RADIO-ELECTRONIC ENGINEERING EDITION

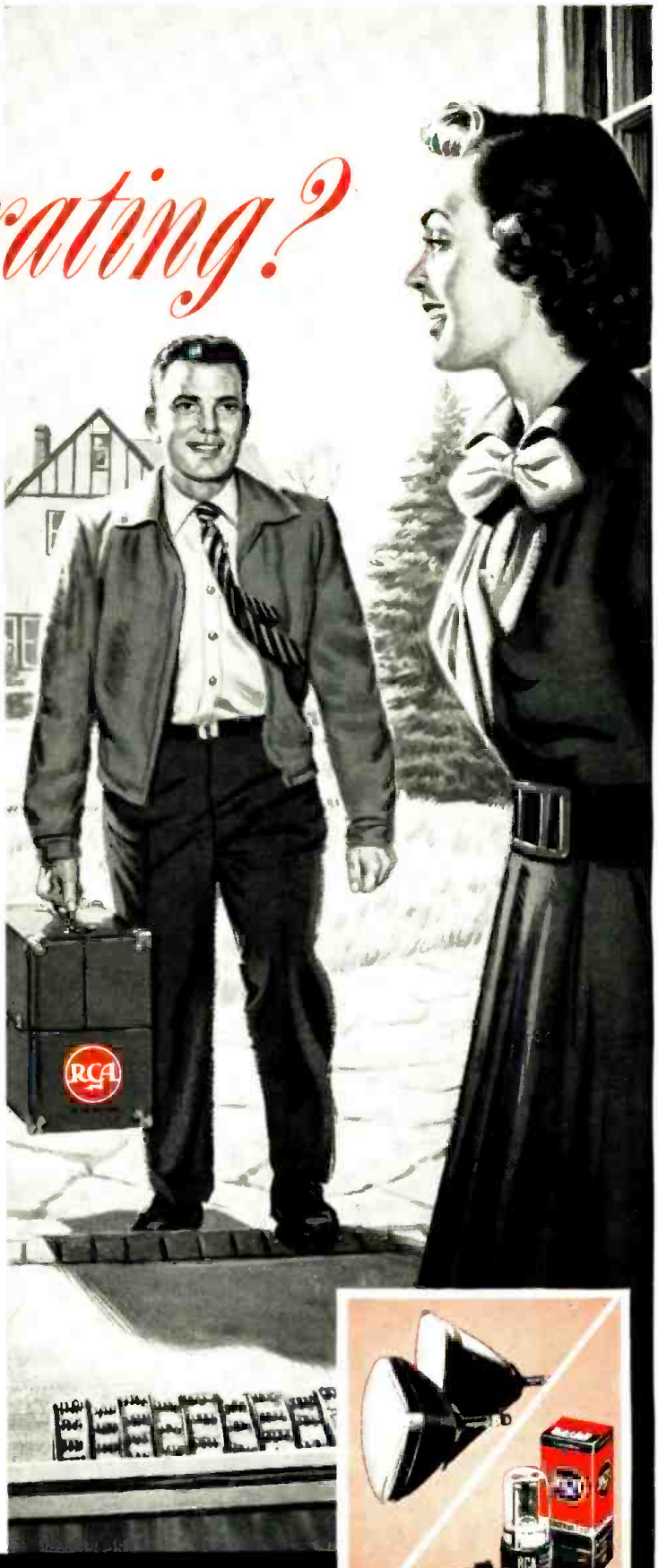
RADIO & TELEVISION NEWS

JUNE
1953

IN THIS ISSUE

How's your

"welcome" rating?



YOU can measure *your* "welcome rating" on the basis of how many times you have to visit a customer to satisfactorily complete one service call. The *less frequently* you are called back, the *more* your good services are appreciated. Fewer call-backs cut overhead . . . build confidence . . . leave you *more* time for *more* satisfied customers. Cutting call-backs is the most effective way of snowballing your profits.

The RCA trade-mark makes your call doubly effective. First, because customers have confidence in products bearing the RCA trade-mark. Second, because experience has proven that the superior quality of RCA Receiving Tubes and Kinescopes is your best measure of protection against costly call-backs due to premature tube failures. You can be sure that, with RCA Tubes, the job is well done.

Helping you to safeguard your reputation is a vital, everyday service of RCA Tubes. And that protection is yours at no extra cost.

Unlock the door to bigger profits

Here's *your* key to better business . . . RCA's dynamic Dealer Identification Program. Ask your **RCA Tube Distributor** for your copy of the colorful, 16-page booklet "A Magic Pass-Key to Customer Confidence." It tells you how—for the first time—you can become a Registered Dealer . . . and get *extra* sales benefits.

RCA

RADIO CORPORATION of AMERICA

ELECTRON TUBES — HARRISON, N. J.

NEW

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YOU BUILD THIS TRANSMITTER

with parts I send. With this Transmitter you practice how to put a station "on the air." You perform procedures demanded of Broadcast Station Operators, conduct many experiments, make many practical tests.

LEARN COMMUNICATIONS by PRACTICING at Home in Spare Time

J. E. SMITH, President
National Radio Institute
Washington, D. C.

For 38 years, the leader in training men for Radio-Television.

YOU BUILD this Transmitter Power Supply used in the basic experiments in RF and AF amplifiers, frequency multipliers, buffers, etc.

YOU MEASURE current, voltage (AC, DC and RF), resistance and impedance in circuits with Electronic Multitester you build. Shows how basic transmitter circuits behave; needed to maintain station operation.

Get Practical Experience on Circuits Common to Radio & TV

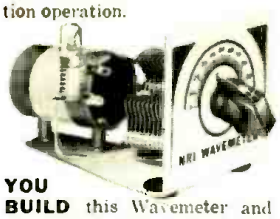
Ever think HOW FAST Radio-Television Communications is changing, developing, growing? Have you considered what this amazing progress can mean to you?

Even without Television the industry is bigger than ever before. 105 million home and auto radios, 2900 Radio Broadcasting Stations, 108 TV Stations with 1800 more now authorized. Expanding use of Aviation and Police Radio, Micro-Wave Relay, Two-Way Radio for buses, taxis, etc. makes opportunities for Communications Technicians and FCC Licensed Operators. New jobs, more jobs for beginners! Better jobs, better pay for experienced men!

MY COURSE INCLUDES TELEVISION

want. If you've had some training in Radio or Radar, or as a Licensed Operator, my course modernizes, increases the value of your knowledge.

