RADIO-ELECTRONICS

MARCH 1956

TELEVISION · SERVICING · HIGH FIDELITY

HUGO GERNSBACK, *Editor*

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Class-B Transistor Push-Pull Amplifier

•

Problems in Color TV Adjustment

•

Easy-to-Construct Sound-Activated Controller

•

Service to Satisfy The Customer

•

Build a Three-in-One (Pentode–U-L–Triode) Audio Amplifier

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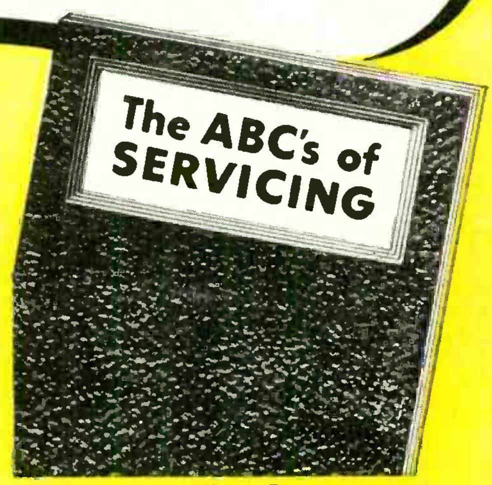

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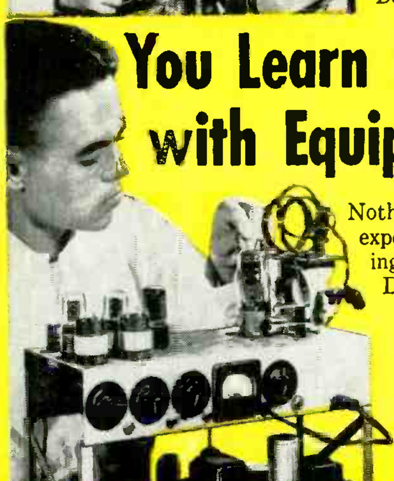

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MARCH 1956 — Vol. XXVII, No. 3

ON THE COVER

Model Polly Aarons listens to an elusive tune with the solar-powered transistor radio described on page 34.

Color original by Dan Rubin

Average Paid Circulation over 175,000

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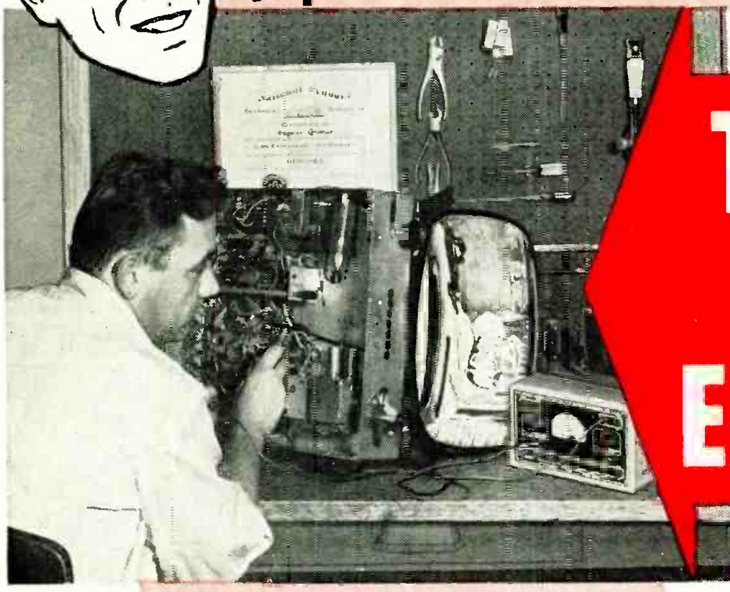

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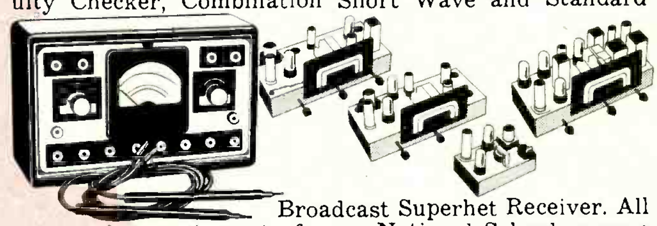

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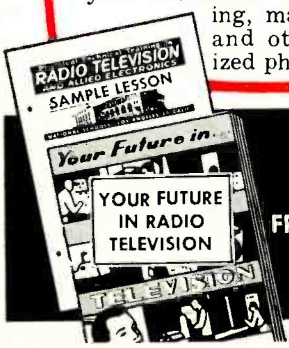

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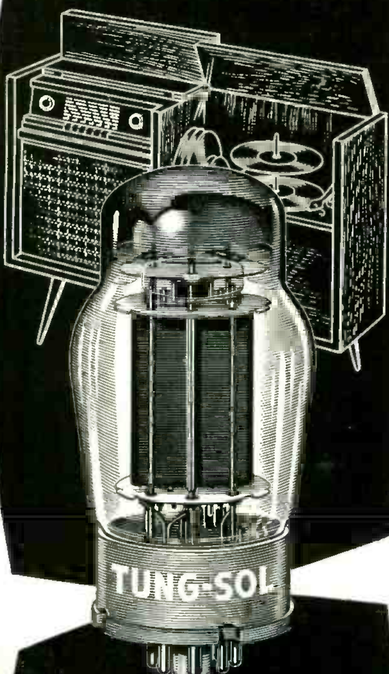

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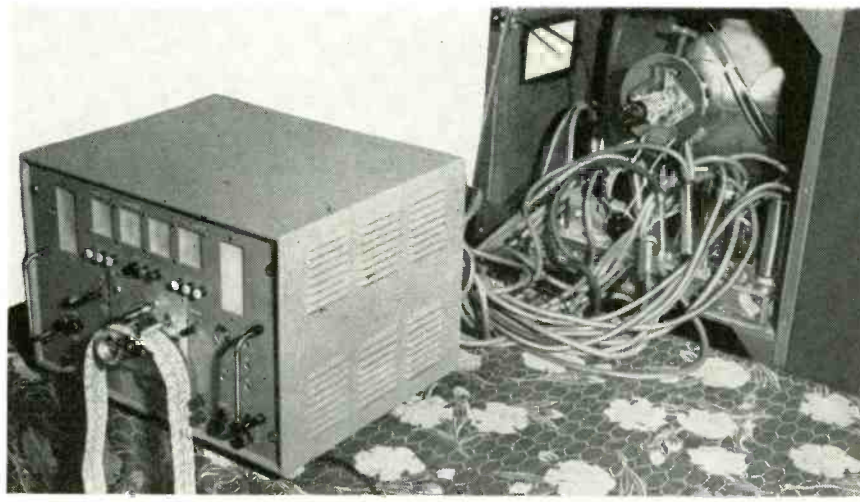
the Radio month

ROBOTESTER, an "electronic service technician" once considered a fit subject for an April Fool hoax (Electronic Brain Servicing, RADIO-ELECTRONICS, April, 1950) has arrived. The automatic tester—faster, lighter, more compact than any other unit of its type—was announced by Stephen D. Lavoie, president of Lavoie Laboratories, Morganville, N. J.

The Robotester (see photo) uses punched tape to program test points and parameters. It performs up to 120 complete circuit measurements per minute and has a capacity of 240 test points per setup. There are over 57,000 possible measurements or tests per setup. Excluding tubes or gross breakage through a dropped or smashed chassis, the instrument will pick up 70–90% of failures or defective parts.



The tester determines whether correct connections have been made, correct components installed and whether parts themselves are defective. The strip tape used for the checks is prepared by an engineer and sets the format for the tests for a particular piece of equipment. Tolerances of 5–20%, or wider, can be set to reject or pass.

TRANSLATORS to pick up vhf or uhf stations and rebroadcast their television programs on any of the 14 upper uhf channels (70–83) have been proposed by the Federal Communications Commission. The translator would have to obtain permission from the originating station but would not be required to meet a specified operation schedule.

Translators are low-powered stations (up to 10 watts) and would operate in areas where there are no regular TV stations. The FCC states that the use of channels 70–83 would "reduce the need for protective spacing with existing uhf stations because most uhf stations operate on lower channels."

The translators differ from "booster" stations in that boosters must operate on the same channel as the uhf parent station to fill in unserved areas within the normal coverage of that station. So-called illegal (unauthorized) boosters do not confine their rebroadcasts to uhf stations, as specified by the FCC, but operate on vhf channels as well.

"Satellites," as distinguished from translators and boosters, rebroadcast on locally assigned channels under experimental authority.

SIX NEW TV STATIONS have gone on the air since our last report:

KRMA-TV Denver, Col. 6
WSAV-TV Savannah, Ga. 3
KHPL-TV Hayes Center, Neb. 6
KBST-TV Big Spring, Tex. 4
KHAD-TV Laredo, Tex. 8
KOSA-TV Odessa, Tex. 7

WJPB-TV, Fairmont, W. Va., channel 35; WCOS-TV, Columbia, S.C., channel 25, and KANG-TV, Waco, Tex., channel 34, have gone off the air.

WTVU, Scranton, Pa., began operating on channel 73 but left the air to convert to channel 44. It failed to resume operation and reverted to construction-permit status.

Canada's 33d station, CKGN-TV, North Bay, Ont., channel 10, has gone on the air.

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2 You see principles, too, with DeVry home movies. You watch electrons on the march; you run the projector as slow or as fast as you want. All this with many modern, easy-to-read, fold-out diagrams right alongside reading matter, re-edited often to include current developments. You get frequent consultation. That's why training is so practical, so interesting, so thorough, at DeVry.

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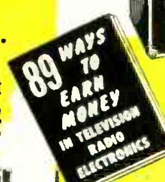
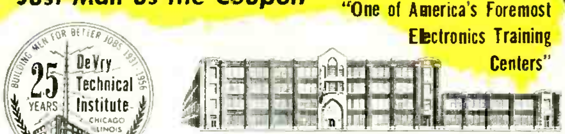
Valuable information for men subject to military service





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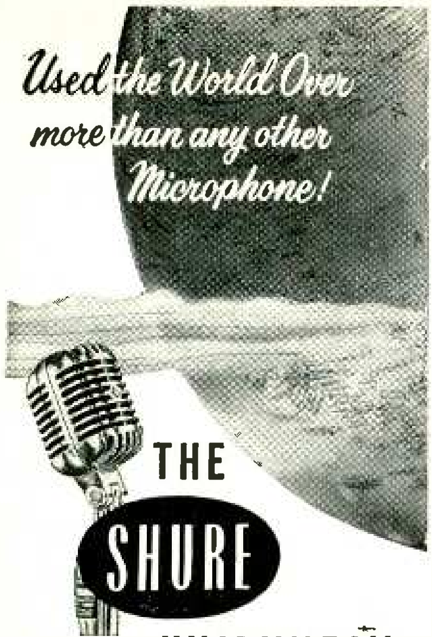

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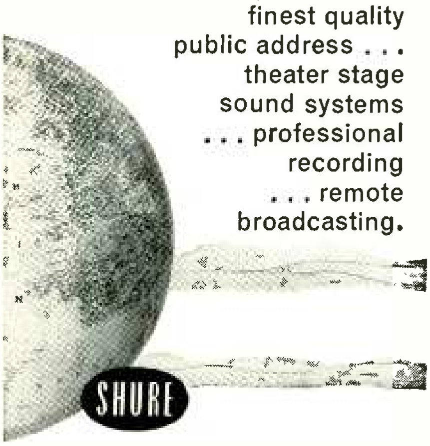

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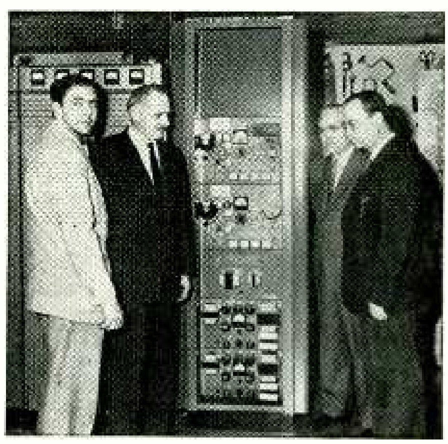
LIGHT AMPLIFIERS, far more sensitive than anything previously known, have been announced both by the Air Force and Bendix. The Air Force device picks up the little light available under "darkness" conditions and focuses it upon the sensitive surface of an image intensifier (RADIO-CRAFT; August, 1948; page 23) which transforms the photons to electrons, accelerates them and uses them to produce a second image similar to the picture on a TV screen. The sensitivity of the device was stated to be at least 1,000 times that of a standard TV camera.

Not as much information is available on the Bendix amplifier, which also works on television principles. A camera with a standard image orthicon tube picks up the image and transmits it over a closed circuit through amplifiers to a viewer unit. Special advanced circuity permits the viewer to see an image more than 40,000 times as bright as the object scanned.

FM MULTIPLEXING went on the air recently when station WFLY, FM outlet of The Record Newspapers in Troy, New York, broadcast the first commercial program of this type in the United States. Without affecting the station's regular broadcast, a second program was simultaneously transmitted "piggy-back" over WFLY's wavelength. The second program could be received only by special receivers designed for this purpose and will be used for transmitting background music for banks, restaurants, factories, etc.



Multiplexing equipment installed in WFLY. Standing, left to right, K. Schabinger, WFLY chief engineer; W. S. Halstead, president of Multiplex Services; R. C. Goodrich, WFLY manager; B. Lord, Multiplex Services' chief engineer.

This type of transmission, authorized last year by the FCC, permits FM broadcast stations for the first time to transmit simultaneously programs not intended for the general public.

TV SET REPLACEMENT BOOM expected in 1956. Based on the estimate of 1,630,000 TV sets scrapped in 1954 and 2,370,000 in 1955, by Frank W. Mansfield, Sylvania's sales research director, this year should be a banner year for television sales. On the supposition of G-E's tube market research manager, R. B. Yepsen, that TV sets are scrapped when they require a second replacement picture tube, nearly all of the 3,533,000 sets purchased in 1948–49 should become eligible for replacement in 1956.

Calendar of Events

3rd Annual Cleveland Electonics Conference, March 2–3, Old Gymnasium, Western Reserve University, Cleveland, Ohio.

IRE Show, March 19–22, Kingsbridge Armory and Palace, Bronx, N. Y.

Exhibit of Airborne Electrical Apparatus, Components and Auxiliary Equipment, Southwestern District Meeting of the AIEE, April 2–4, Baker Hotel, Dallas, Tex.

Special Technical Conference on Magnetic Amplifiers, April 5–6, Hotel Syracuse, Syracuse, N. Y.

13th Annual Radio Component Show, April 10–12, Grosvenor House, London, England.

GREENLEAF WHITTIER PICKARD, one of the great pioneer figures of radio, died Jan. 8 at the age of 78. He had worked in the electronics field as engineer and inventor since 1898. In the early years of the century he was a research engineer for the American Telephone & Telegraph (Bell) Co. and from 1907 to 1930 was consulting engineer for the old Wireless Specialty Co., at one time one of the country's leading communications companies. One of the first to transmit speech by radio (1902), Pickard did important early work in the development of the direction finder (radio compass). He is considered by many to be the inventor of the crystal detector and was one of the country's foremost students of static reduction and wave polarization. During World War I his systems maintained communication through static which destroyed reception from ordinary antennas.

He was a past president and Fellow of the Institute of Radio Engineers and a fellow and member of many other scientific and technical societies, an author of a number of books and numerous papers, and holder of more than 100 U. S. patents. An ardent amateur (W1FUR), some of his papers on wave polarization first appeared in amateurs' magazines. END

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Charles D. Sindelar, Cedar Rapids, Iowa

AIRLINES

"I replied to the job Opportunities you sent me and I am now a radio operator with American Airlines. You have my hearty recommendation for your training and your Job-Finding Service."
James A. Wright, Beltsville, Md.

INDUSTRIAL ELECTRONICS

"Upon my discharge from the Navy I used your Job-Finding Service and as a result I was employed by North American Aviation in electronic assembly (final checkout)."
Glen A. Furlong, Fresno, Calif.

TELLS HOW—

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Broadcast Station in Illinois: "We are in need of an engineer with a first class phone license, preferably a student of CIRE; 40 hour weeks plus 8 hours overtime."

West Coast Manufacturer: "We are currently in need of men with electronics training or experience in radar maintenance, and we would appreciate if you will refer interested persons to us."

Letter from nationally-known Manufacturer: "We have a very great need at the present time for radio-electronics technicians and would appreciate any helpful suggestions that you may be able to offer."

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

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L. M. Bonino, Harlingen AFB, Tex.	2nd Class	16 Weeks
John E. Hutchison, Bluefield, W. Va.	1st Class	27 Weeks

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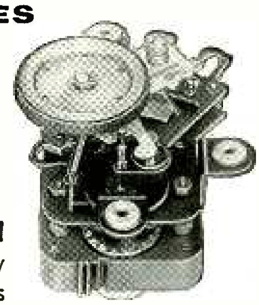

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P. G. A. H. VOIGT WRITES

Dear Editor:

Mr. Hartley's reference (January, page 14) to my Edison Bell days (1922–33) evoked memories of Mr. Johnstone, the chief recording engineer. He had discovered "the hard way," using recording sound boxes with flat glass diaphragms, just which trumpet best suited each particular artist for recording purposes. When I suggested microphones, amplifiers, electric cutters, etc, for this work, he must have known that his experience might soon become useless. Yet he never obstructed my experiments. Instead he taught me much that was to prove of special value later on when during several foreign recording expeditions, I recorded over 1,000 titles. To me Mr. Johnstone will always rank as one of the finest gentlemen I ever knew.

While at Edison Bell I developed the Tractrix horn shape (in 1926). Later this was incorporated in my earliest corner horns for domestic use (1934). Thank you Mr. Augspurger for the nice things you said about that horn (May, 1955, page 83) and thanks to Mr. Briggs for calling attention to its "antiquity" (January, 1956, page 14).

Thanks also to Mr. Chave (present owner of the Lowther Manufacturing Co.) for calling attention to my invention of the twin diaphragm for moving-coil loudspeakers (1933) (July, 1955, page 16), to Mr. Felix (November, 1955, page 14) for indicating that I had done more and to Mr. Beckett (December, 1955, page 10) for pointing out that I had taught Lowthers my special tricks for making these.

For a speaker manufacturer to teach another firm how to make his specialty diaphragms must seem strange unless accompanied by a sale of interests or other arrangement.

Before the war, when Mr. Lowther personally was running the Lowther company, and Mr. Chave was his chief assistant, there had been a friendly "alliance" between Lowthers and my little company. They made tuners and amplifiers while we made speakers.

Apparently I did not make myself quite clear to Mr. Hartley in regard to my business arrangements with Lowthers. I did not sell out. The gentlemen's agreement between Mr. Chave and my company was more complicated and included commissions on sales.

I am indebted to Mr. Hartley for the spirited way in which he champions my fundamental work on speaker design.

(*Continued on page* 14)

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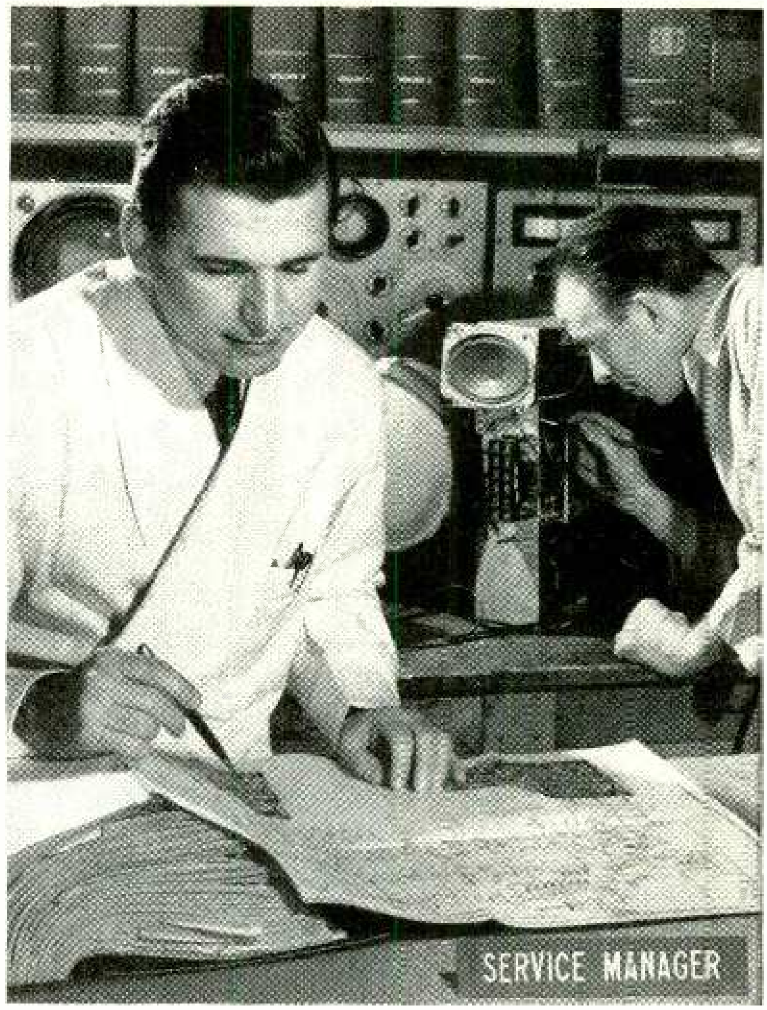

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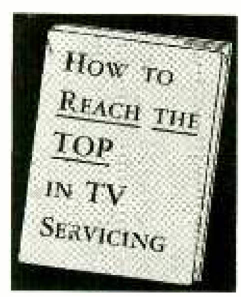

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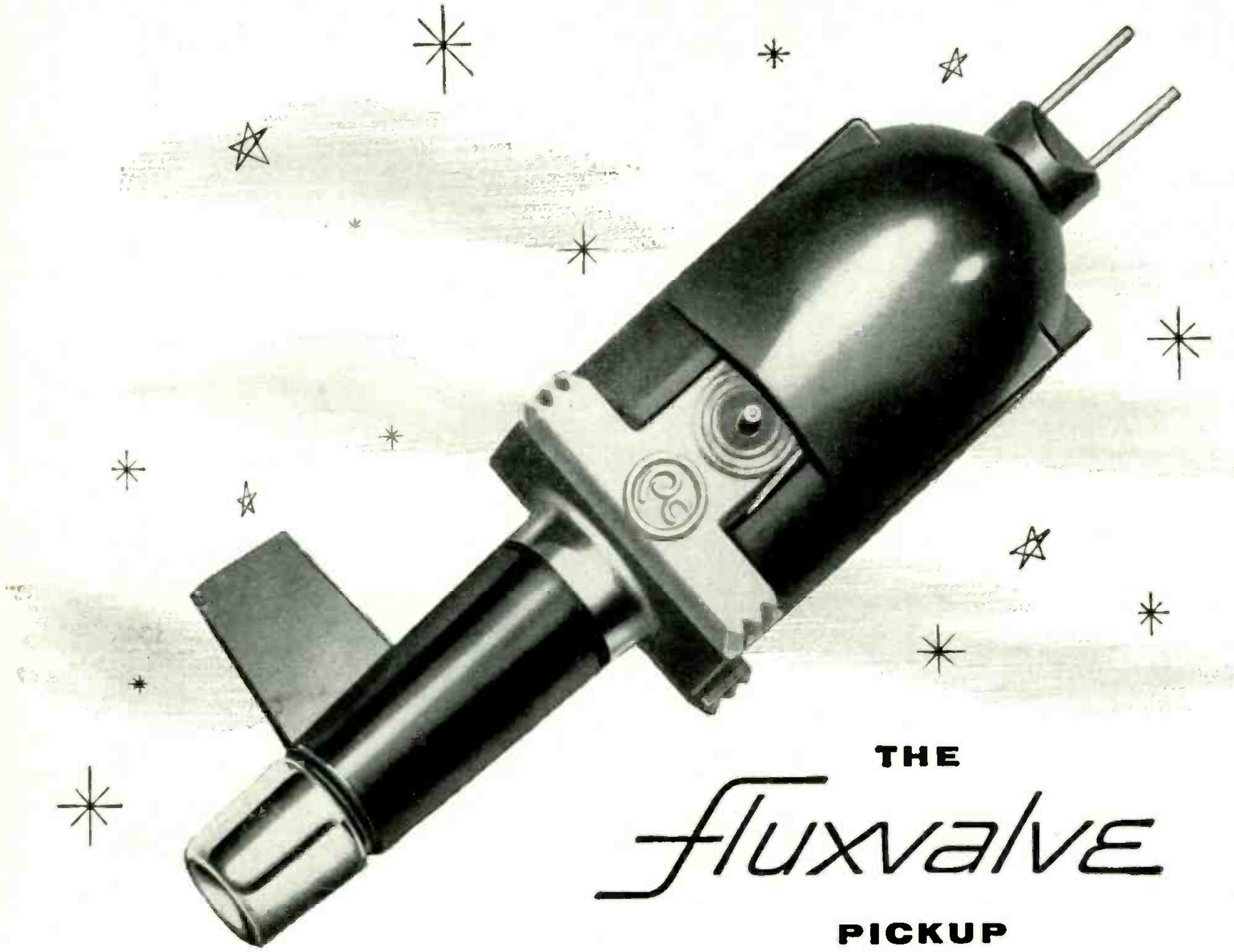

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conducts

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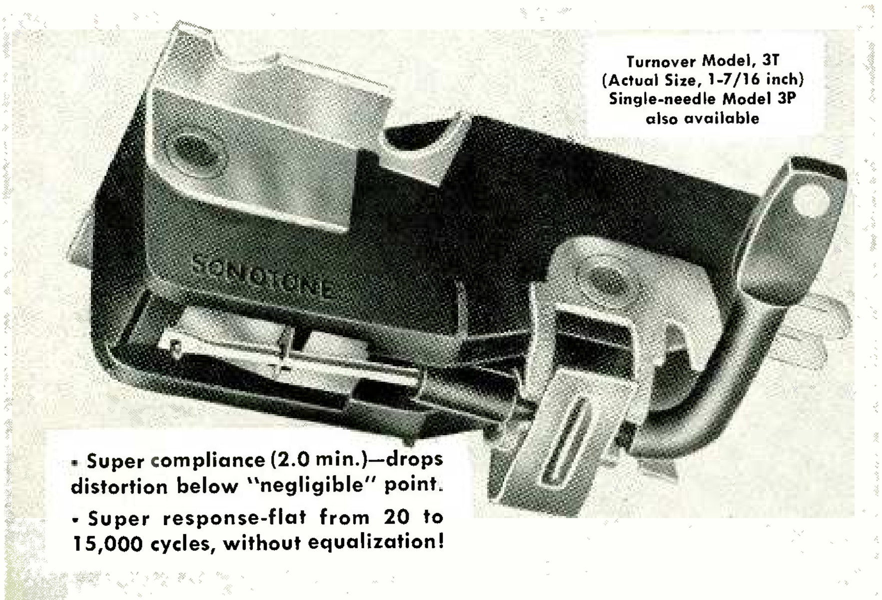
MAR 67

First Announcement!

New Sonotone "3" Series SUPER-FIDELITY Ceramic Cartridges



PARDON US IF WE CALL THEM "REVOLUTIONARY"...

but these new cartridges obsolete pre-amplifiers, equalizers, and old-style pickups!

If you've followed the development of ceramic cartridges since Sonotone pioneered them in 1946, you know we've made enormous advances.

Recently Sonotone has offered ceramic cartridges equal, by test, to most velocity types. Now, Sonotone presents the "3" Series, which set utterly *new* standards of finest performance, by all the measurements engineers know how to make.

These new cartridges make the *inherent* advantages of the ceramic type loom larger than ever. Consider:

WHY A PRE-AMP?

There is only one reason for a pre-amplifier—a velocity pickup puts out too feeble a voltage to drive your amplifier directly. But these Sonotone "3" Series cartridges deliver a whopping 0.5 volts—roughly 50 times as much as most velocity types. So you can *eliminate* the circuitry, noise, space and expense a pre-amp involves. (If you now have a pre-amp, our simple adaptor permits immediate use of Sonotone "3" Series cartridges in your present system.)

EQUALIZING UNNECESSARY

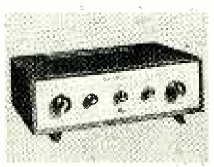
Sonotone "3" Series cartridges end equalization nuisance because ceramic cartridges respond to *amount* of needle movement not velocity. Result, they self-equalize.

These new cartridges eliminate magnetic hum problems. Fit any of the widely used arms.

Single needle model, with diamond, only **$30.00 LIST.** Turnover model with sapphire-diamond needles, **$32.50 LIST.** Less with sapphires.

NEW SONOTONE AMPLIFIER

We built this HFA-100 to realize the full excellence of Super-Fidelity ceramics.



Hum, noise and distortion are virtually unmeasurable—at maximum settings, distortion is only 0.15%! Cabinetry is superb solid walnut or solid mahogany, with solid brushed brass panel. **$117.50 NET.** Similar control unit, for use with power amplifier, **$59.00 NET.**

"Revolutionary" is a big word. But these Sonotone developments are pretty big news, if you like music!

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CORRESPONDENCE (Cont'd from pg. 10)

My understanding of magnet design grew in the mid-Twenties while designing magnets for dynamic recording cutters in which maximum possible gap flux density was needed. The trick is mainly a matter of reducing leakage and providing adequate cross-sectional area everywhere. Later (1929) I developed a loudspeaker magnet, bearing the same dominating principles. For maximum cooling, and also to minimize leakage, I used an open construction in the commercial model. This was fitted with a twin diaphragm. For PA work, weather protection was added.

When the war ended, it was already clear that excited speakers would soon be regarded as obsolete and so both Mr. Chave and I were evolving a PM version of the excited magnet. I insisted that we work independently till the design changes had been crystallized, when we would compare notes. I adopted the central block type of PM while Mr. Chave preferred the material in ring form around the center pole.

A PM speaker requires no cooling fins. Imagine the protected unit without cooling fins, and the pedigree of the Lowther-manufactured unit becomes obvious.

However, I do want to point out that in spite of the similarity in styling and the many internal similarities, the Lowther magnet is not 100% my work as some seem to think. Mr. Chave is responsible for including a design feature aimed at reducing leakage and for providing adequate cross-sectional area in various parts of the magnet ring. The details were settled as the result of considerable experiment, and it is only fair that he should be given proper credit for what he has done.

P. G. A. H. VOIGT
Toronto, Canada

LIST PRICES

Dear Editor:

I firmly believe in the use of list prices. Cut-throat competition reduces dealer profits and leads the customer to believe that dealers that hold the line are reaping enormous profits. Standards should be set on just how much an old television set is worth on a trade-in.

Not helping the situation is the printing of net prices in magazines by manufacturers. Why not quote list prices? People in the trade can easily determine their net prices. Why should the customer know how much I pay for parts?

The "standard-brand tubes at bargain prices" is another sore spot but fortunately tube manufacturers and magazines like RADIO-ELECTRONICS are doing something about that. [See Page 63.—*Editor*]

JOSEPH J. KELLY
Westmere Television
Albany, N. Y.

AUTO RADIO

Dear Editor:

I found the article on car radios by Jack Darr (November, 1955) very com-

(*Continued on page* 18)

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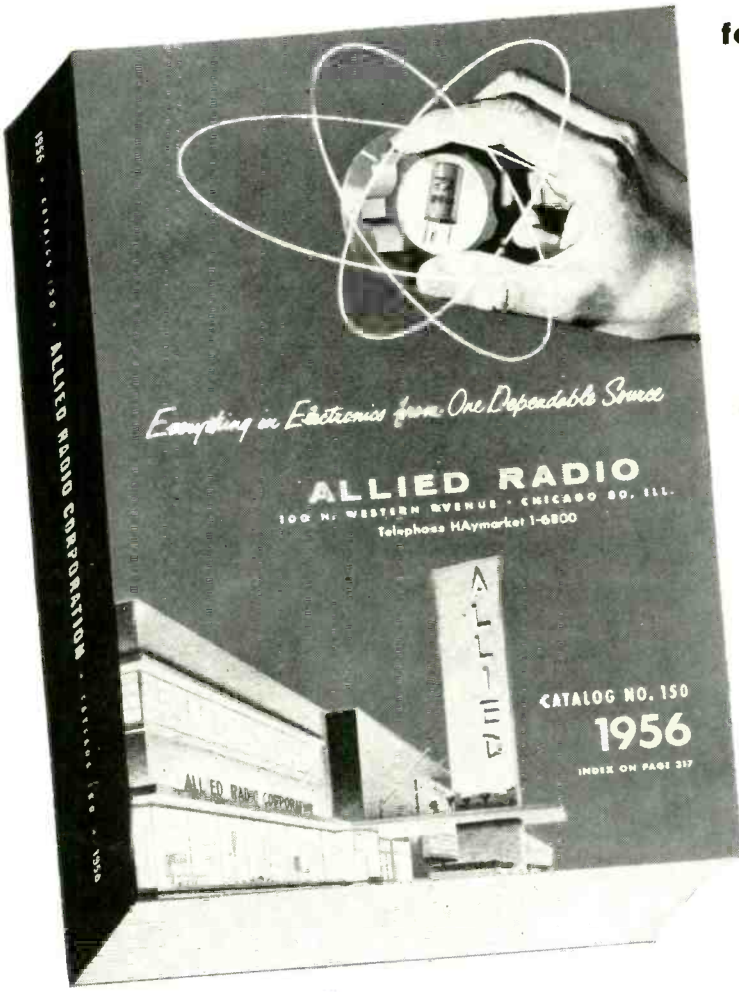

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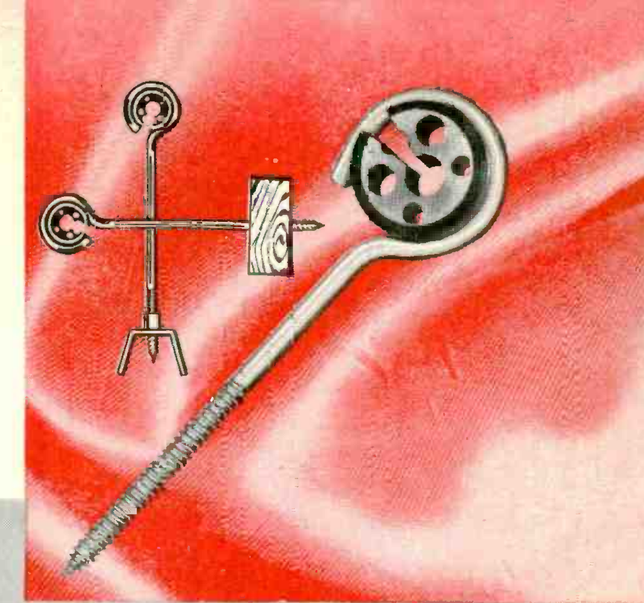

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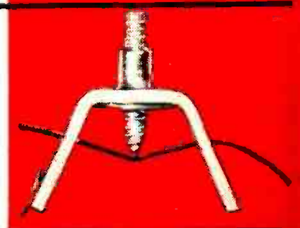

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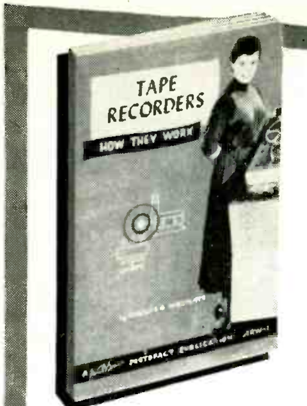

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CORRESPONDENCE (Cont'd from pg. 14)

plete. However, one common failure, usually in the more recent models, was omitted. I have found numerous cases of defective on–off switches, either intermittent or open. As these units are usually a mess to get out, we bridge the old one and sell the customer a new switch which we mount under the edge of the dashboard. This way the switch can be easily replaced when it goes bad.

ROBERT D. LAYTON

Hemet, Calif.

TECHNOTE IMPROVEMENT

Dear Editor:

In your November, 1955, issue, your Technotes section carried an item by Mr. Keller which contained a remedy for vertical noise pulses in the Admiral 21B1 chassis.

He recommends changing the vertical peaking resistor to 460 ohms. I have had perhaps upward of 20 Admiral chassis of that series with a similar complaint and in all cases either a defective filter capacitor or a defective vertical output transformer was the trouble. The transformer was the defective component in over 90% of the cases. With a defective transformer, lowering the vertical spike amplitude *relieves* the condition but *does not cure* the trouble and tends to lead to problems in vertical height and linearity.

Apparently, lowering the spike amplitude slows the rate at which the 6S4 goes into cutoff. Consequently, the vertical retrace spike is smaller and the transformer will not arc over.

LEE RAMSAUER

Tonawanda, N. Y.

FREE ENTERPRISE

Dear Editor:

Screwdriver mechanics—let them continue with no restrictions. Competition is a stimulant to progress; control is stagnating. Competition forces the capable technician to expand his talents, especially if he charges higher rates than the screwdriver mechanic.

How many "trained" men use their skills much beyond tube changing? So many of them are either lazy or do not understand what they have been taught. The screwdriver mechanics do foul up some sets, but not so much more than many of our "trained" technicians. At any rate, let the public have inexpensive service where it gives sufficient results; the cheap Ford eventually benefited everyone.

A highly skilled man should switch from general servicing to specialized work on the dogs brought in by screwdriver mechanics. Let the screwdriver boys make their money changing tubes, the skilled men fixing the tough ones.

The specialist could probably make more money this way and never have to make a house call. All sets would be brought to him—but he would have to use his brains more.

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"Luck," some may say.

"Contacts," others may suggest.

But in your heart, you will know the answer: "Training." And it all may have started the moment you filled out a coupon requesting a copy of a free booklet named "Your Future in the New World of Electronics." From this data you get knowledge of where you stand in Electronics. Tremendous expansion leaves this gigantic industry pleading for trained men. Top manufacturers sold billions of dollars worth of electronic merchandise in 1955. By 1960, the radio-electronics industry should do no less than 15 billion dollars per year, not counting military orders.

Today, there are over 118,000 radio-equipped police cars; over 92,000 radio-equipped taxis; over 30,000 civilian planes have radio; nearly 50,000 American ships have radio.

Today, there are over 132,000,000 radios in use. There are 38,000,000 TV sets and 477 TV stations in operation. Color TV is coming into high gear. Countless positions must be filled—in development, research, design, production, testing and inspection, manufacture, broadcasting, telecasting and servicing. To fill these posts, trained men are needed—men who somewhere along the line take time to improve their knowledge, their skills. Men who, today, perhaps, take two minutes to send for a booklet.

"Your Future in the New World of Electronics" shows you how CREI Home Study leads the way to greater earnings through the inviting opportunities described above.

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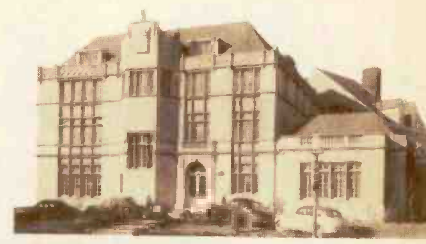

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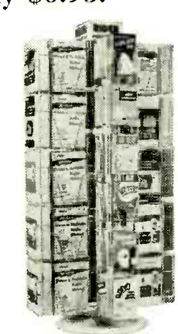

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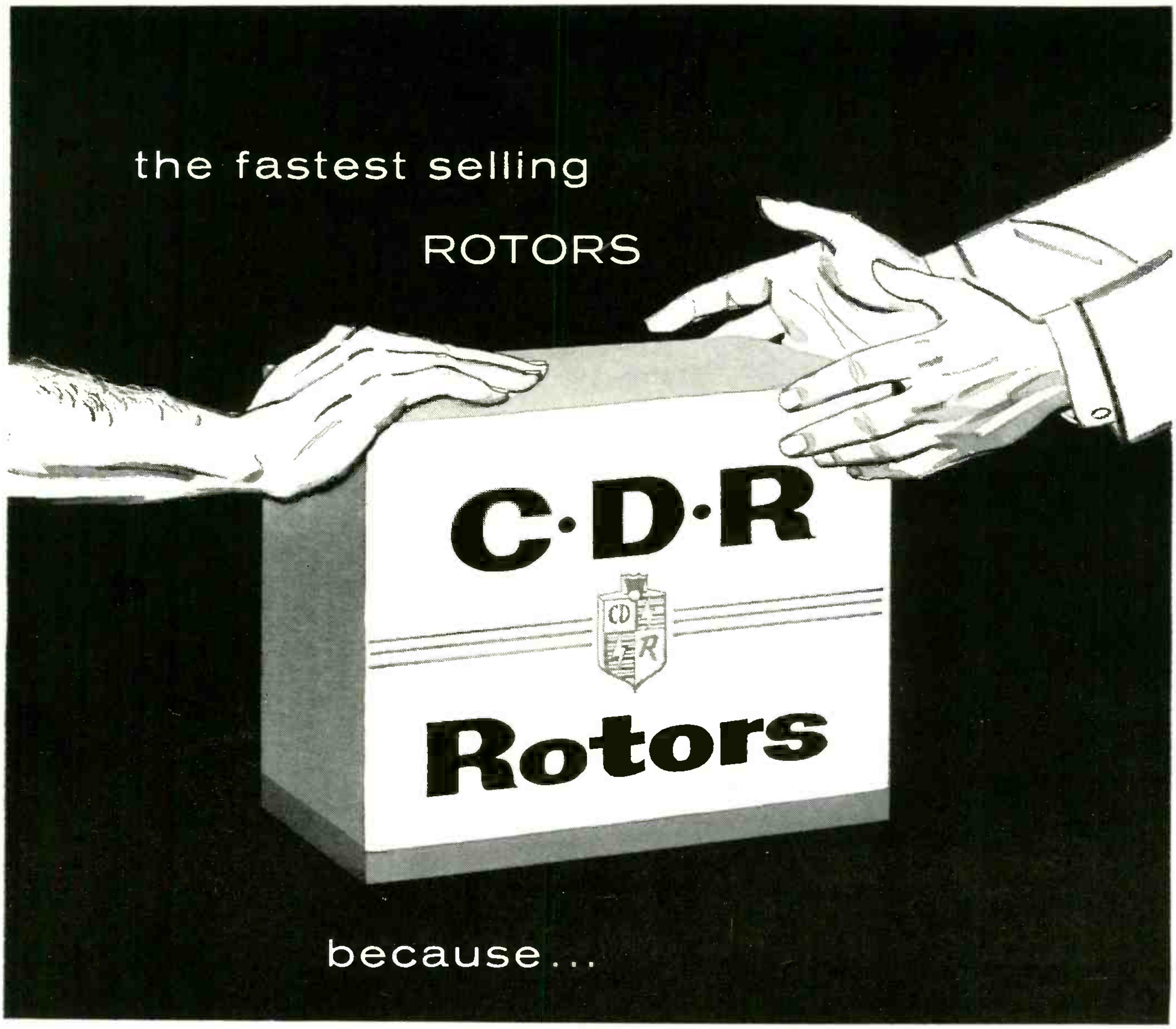

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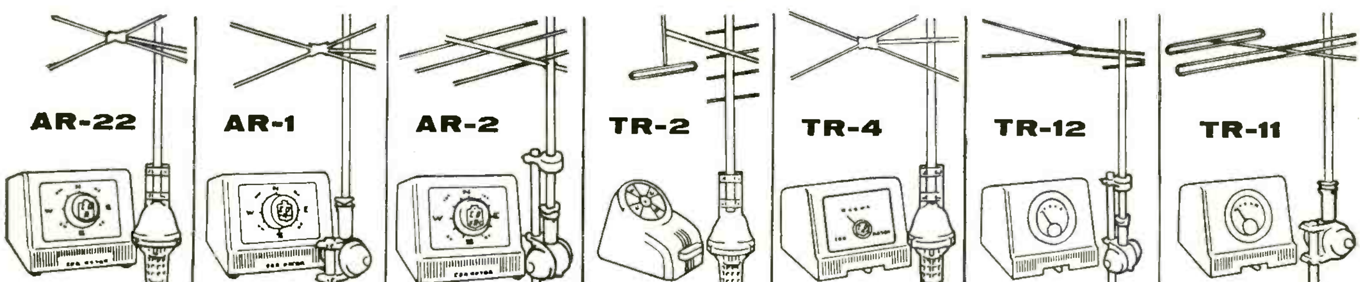

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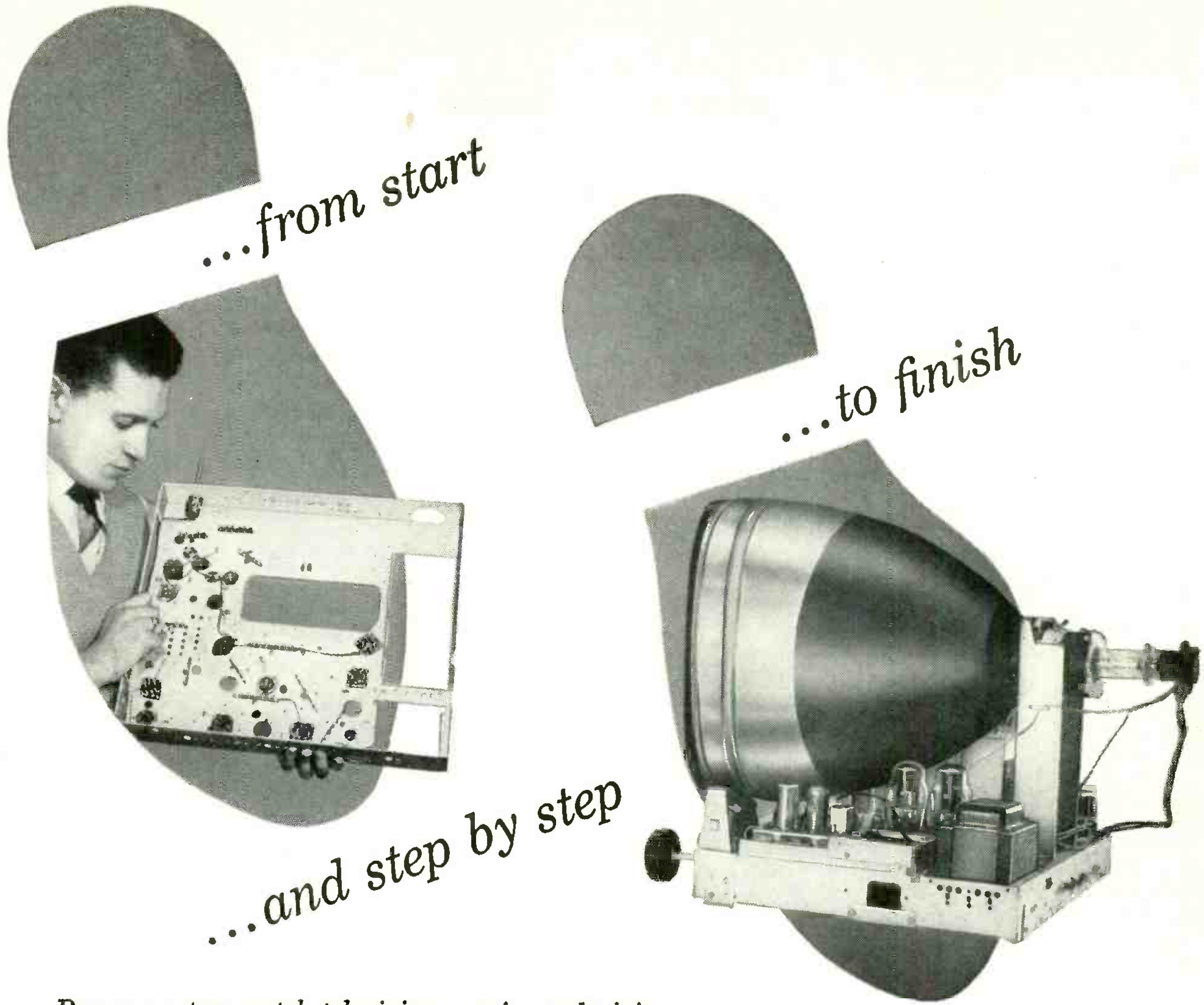

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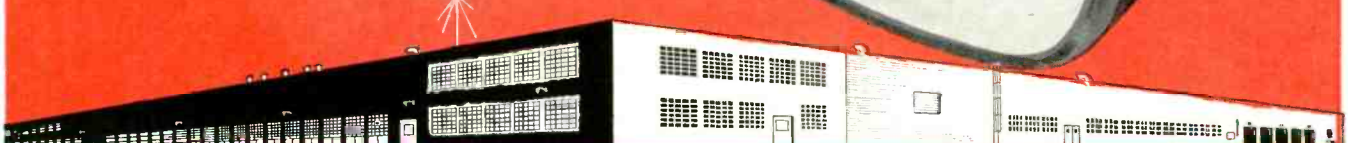

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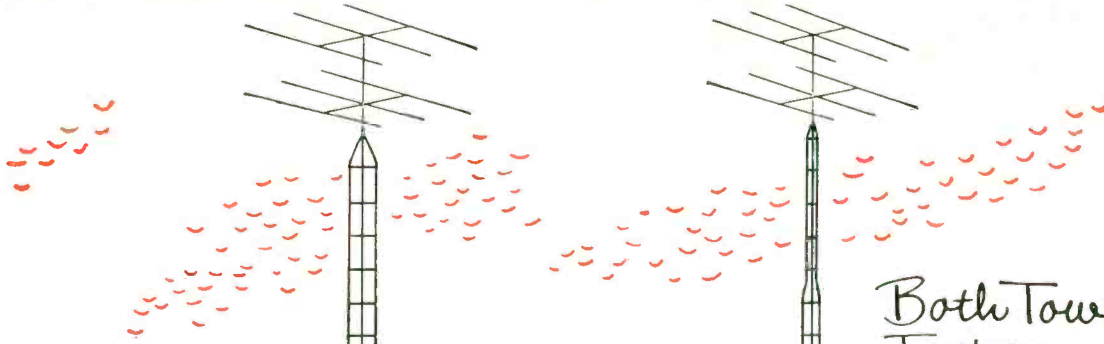

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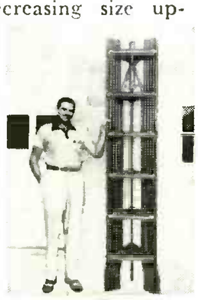

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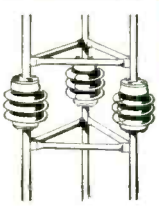

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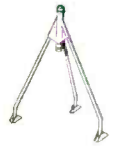

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(SAVE $15.00)

FASTER SERVICING—BIGGER PROFITS

WITH B & B PIX TUBE TESTER— REACTIVATOR

B & B's revolutionary eight position Selector Switch and single lead hook-up quickly checks both picture tube and receiver in a fraction of your normal testing time. Abnormalities are instantly readable on big meter dial — no involved circuitry connections — no questionable readings — your examination is finished accurately, dependably in a jiffy.

Servicemen everywhere are making extra dollars by bringing old tubes back to life and tying up future picture tube sales with this instrument on each service call.

Single Selector Switch provides twelve separate tests of both picture tube and receiver:

- Tests leakage between grid and cathode
- Tests leakage between heater and cathode
- Tests leakage between grid and screen
- Tests grid-cathode voltage from receiver
- Tests effectiveness of receiver brightness control
- Tests receiver screen voltage supply
- Tests receiver video output signal
- Tests effectiveness of brightness receiver control
- Tests beam current MEASURED AT HV ANODE
- Tests grid control of beam current
- Tests overall receiver performance dynamically

One out of every three TV PIX TUBES can be reactivated successfully the B & B way. Just set Selector Switch in "Beam-Curr" position, turn on HV for three minutes and the job is done safely without damage to the cathode.

OUTSTANDING FEATURES OF THIS INSTRUMENT INCLUDE:

- Sensitive 100 Micrometer meter movement
- Built-in 0-600 Voltmeter (1% accuracy)

Bench Model 701	**$54.90**
HV PROBE	**13.95**
	$68.85
Special Combination Price	**$53.85—**

YOU SAVE $15.00

INTRODUCTORY OFFER — LIMITED TIME ONLY — ACT NOW!
10 DAY MONEY-BACK GUARANTEE

UNIVERSAL HIGH VOLTAGE PROBE

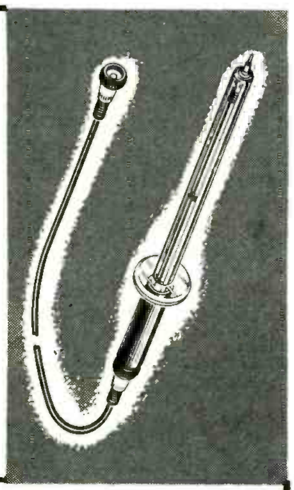
THIS IS THE ONLY PROBE THAT CAN BE USED WITH ANY METER

Up to 0 to 60 KV ON ANY METER with NO EXTRAS TO BUY

INSTRUCTIONS FOR USE WITH METERS OF ALL TYPES (10,000 OHMS PER VOLT OR MORE) CLEARLY AND SIMPLY SHOWN WITH PICTURES, CHARTS, GRAPHS AND TABLES INCLUDED WITH THE INSTRUMENT.

If you change your meter, you can alter your B & B Model 702 High Voltage Probe to suit without additional parts or resistors to buy.

PRICE—Complete with four universally matched precision High Voltage Resistors and full instructions, only.......... **$13.95**



ANY BIAS VOLTAGE FROM 0 TO 30 VOLTS FROM A PERMANENT SOURCE—THE MODEL 704 BIAS BOX

Why buy bias batteries which wear out, can't be adjusted, and whose voltage is not constant, when you can get

Exact Specified Substitute Bias Voltage For

Troubleshooting AVC Circuits in Radio Receivers • Troubleshooting AGC Circuits in TV Receivers • Visual Sweep Alignment of TV and Other Receivers • Industrial Equipment Checking • Troubleshooting and Adjustment of A-F and R-F • Amplifiers.

The Boland and Boyce Model 704 BIAS BOX is designed so the whole unit clips neatly onto the chassis apron, thus supporting it mechanically while at the same time providing an electrical ground. Manufacturers of TV receivers specify in the service data for alignment and other checks that a definite fixed bias voltage must be substituted for the AGC voltage so the AGC action will not interfere with development of visual response curves This substitution is also necessary in trouble shooting the AGC circuits of the TV receiver.

The value of the voltage is adjusted by setting pointer to value on a convenient calibrated "voltage set" scale. Thus, the receivers AGC supply is removed — the Boland and Boyce Model 704 BIAS BOX output applied in its place — and the bias voltage adjusted exactly to that specified by the receiver manufacturer in his service instructions.

Assembled, Wired and Tested.............................$9.90

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☐ Also include leatherette carry case for $5 additional.

☐ Send me Universal High Voltage Probe separately at $13.95.

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Enclosed Find $...............Full price to be shipped prepaid.

$...............25% down—shipped balance C.O.D. Railway Express.

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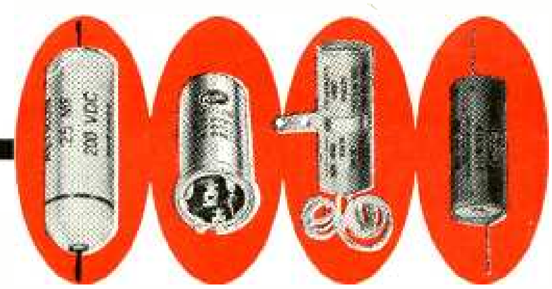

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NOW — while the Television-Radio-Electronics industry is expanding at the fastest rate in history — is the time for you to prepare for a top-pay lifetime job . . . or your own profitable business.

New TV stations are going up constantly . . . sales of TV sets are breaking all past records . . . new products are being announced almost every day . . . new plants are springing up to meet the heavy demand for these products.

Trained men are needed urgently. The head of CBS-Columbia product service department estimates that the industry will need 200,000 service men by 1959. The best jobs will go to the men who are ready for them. *Right* now is the time for you to prepare yourself. Delay can be costly.

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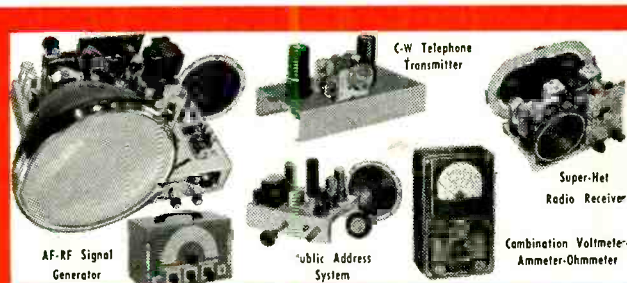

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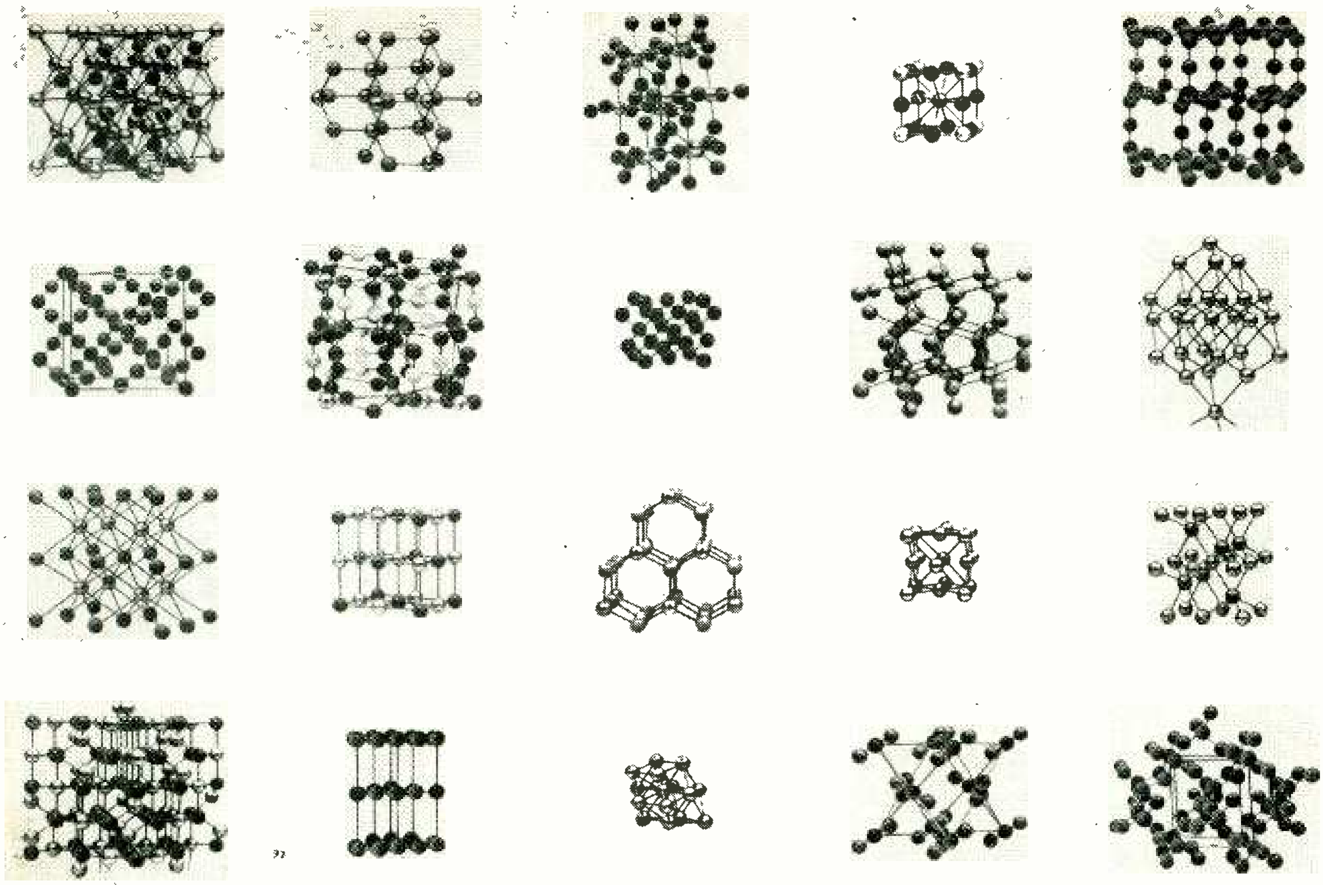

Crystal structure models. Top row, left to right: cuprite, zincblende, rutile, perovskite, tridymite. Second row: cristobalite, potassium dihydrogen phosphate, diamond, pyrites, arsenic. Third row: caesium chloride, sodium chloride, wurtzite, copper, niccolite. Fourth row: spinel, graphite, beryllium, carbon dioxide, alpha-quartz.

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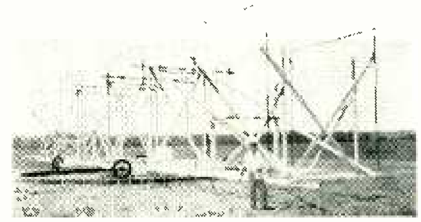
Research at Bell Telephone Laboratories ranges from the ultimate structure of solids to the radio signals from outer space. Radio interference research created the new science of radio astronomy; research in solids produced the transistor and the Bell Solar Battery.

Between atoms and stars lie great areas of effort and achievement in physics, electronics, metallurgy, chemistry and biology. Mechanical engineers visualize and design new devices. Mathematicians foreshadow new communications techniques.

Despite the diversity of their talents, Bell Laboratories scientists and engineers have much in common. A habit of teamwork channels these talents into great communications advances. These men have developed the world's finest telephone system. In doing so, many have become leaders in their fields. Opportunities for achievement await properly qualified scientists and engineers at Bell Telephone Laboratories.

Models of the atomic patterns in solids help Bell Laboratories scientists visualize their electrical behavior.



Directional antenna used by Karl G. Jansky in discovery of stellar radio signals at Bell Telephone Laboratories in 1932.

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NEW! COLOR and Black-&-White LAB & TV 5" OSCILLOSCOPE #460
KIT $79.95. Wired $129.50

The FINEST professional 5 mc wide-band scope value. Ideal for research, h-f & complex waves, plus Color & Monochrome TV servicing. Flat from DC to 3.58 mc ±1 db (color burst freq.), flat DC to 4.5 mc +1, −3 db. Vert. sens. 25 rms mv/in. Vert. Z 3 megs. Has the following outstanding features not found in scopes up to several times its price, kit or wired:

VERTICAL AMPLIFIER: direct-coupled (DC) thruout to eliminate l-f phase shift; **push-pull thruout** for negligible distortion; **K-follower coupling** between push-pull pentode stages for extended h-f resp. (minimizes h-f phase shift, extends useful resp. to 10 mc); full-screen undistorted vert. defl; 4-step freq-compensated decade step attenuator up to 1000:1. **SWEEP CIRCUIT**: perfectly linear sweeps, 10 cps – 100 kc (ext. cap. for down to 1 cps); **pre-set TV vert. & hor. positions** (30 & 7875 cps); automatic sync. ampl. & limiter eliminates sync amplitude adj. **PLUS**: direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; anti-glare filter; bezel fits std photo equipt. **OTHER IMPORTANT FEATURES**: High intensity trace CRT. Finest sq. wave resp. (.06 usec rise time). Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in voltage calibration. Intensity mod. Sawtooth & 60 cps outputs. Astigmatism control. Retrace blanking. Instant, drift-free full-screen vert. positioning & 2X full-screen hor. positioning. **Bal., cal., astig. adj. externally accessible.** 5UP1 CRT, 2–6AU8, 2-6CB6, 1-12AU7A, 2-6J6, 1-6AX5, 1-1V2. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. Designed for easy building at home with no special equipment. 13" x 8½" x 16". 30 lbs.

SCOPE DIRECT PROBE* #PD: KIT $2.75. Wired $3.95. Eliminates stray pick-up & signal re-radiation.

SCOPE DEMODULATOR PROBE* #PSD: KIT $3.75. Wired $5.75. Demodulates AM carriers between 150 kc and 250 mc.

SCOPE LOW CAPACITY PROBE* #PLC: KIT $3.75. Wired $5.75. For signal tracing in high frequency, high impedance & wide-band circuits (as in TV) without distortion from overloading or frequency discrimination.

150 kc to 435 mc with ONE generator!

New! RF SIGNAL GENERATOR #324
KIT $26.95. Wired $39.95
for COLOR and Monochrome TV servicing

New wide-range, stable generator – better value then generators selling at 2 or 3 times its cost! Ideal for: IF-RF alignment, signal tracing & trouble-shooting of TV, FM & AM sets; marker gen.; 400 cps audio testing; lab. work. 6 fund. ranges: **150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%;** 6:1 vernier tuning & excellent spread at most important alignment freqs. Etched tuning dial, plexiglass windows, edge-lit hairlines. Colpitts RF osc., directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. mod. amplifier: only 3.0 volts needed for 30% mod. Turret-mounted coils slug-tuned for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 volts. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. Tubes: 12AU7, 12AV7, selenium rectifier; xfmr-operated. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. 8" x 10" x 4¾". 10 lbs.

The specs are the proof...
4 NEW BEST BUYS by EICO

for COLOR and Monochrome TV servicing

New! PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)
KIT $29.95. Wired $49.95

UNI-PROBE: exclusive with EICO! Terrific time-saver! Only 1 probe performs all functions—a half-turn of probe-tip selects DC or AC-Ohms.

The new leader in professional peak-to-peak VTVMs. Latest circuitry, high sensitivity & precision, wide ranges & versatility. **Calibration without removing from cabinet.** New balanced bridge circuit. High Z input for negligible loading. 4½" meter, can't-burn-out circuit. **7 non-skip ranges on every function.** 4 functions: +DC Volts, −DC Volts, AC Volts, Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. **Zero center.** One zero-adj. for all functions & ranges. **1% precision** ceramic multiplier resistors. Measure **directly** peak-to-peak voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe, & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 12AU7, 6AL5, selenium rectifier; xfmr-operated. 8½" x 5" x 5". Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. 7 lbs.

1 Calibration without removing from cabinet.

New! DELUXE PEAK-to-PEAK VTVM #249 with 7½" METER & UNI-PROBE (pat. pend.)
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All the advanced & exclusive features of #232—PLUS the extra convenience and readability of its big 7½" meter. Your ideal bench instrument.

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VTVM HV PROBE #HVP-2: Wired $4.95. Complete with multiplier resistor. Measures up to 30 kv with any VTVM or 20,000 ohms/volt VOM.

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*Only EICO Probes have all these features: fully shielded; **rugged terminal board parts mounting;** shock-mounted floating construction; swivel-action; color-coding; easy parts accessibility.

COMPLETE with Preamplifier, Equalizer and Control Section

New! 20-WATT Ultra-Linear Williamson-type HIGH FIDELITY AMPLIFIER #HF20
KIT $49.95. Wired $79.95

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price, kit or wired. Every detail, down to the etched, brushed solid brass control plate, is of the fine quality EICO is famous for.

Rated power output: 20 watts (34 w peak). **IM distortion (60 cps: 6 kc/4:1) at rated power:** 1.3%. **Mid-band harmonic distortion at rated power:** 0.3%. **Maximum harmonic distortion between 20 and 20,000 cps at 1 db under rated power:** approx. 1%. **Power response (20w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Frequency response (¼w):** ±0.5 db ±13-35,000 cps; ±1.5 db 7-50,000 cps.

5 feedback equalizations for LP's & 78's including RIAA. Variable turnover feedback tone controls do not affect volume & permit large boosts or cuts at either end of audio spectrum with mid-freqs. unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. 4 hi-level switched inputs: tuner, tv, tape, auxiliary (xtal/ceramic phono or 2nd tuner); 2 low-level inputs for proper loading with all leading magnetic, FM & quality xtal cartridges. Hum bal. control. Extremely fine output transformer has interleaved windings, tight coupling, careful balancing & grain-oriented steel. 8½" x 15" x 10". 24 lbs.

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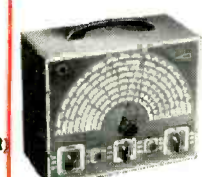

RF SIGNAL GENERATOR #320
KIT $19.95
Wired $29.95
150 kc-34 mc, calibrated harmonics to 102 mc. Pure or mod. RF, & Colpitts osc. 400 cps sine outputs.

CATHODE RAY TUBE CHECKER #630
KIT $17.95 Wired $24.95

Easy, fast test of all types & sizes TV pix & scope CR tubes, in set or carton.

#944 FLYBACK TRANSFORMER & YOKE TESTER
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• fast check **all** flybacks & yokes in or out of set.
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Range 500 kc—228 mc on fund. Cont. sweep width control, 0—30 mc.
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TV/FM SWEEP GENERATOR #360
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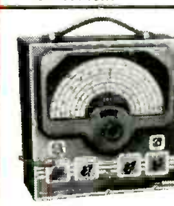

1% accuracy on all 7 ranges. Range 75 kc—150 mc. Volt reg.
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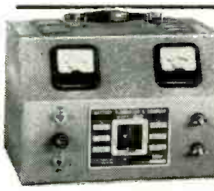
DELUXE RF SIGNAL GENERATOR #315



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Sep. hi-gain RF & lo-gain audio inputs. Special noise locator. Calibrated wattmeter.
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Reads 0.5 ohms—500 megs, 10 mmfd—5000 mfd, power factor.
KIT $19.95
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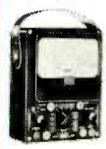
R-C BRIDGE & R-C-L COMPARATOR #950B

New! **BATTERY TESTER #584**
KIT $9.95
Wired $12.95
•
Tests A & B portable radio, hearing-aid, lantern, other batteries—in or out of equipment.



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1000 Ohms/Volt MULTIMETER # 536
KIT $12.90
Wired $14.90

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RADIO – ELECTRONICS

Hugo Gernsbock, Editor

"NATIONAL TV SERVICEMEN'S WEEK"

.... *The Servicing Industry Has Come of Age* ....

ON March 5, 1956, the service technicians of the United States will celebrate the anniversary of *National TV Servicemen's Week,* originated last year by RCA (see page 122).

On this occasion RADIO-ELECTRONICS magazine salutes the more than 125,000 service technicians and wishes them a rousing Happy Birthday and a well deserved prosperity. Every member of the servicing industry will note with justifiable pride that *National TV Servicemen's Week* has been recognized by no less a body than the United States Chamber of Commerce.

With this impressive stamp of approval it may be said that the servicing industry has finally come of age. And let no one think that this industry is puny—in 1955 it had an estimated total turnover of more than $1½ billions. It is bound to be much higher in 1956.

What the servicing industry will do in 1957 and thereafter, due to the impact of color television, is not too difficult to forecast. It certainly is reasonable to assume that it will go close to $2½–$3 billions by 1958.

It may even go a good deal higher if the present impetus of closed-circuit TV and closed-circuit color TV mushrooms into big business, as these branches are certain to do. Add to this transistor radios when they finally go into multimillion production—as they surely will—and one does not require an IBM electronic computer to figure out the staggering amount of business the servicing industry is bound to do by 1960.

It wasn't always thus. Indeed, the electronic servicing industry grew into manhood from minuscule beginnings. This writer, who was present at the very birth of the industry, finds it quite impossible to pinpoint the exact year of its beginning.

Originally—that is in the early Twenties—there was no radio servicing, strictly speaking. Instead, we had thousands of radio experimenters, constructors, set builders and radio amateurs, all of whom were pressed into service when the first factory-made radio sets developed troubles—which they did unfailingly. Most manufacturers of radio receivers in those halcyon days seldom stooped to repair any of their sets—if they were returned to the factory they reluctantly did the necessary repair, usually at fantastic prices. For these reasons it was up to the set owners to find a bright radio amateur or "radio wiz" to repair their silent receivers. It wasn't long before professional radio repair and radio service shops appeared in various cities in the United States to take care of this new demand. And the owners of these shops (in most cases) prospered.

We of Gernsback Publications recognized the radio service technician from the start and devoted many pages of every issue to his trade. One of the earliest issues of this publication (then called RADIO-CRAFT), the September, 1929, issue, editorially announced that henceforth the magazine was to be devoted to *The Professional, The Service Man, the Radiotrician.* Even before that, in the July, 1929, issue, there was a department entitled "*Serviceman's Data.*"

1930 service technicians' emblem designed by this magazine.

Then in the spring of 1930 your editor organized the first service association in this country, the *National Radio Service Men's Association.* A full-page account can be found on page 616 of the June, 1930, issue. A number of well known radio personalities were among its board of directors: Laurence M. Cockaday, David Grimes, John F. Rider and the writer. Prospective members had to fill special examination and application papers before they were issued membership cards and lapel buttons.

The timing of the association, unfortunately, was premature. It was started at the very beginning of the country's severest depression and, despite the outlay of a considerable sum of money and months of effort, did not succeed. So much for the early history of radio servicing in the United States.

This was 25 years ago—the antediluvial epoch of electronic servicing. That serene period when we knew no ac–dc receivers, no cathode-ray tubes, no FM, no signal tracers, no television, no radar, no printed circuits, no transistors—to name but a few newcomers.

But now the electronic flood has engulfed humanity—yet we are only at the merest beginning! On March 5 we celebrate the second birthday of *National TV Servicemen's Week.* It will be most interesting when the present younger service technicians can look back to 1956 on the 25th birthday of the *National TV Servicemen's Week* in 1980. Most of you will have prospered—and what fabulous coming electronic wonders you will have witnessed! How we oldsters envy you! —*H. G.*

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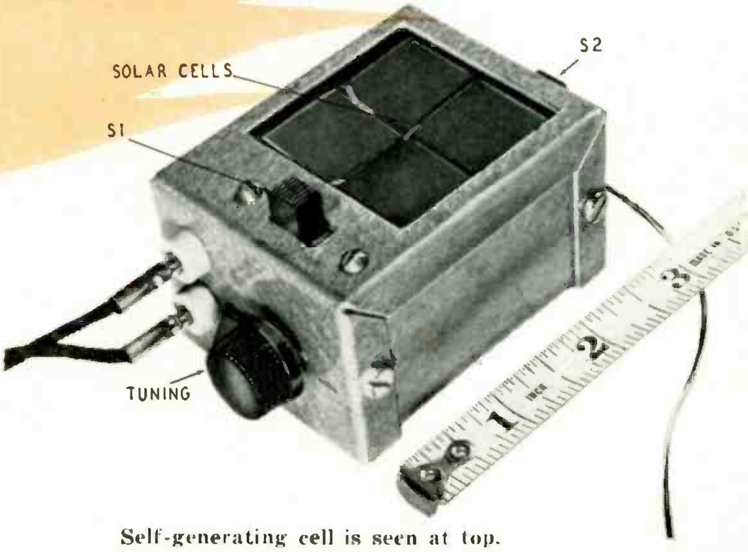
COVER FEATURE

build a SOLAR-powered RADIO

Futuratomic power supply feeds transistorized receiver

By EDWIN BOHR



Self-generating cell is seen at top.

JUST think of it! As long as the sun shines—even a very cloudy day will do—this radio operates from a solar power supply. When there is no sunlight, an auxiliary mercury cell can be switched into operation.

Anyone can build this solar-powered radio. The solar energy converter is a modified self-generating selenium photocell. Previously described solar radios and transmitters have been laboratory-built devices, very expensive and next to impossible for the hobbyist to reproduce. This solar radio, however, uses only standard components and can be built for around $15.

