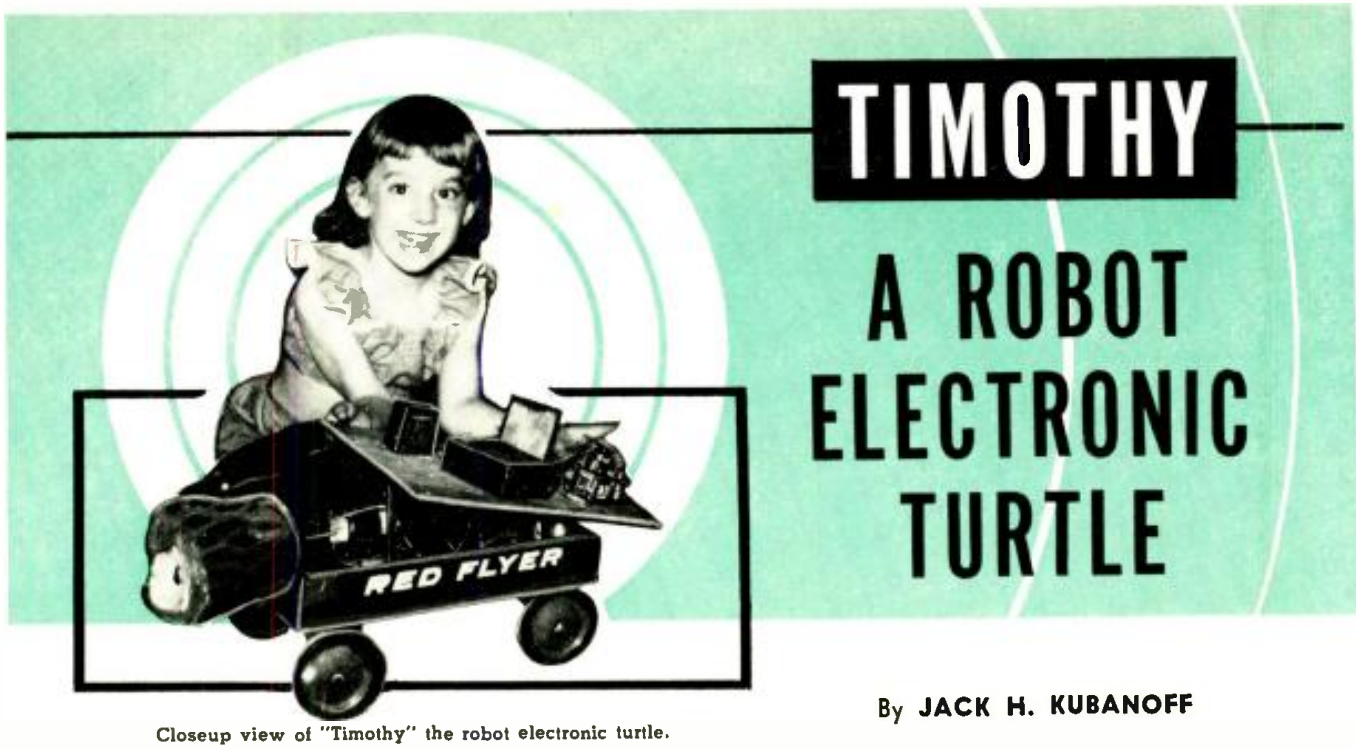
TIMOTHY
A ROBOT ELECTRONIC TURTLE



Closeup view of "Timothy" the robot electronic turtle.

By **JACK H. KUBANOFF**

Mechanical and electrical construction data on a novel toy for the children—which will provide hours of fun.

"TIMOTHY" is an electronic turtle with an ability to perform in a manner comparable to his living counterpart. He can see; he can interpret information; he can follow instructions; he can think; search for food, memorize, and is able to learn. He may be relied upon to retain what he learns for an indefinite period of time.

"Tim" was originally constructed as a toy for my daughter but finally emerged as a full-fledged problem in cybernetics (a study of the control circuitry of the human brain and nervous system as applied to electronic machines. These machines, more commonly known as computers, are devices which are rapidly replacing the human element required in the operation of various mechanical devices.)

In order to obtain scientific information, simplification, wherever possible, always yields results which are both tangible and upon which predictions can be made. "Timothy" is a light sensitive animal and understands only such information as can be transmitted to him by light. This handicap in limiting his scope of operation is overshadowed by the simplicity in circuitry that it affords.

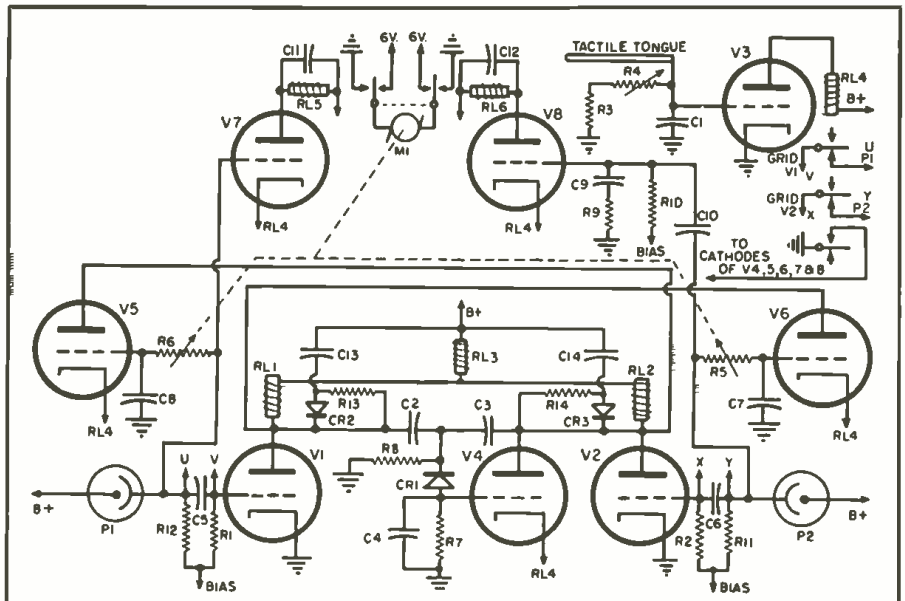
His fundamental operation was that of following a light wherever it was moved about the laboratory. For this purpose, a form of light discriminator was incorporated which will be fully described later. To this function was added the search for a form of sustenance. This gave "Timothy" a real purpose in life and elevated his status to that of a computing machine. At present, "Tim" is quite simple in circuitry but his ability to perform complex functions is remarkable. "Tim" can duplicate many of the functions of the human brain and nervous system and he reacts in much the same manner as his animal equivalent when he is confused or fatigued.

In their proper sequence, "Timothy" will do the following:

1. He will search for food (initially he is hungry). In this mission, he will determine the light word (in this case, a light flashing at a certain rate) for food and follow it to his nest. If any other information is transmitted to him, such as instructions for playing, etc., he will turn away from that source of information and continue in the pursuit of sustenance. Changing the word for food (by changing the flashing rate and duration) only causes some slight hesitation as the repetition of the word provokes "Timothy" into learning the new word for food. The removal of any light he has been memorizing for a period of time will cause him to rely upon his memory for the position of the light. Upon arrival at his nest, he will obtain sufficient sustenance for about one-half hour of playing time.

2. "Timothy" will now follow a light for play anywhere he may be required to travel, using his memory to remember the position of the light if it is hidden from him and disregarding words which indicate food sources. The absence of the "play" light will cause him to stop until he again intercepts the words for play.

Thus "Timothy" can work or play but his most unique characteristic is his ability to learn and make vital decisions concerning his own welfare. "Timothy" has two memories, a vital memory in which he learns a new word and commits it to a memory that retains it indefinitely and a statistical memory, less intense, and through which he retains information regarding the position from which he last received information. Both require repetition and differ only in the length of time they are retained for reference. These memories have their counterparts in real life—the statistical memory, in which we obtain information and store it for future reference but whose retentivity deteriorates from failure to use the information, and the longer vital memory which is sympathetic in nature and is retained for the duration of our lives. It might be interesting to note too that "Timothy's" memories like their human counterparts are not instantaneous in action, but require constant repetition before the information is completely stored. In the same way, words for "Timothy" must be repeated several times before he can commit them fully to memory. "Timothy's" vital memory may be compared to the word "food," being repeated in various dialects. At first, he will find the new dialect strange, but because it contains some similarity to the other words for food he has learned, he will learn the new word and from that time he will respond to the new dialect. "Timothy" can retain in his vital memory only one word at a time. As a result all previous words are rejected in preference to the newest word he has learned. He obviously can become



R_1, R_2, R_3, R_7, R_8, R_{10}, R_{11}, R_{12}—10 megohm, ½ w. res.
R_4—10 megohm pot.
R_5, R_6—Ganged dual 5 megohm control (IRC 31-4141 Type A)
R_9—500,000 ohm, ½ w. res.
R_{13}, R_{14}—1 megohm, ½ w. res.
C_1—4 μfd., 250 v. oil-filled cond.
C_2, C_3, C_5, C_6, C_7, C_8, C_{10}—.1 μfd., 100 v. cond.
C_4—.05 μfd., 100 v. cond.
C_9—.02 μfd., 100 v. cond.
C_{11}—.01 μfd., 100 v. cond.
C_{12}—.001 μfd., 100 v. cond.
C_{13}, C_{14}—.2 μfd., 100 v. cond.
RL_1, RL_2, RL_3—S.p.d.t., 10,000 ohm relay (Allied Type B, Advance Type 1200, Leach Type 1032 or equiv.)
RL_4—Two relays in series, one a Leach Type 1032, s.p.d.t., the other a Leach Type 1037, d.p.d.t.
RL_5, RL_6—Balanced armature relay (Allied Type D.S.)
CR_1, CR_2, CR_3—1N34 crystal rectifier (or equiv.)
P_1, P_2—Type 927 photocell (RCA)
M_1—Memory motor (see text)
V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_8—12AU7 or 6BF7 tube (see text)

Fig. 1. Complete circuit diagram covering the control circuit for the robot turtle.

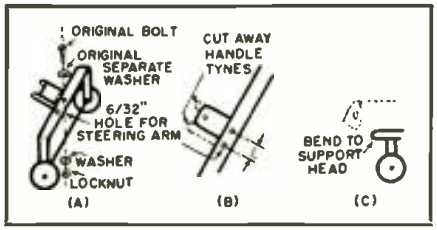
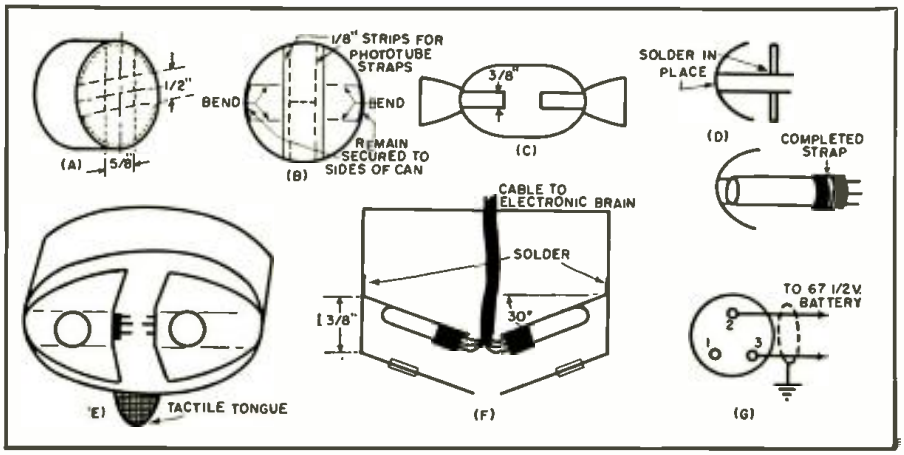


Fig. 2. Front wheel modification of wagon.

confused by changing the dialect more rapidly than he is able to commit it to memory. At this point, of course "Timothy" has the symptoms of a very intense neurosis aggravated by his desire for food and his inability to read the signs which indicate the direction he must go to obtain food. "Timothy's" ability to learn is closely akin to what psychologists term a "conditioned reflex." This can be explained simply.

When two events occur simultaneously over a period of time, it is normal for us to associate the two events with each other, *i.e.*, noise-crowds, heat-fire, etc. Thus, we know by the noise that a crowd is present or by the heat that a fire is present. It is also possible to synthetically produce these sensations. As an example: ringing a bell before dinner is served. After sufficient repetition of bell ringing before dinner, ringing of the bell causes the digestive juices to flow copiously even when dinner is not a consequence. This method of learning is time consuming and as a result "Timothy" can be hopelessly confused. When we can make the word for play appear to him like the word for food, he becomes frustrated; as a result, his actions in frustration can be predicted and given a mathematical significance. We can tell in this manner exactly how "Timothy" will react to various stimuli.

Fig. 3. Construction details for fabricating the turtle's head from a coffee can.



Mechanical Construction

One of "Timothy's" outstanding features is the versatility of his construction. He was constructed of parts that can be found in junk boxes, from old toys, or from the odd parts available in an experimenter's workroom.

"Timothy's" body is a metal cart that was purchased for our first youngster and set aside for the next. It is of the variety that sells for about one dollar. The handle was discarded and the front cut away to within 1 inch of the front wheel bolts. This was done with a metal shears so that it appeared as shown in Figs. 4A and 4B.

The front wheels were removed keeping the original lock nut, bolts, and washers. The tynes for supporting the handle were cut away as shown in Fig. 2B. A hole 9/32" in diameter was drilled about ¼" from the front edge and the resulting tongue-shaped piece of metal was bent back in a radius so that the hole in the tongue was directly over the hole through which the bolt must pass to secure the front wheels to the cart. A small flexible wire was then soldered to the cart body near the head and permitted to make contact with the floor. The cart body will be a common electrical ground throughout the construction and this serves as a return for "Timothy's" tongue!

Construction of "Timothy's" head requires the following parts: two lenses 1" focal length; two *RCA* Type 927 photoelectric cells; a 1 foot length of *Belden* 8423 three-conductor shielded cable; and one empty coffee can.

1. Scribe two lines through the center of the coffee can bottom perpendicular to each other.

2. Select one of these lines and mark off ¼" on either side of the line.

3. On either side of the remaining line, mark off 5/16".

4. Return to the line marked off as in 2 above and using a can opener, cut from each quarter inch mark about the circumference of the can to the same mark on the other side of the can as shown in Fig. 3A. The ends of the ½" strip remain secured to the sides of the can.

5. Cut along the 5/16" marks on either side of the second line; this piece will then come out. Cut ⅛" strips along each long edge of this strip. Then, cut the remaining ⅜" strip in half along its short dimension.

6. Pull the remaining flaps forward so that the inside of the can is more accessible.

7. Solder to the ends of the 3/8" strips, the 1/8" strips and mount the phototubes as indicated in diagram, Fig. 3D.

Drill the openings for the lenses and cement them into place in the center of the flaps still attached to the can. Bend the can into an oval shape as shown in Fig. 3E, and bend the phototube flaps so that the edges fit within the oval can 1 3/8" below the lid flaps. Solder wires to the phototube terminals as indicated in Fig. 3G and set the phototube support and eye flaps at a thirty degree angle as indicated in Fig. 3F.

Pieces of tin from another can may be used to reinforce these structures in order to make them hold their relative positions in the next step.

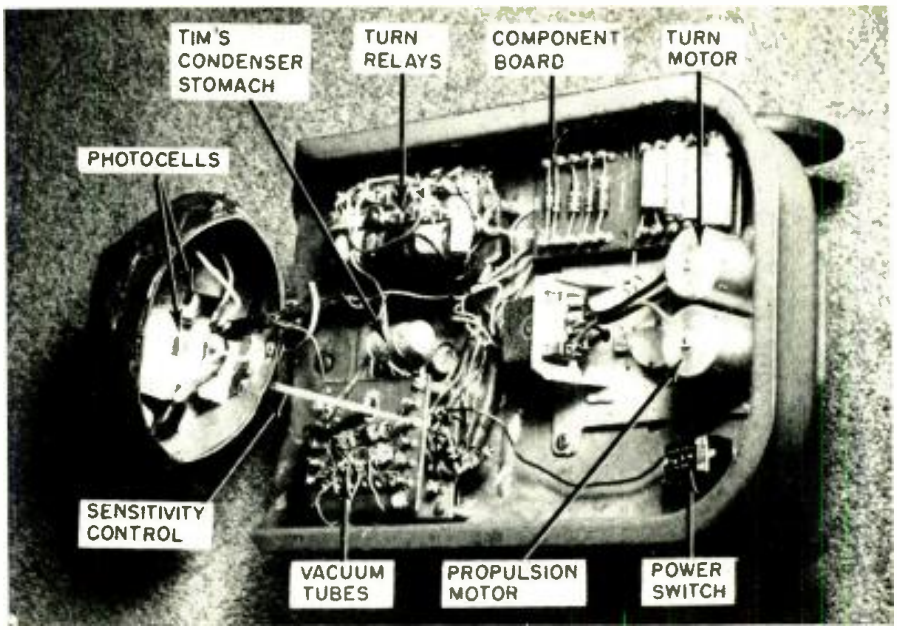
Mix a preparation consisting of one cup of flour and one bottle of mucilage to 1½ quarts of water. Slit newspapers into 1½ inch wide strips and pass them through the well-mixed preparation. Now, lay them about the head of the turtle, covering the can completely except for leaving the back open. By varying the size of these strips and alternating the direction of each strip so that they interlock as they dry, a head for "Timothy" is easily shaped. The final paper mâché head should be put away to dry for at least twenty-four hours. This mixture should be set aside for "Timothy's" shell.

When the head is completely dry, drill a hole at the back for mounting on the support indicated in Fig. 2C. Before attaching the head to the cart body, you may glue a small piece of metal screen to the face and drill a hole through the head for the wire of the tactile tongue. Solder a wire to "Timothy's" tongue, passing it through the head and alongside the cable. "Timothy's" tongue must be insulated from the body! Attach this wire to the grid of V_1, Fig. 1. The head may next be painted any suitable color. The eyes will function best if the area immediately surrounding them is painted white.

Electrical Construction

For the electrical construction, type 12AU7 or subminiature 6BF7 vacuum tubes may be used. All diodes are germanium 1N34's or 1N52's. All tube biases are returned to the negative terminal of the heater supply. The positive terminal of the heater supply is grounded.

The grids of V_1 and V_2 are connected to the clapper of relay RL_3. The phototubes are connected to the normally - closed contacts of RL_3. The cathodes of V_4, V_5, V_6, V_7, and V_8 are connected to the normally-open terminals of RL_3. Remember that this relay is made up of two relays! One a double-pole, double-throw and the other a single-pole, single-throw relay. The grids are applied to the d.p.d.t. relay and the cathodes to the s.p.d.t. relay. The resistors bridging CR_2 and CR_3 (germanium diodes) are 1 megohm, ½ watt units.



Top chassis view of robot with the turtle's "shell" removed to show construction.

Sight

"Timothy's" sight circuits are shown in Fig. 5A. The two photocells shown are located in "Timothy's" head in such a manner that either of his eyes may intercept light signals. The original system was that of balancing light in each eye, but a more positive and reliable system is the one shown in Fig. 5B. Here, three relays are utilized. RL_1 is the "right" relay, RL_2 the "left" relay, and RL_3 the motor relay. RL_3 is connected in series with the power supply so that when a phototube draws current and causes V_1 and/or V_2 to conduct, the current passing through either RL_1 or RL_2 must also pass through RL_3. Thus the interception of light immediately causes "Timothy" to move forward. Note that the arrangement of the relays is such that RL_1 and RL_2 in combination operate the reversible motor for right and left or neutral. Equal light in both eyes will energize both relays and "Timothy" will turn in neither direction but will move forward. The arrangement of the photocells is such that light can be perceived in both eyes for only a very small angle and, as a result, the operation of this system is one that is primarily binary in nature. As "Timothy" approaches a light source, and greater accuracy in his searching is necessary, the images on his photocell retinas travel toward the outer edges of the conductive surface where the slightest movement of "Timothy's" head might cause complete loss of the signal on one side, making necessary an adjustment in his sight position to a very close tolerance. Short focal-length lenses have been used to increase the light intensity in each eye as well as to present a clear-cut image on his retina which defines his exact position with respect to the light source in each eye.

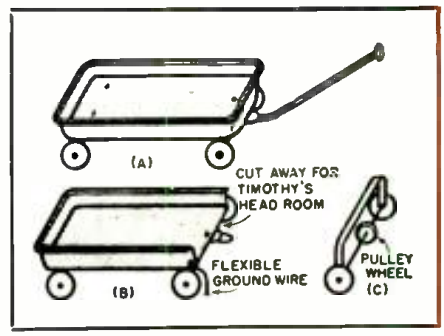
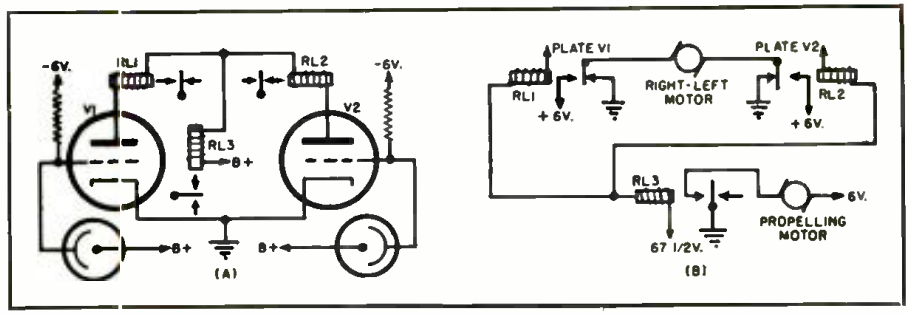
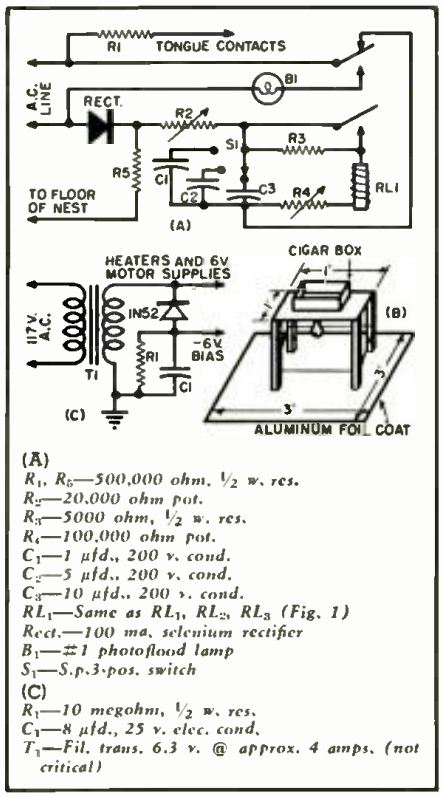


Fig. 4. Wagon and rear wheel modifications.

The photocells are mounted as indicated in Fig. 7 with their long axes horizontal and fixed in such a position that the light reaching each photocell from straight ahead barely reaches the edges of the cell on close light sources. This binary system ("off-

Fig. 5. (A) Fundamental sight circuit and (B) motor circuits for the robot turtle.





(A)
R_1, R_5—500,000 ohm, ½ w. res.
R_2—20,000 ohm pot.
R_3—5000 ohm, ½ w. res.
R_4—100,000 ohm pot.
C_1—1 μfd., 200 v. cond.
C_2—5 μfd., 200 v. cond.
C_3—10 μfd., 200 v. cond.
RL_1—Same as RL_1, RL_2, RL_3 (Fig. 1)
Rect.—100 ma. selenium rectifier
B_1—#1 photoflood lamp
S_1—S.p.3-pos. switch
(C)
R_1—10 megohm, ½ w. res.
C_1—8 μfd., 25 v. elec. cond.
T_1—Fil. trans. 6.3 v. @ approx. 4 amps. (not critical)

Fig. 6. (A) Electrical circuit for "Timothy's" nest. (B) Mechanical details for constructing nest. (C) Alternate circuit for providing the necessary —6 volts bias when the motors operating "Timothy" are a.c. driven.

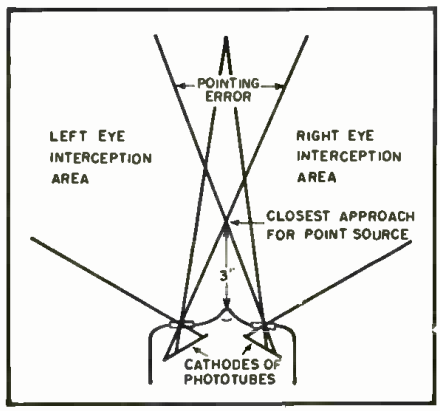


Fig. 7. Maximum and minimum interception range of "Timothy's" phototube "eyes."

on") in each eye, obviously increases "Timothy's" ability to direct his motion more accurately and far more simply than a discriminator action in the normal form since this discriminator action is in the form of a curve with sharp discontinuities in each eye near the point where either photocell conducts.

Functions

"Timothy" has two main functions —eat and play. V_3 of Fig. 1 controls these functions. C_1 charges to about —110 v. through "Timothy's" tactile tongue when it contacts the charged wire in the nest. C_1 then discharges slowly through R_1 and R_2, this time of discharge being determined by the setting of R_2. This discharge period is the "play" period. When C_1 reaches a potential of —2 volts, V_3 conducts and RL_1 switches "Timothy" from "play" to "search" for his food. RL_1 operates the ground return for the cathodes of V_1, V_5, V_6, V_7, and V_8. All tubes used in these circuits are dual triodes. All the diodes used are germanium semi-conductors. A pulsing light transmits "food" information to "Timothy." The duration of the light's off and on periods are variable.

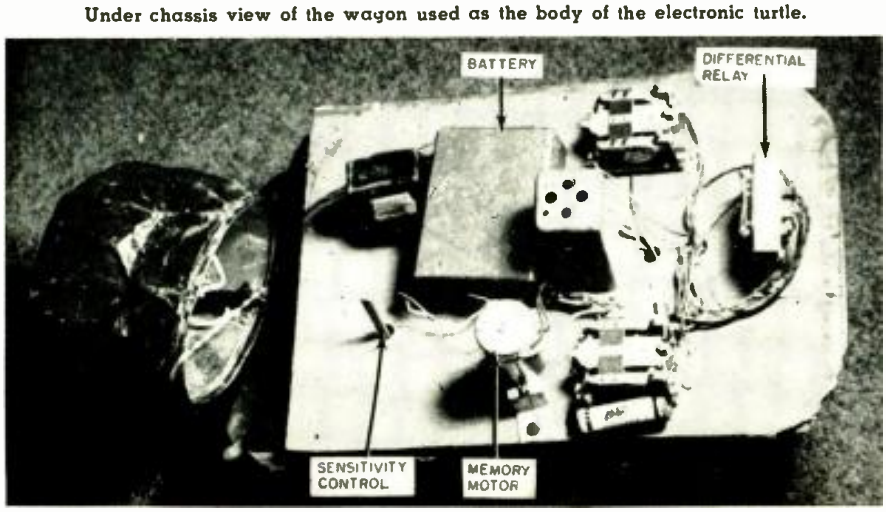
During the function when "Timothy" searches for food, his circuitry changes in such a manner that he is most sensitive to pulsating light. Thus, V_1 and V_2 are capacitively coupled by the action of RL_1 which opens the d.c. path in "Timothy's" light-sensitive nervous system. V_5 and V_6 also add to "Timothy's" preference for obtaining food. If the duration of the light is longer than "Timothy" last remembered it to be, V_5 and V_6 will turn him away from the light source. When V_1 first conducts "Timothy" travels to the left, describing a complete circle, until he intercepts a light source. He will analyze the light in V_1, V_5, and V_6 in the following manner:

Negative pulses appearing at the plates of V_1 and V_2 are applied through C_2 or C_3 or both to diode CR_1. This charges condenser C_1 which causes V_4 to cease conducting, whereupon "Timothy" ceases his searching and will travel toward the pulsing light source, continually testing its duration. If the light is picked up by his right eye, V_1 receives a pulse through C_5 and the same pulse will be applied to the grid of V_5. If the duration of the pulse is long enough to raise the voltage across the integration network consisting of R_5 and C_5 to the point where V_5 will conduct, then V_5 will cause "Timothy" to veer to the left and away from the light source. Obviously then, if a steady beam is suddenly intercepted by "Timothy," he will turn away from it. Now, R_5 and R_6 are adjusted by a small reversible motor which is operated by V_7 and V_8 through the double-coil relay RL_5, RL_6. This relay is so constructed that if the current through both coils is the same, the contacts remain open. If the current through one coil is greater by a sufficient amount than that through the other, the clappers will move in unison, making contacts as shown. Note that the grid of V_7 is connected to V_5, and both have a common cut-off bias. If the duration of the positive pulse is greater than the setting of V_5, V_7 will conduct, increasing R_5 and R_6. This increases the time necessary for charging C_7 and C_8 to the point where V_5 or V_6 will again conduct. Meanwhile, if the pulses are of shorter duration, the pulsing of V_8 causes the motor memory to decrease the value of R_5 and R_6 thus making the time necessary to cause V_5 to conduct shorter. When the duration is the same, the amount that V_8 reduces resistors R_5 and R_6 is the same amount as V_7 increases them! C_{13} and C_{14} are optional memory circuits. When signals appear at the plates of V_1 and V_2, CR_2 conducts and charges C_{13} or CR_3 conducts and charges C_{14}. R_{13} and R_{14} are current-limiting resistors which permit the necessary current to discharge C_{13} or C_{14} and close their respective relays. This system affords a quick method of "Timothy's" learning and a fairly long retentive period or memory. C_{11} and C_{12} associated with V_7 and V_8 perform in essentially the same way.

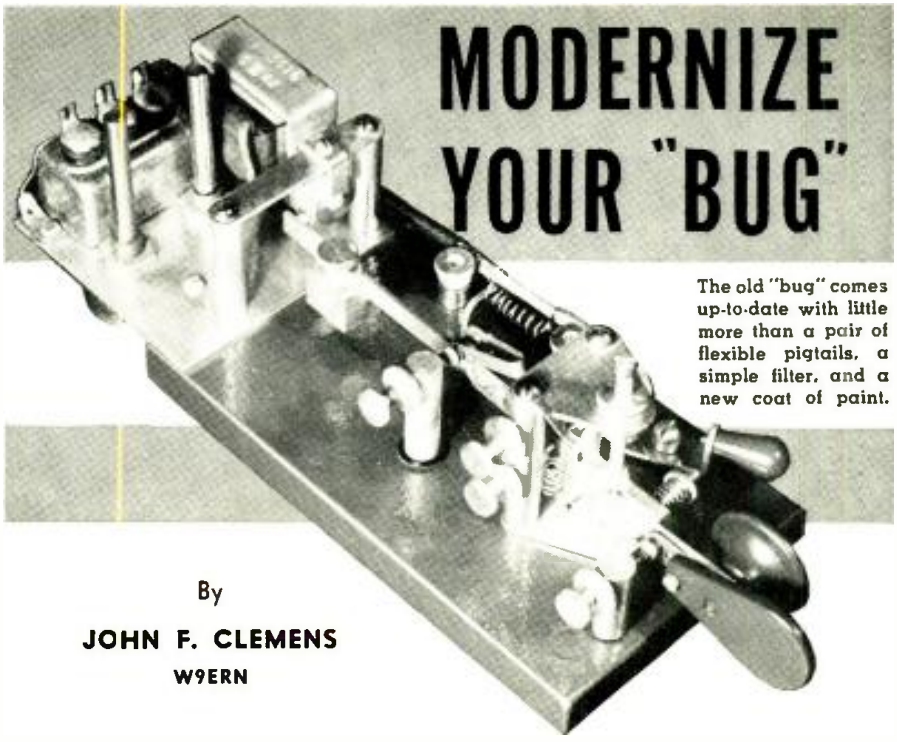
Thus "Timothy" actually measures light duration in a manner which will allow him to retain the information without power consumption. This indicates that he remembers the duration of the light last transmitted to him even though he is activated on rare occasions with long periods of deactivation. These deactivation periods have no limit in time! He can follow the light indicating a food source even though it be modified many times between the first interception and the final arrival at the nest. "Timothy's" condenser is charged, when he arrives at his nest, by a tactile tongue which he extends in search for food. At this point he again switches from pulse light sensitivity to continuous light and is ready to follow a continuous beam of light for the duration of the charge in his "condenser stomach."

(*Continued on page* 150)

Under chassis view of the wagon used as the body of the electronic turtle.



MODERNIZE YOUR "BUG"



The old "bug" comes up-to-date with little more than a pair of flexible pigtails, a simple filter, and a new coat of paint.

By
JOHN F. CLEMENS
W9ERN

Good-bye to missing dots, ragged dashes, haywire filters, and all that. The lowliest "bug" can be a star performer.

THE semi-automatic or "bug" key is found in virtually every amateur station. Various manufacturers supply a wide assortment of models ranging from the bare-essential, or austerity, black crackle version to the chrome-plated model for the "carriage trade."

A little homework will transform a key of most doubtful lineage into an elegant "insect"—no longer a lowly "bug"—without producing panic in the pocketbook. Not only may the appearance be greatly enhanced, but the performance will likewise be improved by a few simple alterations.

The "bug" pictured began life as a J-36 military model, patterned after a well-known commercial type, although produced by a different manufacturer. The base was finished in black crackle, apparently a special grade, probably concocted to meet a government camouflage specification. Its virtue was to attract its weight in dust and unite with same in an inseparable bond. Although purchased new, after three months on the operating table the bug had, chameleon-like, blended into the (dust) color of the desk blotter so as to be all but undetectable to the naked eye!

In addition, electrical contact was made through the bearings of the bug, resulting in an occasional skipped dot. (It couldn't have been the fist!)

A key-click filter has always been used at this station on all of a wide variety of transmitters. Usually the click-filter constants were determined by cut-and-try, and the optimum arrangement was festooned across the operating table.

Finally the haywire click filter became too offensive and a "de luxe" model was designed. The de luxe filter had adjustable inductive lag and adjustable capacitive shunts to enable the operator to soften the keying to suit the requirements of the individual transmitter. Any small filter choke, or the primary of a small output transformer, may be used as the lag inductor. The small-size TV filter chokes are ideal as their d.c. resistance is low. A potentiometer across the choke varies the effective inductance and thereby sets the keying lag. Similarly a potentiometer in series with the shunt paper condenser sets the effective capacity.

In addition, an r.f. choke and bypass condenser are used in the key leads. This is especially important if v.f.o. keying is used as small traces of r.f., induced in the key leads by high power stages, may affect the keying detrimentally. The filter circuit constants are shown in the drawing.

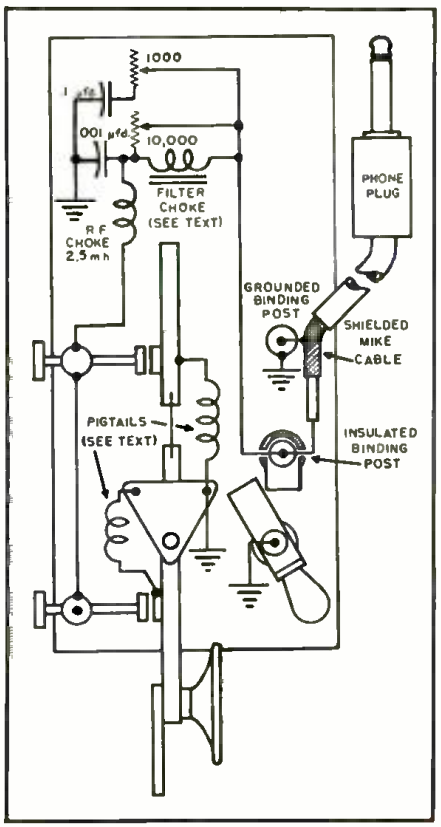
The entire filter is assembled on a small aluminum plate as wide as the "bug" base, and fastened to the base by insertion under the two backstop mounting screws. The photographs show the simplicity of the construction and wiring. To overcome the erratic bearing contact, two flexible wire pigtails were installed, one from the vertical bearing mount to the movable dot contact and the other from the bearing mount to the movable dash contact. The coiled pigtails should be mounted so that action of the key does not cause elongation of the coils. In this way the coils produce no detectable effect on the key action.

The dusty crackle paint was sanded off the base. A dark green enamel was sprayed on with a *"Flit"* gun, after which the base was baked in the oven for 20 minutes at very low heat. The *Bakelite* paddle, knob, and circuit-closing switch knob were similarly given a coat of red enamel, but not baked, of course.

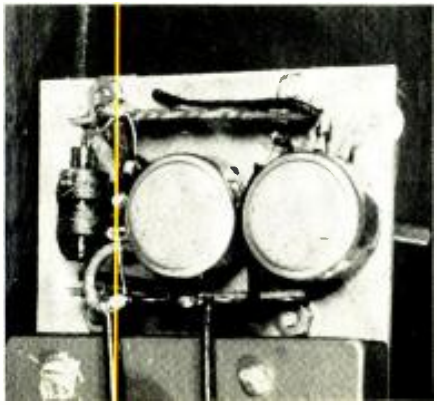
To complete the de luxe "bug," a length of shielded microphone cable was fitted with soldering lugs spaced for the key binding posts. Mike cable is more flexible than r.f. coax cable, and the stranded center conductor is less likely to break.

The extra weight of the filter makes the key less prone to slide around on the table and the smooth enamel finish is easy to clean. You'll find the time well spent in adding these features to your "bug." —30—

Diagram of the key and filter. The pigtails improve reliability of the keying.



The simple keying filter mounts on the "bug" base by means of the backstop screws.



A TRANSISTOR CODE PRACTICE OSCILLATOR

Fig. 1. Truly "pocket-size" code practice oscillator using transistors.

By
LOUIS E. GARNER, JR.

Construction details on an extremely compact unit which can be carried in a pocket and used, with privacy, anywhere.

EDITOR'S NOTE: One important point that has caused some misunderstanding and, therefore, requires further clarification is in regards to the designations "p-n-p" and "n-p-n". Prior to Raytheon's announcement of their junction-type transistor, all literature on the development work of other laboratories on junction-type transistors referred, unless clearly indicated to the contrary, to the "n-p-n" type. Raytheon's units, CK721 and CK722, are of the "p-n-p" type. Circuitwise, there is one major difference between these two types. In the "n-p-n" type, the collector voltage is positive and the emitter voltage is negative. The "p-n-p" units are wired directly opposite, that is, with a negative collector voltage and a positive emitter voltage. The designations "p" and "n" are used to differentiate between germanium crystals having different types of impurities. Junction-type transistors are made with three segments of germanium. In the "p-n-p" type the outer segments are "p" type germanium crystals while the center, wafer-thin segment is an "n" type. The assembly of the "n-p-n" is just the reverse. The characteristics of these two types are decidedly different. Suffice it to say that when using junction-type transistors it is imperative that the builder know the type with which he is working. For further details, refer to the series of articles, "Survey of Transistor Development", by B. N. Slade which appeared in the September, October, and November 1952 issues of RADIO & TELEVISION NEWS.

THE prospective amateur who must learn the radiotelegraph code often finds it difficult to work sufficient "practice" periods into an already heavy schedule. School, work, the study of theory, and social obligations may all combine to make the practice periods erratic at best. On the other hand, regular practice is essential to developing reasonable skill—a moderate period of practice repeated at frequent intervals often is of more value than long practice periods repeated only occasionally.

One solution is to provide means of practicing whenever the opportunity presents itself– during a lunch hour, while in a waiting room, or whenever a few minutes' spare time can be found. Essential items are a code practice oscillator, a headphone (or loudspeaker), and a hand-key.

Unfortunately, code practice signal sources which are normally available are generally either too bulky or too loud to be effective for this type of practice. An electronic (vacuum tube) code practice oscillator is likely to be large and to require a source of power which may not always be available; a battery operated unit may have short battery life and thus be prohibitively expensive to operate. A buzzer and battery combination is the least expensive solution, but also the most unsatisfactory. A buzzer not only requires comparatively large amounts of power, making it necessary to either use large batteries or to replace them frequently, but is also likely to be too loud for practice at odd moments it certainly would not be satisfactory for use in a waiting room.

The ideal solution is a compact oscillator using small batteries, with long battery life, and supplying a signal for earphone operation the oscillator shown in Fig. 5 is a close approach to this "ideal" unit. As can be seen in Fig. 1, the oscillator is small enough to slip in a coat pocket, yet batteries are self-contained and battery life is long. Ample power is provided for earphone operation and, under conditions of low ambient noise, the earphone may be placed on the table and heard by several persons. On the other hand, the volume is not so loud as to prove distracting to others when the headphone is worn normally.

Construction of the oscillator should not prove difficult, and the average technician should be able to assemble and wire the entire unit in a few hours' time. The cost of the components used, while not low, is still not prohibitively high, and should be well within the budget of the prospective "ham."

Circuit Description

Referring to the diagram given in Fig. 3, a *Raytheon* ("p-n-p" type) CK722 transistor is connected as a grounded-base audio oscillator. Feedback is obtained by means of T_1, a 1:3 interstage audio transformer.

The earphone and hand-key are connected in series with the collector circuit, and thus serve to open this circuit when removed (or when the key is open). Because of this, a single s.p.s.t. switch is all that is necessary, and this is provided in the emitter-base circuit (S_1).

Resistor R serves to limit current drain and also has some control over the frequency of operation.

Power is obtained from a penlight cell (B_1), which supplies "bias," and a small 15-volt hearing aid type battery (B_2) which supplies collector voltage.

Construction Hints

No special precautions are required when assembling and wiring the unit shown and the builder need only follow good construction practice. A metal utility box, a plastic case, or

even a small wooden box may be used for housing the components. Shielding is unimportant.

The author used a *Bud* CU-3001 "Minibox" (3¼" x 2⅛" x 1⅛"), and finished it in black glossy enamel. However, the reader may prefer to use an already finished unit (*Bud* also supplies this same size "Minibox" in a gray hammerloid finish at about the same price). Decals were used for lettering.

In order to fit the audio interstage transformer into the small metal box, it was necessary to remove the mounting "ears" on the transformer frame. This was accomplished by simply bending the "ears" back and forth with a pair of heavy pliers until they broke off.

Since the battery life is quite long, it was found practical to make the battery connections by soldering leads directly to the battery terminals rather than by providing special clips. After the connections were made, the batteries were taped together and the terminals insulated by wrapping with *Scotch* electrical tape.

The interior view of the oscillator, given in Fig. 2 clearly shows the general parts arrangement used by the author in constructing the model. It was only found necessary to mount the phone tip jacks and the slide switch. The other parts are held immobile by the compact wiring and by the pressure of the case when the cover is in place.

Parts Substitutions: The circuit given is not critical and a number of substitutions is possible to suit the requirements of the individual builder.

Almost any standard 1:3 interstage audio transformer should give satisfactory results for use as T_1, although the builder may find it necessary to experiment somewhat with the lead connections. The author originally tried the entire secondary winding (the two green leads, Fig. 3), but found that better results were obtained when only half the winding was used.

Resistor R may best be chosen experimentally* to give the tone desired by the builder (as mentioned previously, the size of this resistor has some effect on the frequency of operation). If too small a value resistor is used, the current drain may be large, while if too large a resistor is used, the oscillator may not work. Satisfactory values will generally fall between 2500 and 15,000 ohms.

A rotary switch, toggle switch, or lever switch may be substituted for the slide switch (S_1) if preferred, but the slide switch is the least expensive and most compact.

If the builder prefers, a different size penlight cell or an ordinary flashlight battery may be substituted for B_1. A *Mallory* mercury cell may also be used here, and will give much longer life than a zinc-carbon cell (the *Mallory* RM1000 is an excellent choice).

The headphone and band is likely to prove a little bulky in the pocket. Where maximum convenience is desired, it is suggested that the builder use a *Telex* midget earset (Type A4680, 2000 ohms) in place of the standard headphone unit shown in Fig. 5. Equally satisfactory results will be obtained. Crystal headphones should *not* be used, however.

Substitutions may be made for other components where necessary or desirable, for example, miniature "hearing aid" type plugs and jacks may be used in place of the phone tips and tip jacks, etc.

Lead lengths can be varied to suit the individual user. It is even practicable to mount the hand-key directly on the case of the oscillator and to wire it directly into the circuit, where desired by the constructor. An alternative is to mount the hand-key and oscillator on a small flat wooden or plastic base.

Applications

In addition to the rather obvious application of the transistor code practice oscillator for use as a personal unit for private use, it is well adapted to other uses. A few of these are given below:

Mobile Practice: Military radio operators, especially, make wide use of hand-keys mounted on straps and fixed to one of their legs, for communication work while in a plane, "jeep," or command car. Practice in this technique may be obtained by providing a strap (made from webbing or from an old belt) on the hand-key so that it can be easily strapped to the leg.

By slipping the oscillator in a pocket, practice can be obtained while riding in an automobile, bus, train, or

(*Continued on page* 99)

* A 15,000 potentiometer may be used here to determine the initial value for R.

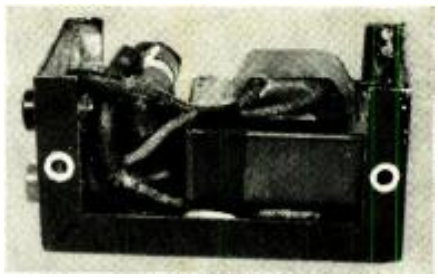
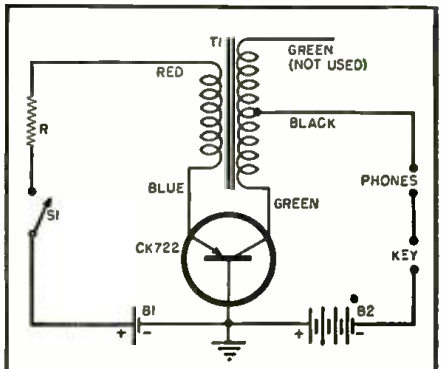


Fig. 2. Chassis view with cover removed.



R—4700 ohm, ½ w. res. used in model (select size for desired tone—see text)
S_1—S.p.s.t. slide switch
B_1—1½ volt battery (Burgess #7 penlight cell)
B_2—15 volt hearing aid battery (Burgess U10)
T_1—3:1 interstage trans. (SNC #1P331)
CK722—Raytheon transistor
1—Bud "Minibox" CU-3001
1—Hand-key
1—1000 ohm headphone unit
4—Phone tip jacks

Fig. 3. Complete schematic of oscillator.

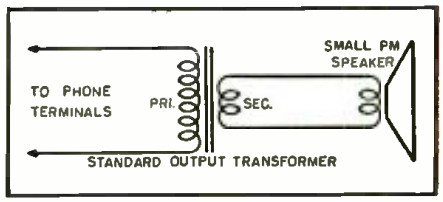
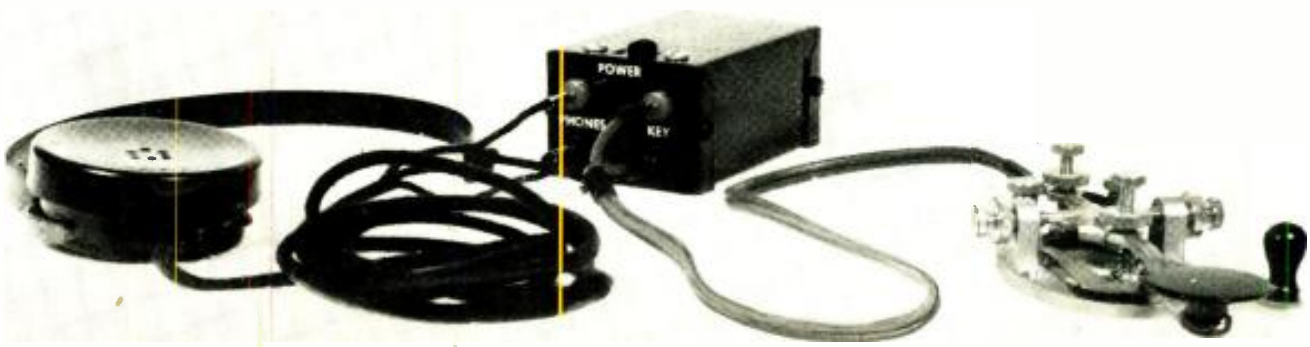


Fig. 4. Circuit variation using a speaker.

Fig. 5. Complete code practice setup including oscillator, key, and headphone. Unit is compact enough to be carried in a suit pocket.



IMPROVED VARIABLE POWER SUPPLY

By
WILLIAM CREVISTON

Fig. 1. Front view of the power supply unit. It is housed in a 5" x 6" x 9" utility box.

An adaptation of an English circuit which provides outputs from 50 to 300 volts using a cathode-follower type hookup.

THE most basic necessity in experimental work with vacuum tubes is a power supply, preferably one which will deliver a wide range of different voltages. A small box with a knob on the front, which will deliver, say, 50 to 300 volts d.c., plus some filament power, will serve not only for powering experimental tube circuits but in calibrating meters and testing generally. Quite a few supplies of this sort have been described.[1]

The one to be described here does more with fewer parts than any other with which the writer is familiar. The circuit is a new one, devised by A. H. B. Walker in England.[2] It is not a regulated supply, but its inherent regulation is as good at 50 volts output as it is at maximum voltage. Output characteristics are those of a standard condenser-input supply at all voltages. Internal impedance at d.c. is about 500 ohms, hum level 5 to 50 millivolts (depending on load), and output voltage range 50 to 300 v. Regulation curves are shown in Fig. 3C.

Basic Circuit

The idea of the Walker circuit is to use a pair of triode-connected power tubes for rectifiers, with the grids returned to a variable d.c. voltage. By cathode-follower action, the cathodes are then constrained to assume whatever voltage level that the grids dictate. The cathodes feed an ordinary condenser-input filter. The basic circuit is shown in Fig. 3A. Only a single tube is shown, half-wave, for simplicity. Suppose that the peak a.c. voltage from the transformer is 300 volts, and that potentiometer, R, is set at 100 volts above ground. If the cathode of the tube tries to rise above + 100 volts, the effective grid bias will increase, eventually cutting the tube off. If the cathode potential falls below + 100 volts, plate current will increase. Fig. 3B shows a 60-cycle voltage wave with these levels marked. The tube can only pass plate current when the plate is above the cathode potential, *i.e.*, the potential determined by potentiometer R through the agency of the grid. Conduction is possible during the shaded portions of the curve.

Minimum output voltage is determined by the cut-off bias of the tube. When R is set at zero, this minimum is generally about 50 or 60 volts. The higher the mu of the tube, the lower the "zero" output voltage. For best regulation, the transconductance of the tube should be high. Maximum plate dissipation of the tube is important if large currents are drawn at low output voltages.

Complete Circuit

The particular supply shown in Fig. 1 uses the circuit shown in Fig. 2. Type 6W6 tubes, triode-connected, are the rectifiers in a standard full-wave

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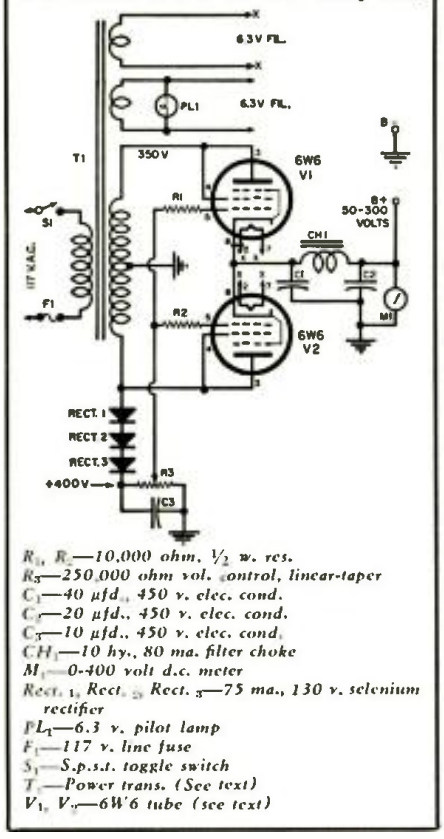
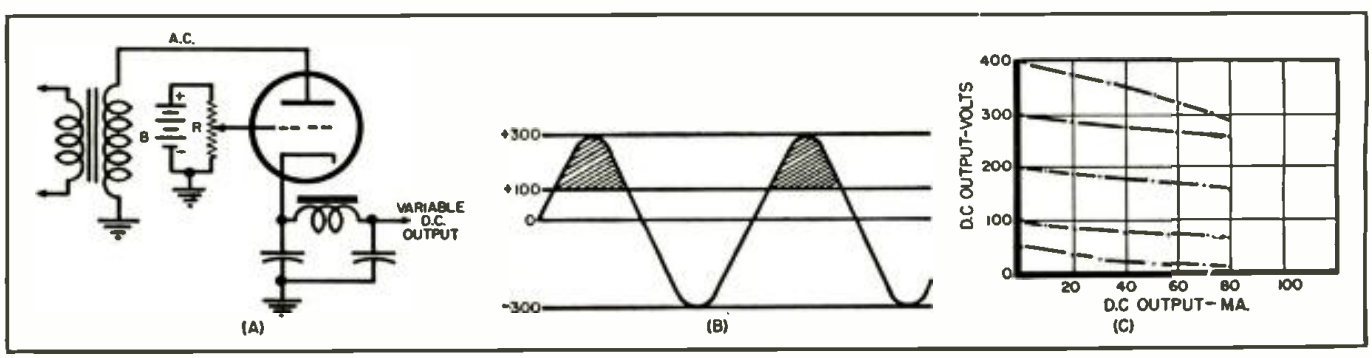


R_1, R_2—10,000 ohm, ½ w. res.
R_3—250,000 ohm vol. control, linear-taper
C_1—40 μfd., 450 v. elec. cond.
C_2—20 μfd., 450 v. elec. cond.
C_3—10 μfd., 450 v. elec. cond.
CH_1—10 hy., 80 ma. filter choke
M_1—0-400 volt d.c. meter
Rect. 1, Rect. 2, Rect. 3—75 ma., 130 v. selenium rectifier
PL_1—6.3 v. pilot lamp
F_1—117 v. line fuse
S_1—S.p.s.t. toggle switch
T_1—Power trans. (See text)
V_1, V_2—6W6 tube (see text)

Fig. 2. Circuit of variable power supply. Output is adjustable from 50 to 300 volts, 70 ma. Regulation is same as regular condenser-input pack at all voltage settings.

Fig. 3. (A) Simplified schematic of cathode-follower rectifier. (B) 60-cycle waveform showing effect of cathode-follower bias. When bias is +100 volts, cathode "rides" at approximately +100 and conducts only during shaded part of cycle. (C) Regulation curves.



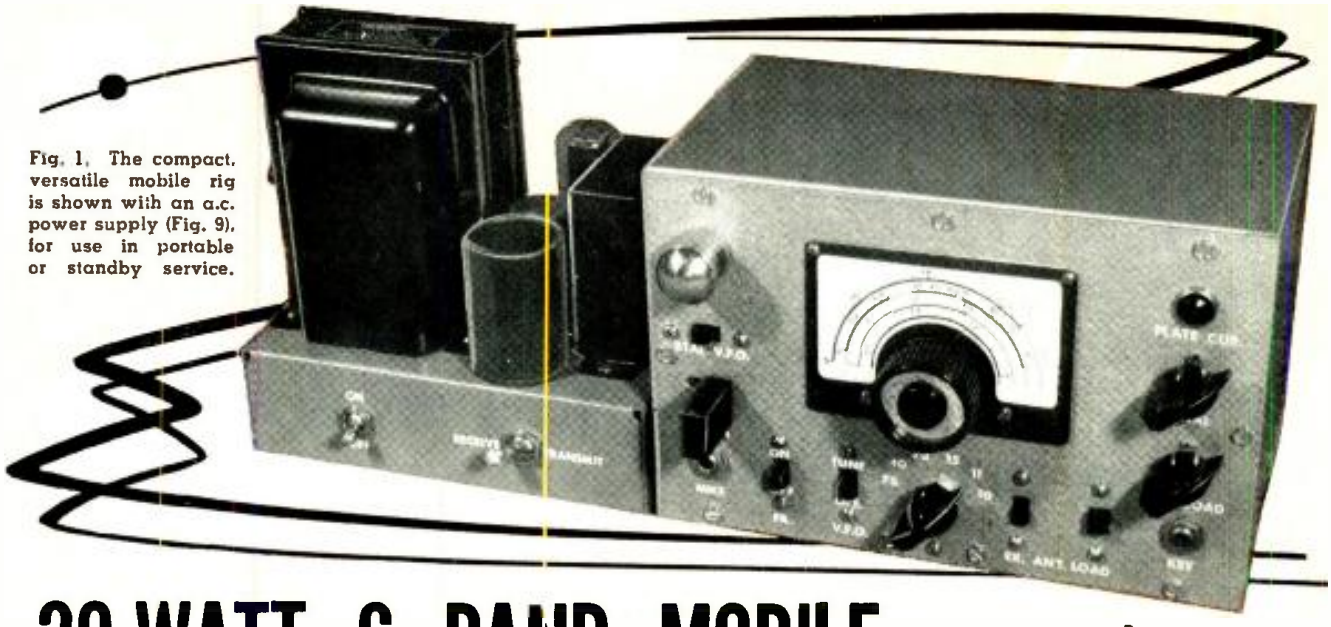


Fig. 1. The compact, versatile mobile rig is shown with an a.c. power supply (Fig. 9), for use in portable or standby service.

20-WATT 6 BAND MOBILE

By
HARTLAND B. SMITH, W8VVD

No more dead band blues! This mobile has the whole works: v.f.o. or crystal, phone or c.w., twenty watts from 10 to 75 meters, for mobile, portable, emergency, or standby use.

MANY hams aren't satisfied unless the family jalopy is loaded down with electronic gadgets. They consider that high power, heavy duty generators and extra batteries are absolute necessities for mobiling pleasure. On the other hand, a lot of fellows believe that the primary purpose of an automobile is to furnish transportation. They feel that radio equipment should be unobtrusive and should put no undue burden on a car's electrical system. The transmitter to be described has been designed for individuals in this latter group.

The author's first mobile, like most home-built rigs, was a one-band, crystal-controlled affair mounted in the trunk. Its lack of flexibility, a minor inconvenience when operating in a populous area, became quite evident during a vacation trip through northern Michigan. Being rockbound on a dead ten-meter band proved very, very disconcerting.

Out of this rather unhappy experience grew the determination to construct a transmitter which would operate on a number of bands, contain a v.f.o., and yet be small enough to mount conveniently under the dash. The bandswitching rig that finally emerged, after much dreaming, planning, and magazine thumbing, works on phone or c.w., crystal or v.f.o. While primarily designed for mobile use, it can be quickly removed from the car and employed as a portable station or as a pinch hitter in place of the regular home transmitter. It will operate on any of six bands and its pi-network plate circuit will match a wide range of antenna impedances. Furthermore, it will run for several hours from a fully charged battery, thus allowing you to park and transmit without having to waste gasoline while the engine idles.

A surplus dynamotor mounted under the hood of the author's *V-8* provides approximately 300 volts at 150 ma. This is sufficient to furnish 20 watts or so to a final with another 20 watts left for the modulator and driver stages. A 2E26 with its 27-watt input limit was picked for the final tube as the best compromise between physical size and power handling capability.

No protective cathode bias is used on the 2E26. While it is true that plate current can soar if excitation is removed from the final, it is doubtful if the 2E26 will be damaged if operated momentarily without bias, since the plate voltage is well below the tube's maximum rating. Elimination of a cathode resistor was felt to be desirable, since the drop in such a resistor would reduce a plate voltage that is none too high to begin with.

The oscillator tube, a 6BH6, was chosen because of its low heater drain. Either a 6AG5 or a 6AU6 could have been used, but an extra 150 ma. would have been required from the car battery. A Colpitts oscillator circuit is employed as it requires no coil tap, thus simplifying bandswitching.

In order to minimize reflected changes in oscillator frequency caused by tuning the final, the output frequency of the transmitter is always a multiple of the oscillator frequency. Multiplication is achieved in the intermediate 12BY7 stage and, on some bands, in the plate of the 6BH6, as well. The 12BY7 makes an excellent multiplier.

Across each band, except ten meters, the 12BY7 drives the 2E26 to more than the required $2\frac{1}{2}$ grid ma. On ten, the final grid current is 2 ma. or better from 28.6 mc. to 29.6 mc. Actually, over most of this range, grid current exceeds $2\frac{1}{2}$ ma. Since output falls off only slightly with 2 ma. instead of $2\frac{1}{2}$ ma. on the grid of the 2E26, the drop in grid current at the band extremes need cause no worry.

Although a number of trick modulation circuits have appeared recently, plate modulation still seems the most practical for mobile work. Despite wide variations in final drive and loading, plate modulation provides acceptable speech quality. This is more than can be said for the various forms of efficiency modulation now so popular.

When the final input doesn't exceed 20 watts, old fashioned class A Heising choke modulation is an inexpensive and effective choice because chokes are cheaper than modulation transformers and because class A stages require no driving power. Sufficient modulator grid voltage can usually be obtained directly from a carbon mike and transformer, thereby dispensing with the need for speech amplifier stages.

A single 6L6 has long been a favorite class A modulator. The 6F6, the

Fig. 2. All controls but the phone-c.w. switch are located on the front panel. Note that several extra self-tapping screws are used to fasten the panel, improving rigidity for the v.f.o.

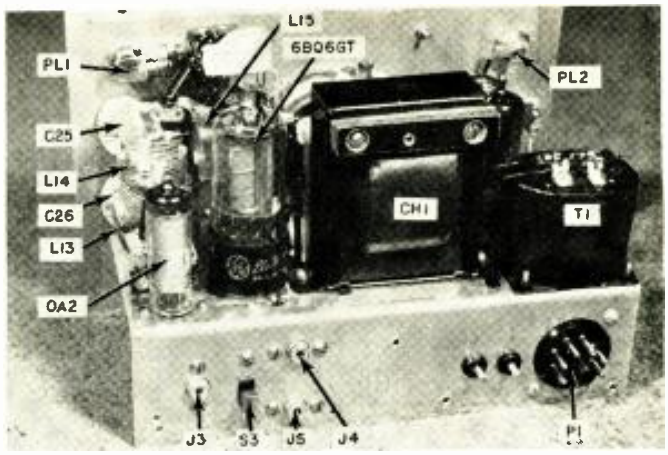


Fig. 3. Inside the 6"x9"x5" box. The Bakelite strip mounted on the choke provides a point for fastening choke to rear panel, further bracing the chassis for assured v.f.o. stability.

6AQ5, and other familiar audio tubes do not perform nearly as well as the 6L6 in this type of service. The size of even a 6L6GA, however, is too large to be practical in a compact transmitter. Luckily, the little 6BQ6GT is a miniature modulator in disguise. While primarily designed for use as a horizontal output tube in TV service, the 6BQ6GT will do the work of a 6L6 modulator without taking up nearly so much precious space.

Any single-button carbon mike with a push-to-talk switch will work in conjunction with the rig, nevertheless, a chest mike containing a high output *Western Electric* F-1 cartridge is recommended. Driving with one hand while holding a mike in the other is a dangerous practice which can get you into plenty of hot water if you become involved in an accident. Wisdom dictates the use of a mike that permits you to keep both hands on the wheel.

Although the author is no lover of International Morse, provision for c.w. operation is included in the rig for use at those times when phone just won't quite make the grade. There is little reason to waste heater and plate power in a modulator stage while pounding brass and so S_2, the "Phone/C.W." switch, opens the 6BQ-6GT heater circuit at the same time it shorts the modulation choke, CH_1. Since S_2 is seldom used, it is relegated to the rear panel.

Whenever possible, a crystal should be employed during c.w. operation, otherwise a slight chirp may be evident on the signal. A class A isolating stage between the 6BH6 and the 12-BY7 would probably clear up this trouble, but the added circuit complexity seems hardly worthwhile when one considers how seldom c.w. is employed in mobile work.

The number of tuning controls is held to a minimum by employing broadband slug-tuned coils in the intermediate stages. The plastic coil forms visible in Fig. 7 were purchased at a bargain sale and so exact duplicates may be rather difficult to obtain. However, ceramic forms of approximately the same dimensions and with powdered iron slugs are listed in most radio catalogues. The resistors across some of the coils are needed to hold the final drive down to a reasonable level. On the lower frequency bands, condensers are also placed across the coils in order to increase the circuit "*Q*," thereby reducing the amount of reflected oscillator frequency shift caused by tuning the final. Without these condensers there just isn't sufficient isolation between the oscillator and the final.

At the time the transmitter was constructed, the only suitable bandswitch that could be located was the surplus unit shown in Fig. 7. Recently, however, a new line of miniature ceramic switches appeared on the market. *Centralab's* new switch model #PA 2025 is recommended for use as S_1. Its small size will provide more room under the chassis, thus simplifying the wiring process.

No claims are made that this little transmitter is completely TVI-proof. Nevertheless, with the final operating on 10 meters, a sensitive field strength meter reveals that at a distance of 50 feet from the car, the second harmonic is appreciably weaker than the signal provided by a Channel 2 TV station some 15 miles away.

The TVI precautions observed in the construction of the unit include complete shielding and the bypassing of every lead coming out of the case. In addition, a low-pass filter is installed in the coax antenna feeder.

Without shielding, bypassing, and a low pass filter, a 20-watter can ruin reception for a block or more, even where TV signals are strong. In a fringe area, a poorly constructed mobile is capable of blanking out a whole community. Thus, it is obvious that every rig must now be designed with a view toward the reduction of TVI.

The transmitter is housed in a 6" x 9" x 5" hammertone gray aluminum box. As suggested in many articles on TVI reduction, paint was removed from all points of contact between the front and rear panels and the case. This was a rather messy, time consuming job, and in this instance didn't measurably cut down on harmonic radiation. Unless you enjoy scraping paint, you might as well forget this one phase of construction.

Since quite a bit of heat is generated within the case of the transmitter, some method of ventilation must be provided. A number of ¼" holes drilled in the rear panel will allow a portion of this heat to escape while still maintaining adequate TVI shielding. It will also pay to put felt feet on the bottom of the cabinet. Then you won't have to worry about scratching up the furniture while operating away from the car at a portable location.

The panel is illuminated by means of a shielded pilot light assembly. For some reason, this style of pilot socket is available from only a few jobbers. If you have difficulty finding one, ask for *E. F. Johnson Co.'s* part no. 147-330.

Mobile v.f.o.'s are often plagued with carrier flutter resulting from mechanical instability. The mechanical stability of the rig being described is comparable to that of similar commercial units now being marketed. All factors considered, the frequency shift caused by mechanical shock is relatively insignificant in this unit.

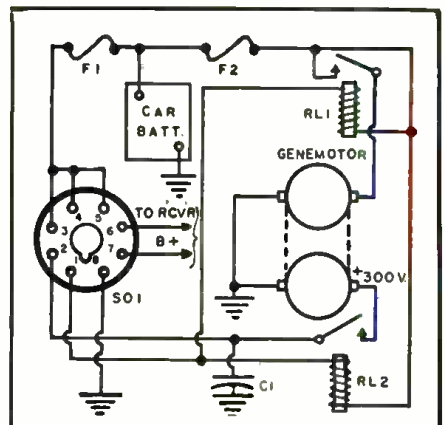
Oscillator microphonics will be held to a minimum if the following points are kept in mind: Use heavy aluminum for the chassis. Employ several extra screws to fasten the front and rear panels to the case. Use a dual-bearing oscillator tuning condenser. Keep floppy wiring away from the oscillator coils. Provide some means of fastening the top of the modulation choke to the rear panel. Support the rear end of the bandchanging switch, S_1, with a small bracket running to the chassis.

Frequency drift resulting from changes in temperature can also prove annoying. Be sure to use silver micas or zero temperature coefficient ceramics for C_1, C_2, and C_3. Make certain that the two oscillator coils are wound on ceramic forms. If you have

access to a surplus TU-10-B tuning unit, the core of one of its r.f. chokes (marked 10) will make a handy form on which to wind L_1. L_2 can be wound on a *CTC* type LS-5 form. Both oscillator coils should be thoroughly coated with polystyrene dope in order to prevent moisture absorption and physical deformation.

For tune-up purposes, there is little reason to waste panel and chassis space on a milliammeter. A 60-ma. pilot bulb, PL_1, will indicate plate current dips just as well, and won't make nearly as big a dent in your pocketbook. Whenever it's necessary to check absolute values, final cathode current can be measured *via* the keying jack, while the final grid current can be obtained by grounding the positive lead of a multimeter to the transmitter case and then inserting the negative prod of the meter in the test plug, J_3, provided on the rear of the chassis. R_{12} in parallel with PL_1 acts as a shunt and holds the off-resonance current through the bulb to a safe value. In addition it provides an auxiliary d.c. path to the final in case PL_1 accidentally burns out.

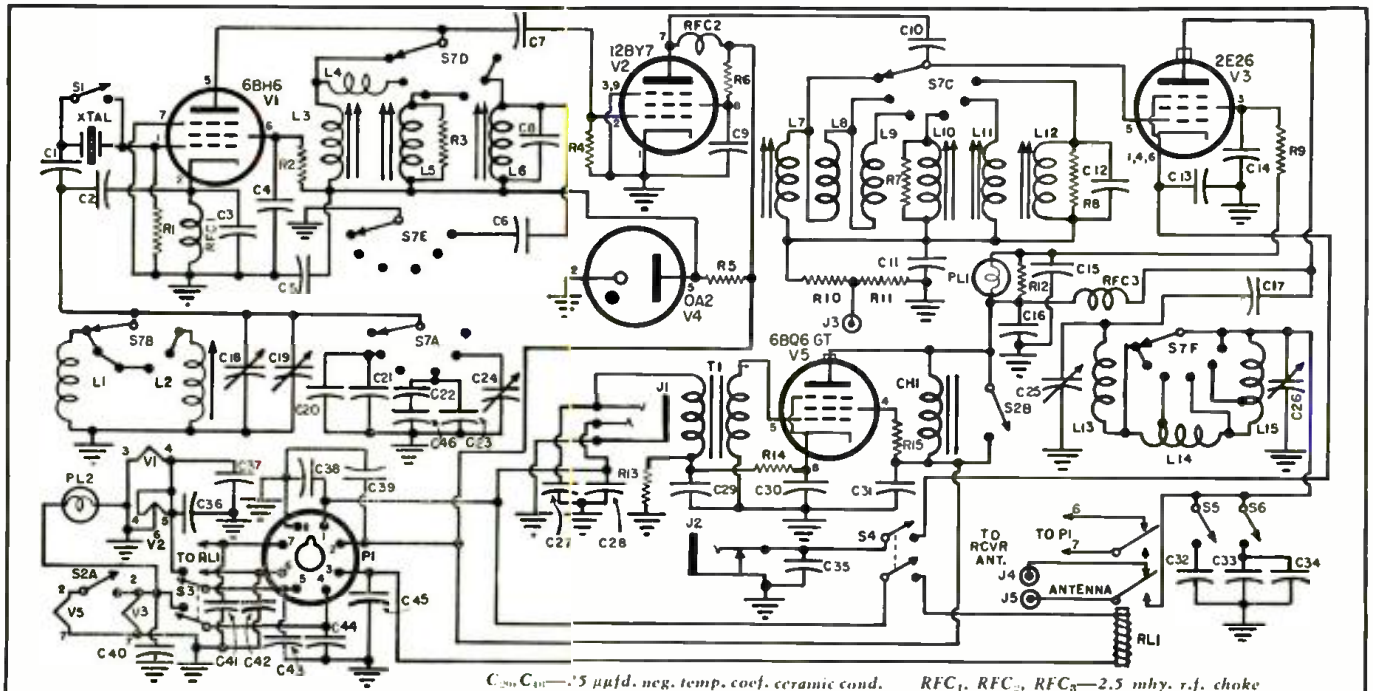
C_{30}, Fig. 5, was originally one section of a dual .0047 μfd., 500 volt disc ceramic condenser. Although subjected to only 300 volts d.c., two successive condensers at this point shorted out after only a few hours of operation. Since it is doubtful that both condensers were of defective manufacture, the cause of failure was apparently a sudden voltage peak which resulted from the collapsing field of CH_1, Fig. 5, following the removal of "B-plus" by RL_2, Fig. 4. In order to reduce the value of any such peak, a 40 μfd. electrolytic condenser, C_1, Fig. 4, was connected to the transmitter side of RL_2. Just to be on the safe side, C_{30} (Fig. 5.) was changed to a .01 μfd., 600 volt unit. Since these two modifications were made, no



C_1—40 μfd., 450 v. elec. cond.
RL_1, RL_2—S.p.s.t., 6 v. d.c. relay
SO_1—Female cable plug (Amphenol 78PF8)
F_1—SFE #6 fuse
F_2—20 amp. house fuse
Genemotor—Stromberg #42486, W.E. #DM35D, or similar surplus unit

Fig. 4. Power supply for mobile use.