YOU PRACTICE setting up code, amplitude and frequency modulation circuits (put voice, music, etc., on "carrier signals" you produce). You learn how to get best performance.



YOU BUILD this Wavemeter and use it to determine frequency of operation, make other tests on transmitter currents.

Television Is Today's Good Job Maker

In 1952, over 18,000,000 homes had TV sets. More are being sold every day. The "Freeze" on building new TV stations has been lifted. The time to act is NOW! Start learning Radio-TV communications. America's fast growing industry offers good pay, a bright future, security. If you are a beginner, my course can help you get FCC License, prepare for the job you

Includes New Developments

Mail coupon now for facts about my practical course in Radio-Television Communications. Let me send you my FREE book. See the nine big Kits of Parts I send that "bring to life" theory you learn. You get practical experience by working on circuits common to both Radio and Television: also lessons on TV principles. Read about the Transmitter you build and operate, about the Electronic Multitester you get. All equipment is yours to keep.

My graduates are filling jobs, making good money in both Radio and Television. Remember, the way to a successful career in Television is through experience in Radio.

Servicing Training Also Offered by N. R. I.

If you prefer a good-pay job in Radio-Television Servicing . . . or your own money-making Radio-Television Sales and Service Shop, I'll train you at home. My famous Servicing Course also includes many Kits of Radio Parts. You use them to get PRACTICAL EXPERIENCE with circuits common to Radio and Television. I also show you how to make $5, $10 a week or more EXTRA MONEY fixing neighbors' Radios while training. Full information in my 64-page book. . . . Mail coupon.

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Send today! See what my Communications course is like. Find out how I get you ready for a brighter future, better earnings, more security in Radio-Television. Send coupon now in envelope or paste on postal. NO OBLIGATION, NO SALESMAN WILL CALL! My book, sent to you FREE, tells the full story. J. E. SMITH, President, Dept. 3 CE, National Radio Institute, Washington 9, D. C. Our 39th year.

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Chief Operator
Power Monitor
Recording Operator
Remote Control Operator

SHIP AND HARBOR RADIO
Chief Operator
Assistant Operator
Radiotelephone Operator

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Operator in Army, Navy, Marine Corps, Coast Guard
Forestry Service DisPatcher
Airways Radio Operator

POLICE RADIO
Transmitter Operator
Service Technician

AVIATION RADIO
Plane Radio Operator
AirPort Transmitter Operator

TELEVISION
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Voice Transmitter Operator
TV Technician
Remote Control Operator

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National Radio Institute, Washington 9, D. C.

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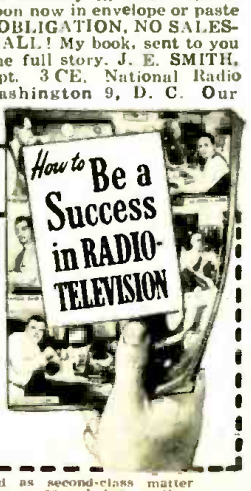
VETS write in date of discharge .....



I TRAINED THESE MEN

"My position with WNBT is video control engineer on the RCA color project. I owe a lot of my success to your textbooks."—Warren Deem, Malverne, N. Y.

"I am a technician at WTOP in Washington and I like it very much. Most of my radio knowledge was from N.R.I."—John Britto, Hyattsville, Md.

AVAILABLE TO VETERANS UNDER G.I. BILLS

"A former employer recommended N.R.I. training. Now employed as transmitter operator at WKBO."—Albert Herr, New Cumberland, Pa.

RADIO & TELEVISION NEWS is published monthly by the Ziff-Davis Publishing Company at 64 E. Lake St., Chicago 1, Ill. Entered as second-class matter July 21, 1948, at the Post Office, Chicago, Ill., under the act of March 3, 1879. Authorized by Post Office Department, Ottawa, Canada, as second-class matter.
SUBSCRIPTION RATES: Radio & Television News—one year, U. S. and Possessions, Pan-American countries, and Canada $4.00; all other foreign countries $5.00. Radio-Electronic Engineering Edition—one year, U. S. and Possessions, Pan-American countries, and Canada $6.00; all other foreign countries, $7.00.
Postmaster—Please return undelivered copies under form 3589 to 64 E. Lake St., Chicago 1, Ill.

COVER PHOTO: Ken Boord, RADIO & TELEVISION NEWS' Short-Wave Editor, logs another station at his Listening Post in Morgantown, W. Va. (Ektachrome by David Creel)