A high-gain transistor (Fig. 1) provides plenty of amplification; a Superex-Grayburne type EFL Loopstick gives souped-up sensitivity and selectivity. Actually the circuit is a crystal set followed by a stage of transistor amplification, but the sensitivity and selectivity are very much better than usually associated with this type of radio.

A fabulously high Q of 350 is the hallmark of the new "energized" loopstick. Detector loading of the tuned circuit can quickly degrade this figure. Nevertheless, by using loose coupling between coil and detector, we retain a single tuned circuit with exceptionally sharp selectivity.

One end of L1 connects directly to the antenna. The opposite end seems to float without any electrical connection to the remainder of the circuit. Coupling does exist though in the form of stray capacitance between L1, the loopstick core and L2.

A padder type variable capacitor with an attached knob is used for station tuning but does not have sufficient range to cover the lower end of the broadcast band. Thus, an extra capacitance is used to permit low-end tuning. (Diagram shows variable unit, but 200-$\mu\mu$f fixed capacitor may be used.) This capacitor parallels the tuned circuit through S1 and effectively splits the broadcast band in two.

L2 is a winding added to the loopstick. Nominally, this coil should be 12 turns wound at one end of L1 as shown in Fig. 2. Increasing the number of turns gives increased sensitivity or loudness, accompanied by some loss in selectivity, and, of course, decreasing the L2 turns gives better selectivity at the expense of signal volume. The size of the wire used to wind L2 is non-critical, but space the turns slightly apart.

The detector is a germanium diode. Any of the many available types are satisfactory. The surplus silicon "radar" crystals, however, are *not* suitable. Typical crystals that can be used are the Raytheon CK705, Sylvania or Radio Receptor 1N34 and the G-E 1N69.

Crystal-detector receivers operate the diode in the low millivolt region. In this low-level signal range no diode is a really good rectifier. Detection takes place because the diode is a nonlinear resistance element passing more cur-

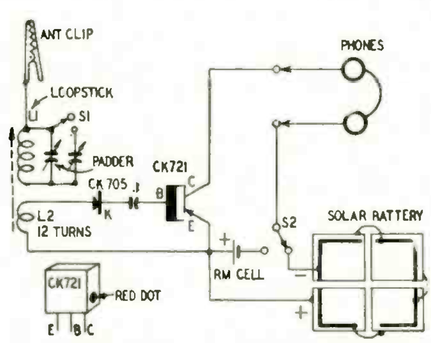


Fig. 1—Schematic of the receiver.

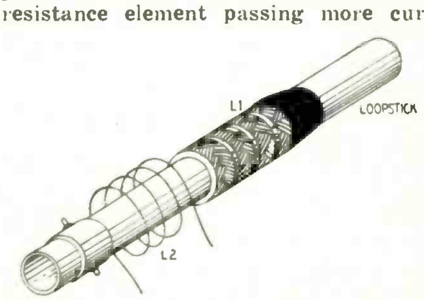


Fig. 2—Windings on the loopstick.

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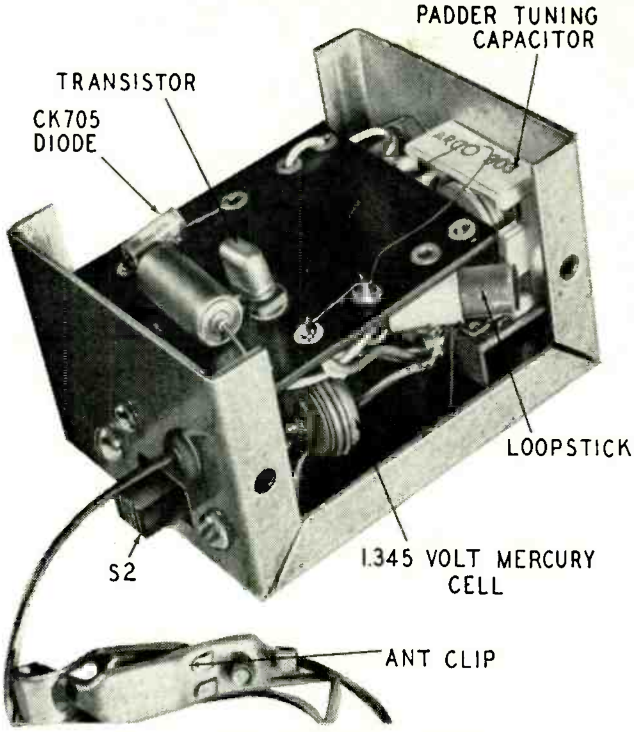

Internal view of solar-powered radio.

rent in one direction than the other. This is termed "square-law detection," the name being derived from the diode characteristics at low signal levels.

Crystal detectors, with no exceptions, operate on this principle. And despite indications to the contrary in some articles, they are not distortion-free. All produce some second-harmonic distortion.

Audio output from the detector is coupled to the transistor by a 0.1-μf capacitor. This can be one of the miniature 200- or 120-volt units commonly found in personal radios. Since the capacitor can discharge back through the nonlinear diode resistance, there is no need for a diode load resistor between the diode and capacitor—they are connected directly together.

The transistor should be a high-gain type, the CK721 for example. Using the CK722 results in a considerable lowering of performance. With a CK721

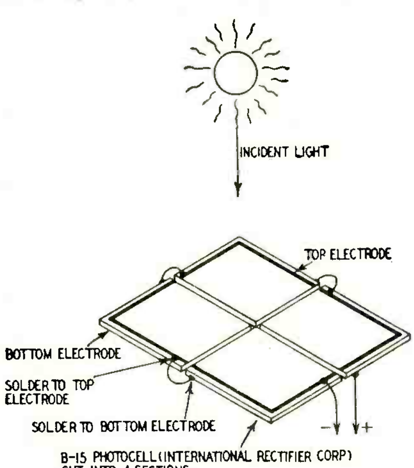

Fig. 3—Details of the solar cell.

and 2,000-ohm earphones, the power gain of the transistor stage should be at least 160. A hermetically sealed type of high-gain transistor was used in the original receiver and is visible in the photograph. Except for the metal case, it is almost identical to the CK721.

Solar power supply

A type B-15 self-generating photocell, manufactured by International Rectifier Corp., forms the basis for the solar power supply. This manufacturer also currently advertises a smaller cell, of the same type, called the "Sun Battery."

The B-15 cell is unmounted. A rectangular silver band around the perimeter of the cell is the negative or front electrode. The solid silver backing is the positive terminal.

For our purpose, the cell must be cut into four equal-area sections. A small hacksaw is suitable for the cutting operation. To avoid overheating the edges, cut slowly. If the cell is clamped in a vise, use cardboard buffers to avoid mutilation of the cell's surface.

Check each of the four photocells by connecting a milliammeter—0–1 ma will do—across its terminals. The four cells should all give approximately the same output. For checking, each cell can be held near a 100-watt light bulb. If any cell gives appreciably lower output, the edge formed by the cut may be partially shorted. This can be corrected by scraping the edge with a screwdriver or knife blade until the cell reads normal.

Pieces of small, flexible, stranded wire connect the cells in series. The wiring arrangement is given in Fig. 3. The wires should be tinned first and then *quickly* soldered to the appropriate silver band or back; otherwise, the silver may melt away from the solder connection. When the cells are soldered together, check them again by connecting a voltmeter across the two output wires. In sunlight, the meter reading should be in excess of 1.5 volts. After the final check, place the cells face down on a square piece of clear plastic and bind them to the plastic with cloth adhesive tape. The modified cell is then ready for installation in the receiver.

Construction and operation

The original receiver was mounted in a small aluminum case. However, I discovered the closed aluminum box reduced the Q of the loopstick. A nonmetallic case is recommended.

To attach a tuning knob to the padder, take a piece of ¼-inch shaft and drill a hole in its center very slightly smaller than the padder shaft. Then heat the ¼-inch shaft until the hole enlarges enough to be pushed onto the padder. When the shaft cools, it will be solidly mounted to the tuning capacitor.

The remaining mechanical details are simple and the parts may be placed wherever most convenient. An easy way to mount the mercury cells is simply to solder the metal extension tab (negative terminal) to the S2 terminal. To avoid damage, soldering to any part of the mercury cell must be done quickly and the cell should be checked afterward with a voltmeter.

For an operational check, clip the antenna lead to something metallic. A screen door, clothesline or short length of wire, say 15 feet long, should do. By tuning the receiver, stations should be heard with the power switch in the mercury cell position. Hold the receiver facing through an open window and flip the switch to the solar cell position. The station should come in just as loud as with the RM cell. Direct sunlight can have an intensity of 10,000 foot-candles; yet the radio operates satisfactorily with only 100 foot-candles.

Parts for solar-powered radio

1—200-$\mu\mu f$ mica capacitor; 1—0.1-μf 200-volt capacitor; 1—65–340-$\mu\mu f$ padder (Arco 303 or equivalent); 1—CK721 transistor (see text); 1—CK705 diode; 1—self-generating photocell (International Rectifier Corp. B-15); 1—Superex-Grayburne type EFL loopstick; 1—mercury cell (Mallory RM-625-RT or equivalent); 1—s.p.s.t. slide switch; 2—phone tip jacks; 1—5-pin hearing-aid tube socket; 1—piece of clear plastic; 1—nonmetallic case; 1—piece of ¼-inch shaft; 1—knob; 1—antenna wire and clip.

Most people are amazed by the volume and selectivity obtainable from such a simple circuit. Strong stations are loud enough to be heard with the phones pushed back from the ears. Selectivity is good enough to separate three stations located at 1550, 1450 and 1230 kc and it "takes some going" to do this with only one tuned circuit. Full credit for this achievement goes jointly to the super loopstick and the high-gain transistor. END

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TIME CONSTANTS . . . *What they do*

By H. P. MANLY

A BASEBALL may be defined as a leather-covered sphere 9 inches in circumference and weighing 5 ounces. A time constant is defined as the number of seconds in which a capacitor acquires 63.2% of maximum charge or loses this percentage of an initial charge. No one would know from the definitions what can be done with baseballs or time constants.

An easy way to get acquainted with time constants is to watch their effects with the setup of Fig. 1. Voltage from a square-wave generator is biased so that instead of going positive and negative, it changes suddenly between zero and positive. The blocking capacitor prevents current from the bias battery reaching the attenuator in the generator. The resistor in series with the battery prevents shorting the generator output.

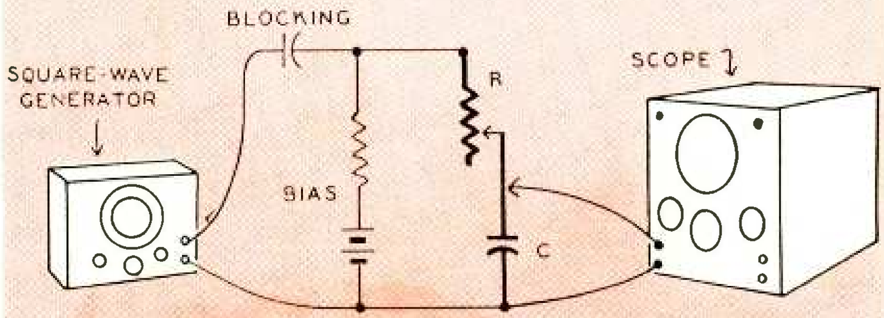

Fig. 1—Setup for time-constant study.

The suddenly shifting voltage is applied to variable resistor R and a .006-μf capacitor (C) in series. Voltage across the capacitor is observed with an oscilloscope. The capacitor will charge as the applied voltage goes positive and discharge when the voltage goes to zero. With the series resistor adjusted for a few hundred ohms the capacitor charges and discharges as in Fig. 2-a, with no great delay.

When series resistance is adjusted for 8,000 ohms, it slows both the charge and the discharge as in Fig. 2-b. With 20,000 ohms the charge and discharge are slowed still more, as in Fig. 2-c. In all cases the charge begins at a rapid rate but slows as the capacitor acquires voltage of its own. Capacitor voltage opposes applied voltage. Discharge begins at an equally rapid rate but slows as the capacitor loses its voltage.

In Figs. 2-b and 2-c the charge is nearly completed soon enough to remain so for some time before discharge begins. Similarly, discharge is nearly completed a while before the following charge begins. But when series resistance is increased to 80,000 ohms, we have the performance of Fig. 2-d. Charge is so slow as to be nowhere near complete before discharge begins and discharge still is continuing at a fairly good rate when the next charge commences.

The scope trace of Fig. 3-a shows what happens when capacitance is changed from .006 to .003 μf and series resistance is made 16,000 ohms. Charge and discharge appear the same as in Fig. 2-b where capacitance was .006 μf and resistance 8,000 ohms. This is strange—or is it? Try multiplying our present .003 (μf) by 16,000 (ohms). The product is 48. Try multiplying the original .006 (μf) by 8,000 (ohms). Again the product is 48.

To check whether these equal products may be the answer to why charges and discharges are alike, let's make another test. The trace of Fig. 3-b shows charge and discharge with a capacitance of .024 μf and a series resistance of 20,000 ohms. Action is practically the same as in Fig. 2-d where capacitance was .006 μf and resistance 80,000 ohms. If you multiply these two combinations of capacitance and resistance, the product is 480 in both cases.

It is true that times for charge and discharge depend not alone on capacitance, not alone on resistance, but on the product of capacitance and resistance. The biggest capacitance and smallest resistance will allow just the same charge and discharge times as the smallest capacitance and greatest resistance, if the products are equal.

Now look at Fig. 4-a. The period of time from the beginning of the charge until the capacitor has 63.2% of the voltage and 63.2% of the charge it would have after an extended charging is one time constant. It is also the time from the beginning of discharge until 63.2% of the charge is lost and 36.8% remains. Time constants **refer** only to these *percentages* of charge **and** discharge, not to full charge or discharge.

Time constants are easy to compute. All you need do is multiply the number of microfarads capacitance by the number of megohms resistance. The product is the time constant in seconds or in fractions of a second.

The scope traces of Figs. 3-a and 2-b are alike because the time constants are equal, both being .000048 second. Traces 3-b and 2-d are alike for the same reason—both time constants are .00048 second. Short time constants mean quicker charge and discharge, long ones mean slower charge and discharge rates.

Here is something rather strange—applied voltage has no effect on a time constant. If we double the applied voltage used for Fig. 4-a, the charge and discharge become as 4-b. Naturally, the charge is greater than before. But because capacitance and resistance have not changed, the *time* for reaching 63.2% of full charge and for losing 63.2% of the charge does not change.

If the applied voltage is reduced to

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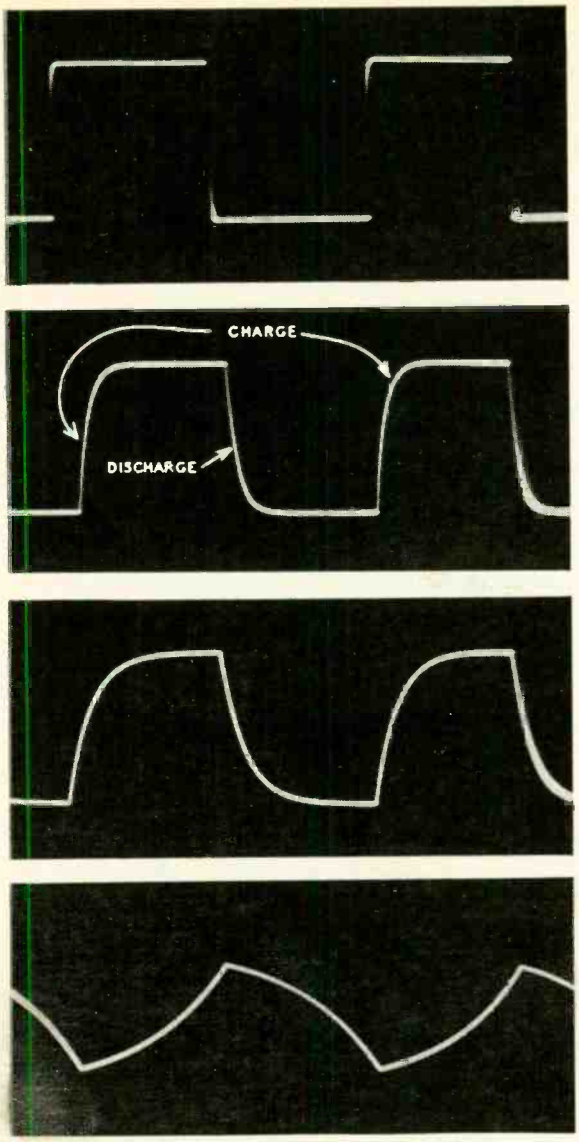

Fig. 2—Effect of varying R in Fig. 1.

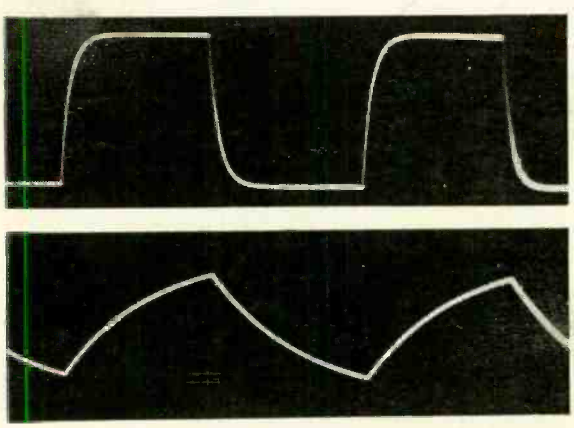

Fig. 3—Changing resistance-capacitance values gives waveforms as in Figs. 2-b, d.

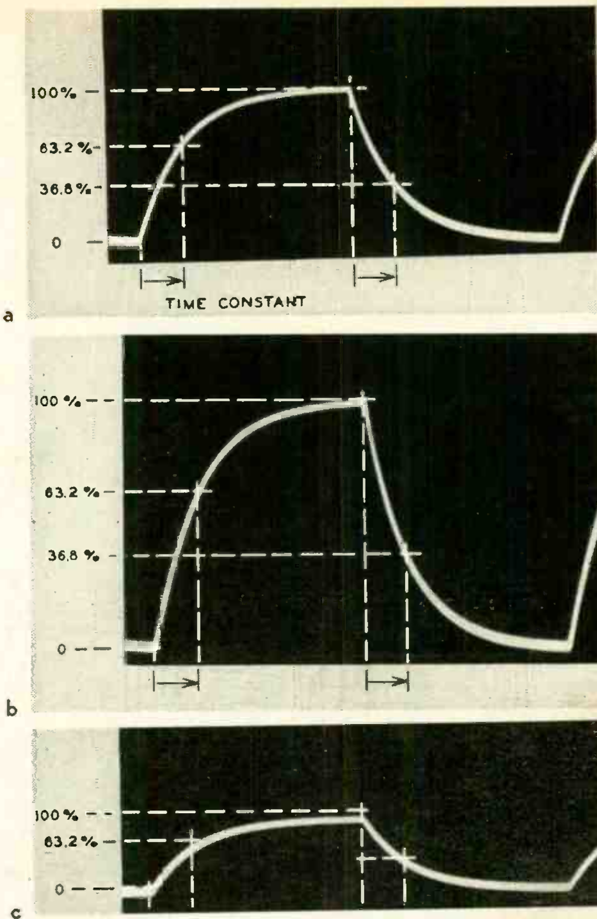

Fig. 4—Waveforms show that changes in voltage do not affect a time constant.

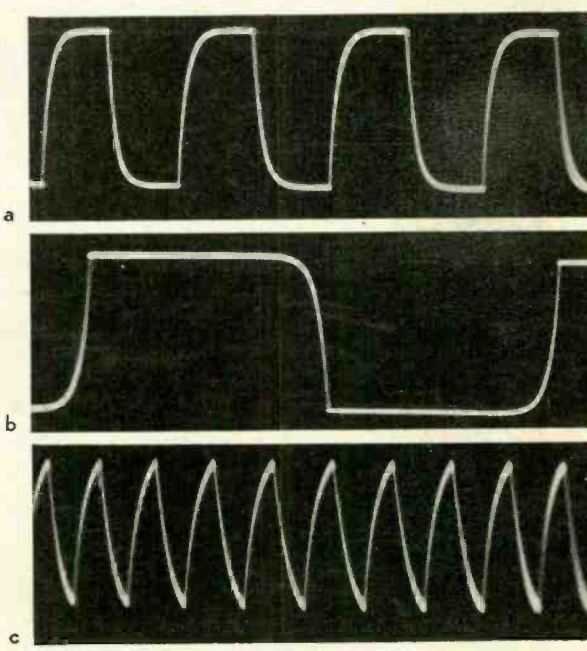

Fig. 5—Frequency effects on waveform.

half that used for Fig. 4-a, we have the charge and discharge of Fig. 4-c. Although full charge is now relatively small, the *time* for reaching 63.2% of full charge is the same as before because capacitance and resistance are the same as before.

Frequency has no effect on the time constant of any given capacitance and resistance. However, any change of either time constant or frequency with respect to the other may have great effect on circuit performance.

Frequency effects are illustrated in Fig. 5. In 5-a the frequency of the applied voltage is such that there is practically full charge and full discharge within about half the time period of each value of applied voltage. The capacitor remains charged or discharged during the remainder of each period.

If the frequency is lowered, we have the condition of 5-b. Portions of the

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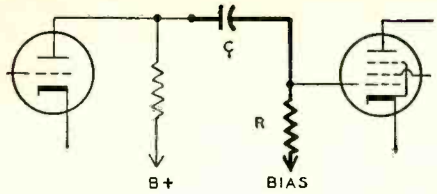

Fig. 6—A resistance-coupled amplifier.

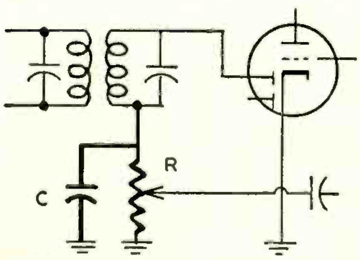

Fig. 7—Basic diode detector circuit.

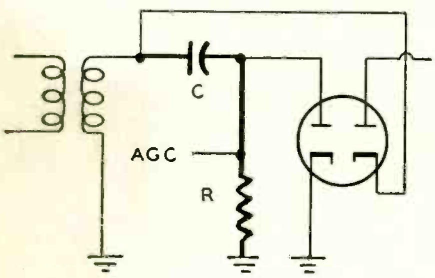

Fig. 8—Diode circuit for agc takeoff.

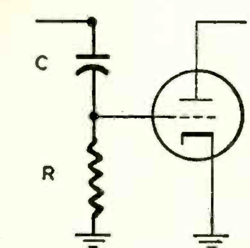

Fig. 9—Circuit for grid-leak biasing.

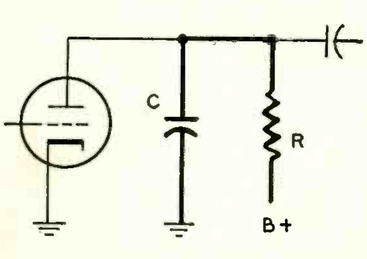

Fig. 10—A basic sawtooth generator.

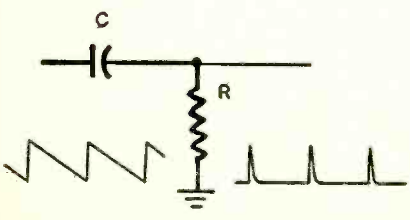

Fig. 11—Simple differentiator network.

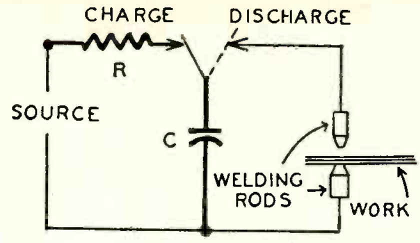

Fig. 12—An electronic spot welder.

trace showing the beginnings of charge and discharge have not changed in form but the capacitor remains charged or discharged for longer times during the longer periods of applied voltage.

If the frequency is raised, as in 5-c, the periods of applied voltage are shortened. The beginnings of charge and discharge have not changed because capacitance and resistance have not been changed. But periods of maximum and zero applied voltage are so short that there is not time for full charge before discharge begins nor for complete discharge before the next charge begins.

Selecting a time constant

Effects of time constants on circuit performance and some of the requirements to be satisfied in selecting time constants can be illustrated by a few examples. Consider first how stage gain is affected by the time constant of capacitor C and resistor R in the resistance coupling of Fig. 6. Although there is amplification in the tube, there is loss of attenuation in the coupling and stage gain depends on both factors.

Since the right-hand tube has fixed bias, grid resistor R probably must not exceed 100,000 ohms or 0.1 megohm. Were we to use .01-μf capacitance at C the resulting time constant would be .001 second. With this combination of capacitance the coupling loss would be about 5.5 db (nearly 50%) at 100 cycles. With .05 μf, for a longer time constant, the loss at 100 cycles becomes less than 1 db, or only about 10%.

What about low-frequency cutoff, usually defined as the frequency at which gain drops to 0.707 of maximum? The cutoff frequency may be found from dividing 0.16 by the time constant. Dividing 0.16 by .001 (our time constant) shows that cutoff occurs at 160 cycles. For any lower cutoff frequency we would need a longer time constant, which might be provided by a larger capacitance at C.

The time constant affects phase shift, especially at low frequencies. With .01-μf capacitance and 0.1-megohm resistance, for a time constant of .001 second in Fig. 6, the shift for signals at 100 cycles will be about 68°. Shift is lessened by a longer time constant. Changing to .05-μf capacitance for a time constant of .005 second would make the shift less than 18° at 100 cycles.

In the resistance coupling we have had to juggle capacitances to change the time constant because resistance is fixed by the manner in which the tube is biased. Were we to use cathode bias the resistance at R might be as great as 0.5 megohm. With five times the original resistance we could obtain the same time constants with only one-fifth as much capacitance as previously mentioned.

In the diode detector circuit of Fig. 7 the time constant is determined by capacitor C and load resistor R which here is a 500,000-ohm (0.5-megohm) volume control pot. If signal modulation as great as 80% is to be detected without distortion, the time constant should be no longer than found from dividing 0.2 by the highest audio frequency. Otherwise, the capacitor cannot discharge fast enough to follow the modulation.

If we assume 5,000 cycles as maximum audio frequency and divide 0.2 by 5,000, we find that .00004 μf or 40 $\mu\mu$f is the maximum capacitance. Usually the shunt capacitance is made somewhat greater to increase detection efficiency, but there will be some distortion on strong modulation at high audio frequencies.

In the agc setup of Fig. 8 the time constant must be long with respect to the time period of one cycle at the intermediate frequency, to maintain control voltage close to the amplitude of incoming signals. But capacitance C should be small to prevent taking too much signal energy from the if amplifier. To obtain a long time constant with small capacitance we need a large resistance at R.

For grid-leak biasing in Fig. 9 the time constant must be considerably longer than the period of one cycle at the lowest signal frequency. Furthermore, capacitance should be so large and its reactance so small at this signal frequency that excessive attenuation is avoided. Then the time constant must be based on signal frequency and large capacitance, using resistance to suit.

For the sawtooth sweep oscillator of Fig. 10 the time constant must be such that charging does not extend too far onto the bend of the curve. That is, we want a sawtooth waveform somewhat as in Fig. 5-c, not a flat top as in 5-b.

In the differentiating filter of Fig. 11 we need a short time constant. The capacitor must charge very quickly and discharge just as fast. Then, even though an applied voltage such as a sawtooth drops rather slowly, there will be only brief rises and falls or only pips of filtered voltage.

For electronic spot welding, an industrial application, each weld requires momentary current of several amperes, but we use a source furnishing only milliamperes. The long-time-constant circuit of Fig. 12 does it. A small current from the source, flowing for the entire period between welds, builds up a large charge in a big capacitance. Then all the stored electricity is discharged almost instantly to make a weld.

END

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SERVICE from the CUSTOMER'S VIEWPOINT

You can make him your most valuable booster, adviser and business consultant

By J. BRUNING

HOW can a service technician use the *customer's* viewpoint as an aid to making more money? Why is it smart business to look at each trouble through the eyes of the customer instead of the service technician? Suppose the customer does try to tell you what *he* thinks is wrong with his set. How can you turn his interference into a source of extra money? In short, what can the service technician do to insure that the customer is not only a source of income but also a valuable business adviser.

We will assume that the technician is neat, fairly competent as a technician, reasonably honest and has the customer's interest at heart. Let's start with a simple case from an old-timer's notebook:

"He didn't get the job." The time was in the days of radio sets with external loop antennas. The customer was a casual acquaintance of the youngster who was just starting to become an old-timer. Said the man, "I have a very fine radio that just stopped playing. What would it cost to fix it?" In his most professional manner the youngster replied that he would have to look it over and then make an analysis of the trouble and come up with an estimate. A few hours later the youngster was busily inspecting a real dog, and an ancient one at that.

A separate loudspeaker was connected to the set through a plug and jack system. Applying hand pressure against the plug brought in the program loud and clear; releasing the pressure caused silence. So our hero propped a book against the plug to keep the set playing while he continued his "analysis." Moving the volume control caused bangs, scratches and blasts from the loudspeaker. Touching the loop antenna in its swivel joint caused more noise. Rotating the tuning capacitor caused a still greater racket. Closer inspection of the loop showed that it had received a direct hit by a well aimed pillow thrown by one of the numerous progeny now standing around with big saucer eyes.

Our hero made a fast mental addition of all the damage, completed his "analysis" and came up with his estimate. "Mr. Jones, it will cost $25 to put your set in first-class condition." There followed a long silence while Mr. and Mrs. Jones looked at each other. Then the fatal words, "Thank you very much for looking at the set. We'll let you know."

A week later our hero watched a neighborhood technician of inferior ability enter the Jones' house and emerge triumphantly a half-hour later with a $5 bill clutched in his grimy hands. How could this happen? He couldn't have made all those repairs in a half-hour! And at such cut-throat prices! Something ought to be done about these chiselers! Curiosity got the better of bitterness and our hero forced himself to ask his competitor what had happened. "Aw, it was nuttin'. Just hadda tighten up the loose spring on the jack." And how about all those other things wrong with the set? "Aw, gee, they didn't need fixin'. The old guy was used to them noises."

Our young hero retired to nurse his wounds and think about this strange turn of events. An inferior technician had taken a job away from a far more capable mechanic, had received $5 for 30 minutes' work and had satisfied a customer all in one fell swoop. And the set still wasn't really fixed!

It didn't take too long for the lesson to sink in. Our hero had been so wrapped up in the technical phase of the job that he had not even bothered to consider the *customer's* viewpoint. And what was this viewpoint? Simply that the set had been playing and then all of a sudden the music stopped. All the customer wanted was to hear music coming from his loudspeaker once more. Very simple—and at the same time, a very profound lesson in business economics. *Find out what your customer wants and supply that want as cheaply as you can.*

"No magician explains his tricks." The time, a little later. The place, a different

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town. The problem, a set that developed a loud howl if anyone walked across the floor. This set had been worked on by just about every technician in town and the customer had spent some real money. Now he was desperate for help. So he took a chance and called the newcomer. Our hero went over that evening all decked out with a clean shirt, bow tie and neatly shined shoes. He could sense the quick air of approval as he entered the room. There followed a brief period of questioning to determine just *what* trouble was being experienced. It was learned that the set had been thoroughly inspected, inside and out, topside and below decks. It was evident that the trouble must be some form of poor connection in a place that was not ordinarily visible. It was probably not a poor soldered joint, plug and jack connection, nor loose tube socket. It *might* be in the grid leak circuit. Possibly the clip that held the grid leak in place. Being careful not to disturb any other part, our hero took a long stick and very lightly touched it to the clip holding the grid leak. Crash, bang! "Ah-ha," said our youngster to Mr. Smith, "just a dirty grid leak holder." It took but a few moments to remove the grid leak, scrape the corrosion from the mounting clip and replace the grid leak. Success! Absolutely no noise, even when shaking the set.

". . . a $5 bill clutched in a grimy hand."

"That is fine," said Smitty. "How much do I owe you?" Trying not to look *too* pleased, our hero replied, "Oh—that was very simple. Nothing at all difficult. Just a lucky guess." "But how much does it cost"? asked Smitty. "Oh," said friend hero, "I guess $5 will be about right." Instead of profuse thanks came a cry of rage. "What? . . . $5 for that simple repair? . . . Five bucks for scraping off one little piece of dirt? . . . What do you think I am, a fool? . . . Do you think I'm going to pay you $5 for 5 minutes' work? . . ." Our hero gratefully accepted the single dollar bill offered by the irate Mr. Smith and departed in great haste (leaving behind a screwdriver worth $1.39).

What had happened? Why was Mr. Smith willing to pay $25 or $30 to six other technicians who had *failed* to find what was wrong, but was furious at the boldness of the *lucky* service technician who had found the trouble and wanted $5 for his effort? Pretty soon, the answer started to form. "Lucky." That was it. Mr. Smith had thought that he was *lucky*. There had been no outward indication of skill, knowledge or display of troubleshooting technique. And where had Mr. Smith got his idea? Why from the technician himself! What a fool to have told the customer, "Oh—that was very simple. Nothing at all difficult. Just a *lucky guess!*"

So a new lesson was learned. Don't talk down the value of your work. The customer can't read your mind. He doesn't know that you spent hundreds of hours learning the little tricks that make your work easier. ***Don't explain how simple it is to recognize some symptom of trouble that enables you to put your finger on the defective part.*** Oh! So you already know that? *You* would never fall into that trap? I wonder. How many times has a TV technician carefully explained to his customer that "those horizontal lines or streaks across the picture tube mean that the horizontal oscillator tube is bad?" Customers are not *all* ignorant. If the streaks tell *you* that the horizontal oscillator tube is bad, they will also tell the customer the same thing the next time they appear. All he has to find out now is the location of the horizontal oscillator tube.

You don't have to mystify your customer but during your course of instruction be careful not to explain away the need for your future services!

"If the customer has a crystal ball, use it." The war is now over. TV is in circulation. Not the scanning disc, but real honest-to-goodness black-and-white TV

"No magician ever explains his tricks."

with a giant 5-inch screen. The flurry of fix-your-own-TV books has not yet hit the market. But customers—as always—are pretty sharp. Joe, "the man next door," has one of these super-dupers but unfortunately his picture is rolling badly at times. Joe once fixed a lawn mower so he figures he is a pretty good mechanic. Anyway, he greets our hero at the door with the remark, "I think the volume control is bad." Our hero tries not to show his scorn as he adjusts the vertical hold control, touches up the other controls and steps back to survey his work.

The picture is clear and steady. "Joe," he says, "the volume control has nothing to do with synchronizing troubles. See how good your set is now?" Joe has to admit that the rolling has stopped. He quietly pays $3.50 and says goodbye.

But he is not really convinced. And he has lost face because he had told his wife and 12-year-old boy that he *knew* the volume control was bad. Secretly he hopes that his dear wife will not yell at him as soon as the service technician leaves. $3.50 is a pretty steep price to pay for someone to come in and turn a knob!

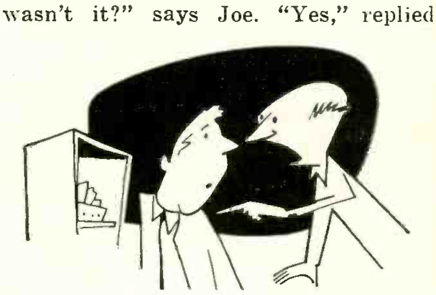
Next day it happens again. Pop comes down the stairs. What does he see? Yes, the picture is skipping. Each time Hoppy fires his gun the picture jumps two or three frames.

"How long has the picture been rolling?" yells Dad. "Oh, it's been doin' that all afternoon," says Junior. Joe turns down the volume control so he can hear what Junior is saying, and lo! the picture has stopped rolling. Now it's Joe's turn. "It *is* the volume control after all," he yells. "Wait till I get that ignorant repairman over here. I paid him $3.50 for nothing. Now he's *got* to fix it, and I'm not going to give him one cent this time. He owes it to me!"

In a few minutes our hero arrives. Joe turns up the volume control to a point where the mirror starts to jump off the wall. "Look!" yells Joe. Sure enough, the picture is rolling a mile a minute. Our hero quickly adjusts the hold control. The picture stops rolling. Then he turns down the volume control low enough to be heard as he starts to explain to Joe. Just then the picture starts to roll again. Our hero is stuck and he knows it.

One hour later the set is in the shop. Sure enough, the volume control *does* affect the vertical hold. He connects a v.t.v.m. across the plate supply and swings the volume control. Yes, the B voltage climbs when the volume is low and drops 30 volts when the volume is maximum. Hmmm. Poor regulation of the power supply. Can't handle the load to the audio amplifier. Out comes the selenium rectifier and in goes a new one. Yep. That does the trick. The B voltage now swings only 5 volts and there is no sign of rolling. Back goes the set to Joe.

"It *was* the volume control after all, wasn't it?" says Joe. "Yes," replied our hero in a quiet voice. "You were right all the time." Joe looks around the room in triumph. Now he feels a little better. His honor has been vindicated. Joe continues, "I've already paid you for your labor. What do I owe you for the new volume control?" "$3," says



"It was the volume control after all!"

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our hero, and he is glad to get the money.

After returning home our technician thinks about the problem. He has told a white lie to Joe. If he had told the truth, Joe would not have believed him. The new rectifier cost $2.65. Total time spent was 3 hours. Cash received, $6.50. Net profit for 3 hours' work, $3.85. That's good for a weekly salary of $51. Our hero just lost a good deal of his reputation and went through an embarrassing situation. You can be sure that Joe will see to it that all his friends and neighbors hear how Joe had to tell the dumb repairman what was wrong with his set!

Our hero reconstructs the chain of events. Why didn't he play along with Joe in the first place? If Joe wanted his volume control changed, why not do it? If he had taken the set to his shop yesterday, he would have stumbled across the relationship between the loud volume and the loss of sync. He could have phoned Joe and told him that after changing the volume control, he had discovered that the selenium rectifier was also defective. He could have charged for both the volume control and the rectifier, and he could have added a sure $5 for shop labor. Joe would have gladly paid. And Joe would have thought our hero was a pretty smart apple to have discovered that the selenium rectifier, buried way down inside the set, was also bad.

Those who have never had to repair a TV set may rise up and say this is an example of unethical practice . . . that it is crooked business to replace a part that is not in trouble. Is it? Do painters skip the good woodwork and only touch up the bad spots? If you hire a gardener to make a new lawn, why does he dig up the *good* grass too? And why do you change your tires after 40,000 miles?

There are times when you will wish to recommend the change of some part just on general principles. Is that ethical? Or is it a wise precaution? Do you know any good TV man who only changes *one* capacitor of a defective vertical integrator? Or still better, one who doesn't substitute a printed-circuit integrator when the old R-C network acts up? And in a set full of old tubes, if you have to replace the 6BG6, wouldn't it be foolish to leave in the old 1B3? So put your mind at ease. Strike a balance between your conscience, the life expectancy of the part in question and your customer's desires. Do the work suggested if it appears at all reasonable. Look at it the way the customer did. He wanted a certain thing accomplished. He is willing to pay for it. If you refuse to comply, you have inadvertently placed your own personal lifetime guarantee on that component.

"Good poker players always win." Our hero used to play poker with an old grandfather-twice-removed. The old codger was a clever player. During the evening he would win a little and lose a little. But sooner or later one player would hold aces, another a full house. The betting would be fast and furious. But grandpop would win, and I do mean win.

This might seem a little remote from the problem of a customer's viewpoint, but it isn't. How did Grandpop become such a consistent winner? He had run-of-the-mill hands like the others. On these he didn't do much better than anyone else. But when he had a good hand, *he made it pay off*. There is a sales approach hidden in this that can mean real money to you. All good service technicians know that on most jobs you do little better than break even. Your profit can't be too high consistently. Let's follow the trail of our hero as he misplays a good hand. What would you have done?

The set, an ultra-modern 24-inch TV; the customer, a new one; the problem, picture is dead. Our hero, now considerably older and wiser, gets the job. He neither wastes time nor hurries unduly. He preserves the right professional approach.

He smoothly and methodically tracks down the trouble and discovers there is no light from the neck of the picture tube. He fights down the impulse to show this important clue to the customer. He uncoils the leads from his ultra-modern v.t.v.m. Then he removes the picture-tube base socket and tests for heater voltage. It's there. Now for a continuity test of the heater. Ah-ha! Wide open!

Our hero, who in the intervening years has gradually become an old-timer who wears glasses, gets up from the floor. Everybody fears the worst, and here it comes. . . . "Your 24-inch picture tube is bad." Silence.

Someone has to break the spell. Our old-timer feels real bad about the situation. So he speaks. "Sometimes, when we have this kind of trouble, the tube itself isn't *really* bad. It may be the wire inside the base pin has come loose. Let me look it over again. Maybe there is something I can still do for you to *save you some money*."

So he retreats behind the massive console. Out comes the soldering iron. Maybe a little heat and some more solder will re-establish contact between the heater lead and the base pin. So he resolders the pins, connects the socket, plugs in the cheater cord and turns on the set. Several seconds later there is a momentary flash of light as the 6SN7 kicks off. Then, *success!* A big bright picture flashes across the screen.

So he puts the back of the set together and puts away his tools. He gets out his sales record book and he writes out the bill. Total time, 30 minutes. Total charge, $5 for repairs. Service call free. Parts used, none. Pop pays the bill gladly. Everybody is full of goodwill. Pop even holds open the front door while the old-timer struggles out with his three suitcases full of tubes, meters, analyzers, tools and sales book.

Who was the smart business man? Who held the best cards in *that* poker game? How much money was either in the pot or *could have been* put into the pot? The old-timer had held a royal flush. How much did it pay off? How much could he honestly and conscientiously have made it pay off?

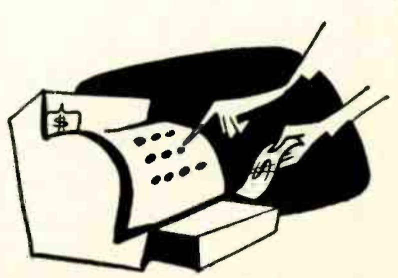
That customer stood to lose $60 or more. Only the knowledge, skill and experience of an old-timer stood between the customer and his expenditure of a large sum of money. What was this knowledge, skill and experience worth?

My answer is that the laborer is worthy of his hire. The customer was not buying 5 minutes of fast work with a soldering iron. He was buying years and years of experience that made it possible for the old-timer to use his soldering iron at the right time and at the right place. If his efforts were successful, he rightfully deserved a successful reward. From the customer's viewpoint, the service technician had been a life saver. There is no doubt that the customer was ready, willing and able to pay handsomely. Don't kid yourself that the job wasn't worth a handsome return. From the customer's point of view, a tragedy had been averted. Why didn't our old-timer look at it *from* the customer's point of view?

To sum up one basic thought will help you to income and prestige: *Always look at your jobs from the customer's point of view.*

If it is *knowledge*, give it to him—but be sure you charge for it. If he wants a *fast repair*, give it to him and be on your way. (If the sound is dead, put in a new 6AQ5 or 6V6 and get going. Don't spend all night touching up the horizontal drive and vertical linearity controls.) If he wants a thorough overhaul, arrange to do it but point out in advance that it will cost real money to restore real performance to an old set.

Don't worry about your competitors who are perfectionists. It's O.K. to add all the little fancy touches, provided the customer wants them and is *willing to pay for them.* The difference between a $50 and a $150 weekly income is not in seeing *how little* you can do for your money but rather *how much* you can do that you will be *paid for.* People always have been and always will be happy to pay good money for what *they* consider good service. Make sure that *your* estimate of what constitutes good service is based on your *customer's* point of view. END



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By HUGO GERNSBACK

A half-century ago, the first radio for the public's use and enjoyment was marketed. Differing vastly from today's radios in construction and function, it opened the field of radio for private interest and amusement rather than commercial communications use.

50 YEARS OF

THE year 1955 marked the 50th anniversary of the first home radio sold to the public anywhere in the world.

It was not radio as we know it today because in 1905 there was no commercial broadcasting. But wireless had been going strong for several years and amateur radio too had just begun. Marconi and other pioneers were transmitting intelligence by the dot-and-dash method; indeed wireless in those days was rapidly forging ahead.

The public at large knew little or nothing about wireless before 1905, except what they read in the papers and in magazines. As for owning a wireless *home set*, it had not as yet been born.

Previous to 1905, in 1903-04, the writer had been working on a small portable transmitter and receiving outfit which he felt could be sold to the public. It took several years to perfect it and make it foolproof so it would work under practically all conditions. It had to be low in cost so everyone could buy the outfit.

This ambition was realized some time in 1905. After making a number of models the writer began to market the first home or private radio set ever sold to the public.

As there were few wireless stations in the country, it became necessary to sell a transmitter, too, so amateurs could set up a transmitter and receiver at home. Then while one person was transmitting signals, the other could receive them. Or the transmitter could be set up in one room and the receiver would ring a bell in the other room without any intervening wires whatsoever.

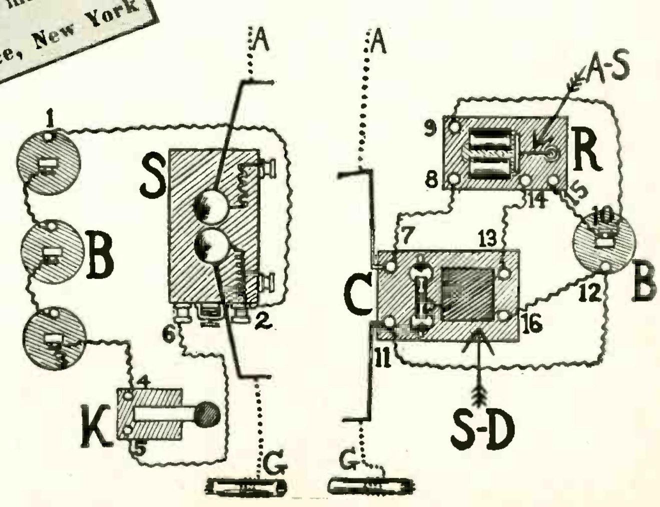
The outfit that accomplished all this was known as the TELIMCO Wireless Telegraph Outfit. TELIMCO is a contraction of the first letters of the writer's old pioneer firm, The Electro Importing Company (E. I. Co.), which became famous between 1904 and 1915 as the first radio mail-order house in the world. Only comparatively few sets were sold in 1905. But in 1906 the little outfit went into quantity production and was sold through many large outlets, including such famous stores as Macy's, Gimbel's and F. A. O. Schwarz, the country's largest toy establishment.

Incidentally, it was first advertised in the magazine *Scientific American* in the issue of Jan. 13, 1906. *This was the first home radio set advertisement to appear in print anywhere.*

The writer well remembers the incredulous looks of many of the store owners when they were first approached to buy "wireless sets." It was necessary to make a demonstration in each case before anyone would stock them.

The complete set, both receiver and transmitter, at first was marketed for $7.50. This was raised later on to $10, at which price most of them were sold.

The photograph shows an exact replica of the original outfit, built by the writer, to commemorate the 50th anniversary of the first home radio set. The transmitter, with the three dry cells and key, was composed of a 1-inch spark coil. The "1-inch" here means that the coil threw a 1-inch spark through free air, between wire points.



Above—Advertisement for the first radio set offered the public. It appeared in *Scientific American*, Jan. 13, 1906. Right—Picture diagram of layout, drawn by Hugo Gernsback in the 1900's: A, G, antenna, ground; S, spark coil; B, batteries; K, key; AS, relay adjusting spring; SD, coherer—Connections: 9, 8, to relay electromagnets; 7, 11, coherer; 13, 16, decoherer; 14, 15, relay contacts.

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Mounted on the spark coil, on two metal standards, were two brass oscillator balls between which a small blue spark jumped the ⅛-inch gap. The spark coil had a fast vibrator so that every time you depressed the key a spark would jump between the two balls. Depressing the key for a short period would give a dot, a longer period would give a dash.

The receiver was a 75-ohm "pony" relay which had to be so sensitive that if you blew your breath slightly against the armature its contacts would close. There was also a single dry cell and the all-important *coherer*. It was simply constructed of two large, double binding posts through the bottom holes of which passed two silver-plated brass rods. A glass tube, placed between the two binding posts, was slipped over the two brass rods. These silver-plated ⅛-inch metal rods fitted the glass so that there was extremely little or no play. The two rods were separated about 3/16 inch, forming a gap. This gap was filled with the "soul of the set"—the coherer filings, composed of 90% coarse iron and 10% coarse silver filings. By shaking the mixture well it was ready to be used. The filings had always to be loose, *never packed tight*.

The decoherer—an ordinary house bell—was mounted so that the clapper of the bell would strike against the glass tube of the coherer at the exact spot where the filings were. If the diagram is studied, it will be seen that every time the relay closes its contacts, the bell will ring through the single cell.

Now, if you depress the key at the transmitter, the two aerials (aerial and counterpoise) will emit radio waves. Curiously enough, the waves which the writer used 50 years ago were of the very short variety (above 30 megacycles) to which modern radio has come back. The two aerial wires of the transmitter measured less than 1½ feet.

Inasmuch as the coherer is directly in the receiver aerial circuit, the filings offer a very high resistance. But under the onslaught of the radio waves they instantly become an excellent conductor —as if they now were a solid conductor. The relay, in the same circuit, now goes into action, attracting the armature which closes its contacts. This sets off the decoherer bell which rings and shakes up the coherer filings. These now fly apart—*they decohere*—and the coherer becomes nonoperative until the next wavetrain comes along.

Thus every time you press the transmitter key, the bell at the receiver rings. It rings as long as you hold the key down. A long ring is a dash, a short one a dot.

You can pick up the receiver and walk to the next room, yet the bell sounds without any visible connection. Even through thick walls, signals still come in.

One of the things that bedeviled us in the early days was sparking at the relay contacts. This would set up electromagnetic waves and often the outfit gave no clear signals; sometimes the bell would ring for seconds *after* the signal. This was overcome by putting a 5-μf capacitor across the relay points.

The range of the TELIMCO Wireless Telegraph Outfit was between 300 to 500 feet when used without ground connections. By using an elevated aerial 50 to 100 feet in length and by grounding one side of both transmitter and receiver to a water or gas pipe, the range was easily increased to one mile. Indeed, hundreds of people who bought the outfit at the time reported excellent reception even over greater distances, but these, of course, were exceptions. Note that this set used *no tuning whatsoever*.

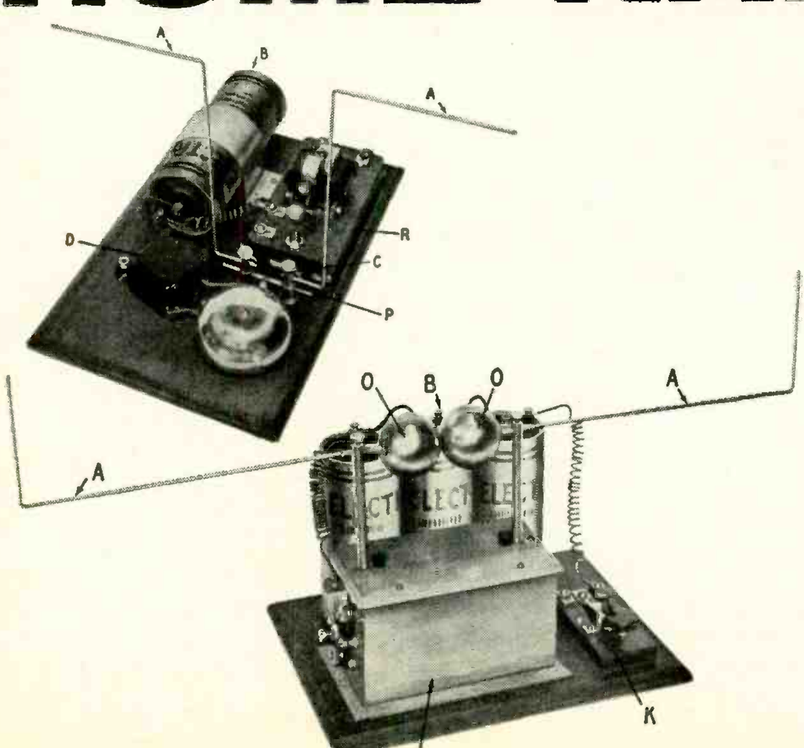
A curious thing about this little outfit today is its strange effect on radio people who never heard of the ancient spark coil and coherer sets. Young radiomen, who have never seen one of these outfits, are usually very much perturbed and astonished when the writer demonstrates it. The reason of course is that people have difficulty realizing that with a little three-dry-cell transmitter it is possible to ring a bell through intervening walls while the novice holding the receiver.

Radiomen today think of devices which operate relays as being relatively large and find it hard to believe that such a small portable transmitter and receiver could do the work.

It is conceivable that some time in the future these same instrumentalities may still find a use in modern radio and electronics which may not be apparent today.

The TELIMCO outfit here described has recently been acquired by the Henry Ford Museum of Dearborn, Mich. It was donated by the writer. It will be permanently exhibited in the radio section of the museum. END

HOME RADIO



Replicas of the original transmitter and receiver, soon being sent to the Ford Museum at Dearborn. Left—the receiver: A, antenna system; B, dry cell; C, coherer; D, decoherer; P, adjustable coherer rods; R, 75-ohm relay. Right—the transmitter: A, antenna and counterpoise; B, dry-cell power supply; C, 1-inch spark coil; O, spark-ball oscillators; K, transmitter key.

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Techniques and procedures for obtaining optimum picture tube performance

COLOR TV ADJUSTMENT PROBLEMS

By MATTHEW MANDL*

ADJUSTMENT problems of black-and-white receivers rarely taxed the technician's ingenuity. Many customers could be satisfied by touching up the linearity a little, adjusting for best focus, centering the picture and making a few other minor adjustments.

With a poorly adjusted color receiver, the viewer is annoyed when his black-and-white reception is marred by a picture tinted blue. He is also annoyed if his color reception is blurred severely or if he sees a scene in which the American flag has green stripes or the stars have an orange background.

Slightly poor linearity can be tolerated in a black-and-white scene. In color reception this distortion is accentuated—even though the degree of nonlinearity is the same. This is probably because color produces a more natural and lifelike scene, deviations from which are quickly noted.

Thus, the service technician must be familiar with the adjustments necessary for the color television receiver and the problems associated with each.

In addition to the controls in a black-and-white receiver (contrast, linearity, size, etc.), the following are usually found in color receivers:

ADJUSTMENT	FUNCTION
High-voltage	Adjusts voltage at cathode of high-voltage rectifier
Color purity	For obtaining a pure unvarying color field for red, blue, green
Convergence	Converges electron beams in picture tube
Color (chroma)	Adjusts density (saturation) of color
Field neutralization	Opposes effects of stray fields on picture tube
I and Q	Regulates gain of I (in-phase) and Q (quadrature) demodulators
Blue, red, green	Adjusts contrast and brilliancy of each color
Burst a.f.c.	Balances phase discriminator and synchronizes 3.58-mc oscillator with burst signal
Focus	Adjusts electrostatic focus in picture tube

Design improvements will eliminate one or two of these in some receivers but most will be with us for some time. Some manufacturers may add additional controls: for example, the RCA model CT-100 has a hue control in the burst amplifier input circuit and affects the hue quality (degree of red or green, etc.).

* Author of *Mandl's Television Servicing.*

Some of the newer receivers have eliminated most secondary controls with relatively minor functions and in their place substituted circuits having close-tolerance parts requiring only major controls.

Though the major controls have been preset at the factory, readjustments are necessary when the receiver is installed. This is particularly true of the purity coil and convergence where the color picture tube is packed separately. Even when the tube is installed at the shop and the receiver delivered to the home, some retouching will be necessary. And if any attempt is made by the viewer to readjust the rear-panel controls to correct color deficiencies, the result is usually a seriously misaligned color section. The viewer has a tendency to turn one control and if the results are not satisfactory he will then turn a second or third without placing the initially adjusted controls in their original positions. Eventually the circuit balance is upset and a complete readjustment by a competent technician is necessary.

Plenty of instructional material will be available to the technician installing a new set. It may not be so easy to get for the older receivers, since few were sold. The material to follow may help the technician called upon to service such receivers—as well as the newer ones—but in all cases it will be well worth while to make every effort to get the manufacturer's original service manuals and other data.

The potential applied to the second anode of the picture tube is critical and must be maintained within approximately 5% for satisfactory color reception. For this reason a voltage regulator tube such as the 6BD4 sharp-cutoff beam triode is used. In addition, a potentiometer is used so that the regulator circuit can be adjusted to produce the required high voltage. A typical shunt regulator circuit is shown in Fig. 1 and is used in the RCA CTC2

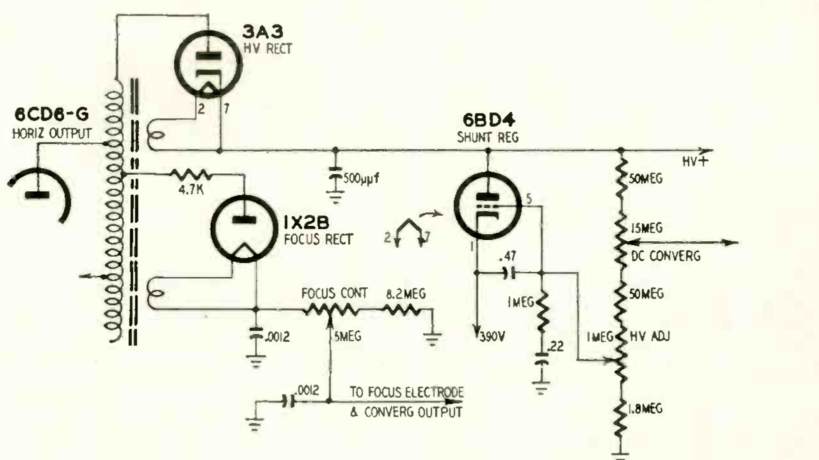

Fig. 1—Diagram of the high-voltage and focus adjustments in the RCA CTC2.

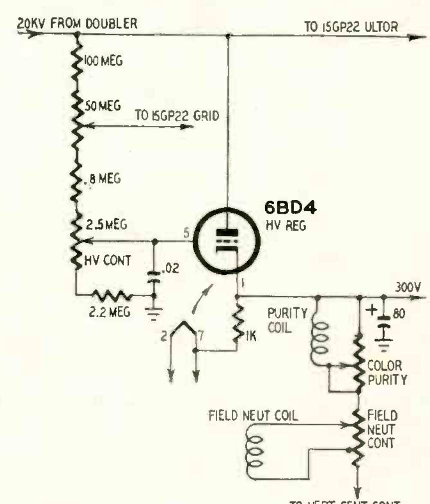

Fig. 2—Purity and field neutralizing controls in Westinghouse V-2284-15.

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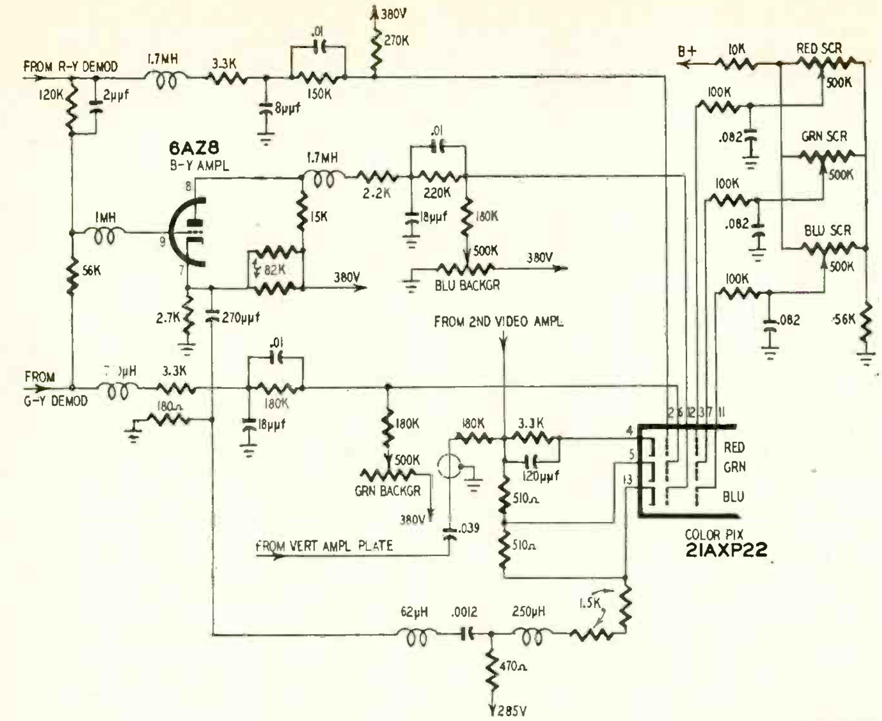

Fig. 3—Diagram of picture-tube element controls in the RCA chassis CTC4.

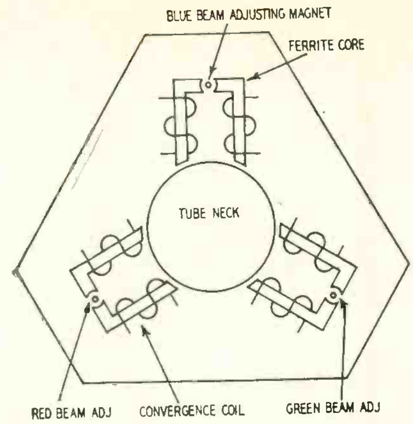

Fig. 4—A typical convergence yoke.

(CT-100) color television chassis. A bleeder network is placed from the high-voltage terminal to chassis and, since the voltage is approximately 20,000, the series resistors which make up the bleeder network have big ohmic values. The high-voltage adjustment regulates the potential applied to the grid of the shunt regulator tube, controlling the voltage at the plate.

Adjust the control while the voltage at the anode cap of the 6BD4 is read with a v.t.v.m. and a high-voltage probe. The service notes for the RCA chassis CTC2 recommend that the adjustment be made to produce a reading of 19.5 kv. A 20-kv adjustment is recommended for the Westinghouse chassis V-2284-15. The voltage should remain fairly constant for changes in brightness control setting. An additional check can be made on circuit performance by inserting a milliammeter in series with the cathode circuit of the 6BD4. For the circuit shown in Fig. 1, a current of at least 600 μa should flow for 19.5 kv at the anode of the shunt regulator.

Inability to obtain a 20,000-volt potential or a voltage that varies with changes in brightness control setting indicates the high-voltage and shunt-regulating circuit should be checked. Try a new high-voltage rectifier and shunt regulator. If tube replacement does not help, circuit parts should be tested for off values. The bleeder network in particular should be checked with an accurate ohmmeter. Before reading individual resistor values, an ohmmeter check can be made of the total resistance of the bleeder network. Since the R × 1-megohm scale of a v.t.v.m. reads to 1,000 megohms, the resistance of the bleeder will fall within its range. Allowing for a 10% tolerance, the bleeder network shown in Fig. 1 should read between approximately 106 to 130 megohms. Values substantially above or below this range would indicate that one or more resistors are defective and should be replaced. The 0.47-μf capacitor between grid and cathode should also be checked for leakage as well as the 0.22-μf unit in the grid circuit to ground.

Color tubes such as the 21-inch 21AXP22 require 25,000 volts from the high-voltage rectifier. Since the amplitude of the horizontal output waveform influences the amount of high voltage obtainable, adjust the horizontal drive below the overdrive point. In the service notes for the RCA 21CT55 receiver the initial procedures for high-voltage adjustment consist of turning the contrast and brightness controls to a minimum. Then, the 0.45-ampere fuse between the low-voltage power supply and the horizontal output system is removed. An 0–500-ma d.c. meter takes the place of the fuse. The horizontal drive and linearity controls are then adjusted for minimum current reading on the meter. The fuse is then replaced and the high-voltage potentiometer adjusted to provide a 25,000-volt reading at the corona cup of the second high-voltage rectifier tube.

Color purity

The color purity adjustments are for obtaining a uniform color over the entire picture tube screen. A purifying coil or magnet is placed on the picture-tube neck between the yoke and the socket. When a purity coil is used, it has a low potential applied to it and the current through the coil is regulated by a potentiometer.

A typical purity coil circuit is shown in Fig. 2 and represents the circuit used in the Westinghouse chassis V-2284-15. The field neutralizing coil also obtains its current from this circuit. Uniform color purity is determined by checking the screen for one primary color. Hence, purity coil adjustments are initially made by turning the contrast control down and adjusting the brightness control for an average-brightness raster with no station

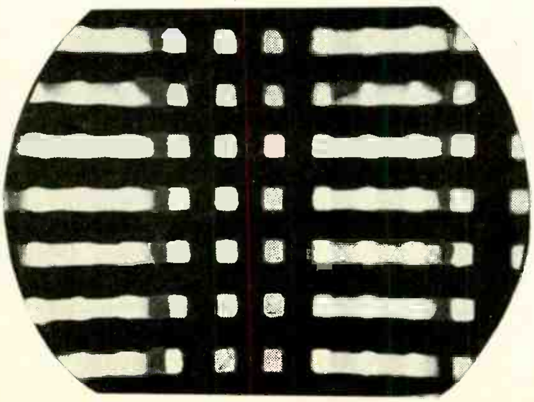

Fig. 5—Pattern of small squares.

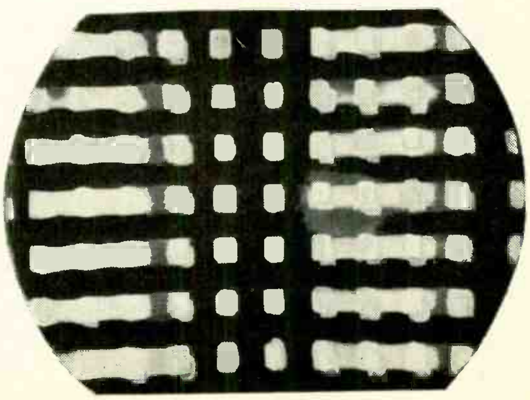

Fig. 6—Incorrect convergence pattern.

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tuned in. The blue and the green gain controls are reduced to produce a red raster. This can be done by increasing the red screen control and turning down the blue and green screen controls in the RCA CTC2 receiver. These controls form a resistive network feeding the control and screen grids of the picture tube.

A typical color circuit with picture-tube control-grid and screen-grid controls is shown in Fig. 3 and represents those of the 21-inch RCA CTC4 color television receiver. In the Westinghouse chassis V-2284-15 a red raster can be obtained by turning off the blue and green cathode switches on the rear apron of the chassis.

The field neutralizing potentiometer is usually adjusted for center range during the purity coil correction. This is best made if only a small central area appears on the raster—produced by moving the deflection yoke away from the flare of the picture tube. The yoke holding screws must be loosened and the yoke slid toward the rear of the tube from 1 to 3 inches. The purity coil is then rotated and the control adjusted for the most uniform red at the center area of the screen.

The yoke is then moved forward again until a raster, uniformly red for the entire screen, is produced. The field neutralizing control is then adjusted to correct for edge impurity. If the purity coil adjustment disturbs proper centering, readjust picture positioning by adjusting the centering controls. The green and blue purity can also be checked by turning up each control individually and turning down the others. Usually a correctly adjusted red screen will also produce good purity in the blue and green screens. If not, the purity adjustment would have to be made for best *average* purity for all three primary colors.

Difficulty in making proper adjustments to either the purity coil or the field neutralizing coil may be caused by poor regulation of the voltage applied to the network. When this is the case, the low-voltage rectifier tube and filter capacitors should be checked. The purity and field neutralizing controls should also be checked for smooth operation since an intermittent control can cause considerable difficulty in making adjustments.

The function of the purifying coil is to align the axes of the three beams in a three-gun color picture tube so that the beams have an axis common with that of the picture tube. This aims the beams at the proper angle so they can enter each hole of the aperture mask and impinge on their respective color dots on the screen surface. The field neutralizing coil creates a magnetic field for neutralizing stray magnetic fields which may disturb the beam alignment and pull it away from its true axis. Adjustment of the control varies the field produced by the neutralizing coil, eliminating the effects of the stray fields by the counter field force developed.

Instead of a purity coil, some of the 21-inch receivers use a purity magnet-ring assembly. This usually consists of two permanent magnet rings. Adjustment procedures follow those of the purity coil except that one or both of the magnet rings of the purifying magnet are rotated until the uniform red raster is obtained.

Some of the newer receivers also use permanent (equalizing) magnets mounted on a metal band for field neutralization. The metal band with about six permanent magnets is mounted around the face end of the picture-tube rim. The individual magnets can be rotated or moved closer or farther from the picture tube rim for field neutralization. Stray magnetic fields near the tube rim or face will upset beam registration and produce false coloring near the edges of the picture tube.

Convergence

The three beams in the color picture tube must cross over at the hole of the aperture mask through which they enter before striking the color phosphor dots. In some receivers this *crossover* or *convergence* point is established at the center of the picture-tube face by adjusting the d.c. convergence control. The latter is also located in the high-voltage bleeder network (Fig. 1). Three beam-positioning magnets are on the purifying coil assembly and each of these is adjusted to compensate for any misalignment of the electron guns during the tube assembly.

A convergence yoke (Fig. 4) is used with the larger-screen color tubes which do not have a convergence electrode. The convergence yoke assemblies contain three U-shaped ferrite cores with adjustable cylindrical magnet inserts for individual adjustments of the three beams. The ferrite cores provide high efficiency for the convergence coils of the assembly. For d.c. (static) convergence adjustment, the knurled knob of each convergence coil magnet is rotated for center-screen convergence.

Dynamic convergence adjustments are also included because the beam length increases as the edges of the screen are scanned. Since correction of non-uniform convergence must be made at the exact time the electron beams are at a certain portion of the screen edge, dynamic convergence is regulated by the vertical and horizontal sweep circuits. Thus, the d.c. voltage on the convergence electrode of the picture tube is modulated by a parabolic waveform which increases the convergence voltage to coincide with the increase in the deflection angle which occurs when the edges of the screen are scanned.

For proper convergence adjustment a signal generator must be used which produces either a dot pattern on the screen or a pattern consisting of small squares (Fig. 5). Incorrect convergence is indicated when the dot pattern is displaced (Fig. 6). Proper convergence demands careful adjustments and readjustments of the horizontal and vertical convergence controls as well as the d.c. convergence control and the beam positioning magnets. If the receiver is considerably misadjusted, the service notes for the receiver in question should be consulted and the step-by-step convergence procedures followed. Convergence adjustments may also affect purity and readjustment of the purity control is usually necessary.

If convergence is only slightly off, the dot generator may not be necessary and correction can be made by adjusting the d.c. convergence control. It is only when convergence is correct that a good black-and-white picture can be received. Improper convergence will not only alter true color reception but will also produce a colored screen during reception of black-and-white pictures. Usually, if a good black-and-white picture can be obtained without color interference, color-signal adjustments will be simplified. Thus, it is

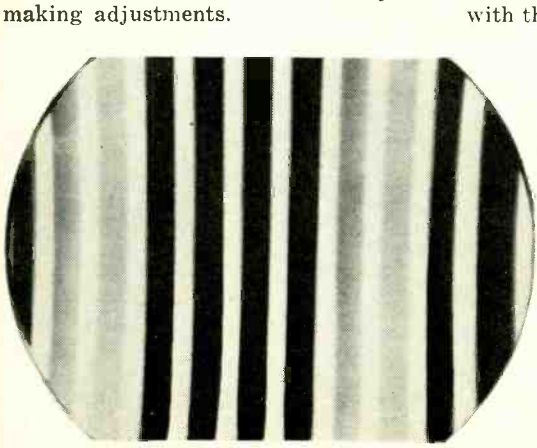

Fig. 7 — Typical color bar pattern.

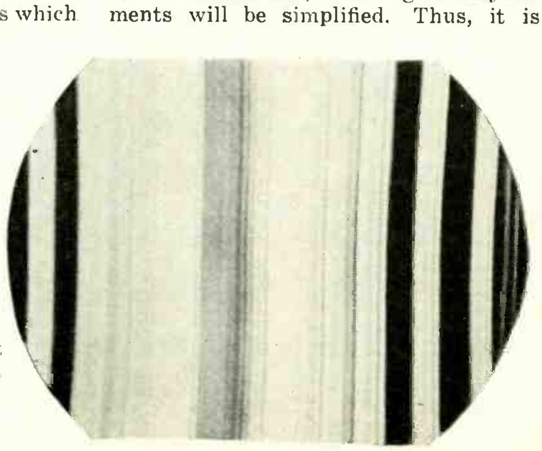

Fig. 8—Incorrect color bar pattern.

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advisable to make sure that the receiver can receive a good black-and-white picture before making extensive adjustments for color.

I and Q adjustments

A 90° phase difference must be maintained between the Q (quadrature) demodulator and the I (in-phase) demodulator for obtaining proper colors. These circuits can be checked by using a color bar generator. This instrument is also useful for adjusting the I and Q gain controls and for proper adjustment of the various color gain controls and the matrix section of the receiver. The color bar generator produces a series of vertical bars equally spaced (Fig. 7) and varying from red bars at the left through blue at the center and green at the right. Lack of any primary color will indicate which stage is at fault or which controls require adjustment.

The conventional color bar generator produces about 10 bars and the colors, from left to right, are as follows for a correctly adjusted receiver: dark yellow-orange, orange, vivid red, blue-red, magenta, blue, green-blue, cyan, bright blue-green, dark green.

Linearity checks

The vertical color bars can also be used for checking linearity, though if the receiver is not adjusted for proper color rendition the absence of one or two primary colors may result in pastel shading of the bars. The individual bars will then blend into each other (Fig. 8) and linearity checking would be difficult.

Linearity is best checked by a linearity pattern generator though the dot generator can be used. Some generators also produce vertical or horizontal bars or both in cross-hatch form (Fig. 9).

When the linearity controls are improperly adjusted, the resultant poor linearity means that the sawtooth sweep waveforms do not have a linear rise time. This distortion of the sawtooth waveshape may affect convergence. The same holds true for improper adjustment of a drive control in the horizontal sweep stages. A misadjusted drive control also contributes to poor linearity by causing left-hand stretch and center compression, and this will also have some effect on dynamic convergence. Thus, it is important that the linearity be adjusted and rechecked whenever convergence troubles are in evidence.

Other adjustments

The chroma or color control is a front-panel adjustment which regulates the strength or saturation of the televised scene. If the chroma control is turned to a minimum (counter-clockwise), a black-and-white picture should result.

The same holds true for the a.f.c. subcarrier oscillator adjustments. The phase discriminator circuit should be adjusted for good stability. The same also holds true for the other controls present in both black-and-white and color receivers. The horizontal a.f.c. system should be adjusted so that the viewer rarely needs to correct for sync loss by adjustment of the horizontal hold control. The vertical system should also be sufficiently stable and the a.g.c. circuits adjusted for proper contrast level for the strongest station to be received in the area, unless compromise adjustment to receive also a much weaker station should be desirable.

With properly adjusted purity and convergence, the black-and-white picture should show no color fringing within a broad range of adjustment of both the contrast and brilliancy controls.