Fig. 5. Diagram of the 6-band mobile transmitter. The bandswitch, S_7, is shown in the 10-meter position. Pins 6 and 7 of P_1 are for breaking receiver "B-plus" while transmitting. Certain condensers, such as C_1 and C_{17}, are halves of dual units.



R_1—50,000 ohm, ½ w. res.
R_2—20,000 ohm, ½ w. res.
R_3—10,000 ohm, ½ w. res.
R_4—150,000 ohm, ½ w. res.
R_5—16,000 ohm, 5 w. res.
R_6—14,000 ohm, 1 w. res.
R_7—9000 ohm, 1 w. res.
R_8—5000 ohm, 1 w. res.
R_9—8500 ohm, 1 w. res.
R_{10}—20,000 ohm, 1 w. res.
R_{11}—300 ohm, ½ w. res.
R_{12}—130 ohm, ½ w. res.
R_{13}, R_{14}—300 ohm, 1 w. res.
R_{15}—33,000 ohm, ½ w. res.
C_1—100 μμfd. silver mica cond.
C_2, C_3—.001 μfd. silver mica cond.
C_4-C_{17}, C_9-C_{30}, C_{11}-C_{10}, C_{11}-C_{42}—Dual .0015 μfd. disc ceramic cond.
C_5, C_{13}, C_{28}—.01 μfd. disc ceramic cond.
C_6, C_{36}—100 μμfd. mica cond.
C_7—100 μμfd. ceramic cond.
C_8—20 μμfd. ceramic cond.
C_{10}, C_{11}, C_{15}, C_{18}—.001 μfd. disc ceramic cond.
C_{12}—50 μμfd. ceramic cond.
C_{17}—650 μμfd. mica cond.
C_{18}—100 μμfd. var. cond.
C_{19}, C_{24}—10-100 μμfd. neg. temp. coefficient ceramic padder
C_{20}, C_{43}—.5 μμfd. neg. temp. coef. ceramic cond.
C_{21}—100 μμfd. zero temp. coefficient ceramic cond.
C_{22}—50 μμfd. neg. temp. coefficient ceramic cond.
C_{23}—51 μμfd. zero temp. coefficient ceramic cond.
C_{25}, C_{31}—140 μμfd. var. cond. (APC type—see text.
C_{27}-C_{28}, C_{32}-C_{11}—Dual .0047 μfd. disc ceramic cond.
C_{29}, C_{30}—.0 μfd., 25 v. elec. cond.
C_{31}—.1 μfd., paper cond.
C_{35}—330 μμfd. mica cond.
C_{37}—50 μμfd. mica cond.
C_{39}, C_{45}—.005 μfd., disc ceramic cond.
C_{38}—.01 μfd., 600 v. disc ceramic cond. (see text)
T_1—Single-button mike-to-grid trans.
J_1—Three-circuit phone jack ("Mike")
J_2—Shorting-type, closed-circuit phone jack ("Key")
J_3, J_4, J_5—Shielded phono pin jack
PL_1—Pilot lamp, 2 v. @ 60 ma. (#48)
PL_2—Pilot lamp, 6 v. @ 150 ma. (#40)
S_1, S_5, S_6—S.p.s.t. slide sw.
S_2—D.p.d.t. slide sw.
S_3, S_4—D.p.s.t. slide sw.
S_7—6-deck 6 pos. ceramic bandswitch
RFC_1, RFC_2, RFC_3—2.5 mhy. r.f. choke
RL_1—D.p.d.t. 6 v. d.c. relay (see text)
P_1—Octal male power plug (Amphenol 86CP8)
L_1—9 t. #18 wire, spaced dia. of wire, ½" ceramic form (see text)
L_2—45 t. #28 wire, ⅜" ceramic form with slug (Cambridge Thermionic Type LS-5 form)
L_3—19 t. #22 wire, ½" plastic form with slug
L_4—12 t. #22 wire airwound, 5/16" i.d.
L_5—40 t. #32 wire, ½" plastic form with slug
L_6—65 t. #34 wire, ½" plastic form with slug
L_7—7 t. #22 wire, ½" plastic form with slug
L_8—9 t. #22 wire airwound, ⅛" i.d.
L_9—11 t. #22 wire airwound, 5/16" i.d.
L_{10}—17 t. #22 wire, ½" plastic form with slug
L_{11}—38 t. #28 wire, ½" plastic form with slug
L_{12}—34 t. #32 wire, ½" plastic form with slug
Note: L_8, L_9, L_9, L_7, L_{10}, L_{11} and L_{12} are close wound. Cambridge Thermionic Type LS-4 forms may be used if desired
L_{13}—6 t. B & W "Miniductor" 3014
L_{14}—6 t. B & W "Miniductor" 3015 tapped 2 t. from L_{13} end
L_{15}—29 t. B & W "Miniductor" 3016 tapped 10 t. from L_{14} end
Xtal—See text
V_1—6BH6 tube
V_2—12BY7 tube
V_3—2E26 tube
V_4—0A2 tube
V_5—6BQ6GT tube

further condenser failures have occurred. The addition of C_1 (Fig. 4) also eliminated a slight genemotor ripple which was previously apparent on the carrier.

For the sake of clarity in the circuit diagram (Fig. 5), several dual condensers were given widely separated numbers for their two sections. Obviously if sections in separate functions like C_1-C_5 were called "C_1-C_5," the reader's eye would have to travel all over the diagram to follow the parts list. Naturally, when the transmitter is assembled it will be found that the connections of the two sections of any dual unit are adjacent, or nearly so. Dual units were used to save badly needed space, although single units will probably fit fairly easily in some places.

The antenna changeover relay, RL_1, Fig. 5, is a surplus item. Originally designed for 12-volt d.c. operation, it was rewound for 6 volts. Those contacts not required for antenna switching are wired to the octal power plug P_1 on the rear of the chassis and can be used to disable the receiver whenever the transmitter goes on the air.

Crystal control may be employed by plugging a crystal into the socket on the front panel and then tuning the v.f.o. dial slightly higher than the crystal frequency. The v.f.o.-crystal switch, S_1, should be thrown to crystal and the final then tuned in the normal manner. Since the setting of the v.f.o. dial has some effect on the crystal's frequency, the carrier can be "rubbered" a kilocycle or so when dodging QRM. On 20, 15, 11, and 10 meters, 40-meter crystals should be used, and for 80- and 40-meter operation, 160-meter crystals are required.

Since the crystal socket is wired in the hot portion of the oscillator grid circuit, whenever a crystal is in the socket, the v.f.o. frequency will be shifted slightly due to stray capacity effects. As a consequence, during v.f.o. operation it pays to remove the crystal from the socket.

This nuisance will be minimized if you can locate a BC-746A tuning unit. The socket from a BC-746A is designed to accommodate two crystals and can be wired so that only two of its four contacts are live. Then, when using the v.f.o., a crystal may be placed in the dead section of the socket for storage.

Both the final tuning condenser and the loading condenser have a rating of 140 $\mu\mu$fd. They, too, are salvaged from BC-746A tuning units. Since the plate voltage is not very high, no arcing difficulties should be experienced, despite the small plate spacing of these condensers.

After trying several different types of final coil switching, a method employed by W2AEF[1] was finally put to use. The coils are mounted at right angles to one another, and therefore little loss is introduced into the circuit as the coils are shorted when switching from one band to another.

The 20-meter coil, L_{10}, is tapped for 15-meter operation and the 80-meter coil, L_{15}, is tapped for 40 meters. No difficulty should be experienced in soldering a tap to L_{10}, but working with L_{15} may not be so easy because of the small spacing between turns. After choosing the proper location for the 40-meter tap, take a thin jackknife blade and push the adjacent turns aside far enough to allow room for easy soldering. Once the tap is in place, use the knife blade to readjust the position of any turns which may have been deformed by the previous operation. Make certain that there are no shorts between turns and then apply two or three coats of polystyrene coil dope to the area surrounding the tap. This will keep shorts from developing while the tapped coil is being wired in place.

Although the 10- and 20-meter final coils are self-supporting, the wire in the 80-meter one is not strong enough for this purpose. Therefore, two pieces of polystrene must be cemented between the latter coil and the terminal strips to which it is soldered in order to provide the required amount of support.

When wiring the final, be sure to keep all plate leads well removed from the grid circuit. Use the rear deck of the bandswitch for plate coil switching and be sure that the final grid circuit switching takes place at least two decks away. About the only other wiring precaution that need be observed is to make all bypass condenser leads as short as possible. If these steps are taken, no parasitic or fundamental oscillation problems should arise.

The transmitter can be aligned without difficulty, providing you have the proper test equipment at hand. An accurately calibrated receiver, a 100-kc. frequency standard, a grid dip oscillator covering all the bands from 160 through 10 meters, and a 0-5 ma. meter are "musts." Without these items you'll find yourself floundering helplessly, but if you have them, the job can be performed with a minimum of effort and wasted time.

First, switch to the 10-meter band and adjust C_{19} until the oscillator just hits 7 mc. with the plates of C_{18} fully meshed. The grid dip oscillator should be coupled to L_7 and the slug of this coil adjusted for resonance at 14.5 mc. L_7 should then be peaked at 29 mc. Tune C_{18} until the v.f.o.'s fourth harmonic falls on 29.1 mc. Peak L_1 and L_7 for maximum final grid current. Tune C_{18} to 28.9 mc. and repeak L_1, then tune to 29.3 mc. and repeak L_7. Grid current will then hold fairly constant from 28.6 mc. to 29.6 mc. It should be at least 2½ ma. over most of this range and shouldn't drop below 2 ma. at the extremes. If this is not the case, readjust L_1 and L_7 until optimum operation is achieved.

Throw S_1 to 11 meters and tune the v.f.o. to 6775 kc. Either compress or expand the turns of L_1 and L_8 until maximum final grid current is obtained.

15 meters is next. Adjust L_8 to approximately 7100 kc. by means of the dipper. Tune the v.f.o. to the same frequency and either squeeze or expand the turns of L_{13} for maximum deflection of the grid current meter.

On 20, tune the v.f.o. to 7100 kc. and peak L_{10} at 14,200 kc.

(*Continued on page* 101)

Fig. 6. Top view of the transmitter chassis. Parts placement is compact but not crowded. Note the right-angle mounting of the output coils, and Bakelite strips on the modulator choke.

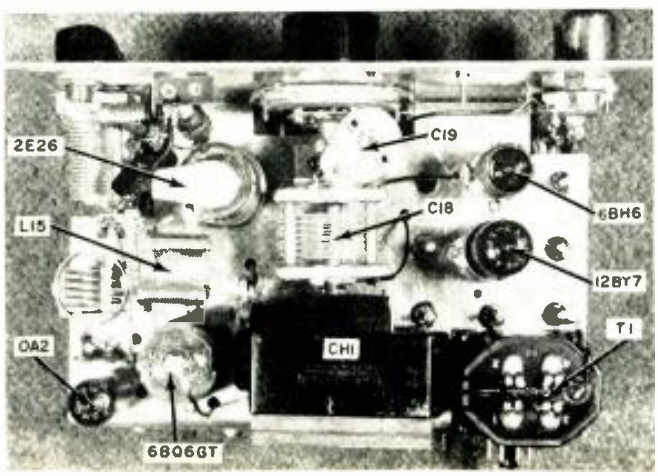
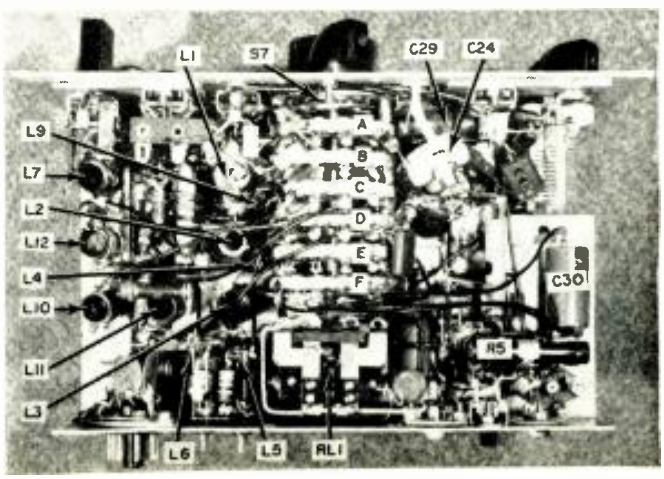


Fig. 7. Bottom view of the chassis. Slug-tuned coils are so arranged that adjacent units do not tune to same frequency, thereby minimizing interaction and aiding unit's stability.



U.H.F. TV CHANNELS

Pertinent frequencies and wavelengths for u.h.f. TV channels. Use this data to determine the element length for an antenna to receive ultra-high signals.

Channel No.	Frequency Range in mc.	Picture Carrier in mc.	Sound Carrier in mc.	Picture Carrier ¼ Wavelength in in.	Channel No.	Frequency Range in mc.	Picture Carrier in mc.	Sound Carrier in mc.	Picture Carrier ¼ Wavelength in in.
14	470-476	471.25	475.75	5.25	49	680-686	681.25	685.75	4.32
15	476-482	477.25	481.75	5.18	50	686-692	687.25	691.75	4.29
16	482-488	483.25	487.75	5.12	51	692-698	693.25	697.75	4.26
17	488-494	489.25	493.75	5.03	52	698-704	699.25	703.75	4.22
18	494-500	495.25	499.75	5.96	53	704-710	705.25	709.75	4.19
19	500-506	501.25	505.75	5.88	54	710-716	711.25	715.75	4.15
20	506-512	507.25	511.75	5.82	55	716-722	717.25	721.75	4.11
21	512-518	513.25	517.75	5.76	56	722-728	723.25	727.75	4.08
22	518-524	519.25	523.75	5.69	57	728-734	729.25	733.75	4.05
23	524-530	525.25	529.75	5.61	58	734-740	735.25	739.75	4.01
24	530-536	531.25	535.75	5.55	59	740-746	741.25	745.75	3.98
25	536-542	537.25	541.75	5.49	60	746-752	747.25	751.75	3.95
26	542-548	543.25	547.75	5.43	61	752-758	753.25	757.75	3.92
27	548-554	549.25	553.75	5.37	62	758-764	759.25	763.75	3.89
28	554-560	555.25	559.75	5.31	63	764-770	765.25	769.75	3.86
29	560-566	561.25	565.75	5.25	64	770-776	771.25	775.75	3.83
30	566-572	567.25	571.75	5.19	65	776-782	777.25	781.75	3.80
31	572-578	573.25	577.75	5.15	66	782-788	783.25	787.75	3.77
32	578-584	579.25	583.75	5.10	67	788-794	789.25	793.75	3.74
33	584-590	585.25	589.75	5.04	68	794-800	795.25	799.75	3.71
34	590-596	591.25	595.75	5.00	69	800-806	801.25	805.75	3.68
35	596-602	597.25	601.75	4.94	70	806-812	807.25	811.75	3.66
36	602-608	603.25	607.75	4.89	71	812-818	813.25	817.75	3.63
37	608-614	609.25	613.75	4.85	72	818-824	819.25	823.75	3.60
38	614-620	615.25	619.75	4.80	73	824-830	825.25	829.75	3.57
39	620-626	621.25	625.75	4.74	74	830-836	831.25	835.75	3.55
40	626-632	627.25	631.75	4.70	75	836-842	837.25	841.75	3.52
41	632-638	633.25	637.75	4.65	76	842-848	843.25	847.75	3.50
42	638-644	639.25	643.75	4.62	77	848-854	849.25	853.75	3.48
43	644-650	645.25	649.75	4.58	78	854-860	855.25	859.75	3.45
44	650-656	651.25	655.75	4.53	79	860-866	861.25	865.75	3.43
45	656-662	657.25	661.75	4.49	80	866-872	867.25	871.75	3.40
46	662-668	663.25	667.75	4.46	81	872-878	873.25	877.75	3.38
47	668-674	669.25	673.75	4.41	82	878-884	879.25	883.75	3.36
48	674-680	675.25	679.75	4.37	83	884-890	885.25	889.75	3.33

For the calculation of the wavelengths given above the following formula was used:

$$\text{¼ wavelength in inches} = \frac{2952}{\text{frequency in mc.}}$$

RECEIVER CHANGES TO IMPROVE FRINGE RECEPTION

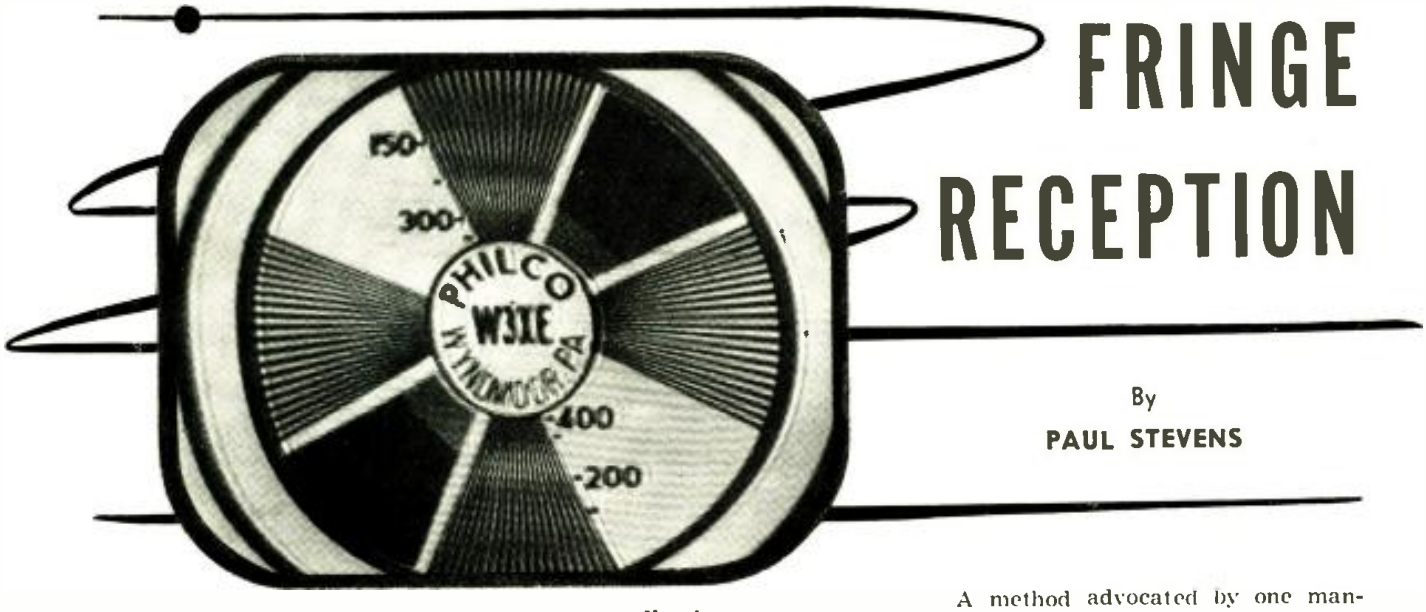


Fig. 1. Undesired regeneration in test pattern. Note how sections of the vertical wedge patterns are unduly intensified.

By
PAUL STEVENS

Part 2. Concluding article covers tube changes for greater sensitivity and other circuit alterations for fringe areas.

IN LAST month's article we considered some of the receiver changes that could be made to increase set sensitivity in fringe areas. We pointed out that, among other changes, the a.g.c. voltage could be reduced or eliminated if *all* signals coming in were weak. If medium-level or strong signals are received, as well as weak ones, more uniformly beneficial results may be obtained by removing the a.g.c. feed to the r.f. amplifier alone, leaving the controlled video i.f. stages as they were.

Such a procedure is particularly recommended when a booster is present. Normally, with the a.g.c. circuit left unchanged, the addition of a booster increases the a.g.c. voltage and lowers the gain of the r.f. amplifier, partially canceling the benefits provided by the booster. With the a.g.c. voltage removed from the r.f. amplifier, however, maximum benefits, *i.e.*, best reduction of "snow" and highest signal amplification, will be obtained from the booster.

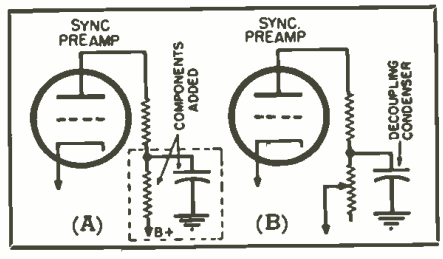
Another change that may be helpful is the replacement of the r.f. amplifier tube with a similar type having a higher gain. For instance, if a 6AG5 is used as the r.f. amplifier, a 6BC5 may be substituted. Similarly, tubes in other stages of the receiver affecting picture and/or sound may be replaced with more peppy types. Consulting a late edition of a good tube manual should supply the technician with ideas regarding possible tube changes.

While we are on the subject of tube changes, we should mention that poor pick up of weak signals may, in some instances, be due to a 6AL5 video detector. Some of these tubes, while they may perform well in other circuits, have too high a perveance and tend to change the i.f. response curve when employed as video detectors. Tubes put out by some manufacturers are more apt to suffer from this defect than those produced by others. Different-make 6AL5's should, therefore, be tried when tube-replacement checks are made as a test of the tube's output.

Raising the plate voltage of the r.f. amplifier by feeding it from a more positive tap in the low-voltage power supply may be feasible in some cases. Reception might be noticeably improved, if all incoming signals were weak.

In all cases where a change is made in the front end, a realignment of this section, of a kind described in the preceding article, is recommended.

Fig. 2. (A) Reducing the plate voltage of a sync preamplifier by inserting a decoupling resistor of suitable value in series with plate load resistor. (B) To find correct value of resistance, a pot may be connected as shown and varied experimentally.



A method advocated by one manufacturer (*Philco*) to boost set sensitivity in fringe areas involves the introduction of regeneration into the r.f. amplifier. A 20% increase in sensitivity on the upper channels, it is claimed, may be obtained in this way. The method is employed when a tube like the 6AG5, having two cathode pins, is used as the r.f. amplifier.

The tube is removed from its socket, and one of the cathode pins is clipped off. It is assumed that the socket's two cathode contacts are connected. If they aren't, and cathode circuit components are present at each contact, a short jumper should be run between them. The tuner is then realigned on the weakest (high-band) received channel. The theory behind the method is that the relatively high capacitance present between the suppressor and cathode elements in the r.f. amplifier, when one cathode is disconnected, provides a feedback path through which the video signal is regenerated.

The realignment should be carefully made, since it is critical. Set sensitivity will be highest on the channel on which the receiver has been aligned, and those channels adjacent to it. The method is, of course, recommended for use in fringe areas only since regeneration on medium- and high-level signals will markedly impair the fidelity of the picture, at best (see Fig. 1), and may lead to oscillation, at worst.

In some cases, increasing the screen-grid voltage on the video amplifier may produce a picture with better blacks. Increasing the plate load resistor of the video amplifier to, say, one and one-half or twice its original value may also effect an over-all improvement of the picture. That is to say, the greater contrast and better picture lighting gained will more than offset the less noticeable loss in high-frequency definition (good high-fre-

quency definition probably wasn't noticeable in the first place anyway, due to the excessive "snow" present). Similarly, the load resistor of the video detector may be considerably increased in value, to improve the overall picture quality. A reduction in the bias of the video amplifier may also produce quite beneficial results.

It is possible that the changes just described may impair the receiver's synchronization due to the sync clipping they may promote in the video amplifier. In such a case, the sync take-off point may be moved to the video detector (if the original take-off point is in the video amplifier circuit).

The change in take-off point may not produce happy results in noisy fringe locations, since a smaller sync signal will be fed to the sync stages when the sync take-off point is changed; also, the noise accompanying the sync signal will be worse, *i.e.*, greater, due to the elimination of the noise-clipping action generally provided in the video amplifier. If changes of the kind to be described improve the sync performance, the video stage changes may be left "as is." Otherwise, some gain-promoting changes will have to be sacrificed to restore sync performance to normal.

If the receiver is being operated in a very noisy fringe area, and a sync preamplifier with a negative-going signal input is present, reducing the plate voltage of the stage may provide better sync performance. Lowering the plate voltage will reduce the cut-off bias, that is, the bias necessary to produce cut-off, and thus more effective clipping of noise pulses that exceed weak negative signal peaks in amplitude will result. In other words, the tube will act more like a limiter. The desired reduction in plate voltage is achieved by adding a bypassed dropping resistor of suitable value in series with the plate load resistor (see Fig. 2). The bypass condenser may be .05 or .1 μfd. The resistor's value will have to be determined experimentally. A 100,000 ohm potentiometer may be used in place of the resistor. The pot is adjusted to a point where optimum results are noted in picture synchronization. Then its resistance at this setting is measured and a suitable resistor is added in place of the pot.

Vertical sync stability is frequently unsatisfactory in fringe areas. When incoming signals are *extremely weak*, the undesired symptom may be a continual roll of the picture. If the received channels are *weak*, but not as weak as in the preceding case, vertical slipping may affect a frame now and then, particularly when a strong noise pulse is getting through the integrator (Fig. 6).

A number of changes may be made to remedy this instability. One such change is to chop off one resistor in the integrator. Such a change is illustrated in Fig. 3. The .002 μfd. condenser is changed to .005 to compensate, in part, for the elimination of the resistor.

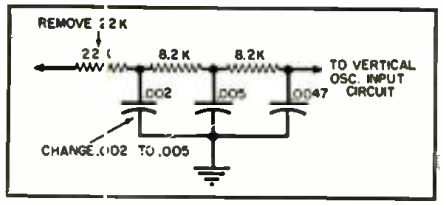


Fig. 3. In a Jackson Industries' receiver (as well as in other sets) vertical stability was improved by removing the 22,000 ohm resistor in the integrator and increasing first .002 μfd. condenser to .005 μfd.

The vertical sync pulse amplitude at the output of the integrator will now be larger, at the expense of an impairment in the discrimination of the integrator against horizontal sync pulses. Horizontal sync pulses will, in other words, be able to charge up the integrator to a greater extent than formerly. Since the horizontal sync pulses are weak (in fringe areas) no impairment of interlace is likely to result.

Another change that may be tried (in place of the one just suggested) is to increase the amplitude of the vertical sync signal applied to the sync separator by changing the values of the components in the voltage divider input circuit of the separator. In a circuit like the one shown in Fig. 4, for example, the series resistor may be reduced from 47,000 ohms to 10,000 ohms, and the coupling condenser increased from 220 μμfd. to .001 μfd., reducing the loss in vertical sync signal across these components and increasing the input across the grid resistor. The grid resistor in this case is reduced in value from 10 megohms to 1.5 megohms, to prevent an excessive horizontal sync input to the separator, and also to keep the vertical sync input correct in size. The addition of a small condenser, approximately 47 μμfd. in size, will further aid in keeping the horizontal sync input from being too large in amplitude. Similar changes may be made in other circuits, exact values of components used depending on the results of experimental substitutions.

The changes described will alter the frequency response characteristic of the video amplifier. Possibly smearing may result. The smear will, however, generally be masked by the excessive noise signal present so that, from the standpoint of over-all picture quality, an improvement may be noticed.

In another method used to improve

(*Continued on page* 141)

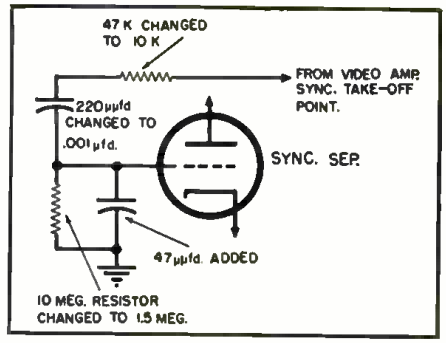


Fig. 4. Increasing the vertical sync input to sync separator to improve vertical hold.

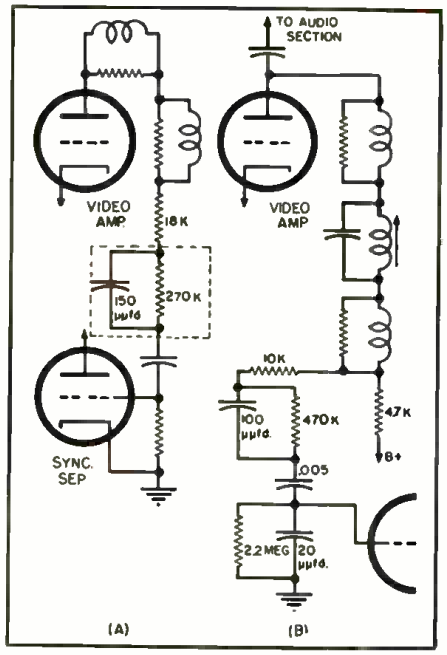


Fig. 5. (A) Inserting a noise filter (dotted box) in series with sync separator input to reject noise and improve vertical stability. Circuit shown is from Admiral 21 series. The 18,000 ohm resistor was originally an 8200 ohm unit. The new value reduces the impairment of high-frequency response in the video amplifier. (B) Noise filter insertion in the Motorola TS-89, TS-94, and TS-95 chassis. The 100 μμfd. and 20 μμfd. condensers and the 470,000 ohm resistor were added. See text.

Fig. 6. Vertical slipping. Retrace lines indicate that blanking pulse amplitude has decreased, probably due to increased a.g.c.

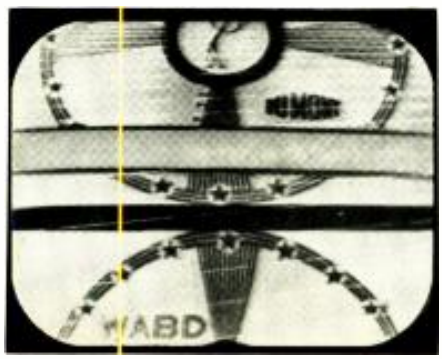
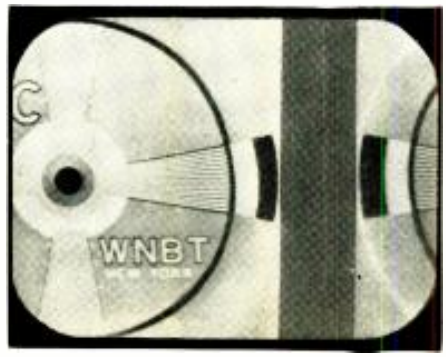
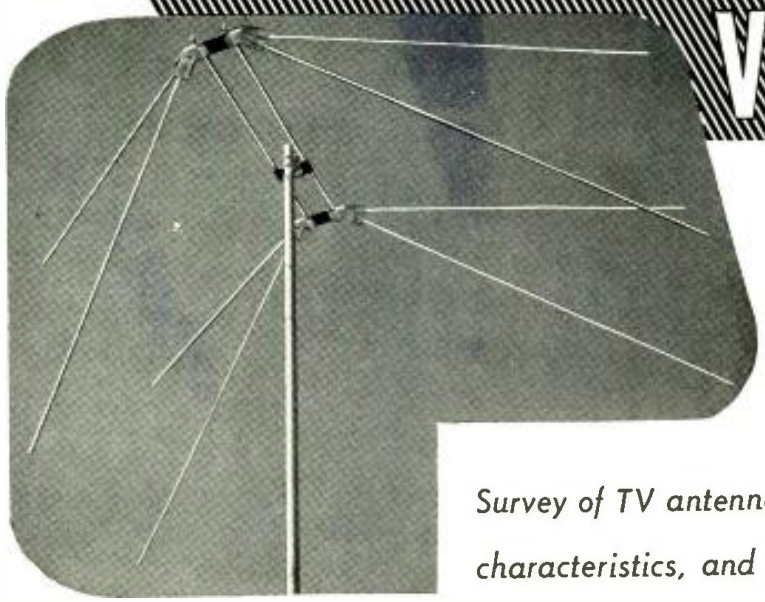


Fig. 7. An example of the type of pattern obtained when the picture is incorrectly phased in the horizontal direction.



V.H.F. FRINGE



By

WALTER H. BUCHSBAUM

Television Consultant

RADIO & TELEVISION NEWS

Survey of TV antennas designed for use in fringe areas; theory, characteristics, and applications for each type are discussed.

Fig. 1. Conical "V" antenna.

THERE are so many new and different types of antennas on the market today that their variety itself creates confusion and makes a choice difficult. In addition, each manufacturer claims special features, extra sensitivity, broader bandpass, better impedance match, etc. It would be impossible to describe or discuss all types here and, anyway, most service technicians are acquainted with the basic types of antennas such as the dipole, folded dipole, conical, "V", and yagi. This article covers only antennas suitable for fringe areas or difficult terrain. Each of the models described has some unique feature, different from the basic types, with a special application in the field. Such features as price, quick assembly, or mechanical construction are not considered here; we will concern ourselves only with the electrical characteristics. Most of these antennas are available from several manufacturers and most jobbers.

Antenna Features

Before citing specific antenna designs, let us examine the various desirable features for fringe area operation. First and foremost is the gain requirement which the word "fringe" itself implies. The gain of an antenna is usually expressed in db and is correctly called "apparent gain" because the antenna is really a passive element and does not increase the signal by amplification. This apparent gain is obtained by comparing the signal picked up by a single dipole, open or folded, tuned to the received channel, with the amount of signal picked up by the antenna under test at the same channel. Actual gain measurements can be made in a variety of ways, each yielding slightly different results. In general, however, any antenna used for fringe reception should have at least 6 to 10 db apparent gain. One method frequently relied upon to increase gain is stacking. This means increasing the number of antennas and matching them to obtain more signal. It is a common misconception that stacking doubles the gain. There is a definite increase, but it is less than 6 db, and the bandwidth of the antenna is invariably reduced.

Bandwidth refers to the gain of the antenna at different channels. The broader the bandwidth, the more equal will the gain be over several channels. Where only a single channel is received, a narrow-band antenna will be satisfactory, but where channels at widely separated frequencies are received, either a broadband antenna or several antennas are required.

Directivity is another important feature in fringe installations. This refers to the antenna's ability to receive signals only from one narrowly defined direction. In many fringe locations this is desirable because it helps reduce ghosts due to reflected waves and also because good directivity usually means high gain. Where several stations are to be received from more than one direction, separate antennas can be employed, or, in some cases, an antenna with a wider reception beam can be used. Another solution is the use of antenna rotating devices.

Impedance match is another important consideration. While mismatch at the antenna between the antenna and lead-in line impedances cannot cause reflections on the line and therefore cannot produce ghosts, it does result in a loss of signal. Thus, impedance match is usually directly related to the apparent gain of an antenna and deserves some consideration in fringe areas where every bit of signal power is needed.

Unfortunately, it is impossible to obtain a large degree of gain, directivity, broad bandwidth, and perfect impedance match in any one antenna. Instead, some types have good directivity and gain, usually coupled with narrow bandwidth, or fair gain and bandwidth but poor directivity, etc. As in every other field, perfection is quite unattainable. The best a service technician can do is to select a good compromise of required features for a particular locality and reception conditions.

"V" Types

"V"-type antennas have several unique features. Their relative gain is fairly good on the high channels where, in many areas, the signal is weakest. Most manufacturers agree that a gain of about 8 to 10 db on Channels 7 to 13 can be expected from a double-"V" stacking arrangement like the one in Fig. 4. On the lower TV channels the gain ranges from 2 db for Channel 2 to 6 db for Channel 6. The directivity of a "V" type also varies greatly with frequency. At the low channels a fairly wide beam and some rear and side reception can be expected, but on the high band the directivity increases and much less rear or side reception occurs. Impedance matching to 300-ohm twinlead presents no problem as a fairly good match occurs over most of the TV band.

One of the many variations of the original "V" type is shown in Fig. 1. This incorporates some of the broadband features of a conical with some of the gain and directivity of the "V"-type. By making the matching bars shorter and lengthening the elements the gain on the low channels has been increased somewhat. Directivity as well as gain, however, are still much better on the high band although impedance match is satisfactory over all channels.

Conicals

Conical antennas are popular for normal signal strength areas because of their broadband characteristics and fairly good gain. For fringe area use

ANTENNAS

conicals are usually stacked two or four bays. A typical two-stacked array is shown in Fig. 5. Especially important in such an installation are the stacking bars and their spacing so as to obtain the correct 300-ohm impedance. The single conical antenna has good impedance match, but, by stacking, the impedances change and therefore a matching arrangement is essential. The directivity of such an array is usually much less defined on the low than on the high channels. In addition, there is a tendency at the high band to develop a very narrow front reception angle and several side or back lobes.

Some improvement in high-band reception is obtained by adding a short third element to the cone and a short reflector, as shown in Fig. 3A. This increases the gain at the highest channels without otherwise materially altering the performance. A further improvement on high channels is obtained by adding, in effect, a separate high-band element in front of the conical. Fig. 3B shows this variation of the conical antenna. This additional element is a director such as is used on a yagi antenna, cut and spaced to increase the apparent gain at the high channels. Directivity on the lower channels is unchanged, but on the high band this director tends to reduce side and rear reception considerably.

Summing up the characteristics of conical antennas it appears that they are especially useful in areas receiving stations of equal strength in the high and low bands. Their directivity varies somewhat with frequency, but, with minor exceptions, side or rear pick-up is negligible. Stacked conicals require properly spaced stacking bars for best impedance match. The gain of a double stacked conical array ranges between 5 and 8 db over the entire band and for a quadruple stacked arrangement anywhere from 9 to 14 db can be expected.

Yagis

While the basic yagi antenna is not new, the latest type of yagi does represent a distinct improvement, for some locations. This new version of the yagi is usually called a "broadband" yagi although it does not cover all TV channels equally well, being designed usually only for 3 or 4 adjacent channels. The main features of the original yagi design were extremely narrow forward beam with practically no side or rear lobes and rather high gain. Unfortunately, this was a very narrow-band antenna with usually not even equal gain over the full 6 mc. of a single low-band channel. Another drawback was the rather low impedance of that antenna, requiring special matching stubs at the antenna terminals. Fig. 7 shows a typical single-channel yagi with the folded dipole consisting of two different size tubes. The result is a change from the normally low impedance to approximately 300 ohms which then matches the line and receiver. Another scheme for matching the impedance of a yagi to a 300-ohm transmission line uses a matching transformer such as the one shown in Fig. 2B. This transformer is especially useful when yagis are stacked (as in Fig. 2A) since the antenna impedance gets lower as the number of stacked elements increases.

To obtain the high gain and directivity of a yagi and still get more than one channel reception, one type of new, broadband yagi uses two driven elements, tuned to different channels and located a fraction of a wavelength apart. Fig. 6 shows a

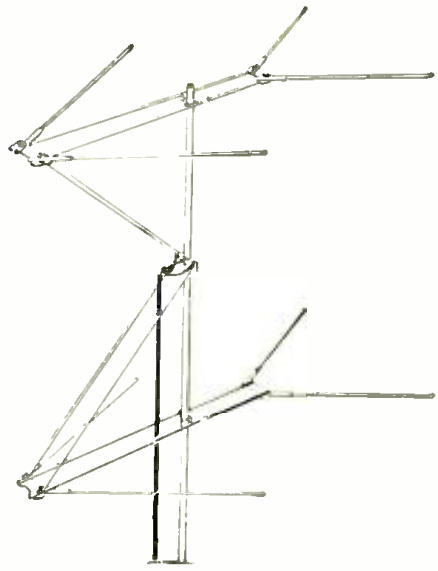


Fig. 4. Stacked "V" antenna.

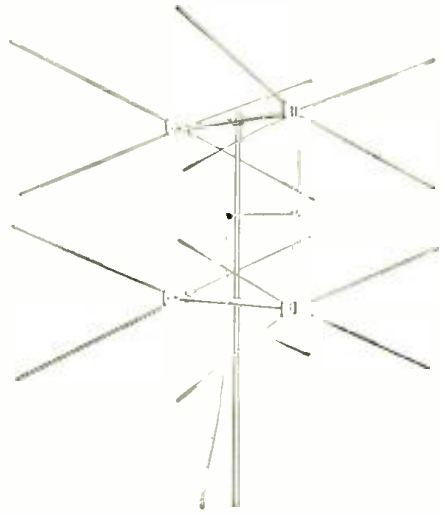


Fig. 5. Conicals joined with stacking bars.

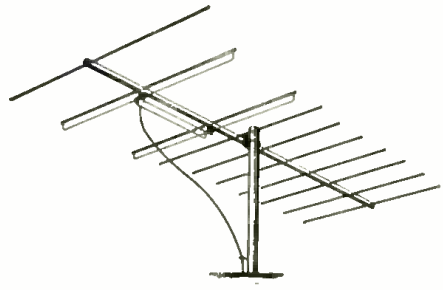


Fig. 6. Broadband, 300-ohm yagi.

Fig. 7. Single band, 300-ohm yagi.

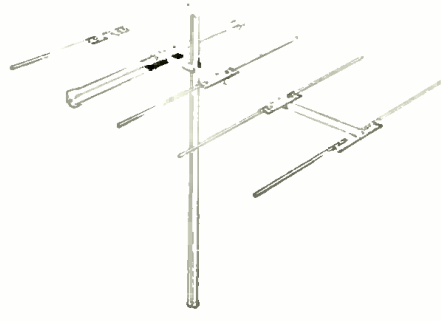


Fig. 2. (A) Stacked yagis. (B) Matching transformer used with stacked yagis.

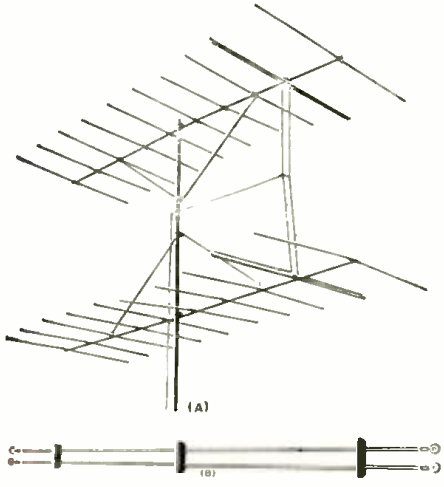
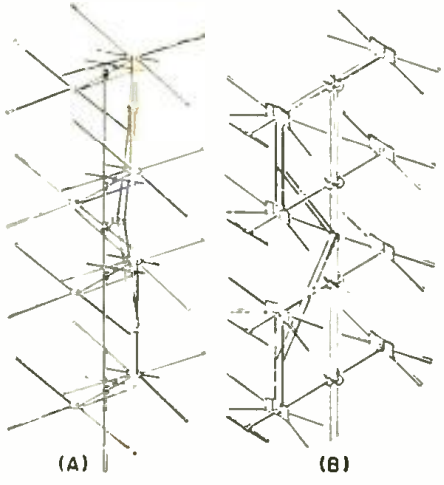


Fig. 3. Two types of stacked conicals. Both have added elements for high band.



typical broadband arrangement covering Channels 4 and 5. By changing the length of the directors, reflector, and driven elements it is possible to cover other channels. As mentioned before, each driven element is made up of two different thicknesses of tubing, spaced and centered to get 300-ohm impedance match.

A somewhat different approach to the broadband yagi depends on spacing and transposed transmission line between the two driven elements for good gain and impedance match. This results in yagi performance over as much as four low-band channels with fairly constant gain.

The characteristics of the yagi antenna show that its main advantages are in apparent gain and narrow reception angle. Its relatively narrow bandwidth makes it usable only for a few stations at best, and because of its directivity it is only useful when all the desired stations lie in the same direction. One feature which is sometimes desirable is the fact that it has very little side and rear pick-up and unwanted reflected signals can therefore be eliminated. The gain of a single yagi can be expected to range between 8 and 10 db with approximately 2 db increase for each additional unit in a stacked array. Unless special means are included to provide a 300-ohm impedance match, matching stubs must be used. The author once measured impedances of classic 3-, 5-, and 10-element yagis and found them to range from 26 to 8 ohms and all the way to 1.8 ohms for a 5 element double stacked array. This clearly shows that unless proper impedance match is obtained at the antenna, the loss in power transfer can completely cancel the apparent gain of the antenna.

Fig. 8. Zig-zag antenna.

Fig. 9. Colinear array.

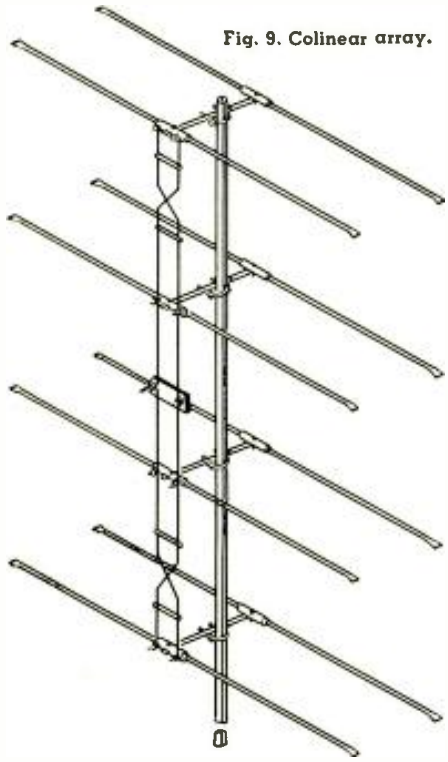
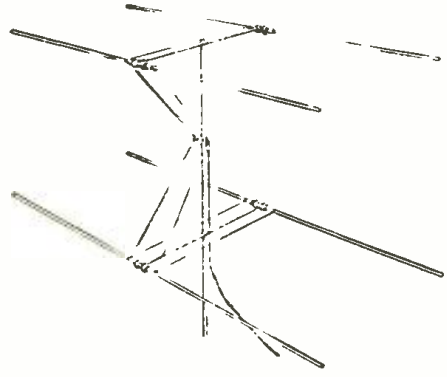


Fig. 10. Driven reflector (quadrature dipole) array.



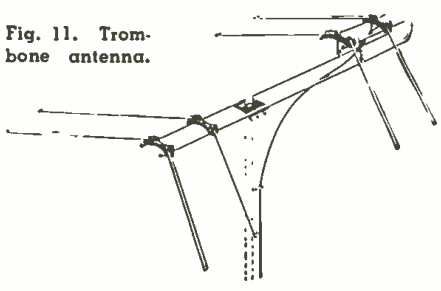
Special Antenna Design

In addition to the antenna types described, certain manufacturers have developed still different varieties. Because their use often is indicated by local conditions and because of their special features we shall here describe some of the most recent types.

Zig-zag antenna: Shown in Fig. 8, this antenna consists basically of a dipole and a series of parasitic elements. The length of the various elements will determine the bandwidth and directivity of the entire unit. The particular model shown in Fig. 8 is capable of gains similar to a broadband yagi, but its directivity is not as sharp. Stacking to achieve more gain is not recommended, rather, the gain depends on the total number of elements used. Stacking is used, however, to connect high- and low-band arrays together. An impedance of 300 ohms is obtained by locating the transmission line connection at the proper distance from the center of the dipole elements.

Colinear array: Where very high gain is required on a single channel and fairly good reception on several others, the antenna array shown in Fig. 9 will fill the need nicely. Depending on the phasing and length of harness of the four stacked dipoles and their reflectors, apparent gains up to 15 db can be obtained for a single channel in the high band. The gain and impedance match as well as directivity on the other high-band channels are not as high and an average of about 6 db gain prevails in the low band.

Fig. 11. Trombone antenna.



Trombone antenna: An extension of the "V"-type antenna is found in the type shown in Fig. 11. Effectively, the antenna contains four driven elements, tuned to the high portion of the low band, as well as the high band. Gains of this antenna vary greatly with frequency with the highest gain of 8 db around Channel 10. One novel feature of this antenna is its good performance on some u.h.f. stations. This is due to the fact that the major elements are a multiple wavelength at those frequencies. Directivity of the trombone antenna is quite good and its 300-ohm impedance matches regular twin-lead without difficulty.

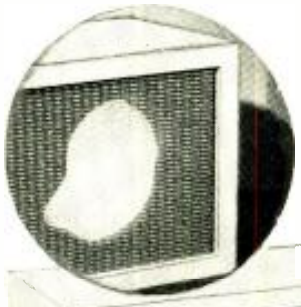
Quadrature dipoles: Shown in Fig. 10 is a broadband, high-gain antenna providing good directivity and impedance match at all low channels. The unusual feature of this array is the fact that the reflector elements are not passive, but are connected to the colinear dipoles. This greatly increases the gain of the system. The upper dipole and reflector are tuned to the high end of the band, while the lower resonates near Channel 2, providing the required broadband response. Directivity of this arrangement approaches that of a yagi, and further gain can be obtained by stacking several bays. Stacking bars, tuned and located for 300-ohm impedance, are used to match the antenna to the line.

Electronic beam rotation: Most readers are familiar with the use of rotating motors to orient antennas where weak signals are received from different directions. In most of these installations the antenna has a very narrow reception angle and is rotated accurately for best pictures. Occasionally it is found that reception from different directions does not require such a narrow angle, especially when no reflected or interfering signals appear from side or rear locations. For such installations an electronically rotated antenna, one example of which is shown in Fig. 12, can be used. Basically a conical antenna, this unit features three conical parts displaced by 120 degrees, each connected by a separate line to a switch at the receiver. This permits the viewer to select any two parts as his conical antenna. Broadband reception with good gain on all channels and good impedance match are usual features of conicals and this type is no exception. One feature of this

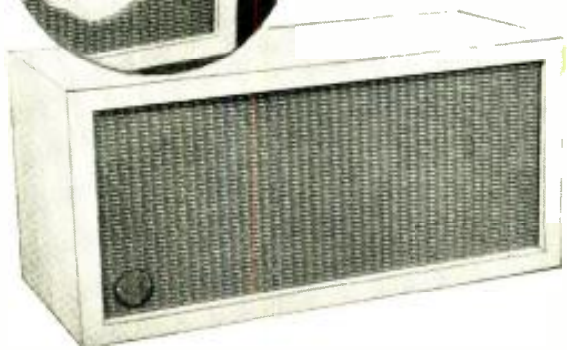
(*Continued on page* 137)

THE R·J SPEAKER ENCLOSURE

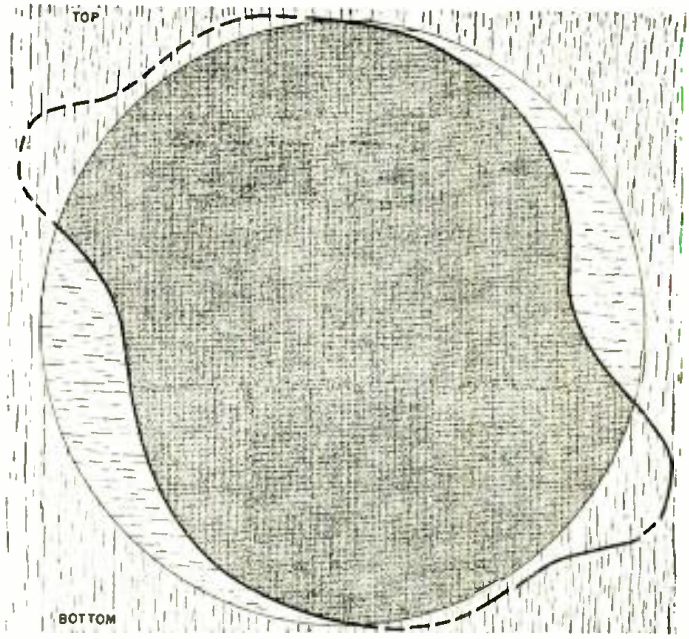
Design details on a very popular speaker enclosure. Considering its low cost and small size, it provides remarkable results. Obviously, the more expensive, larger enclosures perform better.

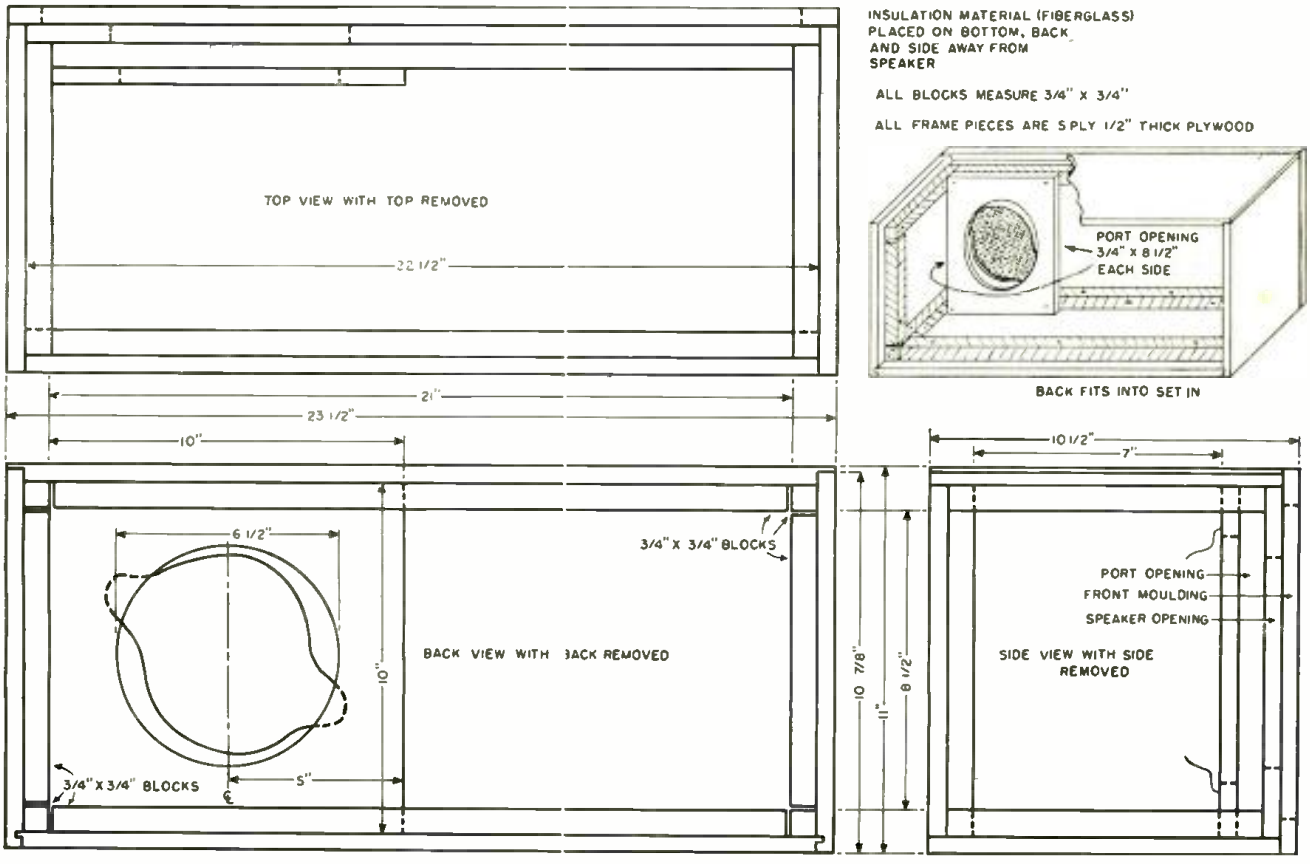


Close-up view of speaker opening. In taking photo a light was placed inside cabinet to show the contour of speaker opening

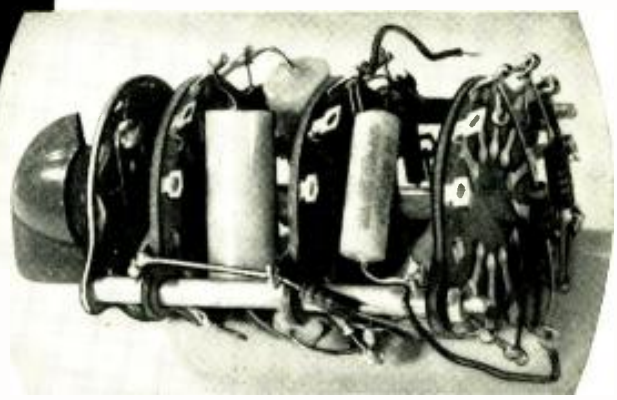


Over-all view of speaker enclosure. To the right is shown contour of speaker opening as viewed from back of cabinet. Circular opening is 6½" dia. In the close-up view above the opening is somewhat distorted because of photo angle.





NEW DEVELOPMENTS IN PHONO EQUALIZERS



Equalizers mounted on three-gang switch. See Fig. 4.

By CHARLES P. BOEGLI
Cincinnati Research Company

New and revised data covering equalizers designed to be used with all of the commercially-available phono discs.

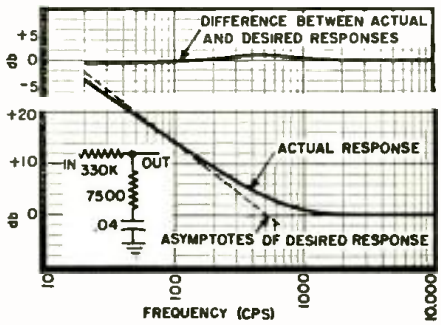
FOR the past several years a series of articles dealing with the design of equalizers for high-fidelity phonographs has appeared in RADIO & TELEVISION NEWS (References 1, 2, 3, 4). At the beginning, this work was complicated by the lack of detailed knowledge regarding the recording characteristics employed by the various companies, and much reliance had to be placed upon secondary sources of information and upon "ear" tests. While the writer has always recognized that the latter forms a very flimsy basis for equalizer design (or, for that matter, for any audio equipment design) the assumption was always made that secondary sources of information could be considered fairly reliable. It has been quite distressing to learn that this is not always the case, and that in spite of considerable effort, errors have appeared in previous tables.

Since the appearance of the last table, therefore, a great deal of work has been done in approaching the various record manufacturers directly for data on recording characteristics used not only at present, but also in the past. The cooperation extended by some concerns (notably *RCA Victor*) has been gratifying; others have been quite slow in replying to inquiries, and a third class has unfortunately chosen to ignore the letters addressed to them. The attitude of this last group makes the task of equalizer design particularly thankless.

The present table is based upon the best data now available to the writer.

With the exception of the "flat" equalizers, the circuits shown in the table actually comprise two sections;

Fig. 1. Design and performance of a flat, 500 cycle-per-second equalizer circuit.



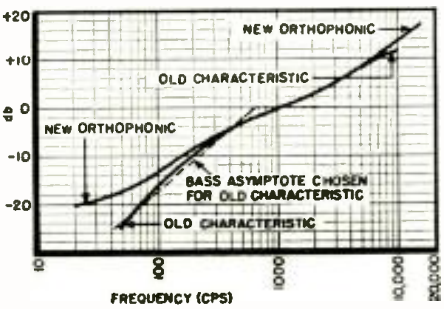


Fig. 2. Characteristics used by RCA Victor for records at all three speeds.

the first compensates for the bass turnover and the second for the treble pre-emphasis. Now, the bass characteristic in most recordings takes the form of a "turnover" at 500, 400, or 250 cps below which the velocities are attenuated at the rate of 6 db-per-octave. This bass drop may continue to the lowest frequencies recorded or there may be another turnover at 50 or 100 cps below which the attenuation ceases. A single-stage equalizer to correct fully for a 6 db-per-octave bass slope can only be made at the cost of almost infinite attenuation of high frequencies. It is consequently necessary to accept a certain amount of undercorrection; with a high-frequency attenuation of 33 db, which is probably as high as desirable, a slope of 5.75 db-per-octave can be attained.

If a circuit providing 5.75 db-per-octave of bass emphasis has its turnover at 500 cps, there will of course be a residual bass drop amounting to about 1 db at 30 cps when this equalizer is being used with the disc for which it was designed. A number of persons consider it desirable to avoid bass drop whenever possible, and this objective can be attained by designing the equalizer for a turnover of approximately 550 cps instead of 500 cps; the greater part of the difference between the actual and ideal performance then occurs around 500 cps where it is probably less objectionable. Fig. 1, the curves for a "flat" 500-cps equalizer, shows the response obtained with the circuit modified in this manner. With an 0.1 μfd. input condenser and an output shunt resistance of 1.0 megohm, the circuit shown will have the correct response ± 1 db down to less than 10 cps. Of course, a full 6 db-per-octave correction can be obtained with a two-section bass equalizer but such circuits have certain disadvantages of their own (Reference 2).

High-impedance circuits have an unfortunate tendency to pick up hum and noise from stray fields; it has been quite noticeable with previous designs which have used quite large (approximately 1.5-megohm) input resistors. This is the reason for lowering the impedance of all the equalizers, which is evidenced by a reduction in resistor values and a corresponding increase in condenser sizes. The modification has been carried out so that condensers of commercially-available sizes can be used; in many cases the employment of resistors that do not appear in the RTMA 10% tolerance series is thus necessitated. Since most enthusiasts have been constructing their equalizers with 5% resistors, however, this is not considered a serious objection. There is a further advantage in the reduction of impedance: the input capacitance of the tube following the equalizer is now quite neglegible in its effect on the treble response.

Beside the changes just noted, individual features of certain equalizers should be stressed:

Flat 250 cps: This equalizer is to be used with *HMV* and English *Columbia* 78-rpm discs, which are both manufactured by *Electrical and Musical Industries, Ltd.* Although the literature supplied by this company indicates that the characteristic is flat above 250 cps, discs played with such an equalizer generally sound somewhat shrill. This probably can be attributed to the type of microphone used in recording, which introduces a noticeable resonant peak in the upper frequency ranges. It has been found that the introduction of a shunt condenser across the equalizer, causing

a drop of 6 db-per-octave above 5500 cps, results in reproduction more nearly approximating that of American discs played with their proper equalizers and also effects a slight reduction in the scratch level. The condenser may be included or eliminated at the discretion of the constructor; its inclusion is especially advantageous if a simplified switching system suggested by Osmundsen (Reference 5) and described later is to be used.

This equalizer is probably the proper one to use with other discs of British origin but the remarks relative to the microphones may not apply and there may be a slight reduction in treble response. The *HMV* long-playing discs being pressed in this country by *RCA Victor* should not be played through this equalizer because they are processed here from tapes recorded in England, and hence have the *RCA Victor* characteristic.

Flat 500 cps: This characteristic was used by many American companies prior to the war, and seems to have been employed by most European companies as late as 1950. In most cases the inclusion of the same shunt condenser used in the 250-cps equalizer results in a reduced scratch level with no appreciable effect on frequency response, since little was recorded of high frequencies when the characteristic was used.

Capitol-Telefunken discs appear to have been made without altering the characteristic of the original recording and should probably be played through this equalizer. The curve used by *Concert Hall* is compensated closely by this equalizer if the shunt condenser is included.

NARTB (formerly NAB): It has been found that the NARTB curve provides for a point at low frequency at which bass attenuation ceases; the maximum bass attenuation is 16 db. The transition is quite sharp; much sharper than can be compensated by a single *RC* filter. Some approximation is therefore necessary if a simple equalizer is to be used; if such a circuit is employed giving a transition point at 60 cps, the reproduction will be reasonably accurate at very low frequencies (there will be about 1 db too much bass at 40 cps). The 68,000 ohm shunt in the equalizer provides the desired curve; it was not included in previous tables.

RCA Victor: Owing to various factors, enumeration of which would serve no useful purpose here, the situation with regard to the *RCA Victor* characteristic has been quite confused for the past several years. As a matter of fact, the previously-published table was also in error regarding the curves. That Fig. 2 represents the two recording characteristics employed by *RCA Victor* at least since 1939 (exclusive of low- and high-pass filters that have at times been used) has been verified by that company. The "New Orthophonic" curve has been well defined by *RCA Victor;* for the purpose of designing an equalizer for the older characteristic a set of bass asymptotes has been chosen as shown in the figure, and it will be seen that these asymptotes lie well within the tolerances specified by the company.

FFRR: When *Decca* FFRR 78-rpm records were first introduced in this country, their characteristic was published (Reference 6); it consisted in a bass turnover at 400 cps and a treble emphasis of 3 db-per-octave beginning at 3000 cps Later, *Decca* FFRR records were withdrawn from the American market and replaced by *London* FFRR, which would be presumed to have the same characteristic. Still later *London* FFRR 33.3-rpm discs were issued, and at this time the characteristic was reported to be the standard NARTB curve (Reference 7). Recent communication with the *London Gramophone Corporation* seems to indicate that this last reference

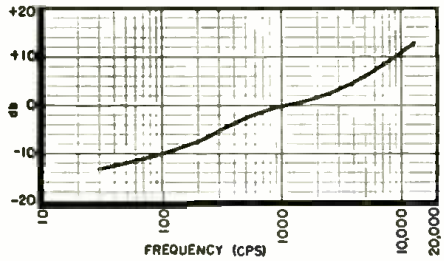


Fig. 3. London FFRR characteristic.

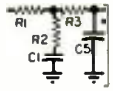
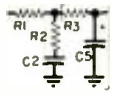
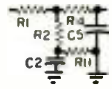
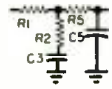
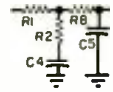
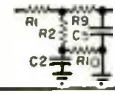
was in error, for the curve which this company supplied is shown in Fig. 3. The "*London* FFRR" equalizer corrects this characteristic. In the event an equalizer for the older FFRR 78-rpm records is desired, it can be constructed following the circuit under "*Decca* FFRR".

Switching Arrangements

In the earliest preamplifiers using

EQUALIZER TABLE FOR PHONOGRAPHS

(Gain of each equalizer at 1000 cps = .022)

EQUALIZER	CIRCUIT	COMPENSATION FOR
(A) Flat 250 cps		HMV 78, English Columbia 78, other English discs (3), Cetra-Soria 78
(B) Flat 500 cps		Most European to 1950, Early American except Victor, Capitol-Telefunken (3), Concert Hall 78 and 33.3 (4)
(C) NARTB (formerly NAB)		MGM (2), Artist, Westminster (5), Tempo 33.3 (6)
(D) Columbia 33.3		HMV 33.3 pressed in England, Columbia LP, Vanguard, Bach Guild, Cetra-Soria 33.3, Vox
(E) Columbia 78		Columbia 78 (1)
(F) AES		Mercury (recent), Capitol, Decca (2), Westminster (5)
(G) London FFRR		London FFRR 33.3 and 45
(H) Decca FFRR		Decca FFRR 78 (1)
(I) RCA Victor		Older RCA Victor, all speeds
(J) RCA Victor New Ortho.		New RCA Victor, all speeds, incl. USA-pressed HMV 33.3

*See text

All data obtained from manufacturers except as noted:
1. Obtained from secondary sources but considered reliable
2. Obtained from secondary sources of unknown reliability
3. Assumed
4. Approximate only, if second section is included
5. As marked on record envelope
6. Approximate.

The following companies failed to reply to inquiries: Decca, Remington, Urania, MGM, American Recording Society

R_1 330,000 ohm	R_5 24,000 ohm	R_9 30,000 ohm	R_{13} 68,000 ohm	C_1 .03 μfd.
R_2 7500 ohm	R_6 20,000 ohm	R_{10} 82,000 ohm	C_1 .08 μfd.	C_5 .002 μfd.
R_3 6800 ohm	R_7 2700 ohm	R_{11} 39,000 ohm	C_2 .04 μfd.	
R_4 43,000 ohm	R_8 27,000 ohm	R_{12} 5100 ohm	C_3 .05 μfd.	

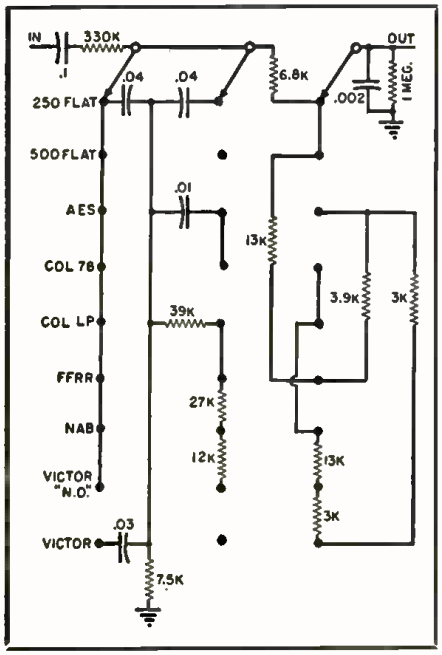


Fig. 4. Equalizers on a three-gang switch.

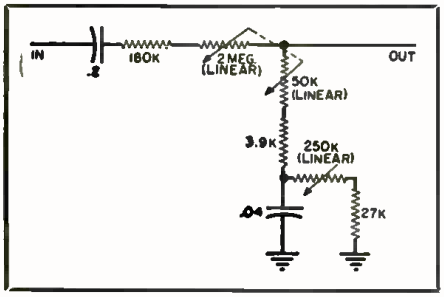


Fig. 5. Circuit to provide bass tone control.

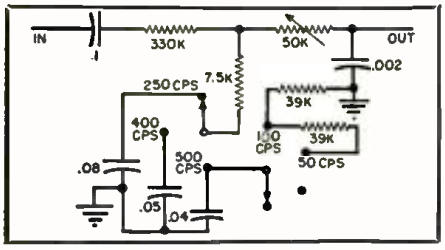


Fig. 6. Simplified bass tone control circuit.

equalizers of the types described, the individual equalizers were completely self-contained and a switch was provided for inserting them one-by-one into the circuit. This system offers the advantage that the removal and subsitution of equalizers can be carried out quite easily without disturbing other parts of the circuit. Furthermore, the equalizers may be potted in some suitable compound to eliminate the effect of humidity upon their characteristics.

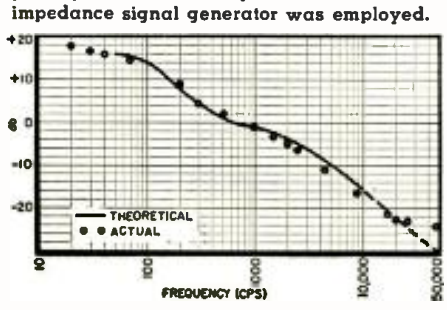
As the simple equalizer-preamplifier utilizing no feedback became more and more widely accepted, it became evident that of the various possible equalizers, certain ones were used far more often than others, and Osmundsen (Reference 5) developed a simple switching arrangement for the most widely-used circuits, which resulted in a considerable reduction in the number of resistors and condensers required. The equalizers covered in this article were designed to be arranged easily in this manner; Fig. 4 shows how it is done.

A third arrangement consists in continuously-variable controls for bass and treble characteristics. Most recording curves are adequately described by three pieces of information, namely, the bass turnover, the point at which bass attenuation stops, and the frequency at which treble accentuation starts. A minimum of three controls is thus required. Variable condensers of the required sizes are difficult to obtain, so the variation in characteristics must be obtained with potentiometers; Fig. 5 shows the circuit for bass control. As the turnover point is adjusted, the output impedance of the bass equalizer also varies (the attenuation remains constant) and it is consequently impossible to provide treble correction by means of a simple second section. With magnetic cartridges, the best way to control the frequency at which treble attenuation begins is to shunt the pickup itself with a suitable potentiometer. For a 500 mhy. cartridge the best value is 50,000 ohms, and for cartridges of other inductances the value will be directly proportional to the inductance. The controls can be calibrated, if desired, either with a signal generator and v.t.v.m. or by computing the desired resistance for various characteristics and finding at what point of rotation the controls provide this resistance.