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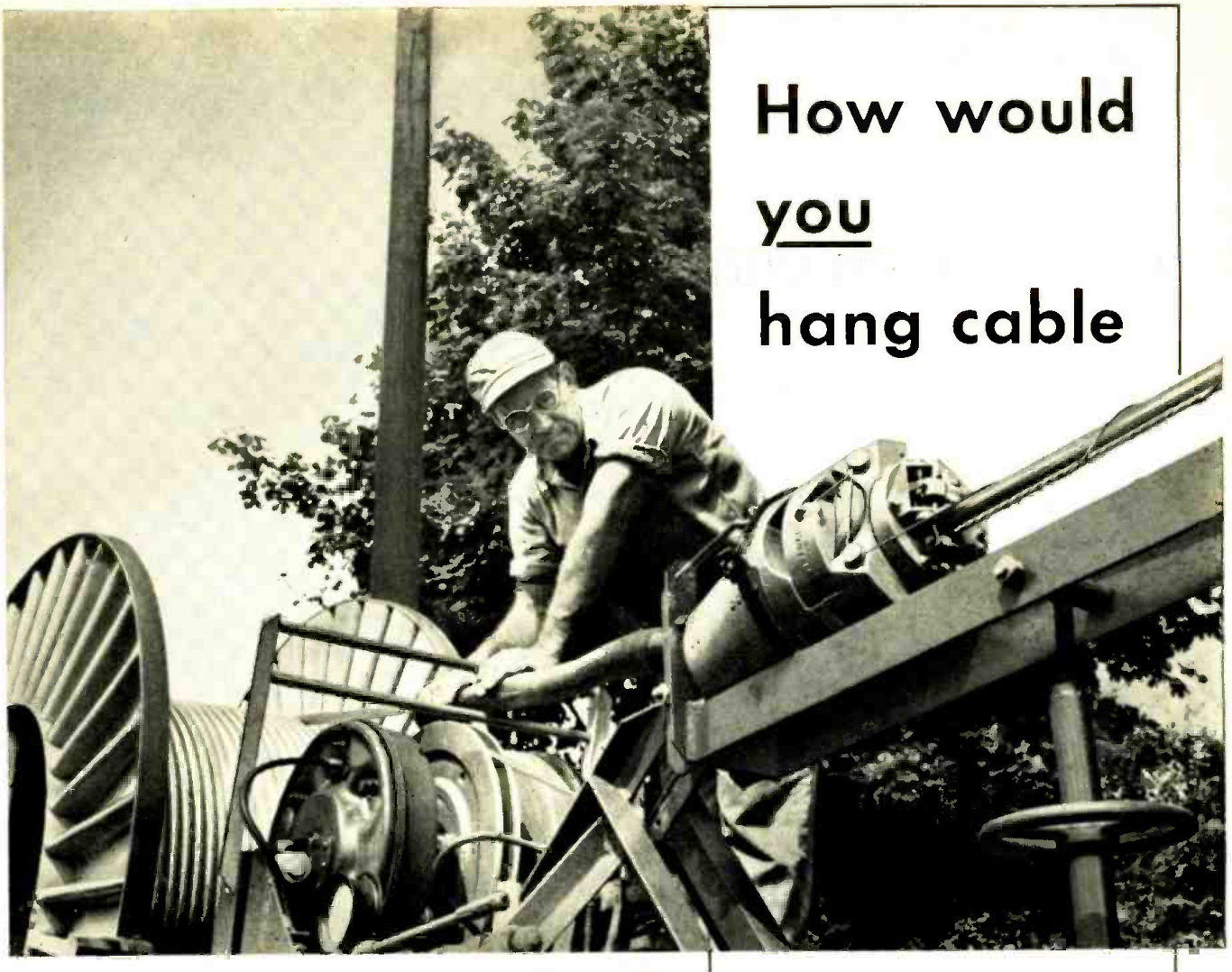
DEPARTMENTS

VOLUME 49 • NUMBER 6

SUBSCRIPTION SERVICE: All communications concerning subscriptions should be addressed to Circulation Dept., 64 E. Lake St., Chicago 1, Ill. Subscribers should allow at least two weeks for change of address.



How would you hang cable ...by the mile?

Cable lasher appears to right of workman. As the cable and supporting strand feed through, the machine rotates, binding them together with steel lashing wire. Meanwhile, a winch hauls the lashed cable into position.

It is a job your telephone company faces every day. Thousands of miles of cable go up each year—all secured to steel strand running from pole to pole. The best way to secure cable is to *lash* it to the strand with a spiral binding of wire.

One way to do this is to raise cable and strand separately, then lash them together by a rotating machine pulled along by workmen on the ground. This produces a strong, tight support for the cable. But each pole has to be climbed as many as four times. So Bell Laboratories engineers devised an easier way.

Now, lashing can be done *on the ground* so that cable, strand and lashing wire may be pulled into position as a complete assembly. Usually workmen need make only two trips up each pole.

For telephone users, the new way means that cable can be installed faster, while costs are kept down. It shows again how work at Bell Telephone Laboratories improves each part of your telephone system.

Bell Telephone Laboratories

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ALWAYS TOPS WITH A hallicrafters

You'll have the best QRK 100 watts can give with Hallicrafters HT20 transmitter—and you'll *listen* to more and hear it better on a Hallicrafters receiver. You be the judge—you hear the difference!

It's value like this—and more of it dollar-for-dollar in every price class—that has made Hallicrafters equipment the unchallenged first choice of the world's most critical expert, the American amateur radio operator, for 19 years.

Hallicrafters equipment is designed specifically for the ham operator—planned to meet his problems—planned to fit his pocketbook. The measure of Hallicrafters success is in the reputation this group of experts extends to this equipment. You can *hear* the answer every night of the year on the air—just listen!

Top Selectivity—Low Price! Model S76—Dual Conversion Super with 50 kc amplifier for tops in selectivity. 500 C.P.S. at 6 db down—3.5 kc at 60 db down. Giant 4-in. "S" meter. 540-1580 kc. 1.72-32 Mc in 4 bands. 1 r-f, 2 conversion, 2 i-f stages. 5 pos. selectivity. Phono input jack. 3 watt output. **$179.50**

A Ham's Dream! Model SX71—Com. Rcvr. especially designed for top ham performance. Double conversion, built-in NBFM limiter stage. 538 kc to 35 Mc, 46-56 Mc in 5 bands. Temp. Comp., voltage reg. 1 r-f, 2 conversion, 3 i-f stages. Xtal. filter, 4-pos. selectivity, 18½" x 8⅞" x 12" deep. Ship. wt. 51 lbs. 115V, A.C. 11 tubes, reg., rect. **$224.50**

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TVI Suppressed 100 Watter—Model HT20—Here's the transmitter you've been waiting for! Continuous coverage from 1.7 Mc to 30 Mc. Full band switching, no more plug-in coils; choice of 10 crystals. Shielded, filtered r-f compartment plus low-pass 52 ohm co-axial line output filter assures at least 90 db suppression of all harmonics above 40 Mc. Only **$449.50**

* QRK—International "Q" Signal for—"What is my readability?"

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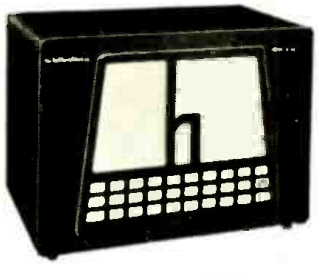

Matched Speaker, Model R46—The perfect speaker for SW. Includes transformer of 500/600-ohm input. Voice coil impedance 3.2 ohms. 10" cone. Black finish. 15" x 10⅞" x 10⅞" deep. Only **$19.95**

For the RECORD

BY THE EDITOR

ELECTRONICS AND RELIABILITY

WE HAVE all heard a great deal in recent years about the importance of "reliability" in electronic equipment. All too often, though, this factor is minimized in new equipment design and engineering with the major emphasis being placed on immediate performance. This has resulted in unreliable equipment being placed in service.

There are many different degrees of reliability to be considered. For example, there is seldom any danger to life and limb when the television set ceases to operate, or when a p.a. system quits. But when the navigation equipment on an intercontinental bomber fails, it can result in the loss of the plane and many lives. In the first case, the problem is an economic one—we must build in as much reliability as the customer is willing to pay for. In the second case, we must approach 100% reliability as closely as possible, regardless of cost. It is interesting to note that a flight of 30 large bombers on a 15-hour mission involves about 1 *million* tube-hours of operation!