The advent of the larger-screen color picture tubes will simplify some of the control adjustments. The CBS Colortron 19VP22, for instance, makes for easier circuit adjustments because of a photographic printing process for applying the tricolor screen directly on the inside of the curved tube face. It uses electromagnetic convergence which reduces to some degree the high-potential problems in electrostatic convergence. Improvements also minimize pincushioning effects. Special three-gun construction tilts each beam toward a common axis for improved convergence. An anode potential of 25,000 volts is required and, as with the circuits previously discussed, a shunt regulator tube must be used since regulation should be kept within 2% for best performance.

Color introduces a number of new problems. Appearing in an early issue, "Tunable Traps in Color TV Receivers," will help clear some of them up. END

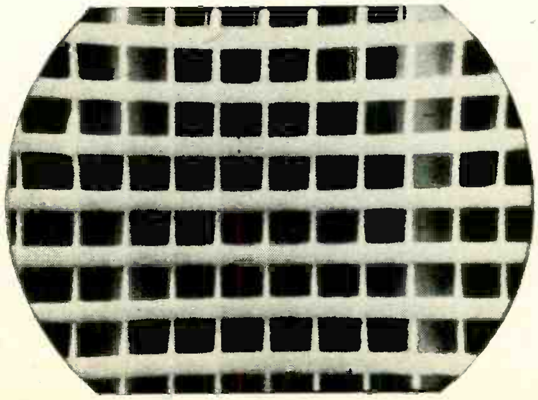

Fig. 9—Typical cross-hatch pattern.

DEFECTIVE SOCKET

RECENTLY I was called to repair a television set which was "burning up." Turning the set on revealed a burned-out low-voltage rectifier, a 5U4. Within a few seconds I could feel the line cord getting hotter and hotter, indicating that the power transformer might have a few shorted turns. A check at the shop showed a shorted B plus filter and a defective power transformer.

Since this is a trouble which happens occasionally, I repaired the set and returned it. Noticing that the power to the home was supplied from a motor-generator set, I inquired about its condition. The customer reported that they did have some trouble with it about a week before the set broke down, but it had been repaired immediately. Satisfied that this could not be a source of trouble, I collected for the repair and returned to the shop.

Before a week had passed I received a call from this customer—the set was again burning up. A little puzzled, I went down to check this set again. Sure enough, the new filter was shorted but the power transformer had not heated seriously. I asked again about the generator. The lady of the house reported that there were no burned-out light bulbs and that all appliances worked fine. However, I decided to check the voltage at the outlet. I suspected that it might be high but I didn't expect a voltage reading of 145. A check showed that the regulator had been thrown out of adjustment during the overhaul and not properly reset.

The customer immediately ordered a voltmeter attached to his equipment so that this would never happen again.
—Paul F. Crowell

LOW VOLUME

Some time ago I was handling the overload work of a one-man service shop. The owner had worked on this particular set—a small a.c.–d.c. job—and then given it to me. It was very weak. He suspected the speaker field and had substituted a PM speaker. I checked the speaker installation and got to thinking about what might be causing the weakness. I checked the field coil of the old speaker—it was O.K. I had assumed that a resistor was wired in place of the field, but I could not find it. I became confused. There was only one answer but I did not figure it out for several hours. It finally dawned upon me to check the filter capacitor. Sure enough, the two sections were shorted internally but still had enough capacitance to filter the hum fairly well.
—Frank H. Reiser

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VERTICAL

SYNCHRONIZATION PROBLEMS

Analyzing and troubleshooting common causes of poor vertical hold

By CARL J. QUIRK*

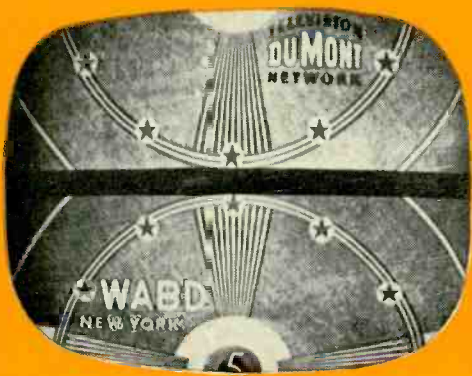

Fig. 1—Appearance of blanking signal.

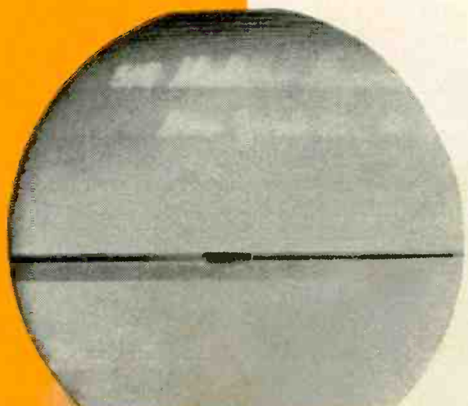

Fig. 2—Sync and equalizing pulses.

INSTABILITY or the complete loss of vertical sync is not necessarily due to a defect in the vertical sync or oscillator circuits. In fact, the more difficult problems usually arise as the result of trouble in some other circuit. An excellent method of reducing troubleshooting time when servicing vertical sync defects is to observe the sync signal on the face of the picture tube.

With the set turned on and tuned to a station, misadjust the vertical hold control until the picture rolls slowly downward. If the receiver has been properly adjusted for brightness and contrast, the effect shown in Fig. 1 will be seen.

The horizontal black bar is the vertical blanking pulse which occurs between successive scanning fields. This is a normal condition, the bar being blacker than any of the "blacks" in the picture. Most TV stations set the black level so that the difference between this blanking signal and the peak blacks in the picture is about 15% when referred to the entire sync amplitude. In many cases, however, this difference in blackness as observed on the face of the picture tube may not be noticeable. The important part is that the bar is *black*.

Next, decrease the contrast and increase the brightness and you will get the effect seen in Fig. 2. Note the black area in the upper section of the bar. It represents the vertical sync pulses and the equalizing pulses. The degree of blackness seen here indicates that the amplitude of the ver-

*Allen B. Du Mont Labs.

Fig. 3—Frequency is below 60 cycles.

Fig. 4—Vertical frequency at 30 cycles.

Fig. 5—Vertical oscillator at about 120 cycles.

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tical pulses is adequate. Since the sync signals are referred to as "blacker than black," it becomes obvious that, if the amplitude of these sync signals is normal, they should be blacker than the blanking pulse.

Since the sync signals must pass through all the picture circuits, it is possible that these circuits might discriminate against these signals in one way or another, causing faulty sync. However, this check (observing the sync signal on the screen) provides a quick and easy way of establishing whether the sync signal, as fed to the sync circuits, is adequate. It might be a little difficult at first thought to consider a pulse amplitude in terms of blackness on the face of the tube. However, a little experience in observing this signal under various conditions of trouble will provide a very valuable troubleshooting tool.

Get "feel" of vertical hold

Another important check point for running down a bad case of vertical sync trouble is the vertical hold control. Get the "feel" of the hold control! This might seem like a rather large order since the technician is called upon to service many makes and models. However, a few basic principles concerning the vertical hold control should be kept in mind.

For example, a receiver with a large-amplitude sync pulse available will also have a wide range of adjustment over which the set will remain in sync. Furthermore, a set with a high-amplitude sync pulse will "snap" into sync as the vertical hold control is adjusted. Sets with a lower-amplitude sync signal have a much narrower range of the control over which the set will remain in sync and will normally not "snap" into sync. In either case the set in question may be perfectly normal, and this is one thing that the service technician will have to get experience with. A good method of gaining it is for the technicians to check the "feel" of the hold control on every set he services even though the trouble is not a vertical condition.

Several years ago I discussed vertical hold difficulty with a technician who had been having trouble with sync noise immunity. His problem concerned a sync circuit that was stable enough of itself, but when a burst of noise appeared the vertical sync would be lost. To overcome this he used a large capacitor (0.1 μf) across the output of the integrator circuit. This in effect bypassed to ground the noise pulses which were giving trouble. It also substantially reduced the amplitude of the sync signal. With this modification, the range of the hold control had become extremely small, almost to the point of being critical. Once set, it would remain very steady. According to him, this was a complete cure. However, the hold control was located on the back of the set, which would have made customer adjustment difficult.

In addition to the sync pulses on the screen and the feel of the vertical hold control, the service technician will find another observation helpful under certain conditions of vertical sync trouble.

As the vertical hold control is rotated in one direction, the picture will roll downward. When it is rotated in the other direction, the picture looks like Fig. 3 — several pictures appear to be partially superimposed. If the vertical hold control has sufficient range, it is possible to get two separate pictures (Fig. 4). In such case, the vertical frequency is running at 30 cycles. As the picture rolls downward, the vertical frequency is above 60 cycles. Again, if the control has adequate range, it is possible to run the frequency of the vertical oscillator up to 120 cycles. Fig. 5 shows the effect that would be seen under this condition.

Summing up this information we can conclude that, if the picture rolls downward, the vertical frequency is above 60 cycles; if the picture shows the effect in Fig. 3 or Fig. 4, the frequency is below 60 cycles.

Now that we are familiar with several checkpoints and a few simple tests, let's go about our business of cleaning up some of the vertical problems apt to present trouble.

Vertical sync due to ghosting

A customer complained that on one channel the picture rolled badly. The service technician verified this complaint — the remaining channels were rock solid. He concluded that the tubes in the receiver were all O.K. His next thought was to establish whether there was any particular reason why this one channel should have poor sync.

To do this he looked at the sync information on the face of the picture tube. The picture on this channel was not as good as that on the other channels. He noticed a ghost of negative polarity (that is, white objects appeared as black in the ghost region and vice versa). He did not concern himself with this detail too much and he then misadjusted the vertical hold control to get a good look at the sync. At first look, the blanking signal seemed normal. But when he adjusted the brightness and contrast controls to get a better look at the sync, instead of seeing the clean-cut black display that represents sync and equalizing information, he saw the ghost of the sync signal cancelling the sync information, since the reflection was negative. So here was the trouble — the ghost was so located that it not only affected the picture but, since it was negative, it cancelled the sync. Thus the difficulty with the one "rolling channel." The trouble was eliminated when the technician modified the antenna position so that this ghost effect was removed.

Loss due to compression

This condition will appear similar to that caused by ghosting. The customer may complain that only one channel rolls. In this case, however, it is much more likely that two or more channels are rolling. Make the necessary adjustments to the set for a look at what the vertical pulse looks like in black-and-white as it were. Fig. 6 shows the vertical sync signal seriously compressed.

In this case, the channel that was affected had just increased its power, thereby resulting in sync compression in the front end of the receiver. A printed-circuit attenuator was used to attenuate the signal relieving this condition. In some cases, it is possible to correct this trouble by adjusting the a.g.c. control, provided of course that the receiver has such a control. It is also possible that sync compression can take place somewhere in the i.f.'s, the video amplifier or even in the sync circuits. This should not be too difficult to determine: during overload, when the sync pulse is compressed and vertical synchronization is lost, other effects are seen. For example, one of the first effects of overload is audio buzz, and the picture may be lacking in its range of shading. If the compression is taking place somewhere in the set, it should not be too difficult to analyze with an oscilloscope.

A crystal probe is necessary when exploring the i.f.'s for possible compression. After the video detector, of course, the scope may be used direct. The usual procedure is to examine the sync waveform at the input and output of each circuit involved. Fig. 7 shows what should be seen when everything is operating normally. Improper voltages, especially in the grid circuit, will produce sync compression.

Various degrees of compression can cause trouble. In one case the trouble appeared as an intermittent vertical and was due to an open screen bypass capacitor at the video amplifier tube. The capacitor was a 10-μf unit. The scope revealed the vertical serrated pulse to be greatly depressed. Incidentally, most popular-priced scopes discriminate against the horizontal sync signal because of inadequate frequency response, with the result that when everything is normal the waveform of the sync signal as viewed in the video circuits appears as shown in Fig. 7. Note that the vertical pulse interval is apparently of higher amplitude than the horizontal. If an oscilloscope having an extended response were used, both would be of equal amplitude. Therefore, if with a lower-response scope both amplitudes are the same, the vertical region is probably being compressed. Whether sync is being affected enough to make a difference in performance will depend upon the set in question.

Improper sync due to hum

This trouble could have been a dilly had not the technician been curious about every little thing he saw in a picture. Let's see how it paid off.

The customer phoned the technician and said that his set would be O.K. for

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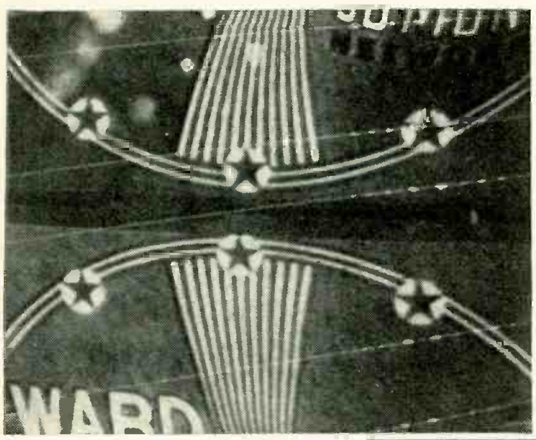
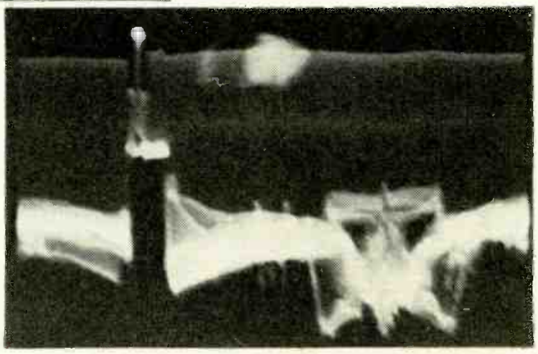


Fig. 6 (Left)—A compressed vertical pulse. Fig. 7—(Below) Normal appearance of waveform.



a while, then the picture would roll a few times, stop, be O.K. for a while longer and repeat the cycle.

The technician examined the sync as it appeared on the face of the picture tube and found it to be normal. He then checked the "feel" of the hold control — also normal. While examining what was happening as the set went out of sync, he noticed a slight ripple in the picture. Since this ripple resembled a sine wave if the picture were turned on its side, he concluded that a 60-cycle signal was getting into the sync circuits. He further noticed, however, that as the positive half-cycle of this ripple got to the bottom of the picture — the region of the vertical sync — the picture would take its several rolls and then recover again. By the time that the next positive half-cycle got to the bottom of the picture the effect would be repeated. The technician concluded that this 60-cycle ripple was causing the trouble. He also knew that the most common way a 60-cycle sine-wave signal gets into a set is through heater-cathode leakage in a tube. By substitution, it was found that the trouble was just that — heater-cathode leakage in the second i.f. tube.

Tubes that have a cathode resistance to ground will produce this trouble. Obviously, if the cathode is grounded, heater-cathode leakage will not have this effect. If the set is in the shop, the stage can quickly be identified by shorting the cathode of each of the possible tubes to ground. When the hum disappears as the short is made, you have located the culprit. This condition happens fairly often, so watch for the symptoms. And if you haven't run into it, you no doubt will sooner or later.

Vertical drift

Here is trouble that turns a technician's hair gray. What usually happens is this: The customer is sitting back in his easy chair enjoying his favorite program when slowly the picture starts to roll downward. He fidgets in his chair, waiting for the picture to settle down, but it doesn't. Reluctantly, he hoists himself out of his favorite spot and lumbers over to the set to adjust the vertical hold. This done, he returns to pipe and popcorn.

A little later, 1 minute, maybe 5 minutes, the above series of events is repeated. Our customer is getting a little peeved. The third time it happens he cannot get it to stop rolling. This is where *you*—the technician—come in.

How do you go about running down such a trouble? You and I would probably change the vertical oscillator tube. Perhaps the trouble would be eliminated. At least you think it is because you watch the set for an hour and it doesn't roll. However, about a week later, you get a call from your customer and he is not happy. It's rolling again, he says, why don't you fix it right? Back you go, to try again.

Let's see which of our checks might pay off in a spot like this. The symptoms here are definitely different than they were for the case of the tube with the heater-cathode leakage. In that trouble the set would correct itself. What about the sync information on the face of the tube? You would not likely see much there, but there is always a possibility that something unusual *might* come up and would be visible. How about the "feel" of the hold control? Perhaps, but not too likely for these symptoms, especially if the set always goes out in the same (frequency) direction.

This specific problem has been encountered by a number of set manufacturers who used a 6BL7 as the vertical oscillator and output tube. A few years ago this was popular, at least until everyone got into trouble with the tube.

At that time, technicians were replacing the tube only to have the condition recur. It was found that if the filament power was reduced slightly, this condition would be corrected in most cases. The only difficulty was that the picture would come to full vertical size rather slowly. However, since it was during the normal warmup time of the set, it was not too important. The filament power was reduced by a resistor (1–1.5 ohms, 4–5 watts) in series with the filament of the tube.

Du Mont got around this problem by using a special adapter containing the resistor. The adapter consisted of an octal tube base with an octal socket inserted in its top with the corresponding pins wired through, except for the filament pins which had the resistor in series. Some time later the 6BL7 was improved, obviating the use of the adapter. If the trouble is not a tube, it is most likely a part of the vertical oscillator circuit. Thus, if the frequency drifts up, some part is changing value so that the frequency will run high. That is, some frequency-determining resistor or capacitor has decreased in value. It follows, therefore, that if the drift is downward in frequency, it is due to a component that has increased in value.

On occasion, a technician will replace a part only to find that the trouble still persists or exists in a slightly different form. This may be due to a component correctly color-coded, but actually not close to its supposed value.

Unstable vertical sync

The customer complained that the picture rolled constantly. Investigation revealed that while it was possible to adjust the vertical sync so that the picture would lock, the hold was extremely "loose" and the hold control was very critical. This set used a blocking oscillator which derived its pulse from an integrator coupled to the grid circuit of the oscillator through a winding on the blocking oscillator transformer. From the feel of the hold control the amplitude of the sync pulse was very low. A quick look at the vertical signal on the face of the tube revealed everything to be normal. So, the fault was laid to the vertical sync circuits (the oscillator was O.K. since adjustment of the hold control would provide the frequency range considered normal for this set). This receiver used an integrator composed of individual capacitors and resistors. The trouble in this case was traced to a leaky capacitor in the integrator that was bleeding most of the pulse to ground. END

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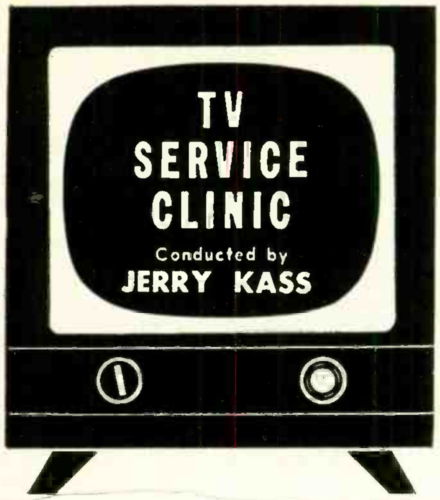

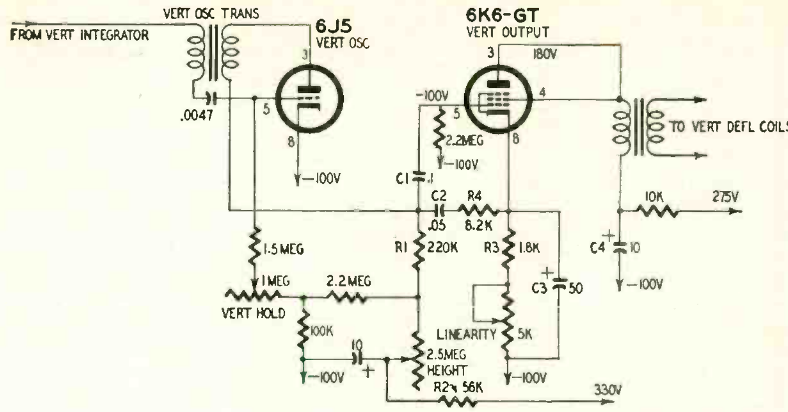

Fig. 3—Vertical sweep circuit in the RCA 8TS30 television receiver.

When hum can be seen on the screen as well as heard from the speaker, the service technician will usually find it easier to concentrate on the video symptom. With only the audio effect, he has to determine whether the trouble is hum or buzz (troubleshooting procedure differs for the two).

Hum generally has a smooth sound; it consists of a sine-wave heater or power-supply ripple of 60 or 120 cycles. Being sinusoidal, very little harmonic distortion is produced. The 60-cycle hum is generally a product of heater–cathode leakage in a tube; 120-cycle hum indicates such trouble as faulty filtering in the B supply.

Buzz has a raspy sound. It is most often produced by harmonic-rich square waves such as the vertical sync and blanking pulses. Other common sources are low-frequency video signals and vertical deflection voltages in a set. The horizontal sweep circuits seldom cause interference because the 15,750-cycle signal falls beyond the response range of television audio amplifiers.

Drawing a still finer line, we should distinguish between picture or video buzz and sync buzz. Picture buzz is by far the more common of the two. In addition, it is easy to spot—it changes in tone and amplitude with any major change in the televised scene, such as produced when switching cameras or breaking into a commercial. Sync buzz, produced by coupling between the audio section and the vertical sweep and deflection circuits, does not vary with changes in video content. We will cover the various causes of buzz at a later date. Now let's concern ourselves with audible hum.

Again we must distinguish between terms: power-supply hum and modulation hum. Power-supply hum can be heard at all times regardless of whether a signal is being received; modulation hum is produced only when tuned to an active channel.

After it has been determined that the trouble is power-supply hum, the first important check is to see if the hum intensity can be varied with the volume control. If it can, the defect is almost always before this point. If varying the volume control has no effect on the hum, it is a fairly safe guess that the trouble lies after the control. When hum can be controlled, replace the audio demodulator and all other tubes between this and the sound takeoff point.

Where the volume control has no effect on hum level, try substituting new tubes in all circuits between the control and the loudspeaker. If this clears up the trouble, heater–cathode leakage was probably the defect. If tubes are not causing hum, a process of circuit elimination can be used.

If removing the audio output tube eliminates the hum, replace the output tube and remove the tube preceding it (generally the first audio amplifier). If hum remains, carefully check the filter capacitors in the B-plus line to the audio output tube and check the output tube grid circuit. This can be done with a scope or headphones plus blocking capacitor.

If removing the first audio tube also removes hum, check the grid and plate circuits of that stage. A quick check of the grid circuit consists of simply grounding it to chassis. If a B-minus bus is used, short the grid to this point. If shorting removes the hum, the trouble lies between this grid circuit and the volume control—check all capacitors. (In shorting grids to ground, be on the lookout for audio tubes also used for voltage dropping. See Fig. 1. The grid may be at about 120 volts.)

Once a circuit has been found to be the source of trouble, make the following additional checks: See that all shielded wire is properly grounded, dress all unshielded wiring and components away from ac power lines and power-supply circuitry. Where audio and ac wiring must cross paths, do so at right angles. Be sure sockets are thoroughly grounded.

If confusion exists between hum and buzz, eliminate possible sources of buzz by removing the vertical and horizontal oscillator and output tubes. For further insurance remove the final sound if amplifier tube. In some cases where hum is introduced into the grid of the first audio amplifier, the volume control can vary its intensity, giving the effect that it is being introduced before the control—watch for this.

In sets with series-string heaters

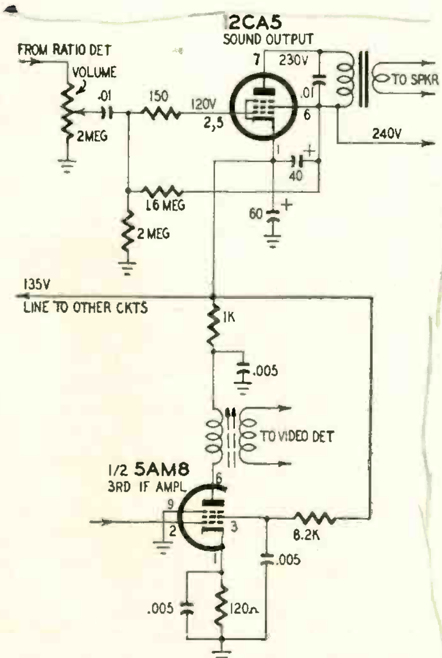

Fig. 1—Audio output tube as voltage-divider resistor in Admiral 17KP3 set.

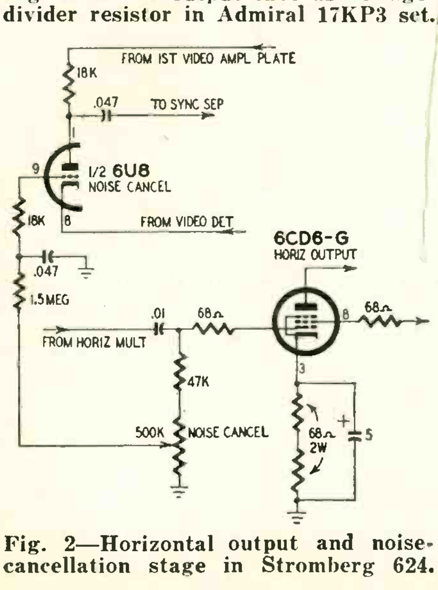

Fig. 2—Horizontal output and noise-cancellation stage in Stromberg 624.

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tubes may still be removed by replacing them with inoperative units (all pins clipped except the heaters).

Modulation hum

This effect is produced by hum in the rf and if amplifiers and exists only when receiving a signal. It is caused by heater–cathode leakage or B-supply ripple in the plate and screen circuits. It generally appears as amplitude modulation on the if carrier and would thus be more noticeable on the picture-tube screen, the ratio detector being fairly effective in guarding against AM. Because of this, tunable hum is found in split-sound receivers where maximum AM rejection takes place when the sound if is exactly the same as the center frequency of the sound detector. In intercarrier sets there is no tunable modulation hum, the 4.5-mc signal being constant. In any case, maximum protection against modulation hum is careful alignment of the sound detector.

The above rules are general and the technician must be on the lookout for misleading variations. For instance, a set having heater–cathode leakage in one of its if amplifiers may produce hum only on weak stations. This could pose a time-consuming problem in which the technician will eventually discover that strong signals produce a large agc voltage that is applied to the defective tube. This greatly lowers its gain and the modulation hum produced by that stage is negligible. On weak stations the hum rides through. But this is what makes servicing so interesting.

High-voltage doubler

A Sylvania 1-512 chassis has been giving more than its share of trouble. The general symptoms are a loss in high voltage and brightness. The circuitry around the high-voltage power supply has been gone over with a fine-tooth comb and, if anything, everything checks too good. I measure about 15,000 volts at the picture tube which is lower than it should be (19–23 kv). However, the horizontal output, damper and high-voltage tubes have been changed with no improvement. I suspect that the horizontal output transformer may be defective.—C. C., Saco, Me.

Of course, if every component associated with the sweep and high-voltage circuitry has been checked and all test good, it is logical to suspect the flyback transformer. However, voltage doublers of this type have a characteristic trouble that should be checked carefully. Between the filament of the input 1B3-GT and the plate of the output 1B3-GT are connected three 1-megohm resistors.

Supplying a 27GP4 which requires 21,000 volts for normal operation, the resistors and capacitors in this circuit are under severe operating conditions and breakdowns under load are common. Most often the 1-megohm resistors change value and cause a surprising loss in high voltage. Thus, replace the three resistors with good-quality 2-watt units—this is most likely the trouble.

Negative Picture

A Stromberg-Carlson model 624 has come in with a strange set of symptoms. So many things check wrong that it seems as if many components are defective. However, the customer states that the set played perfectly until everything went wrong at once. The picture has a negative or engraved effect; it is badly distorted and sync is highly critical. The same effect can be produced by advancing the noise cancellation control under normal conditions.

The agc voltage is very low and may be causing overload. I have carefully gone over the keyed agc circuit but it appears to be in order. The plate pulse is only 200 volts or so which is probably lower than it should be. The noise cancellation circuit has no effect and the grid voltage on the horizontal output tube is very low.—M. R., Wheeling, W. Va.

There are a few highly significant clues that you have uncovered. The low voltage on the plate of the keyed agc tube accounts for the low agc voltage. The pulse at the plate of this tube should be approximately 800 volts. Thus, the very low agc voltage is permitting excessive rf or if amplification, causing video overload and the engraved effect.

Pursuing this further, the lack of negative voltage on the grid of the horizontal output tube accounts for the low voltage on the plate of the keyed agc tube. This is substantiated by the fact that the picture appears the same as when the noise cancellation control (Fig. 2) is fully advanced. The final clue is the normal operation of the horizontal multivibrator circuit.

The trouble lies in the cathode circuit of the horizontal output tube. Replace both cathode resistors. However, most likely the defective component is an open 5-μf 50-volt cathode bypass capacitor. With this capacitor open, the negative voltage disappears and the grid of the noise cancellation tube, normally biased about 7 volts negative, is at ground potential. The tube conducts heavily, fully clipping the sync and producing a distorted and critically synchronized picture.

Poor height and linearity

A real old-timer came in the shop in the form of an RCA 8TS30. The set must be over 8 years old and has undergone much servicing. The present trouble is insufficient height and poor linearity. I cannot be sure that there are two separate problems, since a common trouble could be causing both symptoms.

The wiring in this set is pretty much messed up but it seems to be correct. I have checked the vertical oscillator and output tubes, and some of the more likely components but have drawn a blank.—P. T., Orlando, Fla.

It is very possible that on an old set such as this the trouble is being caused by the general deterioration of several components. However, some are more likely suspects than others. For height, check capacitors C1 and C2 (Fig. 3) by direct replacement—they may be only slightly leaky. Check resistors R1 and R2 for off-values. Because of the age of the set, try to maintain 10% tolerances. Resistor R3 has also proved troublesome through the years. Filter capacitors C3 and C4 should definitely be replaced if even remotely suspected.

Several of these components also affect vertical linearity, primarily capacitors C2, C3 and C4. An important component involved in linearity is resistor R4. This certainly should be replaced. If the above checks fail, it would be wise to replace the vertical output transformer before going on. Several voltages are indicated in the diagram. See that your measurements are within 10% of them. If appreciably lower, check the low-voltage power supply rectifier tubes and filter capacitors.

Horizontal pull

In a Crosley series G Super V chassis I have run into a case of severe pulling on the right side about half-way down the screen. I have the manufacturer's schematic and service notes and have checked everything possible. All waveforms seem perfect and all voltages are almost exactly as stated on the schematic. I have gone over the entire horizontal circuit with a vtvm and scope with no results.—A. L., Detroit, Mich.

The number of possible causes of pulling are far too great to list here. However since you have made such an apparently exhaustive search, it is very likely that the trouble is one common to these Crosley chassis. The pulling takes the form of a triangular notch in the area you described. It appears to be due to core saturation of the horizontal output transformer because increasing the air gap clears up the defect.

Examine the air gap carefully. In some case there is excessive tape there which can be removed—one layer at a time. Other times, you may be able to place a few pieces of plastic tape between the pole pieces. In either case, be careful not to make the air gap too wide or the decrease in horizontal pulling will be accompanied by a decrease in width. END

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COLOR RECEIVERS**
By Matt Mandl
Watch for It!

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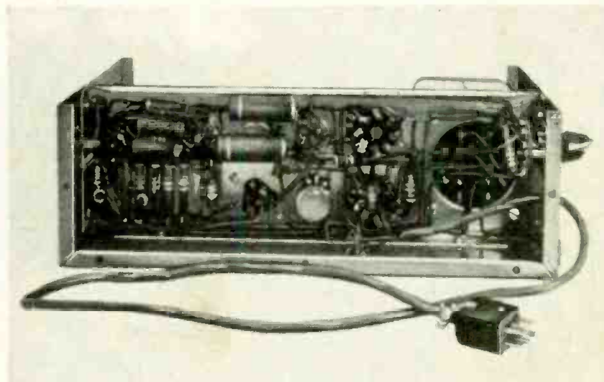
Unit provides triode, pentode and Ultra-Linear operation

Top and bottom views of amplifier chassis. Selector switch is at right.



3-in-1 AMPLIFIER

By ROBERT SHARPE

THERE has always been an argument among audio fans concerning the relative merits of various types of output tube operation. Some will settle for nothing but a triode, others are equally certain that the more efficient pentode is the best choice. A relatively new, but equally avid group, holds that Ultra-Linear operation is best since it has the power advantage of the pentode along with the characteristic low distortion of a triode.

This amplifier solves the touchy problem with the addition of a two-pole three-position switch. Its purpose is to select any one of the three output tube connections. A constructor can build the amplifier without the switch and use his pet connection or add the switch and amuse himself by choosing the output stage which suits his mood. The switch can also be used to confuse purist friends who believe in only one type of output stage since the audible difference in performance at the three positions is very small.

If the only difference between this amplifier and others was the addition of a single switch, there would be nothing remarkable about it. Actually, very careful thought went into the design of each circuit in this amplifier and the following list of features is offered as proof:

1. Response flat from 10 to 100,000 cycles.
2. Hum and noise more than 80 db below maximum output.
3. About 0.3-volt input required for maximum output.
4. Maximum power output of 6, 12 and 13 watts for 1% distortion (Fig. 1) on triode, Ultra-Linear and pentode connection.
5. Less than 1-db variation in overall gain when switching from triode to pentode operation.
6. Only four matched parts needed for accurate signal balance at the grids of the output tubes.

I am dismayed by some of the trends in recent amplifier designs. A typical design uses a monstrous output transformer flanked by a pair of overworked 6L6's, a 40-pound transmitter-sized power supply, a half-dozen mystic adjustments, a couple of voltage amplifiers and 20–30 db of negative feedback to cover up the design blunders. Don't think that the home constructor is the only one guilty of questionable design. A well known manufacturer operates a 12AX7 tube, which has a maximum plate voltage rating of 300, with 484.

I am not satisfied with this type of design, but prefer to construct a neat, compact, reliable, high-quality and moderately priced amplifier which can be simply placed in operation and then *forgotten*. Ten watts of audio power output from 10 to 100,000 cycles with less than 1% distortion is adequate—I am sure—for even the critical listener. Furthermore, it can be achieved with standard parts, conventional circuitry and conservative operation of all parts.

One *best* circuit design does not exist. Many good ones have been made. The circuit described in this article (Fig. 2) has been used in two amplifiers to date

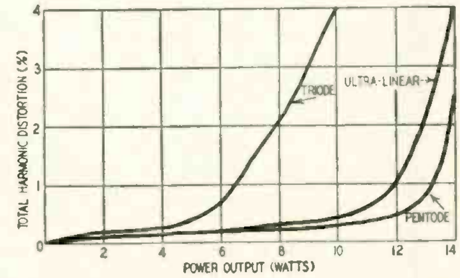


Fig. 1—Harmonic distortion vs output.

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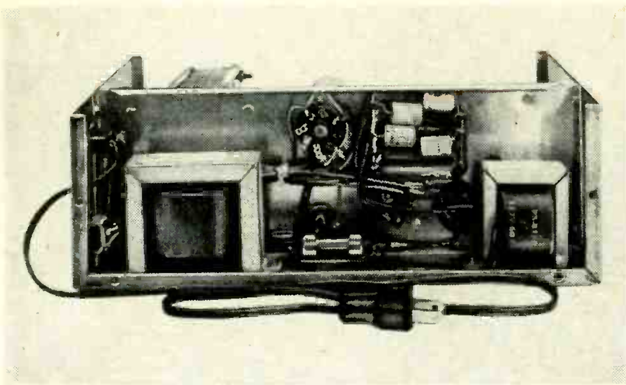

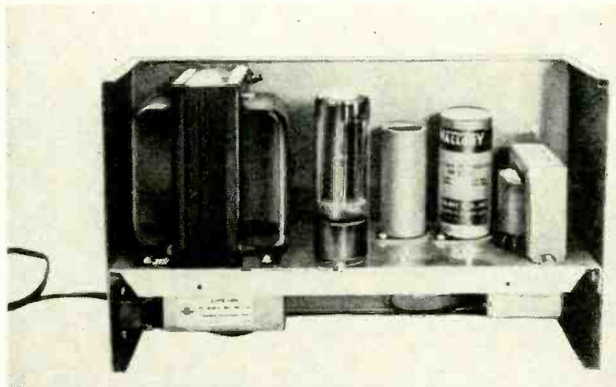

Top and bottom view of the power supply chassis. Note the tubular rectifiers.

and has proven its merits. So that you may see what decisions were involved in the design, a step-by-step outline is presented in approximately the sequence followed.

Output stage

The 5881's in the output stage have a maximum plate dissipation of 23 watts each and yet are small. In the interest of reliability all of the "high-power" components such as transformers and tubes are operated at about 70% of their maximum rating. This called for a plate input to the two 5881's of about 30 watts.

After following a ring of interlocking decisions for a few minutes, I decided that 300 volts at 100 ma would provide the desired 30 watts with the most efficient use of power supply parts. A standard power transformer, rated at 750 volts at 150 ma and working into a choke-input filter, supplies a well-filtered 300 volts with excellent regulation. The choice depended upon maintaining class-A operation of the output tubes along with the use of standard power supply components. Parts which are run too close to ratings are unreliable; using them far under their ratings is uneconomical as well as doing little to improve reliability.

With pentode operation of the output tubes (the 5881 is normally referred to as a beam power tube, but it has five electrodes and could be called a pentode), a maximum power output of 10 to 15 watts could be expected. A Peerless S-226Q output transformer seemed to be the logical choice from a consideration of ratings, quality, cost and size. Its 20-watt rating is adequate, it is very compact and its response flat ±1 db from 10 to 100,000 cycles. Although the secondary can be arranged to match loads of 2, 4, 8 and 16 ohms, high-quality speakers are normally 8 or 16 ohms. The connections were modified from the manufacturer's instruction sheet so that 8- or 16-ohm speakers could be used without any wiring changes in the amplifier. A switch in the screen leads of the output tubes makes the change between triode, Ultra-Linear and pentode.

Cathode-follower driver

The 12AU7 cathode-follower driver has very low output impedance, hence its high-frequency response is good. At the operating conditions selected for this tube, it has an output impedance of something over 300 ohms. Estimating the input capacitance of one output tube at 50 $\mu\mu$f (triode connection, when it is the largest), the high-frequency response is calculated to be less than 3 db down at 1 mc. Capacitive loading on the previous stage is also very low because the input capacitance of cathode followers is inherently low (about 5 $\mu\mu$f for this tube).

Low-impedance output is desirable for another reason. It permits an increase in the amplifier's output by driving the output tubes into grid current. The improvement in power capabilities is evident if the 6-watt rating of this amplifier on triode connection is compared with the value of 4 watts listed in most tube manuals.

Low-distortion drive into grid current requires direct coupling to the output tubes. With it, return to normal conditions is instantaneous after a signal peak has drawn grid current. With R-C coupling, grid current would rapidly charge the coupling capacitor. The charge, slowly leaking off through the high-resistance grid return, would produce a signal not related to the signal

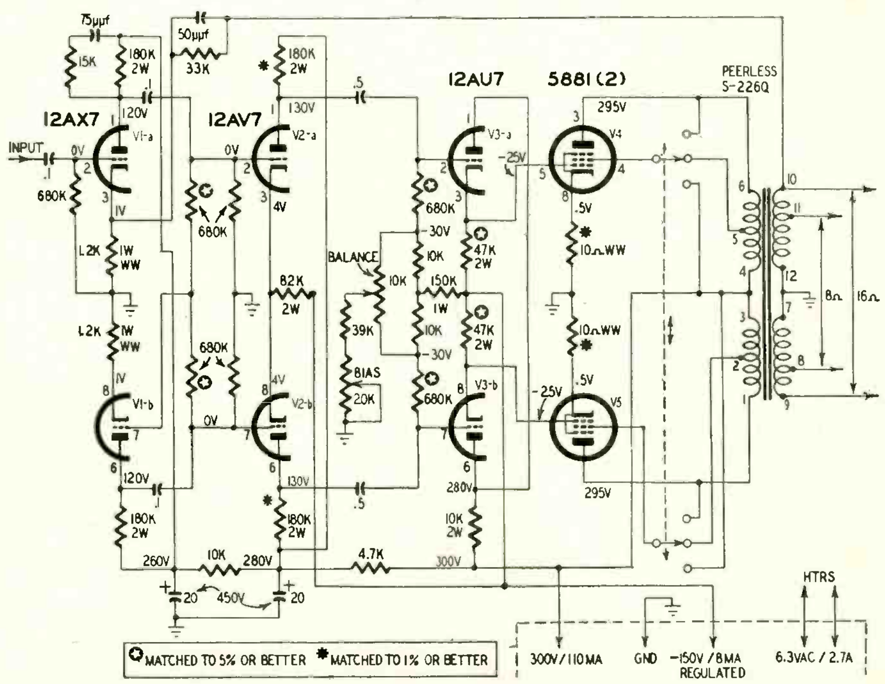

Fig 2—Schematic diagram of amplifier. Switch selects output tube operation.

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peak which caused the grid current. This is truly distortion—a very disagreeable type.

R-C coupling to the cathode-follower type driver prevents dc drift in the bias and balance adjustments for the output tubes. To prevent the distortion just mentioned, in the grid circuit of the cathode follower, a low-mu tube is used. There is a safety margin of about 10 volts between grid-current flow in the output tubes and in the drivers when a 12AU7 is used. A 12BH7 would have been somewhat better but is more expensive. It can be substituted directly into the circuit if desired.

Direct coupling is obtained by grounding the cathode resistors of the output tubes and returning the cathode resistors of the driver to a negative 150-volt supply. This −150-volt supply is also used for a previous stage. The direct coupling produces a simplified balance and bias circuit for the output tubes. Low-wattage carbon pots are used in the grid circuit of the driver and the resulting adjustment is smooth and relatively permanent.

Adjustment is simplified by grounding the cathodes of the output tubes permanently through a pair of matched 10-ohm resistors. Connect a meter on a 3-volt-or-lower scale between the cathodes of the output tubes and set the balance control for zero reading. With the meter from a cathode to ground, set bias for 0.5 volt. A recheck of balance completes the adjustment.

Parts values were chosen so that the output tubes could not be damaged by misadjustment of the bias control. The range of the balance control is sufficient for *good* tubes. If balance cannot be reached with the control, it is a sign that one or both of the output tubes is unsatisfactory.

As the circuit stands, removing the 12AU7 or failure of its heater will not cause any damage. If the cathode follower had not been R-C-coupled to the preceding stage, results would have been very different. While failure or removal of the cathode follower would not cause any harm, removing the previous stage would raise the grid of the cathode follower toward B plus and cause severe overload of the output tubes and power supply.

The cathode follower is essentially free from drift because of the large amount of inherent feedback. But the stage preceding it is likely to drift 10 to 20 volts during its normal life and this amount of signal, direct-coupled to the output tubes, would present a serious drift problem.

Phase inverters

That's right, this amplifier has *two* phase inverters. The first one is a 12AX7 in the common seesaw connection and need not use precision components. The second is a 12AV7 with a long-tailed connection and has accurately matched plate loads. While its chief function is that of a push-pull amplifier, its constants are chosen to *improve* the phase-inverting action of the first tube.

Using standard resistors, the first inverter shouldn't have over 10% unbalance. After passing through the 12AV7 stage, the outputs should be matched within 0.5%. Because of the large amount of feedback in the cathode-follower driver, the signal should reach the grids of the output tubes with less than 1% unbalance. The important feature here is that since the phase-inverting action is essentially independent of tubes, unbalance of less than 2% can be maintained at the output tubes for the life of the amplifier—without any adjustment.

The importance of having accurately balanced signals at the grids of the output tubes should not be underestimated. An unbalance of 20% can increase the distortion generated in the output stage by several times. Measurement on a push-pull 6V6 amplifier without feedback showed that a 20% unbalance in output grid drive increased the distortion by 2.5 times. As for distortion, the unbalance would essentially nullify the effect of 8 db of negative feedback.

Widest possible use of a single part value has been made in this amplifier. This policy makes it simple to select a matched pair. For example, plate loads on both the 12AX7 and 12AV7 are 180,000 ohms. Only the plate loads for the 12AV7 need matching and the best matched pair can be selected from the four resistors. Even if the unused resistors are not needed for immediate use, lots of 5 or 10 can usually be purchased at a reduced rate and pairs selected with an ohmmeter. This way you have a matched pair and some extras at about the cost of a commercially matched pair. If carbon resistors are used, it is wise to use wattage ratings much higher than the power actually dissipated to minimize the resistance change which accompanies temperature change.

Feedback is taken from the transformer secondary to the cathode of the input stage. The compensating networks used were calculated from data measured without feedback but were touched up slightly to provide the best square-wave response on the pentode position, where ringing was a little troublesome. No ringing was noticed with triode or Ultra-Linear connection of the output tubes.

Parts list for amplifier section

Resistors: 1—4,700, 3—10,000, 1—15,000, 1—33,000, 1—39,000, 7—680,000 ohms (two pairs matched to 5% or better), ½ watt; 2—10 ohms (matched to 1% or better), ½ watt, wirewound; 1—150,000, 2—1,200 ohms (wirewound), 1 watt; 1—10,000, 2—47,000 (matched to 5% or better), 1—82,000, 4—180,000 ohms (two matched to 1% or better), 2 watts; 1—10,000, 1—20,000 ohms, potentiometers.

Capacitors: 1—50, 1—75 μμf, mica or disc ceramic, 500 volts; 3—0.1, 2—0.5 μf, 600 volts, metallized paper (Aerovox P82 or equivalent); 1—20-20 μf, electrolytic, 450 volts.

Miscellaneous: 1—output transformer, primary impedance 6,600 ohms ct, secondary 4, 8, 12, 16 ohms (Peerless S-226-Q or equivalent; 1—12AU7, 1—12AV7, 1—12AX7, 2—5881's; 3—9-pin miniature, 2—octal sockets; 1—2-pole 3-position switch; 1—4 x 7 x 12-inch chassis (Fleximount or equivalent); 1—length of 6-conductor cable; 1—6-contact plub (Cinch-Jones P-306-CCT or equivalent).

Parts list for power supply section

Transformers and chokes: 1—power transformer, 750 volts ct @ 150 ma, 5 volts @ 3 amps, 6.3 volts @ 4.5 amps (Stancor PC-8411 or equivalent); 1—power transformer, 250 volts @ 25 ma, 6.3 volts @ 1 ma (Stancor PS-8416 or equivalent); 1—choke, 7 henries @ 150 ma, 200 ohms (Stancor C-1710 or equivalent); 1—choke, 3 henries @ 150 ma, 90 ohms (Stancor C-2309 or equivalent).

Miscellaneous: 1—2,000, 1—3,000, 1—4,000 ohms, 4-watts, wirewound, resistors; 1—30-30 μf, 350 volts, electrolytic; 1—40-40 μf, 450 volts, electrolytic; 1—5U4-GA, 1—0A2; 1—octal, 1—7-pin miniature, sockets; 4—20-ma selenium rectifiers, miniature (Federal 1159 or equivalent); 1—4 x 7 x 12-inch chassis (Fleximount or equivalent); 1—6-contact socket (Cinch-Jones S-306-AB or equivalent); 1—2-amp fuse and holder; 1—line cord and plug.

Power supply

Although a 5U4-GA rectifier is specified in the parts list, a somewhat higher-priced tube, the 5V4-G, would be easier on the output tubes since its cathode type construction delays the B-plus voltage until they have warmed up.

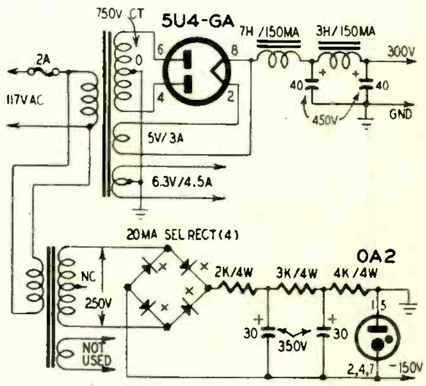

Fig. 3—Schematic of power supply.

The negative 150-volt supply (Fig. 3) must come on before plate voltage is applied to the output tubes since it supplies their bias. Thus, a bridge selenium rectifier is used. A pseudo choke-input filter, 150-volt miniature VR tube and power transformer, complete the parts list. The 0A2 voltage regulator fires within 2 seconds after power is turned on and the positive supply follows by about 10 seconds.

The amplifier and power supply were constructed in a pair of 4 x 7 x 12-inch Fleximount cases. Adequate ventilation is essential to reliable operation and a pattern of holes drilled in the covers suffices.

Standard construction practices such as twisting ac leads, careful placement of parts and shielding input and output from each other should be used. A 6-conductor cable and a pair of Jones connectors facilitates power connections between the two units. END

(Note that Mr. Sharpe has designed his amplifier for best operation in the pentode connection. By using higher plate voltage—easily obtained by using capacitor input instead of choke input in the power supply—and by adjusting output plate loads and grid bias, the characteristic can be changed to optimum for triode or Ultra-Linear operation.—*Editor*)

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Synthetic Music *via* Electronics

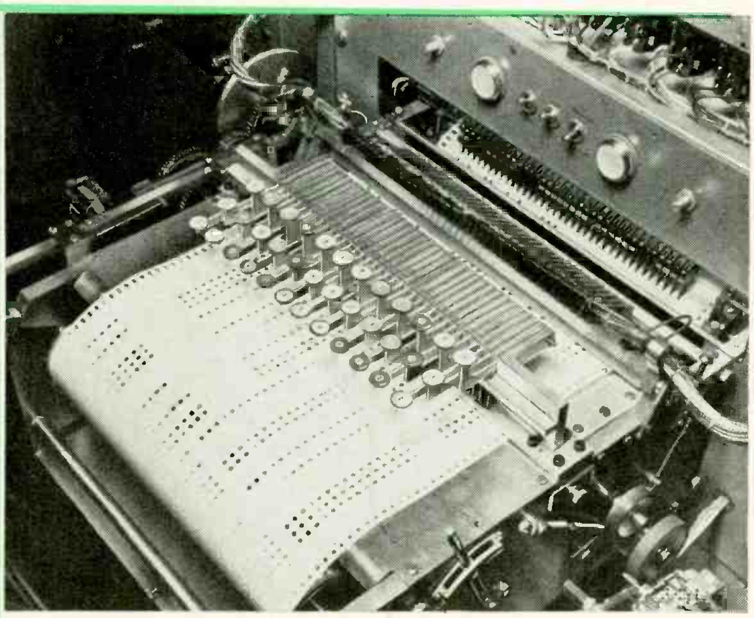

Fig. 2—Keyboard of the Electronic Music Synthesizer. Keys punch the tape. Brushes behind keys pick up music code.

An instrument that may change the whole future of reproduced music

By SOL HELLER

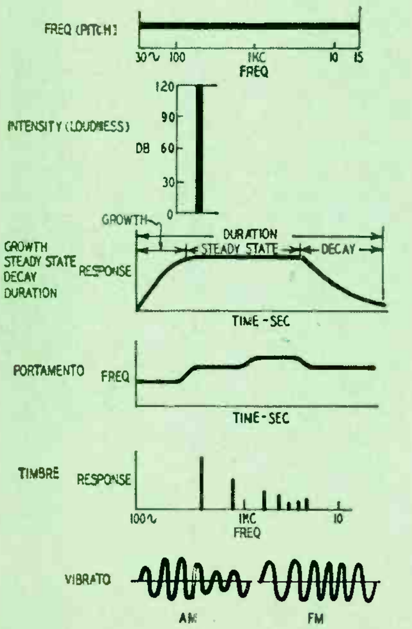

Fig. 1—All sounds can be broken down into components shown in the charts.

TWENTIETH-CENTURY technology has finally swept into the field of musical composition. RCA's Electronic Music Synthesizer may have profound effects on the composition and performance of musical pieces. It can generate any tones or combinations of tones produced by a musical instrument, group of instruments, or by the human voice. Tones never heard before may be produced. Music that's "out of this world" has become a literal possibility.

When the electronic synthesizer is operated by a great composer or conductor extraordinary results may be possible. An unlimited variety of tone colors, rhythms and new sounds remain to be discovered.

To synthesize a natural substance (such as rubber, for instance) the substance must first be broken down and its component parts determined. The same holds true for musical sounds. Ersatz sounds cannot be created until the "stuff" of which the originals are made has been thoroughly tested and analyzed.

Sounds in general, and musical sounds in particular, have certain distinguishing characteristics or properties: *pitch, loudness, timbre, duration, growth, decay, portamento* and *vibrato* (Fig. 1).

The *pitch* of a sound is our perception of its frequency. (It is worth noting, however, that pitch depends to some extent on the sound pressure and waveform of the sound, as well as its frequency.)

The *loudness* of a sound is our auditory response to its amplitude. Loudness also depends, to a lesser extent, on frequency and waveform.

The *duration* of a tone is the length of time it remains uninterruptedly audible.

Growth of a tone refers to the speed with which it builds up from zero to some fraction of its maximum amplitude. *Decay* is the rate of fall from a maximum to zero amplitude. The rates of growth and decay for sounds occurring in different musical passages may vary considerably.

Portamento describes the transition of one tone into another one of a different frequency. A continuous glide takes place in most cases with the first frequency moving smoothly toward the second one through the intervening frequencies.

Timbre or quality of a sound depends on its waveform. The waveform is determined by the harmonic content of the sound. Any complex sound consists of a fundamental frequency and its harmonics or overtones. The timbre of the sound, as gauged by the ear, depends on the number and amplitude of the harmonics as well as on the phase relations of these frequencies.

Vibrato is a tremolo effect that is often produced by singers and musicians. Either frequency or amplitude modulation—or both—occur when a

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vibrato effect is introduced. Vibrato gives music a slightly quavery effect that adds warmth and beauty to a tone and enhances its emotional intensity. Timbre sometimes varies at the same time as well. Many instruments are capable of producing such an effect.

A final characteristic (of musical sounds) that is more intangible than the others is *irregular deviation*. This is a property that relates to the way the sounds are grouped and prevents the music from sounding mechanical.

How it works

The synthesizer is capable of electronically reproducing all the characteristics just described and can thus generate any desired musical tone as well as any combination of tones. It is operated from a simple 36-key keyboard (see Fig. 2). Depressing the keys produces a punched paper record that controls the output of the system. The keys are colored and are arranged in groups to simplify their identification and operation. Each group controls one sound characteristic.

The 36 keys are divided into two basic sets of 18 each. In each set, 4 keys regulate note selection, 3 determine choice of octave, 4 regulate timbre, 3 control the growth, duration and decay characteristic and 4 affect the volume.

Two sets of keys are used because the synthesizer has two coding channels. (Information on the punched paper record is in the form of a musical *code*. The information runs in sequence along a *channel*.) While one channel is operating and producing a tone, the other is being set up to produce a different one. Another advantage provided by a two-channel coding system is that one channel can begin to play a tone before the other has stopped playing the preceding one.

As each key on the keyboard is touched, a hole is punched in the mechanically driven paper tape. The punched paper record passes at a speed of up to 5 inches per second under a brush positioned just behind the keys. The coded information punched into the paper is picked up by the brush and transferred to the appropriate circuits.

The synthesizer produces one sound at a time—i.e., only single tones, such as those produced by one key of a piano or one string of a violin. To create the effect of an orchestra, the sounds made by individual instruments must first be separately formed by the synthesizer, then combined in a recording setup. The system employed is made up of a lateral cutter and a conventional 33⅓-r.p.m. turntable. The turntable is coupled to the drive mechanism of the paper-coding unit to synchronize the two operations.

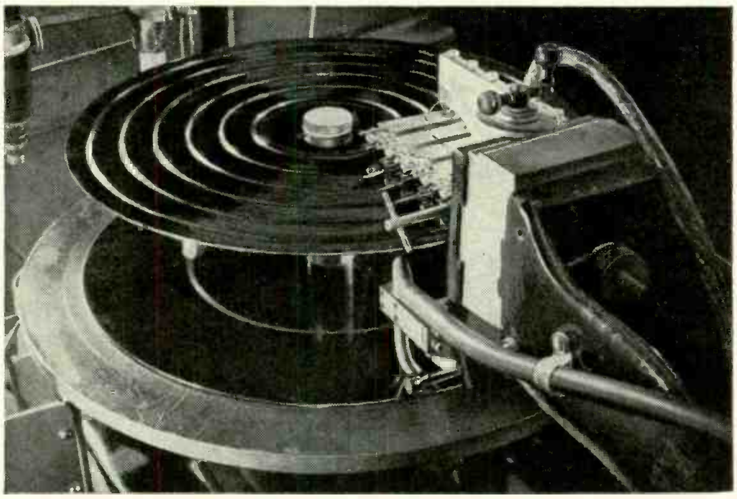

Fig. 3—The recording system. Six pickups on upper record pick up and mix signals to be combined into a single recording on the lower disc.

A 16-inch disc record is used. The record has room for six 3-minute recordings, each of which represents a different single-tone series of notes. When the six recordings have been completed, they are combined into one. Six reproducing heads simultaneously play back all the single-tone series of notes (see Fig. 3) at the same time that a single head on another disc makes one recording of the combined sounds. Using such a combination process, any number of single tones may be mixed to produce the effect of various combinations of instruments.

This system of individually recording a series of single tones permits the operator to work on one instrumental effect at a time, changing it over and over until he is satisfied with the way it sounds.

The synthesizer circuitry

This falls into the following basic groups:

A *frequency generator*, consisting of 12 electrically driven tuning forks. The forks form part of an electronic oscillator (see Fig. 4). Oscillator signal voltage flowing through coil L1 drives the tuning fork. The fork vibrates at the desired frequency and its tines cause a voltage to be induced into L2 and fed to the 6J7 grid. The frequency of this voltage is the same as that of the oscillation in the fork, which is, in turn, equal to the desired oscillator frequency.

The tuning forks create tones whose frequency range is the same as that of an octave on the piano. A schematic of the frequency-selecting system used for one octave is shown in Fig. 5. A *binary coding system*, using a *relay tree*, permits the selection of any of 12 frequencies through the use of only 4 keys.

A *random-noise generator* using a hot-cathode gas triode imitates the sounds produced by drums, maracas and other instruments. When the noise-producing circuits are worked through narrow-band filters, weird and unusual sounds can be produced.

An *octave-selection system* increases the frequency range of the instrument, so it covers the standard piano keyboard and extends beyond it on either side. The octave system is made up of three circuits capable of providing any one of eight octave ranges. The different octaves are obtained by the division or multiplication of the frequencies generated by the tuning forks.

Growth and decay circuits control the rate at which a tone reaches maximum intensity, then diminishes from this peak. This characteristic varies in different instruments. For a plucked or struck string instrument, such as a guitar, the growth or buildup time is relatively short; in the case of a pipe organ, on the other hand, it is relatively long. Decay characteristics vary in a similar fashion.

Three circuits in the synthesizer provide eight different growth and decay characteristics. This is a number greater than conventional musical instruments are capable of providing.

Portamento, as pointed out earlier, refers to the smooth way in which musical tones change in frequency. The transition is usually a gliding rather than an abrupt one. A single

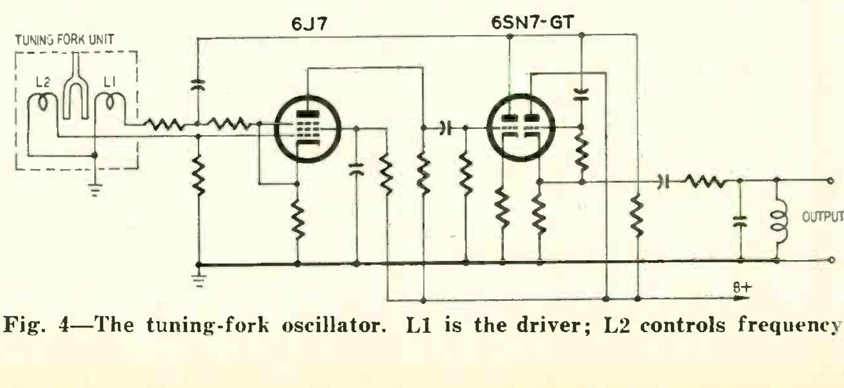

Fig. 4—The tuning-fork oscillator. L1 is the driver; L2 controls frequency.

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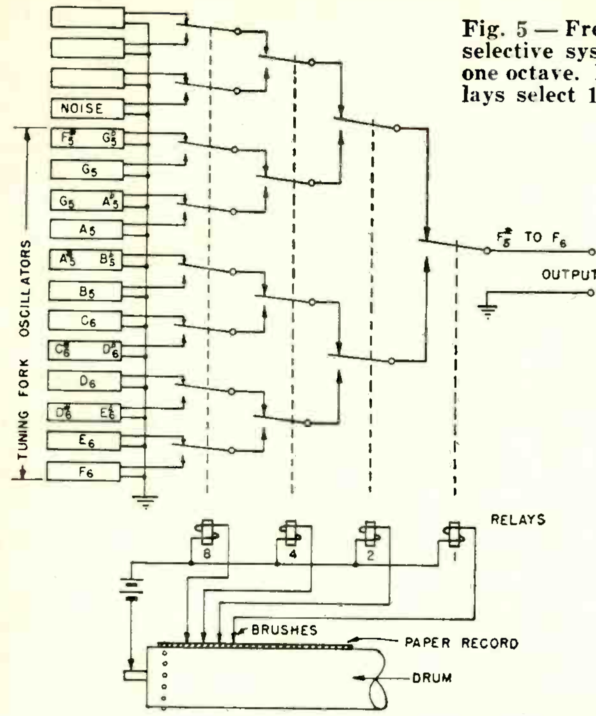


Fig. 5 — Frequency-selective system for one octave. Four relays select 12 notes.

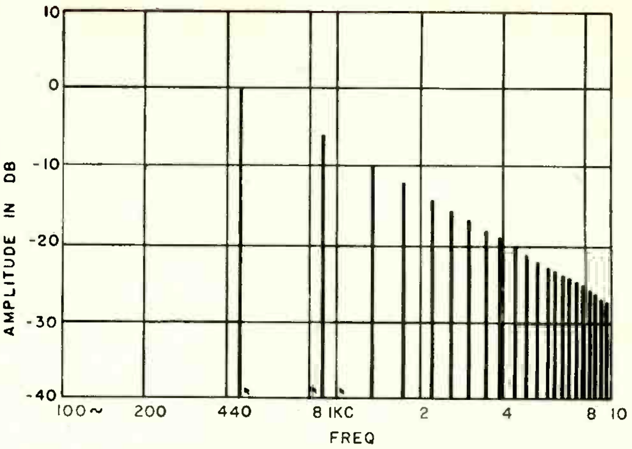
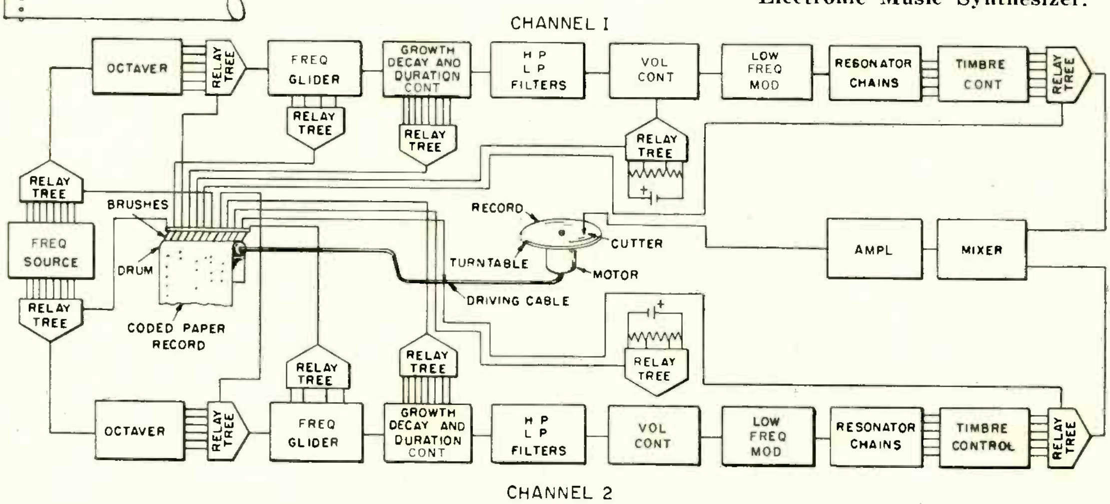


Fig. 6—Harmonics of 440-cycle sawtooth. Harmonics extend to infinity with ever-decreasing amplitudes.

Fig. 7—A block diagram of the RCA Electronic Music Synthesizer.



smooth glide is characteristic of some instruments (such as the trombone or violin). In others, the transition is made in a series of successive approximations. The instrument provides either type of portamento.

Basically, the portamento circuit consists of a specially designed oscillator that adjusts itself to changes in the frequency of the (musical) signal applied to it. When the input signal changes from one frequency to another in an abrupt or discontinuous manner (as when the operator depresses first one frequency key, then another), the output of the oscillator changes in frequency, shifting from the first to the second frequency smoothly or continuously and introducing glide effect.

Timbre differentiates the musical sounds produced by one instrument from those of another. The harmonics associated with the fundamental frequencies generated are responsible for the timbre of an instrument. A choice of 16 different timbres is provided in through 4 circuits.

The sine-wave signals generated by the tuning-fork oscillators are converted into square waves of the same fundamental frequency by two tubes in the frequency-multiplier section. Two other tubes change the square wave into a sawtooth one. Now, a sawtooth signal contains harmonics extending to infinity (see Fig. 6). Frequency-discriminating systems select any desired grouping of harmonics, thus permitting the timbres of various musical instruments to be accurately simulated.

These frequency-discriminating systems are made up of a combined high- and low-pass filter system whose cutoff is variable and a chain of amplifiers (*resonator chains* in Fig. 7) tuned to different frequencies. The setup permits timbre to be changed during the sounding of a single tone.

Vibrato was previously defined as a frequency or amplitude modulation of certain tones. The modulation frequency is generally 7 cycles. A low-frequency modulator in the synthesizer injects this vibrator or tremolo quality.

A volume control system made up of four circuits varies the sound output between 0 and 120 db in a series of 15 voltage steps. Changes in volume may be made during the generation of a single tone or even between tones. The synthesizer's volume control system also controls the overall volume.

One advantage the music synthesizer has over conventional instruments is its elimination of various undesired sounds. Sensitive listeners may be annoyed by the noise of guitar strings being plucked or of piano hammers striking the strings, possibly rattling the mechanism as well. Most instruments produce such extraneous noise in varying amounts.

Some day, perhaps, anyone who wants to compose music or conduct an orchestra, but isn't in the mood to devote possibly 20-odd years to mastering the skills involved, may be able to gratify his wish by operating a music synthesizer. It's something to look forward to—the joy of composing a violin concerto without knowing a note of music, or conducting the same piece without an orchestra. Frankly, I can hardly wait. . . . END

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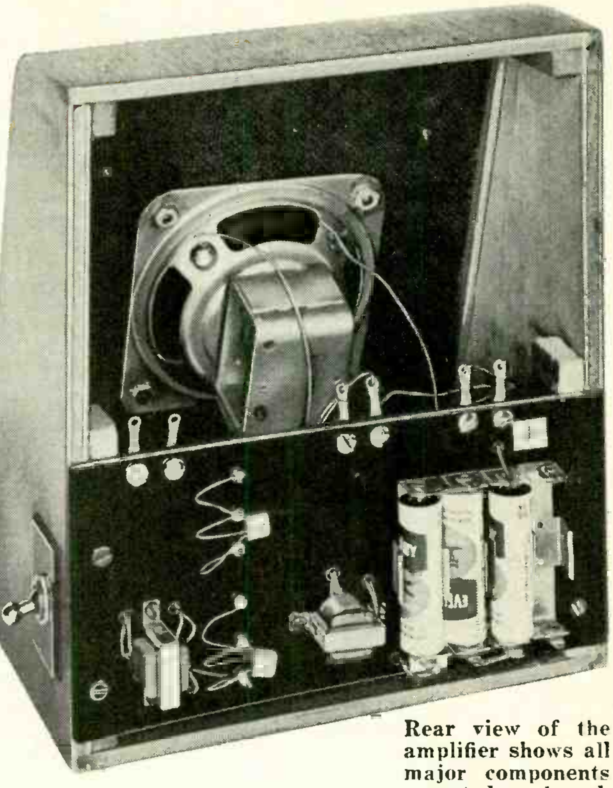
TRANSISTORIZED AMPLIFIER for INTERFLEX TUNER

Unit provides class-B push-pull audio output



Rear view of the amplifier shows all major components mounted on board.

By DR. WILLIAM H. GRACE, JR.

IN compliance with numerous requests from builders of the "Transistorized Interflex Receiver" which appeared in the August, 1955, issue of RADIO-ELECTRONICS, I am pleased to describe the final stage of class-B push-pull audio amplification that was used for PM speaker operation with the Interflex tuner. It is an elementary push-pull affair with a minimum of components and a relatively low battery drain.

No detailed measurements were made as to the exact db gain or the precise output in milliwatts but the resultant signal is of good quality, unusual clarity and sufficient volume for enjoyable listening even in a large living room. Classed only as a medium-power amplifier, its overall frequency response and total volume compare favorably with much more complicated equipment in the same location.

In receivers employing the Interflex principle developed in 1925 by Hugo Gernsback, a crystal detector or diode was connected directly in the grid circuit of a triode and produced a good-quality signal plus substantial audio amplification. I found the same effect could be achieved if a suitable transistor was substituted for the tube and the crystal diode was inserted directly in the base circuit of the transistor. It is by this very arrangement that it becomes feasible to couple the tuner output immediately into a push-pull stage without using a separate driver stage.

This system gives enough volume to activate standard PM type speakers—loud enough to cause a neighbor to complain. Several sizes and makes were tested. In areas where there are no powerful locals an additional driver stage can be incorporated without difficulty. In the New York City vicinity the additional stage was definitely unnecessary.

The circuit (see diagram) is orthodox. It represents about the simplest type of transistor amplifier circuitry possible. No particular transistor experience is needed to assemble this circuit; nothing could be more fundamental.

Equipment and wiring

Two transformers are used. One as a driver couples into the push-pull-connected transistors; the other as an output matching device couples directly into the voice coil of the speaker. Fortunately, it is not necessary to purchase expensive subminiature transistor transformers because there is ample room on the supporting panel to employ slightly larger and much less costly miniature types as the Argonne models (obtainable through Lafayette Radio). Transformer T1 is an Argonne AR-109 and T2 an Argonne AR-119 which appear to be well suited for use with transistors. Handy mounting brackets on the transformers permit easy attachment to the panel by bolts or rivets.

Any fairly matched pair of junction type transistors may be used with this circuit if their specifications are similar or close to the type and make of the ones I used. These happened to be Raytheon CK722 (photo shows RR106's used in later experimenting) because they were in stock at the time the original amplifier was assembled. They are p-n-p types and the circuit diagram shows the correct battery polarity for this type of transistor. A pair of n-p-n junction transistors may be used if the battery polarity is reversed.

The subject of proper polarity often confuses the transistor neophyte yet it is simple to understand. For either n-p-n or p-n-p types merely see that the collector is connected to the battery terminal which corresponds to the middle letter of the transistor. If the middle letter is *p*, the positive battery terminal connects to the collector; if it is *n*, the collector is to the negative battery terminal—you can't go wrong!

The mounting panel (see photos) has a number of machine screws or bolts extending through it for supporting certain components, making connections through the panel, etc. Brass eyelets or rivets would do as well but, in this case, the bolts were available. The transistors are soldered to the heads of six bolts which are seen in a vertical line just to the right (rear view of panel) of T1 which is mounted to the panel by two similar brass bolts. Thus, sockets are eliminated for the transistors.

The objection to the use of sockets

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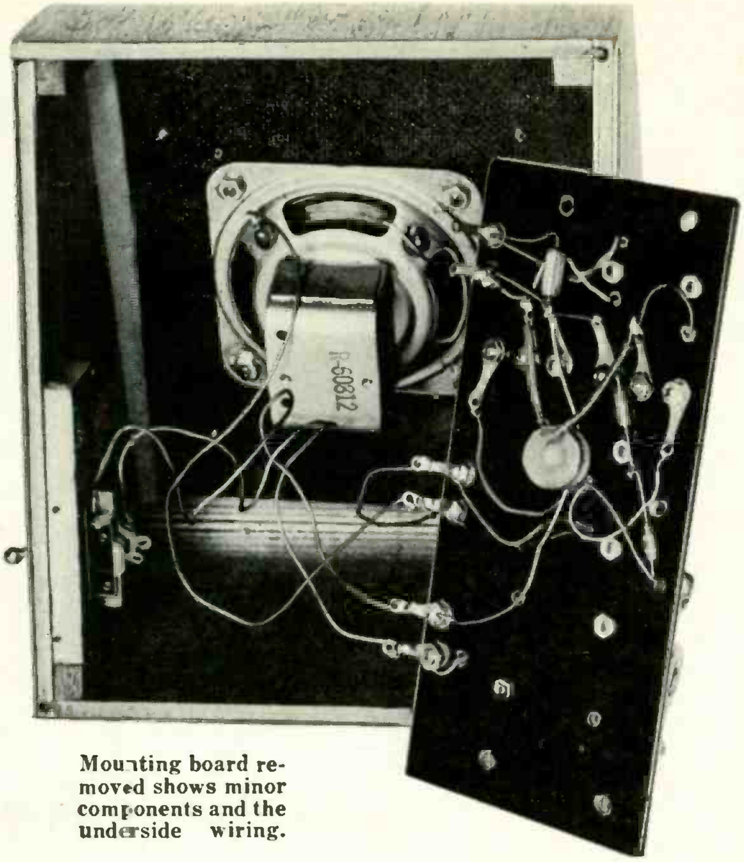


Mounting board removed shows minor components and the underside wiring.

is twofold: they are an additional expense; they can develop troubles hard to locate by making poor contact with the small-diameter leads of the transistors. The wire leads from the transistors should *not* be cut short before soldering and they must be held with pliers to act as a heat sink so the heat will not be conducted up the lead and perhaps seriously damage the element. It is a very wise rule to use no more heat in soldering than is absolutely necessary to produce a sound electrical joint whenever transistor leads are soldered.

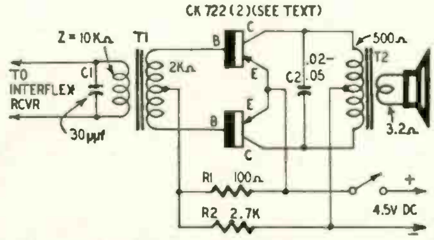
Two fixed capacitors are needed. They may be either paper or mica types as they operate at low voltages. Capacitor C1 has a value of 30 $\mu\mu$f and serves as a bypass unit. It was included during the experimental stage of the amplifier because a high-pitched whistle was heard. This was quickly eliminated by inserting the small capacitor. If the constructor finds no whistle present, this item may be omitted. Capacitor C2 can be of any value between .02 and .05 μf; it goes from collector to collector.

Two ½-watt resistors furnish proper bias and are soldered directly into the wiring on the reverse side of the panel (see photo). Resistor R1 is rated at 100 ohms and R2 at 2,700 ohms. The measured battery drain averaged 3.6 ma at zero signal and 10–14.5 ma at normal operating level for the pair of transistors.