Lastly, separate switches can be used to control the desired characteristics. The circuit of Fig. 5 may be arranged with fixed resistors and tap switches, but another simpler arrangement is shown in Fig. 6. The performance of this circuit is better than the other but there is no control of the point at which bass boost ceases except for the 500-cps turnover position. This is, however, adequate for all modern pressings.

The number of possible combinations with the last systems is quite large, so that if a new characteristic is utilized in the future by some record manufacturer (which, alas, is all too probable) the chances of being able to handle it adequately with present facilities are increased. These types of controls are also ideally suited to an individual who believes that his own ear is a better basis for equalizer selection than a set of instruments, in which class the writer is definitely not numbered. Here are combinations enough to suit the most ardent "fiddler."

Fig. 7. Response of a complete two-stage preamplifier on NARTB position. A 500 ohm impedance signal generator was employed.



Construction and Performance

The accuracy of the response of the equalizers is related to the quality of the condensers and resistors of which they are constructed. The accuracy of the 330,000 ohm input and 1-megohm output resistors is not critical but the remaining resistors should be ½-watt, 5% units. Generally, no other precautions need be taken in the selection of resistors. With condensers, unfortunately, the picture is not so rosy. The tolerances of some commercial paper coupling units are +40%, −20%; such condensers are obviously much too inaccurate for equalizer construction. Furthermore, most condenser manufacturers seem somewhat reluctant to state the tolerances of their paper units. The writer has found that *Sprague* 6TM "Black Beauty" condensers seem to have capacities that agree more closely with their nominal values than most other makes, although even here it is desirable to check values if at all possible. There certainly seems to be a need for reasonably-priced precision paper condensers, in a series of values consistent with their accuracy.

For all the equalizers shown in the table, a 0.1 μfd. input condenser will permit bass response within 1 db to below 10 cps. The outputs should be shunted by a resistor no smaller than 1 megohm. The performance of the equalizers was tested in conjunction with the simple preamplifier circuit of Reference 2, and Fig. 7 shows the result in the NARTB position. The internal impedance of the signal generator was 500 ohms and output was measured with a v.t.v.m. Evidently, the response is very close to the calculated value except for a rise amounting to 3 db at 35 kc.; the reason for this rise is unknown. When the preamplifier is used in conjunction with a pickup and ordinary amplifier the over-all response will certainly not show this rise.

Whether bass response to below 10 cps is desirable or not is a question beyond the scope of this article, since high-pass filters are more properly applied at other points in the amplifying circuit than in the equalizers. Certainly tone-arm resonance may become a serious factor at very low frequencies; there are also such phenomena as eccentricities and bumps in discs that, although inaudible, may actually overload a high-quality reproducer and result in serious distortion of audible frequencies unless a sharp cut-off is provided at some low frequency.

Conclusion

Some months ago it appeared that the equalizer situation was becoming simpler, that is, that fewer and fewer

(*Continued on page* 103)

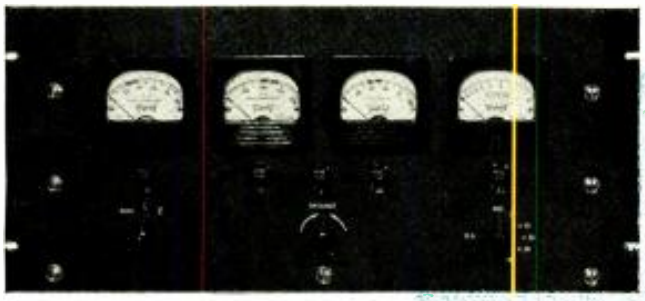


Fig. 1. (Left) Front panel view of the modified Childs' amplifier. (Below) Front view of the power supply unit.

MODIFIED CHILDS' AMPLIFIER-POWER SUPPLY

By

EDWIN C. LOOMIS

Improved version of a 30-watt amplifier which features maximum power handling with minimum distortion.

THE Childs' amplifier circuit, as originally described in the *Radio-Electronic Engineering* edition of RADIO & TELEVISION NEWS (June 1951) and RADIO & TELEVISION NEWS (July 1951) is, in the author's opinion, one of the finest 30-watt amplifier circuits ever offered the audio constructor.

The Childs' amplifier has a very low distortion content, is simple to construct, and has ample power for the majority of playback systems. However, the author felt that certain changes and additions to the circuit would be desirable for his applications. The amplifier was to be used in an electronic organ as well as for the recording and reproduction of sound on discs. He was interested in obtaining maximum power with the least amount of distortion, and was not concerned with the number of components required.

The Childs' amplifier was constructed and tested in breadboard fashion, to determine its merits and weaknesses before constructing the final amplifier.

This amplifier was first checked without the feedback loops connected to the output transformer. These leads were temporarily grounded, so that a thorough check could be made, stage-by-stage. Had the feedback loops been connected, it would have been impossible to check the individual stages, as the correcting factor of the feedback loops would have influenced the results of the test.

The cross-coupled cathode follower phase inverter, which includes a 6SN7 and a 6SL7 tube, was then checked by first applying a square-wave signal to one of its grids with the other grid grounded. It was a simple matter of getting initial balance by adjusting the balancing cathode potentiometer. The inverter maintains a uniform voltage output on each of the plates of the 6SL7 tube throughout the entire frequency range that was to be used. This feature is most important to the Childs' circuit which utilizes double feedback loops around its entire circuit. The intermodulation distortion was so low that it was impossible to obtain a reading on the analyzer. The inverter is entirely hum free.

A single-pole, three-position switch (S_1) was added to the first 6SN7 inverter-input grid. By placing this switch in its 2nd position, which grounds the second grid of the 6SN7 tube, the amplifier functions with a single-ended input. When the switch is placed in the 3rd position, it grounds this grid through a 220,000 ohm (R_1) resistor and connects the second input to this grid. In this position the amplifier has a push-pull input, a most desirable feature, as any hum that is picked up on the line connecting the preamplifier to the main amplifier is automatically canceled. However, it allows any signal which is applied from ground to either one of its inputs to be amplified. If a dual triode is connected as two cathode follower outputs in the preamplifier, it will not be necessary to use any shielding on the input line connecting the preamplifier to the main amplifier, providing the leads are twisted. The reason for this is the effective low output impedance (500 ohms) of the cathode followers, and the canceling effect of the push-pull circuit.

These cathode followers may also be used as an ideal mixer by placing a potentiometer in each of their grids. When the switch is placed in the 1st position, both of the input grids are connected to the No. 1 input terminal for balancing the phase angle to 180 degrees.

The high degree of inverse feedback, the low internal impedance of the cathode follower, and the fact that there are no condensers in the inverter, make this a highly stable circuit with a minimum of distortion. It leaves little to be desired in this inverter.

The push-pull 6SN7 voltage amplifier stage (original Childs' amplifier used a 6SN7 following the 6SL7 stage) was next checked. There was a slight falling off at the high frequency end when a 10,000 cycle square-wave was applied. It was felt that this amount of falling off was not serious and would be corrected when the feedback loops were connected. There was, however, an unbalanced signal voltage on the plates of the 6SN7 tube. Two 6J5 tubes were substituted for the 6SN7 tube, as it was simpler to select a matched pair of 6J5 tubes rather than a balanced 6SN7 tube. Also from the standpoint of the physical layout, it is desirable to use two tubes since identical placement of components helps maintain exactly the same lead lengths, thereby keeping the stray capacitance identical in each half of the push-pull circuit. A balanced output resulted from this change.

The two 6J5 direct-coupled cathode follower driver tubes were substituted for the 6SN7 tube for the same reason mentioned in connection with the previous stage. The plate voltage is in

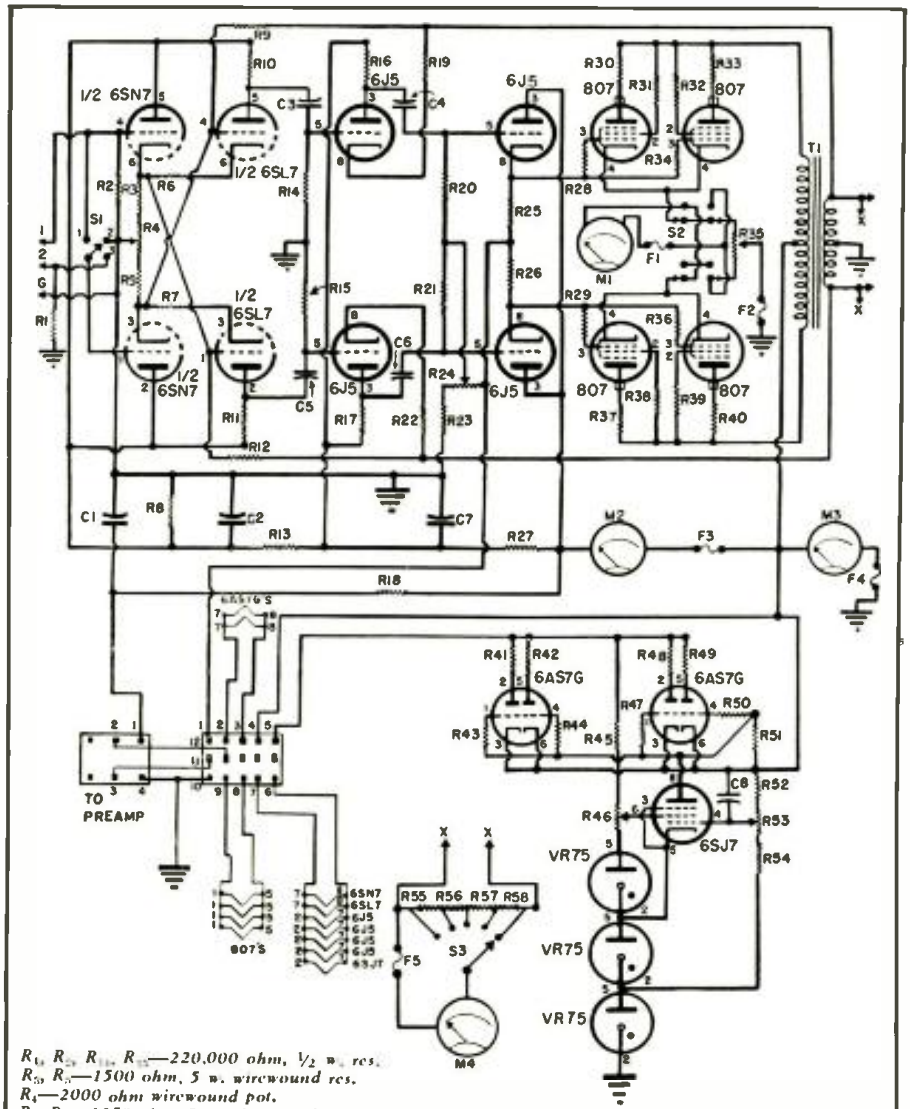
excess of the manufacturer's rating for either the 6J5 or 6SN7 tubes. However, the plate dissipation is not exceeded. The actual voltage applied to the plate is the 450-volt plate supply plus the minus 35 volts that the cathode is held below ground by the bias supply, making the total 485 volts applied to the plate. The author has used 6J5 tubes under these conditions in other circuits for at least three years, and has never encountered any difficulty with the life of the tube or the functioning of the circuit. 6S4 tubes could have been substituted for the 6J5 tubes without exceeding the manufacturer's rating. The 100 percent degenerative feedback within the cathode follower circuit and its low output impedance make an ideal direct-coupled driver for the fixed bias operation of the triode-connected 807 tubes.

At this point, the 807 tubes were inserted in their sockets and the feedback loops were disconnected from ground and connected to the voice coil. A sine wave was applied to the input of the amplifier and a measurement was taken from ground to each half of the voice coil winding to determine the uniform balance of the push-pull circuitry.

Two husky broadcast-quality transformers were tried; both of these transformers had a primary impedance of 2500 ohms and a tapped 500 ohm secondary in addition to the 16 ohm voice coil winding. These transformers were good transformers and had worked very satisfactorily in other circuits. However, due to the stray capacitance caused from the unused 500 ohm winding, it induced sufficient phase shift to give an undesirable unbalanced output over the entire frequency range. This fact is mentioned not to criticize the transformer quality, but to emphasize the necessity for having a transformer that is properly designed for this particular type of circuit. The *Peerless* S265Q transformer was used and found to give a highly uniform balanced output on both halves of the secondary for a frequency range of 15 cycles to 70,000 cycles. Obviously there are other transformers that would work just as well. However only one was actually tried.

The plates of a cathode-ray oscilloscope tube were connected directly to the voice coil winding with a 15 ohm resistive load shunted across this winding. The oscilloscope amplifier was not used in order to eliminate its distortion from the patterns observed. A 15-cycle, 30-cycle, and 60-cycle square-wave signal was applied to the input of the amplifier, and at 18 watts a slight phase shift in the output was observed. There was no overshooting or hangover effect observed in the pattern. The square-wave signal was then increased to 10,000 cycles in steps of 500 cycles. Through this entire range at the 18 watt level there was little noticeable hangover or overshooting observed in the pattern. Very straight sides and no rounding of the corners were seen. For curiosity sake only the square-wave generator was then increased to a 30,000 cycle fundamental frequency and it was observed even at this phenomenally high square-wave frequency the pattern still resembled a square wave. These tests showed that the amplifier was highly stable, had excellent transient response and had a well damped output with a nearly flat frequency response from 15 cycles to over 100,000 cycles. An intermodulation distortion measurement was then made of the entire amplifier at an 18 watt output. Using a test frequency of 60 cycles and 3000 cycles at a 4 to 1 ratio, the intermodulation distortion measured 1.5%. Using a test frequency of 60 cycles and 7000 cycles at

Fig. 2. Schematic and parts list covering the modified Childs' amplifier.



R_1, R_2, R_{11}, R_{12}—220,000 ohm, ½ w. res.
R_3, R_5—1500 ohm, 5 w. wirewound res.
R_4—2000 ohm wirewound pot.
R_6, R_7—1250 ohm, 5 w. wirewound res.
R_8, R_{14}—100,000 ohm, 2 w. res.
R_9, R_{13}—22,000 ohm, 1 w. res.
R_{10}, R_{11}—100,000 ohm, 1 w. res.
R_{13}—2500 ohm, 5 w. wirewound res.
R_{16}, R_{17}, R_{32}—50,000 ohm, 1 w. res.
R_{19}, R_{22}—2400 ohm, 1 w. res.
R_{20}, R_{21}—100,000 ohm, ½ w. res.
R_{23}—3000 ohm, 5 w. wirewound res.
R_{24}—7500 ohm wirewound pot.
R_{25}, R_{26}—25,000 ohm, 5 w. wirewound res.
R_{27}—5000 ohm, 5 w. wirewound res.
R_{28}, R_{29}, R_{31}, R_{39}—1000 ohm, ½ w. res.
R_{30}, R_{33}, R_{37}, R_{40}—20 ohm, 1 w. res.
R_{34}, R_{35}, R_{38}—100 ohm, 1 w. res.
R_{36}—50 ohm, 4 w. wirewound pot.
R_{41}, R_{42}, R_{48}, R_{49}—47 ohm, 1 w. res.
R_{43}, R_{44}, R_{47}, R_{50}—100 ohm, ½ w. res.
R_{45}—10,000 ohm, 10 w. wirewound res.
R_{46}—10,000 ohm, 10 w. wirewound pot.
R_{51}—470,000 ohm, ½ w. res.
R_{52}—100,000 ohm pot.
R_{54}—27,000 ohm, ½ w. res.
R_{55}, R_{56}, R_{57}, R_{58}—Use correct value to calibrate meter to full scale, 6 db, 16 db, 26 db, and 36 db

C_1, C_2, C_7—20 μfd., 600 v. elec. cond.
C_3, C_4, C_5, C_6—.1 μfd. oil-filled bathtub cond.
C_8—.05 μfd., 600 v. mica cond.
S_1—S.p. 3-pos. wafer switch
S_2—4-pole d.t. wafer switch
S_3—S.p. 5-pos. wafer switch
F_1—¼ amp. fuse (Littelfuse)
F_2—½ amp. fuse (Littelfuse)
F_3—⅛ amp. fuse (Littelfuse)
F_4, F_5—1/32 amp. fuse (Littelfuse)
T_1—Peerless 265Q connected 2500 ohm primary, 16 ohm secondary
M_1—0-200 ma. d.c. meter
M_2—0-100 ma. d.c. meter
M_3—0-500 volt d.c. meter
M_4—10 + 6 db meter
1—6SN7 tube
1—6SL7 tube
4—6J5 tubes
4—807 tubes
2—6AS7G tubes
1—6SJ7
3—VR75 tubes
Note: All fuses, S_2, S_3, and R_{36} mounted on meter panel.

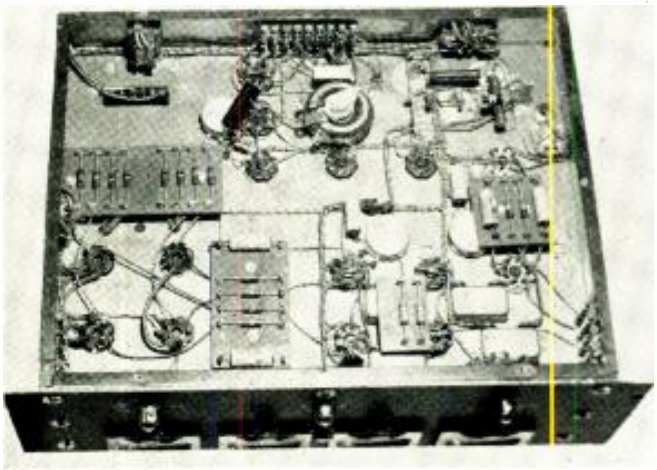


Fig. 3. Bottom view of the 30-watt amplifier chassis.

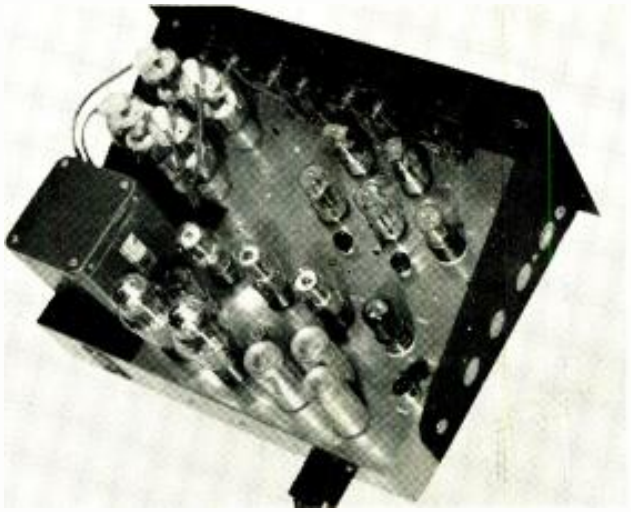


Fig. 4. Top view of amplifier showing parts placement.

a 4 to 1 ratio, the intermodulation distortion measured .8%. As the power was increased beyond 18 watts the distortion rose rapidly. This distortion was caused by a drop from 450 volts to 350 volts in the plate supply. The power supply internal impedance was 1000 ohms.

When the power tubes operate in class A, the plate current does not vary appreciably and, therefore, the plate supply voltage is substantially constant. As the signal is increased and the tubes function in class AB_1, the plate current is no longer constant. There will be a voltage swing proportional to the plate current swing and the internal impedance of the power supply. This varying plate supply voltage then places the quiescent grid potential in the wrong position on the "Plate Voltage-Tube Characteristic Curve" during a portion of the cycle. The regulation factor of the power supply causes a voltage variation to be fed back to the plate transformer in slightly varying phase relationship to the signal. This will not be entirely canceled out by the push-pull circuit and therefore distortion will be introduced into the signal. There will be a loss of power in the output signal proportionate to the signal voltage drop within the internal resistance of the power supply. To correct these conditions, an electronic voltage regulator was added to the entire Childs' circuit, including the external preamplifier. This meant an increase in the power handling capacity of the power supply from 250 ma. to 300 ma. @ 650 volts and the insertion of three isolation resistors and condensers R_{13}, R_{14}, R_{25}, C_1, C_2, and C_7.

The voltage regulator, described by W. L. Kinsell in the June 1948 issue of RADIO NEWS, was selected for its improved regulation over the majority of regulators using a single pentode control tube. A quotation in part from his article is given:

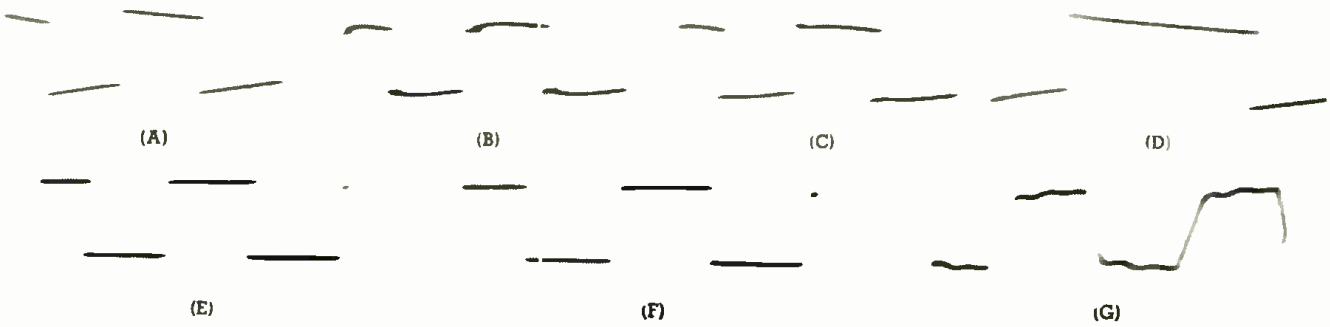
"A method which has been devised to improve the regulation so that the variations of regulated output voltage may be reduced to zero or even reversed is presented herewith. This is accomplished very simply as shown in Fig. 2B (shown as R_{16}, Fig. 2 in this article) which adds a potentiometer or resistor in the screen supply circuit. This reinforces the regulating action as described below and reduces the output voltage variations. They can be made negative if the screen voltage adjustment is run up high enough.

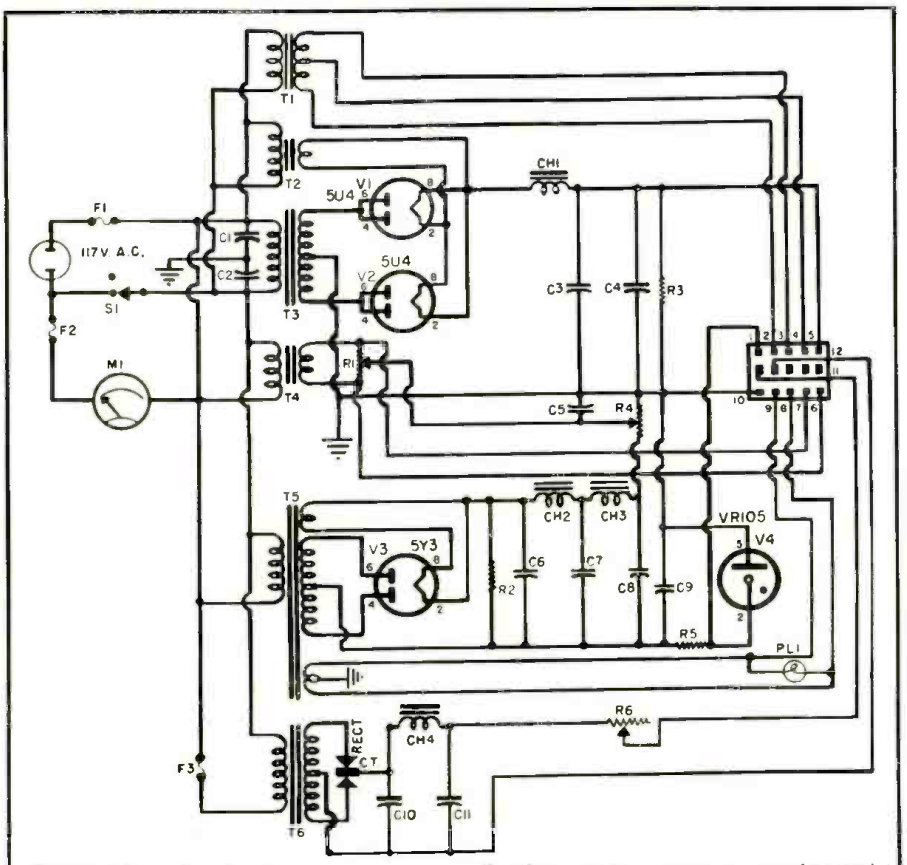
"Suppose the load current is reduced. The output voltage tends to rise, causing the control tube grid to go in a positive direction. The regulating action carries through to keep the output voltage from rising excessively.

"As this occurs, the unregulated input voltage, E, does rise, due to the normal regulation of the rectifier and filter. With RS (shown as R_{16}, Fig. 2 in this article) in the circuit, the control tube screen voltage goes more positive. Since this is the same direction as the change in control grid voltage, the regulating action is reinforced or made more effective than before. It has been found that the variation in output voltage reduces as the setting of RS (R_{16}, Fig. 2) is advanced, until it runs through zero and finally becomes negative. By this simple means then, the ultimate in regulating action is achieved."

The ideal setting of this potentiometer is at a point where the output voltage from the regulator neither rises nor falls with the minimum and maximum current drain of the amplifier. The approximate setting of R_{16} is between one-half and three-fourths maximum. The method of adjusting this potentiometer will be described later. The regulated output voltage of Mr. Kinsell's regulator has been increased from 350 volts to 450 volts by the addition of the VR105 tube. It

Fig. 5. How the damping factor is improved in the 20-30 watt range. (A) 50 cycle square wave with a 30-watt resistive load without the regulated power supply. (B) 50-cycle square wave at 30 watts inductive load without regulated power supply. (C) Same condition as (B) except with regulated power supply. (D) 20-cycle square wave at 30 watts resistive load with regulated power supply. (E) 5000-cycle square wave at 30 watts resistive load with regulated power supply. (F) 10,000 cycle square wave at 30 watts resistive load with regulated supply. (G) 40,000-cycle square wave at 30 watts resistive load with regulated supply.





R_1—50 ohm wirewound pot.
R_2—100,000 ohm, 2 w. carbon res.
R_3—25,000 ohm, 10 w. wirewound res.
R_4—25,000 ohm, 20 w. wirewound adj. res.
R_5—1000 ohm, 50 w. wirewound res.
R_6—500 ohm, 50 w. wirewound adj. res.
C_1, C_2—.1 μfd. oil-filled bathtub cond.
C_3-C_4, C_6-C_7, C_8-C_9—8/8 μfd., 600 v. oil-filled cond. (C_3-C_4 can be replaced by a single 16 μfd., 600 v. elec. cond.)
C_5—50 μfd., 50 v. elec. cond.
C_{10}-C_{11}—40/40 μfd., 150 v. elec. cond.
F_1—4 amp. fuse (Littelfuse)
F_2—1/30 amp. fuse (Littelfuse)
F_3—1½ amp. fuse (Littelfuse)
CH_1—20-4 hy. @ 300 ma. swinging choke
CH_2, CH_3—10.5 hy. @ 110 ma. filter choke
CH_4—4 hy. @ 200 ma. choke
T_1—Fil. trans. 6.3 v. @ 5 amps., c.t. (see text)
T_2—Fil. trans. 5 v. @ 6 amps
T_3—Power trans. 785-0-785 v. @ 300 ma.
T_4—Fil. trans. 6.3 v. @ 5 amps.
T_5—Power trans. 375-0-375 @ 150 ma.; 5 v. @ 3 amps.; 6.3 v. @ 5 amps., c.t.
T_6—Plate trans. 100-0-100 v. @ 150 ma. This is a home constructed transformer and may be substituted for a 117-volt isolation transformer providing a half-wave rectifier is used.
Rect.—300 ma. full-wave selenium rectifier
S_1—S.p.d.t. toggle switch
M_1—150 volt a.c. voltmeter
PL_1—6.3 volt pilot lamp
V_1, V_2—5U4 tube
V_3—5Y3 tube
V_4—VR105 tube

Fig. 6. Power supply circuit. A separate chassis is used in order to reduce hum.

also became necessary to use two 6AS7G tubes to handle the 300 ma. drain on this supply. The insertion of the plate and grid isolation resistors R_{11}, R_{12}, R_{18}, R_{19}, and R_{11}, R_{13}, R_{17}, R_{20} serves to uniformly distribute the plate current on each individual plate and to eliminate any possibility of oscillation. Because the cathodes are 450 volts above ground, it became necessary to raise the heaters so that the heater-cathode potential would not exceed the rated 300 volts. The most convenient way was to use a separate heater transformer for the 6AS7G tubes and return its center tap to the cathodes of the 6AS7G tubes. This gives a zero voltage between heater and cathode at all times. A word of caution—when working around inside of the amplifier or power supply, remember that these 6.3 volt heaters are actually 450 volts above ground and should therefor be considered highly dangerous.

Because of the zero impedance of this supply, if anything goes wrong in the circuit, something is bound to snap. For this reason one should not attempt to eliminate the fuses that are indicated on the diagram or increase their current ratings.

The panel meters could have been excluded from the circuit but they are a convenience when making any adjustments in the voltage regulator or balancing the output stage as the tubes deteriorate. When the voltage regulator was added and the changes made in the Childs' amplifier a preliminary test proved that the circuit was now entirely satisfactory for the author's needs. The amplifier was then dismantled and reconstructed as shown in Fig. 1 (left). The voltage regulator was included on the amplifier chassis as it was convenient to have all of the pertinent controls located on one chassis. The tubes and components were located in such a manner as to maintain balanced lead lengths on each side of the push-pull circuit. The grid and the plate leads are virtually point-to-point wiring even though the resistors are placed on resistor cards. The only leads that are cabled are the ground, plate supply, and heater leads. This method of construction makes it simple to check, to replace any component, and to locate any difficulties that may occur at some

(*Continued on page* 102)

Fig. 7. Under chassis view of the power supply unit.

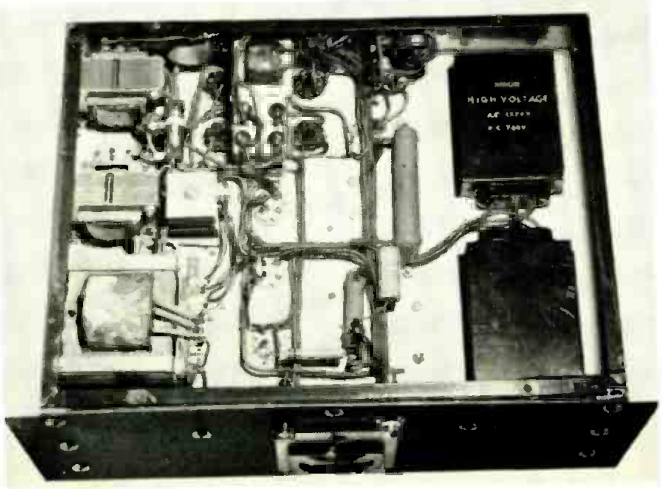
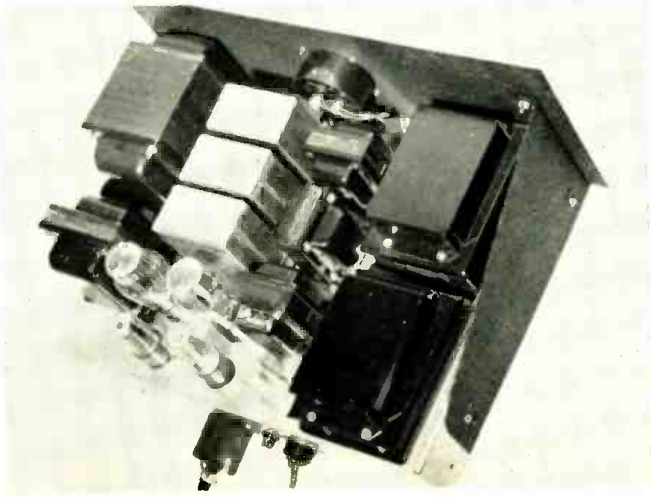
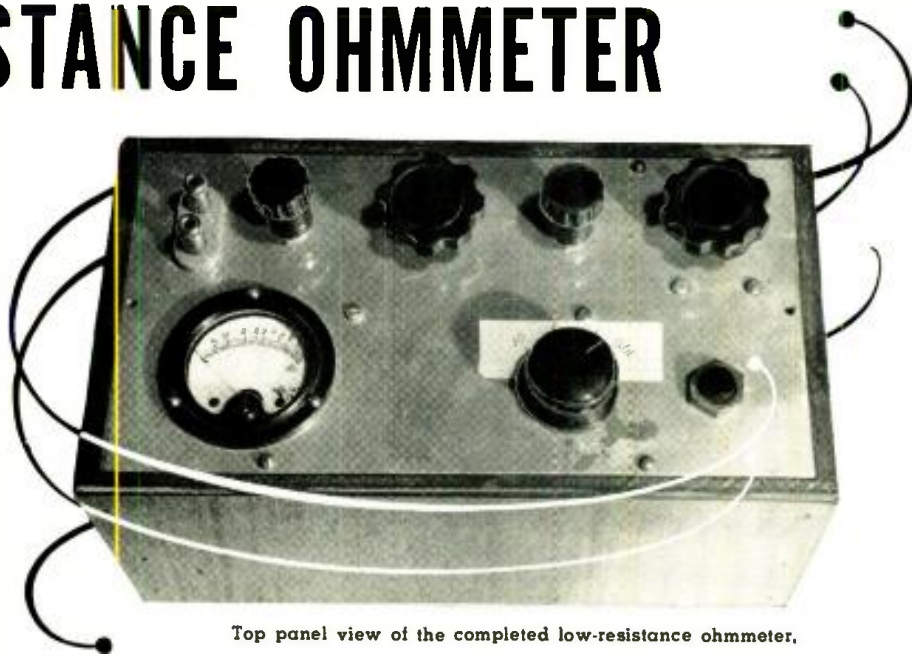


Fig. 8. Top view of the husky, 83-pound power supply.



A LOW-RESISTANCE OHMMETER

By
J. P. C. McMATH
Asst. Prof., Elec. Engr.
University of Manitoba



Top panel view of the completed low-resistance ohmmeter.

Construction details on a handy test instrument which reads resistance from .01 ohm to 2000 ohms in three meter ranges.

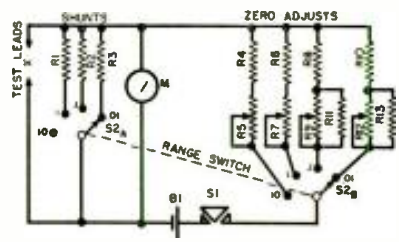
THE usual series ohmmeter is not very accurate for measuring resistance of less than about 10 ohms, and 1 ohm is approaching the limit of detectability; anything smaller being read as "zero." Many readers have probably wished at some time for an instrument which would measure smaller resistances, for use in identifying taps on coils or transformers, for checking switch contacts, high resistance (due to broken strands, etc.) in appliance cords, and circuit checking in general. The writer has found the instrument to be described very useful for such purposes. It has center scale ranges of 237, 23.7, 2.37, and 0.237 ohms, using a 500 microampere surplus meter. On the low range, a resistance of 0.01 ohm is readily detectable, while on the high range the practical upper limit is about 2000 ohms. Three 1.5 volt flashlight batteries are used in parallel for the power supply.

The construction and appearance are clearly shown in the photographs. The four knobs are separate zero adjustments, one for each range. The push-button is "push to read" and is essential in order to limit the drain on the batteries, which on the lowest range is considerable. It must have good low-resistance contacts. The ganged range switch must also have good contacts, the writer used a surplus type which has proven satisfactory. The stud and leaf type used on laboratory equipment would be ideal if available. If wafer type switches are used, contacts on several wafers should be paralleled to obtain low contact resistance, otherwise behavior on the lowest range may be erratic. The writer has obtained best results by soldering battery connections directly to the batteries. This is best done rapidly with a heavy, hot soldering iron, to avoid undue heating of the battery. The test leads should be kept short, with well-sweated ends, and with good husky test clips, as the lead resistance is far from negligible. This may be readily demonstrated by comparing readings obtained on the low range by first clipping leads together, then "shorting" the terminals directly with a piece of clean copper rod.

All components are mounted beneath a 1/8" x 5 5/8" x 10 3/4" aluminum panel, which fits into a wooden box approximately 4 1/2" deep as shown in the photographs. Parts layout is of

(*Continued on page* 146)

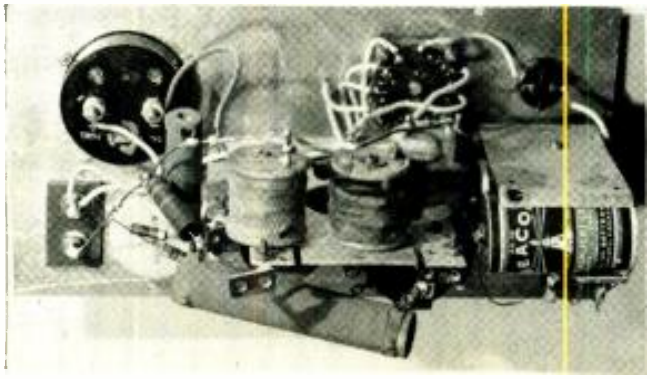
R_1—29 ohm, 1/2 w. wirewound res. (see text)
R_2—2.64 ohm, 1/2 w. wirewound res. (see text)
R_3—.261 ohm, 1/2 w. wirewound res. (see text)
R_4—2500 ohm, 1/2 w. wirewound res., ± 10%
R_5—500 ohm, 1 w. wirewound pot. (linear taper preferred)
R_6—200 ohm, 1/2 w. wirewound res., ± 10%
R_7—300 ohm, 1 w. wirewound pot. (linear taper preferred)
R_8—20 ohm, 1 w. wirewound res., ± 10%
R_9—70 ohm, 1 w. wirewound pot. (linear taper preferred)
R_{10}—2 ohm, 1 w. wirewound res., ± 10%
R_{11}—15 ohm, 1 w. wirewound res., ± 20%
R_{12}—6 ohm, 1 w. wirewound res. (linear taper preferred)
R_{13}—1 ohm, 1 w. wirewound res., ± 20%



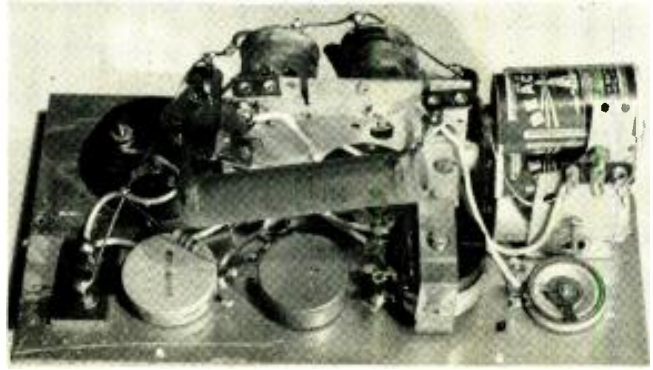
S_1—Push-button switch, normally-open
S_{2a}, S_{2b}—D.p.4-pos. switch (see text)
M—500 μa. d.c. meter, 261 ohms res.
B_1—See text

Fig. 1. Complete wiring diagram and parts list covering the low-resistance ohmmeter.

Rear view of panel on which ohmmeter is construc ed.



Another view of panel showing location of components.



ANTENNA MEASUREMENTS

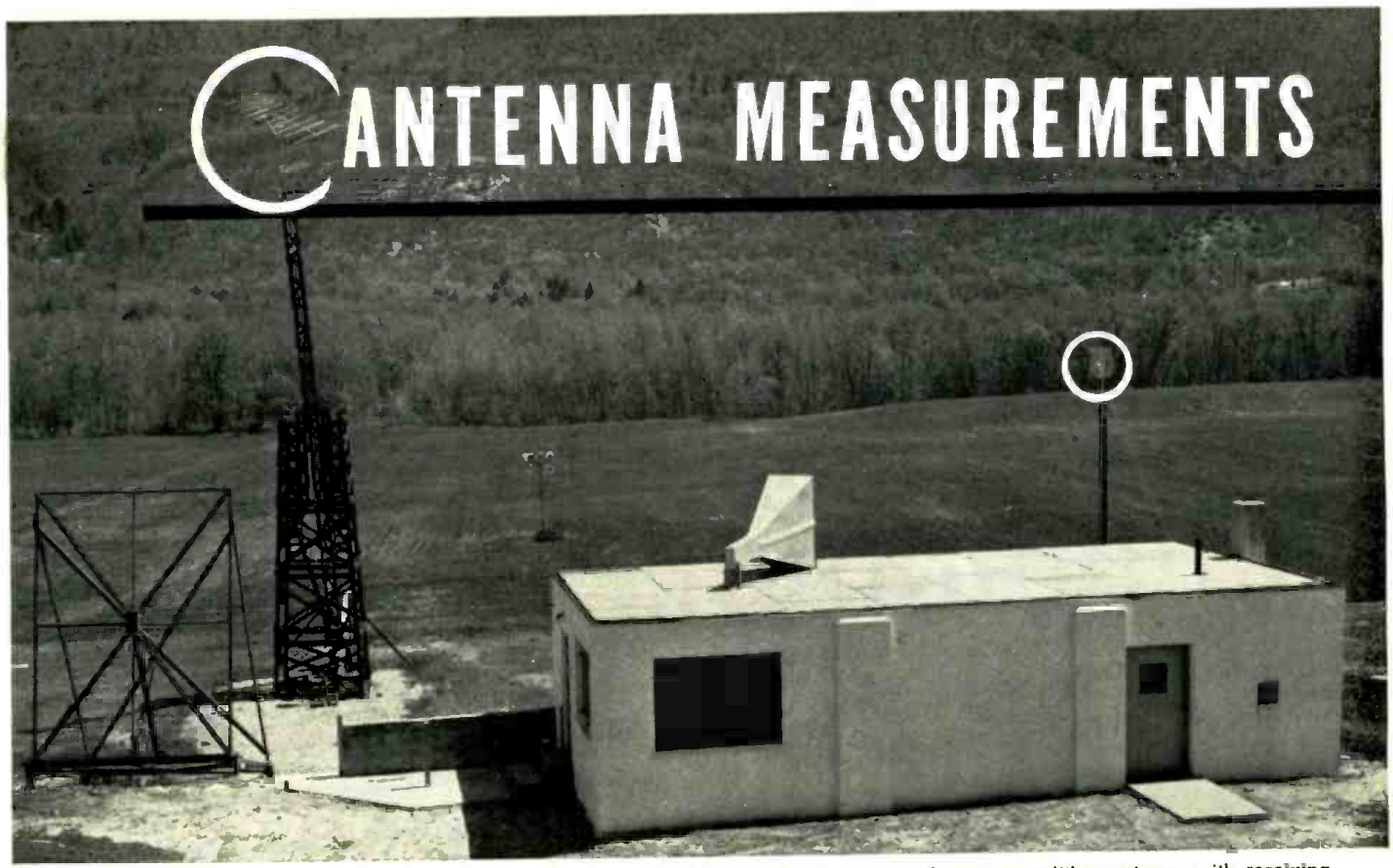
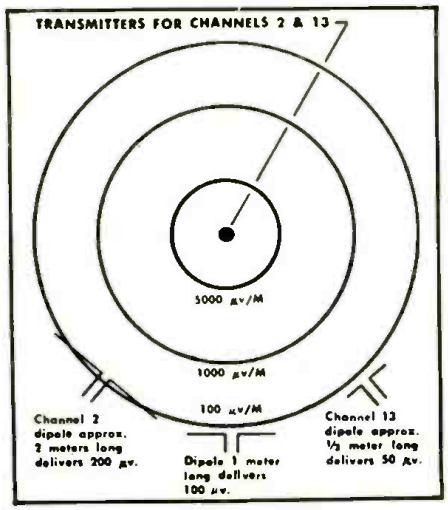


Fig. 1. Channel Master's Antenna Laboratory. Left is v.h.f. range showing broadband corner reflector transmitting antenna with receiving tower (large circle) in background. The u.h.f. horn transmitting antenna is on roof with receiving mast (small circle) at rear of building.

THE performance characteristics of any TV receiving antenna, irrespective of type or frequency range, depend upon three properties: gain, directivity, and impedance.

This month's cover shows a scene in a modern TV antenna test laboratory where these three characteristics are measured. At the engineer's left is the v.h.f. transmitter panel containing a v.h.f. transmitter, the associated modulator, and a selsyn system which controls the rotation of the antenna under test. The engineer is adjusting the tuned output meter which gives direct gain readings in db. To his right is a polinear recorder which plots polar diagrams as the test tower is rotated.

Fig. 2. Setup where both Channels 2 and 13 are transmitting from the same point with the same effective radiated power.



The purpose of this article is to explain these three antenna properties (gain, directivity, and impedance) and to describe how they are measured at *Channel Master*.

The first of the antenna properties is gain. The gain of a television receiving antenna is a measure of its ability to provide a signal. There are many ways to measure the gain of a television receiving antenna and, therefore, many opportunities for misconception or actual misrepresentation. The commonly accepted way, and the method used by most reliable firms, is to compare the gain of an antenna with a tuned dipole at each particular frequency under consideration. In other words, if we speak of the gain of a broadband antenna, its performance on each channel must be compared to a tuned dipole for that specific channel. If we are speaking of the gain of a yagi, it must be compared to a tuned dipole on the channel for which the yagi is cut.

The Decibel

The unit of measurement used to make this comparison between an antenna and a reference tuned dipole is the "decibel" (db). The decibel is not a fixed quantity like a watt, or a volt, or an ohm. Rather, it is a ratio between two quantities. For example, assume that our reference dipole at a given channel will provide a signal of 100 microvolts. This, then, becomes the 0 decibel level. Table 1 is a chart showing the total signal in microvolts resulting from various db gains.

There is an interesting and important point to bear in mind when comparing the gain of an antenna with a tuned dipole for its specific channel. The field strength of a television transmitting station is generally measured in microvolts - per - meter. This means that a length of wire one meter long will intercept a signal of 100 microvolts on the 100 microvolt field strength contour. Fig. 2 shows the transmitting setup where both Channel 2 and Channel 13 are transmitting from the same point with the same effective radiated power. Their field strength contours coincide.

Assume that on the 100 microvolt contour (where a wire one meter long will intercept 100 microvolts) we have a Channel 2 dipole and a Channel 13 dipole. The Channel 2 dipole is approximately two meters long and will, therefore, intercept approximately 200 microvolts. The Channel 13 dipole is only about one-half meter long and it will intercept only 50 microvolts. In other words, a Channel 2 dipole will pick up approximately four times as much signal. These factors should be borne in mind when comparing high-band and low-band performance in antennas. In choosing a broadband antenna, the high-band gain (in decibels) should be much higher than the

By **HAROLD HARRIS**
Vice-President, Engr., Channel Master Corp.
and HARRY GREENBERG
Chief Engr., Ant. Div., Channel Master Corp.

Antenna performance is judged by three characteristics—gain, directivity, and impedance. Here is how such analyses are made.

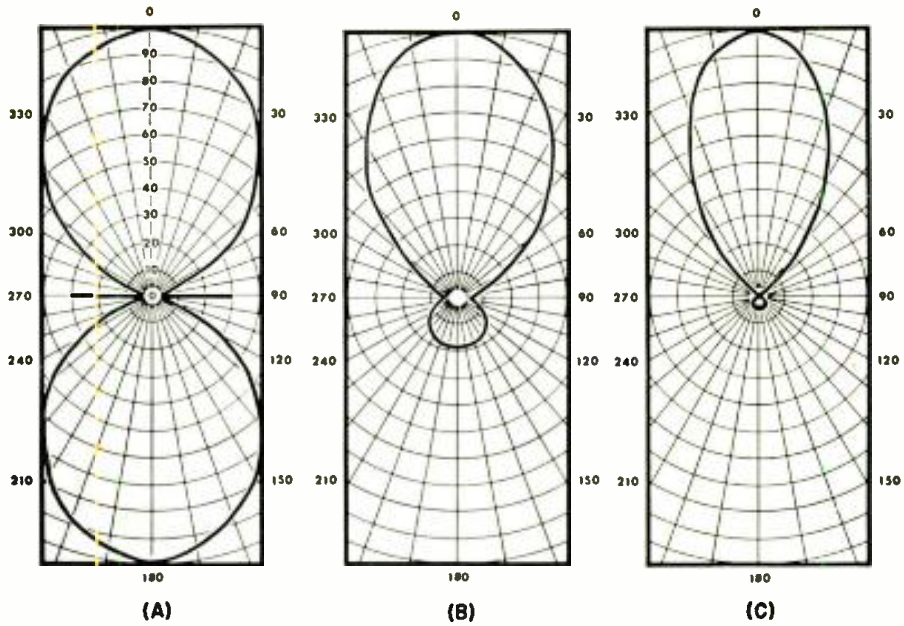


Fig. 3. (A) Horizontal polar diagram of a dipole without parasitic elements. (B) Horizontal polar diagram of a conventional five-element yagi. (C) A horizontal polar diagram which has been plotted in terms of relative power rather than in terms of relative voltage as was done in A and B. See text for discussion.

low-band gain, if the same voltage is to be applied to the transmission line.

How Gain Is Measured

At our laboratory, gain is measured on two test ranges, one for v.h.f. and one for u.h.f. The v.h.f. transmitting system consists of a broadband corner reflector antenna, with a specially designed radiating dipole, which beams its signals up toward the receiving tower (Fig. 1). The standard dipole, or the antenna under test, is inclined so that it is at right angles to the transmitted signal. Precautions are taken to provide an absolutely reflection-free signal to the receiving antenna—the upward angle of radiation prevents reflection from the ground or nearby objects and the receiving tower itself is constructed entirely of wood.

A set of twelve standard dipoles is always available for comparison readings (Fig. 4). These are folded dipoles because all gain measurements are made into a 300-ohm system. The received signal is detected at the antenna terminals by a temperature-controlled crystal detector, and the audio signal is conducted down the tower into the laboratory.

In the laboratory, adjacent to one another, are a v.h.f. oscillator and a crystal calibrator which are used for constant frequency checks. The signal from the receiving antenna is fed into a tuned output meter which is calibrated directly in decibels. In this manner, the engineers can obtain precise gain readings for all antennas under test—development models, quality-control samples from production, and the antennas of other manufacturers.

A similar procedure is followed on the completely independent u.h.f. antenna range that operates simultaneously. The u.h.f. transmitter feeds a specially designed horn radiator transmitting antenna, Fig. 1. This antenna provides a uniform field across the entire u.h.f. band. Test u.h.f. antennas are mounted on the u.h.f. receiving tower. This tower, too, can be swung to the ground so that the standard reference dipoles can be easily put up. The same method of detection and a similar tuned output meter are used for u.h.f. gain measurements.

DB	MICROVOLTS
0 db	100 μv
1 db	112 μv
2 db	126 μv
3 db	141 μv
4 db	158 μv
5 db	178 μv
6 db	199 μv
7 db	224 μv
8 db	251 μv
9 db	282 μv
10 db	316 μv

Table 1. Relative signal strengths corresponding to various db values. See article.

Directivity

The second of the three major an-

(*Continued on page* 123)

Fig. 4. The set of 12 standard dipoles which are available for comparison readings. All are 300-ohm folded dipoles for test.

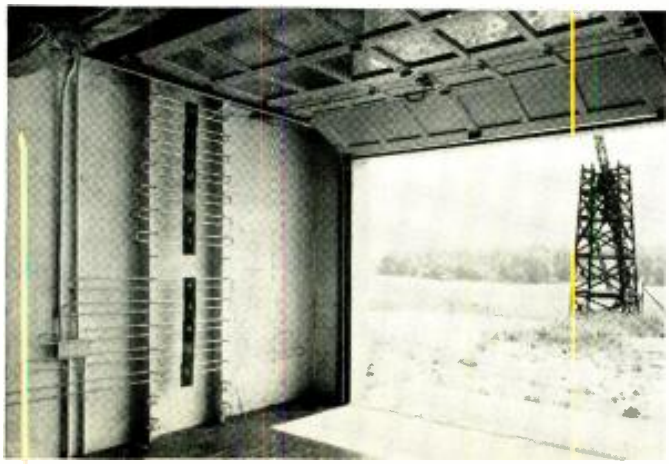
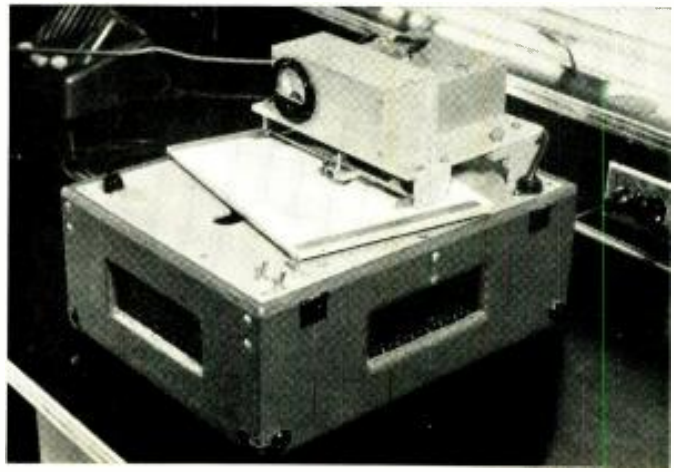


Fig. 5. The polinear recorder used for plotting polar diagrams. Deflection of pen is proportional to the signal being received.



A LINEAR POWER AMPLIFIER

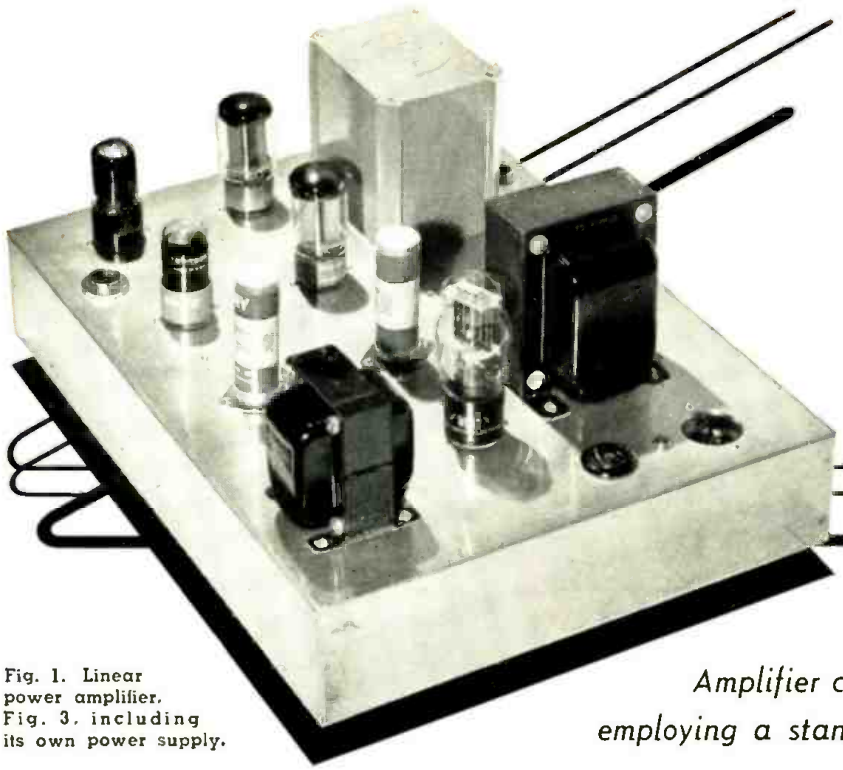


Fig. 1. Linear power amplifier. Fig. 3. including its own power supply.

By
FREDERIC T. C. BREWER

Amplifier conversion to "Ultra-Linear" operation employing a standard audio output transformer unit.

EDITOR'S NOTE: The author, in presenting this article, does not in any way wish to detract from the work done by Hafler and Keroes in their article "Improving the Williamson Amplifier" which appeared in the February issue of RADIO & TELEVISION NEWS. The circuit used by the author is very similar to that presented by Messrs. Hafler and Keroes except for a few variations which help to reduce the cost. Of particular importance is the fact that a standard output transformer (UTC LS-57) has been used instead of a specially-designed unit. The high voltage requirements are lower and there is a variation in the feedback circuits. All-in-all, the author has achieved a good design at a lower over-all parts expenditure.

RECENT literature[1] has focused attention on a new mode of operation for power output tubes. The screen grids of the output tubes are connected to the "B+" supply through taps on the primary of the output transformer. The internal impedance, maximum power output, and distortion are functions of the ratio of screen load impedance to plate load impedance. Proper selection of this ratio gives higher power output than that obtainable from normally connected triodes while exhibiting the low internal impedance of the triode. Distortion values are better than either straight triode or tetrode operation. These facts have led many to "ultra-linearize" the very popular Williamson circuit. The results have been very successful [2, 3]. In effecting "ultra-linear" operation a new output transformer was required in many cases. This article will describe a "linear amplifier" using an output transformer found in many conventional amplifiers constructed during the last few years.

Fig. 2. Another version of the linear power amplifier with its own power supply and including a preamplifier. The preamp diagram is not included in this article. The photo has been presented merely to show relative placement of parts.

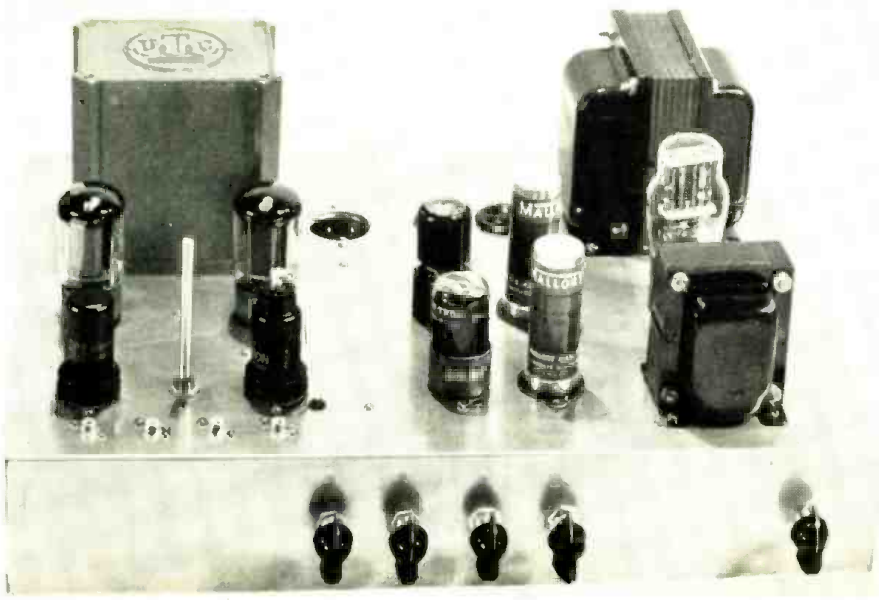


Fig. 1 shows the complete linear power amplifier. The complete circuit of this amplifier is shown in Fig. 3. As can be seen from the schematic the circuit configuration resembles the "Williamson": a voltage amplifier direct-coupled to a split-load phase inverter, followed by push-pull triodes driving the output tubes.

The output transformer is a *UTC* LS-57. The primary of this transformer has two windings. Each winding has a tap 60% from "B+" terminal to plate terminal. Normally the transformer will match 5000 or 3000 ohms depending on whether the total winding or the tap is used. By connecting the plate leads to the "B+" terminals of the transformer the taps are at 40% of the "B+" to plate impedance. If the taps are now connected to the screen grids of the output tubes, a ratio of screen load impedance to plate load impedance of 40% is obtained. Although this is not the optimum ratio recommended by Mr. Hafler and Mr. Keroes in their

[1] *Hafler and Keroes: "Improving the Williamson Amplifier," RADIO & TELEVISION NEWS, February 1953.*
[2] *Hafler and Keroes: "Ultra-Linear Operation of the Williamson Amplifier." Audio Engineering, June 1952.*
[3] *Sarser and Sprinkle: "Gilding The Lily." Audio Engineering, July 1952.*

article, the results are not too far from optimum.

A pair of 5881's are the output tubes. This tube is being widely used for high quality audio work. It is more rugged than the 6L6 and may be used as a direct replacement.

Feedback is taken from the secondary of the output transformer to the cathode of the first stage. Apparently 20 db reduction in output, measured with a resistive load, is obtained with this loop.

A "high frequency" feedback loop is connected from the plate of each output tube to the plate of the tube driving it. The purpose of these loops is to provide a smooth control of the high frequency region. High frequency oscillation often encountered in feedback amplifiers is prevented by the proper selection of R and C in these loops. Transient distortion also seems to be greatly reduced.

It was discovered that by placing a 0.02 μfd. condenser across the common cathode resistor of the 6SN7 the slight bit of high frequency fuzz observable on a cathode-ray oscilloscope at high power output was eliminated.

All stages were designed for wide bandwidth at low distortion. The dual triode 6SL7 in the first stages gives more gain and less distortion than the usual 6SN7.

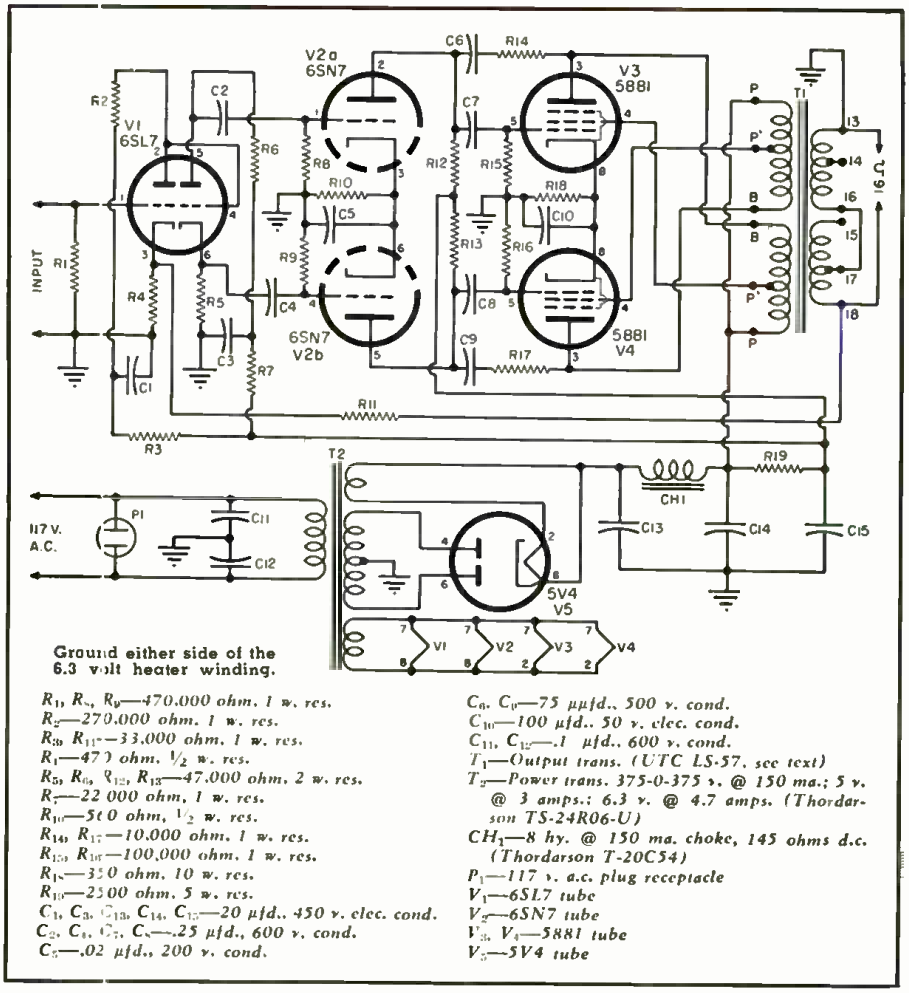
Less than 0.5 volt will drive the amplifier to over 20 watts output. The intermodulation distortion rises to about 2% at an equivalent sine wave power of 22 watts. Frequencies of 60 and 3000 mixed 4 to 1 gave results similar to those obtained with 60 and 7000 cps mixed 4 to 1. The power response was 30 to 20,000 cps flat at over 20 watts.

Construction of the amplifier is straightforward. Fig. 2 shows the amplifier together with a preamplifier[4] on the same chassis. An amplifier which had been in service three years was converted to linear operation. It is shown in Fig. 4. Note the precautions that were taken to obtain the desired results a few years ago. Balancing potentiometers were found unnecessary and are not found in the later models. In fact the amplifier described was constructed of standard components with tolerances no better than ± 20%.

EDITOR'S NOTE: *We disagree, in part, with the author's suggestion regarding the precautions that were taken years ago. Many of the present-day audio amplifiers include these so-called "obsolete" precautions. For ultimate performance to please the most critical ear, it is necessary to use a balancing pot or to choose with care the values of the resistors in the output stage to produce a balanced condition. It is also advisable that the resistances of R_{17}-R_{18} and R_{19}-R_{20} be matched to within ± 1%.*

Excellent results, over a period of time, have been obtained from this amplifier. It is a good construction project and offers those who have amplifiers food for thought. —30—

[4] *St. George and Driska; "Versatile Phonograph Preamplifier." Audio Engineering, March 1949.*

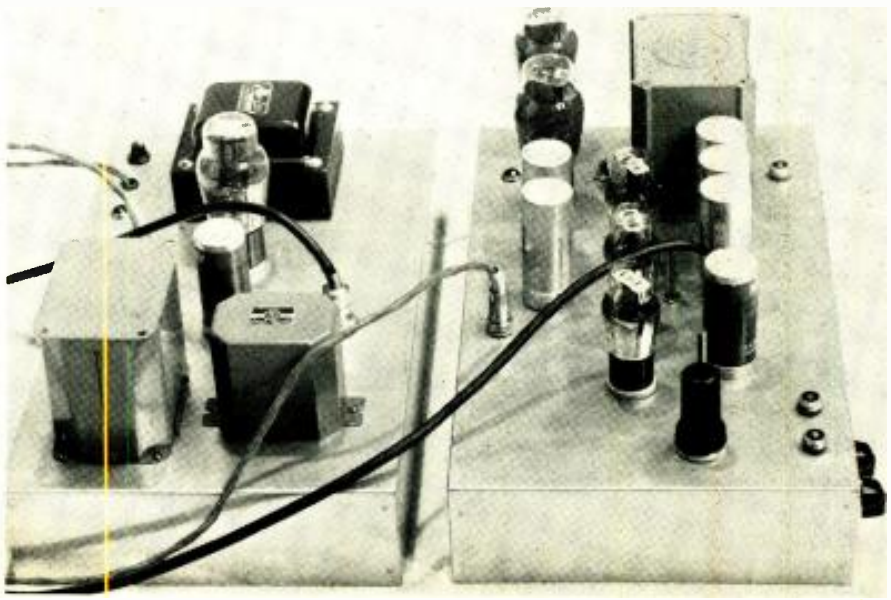


Ground either side of the 6.3 volt heater winding.

R_1, R_4, R_9—470,000 ohm, 1 w. res.
R_2—270,000 ohm, 1 w. res.
R_3, R_{11}—33,000 ohm, 1 w. res.
R_4—470 ohm, ½ w. res.
R_5, R_6, R_{12}, R_{13}—47,000 ohm, 2 w. res.
R_7—22,000 ohm, 1 w. res.
R_{10}—500 ohm, ½ w. res.
R_{14}, R_{15}—10,000 ohm, 1 w. res.
R_{16}, R_{18}—100,000 ohm, 1 w. res.
R_{17}—350 ohm, 10 w. res.
R_{19}—2500 ohm, 5 w. res.
C_1, C_3, C_{13}, C_{14}, C_{15}—20 μfd., 450 v. elec. cond.
C_2, C_4, C_7, C_8—.25 μfd., 600 v. cond.
C_5—.02 μfd., 200 v. cond.
C_6, C_9—75 μμfd., 500 v. cond.
C_{10}—100 μfd., 50 v. elec. cond.
C_{11}, C_{12}—.1 μfd., 600 v. cond.
T_1—Output trans. (UTC LS-57, see text)
T_2—Power trans. 375-0-375 v. @ 150 ma.; 5 v. @ 3 amps.; 6.3 v. @ 4.7 amps. (Thordarson TS-24R06-U)
CH_1—8 hy. @ 150 ma. choke, 145 ohms d.c. (Thordarson T-20C54)
P_1—117 v. a.c. plug receptacle
V_1—6SL7 tube
V_2—6SN7 tube
V_3, V_4—5881 tube
V_5—5V4 tube

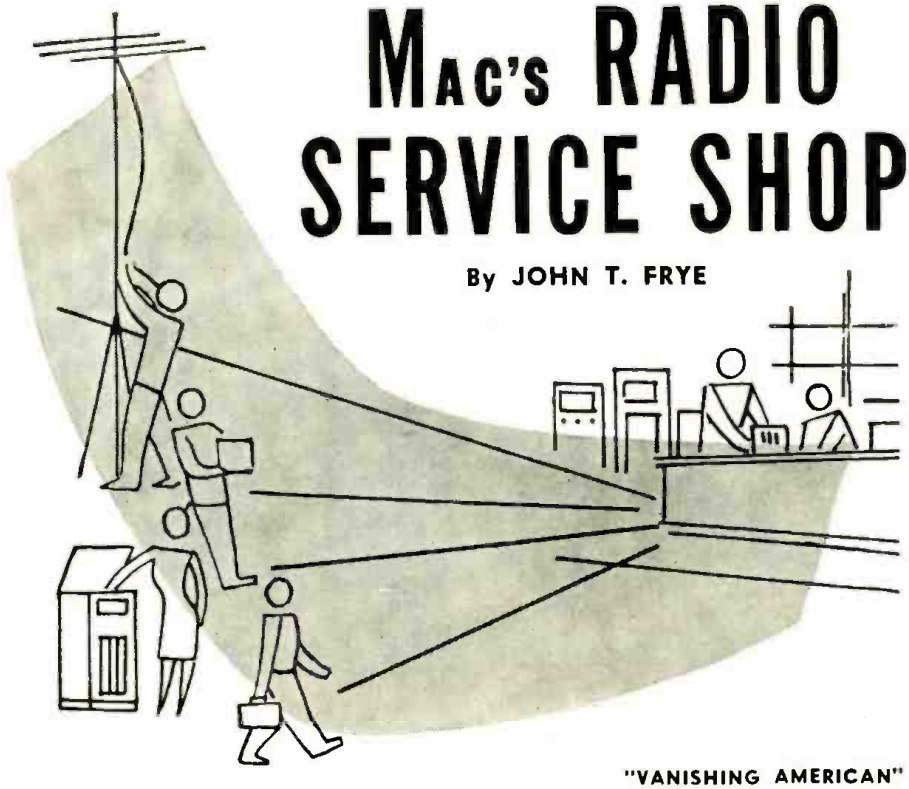
Fig. 3. Circuit diagram of the "linear" Williamson amplifier. The output transformer is shown driving a 16-ohm load. To drive an 8-ohm load, the secondary of the output transformer should be wired as follows: Join terminal 16 to terminal 18, also join terminal 13 to terminal 15. The 8-ohm load is then connected to terminals 13 and 18. If desired, the feedback resistor from the secondary of the output transformer can be changed from 33,000 ohms to 27,000 ohms. However, the over-all performance of the amplifier will not be appreciably altered if this resistor is not changed.

Fig. 4. Another amplifier that was converted to "linear" operation. In this particular case, the power supply was built on a separate chassis. The original Williamson amplifier was designed to be built on two separate chassis, that is, the amplifier and power supply are built as separate units. When converting the Williamson amplifier to "linear" operation, as described in this article, there need be no change in the power supply which may be used as is without affecting performance.



MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE



"VANISHING AMERICAN"

MAC glanced along the service bench to where Barney, his helper, was scowling down at a lone nickel in the palm of his hand.

"What's eating you, Little Sunshine?" Mac asked. "If that is supposed to be your last nickel, and if you are putting on this production in the hope of getting a raise, well—"

"No, not that," Barney interrupted. "I was just looking at the profile on this nickel and thinking that Lo the Poor Indian is rapidly vanishing from the American scene for the *second* time."

"How do you figure?"