There are several possible approaches to the problem of "reliabilizing" electronic equipment. Any final design should incorporate all of these approaches, as well as any others which are available.

Simplifying equipment will, in general, make it more reliable because of the fewer number of components, fewer soldered joints, and the greater dependence on "tried and true" techniques. Many times a piece of equipment is designed to do things which may be convenient but not necessary. The added complexity tends to decrease reliability, requiring further protective equipment, or units to take over in case of failure. This results in greater complexity, calling for still more protective equipment, and so on. Every function of the equipment must be considered carefully, and if not necessary, such a function should be eliminated. Extra frills and reliability are not compatible.

Improving the reliability of individual components is also a fertile approach. Great strides have been made in this direction in recent years. Hermetic seals, improved insulation, new dielectric materials—all have been used to increase the life expectancy of coils, condensers, resistors, transformers, and other components. Ruggedizing has been applied to vacuum tubes with highly satisfactory results. However, the practice of over-rating components still exists. Thus, a 600 volt condenser is used where a 200 volt unit should do the job and a 2 watt resistor is specified when the actual dissipation never exceeds ¼ watt. Components are designed to give optimum life when operated at or near their ratings and such over-rating is not necessary. In this connection, it should be noted that many failures in electronic equipment have been traced directly to misuse of components.

The use of "failure prediction" tests or "marginal checking" has increased rapidly in recent years. Such tests can be used to predict the imminent failure of a tube or other component so it can be replaced before failure actually occurs. This method has been used to increase the reliability of complex equipment (such as electronic computers) by a large factor.

Transistors can be used very advantageously in "reliabilizing" equipment. Previous limitations of temperature, frequency response, uniformity, and power handling capacity are rapidly being overcome. One manufacturer has demonstrated a transistor operating satisfactorily at the temperature of boiling water; another has developed a tetrode junction transistor which will oscillate above 250 mc.; another has developed techniques for air-cooling transistors so that dissipations of one watt or more are permissible; several manufacturers are mass-producing transistors with satisfactory uniformity.

Improved reliability does not depend solely on the increased life and ruggedness of the transistor itself. Less power is required, resulting in less heat dissipation and lower operating temperatures. Because of the low power requirements, the equipment can be operated on batteries, placing less dependence on external sources of power, plugs, and connectors. Lower voltages can be used, with less strain on insulation and other components such as condensers, resistors, etc.

Too much emphasis cannot be placed on this concept of reliability, particularly with respect to military and industrial electronic equipment. Many people outside our field (and inside, too!) feel that electronic equipment is essentially fragile and unreliable and should be used only as a last resort. Overcoming this basic philosophy will require a great deal of intensive engineering on the reliability problem. When electronic equipment has attained the reliability now achieved with mechanical equipment, we can truly say that our industry has reached maturity . . . . O.R.

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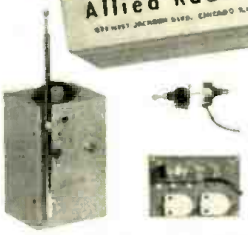
83-730. *Only* **$18.75**
Battery Kit **$3.64**



PHILMORE RADIO CONTROL KIT

Build your own remote-control transmitter and receiver. Operates model airplanes, boats, autos, etc. Crystal-controlled transmitter for 27.255 mc (requires easily obtained FCC operating permit). High-gain super-regenerative receiver. Easy to build. Complete with all parts, telescoping antenna, crystal and cabinet (less batteries). 4½ lbs.

83-034. *Only* **$41.47**
Complete Set of Batteries **$7.15**

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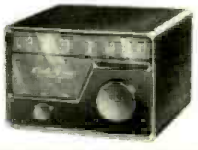
Famous Standard Coil printed circuit TV booster at less than half original price. Provides uniform gain on all 12 VHF channels. Easy to tune; use with indoor antenna in primary areas, with outdoor antenna in near-fringe areas. Improves reception markedly. For 110-120 v., 60 cy. AC. Shpg. wt., 4 lbs.

97-233. While they last, *Only* **$9.95**



ELECTRO-VOICE UNF CONVERTER

New! Micrometer tuning for smooth, continuous reception of all UHF channels. Just connect to antenna input of any VHF TV set and plug in. Operates with all-channel antenna or separate VHF and UHF types. Single-knob, easy control. Uses VHF channels 5 or 6 as IF. 300 ohms input and output imp. Complete with tubes. For 110-120 v., 60 cy. AC. 5 lbs.

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Ultra-compact 60 cycle converter for changing 6 volts DC to 110 volts AC. Capacity: 30 watts continuous, 40-45 watts intermittent. Simply plugs into auto cigarette lighter. Permits mobile use of broadcast and SW radios, recorders, dictating machines, fluorescent lamps, etc. Fully filtered. Only 2½x2½x3½". 3¼ lbs.

80-272. *Only* **$10.63**

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Easy to install under any TV console—permits quick and easy rolling to any desired location. Rolls smoothly in any direction. Steel frame is adjustable to 30" wide, 27" deep to fit practically any console. No tools required for installation. Shpg. wt., 11½ lbs.

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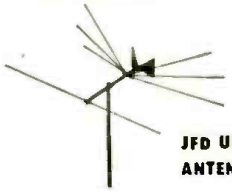
6K-718. *Only* **$35.75**
80-652. *Battery Kit* **$4.36**



JFD UHF-VHF ANTENNA

Wonderfully efficient; uses conical element and reflector for VHF and "bow-tie" for UHF. Equipped with printed circuit antenna coupler for excellent signal transfer into single transmission line. Easy to install. (Less mast and 300-ohm twin line.) Shpg. wt., 6 lbs.

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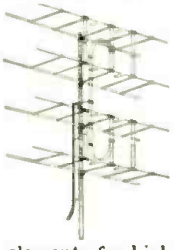

FINNEY 400 A UNF-VNF ANTENNA

New! Double collateral UHF-VHF antenna featuring 32 driven elements for high gain and directivity, with superior signal-to-noise ratio. Superb for fringe-area reception—good for VHF up to 150 miles or more. Rugged; corrosion-proof; pre-assembled, lightweight. Requires 10-ft. mast and 300-ohm twinline. 14 lbs.