For those who wish to experiment, the resistor values may be altered plus or minus within reasonable limits. The total battery drain can be lessened or increased by changes in the bias. The idea is the same as with tubes operating at various degrees of bias but the values used here seemed a good compromise and worked effectively.

The power supply

A dc voltage of 4.5 is furnished by the three dry cells and applied to the collector circuit. The small cells are mounted in a convenient and compact battery holder. (The photo shows holder for four cells. The unit works well on three, but four cells may be used with slightly greater output.) Cells are quickly inserted into the cliplike holder and it is a simple matter to replace them when the occasion demands. The battery holder provides a practical method of making electrical connections to the cells without soldering directly to the cell terminals. Obtainable from the same source as the transformers, these holders come in large sizes as well and will take flashlight-size dry cells if larger units are favored. The two lugs above the battery support leads to the power switch mounted on the side of the speaker housing. The center lugs go to the voice coil of the speaker and the two left-hand (rear view) lugs are the input terminals from the tuner.



Schematic diagram of the push-pull audio amplifier for the Interflex tuner.

Parts for Interflex amplifier

1—100, 1—2,700 ohms, ½ watt resistors; 1—30 $\mu\mu$f, 1—.02–.05 μf, capacitors; 2—matched transistors; CK722's, RR106's, 2N107's, 2N35's, etc. (observe whether n-p-n or p-n-p—see text); 1—driver transformer (primary impedance 10,000 ohms, secondary impedance 2,000 ohms center-tapped; primary resistance 500 ohms, secondary resistance 50 ohms) (Argonne AR-109 or equivalent); 1—output transformer (primary impedance 500 ohms center-tapped, secondary impedance 3.2 ohms; primary resistance 20 ohms, secondary resistance 0.3 ohm) (Argonne AR-119 or equivalent); 1—loudspeaker, 3 to 5 inches; 1—speaker cabinet; 3—penlight cells; 1—battery holder; 1—mounting board; 1—spot switch.

Some speaker tests

During the testing period several makes and sizes of PM speakers were hooked to the amplifier. The sizes ranged from 3- to 12-inch diameter speakers and results were as expected. The smallest speaker attenuated the low notes; the largest one was too bulky to house so a 5-inch size was finally selected. (When the 12-inch speaker was tried with proper baffle the tone was realistic to a degree surprising for such modestly powered equipment.) The speaker cabinet measures 7 inches across the rear so the panel was cut 7 by 3 inches wide. But these dimensions should be altered to suit the size housing used by the builder.

The power switch is on the left side of the cabinet (rear view) and is needed because a separate power supply is used to furnish the dc to the push-pull stage rather than taking it from the same battery used for the Interflex tuner. A separate battery was decided upon to eliminate the filter system with its attendant electrolytic capacitors, etc., which would be necessary with a push-pull stage powered by the same source as the tuner. Furthermore, separate battery supplies will last longer than a single source.

A few bolts, nuts, lugs, insulating spaghetti lengths and connecting wire are all that are required to complete the assembly of the amplifier. After wiring, it is a very sound practice to check and recheck all connections for accuracy and good electrical conductivity. Do this before the battery switch is turned to the on position.

One closing word of caution: Make sure you have marked the proper battery polarity on the battery holder so that when it does become necessary to replace the dry cells you will know exactly how to insert them. If you fail to mark the holder, *now*, you can easily forget the correct polarity at a later date.

The above amplifier gave me a lot of pleasure both for its quality and the fun of building it—may it do the same for you. Happy listening! END

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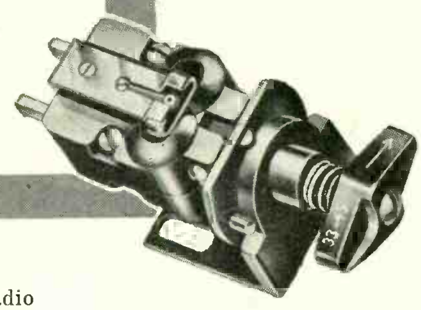
FOR GOLDEN EARS ONLY

The Concertone 20/20 recorder; Recoton-Goldring pickup cartridge; record destaticizers and cleaners

By MONITOR



Recoton-Goldring pickup cartridge.

A RESPONSE from 20 to 20,000 cycles is a pretty big order in a tape recorder regardless of price. When a manufacturer claims it in a job which sells for less than $500 (less cases), many people are naturally rather skeptical. The answer to the first question most readers will ask is given in the Concertone 20/20 response (Fig. 1). This was taken by feeding a metered audio generator into the recorder at 20 db below the so-called *normal* level (0 VU) and measuring the output of the tape, on subsequent playback, with a vtvm. The −20-db level is the proper point for measuring tape-recorder frequency response. A recorder flat at this level will produce flat recordings even when set to record peaks at zero level because the peak power in music is produced by frequencies between 50 and 1,000 cycles. Measuring a tape recorder at 0 VU will saturate the equalizers and tapes at high frequencies and produce a sloping response beyond about 5,000 cycles.

The response at 7½ ips is flat within 1 db from 100 to 15,000 cycles; at 15 ips there is a slow rise between 2,000 and 15,000 but the response at 20,000 cycles is exactly the same level as at 1,000. The rise at 15 ips is the result of the equalizers in the 20/20 being adjustable for a flat response at either 7½ or 15 ips; the one tested was adjusted at 7½ and this produced a slight boost at 15 ips. The slope below 100 cycles is probably deliberate and to minimize wow, flutter and especially head magnetization from transient switching thumps. However, recordings show no lack of bass either with microphone or when dubbing from radio or disc.

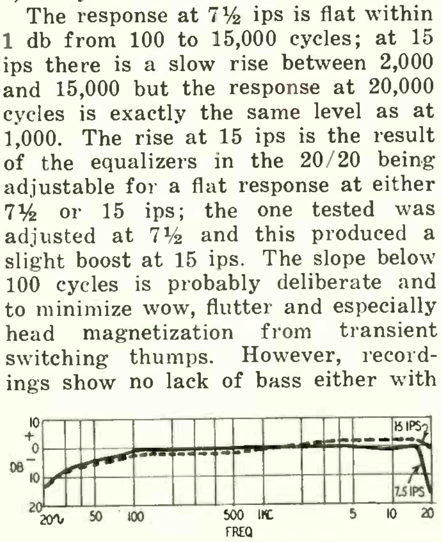


Fig. 1—Response of Concertone 20/20.

The claimed distortion at the so-called *normal* operating level (0 VU) is 2% harmonic. My measurement gave me 2.2%. However, my meter is a null type unit and its readings always include a certain amount of noise and hum. The noise ratio is specified to be 55 db and again my measurements indicated that the figure is conservative if anything. Flutter and wow were completely inaudible throughout the period during which I used the sample, even when considerable bass boost was applied in playback. All in all these are top-notch figures. The 20/20 differs from the Concertone Broadcast model BR-1 (aside from some $100 in cost) in having slightly less expensive motors, a less elaborate amplifier, higher distortion and more slope below 50 cycles.

As for operating flexibility and convenience, the 20/20 will meet all professional standards and needs. It accepts reels up to 10½ inches without need for any extensions or accessories. It is simple to thread and the controls are nicely interlocked and arranged to provide about as foolproof operation as I can imagine. Only one precaution is necessary: the rewind and fast forward are very fast (1 minute for a 10½-inch reel). It works very nicely when the same-sized reel or hub is used on both spindles. But if two different-sized reels are used, the rewind can accelerate to a terrific speed and can break tapes when brought to a sudden stop. Care is necessary with unequal reels during rewind and fast forward.

The provisions for locating cue point and for editing are the best I have ever come across at any price. With a little experience the veriest amateur should have no trouble even with such bits of subtle editing as cutting out a superflous "s" at the end of a word or a short click or pop.

The amplifier has two input channels, one for a high-impedance mike (low-impedance transformer available as an extra to plug into prewired socket) and another for a high-level radio or line channel. Both channels have individual level controls and the two can be mixed any time. The output is from a cathode follower and there are two jacks which can be used simultaneously—one on the back for permanent connection and one on the panel for monitoring headphones or a temporary output. A fader permits monitoring either input or tape output. The meter can also monitor either input or tape output, but a clever provision (meter switch in "record" position) makes it possible for the meter to monitor the tape output continuously while the headphones monitor either the input or the tape for comparison of quality, etc.

Another handy feature useful in home installations as well as for broadcast is that the 20/20 can be tied into a line or a hi-fi system so that the line goes to the recorder and the output of the recorder goes to the other side of the line or to the amplifier in a hi-fi system. When the on–off switch on the 20/20 is turned on, the line is opened and the recorder inserted in it; in the off position, the line is closed to bypass the recorder. Thus the 20/20 can be installed easily in even the simplest hi-fi system—between FM tuner and control unit, for example, but will be drawing current only when actually recording.

All the controls have been well thought out and well placed and no special habit is needed to operate them. With only 10 minutes of experience when assembling the system, I took it with me to a band festival and made 5 hours of recordings without the slightest difficulty.

The 20/20 is by no means as portable as the single-case, 25-pound Ampex 600. However, it can be put into two available cases (along with a playback amplifier available as an extra). The

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cases have plenty of room to take also a microphone, extension cords and several reels of tape. Though this outfit is pretty bulky and weighs well over 50 pounds, it isn't hard to carry in a car and is convenient to set up for operation. When a single recorder must do for both studio and portable work, this is an excellent combination for recording of the very highest quality.

The 20/20 has provisions to accommodate five heads but comes normally with three. The cheapest model has double-track heads. The model I tested is the TWR-1 which has single-track record and erase heads but a double-track playback head. For me this is the ideal combination for it permits professional-quality, single-track recording and playing back double-track recordings made on other recorders or prerecorded commercially. (The quality on 7½-ips prerecorded tapes is exceedingly good.) A wide variety of heads provides just about any combination for recording or playing back single- or double-track, monaural, binaural or all, etc. Those who have special needs should obtain complete specifications. The 20/20 is also available with 7½- and 3¾-ips speeds.

The 20/20 has all the professional type adjustments for bias, equalization, head alignment, etc. Incidentally, the meter can read the bias and be adjusted to give a 100% reading for the bias suitable for any tape. Adjustment is so simple that the supercritical can adjust the bias for different types and brands of tape in a minute or so. Construction is very fine and sturdy. Maintenance is very simple. The 20/20 can be mounted in standard racks or in custom cabinets, vertically or horizontally.

Recoton-Goldring cartridge

One of the things audiophiles have prayed for is a good $10 pickup cartridge with a response to 15,000 cycles or beyond. The Recoton-Goldring (made in England by Goldring and distributed in the U. S. by Recoton)sells for just under $10 (audiophile net). The curves of Fig. 2 were taken with the unequalized cartridge fed directly into an ac vtvm. The 78-rpm curve was taken with a Cook series-10 test record and the 33 rpm with a Cook series 10LP.

The 78-rpm needle has a serious peak at 12 kc, probably due to coupling of needle and record groove. Though the recommended load is 47,000 ohms, the actual load used accidentally was 33,000 ohms—which indicates that the load is not critical. The average output was 12 mv on LP and 25 mv on 78 rpm, or about 5 db higher than that of the G-E. The curves were recorded with a pressure of just over 5 grams and this gave good tracking on the first four bands of the Dubbings D-100 record. The IM distortion with the same Cook records was just a little higher than the lowest I have so far recorded. The tracking was not optimum because, when mounted in an arm which provides proper tracking for the G-E or Pickering, the Recoton-Goldring has about ½ inch less overhang. Presumably, repositioning the arm to provide optimum tracking would result in even better performance and, particularly, lower distortion.

There was no discernible hum at normal levels. Needle chatter is very low. The listening quality is thoroughly first class on LP discs and astonishingly low in scratch on old shellac 78's even when they are played back with a flat treble.

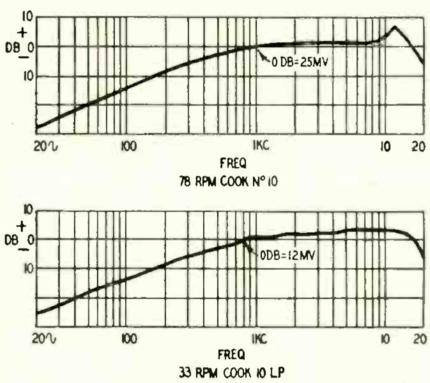

Fig. 2—Unequalized response of Recoton cartridge feeding an audio vtvm.

The cartridge is of the turnover variable-reluctance type with two entirely independent and nonreacting needles which, incidentally, can be changed simply. The cartridge mounts with ½-inch centers in all standard arms capable of taking the G-E. But, as I point out above, the needle will be farther back and hence tracking will not be optimum although the performance with such a tracking error is excellent. The cartridge is also available, at higher prices, with either one or two diamond needles.

Record destaticizers and cleaners

Modern plastic records are highly susceptible to acquiring an electrostatic charge which is expressed in the form of pops and crackles in playback and which also attracts dusts and dirt and thus contributes to wear. Various means are available to neutralize this charge or to clean the record. To test the effectiveness of destaticizing I worked out the following test: I tore a small piece of newsprint into the smallest particles I could manage and scattered them on a portion of a tabletop; the test record was rubbed briskly with a silk cloth to impart a high charge; the charge was verified by holding the record just above the bits of paper—the charge attracted them, making them stand on end and, in some instances, jump a gap of as much as ¼ inch; the record was then treated as recommended by the manufacturer; the record was once more tested for paper attraction.

Walco Stati-Clean is a liquid in an aerosol bomb type can. The manufacturer recommends spraying the record with two bursts and then wiping with a soft cloth. I thought the product was easier to apply uniformly by spraying the piece of cloth with a burst or two and then wiping the record. In either case Stati-Clean is completely effective in neutralizing the static charge. The manufacturer claims that the effect continues for as long as 6 months. I can verify that the record does remain neutral for 2 months.

Quiet is another liquid application which, however, contains also a cleaning agent and some sort of fatty lubricant. The manufacturer claims that it will destaticize records, loosen imbedded dirt so that it will be plowed up by the needle, lubricate the grooves to reduce friction between needle and groove and thus reduce wear and noise. Quiet is applied with a cellulose-sponge applicator supplied with the liquid. It destaticized the records for the 2 months of the test.

It unquestionably cleans the records. The dirt plowed up by the needle fouls the needle and it has to be brushed off—with a brush supplied. The first playback after application will sometimes foul the needle so completely that tracking will cease. But very noisy old shellac records treated once and played back twice subsequently provided much more pleasant reproduction. I had no way of verifying the effectiveness of the lubrication. If records are kept in albums between plays the lubricant does not seem to accelerate fouling.

The above preparations are inexpensive and most convenient to use. But those who want to roll their own can obtain effective destaticizing and cleaning by mixing the liquid detergent Joy with 10 parts of water in any convenient bottle. It can be applied to the records with a soft cloth, a bit of cellulose sponge or a piece of chamois. As a matter of fact, for destaticizing and removing surface lint and dust, a bit of chamois wetted with plain water and wrung out until it is merely moist, is fully effective.

A related problem often a great nuisance is that of lint and dust accumulating on the needle of the pickup and fouling it and the gap. The Kral Rec-O-Clean is a large flat camel-hair brush which resembles the chip-chasers used in disc recording. It is fastened to the turntable top with a pressure-sensitive adhesive disc and is adaptable to just about any size or height of turntable.

The gadget is simple and fairly convenient to use. It handles the problem nicely. The brush is too soft to do any damage. So far as I could determine any tendency for the constant rubbing to build up a static charge is so slow that the increase in frequency of destaticizing is insignificant. Cleaning and destaticizing records once in a while with one of the liquids and then using Rec-O-Clean regularly seems to minimize record troubles. END

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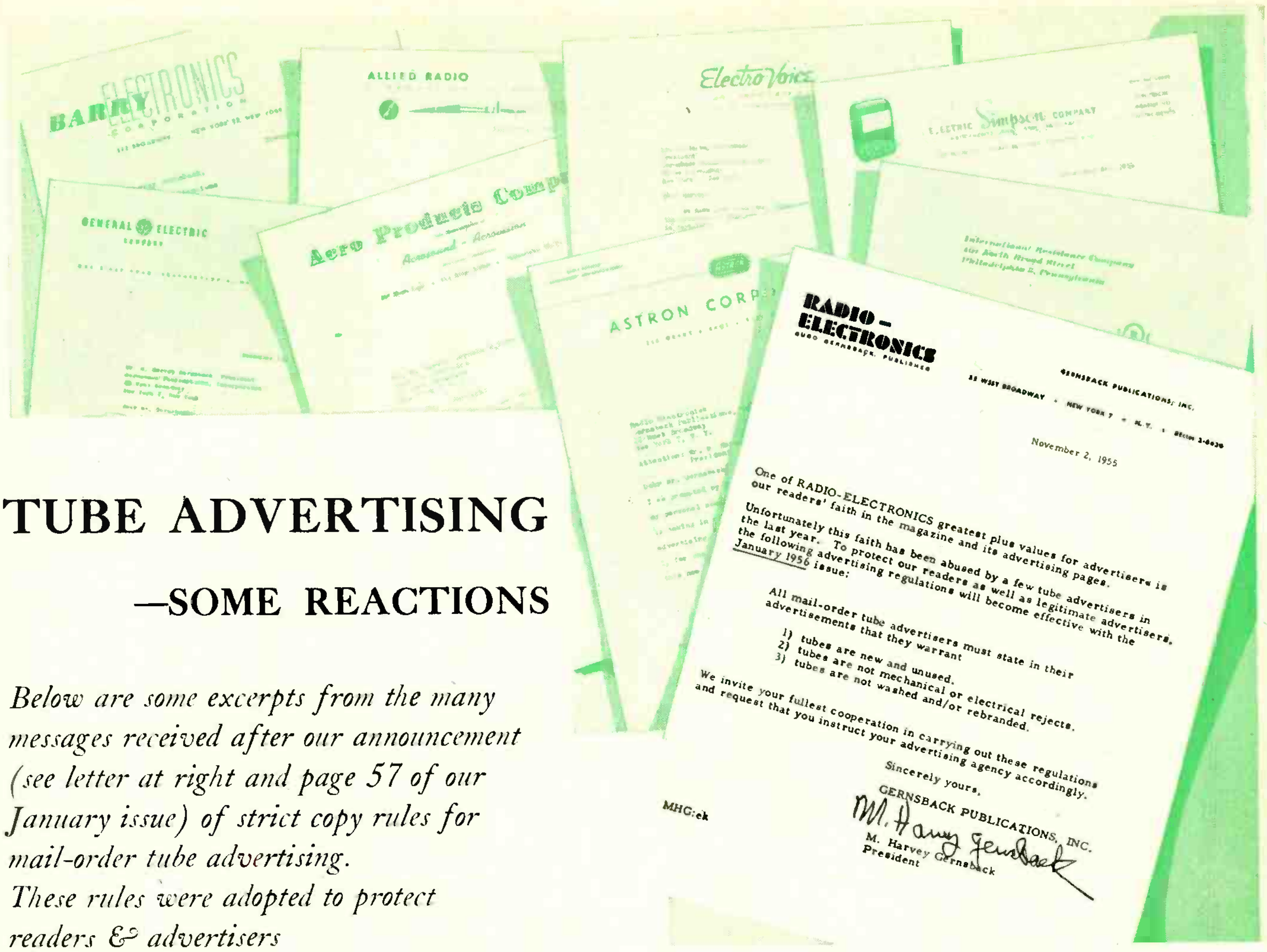

TUBE ADVERTISING

—SOME REACTIONS

Below are some excerpts from the many messages received after our announcement (see letter at right and page 57 of our January issue) of strict copy rules for mail-order tube advertising. These rules were adopted to protect readers & advertisers

TELEGRAM

HARVEY GERNSBACK, PRESIDENT, RADIO-ELECTRONICS
CONGRATULATIONS ON BOLD STAND ON ADVERTISING OF TUBES IN RADIO-ELECTRONICS. MEMBERS OF FEDERATION OF RADIO AND TV SERVICE ASSOCIATIONS, PENNSYLVANIA, PLEDGE TO DESTROY DEFECTIVE TUBES. FURTHER IMPROVEMENT IN MAGAZINE, ELIMINATE NET PRICES.
B. A. BREGENZER, PRESIDENT, FRSAP.

SIMPSON ELECTRIC CO.

I note your announcement of policy whereby rebranded or used electron tubes will no longer be advertised in your magazine. I wish to . . . add my applause to that of the majority of TV servicemen who have complained bitterly against the rebranded tube racket. We are all benefited by your courageous stand.

Undoubtedly, your new policy will cost you some advertising revenue, but I am confident that in the long-term pull, you will more than recoup any temporary loss.

R. G. MIDDLETON
Chief Field Engineer

BARRY ELECTRONICS

We applaud your courage in taking a positive stand against any dealer in the electron tube industry who engages in unscrupulous practices to the detriment of your readership and the industry.

This company has long been a proponent of selling 100 cents' worth of honest value with every dollar's worth of tubes sold, and it has paid off in customer confidence and repeat sales. Your new advertising regulations have long been standard practice with this company. May we refer you to our current ad in RADIO-ELECTRONICS and other publications in the electronics field?

B. N. GENSLER
President

ALLIED RADIO CORP.

All of us here want to congratulate you on this new policy, which can only strengthen your publication with readers and give greater value to advertisers.

ALEX BRODSKY
General Marketing Manager

ELECTRO-VOICE, INC.

We have just read your announcement of the policing of your ads on radio tube offerings. This is certainly a fine effort and we know it will redound to the success of RADIO-ELECTRONICS in the long run.

A like statement, or declaration of policy, to advertisers who abuse the name "high fidelity" would set bells ringing in wild acclaim from over 100 true high-fidelity manufacturers we know of!

HOWARD SOUTHER
Marketing Director

INTERNATIONAL RESISTANCE CO.

I received your note of Dec. 6 advising us of your new policy and I heartily concur. I don't believe that any magazine can carry water on both shoulders. As soon as this situation is cleared up, the industry can go forward.

H. A. EHLE
Executive Vice President

GENERAL ELECTRIC CO.

I appreciate your Dec. 6 letter and the announcement which will appear in the January RADIO-ELECTRONICS concerning advertising policy for mail-order receiving tubes.

Your action should benefit reader and advertiser alike. You deserve hearty congratulations for such forthright action to insure that products advertised in RADIO-ELECTRONICS are properly represented.

GRADY L. ROARK
Manager—Tube Sales

ACRO PRODUCTS CO.

The new advertising policy . . . in your publication deserves a vote of thanks from every business man. It took great courage to make the first step in the direction that I hope will be followed by others in the advertising industry.

JACK SNYDERMAN
Sales Manager

END

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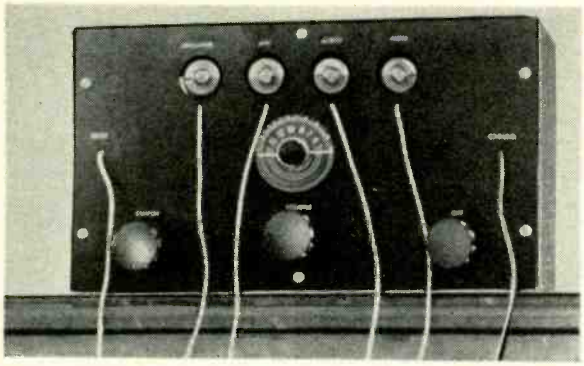
INTERMITTENT SET TESTER

A terrific time saver, tester monitors several circuits simultaneously

By JOHN A. DEWAR

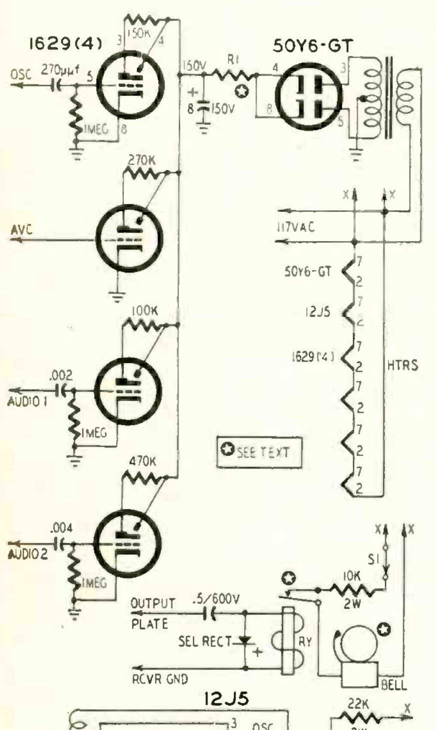


Panel view of the intermittent tester.

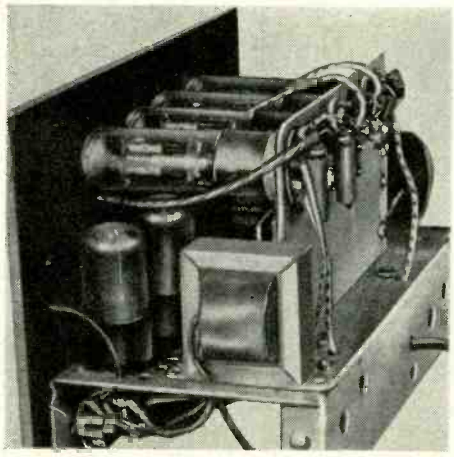
RADIOS which cut off or drop in volume periodically are one of the service technician's worst headaches. This intermittent checker (see diagram) is designed to simplify servicing such sets. It consists of three units on one chassis:

1. A self-contained oscillator to supply a constant signal to the set so that the bench signal generator will not be tied up.

2. An output warning device consisting of a rectifier, relay and bell to indicate when the set cuts off. The speaker voice coil can be disconnected so that the technician does not have to keep one ear cocked or be bothered by the noise and can carry on with other work.



Schematic of set tester — instrument operates from an isolation transformer.



Side view shows components layout.

3. Four electron-ray indicators, coupled to the receiver local oscillator, a.v.c. and first and second audio grids or plates, assist in isolating the fault. For instance, if the second audio indicator shows no signal, the fault is in that circuit. Similarly if the first and second eyes are open, the fault follows the second detector. No a.v.c. indication means the i.f. or r.f. end is dead. The oscillator "eye" open indicates a dead oscillator. (Connecting a test lead to the oscillator grid will detune it to some extent so that compensation will have to be made.)

Series 150-ma tubes were used to eliminate a filament transformer. However 6.3-volt tubes could be used as well with a suitable power transformer. Circuit values and plate voltage of the 1629 tubes were chosen for maximum sensitivity so that the signal level in the set under test would not have to be run too high. A transformer is used to keep the chassis isolated from the line. Since the plate current of the 1629 tubes is small (under 1 ma) a junkbox push-pull audio input transformer can be used and the filter resistor R1 selected to provide the required 150 volts.

The relay (surplus) is a sensitive 5,000-ohm normally closed type requiring from 2 to 3 ma to open. It is coupled to the plate of the receiver output tube through a 0.5-μf capacitor. A standard 65-ma selenium rectifier connected across the relay changes the audio signal to d.c. The other side connects to the receiver ground. The set tester is isolated from the tester chassis so that it will not be hot for a.c.–d.c. sets.

The relay can be used to turn on a light or any other signaling device. In this instrument a buzzer was tried but it set up sufficient r.f. noise to jar the set under test back into operation. The bell is a home-made affair using a small magnetic speaker unit. The hammer from an old alarm clock is soldered to the armature and the clock also supplied the bell. The unit is run from the a.c. line through a 10,000-ohm dropping resistor and, since there is no make-and-break contact, no interference is produced. Switch S1 shuts the bell off after warning of a cutoff.

The self-contained oscillator is a simple tickler feedback type using a broadcast antenna coil and capacitor. The 10,000-ohm potentiometer controls the intensity of oscillation so that for maximum sensitivity the output can be adjusted to a point just beyond where the relay closes. The a.c. on the plate supplies the modulation. Varying the plate voltage varies the oscillator frequency slightly so that it will be necessary to readjust the tuning capacitor. The a.c. section of the oscillator is not connected to the chassis, isolating it from the line. Sufficient signal is fed into the receiver through the other leads so that no direct connection is needed.

The 1629 electron-ray tubes are used because they are available very cheaply from surplus. However their 6-volt equivalent, the 6E5, could be used with a filament transformer. One or two more 1629's could be added to the tester for additional audio checks by substituting a 35Z5 half-wave rectifier for the 50Y6. END

Parts for set tester

Resistors: 1—47,000, 1—100,000, 1—150,000, 1—270,000, 1—470,000 ohms, 3—1 megohm, ½ watt; 1—10,000, 1—22,000 ohms, 2 watts; 1—10,000-ohm potentiometer; 1—R1 (see text).

Capacitors: 2—270 μμf, 1—.002, 1—.004, 1—.01 μf, 400 volts; 1—0.5 μf, 600 volts; 1—8 μf, 150 volts, electrolytic; 1—365 μμf, variable, broadcast type.

Miscellaneous: 4—1629's and sockets; 1—50Y6 and socket; 1—12J5 and socket; 1—antenna coil, broadcast type; 1—selenium rectifier, 130 volts, 65 ma; 1—relay, 5,000 ohms, normally closed, sensitive (see text); 1—bell; 2—s.p.s.t. switches; 1—transformer, 1:1 isolation type (see text); 1—chassis; 1—front panel; 3—knobs; 1—tuning dial; 6—test leads; 1—line cord.

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THE WORLD'S LEADING MANUFACTURER OF ELECTRONIC KITS . . .

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V-7A VACUUM TUBE VOLTMETER: Easily the world's largest selling VTVM. Features peak-to-peak scales—etched metal circuit board—1% precision resistors—full wave rectifier and AC input circuit—reads rms and peak-to-peak AC, DC, and ohms.

O-10 LABORATORY TYPE OSCILLOSCOPE: The world's largest selling oscilloscope kit, and the most successful oscilloscope in history. Designed especially for color and black-and-white TV service work. Its 5 megacycle bandwidth and new 500 Kc sweep generator readily qualify it for laboratory applications. Features easy-to-assemble etched metal circuit board construction.

WA-P2 HIGH FIDELITY PREAMPLIFIER: This is the world's largest selling hi fi preamplifier kit. Features complete equalization, 5 separate switch-selected inputs with individual pre-set level controls, beautiful modern appearance, high-quality components.

HIGH FIDELITY AMPLIFIERS: Five Heathkit Models to choose from at prices ranging from $16.95 to $59.75. Power output range from 7 to 25 watts.

DX-100 TRANSMITTER: A 100 watt phone and CW ham transmitter, offering the greatest dollar value available in the ham radio field today.

Greatest Dollar Value Through Factory-To-You Selling!

ONLY Heathkits CAN GIVE YOU ALL OF THESE DISTINCTIVE ADVANTAGES!

- *The Most Complete Construction Manuals for Easy Assembly.*
- *Originality of Design—Developed Through Pioneering in the Kit Instrument Field.*
- *Greatest Dollar Value—Finest Quality with Real Economy.*
- *Direct Contact with Manufacturer—Lower Price, Guaranteed Performance.*
- *Etched Metal, Prewired Circuit Boards—Save Construction Time, Improve Performance.*
- *High Quality Standard Components for Long-Life Service.*

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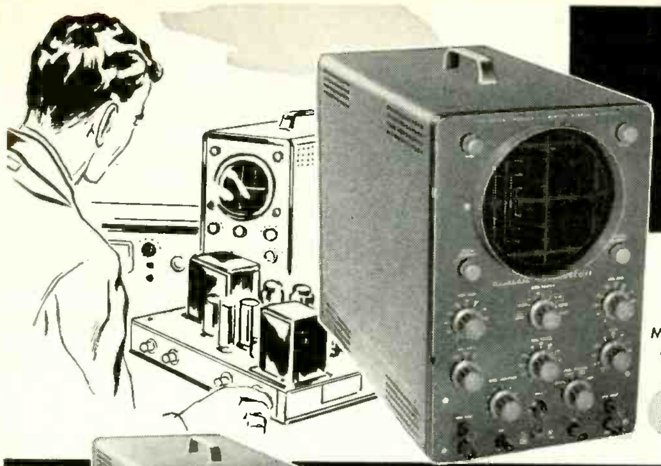
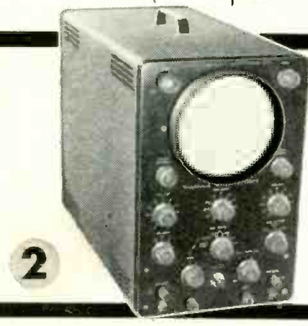


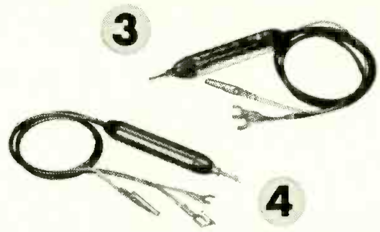
MODEL O-10

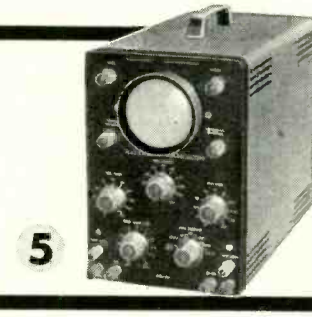
there is no substitute for

HEATHKIT QUALITY

YOU GET MORE: *All first-run, top quality parts—the latest in electronic design—complete and comprehensive step-by-step assembly instructions with large pictorial diagrams and assembly drawings. Proven performance through the production of thousands of kits.*







❶ *Heathkit* ETCHED CIRCUIT COLOR-TV 5″ OSCILLOSCOPE KIT

This deluxe quality oscilloscope has proven itself through thousands of operating hours in service shops and laboratories. Features the best in components—and the best in circuit design.

Features amplifier response to 5 Mc for color TV work, and employs the radically new sweep circuit to provide stable operation up to 500,000 cps. In addition, etched metal, pre-wired circuit boards cut assembly time almost in half, and permit a level of circuit stability never before achieved in an oscilloscope of this type.

Vertical amplifiers flat within +2 db −5 db from 2 cps to 5 Mc, down only 1½ db at 3.58 Mc. Vertical sensitivity is 0.025 volts, (rms) per inch at 1 Kc. 11 tube circuit employs a 5UP1 CRT.

Plastic molded capacitors used for coupling and bypass—preformed and cabled wiring harness provided.

Features built-in peak-to-peak calibrating source—retrace blanking amplifier—push-pull amplifiers and step-attenuated input.

MODEL O-10
$69.50
Shpg. Wt. 21 Lbs.

❷ *Heathkit* ETCHED CIRCUIT 5″ OSCILLOSCOPE KIT

This is a general purpose oscilloscope for the more usual applications in the service shop or lab, yet is comparable to scopes costing many dollars more.

Features full size 5″ CRT (5BP1), built-in peak-to-peak voltage calibration—3 step input attenuator—phasing control—push-pull deflection amplifiers—and etched metal prewired circuit boards.

Vertical channel flat within ±3 db from 2 cps to 200 Kc, with 0.09 V. rms/inch, peak-to-peak sensitivity at 1 Kc. Sweep circuit from 20 cps to 100,000 cps. A scope you will be proud to own and use.

MODEL OM-1
$49.50
Shpg. Wt. 21 Lbs.

❸ *Heathkit* LOW CAPACITY PROBE KIT

Scope investigation of circuits encountered in TV requires the use of special low capacity probe to prevent loss of gain, circuit loading, or distortion. This probe features a variable capacitor to provide correct instrument impedance matching. Also the ratio of attenuation can be controlled.

NO. 342
$3.50
Shpg. Wt. 1 Lb.

❹ *Heathkit* ETCHED CIRCUIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your Oscilloscope by observing modulation envelope of R.F. or I.F. carriers found in TV and radio receivers. Functions like AM detector to pass only modulation of signal and not signal itself. Applied voltage limits are 30 V. RMS and 500 V. DC.

NO. 337-C
$3.50
Shpg. Wt. 1 Lb.

❺ *Heathkit* ETCHED CIRCUIT 3″ OSCILLOSCOPE KIT

This compact little oscilloscope measures only 9½″ H. x 6½″ W. x 11¾″ D., and weighs only 11 lbs! Easily employed for home service calls, for work in the field or is just the ticket for use in the ham shack or home workshop. Incorporates many of the features of the Model OM-1, but yet is smaller in physical size for portability.

Employing etched circuit boards, the Model OL-1 features vertical response within ± 3 db from 2 cps to 200 Kc. Vertical sensitivity is 0.25 V. RMS/inch peak-to-peak, and sweep generator operates from 20 cps to 100,000 cps. Provision for r.f. connection to deflection plates for modulation monitoring, and incorporates many features not expected at this price level. 8-tube circuit features a type 3GP1 Cathode Ray Tube.

MODEL OL-1
$29.50
Shpg. Wt. 14 Lbs.

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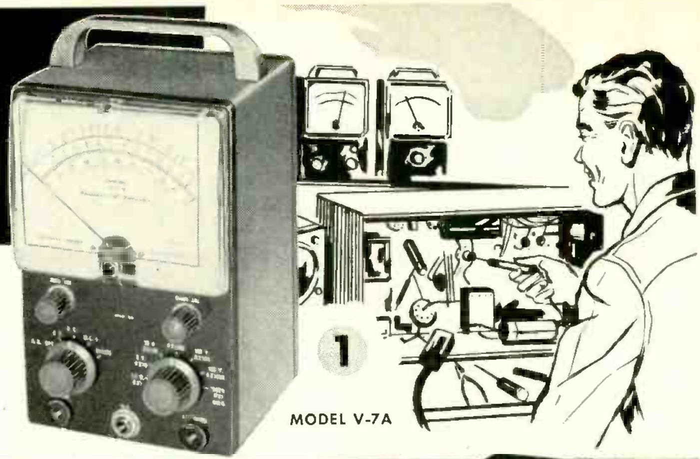
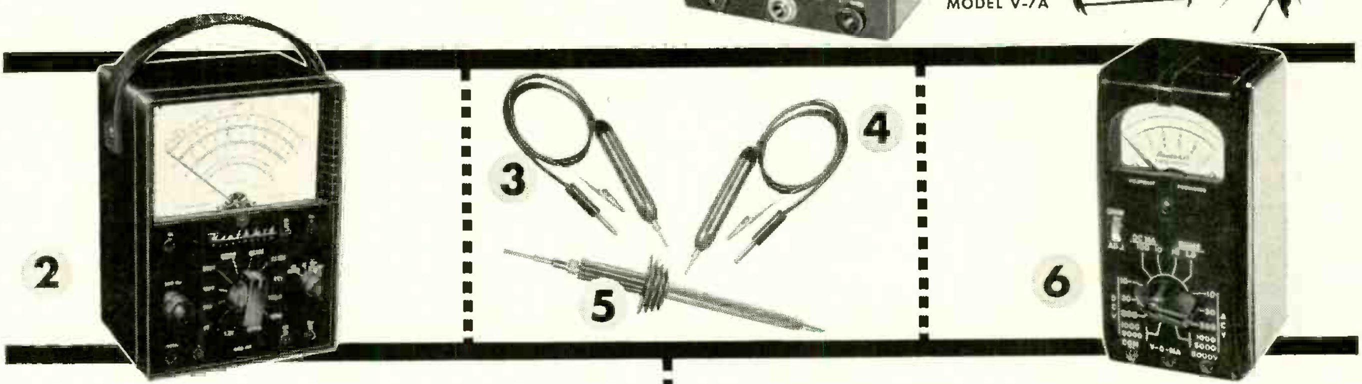
fill your test requirements

WITH HEATHKITS



DESIGNED FOR YOU: *Heath Company test equipment is designed for the maximum in convenience. Besides being functional, Heathkits represent the very latest in modern physical appearance, and incorporate all the latest circuit design features for comprehensive test coverage.*



❶ *Heathkit* ETCHED CIRCUIT VACUUM TUBE VOLTMETER KIT

Besides measuring AC (rms), DC and resistance, the modern-design V-7A incorporates peak-to-peak measurement for FM and television servicing.

AC (rms) and DC voltage ranges are 1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC voltage ranges are 4, 14, 40, 140, 400, 1400, and 4000. Ohmmeter ranges are X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Also a db scale is provided. A polarity reversing switch provided for DC measurements, and zero center operation within range of front panel controls. Employs a 200 μa meter for indication. Input impedance is 11 megohms.

Etched metal, pre-wired circuit board for fast, easy assembly and reliable operation is 50% thicker for more rugged physical construction. 1% precision resistors for utmost accuracy.

MODEL V-7A
$24.50
Shpg. Wt. 7 Lbs.

❷ *Heathkit* 20,000 OHMS/VOLT MULTIMETER KIT

The MM-1 is a portable instrument for outside servicing, for field testing, or for quick portability in the service shop. Combines attractive physical appearance with functional design. 20,000 ohms/v. DC, and 5000 ohms/v. AC. AC and DC voltage ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5000 volts. Direct current ranges are 0-150 μa., 15 ma., 150 ma., 500 ma., and 15 amperes. Resistance ranges are X1, X100, X10,000 providing center scale readings of 15, 1500 and 150,000 ohms. DB ranges cover −10 db to +65 db.

Features a 4½" 50 μa. meter. Provides polarity reversal on DC measurements. 1% precision resistors used in multiplier circuits. Not affected by RF fields.

MODEL MM-1
$29.50
Shpg. Wt. 6 Lbs.

❸ *Heathkit* ETCHED CIRCUIT RF PROBE KIT

The Heathkit RF Probe used in conjunction with any 11 megohm VTVM will permit RF measurements up to 250 Mc with ± 10% accuracy. Uses etched circuits for increased circuit stability and ease of assembly.

NO. 309-C
$3.50
Shpg. Wt. 1 Lb.

❹ *Heathkit* ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Now read peak-to-peak voltages on the DC scale of any 11 megohm VTVM with this new probe, employing etched circuit for stability and low loss. Readings made directly from VTVM scales, from 5 Kc to 5 Mc. Not required for Heathkit Model V-7A VTVM.

NO. 338-C
$5.50
Shpg. Wt. 2 Lbs.

❺ *Heathkit* 30,000 VOLT D.C. HIGH VOLTAGE PROBE KIT

For TV service work or similar application for measurement of high DC voltage. Precision multiplier resistor mounted inside plastic probe. Multiplication factor of 100 on the ranges of Heathkit 11 megohm VTVM.

NO. 336
$4.50
Shpg. Wt. 2 Lbs.

❻ *Heathkit* HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Measures direct current at 0-10 ma. and 0-100 ma. Provides ohmmeter ranges of 0-3000 (30 ohm center scale) and 0-300,000 ohms (3000 ohms center scale). Features a 400 μa. meter for sensitivity of 1000 ohms/volt. Because of its size, the M-1 is a very handy portable instrument that will fit in your coat pocket, tool box, glove compartment, or desk drawer. Makes a fine standby unit in the service shop when the main instruments are in use, or is ideal for the hobbyist or beginner. An unusual dollar value.

MODEL M-1
$14.50
Shpg. Wt. 3 Lbs.

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Heathkit TV ALIGNMENT

GENERATOR KIT

The Model TS-4 features a controllable inductor for all-electronic sweep, improved oscillator and automatic gain circuitry, high RF output, center sweep operation, and improved linearity. It sets a new high standard for sweep generator operation, and is absolutely essential for the up-to-date service shop doing FM, black-and-white TV, and color TV work.

Voltage regulation and effective AGC action insure flat output over a wide frequency range. Electronic sweep insures complete absence of mechanical vibration. Sweep deviation controllable from 0 up to 40 Mc, depending upon base frequency. Effective two-way blanking.

Fundamental output from 3.6 Mc to 220 Mc in 4 bands. Crystal marker provides markers at 4.5 Mc and multiples thereof. Crystal included with kit. Variable marker covers from 19 Mc to 60 Mc on fundamentals, and up to 180 Mc on harmonics. Provision for external marker.

MODEL TS-4 **$49.50** Shpg. Wt. 16 Lbs.

❶ *Heathkit* LINEARITY PATTERN GENERATOR KIT

The new-design Model LP-1 produces vertical or horizontal bar patterns, a cross-hatch pattern, or white dots on the screen of the TV set under test. No internal connections required. Special clip is attached to the TV antenna terminals. Instant selection of the pattern desired for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Dot pattern presentation is a *must* for color convergence adjustments on color TV sets.

Extended operating range covers all television channels from 2 to 13. Produces 6 to 12 vertical bars or 4 to 7 horizontal bars.

MODEL LP-1 **$22.50** Shpg. Wt. 7 Lbs.

❷ *Heathkit* LABORATORY GENERATOR KIT

The Heathkit Model LG-1 Laboratory Generator is a high-accuracy signal source for applications where metered performance is essential It covers from 100 Kc to 30 Mc on fundamentals in 5 bands. Modulation is at 400 cycles, and modulation is variable from 0-50%. RF output from 100,000 μv. to 1 μv. 200 μa. meter reads the RF output in microvolts, or percentage of modulation. Fixed step and variable output attenuation provided.

Features voltage regulation, and double copper plated shielding for stability. Provision for external modulation. Coaxial output cable (50 ohms).

MODEL LG-1 **$39.50** Shpg. Wt. 16 Lbs.

❸ *Heathkit* CATHODE RAY TUBE CHECKER KIT

This new-design instrument holds the key to rapid and complete picture tube testing, either in the set, on the work-bench, or in the carton. Tests for shorts, leakage, and emission. Features Shadowgraph test (a spot of light on the screen) to indicate whether the tube is capable of functioning.

The Model CC-1 tests all electromagnetic deflection picture tubes normally encountered in television servicing. Supplies all operating voltages to the tube under test, and indicates the condition of the tube on a large "GOOD-BAD" scale. Features spring loaded test switches for operator protection.

The CC-1 is housed in an attractive portable case and is light in weight — ideal for outside service calls.

MODEL CC-1 **$22.50** Shpg. Wt. 10 Lbs.

❹ *Heathkit* DIRECT READING CAPACITY METER KIT

Not only is this instrument popular in the service shop, but it has found extensive application in industrial situations. Ideal for quality control work, production line checking, or for matching pairs.

Features direct reading linear scales from 100 mmf to .1 mfd full scale. Necessary only to connect a capacitor of unknown value to the insulated binding posts, select the correct range, and read the meter. The CM-1 is not susceptible to hand capacity, and has a residual capacity of less than 1 mmf.

MODEL CM-1 **$29.50** Shpg. Wt. 7 Lbs.

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MODEL SG-8 **$19.50**
Shpg. Wt. 8 Lbs.

This is one of the biggest signal generator bargains available today. The tried and proven Model SG-8 offers all of the outstanding features required for a basic service instrument. High quality components and outstanding performance.

The SG-8 covers 160 Kc to 110 Mc on fundamentals in 5 bands, and calibrated harmonics extend its usefulness up to 220 Mc. The output signal is modulated at 400 cps, and the RF output is in excess of 100,000 uv. Output controlled by both a continuously variable and a fixed step attenuator. Also, audio output may be obtained for amplifier testing. Don't let the low price deceive you. This is a professional type service instrument to fulfill the signal source requirements in the service lab.

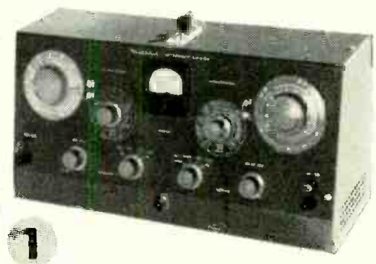
Heathkit SIGNAL GENERATOR KIT

❶ *Heathkit* . . . IMPEDANCE BRIDGE KIT

The IB-2 features built-in adjustable phase shift oscillator and amplifier, and has panel provisions for external generator. Measures resistance, capacitance, inductance, dissipation factors of condensers, and storage factor of inductance.

D, Q, and DQ functions combined in one control. ½% resistors and ½% silver-mica capacitors especially selected for this instrument. A 100-0-100 microammeter provides null indications. Two-section CRL dial provides 10 separate "units" with an accuracy of .5%. Fractions of units read on variable control.

MODEL IB-2 **$59.50**
Shpg. Wt. 12 Lbs.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❷ *Heathkit* "Q" METER KIT

The Heathkit Model QM-1 will measure the Q of inductances and the RF resistance and distributed capacity of coils. Employs a 4½" 50 microampere meter for direct indication. Will test at frequencies of 150 Kc to 18 Mc in 4 ranges. Measures capacity from 40 mmf to 450 mmf within ± 3 mmf. Indispensible for coil winding and determining unknown condenser values. A worthwhile addition to your laboratory at an outstandingly low price. Useful for checking wave traps, chokes, peaking coils, etc. Laboratory facilities are now available to the service shop and home lab.

MODEL QM-1 **$44.50**
Shpg. Wt. 14 Lbs.


2

❸ *Heathkit* 6–12 VOLT BATTERY ELIMINATOR KIT

This modern battery eliminator will supply 6 or 12 volt output for ordinary automobile radios as well as 12 volts for the new models in the latest model cars. Output voltage is variable from 0-8 volts DC, or 0-16 volts DC. Will deliver up to 15 amperes at 6 volts, or up to 7 amperes at 12 volts. Two 10,000 microfarad filter capacitors insure smooth DC output. Two panel meters monitor output voltage and current. Will double as a battery charger. Definitely required for automobile radio service work.

MODEL BE-4 **$31.50**
Shpg. Wt. 17 Lbs.


3

❹ *Heathkit* DECADE RESISTANCE KIT

Twenty 1% precision resistors provide resistance from 1 to 99,999 ohms in 1 ohm steps. Indispensible around service shop laboratory, ham shack, or home workshop. Well worth the extremely low Heathkit price.

MODEL DR-1 **$19.50**
Shpg. Wt. 4 Lbs.

❺ *Heathkit* VIBRATOR TESTER KIT

Tests vibrators for proper starting and indicates the quality of the output on a large "GOOD-BAD" scale. Checks both interrupter and self-rectifier types in 5 different sockets. Operates from any battery eliminator delivering variable voltage from 4 to 6 volts DC at 4 amps. Ideal companion to the Model BE-4.

MODEL VT-1 **$14.50**
Shpg. Wt. 6 Lbs.

❻ *Heathkit* DECADE CONDENSER KIT

Provides capacity values from 100 mmf to 0.111 mfd in steps of 100 mmf. ± 1% precision silver-mica condensers used. High quality ceramic switches for reduced leakage. Polished birch cabinet. Extremely valuable in all electronic activity.

MODEL DC-1 **$16.50**
Shpg. Wt. 3 Lbs.


5
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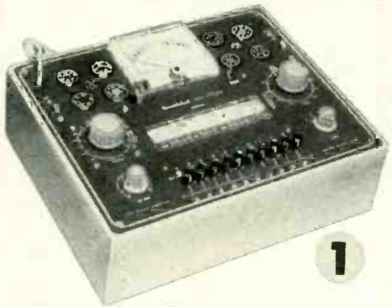
Heathkit TUBE CHECKER KIT



1 The Heathkit Model TC-2 is an emission type tube tester that represents a tremendous saving over the price of a comparable unit from any other source. At only $29.50, you can have a tube tester of your own, even if you are an experimenter, or only do part time service work. Extremely popular with radio servicemen, it uses a 4½" meter with 3-color meter face for simple "GOOD-BAD" indications that the customer can understand. Will test all tubes commonly encountered in radio and TV service work.

Ten 3-position lever switches for "open" or "short" tests on each tube element. Neon bulb indicates filament continuity or short between tube elements. Line adjust control provided. The roll chart is illuminated.

Sockets provided for 4, 5, 6, and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, and the 5 pin Hytron tubes. Blank space provided for future socket addition. Tests tubes for opens, and shorts, and for quality on the basis of total emission. 14 different filament voltage values provided.

MODEL TC-2
$29.50
Shpg. Wt. 12 lbs.

2 *Heathkit* PORTABLE TUBE CHECKER KIT

The Model TC-2P is identical to the Model TC-2 except that it is housed in a rugged carrying case. This strikingly attractive and practical two-tone case is finished in proxylin impregnated fabric. The cover is detachable, and the hardware is brass plated. This case imparts a real professional appearance to the instrument. Ideal for home service calls, or any portable application.

MODEL TC-2P
$34.50
Shpg. Wt. 15 lbs.

3 *Heathkit* TV PICTURE TUBE TEST ADAPTER

The Heathkit TV picture tube test adapter is designed for use with the Model TC-2 Tube Checker. Test picture tubes for emission, shorts, and thereby determine tube quality. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. (Not a kit.)

MODEL 355
$4.50
Shpg. Wt. 1 lb.

4 *Heathkit* . . . CONDENSER CHECKER KIT

Use this Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings taken directly from the calibrated panel scales without any involved calculation. Capacity measurements in four ranges from .00001 to 1000 mfds. Checks paper, mica, ceramic and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser efficiency. Leakage test switch—selection of five polarizing voltages, 25 volts to 450 volts DC to indicate condenser operating quality under actual load conditions. Spring-return test switch automatically discharges condenser under test and eliminates shock hazard to the operator.

Resistance measurements can be made in the range from 100 ohms to 5 megohms. Here again, all values are read directly on the calibrated scales. Increased sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

For safety of operation, the circuit is entirely transformer operated. An outstanding low kit price for this surprisingly accurate instrument.

MODEL C-3
$19.50
Shpg. Wt. 7 lbs.

5 *Heathkit* VISUAL-AURAL SIGNAL TRACER KIT

This signal tracer is extremely valuable in servicing AM, FM, and TV receivers, especially when it comes to isolating trouble to a particular stage of the circuit under test.

This visual-aural tracer features a high gain RF input channel to permit signal tracing from the receiver antenna input clear through all RF, IF, detector, and audio stages to the speaker. Separate low-gain channel provided for audio circuit exploration. Both visual and aural indication by means of a speaker or headphone, and electron beam "eye" tube as a level indicator. Also incorporates a noise locater circuit for DC noise checks, and a built-in calibrated wattmeter (30-500 watts). Panel terminals provided for "patching" output transformer or speaker into external circuit for test purposes. Designed especially for the radio and TV serviceman. Cabinet size: 9½" wide x 6½" high x 5" deep. A real test equipment bargain.

MODEL T-3
$23.50
Shpg. Wt. 9 lbs.

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MODEL HD-1

Shpg. Wt. 13 Lbs. **$49.50**

Used with a sine wave generator, the Model HD-1 will check the harmonic distortion output of audio amplifiers under a variety of conditions. Reads distortion directly on the meter as a percentage of the input signal. Operates between 20 and 20,000 cps. High impedance VTVM circuit for initial reference settings and final distortion readings. Ranges are 0-1, 3, 10, and 30 volts full scale. 1% precision resistors. Distortion scales are 0-1, 3, 10, 30 and 100% full scale. Requires only .3 volt input for distortion test.

Heathkit HARMONIC DISTORTION METER KIT

❶ *Heathkit* AUDIO ANALYZER KIT

This instrument consists of an audio wattmeter, an AC VTVM, and a complete IM analyzer, all in one compact unit.

Use the VTVM to measure noise, frequency response, output gain, power supply ripple, etc. Use the wattmeter for measurement of power output. Internal loads provided for 4, 8, 16, or 600 ohms. VTVM also calibrated for DBM units. High or low impedance IM measurements made with built-in 6KC and 60 cps generators. VTVM ranges are .01, to 300 volts in 10 steps. Wattmeter ranges are .15 mw. to 150 w. in 7 steps. IM scales are 1% to 100% in 5 steps.

MODEL AA-1 **$59.50** Shpg. Wt. 13 Lbs.

❷ *Heathkit* AUDIO GENERATOR KIT

This new Heathkit Model features step-tuning from 10 cps to 100 Kc with three rotary switches that provide two significant figures and multiplier. Less than .1% distortion. Frequency accurate to within ± 5%.

Output monitored on a large 4½" meter that reads voltage or db. Both variable and step-type attenuation provided. Meter reads zero-to-maximum at each attenuator position. Output ranges (and therefore meter ranges) are 0-.003, .01, .03, .1, .3, 1, 3, 10 volts. Step-tuning provides rapid positive selection of the desired frequency, and allows accurate return to any given frequency.

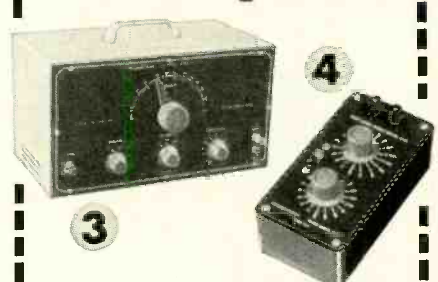
MODEL AG-9 **$34.50** Shpg. Wt. 8 Lbs.

❸ *Heathkit* AUDIO OSCILLATOR KIT

(SINE WAVE — SQUARE WAVE)

The Model AO-1 features sine wave or square wave coverage from 20-20,000 cps in 3 ranges. It is an instrument specifically designed to completely fulfill the needs of the serviceman and high fidelity enthusiast. Offers high level output across the entire frequency range, low distortion and low impedance output. Features a thermistor in the second amplifier stage to maintain essentially flat output through the entire frequency range. Produces an excellent sine wave for audio testing, or will produce good, clean, square waves with a rise time of only 2 microseconds.

MODEL AO-1 **$24.50** Shpg. Wt. 10 Lbs.



❹ *Heathkit* RESISTANCE SUBSTITUTION BOX KIT...

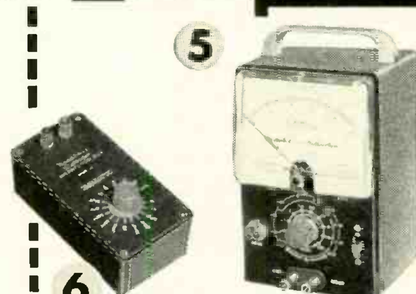
Provides switch selection of 36 RTMA 1 watt standard 1% resistors ranging from 15 ohms to 10 megohms. Numerous applications in radio and TV work, and essential in the developmental laboratory.

MODEL RS-1 **$5.50** Shpg. Wt. 2 Lbs.

❺ *Heathkit* AC VACUUM TUBE VOLTMETER KIT...

The Heathkit AC VTVM features high impedance, wide frequency range, very high sensitivity, and extremely wide voltage range. Will accurately measure a voltage as small as 1 mv. at high impedance. Excellent for sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Frequency response is substantially flat from 10 cps to 50 Kc. Ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 v. RMS. Total db range −52 to + 52 db. Input impedance 1 megohm at 1 Kc.

MODEL AV-2 **$29.50** Shpg. Wt. 5 Lbs.



❻ *Heathkit* CONDENSER SUBSTITUTION BOX KIT...

Very popular companion to Heathkit RS-1. Individual selection of 18 RTMA standard condenser values from .0001 mfd to .22 mfd. Includes 18" flexible leads with alligator clips.

MODEL CS-1 **$5.50** Shpg. Wt. 2 Lbs.

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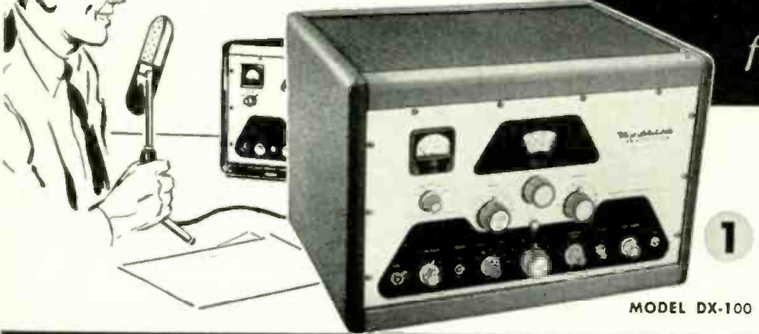
HEATHKIT HAM GEAR

for high quality at moderate cost



1

MODEL DX-100

DOLLAR VALUE: *You get more for your Heathkit dollar because your labor is used to build the kit instead of paying for someone else's. Also, the middleman's margin of profit is eliminated when you deal directly with the manufacturer.*

2

3

4

❶ *Heathkit* DX-100 PHONE & CW TRANSMITTER KIT

The reception given this amateur transmitter has been tremendous. Reports from radio amateurs using the DX-100 are enthusiastic in praising its performance and the high quality of the components used in its assembly. Actual "on the air" results reflect the careful design that went into its development.

The DX-100 features a built-in VFO, modulator, and power supplies, and is completely bandswitching for phone or CW operation on 160, 80, 40, 20, 15, 11, and 10 meters. All parts necessary for construction are supplied in the kit, including tubes, cabinet, and detailed step-by-step instructions. Easy to build, and a genuine pleasure to operate.

Employs push-pull 1625's modulating parallel 6146's for RF output in excess of 100 watts on phone and 120 watts on CW. May be excited from the built-in VFO or from crystals (crystals not included with kit). Features five-point TVI suppression: (1) pi network interstage coupling to reduce harmonic transfer to the final stage; (2) pi network output coupling; (3) extensive shielding; (4) all incoming and outgoing circuits filtered; (5) inter-locking cabinet seams to eliminate radiation except through the coaxial output connector. Pi network output coupling will match 50 to 600 ohm non-reactive load. Illuminated VFO dial and meter face. Remote control socket provided.

The chassis is made of extra-strong #16 gauge copper-plated steel. It employs potted transformers, ceramic switch and variable capacitor insulation, solid silver loading switch terminals, and high-grade well-rated components throughout. Features a pre-formed wiring harness, and all coils are pre-wound.

High-gain speech amplifier for dynamic or crystal microphones, and restricted speech range for increased intelligence. Plenty of audio power reserve. Measures 20⅞" W. x 13¾" H. x 16" D. Schematic diagram and complete technical specifications on request.

MODEL DX-100
$189.50
Shpg. Wt. 120 lbs.

Shipped Motor Freight Unless Otherwise Specified
$50.00 Deposit Required on C.O.D. Orders

❷ *Heathkit* VFO KIT

The Model VF-1 covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10-volt average RF output on fundamentals. Features illuminated and pre-calibrated dial scale. Cable and plug provided to fit crystal socket of any modern transmitter.

Enjoy the convenience and flexibility of VFO operation at no more than the price of crystals. May be powered from plug on the Heathkit Model AT-1 transmitter, or supplied with power from most transmitters. Measures: 7" H. x 6½" W. x 7" D.

MODEL VF-1
$19.50
Shpg. Wt. 7 lbs.

❸ *Heathkit* CW AMATEUR TRANSMITTER KIT

The Model AT-1 is an ideal novice transmitter, and may be used to excite a higher power rig later on.

This CW transmitter is complete with its own power supply, and covers 80, 40, 20, 15, 11, and 10 meters. Features single-knob bandswitching, and panel meter indicates grid or plate current for the final amplifier. Designed for crystal operation or external VFO. Crystal not included in kit. Incorporates such features as key click filter, line filter, copper-plated chassis, pre-wound coils, 52 ohm coaxial output, and high quality components throughout. Instruction book simplifies assembly. Employs a 6AG7 oscillator, 6L6 final amplifier. Operates up to 35 watts plate power input.

MODEL AT-1
$29.50
Shpg. Wt. 15 lbs.

❹ *Heathkit* . . . ANTENNA COUPLER KIT

The Model AC-1 will properly match your low power transmitter to an end-fed long wire antenna. Also attenuates signals above 36 Mc, reducing TVI. 52 ohm coax. input—power up to 75 watts—10 through 80 meters—tapped inductor and variable condenser—neon RF indicator—copper plated chassis and high quality components. Ideal for use with Heathkit AT-1 Transmitter.

MODEL AC-1
$14.50
Shpg. Wt. 4 lbs.

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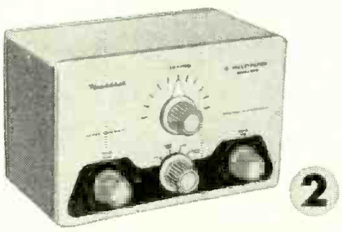

❶ *Heathkit* COMMUNICATIONS-TYPE ALL BAND RECEIVER KIT

The new Model AR-3 features improved IF and RF performance, along with better image rejection on all bands. Completely new chassis layout for easier assembly, even for the beginner

Covers 550 Kc to 30 Mc in four bands. Provides sharp tuning and good sensitivity over the entire range. Features a transformer-type power supply–electrical bandspread–separate RF and AF gain controls–antenna trimmer–noise limiter–AGC–BFO–headphone jacks–5½" PM speaker and illuminated tuning dial.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part No. 91-15, shipping weight 5 lbs. $4.50.

MODEL AR-3
$27.95
Shpg. Wt. 12 Lbs.
(Less Cabinet)

❷ *Heathkit* "Q" MULTIPLIER KIT

Here is the Heathkit Q Multiplier you hams have been asking for. A tremendous help on the phone and CW bands when the QRM is heavy. Provides an effective Q of approximately 4,000 for extremely sharp "peak" or "null." Use it to "peak" the desired signal or to "null" an undesired signal, or heterodyne. Tunes to any signal within the IF band-pass of your receiver. Also provides "broad peak" for conditions where extreme selectivity is not required.

Operates with any receiver having an IF frequency between 450 and 460 Kc. Will not function with AC-DC type receivers. Requires 6.3 volts AC at 300 ma. and 150 to 250 VDC at 2 ma. Derives operating power from your receiver. Uses a 12AX7 tube, and special High-Q shielded coils. Simple to connect with the cable and plugs supplied. Measures only 4-11/16"H.x7⅜"W.x4⅛"D. A really valuable addition to the receiving equipment in your ham shack.

MODEL QF-1
$9.95
Shpg. Wt. 3 Lbs.

❸ *Heathkit* VARIABLE VOLTAGE REGULATED POWER SUPPY KIT

Provides well filtered DC output, variable from zero to 500 volts at no load and *regulated* for stability. Will supply up to 10 ma. at 450 VDC, and up to 130 ma. at 200 VDC. Voltage or current monitored on front panel meter. Also provides 6.3 VAC at 4A. for filament. Filament voltage isolated from B+, and both isolated from ground. Invaluable around the ham shack for supplying operating potentials to experimental circuits. Use in all types of research and development laboratories as a temporary power supply, and to determine design requirements for ultimate power supply.

MODEL PS-3
$35.50
Shpg. Wt. 17 lbs.

❹ *Heathkit* ANTENNA IMPEDANCE METER KIT

Use in conjunction with a signal source for measuring antenna impedance, line matching, adjustment of beam and mobile antennas, etc. Will double as a phone monitor or relative field strength indicator. 100 μa. meter employed. Covers the range from 0-600 ohms. An instrument of many uses for the amateur.

MODEL AM-1
$14.50
Shpg. Wt. 2 lb.

❺ *Heathkit* GRID DIP METER KIT

This is an extremely valuable tool for accomplishing literally hundreds of jobs on all types of equipment. Covering from 2 Mc to 250 Mc, the GD-1B is compact and can be operated with one hand. Uses a 500 μa. meter for indication, with a sensitivity control and headphone jack. Includes prewound coils and rack. Indispensable instrument for hams, engineers, or servicemen.

MODEL GD-1B
$19.50
Shpg. Wt. 4 lbs.

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Heathkits PROVIDE THE "CONSTRUCTIVE" APPROACH TO

HIGH-FIDELITY

EASY TO BUILD: *The assembly instructions supplied with Heathkits are so complete and detailed that anyone can assemble the kits without difficulty. Plenty of pictorial diagrams and step-by step instructions. Information on resistor color codes, soldering, use of tools, etc. Build-it-yourself with confidence!*

1

❶ *Heathkit* ADVANCED-DESIGN HIGH FIDELITY AMPLIFIER KIT

The 25 Watt Model W-5 is one of the most outstanding high fidelity amplifiers available today—at any price. Incorporates the very latest design features to achieve true "presence" for the super-critical listener.

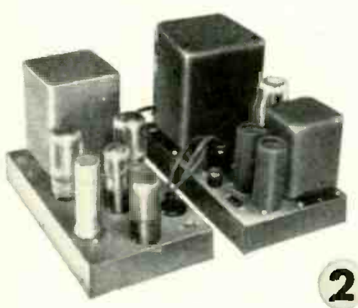
Features a new-design Peerless output transformer, and KT66 output tubes handle power peaks up to 42 watts. The unique "tweeter-saver" suppresses high frequency oscillation. A new type balancing circuit results in closer "dynamic" balance between output tubes. Features improved phase shift characteristics and frequency response, with reduced IM and harmonic distortion. Color styling harmonizes with the Heathkit WA-P2 Preamplifier and the FM-3 Tuner.

Frequency response—within ± 1 db from 5 cps to 160 Kc at 1 watt. Harmonic distortion only 1% at 25 watts, 20-20,000 cps. IM distortion only 1% at 20 watts, using 60 and 3,000 cps. Output impedance 4, 8, or 16 ohms. Hum and noise—99 db below rated output. Uses two 12AU7's, two KT66's and a 5R4GY.

KIT COMBINATIONS:

W-5M Amplifier Kit: Consists of main amplifier and power supply, all on one chassis. Complete with all necessary parts, tubes, and comprehensive manual. Shpg. Wt. 31 lbs. Express only. **$59.75**

W-5 Combination Amplifier Kit: Consists of W-5M Amplifier Kit listed above *plus* Heathkit Model WA-P2 Preamplifier Kit. Complete with all necessary parts, tubes, and construction manuals. Shpg. Wt. 38 lbs. Express only. **$79.50**



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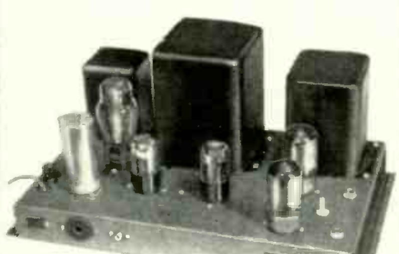
❷ *Heathkit* DUAL-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is a very popular high fidelity amplifier kit that features dual-chassis type construction. The resulting physical dimensions offer an additional margin of flexibility in installation. It features the famous Acrosound TO-300 "ultra-linear" output transformer, and has a frequency response within ± 1 db from 6 cps to 150 Kc at 1 watt. Harmonic distortion only 1% at 21 watts. IM distortion at 20 watts only 1.3% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—88 db below 20 watts. Uses two 6SN7's, two 5881's, and a 5V4G.

KIT COMBINATIONS:

W-3M: Consists of main amplifier and power supply for separate chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 29 lbs., Express only. **$49.75**

W-3: Consists of W-3M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 37 lbs., Express only. **$69.50**



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❸ *Heathkit* SINGLE-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is the lowest priced Williamson type amplifier ever offered in kit form, and yet it retains all the usual features of the Williamson type circuit. Main amplifier and power supply combined on one chassis, and uses a new-design Chicago output transformer. Frequency response—within ± 1 db from 10 cps to 100 Kc at 1 watt. Harmonic distortion only 1.5% at 20 watts. IM distortion at rated output, 2.7% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—95 db below 20 watts. Uses two 6SN7's, two 5881's, and one 5V4G.

Instructions are so complete that the kit may be assembled successfully even by a beginner in electronics.

KIT COMBINATIONS:

W-4AM: Consists of main amplifier and power supply for single chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 28 lbs. Express only. **$39.75**

W-4A: Consists of W-4AM Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 35 lbs. Express only. **$59.50**

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THE VERY BEST IN AUDIO WITH "BUILD-IT-YOURSELF"

HEATHKITS

ATTRACTIVELY STYLED: *Heathkit high fidelity instruments are not only functional, but are most attractive in physical design. Such units as the preamplifier and the W-5 main amplifier are designed for beauty as well as performance. They blend with any room decor and are the kind of instruments you will be proud to own.*

❶ *Heathkit* HIGH FIDELITY PREAMPLIFIER KIT

This outstanding preamplifier is designed specifically for use with the Heathkit Williamson type amplifiers. It completely fulfills the requirements for remote control, compensation and preamplification, and exceeds even the most rigorous specifications for high fidelity performance.

Features five separate switch-selected input channels (2 low level and 3 high level), each with its own input control. Full record equalization with four-position turnover control and four-position rolloff control.

Output jack for tape recorder – separate bass control with 18 db boost and 12 db cut at 50 cps. – treble control offering 15 db boost and 20 db cut at 15,000 cps – special hum control to insure minimum hum level – and many other desirable features. Overall frequency response (with controls set to "flat" position) is within 1 db from 25 cps to 30,000 cps. Will do justice to the finest available program sources. Beautiful satin-gold fiinish.

Power requirements from the Heathkit Williamson type high fidelity amplifier – 6.3 VAC at 1 amp., and 300 VDC at 10 Ma. Uses two 12AX7's and one 12AU7.

MODEL WA-P2
$19.75
Shpg. Wt. 7 Lbs.

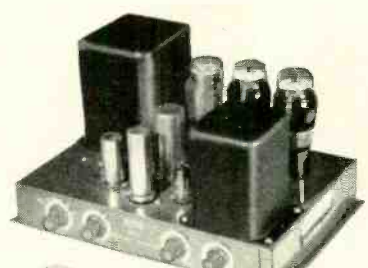
1

❷ *Heathkit* 20-WATT HIGH FIDELITY AMPLIFIER KIT

This Heathkit Model offers you the least expensive route to high fidelity performance. Frequency response is ± 1 db from 20-20,000 cps. Features full 20 watt output using push-pull 6L6's, and incorporates separate bass and treble tone controls. Preamplifier and main amplifier are built on the same chassis. Four switch-selected compensated inputs and separate bass and treble tone controls provide all necessary functions at minimum investment. Features miniature tube types for low hum and noise.

Uses 12AX7, two 12AU7's, two 6L6G's and a 5V4G. A most interesting "build-it-yourself" project, and an excellent hi-fi amplifier for home use. Well suited, also, for public address applications because of its high power output and high quality audio reproduction. Another Heathkit "best-buy" for you!

MODEL A-9B
$35.50
Shpg. Wt. 23 Lbs.



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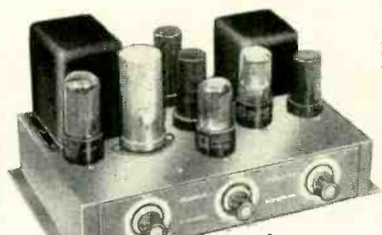
❸ *Heathkit* 7-WATT AMPLIFIER KIT

The redesigned Model A-7D features a new type output transformer for tapped screen operation, and provides improved sensitivity, reduced distortion, and increased power output.

The full 7-watt output of the Model A-7D is more than adequate for normal home installations. Frequency characteristics are ± 1½ db from 20 to 20,000 cps. Potted output and power transformers employed. Push-pull output – detailed construction manual – top quality parts – high quality audio without great expense. Output transformer tapped at 4, 8, and 16 ohms. Bass and treble tone controls provided on the front chassis apron.

MODEL A-7D
$16.95
Shpg. Wt. 10 Lbs.

Model A-7E: Provides a preamplifier stage with two switch-selected inputs and RIAA compensation for variable reluctance or low level cartridges. Preamplifier built on same chassis as main amplifier. Model A-7E. Shipping weight 10 lbs. $18.50.