"Well, the Indian-head test pattern, or any test pattern for that matter, is rapidly becoming extinct. Soon you will stand more chance of seeing a flying saucer than of glimpsing a test pattern. Stations put them on only for a few minutes in the morning hours. Worse yet, they often employ this period to make adjustments on the transmitter. The net result is that you can never be sure nonlinearity seen in the receiver pattern, for example, is not actually being transmitted; and if you start to correct the pattern at your end, they may be doing the same thing at their end. While you're 'zigging' they may be 'zagging.'"

"True, but why get all worked up about it?"

"'Why get all worked up about it?' the man says," Barney mimicked. "I'll tell you why: a whole TV service procedure has been built up around the test pattern. Reams and reams of paper have been devoted to showing the technician how to detect everything from shorted yoke turns to a fly standing on top of the horizontal output tube plate cap just by staring fixedly at a test pattern. 'Study the test pattern,' preached the manufacturers; 'Study the test pattern,' advised the service magazines; 'Study the test pattern,' commanded the TV pundits in their service lectures and books; and now—no test pattern!"

Mac chuckled at Barney's melodramatic vehemence. "There's a lot of truth in what you say, Red," he drawled. "No one can deny TV stations make with the test patterns like a circus con man manipulating the pea in the old shell game: 'Now you see it; now you don't.' Still and all, I think we can salvage some of the effort we put into studying those patterns for symptoms.

"Especially can we do so if, in our studying, we took the trouble to look behind the test pattern symptom to grasp exactly *why* a particular circuit defect resulted in precisely that kind of pattern distortion. If we did that, we'd have little trouble in finding the same symptom in a picture that we taught ourselves to discover in a test pattern. Remember that after all a pattern simply presents a collection of typical picture elements all in one 'scene' so that it can be quickly determined if the set is capable of reproducing every sort of picture. If you have a quick eye and can concentrate on picture elements rather than on the picture as a whole, if you have made a thorough study of how receiver troubles affect the deflection and modulation of that flying spot of light as it traces out any design on the face of the tube, you can learn almost as much from studying an actual picture as you can from looking at a test pattern."

"What do you mean by 'concentrating on picture elements rather than on the picture itself'?" Barney wanted to know.

"Well, suppose you are looking at Marilyn Monroe in a swim suit standing in front of a picket fence. The idea is to concentrate on the fence, noticing if the individual pickets stand out clearly and sharply even as the camera dollys out from the scene. If they do, the horizontal resolution is good, and—"

"Say no more!" Barney interrupted. "There is a limit to what you can expect of human flesh and blood."

"It will not always be that hard," Mac said with a grin. "For example, you can learn a lot about vertical and horizontal resolution by watching the stripes on a football referee's shirt as he moves about the field. If you can still distinguish these vertical stripes when he is standing upright a long ways from the camera, the horizontal resolution is good. On the other hand, if the shirt looks a sort of tattle-tale gray until he stoops over to pick up the ball and then the stripes stand out clearly, you will know that the vertical resolution is superior to the horizontal resolution—as is quite often the case.

"Other tests are the picket fence I mentioned, checked material, and brick walls. As the camera moves away from checked material, the speed with which the individual squares start running together is an indication of the resolution of the set. Some plaids will look like striped material at a little distance, and the way in which the stripes run will give an idea as to which kind of resolution is best. Mortar cracks in a brick wall also furnish reliable information. When the horizontal resolution is good, the short vertical lines between bricks will stand out as clearly and whitely as the long horizontal lines; but when this resolution is poor, the vertical lines will be dimmer and more of a gray color."

"How about linearity? I never had much luck lining that up without a test pattern."

"A bar generator is the logical instrument for this purpose, and since it is comparatively inexpensive, there is little excuse for the TV technician not having one. There may be a few times, though, when he will be called upon to correct the linearity circuits when neither a test pattern nor bar generator is right at hand. With a little patience he can still do it. Vertical linearity can be easily and quickly checked by adjusting the vertical hold control so that the picture drifts slowly downward and watching the vertical blanking bar as it moves down across the face of the screen. This bar should stay the same width. If it is wider when at the top than at the bottom, you know the picture is stretched at the top, and you correct this with the vertical linearity control. If the bar grows wider as it

(*Continued on page* 116)

International SHORT-WAVE

Compiled by KENNETH R. BOORD

A SPECIAL DX broadcast, dedicated to monitors for *RADIO & TELEVISION NEWS*, will be presented over Radio Station 4VEH, Box 1, Cap Haitien, Haiti, operating on 9.685AV in the 31-meter band, on Saturday, April 4, at 1145 (1645 *GMT*) and *repeated* the same day at 2345 (Easter Sunday 0445 *GMT*). The program will consist of transcribed greetings and a program of Easter organ melodies played by your Short-Wave Editor. Reception reports will be welcomed from any place in the world; *correct* reports will be answered by an attractive *new* QSL card. An International Reply Coupon should be enclosed with your report; if you want your QSL card by airmail, enclose sufficient IRC's to cover the cost of one unit of airmail postage to your address. At the time this was compiled, 4VEH was still seeking a clear channel but hoped by April 4 to be using 9.667 for its daily "morning" (*EST*) transmissions and 9.710 for its (Sunday *only*) "evening" (*EST*) transmission.

* * *

Will Verify

M. L. Gibson, W7JIE, Maintenance Technician, AAH, of the Alaska Communication System, says he will be glad to verify all *correct* reception reports on stations of the System by letter, *provided that a self-addressed envelope with sufficient return postage is forwarded with the report; otherwise, reports will have to be filed without reply* since the System has no funds for either QSL cards or postage for verification replies.

AAH is owned and operated by the United States Signal Corps; the headquarters station is located in Seattle, Washington; branch stations are situated throughout Alaska. Several types of transmissions are made, including broadcast; voice transmissions may be either in clear language or in one of several types of privacy. Transmitter powers range from 2.5 kw. to around 20 kw. Frequencies used are from 67.5 kc. to 19.635 mc. in all bands and with various types of radiation, dependent on the frequency and necessity. Normal direction of transmission on rhombic antennas is northwest towards Alaska; conversely, Alaskan stations transmit southeastward toward Seattle in many cases.

When circuit conditions are nonoperative or when a frequency change has been made and is being re-established, the radiotelephone circuits all utilize an identifying call tape in clear language. Normally, the radiophones operate from 3 mc. upwards with varying powers. Broadcast transmissions are made from time to time, relaying networks from Seattle to Alaska. Normally, these transmissions are preceded by one hour of test music and identification. The usual frequencies for these broadcasts—depending on the time of day—are 4.305, 6.910, 10.720, 11.995, 14.8675, 17.500, and 19.510. *There is no regular schedule for any of these broadcasts.*

Reception reports for these stations *—accompanied by a self-addressed envelope with sufficient return postage—* should be sent to: Attention: Maintenance, Room 525, Commanding Officer, Alaska Communication System, 550 Federal Office Building, Seattle 4, Washington, USA.

* * *

WRH Available Now

Of great value to all DX-ers is the 1953 Edition of *World Radio Handbook* which is now available for $1.50, postpaid, direct from Ben E. Wilbur, 1000 Connecticut Ave., N. W., Washington, D. C.

* * *

Radio Club Notes

Sweden—I have just received the monthly bulletin from the *new* Swedish club, Radioklubben Universal, Klorupsvagen 144, Trelleborg, Sweden; the publication is called "Etersvep," and has *English* as well as Swedish sections.

Current QRA for *Malmo DX-aren* is Postfack 7026, Malmo 7, Sweden.

USA—The *Newark News Radio Club*, which observed its 25th birthday on December 8, 1952, will have its 25th anniversary dinner party at the Crystal Brook, Eatontown, New Jersey, on April 18; members from far and near are expected to attend the event, according to Irving R. Potts, veteran president of NNRC.

* * *

This Month's Schedules

(*Note:* Beginning around mid-April, some stations may go on *summer* schedules; in such cases you may find schedules *one hour earlier* than listed herein.—K.R.B.)

Afghanistan—Kabul Radio, 9.975, noted 1050 with news, signing off 1102; on Sunday extends schedule to around 1130 with listeners' requests for popular music; when closing says "Goodnight, good luck, good listening;" announces as "Kabul Calling in the International Service of the Afghan Broadcasting Service;" opens daily around 1045. (Pearce, England) Also noted to 1130 Wednesdays when extended schedule features classical music, by request. (Ridgeway, South Africa)

Albania—ZAA, 6.55A, Tirana, noted at good level from around 1200 to closedown with clock chiming 10 at 1600, then choir singing to 1605; is *not* parallel with 7.850A which has a different language schedule. (Ridgeway, South Africa)

Algeria—Radio Algerie, 6.160, noted 1435 with news in Arabic. (Pearce, England)

Andorra—Radio Andorra, 5.990, is scheduled 0600-0900, 1230-1900. (WRH)

Anglo-Egyptian Sudan—Radio Omdurman announces outlets now as 30.5 m. and 48 m.; however, is heard in South Africa on 9.846V and 6.438A (moved from 9.737A and 7.000A, respectively); *English* on Fri. 1230-1300, Sun. and Wed. 1115-1130. (Ridgeway, South Africa) The 30-m. channel is heard afternoons (*EST*) in USA. (Chatfield, Bellington, N. Y., others)

Angola—Luanda, 11.862, noted to 1730 closedown; the 9.470 outlet closes 1630. (Pearce, England) *Radio Clube do Bie*, CR6RD, Silvo Porto, is back on 7.584; scheduled 1200-1545; good level, some CWQRM. CR6RF, 9.502. CR6-RB, 5.045, Benguela, noted 0630-0800, 1230-1500; the 9.165 channel is not in use now; CR6AA, 7.042, Lobito, is heard weekdays 1300-1630 (listed also 0015-0100) and 0530-0700 with Portuguese program. (Ridgeway, South Africa)

Argentina—Latest schedules from SIRA, Buenos Aires, list *English* daily over LRA, 17.720, to East Coast USA 1700-1928; LRU, 15.290, to West Coast USA 2300-0100, and LRS, 11.880, to England 1300-1358. (Lund, Iowa, others)

Australia—VLA11, 11.760, is heard occasionally around 1330 in beam to Central Europe; is usually good

(*Continued on page* 108)

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

THE MODERN BOOSTER

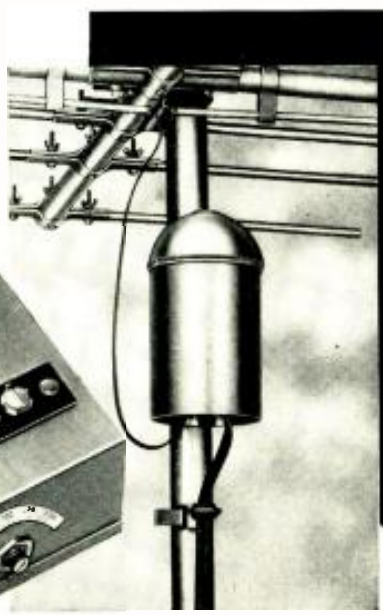


Fig. 1. (A) Right, a commercial mast-mounted TV booster. (B) Below, matching power supply.

Fig. 2. A single-channel TV booster.

By **DOUGLAS H. CARPENTER**

An analysis of modern booster circuits and the factors affecting optimum performance at very high frequencies

THE notable improvements in TV receiver performance in the past few years are a real tribute to the engineers responsible for the advancement of high frequency circuitry. The newer television sets exhibit better contrast, resolution, sensitivity, and most important, a greatly improved signal-to-noise ratio directly attributable to marked changes in tuner design. The introduction of efficient high gain tubes, such as the 6BQ7 and 6BK7, has resulted in excellent low cost "front end" amplifiers, formerly the stumbling block to extended TV coverage. Hand in hand with receiver improvement has grown the problem of providing acceptable preamplification or signal "boost" in areas remote from the TV transmitter.

The basic problem of so-called "fringe" reception is to obtain enough signal from the antenna system to override the inherent losses in the transmission line, and permit the booster-set combination to be "driven" hard enough to provide a satisfactory picture. In other words, the signal-to-noise ratio at the receiving system input has to be of a value sufficient to allow proper synchronization of the receiver sweep circuits, with enough overriding signal amplification to take advantage of weak signals. The enemy of such a desirable state of affairs is, of course, cumulative noise.

The first element to be considered in successful fringe reception is the television antenna itself. Stacked yagi types provide consistent results. A seldom considered advantage of the yagi antenna is its restricted bandwidth. This response "slices" off, or greatly attenuates noise at the channel edges. The sharp horizontal and vertical directivity patterns of such an antenna system permit only that segment of noise picked up in these sharp patterns to be delivered to the receiving system. A broadband system on the other hand, may have excellent gain, but will amplify all noise at adjacent frequencies. When extended TV reception is desired, cumulative noise becomes the most formidable problem.

Noise, or TV "snow," may be listed categorically. The first offender (which at this moment we can do nothing about) is thermal noise due to the movement of electrons in any conductor. A second type is random noise (static, ignition, etc.) which is distributed across all of the v.h.f.-band frequencies, and extends to a slightly lesser degree through the u.h.f. spectrum. Two additional types, over which the engineer has some control, are "shot" effect and partition noise. "Shot" effect is due to the irregular arrival of electrons at the plate of an amplifying tube. Partition noise is caused by the unequal division (*vs* time) of electrons between the screen grid and plate of a pentode amplifier.

To eliminate partition noise, it is only necessary to restrict design to triode amplifiers. A pentode amplifier has inherently high gain and at first it might be thought that this would be ideal for fringe amplification. The high noise factor of pentodes, however, limits their usefulness to i.f. rather than r.f. applications. In deference to manufacturers still making this type of booster, it might be said that unusual although rather unpredictable results are possible with such a circuit. The semiregenerative characteristic of a pentode tube at these comparatively high frequencies injects positive feedback that, in turn, raises the "*Q*" of the input circuit and restricts bandwidth faster than it increases noise. A marked improvement in picture reproduction may be realized at the expense of reduced audio carrier level. This is a simple method of obtaining sharp selectivity with poor resolution. Parallel amplifiers for sound and picture with positive feedback is certainly a feasible idea, but the complexity of common termination through selective filtering has not as yet been solved.

To further stress the importance of signal-to-noise, it might be in order to consider the entire approach to preamplification in the present commercial booster market. The first amplifiers available to the TV public were of the capacitively-tuned type and employed pentode tubes. As a rule, these amplifiers covered either the high or low television channels, and provided signal improvement generally because early television receivers themselves had rather low sensitivity. Noise as such was no better (or generally poorer) in receiver front ends than that generated in these early boosters.

Gradually, receiver front ends obtained higher gain from using improved pentodes such as the 6CB6 with lowered noise factor. *RCA* led the way to improved fringe reception with the still famous 630TS chassis incorporating a matched (300-ohm) input with a push-pull triode circuit. This arrangement gave sufficient amplification to deliver signal with minimum noise to succeeding stages. At this point, the early variable gain, variable bandwidth boosters began to disappear from the commercial market, and circuits of the balanced triode push-pull type came into popular acceptance. The Wallman cascode circuit consisting of a grounded-cathode, grounded-grid amplifier was introduced at the same time but was not generally used in receiver design due to unavailability of highly efficient

dual triodes with the necessary internal shielding between the two stages.

Improvements in tube manufacturing techniques have made possible the design of low noise front ends of high sensitivity. The widespread use of such receivers brought about a demand for boosters having an equal or better noise factor than that of the first r.f. stage in the TV set. Pentode boosters that would show a marked improvement when used on earlier receivers, actually impaired reception of these newer sets. This basic problem of signal-to-noise dictates the use of triode boosters designed first for low noise, and second for gain and proper bandwidth.

There are three different approaches to high frequency preamplification, each one having certain advantages and limitations. Broadband amplification (simultaneous boost of all channels) is useful only in distribution equipment. The relatively high internal noise factor of such amplifiers limits their application to areas of high signal level. The reason that even a properly designed broadband triode amplifier fails to compare with a selective type is more easily explained by reference to Fig. 3. The selectivity curve of the broadband amplifier in this case covers the entire low frequency television spectrum (Channels 2 to 6). The sharp curve at Channel 4 is that of a single-channel type. The single-channel booster will amplify both sound and picture, and will attenuate noise existing at frequencies (shaded portions) adjacent to the desired channel plus the rest of the band. The broadband amplifier will boost these undesired frequencies equally with the required video and sound carriers. The net result is a higher average noise level delivered to the receiver front end. One broadband amplifier that was tested employed a rather ingenious load circuit consisting of a series resonant combination for the high channels, with parallel constants for the lows. At the high channels the parallel combination "looked" like an r.f. choke allowing independent operation of the high channel series load. At the low channels, the series combination was a low impedance and the parallel circuit comprised the entire tube load. This arrangement permitted a single tube to do the work of two. This particular amplifier had four stages, and although the total gain was better than 6 db higher than that of a single-channel booster, it failed to give equal results when compared on weak signals. As mentioned earlier, this system would make an excellent distribution amplifier, but not as effective a fringe booster.

When designing equipment for operation in areas remote from the TV transmitter, this basic problem of signal-to-noise and noise-to-bandwidth is the limiting factor of satisfactory reception. The same problem exists in antenna design, and the curves of Fig. 3 would be representative of a broadband and a yagi type antenna system. These curves could also represent a broadband antenna system used in conjunction with a selective booster. This, in turn, explains why a greater improvement is noticed when a single-channel booster is used with a broadband antenna, than when used with a single channel type.

The tunable booster is probably the most popular type in use today, although it has severe limitations from an engineering standpoint. Single tube, tunable boosters suffer from two practically unavoidable problems. Tracking of the plate and grid load circuits is preset at the factory. This is usually performed by attaching transmission lines (representative of the average field installation) to the input and output terminals. Once the tuned circuits have been aligned, it is assumed that they will hold this alignment when connected to random lengths of transmission line (from the antenna) and to the variable input impedances of receivers X, Y, and Z. Unfortunately, a liberal standing-wave ratio usually exists on both the input and output transmission lines with the booster in the circuit. The reactive component (due to improper termination) detunes the plate and grid circuits, many times in the opposite direction. This means that the selectivity curve is broadened with a resulting deterioration in performance. Fig. 4 illustrates two different types of input circuits used in modern boosters, and it can be clearly seen why the above condition exists.

A second limitation occurs in the tuning system proper. It has been common practice to use powdered iron cores or slug tuning to maintain a fixed "Q" and proper bandwidth in the plate and grid circuits. The use of condenser tuning would necessitate resistive loading of the tuned circuits to avoid a variable selectivity response across either the high or low television channels. Although the use of powdered iron tuning minimizes

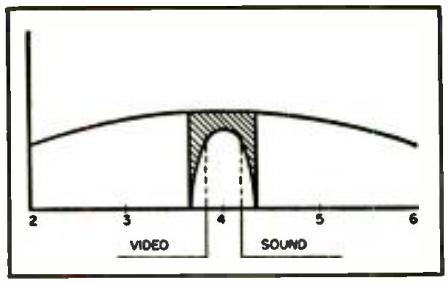


Fig. 3. Comparison between the bandwidths of a broadband and single-channel booster.

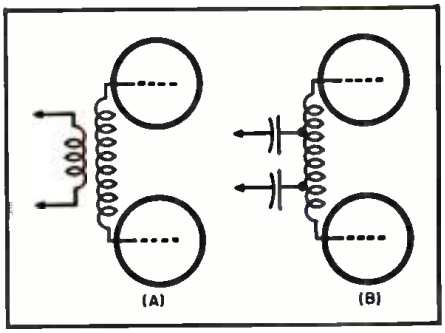
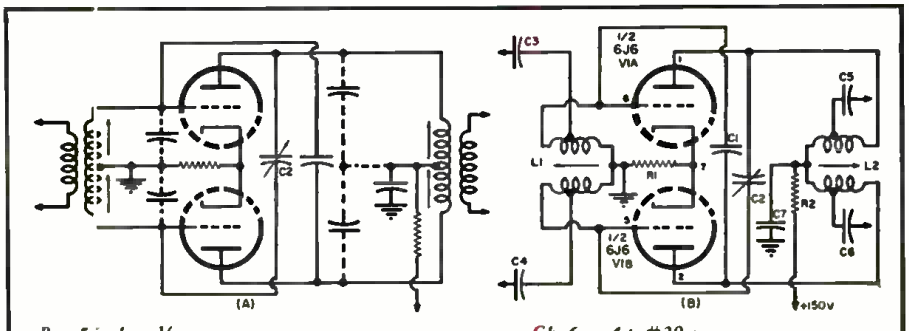


Fig. 4. Two different types of input circuit used in push-pull amplifier v.h.f. boosters.

such a condition, amplifiers covering a range of 54-88 mc. all have variable gain. This is due to the use of a single coil in the plate and grid circuits, and the variation in circuit "Q" as the slug is withdrawn from the coil. The gain of such amplifiers is generally improved as the slug is inserted in the coil, and the normal flux density is reinforced. This contributes additionally to the variable selectivity previously discussed.

A third factor, although not quite as important as the above, is in the actual construction of the coil itself. Fig. 5A is a typical push-pull triode amplifier employing separate tuning adjustments for each coil section. If all coils are resonated at the required frequency, the circuit will be balanced and the internal noise factor would be a function of the amount of negative feedback through the neutralizing

Fig. 5. (A) General circuit of a tunable push-pull triode booster. (B) Schematic of single-channel boosters shown in Figs. 1A and 2, using tapped bifilar coils.



R_1—560 ohm, ½ w. res.
R_2—2500 ohm, ½ w. res.
C_1—4" 150-ohm transmission line.
C_2—2 5" pieces insulated hook-up wire. Twist together to increase capacitance.
C_3, C_4, C_5, C_6—56 μμfd. ceramic cond.
C_7—500 μμfd. ceramic cond.
L_1—Bifilar turns each side (see text).*
Ch. 2 6 t. #20 en.
Ch. 3-5 5 t. #20 en.
Ch. 6 4 t. #20 en.
Ch. 7-13 3 t. #20 en.
L_2—Bifilar turns each side (see text).*
Ch. 2-5 6 t. #20 en.
Ch. 6 5 t. #20 en.
Ch. 7-13 3 t. #20 en.
V_1—6J6 tube
*Wound on ¼" o.d. x 1½", .010" wall form. Slugs are ⅜" x ¾" threaded for form.

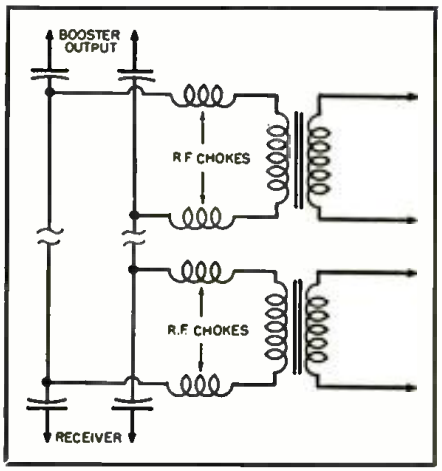


Fig. 6. Method by which a mast-mounted booster is connected to its power supply and TV receiver using one antenna transmission line.

condenser C_2. The greater the feedback through C_2, the lower the gain of the amplifier and the better the noise factor. The "Q" of the grid circuit is reduced by this arrangement, and the frequency response extended slightly. Fig. 5B is the schematic of a commercial version of the same circuit using a bifilar coil in place of the two coil sections of Fig. 5A. The only tricky adjustment is that of the variable neutralizing condenser C_2. Without equipment for adjustment, this condenser can be set using a receiver. Normal procedure is to tune the plate and grid slugs to the proper channel with C_2 set at minimum capacity. The booster will oscillate as the second slug is brought to resonance. C_2 is adjusted (higher capacity) until the oscillation stops. This is the point of maximum gain, but not that of best noise factor. Adding more capacity to C_2 will result in lowered gain and internal noise.

In making bifilar coils only one slug is used and both sections of the coil are wound on a common form. The center or r.f. ground point of both coils is located at one end (the other taps are one turn down), and the windings "criss-crossed" at opposite sides of the coil. This method has been employed in the interests of economy rather than engineering perfection. Since at any instant opposite sides of the coils are 180 degrees out-of-phase, a small voltage cancellation occurs at the crossover points of the individual windings. The arrangement assumes that tube and distributed capacity is equal across the four separate coils involved.

Production tubes and coils cannot be held to these exacting tolerances, and small circuit unbalances occur which vary the amount of effective feedback controlling the circuit gain and bandwidth. Tunable boosters definitely have their place in multi-channel areas, but do not represent the ultimate in engineering design.

Probably the best approach to signal preamplification is to design the booster for a specific frequency and to incorporate proper circuit parameters for low noise and high selectivity. Single-channel boosters have recently become popular in fringe areas due to their improved performance *vs* the tunable types. A booster operating at a single frequency has the advantage of controlled feedback, which directly determines the amount of gain, and the all-important noise factor. Since the plate and grid coils can be designed for optimum "Q" selectivity can be predetermined. When the booster is attached to the TV receiver, the plate and grid slugs may be adjusted to balance out the reactive components of the transmission line, resulting in better selectivity. The circuit of Fig. 5B is supplied with values for single-channel design.

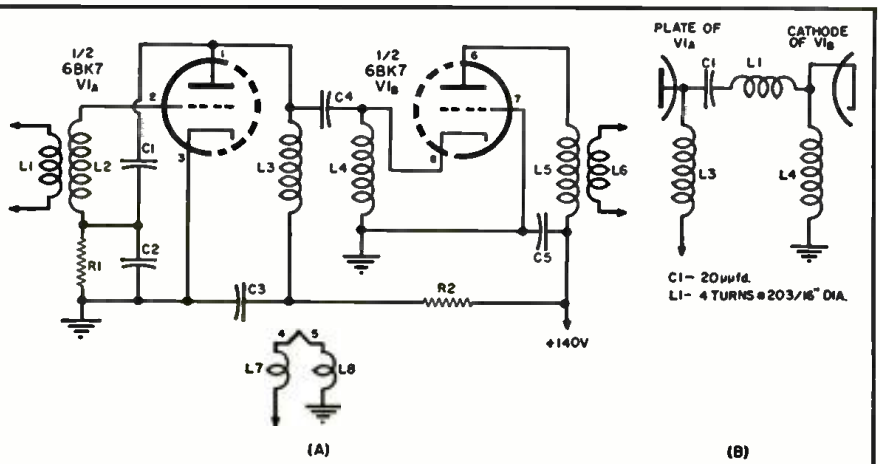
In the quest for extended television reception, mast-mounted equipment has been used extensively in fringe areas. Circuitry is the same as that of the receiver booster with the exception of the power supply. In the case of mast-mounted equipment, a maximum of twenty-four volts is permitted on transmission lines under the national electrical code. This means that the power supply at the receiver must be capable of overcoming the resistive loss of the transmission line and still deliver twenty-four volts to the mast-mounted booster. Variable supplies are necessary to insure proper operation of such external equipment. Fig. 1A is a popular mast-mounted booster, and Fig. 1B a variable power supply. Fig 6 is a commercial method for employing a common transmission line for both the power and r.f. signal without loss to either.

Mast-mounted equipment has two distinct advantages over single-channel boosters installed at the receiver. Noise picked up by the transmission line is overridden by preamplification. The r.f. losses of the transmission line are minimized by the higher signal-to-noise ratio at the booster output. Common 300-ohm polyethylene twin-lead has an average loss of 1.2 db per 100 feet on the low channels, and 3.2 db per 100 feet on the high.

Incorporation of cascode r.f. amplifiers by set manufacturers has created quite an interest in the industry for improved receiver front ends. These sets show much better pickup in areas of weak signal level. This may be directly accounted for by the quieter operation of the cascode r.f. stage. However, if a comparison is made between the cascode circuit and a properly designed push-pull triode amplifier, the difference would be barely noticeable. Push-pull amplifiers were never extensively used by set manufacturers mainly because of mechanical circuit complexity. The cascode circuit, on the other hand, adapts itself nicely to pentode circuitry.

Fig. 7A is the schematic of a commercial version of a cascode amplifier. The controlling element in this circuit is the feedback condenser C_1. Positive feedback is accomplished from the plate-to-grid circuit. The grid circuit "Q" and the first stage gain is controlled directly by this feedback path. As with the circuit in Fig. 5, noise and gain go in opposite directions, and the value of C_1 is a compromise between the two. The interstage coupling transformer is important in the design of low-channel cascode boosters, as the parallel coils L_2 and L_3 (in shunt) represent a broadband tuned load. Throughout Channels 7 to 13 the input impedance of the grounded-grid stage is of such a low value that the coupling arrangement of Fig. 7B is recommended.

Fig. 7. (A) Typical cascode type booster amplifier circuit using one of the new dual-triode tubes developed for this application. (B) High-band coupling circuit.



(A) (B)

R_1—100,000 ohm, ½ w. res.
R_2—500 ohm, ½ w. res.
C_1, C_2—5 μμfd. cond.
C_3, C_4, C_5—500 μμfd. ceramic cond.
L_1—Ch. 2-6 3 t. #20 hook-up wire.
Ch. 7-13 2 t. #20 hook-up wire.
L_2—Ch. 2-4 10 t. #20 en.
Ch. 5-6 8 t. #20 en.
Ch. 7-13 3 t. #20 en.
L_3, L_4—Ch. 2-6 17 t. #20 en.
Ch. 7-13 8 t. #20 en.
L_5—Ch. 2-4 12 t. #20 en.
Ch. 5-6 9 t. #20 en.
Ch. 7-13 4 t. #20 en.
L_6—Ch. 2-6 3 t. #20 en.
Ch. 7-13 2 t. #20 en.
L_7, L_8—16 t. #28 c.c., 3/16" form.
V_1—6BK7 tube
Note: L_1-L_6 wound on ¼" x 2" form. Slugs are ⅜" x ¼" threaded for form.

—30—

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL**	CHANNEL	FREQUENCY (mc.)	POWER (Video)*
California	Salinas	KICU	28	554-560	105
"	Stockton	KTVU	36	602-608	145
Idaho	Boise	KGEM-TV	9	186-192	32
Illinois	Chicago	WHFC-TV	26	542-548	220
Kansas	Hutchinson	KTVH	12	204-210	115
Kentucky	Louisville	WLOU-TV	41	632-638	240
Massachusetts	Northampton	. . . . .	36	602-608	21.5
Minnesota	Rochester	KROC-TV	10	192-198	105
"	St. Cloud	WJON-TV	7	174-180	23.5
Missouri	Kansas City	KCTY	25	536-542	93
"	St. Louis	KSTM-TV	36	602-608	275
"	Springfield	KYTV	3	60-66	61
Montana	Billings	. . . . .	8	180-186	12
"	Butte	KOPR-TV	4	66-72	14.5
"	Great Falls	KFBB-TV	5	76-82	9.5
New Mexico	Santa Fe	. . . . .	2	54-60	54
New Jersey	Atlantic City	. . . . .	52	698-704	20.5
New York	Jamestown	WJTN-TV	58	734-740	100
"	Kingston	WKNY-TV	66	782-788	25
North Dakota	Fargo	WDAY-TV	6	82-80	70
Ohio	Sandusky	WLEC-TV	42	638-644	18
Pennsylvania	Easton	WGLV	57	728-734	125
"	Harrisburg	WTPA	71	812-818	220
"	Hazleton	WAZL-TV	63	764-770	98
"	Pittsburgh	WTVQ	47	668-674	230
"	Pittsburgh	WENS	16	482-488	89
"	Pittsburgh	WKJF-TV	53	704-710	260
South Carolina	Greenville	WGVL	23	524-530	22
Texas	Beaumont	KMBT	31	572-578	31
"	Dallas	. . . . .	23	524-530	220
"	Galveston	KTVR	41	632-638	230
"	Houston	. . . . .	23	524-530	175
"	Houston	KNUZ-TV	39	620-636	100
"	Lubbock	KLBD-TV	11	198-204	92
"	Lubbock	KDUB-TV	13	210-216	31
"	San Angelo	KTXL-TV	8	180-186	11
"	San Angelo	KGKL-TV	3	60-66	6.4
"	Waco	KANG-TV	34	590-596	5
"	Wichita Falls	KFDX-TV	3	60-66	60
"	Wichita Falls	KTVW	22	518-524	18.5
"	Wichita Falls	KWFT-TV	6	82-88	22.5
Washington	Bellingham	KVOS-TV	12	204-210	16
"	Spokane	KHQ-TV	6	82-88	100
"	Spokane	KXLY-TV	4	66-72	100
"	Tacoma	KTNT-TV	11	198-204	29.5
"	Tacoma	KMO-TV	13	210-216	115
"	Yakima	KIMA-TV	29	560-566	55
"	Yakima	KIT-TV	23	524-530	22
Wisconsin	Green Bay	WBAY-TV	2	54-60	100
"	Madison	. . . . .	33	584-590	16.5
"	Madison	WKOW-TV	27	548-554	87
"	Neenah	WNAM-TV	42	638-644	15.5
"	Oshkosh	WOSH-TV	48	674-680	1.31
Wyoming	Cheyenne	KFBC-TV	5	76-82	5.2
Hawaii	Honolulu	KGMB-TV	9	186-192	35

Note: Dayton's WONE-TV (Channel 22) now has call letters WIFE (February listing)

*ERP = (effective radiated power). **Call letters without TV suffix from application files and subject to change; except where included in calls such as KKTV or WTVT. . . = Call letters to be announced

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AN ALL PUSH-PULL AMPLIFIER

By E. R. GAINES, W5LJW

Method of providing the requisite out-of-phase voltage without resorting to usual vacuum-tube phase inverter.

VACUUM tube phase inverters are very popular systems for obtaining out-of-phase voltage for driving push-pull audio amplifiers. Their shortcomings may be one or all of the following: low gain, unbalance, distortion, and the fact that any hum introduced in the circuit prior to or at the phase inverter is fed out-of-phase to the grids of the push-pull output stage resulting in 60 or 120 cycle output.

An excellent remedy for this headache is the elimination of the tube-type phase inverter and the utilization of push-pull stages throughout the amplifier. Out-of-phase voltage is obtained by applying the audio signal to opposite ends of a centertapped resistor or alternately to a dual potentiometer, which also serves as a volume control. Apart from the excellent balance obtained (which is dependent on the precision of the dual potentiometer), the push-pull stages convey the hum picked up in the circuit to the grids of the output stage *in phase* and the 60 or 120 cycle component has a pronounced tendency to balance out in the primary windings of the output transformer.

Fig. 2 is a diagram of an amplifier constructed by the author using a potentiometer phase inverter and push-pull stages throughout. It is indeed a high-fidelity amplifier which is relatively inexpensive—but the most interesting results observed were obtained when the gain control was set "wide open" and the ear was placed near the 15" speaker (bass reflex enclosure)—no hum could be heard! Try this on any amplifier. Good results could be obtained without any shielding at all—just twisted hookup wire running from the audio input source to the amplifier; however, shielded wire is recommended at this critical point.

A detector to enable the builder to use a radio to drive any amplifier with push-pull input provisions is shown in Fig. 1A. A crystal pickup can be used to drive this amplifier provided neither of the two "hot" terminals is grounded. (Fig. 1B). Many of the later model cartridges are grounded externally by means of a clip and present no problem, while some of the older crystal cartridges have the ground strap located in a conspicuous place and it can be removed easily.

Tone controls present no problem except a slight increase in cost. Duplicate halves are required for each side of the circuit and dual potentiometers should be used. No tone controls were used on the experimental amplifier in Fig. 2 as the response was essentially flat from 20 to 20,000 cycles and the reproduction *sounded* excellent. —30—

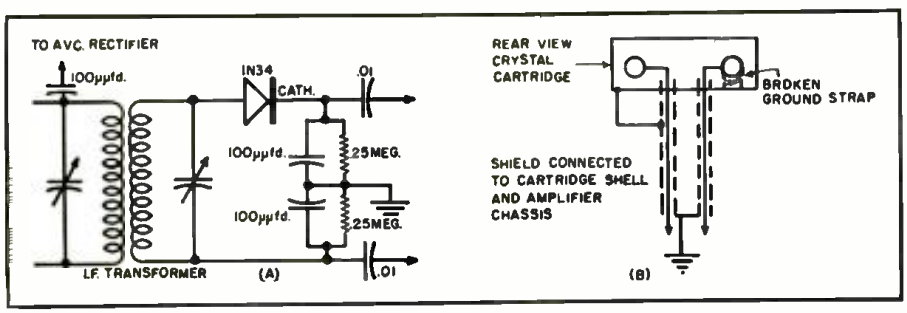
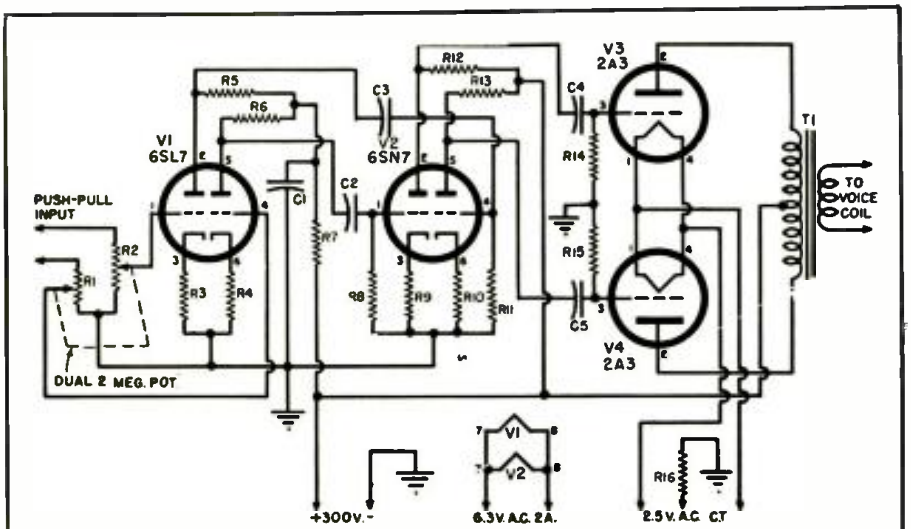


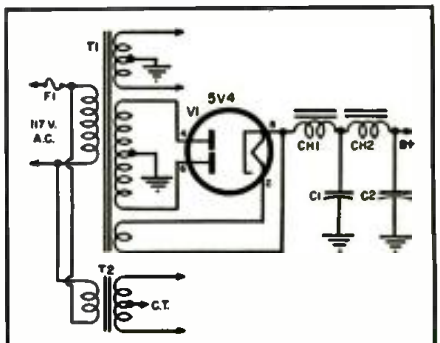
Fig. 1. (A) Detector circuit to permit radio to drive any amplifier with push-pull feature. (B) Driving the amplifier by means of a crystal pickup uses this circuit.

Fig. 2. Circuit of the author's experimental amplifier using dual potentiometers.



R_1-R_2—Dual 2 megohm pot. (See text)
R_3, R_4—4700 ohm, ½ w. res.
R_5, R_6—220,000 ohm, ½ w. res.
R_7—10,000 ohm, 1 w. res.
R_8, R_{11}—500,000 ohm, ½ w. res.
R_9, R_{10}—1500 ohm, ½ w. res.
R_{12}, R_{13}—47,000 ohm, ½ w. res.
R_{14}, R_{15}—270,000 ohm, ½ w. res.
R_{16}—350 ohm, 10 w. wirewound res.
C_1—10 μfd., 350 v. elec. cond.
C_2, C_3, C_4, C_5—.1 μfd., 400 v. cond.
T_1—Output trans. 5000 ohms plate-to-plate to v.c.
V_1—6SL7 tube
V_2—6SN7 tube
V_3, V_4—2A3 tube

Fig. 3. Circuit diagram of the power supply.



C_1—8 μfd., 450 v. elec. cond.
C_2—40 μfd., 450 v. elec. cond.
F_1—117 v. line fuse
T_1—Power trans. to supply 250 to 300 v. d.c. @ 200 ma.; 6.3 v. centertapped @ .9 amp.; 5 v. @ 2 amps.
T_2—Fil. trans. 2.5 v. centertapped @ 5 amps. (used for 2A3's)
CH_1, CH_2—8 hy., 200 ma. filter choke (Merit C-3196)
V_1—5V4 tube

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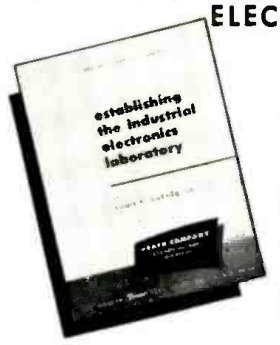

BY LOUIS B. GARNER, JR.

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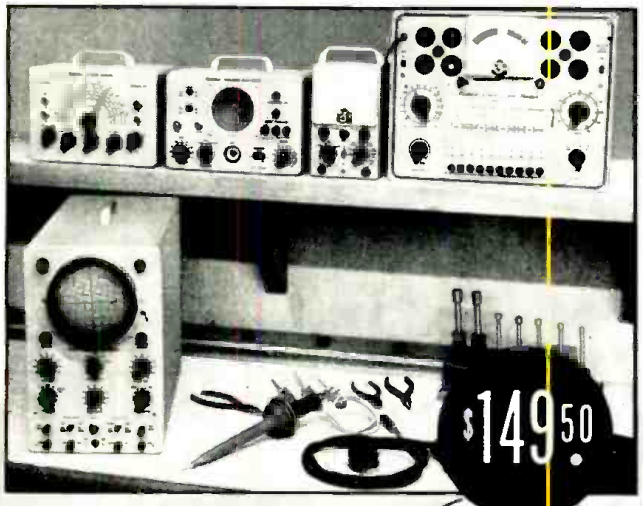

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- Signal Generator
- Signal Tracer
- Tube Checker
- TV Picture Adapter
- High Voltage Probe

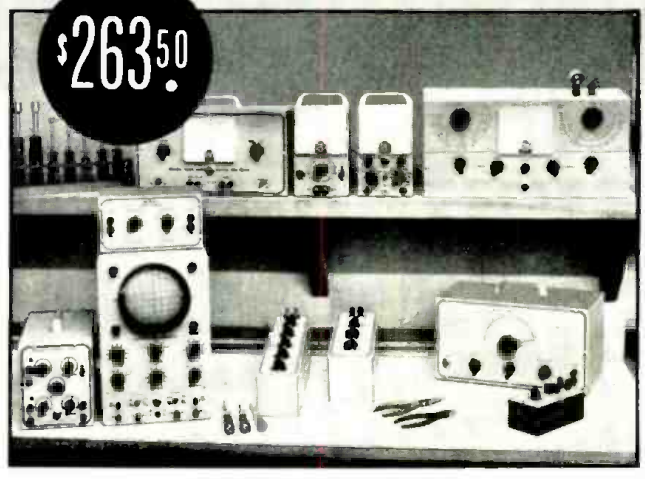
TYPICAL LABORATORY

11 Complete KITS

- Oscilloscope
- Voltage Calibrator
- Electronic Switch
- VTVM
- AC VTVM
- Power Supply
- Q Meter
- Decade Resistance
- Decade Condenser
- Resistance Substitution Box
- Audio Oscillator

This combination of eleven typical instruments, required for any Electronics Laboratory, clearly illustrates the economy offered by the purchase of Heathkit equipment. Practically an entire basic laboratory for the price of one piece of factory built equipment. These instruments can be assembled by a laboratory technician in approximately 55 actual working hours.

$263.50



Additional information regarding these instruments will be found on the following pages. Write to the Heath Company for a free catalogue listing all Heathkits—schematics—specifications and applications.

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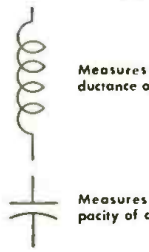
The HEATH COMPANY
. . . BENTON HARBOR 15, MICHIGAN

NEW *Heathkit* "Q" METER KIT

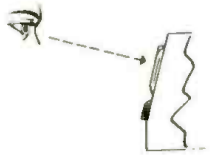
• A HIGH QUALITY Q METER AT LOW COST.

MODEL QM-1
SHIPPING WT. 12 LBS.
$39.50



Measures Q and inductance of coils.

Measures Q and capacity of capacitors.



Slant face cabinet for ease in reading the meter.

- First Q METER within the price range of all.
- Read Q's of 0-500 directly on calibrated scale.
- Stable oscillator supplies R.F. frequencies of 150 kc to 18 megacycles.
- Calibrated capacitor with range of 40 mmf to 450 mmf with vernier of ±3 mmf.
- Simple, easy operation.
- Can be used to measure small inductances or capacitors.
- Measures Q of condensers, RF resistance and distributed capacity of coils.
- Measures capacity by substitution, capacity by resonance, inductance by resonance.
- Slanted panel for convenient operation.

Another outstanding example of progressive HEATHKIT engineering. Now a highly desirable Q METER within the price range of all laboratories, schools and experimenters. No longer is it necessary to deny yourself the many measurement advantages offered by this instrument.

Use the new HEATHKIT Q METER for the following simple basic measurements: capacity by substitution, capacity by resonance, inductance by resonance and Q at the OPERATING frequency all can be read on the calibrated scales. The method used to obtain information regarding the Q of condensers, RF resistance, distributed capacity in coils, etc., is only slightly more involved. In the HEATHKIT Q METER, the generated RF signal is coupled through a cathode follower and injected across a low impedance condenser which is included in the resonant circuit under test. Large 4½" 50 microampere Simpson meter reads Q directly. The resonating condenser and vernier condenser are calibrated in mmf for substitution method capacity tests. The resonating condenser is also calibrated in effective capacity for resonance tests. The inductance calibration serves for rapid determination of the approximate inductance of a coil. The HEATHKIT Q METER has a generator frequency range of 150 kc to 18 megacycles. Vernier capacity covers ± 3 mmf and the resonating condenser is calibrated from 40 mmf to 450 mmf actual capacity or 40 mmf to 350 mmf effective capacity. Meter reads Q directly up to 250. Higher and lower full scale readings can be obtained by varying the injection voltage levels.

The entire kit consists of 12AT7, 6AL5, 6C4, OD3 and 6X5 tubes, 50 microampere Simpson meter, power transformer, cabinet and all other parts necessary for construction as well as instructions for assembling, testing and operation of the completed instrument.

Heathkit DECADE RESISTANCE KIT

The HEATHKIT DECADE RESISTANCE KIT is widely used by schools, experimenters and laboratories because of the extremely wide resistance range offered and the useful, dependable service provided. The DECADE consists of 5 rotary 2 deck ceramic wafer switches with silver plated contacts and twenty 1% precision resistors in a circuit which provides the resistance range of 1 ohm to 99,999 ohms in 1 ohm steps. The HEATHKIT DECADE RESISTANCE KIT is simple to construct and is housed in a beautiful polished birch cabinet with an attractive panel. The DECADE will furnish years of accurate trouble-free service.

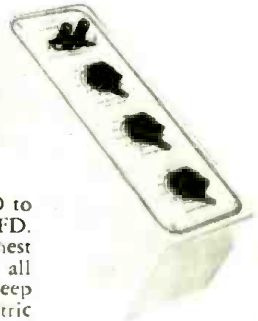
Individual decade sections of above can be purchased separately for special applications.

MODEL DR-1
SHIPPING WT. 4 LBS.
$19.50

NEW *Heathkit* DECADE CONDENSER KIT

Extremely useful in all experimental and design work such as determination of condenser values for: compensating networks, filters, bridge impedances, tuned circuits, etc. *Uses all precision silver mica condensers within ±1% accuracy.* Values run in three decades from 100 MMFD to 0.111 MFD in steps of 100 MMFD. Smooth acting, positive detent, highest quality ceramic wafer switches make all capacitor values easy to set up and keep losses to a minimum. Low loss dielectric terminal board mounts on outside of panel for easy cleaning. Heathkit binding posts accommodate a wide variety of test leads. Comes complete with all parts, including polished birch cabinet.

Individual decade sections of above can be purchased separately.



MODEL DC-1
SHIPPING WT. 4 LBS.
$16.50

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The HEATH COMPANY
. . . BENTON HARBOR 15, MICHIGAN

NEW *Heathkit* OSCILLOSCOPE KIT

• NEW WIDE BAND VERTICAL AMPLIFIER ± 2 DB 10 CYCLES TO 1 MC.

Direct plate connections for modulation tests.

Displays TV sync pulses correctly.

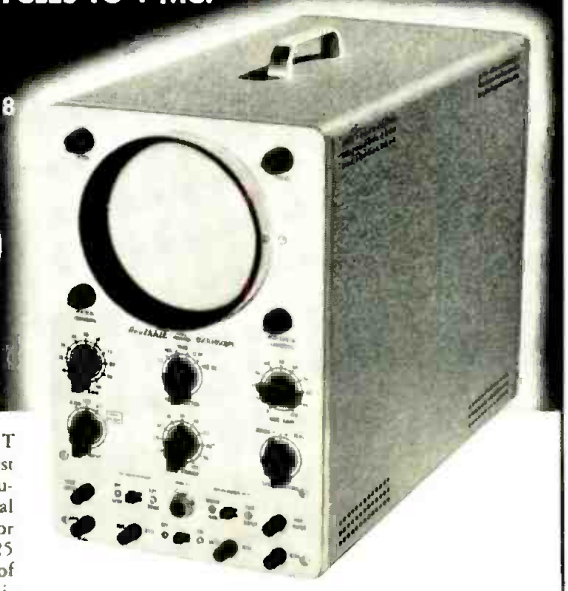
Useful to 5 mc.

Good square wave response at 100 kc.

MODEL O-8

SHIPPING WT. 29 LBS.

$43.50



- New wider band vertical amplifier ± 2 db from 10 cycles to 1 megacycle useful to over 5 megacycles.
- High sensitivity in vertical amplifier. .025 volts RMS per inch deflection.
- New 3 step input attenuator input ranges X1, X10, X100.
- Terminal board and rear cabinet opening provisions for direct connections to deflecting plates.
- Newly styled formed and ventilated aluminum cabinet.
- Wide band sweep generator, 15 cycles to over 100 kc. Will synchronize with 5 megacycle signal.
- 10 tube circuit featuring push pull operation of vertical and horizontal amplifiers.
- Internal synchronization on either positive or negative peaks.
- Reproduces faithfully the front and back porches of TV sync pulses. Excellent square wave reproduction to over 100 kc.
- Optional Intensifier kit available for 2200 volt operation.

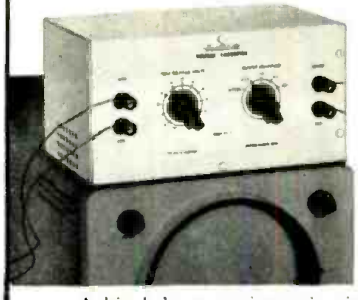
Proudly announcing the new 1953 HEATHKIT Model O-8 OSCILLOSCOPE featuring the finest performance ever offered in this extremely popular kit instrument. Improved wider band vertical amplifier featuring a new 3-step input attenuator affording smooth control of the excellent .025 volts per inch vertical sensitivity. Possibility of overloading the vertical input circuit is minimized. Greater band width in the vertical channel is a decided advantage to TV service men. Permits clear observation of all TV sync pulse detail and excellent square wave reproduction over 100 kc. A handsome, ventilated cabinet with smooth rounded corners and a snug fitting drawn panel adds to the smartly styled professional appearance. Longer life is assured through cooler instrument operation. Push pull output stages in both vertical and horizontal amplifiers for balanced deflection of the spot. All of the many fine features of the previous model have been retained. Rear cabinet access to terminal board for direct connection to CR plates. The entire kit of all 10 tubes, parts, cabinet and panel as well as detailed construction manual for assembly and operation of the instrument included.

Heathkit SCOPE DEMODULATOR PROBE KIT

Trouble shooting or aligning TV, RF, IF and video stages requires demodulation of high frequency signals before Oscilloscope observation. The HEATHKIT SCOPE DEMODULATOR PROBE KIT was specifically developed for this application. Kit consists of a probe housing, crystal diode detector circuit, shielded cable and spade lugs. Assembly is simple and the probe will quickly prove its usefulness as an Oscilloscope accessory.

No. 337
SHIP WT. 1 LB.
$4.50

NEW *Heathkit* VOLTAGE CALIBRATOR KIT



MODEL VC-1
SHIPPING WT. 5 LBS.
$9.50

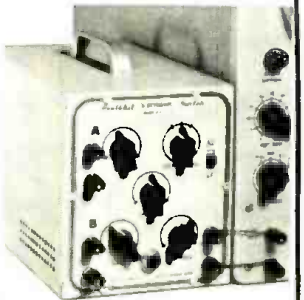
Use the Heathkit Voltage Calibrator with your oscilloscope to measure peak-to-peak TV complex waveshapes. TV manufacturer's specifications indicate correct peak-to-peak voltages and this kit will permit making these important measurements.

A big help to engineers in circuit work. Makes peak-to-peak voltage measurements of complex waveshapes of all kinds. Flat topped semi-square wave output of calibrator assures fast and easy measurement of any voltage between .01 and 100V peak-to peak.

The Voltage Calibrator can remain connected to your oscilloscope at all times for instant use. "Signal" position connects signal under study directly through calibrator and into scope input circuit for direct observation. Eliminates transfering leads from calibrator. *A wonderful scope accessory.*

Heathkit ELECTRONIC SWITCH KIT

A few dollars spent for this accessory will increase the usefulness of a scope immeasurably. An electronic switch will open up a whole new field of scope applications for you. The S-2 allows TWO SIGNALS to be observed at the SAME TIME — this important feature allows you to immediately spot phase shift, clipping, distortion, etc. The two signals under observation can be superimposed or separated for individual study. Each signal input has an individual gain control for properly adjusting scope trace patterns. Has both coarse and fine frequency controls for adjusting switching time. Multivibrator switching frequency is from less than 10 cps to over 2000 cps in three overlapping ranges. Kit comes complete including 5 tubes, power transformer, all controls, instruction manual, etc. *Every scope owner should have one!*



MODEL S-2
SHIPPING WT. 11 LBS.
$19.50

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The HEATH COMPANY

. . . BENTON HARBOR 15, MICHIGAN

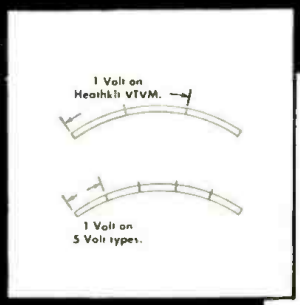
Heathkit VACUUM TUBE VOLTMETER KIT

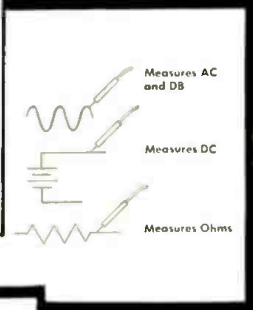
• NEW 1½ VOLT RANGE ON 1953 VTVM.

MODEL V-6

SHIPPING WT., 7 LBS.

$24.50





- New 1½ volt low range gives over 2" of scale per volt instead of less than ¾" found on 5 volt range type.
- Increased accuracy due to expanded scales.
- New 1500 volt DC high range gives 50% greater coverage.
- Seven ranges in all. 1½, 5, 15, 50, 150, 500 and 1500 volts DC (1000 volts maximum AC only).
- Provides proper service ranges 150 volts for AC DC work and 500 volts for AC type service.
- High input impedance, 11 megohms minimizes circuit loading.
- Variety of accessory probe kits available.
- 1% precision resistors in multiplier circuits.
- 200 microampere Simpson meter.
- Center scale zero adjust.
- Transformer operated.
- Test leads included.
- New cabinet styling.
- Large, clearly marked meter scales indicate ohms, AC volts, DC volts and DB.

The 1953 Heathkit V-6 VTVM has improved ranges! The lowest range has been moved way down to 1.5V full scale. This gives 3½" of actual scale length for the 1.5V covered — *that's 2⅓ inches per volt!!* Now you can make your low level measurements faster and with greater accuracy.

And the upper range has been moved up. *Readings up to 1500V DC* can be readily made with new, improved VTVM — plus readings up to 1000V on AC. Higher ranges for extended use.

New vertical chassis mounting gives added chassis space for really easy wiring — no tight corners to worry about. Uses only highest quality components throughout. Simpson 200 microampere meter movement combined with 1% precision resistors in multiplier circuit insure highly accurate and dependable readings.

AC and DC voltage ranges are 0-1.5V-5V-15V-50V-150V-500V-1500V. (1000V max. reading on AC) — a total of seven ranges for convenient, accurate readings. Instrument also measures resistance from .1 ohm to over 1 billion ohms in seven handy ranges of RX1, X10, X100, X1000, X10K, X1 Meg., — all convenient multiples of 10 with no skips. Has Db scale in red for easy indentification.

New panel has tough *baked on enamel finish* for freedom from scratches and maximum durability. Modern styled, formed, compact cabinet with rounded edges and crackle finish is truly handsome.

Comprehensive, detailed instruction manual with step-by-step instructions, figures, pictorials, etc. makes assembly a cinch.

Be sure and look over the special accessory VTVM probes below — for added usefulness.

Heathkit R. F. PROBE KIT

SHIP. WT 1 LBS. $5.50

No. 309

Extends RF range of HEATHKIT 11 megohm VTVM to 250 megacycles ± 10%.

Heathkit 30,000 V. D.C. PROBE KIT

SHIP. WT. 2 LBS. $5.50

No. 336

Provides DC multiplication factor of 100 for any 11 megohm VTVM.

Heathkit PEAK TO PEAK VOLTAGE PROBE KIT

SHIP. WT. 2 LBS. $6.50

No. 338

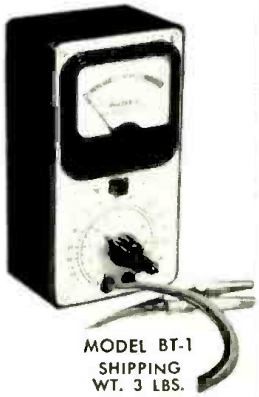
Reads on DC scale of any 11 megohm VTVM 5 kc to 5 megacycle range.

NEW Heathkit BATTERY TESTER KIT

The new Heathkit Battery Tester measures all types of dry batteries between 1½ volts and 150 volts under actual load conditions. Readings are made directly on a three-color GOOD-WEAK-REPLACE scale that your customers can readily understand. Operation is extremely simple and merely requires that the leads be connected to the battery under test. Only one control to adjust in addition to a panel switch for A or B battery types.

The Heathkit Battery Tester features compact assembly. An accurate meter movement and wire wound control mount in the portable, rugged plastic case.

Use the BT-1 to check portable radio batteries, hearing aid batteries, lantern batteries and photo flash gun batteries.



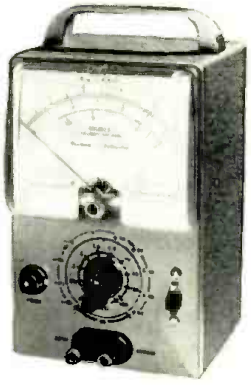
MODEL BT-1

SHIPPING WT. 3 LBS.

$7.50

Heathkit AC VACUUM TUBE VOLTMETER KIT

A new AC VTVM that makes possible those sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Ten full scale ranges of .01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts RMS. 10 DB ranges from −52 to +52 DB. Frequency response within 1 DB from 20 cycles to 50 kc. Simpson 200 microampere meter with large plainly marked meter scales. Precision multiplier resistors. Two amplifier stages using miniature tubes. A unique bridge rectifier meter circuit and a clean layout of parts. Order the AV-2 today and become acquainted with the interesting possibilities offered by this instrument.



MODEL AV-2

SHIPPING WT. 5 LBS.

$29.50

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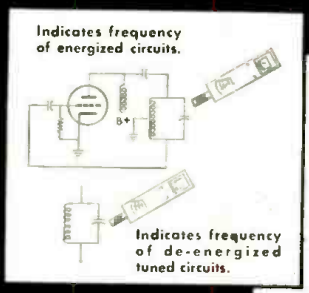
CABLE ADDRESS

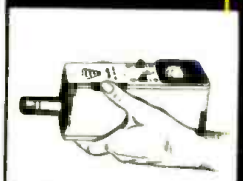
The HEATH COMPANY

. . . BENTON HARBOR 15, MICHIGAN

NEW *Heathkit* GRID DIP METER KIT

• CONVENIENT ONE HAND OPERATION.




Complete unit easily held and operated with one hand.

MODEL GD-1

SHIPPING WT. 4 LBS.

$19.50

- New GRID DIP METER with assembled calibrated coils.
- Uses quality Simpson 500 microampere meter.
- One hand operation, extremely compact, Only 2½" wide by 3" high by 7" long.
- Variable meter sensitivity control.
- Uses newest type 6AF4 high frequency triode in a Colpitts oscillator circuit.
- Continuous coverage from 2 megacycles to over 250 megacycles in 6 ranges.
- Head phone monitoring jack.
- AC power transformer operated for maximum safety.

Here is the GRID DIP METER KIT you have been asking for. This new HEATHKIT instrument is compact highly sensitive and easy to use. Housed in a handsome formed aluminum cabinet—rounded corners—durable oven baked finish on panel and cabinet. The entire instrument can be easily held and operated in one hand, tuning accomplished with the thumb wheel drive. This excellent design feature leaves the other hand entirely free for making circuit adjustments. The instrument with many applications — with oscillator energized, use it for finding the resonant frequency of tuned circuits, locating parasitics, determining characteristics of filter circuits, roughly tuning transmitter stages with power off, and neutralizing transmitters. Useful in TV and radio repair work for alignment of traps, filters, IF stages, peaking and compensation networks within the 2 to 250 megacycle range. With the oscillator not energized, the instrument acts as an absorption wave meter and indicates the frequency of radiating power sources. Locates spurious oscillations, as a relative indication of power in various transmitter stages, etc. Phone jack permits monitoring of AM transmitter for determination of radiated hum, audio quality, etc. (Head phones not included). Complete kit includes plug-in coils, tube, all necessary parts and detailed assembly and instruction manual.

Heathkit IMPEDANCE BRIDGE KIT

MODEL IB-1B

SHIPPING WT. 15 LBS.

$69.50

The HEATHKIT IMPEDANCE BRIDGE is especially useful in educational training programs, industrial laboratories and for experimental work. Use it for measuring AC and DC resistance value of resistors, determination of condenser capacitance and dissipation factor, finding coil inductance and storage factor, electrical measurements work, etc. Quality components: GR 1000 cycle hummer, GR main control, Mallory ceramic wafer silver plated contact switches, ½% precision resistors, etc. The basic circuit is a self powered, 4 arm bridge. Choice of Wheatstone, Capacitance comparison, Maxwell or Hay bridge circuits. Resistance from 10 milliohm to 10 megohm. Capacitance 10 mmf to 100 mfd. Inductance 10 microhenry to 100 henries. Dissipation factor .002 to 1. Storage factor (Q) 1 to 1000. The IMPEDANCE BRIDGE has provisions for external generator use for measurement at other than the 1000 cycle level. Take the guess work out of electrical measurements. The HEATHKIT IMPEDANCE BRIDGE mounted in a beautiful polished birch cabinet with large easy reading panel calibrations will furnish years of accurate, trouble free measurement service.

Heathkit HANDITESTER KIT

The HEATHKIT Model M-1 HANDITESTER fulfills requirements for a portable volt ohm milliammeter. This kit features precision 1% resistors, 3 deck switch for trouble free mounting of parts, specially designed battery bracket, smooth acting ohms adjust control, beautiful molded bakelite case and a 400 microampere meter movement. 5 convenient AC and DC voltage ranges as follows: 10 - 30 - 300 - 1000 - 5000 volts. Ohms ranges 0 - 3000 and 0 - 300,000. DC milliampere ranges 0 - 10 milliamperes and 0 - 100 milliamperes. The instrument is easily assembled from complete instructions and pictorial diagrams. Test leads are included. Carry the HEATHKIT M-1 HANDITESTER in your tool box at all times for those simple jobs and eliminate that extra trip for additional testing equipment.

MODEL M-1

SHIPPING WT. 3 LBS.

$13.50

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The HEATH COMPANY

. . . BENTON HARBOR 15, MICHIGAN

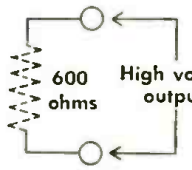
NEW Heathkit AUDIO GENERATOR KIT

• RANGE EXTENDED TO 1 MEGACYCLE

MODEL AG-8

SHIPPING WT. 16 LBS.

$29.50



Low impedance output
High voltage output

Sine wave output from 20 cycles to 1 megacycle.

- Improved design — new low price.
- Frequency coverage in five ranges from 20 cycles per second to 1 megacycle.
- Response flat 1 DB from 20 cycles to 400 kilocycles. Down 3 DB at 600 kilocycles. Down only 8 DB at 1 megacycle.
- Five calibrated output voltage ranges, continuously variable 1 mv, 10 mv, 100 mv, 1 v, 10 v.
- Low impedance output circuit. 600 ohms.
- Distortion less than .4 of 1% from 100 cycles per second through the audible range.
- New HEATHKIT universal type binding posts.
- Durable infra-red baked enamel panel.
- Transformer operated for safe operation.
- Sturdy, ventilated steel cabinet.

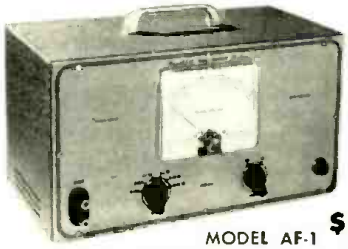
A new Audio Generator with features heretofore found in only the most expensive generators. Such features as complete coverage from 20 cycles to 1 Mc — response flat ±1 db from 20 cycles to 400 Kc, down 3 db at 600 Kc and down only 8 db at 1 Mc.

And it has calibrated output . . . Calibrated continuously variable and step attenuator output controls allow you to easily set calibrated output voltage. Moreover, distortion is less than .4 of 1% from 100 cps through the audible range.

Oscillator section consists of a two stage resistance coupled amplifier (6SJ7 and 6AK6) utilizing both positive and negative feedback for oscillator operation and reduction of distortion. Oscillator section drives a cathode follower output power amplifier (6AK6) which isolates the oscillator from variations in load and presents a low impedance output (600 Ohms). Power supply is transformer operated and utilizes 6X5 rectifier with 2 sections of RC filtering.

An unbeatable dollar value — for here is an audio generator with wide frequency coverage, excellent frequency response, stepped and continuously variable calibrated output, high signal level, low impedance output, and low inherent distortion.

Heathkit AUDIO FREQUENCY METER KIT

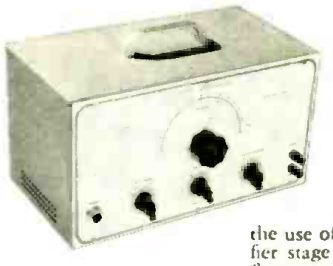


The HEATHKIT AUDIO FREQUENCY METER provides a simple and easy way to check unknown audio frequencies from 10 cycles to 100 kc between 3 and 300 volts RMS. The instrument features 7 ranges for accuracy and wide coverage. The meter itself has a quality 200 microampere Simpson movement and large clearly marked scales. The AUDIO FREQUENCY METER is transformer operated and features a voltage regulator tube to maintain constant plate voltage on the second stage. Kit supplied complete with all necessary construction material and a detailed construction manual.

SHIPPING WT. 15 LBS.

MODEL AF-1 $34.50

NEW Heathkit AUDIO OSCILLATOR KIT



A new Audio Oscillator with both sine and square wave coverage from 20 to 20,000 cycles . . . An instrument designed to completely fulfill the needs of the audio engineer and enthusiast — Has numerous advantages such as high level output (up to 10V obtainable across the entire range), distortion less than .6%, and low impedance output.

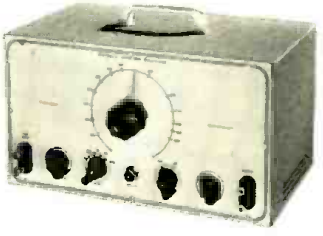
Special design features include the use of a thermistor in the second amplifier stage for keeping the output essentially flat across the entire range.

A cathode coupled clipper circuit produces good, clean, square waves with rise time of only 2 microseconds. Oscillator section uses 1% precision resistors in range multiplier circuit for greatest accuracy.

You'll like the operation of this fine new kit.

MODEL AO-1
SHIPPING WT. 14 LBS.
$24.50

Heathkit SQUARE WAVE GENERATOR KIT



The HEATHKIT SQUARE WAVE GENERATOR is an excellent square wave frequency source with wide range coverage from 10 cycles to 100 kc continuously variable. This feature makes it useful for TV and wide band amplifier work as well as audio experimentation. The output voltage is continuously variable between 0 and 20 volts. The circuitry consists of a multivibrator stage, a clipping and squaring stage and a cathode follower low impedance output stage. The power supply is transformer operated and utilizes a full wave rectifier circuit with two sections of filtering. Another excellent HEATHKIT value at this remarkable low price. Kit includes all necessary construction material as well as complete instruction manual for assembly and operation.

MODEL SQ-1
SHIPPING WT. 14 LBS.
$29.50

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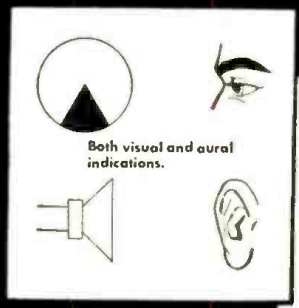
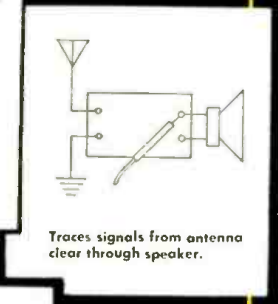
The HEATH COMPANY
. . . BENTON HARBOR 15, MICHIGAN

NEW *Heathkit* VISUAL-AURAL SIGNAL TRACER KIT

• NEW NOISE LOCATOR AND WATTMETER CIRCUITS.





MODEL T-3

SHIPPING WT. 8 LBS.

$22.50

- Permits visual signal observation as well as aural operation.
- Two separate input channels.
- Tremendous RF channel sensitivity. Adequate for actual signal detection at receiver input.
- Separate high gain RF and low gain audio channels.
- A unique and useful noise locater circuit.
- Built-in calibrated wattmeter.
- Two separate shielded probes for RF and audio application.
- Additional test leads supplied.
- Substitution test speaker and output transformer eliminates necessity for speaker removal in service work.
- Utility amplifier. Check record changers, tuners, microphones, instrument pickups, etc.
- VTVM and Scope panel terminals.
- 5 tube transformer operated circuit.

The new HEATHKIT VISUAL AURAL SIGNAL TRACER represents one of the most convenient and useful instruments the service man can use in AM, FM and TV service work. The electron ray beam indicator constantly monitors both input channels for visual observation of the signal. Now, see and hear the signal level for easier estimation of signal strength and gain per stage in a receiver circuit. Separate high gain channel and special shielded demodulator probe for RF circuit work. Low gain channel for audio circuit investigation and for use as a noise locater. In this feature, approximately 200 volts DC is applied to a suspected circuit component and the action of the voltage in the component can be seen and heard to determine satisfactory operation. This feature alone will prove tremendously helpful in locating the source of objectionable noises in coils, transformers, resistors, condensers, cold solder joints, controls, etc. A convenient wattmeter permits rapid preliminary check for voltage distribution circuit breakdown as well as transformer failures. Use the T-3 as a universal test speaker and substitution transformer and save service time by eliminating the necessity for speaker removal on every service call. Additional service uses are: as a utility amplifier for checking the output of record changers, tuners, microphones, instrument pickups, etc. Separate panel terminals permit utilization of other shop equipment such as your Oscilloscope or VTVM. Entire kit supplied complete with 5 tubes, all necessary construction material along with a detailed step by step instruction manual for the assembly and operation of the instrument.

NEW *Heathkit* CONDENSER CHECKER KIT

MODEL C-3

SHIPPING WT. 7 LBS.