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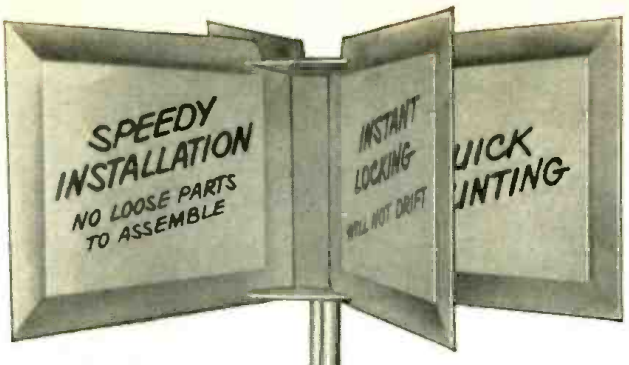

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NOW... customers in YOUR STORE... will SEE and USE this ANIMATED and ILLUMINATED display to see for themselves the fast selling CDR ROTOR! Colorful... it's a silent salesman that does the job on its own! Be the first in your area with this new device... and SELL EVEN MORE CDR ROTORS... faster! After all... it's easy when the display demonstrates the greatest rotor value on the market today!

TR-12 Rotor... complete rotor unit including thrust bearing, handsome modern design plastic cabinet with meter control dial, uses 4 wire cable

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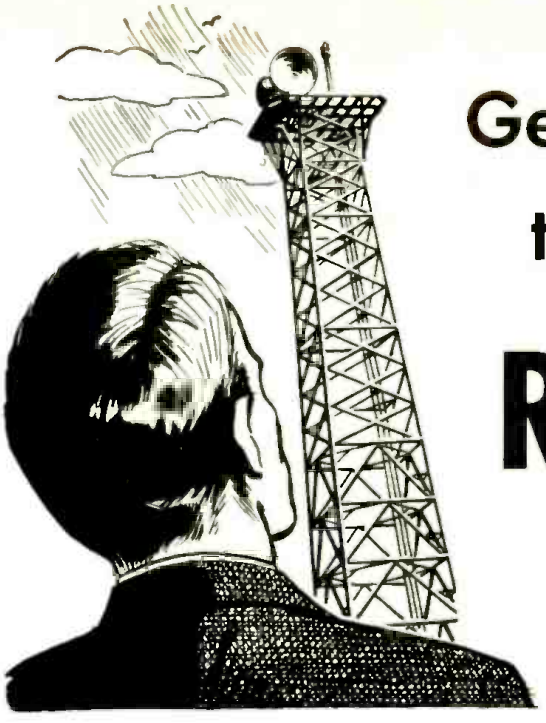

Get yourself on the beam to the BIG MONEY in

RADIO AND TV

THAT's the way to become an expert Radio or Television service man. Study the bedrock theories and principles. These are vitally important. Nothing can take their place—not even the most elaborate kits.

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I.C.S. offers you two new courses in radio and television servicing—one for beginners, the other for experienced amateurs.

The beginner's course, Radio and Television Servicing with Training Equipment, is extremely thorough. You get extra texts featuring experiments and job assignments. You get equipment second to none. Matched parts for an excellent 5-tube superheterodyne receiver. Your own professional-quality multitester. A complete single generator kit. High-grade servicemen's tools. "Rider's Perpetual Trouble-Shooter's Manual." The principles of Television including the most-up-to-date developments (VHF and Color TV, for example).

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- ☐ Diesel—Gas Engines

AVIATION
- ☐ Aeronautical Engineering Jr.
- ☐ Aircraft Engine Mechanic
- ☐ Airplane Drafting

BUILDING
- ☐ Architecture
- ☐ Arch. Drafting
- ☐ Building Contractor
- ☐ Estimating
- ☐ Carpenter and Mill Work
- ☐ Carpenter Foreman
- ☐ Reading Blueprints
- ☐ House Planning
- ☐ Plumbing
- ☐ Heating
- ☐ Steam Fitting
- ☐ Air Conditioning
- ☐ Electrician

BUSINESS
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- ☐ Certified Public Accountant
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- ☐ Advertising
- ☐ Retail Business Management
- ☐ Managing Small Business
- ☐ Sales Management
- ☐ Salesmanship
- ☐ Traffic Management

CHEMISTRY
- ☐ Chemical Engineering
- ☐ Chemistry
- ☐ Analytical Chemistry
- ☐ Petroleum—Nat'l Gas
- ☐ Pulp and Paper Making
- ☐ Plastics

CIVIL, STRUCTURAL ENGINEERING
- ☐ Civil Engineering
- ☐ Structural Engineering
- ☐ Surveying and Mapping
- ☐ Structural Drafting
- ☐ Highway Engineering
- ☐ Reading Blueprints
- ☐ Concrete Construction
- ☐ Sanitary Engineering

DRAFTING
- ☐ Aircraft Drafting
- ☐ Architectural Drafting
- ☐ Electrical Drafting
- ☐ Mechanical Drafting
- ☐ Structural Drafting
- ☐ Sheet Metal Drafting
- ☐ Mine Surveying and Drafting

ELECTRICAL
- ☐ Electrical Engineering
- ☐ Electrician
- ☐ Electrical Maintenance
- ☐ Electrical Drafting
- ☐ Electric Power and Light
- ☐ Lineman

HIGH SCHOOL
- ☐ High School Subjects
- ☐ College Preparatory
- ☐ Mathematics
- ☐ Commercial
- ☐ Good English

MECHANICAL AND SHOP
- ☐ Mechanical Engineering
- ☐ Industrial Engineering
- ☐ Industrial Supervision
- ☐ Foremanship
- ☐ Mechanical Drafting
- ☐ Machine Design-Drafting
- ☐ Machine Shop Practice
- ☐ Tool Design
- ☐ Industrial Instrumentation
- ☐ Machine Shop Inspection
- ☐ Reading Blueprints
- ☐ Toolmaking
- ☐ Gas—Electric Welding
- ☐ Heat Treatment—Metallurgy
- ☐ Sheet Metal Work
- ☐ Sheet Metal Pattern Drafting
- ☐ Refrigeration

POWER
- ☐ Combustion Engineering
- ☐ Diesel—Electric
- ☐ Electric Light and Power
- ☐ Stationary Steam Engineering
- ☐ Stationary Fireman