3

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Brand New

HEATHKIT HIGH-FIDELITY
FM TUNER KIT

MODEL FM-3

Shpg. Wt. 7 lbs. **$24.50** (with cabinet)

Features

- *Brand New, Modern FM Circuit Using Latest Type Miniature Tubes.*
- *Low-Noise Cascode RF Stage—Two IF's—Ratio Detector—Stage of Audio.*
- *Extremely Good Sensitivity and Band-Pass for Outstanding Performance.*
- *Strikingly Attractive Satin-Gold Finish to Match Heathkit Model WA-P2 Preamplifier.*
- *Compact Physical Dimensions for Most Pleasing Appearance and Increased Circuit Efficiency.*

The new Heathkit Model FM-3 features tremendous circuit improvements and brand new physical design. Sensitivity is better than 10 uv. for 20 db of quieting, and it employs a completely modern tube line-up for high gain and stable operation. Incorporates its own power supply, and has provision for low-level or high-level output at low impedance.

The attractive Model FM-3 matches the WA-P2 Preamplifier in color, styling, and physical size.

Incorporates automatic gain control, a highly stabilized oscillator, and illuminated tuning dial. Educational treatment of construction manual simplifies assembly for the newcomer to electronics. *IF* and *ratio* transformers are *prealigned*, and the front-end tuning unit is pre-assembled and aligned. Uses 6BQ7A as a cascode type RF stage, 6U8 oscillator-mixer, two 6CB6's as IF amplifiers, a 6AL5 ratio detector, a 6C4 audio amplifier, and 6X4 rectifier.

HEATHKIT BROADCAST-BAND RECEIVER KIT

Build your own radio receiver with confidence, even if you are a beginner. Complete instructions supplied.

Features transformer-type power supply, high-gain miniature tubes, built-in antenna, 5½" speaker, and planetary tuning from 550 Kc to 1500 Kc. Adaptable for use as AM Tuner and phono amplifier. Educational treatment of the construction manual helps the beginner learn about radio circuits and parts as he builds.

CABINET: Fabric covered plywood cabinet with aluminum panel as shown. Part 91-9, Shpg. Wt. 5 lbs., $4.50.

MODEL BR-2

$17.50 *Less Cabinet*

Shpg. Wt. 10 lbs.

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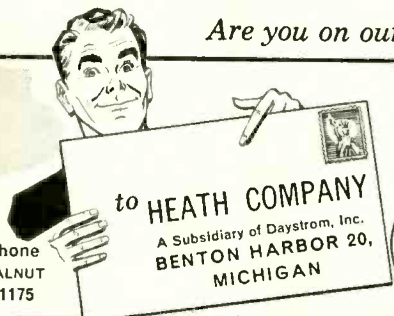

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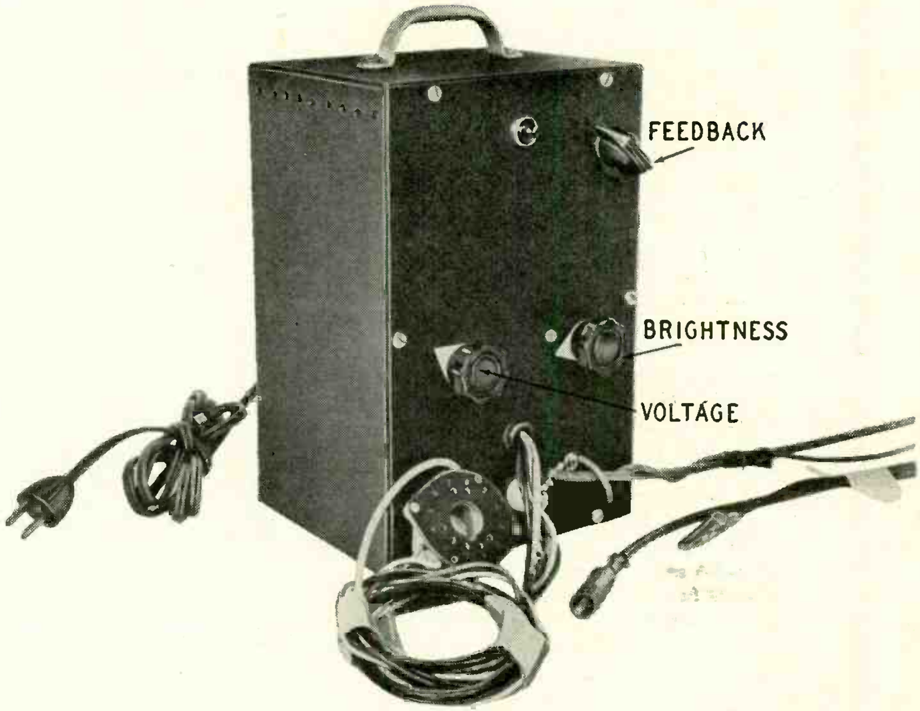
SOMETHING NEW in HIGH-VOLTAGE SUPPLIES

Auxiliary supply develops 9–18-kv output for use in TV receiver servicing

By VAL SANFORD and LEIGHTON BURNHAM



Front-panel view of the instrument.

DURING the past few years various trade magazines have described make-it-yourself TV high-voltage supplies. The appearance of these articles indicates interest in auxiliary high-voltage sources external to the TV chassis.

Not so very long ago the authors needed a compact, stable high-voltage supply and decided to build several models. The most promising of the published designs were constructed and tested.

We found they all contained disadvantages which made them impractical for television use; they either generated insufficient voltage for the larger picture tubes or their regulation was so poor that, when connected to a picture tube, increasing brightness reduced the terminal voltage to zero.

What was needed was a voltage source with an output stable under normal load conditions and capable of being varied from 10–20 kv to accommodate different-size picture tubes. Aside from the high- and low-voltage rectifiers, only one other tube could be used in generating this voltage since the entire instrument was to be enclosed in a small vtvm case and space was at a premium. We decided that only an oscillator–amplifier combination would do the job: provide sufficient isolation between the oscillator and external load and maintain the required regulation.

The result of much experiment appears in Fig. 1. This version satisfies all the original specifications: it is small, oscillator and amplifier being contained in one tube; it is stable—does not produce blooming; it is versatile—output voltage is variable, from 9–18 kv. In addition, all other voltages necessary for kinescope operation are supplied to a universal picture-tube socket. The brightness control has a 0–70-volt range. The unit is relatively inexpensive.

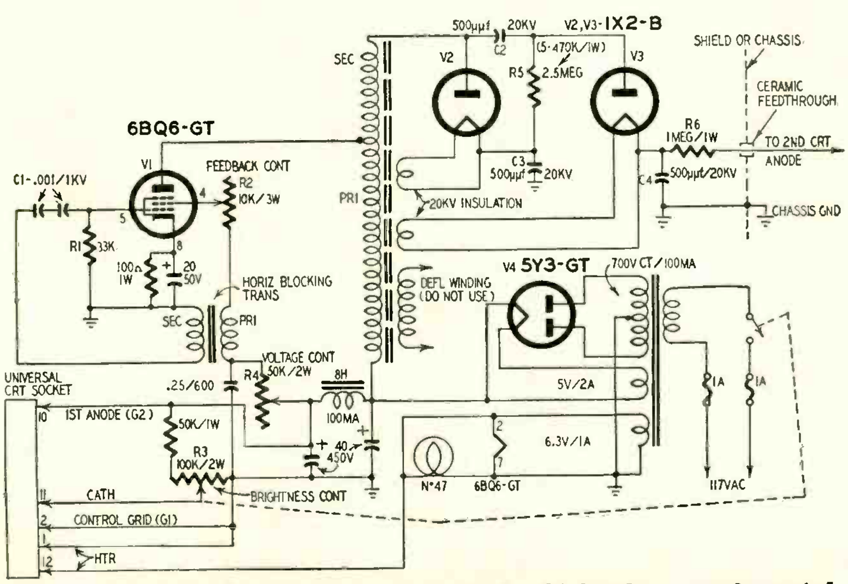


Fig. 1—Schematic diagram of complete supply—high voltage can be varied.

Circuit operation

Except for the plate circuit, the 6BQ6-GT operates as a conventional horizontal blocking oscillator. Similar

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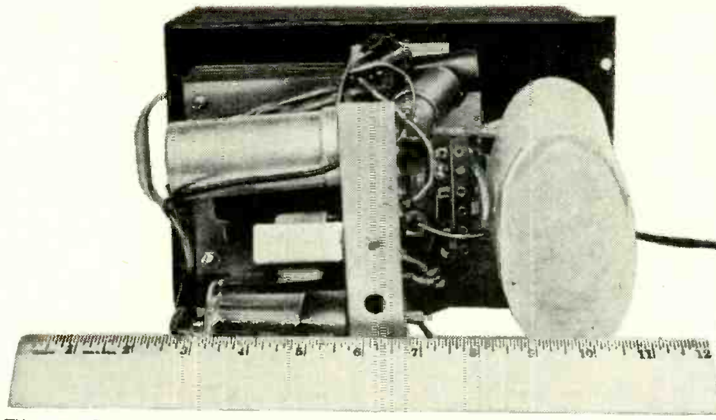


Fig. 2—Rear view shows plastic cover over the voltage-doubler assembly.

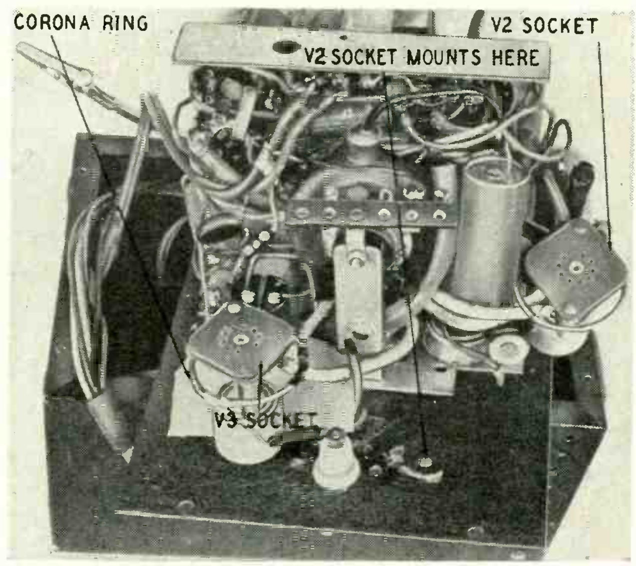
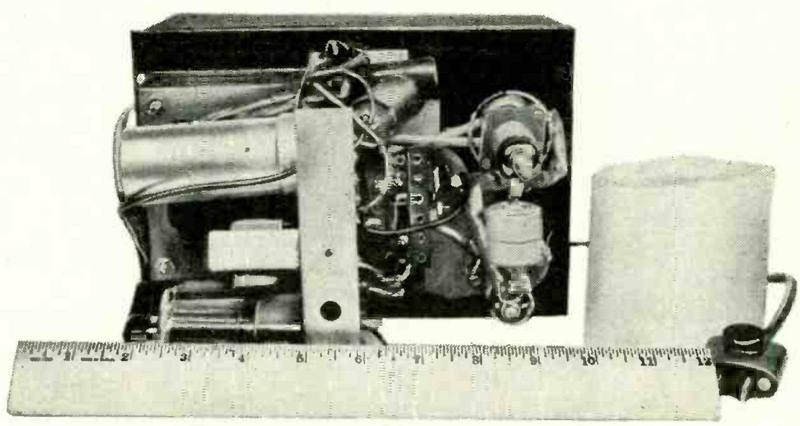


Fig. 3—The high-voltage compartment.



Rear view of the high-voltage supply.

to pentagrid converter action, the screen grid serves as the plate of the oscillator. When the unit is turned on, control grid bias is zero and the B plus on the screen (acting as a plate) causes the tube to conduct. An expanding magnetic field is built up around the blocking oscillator transformer due to the screen current flowing in the primary winding. This expanding field induces a positive voltage in the secondary winding, making the control grid positive and charging C1 (two .001-μf capacitors in series). The tube conducts heavily, more screen current flows and a greater positive voltage is applied to the control grid.

Finally, the tube reaches saturation. The magnetic field stops growing and the positive voltage on the secondary falls off, cutting the tube off through the grid-leak bias resulting from the charge on C1.

The current now ceases in the primary winding, the magnetic field collapses and a high negative voltage is applied to the control grid. Slowly the charge on C1 leaks off through R1. When the discharge curve passes the cutoff axis, conduction begins and the cycle is repeated.

The control grid of V1 is held below cutoff most of the time—depending on the time constant of C1–R1—going positive and conducting heavily for a small portion of its duty cycle. Since the control grid governs not only the screen current (oscillator plate current) but the plate current of V1, heavy plate current will flow through the primary of the flyback transformer during each positive excursion of V1's control grid. When the control grid again goes into cutoff, the current through this winding abruptly ceases. This causes its surrounding magnetic field to collapse and induces a high, positive pulse voltage which shock-excites the flyback transformer. The positive pulse is stepped up by the secondary winding and is applied to the voltage doubler circuit.

To make the output voltage variable, potentiometer R4 was added in the screen circuit. It has a pronounced effect on the gain of V1. To maintain the most effective oscillator feedback at different values of screen voltage, unbypassed 10,000-ohm potentiometer R2 was inserted between the screen and the primary of the blocking oscillator transformer. This acts as a degenerative device, limiting the pulse current in the primary and, consequently, the feedback voltage applied to the control grid.

A well-insulated horizontal blocking oscillator transformer is used, since it must withstand voltages well above normal. Grid leak resistor R1 was chosen by experiment to obtain a frequency at which maximum voltage output and stability occurs—about 15,000 cycles. Some difficulty was encountered in choosing the grid leak capacitor. Due to the high feedback pulse, two .001-μf 1,000-volt ceramic capacitors were used in series. Units of smaller voltage rating would immediately break down.

An rf power dissipation greater than 1 watt (depending on frequency) was found in R1; therefore a 2-watt resistor was used. The flyback transformer need not be anything special. An autotransformer type was used only because it was cheapest. Where there is a choice of several B-plus taps on the flyback transformer, the one producing the highest output voltage should be used. The deflection-coil windings are not used and should be properly taped.

The two 1X2-B rectifier tubes are used in a voltage-doubler circuit. A pulse appears at the high side of the flyback transformer and is applied to the plate of V2, causing it to conduct and charge C3 to full peak voltage. Between successive pulses the charge on C3 leaks off through R5, charging C2 in the polarity indicated. After several pulses C2 becomes fully charged to the peak value of the pulse (assume 9 kv). The 9-kv charge on C2 now adds to the 9-kv pulse from the trans-

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former, presenting a potential of 18 kv to the plate of V3. That tube now conducts and charges its cathode capacitor to 18 kv. The actual output voltage depends upon the load (which limits the extent to which C2, C3 and C4 will charge) and the amplitude of the applied pulse.

Resistor R5 consists of five 470,000-ohm, 1-watt resistors in series, enclosed in spaghetti tubing. Unless an expensive high-voltage bleeder resistor is available, it is not advisable to use anything but this series combination as the voltage rating of each resistor should not be exceeded.

Current-limiting resistor R6 was inserted to reduce shock hazard and the possibility of damaging the rectifier tubes by accidentally shorting the high-voltage cable to ground.

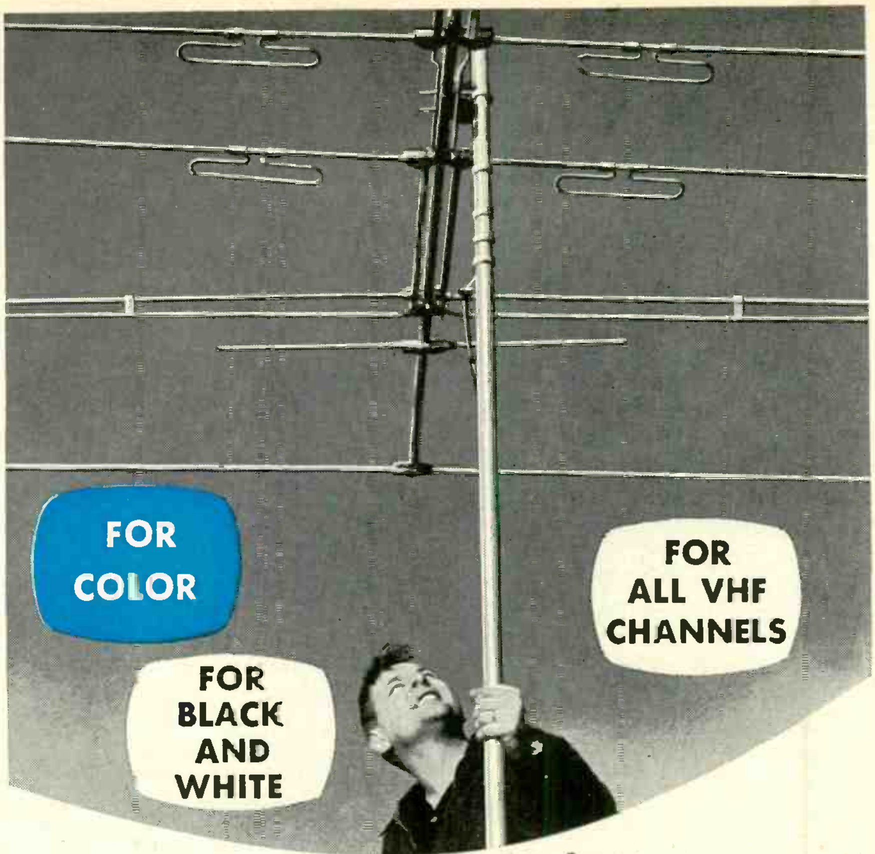
The instrument was designed to supply all picture-tube voltages except the vertical and horizontal sweep—their use is optional. Voltage for the brightness control is supplied by potentiometer R3 which is part of a voltage divider across the low-voltage power supply. The center arm is connected to the kinescope cathode and acts as a brightness control. The control grid is grounded and the first anode goes directly to B plus.

Construction

Only readily available items were used in making this instrument. Parts location is not critical but great care must be taken with the high-voltage compartment. Arcing is always a major obstacle in the development of compact high-voltage devices. It is overcome in this unit by making a polyethylene cover (Fig. 2) that encloses the entire high-voltage doubler circuit. The ends of a rectangular plastic sheet are heated with a soldering iron until they reach a semimolten state and are then pressed together to form a cylinder. The elliptical end piece is heated and inserted in the same way. The finished cover should fit snugly around the entire voltage-doubler assembly. As an added precaution, all wires and connections in that vicinity should be sprayed with three or four coats of high-voltage insulation spray. The problem of component overheating is solved by drilling ventilation holes in both sides of the case.

As can be seen from Fig. 3, the high-voltage unit is mounted on the front panel. The flyback is stripped of its terminal board and all leads are attached to a small terminal strip. Heavy spaghetti tubing surrounds the high-voltage lead from the flyback as well as the high-voltage bleeder string. The two 1X2-B filament wires, which have 20-kv insulation, each make one turn around the core of the flyback. The corona ring is soldered to one side of each filament line.

Select the ceramic feedthrough insulator carefully. If it is not of overlapped construction (such as ICA No. 2306), it will probably arc to the case.



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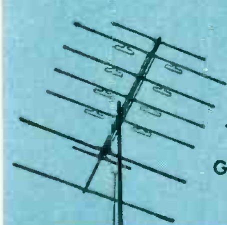

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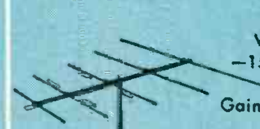

TRAPPER

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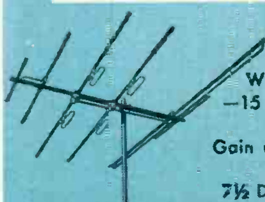

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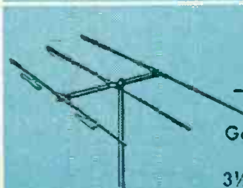

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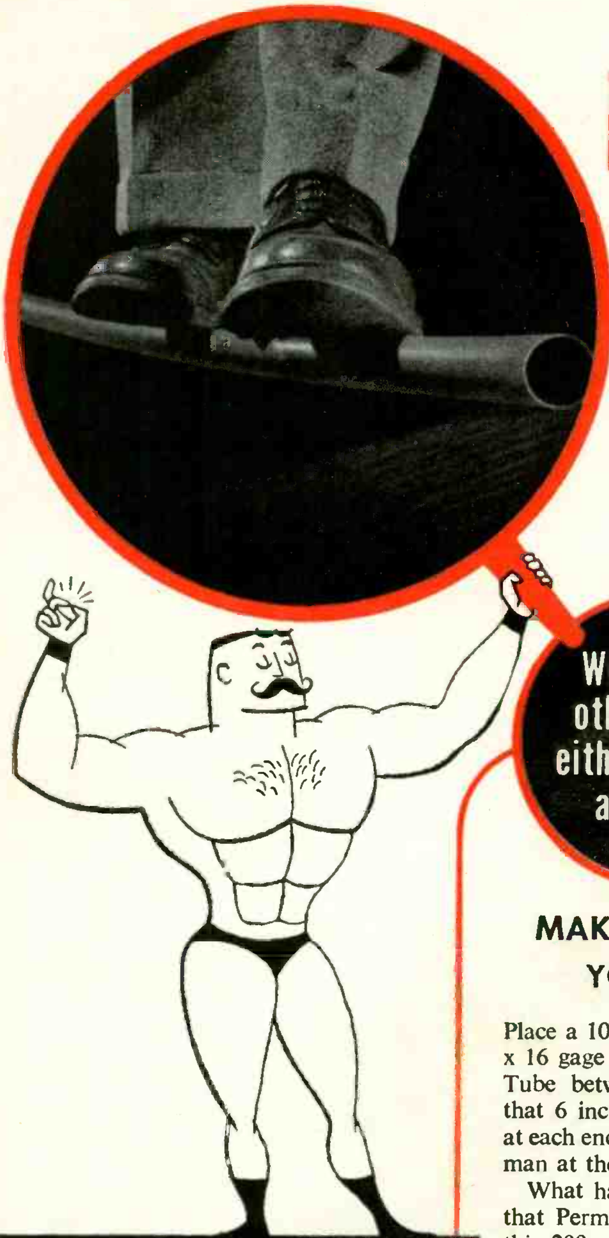

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TEST INSTRUMENTS

All solder connections in the high-voltage compartment must be rounded—sharp edges or bends will permit corona discharge and a proportionate decrease in high voltage.

Operation

Set the 6BQ6-GT screen voltage for maximum by adjusting R4. Then set R2 for the correct oscillator feedback. This point is easily determined since the audible "singing" of the flyback transformer becomes more pronounced at this point. Now adjust R4 for the voltage output desired. As shown in the table, under certain conditions the device can deliver up to 900 microamps at 9 kv. Thus, it is *imperative* that the television chassis be grounded to the instrument at all times during operation. *Failure to do this will invite arcing through the ac line and almost guarantee a dangerous shock.* As a further safety precaution, the high-voltage output cable and alligator clip should be adequately insulated for voltages up to 20,000. Remember always that you are working with dangerous voltages!

PERFORMANCE CHART*

Dummy Load (megohms)	115 Volts ac (line voltage)	95 Volts ac (line voltage)	130 Volts ac (line voltage)
200	18	13	19.5
150	15	11.5	18.5
100	14	10	17
50	13	7	15
30	11	5	12.5
10	9	4	9.5

*Output voltage (in kilovolts) measured across a varying dummy load resistance with varying ac line voltage.

If you have trouble in obtaining sufficient high voltage, it may be due to variations in circuit constants which cause the oscillator to function on other than the most efficient frequency.

Parts for high-voltage supply

Resistors: 1—100, 1—47,000, 5—470,000 ohms, 1—1 megohm, 1 watt; 1—33,000 ohms, 2 watts; 1—50,000—1—100,000-ohm potentiometer, 2 watts; 1—10,000-ohm potentiometer, 3 watts.

Capacitors: 3—500 μμf, 20,000 volts, mica, screw mounting studs; 2—.001 μf, 1,000 volts, ceramic discs; 1—0.25 μf, 600 volts; 1—20 μf, 50 volts, 1—40-40 μf, 450 volts, electrolytics.

Miscellaneous: 1—choke, 8 henries at 100 ma; 1—horizontal blocking oscillator transformer, 2:1 step-down turns ratio (Stancor A-8120 or equivalent); 1—power transformer, 700 volts ct at 90 ma, 5 volts at 2 amps, 6.3 volts at 1 amp (Stancor PM-8409 or equivalent); 1—6BQ6-GT, 1—5Y3-GT; 2—1X2-B; 2—octal sockets; 2—9-pin miniature sockets with corona ring; 1—universal picture-tube socket; 1—metal cabinet; 1—fused plug with 1-amp fuses; 1—pilot-light assembly; 1—line cord; 1—sheet of polyethylene; 1—terminal strip; 1—high-voltage lead with alligator clip; 1—feedthrough insulator (see text); 1—length of spaghetti; 1—flyback transformer (any conventional unit).

To correct such a difficulty remove oscillator grid load resistor R1 and insert a 3-watt 100,000 ohm potentiometer. Vary this pot for the position producing the greatest output voltage. Measure the value of this resistance and insert a 2-watt carbon unit of the same value. END

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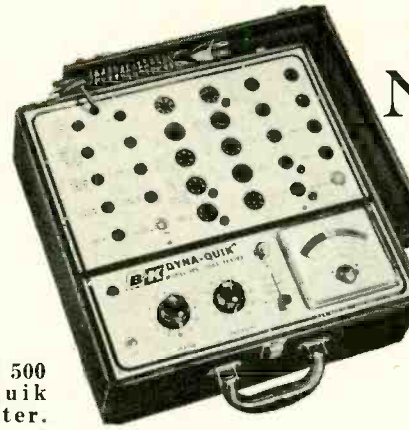
Analysis of the ASD TV-20 and Dyna-Quik model 500



The model 500 Dyna-Quik tube tester.

New TV TUBE TESTERS

By ROBERT F. SCOTT
TECHNICAL EDITOR

IN the days before TV, a tube tester was usually taken on service calls. Now many technicians feel that a tube tester requires too much time to set up. With as many as 10 switches and controls to set for each tube, the better part of an hour may be consumed in checking all the tubes suspected of causing a particular trouble in a TV set—particularly in the older ones with around 30 tubes. Several manufacturers have developed new types of tube testers designed specifically to reduce the time required to check a tube.

In a conventional tester, much of the time is consumed in setting up the bank of 10 or so switches that connect the various socket terminals to the required points in the test circuit. The new testers eliminate this by using separate sockets wired to conform to almost any setup available with the usual free-point selector bank.

ASD TV-20 tester

The American Scientific Development Co.'s model TV-20 (see photo) is not designed to replace conventional tube testers. It is a special-purpose instrument designed for testing approximately 250 TV receiving type tubes—including the new 600-ma varieties. It eliminates the roll chart and time-consuming setups by using 20 sockets with the types of tubes tested in them printed directly on the panel. Wherever possible the tube groupings have been arranged so all horizontal output tubes are tested in one socket, high-voltage rectifiers in another and so on. There are only two adjustable controls—a heater-voltage selector switch and a resistive load control.

The TV-20 is available in portable and bench or panel models for the technician and in counter and self-service types that allow the customer to check his own tubes. Self-service testers are now found in many supermarkets and auto supply, drug and hardware stores in suburban areas where the do-it-yourself fad is widespread.

The diagram in Fig. 1 shows the circuit of the TV-20 with sockets eliminated for simplicity. The test circuit treats the tube under test as an ac rectifier with a meter measuring the dc output. The meter is calibrated BAD-?-GOOD with a 0–100 scale for comparing the quality of tubes of the same type.

Dual tubes such as the 6AL5 and 12AT7 are checked in a single operation by connecting them in series as in Fig. 2. If one section of the tube is weak, the meter will read accordingly even if the other half is perfect. The .01-μf capacitor across the lower section of the tube causes heater–cathode leakage in the upper half to show up in the short test.

Shorts within a tube are located by connecting the cathode and plate to one side of a 145-volt source and the grid or grids and one side of the heater to the other side of the 145-volt supply through a .01-μf capacitor and a neon lamp shunted by 1.2 megohms.

The setup for testing pentodes is shown in Fig. 3. Heater-to-cathode, cathode-to-grid and screen-to-plate shorts or leakage will complete the ac circuit and light the NE-51 neon lamp when the pushbutton switch is pressed. The lamp goes out if the tube is free of shorts. A gassy tube passes high leakage current and will also cause the lamp to remain on when the switch is pressed. The indicator glows when leakage resistance or the short resistance is less than 1.5 megohms. By making the short-test sensitivity high, it is easy to detect tubes that can cause

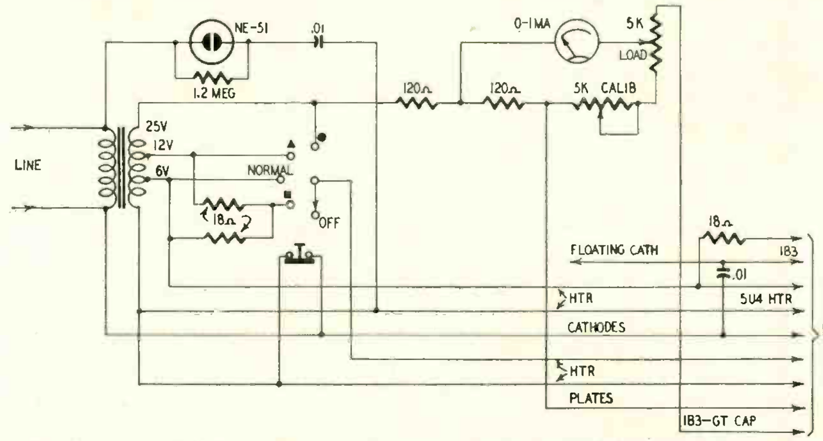
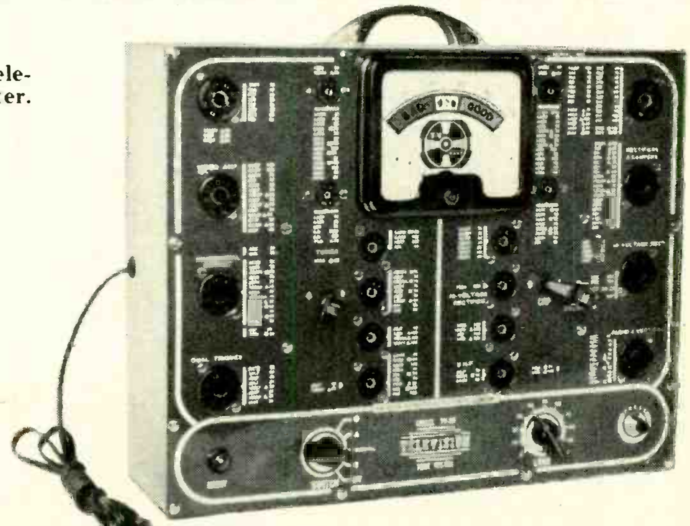


Fig. 1—Simplified schematic diagram of the model TV-20 tube tester.



The model TV-20 television tube tester.

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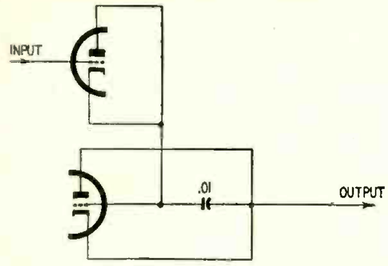

Fig. 2—Circuit checks dual tubes.

trouble in dc restorer, agc, afc and sync circuits.

In later models of the TV-20, heater continuity in tubes not listed on the panel can be checked by plugging the tube into one of four specified sockets and turning the selector switch to OFF. The heater is good if the lamp stays on and bad if it goes out.

Dyna-Quik model 500

A product of the B & K Manufacturing Co., this tube tester is similar in appearance (see photo) to the TV-20 and other testers designed for speedy testing. It is a dynamic mutual-conductance tester with tube quality shown on REPLACE-?-GOOD and 0–6,000- and 0–18,000-micromho scales. An added feature of this instrument is the *life*

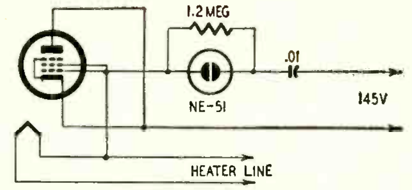

Fig. 3—Circuit for testing pentodes.

test that enables the technician to spot tubes that are usable at the time of testing but whose mutual conductance is gradually dropping and will soon reach the point where a callback will be necessary. It has 30 sockets and HEATER, TEST and SENSITIVITY controls.

The 100 most popular tube types are listed on the panel. Each of these and the correct setting for the sensitivity control are listed next to the socket designated for the test. The setting of the heater-voltage selector is determined by the first number (3, 6, 12, etc.) in the tube type.

Only the most commonly used tube of a given type is listed next to a socket but an asterisk next to the tube listing shows that equivalent types with different heater voltages can be tested in the same socket when the heater voltage is adjusted accordingly. For example, only the 6AL5 is listed on the panel but an asterisk before it shows that 3AL5's and 12AL5's can be tested when the filament selector switch is set to 3 or 12, respectively.

Approximately 200 additional tube types can be tested in the Dyna-Quik 500. These, along with those listed on the panel, are listed on a chart inside the top cover. This chart also lists the socket number, heater voltage, sensitivity-control settings for GOOD-?-REPLACE and direct transconductance measurements and the standard mutual conductance for each tube.

Dyna-Quick circuit

The diagram of the model 500 is shown in Fig. 4. Sockets have been left out for simplicity. The usual manual line-voltage adjustment has been eliminated and replaced by automatic line-voltage compensation. A voltage-sensitive bridge consisting of two No. 44 pilot lamps and two 16-ohm resistors is connected across a 6.3-volt heater winding. This bridge monitors the line voltage and automatically adjusts the sensitivity of the mutual-conductance bridge to compensate for line-voltage variations.

The TEST switch is a lever type with positions marked SHORT, GM, LIFE and

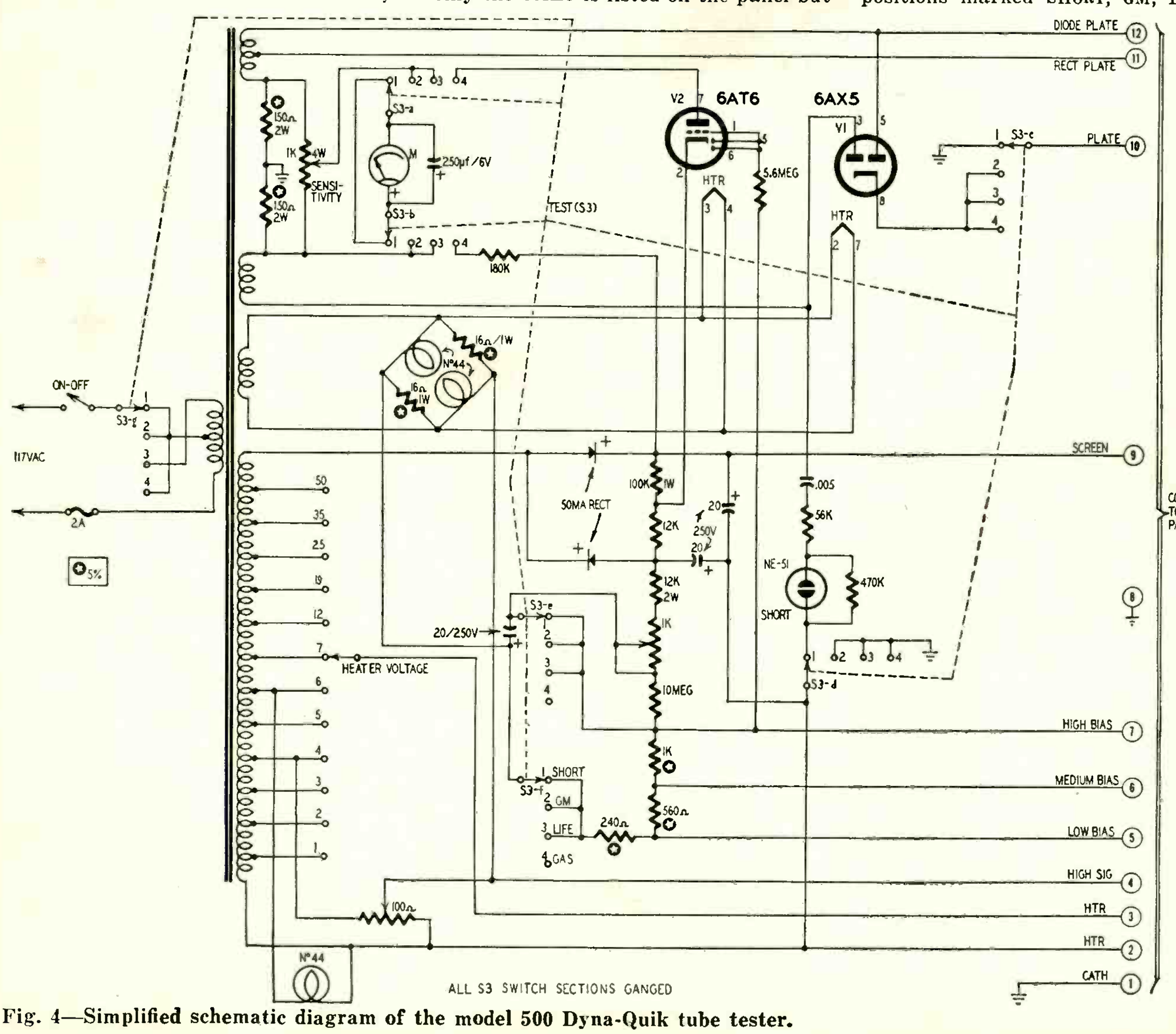

Fig. 4—Simplified schematic diagram of the model 500 Dyna-Quik tube tester.

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GAS (grid emission), respectively. All tubes are checked first with the switch in the SHORT position. In this test, a short or leakage up to 1 megohm between heater and cathode, grid and cathode, grid and plate or screen grid and plate will cause the NE-51 neon indicator to light.

If the tube is not shorted, the switch is then thrown to GM for a qualitative test. With the sensitivity control set as indicated by the number on the panel or in the *good–replace* column on the chart in the cover, the meter will indicate on the GOOD-?-REPLACE scale.

If the exact mutual conductance of the tube is desired, the sensitivity control is set as indicated in the *true* g_m column of the chart. The 0–6,000-micromho scale on the meter is printed in black; the 0–18,000-micromho scale in red. The sensitivity-control settings in the true g_m column are printed in red or black to indicate the meter scale to be used.

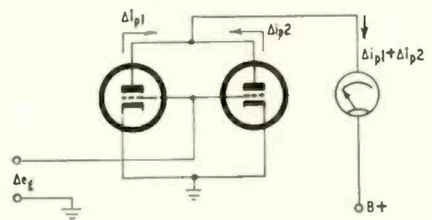

Fig. 5—Measuring g_m of dual tubes.

Mutual conductance is the ratio of a small change in plate current to the small change in grid voltage causing it (with all other voltages remaining constant), or

$$\frac{\Delta i_p}{\Delta e_g}$$

The amplification available from a tube is the product of g_m and the load resistance. Mutual conductance is found by inserting the tube in a sensitive bridge circuit, applying a small ac voltage to its grid and measuring the resulting alternating plate current.

The mutual conductance of dual triodes and dual pentodes is measured with the halves in parallel as in Fig. 5. If the ac signal voltage is applied to the grids in parallel, the meter measures the sum of the plate currents and the g_m is equal to

$$\frac{\Delta i_{p1} + \Delta i_{p2}}{\Delta e_g}$$

If the mutual conductance of either section of the tube is low, the meter reads low.

Life test

Manufacturers have found that probable remaining tube life can be esti-

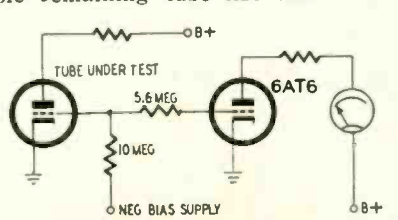

Fig. 6—Grid emission test circuit.

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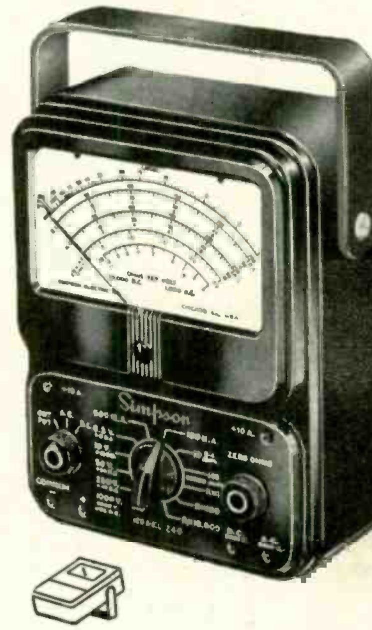

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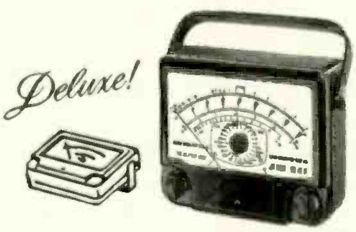

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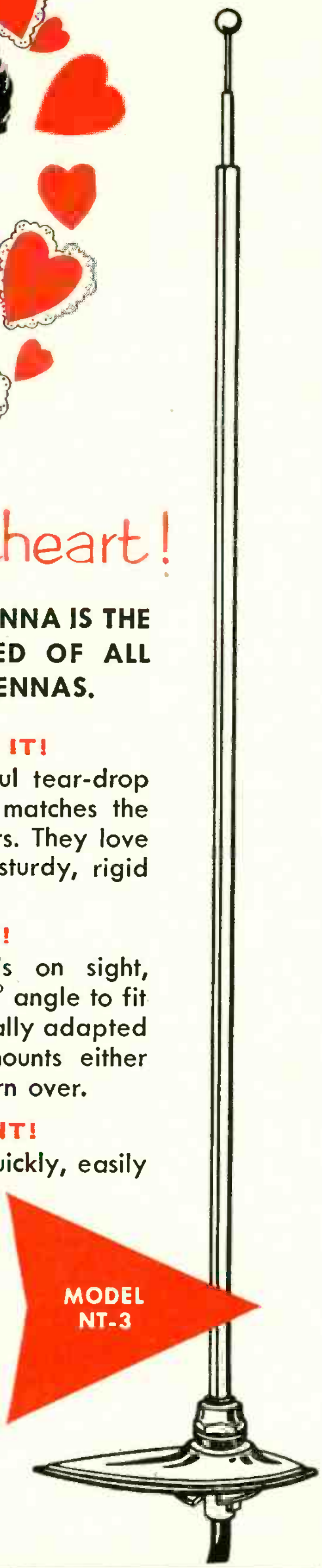

Model NT-3 with 4′ lead for front mounting

Model NT3-15 with 15′ lead for rear mounting

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mated reasonably by testing with the heater voltage reduced 10–15%. Under these conditions, there may be a sharp drop in g_m. This indicates that the space charge has dropped to the point where the tube will have little remaining life. The instruction manual does not indicate the percentage of change in g_m that is considered pertinent for a given tube type but no doubt this can be determined reasonably by experimenting with tubes that give different readings on the GOOD-?-REPLACE scale.

Grid-emission (gas) tests

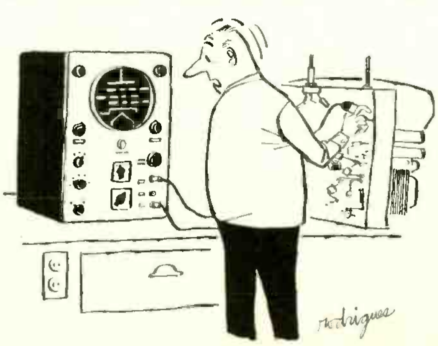
When a tube is being made or when it is improperly operated, some of the cathode coating material may evaporate and deposit on the grid. When the tube warms up, this material emits electrons that flow from grid to plate, through the power supply and grid resistor, back to the grid. This grid current flow is in the direction that tends to reduce the normal grid bias and make the grid more positive with respect to the cathode.

If there is a small amount of gas in the tube, electrons from the cathode will strike the gas molecules and knock off one or more electrons, converting the molecules to positive ions. Some of the ions may then strike the grid and take on an electron and become a gas molecule again. When this molecule again becomes ionized by striking electrons from the cathode, the electron from the grid is released to flow to the plate. This process continues and results in gas current that tends to drive the grid positive in the same manner as grid emission due to contamination.

Grid emission and gas oppose the normal grid bias and usually cause plate saturation, resulting in clipping and overloading.

When a tube is tested for grid contamination or gas, normal plate voltage is applied but its grid is biased to cutoff so no plate current flows. This bias is applied through a 10-megohm resistor that also connects to the grid of the 6AT6 dc amplifier in the tester. Under these conditions, the 6AT6 is also cut off and the meter in its plate circuit does not deflect. (See Fig. 6.)

However, if the tube being tested has a contaminated cathode or is gassy, current flows from grid to plate and then back to the grid through the power supply and the 10-megohm resistor. This current flow develops a voltage that opposes the cutoff bias and causes the meter to deflect. This test indicates grid current as low as 2 μa. END



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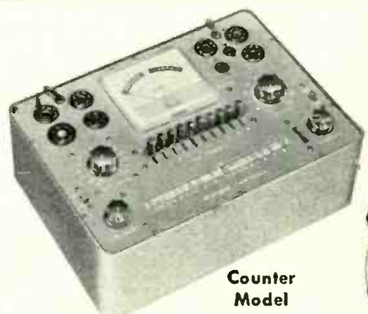

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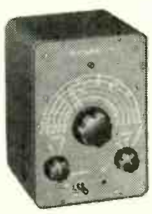

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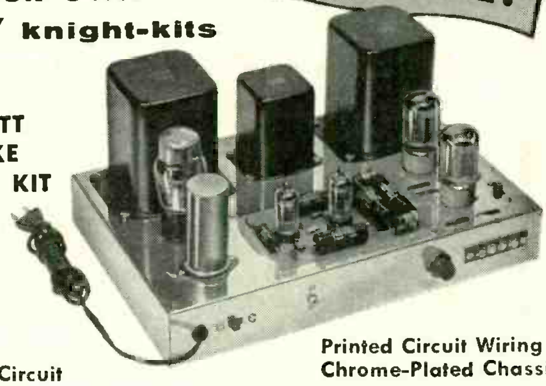

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UNDERSTAND YOUR *Sweep Generator Better*

This is a sequel to the article "Understanding Your Sweep Generator" which appeared last August

By ROBERT G. MIDDLETON*

ONE of the finer points of testing sweep generator output is recognition that the output from a signal-tracing or demodulator probe, at low operating levels, is not strictly proportional to the input voltage. The crystal characteristic is curved, as shown in Fig. 1, which expands the upper portion of the pattern and compresses the lower portion when the input signal is small. At levels in excess of 1 volt, the signal-tracing probe operates in a practically linear manner (Fig. 2). The output from a typical sweep generator is approximately 0.1 volt r.m.s., which falls in the nonlinear region of the crystal characteristic. Furthermore, the crystal accepts all harmonics from the generator, while a tuned circuit under test does not, having a cutoff point such as 4.5 mc, etc.

Thus, when testing the output from a sweep generator with a demodulator probe, various spurious markers may be observed on the test trace (Fig. 3). These represent an unusually bad condition of harmonic and spurious output beating but may sometimes be seen when working with inferior sweep generators. It is necessary in such tests to make certain that there is no source of marker voltage in the shop and that the spurious markers observed are developed by the sweep generator itself.

Fig. 4 illustrates the fact that the deviation of a harmonic is greater than the deviation of the fundamental output from a sweep generator. Thus, the second-harmonic sweep is twice as wide as that of the fundamental, and the third-harmonic sweep is three times as wide. Of course, the unfiltered output from a beat-frequency sweep generator contains at least two and sometimes three fundamental sweeps, all of which will be accepted by the untuned signal-tracing (demodulator) probe.

Now, if the video-frequency output of a sweep generator is being tested, as shown in Fig. 5, while the fundamental voltage is sweeping from 0 to 5 mc, for example, the second harmonic is sweeping from 0 to 10 mc and the third harmonic from 0 to 15 mc. *The presence of these second- and third-harmonic sweeps will not show up as an impairment of the sweep flatness* in a test with a demodulator probe because the probe is a wide-band device which accepts these harmonic sweeps over their entire sweep width.

If a pure fundamental marker frequency is mixed with the sweep output, the spurious (harmonic) sweeps will appear as spurious marker indications on the swept trace; this is the best method of checking for such spurious sweeps. The relative voltages of the spurious sweeps are *directly proportional* to the heights of the spurious markers, except for the nonlinearity of the crystal probe, as has been noted. This method of checking the relative voltages of the fundamental and various harmonic outputs is simple, accurate and not as well recognized in the service field as it deserves.

The display shown in Fig. 3 is oriented with the zero-frequency point at the right-hand end of the base line. By adjusting the tuning dial of the sweep generator, the zero-frequency point can be brought to the center of the display (Fig. 6). It is sometimes puzzling to the beginner to observe dissymmetry between the two sweeps on either side of zero frequency, as appears in Fig. 6. Since this may be caused by either the demodulator probe or irregularities in generator operation, it is useful to distinguish between these two sources of dissymmetry. Evidently the left-hand sweep will be more useful in practical work than the right-hand sweep since it extends to a lower frequency with a flatter characteristic.

When the retrace is unblanked, as shown in Fig. 7, the retrace may or may not appear identical with the forward trace. In most cases, when the two do not appear identical, the retrace appears as a mirror image of the forward trace. The pattern seen in Fig. 7 indicates that the dissymmetry arises in the generator. Whether the situation can be corrected depends upon circumstances which may involve design factors.

When dissymmetry is caused by too long a time constant in the output network of the probe, the distortion appears in mirror-image form because the forward and return traces are developed in opposite directions across the scope screen. In such case the forward and return traces cannot be made to coincide by adjusting the horizontal

* Chief field engineer, Simpson Electric Co.

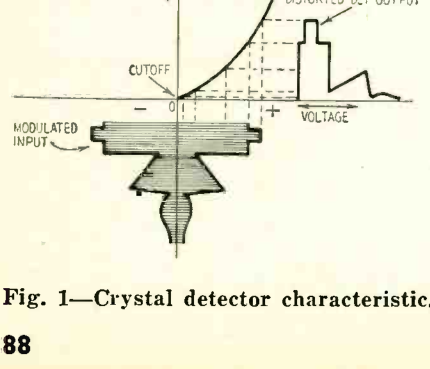

Fig. 1—Crystal detector characteristic.

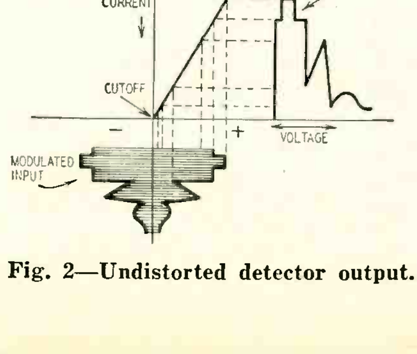

Fig. 2—Undistorted detector output.

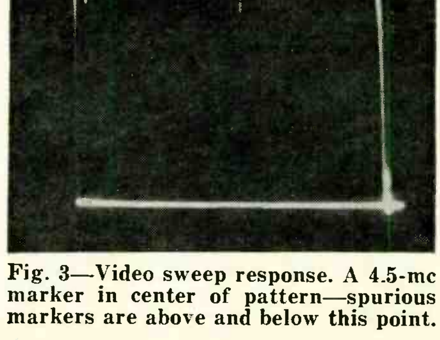

Fig. 3—Video sweep response. A 4.5-mc marker in center of pattern—spurious markers are above and below this point.

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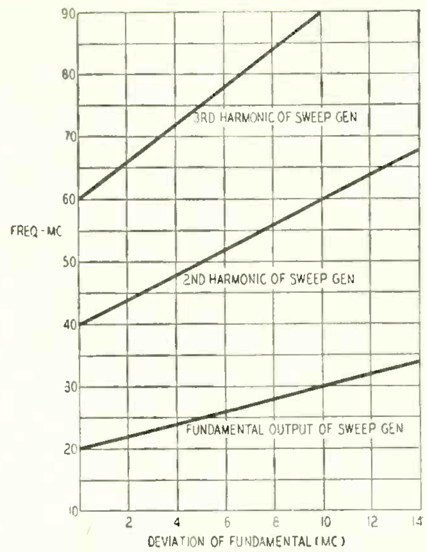

Fig. 4—Relation of harmonic deviations.

sweep phasing control of the scope. A further check can be made to corroborate this conclusion by advancing and backing off on the setting of the sweep generator attenuator. If the distortion pattern changes with the attenuator setting, it is conclusive that the fault lies in the generator.

If the sweep-width control of the generator is now set for a small sweep width, the detail of the generator output in the vicinity of zero frequency becomes evident (Fig. 8). Note the extent of the locking region, since it is this region that determines the lower limit of frequency output from the generator. The extent of pulling and locking is determined by the residual coupling between the fixed and swept oscillators in the beat-frequency generator.

Fig. 9 shows the basic arrangement in a beat-frequency sweep generator and indicates the residual coupling between the two oscillators as stray capacitance C. The two oscillators pull before they lock, and in this pulling region they move off normal frequency, approaching a frequency intermediate

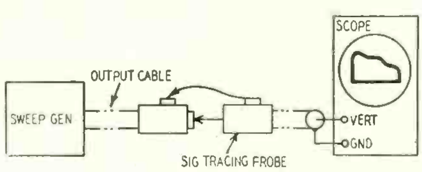

Fig. 5—Checking generator output for flatness—ground lead must be short.

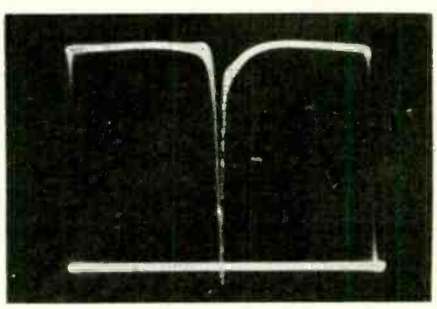

Fig. 6—The zero-frequency point is brought to center of the sweep trace.

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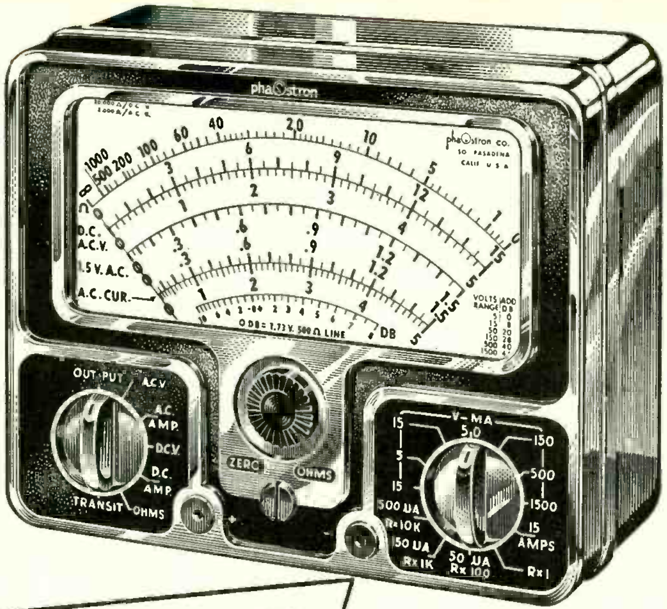

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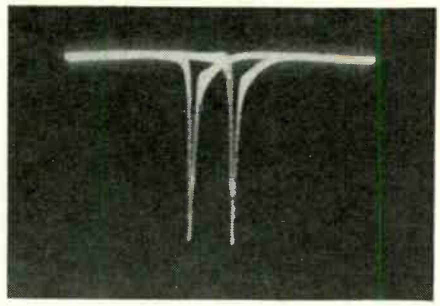


Fig. 7—Unblanking the retrace in Fig. 6 shows dissymmetry in the generator.

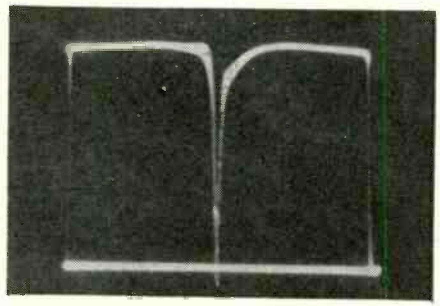


Fig. 8—Reducing sweep width shows details of zero-frequency point in Fig. 7.

between the normal frequencies. In this pulling region, the output becomes badly distorted, generating an excessive number of harmonics; the output becomes attenuated. And finally, as the operating frequencies of the oscillators approach the locking region, the two oscillators suddenly "seize" the same frequency and the output drops to zero until the swept oscillator again moves out of the locking range.

Because the output from a beat-frequency generator such as shown in Fig. 9 contains a sum as well as a difference beat, it is apparent that the test shown in Fig. 5 is not entirely valid unless a suitable low-pass filter is used in the output system of the sweep generator. The low-pass filter should have a characteristic impedance equal to that of the output cable to avoid disturbance of the cable impedance. The cutoff frequency of the filter should be chosen to pass the difference-frequency band of the generator, but to suppress the sum-frequency band.

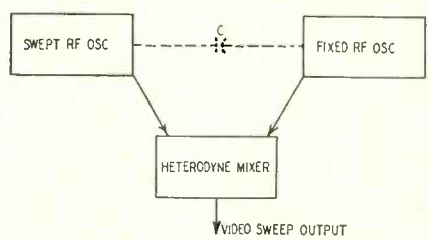
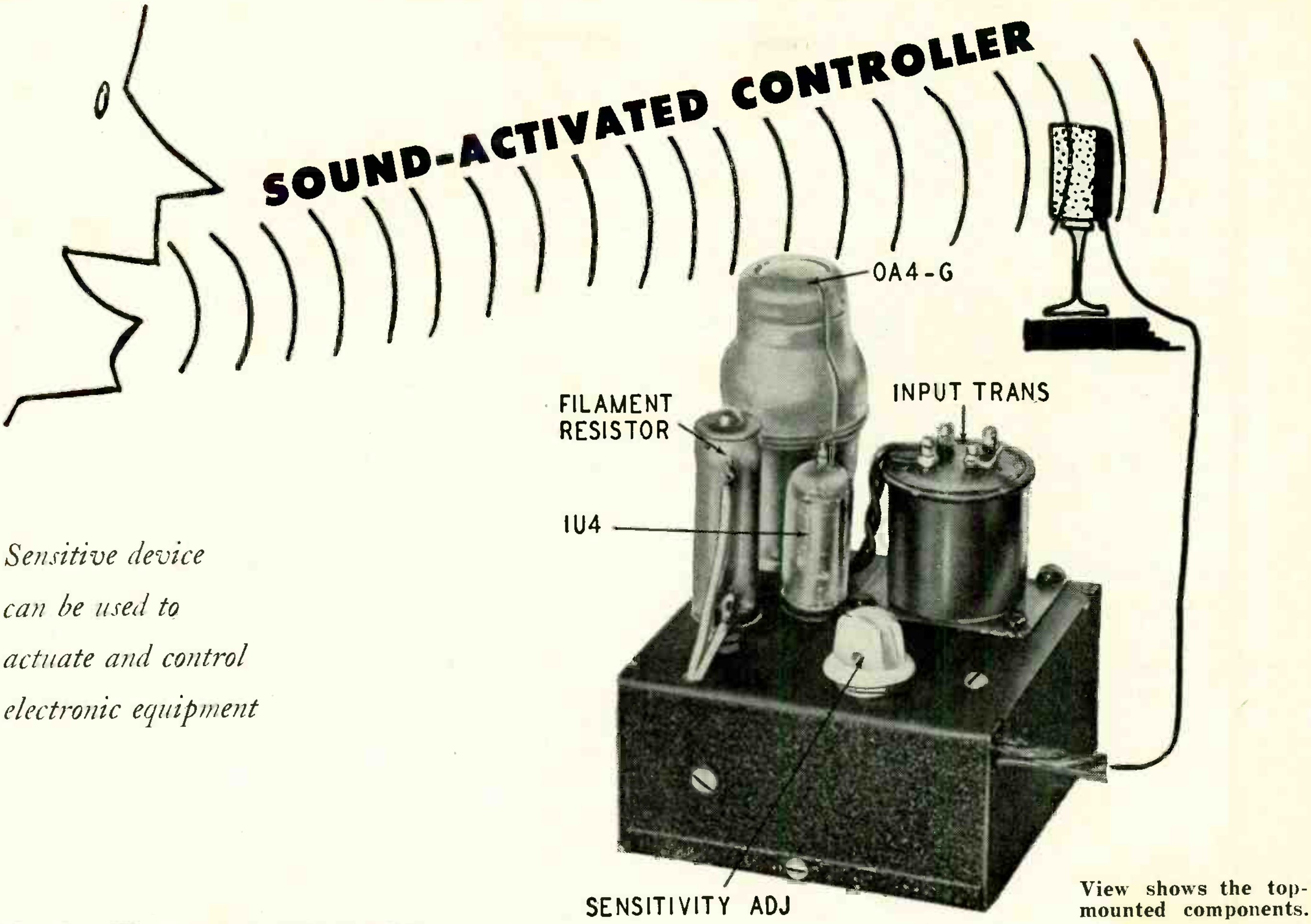


Fig. 9—Diagram shows basic arrangement for a beat-frequency sweep generator.

For technicians who like to build their own equipment, details of low-pass filter construction may be found in publications such as the *ARRL Handbook*, and in most books on circuit theory. END

SOUND-ACTIVATED CONTROLLER



View shows the top-mounted components.

Sensitive device can be used to actuate and control electronic equipment

By RICHARD J. SANDRETTO

A SOUND-ACTIVATED controller can be used to switch a paging system on automatically at the first word of an announcement and off again at the end, to give an auxiliary alarm for deaf people when the telephone rings or to give an alarm when the baby starts crying. Such a device can also be used to operate an unattended tape recorder so that infrequently occurring sounds or radio transmissions can be recorded without having the recorder run continuously. Other uses include automatically increasing the volume of a radio or TV set so that a program can be heard above occasional loud outside noises and functioning as an automatic talk–listen switch on radiotelephone and intercom systems.

In some instances it might be desired that a sound switch be set off by sounds of one particular narrow range of frequencies but be unaffected by other sounds. This type of sound switch is called a tone-operated relay.

Two very versatile and unique sound switches are described in this article. Each uses an 0A4-G thyratron tube for economy of operation, simplicity and dependability. The two-tube model has much greater sensitivity than the single-tube design. Both have been carefully planned to be easily adaptable to almost any special situation.

Circuit description

The circuit of a basic 0A4-G sound switch is shown in Fig. 1. The tube initially does not conduct although filter capacitor C is kept charged to the peak value of the line voltage by the selenium rectifier. Tube conduction, and consequent closing of the plate relay, will occur only if a sufficiently high voltage is placed on the starter anode of the tube. Voltage-dividing potentiometer R permits adjustment of this voltage to a value slightly lower than that necessary to start tube conduction.

Sounds reaching the carbon microphone cause corresponding voltage variations across the input transformer primary. The transformer steps up each variation and adds it to the preadjusted dc potential already on the 0A4 starter anode. The tube will fire if the total voltage is high enough.

Once the tube has fired it continues to conduct and the relay remains closed. Resetting requires momentarily breaking any part of the tube conduction circuit. Such a unit would be useless for most applications because it can respond only once and then has to be manually reset. This circuit is excellent nevertheless for lock-in operation.

Fig. 2 gives the circuit of a unit which, once set off, holds the relay armature in for a predetermined period and then automatically resets itself, ready for instant use again.

The circuit operates like that of Fig. 1 except that the closing of the relay disconnects one side of the power line and shunts R4 across the tube. This causes C to discharge through the relay coil and R4. The relay remains closed until the current through its coil drops to a value too low to hold the armature in. The relay then opens and resets the unit.

The selenium rectifier is protected from overloads by R2 which limits the current surge at the reset moment.

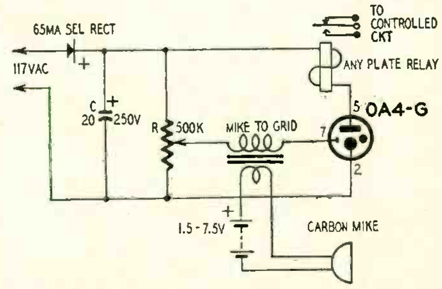


Fig. 1—Diagram of basic controller. Relay locks in when tube is fired.

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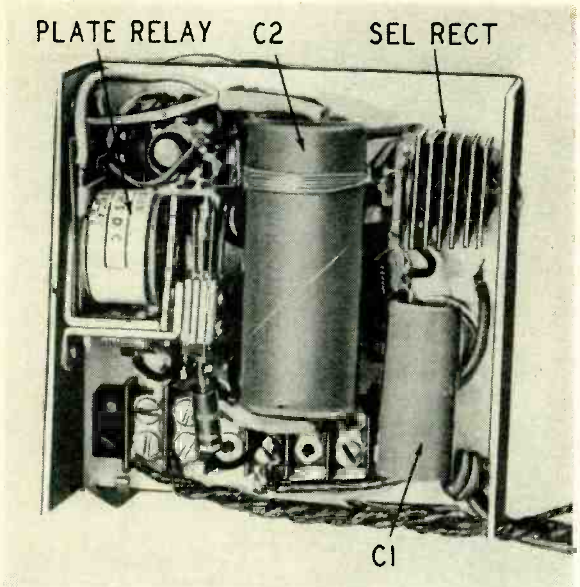


Underchassis components of controller.

The circuit of Fig. 2 will operate without it but it could not be omitted in Fig. 3. Here, an unlimited current surge will produce interference which will cause immediate refiring.

Three factors govern the relay hold-in period with any given relay. The most obvious is that increased capacitances of C give increased periods. Similarly, lower capacitances give shorter periods.

Second, if a greater period is needed than can be conveniently obtained with increased filter capacitance, R3 (Fig. 2) can be added to the circuit. Its value is chosen by experiment. When the unit is fired, this resistor allows some current to flow into C from the power line, but not enough to replenish completely the energy being drawn by the relay circuit. The capacitor charge lasts longer because of this aid. C should have a relatively high capacitance for stability. The circuit shows R3 and its chosen value for the author's particular unit. For applications not requiring an extended hold-in period this resistance is omitted.

The third method to lengthen the hold-in period further is the addition of R4. This too is chosen by experiment. If not needed, its connection points are shorted. It will add only slightly to the period.

Fig. 3 shows the resulting combination when a stage of high-gain audio amplification is added to the circuit of Fig. 2. Greatly increased sensitivity is achieved and careful design has maintained the features of simplicity and economy of operation.

In this circuit the 1U4 miniature pentode acts as a variable resistance, forming one leg of a voltage-dividing circuit. The other leg is formed by R1 and R5. Resistor R5 is protection against accidentally placing a damaging voltage on the 1U4 plate and 0A4-G grid when R1 is adjusted.

The 1U4 conducts current steadily unless an audio signal reaches the microphone. The voltage between its cathode (filament) and plate is relatively low after R1 has been properly adjusted. The 0A4-G starter anode is at this same potential and will not fire until the voltage increases to approximately 90. Ac signals from the input transformer cause the potential on the 1U4 grid to fluctuate. During the periods that the grid becomes negative the plate current decreases, causing an increase in plate voltage. This increase may be sufficient to fire the 0A4-G, depending on the setting of R1 and the microphone signal strength.

The 1U4 filament is continuously supplied with filtered dc from the power line. The unit's total power consumption could be reduced from about 10 to approximately 2 watts, and R7 and C1 could be omitted if the filament were supplied by a 2-volt radio storage cell. A 15-ohm ½-watt resistor would be needed in series with the tube filament which is rated at 1.4 volts. The same storage cell could also supply carbon microphone current.

Construction

The photographs show a Fig. 3 type unit. Minor wiring changes and removal of the 1U4 convert this unit to the single-tube operation of Fig. 2.

The component values, except for R3 and R4, are not in the least critical. These resistors are omitted unless an extended relay hold-in period is needed and then are chosen experimentally for each particular unit. The values shown serve only as rough guides. Caution: Do not make R3 so low that line-voltage variations appreciably change period length and possibly cause relay lock-in.

When a short period is wanted, the value of C2 (C in Fig. 2) is lowered. The period cannot be determined beforehand because of the possible variations in components that can be used. Here are some rough guides to go by: For a very brief period try 10 µf for C2 and omit R3 and R4. A 5-second period will require about 80 µf and also R4. A 9-second period will require about 120 µf and both R3 and R4. Greater periods than this can also be obtained.

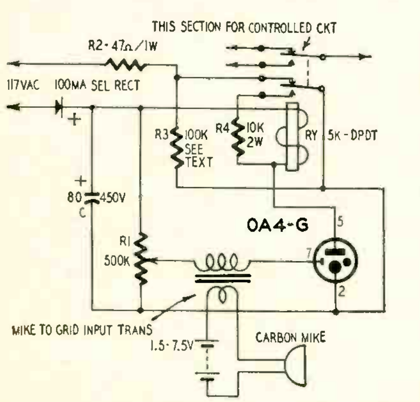
It is a good precaution to make the grid leads, especially that of the 1U4, short and shielded to minimize hum and other interference pickup.

The relay must have the contact arrangement needed for the external control circuit in addition to spdt contacts for circuit resetting. I used a 5,000-ohm Guardian series 200 dpdt unit which was made more sensitive by stretching the armature spring slightly. A 2,500-, 5,000- or 10,000-ohm dpdt Potter & Brumfield type LM-11 relay would work well also.

The input transformer can be any low- to high-impedance unit designed for matching carbon or dynamic microphones or PM speakers to input grids.

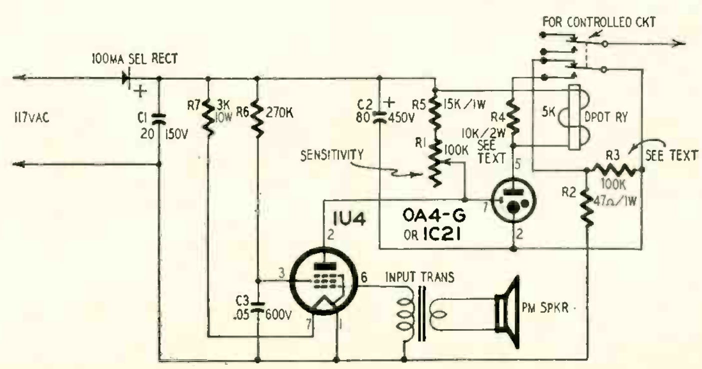
A 1C21 thyratron tube can be directly substituted for the 0A4. The 1C21 is 1½ inches shorter than the 0A4 and is slightly more sensitive.

Light lowers the breakdown voltage



Left—Fig. 2—Automatic resetting circuit.

Right—Fig. 3—Circuit of Fig. 2 with a stage of amplification added to it.



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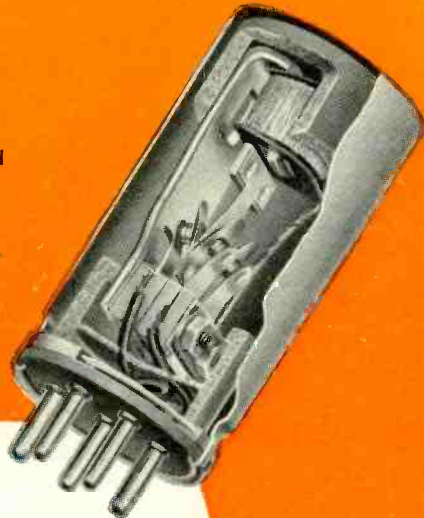

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characteristics of these tubes; a bright light may cause the controller to fire falsely. Therefore, the 0A4-G should be shielded from outside light. This can be done by enclosing it in a case, painting the bulb black or using a tube shield. The manufacturer paints the 1C21 bulb black; a glow discharge inside this tube could not be used for visual indication unless part of the paint were scraped away.

When the Fig. 3 type is plugged into the power line, it will immediately fire. This is due to a high-voltage drop across the 1U4 because it is not yet conducting.

All units are adjusted by slowly turning sensitivity control R1 until the unit fires. Then the control is backed up slightly until the unit no longer fires without activation. Sensitivity can be decreased by backing up this control further.

A telephone type carbon microphone unit gave excellent results. They are sometimes obtainable on the surplus market for less than a dollar.

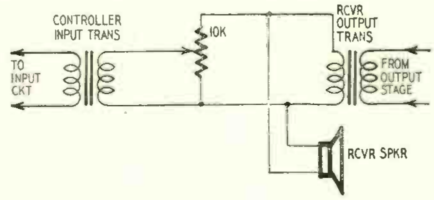

Fig. 4—Diagram shows controlling signal taken from radio or amplifier.

The sensitivity obtained with a carbon microphone depends to a large extent on its battery voltage. Ordinarily this should be between 1.5–7.5 volts. Use the lowest voltage that still gives the needed sensitivity. Additional voltage only wastes battery power and may ruin the microphone. The unit of Fig. 3 is highly sensitive and when used with a carbon microphone even 1.5 volts will be more than needed for some applications. A series-connected resistor should then be tried to see whether current consumption can be further lowered. Dry cells, storage batteries or low-voltage power supplies can be used to furnish the current.

Parts list for Fig. 3 controller

Resistors: 1—100,000 (see text), 1—270,000 ohms, ½ watt; 1—47, 1—15,000 ohms, 1 watt; 1—10,000 ohms (see text), 2 watts; 1—3,000 ohms, 10 watts; 1—100,000 ohms, potentiometer.

Miscellaneous: 1—100-ma selenium rectifier; 1—.05-µf 600-volt capacitor; 1—20-µf 150-volt capacitor; 1—80-µf 450-volt capacitor; 1—1U4 and socket; 1—0A4-G and socket; 1—dpdt plate relay, approximately 5,000 ohms (Guardian 200 series, Potter & Brumfield model LM11 or equivalent); 1—input transformer for matching low impedance to grid; 1—6-terminal barrier strip; 1—carbon microphone and battery, or PM speaker; 1—chassis; 1—shield for 0A4-G; 1—knob.

However, if a low-voltage power supply is used, it must be well filtered.

A PM speaker connected directly across the input transformer primary, as in Fig. 3, can be used for a microphone. Then a power-consuming microphone current supply is unnecessary because the speaker generates voltages when audio signals reach it. Sensitivity

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is much lower than it is with a carbon microphone, yet it is more than needed for many applications when used with the more sensitive controller of Fig. 3.

Use speakers with heavy Alnico magnets and large diaphragms which are more sensitive than those with lighter magnets or smaller diaphragms.

For situations such as recording intermittent radio announcements the controlling signal is taken directly from the low-impedance output of a radio or amplifier (Fig. 4). The potentiometer is used to reduce high noise level which might otherwise cause the controller to fire falsely. It also acts as a second sensitivity control.

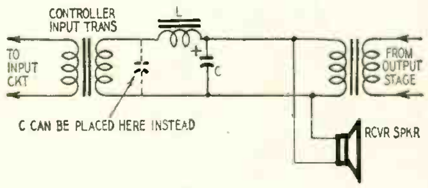

Fig. 5—Adding interference filter.

When connected to a receiver the controller can be adjusted to respond to a CW signal, voice, code or music on a continuous carrier. Any "click" sounds heard in the receiver loudspeaker may also activate the controller if it is adjusted to respond to a weak signal. Fig. 5 shows a filter that can be used to reduce the effect of clicks. Here, too, values of L and C may be selected experimentally.