$19.50

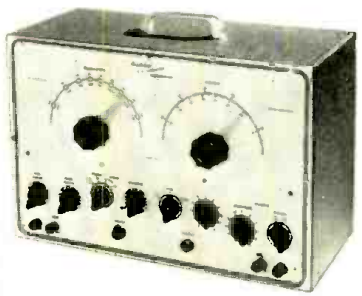
Announcing the new improved Model C-3 HEATHKIT CONDENSER housed in a new smartly styled professional appearing cabinet featuring rounded corners and snug fitting drawn panel. Adequate provisions for ventilation insures longer instrument life through cooler operation. Use the C-3 to accurately measure those unknown condenser and resistor values. All readings of condensers and resistors are read directly on the calibrated scales. Range of condenser measurements is from .00001 mfd to 1000 mfd. Calibrated resistance measurements can be made from 100 ohms to 5 megohms. A leakage test with a choice of 5 DC polarizing voltages will quickly indicate condenser operating quality under actual voltage load conditions. The spring return leakage test switch automatically discharges the condenser under test and eliminates shock hazard. An electron ray beam indicator tube is used in a new leakage test circuit for added sensitivity. The instrument is transformer operated for safety and will prove an extremely welcome addition to your shop equipment. The kit is furnished complete with all necessary parts, test leads and includes a step by step detailed construction manual for assembly and opetation.

Heathkit TV ALIGNMENT GENERATOR KIT

MODEL TS-2

SHIPPING WT. 20 LBS.

$39.50



Here is an excellent TV ALIGNMENT GENERATOR designed to do TV service work quickly, easily and properly. The Model TS-2 when used in conjunction with an Oscilloscope provides a means of correctly aligning TV receivers. The instrument furnishes a frequency modulated signal covering in 2 bands the range of 10 to 90 megacycles and 150 to 230 megacycles. An absorption type frequency marker covers from 20 to 75 megacycles in 2 ranges: therefore you have a simple, convenient means of checking IF's independent of oscillator calibration. Sweep width is variable from 0 to 12 megacycles. Other excellent features are horizontal sweep voltage controlled with a phasing control — both step and continuously variable attentuation for setting the output signal to the desired level — a convenient stand by switch — and blanking for establishing a single trace with a base reference level. Make your work easier, save time and repair with confidence. Order your HEATHKIT TV ALIGNMENT GENERATOR now.

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CABLE: ARLAB, N.Y.

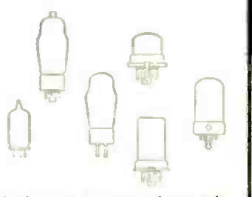
The HEATH COMPANY

. . . BENTON HARBOR 15, MICHIGAN

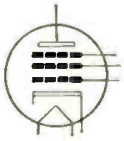
Heathkit TUBE CHECKER KIT

MODEL TC-1
SHIPPING
WT. 12 LBS.

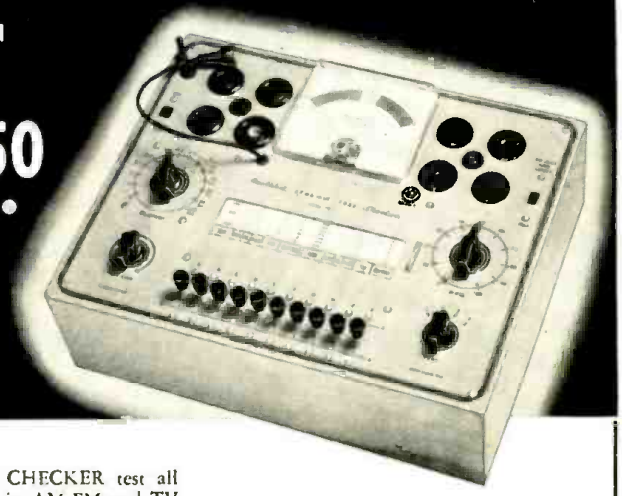
$29.50



Checks 7, 8, 9 prong tubes, octals, loctals, 7 and 9 prong miniatures, 5 prong Hytrons, pilot lights.



Checks for opens, shorts, emission, filament and filament tap continuity.



- Beautiful counter type birch cabinet.
- 4½" Simpson 3 color meter.
- Simplified setup procedure.
- Built-in gear driven roll chart.
- Checks emission, shorted elements, open elements and continuity.
- Complete protection against obsolescence.
- Sockets for every modern tube.
- Blank for new types.
- Individual element switches.
- Contact type pilot light test socket.
- Line adjust control.

PORTABLE TUBE CHECKER KIT
MODEL TC-1P

Same as TC-1 except supplied with polished birch cabinet (with removable lid) instead of counter type cabinet. Shipping weight 14 lbs..... **$34.50**

No. 365 Polished Birch Tube Checker Cabinet only. Shipping Weight 7 lbs..... **$7.50**

With the HEATHKIT TC-1 TUBE CHECKER test all types of tubes commonly encountered in AM-FM and TV receiver circuits. Test setup procedure is simplified, rapid and flexible. Tube quality is read directly on a beautiful 4½" Simpson three color BAD - ? - GOOD scale that your customers can readily understand. Panel sockets accommodate 4, 5, 6 and 7 prong tubes, octals, loctals, 7 and 9 prong miniatures, 5 prong Hytrons, a blank socket for new tubes and a contact type socket for quick checking of pilot lights. Built-in gear driven roll chart for instant reference. Neon short indicator, individual three position lever switch for each tube element, spring return test switch, line set control to compensate for supply voltage variations. At this low price, no service man need be without the advantages offered by the HEATHKIT TUBE CHECKER.

Heathkit TV PICTURE TUBE TEST ADAPTER

Use your HEATHKIT TUBE CHECKER with this new TV TEST ADAPTER to determine picture tube quality. Check for emission and shorts, independent of TV power supply. Consists of standard 12 pin TV tube socket, 4 feet of cable, octal socket connector and data sheet. Quickly prove TV picture tube condition to yourself and your customer.

No. 355
Ship. Wt. 1 lb.
$4.50

Heathkit RESISTANCE SUBSTITUTION BOX KIT

MODEL RS-1
SHIPPING
WT. 3 LBS.

$5.50

NEW HEATHKIT RESISTANCE SUBSTITUTION BOX KIT provides switch selection of any single one of 36 RTMA 1 watt 10% standard value resistors, ranging from 15 ohms to 10 megohms. This coverage available in 2 ranges in decades of 15, 22, 33, 47, 68 and 100. Housed in rugged plastic cabinet featuring new HEATHKIT universal type binding posts. The entire kit priced less than the retail value of the resistors alone.

Heathkit BATTERY ELIMINATOR KIT

A clean 6 volt d-c supply source is definitely required for successful automobile radio servicing. Has a continuously variable d-c output from 0 to 8 volts. It can be safely operated at a steady 10 ampere level and will deliver up to 15 amperes for intermittent periods. The voltage output terminals are completely isolated from the chassis to accommodate additional service applications such as supplying bias voltages or d-c substitution voltages for battery operated tube filament circuits.

The output of the Battery Eliminator is constantly monitored by a d-c voltmeter and a d-c ammeter. The circuit features an automatic overload relay of self resetting type. For additional protection, a panel mounting fuse is provided. Build this kit in a few hours and pocket a substantial savings.

MODEL BE-3
SHIPPING
WT. 20 LBS.

$24.50

Heathkit VIBRATOR TESTER KIT

Repair time is valuable, and the Heathkit Vibrator Tester will save you hours of work. Instantly tells the condition of the vibrator under test — and the check is thorough and complete. Checks vibrator for proper starting, and the easy-to-read meter indicates the quality of output on large BAD-GOOD scales. Tests both interrupter and selfrectifier types of vibrators. Five different sockets for checking hundreds of vibrators.

Operates from any battery eliminator capable of delivering continuously variable voltage from 4 - 6V at 4 amps. The Heathkit BE-3 Battery Eliminator is ideal for operating this kit.

Faulty vibrators can be spotted within seconds and you're free to go on to other service jobs.

MODEL VT-1
SHIPPING
WT. 7 LBS.

$14.50

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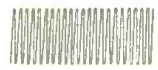
Heathkit SIGNAL GENERATOR KIT

Modulated or unmodulated RF output.



400 cycle sine wave output.

MODEL SG-7

SHIPPING WT. 7 LBS.

$19.50

- Step attenuated RF ouput.
- 6 to 1 vernier dial ratio.
- Turret mounted coil sub-assembly.
- Pre-calibrated and adjusted coils.
- Hartley RF oscillator circuit.
- Colpitts ascillator 400 cycle sine wave output.
- Modulated or unmodulated RF output.
- Frequency coverage on fundamentals 160 kc to 50 megacycles in five ranges. 51 megacycles to 150 megacycles on calibrated harmonics.
- RF output in excess of 100,000 microvolts.
- Audio output 1½ to 2 volts.
- AC transformer operated.
- Professionally styled cabinet.
- Infra red baked enamel panel.

The new HEATHKIT Model SG-7 SIGNAL GENERATOR easily fulfills requirements for a controllable, modulated or unmodulated source of variable frequency. A convenient 400 cycle sine wave output is available for audio work. All RF oscillator coils are precision wound and adjusted to calibration before shipment thereby assuring maximum accuracy. The coils, band switch and tuning condenser all mount as a turret assembly so as to offer the advantage of short wiring leads and easy mounting of parts. The RF output circuit is of the low impedance type obtained by the use of cathode coupling to the output jacks. The level of RF output is varied by means of the RF step and RF output control. Use the HEATHKIT SG-7 as an RF signal source modulated or unmodulated for radio repair, laboratory work, experimental testing, 400 cycle sine wave audio testing, checking RF stages, alignment of both AM and FM IF stages, marker generator for TV alignment, etc. The kit is transformer operated and utilizes miniature tubes for ease in handling high frequency. Panel jacks and a convenient switching system permit either external or internal modulation. The entire kit is supplied complete with tubes and all necessary material as well as a detailed step by step instruction manual for the assembly and operation of the instrument.

Heathkit INTERMODULATION ANALYZER KIT

MODEL IM-1

SHIPPING WT. 18 LBS.

$39.50

The HEATHKIT MODEL IM-1 is an extremely versatile instrument specifically designed for measuring the degree of interaction between two signals caused by a specific piece of apparatus, or a chain of equipment. It is primarily intended for tests of audio equipment but may be used in other applications such as making tests of microphones, records, recording equipment, phonograph pickups and loud speakers. Use it for checking tape or disc recordings, as a sensitive AC voltmeter, as a high pass noise meter for adjusting tape bias, cutting needle pitch or other applications. High and low test frequency source, intermodulation section, power supply and AC voltmeter all in one complete unit. Percent intermodulation is directly read on three calibrated ranges. 30%, 10% and 3% full scale. Both 4 to 1 and 1 to 1 ratios of low to high frequencies easily set up. At this low kit price YOU can enjoy the benefits of Intermodulation analysis for accurate audio interpretations.

Heathkit LABORATORY REGULATED POWER SUPPLY KIT

MODEL PS-2

SHIPPING WT. 20 LBS.

$29.50

New HEATHKIT LABORATORY POWER SUPPLY provides continuously variable regulated DC voltage output from 160 volts to 400 volts depending on load. Panel terminals supply separate 6.3 V. AC supply at 4 amperes for filament circuits. A 3½" plastic cased panel mounted meter provides accurate metered output for either voltage of current measurements. Exceptionally low ripple content of .012% admirably qualifies the HEATHKIT LABORATORY POWER SUPPLY for high gain audio applications. Ideal for laboratory work requiring a reference voltage for meter calibration or for plotting tube characteristics. In service work, it can be used as a separate variable voltage supply to determine the desirable operating voltage in a specific circuit. Use it as a DC substitution voltage in trouble shooting TV circuits exhibiting symptoms of extraneous undesirable components in plate supply circuits. Entire kit, including all 5 tubes now available at this low price.

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Heathkit WILLIAMSON TYPE AMPLIFIER KIT

The new HEATHKIT WILLIAMSON TYPE AMPLIFIER- incorporates the latest improvements described in Audio Engineering's "Gilding the Lily." 5881 output tubes and a new Peerless output transformer with additional primary taps afford peak power output of well over 20 watts. Frequency response ±1 db from 10 cycles to 100 kc. allows reproduction of highs and lows with equal crispness and clarity. Harmonic and intermodulation distortion have been reduced to less than ½ of 1% at 5 watts. This eliminates the harsh unpleasant qualities which contribute to listening fatigue. Make this amplifier the heart of your radio system to achieve the fine reproduction that is the goal of all music lovers.

The HEATHKIT PREAMPLIFIER (available separately or in combination with the amplifier kit) features inputs for magnetic or low level cartridges, crystal pickups and tuners, turnover control for LP or 78 type records, individual bass and treble tone controls each providing up to 15 DB of boost or attenuation. Special notched shafts on preamplifier controls and switches adaptable to custom installation. The preamplifier can be mounted in any position and a liberal length of connecting cable is supplied. No radio experience is required to construct this amplifier. All punching, forming, or drilling has already been done. The complete kit includes all necessary parts as well as a detailed step by step construction manual with pictorial diagrams to greatly simplify the construction.

ACROSOUND TRANSFORMER OPTION. If desired, the output transformer with the kit will be the Acrosound output transformer, type TO-300. The use of this transformer permits ultra-linear operation as described in Audio Engineering's "Ultra-Linear Operation of the Williamson Amplifier."

PRICES OF VARIOUS COMBINATIONS

W-2 Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 39 lbs. **$69.50**

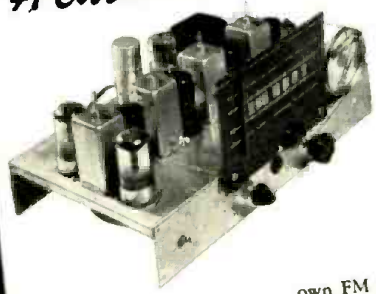
W-2M Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only **$49.75**

W-3 Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 39 lbs. Shipped express only **$69.50**

W-3M Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only **$49.75**

WA-P1 Preamplifier Kit only. Shipping Weight 7 lbs. Shipped express or parcel post. **$19.75**

Heathkit FM TUNER KIT



MODEL FM-2

SHIPPING WT. 9 LBS.

$22.50

The HEATHKIT MODEL FM-2 TUNER specifically designed for simplified kit construction features a preassembled and adjusted tuning unit. Three double tuned IF transformers and a discriminator transformer are used in an 8 tube circuit. Smooth tuning is obtained through a 9 to 1 ratio vernier drive using a calibrated six inch slide rule type dial. The usual frequency coverage of 88 to 108 megacycles is provided. Experience the thrill of building your own FM tuner. Operate it through your amplifier or radio and enjoy all the advantages of true FM reception. Transformer operated power supply to simplify connections to all types of audio systems. The kit is supplied complete with all 8 tubes and necessary material required for construction. A complete instruction manual simplifies assembly and operation.

Heathkit ECONOMY 6 WATT AMPLIFIER KIT

MODEL A-7

SHIPPING WT. 10 LBS.

$14.50

The HEATHKIT Model A-7 amplifier features beam power, push pull output with frequency response flat ±1½DB from 20 to 20,000 cycles. Separate volume, bass and treble controls. Two input circuits, output impedances of 4, 8, and 15 ohms. Peak power output rated at full 6 watts. High quality components, simplified layout, attractive gray finished chassis, break off type adjustable length control shafts and attractive lettered control panel.

THE MODEL A7A amplifier incorporates a preamplifier stage with special compensated network to provide the necessary voltage gain for operation with variable reluctance or low output level phono cartridges. Excellent gain for microphone operation in a moderate powered sound system..... **$16.50**

Heathkit HIGH FIDELITY 20 WATT AMPLIFIER KIT

The HEATHKIT MODEL A-8 amplifier kit was designed to deliver high fidelity performance with adequate power output at moderate cost. The frequency response is within ± 1 DB from 20 to 20,000 cycles. Distortion at 3 DB below maximum power output at 1000 cycles is only .8%. The amplifier features a Chicago power transformer in a drawn steel case and a Peerless output transformer with output impedances of 4, 8, and 16 ohms available. Separate bass and treble tone controls permit wide range of tonal adjustment to meet the requirements of the most discerning listener. The amplifier uses a 6SJ7 voltage amplifier, a 6SN7 amplifier and phase splitter and two 6L6's in push pull output and a 5U4G rectifier. Two input jacks for either crystal or tuner operation. The kit includes all necessary material as well as a detailed step by step construction manual.

MODEL A-8

SHIPPING WT. 19 LBS.

$33.50

MODEL A8-A features an added 6SJ7 stage (preamplifier) for operating from a variable reluctance cartridge or other low output level phono pickups. Can also be used with a microphone. A 3 position panel switch affords the desired input service. **$35.50**

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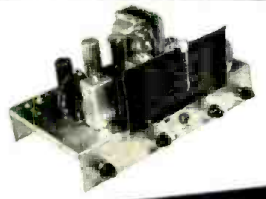
Heathkit SUPERHETERODYNE RECEIVER KITS

- High gain dual iron core tuned type IF transformers
- AC transformer operation for safety
- Continuously variable tone control
- Sturdy punched and plated steel chassis
- Ideal for custom installation
- Full AVC action
- Inverse feedback for improved frequency response
- Kit supplied with all necessary construction material except speaker and cabinet. (Available separately if desired).

6 tube all wave circuit. 3 ranges, continuous coverage 550 kc to over 20 megacycles, shipping wt. 11 lbs.

Model AR-1

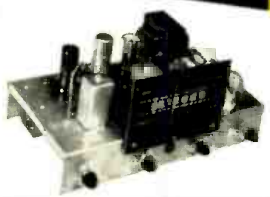
$23.50



5 tube broadcast band 550 to 1600 kc coverage, shipping wt. 11 lbs.

Model BR-1

$19.50



Two excellent radio receiver kits featuring clean design and open layout for simplified construction. Satisfy that urge to build your own radio receiver and select the model which meets your requirements. Both receivers feature continuously variable tone control, a radio phono switch and phono input and an AC receptacle for the phono motor. A six inch calibrated slide rule type dial with a 9 to 1 ratio vernier dial drive insures easy tuning.

SHIPPING INFORMATION

ON PARCEL POST ORDERS include postage for weight shown and insurance. (We insure all shipments.) Don't worry about sending more than the correct amount — if you send us too much, every extra cent will be promptly returned.

ON EXPRESS ORDERS do not include transportation charges. They will be collected by Express Agency on delivery.

ORDERS FROM CANADA must include full remittance for merchandise.

Orders processed on the same day received. Customers notified of unavoidable delay.

U. S. postal or express money orders, bank drafts or checks are acceptable. Do not send loose coins or stamps.

ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE

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- ☐ Freight
- ☐ Best Way

QUANTITY	ITEM	PRICE		QUANTITY	ITEM	PRICE	
	Heathkit Oscilloscope Kit—Model O-8 (29 lbs.)	$43.50			Heathkit Square Wave Gen. Kit—Model SQ-1 (14 lbs.)	$29.50	
	Heathkit Intensifier Kit (O-8 only) No. 339 (1 lb.)	7.50			Heathkit AC VTVM Kit—Model AV-2 (5 lbs.)	29.50	
	Heathkit Voltage Calibrator Kit—Model VC-1 (5 lbs.)	9.50			Heathkit Intermodulation Analyzer Kit—Model IM-1 (18 lbs.)	39.50	
	Heathkit Electronic Switch Kit—Model S-2 (11 lbs.)	19.50			Heathkit Regulated Power Supply Kit—Model PS-2 (20 lbs.)	29.50	
	Heathkit Scope Demodulator Probe Kit No. 337 (1 lb.)	4.50			Heathkit Handitester Kit—Model M-1 (3 lbs.)	13.50	
	Heathkit T.V. Alignment Generator Kit—Model TS-2 (20 lbs.)	39.50			Heathkit Decade Resistance Kit—Model DR-1 (4 lbs.)	19.50	
	Heathkit Q Meter Kit—Model QM-1 (12 lbs.)	39.50			Heathkit Decade Condenser Kit—Model DC-1 (4 lbs.)	16.50	
	Heathkit Grid Dip Meter Kit—Model GD-1 (4 lbs.)	19.50			Heathkit Impedance Bridge Kit—Model IB-1B (15 lbs.)	69.50	
	Heathkit VTVM Kit—Model V-6 (7 lbs.)	24.50			Heathkit Battery Tester Kit—Model BT-1 (3 lbs.)	7.50	
	Heathkit RF Probe Kit No. 309 (1 lb.)	5.50			Heathkit Resistance Substitution Box Kit—Model RS-1 (3 lbs.)	5.50	
	Heathkit HV Probe Kit No. 336 (2 lbs.)	5.50			Heathkit F.M. Tuner Kit—Model FM-2 (9 lbs.)	22.50	
	Heathkit Peak-to-Peak Volt. Probe Kit No. 338 (2 lbs.)	6.50			Heathkit Broadcast Receiver Kit—Model BR-1 (11 lbs.)	19.50	
	Heathkit Visual-Aural Signal Tracer Kit—Model T-3 (8 lbs.)	22.50			Heathkit Three Band Receiver Kit—Model AR-1 (11 lbs.)	23.50	
	Heathkit Condenser Checker Kit—Model C-3 (7 lbs.)	19.50			Heathkit Amplifier Kit—Model A-7 (10 lbs.)	14.50	
	Heathkit RF Signal Generator Kit—Model SG-7 (7 lbs.)	19.50			Heathkit Amplifier Kit—Model A-7A (10 lbs.)	16.50	
	Heathkit Tube Checker Kit—Model TC-1 (12 lbs.)	29.50			Heathkit Amplifier Kit—Model A-8 (19 lbs.)	33.50	
	Heathkit T.V. Tube Adapter No. 355 (1 lb.)	4.50			Heathkit Amplifier Kit—Model A-8A (19 lbs.)	35.50	
	Heathkit Battery Eliminator Kit—Model BE-3 (20 lbs.)	24.50			Williamson Type Amplifier Kit (Type) Shipped express only		
	Heathkit Vibrator Tester Kit—Model VT-1 (7 lbs.)	14.50			WA P1 Preamplifier Kit (7 lbs.) (Shipped exp. or p.p.)	19.75	
	Heathkit Audio Generator Kit—Model AG-8 (16 lbs.)	29.50					
	Heathkit Audio Oscillator Kit—Model AO-1 (14 lbs.)	24.50					
	Heathkit Audio Frequency Meter Kit—Model AF-1 (15 lbs.)	34.50					

*Please ship C.O.D. ☐ Postage enclosed for _____ lbs. Enclosed find ☐ Check ☐ Money Order for _____

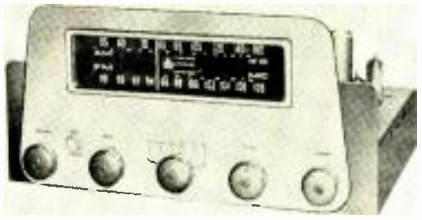
WHAT'S New in Radio

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

FM-AM TUNER

A new high-fidelity FM-AM tuner, featuring high sensitivity and push-button selection of a.f.c. action, has been introduced by *David Bogen Co.*, 29 Ninth Ave., New York 14, N.Y.

The Model R701 is a 14-tube unit which utilizes a cascode r.f. amplifier



and triode mixer to provide increased sensitivity. It requires only a 3 microvolt input for 30 db quieting. The unit has continuously variable treble and bass controls, a volume control, tuning control, and a six-position function selector switch.

DISC CONDENSERS

Erie Resistor Corporation, Erie, Pa. has a new line of high-voltage disc ceramicons available which is designed both for space saving and production economy.

The standard sizes in the new line are ⅜", 1⁹⁄₃₂", and ¾" maximum diameter. They have phenolic dipped, vacuum wax impregnated case insulation. Leads are #22 tinned copper wire. Standard d.c. working voltage ratings are 1000, 1500, 2000, 3000, 5000, and 6000 with a dielectric strength test of twice the rated working voltage.

PRINTED CIRCUIT

Circuitron, Inc., 400 Ninth St., Hoboken, N.J. is now offering a new type of printed circuit which uses a radically different method of bonding the pattern to the insulated base.

The conductive pattern can be run from one side of the base material to the other by plating through holes, maintaining circuit continuity without the need for eyelets or other hardware. This permits crossovers, greater design flexibility, and easy adaptation to single-dip soldering.

The new *"Circuitrons"* can be custom-engineered for a wide variety of applications. For full details, write the company direct.

RELAY RACK

An open-face relay rack, which is designed to accomodate 19" panels, is now being offered by *Insuline Corporation of America,* 3602 35th Ave., Long Island City 1, N. Y.

Made of ⅛" steel and finished in durable black ripple enamel, it measures 38¼" high, 20" wide, and 18⅜" deep, weighs 39 pounds, and has 36¾" of vertical panel space.

The rack, designated as catalogue No. 3913, is intended for radio transmitters, transmitter-receiver combinations, p.a. amplifiers and distribution systems, tape and wire recorders, laboratory or service shop test equipment, etc.

SOLDERING IRON

Wall Mfg. Co. of Grove City, Pa. has introduced a new instant-heat

gun-type soldering iron which does not require a transformer.

The unit has a light, plastic gun-grip, heats quickly, maintains accurate heat, and has a heat-control thermostatic action which is guaranteed for the life of the iron.

A switch-controlled spotlight makes interior soldering easier. The iron causes no radio interference when in use. It operates from 115-120 volts a.c. or d.c. and draws 400 watts in operation and 100 watts idling. A free catalogue sheet is available.

V.T.V.O.M. KIT

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7 has announced a new, low-cost, easy-to-build vacuum tube volt - ohm - milliammeter kit, the *"Knight* VTVOM."

The new unit has six ranges for measuring a.c. peak-to-peak volts, six

H. D. Suesholtz,
General Manager,
Transvision, Inc.

Servicemen, Technicians, secure your future —

I WILL START YOU in a WELL-PAYING TV SET BUSINESS

FOR THE AMAZINGLY SMALL INVESTMENT OF ONLY **$9.95**

Be a TRANSVISION Factory Agent –

and make good money full time or part time.

Would you like to boost your income with at least $2000 to $5000 a year, or more? Then get on the *Transvision Factory Agent* band wagon. Here's a golden opportunity to get that extra income you've been dreaming of—*without investing in merchandise or overhead.*

That's right — I don't tie you up with inventory. ALL YOU NEED is my SALES KIT costing only $9.95. This kit gives you our *3-Dimensional Illuminated Viewer, Natural-color Slides* displaying our complete line of gorgeous TV Sets; also our spiral-bound *Salesman's Catalog* and *price list.*

YOU CARRY NO STOCK: With my Sales Kit you sell from our million-dollar inventory. We ship either to you, or direct to your customer, as you wish. YOU MAKE 2 INCOMES FROM EACH SALE — *profit on the set,* and a fee for the *installation* (we expect all of our Factory Agents to be *competent installation-and-service men*).

YOU CAN BEAT COMPETITION: Our prices on giant screen TV sets will enable you to meet and best competition at a *good profit.*

YOU SELL THE FINEST SETS: You sell sets with the incomparable RCA-licensed 630 Chassis — the finest on the market — or the famous fine-quality Transvision A4 Chassis. You have a wider sales range — a greater choice of *Table Models, Consoles, Combinations,* in screen sizes from 17" to 21". *You have a set and a price for every prospect.*

SECURE YOUR FUTURE: Don't lose time. Get started making more money now. *Fill out and mail the coupon to me — TODAY!*

CLINCH SALES in prospect's home with my 3-Dimensional Illuminated Viewer, Natural Color Slides, and Salesman's Catalog.

We offer the LATEST, 31-tube

630 TYPE RCA licensed CHASSIS with High-Fidelity Sound

This famous Chassis offers many exclusive features, including . . . high-fidelity sound . . . flat response, 60-12,000 cycles . . . push-pull amplifier . . . 31 tubes (27 tubes, pic tube, 3 rectifier tubes) . . . designed for optimum UHF performance . . . handles all picture tubes up to 24" . . . made with only the finest parts . . . carries standard RMA Guarantee.

Buy this great Chassis direct from my factory.

SEAL OF APPROVAL · ASSOCIATED RADIO-TELEVISION SERVICEMEN · NON-PROFIT ORGANIZATION · ARTS · DEDICATED TO *Integrity* IN TELEVISION SERVICING

TRANSVISION, INC.

NEW ROCHELLE, N. Y.

NE 6-6000

RUSH THIS COUPON NOW

BEAUTIFUL, IRRESISTIBLE CABINETRY: This illustration is only suggestive of our vast line of gorgeous TV Sets. *Get the SALES KIT.* See the Natural-Color Slides. You'll agree that Transvision offers the hottest TV deal in the entire industry!

Mr. H. D. Suesholtz, Gen. Mgr.

TRANSVISION, INC., NEW ROCHELLE, N. Y. Dept. RN-4T

☐ I enclose $9.95 for your complete SALES KIT.

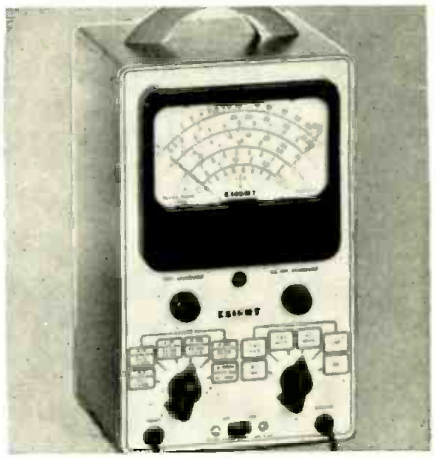
☐ I like the idea but would appreciate more details.

Name_____

Address_____

City_____ State_____

milliampere ranges, and five capacitance ranges. Frequency response is as high as 2.5 mc., adequate for TV



circuits as well as for servicing audio units.

Complete step-by-step instructions include schematic and pictorial diagrams to make assembly and wiring easy for those with some kit-building experience. The unit comes complete with all parts and a case measuring 9" high, 5⅝" wide, and 5" deep.

SEALED TRANSFORMERS

A.J.F. Industries, Inc., 852 Monroe St., Brooklyn 21, N.Y. is in production on a line of hermetically-sealed transformers which meet MIL-T-27 specifications.

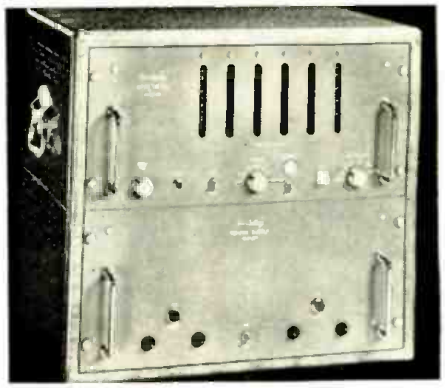
Sizes range from the sub-subminiature (less than ¼ oz.) to 1 kva. units for the audio, power, plate and filament applications covering a temperature rise of 40 to 65 degrees C.

Details on the company's line of transformers as well as delivery and other pertinent data is available from M. Clifford Agrees at the company's address.

ELECTRONIC COUNTER

Berkeley Scientific, 2200 Wright Ave., Richmond, Cal. has a new high-speed electronic counter on the market, the Model 5558.

This events-per-unit-time meter in-



corporates an accurate time base to provide an instrument that will automatically count and display the number of events that occur during a precise time interval. These events may be any mechanical, electrical, or optical occurrence that can be converted into changing voltages.

It will count events occurring either regularly or with random distribution at rates from 20 to 1,000,000 events-per-second with an accuracy of one count.

SEALED RESISTORS

The Daven Co., 191 Central Ave., Newark 4, N.J. now has available two new hermetically-sealed resistors, the Series 1160 and 1161.

Featuring rugged, shock-resistant construction which provides complete protection from corrosion, fungus, and other harmful effects of extreme humidity and temperature, these units are designed for use as secondary standards, resistance elements in bridge networks, in voltage divider circuits, in attenuation networks, etc.

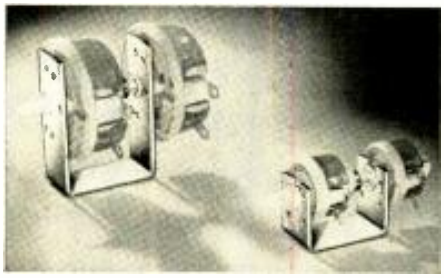
The resistors are available in a variety of characteristics depending on application. For full details write direct to Dept. HR giving application for which units are intended.

COUPLING KITS

Two new rheostat tandem coupling kits which enable purchasers to mount certain of the company's standard rheostats in tandem are now being offered by *Ohmite Mfg. Co.'s* distributors.

With the new kits, distributors can assemble tandem rheostats from standard rheostats carried in stock or can sell coupling kits for assembly by the purchaser.

Each kit consists of a steel "U" frame, mica washer, coupling, *Allen*



wrench, and assembling instructions. The large frame is designed for use with Model G, K, or L rheostats while the small frame is for use with Model H or J rheostats.

Bulletin No. 143 provides complete details on these kits.

NEW RECORDING TAPE

Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul, Minn. has developed a new magnetic tape for critical recording applications with more than double the output of any tape on the market.

Designated as "*Scotch* No. 120 High Output" magnetic recording tape, the new product is designed especially for use in radio, television, and recording studios, in computer work, and other critical applications.

The new tape produces at least 8 db more output at a given distortion level than other tapes currently available, according to the company. Output uniformity at 1 kc. is guaran-

(*Continued on page* 107)

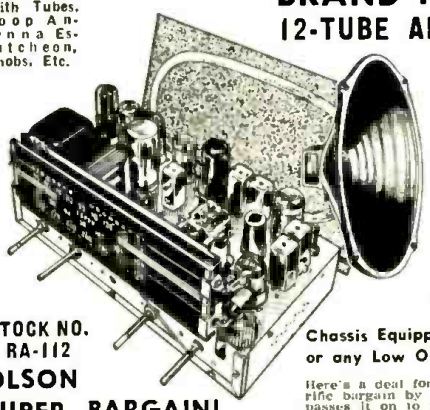
OLSON'S PENNY PROFIT POLICY MEANS GREATER BARGAINS

BRAND NEW 1953 ESPEY 12-TUBE AM-FM RADIO CHASSIS

COMPLETE WITH

12" MAGNAVOX SPEAKER

COMPLETE: With Tubes, Loop Antenna Escutcheon, Knobs, Etc.



LOOK HOW YOU SAVE

12" Magnavox Speaker . . $ 20.00
12 Tube AM-FM Chassis . 130.00

Regular List Price $150.00

DESIGNED FOR QUALITY CUSTOM INSTALLATIONS

Chassis Equipped with Built-In Pre-Amp for GE or any Low Output Variable Reluctance Pickup

STOCK NO. RA-112

OLSON SUPER BARGAIN!

BOTH FOR ONLY $66.66

Here's a deal for you! Don't pass it up. We got a terrific bargain by paying cash on the barrel-head. Olson passes it on to you. It we went out to duplicate this offer WE COULD NOT DO SO TODAY. Order Your Outfit Now!

LOOK AT THESE FEATURES: You get a full size AM-FM Chassis including 12 tubes (4 are dual purpose, thus giving you the equivalent of 16-tube performance). Push-Pull Output Audio Stage delivers 10 Full Undistorted Watts. Improved FM Circuit, drift compensated. Built-in Automatic Volume Control. Inverse Feed-back. High-Fidelity assured on both AM and FM channels. Full Range Combination Bass-Treble Tone Control. Slide Rule Dial is indirectly illuminated. Equipped with Loop-Antenna for AM and Folded Dipole Antenna for FM reception. Has provisions for external antennas too. Has Input Jack for both Crystal Cartridge Tone Arm or any Magnetic Low Voltage Cartridge. Also has Microphone Input for Public Address use. Fully licensed under both RCA and Hazeltine Patents.

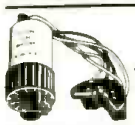
Receives standard AM broadcast 550 to 1700 KC and FM 88 to 108 MC. The FM Circuit includes an aperiodic RF Amplifier Stage. 2 Stages of High-Gain Intermediate Frequency Amplification and an advanced design Ratio Detector Circuit which provides Low Noise Level between stations, freedom from AM interference, ease of tuning and ample gain.

High-Fidelity Reproduction is assured through well-engineered Circuits and the use of High Quality Parts throughout.

TUBE COMPLEMENT: 1—6BE6, 2—6BA6, 2—12AT7, 1—6SH7, 1—6AL5, 2—6BQ7, 2—6V6GT and 1—5Y3GT. Wide Frequency Response is assured by the Push-Pull Output Stage. Chassis size 13½" wide x 9" high x 9" deep. Complete with Tubes, Knobs, Front Escutcheon, Mounting Hardware and Full Size Layout Template. Operates on 115V AC 60 Cycle.

The 12" Magnavox PM Speaker is of the Highest Quality and is found in the most expensive Console Radios. You can depend upon it to render life-like tone when connected to the chassis. All metal parts are heavily cadmium plated. Full Size Heavy Alnico 5 Magnet is permanently centered. Cone is Full Frequency Construction and the Voice Coil is Fully Dustproofed both inside and out. A Rare Combination such as this AM-FM Chassis and Magnavox 12" PM Speaker is hard to find. Here is truly a generous offer. ORDER YOUR OUTFIT TODAY! Be the envy of everyone who hears the magnificent performance of Radio at Its Best. Original Factory-Sealed Cartons. Shpg. wt. 25 lbs.

DON'T THROW AWAY OLD PICTURE TUBES



$2.95

Stock No. T-100

BOOST BRILLIANCE WITH THIS TV TUBE BOOSTER

Completely automatic. Easy to install—no tools needed. Just plug into old picture tube that is starting to dim and watch the big change. Works on any Tube—10" to 30" in all AC parallel circuits. Adds months and months of service to those old tubes. Reg. $3.95. Shpg. wt. 1 lb.

6J6

Reg. List $2.50
Single, ea., 99c
Lots of 10, 69¢ ea.

MOST POPULAR TV TUBES—Discount Over 72%

INDIVIDUALLY BOXED • BRAND NEW MADE BY LARGEST MFG.

Here's the inside story on how Olson bought these fine brand-new tubes. America's largest tube manufacturer made them and was ready to ship in a big company when they suddenly got a cancellation. Olson stepped in and made a deal and bought a terrific quantity. Then we had our "Akrad" brand put on every tube. They're individually boxed and carry the usual 100% Olson Money-Back Guarantee. Order Plenty at This Price.

REAR DECK AUTO SPEAKER KIT FOR ALL CARS

$2.95 EACH

Stock No. AS-81

Install a rear seat speaker in any car, any radio. Complete Kit of parts furnished with easy instructions. Includes beautiful grille and 3-way dashboard switch for operation of front and rear speakers separately or together. Supplied less speaker. Requires popular 6" x 9" size speaker. Shpg. wt. 3 lbs.

SPEAKER FOR AS-81 KIT

Heavy duty—high volume PM 6"x9" speaker with 3.2 ohm voice coil for AS-81 Installation. Shpg. wt. 6 lbs.

$3.39 EACH

Stock No. S-114

OLSON ELECTRIFYING BARGAIN!

THE NEW WONDER OF ELECTRONIC CONTROL CAN BE YOURS FOR PRACTICALLY NOTHING

THYRATRON REMOTE CONTROL

SERVICEMEN—HOBBYISTS—HAMS EXPERIMENTERS—RADIO SCHOOLS

You get the complete outfit, including cabinet, 3 tubes (6SL7, 6SN7 and GL-5662) and wiring diagram.

STOCK NO. RA-111
Single, each $5.99
Lots of 3, each . . . . .

$4.99

POWER CORD makes it easy to connect to 115 V AC line. Consists of 12 ft. heavy rubber covered wire with rubber molded plugs. STOCK NO. W-116, ea., 49c.

Can easily and quickly be modified for Electronic Remote Control of: Transmitters; Turn Radio and TV on and off; Open and Close Garage Doors from your car; etc.

Here's the chance of a lifetime to own a genuine Thyratron Electronic Remote Control of your own at a fraction of its regular price! This mighty handful (only 5¾"x5"x3¼") of miracle control can be made to perform hundreds of practical, fascinating feats of remote control. A complete schematic showing the circuit is included with each unit. It's a steal! Buy it just for the parts alone. Take it apart! Look what you get: 20 Valuable parts and tubes galore that you can so easily use in any other radio, amplifier, etc.—or for experimenting.

LOOK AT ALL THE PARTS YOU GET

- 6SL7 and 6SN7
- GL-5662 Tube
- 16 Mfd. @ 150 Volts
- .1 Mfd. @ 200 Volts
- .02 Mfd. @ 200 Volts
- .1 Mfd. @ 2600 Volts
- .1 Mfd. @ 200 Volts
- Control Relay
- Switch—SPST
- Pilot Lamp, Type 44
- Dial Assembly
- Control Housing
- Bottom Plate
- 5 Prong Plug
- Filament Transformer
- 175 Ohm Var. Control
- 600 Ohm Calibration Control
- 1 Megohm—½ Watt Carbon
- 2000 Ohm—½ Watt Wirewound
- 1000 Ohm—½ Watt Wirewound
- 8000 Ohm—10 Watt Wirewound
- 3000 Ohm—½ Watt Wirewound
- 1 Megohm—½ Watt Carbon
- 240,000 Ohm—½ Watt Carbon
- 2 Ohm—½ Watt Wirewound
- 1 Megohm—½ Watt Carbon
- .24 Ohm—2 Watt Wirewound
- 33 Ohm—½ Watt Wirewound
- 15,000 Ohm—½ Watt Carbon
- 500 Ohm—½ Watt Carbon

How can you lose? These parts are certainly worth THREE TIMES this amazing low cost. The General Electric Thyratron Type GL-5662 tube alone costs $3.30 wholesale. Besides, consider the plate sensitive relay, filament transformer, tubes, condensers, resistors (many of them 1% precisions). No matter how you use it, here's a great, great Olson Bargain. Operates on 115 V. AC. Shpg. wt. 5 lbs.

GIANT AKRAD "LOADMASTER" CONDENSER KIT

69 PIECES List $52.00

STOCK NO. AS-20

$16.95

4-DRAWER STEEL CABINET FREE!

Here's your chance to get 69 By-Pass and Electrolytic Olson Akrad "LOADMASTER" Condensers all packed in a Big 4-Drawer Chest (10" x 11½" x 10") which we give you absolutely FREE. Treat yourself to a supply of these high-quality Condensers and see for yourself why 150,000 Radio Repairmen insist upon Akrad.

42 "LOADMASTER" By-Pass Condensers

Qty.	Cap.	Volts	List. ea.	Total
2	.001	600	$ .25	$ .50
2	.002	600	.25	.50
2	.005	600	.25	.50
5	.01	600	.30	1.50
5	.02	600	.30	1.50
10	.03	600	.40	4.00
10	.1	600	.45	4.50
2	.005	1600	.60	1.20
2	.008	1600	.65	1.30
2	.01	1600	.65	1.30

27 Akrad "LOADMASTER" Electrolytic Condensers

Qty.	Cap.	Volts	List. ea.	Total
2	10	25	$1.00	$2.00
2	25	25	1.00	2.00
3	20	150	1.20	6.00
5	40	150	1.35	6.75
4	20-20	150	1.65	6.60
5	8	450	1.25	6.25
4	16	450	1.40	5.60

69 Condensers List Value $52.00

12" Magnavox Speaker and Baffle Close-Out

Stock No. AS-66
Get both for only . . .

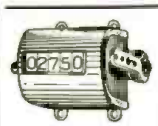
$7.95

In lots of 4 sets. One set for $8.95.

Shpg. wt. 12 lbs.

You get Magnavox's fine 12" PM speaker with Alnico 5 magnet. (Same as you'll find in those expensive Magnavox Super-Radio-Phono Combinations.) Power output 8 watts. Voice coil fully dustproofed. Impedance 6-8 ohms. In addition you get a walnut Speaker Baffle to bring out the full rich, rounded tones of the Magnavox Speaker. Baffle may be mounted on a wall or it will stand on a table. Here's the ideal combination for extension speakers for porches or other rooms. Can be connected to any radio or amplifier. Order 4 or more sets and install them in restaurants, auditoriums, halls.

DELUXE COUNTER



$1.69

Stock No. X-298

We're letting these go at a fifth of Actual Cost—$8.50. Keep an accurate count up to 100,000 on transactions, traffic, production, etc. Just touch a lever and it counts. Shpg. wt. 1 lb.

BIG INSULATED RESISTOR KIT

OLSON SPECIAL PRICE

Contains a carefully selected assortment of 100 Insulated resistors. Standard RMA color code. Included are 70—½ watt, 20—1 watt and 10—2 watt resistors. Handsomely packed in a durable pliofilm bag. Regular List Price $15.80. Shpg. wt. 2 lbs.

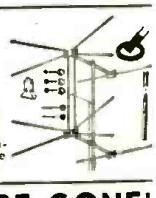
$2.99

Stock No. AS-32

COMPLETE TV ANTENNA

A complete stacked array. Made by a famous manufacturer whose name and brand is on every factory sealed carton. Look what you get: 2 Six-element coaxial bays, 1 pair "Q" bars, 2 Five-foot mast sections, 60 ft. 300 ohm twin line, 5 Standoff insulators, 1 mounting base, 1 guy ring, 1 clamp, hardware. Elements are highest quality aluminum. Reg. list price is $31.95. Shpg. wt. 15 lbs. Express only.

Stock No. AU-24



$11.99 Complete Set

NO MORE WHEN THESE ARE GONE!

SPECIAL SALE!

WILCOX-GAY RECORDIO TAPE RECORDER

2 Full Hours of Recording or Playback—Automatic—Foolproof Push-Button Controls • 2-Speeds • Records • Plays Back • Erases

STOCK NO. AMP-10
BRAND NEW REGULAR $149.95 ONLY . . .

$99.50

Order your Wilcox-Gay Tape Recorder for less than Dealer's Cost! This is the finest Recorder Olson has ever offered—at a price that is really give-away. We made a real deal and you get the benefit.

Five "Preset-o-matic" Push-button Controls allow instant choice of all operating functions—fast forward and reverse, record, stop, and playback. The easiest of all recorders to operate. Handles up to 7" reels. Full range of recording times—7" reel records for a full hour at 3.75" per second, plus another hour on other half tape; and at 7.5" per second you get a full recording hour on both halves of tape. Rewinds in less than 3 minutes.

Automatically records from FM or AM radio, phonograph, TV or mike. Plays back through powerful built-in amplifier and 5"x7" elliptical speaker. Frequency response—70-8500 cps at 7.5" per second, and 90-6000 cps at 3.75" per second. Output—2 Watts. Maximum Fidelity gained by Automatic Speed Selector.

Complete with Controlled Reluctance Mike, Record Lock Button, External Speaker Jack, Full Range Variable Tone and Volume Controls. 4 Tubes—6BJ7, 6AQ5, 12AX7, 6X4 Rectifier. 7 ft. Cord. Neon Recording Indicator. Handsome Removable Cover.

Ideal for Office, School, Church, Club, Home, etc. Lightweight, only 23 lbs. complete. Portable size 12"x14"x8". 110-120 Volt 60 cycle AC. U.L. Approved.

RECORDING TAPE—FAMOUS MFR.'S CLOSEOUT

PLASTIC BASE 600 FT. REEL
STOCK NO. X-275
Single, ea. $2.49
Lots of 10 $1.29 each

1200 FT. REEL
STOCK NO. X-249
Single, ea. $3.19
Lots of 10 $1.99 each

Get the buy of your life. Save up to 64% on high quality RECORDING TAPE. A large manufacturer had to sell his inventory and he unloaded the whole deal. Olson now offers you this high grade recording tape at prices which defy competition. Standard ¼" wide. 500 and 1200 ft. lengths. Frequency response 50 to 8,000 cy. Plastic Reel included with each. Shpg. wt. 1 lb.

USE HANDY ORDER BLANK ON NEXT PAGE ▶

OLSON AKRAD OLSON RADIO WAREHOUSE • 275 E. Market St., Akron 8, Ohio

MAIL YOUR ORDER TODAY—OLSON WILL RUSH IT RIGHT AWAY!

TOOL BARGAINS—STOCK UP NOW!

7-PIECE HEX NUT-DRIVER KIT

STOCK NO. TL-12

SET OF 7, ONLY $2.69

Latest style 7-Piece Set featuring six detachable hex nut wrench shafts. Hardened steel. Precision handle with clutch. Packed in handy plastic 7-pocket tool roll. Contains: 4½" Amber Handle with Chuck, 3/16" Hex Nut Wrench, ¼" Hex Nut Wrench, 5/16" Hex Nut Wrench, 11/32" Hex Nut Wrench, ⅜" Hex Nut Wrench, 7/16" Hex Nut Wrench. Shpg. wt. 3 lbs.

5-PIECE PLIER and SCREW DRIVER KIT

Stock No. TL-11 COMPLETE SET OF 5, ONLY $1.79

Dependable quality pliers. Amber Chuck type Handle and 3 blades. Contains: 5¾" Long Nose Pliers, 3¾" Insulated Amber Handle with Chuck, 4"x¼" Blade, 4"x¼" Blade, Phillips Blade. Shpg. wt. 3 lbs.

SET OF 3 PLIERS

STOCK NO. TL-10 COMPLETE SET OF 3, ONLY $2.79

Finest drop forged tool steel with ground and polished heads. Supplied with plastic pouch with three pockets. Contains: 7" Lineman Slip Joint Pliers, 5¾" Long Nose Pliers, 5¾" Diagonal Cutter. Shpg. wt. 3 lbs.

SET OF 6 SCREW DRIVERS

STOCK NO. TL-14 COMPLETE SET OF 6, ONLY $1.59

Featuring the new Unbreakable, flame-proof and Shock-proof handles. Set contains a wide variety of sizes for all needs. Blades firmly imbedded in handles. Contains: 8½"x3/16", 3½"x¼", 5½"x⅛", 10"x⅜", 12"x⅝", 7½" x No. 2 Philips Head. Shpg. wt. 3 lbs. We guarantee every set to be worth TWICE the prices shown.

STOP "SOLDER-JOB" HOLDUPS with WEN Soldering Guns

Fastest, most convenient way to solder. Heats almost instantly; economical trigger control saves on electric bills; built-in spotlight and "long reach" replaceable tip combine to make the tightest corner solder job easy. Sturdily constructed—heat and shock resistant fully guaranteed. 250 Watts 120V—AC. Shpg. wt. 6 lbs.

ONLY $9.71

STOCK NO. TL-22 Pkg. of 6 tips for gun. STOCK NO. TL-23 ..... $.90

25-WATT AMPLIFIER

This is one of the best amplifiers we've ever handled. Brand new in factory-sealed cartons. Order Today—you'll be glad you did. Amplifier will handle 2 high impedance microphones and one phono or radio. Tone control is latest design. Output impedances: 3.2, 4, 8, 16, 250 and 500 ohms. Shpg. wt. 20 lbs.

STOCK NO. RA-133

$34.95 LESS TUBES

KIT OF TUBES for RA-133: 1—6SQ7, 2—6SC7, 2—6L6G and 1—5U4G. STOCK NO. AS-78. ONLY $5.26

15-WATT AMPLIFIER

STOCK NO. RA-97

$24.75 LESS TUBES

Brand new. In factory sealed cartons. Here's an all around amplifier to take care of most of your PA needs. Has an input for crystal mike and phono. Separate volume controls. Also tone control. Output impedances: 4-8-16-500. Equipped with handsome grey cover. Shpg. wt. 16 lbs.

KIT OF TUBES for RA-97: 1—6SJ7, 1—6SC7, 2—6V6 and 1—5Y3GT STOCK NO. AS-54—$3.99.

BUILD YOUR OWN 3-TUBE POWER AMPLIFIER

STOCK NO. AMP-11

$7.95 LESS TUBES

Olson Super Bargain. Kit includes punched chassis, sockets, condensers, power transformer, choke, 2 controls, connectors, all hardware and complete wiring diagram. 115V AC. Input for any crystal, dynamic or ribbon mike and separate input for phono. Shpg. wt. 10 lbs.

KIT OF TUBES FOR AMP-11: 6X5, 6S.7, and 6V6GT. STOCK NO. AS-69—$2.59.

OUTPUT TRANSFORMER FOR AMP-11: Matches 6V6 to any 3.2 ohm voice coil. STOCK NO. T-57—69c.

CRYSTAL MIKES

Astatic high output crystal mike for PA systems and recorders. Equipped with handle base and 7' shielded cable. Shpg. wt. 3 lbs.

STOCK NO. M-67, each $5.95

STOCK NO. M-66, same but with on-off switch built into handle $6.95

CONDENSER KIT

YOUR COST ONLY $1.99

Stock No. AS-13

50 POPULAR BY-PASS CONDENSERS

Contains values from .0001 Mfd. to .05 Mfd. All brand new. Famous manufacturers' overstocks. List price $9.85. Shpg. wt. 2 lbs.

FREE! OLSON'S BIG NEW BARGAIN CATALOG

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UNRECOGNIZED HAZARDS IN ELECTRONICS

By **THOMAS R. HUGHES**

Elec. Safety Engr., Div. of Industrial Safety, State of California

"Familiarity breeds contempt" but technicians who ignore the dangers of carbon tet and selenium invite trouble.

WE FIND that radio technicians and electronics experts are universally ignorant of the serious toxic hazards presented by two agents commonly used in the trade. The first one we will discuss is carbon tetrachloride.

Probably the reader will say we are being absurd. He has used "carbon tet" to clean contacts of rheostats and selector switches for years and he never has heard of any trouble from its use. But the insidious aspect is that neither users nor doctors recognize the symptoms until the damage has been done.

Usually the normal radio or electronics technician does not absorb enough of it to cause harm but, if he is going to use it at all, he must be informed of the hazard. Carbon tet used to be the favorite item for removing spots in the dry-cleaning business until it was finally realized that "spotters" were dying off at an early age and spending their last few years in misery from internal disorders. The fact we want to impress on the reader is that carbon tet produces a cumulative injury—a little bit here and a little bit later.

Carbon tet is one of the family of halogenated hydrocarbons: tetrachloromethane, dichloroethylene, trichloroethylene, etc., are commonly used as degreasing agents in the manufacturing industry. Chloroform is a first cousin of carbon tet and was commonly used as an anesthetic until medical men realized the pathologic damage it was producing. Years later it was finally recognized that the whole family of compounds produce the same injuries in varying degrees.

Briefly, carbon tet (just as with chloroform) in a serious exposure, is a powerful anesthetic and narcotic; a depressant to the heart muscles; and produces lasting degeneration of the liver, pancreas, and, to a lesser degree, the kidneys. In continued but light exposures it produces gradual but progressive deterioration of the last three mentioned organs.

It is absorbed primarily through the mucous membranes of the nose and throat and the eyes, but may also be absorbed to a lesser degree through the skin. After light but continued exposure it produces these symptoms: irritation of the aforementioned mucous membranes; noticeable catarrh and coughing up phlegm from the throat; and jaundice.

If it is accidentally splashed in the eyes they must be washed thoroughly with water for 15 minutes and the patient should then be treated by an ophthalmologist.

The heavy wartime use of the halogenated hydrocarbons brought out the fact that alcoholics, diabetics, and some other individuals are especially hypersensitive or allergic to their use. It should be noted that alcohol in a person's system hastens the hepatic (liver) damage produced by these compounds.

Preventing Injury

Carbon tet is five times as heavy as air, in its vapor form. Thus the vapors tend to stay in the can or pot in which they are being used or seek a lower level when released by use outside the container. The normal use around radio shops (cleaning small parts with a small brush dipped in a pot of it) does not present much hazard if the face is kept away from the operation and it is not spilled on the hands as a regular procedure.

Records of the California Division of Labor Statistics show that the greatest number of injuries occur in the aircraft industry and related servicing. Commercial and military planes are packed with relays and controls having contacts to be cleaned. Carbon tet is by far the greatest offender although the other compounds are used in much greater quantities in degreasing equipment for parts other than electrical.

But the records show that California's large radar and television manufacturing industry runs a close second in number of injuries reported. We mention these records merely to show the technician that it is the small cleaning operation that is producing the majority of injuries and that it is such as he that are being injured.

In a large shop, where the pot of carbon tet is kept fairly busy, a local exhaust system (small blower used to pick up the vapors and discharge them outdoors) should be used at or below the point of operation. Rubber gloves should be worn by the user and a good idea is to suspend a glass window above the point of operation so that the user can do the cleaning under the glass while observing his work from above. In larger operations where it is used all day long, the man-

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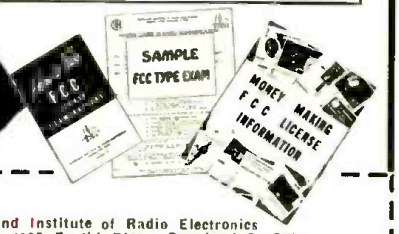

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agement can obtain diagrams or instructions on safe methods from safety organizations; employee compensation insurance groups; or the U. S. Department of Labor.

Most people realize that the burning of carbon tetrachloride vapors produces the poisonous phosgene gas. For this reason, carbon tet should not be used around open flames in any operation that liberates its vapors.

If the employer is concerned about the degree of hazard his use is producing he may call in a county or city health bureau or a hygiene engineer to take samples of the atmosphere around the operation for testing. Fifty parts per million parts of air is the maximum safe working level permitted by safety codes and 100 to 160 p/m are sure to cause chronic injury.

Another Hazardous Agent

The second substance we want to call attention to is selenium, as used in rectifiers. Although it is of no concern to the regular electronic technician, the raw selenium powder is a poison when ingested (by getting on the hands and hence into one's food, on cigarettes, or by other paths).

In the finished rectifiers it is not possible to obtain any selenium as powder but the user of such rectifiers may be subjected to the extremely poisonous fumes given off when an arc-over or burn-out occurs in a rectifier. These fumes have a very putrid odor, similar to that of rotten cabbage.

The products of the burning contain selenium dioxide and hydrogen selenide. Toxicologists recommend that continued exposure should be avoided if more than .05 parts per million of the latter substance is found in air. That is as low a permissible concentration as is set for any of the recognized fumigants so you can draw your own conclusions about the seriousness of such fumes.

When an arc-over occurs, people that are near should breathe no more than absolutely necessary until they can get out in the fresh air. Windows should be opened to remove the fumes and the equipment, containing the burned rectifier, should be taken outdoors as soon as safely possible.

It is important not to handle damaged portions of a rectifier with bare hands, for two reasons. The first is to prevent transferring any of the substance to the mouth and the second is that it can be absorbed through burns in the skin. Even when thermally cold the substance produces a form of burn, such as do caustics, and it is absorbed to a certain extent through such burned skin.

Preventing Burn-Outs

Some authorities say that selenium rectifiers will ultimately burn out in regular use, under the best of conditions, but this is disputed by others. In the light duty they perform in ordinary radio or television use, they seem to go on indefinitely if not overloaded or overstressed by faults in the equipment they supply.

As a first precaution all selenium rectifiers should have a fuse, of the correct size for the load, placed directly ahead of them. Time-lag fuses (such as the *"Slo-Blo"*) can be obtained in the small glass cartridges, in values as low as a quarter of an ampere. For half-wave rectification the a.c. fuse must be at least 2.3 times the rated d.c. current and for full-wave operation it must be at least 1.15 times the rated d.c. current of the rectifier.

The second precaution has to do with keeping rectifiers cool. Place them well away from heat producing components; always have cells (plates) in a vertical plane so the air can pass upward through them; and keep deposits of dust or fuzz out of them.

In large rectifiers for industry (such as for plating, heavy battery charging, energizing aircraft on the ground, etc.) rectifiers are worked to about 250% of normal capacity by cooling with a fan or blower. The intake of this blower may pick up a paper or rag and slap it against a section of the rectifier. If not discovered this will cause that section to overheat and burn.

In working around rectifiers, don't let hot solder or flux fall on the plates. For small loads at ordinary a.c. line voltage, use a low resistance (15 to 50 ohms) ahead of the rectifier to cut down the peak charging current.

Radio technicians are familiar with selenium rectifiers as used in power packs of radio and television sets but, since the war, these rectifiers have been invading every field. They are used in complex business machines; remote control circuits in everything from house light control to pipe organ key circuits; industrial control and chart recorders; to mention a few.

Overstressing a selenium rectifier from a voltage standpoint is more serious than from surges of heavy current, although continued overcurrent will heat up the plates. These rectifiers must never be operated at or allowed to be heated by other sources to over 140 degrees or they will certainly be due for an arc-over. Of course they should never be operated at anywhere near that temperature if one knows what he is doing.

They have a normal current rating of around 50 milliamperes per square centimeter of the cell area but this does not include the whole area of the plate. Each cell is worked at from 10 to 20 volts a.c. input.

When a rectifier has been overstressed and is about to break down, its forward resistance increases and its delivered d.c. voltage and current will fall off. Thus, if the supplied equipment is not performing properly, the voltages on the a.c. and d.c. sides of the rectifier should be compared with those of a new one of similar rating. Its use should be discontinued if the voltage is down on the d.c. side.

—30—

Code Practice Oscillator

(*Continued from page 41*)

streetcar. Probably the only difficulty encountered would be the stares of fellow passengers.

Group or Class Practice: While the unit was originally designed for private use, it is capable of giving sufficient loudspeaker volume for a class of ten to twenty students, where the background noise is kept reasonably low. Use the circuit arrangement shown in Fig. 4.

A 3" to 6" PM loudspeaker is used (better results are obtained with the larger speaker) together with a standard audio output transformer, such as the *Stancor* Type A-3856. The primary of the audio transformer is connected in place of the headphone connections (Fig. 3).

Where desired, the loudspeaker and transformer could easily be mounted in a small metal utility box or wooden baffle and plug-in leads identical to the headphone leads provided. The basic oscillator would then serve equally well for classroom (group) or private use, as required.

For practice in group sending, a hand-key may be provided for each student, with all the keys connected either in series or in parallel. If connected in series, all students except the one actually sending close the switches of their keys. Practice can be carried on in "round robin" fashion, with first one, then another, and another student sending a group of test words.

Audio Signal Source: The completed oscillator will serve as a satisfactory portable audio signal source for *signal injection* testing of phonograph amplifiers, public address systems, or the audio section of radio or television receivers.

In this application, either the "Key" or "Phones" terminals should be shorted together and a potentiometer connected between the other pair of terminals (from 500 to 47,000 ohms will be satisfactory . . . higher output voltages will be obtained with the higher resistance values). Output is obtained from the center arm of the pot and one of the outer terminals. A blocking condenser should be used if the audio signal is fed into circuits where d.c. cannot be tolerated.

In general, the audio signal obtained *will not be a sine wave,* but it is still useful for general purpose signal injection tests.

The transistor code practice oscillator described, useful in its own right, also makes an excellent construction project for the experimenter desiring to work and to gain familiarity with transistor circuits and applications. Work with comparatively simple projects helps to develop the experimenter's knowledge of transistor behavior and to instill the confidence necessary to undertake increasingly complex and more difficult projects. —30—

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Floor type mike stand instead of desk stand **$4.95** extra.
(SEE OFFERING TO THE RIGHT FOR WALL SPEAKERS INSTEAD OF THE PORTABLE SPEAKERS.)
The AP-28X P.A. system is offered with two of the 25 watt weatherproof trumpet and drivers No. MA-33 shown below in place of the two portable speakers with baffles. Specify that you want MA-33 trumpets with your amplifier and add **$35.00** to the cost. Stock No. MA-28XX. Net price **$104.95.**

28-WATT AMPLIFIER WITH 12-INCH WALL SPEAKERS

The 28 watt amplifier shown to the left is also offered without the portable speakers. In their place we will ship two Leatherette wall baffles with two heavy duty 12 inch alnico V magnet PM Speakers and 500 ohm line matching trans. Stock No. SS-28R 28 watt amplifier with 3 speed phono top with two 12 inch wall speakers. **$69.95.** Extra 12 inch wall speakers **$11.95.** Model 910 Electro Voice mike **$8.95** extra. Floor stand **$4.95** extra.

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10-tube portable 50-watt public address system. 4—6L6G (push-pull parallel) output tubes. Inputs for 2 microphones, either crystal or dynamic, with separate mixing volume controls. Twin bass and treble tone controls. High fidelity wide range output transformer with taps at 4, 8, 16, 125, 250 and 500 ohms. Complete with 2 super heavy duty 12" PM speakers and 25 ft. cables mounted in separate leatherette-covered carrying cases, 21"x21"x13". The amplifier fits in one of the cases for carrying. This amplifier will put out 40 watts all day long and 50 to 60 watts peak with ease. 3-speed turntable and pickup arm to play all records 33⅓, 45 and 78 RPM is mounted in the top of the amplifier. Stock No. AP-60X, 50 watt portable P.A. system similar to the 28-watt model pictured above, less microphone. Sale price, **$99.95.** Shipping weight, 100 lbs. Shipped via Express or Truck only.
Regular $45.00 list Electro-Voice 610 dynamic microphone with 20 ft. cable and desk stand, **$11.95** extra. For floor stand instead of desk stand, add **$4.95.**

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1L4	.59	6BA6	.49	6SA7GT	.59	12AT6	.49
1R5	.59	6BA7	.69	6SH7GT	.59	12AT7	.69
1S5	.59	6BC5	.59	6SF5GT	.59	12AU6	.59
1T4	.59	6BD6	.49	6SK7GT	.39	12AU7	.69
1U4	.59	6BF5	.59	6SL7GT	.69	12AV6	.59
1U5	.59	6BF6	.59	6SN7GT	.69	12AV7	.89
3Q4	.59	6BG6G	1.29	6SU7GT	.69	12AX4GT	.59
3Q5GT	.69	6BH6	.59	6T8	.79	12AX7	.69
3S4	.59	6BJ6	.59	6U8	.79	12BA6	.59
3V4	.59	6BK7	.99	6V6GT	.59	12BE6	.59
5U4G	.49	6BL7GT	.99	6W4GT	.59	12BD6	.59
6AB4	.69	6BQ6GT	.99	6X4	.39	12BF6	.79
6AK5	.89	6CA4	.39	6X5GT	.49	12K8GT	.59
6AL5	.49	6CB6	.59	7A7	.69	12Q7GT	.59
6AQ5	.49	6CD6G	1.49	7B6	.69	12SF5GT	.69
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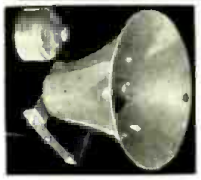

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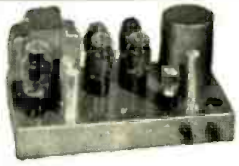
25-Watt Weather-Proof Out-Door Speaker $28.95

8" PM AND LEATHERETTE BAFFLE, $4.95 LOTS OF 10, $4.75

The finest Leatherette Baffle we have ever offered. New self-supporting plastic grill material, baffle is covered tan with matching grill. Offered with a good heavy duty 8" Alnico V PM speaker with 3.2 ohm voice coil, Stock No. 818, Speaker and Baffle, **$4.95** ea.; lots of 10, **$4.75** ea. 8" Baffle only. Stock No. NV-8. **$2.29** ea.; 10 for **$19.95.**

ORDER FOR USE WITH ANY P.A. SYSTEM OFFERED ON McGEE'S 2 PAGES OF ADVERTISING

25-WATT HORN 25-Watt Driver and 3½-foot air column re-entrant Trumpet. The standard type trumpet and driver you see the most. Drivers are 100% weatherproof, horn is spun aluminum, offered to you at a considerable savings. Stock No. MA-33. Shipping weight 20 lbs. Net price **$28.95.**



50-WATT BOOSTER AMP. $39.95

2-Mike Pre-Amp $12.95 Extra. Not a Kit, but a Manufactured Amp.

50-WATT BOOSTER A sensational value. 50 watt booster amplifier with push-pull parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X Pre-amp to add the use of 2 mikes and one low level input. The booster amplifier has one input jack and with 1 volt input gives 50 watts of audio. Booster has a 6 lb. potted case high fidelity output transformer, matches speaker with 4-8-16 ohm voice coil, also 60 ohm and 250 ohm line. Booster has a 225 mill power supply with 5U4 rectifier. Price includes tubes: 4 6L6, 7N7 and 5U4. The two variable controls are for master volume control and bass boost tone control. Size 8 x 6½ x 14½. Stock No. PA-55N. Shipping weight 26 lbs. Sale price **$39.95** ea.

2-MIKE PRE-AMP. Pre-amplifier plugs in directly to the PA-55N Booster amplifier. It enables use of 2, Crystal or Dynamic Mikes plus one low level input. Furnished with 4 foot cables and plugs for remote control of the 55 watt Booster Amplifier. Small chassis size 5 x 3¼ x 4". Stock No. PR-2X, with tubes 7F7 and 7N7. Net price **$12.95** ea.

IT'S McGEE FOR COAXIAL SPEAKERS—3-SPEED CHANGERS—FM-AM CHASSIS

McGEE'S $62.50 LIST 15" COAXIAL SPEAKER, $21.95
21 OZ. ALNICO V MAGNET—5" TWEETER

This is the finest 15" coaxial PM speaker value that we have ever offered. New 1952 production, of a famous manufacturer of fine speakers. The 15" speaker has a 21½ oz. Alnico V magnet, equivalent to 68 oz. of the Alnico 3 type magnet. The cone is free floating, of one piece construction. Will reproduce low frequencies down to 20 cps. The 5" tweeter is coaxially suspended and has a ridged cone to reproduce only the high frequencies. It will respond up to 17,500 cps. The high-pass filter is concealed under the pot cover, leaving only two wires to connect both the tweeter and woofer to any 8 ohm output transformer of a radio, or high fidelity music lover's amplifier. Stock No. P15-CR, shipping weight 13 lbs. Net price **$21.95.**

12" COAXIAL SPEAKER, $12.95

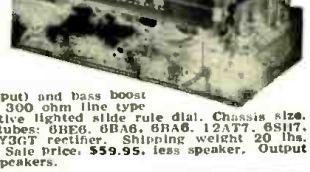
McGee offers the new 1952 model 12" coaxial PM speaker. Quality you would put in your finest sets if you were a manufacturer. 12" woofer has 6.8 oz. Alnico V magnet. Tweeter is coaxially suspended and has a metal diffuser. High pass filter is under the pot cover. Only two wires to connect to your radio or audio amplifier. 8 ohm with 18 watt peak and 10 watt average. Shipping weight 8 lbs. Response from 30 to 17,500 cps. Stock No. CU-14Y. Sale price **$12.95** each; 2 for **$25.00.**

12" JENSEN PM, $15.95

Another McGee Scoop! Jensen Concert 12", 14½ oz. Alnico V magnet PM speaker, 8 ohm voice coil. Will take 25 watt audio. You save dollars on this speaker. Just 100 to sell. Shipping weight 8 lbs. Stock No. P-12P. Sale price **$15.95;** 2 for **$30.00.**

ESPEY 12-TUBE FM-AM CHASSIS, $59.95

- ★ **BUILT-IN PRE-AMP FOR G.E. VARIABLE RELUCTANCE PICK-UP**
- ★ **WIDE RANGE AUDIO**
- ★ **WHY NOT ORDER WITH A COAXIAL SPEAKER AND A RECORD CHANGER? SEE OUR SPECIAL OFFERING**



McGee's new 1953 model 12-tube FM-AM chassis. Latest design with phono inputs for all types of record players, crystal or G.E. variable reluctance. Receives standard broadcast 550 to 1700 kc and FM 88 to 108 mc. Wide range audio response (push-pull 6V6 output) and bass boost tone control. Loop antenna for broadcast and 300 ohm line type FM antenna may be stapled in cabinet. Attractive lighted slide rule dial. Chassis size, 13½" x 9" high and 9" deep. Complete with tubes: 6BE6, 6BA6, 6BA6, 12AT7, 6BH7, 6AL5, 6SQ7, 6SQ7, 12AT7, 2—6V6GT and 5Y3GT rectifier. Shipping weight 20 lbs. Stock No. 7C-X Espey 12-tube FM-AM chassis. Sale price, **$59.95,** less speaker. Output matches voice coil of our 12" or 15" coaxial speakers.

ESPEY DEAL (1), $99.95

Espey 7-C chassis complete with 12" coaxial PM speaker CU-14Y and VM-950 G.E. 3-speed changer equipped with a G.E. turnabout variable reluctance cartridge. A better home music system than ordinarily available. Espey Deal #1. Sale price **$99.95.** With 15" coaxial PM speaker P15-CR instead of CU-14Y. **$10.00** extra.