RADIO, TELEVISION, COMMUNICATIONS
- ☐ General Radio
- ☐ Radio Operation
- ☐ Radio Servicing—FM
- ☐ Television
- ☐ Electronics
- ☐ Telephone Work

RAILROAD
- ☐ Locomotive Engineer
- ☐ Diesel Locomotive
- ☐ Air Brakes ☐ Car Inspector
- ☐ Railroad Administration

TEXTILE
- ☐ Textile Engineering
- ☐ Cotton Manufacture
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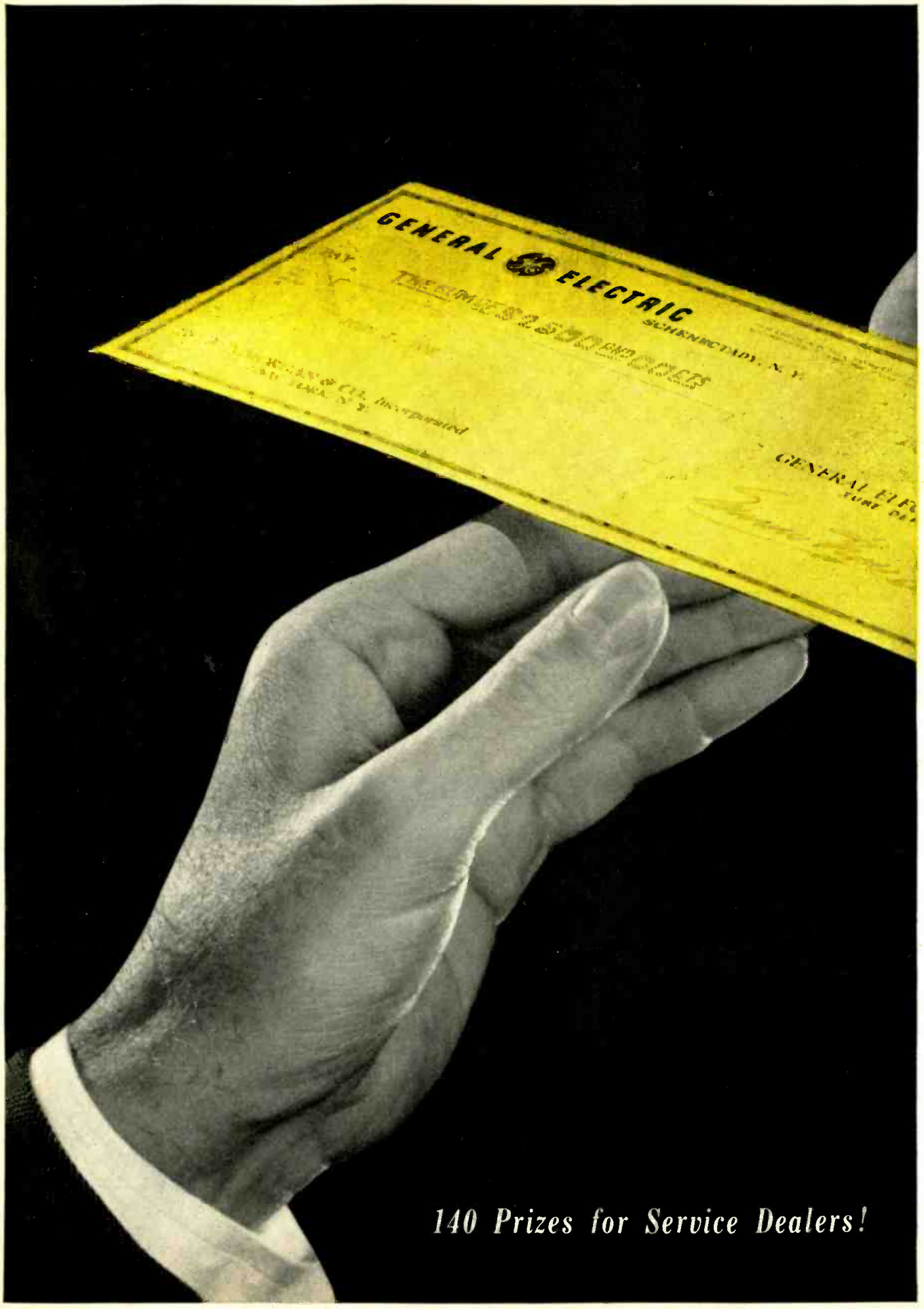

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GENERAL ELECTRIC

Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

COLOR TV, the perennial problem child of industry and Congress, too, whose committees have investigated and re-investigated its "delayed" full-scale debut, found itself on Washington's hottest griddle a few weeks ago, when members of the House opened a sizzling inquiry into the exact reasons for the prolonged hibernation of the reds, greens, and blues.

Three factors were cited as the cause for the latest outburst and hunt for information: A color TV test report, issued during the summer of '52, disclosing that superior performance was now available on an industry-approved compatible scheme; the contradictory M-90 ruling of NPA declaring that defense commitments made it necessary to halt any production of disc-type chassis (no quantity production was under way in any plant at the time); and particularly a letter from Senator Edwin C. Johnson to Senator Charles W. Tobey, stating that "powerful interests" were deliberately delaying widespread use of colorcasting. Noting that . . . "it is a little less than three years ago since the Federal Communications Commission, the arm of Congress mandated to act in the public interest, adopted the standards for color television, and stated that it was here and that it should be made available to the public," the Senator asked why, in view of this official verdict, there still was no color TV. And he followed this query with four more direct questions: "Is this delay in manufacturing color receivers deliberate? Are the standards adopted by the Commission unsound? If so, in what manner? Have new standards been developed? If so, why are they not submitted to the FCC?"

It had been assumed that an immediate reply, in the form of a full-scaled inquiry, would be staged by a Senate committee. Instead, the House Interstate Commerce Committee, chairmaned by Rep. Charles A. Wolverton, raced onto the scene and declared that it would hold a public hearing on color TV to determine the basis for the repeated delays. Supported by Congressmen Carl Inshaw and James I. Dolliver, Rep. Wolverton began his session shortly after the Johnson letter appeared. Five of the industry's leading lights on colorcasting were summoned to Washington for a grueling "Q and A": Dr. E. W. Engstrom, *RCA* lab headman; *CBS* Prexy Frank Stanton; picture tube pioneer, Dr. Allen B. Du Mont; *Chromatic Lab* President Richard Hodgson; and *G-E*'s electronics division general manager, Dr. W. R. G. Baker, who is also chairman of the NTSC.