Special connections

It may sometimes be necessary to use the same microphone for sound switch operation as for the input of an amplifier such as a paging system or intercom. Fig. 6 shows a method that

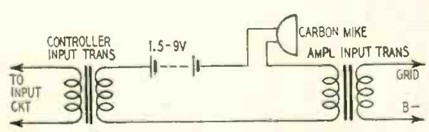

Fig. 6—Single microphone serves controller and amplifier or intercom.

works well with battery, ac–dc or ac type amplifiers. The amplifier input transformer isolates the units. Its primary impedance will reduce circuit sensitivity slightly, but the battery voltage can be raised to compensate.

Any other method that does not isolate the units will result in a high hum level, possible short circuits and shock hazard unless the amplifier ground and sound-switch B minus are permanently connected to the same side of the power line.

When the controller is used with a microphone, it will be more sensitive to a narrow band of frequencies or to some particular types of sounds. This selective response characteristic seems to be caused by microphone resonances and sometimes varies considerably with different microphones. END

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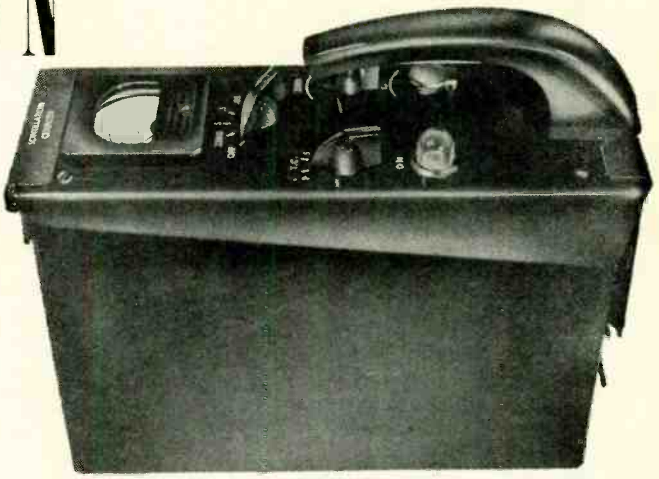

Part II—Probe construction and assembly; adjusting and operating the counter

By JAMES W. BRAY

THE probe assembly for the phototube is shown in Fig. 1 and the photographs. It was made for a previous model and is unnecessarily elaborate for use here. Considerable machine work is necessary and the job was turned over to a local machinist.

The main probe housing is 2 x 5¾ inches, including the threaded portion. It may be cut from a 2 x 6-inch length of brass tubing (latrine flush connector available from any plumbing firm). The threaded portion of the main probe housing consists of the end section from a 100-ampere fuse cartridge and is soldered to the inside of the housing.

The crystal housing is constructed from 1½-inch thin brass tubing with an aluminum or thin brass end piece soldered on. At the other end of the 1 5/16-inch length of tubing is a retaining lip made from the same material as the end piece. The lip is soldered to the edge of the tubing and made to fit inside the knurled cap from the fuse cartridge. The cap fits tightly over the hat-shaped crystal housing and holds it securely. Fig. 2 shows the internal layout of the probe. A simpler unit, shown in Fig. 3, can be constructed more easily with tools usually found in the home workshop. Either probe simply forms a housing for the crystal, phototube and associated voltage divider and capacitors. Lighttight construction is a must; extraneous light must not reach the phototube! Black Scotch tape is useful for closing light leaks.

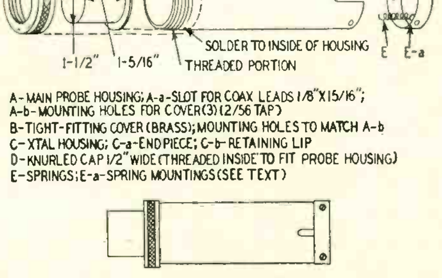

Fig. 1—Probe assembly for phototube.

A piece of flexible Mumetal shielding should be wrapped around the phototube in direct contact with the glass envelope. It can be held in place by wrapping tightly with the above-mentioned tape. This shielding counteracts the effects of the Earth's magnetic field. If Mumetal is not available, a steel shell of some sort might be used.

After the shield is attached, the tube is fitted into the probe housing with a thickness of sponge rubber between. This will keep the tube and crystal in place. The probe with the screw-cap end was designed to allow quick inspection of the crystal and phototube. However, performance will be just as good with the simpler housing of Fig. 3.

The phototube socket is fitted with a terminal strip (see photo) for connection to the coax cables. The strip is separated from the socket by 3/16-inch spacers ¾ inch long to allow space for mounting the 22-megohm voltage-dividing resistors R1 and the capacitors C1 (see Part I). The spring contacts supplied with the duodecal socket are reshaped at the connection end to allow them to pass through small holes drilled

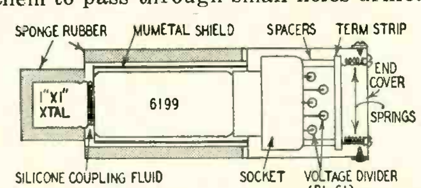

Fig. 2—Cross-sectional view of probe.

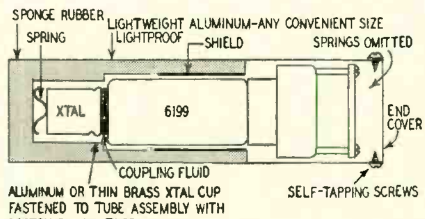

Fig. 3—Diagram of a simplified probe.

in back of each socket pin (see photo). In this manner, a lug from each pin contact extends through a hole to the back of the socket at which point connection is made. The resistors and capacitors are soldered directly to these lugs.

On top of the terminal strip are two short sections of spacer material which engage the two springs that in turn maintain a slight pressure against the phototube to assure good contact between tube and crystal. Two more similar spacers are bolted to the end cap of the probe assembly to hold the other end of the springs. Select a spring which will not put too much pressure against the tube, damaging the tube or crystal.

Crystals are available in various sizes and the sensitivity of the instrument is directly related to the crystal size. In this counter a 1 x 1-inch crystal was used. Crystals as small as ½ x 1 inch can be purchased, but the 1 x 1-inch size is recommended. This crystal will give very good performance from a plane at low altitudes and the ½ x 1-inch unit will give good sensitivity for foot-prospecting.

Scintillation crystals are very fragile and should not be subjected to shocks (either physical or erratic temperature change). When ordering, be sure to specify that it is to be used in a portable device with a 6199 tube and the manufacturer will supply the most rugged.

The probe is connected to the subpanel with two lengths of RG 58/U or 59/U coax. These contain the signal from the phototube anode, and high voltage to the probe. The plug is an Amphenol MC3M with all brass fittings removed so that it will fit into the space between the panels. The receptacle, a type PC3F, is mounted on the subpanel.

Probe modification

After this counter was completed, an arrangement came to mind which would greatly increase the usefulness of the instrument. For certain types of sur-

(*Continued on page* 100)

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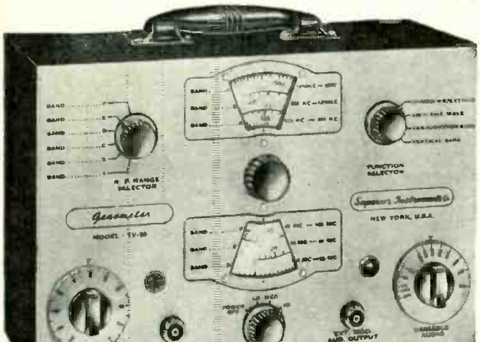

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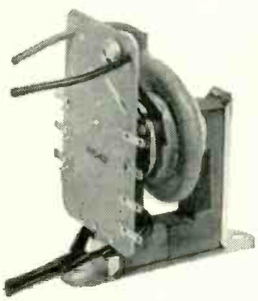

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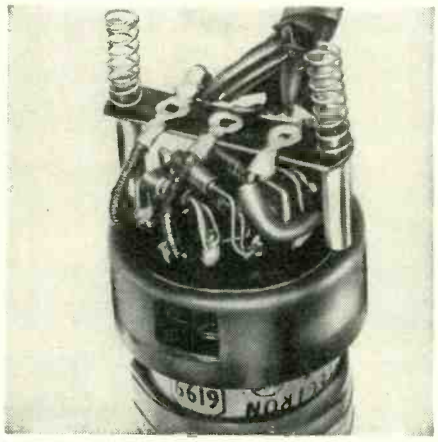
veys it is desirable to have a separate probe, small and mobile to allow its use in out-of-the-way corners and crevices. The counter described here can have this advantage in addition to its self-contained one-piece feature. The only changes necessary are:

1. Make the probe cable long enough to reach well away from the main case; 3 to 4 feet should be the maximum.

2. In place of the probe clamp described below, make one from spring material shaped like a large fuse clip. Install it on a block to bring it high enough to hold the probe firmly in the mounting blocks described below.

3. Reroute the cable to front of case and eliminate cable clamps so that the cable can be disconnected easily.



Phototube socket arrangement.

4. Obtain one of the waterproof snap covers of the type used with weatherproof outdoor electrical outlets. Mount this so that it will cover a ¾-inch or larger hole cut in the front of the case near the top. To use the probe outside the case, simply unclip it, remove the coax plug and rethread the cable through the hole in the case.

Installing the probe

The probe is mounted in the case on two Bakelite blocks, made by sawing out curved portions slightly larger than the contour of the probe. Cement thin pieces of sponge rubber on top surfaces. Drill and tap the bottom for mounting.

With the blocks mounted in the case, put the probe in place and bend a piece of ½-inch-wide aluminum strap over the probe (see photo). Cut the strap to size, allowing space on each end for mounting, and attach a piece of thin sponge rubber to the underside. Mount one end of the strap rigidly with a screw passing through the bottom of the box. Fasten the other end of the strap with a knurled nut on a longer screw passed through the bottom.

A round piece of sponge rubber is cut and cemented to the inside of the box opposite the crystal end of the probe to cushion it in case the strap comes loose. No opening was made in the case for rays to enter since the aluminum case caused little or no attenuation.

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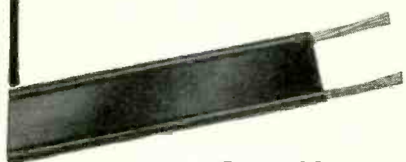

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TC3-E	2	3	4			7	8	9	10	11	12	13
TC3-F	2	3	4			7	8	9	10			
TC3-G	2	3	4				8	9	10	11		
TC3-H	2	3	4						10	11	12	13
TC3-I		3	4	5	6	7	8	9	10	11	12	13
TC3-J		3	4	5	6	7	8	9	10			
TC3-K		3	4	5	6		8	9	10	11		
TC3-L		3	4	5	6				10	11	12	13
TC3-M			4	5	6	7	8	9	10	11	12	13
TC3-N			4	5	6	7	8	9	10			
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TC3-P			4	5	6				10	11	12	13

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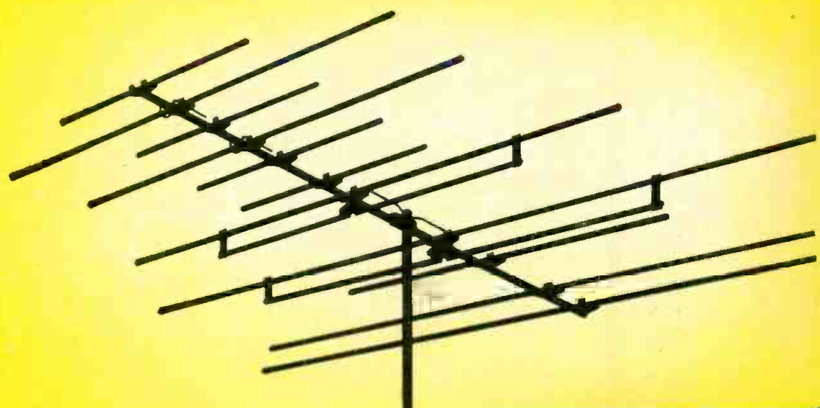

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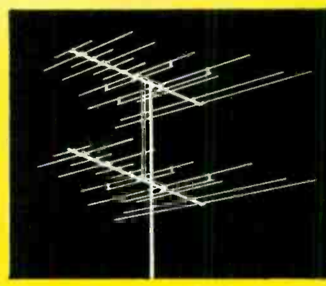

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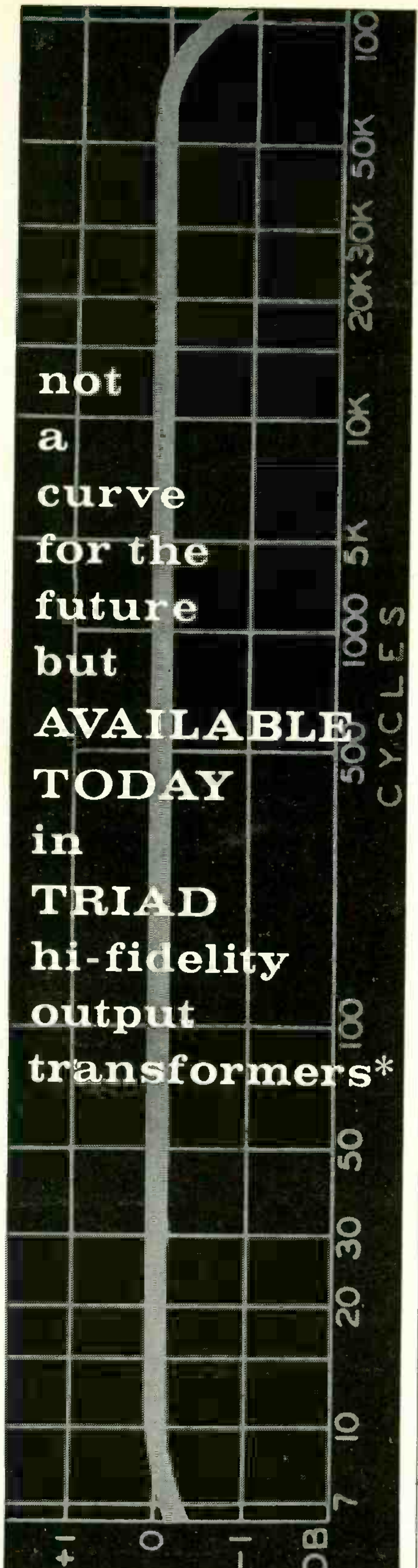

*Curve plotted from stock amplifier using TRIAD HSM-189 output transformer, as listed in General Catalog.

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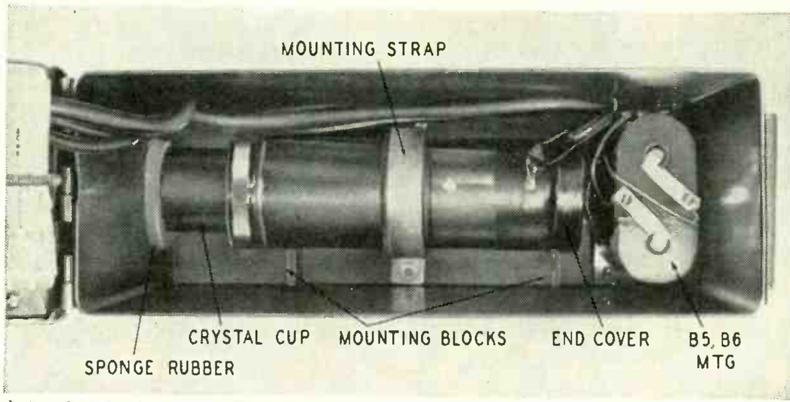

All photos by Charles Y. Caldwell, Jr.

View looking down into probe case.

It might appear that the probe assembly is mounted in the wrong plane, since the most sensitive part of the instrument is the end facing the crystal. The mounting used, however, was chosen after tests showed negligible directional effects from the probe. Weight distribution is such as to unbalance the unit slightly so that it slopes downward, pointing the probe toward the ground.

The Sunbeam Mixmaster handle serves as a carrying handle. It was chosen because it fits the hand well and remains comfortable through hours of use. A spacer of ¼-inch Bakelite raised the handle to allow more hand space.

The case is finished by spraying with gray lacquer or enamel and decals (see photo) are attached after the paint has thoroughly dried.

Adjustment and operation

After wiring is complete, inspect carefully for errors—especially in the filament circuit of the subminiature tubes. *Do not* use an ohmmeter for this without taking care to prevent excessive voltage from being applied by the meter to the tube filaments.

Next, with chassis and probe outside of case, plug in the probe. Connect a 20,000-ohms-per-volt meter between the cathode of V4 (Part I, Fig. 1) and ground. Check the polarity and set the meter on the 5,000-volt dc range. CAUTION: High voltages are encountered from here on which are dangerous. Be careful! Now turn the switch to ZERO. The ratemeter will probably deflect one way or another. Reset it to zero with the ZERO (R7) control. Observe the meter reading—it should be approximately 750 volts. If it is, the high-voltage supply is working properly. If not, switch to OFF and look for wiring errors, faulty components, etc.

When correct readings are obtained, remove the voltmeter test leads and turn switch S1 to the FIVE (5 milliroentgens per hour) range. The ratemeter should give a slight deflection. As the range switch is turned to lower ranges, this reading should get progressively higher. The reading on the ratemeter is entirely dependent upon the setting of calibration control R3. This control operates over wide limits and can usually be adjusted to a point where the univibrator will go into self-oscillation. Somewhere before this point is reached, proper operation will occur.

From this point on, calibration will depend entirely upon the means of calibration available. For this particular instrument, ranges in milliroentgens per hour in even multiples of 5 were selected for convenience with the scale on the meter used. Actually only a relative calibration, it was found suitable for prospecting work. Calibrated samples can be purchased for setting these scales, if desired. (See Part I.) A small calibrated sample serves as a handy means of setting up the instrument to the same operating point each time it is used. Radioactive material which has not been calibrated (such as radium-dial watches, luminous light-fixture cord pulls or even rocks containing radioactive substance) can be used to reset the instrument.

As a rough setting to begin with, turn the range switch to .05 and adjust calibration so that the meter gives an average reading of .01 to .02 milliroentgen per hour. Known as "background count," it will be present whenever the counter is turned on. Be sure to keep any radioactive material well away while making this adjustment. The background will vary considerably from one location to another. When a piece of radioactive material is brought close, the meter should read upward, the amount depending upon the radioactivity content of the specimen. For prospecting use, the count should show at least two to three times the background to be of interest.

The time-constant control gives a more accurate measurement of radioactivity when switched to the SLOW position. But at least 1 minute must be allowed for the meter to settle down before making a measurement.

Once the calibrate control is set, very little adjustment is necessary. Slight changes will take place as batteries weaken. This can be compensated for by readjusting the control to give the same reading previously recorded from the radioactive substance used for that purpose.

The B batteries should last at least 200 hours in normal use, the D-99 cells (B5, B6) might have to be changed more often. END

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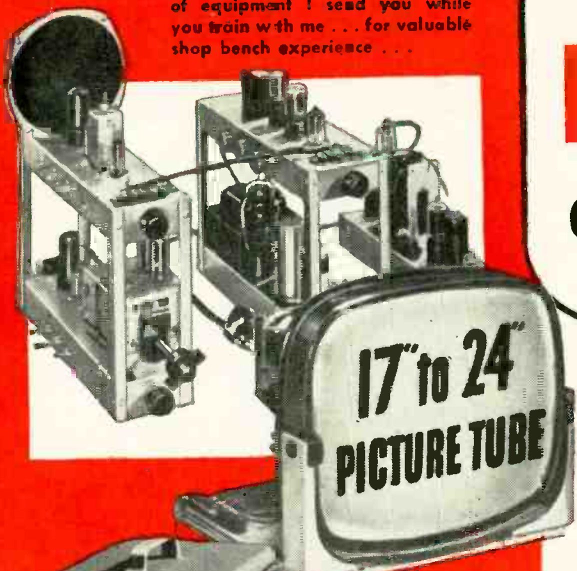

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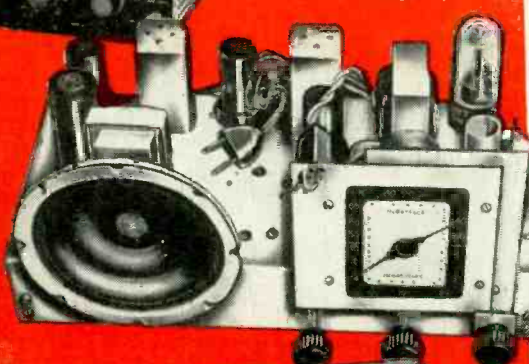

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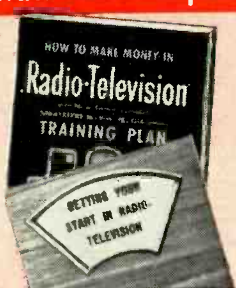

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Electronic Counter Tube

A special type of C-R tube, the EIT can count in tens

By J. R. DAVIES

ONE of the most fascinating branches of electronics is that of counters and computers. Devices of this type, with their phenomenal speed and accuracy, appear to the layman to be somewhat of a near-miracle. To describe some of the more advanced computers as "electronic brains" is not too far from the truth—such equipment, in their special use, simulate functions of the human brain very closely.

The basic "cell" of most conventional counters and computers is the vacuum tube, usually working in what are known as binary units, or "bits." The reason for this choice of units is that a single tube can be relied upon only to indicate one of two states: when it is conductive (passing cathode current); when it is nonconductive (beyond grid cutoff). It would be impracticable to expect a tube to cope reliably with three states such as: off (past grid cutoff); half-on (low cathode current); fully on (high cathode current). Tube spread and deterioration could cause the half-on and fully on states to lie too close together after a period of use, and there would be a risk of misinterpretation.

A tube capable of counting in 10's or decades would overcome this trouble. This type of tube exists, a typical one being the EIT made by Mullard in England. This tube may be used in cascade with others with the result that when one tube has reached what would otherwise be "10" it triggers the next tube in the circuit and slips back itself to zero. Thus, a group of three tubes can be used to count to 999: the first tube counts digits and triggers the second tube at every decade; the second tube counts in 10's and similarly triggers the third tube which counts in 100's.

To add to its versatility, each of the EIT tubes not only counts but also indicates its number on an easily read built-in fluorescent screen. The photo shows the tube and its indicating screen. The top counting speed is 30 kc.

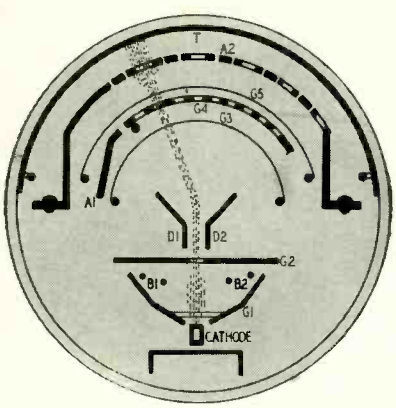

Fig. 1—Internal construction of EIT.

Construction and circuitry

The internal construction of the EIT is shown in Fig. 1. Fig. 2 illustrates a typical circuit.

In Fig. 1 the cathode emits an electron stream which passes through grid G1 and the beam-forming electrodes B1, B2. The stream next passes through G2 and, being at B-plus potential, is accelerated. Leaving G2 the electron stream is in the form of a thin ribbon-shaped beam, the major width of the ribbon being at right angles to the surface of the paper.

The beam now travels through deflector plates D1, D2 to G4. However, G4 is perforated and the narrow beam is not wide enough to pass through more than one of its 10 apertures before it reaches segmented plate A2. This plate has apertures also and the beam has to pass through one of these before it finally strikes fluorescent conductive target T. The apertures in A2 are staggered alternately, thus allowing the fluorescent indications on the target to be similarly staggered for well spaced out readings. In addition, A2 is sectionalized, preventing the beam from spreading too widely after it has passed through the particular aperture it has chosen in G4.

Due to the narrowness of the beam, once it has settled at a particular aperture in G4, it remains locked there until some external force is applied to move it elsewhere. Deflector plates D1 and D2 are arranged so that they provide this beam-moving force in a horizontal plane relative to the surface of the paper in Fig. 1. Plate D2 has a positive potential higher than that on D1. Thus the beam is attracted, when the tube is first switched on, to the furthermost right-hand aperture of G4. This position corresponds to 0 on the fluorescent target.

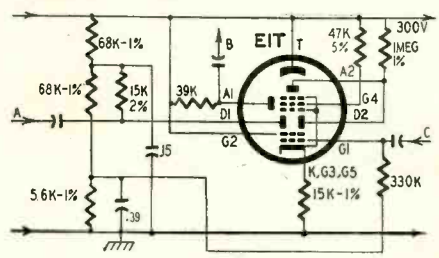

Fig. 2—Schematic of a typical circuit in which the EIT may be used.

When a positive counting pulse of the correct shape (provided by a suitable input filter) is injected into the circuit of Fig. 2 at A, D1 becomes momentarily more positive than D2 causing the beam to move to the left. However, the shape of the pulse is such that the beam moves only one step (or one aperture in G4) whereupon it then stops and becomes locked in its new position. Successive pulses cause the beam to move to successive apertures. On the arrival of the tenth pulse, the beam passes from the tenth aperture of G4 and strikes A1. Current is drawn by this plate, causing a negative pulse to appear at point B (Fig. 2). This negative pulse triggers an external circuit which does two things: it applies a reset pulse to the tube so that it may return to zero; it passes a counting pulse to the next decade-counting tube along the line.

The reset pulse consists of a negative pulse injected at C and causes G1 to go negative, whereupon the tube cuts off altogether. When the negative pulse at G1 ceases, the counting cycle starts up all over again with the electron beam of the tube passing through the furthermost right-hand aperture in G4.

The tube is then ready to count another decade. END

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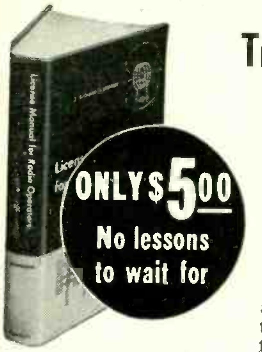

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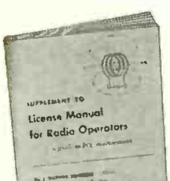

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MISCELLANY

THE FUND REACHES $11,874.73

HELP-FREDDIE-WALK FUND

RECENTLY the Help-Freddie-Walk Fund received some wonderful news from Herschel Thomason, service technician of Magnolia, Ark., and father of 7-year-old Freddie.

As most of our readers know, Freddie was born without arms or legs. Some time ago, he was fitted with legs and has learned to walk and run almost as well as normal children. Just a few months ago, his father writes, he received his right arm, a mechanical arrangement fitted to his shoulder and manipulated by moving his shoulder up and down. Already Freddie has learned to feed himself and pick up and hold various items, including a glass, with his split utility hook. Freddie's progress has amazed everyone, but he was so anxious to get his arm and so determined that he would use it well that he has been able to cover a great deal of ground in a short time.

When Freddie received his arm, he was also fitted with a new pair of legs, which meant learning to balance himself and walk all over again. Changes in the mechanical appliances upon which he depends must be made regularly, and although at present Freddie is not as tall as the average 7-year-old, it is hoped that in the near future he will reach his "normal growth."

Needless to say, such changes are horribly expensive . . . and Freddie still has to be fitted with another arm. During the past years, our readers have been extremely generous—the Fund has turned over to Freddie's parents almost $12,000—but we ask you to be even *more* generous in 1956, so Freddie's progress will not be held up because of lack of funds. His parents are doing all they can, not only financially, but in giving to Freddie love, encouragement, faith and determination.

Any contribution you might be able to make will be acknowledged and sincerely appreciated, no matter how large or small it may be. *Make out all checks, money orders, etc., to Herschel Thomason.* Send all contributions to:

Help-Freddie-Walk Fund
c/o RADIO-ELECTRONICS Magazine
25 West Broadway
New York 7, N.Y.

RADIO-ELECTRONICS Contributions as of Oct. 10, 1955	$11,214.23
FAMILY CIRCLE Contributions	602.50
Anonymous, Waterbury, Conn.	10.00
Jack Farrance, Falls Church, Va	3.00
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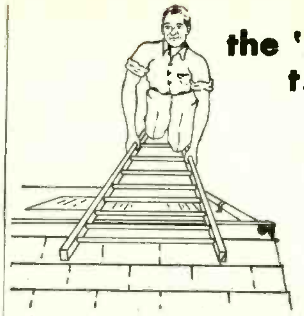
M. Rosenburg, River Vale, Westwood, N. J.	2.00
Ed. Thornborrow, Great Falls, Mont	5.00
TOTAL CONTRIBUTIONS as of Jan. 10, 1956	$11,874.73



the '2nd' trip up.. Costs *YOU!*

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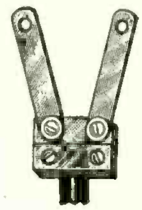

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MISCELLANY

ELECTRONIC TERMS, OUR ABBREVIATIONS

A NUMBER of our readers have pointed out that "Our Abbreviations of Electronic Terms" (page 138, January, 1956) was useful chiefly to the person who wished to find the abbreviation for a certain term. But because the items were indexed by terms, the person who found an unknown abbreviation was often at a loss. The letter E, for example, might stand for *emitter*, in which case the reader would find it without difficulty. But it might also stand for *voltage* and he would not be likely to look for an E among the V's.

We have therefore prepared this revision of the January list indexed according to abbreviations. This represents the forms consistently used in our magazine. As pointed out in the January issue, many of these are abbreviated in art work only and are usually spelled out in the text. Periods are omitted except where the omission would cause confusion. Abbreviations in lower-case letters are so printed in text—are capitalized in artwork. Those printed in capitals are capitalized in both text and artwork.

ABBREVIATION	ELECTRONIC TERM
ac	alternating current
ACC	automatic chroma control
ADJ	adjacent
af	audio frequency
afc	automatic frequency control
af choke	audio-frequency choke
AFT	audio-frequency transformer
agc	automatic gain control
AM	amplitude modulation
amp	ampere(s)
AMPL	amplifier
ANT	antenna
apc	automatic phase control
ATTEN	attenuator
AUTOTRANS	autotransformer
avc	automatic volume control
AWG	American wire gauge
b or base	base (of transistors)
BATT	battery
BCI	broadcast interference
bfo	beat frequency oscillator
BO	Barkhausen oscillation
BTO	blocking tube oscillator
c (of transistors)	collector
C, CAP	capacitor (capacitance)
CALIB	calibrate
cath (K on tube diagrams)	cathode
CATH FOLL	cathode follower
CH (or CHOKE)	choke
CHAN	channel
CHG	charge
CKT	circuit
CKT BRKR	circuit breaker
coax	coaxial
COM	common
COND	conductor
CONN	connection
CONT	control
CONV	convergence
CONVTR	converter
counter emf	counter electromotive force
C-R	cathode-ray (tube, etc.)
CRO	cathode-ray oscilloscope
CW	continuous wave
db	decibel
dc	direct current
dcc	double cotton covered (wire)
DC REST	direct current restorer
DEFL	deflection
DEMOD	demodulator
DET	detector
df	direction finder
DIELEC	dielectric
DISCH	discharge
DISCRIM	discriminator
dpdt	double pole double throw
dpst	double pole single throw
dsc	double silk covered (wire)
DYN	dynamic
dx	distance
e	emitter (transistor)
E	potential
E (sometimes V in transistor diagrams)	voltage
ELEC	electric
ELECT	electrode
emf	electromotive force
ENAM	enamelled (wire)
EQUIV	equivalent
ERASE HD	erase head
ERP	effective radiated power
EXT	external or extension

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PUTS AN END TO ALL LINE VOLTAGE HEADACHES

Insure full size, strength and sync of TV picture when low line voltage shrinks or weakens picture. All units have baked wrinkle finish, built-in AC receptacles and 6′ line cord.

NEW! LVS 153 LINE VOLTAGE STABILIZER

A popularly priced, quality automatic voltage regulator. Stabilizes line for TV, radio or industrial use where load is constant. Input may vary between 95-130 volts, nominal output voltage regulated ±3%. One model covers 125 to 300 watt range. Built-in automatic relay turns stabilizer on with equipment. Waveshape is free from distortions and frequency sensitivity of resonant type regulators.

Size: 10″x5″x9½″ high
Weight: 10 lbs.
List Price: 29.95

DEALER NET: 17.95

NEW! LVB-350 METERED VARIABLE VOLTAGE ADJUSTER

Constant duty unit used as step-up or step-down. Automatically operated—turns on and off with set. Easily adjusted by manually turning 7-position rotary switch until built-in voltmeter reads 115 volts output. Has input switch positions for 90 thru 130 volts.

Watts: 350 Weight: 7 lbs.
Size: 7″x3¼″x3⅞″ high
Mounting Centers: 5″x2½″
List Price: 24.75

DEALER NET: 14.85

LVB-117 LINE VOLTAGE BOOSTER

Multi tap selector switch restores line voltages of 90 thru 135 volts to 117 volts output. Calibrated neon indicator permits exact voltage adjustment. Automatically operated—turns on and off with set. Overload fuse protects against unsafe line increases.

Watts: 350 Weight: 4 lbs.
Size: 4⅞″x3¼″x3⅞″ high
Mounting Centers: 2 3/16″x2½″
List Price: 17.95

DEALER NET: 10.80

LVB "Jr." UP-DOWN VOLTAGE BOOSTER

Reliable, budget-priced unit. Single switch provides 10 volt boost or drop or straight-through line.

Watts: 350 Weight: 3 lbs.
Size: 2⅞″x3¼″x3⅞″ high
Mounting Centers: 1 11/16″x2½″
List Price: 6.75

DEALER NET: 4.05

PICTURE TUBE REJUVENATOR

Boosts CRT brightness. Units are resin treated; new design insures cool and buzz-free operation; 8 oz.

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#49C:	Parallel sets, 5 leads	$1.50
#50D:	Series sets, 6 leads	$1.75
#51E:	Parallel, isolation, 6 leads	$2.25
#52:	Parallel, 2-step boost, 6 leads	$3.75
#53:	Universal, isolation & boost	$4.25

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* *Vernier Precision*

INTERCHANGEABLE ROTATORS

Famous Superotor models "100" and "500" have both been designed for automatic operation.

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Special! "Cub-Kit" with bonus plastic service dispenser.

Ask your C-D Distributor. He's listed in your local Classified Telephone Directory.

There are more C-D capacitors in use today than any other make

CONSISTENTLY DEPENDABLE

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CATHODE RAY SCOPE TUBE

3AP1, made by famous tube maker - Jan type! Electrostatic focus and deflection. Medium 7 pin base Individually cartoned. Packed for export.
Regular net $15.75.

79¢ ea. Lots of 4 individ. packed 4 to a carton (7 lbs. to cart. of 4)

SINGLE **99¢** EA.

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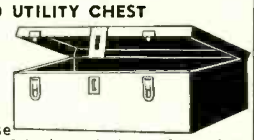

Sturdy, all purpose case 20¼"x9½"x7¼", 2 locks and clasp. No nails, all countersunk screws. Approx. shipping weight 11 lbs. Reg. $14.46. **$1.95**

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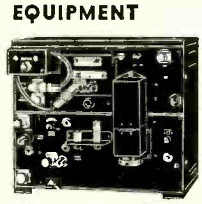
Complete with 44 tubes $17.95 each. **$5.95** ea.



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MISCELLANY *(Continued)*

ABBREVIATION	ELECTRONIC TERM
F (f in combination)	farad(s)
f, FREQ	frequency
FIL (F in tube diagrams)	filament
FM	frequency modulation
FOLL	follower (ing)
G (in tube diagrams)	grid
GCA	ground controlled approach
GDO	grid dip oscillator
GEN	generator
GND	ground
h	henry
HD	head
hf	high frequency
HORIZ	horizontal
HTR (H)	heater
I	current
if	intermediate frequency
ILS	instrument landing system
IM	intermodulation
IN	input
INV	inverter
ips	inches per second
K	thousand
kc	kilocycle
kw	kilowatt
L	inductor
L	coil
lf	low frequency
LIN	linearity
LIM	limiter
μ	micro- (one-millionth)
μf	microfarads
μh	microhenry(ies)
μμf	micromicrofarad(s)
μsec	microseconds
M	meter
ma	milliampere(s)
max	maximum
mc	megacycle(s)
meg	megohm
mh	millihenry(ies)
mike	microphone
MIN	minimum
MOD	modulation (modulator)
MULT	multiplier
MVD	multivibrator
NBFM	narrow-band FM
NE	neon
NEG	negative
NET	network
n-p-n	negative-positive-negative (transistors)
OSC	oscillator
OUT	output
P	plate
PA	public address
PERM	permanent
phone(s)	telephone
pix	picture (TV)
PL	pilot lamp
PM	permanent magnet (speaker)
PM	phase modulation
p-n-p	positive-negative-positive (transistors)
POS	positive
POT	potentiometer
PP	peak-to-peak
PPI	plan position indicator (radar)
pps	pulses per second
preamp	preamplifier
prf	pulse repetition frequency
PRI	primary
Q	reactance-resistance ratio
QUAD	quadrature
R	resistance (resistor)
RCDG	recording
RCDR	recorder
RECT	rectifier
REG	regulator
regen	regeneration
rf	radio frequency
RFC	radio-frequency choke
RFT	radio-frequency transformer
rms	root mean square
Ry	relay
S	switch
scc	single cotton covered (wire)
SEC	secondary
SEL (RECT)	selenium (rectifier)
SEP	separator
SG	screen grid
SIG	signal
spdt	single pole double throw
SPKR	speaker
spst	single pole single throw
ssc	single silk covered (wire)
SW	shortwave
SWR	standing wave ratio
sync	synchronization
T	trimmer
TELEG	telegraph
TERM	terminal
tptg	tuned plate tuned grid
TRANS	transformer
trf	tuned radio frequency
TVI	television interference
uhf	ultra high frequency
v	volt(s)
V	tube, transistor
va	volt-ampere
vac, vdc	volts ac, dc
VAR	variable
VC	voice coil
VERT	vertical
VFO	variable frequency oscillator
vhf	very high frequency
VIB	vibrator
VOL	volume
VOM	volt-ohmmeter
vswr	voltage standing wave ratio
vtvm	vacuum-tube voltmeter
VU	volume unit(s)
W	watt(s)
X	reactance
xtal	crystal
Z	impedance

—END—

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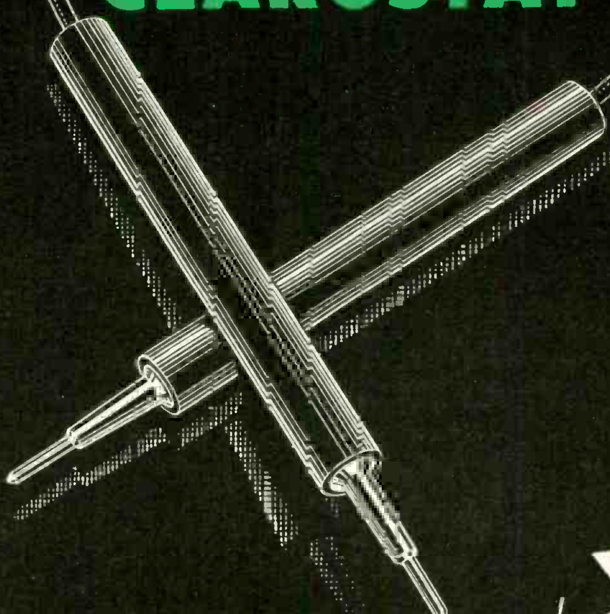

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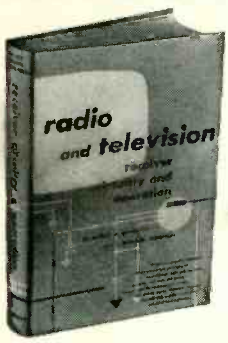


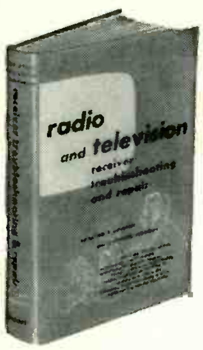
Radio and Television Receiver
CIRCUITRY AND OPERATION
By Ghirardi and Johnson
669 pages, 417 helpful illustrations; Price $6.50

Learn all about Circuits . . . AND WATCH SERVICE "HEADACHES" DISAPPEAR

Years of experience plus hundreds of talks with service technicians proved to Mr. Ghirardi the need for a book that got right down to earth in explaining the basic circuits and operation of modern radio and television receivers. Radio & Television Receiver Circuitry and Operation is the result. Backed by what you can learn from it, you'll find that 9 out of 10 service jobs are tremendously simplified. You'll work faster with less testing—and make more money in the bargain! Guesswork is eliminated.

Starting with AM and FM processes and characteristics, the book progresses to a complete understanding of basic circuits, how they operate, how to recognize them quickly and what is likely to go wrong with them. By making it easy for you to understand each circuit and its relation to other circuits, the book helps you go right to the seat of trouble in far less time. You'll know what different trouble symptoms mean — and you'll know how to repair troubles lots faster and more efficiently.

Sold separately for $6.50. Try it for 10 days on our FREE examination offer.



Radio and Television Receiver
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By Ghirardi and Johnson
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Complete Training in MODERN PROFESSIONAL SERVICE METHODS

This big book makes the tough service jobs easy, makes the easy ones a cinch!

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First you get a full analysis of components, their functions, their troubles and their remedies. Next you learn modern troubleshooting methods from "static" tests to dynamic signal tracing and injection techniques. You learn basic procedures and how to interpret performance data. Four big chapters show how to realign Television, FM and AM receivers in less time. You'll learn how a glance at a TV set may quickly tell you what is wrong. Special hard-to-fix service. Problems are explained. Puzzling "intermittent" troubles and their remedies are clearly outlined. Step-by-step service procedure charts demonstrate many operations almost at a glance. In short, from the simplest troubles to the most difficult ones, nothing has been omitted—nothing has been condensed. Everything is carefully explained—and the entire book is fully indexed so you can find exactly what you want in a jiffy.

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OUTSIDE U.S.A.—$7.25 for TROUBLESHOOTING & REPAIR book; $7.00 for CIRCUITRY & OPERATION; $13.00 for both books. Cash with order only. Money refunded if you return books in 10 days.

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Patents

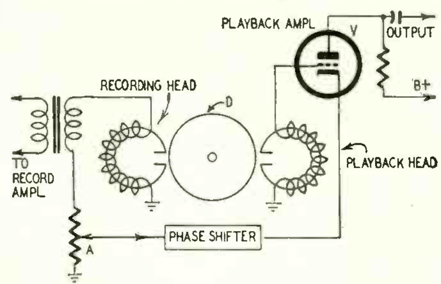
MAGNETIC RECORDING SYSTEM

Patent No. 2,713,676

Howard M. Fleming, Jr., Orange, N. J. (Assigned to Monroe Calculating Machine Co.)

In most computers, a magnetic tape or drum is used to store or "memorize" data. Much time may be saved if it is possible to *record* data on one channel while an adjacent channel is being *played back* for other data. Ordinarily this creates interference because the flux field of the recording head is strong and affects the playback head. Here is an effective method for cancelling this reaction.

The diagram shows recording and playback



heads, both contacting the same magnetic drum D. The signal from the recording circuit arrives at tube V via two different paths. One is through A and the phase shifter to the *cathode.* The other is through the flux field generated by the recording head. This is picked up and fed to the *grid*. When these signals are identical, V has no output. They can be made equal by adjusting arm A and the phase of the shifter. After these adjustments are correctly made, the playback circuit is free from interference.

Playback is not affected. The reproduced signal is fed to the *grid only* and is amplified as usual.

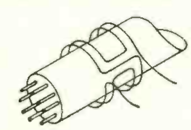
SPOT-WOBBLER

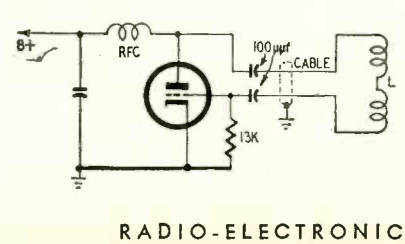
Patent No. 2,722,627

Michael T. Pappas, Ardsley, and George W. King, Pleasantville, N. Y. (Assigned to General Precision Laboratory, Inc.)

TV spot-wobblers have been mentioned in this magazine on several occasions. They are used to modulate the horizontal lines scanned on a picture tube. Ordinarily these lines are straight, therefore noticeable and often distracting. When modulation or wobbling is applied, the lines are broken up or take on a wavy character which is less annoying to viewers.

The triode is an ultra-audio oscillator which needs an untapped coil as tank circuit. This is provided by the spot-wobbler (L) yoke itself. A frequency near 10 mc is chosen for the wobble frequency. Note that L is connected to





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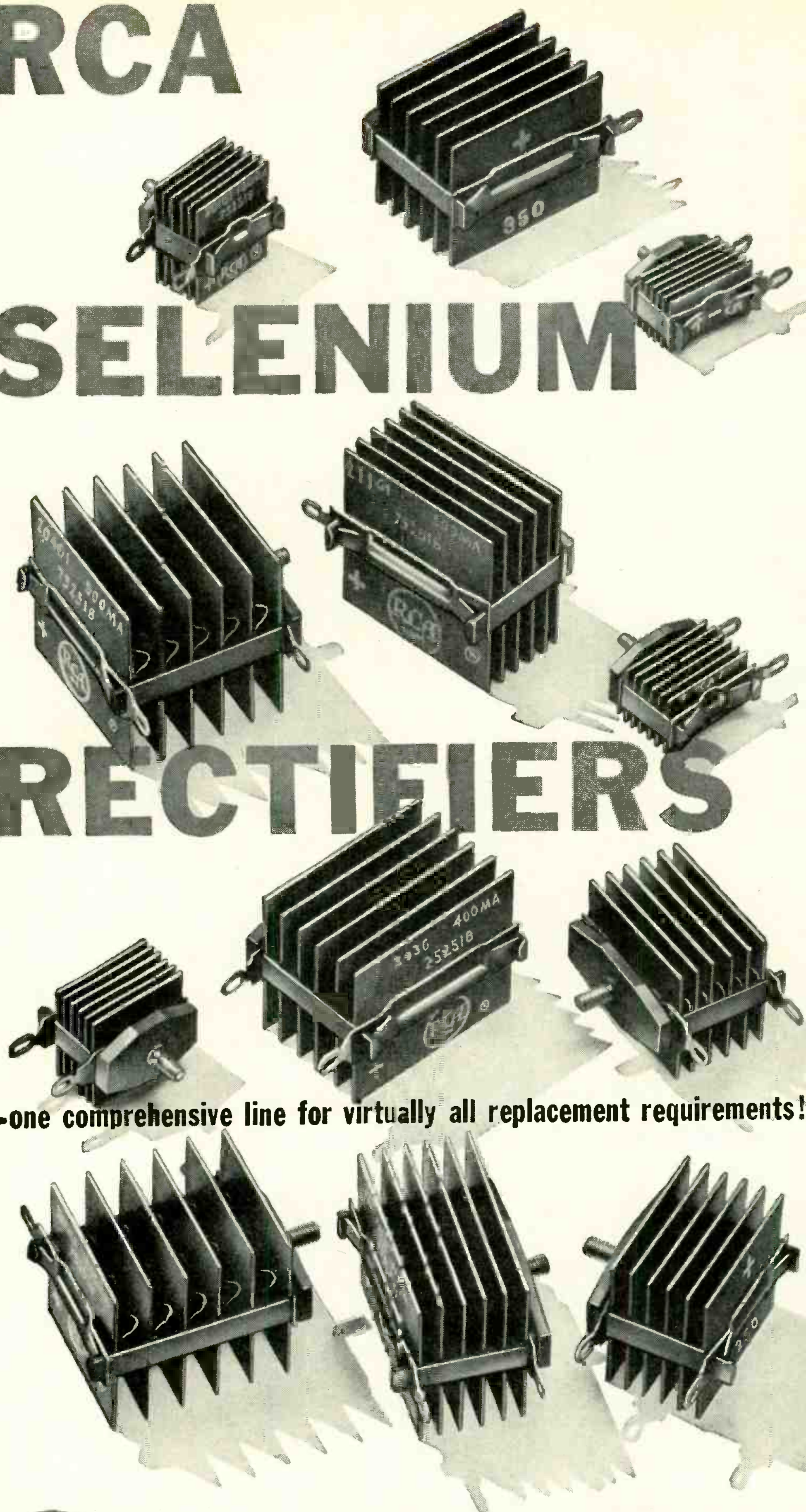
RCA SELENIUM RECTIFIERS



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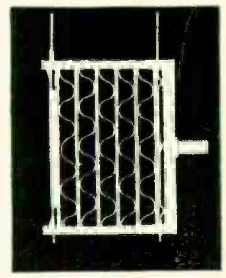

Note the wide-open plate spacing for elimination of solid center "hot spot." Design utilizes corrugated spacers for *excellent heat dissipation and rigid construction for rugged service.*

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75	130	200G1
100	130	206G1
150	130	201G1
200	130	207G1
250	130	208G1
300	130	202G1
350	130	209G1
400	130	203G1
500	130	204G1
400*	130	210G1
500*	130	211G1

*Special thin types for use where available space will not permit the use of type 203G1 or 204G1.

RADIO CORPORATION of AMERICA
ELECTRONIC COMPONENTS — HARRISON, N. J.

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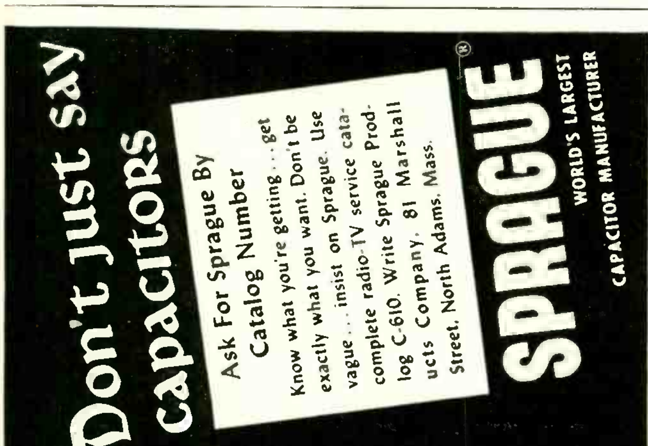


the tube through a shielded cable for minimum pickup and radiation.

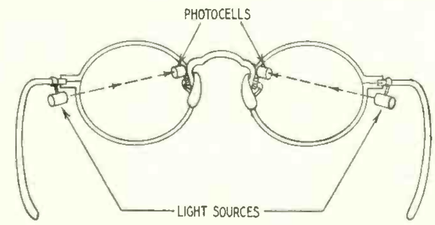
The insert shows how a typical yoke is made of two sections, each of two turns. It is placed over the neck of the picture tube.

DRIVING ALARM

Patent No. 2,726,380

Hugo Amilio Campisi, Belmont, Calif.

This unusual pair of spectacles warns the driver of a vehicle when he is becoming too drowsy to operate his car safely. A beam of light is focused from each bow of the frame onto the nosepiece. The light follows a path just in front of the eyes so that, when the eyelids close, the eyelashes interrupt the beam and prevent it from falling onto a photocell mounted on the nosepiece. Thus if the driver's eyes close. even for a short interval, an alarm



sounds to waken him immediately. The figure shows the general appearance of the spectacles.

The photocell output is amplified and fed to a bistable multivibrator. This circuit has two stable states. Normally, when the driver's eyes are open, its first tube is conducting. The second tube (which feeds into a relay) is blocked. The relay is inoperative during this time. When the driver closes his eyes, photocell output disappears and the multivibrator goes into its other stable state. The second tube begins to conduct and the relay is energized. This sounds an alarm—which may be a buzzer or other device — to waken the driver at once.

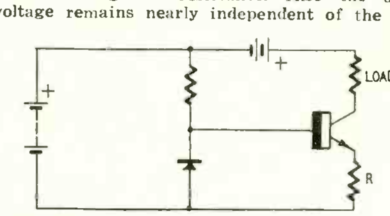
TRANSISTORIZED REGULATOR

Patent No. 2,716,729

William Shockley, Madison, N. J. (Assigned to Bell Telephone Labs, Inc.)

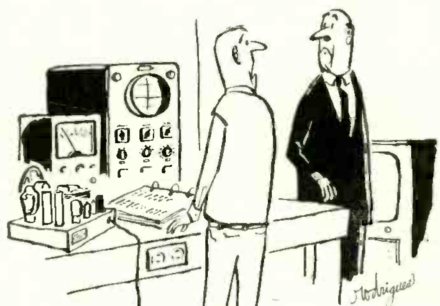
Tubes are often used as voltage regulators. Here a transistor is used to regulate *current*. The circuit requires a junction transistor and a junction diode. A constant current flows through the load.

The diode is biased in the blocked direction within its Zener or breakdown region. In this region a diode exhibits unusual characteristics including negative resistance. Also the diode voltage remains nearly independent of the cur-



rent flowing through it. Therefore, in the diagram shown, the emitter-to-base bias on the transistor remains constant.

R controls the value of regulated current since it determines emitter flow. END



"I can't find any 60 C-Y-C-L-E listed in here."

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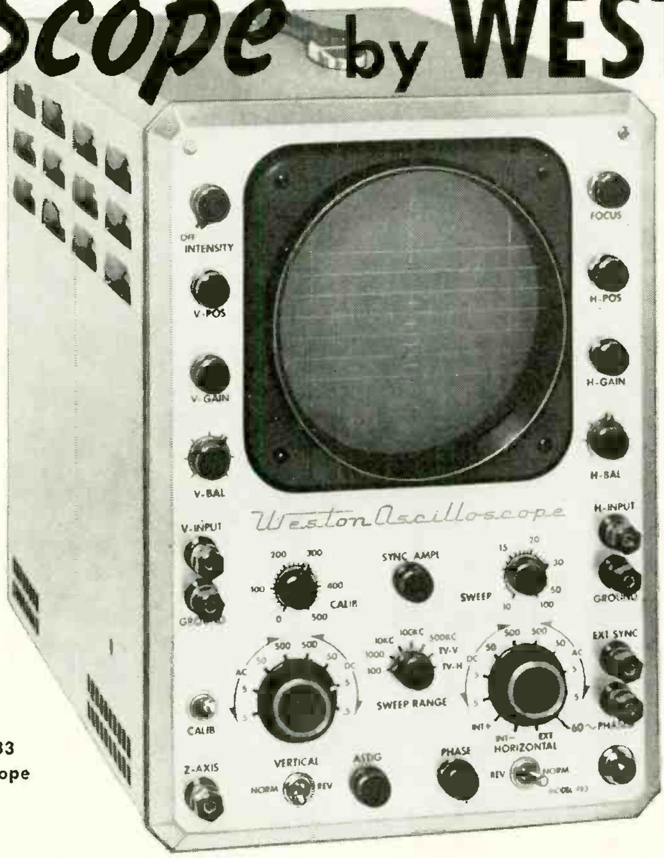
NOW...*the All-purpose 'Scope* by WESTON



Weston Model 983 Oscilloscope

Model 983 is a high gain, wideband Oscilloscope designed to accurately reproduce waveforms comprising a wide band of frequencies. High sensitivity of 15 millivolts per inch RMS makes this "scope ideal for—SETTING RESONANT TRAPS...SIGNAL TRACING IN LOW LEVEL STAGES...AS A GENERAL NULL INDICATOR...for PHASE CHARACTERISTIC MEASUREMENT IN INDUSTRIAL APPLICATIONS...and for SWEEP FREQUENCY VISUAL ANALYSIS.

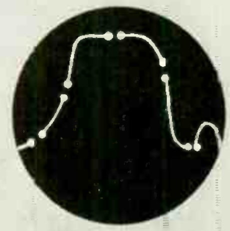
The 'scope contains identical vertical and horizontal push-pull amplifiers with a choice of AC or DC coupling without affecting either sensitivity or band width. Both amplifiers have compensated step attenuators and cathode follower input. *It has excellent square wave reproduction with overshoot of only 2 to 5%, with a rise time of 0.1 microsecond. The 'scope response is essentially flat throughout the specified range of 4.5 mc and is usable to 6 mc.*

The unit has provisions for internal calibration, internal phased sine wave, and Z-axis intensity modulation. Reversal of polarity of both horizontal and vertical signals is easily accomplished by means of toggle switching. *Tube replacements are non critical, and etched circuitry facilitates quick and rapid maintenance.*

The Model 983 Oscilloscope is now available through local distributors. For complete literature write WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey. *A subsidiary of Daystrom, Incorporated.*

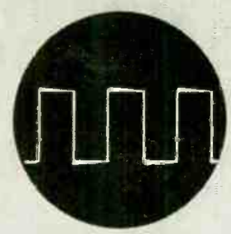
WESTON *Instruments*

WAVEFORM ANALYSIS



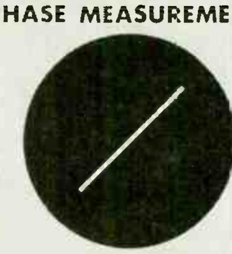
Response curves accurately displayed. Ideal for use with Weston intensity marker display. A fast, retrace sweep circuit with cathode follower output prevents pattern distortion.

SQUARE WAVE RESPONSE



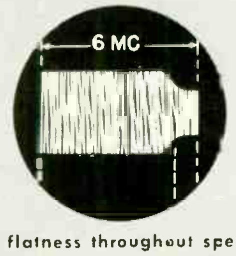
Overshoot is only 2 to 5%. Rise Time is 0.1 Microsecond. Square wave depicted 250 kc.

PHASE MEASUREMENTS



Phase shift between horizontal-vertical amplifiers, 0-500 kc-0°, to 1 mc within 2°; by internal adjustment with gain controls at max 0° phase shift possible on any specific frequency to 6 mc.

RESPONSE CHARACTERISTIC



Note flatness throughout specified range; to 3.6 mc down 1.5 db, at 4.5 mc down 3 db, at 6 mc down 6 db.

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The Progressive Radio "Edu-Kit" uses the principle of "Learn by Doing." Therefore you will build radio circuits, perform jobs, and conduct experiments to illustrate the principles which you learn. These circuits are designed in a modern manner, according to the best principles of present-day educational practice. You begin by building a simple radio. The next set that you build is slightly more advanced. Gradually, in a progressive manner, you will find yourself constructing still more advanced multi-tube radio sets and doing work like a professional Radio Technician. Altogether you will build Receiver, Transmitter, Code Oscillator, Signal Tracer, Signal Injector Circuits—16 in all. These sets operate on 105-125 V. AC/DC. For use in Foreign Countries having 210-250 Volt Source, an Adaptor for 210-250 V. AC/DC is available.

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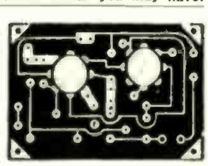

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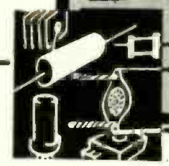

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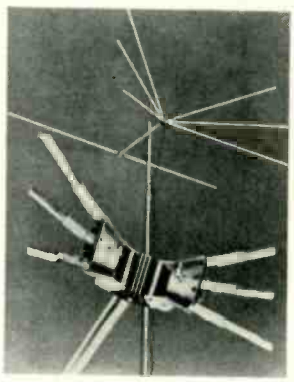
ANTENNA, *Super Fan,* heavy-duty fan head of high-impact polystyrene combined with heavy-gauge aluminum. Elements snap out and lock into

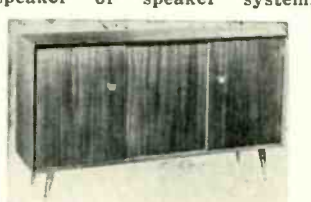


place automatically. No hardware, tools or tightening necessary. Elements reinforced with ½-inch diameter external aluminum sleeves 3½ inches long. *Series 313A* of seamless tubing in 1-, 2- and 4-bay arrays; *series 713A* with butted tubing elements in 1- and 2-bay arrays. —**Channel Master Corp.,** Ellenville, N.Y.

TOWER, *No. 40,* heavy-duty radio communication and microwave type. Self-supporting to 66 feet; to 300 feet when guyed.

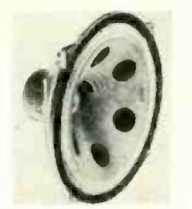
18-inch equilateral design with steel cross-bracing; electrically welded.—**Rohn Mfg. Co.,** 116 Limestone, Bellevue, Peoria, Ill.

HI-FI CABINETS. *Model 65* accommodates radio tuner, amplifier, record changer or player, manual player or professional turntable, tape recorder and speaker or speaker system.



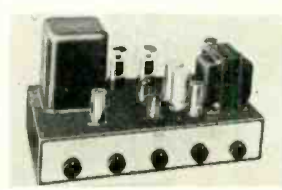
Model 65 D: phonograph record or tape storage in lieu of speaker compartment. Adjustable-shelf storage section finished inside. Combination of hinged and sliding doors. Hand-rubbed mahogany, walnut and korina (blond mahogany), and black lacquer.—**Cabinart,** 99 N. 11th St., Brooklyn 11, N.Y.

EXTENDED RANGE HI-FI SPEAKER, *Stentorian model H.F. 1214.* Cambric cone construction for good low-frequency response. Six stabilizing discs of long-staple fiber impregnated into front of cone for smooth response in mid-register from 1,000 to 3,000 cycles. Large magnet system for good response



over entire range. Bass resonance, 39 cycles; overall response 25 to 14,000 cycles; power rating, 15 watts; 5-lb 8-oz Alcomax 3-inch magnet; 14,000 gauss, 1½-inch diameter voice coil; impedance 15 ohms.—**Beam Instruments Corp.,** 350 Fifth Ave., New York, N.Y.

HI-FI AMPLIFIER, *EICO HF20,* 20-watt Ultra-Linear Williamson type. Kit or factory-wired. Preamplifier with 5 positions of feedback equalization. Variable turnover feedback tone controls. Separate panel level control. Full adjustable Fletcher-Munson loudness compensation. Rated power 20 watts (34-watt peak). Power response: (20 watts) ±0.5 db from 20 to 20,000 cycles, ±1.5 db from 10 to 40,000. Frequency response:



(¼ watt) ±0.5 db 13 to 35,000 cycles, ±1.5 db 7 to 50,000. IM distortion (60 cycles and 6 kc, 4:1, 20 watts.) 1.3%; mid-band harmonic distortion 0.3%; maximum harmonic distortion (between 20 and 20,000 cycles at 1 db below 20 watts) 1%. Speaker taps 4, 8, and 16 ohms. —**Electronic Instrument Co., Inc.,** 84 Withers St., Brooklyn 11, N.Y.

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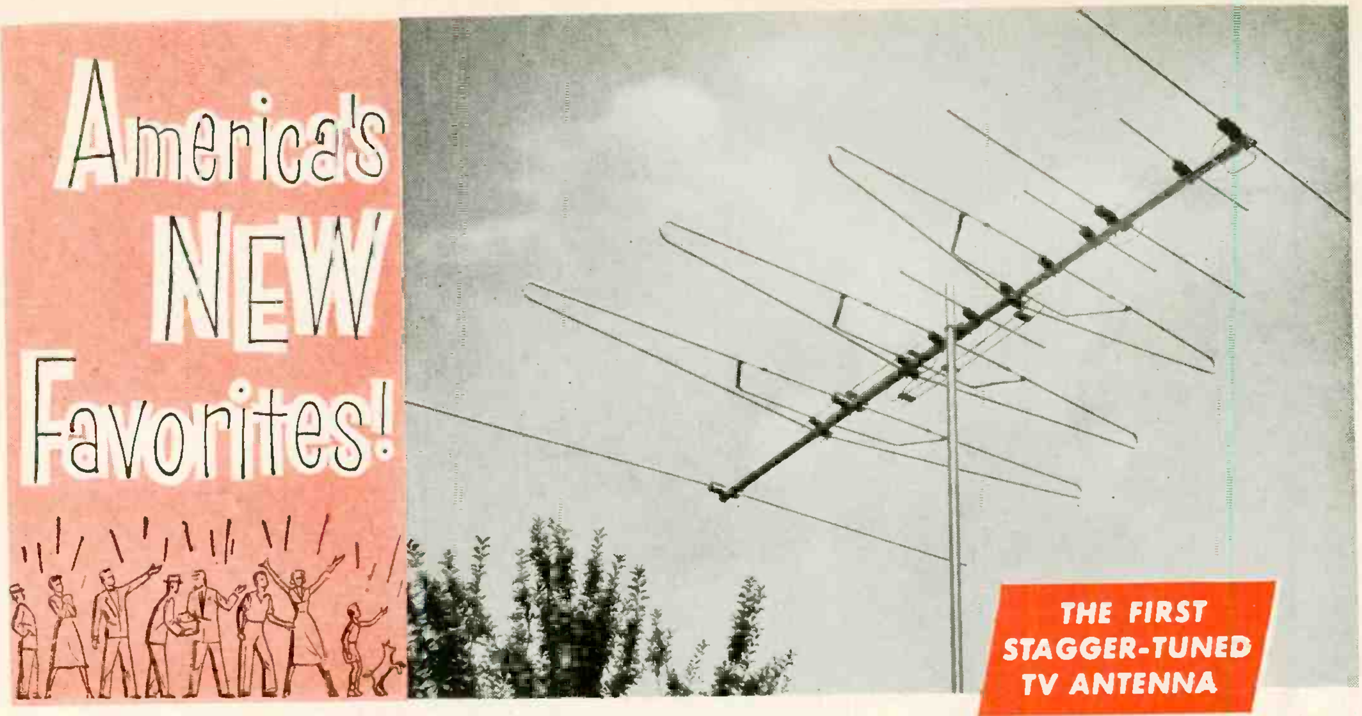

MODEL ZR-1 PATENT NO. 2,703,840

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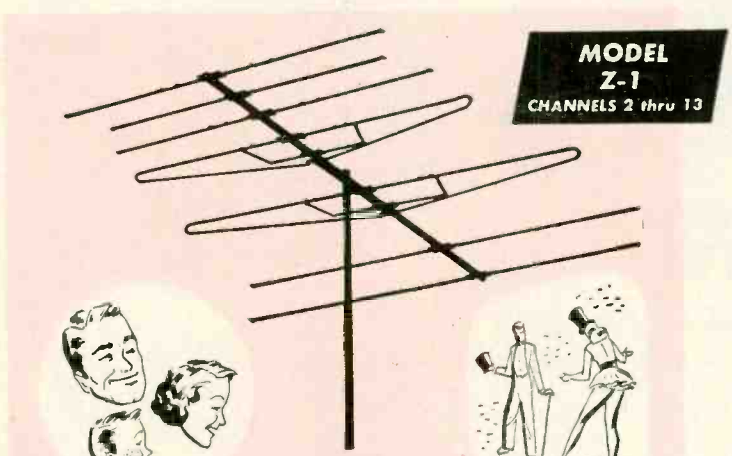

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(Continued)

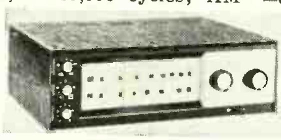
HIGH-POWER AMPLIFIER, *model 275,* delivers 75 watts continuously, peaks up to 150 watts. Rated at 65 watts with IM distortion less than 0.5% (any combination of frequencies within audio spectrum). 12½ x 7 x 7 inches, weighs 32 lbs. Damping control adjustable from 0.1 to 10. Primary taps

for any line voltage from 105 to 125. Adjustments for dynamic balance of 6550's bias and dc plate current balance. Output impedances: 4, 8, 16 ohms. Input signal for full rated output, 0.8 volts—**Fairchild Recording Equipment Co.,** 154 St. & 7 Ave., Whitestone, N.Y.

HI-FI AM-FM RADIO TUNER, *ST-4,* with electronic eye. Electrically matched for plug-in use with home-assembled music systems. Extended frequency range

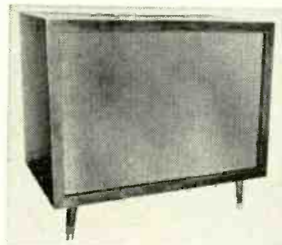
20–15,000 cycles. Audio output 1.5 volts. 6½ x 14¼ x 12¾ inches. Only two controls, requires only one cutout for tuning dial and controls. — **Radio Corp. of America,** Theatre & Sound Products Dept., Camden, N. J.

HI-FI ENSEMBLE, *Golden Ensemble HF535,* combines AM-FM tuner, preamp and 12-watt amplifier. Separate FM and AM front ends. FM section: tuned rf stage, discriminator with dual limiters, afc with defeat on function switch, drift-compensated circuits, 300-ohm balanced antenna input, dipole antenna supplied; AM section: tuned rf stage, ferrite loop, input for magnetic or ceramic pickup with RIAA response curve, separate bass and treble tone controls, choice of regular volume control or loudness control. FM sensitivity, 3μv for 20 db of quieting, 5μv for 30 db. AM sensitivity, 5μv for 0.5-watt output. Frequency response: FM—±0.5 db, 20–20,000 cycles; AM—±3.0



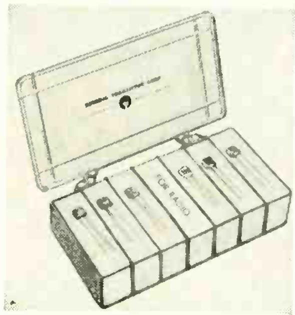
db, 20–5,000 cycles; phono—±0.5 db, 20 to 20,000 cycles. Harmonic distortion: radio input less than 2%; phono input less than 0.7%. Tone controls: bass — +16 to −16 db at 40 cycles; treble— +16 db to −16 db at 10,000 cycles. TV control position intended for use with Rauland TV55 TV sound tuner.—**Rauland-Borg Corp.,** 3515 W. Addison St., Chicago 18, Ill.

SPEAKER ENCLOSURE, *Catalina.* Fully expanding rear-horn loading with all front radiation. Houses single 15-inch



speaker or two speakers. Three-way systems also accommodated. Blond, walnut or mahogany; choice of beige, bronze or random-gold grille cloths. 30 x 36 x 20 inches.—**Stephens Mfg. Corp.,** 8538 Warner Dr., Culver City, Calif.

TRANSISTOR KIT, *No. 2,* for all radio receivers. Includes



one converter–oscillator transistor, two intermediate-frequency transistors and three audio transistors packaged in functional Lucite box.—**General Transistor Corp.,** 95-18 Sutphin Blvd., Jamaica 35, N. Y.

Q MULTIPLIER KIT, *Heathkit,* for phone and dx bands when QRM is heavy. Effective Q of approximately 4,000 for extremely sharp peak or null. Peaks desired signal or nulls undesired signal or heterodynes. Tunes to any signal within if bandpass.

Broad peak for conditions where extreme selectivity not required.

Operates with receivers having if between 450 and 460 kc. Not usable with ac–dc receivers. Requires 6.3 volts ac at 300 ma; 150–250 volts at 2 ma. Operating power from receiver. Uses 12AX7 tube, high-Q shield coils. Connecting cable and plugs. 4 11/6 x 7⅜ x 4⅛ inches. **Heath Co.,** Benton Harbor, Mich.

VACUUM-TUBE COMPUTER, quick-way tube pin locator and identifier.

Tube-number dial automatic-

what you want . . . when you want it with an

ERIE CERAMICON® TV SERVICE KIT

HERE'S WHAT YOU GET

1. 63 High Stability ERIE Disc or Tubular Ceramicons
2. 18 Popular Values
3. Handy, Convenient 18 Section Plastic Storage Case
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63 Piece ERIE Ceramicon Assortment $15.00

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Grommes
BEST BUY IN HI-FI

55-C 12-Watt Amplifier

Grommes hi-fi amplifiers, available separate or as a complete system with FM-AM tuner, record changer and speaker. Output: 12 watts. IM distortion—1%. Response ± 0.5 DB, 15 to 30,000 CPS. Built in preamplifier with separate roll-off and turnover controls. Calibrated bass and treble controls.

GROMMES
Division of PRECISION ELECTRONICS
9101-RE, King Ave., Franklin Park, Ill.

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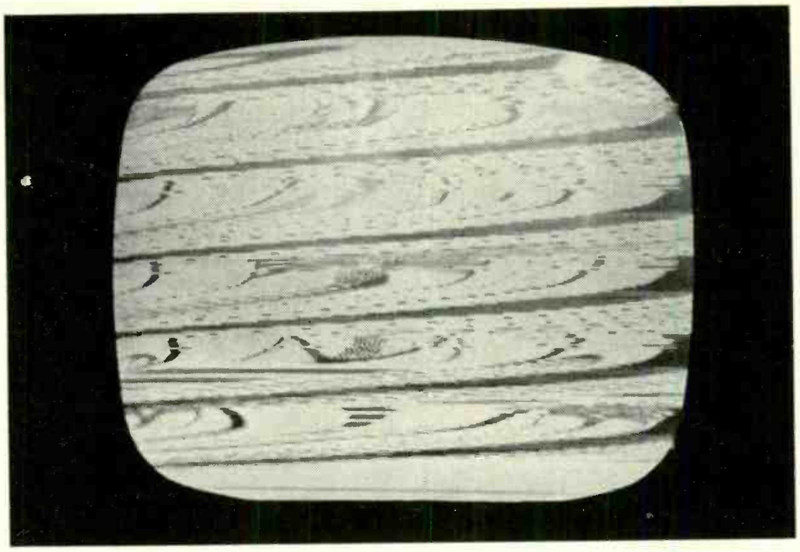
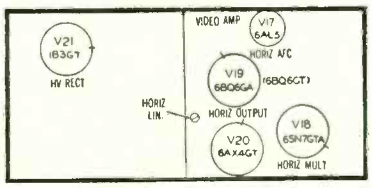
how long would it take you to solve this service problem?



SYMPTOM:

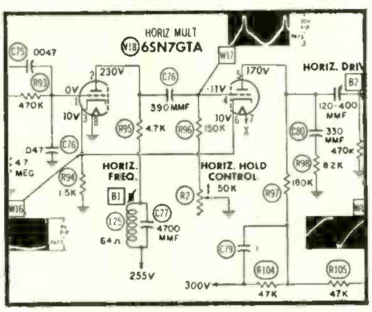
Loss of horizontal hold. Hold control will not pull the picture into synchronization. Sound is normal.

There's no telling how long it might take to solve this problem with hit-or-miss methods—it's been known to take hours. With a PHOTOFACT Folder by your side, the job takes just minutes. Here's why:



In just seconds, you locate the tubes most likely to cause this symptom by referring to the Tube Placement Chart* and Tube Failure Check Chart* you'll always find in the same place in each PHOTOFACT Folder.

In this case the trouble wasn't caused by tube failure, so...



In just seconds you refer to the Horizontal Circuit on the Standard Notation Schematic* featured exclusively in all PHOTOFACT Folders. Circuits are always laid out in the same uniform manner. The Horizontal Circuit is always located in the lower center of the schematic. In a matter of minutes you check waveforms and voltages—they're right on the schematic. And in those same few minutes you find the answer to the problem in this case history. The waveform at W17 and the voltage reading at Pin 4 show a leaky coupling capacitor C78. Yes, you have your answer in just minutes!

C74	270	500	RCM20A271K	SI270	D6-271
C75	.0047	400	RCP10M4472M	SI4700	D6-472
C76	.047	200	RCP10M2473M	BPD-05	DF-50
C77	4700	500	47X543	1464-0047	
C78	390	500	RCM20B391J	1469-00039	D6-391
C79	.1	400	RCP10M4104M	P488N-1	DF-104
C80	330	500	47X570	1469-00033	D6-331

And PHOTOFACT, through its accurate Parts Listings*, instantly gives you a choice of the proper replacement required to accomplish the repair. You save even more time!