ESPEY DEAL (2), $118.95

Espey 7-C chassis complete with 12" coaxial PM speaker CU-14Y and the English Garrard 3-speed changer equipped with a G.E. variable reluctance turnabout cartridge. Our best home music system, Espey Deal #2. Sale price **$118.95.** With 15" coaxial PM speaker P15-CR instead of CU-14Y. **$10.00** extra.

ESPEY DEAL (3) $138.95

Espey 7-C chassis complete with THREE 12" coaxial PM speakers CU-14Y (these three 12" coaxial speakers give a cone area equal to an 18" speaker) and a Garrard 3-speed changer with G.E. variable reluctance turnabout cartridge, Espey Deal #3. Sale price **$138.95.**

G.I. 3-SPEED CHANGER WITH G.E. $22.95
VARIABLE RELUCTANCE TURN-ABOUT CARTRIDGE

Another tremendous McGee Scoop! Brand new General Instrument 3-speed automatic record changers. Complete with RPX-050 G.E. variable reluctance cartridge with turn-about stylus. Plays all 3 speeds automatically: 7", 10" or 12" records. Has reject button. Repents last record. Base size, 12"x12⅞". Shipping weight 14 lbs. Stock No. 700-GE. Scoop price. **$22.95.**

GI 3-speed changer same as above, but with Webster flip-over twin needle cartridge. Stock No. GI-700. Sale price, **$21.95** each.

TELEVISION BOOSTERS AND CONVERSION KITS ON SALE AT McGEE

GENUINE STANDARD COIL T.V. BOOSTER $11.95

Not Surplus, But Right From the Factory

Latest Model B-51 Standard Coil Television Booster. McGee makes another lucky purchase and as usual, passes the saving on to you. The famous Model B-51, 12 Channel Standard Coil TV booster, which lists for $35.00, is offered to you for only $11.95 each. Brand new, factory cartoned and fully guaranteed by McGee. This top quality single stage booster utilizes printed high frequency circuits, for improved performance on all channels. Uses 6AK5 tube. Average gain, 6 to 7 volts on low channels and 5 or 6 on high channels. No distorting of picture or sound. Has extremely low noise factor. Continuous one-knob tuning and channel selector control switch for off-on and by-passing 300 ohm lead-in to set. Modern design, dark brown plastic cabinet, 8"x4¼"x4½". Made for 110 volt, 60 cycle AC operation. Shipping weight 3 lbs. Model B-51. Sale price, **$11.95** each, or buy 2 for only **$22.00.**

FRINGE AREA TV RECEPTION IS BETTER WITH OUR McMURDO SILVER TV BOOSTER $10.95—TWO FOR $20.00

Read the article on pages 52 and 53 of the December "Radio & TV News." You will see how a booster like the McMurdo Silver Super Sonic was used for fringe area TV reception. We can't guarantee this unusual reception, but we will guarantee this booster to be a sensational value. Continuously variable inductance type tuner from channel 2 including the FM band through channel 13. Self-powered for 110 volts AC operation. Incorporates a 6J6 tube. Input for 300 ohm TV line and 300 ohm output to TV set. Single knob tuning. Attractive plastic case. McMurdo Silver Super Sonic TV-FM booster. Stock No. GB-6B, shipping weight 5 lbs. Sale price, **$10.95** each or two for **$20.00.**

20 INCH CONVERSION KIT $29.95

YOU GET—

20HP4—20" PICTURE TUBE

20-INCH PLASTIC MASK

14 K.V. FLYBACK AND 70° YOKE

Our 20" conversion kit includes a 6-month guaranteed 20HP4, 20° rectangular blackface picture tube, plus a 14,000 volt G.E. built high voltage flyback transformer, plus a matched 70° cosine yoke, plus a 20" rectangular gold trimmed plexiglas mask and suggested diagram. The picture tube is the latest electro-static focus type that requires no focus coil. Shipped via express or truck only. Ship. weight, 40 lbs. Stock No. 20-TP, net price, **$29.95.**

14-Inch Conversion Kit $25.95

14-inch conversion kit: You get a 14-inch black face, 1 year guarantee G.E. 14CP4 picture tube, a 70° deflection yoke with matching 14,000 volt G.E. flyback and a 14" plexiglas gold trim safety mask, plus conversion instructions. Stock No. 14CC-G. Sale price, **$25.95.**

17-INCH CONVERSION KIT $25.95

You Get—17BP4A 17" Picture Tube
17-Inch Plastic Mask
14 K.V. Flyback and 70° Yoke

17-inch conversion kit with a 17BP4A, 17" rectangular blackface electro-magnetic focus picture tube with 6 months guarantee, plus a matched 70° cosine yoke, a G.E. built 14,000 volt flyback and a 17" rectangular gold trimmed plexiglas mask and safety shield. Suggested diagram furnished. Shipping weight, 30 lbs. via Express or Truck only. Stock No. 17-4XL. 17" conversion kit. Sale price, **$25.95**

CAPEHART CABINET, $79.95

BLANK OR CUT TO FIT ESPEY CHASSIS

Buy this cabinet with Espey chassis and the VM changer at the left and have a fine radio-phono combination for less than the value of the cabinet alone. This beautiful cabinet was intended for a Capehart $800.00 combination. It is the finest possible furniture quality cabinet workmanship, 37" high, 40" wide and 21" front to back. Hinged top lifts in two sections. 25½" lid covers the changer compartment and 11½" is the width of the radio compartment. Changer mounting panel is furnished blank. Radio panel is shipped ready cut to fit the 7-C Espey chassis. Baffle is cut to hold 2—12" speakers. Made of top quality walnut veneer. ⅛" material used throughout. Shipped via truck, rail or express only. Shipping wt., 160 lbs. Stock No. C-175, with panel cut to fit Espey 7-C, **$79.95.** Stock No. B-175B, with blank changer and radio panel, **$79.95.** Buy 2—12" 32 oz. Alnico PM speakers for use in this cabinet for only **$15.00 ($7.50 each).**

RCA 201E1 T.V. TUNER $7.95

Terrific buy on this RCA tuner. We have a limited quantity of the famous original 201E1, 13 channel completely wired and tested TV front end tuners. Ready to connect to your TV video I.F. strip. Offered at a sacrifice. Price was $44.00. Now only **$7.95** each, with tubes. Each tuner in good condition but has been repaired. Stock No. RCA-13P. TV front end tuner. Convertor coil type for separate sound as used in the famous 630 chassis. Complete with 3—6J6 tubes. **$7.95.** Specify shaft length desired, either 2" or 4".

RCA 201E-1 T.V. TUNER

Same as pictured above only new—with 2⅞" shaft. Stock No. 2Z01. Sale Price, **$11.95.**

3-TUBE SARKES-TARZIAN T.V. TUNER $9.95

This popular Sarkes-Tarzian Type 3 tuner is widely used. 13 channel rotary type switch with individually tuned coils. Price is complete with diagram and three tubes: 6C4 osc., 6BH6 R.F. and 6AG5 mixer. Regular factory cost is twice our price. Each tuner is wired ready to hook up to a video and sound IF strip. May be used with either inter-carrier or separate sound IF circuits. Has built-on convertor coil, built in fine frequency control. Sarkes-Tarzian TV tuner, with 3 tubes. Net price, **$9.95** each. Specify shaft length, either 2⅞" or 4¾".

RCA PRINTED CIRCUIT T.V. TUNER $14.95

RCA Printed Circuit T.V. Tuner with 6J6 and 6CB6 tubes. Similar mechanically to the standard coil (same knobs fit). Snap-in channel segments. Has 6½" shaft. Used on late Hallicrafters T.V. sets. Stock No. RC-A12, 12 Channel Tuner with Tubes, New, **$14.95.** Knobs, **59c.**

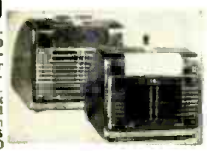
T.V. TUNER FOR EMERSON $12.95

STOCK NO. SC-947E

For Emerson 650D ETC. Has 2¼" insulated shaft and tubes 6BC5—filaments in series—shunted to .6 amps. Stock No. SC-947E. Sale Price, **$12.95.** Knobs, **59c.**

3 STATION INTERCOM MASTER $16.95

SUB STATION $3.95



3-station intercom master housed in chrome plated metal cabinet 7¼"x6"x5" sloping front. Full 3-tube amplifier for 110 volt AC-DC operation. Press-to-talk switch is on top of the cabinet and volume control with off-on switch and station selector switch are on either side. May be used with from one to 3 substations. (See matching cabinet chrome plated sub-station No. PM-A5). Master is quiet at all times except when press-to-talk switch is pressed at the master or call-back switch is pressed at the sub. Uses 3-wire intercom cable. 3-station intercom master MPM-A3, shipping weight 10 lbs. Sale price, **$16.95** each, sub-stations extra. 3-wire plastic intercom cable. 100 ft. for **$1.95,** 500 ft. for **$8.95.**

INTERCOM SUB STATIONS $3.95

Chrome plated, with call back switch for a 3-wire intercom master. Size 7½"x6"x5" sloping front. 5" Alnico V PM spkr. Intercom dealers buy at less than present production costs. Limited quantity. Stock No. PM-A5, ship. weight 8 lbs. Sale price, **$3.95** each or 3 for **$10.00.** Special 3-wire plastic intercom cable. 100 ft. **$1.95,** 500 ft. for **$8.95.**

Brown leatherette covered intercom sub-station with call back switch for use with 3-wire intercom masters. 5" square and 2½" deep. Has new plastic grill cloth. Alnico V PM speaker. A true McGee value. Stock No. NE-5, ship. weight, 1½ lbs. Sale Price **$3.95** each or 3 for **$10.00.** 3-wire plastic intercom cable. 100 ft. for **$1.95.** 500 ft. for **$8.95.**

CAPEHART CABINET FOR 1000 SET—ONLY $99.95

BEAUTIFUL WALNUT

Beautiful, finest quality walnut combination radio-phono cabinet, 42" high, 42" wide and 22" deep. Made for Capehart's finest combination, selling for $900 and up. Cabinet cost manufacturer over $200.00. Has highly polished matched walnut panels. Made of ¾" material. Top 1⅛" solid stock. This cabinet weighs approximately 175 lbs. The changer radio and speaker grill all have hinged doors. Radio compartment on right hand side is 14" high and 11½" wide. Made to mount chassis vertically. Changer compartment is 14" high by 26½" wide. Large enough to hold any record changer or recorder mechanism. Front 10" of top over the changer compartment is hinged to fold back for easy access to the changer. Both radio and changer compartments come with uncut blank panels. Speaker baffle is cut for a 12" speaker and the speaker compartment is completely enclosed. Shipping weight, 275 lbs. Stock No. K-275W Capehart combination cabinet. Net price, **$99.95.** Walnut.

COMPLETE RADIO, TELEVISION AND AMPLIFIER KITS AT McGEE

3-WAY PORTABLE KIT $15.95

New 1952 Model 3-way personal portable radio kit. Operates on 110 Volts AC-DC or 67½ B plus 1½ volt self-contained batteries. Leatherette covered case size, 5½"x5¾"x8". Receives broadcast 550 to 1650 KC. A conventional 2-gang superhet circuit with 456 KC iron core IF's. Incorporates the new super gain stick loop antenna. All plated chassis. Lab. approved circuit—matched parts. Price includes all parts, tubes, diagram, Alnico V PM speaker. A factory quality kit. Stock No. PN-4T, shipping weight 7 lbs. The complete kit. Less batteries. **$15.95.** 67½V. B, **$1.59;** 1½V. A, 39c extra.

Build Your Own Phono-Mike Broadcaster $7.95

Kit Model DE-6R. With this simple kit, you can build a 3-tube phono oscillator that also has a mike input. Will broadcast over any radio, within your home, (about 75 feet) from 1000 to 1500 kc. Inputs for crystal mike or crystal phono pickup. Fader control fades from mike to record. Ideal for a home P.A. system, baby listener and home entertainment. A complete kit of parts including tubes. Kit Model DE-6R. Net price, **$7.95.** DE-6RWT, wired and tested. Net price, **$9.95.** Crystal mike and desk stand, **$4.95** extra. Concealed microphone unit, only 1" in diameter and ¼" thick. Specify hidden mike when ordering. Stock No, T-001. Net. **$3.95** extra.

8-Tube Hi-Fi Amplifier Kit $29.95

A complete kit, including tubes: 3-7E5, 2-12AX7, 2-triode plus rectifier diagram and photos. Inputs for radio tuner and any kind of phono pickup (crystal or G.E. variable reluctance) and either crystal or dynamic mike. Output matches 8 ohm voice coil. Twin electronic bass and treble tone controls with range selector switch for either juke box quality with heavy bass response or brilliant symphonic range. Response 18 to 20,000 cps, 8 tube all triode amplifier kit, complete with tubes. Shipping weight 25 lbs. Model TX5. Net **$29.95.**

10-Watt Hi-Fi Amplifier Kit $14.95

A complete kit of parts including tubes 12AX7, 12AU7, 2-50L6, plus rectifier, diagram and instructions to build a high fidelity twin tone control audio amplifier with bass and treble boost. Inputs for radio tuner, crystal mike and crystal phono pickup. Output matches 8 ohms. Response from 50 to 15,000 cps. Chassis ready punched. Ventilated cover. Straight forward circuit with twin triode gain stages and 2-50L6 tubes in push-pull. Size, 5¼" x 10" x 5¾" high. Model AP-10K, ship. wt. 8 lbs. Sale price **$14.95.**

10-TUBE RADIO KIT $29.95

10 tube broadcast radio chassis kit, complete with tubes: 2-6SK7, 6SA7, 3-6SN7, 1-6SL7, 2-6V6 plus 5Y3 rectifier, diagram and instructions. 3 gang superhet with 8" slide rule dial. Chassis size, 12½"x10"x6½" high. Features push-pull 6V6 high fidelity audio. Output matches 3 to 8 ohm voice coil speakers. Inputs for G.E. variable reluctance or crystal phono pickup and crystal mike. Heavy duty power transformer. Model BK-R10 kit less speaker, shipping weight 18 lbs. Net **$29.95.**

17, 20" T.V. Kit $59.95 Less Tubes

A complete kit of parts to build an AC transformer operated television chassis for use with a 16", 17" or 20" rectangular picture tube. The 12 channel Sarkes-Tarzian tuner is ready wired, as is the 4 tube video IF strip. Circuit is of the conventional design. Do not buy this unless you understand Television. It is difficult to wire. We furnish schematic. Kit model WH-20. Ship. wt. 40 lbs. less all tubes. Net **$59.95.** Kit of 22 tubes, less picture tube **$16.95,** 17" 17BP4A, **$19.95.** 20HP4, **$25.00.**

6-TUBE 2-BAND KIT $14.95

Popular with schools and colleges for training. 6 tube AC-DC, 2 band radio kit with plastic cabinet. Receives broadcast and 6 to 18 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12SK7, 12K8, 12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Factory quality. Cabinet size 13"x6¾"x6¼". Shipping weight 12 lbs. Model ME6-2. Net **$14.95.**

5-TUBE AC-DC KIT $12.95

Model RS-5. A 5 tube AC-DC straight broadcast kit, housed in the same cabinet as ME6-2 above. Complete with tubes. Shipping weight 10 lbs.. Net **$12.95.**

AC POWERED BROADCAST TUNER KIT $12.95

A self-powered, 3-gang superhet tuner kit with R.F. stage. This complete kit is furnished with a diagram, photos and tubes. 6BA6 R.F., 6BE6 oscillator R.F., 6BA6 I.F. detector, 6AL5 diode, AVC, plus rectifier. Connect to any audio amplifier. Ideal for use with our S-2020 or 7x5 amplifier kits. Chassis size, 9½x4x4½" high. Shipping weight, 7 lbs. Broadcast tuner kit Model BT-38X. Net price, **$12.95.**

Childs' Amplifier

(*Continued from page 60*)

future time. The only shielded leads used are the feedback loops from the output transformer to R_{19} and R_{22}. All ground leads are brought to one point near the 6SN7 tube and grounded to the chassis. Careful matching of all paired resistors is important. If the wirewound resistors are not identically matched, shunt a small carbon resistor of proper value across the one having the highest resistance.

The power supply (see Figs. 7 and 8), is a husky one weighing 83 pounds. The author wishing to use components he had on hand rather than purchasing new ones, selected the large chokes, CH_1 and CH_2. All components listed in the parts list are the components the author actually used, except for CH_1. The 6.3 volt winding on T_5 had insufficient capacity to handle all of the 6.3 volt heaters in the circuit and for this reason, the 6.3 volt transformer, T_4, was added.

The d.c. heater supply (T_6, Fig. 6) for the preamplifier stage is optional but eliminates a lot of the hum problem within the preamplifier. This heater power supply is not grounded on the power supply chassis. This ground is made at the socket of the 12J7 input tube in the preamplifier.

The internal impedance of the plate supply line feeding the electronic voltage regulator is 800 ohms and will supply a voltage varying from 650 volts to 550 volts, depending upon the current drawn by the amplifier. There is ample filtering in this circuit as any hum that remains will be regulated out in the electronic voltage regulator.

After completing both units the entire circuitry was thoroughly checked and met all the requirements desired by the author. The hum and thermal hiss was so low that it was necessary to place one's ear next to the high frequency speaker to detect it. Using a test frequency of 60 cycles and 3000 cycles at a 4 to 1 ratio at 30 watts, the intermodulation distortion was .6%, and with a test frequency of 60 cycles and 7000 cycles at a 4 to 1 ratio at 30 watts, the intermodulation distortion was .4%.

The improved damping factor in the 20 to 30 watt range, due to the electronic voltage regulator, may be seen by comparing the 50-cycle square waveforms shown in Fig. 5.

The proper procedure for making the final adjustment of the amplifier is as follows: Before turning the amplifier on, adjust the bias potentiometer R_{24} for minimum plate current on the 6J5 drivers. This will increase the bias on the 807 tubes so as not to draw excessive plate current until the voltage regulator is properly adjusted. R_{24} will be in the position where the center tap arm is swung as far away from R_{23} as possible.

Next, turn on the power supply, allowing ample time for the tubes to warm up, then adjust potentiometer R_{16} at approximately its mid-position. Advance the voltage control potentiometer R_{63} until an indicated voltage of 450 volts is read on the voltmeter. Next, advance the bias control R_{21} until approximately 25 ma. is read on the cathode meter M_1. At this point roughly balance the current in both 807 cathode circuits by adjusting R_{35} and switching S_2 from left to right position; when a rough balance is reached, it then may be safe to decrease the bias voltage by adjusting potentiometer R_{21} until 100 ma. is read on the cathode milliammeter, and at this point a careful balance should be made on both cathodes by a fine adjustment of R_{35}.

The internal impedance of the voltage regulator supply may now be adjusted to zero. Move the bias control R_{24} back and forth momentarily, thereby increasing and decreasing the load in each cathode circuit from 75 ma. to 150 ma. as indicated on the cathode milliameter. At the same time seesaw the positions of the potentiometers R_{16} and R_{63} back and forth until a point is found where a constant reading of 450 volts is maintained with the minimum and maximum current drain. Readjust R_{24} for an indicated 100 ma. on each cathode circuit. The final adjustment of the amplifier is balancing the phase inverter so that its two plates are 180 degrees out-of-phase. This is done by placing switch S_1 in the first position and applying a complex wave from a square-wave generator or record player, etc., into the No. 1 input and carefully adjusting potentiometer R_4 until no sound is heard in the loudspeaker. Return S_1 to one or the other of its operating positions. Adjust R_4 in the power supply to plus 30 to 40 volts above ground, the reading being taken at the center tap of potentiometer R_1. An adjustment of R_1 should then be made to eliminate any trace of hum which might remain after all other adjustments have been completed.

In high grade commercial amplifiers it is a common practice after soldering joints to cover them with colored lacquer. This is done to keep the corrosion down at the joints, also to show whether any connection has been tampered with and to facilitate the identification of leads. The writer prefers to apply a wax crayon to the joint prior to its becoming completely cooled after soldering. These crayons offer a large variety of colors and a fifteen cent box will go a long way. They have the advantage of keeping the corrosion to a minimum and if it ever becomes necessary to unsolder a joint, it is not necessary to clean the wax from the joint as the majority of this will evaporate when the soldering iron is applied and in no way will the remaining wax interfere with the resoldering of the joint. This makes a neat job and well worth the additional time spent in the construction of amplifiers. —30—

Phono Equalizers

(*Continued from page 56*)

equalizers would be required to compensate satisfactorily for most commercial pressings. The current trend of events, however, seems to be in the opposite direction! The need for some sort of standardization is becoming ever more pressing and, since collectors have a habit of retaining their discs after they acquire them, such standardization should certainly be carried out before vast numbers of discs are issued with all sorts of varying characteristics—if it isn't already too late.

The purpose of any reproducing system is, of course, to duplicate the sound issuing from the monitor speaker at the recording session, which is, in turn, the result of adjustments made in microphone placement and system response in accordance with the desires of the artist and recording engineer. Irrespective of the quality of the reproducing system, whether or not the adjustments give the listener the impression of the "performers being in the same room" is determined in large part by the qualifications and tastes of these individuals; the reproducing system can at best merely duplicate the sound desired, with minor modifications such as are introduced by the use of tone controls. The function of equalizers in the reproducing system is thus simply to correct for the frequency nonlinearity deliberately introduced, for technical reasons, into the disc recording.

Since the listener generally has no way of knowing what the artist and technical director want in the way of reproducing sound, random choice of an equalizer, based on "ear" tests, will almost never result in reproduction satisfactory in the sense described above, and this is essentially the reason why so much has been published on equalizer design.

It would be very helpful if—until some sort of standardization can be effected—record manufacturers would indicate on labels of their discs the characteristic used in recording. As a poor substitute for this, the writer would suggest they make it as easy as possible for interested persons to obtain the data from qualified and correctly-informed sources.

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6-Band Mobile Unit

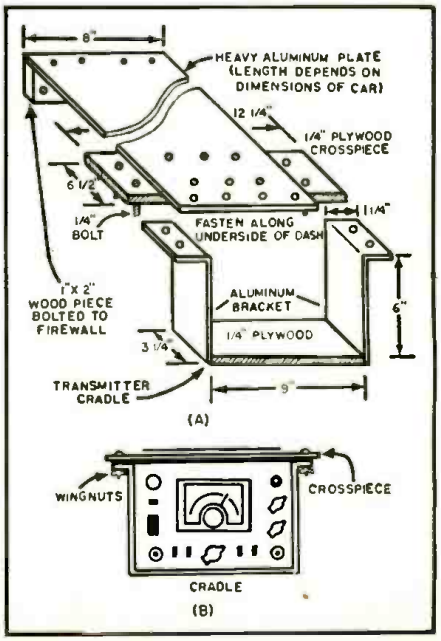
(Continued from page 46)

Next, go to 75 meters and adjust the slug of L_2 until the oscillator hits 2 mc. with the plates of C_{18} unmeshed. Throw S_7 to 40 meters and adjust C_{24} so that the v.f.o. is at 1.75 mc. when the plates of C_{18} are fully meshed. Adjust the slug of L_{10} to peak at 3575 kc. L_{11} should then be tuned to 7150 kc. Switch back to 75 and peak L_{12} at 3850 kc. Finally, recheck each of the previous adjustments in order to make certain that the proper amount of final grid current is available on each band.

After alignment has been completed, the dial may be calibrated. The printed scale of the *National* MCN dial should be reversed and four semicircles drawn on the blank side. The 75-meter band, from just below 3.7 mc. to 4 mc. will cover one of the semicircles and the 10-meter band will cover most of another. The 40-meter band can be allotted to the third semicircle, while the fourth one will have adequate space for the 11-, 15- and 20-meter bands. The values of C_{20} through C_{23} and C_{16} are such that the three latter bands will not overlap one another on the dial scale.

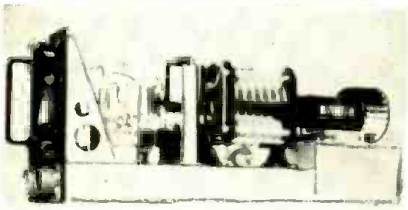
When installing the rig in the car, it will pay to run separate fused leads from the battery to the tube heaters, and from the battery to the genemotor. If a common lead is used, the relatively heavy current drawn by the genemotor will produce a drop in heater voltage whenever the transmitter is switched on. The lowered heater voltage, in turn, will cause a drop in tube cathode temperatures which will reduce grid drive to the final and may produce a slight see-saw frequency shift of the carrier. This latter effect results when the elements near the cathode of the oscillator tube are at

Fig. 8. Details of the mounting cradle.



—THE BEST IN ELECTRONIC SURPLUS—

27-34 MC. TRANSMITTER



Designed for "jamming" at indicated frequencies, but easily converted to handsome 60-75 W. RF Final, or sweep oscillator. Has expensive motor-driven (27 V. DC) butterfly variable, 0-150 ma 2" front-panel meter. 2-35T Eimac tubes (platinum grids) in push-pull, low-loss RF Tank Coil with center link, and (110V.) 400-2600 cycle power transformer which will make an excellent 100 W. speech modulation transformer. BRAND NEW! Dim.: 20" x 5" x 7½", with metal case, (not shown). Shpg. wt. 55 lbs.

A STEAL AT EACH $19.95

RADIOSONDE TRANSMITTER

For radio and science students. This is a lightweight transmitter combined with valuable scientific instruments for weather studies. Uses a 3A5 tube in a tiny 68 to 74.0 mc transmitter with a temperature element, humidity element, pressure element (baro-switch), and an 80 to 95 contact "commutator" and relay to automatically connect in above elements to radio circuit. Supplied complete, less balloon and batteries, with diagram and technical data sheet. Shpg. wt. 2½ lbs.

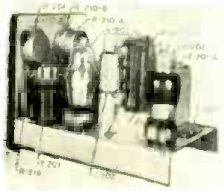
EACH $5.95

90-100 MC RECEIVER

This will make an outstanding 2 meter receiver for beginners, with simple changes. Has 3 6C6 tubes in a detector and 2 audio stages, beautifully constructed on aluminum chassis and case, with locking-type dials, all shock mounted. Change detector circuit to "super-regen" and remove approx. 3 turns from bottom of coil for 2 meter coverage. Diagrams supplied with each. Power plug in rear for connections to battery or your own AC supply. Dim.: 13" x 6" x 7". Quantity limited! Shpg. wt. 10 lbs.

EACH $10.45

2-STAGE AUDIO AMPLIFIER WITH 90 & 150 CYCLE FILTERS



Here is an unusual amplifier for labs and experimenters. Has 2 tubes, twin trioles 6C8G and 6F8G, in 2 audio stages with 2 selective filters 90 and 150 cycles which are very valuable. Use as "bass boosters" in your favorite amplifier, or use entire unit as "bass boost" amplifier. Remove filters and you have a high quality amplifier for general use. Handsomely built on aluminum chassis, with case and shock mount, power plug in rear for batteries or your own AC supply. Dim.: 9" x 5½" x 7". Shpg. wt. 9 lbs. With Diagrams.

NEW UNITS. EACH, only $8.95

DUAL-METER INDICATOR

110 Microamp and 210 Microamp Meters

This indicator employs two separate meter movements, 110 (vertical) and 210 microamp (horizontal pointer) respectively, and arranged so that the pointers cross each other. These expensive D'arsonval meter movements (Westinghouse) can be removed for making sensitive test meters, S meters, or used as is for unique applications. All NEW units. Dim.: 3¼" Dia. x 3" deep. Shpg. wt. 3 lbs.

EACH $7.95

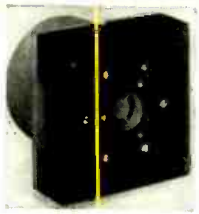
INFRA-RED IMAGE "SNOOPERSCOPE" TUBE *Extra-Special!!*

We've sold thousands of them to Labs, experimenters, Industrials, studios, etc. By using Infra-Red rays, this tube enables you to see in the dark. No scanning, no amplifiers, just a high-voltage power supply is all you need with this tube. Shows image in greenish-white on 1¾" screen. For night photography, signalling, snooper or sniper scopes, underwater detectors, etc. British mnfr. SOLD IN LOTS OF 6 ONLY! Literature and diagrams furnished with each sale.

6 for $15.00

FRONT-END LENS, for Infra-Red Tube. Bausch & Lomb. . Ea. **$10.00**
Plain, Mounted Type ..... Ea. **7.00**

50-60 W. SPEAKER UNIT



Western Electric Speaker units, for horn or baffleboard mtg. Shock and blast proof diaphragm, will handle up to 60 watts. Response to 7,000 cps, favoring high freq. Impedance 13 ohms. Dim.: 6" x 6" x 4½" deep. Throat opening — 1¾" dia. Alnico 5 slug wt. 6 lbs.

SPECIAL, PRICE EACH $18.75

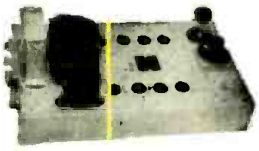
INDUSTRIAL CAPACITORS

G. E. TYPE 18F75
Syncro—Capacitor

50-50-50 mfd., Pyranol filled, Delta connected, 90 V. AC, use any two of the three terminals for 75 mfd. 400 V. AC capacitor. All NEW, packaged capacitors. For power-factor correction on 115 V. 3 phase AC, etc. Large quantity available.

EACH $6.95

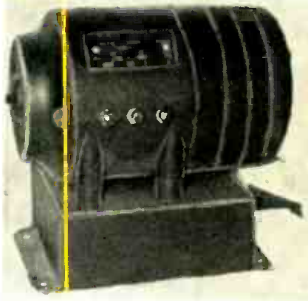
G. E. VOLTAGE REGULATOR AND POWER SUPPLY MODEL 3GVD14B3



Output 750 volts at 10 ma; complete power supply using 8 tubes, with selector switch for regulating or non-regulating. Operates from 110 V., 60 cycles AC. NEW units, less tubes, with operational data and diagram.

EACH $15.95

32 VDC-110V AC CONVERTER



Mfd. by Kato Engineering, for marine or farm installation. Rotary type, compact and ruggedly built for continuous duty. Rubber shock mounting on filter case, with complete input and output filtering. Output 110 volts, 60 cycles AC. .225 KVA, but will operate efficiently on loads up to 300 watts. New units only.

PRICE, EACH $39.95

All Above Material Subject to Prior Sale. 25% Minimum Deposit with All C.O.D.'s. All Prices F.O.B. Our Address.

—TELEMARINE— COMMUNICATIONS CO.

3040 W. 21st Street, Brooklyn 24, N. Y.
Phone: ES 2-4300

DIRECTION-FINDER FOR MARINE OR AIRCRAFT

This is an outstanding Direction-Finder Receiver for boat or aircraft owners, at an unusually low price for such high-quality equipment. Tunes from 15 to 70 KC, and 100 KC to 1750 KC, all in 6 bands, covering maritime radio direction-finding, aeronautical navigation and full broadcast band frequencies. You can fix position on any station operating in those frequencies, as well as on broadcast stations, and use it for broadcast band reception. 8 tube superheterodyne, receives CW and tone signals. Loop supplied with either 34" or 55" extension shaft (specify), 24 V. DC Dynamotor w/filter, cables, instruction manual, etc.. Mfd. by RCA. All NEW eqpt. For this month only.

EACH $99.50

VHF DIPOLE ANTENNA

Rugged cast aluminum center piece bracket contains matching coupler and transmission line (short length with plugs supplied), connector and porcelain insulated terminals to which antenna dipole rods thread. Dipole elements cut for 90-100 mc coverage, cut down for 2 meter or higher frequency operation. This is a well-built, hi-efficiency VHF Dipole. Shpg. wt. 3 lbs. Well Worth our **PRICE** of . . **EACH $4.25**

CAPACITORS

MFD.	V.DC	DESCRIPTION	MTG.	EACH
75	25	Electrolytic, 1¾" Dia., 3¼" H.	Locknut	.60
4	50	Mallory Oil Bathtub, 2"x2"x1"	Bottom Tabs	.25
10	50	Electrolytic 1½"x⅞"Hx⅞"	Bottom Tabs	.35
2.25	100	Solar, Bathtub 1¾" 1½"Hx⅞"	Bottom Tabs	.35
1.25	150	Tube, Electro. 1⅜" Dia. x 1¼"H.	None	.15
.00755	250	W.E. #D99942 3½"x1⅜"x½"	None	.35
.5x.5	250	Oil, Bathtub 1¼"x2"x⅝"	None	.30
.1	400	Bathtub, 1¼"x1¼"x⅝"	None	.20
2x.1	400	Bathtub, Solar 1½"x1¼"x½"	Top Tabs	.35
3x.1	400	Bathtub, Aerovox 1¾"x1"x⅝"H.	Bottom Tabs	.40
.15	400	Bathtub, Solar 1¾"x1"x⅝"	Top Tabs	.30
3x.5	500	Oil, Aerovox, 2¼"Hx1¾" Sq.	Bottom Tabs	.45
1.0	500	GE Pyranol, Type 23F133	Top Tabs	.60
1.0	500	GE Pyranol, Type 23F206	Bottom Tabs	.60
2x.1	600	Solar Oil, 1¾"x1½"x½"	Top Tabs	.50
3x.1	600	Sprague Bathtub, 1¾"x1"x½"	Bottom Tabs	.55
.25	600	Solar Oil, 1⅝"x1¼"x⅜"	None	.50
3x.25	600	Solar Oil, 2½"x1¾"x½"	Top Tabs	.55
1.0	600	Solar Oil, 1¾"x2¾"x½"	Top Tabs	.60
1.0	600	Solar Oil, 2¼"x1¾"x1"	None	.65
1.5	600	Micamold Bathtub 2" Sq.x1" O	Bottom Tabs	.45
3.0	600	Oil Round Can 2¼" Dia.x2½"H.	None	.75
1.0	1,000	Oil, 2⅛"Hx1½"x1"	Mtg. Bracket	.85
2.0	1,000	Oil, Ind. Condenser 4"Hx1½"x1"	Mtg. Bracket	.95
2.0	1,000	Oil Solar, 1½" Dia. x4½"H.	Lock Nut	1.35
.5	2,000	GE Pyranol Type 26F698	None	1.50
1.0	2,000	GE Pyranol Type 23F1260	None	1.75
1.0	3,000	Oil-Solar, 1½" Dia. x 3"L	None	1.95
1.0	3,500	Oil, Micamold 1⅜" Dia. x 3½"L.	None	1.85
.375/.75	16/8 KV	GE Pyranol Type 14F101	None	12.75
.00025	25 KV	WE #D165618	None	14.50
1	25 KV	GE #14F52	None	17.00
50	500	West. #CAY-48489	None	7.00

Take 10% Discount from indicated prices if ordering 6 or more of each.

EXPORTERS, GOVERNMENT AGENCIES, INDUSTRIALS!

We have a large stock of Transmitters, Receivers, Walkie-Talkies, VHF Equipment, Ship & Shore Communications, FM Broadcast Stations, Radar, Accessories, etc. Write and tell us of your requirements. Descriptive literature and prices available upon request.

BARGAIN-SPECIAL!!

LUMINOUS TAPE, glows in dark for hours after exposed to light. Use it for locating wall switches, cellar steps, garage driveways, etc. 100 ft. rolls x ½" width, **SPECIAL 2 Rolls for $1.00.** Sent postpaid uninsured. Add 10c if insurance desired.

one temperature during standby, and at another during transmission.

As shown in Fig. 8, the transmitter is mounted so that hy removing four wingnuts and pulling the power and antenna plugs, it can be easily removed from the car and brought into the shack for operation from an a.c. power supply. Thus it can serve as a standby transmitter to be used in place of the home rig or it can be quickly set up wherever needed to furnish communications during an emergency.

A suitable power supply is diagrammed in Fig. 9. The *Mallory* 1B8R rectifier furnishes d.c. to operate the antenna relay inside the transmitter case. During a.c. operation, d.p.s.t. switch S_2, Fig. 9, is employed as a "send-receive" switch in place of the microphone push-to-talk switch.

The lowest resistance that can be matched by means of a pi-network is equal to the tube load resistance divided by the square of the circuit "*Q*."[2] Thus, especially on 75 meters, the final tank capacity must be rather high if the transmitter is to be capable of properly feeding the low antenna resistances often encountered in mobile and portable work. For this reason, a 140 $\mu\mu$fd. condenser is employed at C_{25}. Due to the capacity range of this condenser, the final can be resonated at undesired frequencies outside the ham bands unless a little care is exercised during the tune-up process. When operating on 75 and 40, the final should be dipped by tuning from maximum to minimum capacity, while on 10, 11, 15, and 20, adjustment should begin from minimum capacity.

The procedure for tuning the rig, once it is installed in the car, is as follows: Throw bandswitch S_3 to the desired range and open S_1, the "tune-operate" switch. Close the mike's push-to-talk switch and tune the v.f.o. until the oscillator can be heard in the receiver at the desired frequency. Close S_1 and make sure that both loading switches, S_5 and S_6, are also closed. Set loading condenser C_{26} to maximum capacity and tune plate condenser C_{25} for a dip in brightness of the screen indicator bulb, PL_1. Open loading switch, S_5, and redip the final. Open S_6 and, if possible, again redip the final. With some combination of the settings of S_5, S_6 and C_{26}, the dip in brightness of PL_1 will be barely perceptible. A measurement of cathode current at this time should result in a reading of between 50 and 60 ma., a suitable operating value. Heavier loading of the final will cause the power output of the rig to drop.

Although the foregoing instructions appear somewhat complicated when set down on paper, after you've gotten used to operating the rig, you'll be able to scoot up and down the dial in nothing flat. Of course, it will take a bit longer to go from one band to another, depending on how much time is required to change antennas.

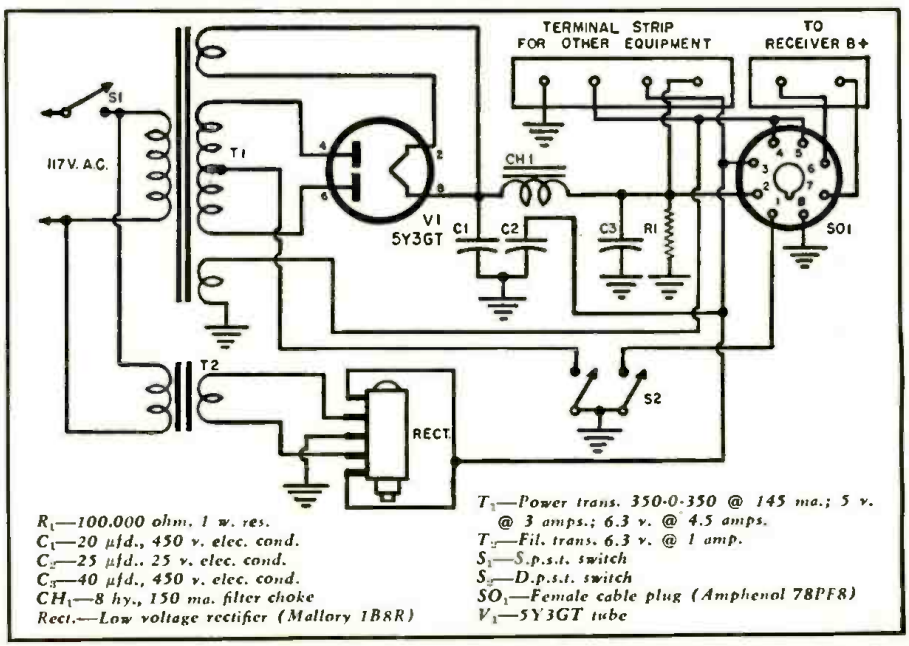
Once you have a bandswitching v.f.o. rig up front, you'll wonder how you ever got along with that old fashioned crystal job in the trunk. The ability to zero beat the other fellow really makes a difference in the ratio of calls-to-stations worked. Furthermore, when you can switch from one band to another you'll just about always be sure of finding some portion of the spectrum where there are plenty of hams to talk with. Build a rig like this one and you'll be able to say goodbye forever to those "Dead Band Blues."

REFERENCES

1 *Scherer, W. M.: "The W2AEF Mobile Special," CQ. May 1952.*
2 *Bruene, Warren B.: "How to Design R.F. Coupling Circuits," Electronics. May 1952.*

—30—

Fig. 9. An a.c. power supply for portable-standby operation of the mobile transmitter. The terminal strip permits use with other transmitters. As in Figs. 4 and 5, the receiver "B-plus" is connected through the transmitter relay for silencing.



R_1—100,000 ohm, 1 w. res.
C_1—20 μfd., 450 v. elec. cond.
C_2—25 μfd., 25 v. elec. cond.
C_3—40 μfd., 450 v. elec. cond.
CH_1—8 hy., 150 ma. filter choke
Rect.—Low voltage rectifier (Mallory 1B8R)
T_1—Power trans. 350-0-350 @ 145 ma.; 5 v. @ 3 amps.; 6.3 v. @ 4.5 amps.
T_2—Fil. trans. 6.3 v. @ 1 amp.
S_1—S.p.s.t. switch
S_2—D.p.s.t. switch
SO_1—Female cable plug (Amphenol 78PF8)
V_1—5Y3GT tube

What's New in Radio

(*Continued from page 93*)

teed not to exceed ± ¼ db within a reel and ± ½ db from reel to reel. It is available in lengths of 2400 ft. on the NARTB reel or hub and in 1200 ft. lengths on the 7" professional plastic reel. All lengths are guaranteed splice-free.

COMMUNICATIONS RECEIVER

Radio Apparatus Corp., 55 N. New Jersey St., Indianapolis, Inc. is now marketing a two-band communications receiver, the Model DR200.

This fixed and tunable combination a.c. receiver covers the 30-50 mc. and 152-174 mc. bands. Operating in two pertinent fixed frequency ranges, the tunable feature can be used alternately.

Under routine operating conditions the DR200 performs as any standard crystal-controlled monitor receiver. When conditions require and monitoring of any other channel or channels is desired, a flip-of-the-switch makes the unit tunable across the full frequency range.

HI-FI AMPLIFIER

Precision Electronics, 9101 King Ave., Franklin Park, Ill. has developed a new amplifier, the Model LJ2.

This unit has a power output of 8

watts with 18 watts peak. Distortion at 8 watts is 1½% harmonic and 4% intermodulation. Frequency response is ± 1 db from 20 to 20,000 cps at the 3 watt level. The unit has selector switches from radio channel to magnetic pickup, volume control, treble and bass controls.

Complete specifications on the LJ2 are available from the company.

SLIDE SWITCH

The Electronic Components Division of *Stackpole Carbon Co.*, St. Marys, Pa. has released an inexpensive, miniature d.p.d.t. slide switch rated at .5 ampere at 125 volts.

The switch measures 1⅜" long by 17/32" wide by 11/32" deep. It provides d.p.d.t. switching action in smaller size but uses the same mounting centers as the company's conventional switches. Separate indenting for each pole assures positive yet smooth snap action. A special fiber-surface laminated *Bakelite* base reduces arc tracking and increases the safety factor.

-30-

International Short-Wave

(Continued from page 69)

around 1600 to Britain, Europe. (Dick, N. J., others) VL19, 9.500, noted with weather report 0335; VL16, 6.090, heard 0600 with ABC news; these are in Sydney. (NNRC) VLQ9, 9.66, Brisbane, heard 0400 with ABC news. (Pearce, England) VLX4, 4.897, Perth, noted recently 1615-1715, fair level in Va. (Saylor)

Austria — Blue Danube Network, 9.617, Salzburg, noted 0400 with news. (Pearce, England)

Azores—Ponta Delgada, 4.865, noted 1625 with Portuguese songs; news in Portuguese 1730. (Pearce, England) Heard at excellent level on 11.090 at 1500-1600 closedown; all-Portuguese. (Niblack, Ind.)

Bahamas—Telecommunications Department, Box 48, Nassau, Bahamas, is *testing* irregularly on 4.5125; some CWQRM, but usually is easy to read; time is verified from 2000 to 2230. (Lancelot, Dexter, Corson, Iowa)

Bechuanaland—Mafeking's ZNB is again using its old 5.900 channel in parallel with 8.232 at 0600-0700, 1200-1430; relays SABC news 0615, 1200. (Ridgeway, South Africa)

Belgian Congo — OQ2AB, 11.900, Elisabethville, is heard in Sweden Sun. 1040. (*Eterevep,* Sweden) *Radio Congo Belge,* 11.717A, 9.380, audible lately as early as 1330. (Niblack, Indiana)

Belgium—ORU, 6.000, Brussels, noted at weak level signing on 1300, improved by 1315. (Pearce, England) Noted on 15.335 at 1100 tune-in, parallel 17.86. (Bellington, N. Y.) Heard on 6.085 with news to North America 2000. (Hornstein, Mich., others) Closing down 2230 now. (Niblack, Ind.)

Bolivia—CP38, 9.505A, La Paz, is currently scheduled Sun. 0655-0930, 1100-1630; weekdays 0555-0730, 0930-1245, 1715-2115; is *"silent"* now Tue.; has added *English* lesson Mon., Wed., Fri. 1900. (Ferguson, N. C.)

Brazil—ZYN22, 3.345. *Radio Cultura,* Bahia, noted 1730. (French, Mass.) ZYK3, 9.565, was heard recently on a weekday ending *English* session ("Brazil Calling") at 1925; signed off 1930. (Lund, Iowa) PRL5, 11.950, noted 1615 with strong level in Portuguese program of news. (Sanderson, Australia) *Radio Continental,* 11.736, Rio de Janeiro, heard from 0445; noted closing 2015. *Radio Brazil,* ZYY3, 4.758, Sao Paulo, heard at good level 1730, closing with anthem 2100; *Radio Gaucha,* PRC22, Porto Alegro, 9.675, noted from 1745 to closing 2100, call about every half-hour, two-toned gong. (Ridgeway, South Africa)

British Guiana—ZFY, 5.981, noted around 2000 at good level in Mich. (Hornstein)

British Honduras—A verification letter from ZLK2, 4.951, Belize, stated that the station is operating on "6.1 in the 49-m. band" (*not* reported to *ISW DEPARTMENT* as heard there);

TUBES

ALL TUBES are guaranteed for one year . . . individually boxed. Very BEST BRANDS available for immediate delivery!

FREE OFFER!

5 lbs. of good usable radio service ports with every 100 tubes ordered; a kit of assorted radio repair hardware free with every 50 tubes ordered!

0Z4		2E5	.89	6AU5GT	1.29	6E5	.69	6SH7GT	.69	7C4	1.30	12AW6	1.19	14F8	1.45	35Z5	.55	80	.69
0Z4G	59c	2X2/879	.74	6AU6	.59	6F5GT	59c	6SJ7	.79	7C5	.89	12AX4	.69	14H7	1.12	35/51	.79	83	1.45
1A5GT		3LP4	1.25	6AV5GT	.89	6F6GT		6SJ7GT	59c	7C6		12AX7	.69	14Q7	1.05	36	1.06	84/6Z4	.72
1A7	.69	3Q4	.69	6AV6	.59	6F7	1.59	6SK7GT		7C7	79	12BA6	.59	14W7	1.19	37	.93	85	.79
1B3GT	.95	3Q5GT	.89	6AX4	.69	6F8G	1.59	6SL7GT	.69	7E5		12BA7	1.19	14X7	1.19	38	88c	VR90	$1.19
1B5	.29	3S4	.69	6AX5	.79	6G6G	.95	6SN7GT	.69	7E6		12BE6	59c	19BG6G	1.49	39/44		VR105	
1H5GT	.59	3V4	.95	6AX5	.69	6H6GT	.89	6SQ7		7E7		12BF6	.69	19T8	.89	41	.72	VR150	
1J6GT		5T4	1.40	6AY5GT	.89	6J5GT	.59	6SQ7GT	59c	7F7	.89	12BH7		20	1.40	42	.69	117L7	1.40
1L4	69c	5U4G	.59	6B4G	1.44	6J6	.79	6SR7GT		7F8	1.47	12F5GT	.65	24A	.69	43	72c	117N7	1.95
1L6		5V4G	.87	6B8GT	1.15	6J7G	.69	6SS7	.99	7G7	1.19	12H6	.89	25AC5GT	1.04	45		117P7	1.95
1LA4	1.19	5W4	59c	6BA6	.59	6J8G	1.15	6T7G	1.15	7H7	1.05	12J5GT	.75	25BQ6GT	1.15	45Z5	.69	117Z3	.59
1LA6	1.19	5W4GT		6BA7	69c	6K5GT	.69	6T8	.89	7J7	1.19	12K7GT	.69	25L6GT	.59	46	89c	117Z6	1.19
1LC5	.69	5Y3GT	.45	6BC5		6K6GT	.59	6U5		7K7		12Q7GT	.89	25W4GT	.69	47		715B	7.75
1LC6	1.19	5Y4G	.54	6BC7	1.05	6K7GT	.69	6U6GT	69c	7L7	.79	12SA7GT	.69	25Z5	.69	50A5	1.05	807	1.55
1LD5		5X4G	81c	6BD5GT	.89	6K8GT	1.19	6U7G		7N7	.69	12SC7	1.05	25Z6GT	.69	50B5	69c	813	10.95
1LE3	1.19	5Z3		6BE6	.59	6L5G	.95	6U8	.89	7Q7	.79	12SF5GT	.69	32L7GT	1.15	50C5		866A	1.49
1LH4	1.19	6A3	1.68	6BF5	69c	6L6G	95c	6V3	1.29	7R7	1.19	12SF7	.99	26	59c	50C6G	1.39	1294	
1LN5	1.19	6A7	1.21	6BF6		6L6GA		6V6GT	.69	7S7	1.19	12SG7	.89	27	.99	50L6	.69	1299	29c
1N5GT		6A8GT	69c	6BG6G	1.69	6L7	1.19	6W4GT	.59	7V7	.79	12SH7GT		35A5		50X6	.69	1619	
1P5GT	69c	6AB4		6BH6	69c	6N6G	1.40	6W6	.69	7W7	1.19	12SJ7GT		35B5		50Y6	.99	1629	
1Q5GT		6AB7	1.15	6BJ6		6N7GT	1.19	6X4	59c	7X6	1.05	12SK7GT	69c	35C5	69c	70L7	89c	2050	2.00
1R5	.89	6AC5GT	.89	6BK7	.98	6P5GT	.69	6X5GT		7X7	79c	12SL7GT		35L6		70L7GT		2051	1.15
1S4	.99	6AC7	1.45	6BL7	.79	6Q7GT	.59	6Y6G	.69	7Y4		12SN7GT	.99	35W4	.59	71A	.87	7193	.87
1S5		6AG5	1.05	6BN6	.89	6R7GT	.69	6Z4/84	.72	7Z4	.89	12SQ7		35Y4	99c	75	.79	VT51	.69
1T4	69c	6AG7	1.49	6BQ6GT	.85	6S4	.59	7A4	.95	12A7	1.59	12SQ7GT	69c	35Z3		77	.69	VT52	29c
1U4		6AH6	1.89	6BQ7	1.19	6S7GT	1.15	7A5	1.19	12A8	.69	12SR7GT		35Z4	.75	78/6D6	1.10		
1U5	.59	6AK5	.89	6BZ7		6S8GT	1.25	7A6	.89	12AH7	1.38	12Z3	.95						
1V	.88	6AK6	1.08	6C4	.59	6SA7GT	69c	7A7	79c	12AL5	.54	14A7	1.05						
1X2A	.89	6AL5	69c	6C5G		6SC7		7A8		12AT6	.59	14AF7	.93						
2A6		6AQ5		6C6	69c	6SD7GT	.99	7B4	.89	12AT7	.89	14B6	89c						
2A7	89c	6AQ6	.81	6CB6		6SF5	.59	7B5	.89	12AU6	.69	14B8							
2B3	.89	6AR5	.79	6CD6	1.69	6SF5GT	.59	7B6	.89	12AU7	.79	14C5	1.25						
2B7	.89	6AT6	.59	6D6/78	1.10	6SG7		7B7	89c	12AV6	.59	14C7	1.12						
2C34	.60	6AS5	.90	6D8G	1.15	6SH7	69c	7B8		12AV7	.89	14F7	1.05						

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12"	3.00	17"	3.00	24"	8.00
14"	3.00	19"	4.00		

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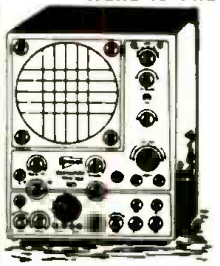

7" tube size. Sweep magnifier, complete push-pull from input through output. Vertical sensitivity 10.6 mv. R. M. S. per inch. Band-pass + 0 − 3db., 0 to 5 mc, complete with phasing control, blanking control, intensity mod. and self-measurement peak to peak feature, with 0C amplifiers throughout as found only in scopes selling for over $950.00. Exclusive easy maintenance feature: all small tubes mounted directly behind front panel.

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Model	Watts	For All Types of Soldering
WS-100	150	$8.77
Single heat		
WS-200	275	
Single heat		$9.75
WD-135	150-200	
Dual Heat		$10.73
WD-250	275-350	
Dual heat		$11.71

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for 6V6 39c
UNIVERSAL OUTPUT TRANSFORMER, 12 watt 99c
CHIMNEY MOUNT for TV ant. 98c
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21" Console, mahogany	$204.21
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12" COAXIAL PM SPEAKERS ..... $12.95 ea.
High Fidelity with high pass filter attached. 20 watt; 40-17500 cps. response; 8 ohm Voice-Coil.

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Very best quality—NATIONAL BRANDS. Individually Packed.

3"	ea. $1.39	8"	ea. $3.23
4"	ea. 1.59	10"	ea. 5.10
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6" SPECIAL PRICE	ea. $1.79		

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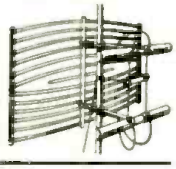

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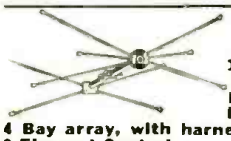
5' aluminum mast heavy gauge 1¼" diam. with interlocking end. Slip two sections together for a ten footer ..... each $1.00

TV ANTENNAS



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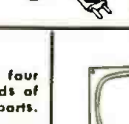

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100 ft. $1.49
20 GAUGE ..... 1000 ft. $16.95
80 MIL WEB ..... 100 ft. 1.89

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promised QSL card as soon as printed; is on the air around 1830-2030 when closes with "God Save the Queen." (Bellington, N. Y.) Noted with news on 4.951 at 1930. (Patterson, Ga., West, Va.)

Bulgaria—Radio Sofia, 9.700A, heard signing on 1820 carrying *Radio Moscow's* North American transmission which runs to 0100; has its own *English* session 2000-2030, then resumes Moscow relay. (Scheiner, N. J., others)

Heard on 7.671 with news 1545, on 6.070 with news 1600. (Sanderson, Australia)

Burma—Rangoon now noted on 4.777 parallel 9.543 closing 1015 in *English*. (Ridgeway, South Africa)

Canada—CJCX, 6.010, Sydney, N. S., noted 1300 in USA at good level; heard signing off 2310. (URDXC) CHNX, 6.130, Halifax, N. S., noted 1100-1200, good level. (French, Mass.) CBNX, 5.970, St. John's, Newfoundland,

NEW TV STATIONS ON THE AIR

(As of March 20, 1953)

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER* (IN KW.)
Alabama					
Mobile	WALA-TV	10	192-198	5.08	316
	WKAB-TV	48	674-680	1.45	22.5
Arizona					
Tucson	KOPO-TV	13	210-216	4.65	316
Colorado					
Colorado Spr.	KKTV	11	198-204	4.93	250
Denver	KFEL-TV	2	54-60	17.8	56
	KBTV	9	186-192	5.25	240
Pueblo	KDZA-TV	3	60-66	16.06	16.6
Connecticut					
Bridgeport	WICC-TV	43	644-650	1.52	180
New Britain	WKNB-TV	30	566-572	1.73	20
Illinois					
Peoria	WEEK-TV	43	644-650	1.52	170
Indiana					
South Bend	WSBT-TV	34	590-596	1.66	170
Louisiana					
Baton Rouge	WAFB-TV	28	554-560	1.77	216
Maine					
Bangor	WABI-TV	5	76-82	12.74	1.9
Massachusetts					
Springfield	WWLP	61	752-758	1.31	150
Mississippi					
Jackson	WJTV	25	536-542	1.83	180
Nebraska					
Lincoln	KOLN-TV	12	204-210	4.79	26.9
New Jersey					
Atlantic City	WFPG-TV	46	662-668	1.48	18
North Carolina					
Asheville	WISE-TV	62	758-764	1.29	23
Ohio					
Youngstown	WKBN-TV	27	548-554	1.79	200
	WFMJ-TV	73	824-830	1.19	175
Oregon					
Portland	KPTV	27	548-554	1.79	91
Pennsylvania					
Altoona	WFBG-TV	10	192-198	5.08	5
New Castle	WKST-TV	45	656-662	1.50	20.5
Reading	WHUM-TV	61	752-758	1.31	260
Wilkes-Barre	WBRE-TV	28	554-560	1.77	1000
York	WSBA-TV	43	644-650	1.52	170
Texas					
Austin	KTBC-TV	7	174-180	5.61	109.6
El Paso	KROD-TV	4	66-72	14.61	56.3
	KTSM-TV	9	186-192	5.25	64
Lubbock	KDUB-TV	13	210-216	4.65	31
Virginia					
Lynchburg	WLVA-TV	13	210-216	4.65	28
Roanoke	WROV-TV	27	548-554	1.79	1
	WSLS-TV	10	192-198	5.08	250
Washington					
Spokane	KHQ-TV	6	82-88	11.8	100
	KXLY-TV	4	66-72	14.61	47.9
Hawaii					
Honolulu	KGMB-TV	9	186-192	5.25	35
	KONA	11	198-204	4.93	117

*From Station CP application.

Formula for computing wavelength in feet of video carrier:

$$\text{wavelength in feet} = \frac{984}{\text{video carrier freq. (mc.)}}$$

The frequency of the video carrier = 1.25 + channel lower freq. limit.

Total number of television stations now on the air: 145 (18 of which are u.h.f.)

noted 0630 with news, strong level in N. Y. (Chatfield)

Canary Islands — Tenerife, 7.295, noted 1600-1745. (*Short-Wave Listener*, London)

Cape Verde Islands—CR4AA, 5.885, Praia, noted 1640-1700 closedown. (Patterson, Ga.)

Ceylon—Radio Ceylon, 11.975, still good level from 0845 sign-on to 1200 or later. (Scheiner, N. J.; Powers, Ohio; Golden, Mass., others) Heard on 15.120 with music 2330. (Sanderson, Australia)

Chile — CE1180, 11.998, Santiago, noted 2000-2030 in Spanish with Latin American music; CE1190, 11.950, Valparaiso, heard 2030-2130 with dance music. CE662, 6.220, Santiago, signs off 2400. (NNRC) CE920 Punta Arenas, now noted opening 2900 on 9.199A and closing 2200-2205; good signal; mostly classical music. (Ridgeway, South Africa)

China—Radio Peking some days is fairly good level with *English* 1730-1800 on 7.500. (Sutton, Ohio; Lancelot, Iowa, others) Heard on this channel 0915, woman in Chinese. (Pearce, England) Noted with *English* 1730-1800 on 11.69A. (Boepple, Ohio) Peking noted lately on *new* channel of 7.532 parallel 7.500, 10.200 around 0800; 7.532 outlet closes 1230, others run to 1330; other channels heard in Chinese include 6.050, 6.140 parallel from around 1030 to 1330 closedown. (Ridgeway, South Africa)

Colombia—A Bogota station has been heard around 1750 lately with symphonic music; may be harmonic, (Bellington, N. Y.) HJBB, 4.815, Cucuta, noted 2000 at strong level, music. (URDXC)

Costa Rica—TIMC, 6.200, noted 1820 at fair level. (URDXC)

Cuba—Havana, 6.450, noted 0100-0130 with Spanish music but with many announcements and commercials in *both* Spanish, *English*. (Hornstein, Mich.)

Cyprus—Limassol sent schedule of 2255-0130, 0330-1400, 6.120, 6.170, 6.790, 9.650, 11.720. (Scheiner, N. J.)

Czechoslovakia—Prague is scheduled for *English* on 9.504 at 1400; on 9.550 at 1930 and 2300; on 11.340 at 0715. (WRH)

Denmark—Copenhagen, 15.18, noted in Danish-*English* 0825-0900. (Roennau, Ontario) Good in transmissions to North America 2030-2130, 2200-2300 on 9.520. (Beach, Mass.) Has *English* also Sundays now in first half of these transmissions; is "quiz" program. (Saylor, Va.)

Dominican Republic — Station on 3.375A appears to be *Radio Baru* at San Pedro de Macoris, noted around 2100-2200. (Stark, Texas) HI1J, 6.025, noted as early as 1330. (Saylor, Va.)

Ecuador—HC1AC, Quito, was noted recently up to 9.63A from 9.557, closing 2335. (Bellington, N. Y.) HCJB, Quito, fine level from 1900 or both 9.745, 11.915. (Dalstrom, Nebr.)

Egypt—Cairo, 11.815, appears now to come on around 1345 instead of 1320; has *English* 1400-1600 on Mon.,

Tue., Sat., French on Sun., Wed., Fri.; closes down 1610. (Scheiner, N. J.) SUX, 7.867A, Cairo, noted in Arabic *only* 1330-1645; sometimes does play Western classical recordings; good level in South Africa. (Ridgeway)

El Salvador—YSC was noted recently 0610 on 6.075A in Spanish, fine level in N. Y. (Chatfield)

Ethiopia—*Radio Addis Ababa* is sending out a *new* schedule which indicates that *both* 15.060 (varies) and 9.658 are used for *English* 2330-0030, 0500-0600, 1100-1130, 1315-1430 closedown; Amharic 0600-0700, 1130-1300; Arabic 1300-1315. (Pearce, Catch, England, others)

Falkland Islands—According to WRH, Port Stanley operates on 3.400 with 250 watts which will be increased *this year* to 5 kw.; is on the air Mon. 1930-2030, Tue., Wed., Thurs., Fri., 1815-2000; Sat. 1600-1700, 1815-2000, and Sun. 1600-1700, 1800-1859.

Finland—Helsinki, 15.190, noted signing on 0640; news 0700 for West and South Europe; transcribed edition for North America 1430; uses 15.190, 17.800, 9.550. (Pearce, England) Heard on 15.190 at fair level in *English* 1430-1452, then music. (Lancelot, Iowa)

France—Paris, 17.85, noted at fair level from 1040 tuning; either off or buried by 1100. (Bishop, Ohio) Paris heard in French 1145 on 15.295; on 9.55 at 1630. (Roennau, Ontario)

French Equatorial Africa—Brazzaville, 9.964, noted with music 1715, then news in French. (Sanderson, Australia) *Radio Brazzaville*, 9.440, 11.970, noted 1445 with French lesson for *English* listeners—"The French Have a Word For It." (Pearce, England) Heard on 9.44 with news 1550.

French Morocco—Rabat, 6.006, noted 0205 with vocal Arabic music; also heard 1745 and to 1900 closedown. (Pearce, England)

French West Africa—*Radio Dakar* is using 4.951 in parallel with 11.897 in its 1400-1730 session with French program; 9.56 is still used 1500-1730. (Ridgeway, South Africa) Noted on 11.897A at 1530 in French. (Cox, Dela.)

Germany—NWDR, 6.27, Hamburg, noted from opening 2300; on 7.290 at 1100-1600 with German for South Africa. (Ridgeway, South Africa) *Süddeutscher Rundfunk*, 6.030, Stuttgart, verified direct with prepared QSL on UPU reply card; indicated 20 kw. transmitter is crystal-controlled; antenna is dipole with director and reflector beamed northwest. (Kary, Pa.) AFN's relay transmitter at Bayreuth, 250 w., is heard in Sweden with fine signals daily 0900-1200 on 5.470; in QSL letter said does "not maintain a regular supply of printed QSL cards." (Svensson)

Gold Coast—ZOY, 4.915, Accra, noted from 1230 when Madras, India, leaves 4.920. (Pearce, England)

Greece—*Radio Athens*, 7.300, noted 1430 with news; French news 1445. (Pearce, England) Noted on 15.345 at 0400 with relay of Home Service. (DX-Radio, Sweden) Heard on 7.300 to North America 2000-2100; *English* around 2040-2050. (Ferguson, N.C.)

Greenland—OZL, *Angmagssalik Radio*, 7.570, is heard some days around 0900-0945. Gives call in Danish at closedown. (*Etersvep*, Sweden) Although he has not definitely identified this station as Greenland, Pearce, England, hears it irregularly from 0900A to 0950 closedown; man talks in Nordic language; often has dance music with *English* vocals; has no signature tune.

Guatemala—TGLA, 6.295, noted 1915. (French, Mass.) TGNA noted on 11.85 and 9.668 on Wednesdays 2200-2250 sign-off; other days to only 2230A. (Lieberman, N.Y.)

Haiti—Current schedule for 4VEH, Cap Haitian, is daily 0630-0900 on 9.667A, and Sun. with additional period 1630-2130 on 9.710A. (Ferguson, N.C.) 4VWA noted on 6.23A around 1715 with identification in French. (Bellington, N.Y.) The poorly-modulated Haitian on 6.390A is 4VCP, *La Voix du Nord*, Cap Haitien, with identification approximately every quarter-hour in French (or Creole), *English*, Spanish; news in French (or Creole) daily 1745. (Kary, Pa.) 4VRW, Port-au-Prince, appears now to be on 10.06AV, noted 1140 at poor level in Ohio. (Bishop) *Radio Haiti* also heard on 5.840A around 2230. (Levy, N.Y.)

Honduras—HRA, 5.942A, Tegucigalpa, noted 1515-1530; QRM'd by teletype. (Cox, Dela.)

Hong-Kong—ZBW3, 9.525. Victoria, noted 0730, fair level. (Ballou, Calif.)

Hungary—Budapest noted with *English* 1700-1730 on 9.833. 7.22, 6.247A. (Pearce, England) Noted with *English* 2310 on 6.247A. (Niblack, Ind.) Heard on 7.22 in *English* 1930 through heavy CWQRM.

Iceland—Reykjavik noted Sun. *only* over TFJ, 12.175, with news in Icelandic 1115-1128A sign-off; calls "Utvarp Reykjavik." (Loven, Sweden; Pearce, England, others)

India—VUC2, 4.880, Calcutta, heard 1445-1545 in European Service. (Svensson, Sweden) VUB2, 4.838, Bombay, noted at high level from 1000 with regional native programs; closes 1230. (Ridgeway, South Africa) VUM2, 4.920, Madras, noted lately closing 1230 after clock strikes 11; formerly closed 1200. Delhi noted opening 1000 on 9.565, 11.780. (Pearce, England) When this was compiled, the *English* session for Southeast Asia, Far East was being heard well in West Virginia 0830-0945 on 11.85 (but still announced for 11.780) parallel 9.565 (weaker). Noted by Glick, Ind., with news 0835 on the 11.85 outlet. Chatfield, N. Y., reports AIR. 6.11, with news 0730.

Indo-China—Hanoi, 7,405A, noted 0600 with French session of news and music; *Radio France-Asie*,, 11.925, Saigon, noted 2030 in *English* program of news, strong level; and on 15.430 with news and music 0445, strong level; *"Voice of Vietnam,"* 9.620, noted 1800 with music and news in Vietnamese. (Sanderson, Austra-

lia) *Radio France-Asie,* Saigon, noted more recently on 11.925 with bilingual program around 1000, closing 1117A with "La Marseillaise"; the 9.754 outlet now has news 1100A, and when closing with "La Marseillaise" 1126A says next *English* is 2330 on 7.230; opens and closes *English* sessions with "Knightsbridge March." (Pearce, England) The *English* 1100-1130A is for Europe. (Ridgeway, South Africa)

Iraq—Radio Baghdad, 6.135, noted with *English* 1415-1500 closedown (when tuned included Arabic lesson in session); 11.724 is in parallel. (Pearce, England)

Ireland (Eire)—Bellington, N. Y., has received word from an official of *Radio Eireann* that short-wave transmissions likely will *not* be resumed for some time; no reason given.

Israel—Tel Aviv, 9.010A, good level in *English* 1615-1700 closedown. (Glick, Ind.)

Italy—Rome, 21.560, noted parallel with 15.120 in news to South Africa 1045; heard on 17.802 2030-2130 with popular dance music, then talk in Italian. (NNRC) Noted in Newfoundland on 3.940 to 1700, good signal. (Peddle)

Jamaica—Radio Jamaica, 4.950, fair level 0720. (Scheiner, N.J.) Noted recently on 3.29A around 2150 instead of regular 3.360 (which runs to 2308A sign-off now). (Bellington, Levy, N.Y.)

Kenya Colony—Nairobi, 4.855, noted with time pips 1500 and then closing with "God Save the Queen." (Pearce, England)

Kuwait (Al)—"Huna Kuwait," 5.000, noted 1230 with Arabic music and vocals; heard signing off 1400A. (Pearce, England) Is operating in *winter* 1130-1400, *summer* 1230-1500, Fri. also 1900-2000; 1 kw.; all-Arabic. (WRH)

Lebanon—Beirut, 8.036, heard closing down in Arabic and French 0230; noted 1002 with *English* session, (Pearce, England) On Fri. 1400-1455 has American dance recordings. (*Nattugglan,* Sweden)

Liberia—ELBC, 6.024A, Monrovia, noted from 1745 tune-in to 1845 close-down; heavy QRM at times. (Saylor, Va.)

(*Continued on page* 126)

Improved Power Supply

(*Continued from page 42*)

circuit. Plates go to opposite sides of the high-voltage transformer winding. Cathodes are connected together and feed a regular condenser-input filter C_1, CH_1, C_2.

The grids of the rectifier tubes are connected together through parasitic-suppression resistors R_1, R_2, to the movable arm of the potentiometer R_3. This potentiometer is the main voltage control. A potential of around 400 volts is maintained across R_3 by means of an auxiliary positive supply consisting of three small selenium rectifiers *Rect.*$_1$, *Rect.*$_2$, and *Rect.*$_3$ and a single filter condenser C_3. This auxiliary supply is almost the only extra equipment required as contrasted to an ordinary condenser-input power supply using a 5Y3 or 5U4 rectifier. Cost of the extra parts is quite small and the space required is negligible. A 6X4, 6X5, or similar rectifier tube can be used in place of the selenium rectifiers if desired, provided suitable filament windings are available on the power transformer.

The transformer used in this particular power supply was a commercial surplus unit having two 6.3 volt filament windings, and a plate winding of 700 volts center-tapped at 70 ma. There are few replacement-type or new-equipment type transformers on the market which have the necessary two filament windings, although some suitable types may appear with the increasing use of the 6.3 volt heater-type rectifier tubes such as the 6AX4. Hence, any handy transformer delivering enough voltage will do, and it may be necessary to add a filament transformer to get the extra 6.3 volt filament source that the circuit demands.

Output Characteristics

Fig. 3C shows curves of output voltage *vs* output current. Maximum output is 290 volts at 80 ma.; minimum output is about 50 volts no load. The minimum no-load voltage is essentially the cut-off bias of the tubes at the applied plate voltage. When the d.c. output voltage is 50, the applied plate voltage is 350-50, or 300 r.m.s. When the d.c. output voltage is high, say 300, the plate voltage is only about 50, because the cathodes are so high above ground.

The drop-off in the regulation curves at high voltage (300) is due to the lack of adequate plate-cathode voltage to give good current conduction through the tubes. If more output at high voltages is desired, use a power transformer with higher secondary voltage—400 or 450.

Limiting factor at low output voltages is plate dissipation. Suppose we want to draw 80 ma. at 50 volts. The voltage across the tubes is 300, the total current 80 ma.; power loss in the tubes is 24 watts. This is a shade over the rated dissipation of 10 watts per tube—20 watts total. But at 250 volts and 80 ma., the actual plate dissipation is only $(350 - 250) \times .08 = 8$ watts, or 4 watts per tube. For a generally beefier power supply, use a transformer delivering about 450 volts each side, and a pair of 6L6's for rectifiers. These bottles with the man-sized bulbs are rated at 19 watts dissipation.