Appearing as the first witness, Dr. Engstrom testified that his company believed that compatible color TV was here and the Commission could legally approve such a system now. He pointed out that the FCC and its staff have been kept continually advised of the extensive research and development work which has been done on the system, not only by his company but by members of the NTSC. It would be wise, he felt, to authorize commercial broadcasts of not only compatible color signals now, but reinstate incompatible colorcasting too, so that the public could evaluate the two techniques.

Declaring that *RCA* had invested substantial sums in the establishment of a pilot operation for tri-color tube production in Lancaster, Dr. Engstrom noted that this manufacturing unit will have a production capacity of 2000 color tubes per month, and can serve as the prototype for other units in the establishment of factory facilities for large-scale, high-speed production.

Two color transmitting studios were said to be available for programming. One is located at *NBC* headquarters in Radio City and another in a theater which has been completely converted for color work.

Debonair Frank Stanton followed Engstrom and frankly admitted that *CBS* would support any color television system which works well, is practical, and has a reasonable cost. Such support would be forthcoming, even if the system were developed by a competitor. But, he added: "I cannot tell . . . whether we shall support the NTSC system . . . simply because we do not know enough about it, and hence we must reserve judgment."

And then, in a statement which rocked industry, he declared that . . . "reluctantly but realistically," *CBS* had no plans under present circumstances to broadcast or manufacture under the approved field-sequential system. Many factors were said to be responsible for this decision, particu-

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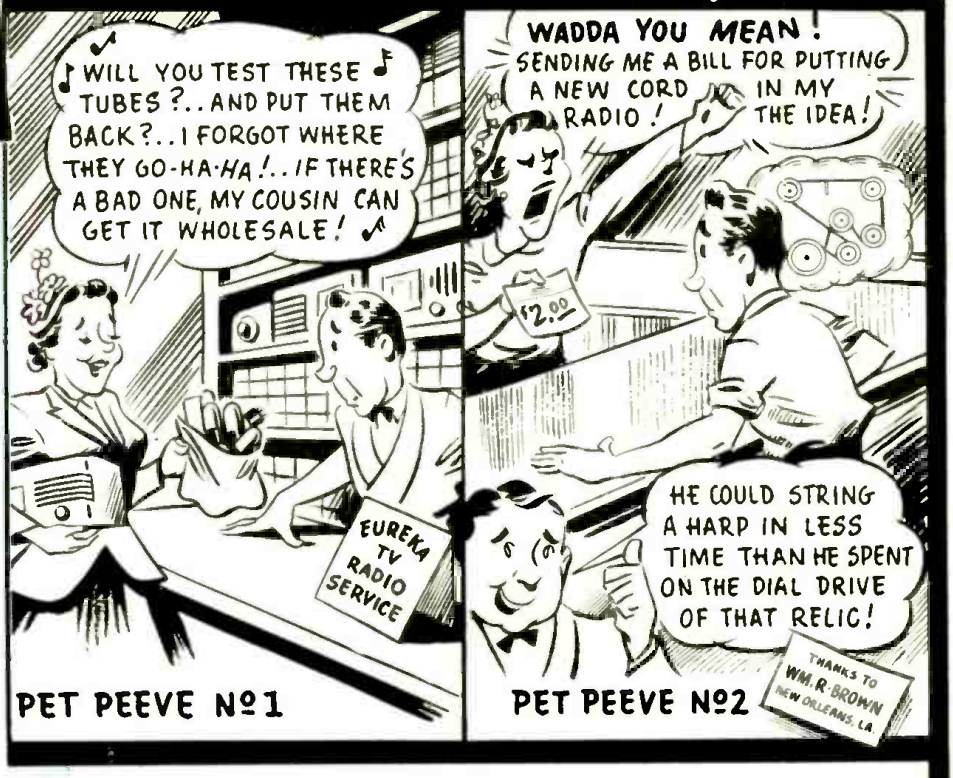

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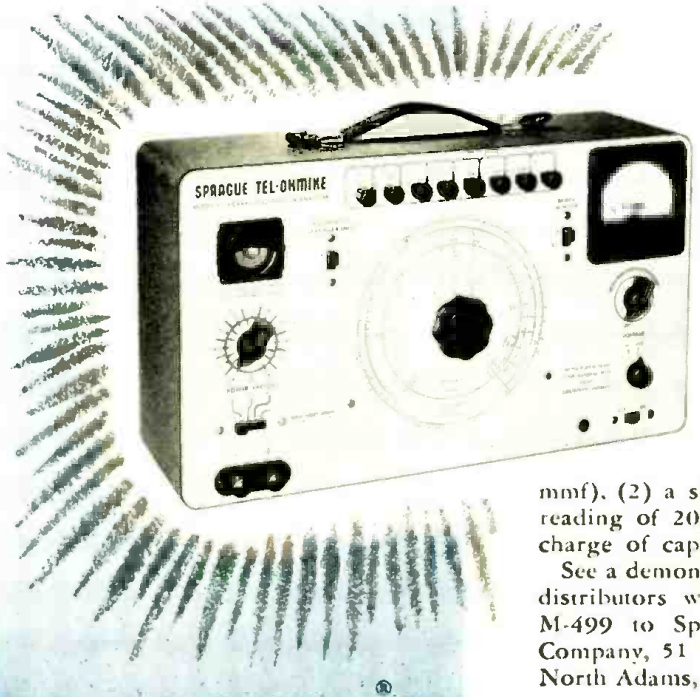

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larly the lack of industry support. "I think we would be tilting at windmills to undertake now . . . to try to pick up again where we were forced to leave off in October, 1951," he added.

His company had thought, Stanton went on, that the FCC decision would bring ". . . an end to the conflicting claims (as the FCC black and white decision had done in '41) and to the public's confusion and bewilderment which resulted from such claims. We had thought, and we had hoped, that our broadcasting and manufacturing efforts which cost us enormous energies and millions of dollars would supply enough impetus and competitive incentive for other broadcasters and other manufacturers to begin to follow our lead."

But the sequential system has been "completely becalmed" for the last year and a half, Stanton said, and black and white sets have increased to almost 23,000,000.

"I cannot minimize the problems which this creates," the *CBS* prexy continued. "I do not think that the problem of incompatibility is necessarily fatal. But I do think that the problem . . . has grown to such proportions that in combination with other factors, it becomes quixotic and economically foolish for us singlehandedly at this time to resume a large-scale broadcasting and manufacturing program."