From start to finish, you solve your service problems in just minutes...you service more sets and earn more daily with PHOTOFACT by your side!

*One of 32 features found exclusively in PHOTOFACT—the world's finest service data

MONEY BACK GUARANTEE!

Got a tough repair? Try this—at Howard W. Sams' own risk: see your Parts Distributor and buy the proper PHOTOFACT Folder Set covering the receiver. Then use it on the actual repair. If PHOTOFACT doesn't save you time, doesn't make the job easier and more profitable for you, Howard W. Sams wants you to return the complete Folder Set direct to him and he'll refund your purchase price promptly. GET THE PROOF FOR YOURSELF—TRY PHOTOFACT NOW!

free

Send for Sams' INDEX TO PHOTOFACT FOLDERS—your guide to virtually any receiver model ever to come into your shop; helps you locate the proper PHOTOFACT Folder you need to solve any service problem on any model. You'll want this valuable reference guide. Send coupon now.

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2205 E. 46th St., Indianapolis 5, Ind.

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precise

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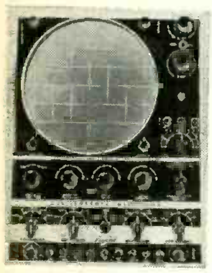
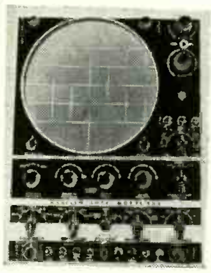
EXCLUSIVE..

who murdered the serviceman?



THE FIRST LOW PRICED 7" COLOR SCOPE
300K **$94.95**
300W $199.50



THE FIRST AND ONLY 8½" COLOR SCOPE
308K **$129.50**
308W $229.50

LOW PRICED 5" SCOPE
315K $49.95
315W $84.95

THE FAMOUS MODEL #111
111K $69.95
111W $139.95

LOWEST PRICED WIRED 4½" VTVM
909K $25.98
909W **$37.50**

RF—AF—BAR GENERATOR with pre-assembled* head
630K $33.95
630KA* $38.95
630W $53.95

OR at least the serviceman's confidence in tube testers. LOOK at the FACTS —A serviceman trusts his VTVM (like the Precise 9071 or 909); his signal generator (like the Precise 610 or 630 or 635); his oscilloscopes (like the famous 300 or 308 or 315).

BUT . . . HE DOES NOT TRUST HIS TUBE TESTER (UNLESS IT'S A PRECISE 111).

For the serviceman's sake, WHY?

Precise engineers recognize him as a logical, intelligent fellow. They knew he had good reasons and they looked into the matter with him in mind. Our electronic sleuths found that some manufacturers used an Em (emission) test, some a Gm (mutual transconductance), some a so-called combination, and some a sort of OUIJA board. Some manufactured tube testers that were fast—some slow—some tied almost all the elements together. In some you could cut off pins and the tube merrily read "good." Some didn't even connect all the pins. NO wonder our serviceman's confidence was being murdered!

What then has Precise done to prevent this mayhem. We went directly to the tube manufacturers before offering the serviceman a tube tester. We found out how the tube manufacturer gets the kind of check a serviceman wants . . . a 100% test! We wanted to offer a tube tester that simulates operating conditions in a set. WE HAVE DONE THIS. We added a lot of other requirements . . . A SHORT CHECK, GAS CHECK, Gm, Em, LIFE, FILAMENT CURRENT for 600 mil tubes, BIAS, NOISE and other checks.

RESULT, a tube tester with built in confidence . . . you can even see the tube characteristic curve on an oscilloscope. What's more you can operate this tube tester as simply as the ordinary testers. The Precise 111 has about the same number of controls . . . Remember! it uses rotary switches instead of lever type, because the rotary gives over twice the protection against becoming obsolete. Furthermore, several tests are listed for each tube (an Em and a Gm) with the 100% test starred.

NOW YOU CAN TEST YOUR TUBES COMPLETELY. SEE YOUR LOCAL DISTRIBUTOR FOR PROOF OF WHAT WE OFFER—OR WRITE US FOR DOCUMENTARY RESULTS OF AN INDEPENDENT SCIENTIFIC SURVEY.

THE FINEST VOLT, REG, 7" VTVM KIT
9071K $35.95
9071W $49.95

LOW PRICED RF SIGNAL GENERATOR "BEST BUY" IN GEN. FIELD
610K $23.95
610KA pre-assembled head........ $28.95
610W $39.95

UNIV. AF, SINE, SQ, & PULSE GEN.
635K $33.50
635W $52.50

Prices slightly higher in the West. Prices and specifications subject to change without notice.
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precise THE FINEST KIT AND WIRED TEST EQUIPMENT

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DEVELOPMENT CORP. OCEANSIDE, NEW YORK, U.S.A.

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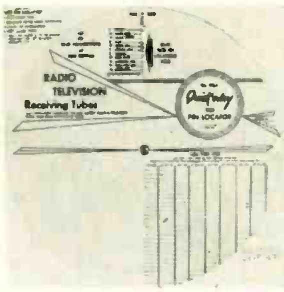
ally selects all pin locations at once. Covers receiving tubes



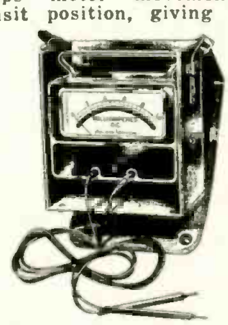
used in radio, TV, amateur radio, hi-fi amplifiers, counters, etc. New tube log also on computer face.—**Airport Television & Radio Co.**, 188 Airport Rd., Reno, Nev.

RF SIGNAL GENERATOR, *EMC model 501*, for AM, FM or TV—color and monochrome servicing. Factory-wired or easy-to-assemble kit form. 6-band frequency range: 115 kc to 110 mc on fundamentals; to 220 mc on first harmonic. Modulated or unmodulated rf output controlled by fine and

coarse 3-step attenuator with fixed output of 72 ohms at each step. 400-cycle sine-wave modulation, rf output to 100,000 μv. frequency accuracy of ±1.5%, provision for audio output to test amplifiers. **Electronic Measurements Corp.**, 280 Lafayette St., New York 12, N. Y.

PORTABLE LABORATORY INSTRUMENTS, self-contained, ready-to-use, in 38 standard ranges with rated accuracy of either 0.5% or 1% of full-scale deflection. Overload network protects meter up to 500 times full-scale value for short periods.

Multirange portable instruments provide up to six ranges with multiplier switch. Switch damps meter movement in transit position, giving addi-

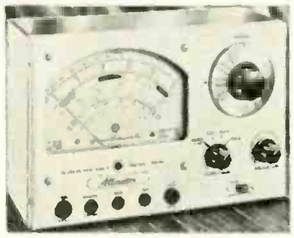


tional protection during storage and transit.

Leather carrying case, calibration chart, probes, metal cases, double magnetic shielding, mirrored scales and double probe outlets.—**Phaostron Instrument & Electronic Co.**, 151 Pasadena Ave., S. Pasadena, Calif.

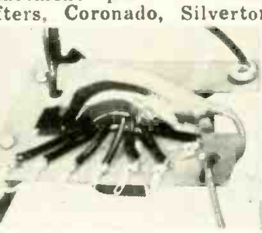
MULTIMETER, *model TV-60 Allmeter*, all-purpose 20,000 ohms per volt. Recessed 6½-inch 40-μamp meter with mirrored scale, rf signal tracer and audio signal tracer.

8 dc voltage ranges (20,000 ohms per volt): 0–15, 75, 150, 300, 750, 1,500, 7,500, 30,000; 7 ac voltage ranges (5,000 ohms



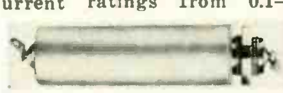
per volt): 0–15, 75, 150, 300, 750, 1,500, 7,500; 3 resistance ranges: 0–2,000, 200,000 ohms, 20 megohms, 2 capacitance ranges; .00025–0.3μf .05–30 μf, 5 dc current ranges; 0–75 μamp; 0–7.5, 75, 750 ma; 0–15 amps; 3 decibel ranges, −6 +18, 14–38, 34–58. **Superior Instrument Co.**, 2435 White Plains Rd., New York 67, N. Y.

FLYBACK TRANSFORMERS, *HVO-50* and *HVO-52*. *HVO-50* exact replacement for Travler parts TV-X-104–TV-X-114. *HVO-52* (illustrated) exact replacement part for Hallicrafters, Coronado, Silvertone



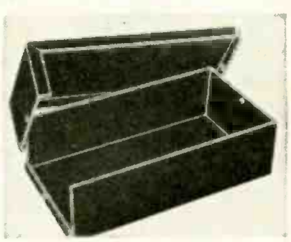
and Truetone parts numbers 55C133, 55C143 and 55C155. **Merit Coil & Transformer Corp.**, 4427 N. Clark St., Chicago 40, Ill.

TUBULAR PI FILTERS, *Quietone*. Wide range of attenuation characteristics and container shapes, sizes, terminals and terminal arrangements. High insertion-loss values for suppression of radio noise. Current ratings from 0.1–50



amps. Voltages: 28, 50, 100, 300 and 500 dc; 115 and 125 ac. Frequencies 60, 400 and 1,000 cycles. Slotted-hole mounting prevents filter unit from turning and jogging loose.—**Cornell Dubilier Electric Corp.**, S. Plainfield, N. J.

BOX CHASSIS, *Flangelock*, dustproof, 100% shielded, moistureproof. 33 sizes for outdoor applications. Can be sealed for



rainproofing.—**LMB**, 1011 Venice Blvd., Los Angeles 15. END

All specifications given on these pages are from manufacturers' data.

LEARN MORE! EARN MORE!
WITH H. G. CISIN'S TV SERVICE BOOKS

FAMOUS 1956 TV CONSULTANT!

NEW! Easy way to solve toughest TV troubles. New rapid methods of pin-pointing faults. New alignment methods shown by pictures, diagrams and easy to follow directions. **TV CONSULTANT** tells exactly **WHAT TO DO** and **HOW TO DO IT. UHF** section includes conversion, installation and servicing. Lists instruments needed for servicing **COLOR TV**. Practical pointers on use of TV Test Instruments. 300 pix, raster and sound symptoms. Detailed directions tell **WHERE** and **HOW** to find faulty parts. Over **135 RAPID CHECKS** including many using picture tube as trouble locator. Over 125 illustrations of scope wave-forms, diagrams, station patterns showing various defects—make TV servicing a pleasure. **NO MATH, NO THEORY — NO FORMULAS** — just practical servicing information covering all types of TV sets.

TV Serviceman's Silent Partner—No. L1.....$2

SHOOT TV & RADIO TROUBLE FAST

This latest edition of H. G. Cisin's world famous Rapid TV Trouble Shooting Method has been enlarged, revised and brought up to date. Enables you to locate faults in record-breaking time, regardless of make or model. Includes section on **RAPID TROUBLE SHOOTING** of **AC-DC RADIO SETS** and servicing of **PRINTED CIRCUITS.**

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TROUBLE INDICATING TUBE LOCATION GUIDES over 3000 most popular models. Admiral to Zenith. Shows **PIX** tubes used in each model. Covers products of over 110 different TV manufacturers. Over 135 common TV troubles are listed with explicit directions for locating defective tubes which cause each fault.

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PIX GUIDE

Sect. 1 is a fully illustrated Guide to oft-recurring picture faults. Causes and cures explained. Copyrighted illustrated **CHART** tells where troubles start in typical TV set. Illustrations show resulting faulty TV pictures.

Sect. 2 explains hundreds of TV terms in non-technical language.

PIX SHOW FAULTS—No. G1..$1

TV DOCTOR

How to Diagnose and Remedy TV Troubles: Useful Info About TV Sets: Easy Trouble Checks: UHF Servicing: Antenna Know-How: Servicing Hints: Color TV: Troubles Due to Defective Tubes: How to Read Schematic Diagrams. Practical hints for prospective TV servicemen.

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RCA TV TUBE LOCATION GUIDES

1947-1955 Models

Contains hundreds of Trouble Indicating Tube Location Guides of RCA TV models. Uses new, simplified method to tell tube functions. Includes RCA color models and also valuable tables.

FITS ALL TUBE CADDIES— No. A1....................$1

TV TROUBLE TRACER

Each vol. has different TROUBLE INDICATING TUBE LOCATION GUIDES of hundreds of popular TV models. Each has over 70 illustr. & Guides. 40 most common pix troubles illustrated.

Vol. 1 (No. TT1) older models
Vol. 2 (No. TT2) 1952-1953 sets
Vol. 3 (No. TT3) 1953-1954 sets
Vol. 4 (No. TT4) 1954-1955 models

EACH VOL...................50c

TV & RADIO TUBE SUBSTITUTION GUIDE

1st section gives tube replacements for TV sets, radio's and other electronic devices, all **FIT SAME SOCKET, & WITHOUT CHANGES IN WIRING.** 2nd section gives **TV PICTURE TUBE** replacements, many directly, others with only slight changes.

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H. G. Cisin's remarkable new book takes the mystery out of Color TV. All explanations in easily understandable language. Fully illustrated. Covers basic color principles. Color transmission & reception, the color signal, color tubes will help you cash in on this rapidly expanding new field.

COLOR TV SIMPLIFIED— No. R1 ....$1

FREE: TV & RADIO TUBE SUBSTITUTION GUIDE *with every purchase of $5 or over*

FREE: TV & RADIO TUBE SUBSTITUTION GUIDE plus TV TROUBLE TRACER, Vol. 4 *with every purchase of $8 or over*

If jobber is out of stock send coupon to:
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Order $5 or over INCLUDE ☐ FREE $1
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No TV Serviceman can afford to be without this new time-saver!

Thousands in use with excellent results!

THE Sel-Son CRT SUBSTITUTER®

The Best Possible Picture Tube Tester is to Substitute Another CRT!

- Determines immediately whether trouble is in picture tube or chassis — *without guesswork!* Takes only 60 seconds to hook-up!
- Exclusive insulation-piercing clips eliminate need for variety of deflection yokes, connectors, etc.
- Ideal for use in shop — just connect to receiver.

The new Sel-Son CRT Substituter now makes it possible for servicemen on calls to see at a glance whether trouble is in television tube or chassis, without removing the tube, yoke, focus arrangement or ion trap from set. Once the service technician has a solution to the problem, it is a simple matter to remove only the chassis, without disturbing the picture tube and components in the cabinet. In his shop he can connect the receiver to the CRT Substituter and operate it on his bench or shelf.

Available from your parts jobber or write

In compact, completely enclosed unit, with convenient carrying handle

44^{95} complete

Also in kit form, less tube

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Sel-Son ELECTRONIC TUBE CORP.

DARBY, PA.

One of America's Leading sources for Television Picture Tubes

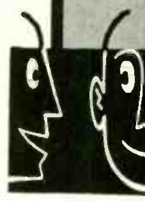
DON'T JUST SAY CAPACITORS

Ask For Sprague By Catalog Number

Know what you're getting . . . get exactly what you want. Don't be vague . . . insist on Sprague. Use complete radio-TV service catalog C-610. Write Sprague Products Company, 81 Marshall Street, North Adams, Massachusetts.

SPRAGUE®

WORLD'S LARGEST CAPACITOR MANUFACTURER

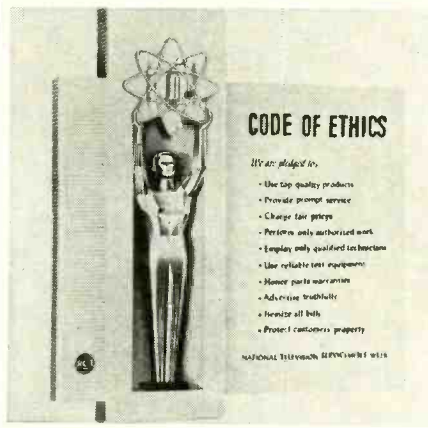


Technicians' News

TV TECHNICIANS' WEEK

The second annual National Television Servicemen's Week, an RCA promotion designed to improve the relations and tighten the contacts between the TV service dealer and his public, gets under way March 5. The "Week" is registered with the United States Chamber of Commerce and is being publicized with an unprecedented amount of effort—window and truck stickers, window displays and newspaper, direct mail and television and radio advertising. A booklet *What's Your Television I.Q.?* and a safety-glass cleaning cloth—designed to be given away by the service dealer to his customers—are featured.

A TV Service Plaque (see photo), with a figure somewhat reminiscent of that used last year, will be supplied by



RCA distributors to active participants in the Week. It carries the following Code of Ethics:

We are pledged to:

- Use top quality products
- Provide prompt service
- Charge fair prices
- Perform only authorized work
- Employ only qualified technicians
- Use reliable test equipment
- Honor parts warranties
- Advertise truthfully
- Itemize all bills
- Protect customers' property

An identification card, as well as the window display plaque, is offered technicians who subscribe to the Code of Ethics.

NO LICENSE IN COLUMBUS

Sixty-three TV and radio technicians of Columbus, Ga., expressed disapproval of an ordinance proposed by the city to regulate the business of repairing and distributing radio and television sets and other electronic devices. The city was represented by the assistant city manager and the city attorney.

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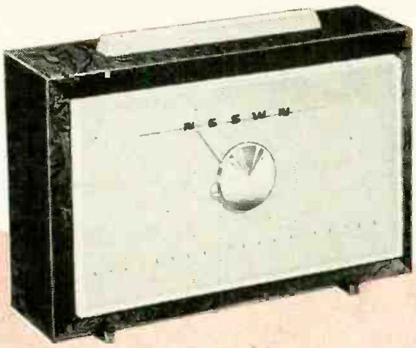
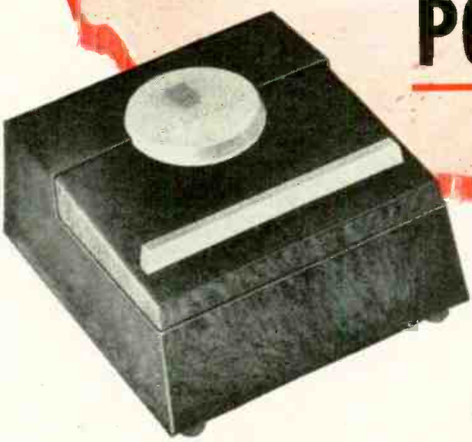


ALLIANCE TENNA-ROTOR MODEL T-10—with Tenna-Teller pointer. Gives constant and immediate readings. Highly accurate. Most modern styling. Fingertip electrical control. **$29.95**

ALLIANCE TENNA-ROTOR MODEL U-83—Deluxe Model. Points antenna directly, positively, instantly to target station. The *only* fully automatic rotator! Just set it and forget it! **$39.95**

You profit most-Coast-to-Coast from ALLIANCE

POWER-PACKED PROMOTION



ALLIANCE TENNA-ROTOR MODEL K-22—Economy Model. Same *quality*, precision manufacture. Neat, compact, fully guaranteed. **$19.95**

30,000,000 "home demonstrations" on TV week after week . . . seven years of continuous Alliance TV advertising! That's solid backing for you which no other TV accessory has even approached.

And that's not all . . . Alliance magazine and newspaper advertising and point-of-sale displays provide added impact.

Millions KNOW about Alliance . . . more USERS have Alliance Tenna-Rotor.® You can't miss with the "leader"!

Another Outstanding Profit-Maker!

Alliance "Genie"®

LIFT-A-DOR
GARAGE DOOR OPERATOR

Radio-controlled (from car dash) automatic garage door operator—opens, closes, locks door, turns lights on and off. Factory-assembled for easy installation. Customers gleam when you tell them the *low* price! Models from **$79.95** up.

alliance TENNA · ROTOR
(TV ANTENNA ROTATOR) ®

THE ALLIANCE MFG. COMPANY, INC. • Alliance, Ohio

IN CANADA—ALLIANCE MOTORS, SCHELL AVENUE, TORONTO 10

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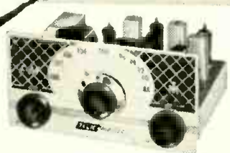
Half the fun is building it... with a TECH-MASTER Kit!

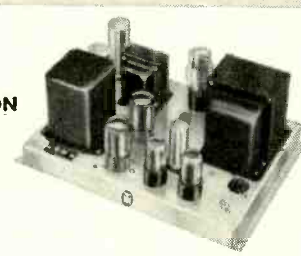
Yes, you'll enjoy building a Tech-Master Kit almost as much as you'll enjoy using the finished product. Simple, step-by-step pictorial diagrams guide your every move right down to the last detail. Your feeling of pride and accomplishment will be well justified when you plug in the last tube and put your unit to its initial test. Then you will definitely agree, as do thousands of others, that when you build with Tech-Master, you build the best.

New **HI-FI FM TUNER**



Self-contained power supply • Tuning range 87-109 Mc • 200Kc IF bandwidth • Grounded-grid RF stage • AFC with front-control cutoff • Micro-vernier tuning • No-drift ratio detector • 4 uv sensitivity for 20 db quieting • Standard de-emphasis network • .8 volt RMS cathode-follower output • 3.2 volt RMS high-impedance output • 300 ohm input impedance • Switch-controlled AC receptacle for auxiliary equipment.
Model FM-18, complete with punched chassis, tubes, and hardware (less wire and solder) $29.50

New **WILLIAMSON TYPE 20-WATT AMPLIFIER**



Frequency response flat and smooth thru entire audible range • Less than .0025 distortion at normal listening levels • Excellent transient characteristics.
Model TM-15A, complete with tubes — sockets, terminal strips, and connectors mounted $49.95

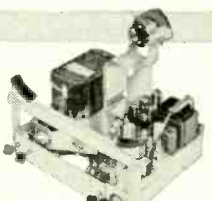
Deluxe **Self-Powered PREAMPLIFIER EQUALIZER**

Cathode-follower output • Loudness-compensating control • Input selector • 4 input channels • Independent bass and treble boost and attenuation • 5-position equalization control • AC receptacle for auxiliary equipment • Self-contained power supply.
Model TM-16SP, complete with matching gold escutcheon. $24.50

Economy **PREAMPLIFIER with Cathode Follower Output**

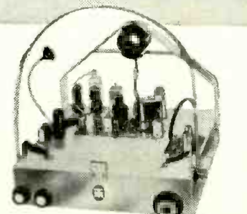
4 input channels • Separate bass and treble controls • 3-position equalizer • AC outlet for auxiliary equipment • Powered by main amplifier.
Model TM-17P, complete $19.95

America's Finest **630-TYPE TV KIT**



Advanced Cascode turret • AFC horizontal sync. • 3-stage sync. amplifier, clipper and separator • 4-stage stagger-tuned video IF • Adjacent-channel trap • 2-stage video amplifier • Direct-coupled keyed AGC circuit • 5 microvolt sensitivity • For 21" to 27" (90°) picture tube.
Model 630-9, complete with all components, brackets, speaker, and tubes (less kine, wire and solder). $159.50

New **T-V CRAFT KIT**



Super-selective 12-channel turret tuner • IF section completely wired and aligned • 9 microvolt sensitivity • 3-stage stagger-tuned IF • AGC • Syncro-guide AFC with horizontal hold • Ceramic core horizontal output xmfr with beam power amplifier. For L.V. electrostatic kines 17"—21".
Model 5516W, complete with tubes, hardware, and brackets (less kine, wire, and solder) $94.50

Note: The quality and performance of Tech-Master kits reflect the combination of long experience, skilled engineering, and painstaking craftsmanship, which has made Tech-Master the foremost name in Custom Television. This is your assurance of the uniform excellence of every Tech-Master product.

Deluxe **SUPERHET AC-DC RADIO**

Broadcast Band — 550-1720 KC • Super-sensitive circuit with built-in loop antenna • AVC • 5 tubes.
Model 3B5K, complete with tubes and handsome bakelite cabinet (less wire and solder) $19.95

Television • Radio • Audio

Write for latest catalog of complete Tech-Master line

TECH-MASTER CORPORATION
75 Front Street, Brooklyn 1, N. Y.

The meeting was a result of an earlier one in which the local Radio & Television Dealers Association had asked the City Commission to enact an ordinance similar to that in effect in St. Paul, Minn., where service shops and technicians are licensed and certain minimum requirements for a TV–radio repair business are set up. No information is as yet available on the difference between this proposal and that made by the city authorities.

NEW ASSOCIATION PLANNED

Representatives of local and state associations met in Chicago Jan. 15 to discuss how the national objectives of their associations could best be accomplished. They represented associations whose membership voted against accepting the proposals brought back by their delegates from the meeting held in Indianapolis Oct. 9 last.

The meeting decided to ask the advice and opinions of all known electronic service associations relative to the character and structure of an organization that would be truly democratic and would give electronic service technicians representation on a national level, thus gaining cooperation and recognition from distributors and manufacturers.

To obtain this information, and looking forward to the formal organization of a suitable association, a steering committee was elected consisting of:

Forrest Baker, Texas Electronic Association, temporary president;

Bert Bregenzer, Federation of Television–Radio Service Associations of Pennsylvania, temporary vice president;

Murray Barlowe, Radio & TV Guild of Long Island (N. Y.), temporary treasurer;

Howard Wolfson, Associated Radio & TV Servicemen, Chicago, temporary secretary.

Four subcommittees were formed to handle publicity, finance, objectives and fact-finding questionnaires.

ARTSNY SUBDIVIDES

The Associated Radio & Television Service Technicians of New York (City) has created individual borough chapters for Manhattan, Bronx, Brooklyn and Queens. The recent announcement to this effect formalized a plan under which experimental steps had already been taken. The borough chapters will elect their own officers and exercise local autonomy while working within the framework of the present organization's constitution.

The 1956 agenda calls for a service clinic in each of the boroughs. The latest clinic to open its doors is held at 401 East 74th St., Manhattan, and holds sessions on the first and third Mondays of each month from 8 to 11 p.m. The Brooklyn clinic, 220 Knickerbocker Ave., is maintaining its regular Wednesday night schedule.

Recently elected officers for the main organization are Peter La Presti, presi-

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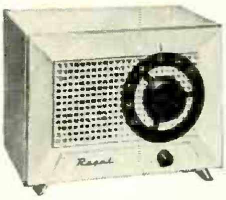
REGAL RADIOS Licensed by RCA, Complete with Tubes, Ready to plug in and play AT LESS THAN ½ LIST PRICE

Model #471 5 Tubes



List $25.50 slashed to **$11.97**

Model #271 5 Tubes

List $30.95 slashed to **$14.32**

3-Way Portable #1877

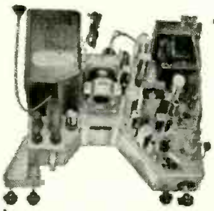
List $36.95 slashed to **$16.99**

Also the REGAL 3-WAY #P175 Round-The-World PORTABLE

Receives all Domestic & Foreign Stations; Powerful 6-Tube Superheterodyne in a handsome Brown Alligator Grain finish with 6' slide-in whip antenna.
List $84.00 slashed to **$39.74**

* Colors on #471, 271 and 1877 are Walnut, Ivory, Ebony and Maroon. In event we cannot supply specified color, we will send next available color.

Catalog showing all Model REGAL RADIOS, on request.



Build your own

SUPER DE LUXE 31-TUBE #630 TV CHASSIS

#630 SUPER DELUXE 31-TUBE TV KIT

OPERATES 16" to 21" PICTURE TUBES • Engineered in strict adherence to the genuine **RCA #630** plus added features • **FULL 4MC BANDWIDTH** • **CASCODE TUNER** • **COSINE DEFLECTION YOKE** • **LARGER POWER TRANSFORMER** • **KEYED AGC** • **12" SPEAKER** • **CONDENSERS** and **RESISTORS** at rated capacities and tolerances. You receive a **COMPLETE SET of PARTS** and **TUBES**, everything needed is included (less CRT & wire). All I.F. Coils and Transformers are factory pre-aligned and tuned. You will enjoy building it with **"LIFE-SIZE** easy to follow step-by-step **ASSEMBLING INSTRUCTIONS"** included with each **KIT.**

Slashed to **$99.99**

Similar KIT for 24" or 27" CRT slashed to $110.39

CUSTOM-BUILT CABINETS FROM FACTORY TO YOU

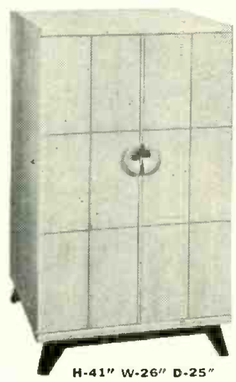
3 LEADING 1956 STYLES in genuine Mahogany or walnut (blond 10% extra) • Ready drilled for any #630 TV chassis and cutout for any 16", 17", 19", 20" or 21" picture tube at no extras in price • Also supplied with undrilled knob panel for any other TV set • EVERYTHING NECESSARY for an easy perfect chassis and CRT assembly is included • Each cabinet is delivered complete as pictured with mask, safety glass, mounting brackets, backboard, back-cup, hardware and assembling instructions • Each cabinet is shipped in an air cushioned carton **from FACTORY to YOU!**

GEM $35.91

H-25" W-26" D-22"

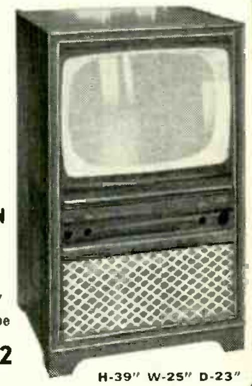
GEM also available for 24" or 27" picture tube **$59.54**

WESTCHESTER $88.70



H-41" W-26" D-25"

MANHATTAN $53.43



H-39" W-25" D-23"

MAN-HATTAN also available for 24" or 27" picture tube **$79.22**

#630 SUPER DE LUXE TV CHASSIS

LICENSED UNDER RCA PATENTS

COMPLETE READY TO PLUG IN AND PLAY

Similar in features to the 16" to 21" TV KIT above.

Slashed to **$142.27** (less CRT)

DUMONT OR THOMAS PICTURE TUBES

BRAND NEW in Factory Sealed Cartons — With a Full Year Guarantee

17" #17BP4A **$22.66** | **21"** #21EP4B Aluminized **$32.21** | **24"** 90° #24CP4A Aluminized **$48.99** | **27"** 90° #27EP4A Aluminized **$74.31**

#630 BY TECHMASTER

COMPLETE LINE AT SPECIAL PRICES

Catalog mailed on request

PULSE KEYED AGC KIT

Finest, most accurate and the easiest Kit to install in any make **TV RECEIVER** including the No. 630. Improves performance and insures a steady picture on all channels.

COMPLETE SET OF PARTS $2.99
Including 6AU6 tube & Instructions

FLYBACK TRANSFORMER

This is the most terrific new sensation in Flyback Transformers. It is similar to the popular No. X-053 and goes up as high as 16KV. With it you receive easy-to-follow instructions and schematic diagrams that apply to improve practically all makes of TV Receivers.......... **$4.86**

COSINE DEFLECTION YOKE

The latest achievement in the 70° type, with complete wired network. Will add new life to any TV Set, in brilliance, clarity and sweep. This is the same type we supply with our Kits, with it you receive easy-to-follow instructions and diagrams **$4.92**

18KV FLYBACK TRANSF.

This new Flyback Transformer now makes 90° conversions easy on any make TV Set. Customers report excellence on 24" and 27" TV sets built or converted with this Transformer. Instructions and schematic diagrams included **$5.24**

COSINE DEFLECTION YOKE

NEW 90° TYPE, with complete wired network. It solves all problems formerly sought for, in 90° Yokes, for undistorted clear pictures and ease of overall sweep. Instructions and schematic diagrams included for building, replacing and converting **$5.98**

21" TV CONVERSION KIT

Convert any Size, any Make **TV RECEIVER** to operate the 21" or **ANY 70° PICTURE TUBE**

COMPLETE SET OF ESSENTIAL PARTS includes matched set of Todd 70° **COSINE DEFLECTION YOKE and TODD HV FLYBACK TRANSFORMER, FOCALIZER, 20KV FILTER, DRIVE TRIMMER, LINEARITY COIL, CONDENSERS, RESISTORS.**

List Price $33.50

Your price... **$13.97** Incl. CONVERSION MANUAL with Step-by-Step Instructions & Diagrams.

27" TV CONVERSION KIT

Convert any Size, any Make **TV RECEIVER** to operate the 27" or **ANY 90° PICTURE TUBE**

COMPLETE SET OF ESSENTIAL PARTS includes matched set of Todd 90° **COSINE DEFLECTION YOKE and TODD 18KV FLYBACK TRANSFORMER, 30KV FILTER, 6AX4 TUBE, YOKE BRACKETS, WIDTH CONTROL, CONDENSERS, RESISTORS.**

List Price $39.75

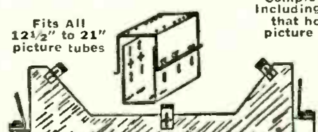
Your Price... **$15.98** Incl. CONVERSION MANUAL with Step-by-Step Instructions & Diagrams.

Illustrations for mounting TV Sets flush with wall extending into garage, closet or wall recess included.

UNIVERSAL Picture Tube MOUNTING BRACKETS

Fits All 12½" to 21" picture tubes

Complete — Including band that holds picture tube



$4.97

STANDARD CASCODE TUNER

For better all around performance
Complete with tubes and Brooks **CASCODE MANUAL** with step-by-step instructions and all extra parts needed. **$15.97**

TUBULAR CONDENSERS—85°C

TOP QUALITY—Equally as good for TV or Radio Work. Example of value we offer . . . .047—600v lists at 36c

.005—400v	4c	.047—600v	9c
.01 —400v	5c	.1 —600v	12c
.02 —400v	5c	.25 —600v	14c
.047—400v	7c	.001—1000v	11c
.1 —400v	9c	.01 —1000v	14c
.25 —400v	12c	.035—1000v	16c
.005—600v	7c	.05 —1000v	18c
.01 —600v	8c	.1 —1000v	22c
.02 —600v	8c	.5 —400v	28c

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Regular factory stock in, Stackpole, I.R.C. Speer. Order any ohmage from 2.2 ohms to 10 meg in the desired tolerance. Deduct 10% on lots of 100 or over.

½ WATT	5%....5c	10%....4c	20%....3c
1 WATT	5%....6c	10%....5c	20%....4c
2 WATT	5%....9c	10%....7c	20%....5c

ELECTROLYTIC CONDENSERS—85°C

40/10/80 mfd—450/450/150v	$1.37
40/40/10 mfd—450/450/450v	1.49
80/50 mfd—450/50v	1.49
40/10/10 mfd—450/450/350v	1.37
20/80 mfd—450/350v	1.49
250/1000 mfd—10/6v	.98

20 mfd—150v	27c	8 mfd—450v	26c
20/30 mfd—150v	38c	20 mfd—450v	42c
50/30 mfd—150v	39c	30 mfd—450v	49c

MICA & CERAMIC CONDENSERS

Values up to 85c each
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7 major quality checks

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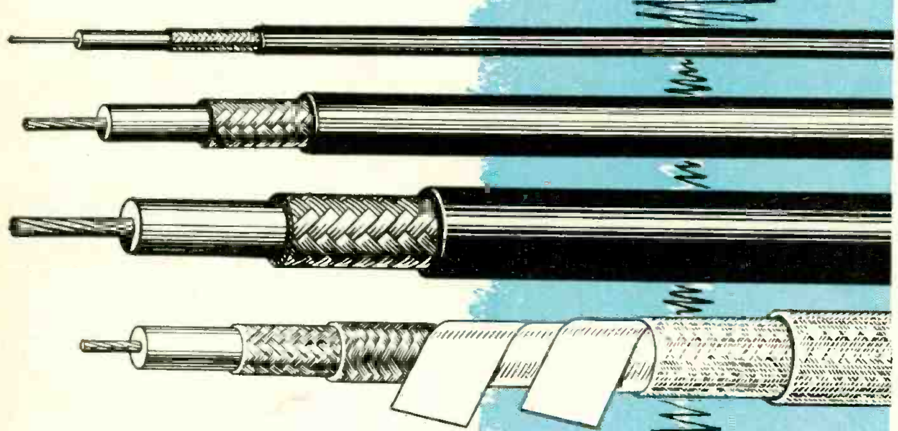

7 major quality checks, on the line and in the laboratory assure the top performance of dependable AMPHENOL coaxial cable.

1 Center conductor: lab check of mechanical and electrical characteristics.

2 Dielectric: rolling micrometer checks dimensions during extrusion.

3 Finished Core: micrometer checked again before jacketing.

4 Shielding: checked after braiding for percentage of coverage, loose ends, tightness.

5 Jacket: inspected 100% during extrusion.

6 Complete cable: special lab check of every run, electrically and mechanically.

7 Complete cable: every foot extruded is run through automatic machinery for final dimensional check.

Constant inspection and testing during manufacture, the use of fine materials, modern equipment, skilled workmen: all are combined at AMPHENOL. Specify and insist upon AMPHENOL coaxial cables!

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dent; executive secretary, Bob Olson; corresponding secretary, Marty Boxer; treasurer, Jack Spegal; technical section vice president, H. M. Layden; business section vice president, Wm. Goldfarb.

NATESA REGIONAL MEET

The first regional meeting to be held under the regional setup of the National Alliance of Television & Electronic Service Associations got under way in Oklahoma City Dec. 11 last. Representatives from seven states battled snowstorms to make their way to the meeting.

The meeting was planned by Vincent Lutz, executive officer of the NATESA West Central Region and NATESA vice president; William Briza of Omaha, North Plains zone governor; Harrol Eales of Oklahoma City, South Plains zone governor; and Joseph Driscoll of St. Paul, West Central Region secretary. The Oklahoma City Radio & TV Service Association was host and Mr. Eales, a past president, was chairman in charge of details and program.

Over 250 people registered for the meeting, representing 41 cities and towns in 8 states. The meeting was open to all service dealers and service associations whether they belonged to NATESA or not. Applications were received from 3 associations for membership in NATESA. The business session and seminars were highly successful, well planned and executed, Mr. Lutz said. A banquet and floor show was an evening highlight to close a busy day.

It was announced that a spring meeting of NATESA officers from all geographical divisions, all directors and delegates from new affiliates, will be held in Omaha, Neb., April, 1956.

SANTA CLARA VICTORY

The Radio & Television Association of Santa Clara Valley (RTASCV) claims a victory for the independent service technician in the recent revision of RCA Victor policy in the installation of the *Magic Brain* remote TV control.

Dealers were originally asked, in an October, 1955, RCA bulletin, to purchase *Magic Brain* units from the RCA Service Co., ". . . who will then install the unit and bill you . . . leaving you a net profit of $10." RTASCV's attorney, Tony Anastasi, was directed to write letters of protest to all concerned at RCA. According to H. Lawrence Schmitt, RTASCV president, this was the only protest he heard of.

On Dec. 2, RCA issued another dealer bulletin, stating that individual dealers may purchase and install the new remote control. While many members of the association believe that the RCA announcement "did not seem to be consistent with the manufacturing firm's policy of selling tubes and parts to service shops", all welcomed the opportunity to make any necessary installations without contacting their customers with outside service organizations.

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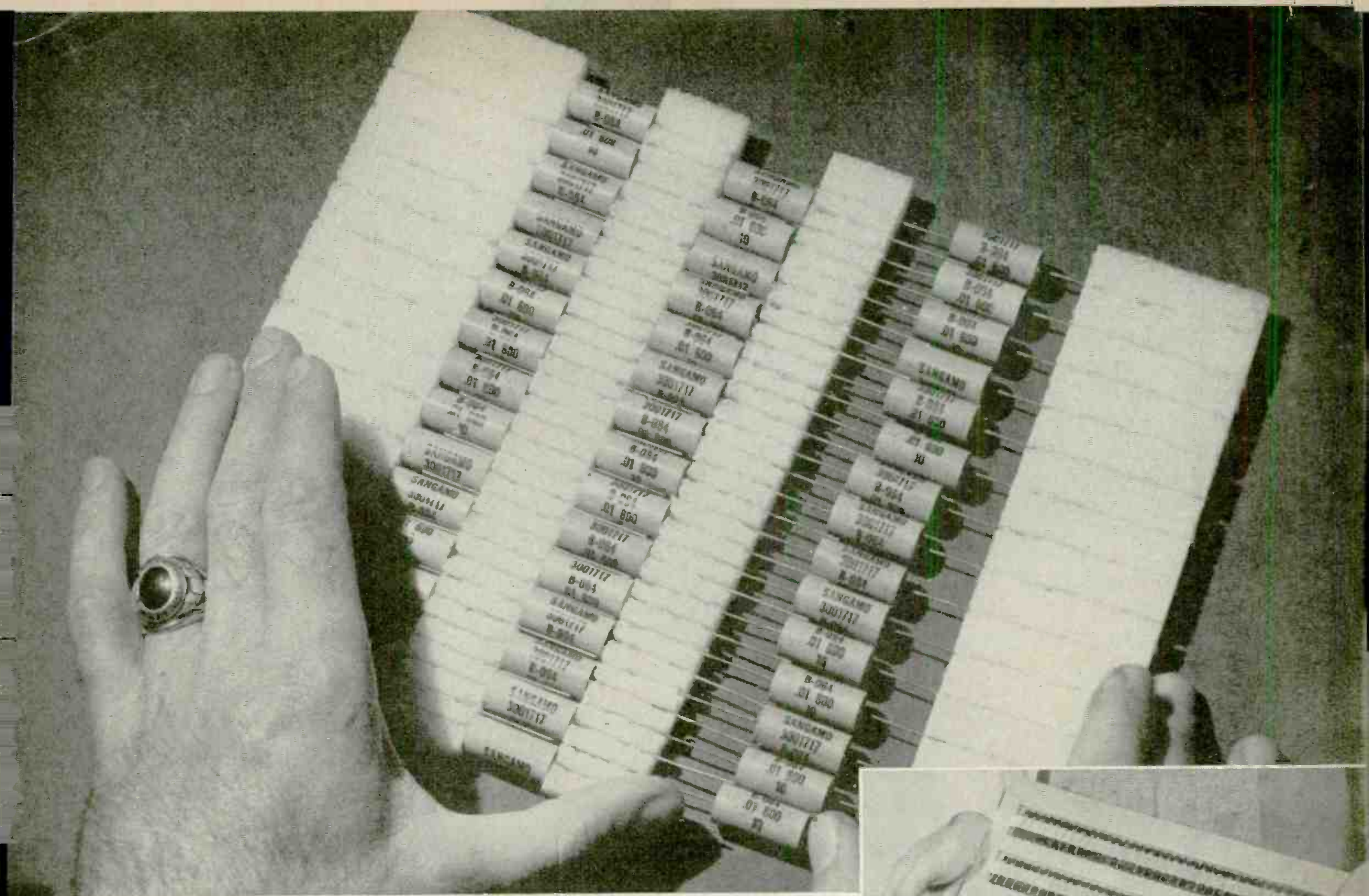
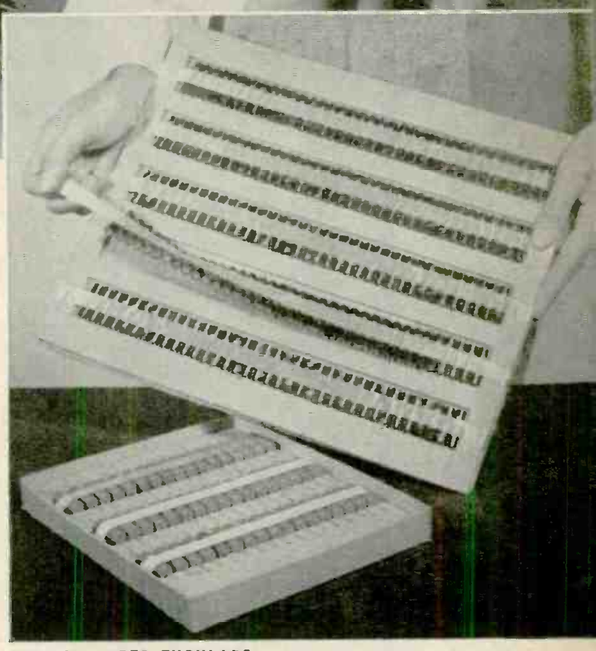


COMPRESSED GLASS SEALED TYPES—Packed in light-as-air Styrofoam which holds axial type leads straight . . . keeps shipping costs down. Capacitors are easily removed from packing to be fed to automatic fabricating machines.



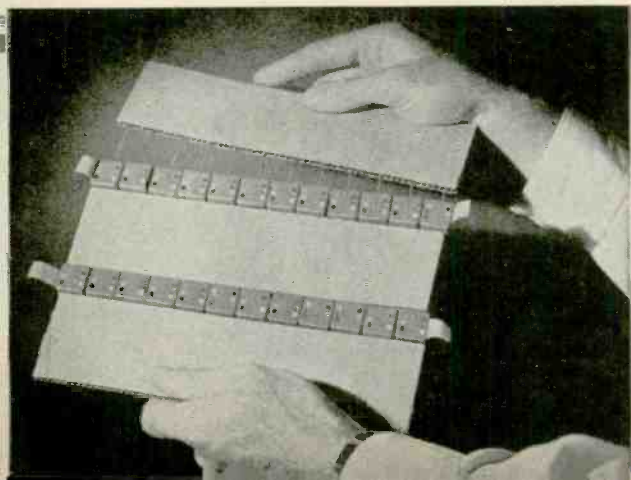
PLUG-IN PAPER TUBULARS—Attached to glass filament tape, uniform rows of these Type 36 paper tubulars can be lifted from the card and fed to assembly machines. Close tolerances between leads are maintained throughout shipping in spite of rough handling. Similarly-packaged standard paper tubulars, shown in the foreground, are also available. SC56-1

Specially packaged capacitors speed automated chassis assembly

New methods of packaging capacitors for automatic machine assembly of printed electronic circuits have been developed by the Sangamo Electric Company. With this special packaging, there's no need for time-consuming straightening of wire leads or checking if close tolerances between leads have been maintained throughout shipping and handling. This special packing makes it easy to remove Sangamo Capacitors from their containers in uniform rows, with wire leads always straight.

Here are a few examples of Sangamo packaging. Sangamo will be glad to discuss special packaging to fit your particular requirements. Write to the factory today.

SANGAMO ELECTRIC COMPANY • Marion, Illinois



WIRE LEAD MICA CAPACITORS—Packaged to keep pre-trimmed leads straight in transit. Taped for ease of handling and feeding through magazine of automatic machines.

SILVERED MICA BUTTON CAPACITORS—Fixed in cardboard squares and boxed. Users like them because they may be easily stored and they provide quick identification of inventory. Color code does not chip off and terminals are kept from bending by this special packaging.

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SERVICING AND TEST INSTRUMENTS

***NEW!* The V.T.V.M.**—No. 57. How to use the V.T.V.M. to best advantage. 224 Pages. Paper cover **$2.50.** Hard cover edition **$4.60**

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The Oscilloscope—No. 52. How to get more out of your scope. New uses. 192 Pages. Paper cover **$2.25.** Hard cover **$4.00**

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Television Technotes—No. 46. Causes, symptoms and cures of over 600 actual troubles. Cuts troubleshooting time to the bone. 128 Pages. **$1.50**

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Transistors — Theory and Practice—No. 51. For the practical man—theory and applications in circuits. 144 Pages. **$2.00**

AUDIO-HIGH FIDELITY

***NEW!* Basic Audio Course** — No. 66. Audio fundamentals from theory of sound to advanced techniques. 224 Pages. Paper cover **$2.75.** Hard cover **$5.00**

High-Fidelity — Design, Construction, Measurements—No. 48. How to achieve top performance. Amplifier construction. 128 Pages. **$1.50**

High-Fidelity Techniques—No. 42. A humorous but practical guide to getting more out of your hi-fi system. 112 Pages. **$1.00**

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Radio-Control Handbook—No. 53. A complete, practical guide on how to build R/C systems. 192 Pages. **$2.25**

Model Control by Radio—No. 43. Theory of R/C and practical suggestions on building units. 112 Pages. **$1.00**

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Radio Tube Fundamentals—No. 45. How and why tubes work as they do. 96 Pages. **$1.00**

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Radio & TV Hints—No. 47. 300 hints, kinks and short cuts. 112 Pages. **$1.00**

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TUBE DISCOUNTS DISCUSSED

The evils of selling tubes at a discount by the independent service technician formed the subject of lively debate at the January meeting of the Radio–Television Guild of Long Island (N.Y.).

The feeling of a large part of the meeting was expressed by Bob Henderson of Baldwin, L. I., who stated, "If the service industry is forced to discount tubes, the dealer will have to raise labor charges on servicing. Service charges are inadequate now and tubes are helping to level off the inadequacy of these rates." Later, he pointed out that service technicians should never "get into combat with discount houses. To do so we would have to lower our standards of servicing. . . ."

Another point of view, presented by Robert Larsen of Windsor TV Service, Rosedale, was that a more realistic list price should be determined as a means of cutting the advantage the discount houses, farmers' markets, drug and hardware stores now have. For instance, if tubes were sold at 40% off list, one that now lists at $2 would sell for $1.20 and would cost the service dealer 80 cents. In other lines such a markup would be considered excellent.

Guild president Murray Barlow—expressing not his own opinions but quoting arguments that had been presented to him, and referring particularly to the automatic tube venders that are becoming common in the area—stated:

". . . If tubes were available to consumers locally at 40% off list, the drug stores, hardware stores and supermarkets would have to drop their prices to meet competition. This would take that beautiful 150% profit that we have created for these operators to split between themselves and the stores and chop it down to 50%.

"After deducting the cost of amortizing the tube testers, the losses due to pilferage, etc., there would hardly be enough left over after the split to cover the shipping."

NONAFFILIATION VOTED

The new California State Electronics Association went on record at its January board of directors' meeting against affiliation with any national association now in the field.

The association is concerned primarily with state-wide public relations functions, relationship with dealers and manufacturers and state legislation affecting the radio–TV industry.

ARTSD ELECTS

The new president of the Associated Radio–Television Service Dealers of Columbus, Ohio, appointed 12 committees, ranging from advertising to a TESA (Ohio) delegate. The 1956 officers are: Jim Cumbow, president; Harry Walcutt, vice president; Bob Hawthorne, treasurer; Jack Voigt, secretary. A five-man board of directors—plus one jobber representative on the board—was also elected. END

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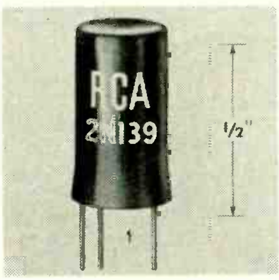
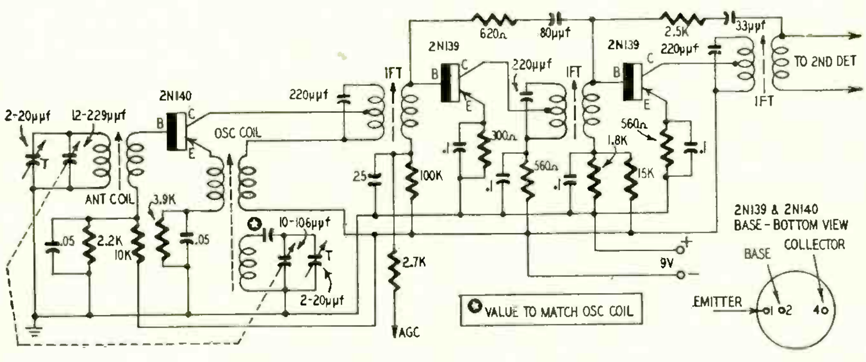
new Tubes & Transistors

2N139, 2N140

RCA has announced two new transistors, the 2N139 and 2N140, intended for intermediate-frequency amplifier and converter service, respectively, in transistorized portable and automobile radio receivers. Both transistors are hermetically sealed and are of the germanium-alloy, p-n-p junction type.



The 2N139 (see photo) designed especially for 455-kc applications, can provide a power gain of 30 db at 455 kc in suitable common-emitter circuits (see diagram). It has excellent stability, low collector cutoff current, is only 0.26 inch in diameter and has a seated height of 0.495 inch.

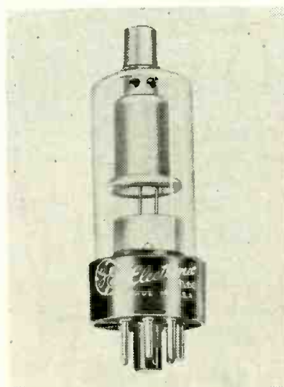


The 2N140 is mechanically like the 2N139 but has characteristics which especially meet the requirements of converter and mixer–oscillator applications in the standard AM broadcast band. In typical operation in a common-emitter circuit (see diagram) the 2N140 features a conversion power gain of 27 db at 1 mc. The circuit is sufficiently stable to permit changing transistors without readjusting the oscillator.

Maximum ratings for the 2N139 and 2N140 are: collector voltage, −16; collector current, −15 ma; collector dissipation, 35 mw; emitter voltage, −12, emitter current, 15 ma.

2B3-GT

A new high-voltage rectifier tube, the 2B3-GT, has been announced by G-E. Intended for use in television receivers in place of the popular 1B3-GT, the tube can be operated directly from a flyback transformer without a filament dropping resistor. The 2B3-GT (see photo) has a filament rating of 1.75 volts at 250 ma as compared with the 1B3-GT rating of 1.25 volts at 200 ma. Other ratings and pin connections remain the same as those of the 1B3-GT. The new high-voltage rectifier should give longer tube life and reduce television set manufacturing costs.



2B3-GT

6CS5, 12CS5

Designed for use in low-voltage audio applications, the 6CS5 and 12CS5, developed by CBS-Hytron, are miniaturized beam pentodes with the same power-handling capability and electrical characteristics as the 6W6-GT. The tubes fulfill the demand for high audio-power output with low supply voltages and may be used in printed-circuit radio and television receivers. The tubes are nine-pin units with the 12CS5 de-

NOW... model SX-100

Selectable side band receiver

BUILT TO THE SPECIFICATIONS OF 1,000,000 FIELD EXPERTS

See it at your Jobber—only $295.00

Model SX-100. *Amateur Net* $295.00
Matching R-46B Speaker $17.95
Frequency Range 538kc-1580kc
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The writers' products include Hughes equipment operating instructions; pilot and radar operator instruction manuals; service instruction books; test equipment use and service manuals; illustrated parts catalogues. Tape recorders are a time- and effort-saving tool in this work.

Evening classes are available nearby at the University of California, Los Angeles, and the University of Southern California, for engineering writers desiring to advance their knowledge of the electronics arts.

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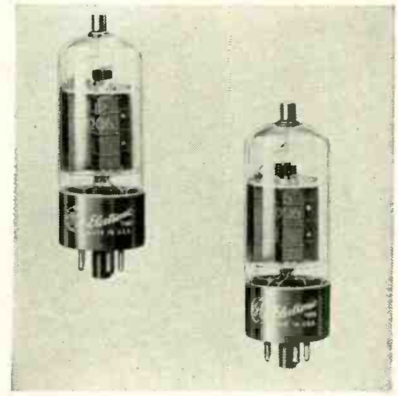
Photo, above: Engineering writer working with Hughes engineers on a design phase of the Hughes Falcon air-to-air guided missile.

signed for 600-ma series-string operation.

6DQ6, 12DQ6

An addition to their line of 600-ma controlled-warmup tubes has been announced by G-E with the introduction of the 12DQ6. The 6-volt version is the 6DQ6. The tubes (see photo) are designed for horizontal-deflection amplifier service. They have extremely high perveance, permitting the design of a high-efficiency 90°-deflection system. The 6DQ6 and 12DQ6 are rated at a peak plate pulse of 6,000 volts and a plate dissipation of 15 watts.



Left—12DQ6, Right—6DQ6

The 6DQ6 heater is rated at 6.3 volts and 1.2 amperes; the 12DQ6 at 12.6 volts and a heater current of 600 milliamperes.

6842

A seven-pin miniature tube with an overall height of 2¼ inches, the 6842 is designed for use in regulated power supplies or voltage amplifier circuits operating at plate potentials of 300 volts to 4 kv. This National Union tube is useful as a shunt regulator or in a series regulator circuit in equipment that requires a stabilized voltage independent of line-voltage and load-current variations. The 6842 (see photo) can provide up to 10-ma average plate current and dissipate approximately 8 watts.

The low capacitances, high gain and high voltage ratings of the 6842 make the tube well suited for applications in television receiver and oscilloscope sweep circuits employing electrostatic deflection. END

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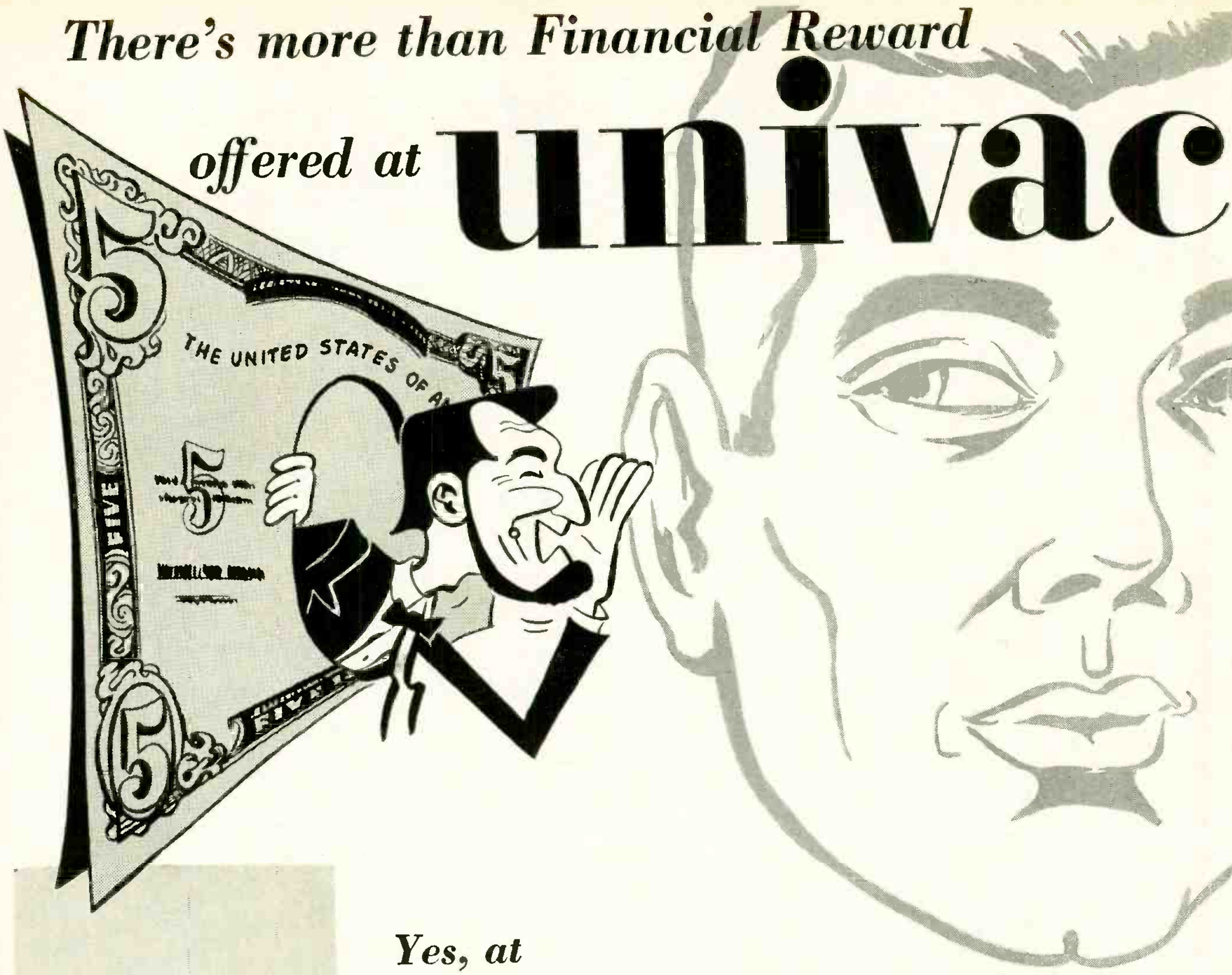

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TCHAIKOVSKY: ***1812 Overture***
Capriccio Italien
RIMSKY-KORSAKOV:
Capriccio Espagnol
Russian Easter Overture
Vienna State Opera Orchestra conducted by Mario Rossi.
Vanguard SRV-101

This Vanguard entry into the demonstration record sweepstakes is disarming in its lack of pretension. No percussion bands, no frequency-range sweeps, no commentary, indeed no explanations except the usual musical notes on the jacket. Just four *complete* samples of Vanguard recordings from the series made by the Vienna State Opera Orchestra under Mario Rossi. The music includes some of the most brilliant hi-fi warhorses, from a deep gutty bass to tinkling traps and triangles, and is distinguished for the exceptional clarity, definition, cleanness and faithfulness to tone.

Each is spectacular in its own way. Moreover, although it sounds best on the best systems, it will sound impressively good on average and middling systems for Vanguard includes nothing that would really floor today's good average system—like the big drum in the *Egyptian March* of its Strauss record *Vienna Bon-Bons.* In fact, the inherent high quality will make up for many system deficiencies. Still, there are tremendous clean climaxes, big transients in attacks, sharp cutoffs to test decay, almost fearful concatenations of the full armory of the big orchestra to try definition. Here is material for testing almost any audio quality.

SMETANA: ***The Moldau***
ENESCO: ***Rumanian Rhapsody***
KODALY: ***Dances of Gelanta***
DVORAK: ***Scherzo Capriccioso, Opus 66***
Bamberg Symphony conducted by Jonel Perlea
Vox PL-9500

For those who object to "hi-fi jinks" here is a demonstration record that will prove that high fidelity is worth while. Four of the most popular pieces of program music based on national folk airs are played with vivacity, interpreted with proper faithfulness to the composers' ideas and intentions and brilliantly recorded. There are almost no high-highs but the rest of the spectrum is smooth. The bass is not overwhelming but well defined and with no boom. There is a nice big-hall liveness capable of yielding a very high degree of presence in a good living room. Especially in the *Rumanian Rhapsody,* there are lovely woodwinds, singly and in choirs. The overall effect has brillance but is mellow throughout and guaranteed not to hurt anyone's ears short of eardrum-bursting loudness.

SURINACH, Carlos: ***Ritmo Jondo***
Three Berber Songs
Tientos (Essays)
Various chamber ensembles conducted by the composer
MGM E-3268

A brief version of *Ritmo Jondo* is found on MGM's E-3155 *Spanish and Latin American Music* which I liked so much. Here it is in full

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and even more impressive in the novelty of the musical effects and its value for demonstration and testing. Fine kettle drums, xylophone, a notably fine bassoon, hand clapping, a fascinatingly complex rhythm and music which verges on the edge of dissonance but is always interesting — provided the playback system contributes no distortion.

This *Tientos* again is superior to that on Capitol's P-8309 with harp instead of harpichord, very fine kettle drums plus a very fine English horn. *The Berber Songs* are brand-new to LP and share the same novelty of tonalities and present the woodwinds especially with beautiful faithfulness of tone. The bass in the *Ritmo Jondo* and *Tientos* is tops for dullness; all three selections have sharp attacks and excellent transients. If you don't mind modern music with a Spanish flavor—and that kind is perhaps the easiest of all to take—you'll find this one of the best test records available.

PROKOFIEFF: *Prodigal Son*
(Complete ballet music)
New York City Ballet Orchestra
conducted by Leon Barzin
Vox PL 9310

The New York City Ballet Orchestra continues to give Vox some of the grandest sound being recorded today. On the finest single-channel systems this is capable of providing an illusion of presence worthy of comparison with stereo sound but without its distractions. The big-hall liveness is just right when played at a moderately loud level to take the living room into the auditorium. The drums and basses are excellent and the lesser instruments are plainly heard without seeming to step out of the orchestra into the listener's lap. The fortissimos are clean and brilliant. The horns are especially good. A good example of modern recording at its best and without hi-fi jinks. One of Prokofieff's best ballets, this is easy to take without the dancers.

Concertos Under the Stars
Leonard Pennario, piano
Hollywood Bowl Symphony
conducted by Carmen Dragon
Capitol P-8326

Another contribution by Capitol to the library of "popular" symphonic music played with sufficient verve and color to appeal to the casual music listener and excellently recorded. Here are seven "concerto arrangements" including the *Warsaw Concerto, Swedish Rhapsody, Cornish Rhapsody. Adagio* from the *Moonlight Sonata, Liebestraum, Prelude in C Sharp Minor* and the more obscure *Scherzo* from *Concerto Symphonique* by Litolff. Pennario plays them with less boredom than in previous potpourris and the overall sound is capable of being spectacular on good hi-fi systems, though not in the same class as the Vanguard or Vox above. Don't play this for real long hairs; but the man in the street should love it.

Sounds of the American Southwest
Folkways FPX-122

Sounds of Sea Animals Vol. II
Folkways FPX-125

Sounds of Carnival
Folkways FPX-126

Sounds of Medicine: Operation Body Sounds
Folkways FPX-127

I don't know how many of you have discovered as I have that one of the most entertaining uses for a high-fidelity system is that of presenting a "concert" of various noises. Here are a few more records suitable for an "evening at the audiophiles home."

Sounds of Carnival is fairly routine. One side is all calliope music and reasonably faithful to the wheezing, hay-wired sample in use by the American Royal Shows; but one or two bands is a plenty. The other side offers various barkers and assorted carnival and crowd noises. Unfortunately this is too amateurish a recording job; and I presume will be most useful to radio and TV stations for sound effects.

Sounds of the American Southwest is loaded with rattlesnakes (at least a half-dozen varieties) plus various birds, toads, beetles, wild-

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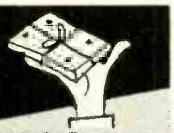

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cats, etc. The portable recorder used did not do them as complete justice as a hi-fi man would like, but the rattlesnakes are natural enough to frighten if you've ever heard one.

The operation in *Sounds of Medicine* is fairly hair-raising in its verisimilitude, but the prize of this disc are the bands on the other side of normal and abnormal heartbeats, respiration and bowel noises. The normal heartbeat has some awesome transients and the respiration obviously contains high-high components resembling white noise.

One side of *Sounds of Sea Animals* covers the field of natural undersea noises in a fast once-over-lightly; the other side covers in detail the fascinating case of porpoise sounds which, the evidence suggests, are a type of pulse-time modulated sound ranging. Particularly novel for test purposes is the track giving porpoise clicks at 1/64th of natural speed and frequency, followed by echoes from the surface and bottom. The pulses are genuine transients, the echoes are faint; it takes a good system to hear them clearly and sharply.

Jimmy Durante in Person
MGM E-3256

Nothing of hi-fi interest here that I can find but anybody who has ever liked Durante should welcome this opportunity to get on one disc all his classic songs, including my own favorite, *The Lost Chord* and 11 others.

BEETHOVEN: *Violin Concerto in D Major*
Nathan Milstein, violin
William Steinberg and the Pittsburgh Symphony
Capitol P-8313

Milstein and the Pittsburgh Symphony give one of the greatest of all violin concertos a very worthy performance. Some audiophiles may recall that this is the concerto which gives the kettle drums a real workout and the juxtaposition of the drums and the fiddle is often very interesting particularly for checking intermodulation distortion.

Milstein's violin is its usual, almost incredibly, sweet self and his playing is characteristically unforced, the high notes especially being pure and right on the head. The Pittsburgh Symphony which on some of its discs suffers from the acoustics of the Mosque in which it plays, here is really impressive. Many audiophiles will especially like the deep bass and in those portions where it underlies the fiddle it provides a fine measure of IM distortion. Those who insist on fine sound as well as fine performance will, I think, agree that this is *the* version for them. The first movement is exceptionally good.

SAINT-SAENS: *Cello Concerto No. 1 in A minor*
LALO: *Cello Concerto in D minor*
Andre Navarra, cello
Orchestra of Paris Opera conducted by Emanuel Young
Capitol P-8318

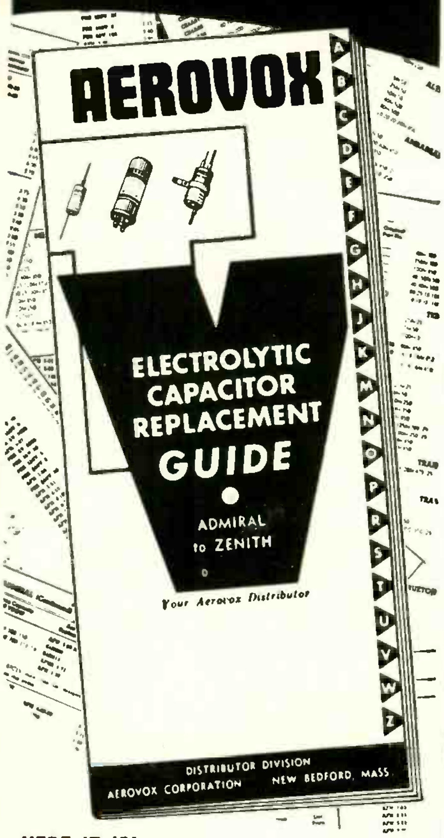
This very faithful rendition of the cello provides a lovely middle bass that will give an impressive demonstration of bass quality on small speaker systems that cut off somewhere above 50 cycles. There is also, however, an excellent choir of double basses offering contrast between the two instruments which will be most obvious on systems with a wide bass range. These are two of the most melodic and interesting major works for the cello. The recording is very fine and clean and the bass definition is exceptionally good.

Holiday in Cuba
Don Marino Barreto, Jr. and his Cuban Orchestra
Vox VX-25020

Except that, like many other popular records, it is slightly overcut in spots, here is a first-class popular demonstration record with plenty of jingling highs of all kinds, a very notably dull, deep bass and plenty of brass. END

Names and addresses of manufacturers of records mentioned in this column may be obtained by writing Records, RADIO-ELECTRONICS, *25 West Broadway, New York 7, N.Y.*

let THIS be your guide



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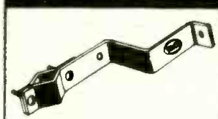
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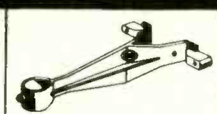
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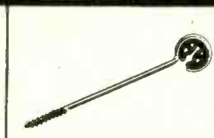
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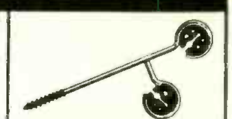
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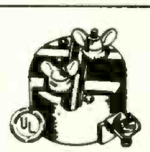
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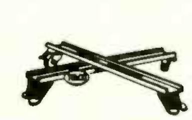
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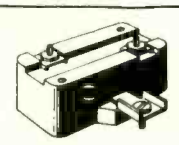
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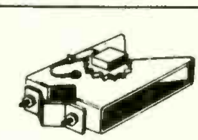
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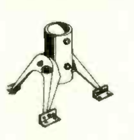
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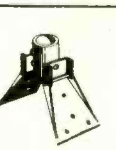
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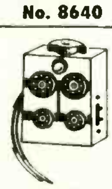
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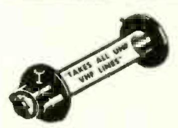
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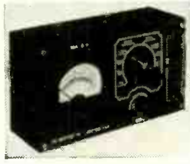

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WESTON	Model 507, F.S. 1, 2 Milliam. Meter	12.95	3.95
TRIPLETT	331-JP 30 Amperes, Meter	12.95	4.95
MARION	3" D'Arsonval Type, 1 Milliam. with calibrated Volt-Ohm Current Scale, Meter	12.95	3.95
ACRO	Radio & Phonograph Chassis Cradles	6.95	2.95
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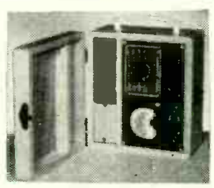

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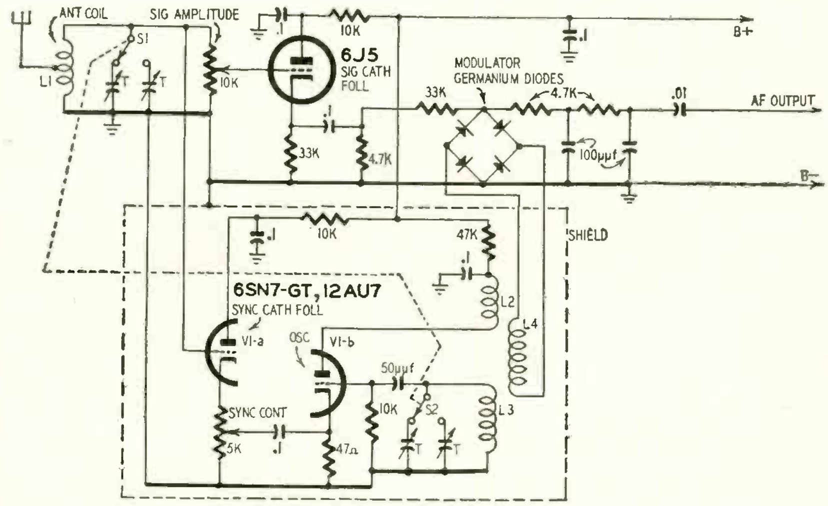
radio-electronic Circuits

SYNCHRODYNE TUNER

Since publishing the article on a synchrodyne receiver (April, 1951) we have received periodic requests for additional circuits and references. The diagram shows the circuit of a simple constants selected so the circuit is unstable and locks in easily with the external sync signal.

A tertiary winding (L4) on the oscillator transformer applies an oscillator



synchrodyne type local-station AM tuner designed for the experimenter by G. A. French and described in *The Radio Constructor* (London, England).

Basically, the synchrodyne is a superhet with an i.f. of *zero*. The oscillator is synchronized and locked in on the frequency of the incoming signal so the difference frequency is zero. The oscillator signal beats with the sidebands of the broadcast signal and produces a.f. signals identical to those modulating the transmitter.

Signals from the antenna are coupled to L1 and the desired station is tuned in by the trimmer capacitors selected by S1. The tuned circuit is heavily loaded by the 10,000-ohm control so its response is broad—a requirement for good synchrodyne operation. A portion of the incoming signal, tapped off the control and fed through the 6J5 cathode follower, is applied to one set of terminals of a diode type balanced modulator circuit.

The incoming signal is also fed to the grid of V1-a, the sync cathode follower. The output of V1-a is then injected into the cathode circuit of the oscillator to synchronize it with the desired carrier frequency. V1-b is a conventional tuned-grid oscillator with voltage of approximately 1 to the remaining terminals of the balanced modulator.

Switch tuning eliminates tracking problems. Only two sets of tuning capacitors are shown. Others can be added. L1 is a standard broadcast antenna coil. You can use one with a separate primary instead of a tap. A good outside antenna is recommended for this circuit.

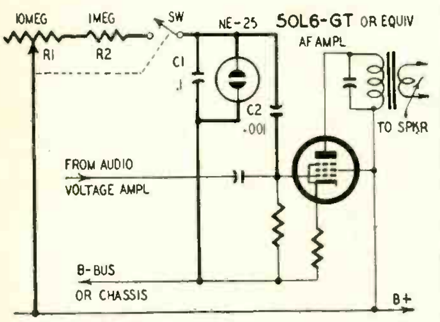
The oscillator coil is a broadcast type r.f. coil with the primary used for L2 and the secondary for L3. L4 is an added winding with enough turns to develop about 1 volt across the modulator.