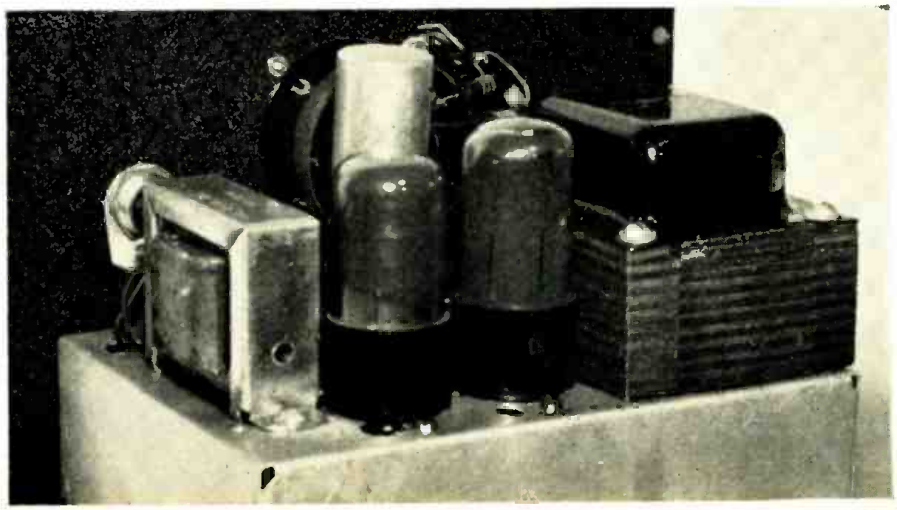
The small 6W6 has the virtue of very low voltage drop at zero bias, and so holds up better at the high end than most other tubes, when the available transformer voltage is limited. However, 6V6's work nearly as well—the droop in the top-voltage output curve is a bit worse. 6K6's and 6F6's will give about the same results.

An outstanding virtue of this type of power supply is its lack of fussiness about tube types and other component variations.

A 5" x 6" x 9" utility box was used for the cabinet, the chassis a standard unit cut down to fit inside. If tubes larger than 6V6's are used, the box will have to be larger. In any case, cut plenty of ventilating holes in the back.

An output voltmeter is very desira-

Fig. 4. Rear chassis view of the cathode-follower supply showing the parts layout.



ble in any variable power supply, not only for convenience but for safety. There are always some types of parts failures which will cause the supply to put out its maximum voltage, irrespective of the control setting; although this type of failure is much less likely in the supply described here than in the more complicated regulated supplies.

REFERENCES

1. Houle, J.: "Wide-Range Voltage Regulators," *Electronics*, August 1951.
2. Walker, A. H. B.: "Variable H.T. Power Pack," *Wireless World*, September 1952.

—30—

TORONTO ON TV NET

NETWORK television service has now been extended to Toronto, Canada through Buffalo by means of a radio-relay route across Lake Ontario.

This 66-mile, two-section route, which was constructed by The Bell Telephone Company of Canada provides a single TV channel from Buffalo to Toronto at the present time. Montreal will be added later this Spring via microwave link from Toronto. —30—

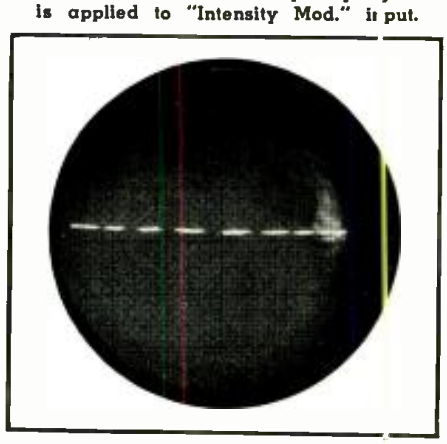
FREQUENCY CHECKING

By RUFUS P. TURNER, K6A

THE well-known "spot-wheel" oscilloscope pattern is handier than Lissajous loop patterns for checking an unknown audio frequency in terms of a standard frequency when the ratio between the two is high. But this pattern requires an external phase-shifting RC network which often is not convenient to operate.

The network may be eliminated if the unknown signal is applied to the "Intensity Modulation" (Z-axis input of the oscilloscope, and the standard frequency to the horizontal amplifier input. The internal sweep is not used. The result is a straight horizontal line broken up into dots or segments, as shown in Fig. 1. The unknown frequency is determined by multiplying the standard frequency by the number of dots. Keep the intensity as low as visibility permits, otherwise the glare will obscure the segments. —30—

Fig. 1. Broken-line frequency identification pattern on scope screen. Here the test frequency (540 cycles) is 9 times the 60-cycle reference frequency. In this instance the 60-cycle sine-wave sweep of the scope is used as the horizontal reference trace and the test-frequency signal is applied to "Intensity Mod." input.



Mac's Service Shop

(Continued from page 68)

nears the bottom, you know the lower part of the picture is stretched. The vertical linearity and the vertical size controls are juggled together until the bar remains the same apparent width during its journey across the face of the tube; then the vertical linearity will be correct."

"Yeah, but how about horizontal linearity. You can't drift the horizontal blanking bar sideways across the screen in the same fashion."

"No, but you can achieve the same result by watching an object on the screen while the camera pans across it and observe if its apparent size changes as it moves from one side of the screen to the other. Take a weather map for example. Keep your eye on one state as the camera swings back and forth and notice if the width of that state seems to decrease or increase as it occupies different positions from left to right on the screen. If it does, note where the narrowing or broadening occurs, for then you will be sure the picture is respectively cramped or stretched at that point. Almost any semi-static picture or commercial can be observed while corrective adjustments are made to remove the nonlinearity.

"Over-all linearity can be checked by observing any design that carries a large circle, oval, or other geometrical figure. The *CBS* 'eye' is a good example. Many commercials use something of this nature. The *Lucky Strike* emblem and the elliptical designs used in a couple of the beer commercials will quickly tell you if the linearity is poor, and in what manner it is off."

"How about such things as focus, phase shift, ringing, and so on? Can you judge these matters in a picture?"

"Just as easily as in a test pattern. If the tracing dot is really round, you can focus for the smallest diameter of raster lines; but if it tends to be out-of-round, as is often the case, it is better to adjust for best horizontal resolution as indicated by one of the methods we talked about before. Smearing caused by phase shift, ringing, and inadequate video amplifier response can be quickly spotted in any scene in which a large white area is suddenly broken by a black area, or *vice versa*, such as happens in block lettering, black state boundary lines on a white map, etc. Weather maps are very good for spotting ringing, for when it is present the vertical lines will be followed by two or three fainter lines on the right-hand side. Phase shift will often produce the effect of a boxing-ring rope that apparently can be seen right through the referee. One thing to watch, though, is whether or not the trouble is present only when viewing a network program. Quite often some phase-shift is present on such programs which will disap-

pear when the program originates in the station studio. Naturally, you cannot correct in the receiver a defect that actually is being transmitted."

"You know, I'm beginning to think you may be right," Barney grudgingly admitted. "I was thinking that some troubles like the horizontal pulling due to a.c. in the video circuits would show up even quicker in a picture than it would in a pattern. As for shading, everyone sets the contrast to suit himself anyway; so there would be no point in employing a test pattern just for that. Maybe we *can* learn to use the picture to spot trouble."

"It's about a case of necessity as you yourself pointed out," Mac said. "Not many of us are going to be able to afford a test-pattern generator of our own. There are, of course, some substitutes on the market, such as precision dot generators; but I have had no experience with these, nor has anyone I know; so I can't say just how good a substitute they are. Anyway, in the final analysis, the purpose of television is to broadcast *pictures*, not test patterns, and there is no good reason why the performance of a set should not be judged by a careful and critical inspection of the picture it receives.

"Back in the early days of radio," he went on, "each new set was introduced with a flock of imposing fidelity, sensitivity, and selectivity curves; and the technician was supposed to compare the performance of a receiver on which he worked with these curves. This did not last long. The technician did not have the time or expensive equipment necessary to do that; and even if he did have, few customers would have been willing to pay what the operation would have cost. Instead, the technician taught himself to judge a receiver's performance simply by how it sounded, the weak stations it would pick up, and how good a job it did of separating strong stations on adjacent frequencies.

"We are going to have to do the same thing in television. After all, if a trained technician can find nothing wrong with a received picture there surely cannot be much wrong with the set; and if we start now to train ourselves to locate trouble by looking at a picture instead of a pattern, the case of the 'Vanishing American' as you call it, will be of concern to no one."

—30—

OLD TIMER'S NITE

THE Ninth Annual Old Timer's Nite Round-Up and banquet will be held Saturday, April 25th at the Hotel Stacy-Trent in Trenton, N. J.

Sponsored by the Delaware Valley Radio Assn., the program will include a turkey dinner at 6:30 and various contests and stunts.

Tickets for this stag are $5.00 each before April 21st, $6.00 at the door. Write Ed. G. Raser, W2ZI, 315 Beechwood Ave., Trenton 8, N. J.

—30—

SERVICE HINTS ON ADMIRAL TV SETS

20T1 CHASSIS

To increase sound in fringe areas.

1. Disconnect audio lead from pin 2 of 6AL5 video detector (V304) and connect it to pin 5 of 6AU6 video amplifier (V305).
2. Retune L201 sound take-off coil. Use a station signal.

Long warm-up time.

This may be caused by a poor connection between the plate cap lead and the plate cap to the 6BQ6GT.

Touch a hot soldering iron to the solder joint inside the plate cap.

20T1 & 20V1 CHASSIS

Vertical bars in picture.

To remove shadow type vertical bars at left of raster:

1. Dress the picture tube cathode lead (yellow) away from the horizontal output tube.
2. Install filter as follows:
   a. Construct filter from .005 μfd., 600 v. condenser; 470 ohm, 1 watt resistor; and variable inductance (54-245 μhy., 53 ohm width coil *Admiral* part 94A4-2) wired in parallel.
   b. Remove high voltage shield and remove the two leads on terminal 8 of the horizontal output transformer.
   c. If a 79C32-1 type transformer is used (two E-shaped core pieces) connect single-stage filter between terminal 8 and disconnected leads.
   d. If a 79C36-1 type transformer is used (two U-shaped core pieces) two filters connected in series may be necessary connected as in c. above.
   e. Filter must be placed inside high voltage shield.
   f. Vary the inductance until the bars are removed or reduced to a minimum.

Horizontal tearing or bending.

1. Sync pulses of excessively strong signals may be clipped in the video amplifier. To prevent this, increase a.g.c. voltage by removing R302 from the circuit at test point "T."
2. Incorrect a.g.c. voltage may be caused by a high resistance leak between the control grid and screen or cathode in i.f. and r.f. amplifier tubes. Check these tubes for leakage.

21 CHASSIS

Bending or tearing picture.

1. Bending as contrast control is changed may result from improper sync separation due to variations in transmission. Reduce R417 to as low as 10,000 ohms, depending on the amount of bend.
2. Check r.f. and i.f. amplifier tubes for leakage between control grid and other elements. High resistance leakage will shunt a.g.c. voltage and cause loss of sync pulses at overloaded video amplifier.
3. For bending near top of picture check the sync separator and clipper tube V403 (12AU7). Check resistor R417 (18,000 ohms). If this resistor measures over 20,000 ohms replace it.

Bright horizontal bar at bottom of picture.

1. Check to see that line voltage is not below normal.
2. Check the vertical output tube (V402), particularly if it is a 6S4; check also the 5U4G rectifier (V501).
3. Increase vertical and horizontal sweep by connecting a .002 to .005 μfd. condenser across width coil L402.
4. Tighten the collar on the deflection yoke so that the air gap between the two semi-circular powdered iron core pieces is less than 1/32 inch. Remove the collar and smooth the insulation between the core pieces if necessary to reduce the air gap.

Buzz in audio.

1. This can be caused by audio circuit pick-up from vert. sweep. Dress the shielded audio cable connecting to the volume control R208A away from the vertical output tube V402.
   Check that one end of the shield is soldered to the chassis.
2. Check condenser C201 for leakage or short.
3. Check condenser C205, if it is 50 μμfd. replace it with a 500 μμfd. ceramic condenser.

Distorted sound.

If realignment of ratio detector transformer T201 does not cure this permanently, do the following:

1. Connect a 20 μμfd., 750 v. zero-temp. coefficient ceramic con-

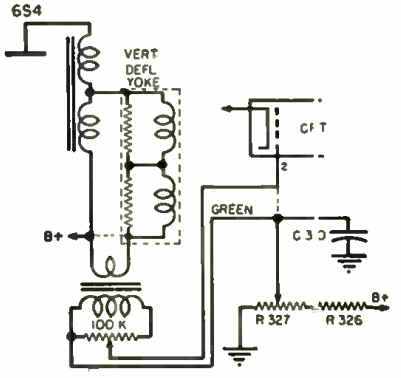
denser (*Admiral* part number 65B6-26) in parallel with condenser C204.
2. Realign ratio detector.

To increase width.
1. Change C431 from .1 μfd. to .05 μfd.

Loss of sync or fuzzy picture.
Check resistor R323, it should be 18,000 ohms.

Picture jitter (up and down) and high level sync buzz.
If the buzz changes pitch as the vertical hold control is rotated, the cause is probably a breakdown between the windings of the vertical output transformer T402. Replace transformer.

Retrace line elimination.
(The following provides an adjustable control for retrace elimination to compensate for tube aging, etc.)
1. Connect a 100,000 ohm potentiometer across the primary winding of an output transformer.
2. Connect the voice coil winding of the output transformer in series with the vertical deflection yoke.



3. Disconnect the green lead from pin 2 of the CRT and connect pin 2 to the center arm of the potentiometer. Connect the green lead to one side of the pot.
4. If adjusting the pot. does not eliminate or reduce the retrace lines, connect the green lead to the other side of the pot.

To eliminate retrace lines when brightness control is turned fully on, as in weak signal areas:
1. Connect a 270,000 ohm, ½ watt resistor in series with pin 2 of the picture tube and the lead from the junction of C310 and R327.
2. Connect a .05 μfd. condenser from the junction of C406 and R407 to pin 2 of the picture tube.
(Note: if the picture smears, use a 47,000 ohm resistor in place of the 270,000 ohm unit. If shading appears at top of picture reduce the condenser in 2. to .001 μfd.)

White horizontal bars across picture and temporary loss of sync.
Caused by high amplitude noise pulses in weak signal areas.

1. Connect a .47 μfd. 200 v. condenser across C317.
2. Remove R331 (220.000 ohms) and replace it with a 470.000 ohm. ½ watt unit.
3. If the change in 2. above causes horizontal jitter on a strong signal, change R331 to about 330,000 ohms.

Wide spacing or pairing of raster lines.
This is an indication of improper vertical interlace. Insert a .05 μfd. condenser across R407 (8200 or 10.000 ohms) in the vertical output stage. Insert a 330 μμfd. condenser from pin 1 of the vertical oscillator tube (V401A) to ground.

SERIES 21 CHASSIS (sets with socket M509 and plug M510)

Intermittent sound, picture, or sync.
This can be caused by poor contact between the color converter plug M510 and socket M509. Remove plug and tighten socket contacts with long nose pliers. Clean contacts with carbon tet.

SERIES 21B1 CHASSIS

Long warm-up time.
This may be caused by a poor connection between the plate cap lead and the plate cap to the 6BQ6GT.
Touch a hot soldering iron to the solder joint inside the plate cap.

To increase sound in fringe areas.

1. Disconnect audio lead from pin 2 of video detector (V304) and connect it to pin 8 of 6AC7 video amplifier (V305).
2. Retune L201 sound take-off coil. Use a station signal.

21B1 AND 21C1

Second anode lead arcing to lead support.
Check the second anode lead support, if it is 3 7/16 inches long either eliminate it or replace it with a shorter support (3 3/16 inches long).

21B1, 21C1, 21D1, 21H1, AND 21J1 CHASSIS

Vertical bars in picture.
To remove shadow type vertical bars at left of raster:

1. Dress picture tube cathode lead (yellow) away from the horizontal output tube.
2. Install the following filter:
   a. Construct filter from .005 μfd., 600 v. condenser; 470 ohm, 1 watt resistor; and variable inductance (54-245 μhy., 53 ohm width coil; *Admiral* part 94A4-2) wired in parallel.
   b. Remove the high voltage shield and disconnect lead from terminal 4 on horizontal output transformer.
   c. Connect filter between terminal 4 and disconnected lead.

d. Adjust the inductance until bars disappear or are reduced.

21D1

Poor vertical linearity or foldove..

1. Check vertical output tube V402.
2. Check resistor R411, if this resistor is 820 ohms replace it with a 680 ohm, 1 watt resistor.

Vertical roll.

Vertical oscillator may be triggered by ripple from vertical output stage in "B+" supply. Roll will result if ripple voltage has shifted in phase.

Change the "B+" connections of the 6W6GT vertical output tube as follows:

1. Disconnect from the 80 μfd. filter condenser C407C the red wire coming from the vertical output transformer.
2. Connect the red wire to junction of C427 and L403 through a decoupling resistor (5,000 ohm, 5 watt or three 15,000 ohm 2 watt in parallel).
3. Connect a 20 μfd. 450 volt condenser from the junction of the red wire and the decoupling resistor to ground.

21B1 THROUGH 21Z1A CHASSIS (above Run 15)
SERIES 22 CHASSIS

Improving sync in extreme fringe areas.

1. Increase sync separator voltage by increasing R417, in some cases to four times its original value.
2. Increase resistor R423 (1000 ohms) to 4700 ohms to remove vertical jump.
3. If 2. above does not work satisfactorily, change condenser C315 to 470 μμfd.

SERIES 22 CHASSIS

Wide spacing or pairing of raster lines.

See hint under Series 21 Chassis.

Retrace line elimination.

See hint under Series 21 Chassis.

Bending picture.

Bending as contrast control is changed may result from improper sync separation due to variations in picture transmission. Reduce R417 to as low as 10,000 ohms, depending on the amount of bend.

To increase width.

Change C431 from .1 μfd. to .05 μfd.

22A2, 22A2A, AND 22Y1 CHASSIS

To increase sound in fringe areas.

In tuning for the best picture in fringe areas, the sound carrier is moved down the i.f. curve closer to the frequency of the adjacent channel trap (L108). This causes attenuation of the sound level. To increase the sound level detune the 19.75 mc. adjacent video

channel trap L108. Turn the L108 slug in about 7 or 8 turns or until no further increase in sound is apparent.

24D1

Horizontal instability (jitter).

Out-of-phase horizontal signal fed to grids of first and second i.f. amplifier stages via a.g.c. modulates the video signal causing instability.

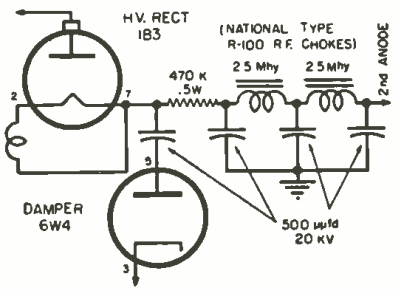
Connect a .1 μfd. condenser from the junction of R434 and R435 to ground.

ALL SETS

Eliminating horizontal sweep interference in broadcast receivers.

Radiation of harmonics of television sweep circuits sometimes causes whistles or buzz on broadcast receivers in the vicinity.

1. Connect a long wire antenna to the broadcast receiver to increase signal input on weak stations.
2. Revise TV receiver circuit as follows for glass picture tubes:
   a. Connect .01 or .015 μfd. 600 v. condenser from each side of 117 volt a.c. line to chassis ground.
   b. Connect a 500 μμfd. 20 kv. condenser between the second anode lead of the cathode-ray tube and chassis.
   c. Completely cover the bell of the CRT with aluminum foil; ground this foil.
   d. Shield the exposed windings and leads of the focus coil and deflection yoke with aluminum foil tape.
   e. Shield with metal braid any exposed part of the plate lead of the horizontal output tube. Be sure that this braid is grounded.
   f. Replace the picture tube cathode lead (pin 11 on CRT socket) by a piece of RG59U coaxial cable.
3. Revise TV receiver circuit for metal picture tubes as follows:
   a. Make changes a, d, e, and f above.
   b. If radiation persists, additional filtering may be added to the second anode



lead as illustrated. Be sure to locate chokes and condensers equidistant from all parts to avoid flashover.

TUNERS

Increasing sensitivity in weak signal areas.

Check condenser C105; if this condenser is 120 μμfd. replace it with a 1000 μμfd. unit. This will increase over-all gain by 10 to 15 per-cent.

No picture or extremely snowy picture with cascode tuners.

Plate resistor R104 (1000 ohms) may burn out either because of excessive plate current in the r.f. tube (6BK7 amplifier) or because of a shorted condenser C105. Condenser C105 may be shorting to the cover plate of the tuner. Replace this resistor with a 1-watt unit. -30-

AUXILIARY SPEAKERS FOR TELEVISION RECEIVERS

By ROBERT W. WOLFE

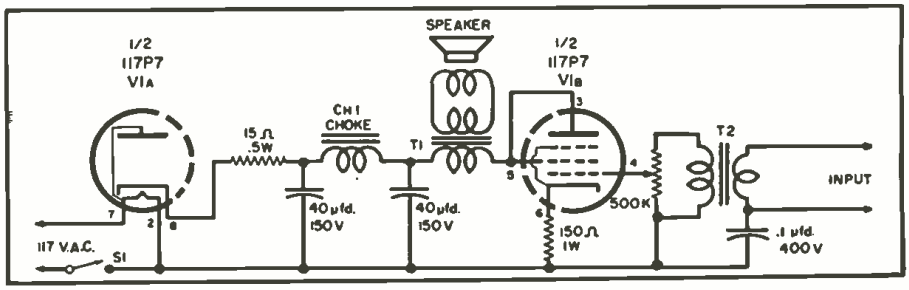
HAVING many occasions to connect auxiliary speakers to television sets inexpensively and conveniently, the method shown in Fig. 1 was evolved.

Choke CH_1 is the field of a small dynamic speaker removed from an old a.c.-d.c. radio. The plate current of the type 117P7 tube is sufficient to energize the field. A PM speaker may be used just as well if a suitable resistor is used in the filter network. Transformer T_2 can be any type of single-ended or push-pull output transformer with a 500,000 ohm potentiometer across the entire primary. The author used a Thordarson TS-24S60.

All ground leads are returned to a common bus isolated from the chassis. The entire unit is small enough to be installed along with the speaker in the type of box used for intercom remotes.

In four installations the author has not found it necessary to remove the back of the set as the connection has been made to the speaker plug. Volume obtainable by this method is high even when the volume on the set is reduced to inaudibility. -30-

Fig. 1. Schematic for adding an auxiliary speaker to a television receiver.



Antenna Measurements

(*Continued from page 63*)

tenna characteristics is directivity. In a television receiving antenna, directivity is a measure of the ability of the antenna to receive or reject signals from different directions. This data is generally presented on a horizontal polar diagram. Fig. 3A shows the horizontal polar diagram of a dipole without any parasitic elements. The dipole is drawn on this diagram to show the direction of front and rear signals relative to the dipole. Maximum reception is obtained equally from the dipole's front and rear, that is, at right angles to its direction. Minimum reception is obtained off the ends of the dipole.

It is important to completely eliminate the notion of gain in evaluating a horizontal polar diagram. The major lobe is generally set at the outermost circle on a horizontal polar diagram. This circle is generally marked 100. However, this does not mean 100 microvolts, or 100 decibels, or 100 of any unit. Referring back to Fig. 3A, it can be seen that the curve crosses the circle labeled 50 at 50 degrees. This means that the antenna is 50% as sensitive at an angle of 50 degrees as it is head-on at 0 degrees. But it does not say what the gain is or how many microvolts the antenna will provide.

Front-to-Back Ratio

Fig. 3B shows the horizontal polar diagram of a conventional five-element yagi antenna. It will be noticed that its major lobe is set at the circle representing 100. Now the lobe to the rear of the antenna extends only to the second circle (20). This means that the antenna is five times as sensitive to signals from the front as it is to the rear. In other words, it has a front-to-back ratio of 5 to 1.

Fig. 3C shows a horizontal polar diagram of an antenna which is apparently far superior. However, this is not the case. Fig. 3B shows this information in terms of relative *voltage*. Fig. 3C shows the same information in terms of relative *power*. The results are exaggerated because the power is proportional to the square of the voltage.

If the 5 to 1 front-to-back ratio is squared, the ratio becomes 25 to 1 in terms of relative power. The same figure could be obtained by squaring the 100 (which would give 10,000) and squaring the 20 (which would give 400). The ratio is still 25 to 1.

When evaluating a horizontal polar diagram, it is always important to ask: "Is this presented in terms of relative voltage or relative power?" While both methods are technically correct, the presentation of horizontal polar diagrams in relative power is misleading. The signal picked up by the antenna and fed to the set is a voltage signal; for the case just dis-

cussed, a 5 to 1 front-to-back ratio in voltage would still permit some interference from signals picked up from the rear, whereas a 25 to 1 ratio in voltage would not.

One other point to bear in mind about horizontal polar diagrams is that the information is for one particular frequency only. An antenna may have an excellent front-to-back ratio at one channel, and an extremely poor one at another. Indeed, the front-to-back ratio can vary between the video carrier and the audio carrier of the same channel.

Plotting Polar Patterns

At *Channel Master,* an extremely ingenious method is provided for automatically obtaining horizontal polar information in terms of relative voltage. The receiving antenna is mounted on the same test tower used for gain measurements, and is rotated by a synchronous motor which drives the mast on the tower. Obviously, as the receiving antenna is rotated and turns away from the transmitting antenna, it will receive proportionally less signal.

Inside the laboratory, the detected signal is amplified and fed directly to a polinear recorder. This instrument is like a voltage meter except that it has a pen instead of a needle. See Fig. 5. The deflection of the pen is proportional to the signal being received. A sheet of horizontal polar coordinate paper is placed on a turntable directly under the pen. This turntable is rotated synchronously with the motor that turns the receiving antenna.

Let us follow a directivity test of a simple dipole. As the dipole faces the transmitting antenna, maximum signal will be received and the deflection of the pen will be maximum, at the 100 circle. As both the antenna and the polar paper rotate, the signal drops off and, therefore, the deflection of the pen decreases until, at 90 degrees, zero signal is picked up and zero deflection is recorded by the pen. The test is completed when the antenna (and polar paper) have made a complete rotation. In this manner, by rotating the antenna once at any given frequency, the pen automatically draws the horizontal polar diagram of the receiving antenna in terms of relative voltage. Thus, in a very short span of time, the directional characteristics of any receiving antenna can be plotted automatically.

Impedance

The third important antenna quality is impedance. This is the most difficult of the three antenna properties to measure. It is further complicated by the fact that reactive components, both capacitive and inductive, enter into consideration.

In any system comprising a generator (receiving antenna), a transmission line, and a load (television set), maximum energy will be transmitted when the generator matches the line and the line matches the load. Since most receiving sets and transmission lines are designed to have a 300-ohm impedance, most antennas aim for this same figure.

However, impedance must be considered in another important manner. The ability of an antenna to hold its impedance is actually a measure of its bandwidth. A conventional yagi will work only on one channel because its impedance is about 300 ohms only for the frequencies covered by that channel. A broadband antenna works well over a number of channels because its impedance is held fairly constant over this wider range.

Impedance—A Variable Factor

The impedance of any antenna is not an absolutely fixed quality. It will vary not only with frequency but with height above ground, and in proximity with other objects and antennas. For instance, in stacking antennas, the presence of a second bay affects impedance by an amount depending upon the distance between the bays. This effect is called "mutual

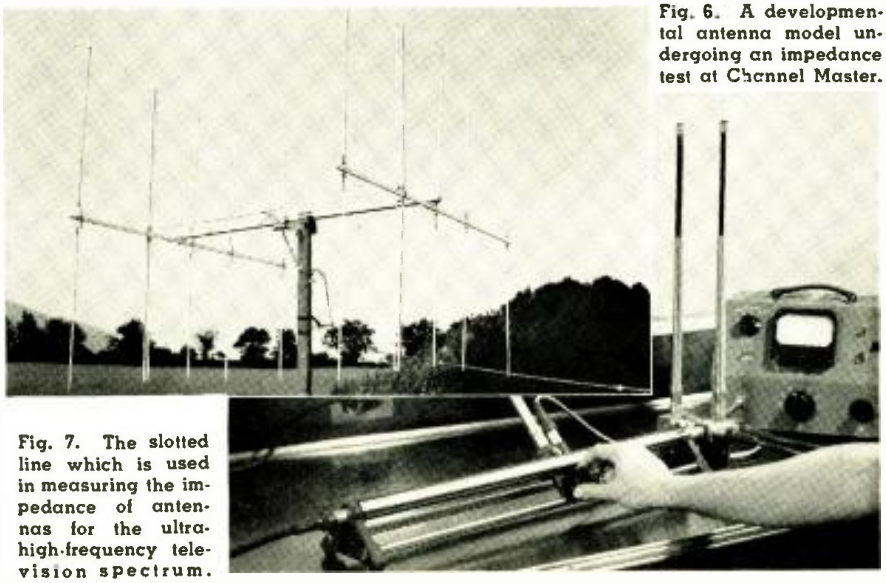


Fig. 6. A developmental antenna model undergoing an impedance test at Channel Master.

Fig. 7. The slotted line which is used in measuring the impedance of antennas for the ultra-high-frequency television spectrum.

impedance" and is an important consideration in designing stacked arrays. Impedance considerations become increasingly important when we stack antennas because the connecting rods, acting as quarter-wave transformers, tend to multiply impedance errors. This difficult concept of impedance is of prime importance to design engineers who must master it if they are to create antennas that will operate over wide ranges of frequencies, that will stack into two- or four-bay arrays, and that will match closely 300-ohm line in any combination of arrays.

Measuring Impedance

At *Channel Master,* although the measuring setups for gain and directivity are similar, different kinds of impedance testing facilities are used for v.h.f. and u.h.f.

The v.h.f. impedance measuring equipment consists of a modulated oscillator, an admittance-type bridge, and a tuned detector and amplifier. The signal from the oscillator is fed through the admittance bridge out to the antenna being measured (Fig. 6). The mismatch at the antenna will cause standing waves which are reflected back to the admittance bridge. Here, these standing waves are evaluated in terms of phase and magnitude and this information is converted into impedance. Figures are presented with both resistive and reactive components.

The same information is obtained in the u.h.f. range by use of the slotted line (Fig. 7). A signal reflected back along the transmission line from the u.h.f. antenna is measured on the slotted line. The standing-wave ratio is converted to impedance and again this impedance is analyzed mathematically so that both the resistive and reactive components can be obtained. —30—

EDISON HAM AWARD

DON L. MILLICAN of Searcy, Arkansas, has been named winner of the 1952 Edison Radio Amateur Award presented annually by the General Electric Company's Tube Department in recognition of outstanding public service by a radio amateur.

Mr. Millican's honor was bestowed because he stuck to his rig almost without relief for more than five days to bring emergency crews to Searcy and the nearby towns of Judsonia and Bald Knob.

He received a trophy emblematic of his efforts at a dinner held at the Mayflower Hotel in Washington, D. C.

Mr. Millican, W5PHP, took to the air immediately after the tornado hit Searcy on Friday, March 21st. He operated almost continuously until Monday afternoon handling Red Cross messages and emergency traffic. He was the only link between the stricken towns and relief operations.

He got his first amateur license in 1948 although he has been interested in radio since boyhood. He is now a junior at Harding College in Searcy. He plans to become a missionary. —30—

International Short-Wave

(*Continued from page* 113)

Madagascar — Radio Tananarive, 9.515, is heard in the United Kingdom from around 1130 with light music; call in French is "Ici Radio Tananarive" at 1200. (Pearce, ISWC, England)

Malaya—Radio Malaya, 4.780, Singapore, noted 0615 with musical program and BBC relay; BFEBS, 15.430, Singapore, noted with news 0500 relayed from BBC. (Sanderson, Australia) *Radio Malaya,* 7.220, Singapore, noted in *English* 0700, but soon fades out. (Washington)

Mexico—XEBR, 11.820, Hermosillo, noted 1830 with dance tunes. (NNRC) XEQ14A, 6.750A, noted around 2100 in Spanish and broken *English;* is located in Ciudad General Aleman, State of Vera Cruz. (Stark, Texas) *Measured* 6.7511 around 2135; signed off 2159; asked for reception reports.

Monaco—Radio Monte Carlo, 6.035, 7.349, noted 0200 with music and commercials; Wed., Thur., Fri. with religious broadcasts in *English* 1730-1800A. (Pearce, England, others)

Mozambique — Lourenco Marques sent schedule of Portuguese 0000-0100, 11.952, 4.830; 0430-0630, 11.952, 7.216; 1100-1500, 4.830, 15.285. *English* 2300-0200, 11.761, 4.916; 0200-0800, 11.761, 7.262; 0800-1200, 11.761, 9.766; 1200-1600, 9.766, 4.916, 3.490 (from 1300).

New Zealand—Is heard well some days 0200-0545 on 9.540, 11.780. (West, Va.)

Nicaragua — YNBH, 6.015, Managua, heard 2330 with Latin American music and announcing "Radio Panamericana." (NNRC) YNVP, 6.185, *La Voz de Nicaragua,* closes 2000A Sun., other days usually 2300. (Stark, Texas) YNWW, 7.850, Granada, noted around 1900-2000 with many North American recordings. (*United 49'ers Radio Society*)

Nigeria — Latest schedule direct from *Radio Nigeria* reads—National Program, Lagos, 6.100, 0.3 kw., 0000-1700; 4.975, 7.5 kw. to be increased to 20 kw. during 1953. 0500-0800; 4.933, 0.3 kw., 1100-1500. Kaduna (North Regional), 3.300, 2340-0445, 1115-1200; 7.170, 0.3 kw. to be increased to 7.5 kw., 0530-1100. Enugu (East Regional), 7.097, 0.3 kw. to be increased to 2.5 kw., Sun. 0000-1710, weekdays 0500-1700. (WRH) Catch, England, flashes that he has picked up Lagos on *measured* 4.803 at 1445 with native session; 1500 time pips followed by BBC news relays heard to *after* 1600 and probably closes 1700. Lagos is heard in New York 0100 on a channel which *varies* 4.98-4.975, according to Bellington.

Northern Rhodesia—ZQP, 4.826, Lusaka, noted 1220 with talk in *English;* 1300 news from BBC; 1325 local news.

Norway — Oslo's *English* session ("Norway This Week") on Sun. *only* noted at excellent level 1200-1220 on 15.175. (Mast, N.Y., Scheiner, N.J.)

Pakistan—APK2, 17.770, noted 0415 with musical program by courtesy of U.S. Information Service; APK3, 7.010, heard 1545 in transmission to Britain; APD1, 15.335, noted 2015 with Home Service; APK1, 11.885, noted 2020 with Home Service in native news, then news in *English;* APK2, 11.725, noted 0630 in *English.* (Sanderson, Australia) Noted on 15.270 with session to Indonesia 0630-0715; announced a 25-m. channel in parallel (11.675A has replaced 17.835, according to Ridgeway, So. Africa, others); Home Service near 17.715 heard with news 0200, 0330, call 0400; with news 1015 on 9.630, then in Urdu; heard with General Overseas Service with news at dictation speed 1210 on 6.235, 7.010, and closing down 1600 on these channels to United Kingdom. (Pearce, England)

Heard with news 0730 on 11.675A parallel 7.096. (Bellington, N.Y.)

Panama—HOLA, 9.505, Colon, noted with popular American recordings and closing *English* announcemen s 1803; continued in Spanish; good level. (Niblack, Ind.)

Paraguay — ZPA1, 6.275, Asuncion, noted 1930 with music. (Niblack, Ind.) ZPA5, 11.948V, Encarnacion noted 1230 with Spanish music. (Cox, Dela.)

Peru—OAX4S, 5.965, Lima, has Spanish music 1930. (NNRC) OAX4W, 9.404, Lima, noted 0030 at strong level; *no English heard.* (Chatfield, N.Y.) *Radio Libertad,* OAX5C, 9.476, Ica, is heard with weak signal from 1730 until *after* 2215. (Ridgeway, South Africa) OBX4B, Cerro DePaxco, 6.170, 0.35 kw., is scheduled 1700-2230. (WRH)

Philippines — DZH3, 9.500, Manila, noted 0500 with news, then music. (Sanderson, Australia) DZH8 15.300, Manila, noted Tue.-Sat., has a program called "Sacred Song Request Program" 0730-0800, (Svensson Sweden)

Poland — Warsaw, 6.025A, noted closing in *English* 2343. (Ferguson, N.C.)

Portugal — Lishon's 11.996A channel noted in Portuguese 1230-1530. (Scheiner, N.J.) Heard on 15.125 at 0620 in Portuguese. (Pearce, England)

Portuguese Guinea—CQM4, 5.835A, Bissau, noted 1730-1800 with severe CWQRM. (*GDX-aren,* Sweden)

Portuguese India—Radio Goa, 9.610, was heard recently at good level when tuned 1020; closed Portuguese session 1030, then carried *English* release of "Bringing Christ to the Nations." (Pearce, England)

Somali—Radio Mogadiscio in verifying listed channel of 7.420 (but is still near 7.380, however) and schedule of 0530-0615 Italian; 0915-1015 and 1100-1200 Somali; 1200-1300 closedown Italian. (Pearce, England)

South Africa—SABC, 11.937 Johannesburg, noted 1100 with news; closed 1130, returned 1145 on 9.870; noted on 4.895 at 1240 with religious service in Afrikaans in progress, parallel 9.870; heard with news 1200 on 9.870. (Pearce, England)

Southern Rhodesia—ZEAF, 3.320, Salisbury, can be heard in Sweden with good level 1100-1200; signs off 1500. Bulawayo has been heard on the *new* channel of 4.800 in *English* to 1415 and in Afrikaans then to 1500 closedown. (Radio Sweden)

Spain—Radio S.E.U., 7.088, Madrid, noted 1440 with songs. (Pearce, England) *Radio Nacional de Espana en Malaga* has moved from 6.950A to 6.980; closes daily 1830A. (Kary, Pa.)

Sweden—Radio Sweden, 6.065, noted with news for North America 2000. (Morrison, R.I.) Heard on 9.535 with press news 1200. (Cox, Dela., NNRC)

Switzerland — Berne, 7.210, good level to North America 2030-2300. (McKee, Ohio) Ending *English* 1130 on 11.865. (Cox, Dela.)

Syria—Damascus, 6.165, noted open-

ing 2330 with march. (Bellington, N.Y.)

Taiwan—BED6, 11.735, heard 2345 with news; BED26, 10.080, noted 1745 with Chinese news and Western music, fair level in Australia; BED32, 9.778A, heard 0500 with Western music and Chinese news. (Sanderson) Taipeh, 6.095, noted 0925 at good level, moderate fading. (Ballou, Calif.)

Tanganyika – Dar-es-Salaam, 5.049, in verifying said was "amazed" to get reception report and that must have been due to "freak conditions" as this station is not received in many parts of Tanganyika itself. Said was using *experimental* transmitter of 250 watts but hoped to be using 20 kw. by mid-1954; is still heard regularly when QRN permits, on 5.049 around 1045-1230; some days has news 1100; some days runs to 1415. Closes with "God Save the Queen." (Ridgeway, South Africa)

Tangier—Radio Sweden says *Radio International* is on 6.110 with *English* daily 0600-0630. Thurs. 1130-1200, Sat. 1200-1300, and Sun. 1130-1300. Requests reports. Pearce, England, notes this one at 0215 with French songs, light musicals.

Pan-American Radio, 7.126, noted with DUX Radio Program in Swedish 1500-1530 (Tue.) and 1530-1600 (Thurs.) (Pearce, England)

Thailand—Bangkok, 11.910, noted 1945 with news in Thai, music; also with news 0515; heard on 6.240 with news 0615. (Sanderson, Australia) Heard with Thai from 0630 on 15.915. 11.910 (also heard on 7.105A and 6.420 in parallel with others from around 0900); Sun. closedown is around 1030, other days seems to be 1120A. (Ridgeway, South Africa)

Trinidad — VP4RD, 3.275, Port-of-Spain, noted with BBC news relay 2100, good level. (URDXC) Heard 1745. (Dexter, Iowa) A Cable and Wireless station on 10.72A has been heard widely in USA from as early as 0900 to around 1600 carrying cricket game commentaries (apparently relayed from VP4RD. (Bellington, N.Y., Sutton, Ohio, others)

Turkey—TAP, 9.465, noted parallel TAS, 7.285, in *English* for Britain 1600 - 1645. (Sanderson, Australia) TAT, 9.515, is extremely strong level in *English* to North America 1815-1900. (Dick, N.J., others) TAZ, *Radio Izmir*, Smyrna, is heard in Sweden from around 1045 to *after* 1300.

USI—Djakarta's *English* session for Europe 1400-1500 is now back on 11.770 in parallel 15.150; excellent in England on the 11.770 channel. (Radio Sweden) Noted on 9.866 at 1715 with Indonesian news, music. (Sanderson, Australia); heard on that channel well around 0500, and on 6.045 at 0620 at fair level in Calif. (Ballou)

USSR—Radio Tashkent, 6.825, noted with *English* 1000 and 1100. (Pearce, England)

Vatican—HVJ, 15.120, 11.740, 9.646, noted with news 1000; news in Polish 1015. (Sanderson, Australia) Heard on 7.280 with *English* 1315; ending

French session 0630 on 15.120. (Pearce, England) Good on 9.55 in *English* 1315. (Van Macle, Belgium) Now has *English* for India, South Asia, South Africa on Tue. *only* 1030-1055 on 11.685. 9.646. (Radio Australia)

Venezuela — Radio Rumbos, 4.970, Caracas, good level with *English* daily 1800-1900. (Van Gilder, Mass.)

Yugoslavia—Belgrade, 6.100, noted with news 1200 and 1345. Pearce, England) Heard with news to North America 1645-1700 on 6.100, 6.150. (Boepple, Ohio) Heard in *English* 0140 on 6.100 (Machajewski, N.Y.)

* * *

Press Time Flashes

According to overseas sources, Cayenne, French Guiana, has been on the air since June 1951 with 350 watts, first on 6.660, then on 6.200, now on (*announced*) 6.198; it was not heard in Europe, however, until November 1952, and it has not yet been reported to the *ISW DEPARTMENT* as having been heard at all in North America. However, Scheiner, N. J., did receive word recently from the station that it is on the air daily 1800-1900 and that power is only 300 watts; frequency was listed 6.199.

According to ISWC, London, the Cayenne station announces "Ici Cayenne, Radiodiffusion Francaise," and QRA for reports is Prefecture de la Cayenne, French Guiana; will welcome reports and comments and is having a QSL card printed.

The clandestine *Radio Free Japan*, Communist-controlled and probably located on the Chinese mainland, has been heard on 10.180 at 0530 with Japanese news, music. (Sanderson, Australia)

Radio Renascenca Emissora Catolico Portuguesa, 6.154, Lisbon, noted 1745 with symphonic music; still strong at 1831 tune-out. (Pearce, England)

Ridgeway, South Africa, flashes via airmail that he has been hearing an unidentified French-speaking station on 15.098 at 1045-1130; call at 1100 and sometimes also 1115 and 1130 sounds like "Ici Paramate;" man and woman announcers on alternate days; very strong signal; must be *test* transmission.

Direct from a monitor in Germany it is learned that a *new* station is being constructed in Berlin; details are promised shortly.

Mast, N. Y., says the *Chinese Patriot Radio*, evidently clandestine on the Chinese mainland, is broadcasting anti-Communist propaganda irregularly about every fourth day; uses Peking channels usually immediately after Peking leaves the respective channel; uses *only* Chinese, Korean; noted on 6.103A and 15.060, among others; transmissions last usually 5-15 minutes *only;* watch for these transmissions between 0000-0700 whenever there is a break in Peking's transmissions.

Clandestine *Radio Stanica Emigrante Yugoslavia*, 6.890, is now heard

(*Continued on page* 130)

2315-2345 in addition to other times. (Ridgeway, South Africa)

The 1015 newscast from *Radio Pakistan* is now carried by Dacca, 3.320; Dacca uses 4.807 at 0600-0800, then changes to 3.320; Lahore operates on 3.490, while Karachi uses 9.645 and 5.990 for the news 1015, also. (Radio Australia)

The Chinese-speaking station on 10.056 is BEC26, *Tso-ying Military Radio* at Tso-ying, Kao-siung City, Taiwan. (Radio Sweden)

When this was compiled, the *German Overseas Service* from Hamburg (using NWDR facilities) was scheduled on 7.290 at 2030-2330, 0930-1230, 1300-1600, 1700-2000, and on 11.795 at 0530-0930; output is 20 kw.; transmitter is at Norden-Osterloog near Emden; programs are all-German and are relayed from Cologne. (Buettner, Germany, others)

* * *

Acknowledgment

Many thanks for the FB cooperation; reports should be sent to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. Good listening! . . . K.R.B.

SOUTHWESTERN ELECTRONIC CONFERENCE

THE Fourth Annual Southwestern Electronic Conference of distributors, manufacturers, and representatives was held recently at the Fort Clark Ranch in Brackettville, Texas.

This year's attendance represented an increase of 100% over the initial conference held in 1950. This increase is attributed to a recognition of the fact that the Southwest must work together as a group or fail individually. The problems of this territory include the conquest of vast distances—a problem unique with that section of the country.

The highlight of the conference was a sales forum held on the fourth day, following three morning sessions of distributors and manufacturers. Jim Schoonmaker of Dallas acted as moderator while Hal F. Corey served as secretary.

Jack F. McKinney of Dallas presented sales training records which were played to the group to show the type of training which "The Reps" will put into effect during this year in order to give the distributor and his countermen better and more comprehensive sales ammunition than ever before.

At the forum it was stressed that the two co-related problems of the Southwest—vastness of the electronic industry itself coupled with the vastness of territory—rule out the old-time competitive spirit wherein it was "every man for himself." Under the new plan, Southwestern representatives will go out into their territories at their own time and expense to train for better electronic product sales for industry.

Other points covered in the forum concerned a plan for next year's conference and a discussion of product merchandising to aid the distributor.

During the three morning meetings between manufacturers and distributors, a new system was used whereby the distributors were assigned tables and the manufacturers made appointments to talk to them. The appointments were for 15-minute sessions but in the case where a manufacturer required additional time, arrangements were made to grant it. Impromptu business sessions were also held in the various dude ranch cottages following the formal sessions in the conference hall.

Entertainment, planned by Mose Branam ably assisted by Mrs. Lloyd Lund, was more elaborate than in previous years. Since the conference was held near the Mexican border the entertainment motif was Mexican. Each guest was provided with a sombrero and serape imported from south of the border and a mariache band played during the cocktail hour and after dinner. Texas folk dancing and square dancing was also on the agenda.

This highly successful meet was under the over-all direction of John Crockett, president. Housing facilities were handled by Bob Campion, assisted by John Guenther.

RADIO & TELEVISION NEWS was represented by Oliver Read, editor and assistant publisher, and by John Ronan, Midwest advertising manager. —30—

The forum, held in conjunction with the Southwestern Electronic Conference, attracted a record crowd whose rapt attention testified to the vital importance of meet.

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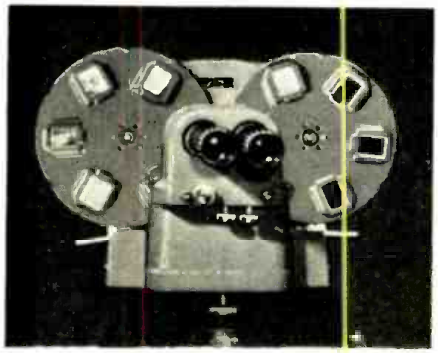
NEW TV PRODUCTS On The Market

"TELOJECTOR"

Gray Research and Development Co., Inc. of New York is currently marketing a new, lightweight projector for TV stations which provides automatic, remote, or local control "lapping" of an unlimited number of 2" x 2" transparent slides.

Known as the "Telojector," the new unit provides a sequence of twelve



slides from a single loading of the two turrets. Additional loaded slide turrets, which can be substituted for used turrets in a matter of seconds, provide an unlimited sequence.

The unit is 14½" high, 10½" wide, and 16" long. It weighs 32 pounds.

WESTINGHOUSE SETS

Westinghouse Electric Corp. has unveiled seventeen new television sets which constitute its 1953 line.

An exclusive feature of the new line is an automatic brightness control which provides a perfect picture under any room lighting condition completely automatically. When room lights are bright there is no picture washout and when room lights are low there is no unpleasant glare as the receiver instantly and automatically adjusts the picture contrast to existing conditions.

The new line has complete accommodation for all 70 new u.h.f. channels in addition to built-in antennas for both u.h.f. and v.h.f.

ANTENNA COUPLERS

JFD Mfg. Co., Inc. of 6101 16th Ave., Brooklyn 4, N.Y. has developed an electronic coupler for u.h.f. and v.h.f. antenna installation, the "Je-Tie".

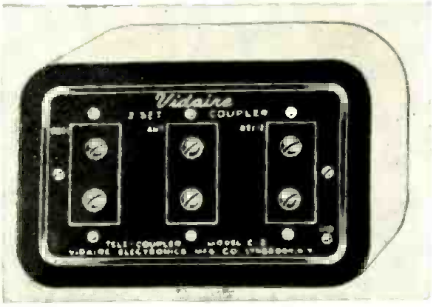
The new unit is a silver-printed circuit hermetically sealed in a *Butyrate* case. The coupler has four sets of terminals; one pair of terminals is for v.h.f. antennas covering Channels 2-6, another for Channels 7-13. The third

set is for any u.h.f. antenna while the fourth set of terminal points is for the lead-in wire to the set.

"TELE-COUPLER"

Vidaire Electronics Mfg. Co. of Lynbrook, N. Y. has begun deliveries on its new "Tele-Coupler," a device which permits the use of one antenna with two television receivers.

The unit is designed to provide maximum signal transfer from a



single antenna lead to the sets without interaction. It also reduces effects of local oscillator radiation between receivers and its filter action cuts interference at i.f. frequencies. Engineered for either 72 or 300 ohm input receivers, the Model C-2 measures 3⅝" x 2⅜" x 1¼" and is finished in two colors mounting on the wall or at the television set.

HALLICRAFTERS' SETS

The Hallicrafters Company, 4401 W. Fifth Ave., Chicago 24, Ill. has introduced 17 new television receivers in its line.

Features of this new series include the introduction of duplicate models designed to receive either v.h.f. or all-channel v.h.f.-u.h.f., 17" table models in brown leatherette cabinets, 21" consoles, and a popularly-priced 20" table model line in plastic cabinets.

The combination sets feature "precision eye" tuning, operated by the right-hand tuning control which has direct selection of v.h.f stations. The u.h.f. stations are read in a center lucite prism and the control is so geared as to provide quick selection of station range.

CBS U.H.F. CONVERTER

CBS-Columbia, Inc., 170 Fifty-third St., Brooklyn 32, N. Y. has announced

the availability of its new u.h.f. converter.

Known as the Model 2001, the new unit enables *CBS-Columbia* and other makes of television sets to receive the

entire u.h.f. band. A single switch on the converter changes the operation of the receiver from v.h.f. to u.h.f. With the continuous tuning knob positioned on the lower right part of the set, easy dialing of the u.h.f. channels is possible.

NEW CRYSTAL

Electronic Instrument Co., Inc., 84 Withers St., Brooklyn 11, N. Y. has released a new Model C4.5, 4.5 mc. crystal designed to facilitate the alignment and servicing of television sets having the new i.f. frequencies.

The Model C4.5 is designed for use with most FM and TV oscillators, accommodates standard sockets and circuits, and works well with the company's Model 360 TV-FM sweep generator.

NEW ANTENNAS

JFD Mfg. Co., Inc., 6101 16th Ave., Brooklyn 4, N.Y. has added a new yagi to its line of v.h.f. antennas. These broadband cascode yagis are now available in four models: No. 10B713 (Channels 7, 8, 9, 10, 11 12, and 13); No. 10B2345 (Channels 2, 3, 4, and 5); No. 10B3456 (Channels 3, 4, 5, and 6); and No. 10B456 (Channels 4, 5, and 6).

Neal Electronic Co., 106 Seminole Dr., Huntsville, Ala. is marketing a complete line of high-gain five- and ten-element yagi antennas. The line features extra high gain on the high channels. Data sheets on all of the antennas manufactured by the firm are available on request.

Radio Merchandise Sales, Inc., 2016 Bronxdale Ave., New York 60, N.Y. is offering a new indoor antenna which features a "NevaTip" design. By utilizing a lower center of gravity and providing a gradual increase in the weight of the base from the center to the sides, the resultant antenna is unusually stable.

Snyder Mfg. Co., Philadelphia 40, Pa. has added two new antennas to its line. The u.h.f. yagi comes in three models coded UHF-3A, UHF-3B, and UHF-3C which cover Channels 14 to 48, 26 to 62, and 47 to 83 respectively. The second unit is a conical, the AX-622. This model comes completely preassembled and requires only that the elements be snapped into position on the superstructure locking plate where they are held firmly and permanently.

Telrex, Inc., Asbury Park, N. J. has introduced a high-gain screen reflector array, Model 800-2X. The antenna consists of two preassembled units for easy installation. It is designed for all-channel operation in the u.h.f. band.

Ward Products Corp., 1148 Euclid Ave., Cleveland, Ohio is now marketing its "Jazz Trombone" u.h.f. antenna, the Model TV-180. The antenna comes completely assembled and is of all-aluminum construction. Two- and four-stacked models are also available.

-30-

MANUFACTURERS' LITERATURE

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

SURPLUS CATALOGUE

Boulevard Electronics, Inc., 808 W. Jackson Blvd., Chicago 7, Ill. has issued a new catalogue covering surplus radio and television parts.

Included in the listings are antennas, guy wire, high-voltage transformers, power transformers, deflection yokes, focus coils, phono amplifiers, tube sockets, tube caps, dynamic and PM speakers, resistor kits, hardware kits, mica condenser kits, radio and television tubes and shields, etc.

When writing for copies please specify Catalogue No. SRTP 12853.

HUDSON SOUND CATALOGUE

A new, complete catalogue covering high-fidelity sound reproducing equipment has been issued by *Hudson Radio & Television Corp.*, 48 W. 48th St., New York 36, N. Y.

Designed for music lovers, hi-fi enthusiasts, audio technicians, etc., it supplies the essential information about all standard makes of equipment. The catalogue section illustrates and describes the separate components which make up a high-fidelity sound system. In addition, the catalogue lists p.a. systems, intercoms, custom cabinets, TV chassis, portable phonographs, tape and wire recorders, tubes, and replacement parts.

U.H.F. BOOKLET

Hoffman Radio Corp. of 3764 S. Broadway Place, Los Angeles 3, Cal., has issued a 12-page booklet on u.h.f.

The booklet covers data on basic facts about u.h.f., material on u.h.f. antennas, tuners, and information on the company's television sets for u.h.f. and v.h.f.

The leaflet was designed as a consumer publication for dealer distribution, particularly in areas where u.h.f. transmitters have gone on the air or are in the process of construction.

TUBE DATA

A technical data sheet covering the *"Los Gatos"* 4D21 power tetrode is now available from *Lewis and Kaufman, Ltd.*, 70 El Rancho Ave., Los Gatos, Cal.

The bulletin illustrates the tube, gives dimensional data, general electrical characteristics, and constant current curves for 350 screen volts.

SOLDERING DATA

An illustrated brochure entitled "The New Way to Solder" is now being offered by *Wasserlein Mfg. Co., Inc.* of 126 W. Cass St., Joliet, Ill.

The bulletin explains resistance soldering and outlines its uses for production and maintenance in industry. The booklet also contains concise operating instructions for using the company's "Glo-Melt" resistance soldering unit and its accessories.

HI-FI CATALOGUES

Electro-Voice, Inc., Buchanan, Mich. has issued two 8-page bulletins, No. 185 and No. 189, on the company's "Aristocrat" and "Regency" folded horn corner enclosures.

Detailed data is provided on the individual coaxial speakers, high- and low-frequency drivers, diffraction horns, and crossovers and on complete speaker systems for these cabinets. Information on response, impedance, efficiency, and distortion is also included.

TEST INSTRUMENTS

H. L. Hoffman & Co., 110 E. 23rd Street, New York 10, N. Y. has issued a 20-page catalogue covering test equipment handled by the firm.

Included is information on the products of *Communications Measurement Labs, Inc., Spencer-Kennedy, Berkeley, Microlab, Advance Electronics, Edin Co., Frequency Standards, Industrial Electronics, Audio Instrument Co., A. F. Smuckler & Co., Reon Resistor, and Electronic Transformer Co.*

The instruments include power supplies, generators, electronic filters, high speed sweep generators and scopes, counters, filters, industrial and laboratory oscillographs, phase meters, frequency meters, control units for industrial equipment, broadcast equipment, voltmeters, precision resistors, etc.

TOWER DATA

Penn Boiler & Burner Mfg. Corp., Lancaster, Pa. has issued a single-page data sheet covering its standard "Teletower" and its telescoping tower.

Information on these two models is provided in picture-and-caption form to permit its use by dealers when talking to customers. Complete engineering data is available on a separate sheet.

CONTROL CENTERS

The Allen-Bradley Co. of Milwaukee, Wis. is offering a 28-page bulletin covering its multi-unit control centers.

The bulletin includes a complete explanation—from the purpose to the construction of multi-unit control centers. Included are unit dimensions and ratings, some typical applications,

layout charts and floor arrangements, and typical specifications.

HOME SOUND SYSTEMS

Copies of the booklet "A Sound Approach to Better Listening at Home" by Deems Taylor are currently available from *The Radio Craftsmen, Inc.*, 4401 N. Ravenswood Ave., Chicago 40, Ill.

This little 24-page booklet contains an informal and non-technical discussion of the elements that comprise a high-fidelity music system, an exposition of high-fidelity as a term and as a reality, and installation data. The booklet is illustrated with photographs of component units and complete installations.

Copies of the publication are available at 10 cents each from Dept. BL of the company.

TEST EQUIPMENT

Heath Company, Benton Harbor, Michigan has issued a 32-page catalogue covering its complete line of test equipment in kit form.

Included are specifications on amplifiers, v.t.v.m.'s, audio generators, audio oscillators, battery eliminators and testers, condenser checkers, decade condenser and resistance, demodulator probe, electronic switch, FM tuner, grid-dip meter, oscilloscope, receivers, signal generator, tube checker, TV alignment generator, etc.

A copy of this 1953 catalogue is available on request.

DEJUR PUBLICATIONS

DeJur Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y. has issued several new catalogues covering its precision components.

A 4-page catalogue covers the series L-400 potentiometers; a 6-page folder on the Series 20 miniature connectors, a single sheet on the Series 16 power connectors, a single-data sheet on the company's line of miniature connectors, and two single sheets on linear and non-linear pots and external phasing pots are included.

Copies of these publications are available on request.

EQUIPMENT CATALOGUE

Equipto, division of *Aurora Equipment Co.*, Aurora, Ill. has released an 8-page catalogue especially designed for the electronics industry.

Items such as work benches, catalogue racks, manual racks, chassis stands, sales counters, heat run racks, steel shelving and bins, test stands, trucks, and warm-up racks are included.

The equipment is shown in specific installations for radio and TV service shops, jobber, dealer, and manufacturer applications. Copies of this catalogue are available without charge.

CONDENSER CATALOGUE

Wells Sales, Inc., 933 W. Chicago Ave., Chicago 22, Ill. has issued a 16-page catalogue which covers a wide variety of condensers.

Included are transmitting and re-

ceiving micas, molded paper, wax tubulars, bathtubs, electrolytics, oil-filled transmitting, ceramics, trimmers and padders, and other variables. Dimensions, prices, and other useful information are provided. Ask for Catalogue C-10 when writing the company for copies of this publication.

—30—

NEW HAM REGS

NEW privileges have been granted to both General and Novice Class amateurs in recent rulings by FCC. The phone sections of the 75- and 20-meter bands, heretofore restricted to Advanced and Extra Class licenses, have been opened to General Class stations. General and higher class amateurs may also operate phone in the 7.2-7.3 mc. segment of the 40-meter band, and in the new 15-meter band between 21.25 and 21.45 mc. Frequency-shift keying, or Type F1 emission, is permitted in the segments 21.0-21.25 mc. and 7.0-7.2 mc. Phone emissions may be straight AM, narrow-band FM, or phase modulation. The f.s.k. provisions are a boon for radioteletype and other experimenters.

Novices may now operate c.w. with their usual power limitations in a segment of the 40-meter band, from 7175 to 7200 kc. The Novice band at 26.96-27.23 mc. has been eliminated, but a new band was opened for Novices on 15 meters, between 21.10 and 21.25 mc. No additional phone bands were granted Novices as was the case with other classes. The Novice phone band remains at 145-147 mc.

—30—

TV SERVICE CONVENTION

THE first annual convention of the National Alliance of Television & Electronic Service Associations will be held from April 10 to 12 in Kansas City, Missouri. One and a half floors of the Continental Hotel have been reserved for the various displays of u.h.f. tuners, boosters, antennas, and other television equipment and parts made by the approximately fifty manufacturers who will participate.

Host for the convention, to which all service shop operators and management personnel are invited, is the Television Service Engineers of Greater Kansas City, an affiliate of the National Alliance of Television & Electronic Service Associations.

The tentative program for the convention includes registration and cocktail hour on Friday, April 10th; sessions on u.h.f. TV equipment, business management and ethics, and an address by Frank Moch, president of NATESA on Saturday morning and afternoon; and a banquet at which awards will be presented on Saturday evening. A floor show and cocktail party will round out the Saturday program.

Sunday morning will be open for various exhibits and round table discussions.

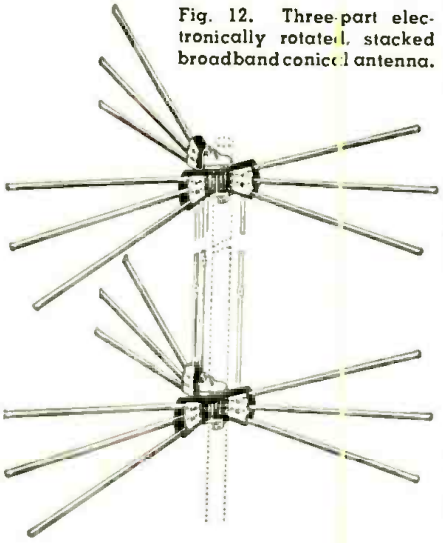
Registration blanks for the convention are available from Television Service Engineers, Inc., P.O. Box 8424, Kansas City, Mo. For additional information on the convention write to Walter L. Niswonger, Jr., chairman of the advertising committee at the above address.

—30—

scheme that deserves consideration, however, is the fact that its pick-up from the rear of any selected arrangement is almost as good as from the front. The reception angle is fairly wide and if strong interference from side or rear is present, this antenna may present some difficulties.

Fretaray: As shown in Fig. 13, this is a combination "V" antenna for the high-band channels and a zig-zag shaped dipole for the low channels. The combination of these two principles provides a fairly even, high-gain antenna over the entire v.h.f. TV range. Care should be taken when using this antenna that it will not be subjected to very heavy winds because of the light elements used. At the low channels the reflectors give a good front-to-back ratio, but on the high channels the reflectors are no longer true reflectors and the pick-up from the rear may cause ghosts in some localities. Its main features then are good gain on high and low channels and, because of the matching bars, good impedance match.

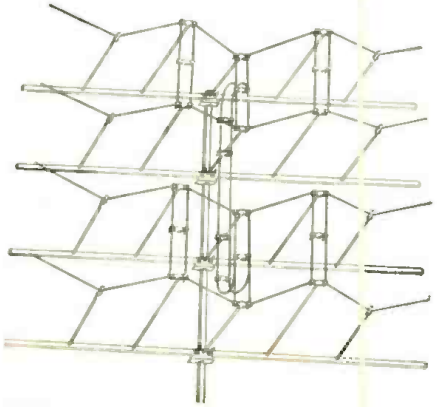
Fig. 12. Three-part electronically rotated, stacked broadband conical antenna.



Conclusion

A large number of different anten-

Fig. 13. "Fretaray" four-stacked co linear.



nas and an apparently bewildering combination of stacking and matching devices are now available for fringe area installations. To select the best antenna requires a full knowledge of the reception conditions at the customer's home. A test installation is often required to determine just what difficulties prevail and then, with a sound knowledge of the characteristics of various antenna types, the proper choice can be made. It is often said that "for each man there is a maid" and similarly, for each installation there is an antenna, the right one just has to be found.

—30—

Spot Radio News

(*Continued from page* 18)

to be used extensively by the new administration, during a recent news conference conducted by the President's news secretary, James C. Hagerty. Noting that we are in a day of a new medium, TV, Hagerty said that perhaps it might be possible to devise a system whereby the President could give monthly talks, or conduct press conferences *via* television once a month. No specific details on the plan were issued, but it was indicated that the networks are being consulted on the most practical methods that could be used.

Prexys of the nets applauded the news that such a regular TV schedule from the White House might soon become a reality, and all indicated that they would be very willing to cooperate in working out the various arrangements.

All Presidential telecasts would also be carried *via* standard broadcast facilities, Hagerty also indicated, thus making it possible for over 100,000,000 to see and hear the President.

THE LONG-DELAYED all-important theater TV hearings finally received a go-ahead during the early part of the year, and engineering and accounting experts of motion picture interests, and radio and wire companies began offering testimony.

Appearing on the stand were representatives from the National Exhibitors Theatre Television Committee and the Motion Picture Association of America, *AT&T, RCA, Western Union,* American Petroleum Institute, Theater Network Television. Theater Television Authority, Independent Telephone Association, Aeronautical Radio, American Trucking Association, and the American Civil Liberties Union.

Briefs did not seem to impress the Commissioners too much, and some of the members bluntly asked if the hearings would serve any purpose. Three factors appeared to disturb the seven-man body; lack of a programming plan and cost data, and details on the number of hours that might be used. Many inconsistencies in testimony covering the classification of

theater TV in the frequency spectrum also puzzled and annoyed the Commissioners. Some of the industry reps have at times requested consideration of the new service on a common-carrier basis and at other times, the private non-common carrier format has been suggested.

Telephone companies, safety and special services, and the telecasters are not too keen about the proposed system either. The phone folks feel that theater TV would only serve as an opening for a wasteful use of the spectrum and would simply duplicate common carrier links. The safety and special radio group find that the suggested theater plan would seriously interfere with their frequency requirements, and TV broadcasters noted that the proposed scheme of telecasting to theaters would cause talent raids, reduce source of writers and other specialists, and boost costs of all types of shows.

THE MAYFLOWER HOTEL in Washington was the scene of an interesting ham award-dinner recently, when 20-year old Don Mullican, who served as a communications link for disaster aid in tornado-striken Arkansas last March, received the Edison Radio Amateur Award for 1952, as a distinguished audience including FCC Commissioners George Sterling, Ed Webster, and Paul A. Walker looked on, and applauded heartily.

Other representatives from government who came to pay tribute to this heroic young man included Congressman Wilbur D. Mills of Arkansas; George K. Rollins, chief of the state-local government and amateur division of the FCC; William Grenfell of the safety and special service bureau; Captain C. L. Countryman of the Bureau of Ships; Brig.-General J. D. O'Connel, deputy chief signal officer of the U. S. Signal Corps; Col. William M. Talbot, director of the warning and communications section of FCDA; and Ralph H. McRoberts, chief of the communications systems unit of FCDA.

For staying at his ham rig for five days, without relief, to bring help to nearby towns which had been hit by the raging storm, Don received a striking trophy and a handsome watch, but particularly the heartfelt thanks of his neighbors, the entire ham fraternity, and the nation too.

THE MARKED IMPROVEMENT and reliability of transmitter equipment, satisfactory utilization of lesser grade operators, successful operation by non-technical personnel of many electronic devices of a complex nature, upon which the safety of life and property is often dependent, and the extensive reliance of stations on their chief engineer for significant repair work, has made it possible to relax operator license requirements, and permit remote-control operation of certain low-power AM, FM, and non-commercial FM stations.

Under a new set of rules, holders of commercial radio op licenses of any class, except aircraft radiotelephone-operator authorizations or temporary limited radiotelegraph second-class licenses, may be employed to stand regular watches and perform limited duties on all AM stations with operating power of 10 kilowatts or less when employing non-directional antennas, and at all FM stations using 10 kilowatts or less.

ONE OF THE MOST ELABORATE BROADCASTING and television-coverage plans ever conceived will be employed during the Coronation of Queen Elizabeth in Great Britain in June.

Over 400 sound and TV circuits will be used, and 800 extensions for microphones, cue-lights, and headphones will be available. At least 17 cameras will be lined up at strategic points to assure maximum video pickup. Not only will there be live TV broadcasts, but film recordings will be made, and transmitted during the evening. Special films will also be made for our TV stations and flown over. Originally a transatlantic net was to have been used for live showing, but the expense and involved technical problems made it necessary to shelve the plan.

The BBC and its foreign services will broadcast accounts of the ceremony in 40 different languages: Danish, Norwegian, Finnish, Swedish, Dutch, French, German, Polish, Czech, Slovak, Hungarian, Spanish, Portuguese, Greek, Turkish, Albanian, Bulgarian, Rumanian, Serbo-Croat, Slovene, Afrikaans, Maltese, Hindi, Tamil, Marathi, Bengali, Sinhalese, Urdu, Arabic, Hebrew, Persian, Cantonese, Kuoyu, Burmese, Malay. Thai, Japanese, Indonesian, Vietnamese, and Russian, too.

Commentators will be stationed at 80 points along the procession route. A temporary sound control room will be set up in Westminster. The control position for audio transmission will be in the Head Verger's room in Westminster Abbey, and television pickup will be controlled from the BBC broadcasting center, with a main subcontrol outside the Abbey.

Two temporary TV stations will also be set up. One will be at Pontop Pike and another at Belfast. The former will share Channel 5 with Wenvoe, and the latter will use Channel 1, sharing it with Alexandra Palace, London. For the first time in England, horizontal polarization will be used for transmission, as a precaution against mutual interference by stations sharing the same channel.

Under consideration is a TV link across the channel, which might make it possible for the Dutch, West German, and Danish TV networks to tie in with Paris for transmissions. It appears as if the Coronation will not only be a big show in London, but in many parts of the world, too . . . . . L.W.

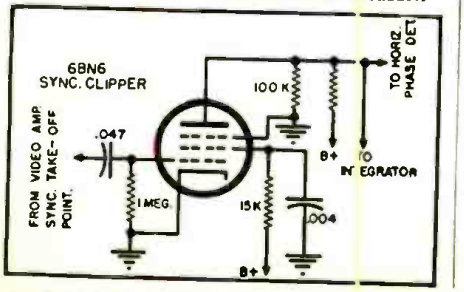
vertical stability, the "B" supply voltage to the sync separator is raised 20 or 30%. This change should send a stronger vertical sync signal to the vertical oscillator, permitting it to be better controlled.

The changes cited in all cases are, it should be repeated, intended for receivers in fringe areas only. In medium-level or strong signal areas, noticeable smearing will be the result of increasing the vertical sync input to the sync separator by changing the components in the video amplifier plate circuit. If the "B" supply voltage to the sync separator is increased in such areas, the action of the sync separator will be improper. The horizontal a.f.c. system present will tend, at high contrast settings, to operate on the leading edge of the blanking pulse top section or sync pulse pedestal, instead of on the leading edge of the sync pulse itself. Changing the contrast control settings from high to low, or *vice versa*, will therefore tend to impair the horizontal phasing of the picture, causing the horizontal blanking bar to become visible (Fig. 7).

Another change to improve vertical stability in noisy fringe locations consists of adding an *RC* filter in series with the sync separator input circuit (see Fig. 5). The filter consists of a condenser and a resistor, connected in parallel. The condenser value is around 100 $\mu\mu$fd., when R is 470,000 ohms; it can be 150 $\mu\mu$fd., when R equals 270,000 ohms.