To adjust the receiver, tune the input circuit to a strong local station. A simple r.f. signal tracer will be useful in this operation. Set the signal amplitude control to maximum and the sync control to minimum. Temporarily short out the 47-ohm oscillator cathode resistor and adjust the oscillator trimmer until a beat note is heard. Remove the short from the resistor and adjust the sync control until the oscillator just locks in and the modulation signal is heard clearly. Now, adjust the signal amplitude control and antenna tuning capacitor for best results.

SIMPLE METRONOME

Most metronome circuits require an amplifier, power supply and speaker. This one uses those of a typical five-tube a.c.–d.c. radio. The metronome circuit is shown in the diagram. The only new parts needed are shown in heavy lines. The rest of the circuit is a part of the receiver.

The circuit is basically a relaxation oscillator. C1 charges through R1 and R2. When the voltage across C1 reaches the striking potential of the neon lamp, it breaks down and feeds a pulse to the grid of the audio output tube through C2. This produces a loud click in the speaker. The repetition rate of the click



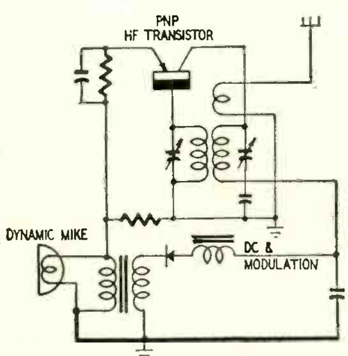
depends on the setting of R1. The greater its resistance, the slower the click tempo.

When using the metronome, warm up the radio and then tune it to a dead spot on the dial. Turn R1 clockwise to close SW and start the metronome.

Assembly and construction are simple. Drill a hole in the side of the receiver cabinet and mount R1 and then mount the neon lamp and remaining parts under the chassis among the other parts of the receiver. R1 may be calibrated by counting the number of clicks per minute and recording them on a small cardboard dial under the control knob.—*Jess Jacobson*

VOICE-POWERED RADIOTELEPHONE

A transistorized voice-powered radio transmitter that would make a nice companion piece for the Transistorized Wrist Radio (RADIO-ELECTRONICS, March, 1954) has been developed at the Signal Corps Engineering Laboratories in Fort Monmouth, N. J. The unit is built into a telephone handset (see photo) and is designed along the lines of the basic circuit shown in the diagram.



The microphone is a moving-coil or armature type, transformer-coupled to the tuned-base tuned-collector type rf oscillator. Operating voltage for the transistor is developed by rectifying the af signal at the secondary of the

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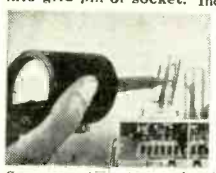

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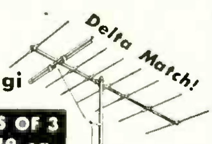

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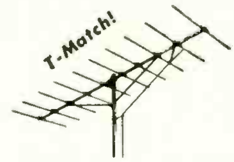

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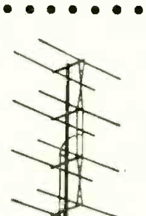

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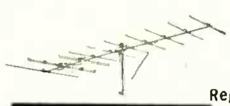

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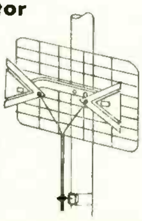

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In March, 1922, *Science and Invention* (formerly *Electrical Experimenter*)

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Question Box

DIRECTION-FINDER MODIFICATION

I'd like to build the direction-finder receiver described in the May, 1955, issue but I want to include the broadcast and 2–3-mc marine bands as well. Please show how these can be added. —T. B., Danielson, Conn.

The Fig. 1 diagram shows the tuning of the direction finder as modified to include coverage of the 540–1,500- and 1,500–4,500-kc bands. L1 is the modified ferrite-rod antenna and T1 and T2 are the 140–425-kc r.f. transformers used in the original circuit. T3, T4 and T5 are dual-band antenna and r.f. transformers covering the added bands. T3 is a J. W. Miller type 3996-A or equivalent and T4 and T5 are Miller 3996-RF or equivalent types.

The bandswitch is a six-circuit, three-position rotary type. We suggest one having at least three wafers or decks.

The coils, tuning capacitor, bandswitch and r.f. amplifier and detector tubes should be carefully positioned for the shortest possible leads. The space required for the new components will probably make it necessary to modify the original parts layout or use a larger cabinet. One scheme would be to house the batteries in a box below the base of the receiver and bring the leads through a threaded pipe substituted for the carriage bolt in the pivot assembly. A stop should be added to prevent the receiver from being rotated through more than 360°.

Sensitivity and selectivity on the broadcast and shortwave bands can be greatly increased by converting the detector to a regenerative type as shown in the simplified circuit in Fig. 2. The primaries of T2 and T5 are omitted

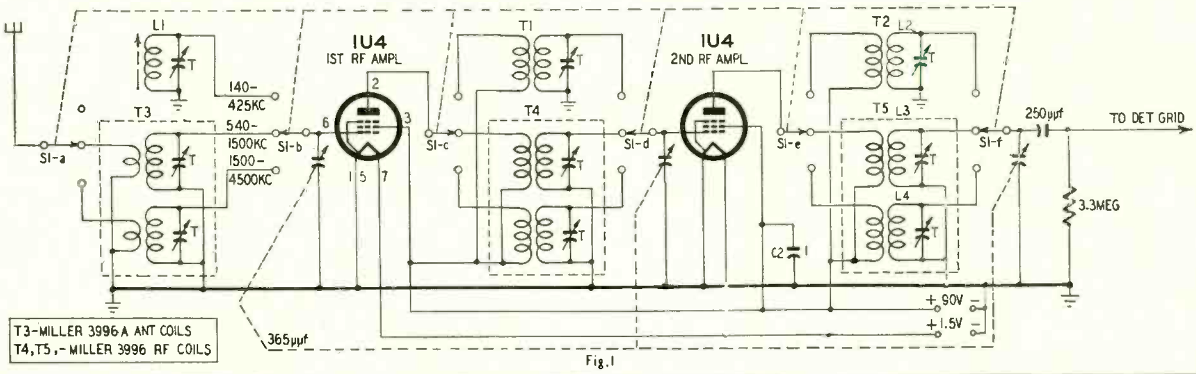
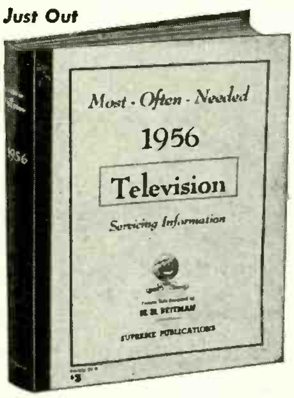


Fig. 1

Just Out



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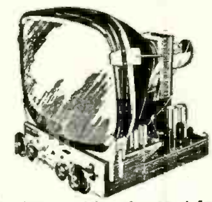

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for simplicity. Ticklers L5 and L6 are wound at the ground ends of L3 and L4, respectively, to provide the necessary feedback. L5 and L6 are approximately 16 and 10 turns, respectively,

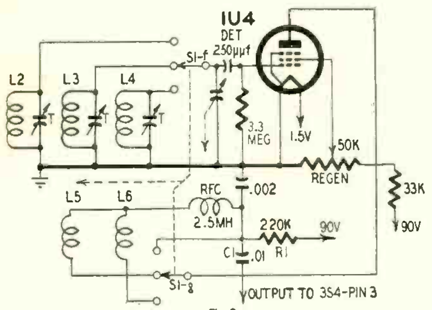
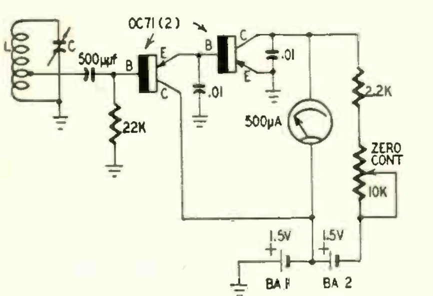


Fig-2

of No. 30 enameled wire closewound at the ground ends of L3 and L4. Adjust the number of turns so the circuit starts to oscillate with 30 to 50 volts on the screen grid. Regeneration is controlled by the sensitivity control.

TRANSISTORIZED WAVEMETER

I am experimenting with transistorized oscillators and transmitters and have difficulty in adjusting the circuits for maximum performance because the power output is too low to operate a wavemeter. The S meter on my receiver is not sensitive enough to respond to such minute changes in output. Is there any type of amplified wavemeter or similar rf output indicator that I can



use? I want to use it on the broadcast and lower-frequency amateur bands.—J. K., Flushing, N. Y.

Here is the circuit of a transistorized wavemeter described in *The Philips Experimenter*, a series of data sheets and application notes distributed by Philips Electrical Industries of New Zealand.

The input transistor, the one coupled to the tuned circuit, is connected in a common (grounded) collector circuit. The 22,000-ohm resistor in the base return biases this transistor close to cutoff. The output signal is taken off the emitter, which is direct-coupled to the second (output or meter-amplifier) transistor, connected in a common-emitter arrangement.

Since the emitter circuits of the two transistors are in series, the second is likewise biased close to cutoff and the current through the meter is small. Both transistors are powered by BA1.

Standing current through the meter is bucked out by a reverse current from BA2 through the 2,200-ohm resistor and the ZERO control.

When an rf signal is induced in the tuned circuit, the base and emitter of the input transistor act as a diode detector connected to conduct only on negative half-cycles. The two transistors conduct and the collector current of the output stage is read on the 500-μa meter.

Coil L and tuning capacitor C are selected to cover the desired frequency range. The input impedance of the input stage (about 20,000 ohms) is high enough to provide good selectivity if the tap is placed well down toward the ground end of the coil.

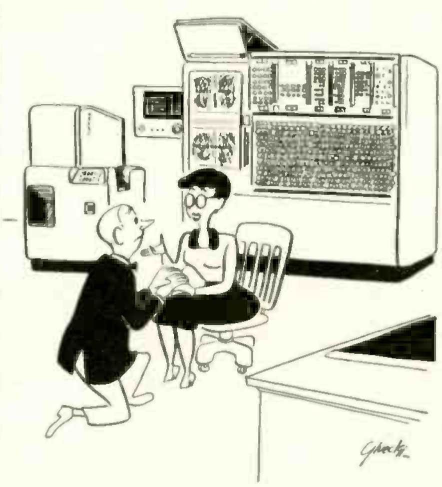
TV SET TO SCOPE?

I have an old 12-inch TV set that I want to convert to an oscilloscope. Do you have a set of general conversion details or a diagram that I can use?—H. T. T., Bronx, N. Y.

We assume that your set has a C-R tube requiring electromagnetic deflection. If this is the case, conversion to an oscilloscope is not practical. In a TV set, the vertical and horizontal deflection circuits operate on fixed frequencies of 60 and 15,750 cycles, respectively. The output transformers and deflection-yoke windings are designed to operate best at these frequencies.

An oscilloscope uses a single-line type display rather than a modulated raster as does a TV set. The vertical amplifier in a scope is designed to pass a wide band of frequencies—often ranging from near dc to 4 mc or higher. The horizontal deflection circuit is fed by a variable-frequency oscillator and passes signals ranging from around 30 cycles to 100 kc or so. Because of the differences in the frequencies fed to the deflection circuits in TV sets and general-purpose and servicing type scopes, oscilloscopes use C-R tubes requiring *electrostatic* deflection.

We recommend that you start from scratch and construct a scope. END



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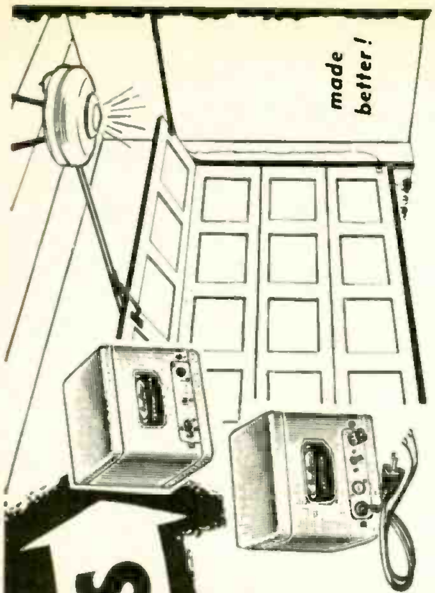

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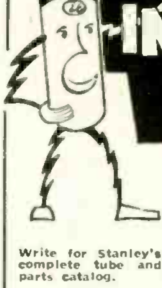

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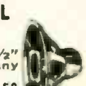

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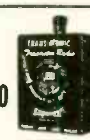

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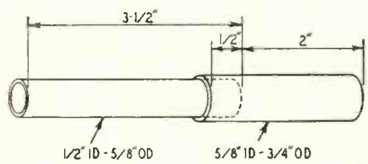
Technotes

COLOR TV CHEATER

Removing the rear cabinet screen of sets using the RCA CTC4 chassis actuates the high-voltage interlock, grounding out the high-voltage capacitor. With the set on, the high-voltage fuse will blow. This can be avoided by using a cheater (see diagram) that can be inserted in the chassis interlock receptacle.

The interlock plug can be constructed



of Plexiglas or Lucite tubing. It is important that the two tubes be overlapped exactly ½ inch and that General Cement Q Dope, or equivalent, be used to join the tubes together. If desired, the 2-inch section of tubing may be shortened to allow a high-voltage probe to contact the high-voltage measuring point.—*RCA Television Service Tips*

RCA 9T57

This receiver was found to have erratic width and brightness. There was a tendency to blooming, and turning the width potentiometer in the rear would cause the picture to go out completely.

The trouble was traced to a partially shorted 100-μμf capacitor which went from screen grid to cathode of the 6BG6-G tube. Not only did this remove screen voltage from the tube but it also burned out the width control which has a value of 20,000 ohms. Replacing the width control and 100-μμf capacitor cured that one.—*Jacob Dubinsky*

WESTINGHOUSE V-2150-176

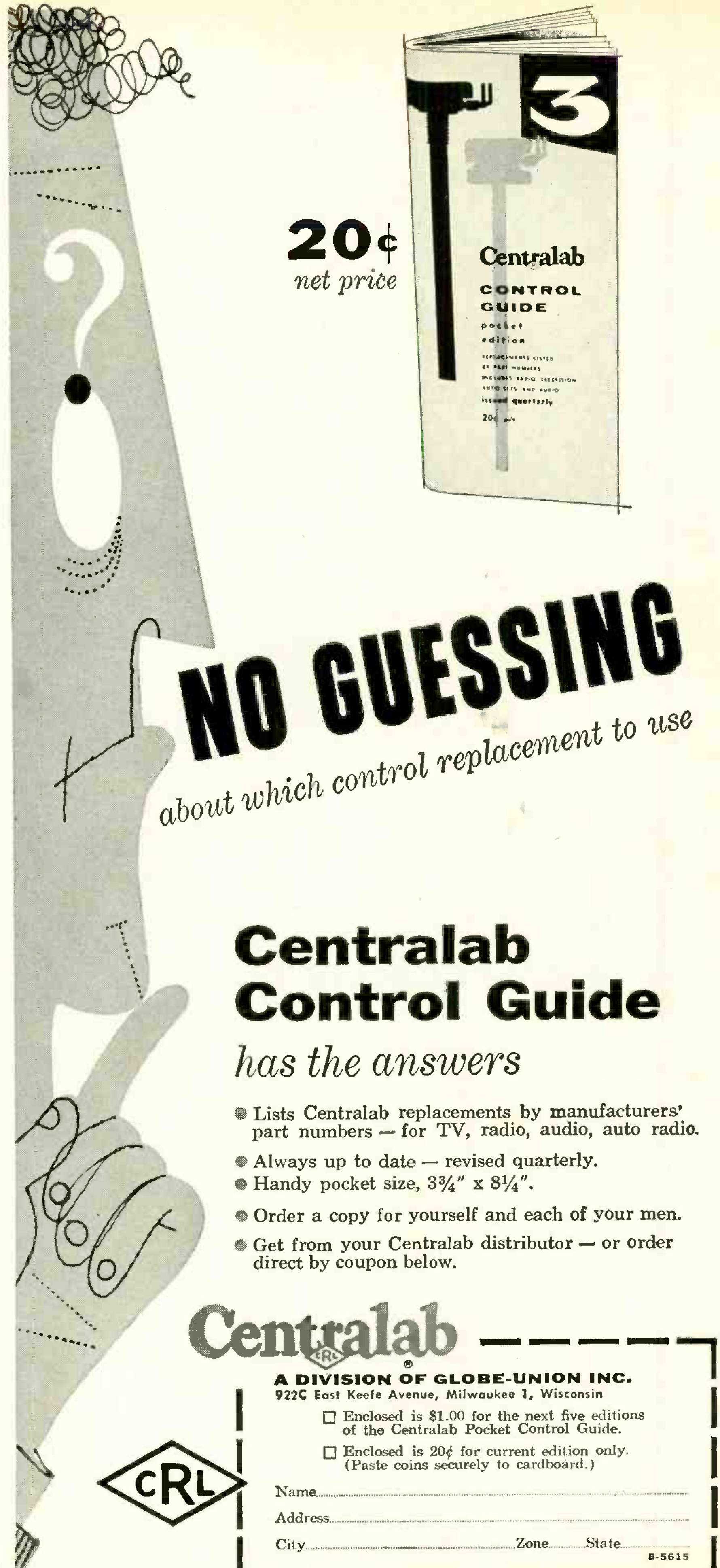
To improve horizontal linearity, change the 680-μμf horizontal discharge capacitor (C427) to a 330-μμf unit.—*Lyle Briggs*

HICKOK 539A TUBE TESTER

The checker would oscillate and gave false readings when checking 6BQ6 and other tubes with anode cap.

Remove grid lead from jack when checking tubes with plate caps, as it causes feedback.—*W. G. Eslick*

(Hickok engineers suggest that it is a good idea to keep both leads out of the grid and plate jacks unless the data on the roll chart call for their use. —*Editor*)



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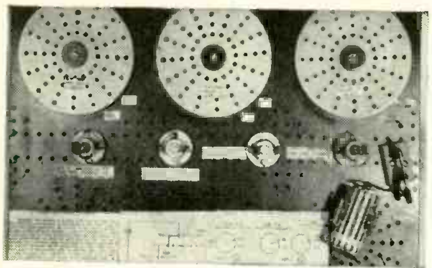

Control Panel of GENIAC set up to do a problem in check valve research.

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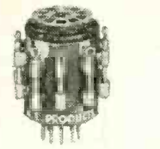

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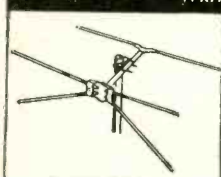

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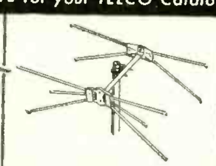

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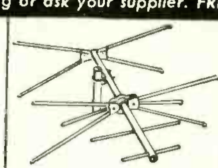

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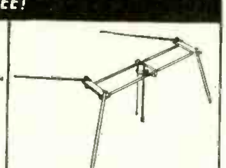

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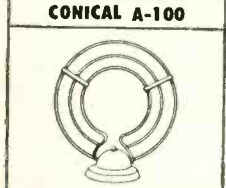

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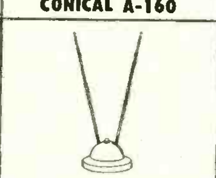
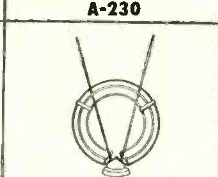
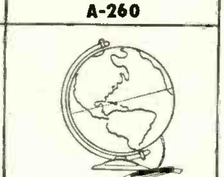


TELCO ROTO-INDOOR A-8160-TP



TELCO GOLDEN V A-8125



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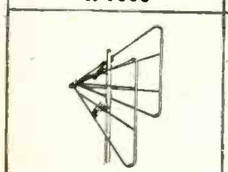

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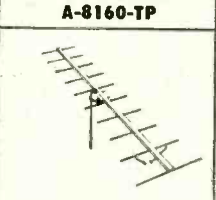
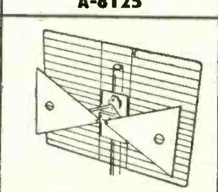
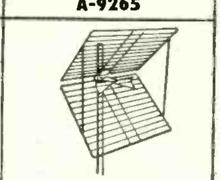


TELCO GOLDEN YAGI A-320



TELCO DELUXE BOW-TIE A-8965



TELCO CORNER REFLECTOR A-8984

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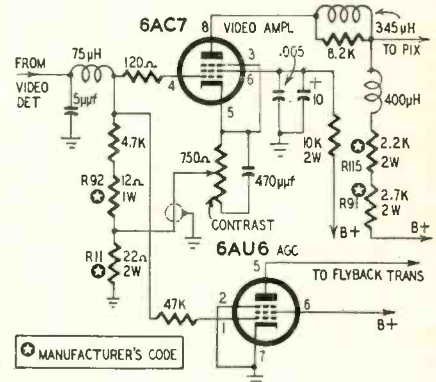
STROMBERG 16 SERIES

This series is fairly easy to work on in comparison with other Stromberg-Carlson models. With some modifications the 16 is similar to the TC-125 and 116 series. In cases of no agc or poor sync, check R11, R92, R91 and R115 (see diagram) for changed values. If the peak-to-peak voltage at the 6AU6 agc keyer plate is less than 150,



change the horizontal output transformer if everything else checks OK. To prevent picture blooming when the brightness control is advanced, replace R39, R66, R75, the bleeder string in the high-voltage cage with three 680,-000-ohm 2,000-volt resistors in series. R70, a 220,000-ohm resistor in series with the brightness control also causes blooming. Replace the 12AU7 vertical output tube with a 12BH7 if it is difficult to obtain height. Horizontal-oscillator instability is usually caused by the 6SN7 horizontal oscillator resistors (R54—5,600 ohms, R58—270,000 ohms) changing value or loss of Q in the ringing coil.—*Wilbur J. Hantz*

TURRET TUNERS

It was noted that after the standard job on turret tuners with dirty contacts (clean and apply the usual contact lube) was performed, the set would require the same job in six months or less.

Applying a very small daub of petroleum jelly (Vaseline) with the tip of a toothpick (so as not to smear grease over the tuner strip) the job will stand up a year or more.—*Elmer Woods*

RCA TV FUSE FAILURE

An 0.3-ampere 250-volt fuse with wire leads (stock No. 78214) is now used in many RCA models. It should be replaced only with a fuse of the same rating.

When fuses blow out, examine the glass body interior to determine the cause. Where a small segment of the fuse link has melted, a defect in the horizontal deflection circuit is indicated. Check the horizontal output and damper tubes and watch for a possible intermittent resistor or capacitor in these circuits.

Failures where the fuse link has vaporized against the glass fuse body

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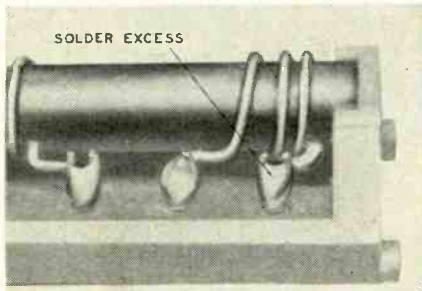
can be due to an intermittent short in the 6AQ5 vertical output tube. In some cases this is caused by a momentary flashover that clears itself.—*RCA Radio Phono Television Service Tips*

TUNER INTERMITTENT FROM SOLDER BLOB

The photograph shows a part of a turret type tuner oscillator channel strip which caused an intermittent with some headaches. The trouble would occur only on rather hot days after considerable warmup of the set. A new channel strip was installed by the serviceman who brought the old one back



to the shop for inspection. The solder blob shown in the picture was the only thing that seemed unusual about the coil strip so the turns were pried apart a little. The strip was then installed in a set and has been operating daily for months.—*James A. McRoberts*

RCA T-120, T-121

Poor horizontal sync stability in several of these sets was caused by a 150,000-ohm grid resistor in the horizontal output stage.

Howard Sams' schematic shows a 1-meg resistor and for the KCS34C chassis a 470,000-ohm resistor. The 470,000 resistor gives the best results. If the picture is narrow after changing to 470,000 ohms try several 6SN7-GT horizontal oscillator tubes. Choose one that gives more than normal drive, first making sure the 5U4-G and 6BG6-G are OK. Then align the horizontal oscillator. For the waveform adjustment connect a 15-$\mu\mu f$ capacitor (ceramic or mica) in series with the test lead. This is very important on scopes that don't have a cathode follower input.—*G. P. Oberto* END

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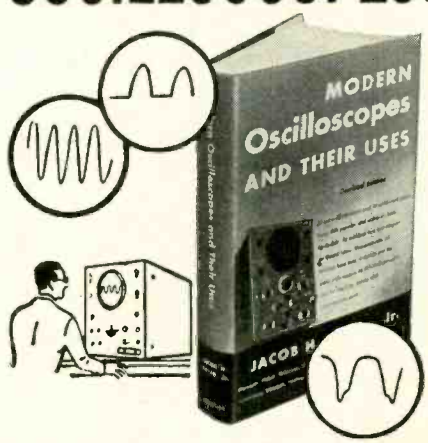

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When the voice-coil lead on a speaker breaks close to the cone at a point that cannot be reached from the rear with a soldering iron, cut a V (not a triangle) in the cone over the spot where the lead is to be soldered.

Bend the point of the V outward and insert the soldering iron into the opening to make the repair. Bend the V-flap back, match the edges and apply cone cement to form a solid seam over the cut. If you are careful, the repair can be made without noticeably changing the speaker's response.—*Stanley Clark*

TIMING SERVICE JOBS

Most service technicians time the labor on a service job by noting the time as the job is started and completed. However, in some cases, there are many unavoidable interruptions and the job cannot be timed accurately. If interruptions cannot be avoided, try timing with a small self-starting electric clock.

Set the clock to 12 and turn it on when starting a job. Turn it off when interrupted and on again when work is resumed. When the job is completed, the clock will record the total time consumed.—*A. von Zook*

PANEL PROTECTION

An instrument panel and its decal or silk-screened markings are easily defaced by pointer type indicator dials. A sheet of clear plastic placed between the pointer and panel protects against scratches and preserves the original finish and markings. Two small 4-36

screws are usually sufficient for mounting the plastic sheet.—*Edwin Bohr*

(Small control knobs without skirts also permit the fingertips to mar the panel finish and markings. Circular plastic discs cemented to the back of the knobs or fastened to the panel will eliminate this trouble.—*Editor*)

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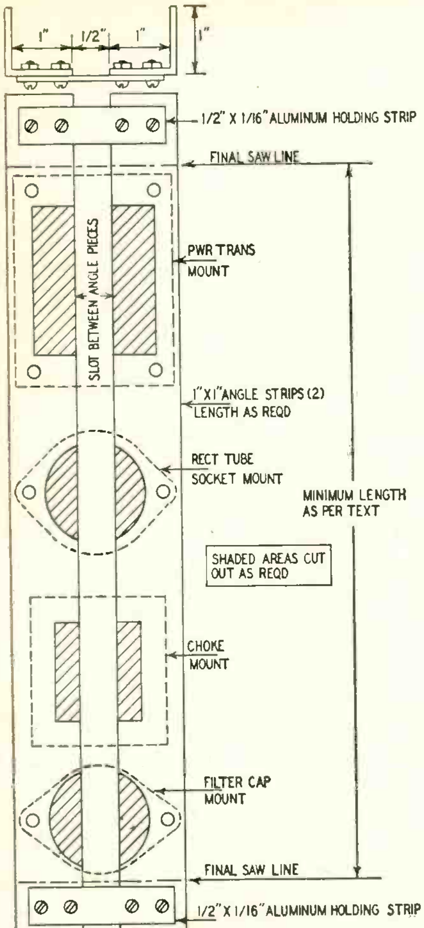

Fig. 1

(Continued)

NOVEL CHASSIS CONSTRUCTION

I recently needed a narrow, odd-sized chassis for a small power supply. Unable to purchase the size I wanted, I improvised an extremely neat assembly out of two 1 x 1 x 1/32-inch aluminum angles as shown in Fig. 1 (left).

The width can be varied according to the need and other combinations can be worked out using larger angles. The center slot is not unsightly and provides good ventilation. The aluminum strips at the ends can be removed after the components have been bolted in place. The chassis can then be sawed to minimum length. The chassis can be mounted on a wooden base with a wood screw and washer as in Fig. 2.—*Alan M. Palmer*

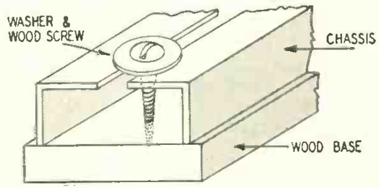

Fig. 2

INSTALLING TV ANTENNAS

An ordinary galvanized iron bucket and a hank of ¼-inch sash cord or clothesline come in handy when install-

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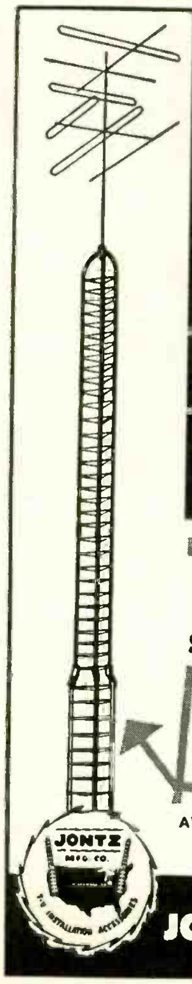

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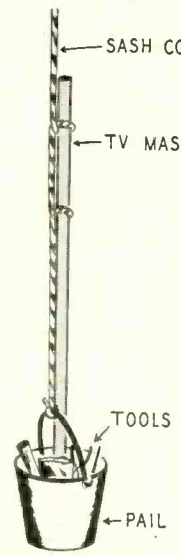
ing TV or FM antennas on a roof. In the bucket I keep two end wrenches, a hammer, oil can, sandpaper, a paper bag of assorted nuts and bolts, pliers, screwdriver, cutters and other tools I may need. Stick one end of the mast



in the bucket and throw a couple of half-hitches of line around the other end. Carry the line to the roof and haul away. See drawing. It's easy to hoist antennas in cartons this way too.

Always keep your tools in the bucket. It is easy to lose them if you lay them on a roof.—*Frank W. Dresser* END

CORRECTION

In his article "Transistor Demodulator Probe" in the September issue, Mr. Davidson inadvertently showed the 1N34 detector diode in a series type detector circuit that will not work because there is no d.c. return to the input side of the diode.

Correct this error by shunting the 1N34 directly across the 1,000-ohm resistor with its cathode terminal connected to the ground line.

We thank L. D. Oder, of New London, Conn., for spotting and reporting this error.

The photos in Figs. 5 and 6 of Middleton's article "Again—the Matrix" in the November issue were transposed. The captions are correct as printed. This obvious error was spotted by Ed Zreet, of KTBC-TV, Austin, Tex.

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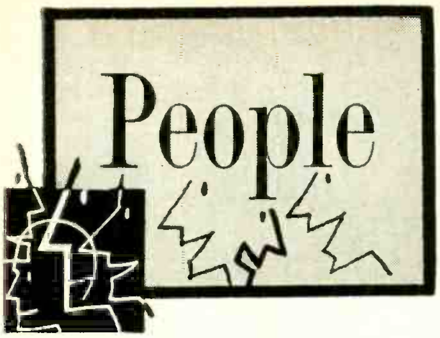
People



William J. Halligan, Sr., founder of Hallicrafters Co., Chicago, was reelected chairman of the board and elected president to succeed Raymond W. Durst, who withdrew from an active managerial position because of personal interests. Durst will continue as a member of the board of directors.

William J. Halligan, Jr. was elected vice president–sales. He has been manager of shortwave communications sales and a director. **Robert F. Halligan,** director of operations for the past two years, was also elected a vice president.

Clifford W. Perkins, chief comptroller of both Walter L. Schott Co. and Walsco Electronics Corp., Los Angeles, will assume additional duties as secretary–treasurer of the Walter L. Schott Co. and secretary of Walsco Electronics.

Irving I. Ser, assistant sales manager in charge of original equipment sales for Astron Corp., East Newark, N. J., was promoted to the position of company sales manager.

J. W. (Jack) Merritt was promoted to sales manager of the new Photofact Division of Howard W. Sams & Co., Indianapolis. He joined the company in 1948 and has since served in various sales capacities. Other appointments in line with the company's expansion plans include **W. W. (Bill) Hensler**, technical editor of the *PF Reporter*, to sales manager of the Book Division; **J. H. (Joe) Morin**, sales manager of the *PF Reporter*, sales manager of the new Magazine Division; **W. D. (Bill) Renner, Jr.**, one of the original 12 who started in the company's Engineering Department, to head the Educational Division; **Joseph O. (Joe) Goetz** of the sales staff in charge of the Customer Service Division; **A. E. (Archie) Cutshall**, production manager, advertising

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IT REPAIRS: Activates the CRT cathode by removing surface contamination • Restores emission giving life to weak and dim tubes • Clears inter-element shorts and leakage.

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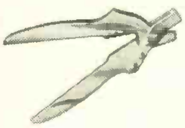
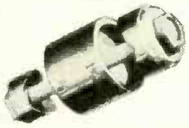

G-C 300-OHM LINE TOOL
Slot, strip, cut twin leads.
No. 9220


G-C DUAL SHEET METAL PUNCH
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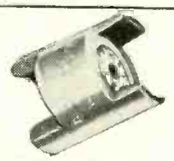
No. 9260


G-C DUAL TUBE PIN STRAIGHTENER
For both 7 and 9 pin tubes.
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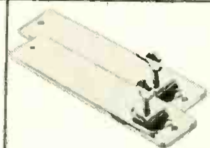
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Tilt chassis safely.
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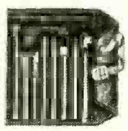
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Pressure spray silicone resin.
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Cleaner for radio, TV controls.
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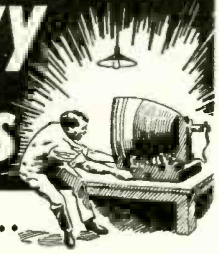

WHEN A FINGER TIP WILL DO THE JOB FOR YOU...

How many times have you had to lift and turn a big chassis in order to get the light correctly focused so that you could make a solder connection...or look for a broken lead? All this extra work can now be eliminated if you put a LUXO LAMP above your bench.

LIGHTWEIGHT AND PORTABLE...YET SO STURDY!

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manager. The photo shows, left to right: W. D. Renner, W. W. Hensler, A. E. Cutshall, Joseph O. Goetz, J. W. Merritt and J. H. Morin.

C. T. Gabriele

Charles T. Gabriele joined Tel-rex, Inc., Asbury Park, N. J., in the position of advertising and public relations manager. He came to the company from Thomas A. Edison, Inc.

A. Batcheller

Arthur Batcheller retired as engineer in charge of the Second Radio District of the Federal Communication Commission after 38 years of service. He joined the Department of Commerce Radio Division in 1917.

Obituary

Kenneth Kistler, traffic manager of Allen B. Du Mont Labs., Clifton, N. J., suddenly at his home in Fairlawn, N. J., at the age of 39.

Personnel Notes

. . . **Harold Metz** was appointed director of personnel and organization development for RCA. He had been director of personnel. **Arnold K. Weber**, director of organization development, was named director of manufacturing.

. . . **Thomas H. Moss**, active with the Turner Co., Cedar Rapids, Iowa, for a number of years, was appointed jobber sales manager according to an announcement by Renald P. Evans, president of the firm. **H. M. Murdock** continues as general sales manager.

. . . **Helen Staniland Quam**, distributor sales manager of Quam-Nichols Co., Chicago, resigned as treasurer of the Association of Electronic Parts & Equipment Manufacturers because of the pressure of company business. She retires from the post after 20 years' service.

. . . **Paul F. Leopold** was appointed sales manager of the Home Instrument Division of Crescent Industries, Chicago. He had been assistant sales manager.

. . . **Glenn Hall** was promoted to advertising manager of Clarostat Manufacturing Co., Dover, N. H. He was

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formerly a technical writer with the company and set up its replacement television program. **George H. Immen** joined the company as applications engineer. He has held various electronic engineering and sales positions during the past 25 years.

. . . **Irwin Goldman** was appointed manager of technical planning for the Research Laboratories of Sylvania Electric Products. Prior to this appointment he headed the technical services of Sylvania's Physics Laboratory. **Dr. Edwin G. Schneider**, former manager of Sylvania's Missile Systems Laboratory, was named chief engineer of the Electronic Systems Division.

. . . **Abe Kosakowsky** joined Pyramid Electric Co., North Bergen, N. J., as sales service engineer in the Jobber Division. He comes to the company from Steelman Radio & Phonograph Co.

. . . **Russell Jornd**, chief engineer in charge of tool processing for Littelfuse, Des Plaines, Ill., was promoted to director of engineering; **John Marquis**, chief electrical engineer, to chief engineer of circuit breaker and thermo devices; **Art Steele**, fuse engineer, to chief engineer in charge of fuses, and **Leon Uhl**, research engineer, to chief research engineer.

. . . **Peter Schnipper**, assistant quality-control supervisor of Triad Transformer Corp., Venice, Calif., was promoted to manager, quality control department.

. . . **Dause L. Bibby** joined Daystrom Inc., Elizabeth, N. J., as executive vice president. He had been vice president of International Business Machines.

. . . **Niles P. Gowell** was appointed chief engineer of the Raytheon Manufacturing Co.'s Receiving Tube Division, Waltham, Mass. He formerly headed its Quality Control and Applications Engineering Departments. **John M. Palmer** was appointed manager of manufacturing for the Receiving Tube Division. He has had more than 20 years experience in tube manufacturing and was most recently with Lansdale Tube Co.

. . . **Stanley F. Patten** was elected treasurer of Allen B. Du Mont Labs., Clifton, N. J., in addition to his duties as vice president and a director. He succeeds Paul Raibourn who continues as a director of the corporation. **Nicholas De Falco**, assistant general quality-control manager of Allen B. Du Mont Labs., was promoted to general quality control manager.

. . . **Thomas P. Walker**, vice president of Triad Transformer Corp., is to head the Los Angeles Council of the West Coast Electronic Manufacturers Association.

END

KIT KING

Lektron's SPRING DOLLAR SALE!

PLUS—ANY ITEM IN THIS AD *FREE* WITH EVERY $10 ORDER!

☐ **12 AC-DC LINE CORDS.** POSJ type, 2 cond. #18 stranded. Rubber jacket w/molded plug. Wt. 1 lb. Reg. $2.50 **$1**

☐ **5 ROLLS TAPE.** Guaranteed fresh. Cellophane wrapped. Friction, plastic, rubber. Wt. 1 lb. Reg. $2.50 **$1**

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☐ **100 STEATITE COIL FORMS.** Builders' special! Many sizes, styles. Some worth $2 ea. Plus 30 asstd. iron slugs FREE. Wt. 2 lbs. Reg. $15 **$1**

☐ **125 CARBON RESISTORS.** 30 values: 100 ohms to 1 meg. ⅓, ½, 1 & 2 w. Uninsulated. Wt. 1 lb. Reg. $21 **$1**

☐ **10 VOLUME CONTROLS.** Asstd. values for radio, TV, lab. 10 ohms to .5 meg. Wt. 2 lbs. Reg. $9.00 **$1**

☐ **13-PC TWIST DRILL KIT.** 1/16 thru ¼" to fit ¼" chuck. Fine tempered steel. Plastic case. Wt. 1 lb. Reg. $3.00 **$1**

☐ **G-E PRE-AMP KIT.** Chassis, condensers, resistors, wire, socket, schematic. Uses 6SC7 (comes less tube). Wt. 1 lb. Reg. $4.50 **$1**

☐ **150 RADIO PARTS!** Large asst. of coils, ceramics, paper, moulded & condensers, resistors. Wt. 1 lb. Reg. $30 **$1**

☐ **25 TUBE SOCKETS.** 4 to 14 pins, subminiatures, miniatures, loctal, octal. 15 types. Mica & ceramic, too! Wt. 1 lb. Reg. $9 **$1**

☐ **3 LBS. HOOKUP WIRE.** Repeating a sellout! Hundreds of pre-cut lengths in asstd. sizes, colors. Stranded, lengths up to 18" Reg. $9 **$1**

☐ **60 MICA CONDENSERS.** Postage stamp types. 25 values: .00001 to .01 mf. Many silver, 5%, too! Wt. ½ lb. Reg. $17 **$1**

☐ **20 POWER RESISTORS.** Wirewound, candohm & tubular. 20 values to 10,000 ohms; 5 to 50 w. Wt. 1 lb. Reg. $12.00 **$1**

☐ **60 CARBON RESISTORS,** insulated. 35 values: 15 ohms to 10 megs; ½, 1 & 2 w. Many 1 & 5% Wt. ½ lb. Reg. $18 **$1**

☐ **50 CERAMIC CONDENSERS.** Cartwheel, disc, button, standoff & tubular types. 25 values: 5 mmf to .01mf. Duals, too! Wt. ½ lb. Reg. $18 **$1**

☐ **8-PC POCKET TOOL CHEST.** 2 Phillips, 2 screwdrivers, chisel, awl, tacklifter, plastic handle. Wt. 1 lb. $3.50 value **$1**

☐ **10 ELECTROLYTICS.** FP & tubular. 8 to 1000 mf up to 450 V. Multiple sections, too. Some $2.50 each! Wt. 2 lbs. Reg. $18 **$1**

☐ **50 INDUCTORS.** Wide variety—slug-tuned: RF, ant., peaking coils; RF & xmtg. chokes. Shop must! Wt. 1 lb. Reg. $21 **$1**

☐ **50 KNOBS,** instrument, radio, TV & appliance types: knurled, skirted, push-on, pointer types. Some 50c ea. Wt. 1 lb. Reg. $12 **$1**

☐ **3 SELENIUM RECTIFIERS.** One each 24 VDC @ .5A; 12 VDC @ .25A; one meter or instrument type. Wt. 1 lb. Reg. $15 **$1**

☐ **60 TUBULAR CONDENSERS.** 30 different values: .00035 to 1 mf. to 1600 V. Oils & Mouldeds, too! Wt. 2 lbs. Reg. $10 **$1**

☐ **1000 PCS. SPAGHETTI.** Asstd. sizes, colors, insulation. Lengths to 4". Builders' note! Wt. ½ lb. Reg. $7 **$1**

☐ **8-PC NUTDRIVER KIT.** Plastic handle, 3/16, 7/32, ¼, 5/16, 11/32, ⅜, 7/16" steel socket wrenches in plastic case. Wt. ½ lb. $3.50 value **$1**

☐ **4 POPULAR DIODES.** Exclusive! One each: 1N21, 1N22, 1N23, 1N34A in poly bag. Reg. $11 **$1**

☐ **40 MOULDED CAPACITORS.** .001 to .25 mf to 1000 V. Asst. values, makers. Wt. 2 lbs. Reg. $14 **$1**

☐ **2000 PCS. HARDWARE.** Screws, washers, lugs, grommets, etc. Wt. 3 lbs. Reg. $11 **$1**

☐ **60 TERM. STRIPS, BOARDS.** Wide variety. 1 to 12 solder lug points, binding posts, too. Builder's must! Wt. 1 lb. Reg. $6.00 **$1**

☐ **TEN CHASSIS!** Scoop! 2 to 6 tube—for pre-amps, amplifiers, power supplies. Wt. 3 lbs. Reg. $9.00 **$1**

☐ **15 ROTARY SWITCHES.** Experimenters, note! Varied asst. single & dual gangs. Wt. 2 lbs. Reg. $17 **$1**

☐ **10 PANEL SWITCHES.** Asstd. micro, toggle, push; mobile types, too! Some worth $2. Wt. 1 lb. Reg. $12 **$1**

☐ **15 PRECISION RESISTORS.** Up to 100 megs. Asstd. values, mfrs. wattage. Some ½ % included! Wt. ½lb. Reg. $24 **$1**

THIS MONTH'S SPECIALS!

☐ FIVE IF TRANSFORMERS, 455 KCS. Reg. $1.10 each. **$1**
☐ FIVE FULL WAVE RECTIFIERS, 12 VDC @ 250 MA. Reg. 95c each **$1**
☐ 10 SLUG-TUNED COILS, 1000 MCS. Reg. 69c each **$1**
☐ SIX 100 MEG 5% PRECISION RESISTORS. Reg. $1.00 each **$1**
☐ 0-60 MINUTE TIMER, BELL ALARM. Reg. $5.00 each **$1**
☐ 5 XMTG. CHOKES, 250 MICROHENRIES Reg. $1.50 each **$1**
☐ 10 XMTG. CONDENSERS, .01-600, low loss type. Reg. $2.00 each **$1**
☐ 15 ERIE VARIABLES, 8-50 MMF. Reg. 89c each **$1**
☐ 2 DeJUR PRECISION POTS. 20,000 ohm, 6 watts. Reg. $5.00 each **$1**
☐ THREE 200 MA CHOKES, 2 Henries. Reg. $1.50 each **$1**
☐ TWO 4 MF, 600 V OIL CONDENSERS. Reg. $4.50 each **$1**
☐ 1 PR. 5" wire-cutting DIAGONAL PLIERS. Reg. $2.00 **$1**
☐ 3 VARIABLES, DUAL GANG, 3-15 mmf. Reg. $1.40 each **$1**

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HOW TO ORDER: Check items wanted. Return entire ad with check or MO. Incl. sufficient postage, excess returned. C.O.D. orders, 25% down. Rated, Net 30 days. RE-3

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16AP4A	44.75	19.99
16RP4	36.75	17.95
16WP4A	41.50	18.00
17BP4A	32.00	19.00
19AP4	39.75	23.00
20CP4	39.00	24.00
21ALP4A	46.00	24.00
21AUP4A	46.00	24.00
21EP4A	39.00	24.00
21FP4	39.75	24.00

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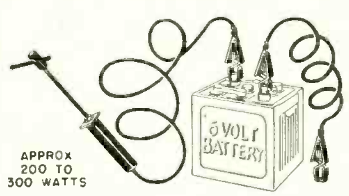
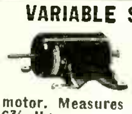
U.S. Army release. Brand New—Never Used. Fully Guaranteed. This soldering iron can be used to solder or weld when connected to any six-volt storage battery. Uses approximately 200 to 300 watts. The high intensity arc created between the metal to be soldered and the carbon electrode (carbons supplied free with iron) can be used to heat tin or aluminum solder. Suitable also for light brazing and spot welding. Arc can be used for melting metals, cutting holes and soldering seams in chassis. Also useful for analyzing metals and minerals.

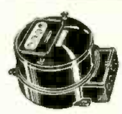
Battery soldering iron outfit includes 2 carbons, 3 heavy duty spring clips, 2 pieces 5 ft. heavy duty wire cable. (Battery not included.) Ideal for use where current is not available. Ship wt. 4 lbs.



APPROX 200 TO 300 WATTS

ITEM NO. 126
UNUSUAL BUY ....(P.P. & Hdlg. Chgs. 50c) **$1.95**

VARIABLE SPEED UNIVERSAL MOTOR

FOR 110 VOLTS, A.C. OR D.C. Used, but in excellent condition. Special lever control permits variable speeds up to 3000 r.p.m., 1/4" shaft extends from both sides of motor. Measures 7½ x 3¼" diam. overall Shp. Wt. 6¾ lbs.
ITEM NO. 127
Your Price.............. **$2.45**
PP. & Hdlg. Chgs. 75c

WATTHOUR METER

Leading makes — reconditioned. Ideal for trailer parks. 100-110 volts, 60 cycles, 2-wire A.C. 5 amp. Heavy metal case 8½" x 6¼" x 5". Easy to install. Ship. wt. 14 lbs.
(P.P. & Hdlg. Chgs. $1.25)
ITEM NO. 33 **$4.50**

AMAZING BLACK LIGHT
250-watt ultra-violet light source. Makes fluorescent articles glow in the dark. Fits any lamp socket. For experimenting, entertaining, unusual lighting effects.

Ship. wt. 2 lbs.
ITEM NO. 87 **$2.45**
(P.P. & Hdlg. Chgs. 35c)

BLAK-RAY SELF-FILTERING ULTRA-VIOLET LAMP

BLAK-RAY 4-watt lamp, model X-4, with U-V tube. Lamp has a wave-length of 3654 to 4000 angstrom units. Some of the substances made to fluoresce are certain woods, oils, minerals, milkstone, cloth, paints, plastics, yarn, drugs, crayons, etc. Self-filtering and harmless. Equipped with aluminum reflector. 110 volt 50-60 cycle A.C. 2000 to 3000 hours of service. Approved by Underwriters has a built-in transformer.
ITEM NO. 125 **$16.75**
(Shp. Chgs. 80c)

POWERFUL ALL PURPOSE MOTOR
Sturdy shaded pole A.C. induction motor. 15 watts, 3000 rpm. 3"x2"x1¾"; 4 mounting studs; 7/8" shaft, 3/16" diameter; 110-120 volts, 50-60 cycles. A.C. only.

ITEM NO. 147
UNUSUAL BUY **$2.45**
(P.P. & Hdlg. Chgs. 35c)

250 POWER TELESCOPE LENS KIT
Make your own high powered 6 ft. telescope! Kit contains 2" diam., 75" focal length, ground and polished objective lens and necessary eye pieces. Magnifies 50x to 250x. Full instructions.

ITEM NO. 123 **$2.95**
(Shp. Chgs. 10c)

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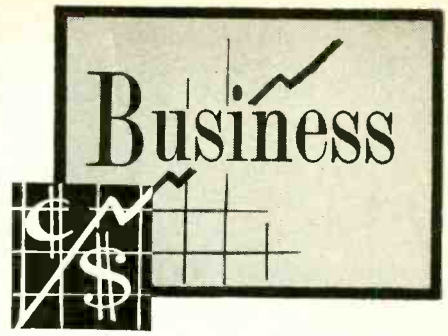
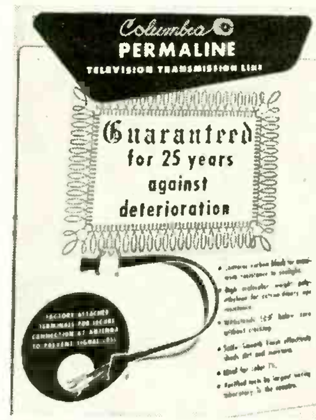


Merchandising and Promotion

CBS-Hytron, Danvers, Mass., launched an advertising and merchandising campaign to promote its *Silver Vision* TV picture tube. It will be advertised on the Garry Moore TV Show over the CBS network and in national magazines. The chief appeal will be made to women because a recent survey indicated to the company that it is the housewife who makes most of the calls for TV service.

Columbia Wire & Supply Co., Chicago, designed a display card which shows actual samples of its TV transmission line.



ORRadio Industries, Opelika, Ala., doubled its mid-winter advertising program for its *Irish Brand* recording tape during January and February. During the winter quarter 39 ads in 23 national publications are scheduled.

Weller Electric Corp., Easton, Pa., is promoting its soldering kit to high-fidelity fans with a specially designed display card. The photo shows Albert N. Kass of Radio Electric Service Co. of Penna., Philadelphia, displaying the kit.

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General Electric Tube Department, Schenectady, N. Y., developed a method

of visual tube inventory control by which the service technician can observe his tube requirements at a glance. The new *See-Lect-A-Tube* method features a dispenser unit which holds 250 tubes compactly.

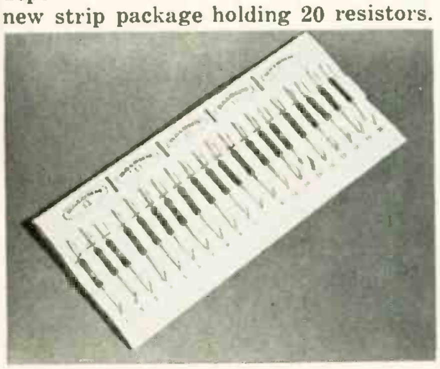
Tescon TV Products, Inc., Springfield

Gardens, N. Y., is now imprinting distributors' names on its antenna cartridge.

Kay-Townes Antenna Co., Rome, Ga., announced the winners of its $12,000 Golden Harvest contest for distributor managers, distributor salesmen and dealers: Mrs. Louise Teague (Teague Radio-TV Supply, Blytheville, Ark.),

first prize a 1956 Cadillac; Reg Holland (Yancey Co., Savannah, Ga.), top salesman prize of $3,500 Series E bond, George S. Spann (Spann Hardware Co., Dothan, Ala.), first dealer prize of a $1,000 Series E bond. Photo shows C. J. Harshbarger, Kay-Townes sales manager (extreme left) with the committee who drew the winners.

Dale Products, Inc., Columbus, Neb., is now packaging its *Dalohm type RS* miniature power resistors and *type DC* deposited-carbon resistors in a handy new strip package holding 20 resistors.



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FAULT—Picture compression and stretching.
CAUSE—Capacitance value of boost capacitor (connected to linearity coil) too low.

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CAUSE—Short in horizontal winding of Yoke.

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For over 10 years, RAM has specialized and pioneered in sweeps exclusively. RAM designs them, makes them, counsels TV set manufacturers on them, field-services them, educates Servicemen on them — leads the industry.

No one but RAM can bring you such proven data — as shown here and in the RAM Manual. In manufacturing know-how and field experience, you can depend on RAM for . . .

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Send coupon today — get the BEST information from the FOREMOST manufacturer now!

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Export Dept: Dage Corp., 219 E. 44 St., New York, N. Y.

House Current Anywhere

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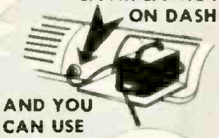
JUST PLUG INTO CIGAR LIGHTER ON DASH



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"101" USES—No need to leave appliances for work or pleasure behind. Take them along. Use them on business trips, camping, at the cabin, hunting, etc. Just plug Trav-Electric into cigar lighter on dash. Plug appliances into Trav-Electric. That is all!

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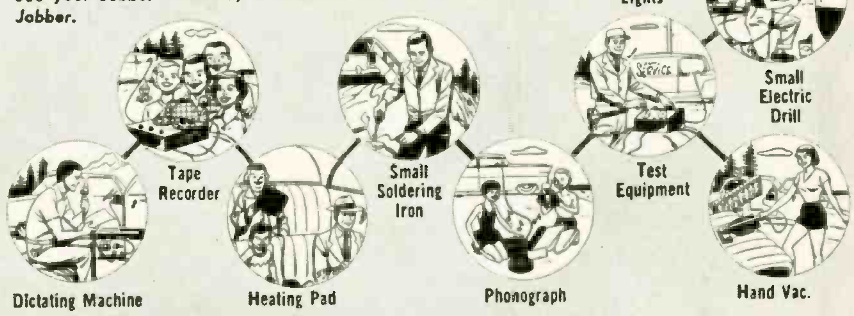
See your Jobber Salesman, or write for name of nearest Jobber.



TERADO COMPANY
Mfrs. of Electronic Equipment Since 1927
1057 Raymond Ave., St. Paul 14, Minn.

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Export Sales Division: Scheel International, Inc., 4237 N. Lincoln Ave., Chicago 18, Ill., U. S. A. —Cable Address—Harscheel

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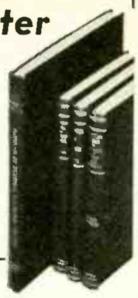

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Day by day industrial plants are adding more electronic devices—for sorting, counting, checking almost any control job you can name. Cash in on industry's great need for men who can keep these devices in top working order. Make more money, feel more secure, doing work that is second nature to you. With what you already know about electronics you have a long head start in a field just beginning to boom. GET INTO IT RIGHT NOW with the help of

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60 Franklin St., East Orange, N. J.

NOW IN STOCK at **R.P.D.** arthur nagel, inc.
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Chicago 15, Illinois

NEW **EICO** ® COLOR & MONOCHROME Laboratory & TV SERVICE 5-MC SCOPE
KIT $79.95
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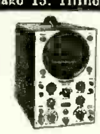

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Production and Sales

RETMA reported the production of 7,151,895 TV sets and 13,108,365 radios, for the first 11 months of 1955 compared with 6,513,292 TV sets and 9,138,955 radios for the 1954 period.

RETMA announced that 9,992,769 TV picture tubes worth $191,474,413 were sold by manufacturers during the first 11 months of 1955 compared with 8,904,106 tubes valued at $185,554,432 for the comparable 1954 period. The association also noted the factory sale of 441,753,000 receiving tubes for the first 11 months of 1955 compared to 347,180,000 for the same period in 1954.

New Plants and Expansions

Philco Corp., Philadelphia, acquired a new 100,000-square-foot plant in Spring City, Pa., which will be devoted exclusively to the production of transistors, diodes and other semiconductors.

Howard W. Sams & Co., Indianapolis, Ind., plans to add a new 18,000-square-foot wing to its plant which was completed 18 months ago.

C. P. Clare & Co., Chicago, opened a new production unit at Fairview, N. C.

American Electronics Inc. opened a marketing division in Los Angeles.

Mergers

Sarkes Tarzian acquired the entire facilities of the Silicon Corp. of America. It will move the company's production facilities to Bloomington, Ind. Silicon Corp. will be operated as part of the Rectifier Division. Key personnel of Silicon Corp. have transferred to the new division in Bloomington.

Cannon Electric Co., Los Angeles, purchased the facilities, assets and inventory of the **Diamond Manufacturing Co.** of Wakefield, Mass. which will now operate as the Diamond Division of Cannon Electric. The transaction did not include plant building or liabilities.

Tricraft Products Co., Chicago antenna manufacturer, has been acquired by Frank J. Klancnik, president of **Hi-Lo TV Antenna Corp.** also of Chicago. The companies will be operated as separate corporations.

Penn-Texas Corp. has purchased the business and all the assets of **Hallicrafters Corp.,** Chicago, which it will operate as a subsidiary under present management.

Business Briefs

. . . **General Electric** Tube Department's general manager, J. M. Lang, stated that Americans would spend $300 million to replace picture tubes in 6,000,000 TV sets in 1956 and would replace more than 150,000,000 smaller vacuum tubes during the year. He noted that the average picture-tube life is about four years.

. . . **Channel Master Corp.,** Ellenville, N. Y., and **JFD Manufacturing Co.,** Brooklyn, N. Y., have settled their differences and agreed to license each other under their patents. END

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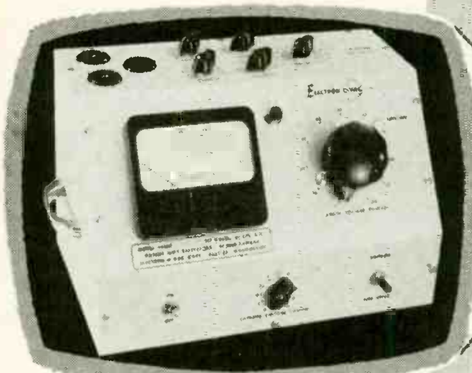
WITH ELECTRON-O-VAC

This is an entirely new method of renewing cathode ray and receiving type tubes for television, radio and other electronic circuits . . . the only known instrument on the market that will reactivate BOTH TV picture tubes and receiving type radio and TV tubes.



Distributors' Inquiries Invited

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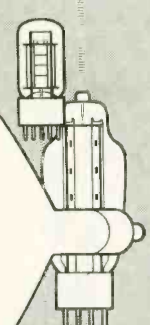

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- Major TV Manufacturer
- Police Mobile Communications
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- Industrial Users

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TRANSISTOR RADIO KIT

List $8.95 Earphone $1.00 w/order.

WORKS LIKE MAGIC . . . indoors, outdoors, anywhere! So small, fits in your palm, pocket or purse. Economical too . . . works for months on 10c batteries. Features genuine Germanium Transistor, Germanium Diode, Slide Rule Dial for precision tuning, world famous Loopstick antenna for sensational reception. Comes pre-punched, complete with instructions . . . only a screwdriver is needed for quick, easy assembly.

THIS IS A "HOT" ITEM and supply may be limited . . . so get your order in today!

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World's most sensitive, compact radio antenna. Replaces inefficient loops . . . pulls in stations strong and clear. DON'T ACCEPT IMITATIONS! Ask for VARI-LOOPSTICK by name.

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for QUIET CONTROLS QUIET CONTACTS

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NEW Superex FILTA-COUPLER®

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SUPEREX COMBINES 2 NECESSARY ITEMS for homes with two TV sets. 2-set coupler eliminates second antenna . . . built-in High-pass filter insures perfect reception. Don't accept ordinary couplers . . . insist on double—action FILTA-COUPLER.

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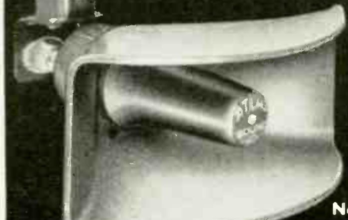

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Designed for wide angle coverage, paging, high efficiency intercom, sensitive talk-back. Tops in articulation. Convenient omni-directional mounting bracket. In appearance, they're "beauts".

SPECIFICATIONS	CJ-30	CJ-14
Input pwr (cont.)	15 w	5 w
Input imp.	4 or 8 Ω	4, 8 or 45 Ω
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Dispersion	120° x 60°	120° x 60°
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- Also available chrome plated!
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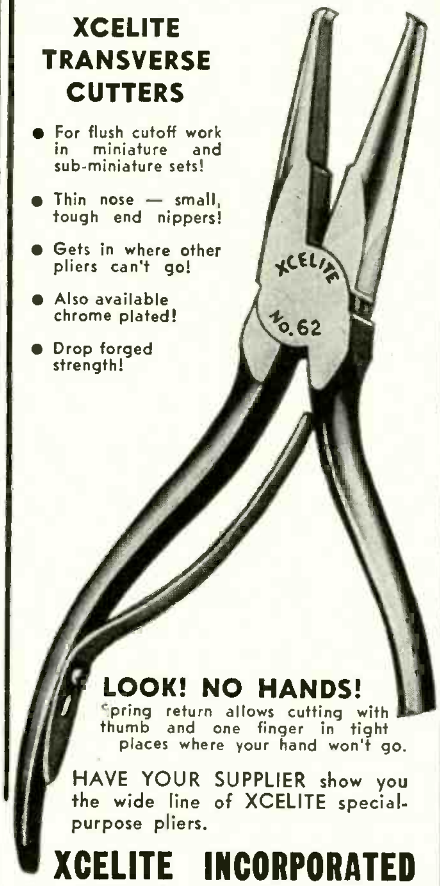

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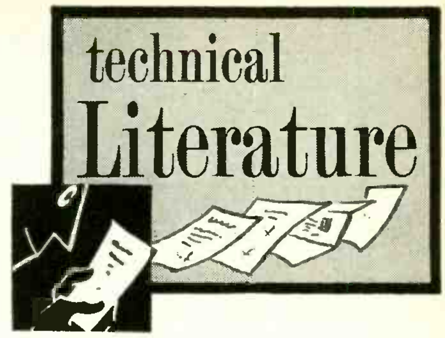

1956 CATALOG

Allied's new 1956 *Catalog No. 150* lists over 26,000 items in 324 pages. Data on high-fidelity components, including 34 complete hi-fi systems; television chassis, boosters, rotators and u.h.f. converters; table model and portable phonographs; professional and home recording equipment; PA amplifiers and complete systems; amateur receivers, transmitters and other gear; industrial v.h.f. radio and radiotelephone equipment are contained in 128 pages.

Other listings cover a wide selection of kits and supplies, books, manuals, diagrams, tools and hardware, plus additional radio, television and industrial electronics items.

Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears.
UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

TUBE DATA SERVICE

An automatic roll-chart and tube-data service is being made available to all owners of Precision tube testers. The new service is intended to keep owners abreast of the newest tube releases and free them from the necessity of writing the company when they require testing data on new tubes. The service will include a minimum of two new roll charts plus other test data mailings annually.

Full-year subscription, $2. Precision Apparatus Co., Attention Tube Test Data Dept., 70-31 84 St. Glendale 27, N. Y.

DEPOSITED "CARBON PRECISTORS"

Bulletin B-4a contains 4 pages of comprehensive data on tests, applications, specifications, tolerance, ranges, performance and dimensions on deposited carbon Precistors. Charts and graphs are also included.

International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

TV PICTURE TUBES

Sylvania's 24-page booklet *Characteristics of Sylvania Television Picture Tubes* lists picture and other cathode-ray tubes including those of all domestic manufacturers as well as several foreign types. Tubes are divided into two groups—those with magnetic deflection and those with electrostatic.

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Signal out: 10V
115 Volts. 50-60 cycles.
5 watts.

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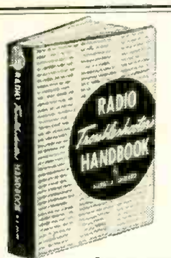

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Here's the data you need to fix old sets FAST—good as new

Just look up the how-to-do-it data on that old radio you want to fix!

Four times out of 5, this giant, 3½-pound, 744-page Ghirardi RADIO TROUBLESHOOTER'S HANDBOOK gives exactly the information you need to fix it in a jiffy. Tells what is likely to be causing the trouble . . . shows how to fix it. No useless testing. No wasted time. Handbook covers common troubles and their remedies in practically every radio receiver model made by 202 manufacturers between 1925 and 1942. Using it, even beginners can easily fix old sets which might otherwise be thrown away because service information is lacking. With simple repairs, most of these old sets can be made to operate perfectly for years to come.

THE ONLY GUIDE OF ITS KIND!

Cuts service time in half!

Included are common trouble symptoms and their remedies for over 4,800 models of old home, auto radios and record changers. Airline, Apex, Arvin, Atwater Kent, Belmont, Bosch, Brunswick, Clarion, Crosley, Emerson, Fada, G-E, Kolster, Majestic, Motorola, Philco, Pilot, RCA, Silvertone, Sparton, Stromberg and dozens more. Gives how-to-do-it data on SPECIFIC jobs—NOT general theory. Includes hundreds of pages of tube and component data, service short cuts, etc., no longer available from any other source still in print.

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Within these groups the tubes are listed numerically and alphabetically. The important electrical and screen characteristics and mechanical dimensions are shown for each tube. The characteristics and typical uses of standard phosphors are presented in table form.

Sylvania Central Advertising Distribution Dept., 1100 Main St., Buffalo 9, N. Y.

SPEAKERS AND HORNS

Bulletin B-1 describes *model 375* compression driver type loudspeaker. *Bulletin B-2* describes the *model 537-500* horn and lens assembly featuring the *Koustical* lens. *Model 537-508* horn and lens assembly is detailed in *Bulletin B-3* and *model 537-512* in *Bulletin B-4*.

James B. Lansing Sound, Inc., 2439 Fletcher Dr., Los Angeles 39, Calif.

CONNECTORS

Deutsch's AN connector chart contains a section on how to select the right AN connector, which includes number of contacts, contact size, voltage rating, creepage distance and spacing information. It tells how to specify the complete connector assembly covering special insert insulation materials and shell finishes. It also contains shell dimensions, availability check list and shell data and code of contact sizes of AN connectors.

Available to interested parties from Deutsch Co., 7000 Avalon Blvd., Los Angeles, Calif.; Attention R. H. Cummins.

1956 CATALOG

EICO's 1956 catalog describes 54 models of professional electronic test instruments in both kit and factory-wired form. Features, applications and specifications for each model, including kit and factory-wired prices, are given in the 12-page catalog. It includes such units as oscilloscopes, vtvm's, multimeters, signal and sweep generators, tube testers, signal tracers, resistance and capacitance boxes, accessory probes and hi-fi amplifiers.

EICO, 84 Withers St., Brooklyn 11, N. Y.

SELENIUM RECTIFIERS

Specifications and replacement requirements for all radio and TV sets using selenium rectifiers are listed in a pocket-sized 28-page selenium rectifier replacement guide *Bulletin 213*. It contains a cross-reference of Radio Receptor rectifiers and competitive types.

Dept. E., Semiconductor Div., Radio Receptor Co., Inc., 251 W. 19 St., New York 11, N. Y.

HEATHKITS

The *Heathkits for 1956 Catalog* contains specifications, features, descriptive material as well as illustrations and schematics of test equipment, high-fidelity amplifiers and preamplifiers, amateur gear and speaker-system kits. The new Heath analog computer kit is also described.

Heath Co., Benton Harbor, Mich. END

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"TABTRON" HI CURRENT PWR SUPPLY

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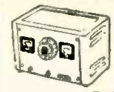

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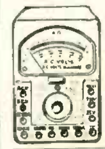

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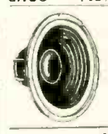

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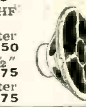

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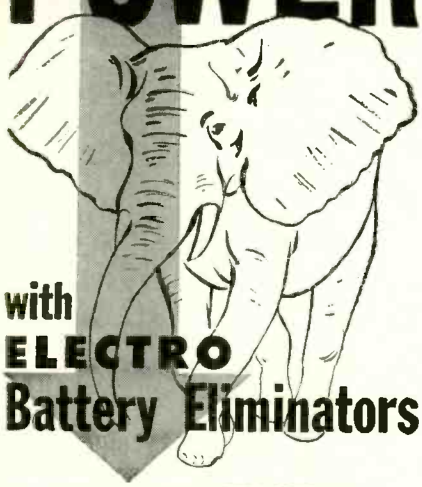

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Books

PRINCIPLES OF COMMUNICATION SYSTEMS, by W. D. Hershberger. Prentice-Hall, Inc., New York, N. Y. 5½ x 8 inches, 253 pages. $6.65

This book describes *systems* rather than actual equipment. It emphasizes the capacity to transmit, store and receive information, as well as limiting factors. Many interesting subjects not usually encountered in radio texts are found here. Math is at undergrad level.

Special attention is given to the binary number system, noise and its measurement, modulation (and demodulation), characteristics of radio waves. A chapter on Fourier series and the Fourier integral shows effective methods for studying the square-wave and other basic signals. The author discusses af, radar and TV systems, showing how certain factors control the rate at which information flows.

The human factor is not ignored. Music and articulation tests and their results are given in Chapter 8.—*IQ*

MODERN OSCILLOSCOPES AND THEIR USES, by Jacob H. Ruiter, Jr. (revised edition). Rinehart & Co., Inc., 232 Madison Ave., New York 16, N. Y. 5¾ x 9 inches, 346 pages. $6.50

Going far beyond the usual book on this subject, this covers not only alignment and testing of radio-TV receivers (and in great detail) but shows how to make a host of other electronic measurements as well. The treatment is clear at all times. Step-by-step procedures are accompanied by diagrams and scope patterns.

From early Crookes and Braun beginnings, the book moves rapidly to our modern-day tube. First a general background is provided on deflection, acceleration, focus, attenuation, timebase generation, etc. Then the author goes into greater detail, discussing each circuit and control separately.

The heaviest chapters are those devoted to alignment and servicing of AM, FM and TV receivers and transmitters. The step-by-step treatment throughout is such that even a beginner cannot get lost.

Aside from radio-TV, the author shows other applications for the scope. They include time measurement, null indication, potentiometer test for noise, frequency runs on amplifiers. Everywhere we find scope patterns of actual measurements and diagrams.

The uses of a scope in teaching (circuit demonstrations) occupies an entire chapter. The same holds for various methods for photographing from a scope screen.—*IQ*

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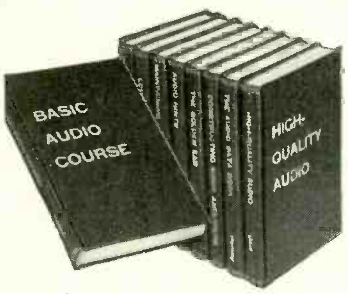

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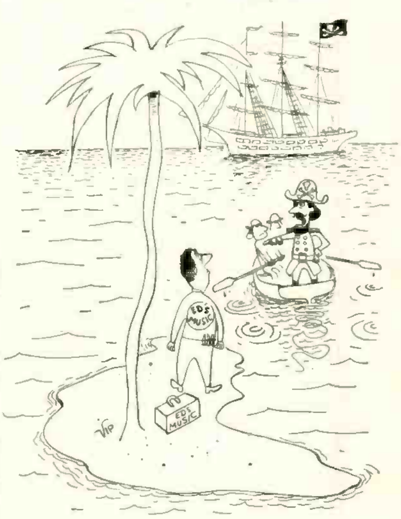

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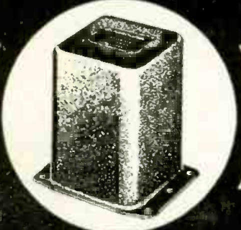

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THE FABULOUS PHONOGRAPH, by Roland Gelatt. J. B. Lippincott Co., 521 Fifth Ave., New York, N. Y. 5½ x 8½ inches, 320 pages. $4.95.

The author's musical background causes him to record the phonograph's development in terms of the records it played and the artists who could be persuaded to perform for it. We are led through the period of scratchy zinc discs to the engraved wax disc, the shellac record and so to ffrr and modern microgrooves.

The historical value of the book is weakened by a lofty disregard of the cylinder phonograph. The first decade of the century is represented as a struggle between the Victor Talking Machine Co. and Columbia, though (to this reviewer's memory at least) the Edison phonograph held an important if not dominant position through most of that period, and even Columbia made cylinder records till 1912.

The treatment of Edison, in fact, verges on open hostility. He is virtually accused of forgery in the first chapter and the same feeling continues to page 250, where he is described as "deserting his invention after years of bumbling mismanagement." Yet the author's passion for facts compels him to refer—often almost in asides—to Edison's introduction of the diamond stylus, microgroove cylinders and improved surface materials, resulting in "a standard of sound reproduction far above the general level achieved by pre-World War I recording techniques."

There is a meticulous and enthusiastic history of the Victor, and an excellent account of the near-eclipse of the phonograph during the rising years of radio. Among the other interesting points brought out, most striking is that the two most important advances in phonography came from outside the entertainment record industry. Bell Labs developed the electrical transcription process in 1924 (inventing the orthophonic horn as a byproduct) and full-frequency range recording was developed by the British Decca Co. under the sponsorship of the British Admiralty as a means of distinguishing between the sounds of British and German submarines.—*FS*

ELECTRONICS, by Thomas Benjamin Brown. John Wiley & Sons, Inc., New York, N. Y. 6 x 9 inches, 545 pages. $7.50.

This practical text on tubes and tube circuits is the result of many years of study and teaching. Special attention is given to graphical analysis.

Vacuum tubes are covered in the first part of the book, gas types following. Lab and demonstration experiments are given to accompany the text so that the reader may prove the theory and equations and become more familiar with the principles.

The many diagrams show circuits for measuring tube constants, various amplifiers, oscillators, modulators, etc. so that the reader can set up the proper equipment for the experiments. END

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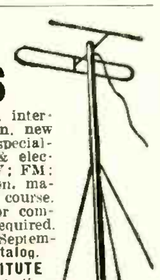

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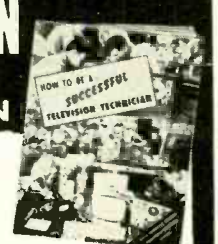

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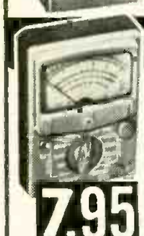

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