The time constant of the filter is very short, compared to the duration of most noise pulses. The filter will therefore attenuate these noise pulses, since the condenser will not be appreciably charged by the pulses, and will thus allow very little noise current to flow through it. Vertical sync pulses will also be attenuated by the filter. To make up for this attenuation, the grid return resistor of the sync clipper may have to be increased. In the circuit of Fig. 5B, it is raised from 1 to 2.2 megohms. A condenser of about 20 $\mu\mu$fd. is added from sync separator grid to ground in this circuit, to aid in the noise-rejection action.

Fig. 8. Reducing the grid-leak bias resistor will increase size of sync pulse since sync clipping takes place closer to the base of sync pulse (and a larger amount of the sync pulse thus gets through). Circuit shown is from Zenith 22H20 chassis.



When a 6BN6 sync clipper with a grounded cathode, using grid-leak bias, is found, reducing grid-leak resistance may improve vertical synchronization in weak signal areas (Fig. 8). The resistor may be reduced from 1 megohm to a value as low as 10,000 ohms, provided no horizontal distortion, *i.e.*, sync impairment, appears during the reception of any channel. The output of the separator is increased, since less of the applied sync pulse is cut off. Its separation action, however, may be impaired, since video signals can theoretically get through when the signal input is not large enough to drive the separator from zero bias to well beyond cut-off. Since any video signals that do get through will be weak, they are not apt to noticeably affect horizontal or vertical synchronization. In any case, the subsequent check for such impairment will show whether the circuit change is acceptable (Fig. 9).

In areas where the signal strength is low, better reception may be obtained with the contrast setting reduced, and the brightness control setting advanced (noise signals, or "snow" producers, will not be amplified as much under such conditions). Vertical retrace lines may, however, be seen (Fig. 10) when the brightness control is moved beyond a certain point (below the setting desired).

A circuit change to blank out the CRT during vertical retrace time, and thus eliminate the retrace lines, is illustrated in Fig. 11A. The circuit shown causes the relatively large voltage pulses produced during vertical sweep retrace time to be transferred to the CRT cathode. If the correct lead from the vertical output transformer is attached to the CRT cathode circuit, this voltage will be positive during retrace time and will cause the CRT bias to go beyond cut-off at this time, blanking out all or most of the retrace lines. The 27,000 ohm resistor and .05 μfd. condenser integrate the vertical pulse, changing it to the sharp-peaked type necessary.

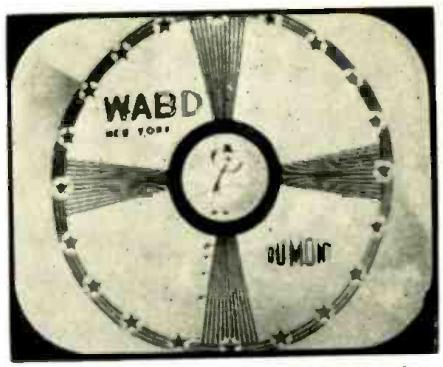


Fig. 9. When video signals get through the sync separator, impaired interlace is apt to result. Mottling of horizontal wedges (moire effect) may be seen in such a case.

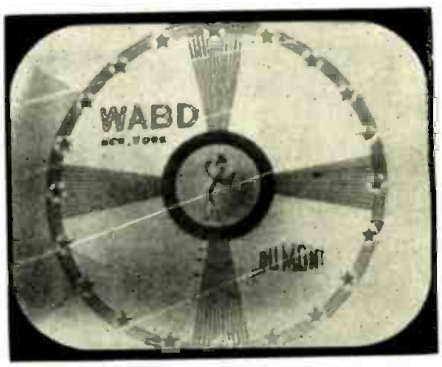
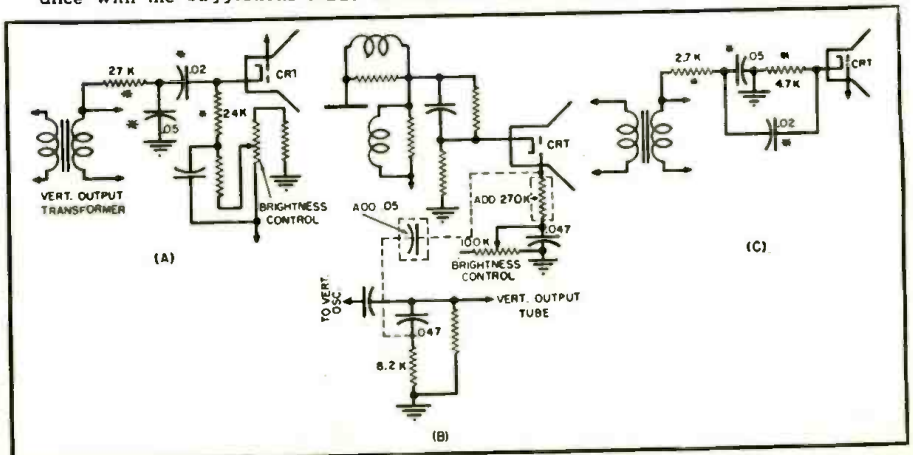


Fig. 10. Appearance of vertical retrace lines may prevent desired advancement of brightness control in the weak-signal areas.

Another circuit that can be used for vertical retrace blanking is shown in Fig. 11B. If the picture tends to smear when a light background is present in the televised scene, a 47,000 ohm resistor should be tried in place of the 270,000 ohm unit. If a shaded area at the top of the picture is always present, reduce the value of the .05 μfd. condenser, in steps, to a capacitance as low as .001 μfd. A third circuit is illustrated in Fig. 11C. —30—

Fig. 11. (A) Retrace line removal in a circuit similar to the General Electric 830. Starred components were added. (B) Changes for vertical retrace line elimination in an Admiral 21 series chassis. (C) Variation of the retrace elimination circuit shown in (A). Starred components were added. The cathode of the CRT, which was originally connected to the chassis, was opened and a 4700 ohm resistor inserted. This resistor can be increased in value if any retrace lines remain visible. Circuit is from an RCA Victor 630TS, converted to larger screen operation in accordance with the suggestions made in General Electric's publication, "Techni-Talk."



Technical BOOKS

"BASIC ELECTRONIC TEST INSTRUMENTS" by Rufus P. Turner. Published by *Rinehart Books, Inc.,* New York. 245 pages. Price $4.00.

Unlike Mr. Turner's previous book, "Radio Test Instruments," this present work deals with commercially-available instruments and kits. As the author points out in the Foreword, the availability of good commercial equipment at reasonable prices has more or less obviated the design and construction of such test gear except for certain highly specialized units.

The book is divided into sixteen chapters and covers such familiar test units as simple current and voltage meters, ohmmeters and v.o.m.'s, v.t.-v.m.'s, power meters, impedance meters, condenser checkers, inductance checkers, special-purpose bridges, oscilloscopes, r.f. test oscillators and signal generators, audio oscillators, frequency measuring devices for r.f. and a.f., audio amplifier test units, r.f. signal tracers, and tube testers.

The text material discusses how such equipment operates and how it is used in radio, television, and electronic testing and servicing. The exposition is handled in Mr. Turner's usual lucid style. The service technician, experimenter, ham, or student will find much of value in this practical volume.

* * *

"REMOTE CONTROL BY RADIO" by A. H. Bruinsma. Published by *Philips Technical Library,* Eindhoven, Holland. Available in the U. S. from *Elsevier Press Inc.,* 402 Lovett Blvd., Houston 6, Texas. 96 pages. Price $1.50.

This is a practical handbook covering two systems for controlling small models by radio; an AM system with two independent channels, and a pulse-modulation system with eight channels.

The only prerequisite to an understanding of this text is a general knowledge of radio and low voltage techniques. Complete circuit diagrams of the transmitters and receivers used in the systems are included along with a detailed parts list. The parts included in the construction are standard and no difficulty should be encountered in purchasing these items in the United States.

One especially helpful chapter deals with the construction of the boat in which the radio equipment is installed. The demonstration craft is capable of performing the following functions with its eight-channel system: port screw, starboard screw, rudder, lowering and hoisting of four lifeboats, turning a crane, operating the hoisting cable of the crane, and operating the catapult for shooting off an airplane. The sound channel is the eighth function. Dimensions

are given in meters and weights in grams but conversion to inches and pounds is not too difficult and should not cause the builder any trouble.

For a practical, how-to-do-it book covering a fascinating project, this little text seems to meet all of the requirements.

* * *

"TELEVISION" by F. Kerkhof & W. Werner. Published by *Philips Technical Library*, Eindhoven, Holland. Available in the U. S. from *Elsevier Press Inc.*, 402 Lovett Blvd., Houston 6, Texas. 475 pages. Price $7.75.

This book, written by two engineers from the television development laboratory of the *Philips* organization, is designed for technicians and engineers with a solid background in radio theory.

The treatment is mathematical and progresses from the basic principles of television to the circuit developments leading up to the design of modern television transmitters and direct-view and projection receivers.

The thirteen chapters into which the text material is divided cover such subjects as the physical principles of electronic scanning, pickup and picture tubes, the transmission and separation of the signal, the excitation and application of electrical relaxation phenomena, the time-base generator, the generation of high voltage for the picture tube, wide-band amplifiers, transmission or feeder lines, antennas, picture synthesis, color television, and television receivers.

The serious student or engineer will find this volume a valuable addition to his basic library.

* * *

"TV MANUFACTURERS' RECEIVER TROUBLE CURES" edited by Milton S. Snitzer. Published by *John F. Rider Publisher, Inc.*, New York. 102 pages. Price $1.80. Paper bound. Volume 1.

This is the first of a new series of publications designed to assist the technician to service receivers faster and more accurately.

The book deals with specific television receiver troubles and their cures. The suggested cures are the ones that the manufacturers themselves have devised to handle specific problems that arise in the servicing of their sets.

This volume covers receivers manufactured by *Admiral, Air King, Andrea, Arvin, Belmont-Raytheon, Bendix, Calbest, Capehart-Farnsworth, CBS-Columbia, Certified, Crosley,* and *Du Mont.* Definite instructions are given for curing various troubles. Where necessary, portions of the receiver schematic have been reproduced to show circuit changes.

* * *

"PRINCIPLES OF TELEVISION SERVICING" by C. V. Rabinoff & M. E. Wolbrecht. Published by *McGraw-Hill Book Company, Inc.*, New York. 522 pages. Price $7.50.

This is a basic text designed to provide the embryo technician with prac-

tical and easily-understood data on television servicing. The only prerequisite for the reader is a basic understanding of electronic circuits and a grasp of the fundamentals of t.r.f. and superheterodyne receivers.

The book is divided into twenty-two information-packed chapters ranging all the way from a survey of commercial receivers through details on how to build up a service business. The text material itself is presented in simple, not-too-technical language. Mathematical treatment has been eliminated. The book makes use of many photographs and drawings to illustrate the points under discussion —all of which contributes to the ease with which the reader can grasp the subject matter.

Review questions at the end of each chapter and appendices covering RTMA color codes, etc., also add to the value of the text.

This book is admirably suited for the self-instructed technician or the beginning television student.

* * *

"HOW TO BUILD INSTRUCTION MANUAL" compiled by *Thordarson-Meissner*. Published by the Manufacturing Division, *Thordarson-Meissner*, Mt. Carmel, Illinois. 160 pages. Price $1.50. Paper bound.

This manual has been designed for beginners, advanced students, instructors, service technicians, hobbyists, and experimenters. It contains practical data on the basic theory, design, and construction of AM circuits, FM circuits, phono pickups, audio amplifiers, speakers, disc recorders; data on the selection of transformers; and the construction of power supplies, transmitters, photoflash packs, and other useful electronic gear.

Both pictorial and schematic diagrams have been included to smooth the path for the novice constructor. The text material is concise and clear. No extra verbiage clutters up the exposition which makes this book ideal for all types of project work. The instructor seeking equipment for his students to build will find a wealth of gear at hand. The hobbyist and experimenter will be stimulated by the suggested building projects to branch out on his own to more ambitious construction. —30—

EXPOSITION SCHEDULED

The Audio Fair In Chicago will be combined with the 1953 International Sight and Sound Exposition to be held at the Palmer House in Chicago September 1, 2, and 3.

The three-day public and trade display of leading American and foreign equipment is expected to draw more than 20,000 persons.

Further details are available from the Exposition Office, One North La Salle St., Chicago 2, Illinois. S. I. Neiman is president of the Exposition while Harry N. Reizes is the manager of the Audio Fair.

The sponsors point out that this will be the only public hi-fi audio-video show in the Midwest during 1953. —30—

"Mrs. O'Toole, may I have that kit of JENSEN NEEDLES on the chair, please?"

Low-Resistance Ohmmeter

(Continued from page 61)

course not at all critical and may be varied to suit the taste of the constructor. The schematic diagram as used by the writer is given in Fig. 1. Note that the component values given in the parts list are correct only for a meter of the sensitivity and resistance specified. Several large wattage resistors and a dual potentiometer will be noticed in the photographs. These were used merely because they were available; the ratings given in the parts list are adequate. The meter shunts R_1, R_2, and R_3 should be made from a resistance wire alloy, preferably manganin, although the more generally available nichrome from an old heating element or wirewound resistor will do nicely. The easiest way to adjust the meter shunts to their correct value without using laboratory equipment is as follows, referring to Fig. 2:

The meter, switch S_{2A}, and shunts are wired in, leaving connections to the zero-adjust branches temporarily open. The series resistances R_4 and R_5 (used for calibration only) may be any convenient value greater than about 10 times the parallel resistance of the meter and shunt (if any) connected. This is desirable to avoid error due to change in battery voltage when the load resistance is decreased by switching in the meter shunt.

The calibration procedure is:

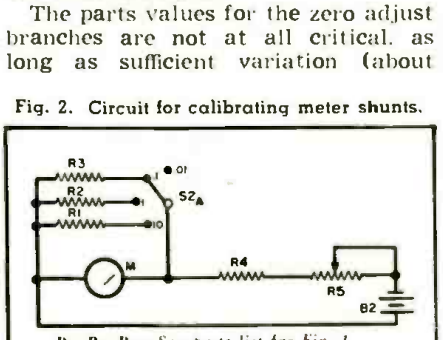
(1) With S_{2A} open, adjust R_4, R_5 and B_2 to give exactly full scale deflection. Now switch R_1 in. If its value is correct the meter will now read one tenth full scale. If it does not, adjust R_1 (by removing or adding wire, being careful to solder all connections) accordingly.

(2) Now readjust the series resistance (and battery if necessary) to again give full scale deflection, with R_1 connected. Now switch in R_2, and adjust it as explained for R_1 until the meter again reads one tenth of full scale.

(3) Now readjust the circuit to again give full scale deflection with R_2 connected. Now switch in R_3 and adjust it to again obtain one tenth full scale deflection.

The parts values for the zero adjust branches are not at all critical, as long as sufficient variation (about

Fig. 2. Circuit for calibrating meter shunts.



R_1, R_2, R_3—See parts list for Fig. 1
R_4, R_5—See text
B_2—See text
M—See parts list for Fig. 1

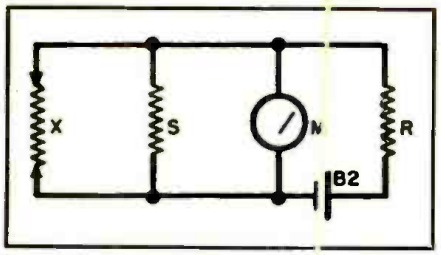


Fig. 3. Circuit to illustrate theory of operation. See text for full explanation.

± 20%) is provided for zeroing over the range of battery voltage. At this point it is well to note that the large variation in current drawn from the battery on different ranges will tend to make the effective battery voltage vary from approximately 1.55 volts on the highest range to about 1.40 volts on the lowest range. This should be considered when deciding on the values for these resistors. It will be noted that in the writer's parts list R_1 is given a value of 2500 ohms whereas 2000 might have been expected from the values shown for R_6, R_8, and R_{10}. This was found necessary for correct zeroing on the high range, due to the relatively high battery voltage when only 0.5 ma. current is being drawn.

In use, the desired range is selected, and the zero adjusted so that full scale deflection is obtained *with the leads open*. The leads are then connected to the unknown resistance to be measured, the push-button pressed, and the resistance read (scale reading x appropriate multiplier).

In order that the constructor may adapt this circuit to any available meter, the essential theory follows, where Fig. 3 indicates the essential components for any one range.

Now let:

X = *res. to be measured.*
S = *res. of meter shunt.*
M = *res. of meter.*
R = *total res. of zero-adjust branch.*
E = *battery terminal voltage (operating).*

For decade ranges, the values of S for each range will be R_1, R_2, R_3 and will be given as $R_1 = M/9$; $R_2 = M/99$; $R_3 = M/999$, etc.

Now let Q = parallel resistance of range being considered, *i.e.*:

$$Q = \frac{MS}{M + S}$$

Let the current for full scale meter reading with X disconnected (obtained by adjusting R, *i.e.*, by zeroing) be i_o.

Let the corresponding current obtained with X connected be i_x. Then it can be shown that:

$$X = \frac{A}{(1 - A)} \frac{RQ}{(R + Q)} \quad \ldots\ldots (1)$$

where:

$$A = \frac{i_x}{i_o}$$

The highest range is determined for no shunt, *i.e.*, for S = infinity and Q

$= M$. For center scale reading we have

$$A = i_m/i_o = \tfrac{1}{2} \text{ and}$$

$$X = \frac{\frac{1}{2}}{(1-\frac{1}{2})} \frac{RM}{(R+M)} = \frac{RM}{R+M}$$

Since R must limit current to give full scale deflection when terminals are open-circuited, we have

$$i_o = \frac{E}{R+M}$$

whence:

$$R = \frac{E}{i_o} - M \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

For the next lower range R must limit the current to 10 i_o with meter shunted by S. Therefore

$$R_2 = \frac{E}{10\, i_o} - \frac{MS}{M+S} = \frac{R}{10}$$

and similarly $R_3 = R/100$, etc.

The lowest range is determined by the allowable battery current and the sensitivity of the meter. For this intermittent use a current of 0.5 ampere can be delivered by three flashlight cells paralleled. However, new batteries should never be paralleled with old—the new ones will discharge through the old ones.

Regarding calibration of the meter scale itself, the easiest and most practical method is to mark the scale directly using resistors of known values, preferably a decade resistance box; however, if such is not available a satisfactory calibration is possible from formula (1) given previously, noting that:

$$A = \frac{i_m}{i_o} = \frac{X}{\frac{RM}{R+M} + X} \quad . \quad . \quad . \quad . \quad (3)$$

for the highest range, *i.e.*, where no meter shunt is used.

If this method is used, the value of R actually required to zero the meter on the x10 range should preferably be used. -30-

FM RECEIVER TUNING INDICATOR

By HARRY R. HYDER

SINCE the advent of FM broadcasting, there has been a real need for an effective tuning indicator for FM sets. How many times have you thought you had your set tuned properly, only to be annoyed by ignition noise from some passing car. You rush to the set to retune, but by the time you reach it, the car is gone and you are as much in the dark as before. On weak stations particularly, the "no noise" point is very sharp.

A zero-center microammeter is fine but expensive and it can only be used with the Foster-Seeley type discriminator. Various types of "magic eye" tubes suffer from lack of sharpness and other faults. None of them will work with the gated-beam tube (6BN6) type of FM detector.

The tuning device to be described is absurdly simple, is equally effective with all types of FM detectors, and costs practically nothing to build. Furthermore, it is foolproof, since it attacks the problem directly.

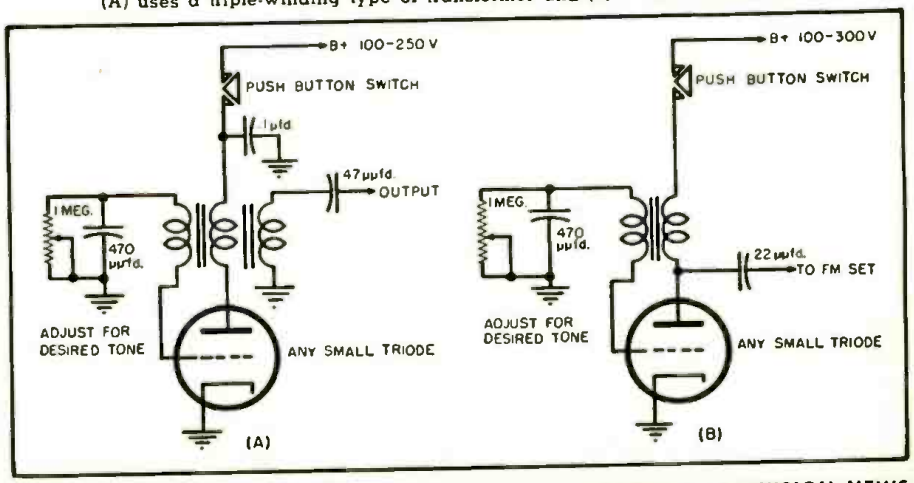
Fig. 1 shows a simple blocking oscillator, using a war-surplus blocking oscillator transformer. The output is loosely capacity coupled to the antenna input of the FM set. A few turns of wire around the twin-lead is usually sufficient. Plate voltage is applied to the oscillator through a door-bell type push-button switch. Just tune in the station you want, push the button, tune to the noise null, release the push-button, and you are tuned in as well as you can possibly be.

A blocking oscillator generating a short pulse with a fast rise time puts out a fairly uniform noise spectrum throughout the v.h.f. region. The fundamental repetition rate of the oscillator, which is in the audio region, gives a tone to the noise.

You can get the same results by using your electric razor, or an ordinary door buzzer should work, due to the sparking at its contacts. The blocking oscillator has the advantage of being silent.

Both Utah and Raytheon transformers have been used successfully. Although it has not been tried, there is no reason why one of the old style TV blocking transformers should not work, with suitable values of R and C. -30-

Fig. 1. Two simple blocking oscillator circuits used to tune FM receivers. (A) uses a triple-winding type of transformer and (B) a two-winding one.



Within the Industry

(*Continued from page 26*)

of a special committee of the Technical Products Division calling for expansion and reorganization of RTMA to provide greater recognition for manufacturers in the advanced electronics field.

The major recommendations of the committee in charge of evaluating the report included: 1. RTMA change its name to the Electronics Manufacturers Assn. or some similar name; 2. a division for manufacturers of advanced products be established; and 3. the engineering dept. be expanded to cover advanced electronic products.

Future action on these proposals will be reported as soon as some definite step is taken.

* * *

HAROLD P. GILPIN has been named general sales manager of the radio tube and television picture tube divisions of *Sylvania Electric Products Inc.* He will make his headquarters at the company's executive offices at 1740 Broadway, New York City.

He will supervise the sales program for the company's products manufactured in the ten plants of the divisions located in New York, Pennsylvania, West Virginia, Ohio, Iowa, and Oklahoma. -30-

NEW OFFICERS NAMED

THE San Antonio Radio and Television Association, Inc. selected its new officers for 1953 recently at a business meeting following the annual banquet at the St. Anthony hotel in San Antonio. The new president is Al Niehaus, vice-president is A. B. O'Keefe, secretary is Forrest L. Baker, and treasurer is Tom Boyd. In addition, a new board of directors was chosen.

The Association, which has been operating since 1949, has adopted a code of ethics to assure customers the utmost in dependable service. Each member of the group displays a large poster with the code in full view of his customers.

Two technical sessions and one business session are held each month by the group. Invited to the technical sessions are the associate members of the Association consisting of shop technicians, students, and other interested persons. Presently, the complete television course developed by Philco is being given under a competent instructor. The G-E fundamental and advanced course in television service was given previously.

The business sessions are largely devoted to business problems arising out of the day-to-day operations of the service dealer.

A booklet entitled "Interesting Facts About Your TV Set" is made available by the Association for distribution to customers in addition to many advertising aids. -30-

"Timothy"
(*Continued from page 38*)

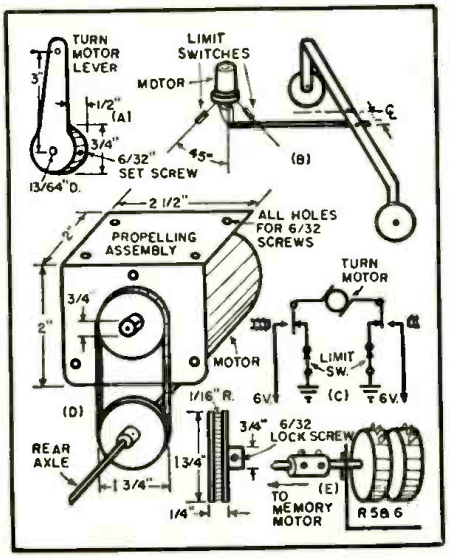
The motors can be powered either from a 6 volt battery mounted inside the body, or from the 6.3 volt secondary winding of a filament transformer. In the latter case, an extension cord must be provided which is long enough to reach the turtle from the nearest outlet. This transformer can be seen in the photographs, mounted on the upper platform. When the transformer is used, a bias supply capable of providing a negative 6 volts must be provided. The circuit of Fig. 6C shows how this can be easily accomplished with a minimum of components.

The "B+" voltage is provided by a single 67½ volt "B" battery, mounted inside the turtle's body.

Motor and Control Circuits

There are two motors used in "Timothy's" mechanical motion circuits. These are a power drive motor and a turning motor. They are of the type described in drawing number 7100 of the *Hansen Mfg. Co.*, Princeton, Indiana. It is a six volt, 1/2000 hp., 5400 rpm, 16.2 ft. lbs./minute unit. With the gear-reduction unit, the speed is approximately 18 rpm. This is a type C gear-reduction unit. The turn motor is fashioned as follows; a piece of aluminum is fabricated according to Fig. 8 and is mounted to fit the drive shaft of the motor. Again the dimensions are not critical except for the lever arm which is 3". A set screw (6/32) is used in the shank to secure the lever to the gear box of the six-volt motor. The lever is then secured by a 6/32 screw and bolt to a torque arm which extends from the point at which the motor is mounted to the hole in the front wheel assembly where it is attached by a second 6/32 bolt and lock washer, as indicated in Figs. 2A and 2B and Fig.

Fig. 8. Mechanical details of the turn, memory, and drive motors and associated parts.



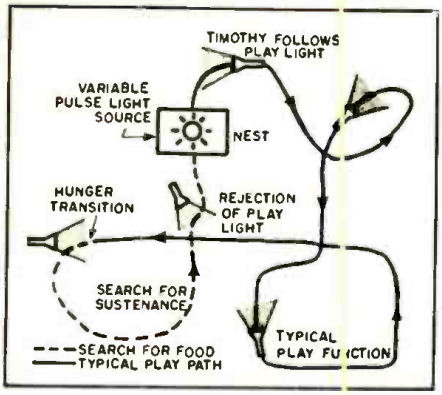


Fig. 9. "Timothy's" operation includes a search for food (dotted path) and typical play path (shown in solid line on diagram).

8. Limit switches ("switchettes") are optional and are of the normally-closed variety — single-pole, single-throw.

They are connected in series with the ground return from each relay contact as shown in Fig. 8C. They are mounted so that the lever may traverse forty-five degrees from center of the neutral position.

Propelling Motor

This motor is mounted on a 2" x 2" bracket, three of which are required. One will be used for the propulsion motor and the other two in the memory circuits. This bracket will be secured to the underside of the chassis (cart body). A grooved drive wheel to carry a rubber or spring-drive belt is connected to the gear reduction shaft and a second wheel of similar dimensions is mounted on the rear axle. The drive wheel used in the original turtle is 1¾" in diameter with a sleeve ¾" in diameter and 6/32 lock screws. The wheel is ¼" wide with a 1/16" radius grooved into the circumference to accept the drive belt. The drive belt is of the type used in motion picture projectors or radio dials and may be purchased from any reliable drive belt manufacturer. The belt used in "Timothy" was manufactured by *S. S. White Dental Mfg. Co.*, 10 E. 40th St., New York, N. Y. The third or memory motor is mounted on the second bracket and is coupled to the dual potentiometer R_5-R_6 as indicated in Fig. 8E. It is mounted on the third bracket fabricated as mentioned before.

"Timothy's" Nest

"Timothy" will retire to his nest to fill his condenser stomach and he does so through the use of a #1 photoflood lamp. This lamp is flashed off and on at variable intervals. The operation of the circuit is as follows. A selenium rectifier (100 ma.) charges a condenser through the solenoid of a relay. The relay closes due to this current and remains closed until the condenser reaches a potential where less than 1 milliampere will flow. At this point, the condenser is switched across the solenoid and discharges through the solenoid to a point where

again the difference in potential across the solenoid terminals will permit less than one milliampere to flow at which time the relay again opens and repeats the cycle. The cycle may be varied by potentiometers R_2 and R_4 which change the charging and discharging time for the condenser. The circuit is shown in Fig. 6A.

The relay used in the nest circuit is the same type as RL_1 in Fig. 1.

"Timothy's" nest is of simple construction. A 1' x 1' fiberboard roof is supported by 1" x 1" x 10" wooden pillars. A cigar box above the roof houses all the electronic equipment associated with the nest. A wire is secured by staples to the pillars in such a manner as to be just high enough above the floor to contact "Timothy's" tongue. The other end of this wire is attached to the rectifier supplying the switching action for the light as shown in Fig. 6B. A fiberboard base 3' x 3' is coated with aluminum foil and the other side of the a.c. line is attached to this floor through a 500,000 ohm resistor. Thus, as "Timothy" enters his nest, the ground wire of his body makes contact with the floor of the nest and finally the tactile tongue touching the suspended wire fills his condenser stomach to the brim. A 500,000 ohm, ½ watt resistor should be connected in series with the rectifier and charging wire to avoid a serious electrical shock. It is advisable that the nest be carefully guarded from the children as the exposed terminals might shock them even slightly and this is an undesirable condition. For daily play, "Timothy's" work-play control tube is disabled (V_3) and he will follow the children about the room or outdoors without requiring a nest or experiencing a single pang of hunger!

The Shell

"Timothy's" shell is a shaped chicken wire form and paper mâché covering which is painted and secured to "Timothy" by means of a central supporting pillar of wood or metal. Actually, "Timothy's" support for his shell is a discarded i.f. can. This offers a broad shell support while the two screws which normally secure the can to a metal chassis offer the requisite rigidity.

The layout of "Timothy's" circuits is optional and are constructed as simply as possible. The vacuum tubes as well as the turn relays in the turtle were mounted in the cart body. The other functional relays were mounted on the platform above the cart body. The platform consists of ¼" plywood fashioned to the perimeter contour of the cart body.

"Timothy" is an initial experiment in self-contained control systems. He can be improved upon by increasing his powers of perception. By allowing him to have variations of tactile sense, his ability to recognize and remember shapes, temperatures and even taste is a distinct area of improvement. These senses will open a

completely new system of closed control. The interaction and combination of these controls in a system as simple as that indicated in "Timothy's" original control circuitry makes a self-controlled electronic robot a distinct possibility and an intriguing problem in cybernetics.

Acknowledgement is gratefully made of the help of Edward Jacuack and Fred Tulley for their frequent consultations on the mechanical devices incorporated in "Timothy." —30—

RADIO CLUB ELECTS

JOHN H. Bose was re-elected president of the Radio Club of America for the 1953 season. Serving with him will be Ralph R. Batcher, vice-president; Joseph Stantley, treasurer; F. H. Shepard, Jr., corresponding secretary; and Frank A. Gunther, recording secretary.

Ernest V. Amy, Edwin H. Armstrong, George E. Burghard, Alan Hazeltine, Harry W. Houck, Jerry Minter, and Harry Sadenwater were elected to the board of directors of the club for this year. —30—

ANTENNA ORIENTOR

By ELMER C. FISCHER

IN HANDLING one-man antenna installations where orientation is a critical operation, the author has found an antenna rotator of the type that drives from the bottom end of the mast to be a very valuable aid.

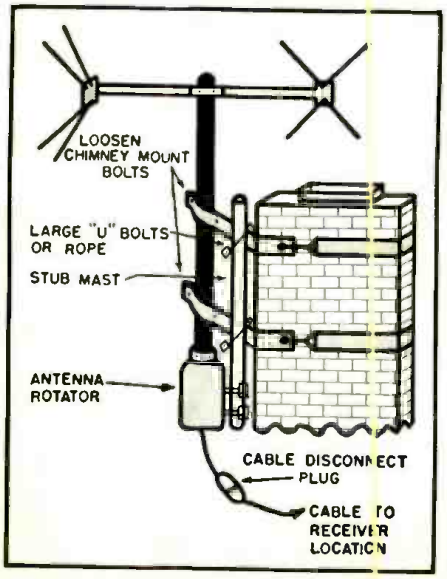
The rotator is clamped to a stub mast that can be fastened to the chimney mount brackets with large "U" bolts or merely tied on with clothesline. (In other types of installations, the stub mast is merely affixed to the brackets to be used for the antenna mast and some temporary support may be rigged up for the antenna.)

After the rotating cup is fastened to the antenna mast the bracket bolts holding the mast can be loosened enough to allow it to turn.

A temporary cable is then run to the control box at the receiver location and the antenna can be oriented very precisely in short order.

Tighten the bracket bolts, remove the stub mast and rotator, roll up the cable, and the job is done. —30—

How antenna can be oriented by one man.



RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

THE television service business is probably the nation's number one opportunity for alert, aggressive individuals to establish businesses of their own. It is a field in which an ingenious, ambitious man can start in a small way and expand the business to the limit of his capacity and capabilities to manage it.

While it is basically a technical activity, a nontechnical businessman who possesses managerial ability and has a flair for sales promotion can build a stable, profitable business out of it. Some of our most successful radio-TV service businesses are owned and operated by men who are not technicians. These men, because of their managerial qualifications, are able to employ good technicians, pay them more money than they could make working for themselves, and direct their work so they are able to produce more income from their efforts than if they were working on their own.

But these business opportunities that abound in television service more often than not prove to be treacherous quicksand to the technician who branches out on his own. Most men who are attracted to television service as a means of livelihood are basically hobbyists or experimenters at heart. They like the idea of matching wits with the intangibles of electronic circuitry and they feel when they go into the service business their technical skill and competence will pull them through.

The first yardstick anyone can use in measuring a service operator's business acumen is how he prices his labor. If he operates on the theory that he must keep his service charges low because his competitors' prices are low he is not a service businessman; he is a technical tinkerer. If he were a businessman he would have an operating blueprint or plan which would provide a definite basis for determining the income he must have from labor in order to pay his overhead, his suppliers, himself a worthwhile salary, and to provide a surplus when business is good to tide him over the periods when business is bad.

Very few service business operators bother to develop an operating plan. That's why the failure—business mortality—rate is so high in the television service business. During the summer of 1951 when the television service business hit rock bottom for about four months, 21 out of every 100 went out of business.

TV Service a Retail Business

The grocer sells foodstuffs to keep human machines running: the TV serv-

One view of the customer's service section of SREPCO's new parts, supplies, and equipment store in Dayton, Ohio. All stock shelves can be quickly replenished from reserve supplies directly behind each battery of shelves. Completely departmentalized, this carefully planned store layout permits rapid order handling.

ice businessman sells time, know-how, and parts to keep an accepted, important information-entertainment machine in operation. As time goes on, good television viewing may become just as important to the average person as the foodstuffs he needs to keep his body in operation.

The successful operation of a TV service business requires the application of planned managerial direction the same as any other retail business. It needs more sales promotion than the average business that handles the so-called necessities of life. The rapid growth of community newspapers in metropolitan areas proves how independent grocers, druggists, and other small retailers have grown up in their knowledge that they must advertise and merchandise their business and the things they have to sell in order to stay in business against chain store competition.

A businessman in television service has any number of professionally-prepared sales promotion campaigns available to him at ridiculously low cost. Practically all of the major tube companies have had their advertising agencies prepare really brilliant advertising material for independent service operators. Any radio service businessman who will use such material regularly and consistently will *build* business volume. When a service operator carries out a planned business building program he is running his business; when he depends on the whims of customers to call him for service his business is running him.

The standard reason service operators give for not using direct-mail sales promotion material is that they haven't the facilities to address and mail cards.

In practically every city in the country today there are businesses that specialize in circulating advertising material either through house-to-house distribution or by mail. Assume you have a service business in the northern section of a city of one-hundred thousand population. You want to get your message into the hands of five thousand homes in the vicinity of your shop every month. Here's how you can get out a monthly business-building postcard promotion without having to do any of the work involved:

Look up a local mailing company. They will have a list of addresses in your area made up from the latest telephone directory. Chart out for them on a city map the area you want to have blanketed with your promotion.

Call on your parts distributor and look over the postcard mail campaigns that are available from tube companies. Select a campaign that has six to ten cards available. Place an order to have five thousand cards, imprinted with your name and address, delivered to you monthly. These government postcards, carrying striking copy and imprinted with your name and address, will cost you only about $2.50 per hundred on an average. The

mailing company will charge you probably fifty cents per hundred to *address and mail* five thousand cards per month.

For only one-hundred-and-fifty dollars per month a personal message from you will be put into the hands of five thousand service prospects every month. These interest-impelling messages, written by experts and illustrated by artists who know how to capture reader attention, will keep those five thousand service prospects familiar with your business. They will know *whom* to call when a radio or television set needs service.

In a recent house-to-house canvass on home electronic equipment, interviewers found that 80 out of the 100 TV set owners did not know what service company they would call when their TV set needed service. Seventeen of them said they would call the dealer from whom they bought the set—and mentioned the dealer by name. Only three out of one hundred mentioned the names of independent service businesses as the people they would call for TV service!

The lack of consistent sales promotional activity on the part of established independent service businesses leaves a fertile field for amateur and fringe service technicians. If the independent service industry wants to benefit from the excellent advertising programs to upgrade set owner thinking about service now being conducted by *G-E* and other manufacturers, reliable independent service shops must identify themselves with these programs. There is no better way to establish blanket contact with consumers than through planned, consistent direct-mail advertising.

Direct Mail Campaigns

With the addressing facilities that are available in most cities, postcard sales promotional programs are ideal for an independent service shop. The average TV set user owns at least three AM radios and a record player, all of which will require service at some time or another.

A direct-mail campaign permits the service operator to focus his promotion on the area that he prefers to cover. It provides blanket coverage of that area. As TV sets age and require more service, a service operator with an average of twenty customers per city block in his vicinity can operate more economically than one who averages one regular customer per block throughout the city.

Concentrated promotion in a select area within economical operating distance of a service shop can be accomplished through direct-mail promotion.

G-E Receives FRSAP Award

In January the Federation of Radio Servicemen's Associations of Pennsylvania met in Harrisburg, Pa., with more than 65 delegates representing twenty technician and service dealer associations from surrounding states, to honor the *General Electric Company* at a presentation luncheon.

The annual FRSAP award was bestowed upon the *General Electric Company* "for their initiative in providing a public relations program on behalf of the independent television technician."

The award was accepted by John T. Thompson, sales manager of the *G-E* Replacement Tube Department, on behalf of the *General Electric Company*. In his acceptance speech Mr. Thompson detailed the results of the *G-E* 1952 public relations program for the independent TV service technician and presented an outline of the campaign planned for this year. He pointed out that the 1953 program will help the entire servicing industry both in creating a better and healthier public opinion of radio-television service and in helping service operators to merchandise the commodity they have to sell—service.

Gordon E. Burns, field sales manager for the *G-E* Replacement Tube Department, speaking for J. M. Lang, general manager of *G-E* Tube Department, presented an optimistic outline of the tremendous future of electronic servicing stemming from the industry's rapid expansion with u.h.f. in the immediate future followed by color television and the expansion of the art made possible by transistors. Mr. Burns pointedly stressed the great need for continued study on the part of all TV technicians and stated that the industry should provide suitable training programs to help keep technicians abreast of technological developments.

Bert Bregenzer, head delegate of the Pittsburgh Radio Servicemen's Association in FRSAP, made the presentation of the Federation's award.

Phono Industry Plans

The Record Industry Association of America and the Phonograph Manufacturers Association have teamed up with the RTMA to form a joint committee to develop a program to revitalize public interest in recorded music and playback equipment for home use.

During a frank discussion by members of the joint industry group at their first meeting, it was brought out that the program should encompass a "mutual assistance pact" by the various industries represented with the aim of increasing sales of records and recording apparatus, including radio-television-phonograph combination sets. In this connection, it was revealed that approximately twice the number of set manufacturers will include phonograph combinations in their lines in 1953 as the number who offered this type of equipment in 1952.

At the next meeting, the joint industry group plans to discuss methods of cooperation in a proposed test campaign of RIAA to increase sales of record players and records in a specific city this fall. RIAA is tentatively planning to promote this campaign in Buffalo, N. Y., during a three-week period in September.

It is apparent from the information developed in several recent surveys that the public's interest in home record reproduction has dropped to a very low level in television areas. The public will probably have to be given a good, strong treatment of hi-fi indoctrination to recapture its interest in recorded music.

College TV Service Seminar

Ten member-companies of the Radio-Television Manufacturers Association contributed equipment and personnel for use in a television service technician training seminar recently conducted at the Iowa State College at Ames, Iowa. The industry's activities in the seminar were coordinated by W. L. Parkinson of the *General Electric Company*, a former RTMA Service Committee chairman.

The course, which was supplementary to the present training offered by other schools and the industry, was limited to 50 experienced television service technicians. It was conducted as part of the activities of the Engineering Extension Service at Iowa State College. A one-week break in the two-week course was provided so that students could attend without too much interruption in their regular business activities.

RTMA member companies participating in the seminar included: *General Electric Company; Allen B. Du Mont Laboratories, Inc.; Capehart-Farnsworth Corporation; Motorola Inc.; Crosley Division* of the *Avco Manufacturing Corp.; Philco Corporation; Howard W. Sams & Co., Inc.; Sylvania Electric Products Inc.; John F. Rider Publisher, Inc.;* and the *Radio Corporation of America.*

Educational Television

Dr. W. R. G. Baker, vice-president of the *General Electric Company*, recently urged the adoption of a system of educational television in New York State as an economic necessity vital to the security of the United States.

Dr. Baker told the state commission on educational television that "if the great state of New York does not take the leadership in setting an example for the other 47 states, the benefits of effective educational television may be lost to the nation."

Television channels which were set aside for educational television carry a "time" element in the allocations plan. In setting aside certain channels for noncommercial use the Federal Communications Commission stated that if action was not taken to build and operate stations on these channels within a reasonable period of time they would revert to the status of channels available for commercial use.

Although Benjamin Abrams, president of the *Emerson Radio & Phonograph Company*, and the Ford Foundation both set up substantial endowments to encourage the construction of stations for educational TV, interest in the development of these stations has been lethargic.

In urging the development of educational television as a New York State project Dr. Baker said," We cannot afford to discard what may well be one of the keys to the most rapid advance of civilization that this world has yet witnessed."

He claimed that the country's developmental research, both for industrial and military purposes, is being hampered by a shortage of trained and educated workers, and that the general education standard of the country is not adequate to keep pace with the nation's rapid technological advancement.

"Beyond a shadow of a doubt," he said, "educational television offers a means of increasing education, and increased education means a stronger economy.

"If this nation is to withstand the onslaught of the forces of communism, we must make ourselves as economically strong as we possibly can. The intellectual germ warfare of Marxism can never be effective in a country where the standard of living is high, and where no sane man or woman would consider exchanging his or her birthright of a full, free life for a mess of promises.

"For this reason," he concluded, "and for the reason that we must maintain a strong economy if we are not to fall under the weight of the cost of continuing preparedness, I believe educational television to be an economic necessity and a means by which we can bring added security to this nation."

Growth of an Industry

The tremendous expansion that has occurred in the replacement parts and equipment industry is revealed perhaps most spectacularly in the building of new plants by parts distributors in all sections of the country to handle their greatly increased volume of business. "Open House" receptions by distributors to introduce their customers and their suppliers to their new buildings have been commonplace during this past year.

One of the most modern plants visited is the building recently completed by *SREPCO, Inc.*, of Dayton, Ohio, which was designed to provide maximum service for their customers. One feature of the new plant interested us particularly—a drive-by window where a service technician can pick up an order previously phoned in without getting out of his car or truck. Brother, that's service! The customers' parking ramp around the building will easily accommodate ninety cars.

The new building plan includes a meeting room which will accommodate 300 people. It has an entrance independent of the main storerooms so that service groups can hold evening meetings without the necessity of opening the store.

Shortly after its official opening *SREPCO* officials sponsored the Tele-

vision Technicians Lecture Bureau lecture on u.h.f. television with Edward M. Noll as the speaker. Nearly 450 technicians and shop operators arrived to attend the lecture, which literally taxed the capacity of the hall.

The company is planning to provide its service customers with a regular series of noncommercial lectures to help them keep on top of circuitry and equipment developments in television and electronics of interest to the service industry.

TV Labor Charges

Service operators who attend the TTLB meetings are intensely interested in the charts of standard TV labor charges that have been prepared by the Bureau staff. How to figure equitable labor charges for their work seems to confuse most technicians.

Several major service organizations set up standard charges for the various operations that may have to be performed in repairing or overhauling a TV receiver. These schedules were determined from actual time studies of these service operations performed on a wide variety of sets with the work done by technicians of varying degrees of competence.

The Bureau has a limited quantity of this schedule of standard labor charges which was developed and is being used by a leading TV service company. Service operators who would like to have a copy of this standard TV labor charges chart may obtain one by writing to the Television Technicians Lecture Bureau, P.O. Box 1321, Indianapolis, Indiana and *enclosing ten cents in postage stamps to cover cost of handling and mailing.*

EDITOR'S NOTE: *In writing for bulletins and other material offered in this department* be sure to include your address *in your letter. We have received several letters that did not have the mailing address on either the letter or the envelope.* —30—

PHOTO CREDITS

Page	Credit
48	Philco Corporation
49 (left), 142	Allen B. Du Mont Laboratories, Inc.
49 (right)	Radio Corporation of America
50	Radio Merchandise Sales, Inc.
51 (Fig. 2)	JFD Mfg. Co., Inc.
51 (Fig. 3A)	Insuline Corporation of America
51 (Fig. 3B)	Radelco
51 (Fig. 4)	Walter L. Schott Co.
51 (Fig. 5)	Cornell-Dubilier
51 (Fig. 6)	Telrex
51 (Fig. 7)	TV Products Co.
52 (Fig. 8)	Trio Mfg. Co.
52 (Fig. 9)	Technical Appliance Corporation
52 (Fig. 10)	Gonset
52 (Fig. 11)	Ward Products Corporation
62, 63, 124	Channel Master Corporation
70	LaPointe Electronics, Inc.
137 (Fig. 12)	Snyder Mfg. Co.
137 (Fig. 13)	Freteo, Inc.
154	SRE?CO, Inc.

ERRATUM

In Fig. 3, page 45, of the February issue ("Improving the Williamson Amplifier") the junction of R_{10}, R_{11}, and R_{12} should be grounded.

INDEX OF Advertisers

APR. 1953

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Classified

Rate 50c per word. Minimum 10 words

RADIO ENGINEERING

COMPLETE radio, electronics theory & practice: television; broadcasting; servicing; aviation, marine, police radio. 12 or 18 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

FOR SALE

SCR-300 walkie-talkies complete. $150. Sternheimer, 4417 Monument Ave., Richmond 21, Va.

SAVE 90% on your test equipment. Free information. Technological Developments, 475 Fifth Ave., New York 17.

RECONDITIONED Television Sets, $30 & up Jones Radio, Douglassville, Pa.

EIMAC 304TL Sealed Cartons @ $9. Surplus parts, tubes, list. WIJR, Gardner, Mass.

TAPE Recorders, Phonographs, Record Changers. Unusual Values. Dressner, 624-R East 20th St., New York City 9.

DIAGRAMS Radio, Record Changers, Recorders, 75c; Television with Service Data, $1.25 up. State manufacturer and model number. Kramer's Radio Service, Dept. F53, 36 Columbus Ave., New York 23, N. Y.

ALL types of Antennas for Amateur and TV. Aluminum Tubing. Willard Radcliff, Fostoria, Ohio.

TUBES and equipment bought, sold, and exchanged. For action and a fair deal, write B. N. Gensler, W2LNI, 136 Liberty, N. Y. 6, N. Y.

NEW RCA 3AP1A original cartons, $8.75 each. Tubes, surplus—bought, sold. Free list. Write, Mark, Box 14, New York City 72.

BC-221 Frequency Meters, $85. Williams Electronics, 62 Cortlandt St., New York 6, N. Y.

TELEVISION towers from 10 to 90 feet use "Tuffy", "Americas favorite tower". Write Youngstown Steel Towers Co., Box 2825, Youngstown 8, Ohio.

ALTEC (A323-B) HI-FI Amplifier. Excellent Condition; only $45.00. B. K. Balch, 516 Jefferson Ave., Rahway, N. J.

TV-FM antennas. All types including UHF. Mounts, accessories. Lowest prices. Wholesale Supply Co., Dept. H, Lunenburg, Mass.

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WANTED—Top Prices Paid—Navy Selsyns 1DG, 1F, 1CT, 1G, 5DG, 5D, 5CT, 5G, 6G, 7G, etc. and BC-348, BC-221, AN/ART-13, AN/ARC-1, AN/ARC-3, RTA-1B, AN/APR-4. Lectronic Research, 719 Arch St., Philadelphia.

AN/APR-4, other "APR-," "ARR-," "TS-," "IE-," ARC-1, ARC-3, ART-13, everything surplus: Tubes, Manuals, Laboratory equipment. Describe, price in first letter. For Sale: Reconditioned Watthour Meters, four for $10.60. Engineering Associates, 434 Patterson Rd., Dayton 9, Ohio.

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USED correspondence courses and educational books, bought, sold, rented. Catalog free. Educational Exchange, Summerville, Ga.

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BUSINESS Cards $2.50 1,000. Samples free. Signal, Box 927A, Los Altos, Calif.

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PUSH TO RESET

Amps 3—5—7—10—15—20
Each 27c; 4 for $1.00
25 for $5.00; 100 for..$18
Circuit Breaker Fuse W/2 Mounting Clips 39c
3 for $1.00; 20 for $5.98; 100 for...$25
Fuse is 3AG Size. Operates up to 24 Volts
Please specify current (amps) desired.
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Each $1.69; 10 for $15.98
Sq. D & CH Toggle Sw Brkrs, Amps; 5, 10, 15, 20, 25..........98c; 10 for $8.98
Klixon Thermal Push Button Brkrs Amps; 5, 10, 15, 20, 30.......89c; 10 for $7.98

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Current (cont.)	18/14 Volts	36/28 Volts	54/40 Volts	130/100 Volts
1AMP	1.35	2.15	3.70	7.50
2AMP	2.20	3.60	5.40	10.50
4AMP	4.25	7.95	12.95	25.25
6AMP	4.75	9.00	13.50	33.00
10AMP	6.75	12.75	20.00	40.00
12AMP	8.50	16.25	25.50	45.00
20AMP	13.25	25.50	39.00	79.50
24AMP	16.25	32.50	45.00	90.00
30AMP	20.00	38.50		
36AMP	25.00	48.50		

Full-Wave Selen Rect & Trans. In Kit Form. All 115V/60 cy inputs
up to 14VDC at 12 amps..........$18.98
up to 28VDC at 12 amps.......... 28.98
up to 28VDC at 48 amps..........117.00

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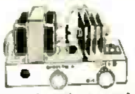
18.8–19.2–20.4–21.4 Volts/12 Amp.$10.98
31—32—34—36 Volts/12 Amp..... 14.49
15—15.5—16—16.5 Volts/6 Amp... 5.98
31—32—35—36.7 Volts/6 Amp.... 8.98
18V/2A $2.75; 28-24-20V/4A 4.69

"HO" RAILPACK



0 to 12 VDC/2 Amp. Variable DC supply, uncased and completely built—Inpt. 115v/60 cy. Usable LAB supply, filament D.C. plating, battery charging, model railroad, includes voltage or speed control and center off reversing sw. Ideal for two "HO" locomotives. "TAB" SPECIAL....$10.95; 2 for $20.00

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10-0-10V (CT) 120 Amp., fan cooled. Replace your old inefficient sulfide rectifier w/new selenium type. SPECIAL...$11.98
Write for Quantity Price.

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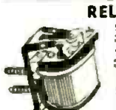

SPST min. size 115V/60CY 3A CTS 98c; 3 for...$2.75
SPDT min. sizes 115V/60CY 3A CTS $1.39; 3 for...$3.75
SPDT 24V DC. 5A CTS 98c;
SPNO 115VAC 15A CTS 2.98
DPDT & SPNO 12VDC 10A CTS ....$2.98; 4 for $10
DPDT Clare SK5010, Octal Base 18-28V, 2Amp Cts, Nitrogen Sld. $1.49; 4 for $5.00
DPNC & SPNO Clare Telephone Type 115VAC. Octal Base..............$3.95

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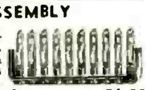
SPDT 3A/250V ....35c; 4 for $1.00
SPDT Momentary ......49c; 5 for $2.00
DPST 15A/125V ....89c; 3 for $2.50
DPST CH CSD 8A/125V.85c; 5 for $2.95
DPST 20A/250V .....$1.25; 3 for $3.25
DPDT Center Off 1A/115V..........75c
SPDT Momentary Both Sides.........85c
DPDT Cent Off Mom......98c; 6 for $5.00

SOCKET ASSEMBLY



For 10 slide lamps. Excellent on-off indicator for control panel. As illustrated with lamps $2.98
SLIDE LAMP, type T-2, 24V ....18c; 10 for $1.50
SLIDE LAMP,typeT-2, 12V18c; 10 for $1.50
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PILOT LIGHT SOCKET 1" Jewel High Polish Finish ....75c; 10 for $6.49
1" LIGHT SOCKET, w/115V6WattBulb.85c

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Made by General Radio. Model 200CU. Rated 0-135 Volts at 7.5A. Reconditioned. Tested and "TAB" Guaranteed.....$14.98
"GR" 100R/0-230V/2KW/9A 30.00
"GR" 50B/0-270V/7KW/28A 110.00
BRUSHES 200CU & 116/116U..49c; 5/$2

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Primary 7.5KW, W/110V Inpt. Two Secondaries Divr 220V at 7.5 Amp Each, or One 440V at 7.5A. Same but 220V Pri. Will Deliver 2X440 at 7.5A Each, or 880V at 7.5A. "TAB" SPECIAL.......$124.50

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2 Tubes, Sckts, xfmr 115v 60cyc Inpt. outpt. 2.5vct. 10A/Hvinsul. SPECIAL..$5.49

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"PHIMAX"Gun115VACKordlessTip.. 7.69

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Element #38/Am.Beauty2138/100W.. 2.00
#58 Am.Beauty3158/200W 5/8Tip .. 6.30
Element #58/Am.Beauty3158 200W.. 2.75
#78 Am.Beauty3178 300W 7/8Tip .. 8.18
Element #78/Am.Beauty3178 300W.. 3.65
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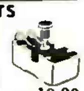

GE RPX041 Phono Cart...$4.49
GE RPX050 Triple Play... 5.69
Electrovoice Triple Play.. 2.69
Pickup Arm&Xtal Hi-Outpt. 2.39
PM 12"Hi-Fi British Spkr. VC 4.98
PM 12"GE S1201D Speaker 19.00
PM 8" Blue 8T18-1 Permflux 13.00
PM 5" Speaker Gud Tone.......... 1.98
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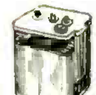
Crystal Mike & Cable.............. 3.98
Crystal Mike Cartridge (Lapel type) 2.98
Crystal Mike Cart. Ceramic Wetpruf 3.98

STORAGE BATTERIES



36 Volt WILLARD Mini-BRAND 5 oz.......98c; 4 for $3.00
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2V/20AH Battery Plus 2 Volt Vibrator 2.98
2V/20AH w/vib & acid. 3.59
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Hydrometer 1.06 to 1.24 Sp Grav.. 1.98
We ship acid in bottles. R'exp only.

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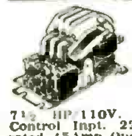
2 ohm 50 W Model J..$2.25; 5 for $10.00
6 ohm 25 W Model LH 1.98; 3 for 5.00
15 ohm 25 W w/knob. 1.98; 3 for 5.00
20 ohm 50 W Model J. 2.35; 6 for 12.00
60 ohm 50 W w/knob.. 2.49; 3 for 7.00
100 ohm 50 W Model K 2.25; 3 for 6.00
200 ohm 25 W Model D 1.98; 5 for 9.00
250 ohm 25 W ....ea.. 1.39; 4 for 5.00
300 ohm 225W Model P 3.98; 2 for 7.00
350, 500, 5000 ohm Slotted shaft. 25 watt .... 79c; 3 for 2.00
1000 ohm 25W Model J 2.10; 5 for 10.00

CONTACTOR



G. E. CR2811C22AQ. Heavy Duty Electric Starter, Transmitter or Motor Starter Switch. For Single or 2 or 3 Phase Appl. Rated 1 Phase 3HP/110V. 7 1/2HP220V 10 HP/600V. Rated 2 or 3 Phase 7 1/2 HP 110V, 15HP/220V, 25HP 600V. Control Inpt. 220V/1PH 60 Cy. Enclosed rated 45Amp Open 50 Amp GE.
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Controls, 50 ohm to 2 Meg..10 for 2.50
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TABOGRAM

WRITE FOR IT
WE STOCK LARGE VARIETY OF COMPONENTS. TELL US YOUR NEEDS. SELL US YOUR TUBES & EQUIPMENT.

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PRICES SUBJECT TO CHANGE
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0A2	$0.95	3D6/1299	.69	6SD7GT	.80	FG105	17.64	723A/B	25.00
0A3/VR75	1.04	3D21A	4.98	6SF5	.77	117L/M7GT	1.59	724A	3.95
0B2	1.37	3D22	13.95	6SF7	.73	117N7GT	1.79	724B	3.45
0B3/VR90	1.09	3D23	4.90	6SG7	.72	117P7GT	1.39	725A	8.49
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1B21/471A	2.85	4-1000A	108.50	6SL7GT	.69	F127A	19.98	801A	.45
1B22	2.20	4C35	27.25	6SN7GT	.70	VT127A	3.90	803	3.89
1B23	9.90	EL5BHD	16.98	6SN7WGT	2.25	CV148	4.98	805	3.90
1B24	9.45	5C21/C6J	6.95	6SQ7GT	.63	FG166	49.00	807	1.65
1B26	2.45	5C22	52.00	6SR7	.65	FG172	29.00	808	2.59
1B27	12.75	5C30/C5B	3.95	6SS7	.75	250TH	22.25	809	2.43
1B32/532A	3.90	5D21	21.69	6ST7	.98	250TL	17.75	810	9.95
1B35	11.25	5D23 RK65	36.50	6SU7GTY	2.69	304TH	8.90	811	2.90
1B37	16.98			6V6	1.39	304TL	8.90	812	2.70
1B38	29.95	5J29	12.40	6V6GT	.57	388A	1.49	813	12.49
1B40	4.95	5R4GY	1.39	6W4GT	.57	WL417A	8.95	814	2.97
1B41	49.95	5R4GYW	1.75	12AH7GT	1.45	417A/5R42	18.50	815	2.98
1B42	18.00	6AG5	.79	12AK5	1.98			816/866Jr.	1.07
1B46	1.98	6AG7	1.39	12AK5W	2.98	GL434A	12.69	828	.95
1B53	49.95	6AH5G	1.49	12AL5	.75	446A	1.05	829	11.49
1B56	38.50	6AH6	1.22	12AT6	.52	446B	3.89	829B	12.45
1B58	175.00	6AJ5	1.40	12AT7	.81	450TH	45.00	832	7.65
1B60	69.75	6AK5	.74	12AU6	.72	450TL	52.00	832A	9.65
1B63	50.00	6AK5W	2.98	12AU7	.63	460/HF200	15.95	833A	39.45
1B63A	75.00	6AK6	1.05	12AV6	.49			834	5.95
2C36	27.00	6AL5	.54	12AV7	.98	GL471A	2.69	836	4.75
2C39	21.00	6AL7GT	1.29	12AW6	1.79	CK501X	1.26	837	1.45
2C39A	29.50	6AN5	2.90	12AX4GT	1.20	CK501AX	2.20	849	29.45
2C40	7.29	6AQ5	.55	12AX7	.79	GL502A	1.79	860	4.90
2C43	14.75	6AQ5W	3.98	12AY7	2.95	CK502AX	1.49	861	23.95
2C43/464A	9.49	6AQ6	.81	12AZ7	1.49	CK503AX	1.49	865	1.29
2C44	1.20	6AQ7GT	1.29	12BA6	.59	CK505AX	1.79	866A	1.50
2C51	6.45	6AR5	.79	12BA7	.79	CK506AX	1.49	872A	3.29
2D21	1.26	6AR6	2.98	12BD6	1.23	RH507	9.98	CK1005	.85
2E31	1.49	6AS5	.79	12BE6	.59	CK509AX	1.79	CK1027	2.98
2E36	1.49	6AS6	2.43	12BF6	.85	CK512AX	1.45	CK1028	15.98
2E41	1.54	6AS7G	4.65	12BH7	1.29	CK522AX	1.29	5654	2.79
2E43	1.49	6AT6	.63	12BY7	1.35	CK525AX	1.29	5670	5.30
2G21	1.49	6AU5GT	1.10	12BZ7	1.25	CK526AX	1.49	CK5672	1.29
2J31	27.00	6AU6	.59	12SA7GT	.69	CK528AX	1.49	CK5678	1.89
2J31A	79.95	6AV5GT	1.29	12SC7	.80	CK529AX	1.79	5687	5.49
2J32	37.00	6AV6	.49	12SF5GT	.72	GL530	22.00	CK5702	3.49
2J33	27.00	6AW6	1.89	12SF7GT	.49	CK531DX	1.89	CK5703	1.29
2J34	27.00	6B4G	1.23	12SG7	.83	531	6.98	Xtal Diodes	
2J36	108.00	6BA6	.63	12SH7	.63	CK532DX	1.89	1N21A	$1.55
2J37	12.70	6BA7	1.27	12SJ7GT	.59	WL532	3.98	1N21B	2.89
2J38	11.75	6BC5	.63	12SK7	.72	CK533AX	1.29	1N21C	21.50
2J39	44.00	6BC7	1.23	12SL7GT	.65	CK534AX	.99	1N22	1.25
2J42	187.00	6BD5GT	1.65	12SN7GT	.75	CK536AX	.99	1N23	1.35
2J48	24.25	6BD6	.83	12SQ7GT	.63	CK537AX	3.04	1N23A	2.20
2J49	67.25	6BE6	.59	12SR7	.63	CK538DX	.98	1N23B	3.49
2J50	21.25	6BF5	.98	FG17	3.95	CK539DX	2.19	1N25	4.98
2J52	249.50	6BF6	.65	19T8	1.09	CK541DX	1.99	1N26	8.75
2J55	85.00	6BF7	2.55	19V8	1.62	CK542DX	.99	1N27	1.55
2J56	149.00	6BG6G	1.39	RK20A	8.95	CK543DX	.99	1N29	3.50
2J61	49.95	6BG7	1.98	24G/3C24	1.90	CK544DX	.99	1N32	23.75
2J62	49.45	6BH6	.63	25BQ6GT	1.19	CK546DX	1.99	1N34	.64
2K22	49.95	6BJ6	.69	25L6GT	.69	CK547DX	1.98	1N34A	.90
2K23	29.00	6BK7	2.15	25Z5	.79	CK571AX/5886	2.49	1N35	1.65
2K25	39.95	6BL7GT	1.45	25Z6GT	.99			1N38	1.43
2K25/723AB	31.59	6BN6	1.49	FG27A	8.70	CK573AX/6029	3.49	1N39	4.15
2K28	32.00	6BN7	1.69	RK28A	4.89			1N40	10.49
2K33	300.00	6BQ6GT	1.20	28D7	1.95	WL579	10.49	1N43	1.73
2K35	398.00	6BQ7	1.65	FG32/5558	13.85	WL579B	12.98	1N44	1.24
2K41	109.00	6BY5G	1.45	35Z5GT	.59	KU627	18.00	1N45	1.45
2K42	145.00	6C21	29.45	RK39	2.89	WL652	65.00	1N46	.69
2K47	460.00	6CB6	.69	RK48	6.85	WL673	117.00	1N47	4.00
2K48	118.00	6CD6G	1.69	RK49	7.50	WL676	39.95	1N48	.55
2X2	.49	6D4	2.70	50L6GT	.69	WL686	35.00	1N51	.45
3B22	2.70	C6J/5C21	6.95	RK61	3.05	705A	1.98	1N52	1.62
3B23 RK22	4.95	6J4	6.66	80	.69	707A	7.90	1N54	.89
3B24	5.40	6J5GT	.47	81	1.69	707B	13.50	1N55	2.35
3B25	4.50	6J6	.63	82	1.19	715A	6.00	1N56	.89
3B26	3.70	6K4A	6.45	82V	1.39	715B	8.19	1N57	.89
3B28	7.90	6L6	2.09	83	1.45	715C	19.80	1N58	1.19
3C22	77.00	6L6G	1.35	83V	1.79	717A	.90	1N60	.60
3C23	9.90	6L6GA	1.35	84/6Z4	.99	718BY	48.45	1N61	2.10
3C31/C1B	3.45	6L6GAY	2.29	FG95/5560	24.85	718CY	48.45	1N63/K63	2.49
3C33	14.98	6SA7GT	.63	FG98	19.95	719A	28.50	1N64	.69
3C34/HK24	5.49	6SA7GTY	3.37	100TH	7.83	721A	2.49	1N67	1.95
3C45	15.48	6SB7Y	1.19	FG104	37.98	722A/287	2.45	1N69	1.19
		6SC7	.90			723A	11.95	K34	1.35

AUDIO AMPLIFIERS READY TO GO

Model 305MP 5 Watt Ampl. as Pictured Above Features Mike & Phono Inpts. W/Sep. Gain Cntrls. Latest Compensated Tone Cntrl. Design. Complete with Tubes.
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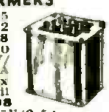
Model 302PA 3 Tube Phono Ampl. Ideal for Custom Building Your Phonograph. W/Tubes. SPECIAL $4.98

OIL CAPACITORS

Mfd	Each	Mfd	Each	Mfd	Each
50wvdc		1000wvdc		12500wvdc	
4	$0.40	1	$0.79	2	95.00
150wvdc		2	.85	15000wvdc	
1-1-3-5	.98	5	2.98	.0016	9.98
250wvdc		15	4.98	25000wvdc	
2x.25	.19	1400wvdc		.00025	7.49
300wvdc		.25	1.29	1	95.00
1.2	.29	.5	1.39	AC RATED	
400 wvdc		1500wvdc		220vac/600dc	
.1	.39	.5	1.49	2	.69
.5	.45	.75	1.69	4	.89
1	.69	1	1.79	5	1.29
4	.98	5	3.49	225vac/630dc	
6	1.08	6	3.98	3.3	.79
10	1.39	2000wvdc		230vac 630dc	
2x.1	.75	.1	1.49	5	1.29
2x.5	.94	2x.1	1.69	330vac 1000dc	
3x.1	.91	1	1.75	1.25	.63
3x.25	.99	2	3.98	1.5	.70
600wvdc		3	3.69	1.75	.98
.034	.30	8	9.49	2	.33
.1	.35	2500wvdc		2.5	.90
.25	.39	.25	2.29	2.8	.95
.5	.42	3000wvdc		3	1.00
1	.52	.1	2.49	4	1.29
2	.65	2	4.45	5	1.49
4	1.60	4	7.89	15	3.98
5	2.25	4000wvdc		25	6.49
6	2.59	2	8.98	405vac/1200dc	
7	2.89	5000wvdc		.15	1.29
10	3.10	.2	4.49	600vac/1800dc	
2x.1	.59	4	19.98	16	6.98
2x.25	.78	6000wvdc		660vac/2000dc	
2x.5	.89	1	7.49	5	4.49
2x1	1.05	7000wvdc		6	4.98
2x2	1.25	.002	1.69	10	6.98
2x8	3.25	.0075	1.98	16	7.98
3x.05	.75	.1	4.98		
3x.22	.85	7500wvdc			
3x.25	.98	.03	2.98		
700wvdc		.05	3.49		
4	1.50	10000wvdc			
800wvdc		.03	3.49		
.1	.69	12000wvdc			
		.02	4.98		

POWER TRANSFORMERS



2500V for Crt 6.3V/.6A. 2.5 V/1.75A csd Hvins 4/BC412 replmnt $7.98; 2 for $14.98
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950VCT 100MA, 5V/5A. 5V/2.5A. 45V/1A. 10V/1.5A 5.49
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840VCT 110MA, 530vct 21ma, 2x5V/3A, 6.3vct/1A, 6.3vct/.3A...... 4.98
770VCT/85MA, 5V/2A, 6.3V/3.5A... 3.98
760VCT/120MA, 2.5vct/10A, 6.3vct/2A 5V/3A, 10V/3.25A 6.98
700VCT/120MA, 2x6.3V/3A, 6.3V/1A ....$3.98; 2 for 7.25
550VCT/150MADC, 5V/3A, 6.3V/5A. 3.49
500VCT/60MA, 6.3V/4A Hsld...... 2.98
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2.5vct/10Amp 5 Kvins.... 3.59
5V/60A 13.98
6.3v/.6A $1.98
7.5vct/12A 15Kvins ...10.98
24v/1.25 csd. 1.98
2x12V/2A ... 3.89
5V/115A 16.95

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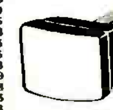

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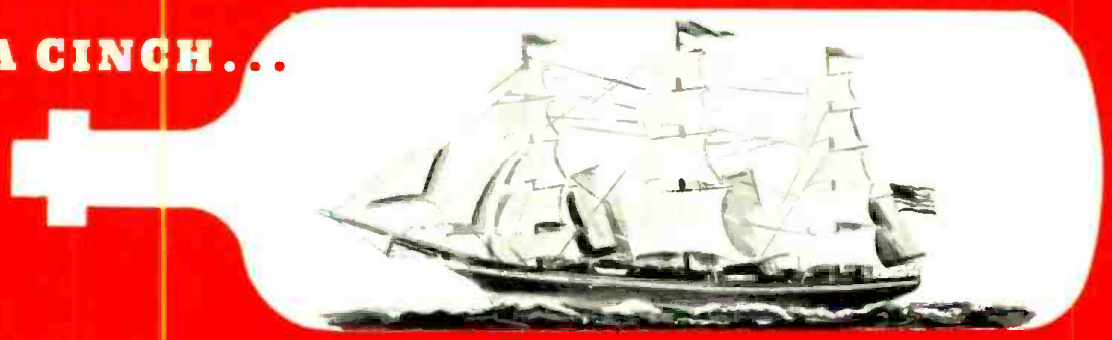

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Assembling the components of Raytheon Electron Tubes is a thousand times more exacting than building boats in bottles, yet Raytheon has hundreds of skilled technicians who (we think) assemble tubes better than anyone else in the world.

They do it better because Raytheon has specialized in the design, development and *manufacture* of highest quality Electron Tubes for *thirty years.* The skill, experience and "know-how" gained through dealing with every phase of quality tube production have been passed on to make these highly trained technicians the best in the business.

This precision assembly is a mighty important reason why Raytheon Radio and Television Tubes are Right for Sound and Sight!

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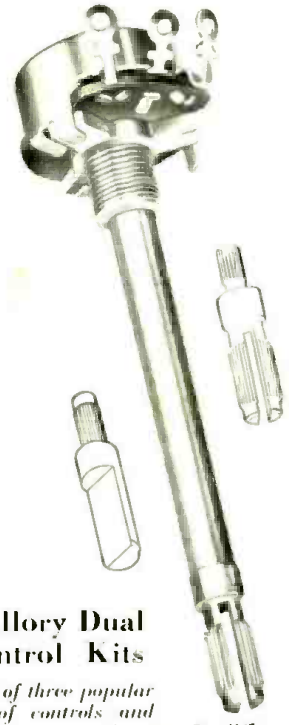

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Round tubular shafts are built for fast, accurate cutting . . . fit split-knurl and flatted-type knobs.

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