The imminence of a compatible system was stressed as a key factor in arriving at such a decision. Explaining this situation, Stanton declared: "I think it would be wholly unrealistic for us to expect that no matter how vigorously or exhaustively we engaged in broadcasting or manufacturing under the field-sequential system, any other manufacturer would make sets under that system, or any substantial number of the public would buy such sets even if made, so long as there is the expectation that a new compatible system will momentarily be perfected and will be brought before the FCC."

To sprinkle the occasion with more confusion, NPA then announced that at long last it had decided to revoke its M-90 rule, making it possible for set makers to produce sets designed to receive sequential signals, that no one was broadcasting. Commenting on the revocation, Acting NPA Administrator H. B. McCoy pointed out that since June '52, manufacturers have been allowed to produce color TV sets under certain conditions, but no applications for such permission had been received.

"M-90 was invoked originally in November '51 to conserve both materials and engineering manpower for the nation's defense effort," McCoy declared. "With the easing of the materials situation in mid-'52, we amended the order to permit the manufacture of color TV sets by companies whose defense contracts were on schedule or by companies having no defense contracts who could show such

(*Continued on page* 143)

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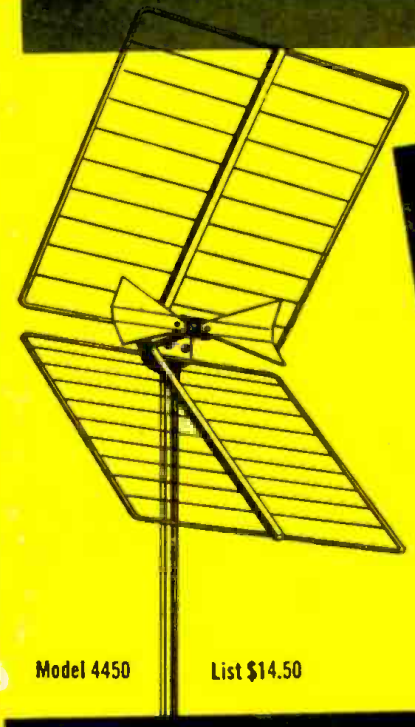

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ANTENNA D	YES	NO	YES

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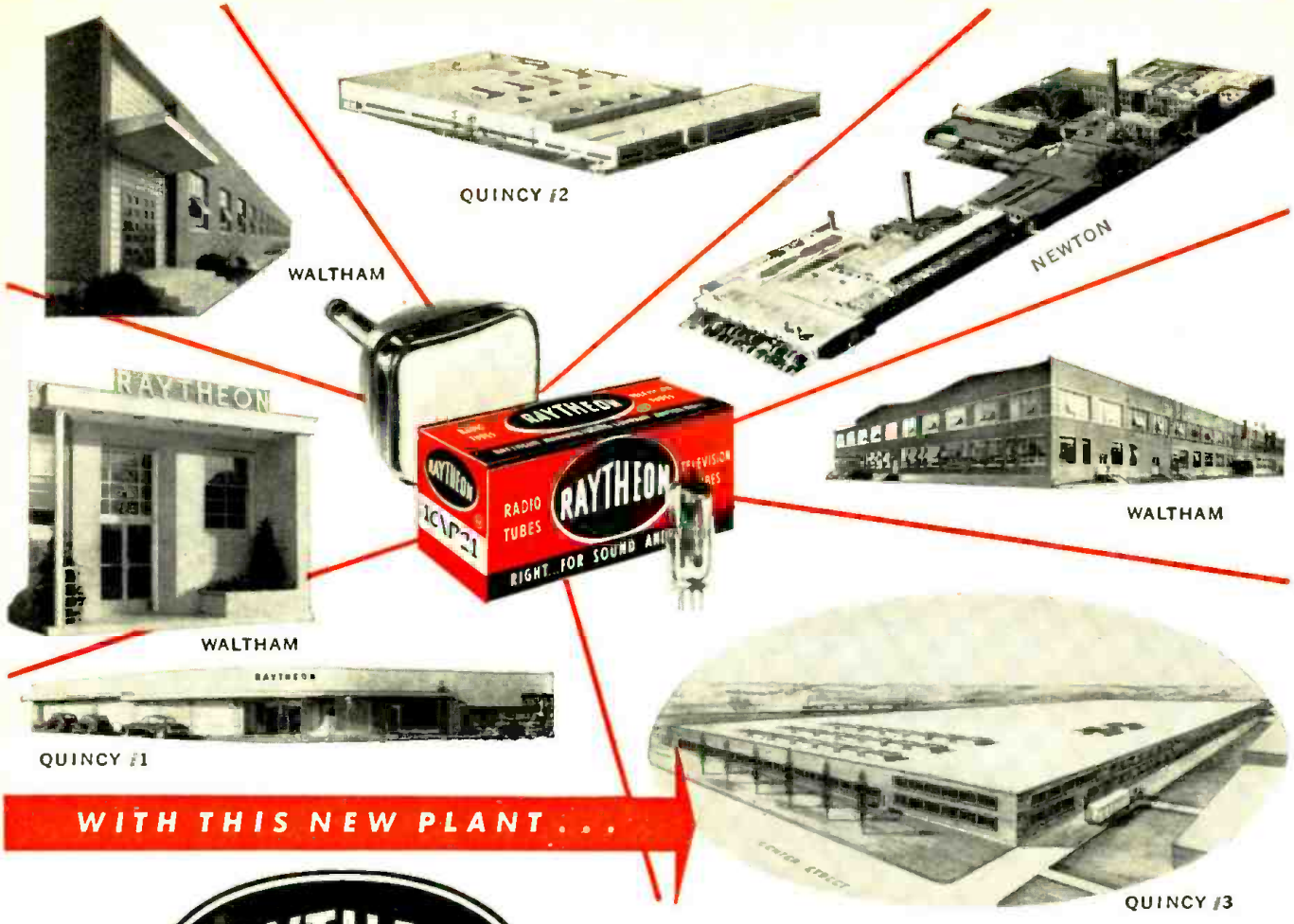

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RADIO-ELECTRONIC Engineering SECTION

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RADIO & TELEVISION NEWS

TELEVISION • RADAR • ELECTRONICS • RESEARCH • COMMUNICATIONS • MICROWAVES

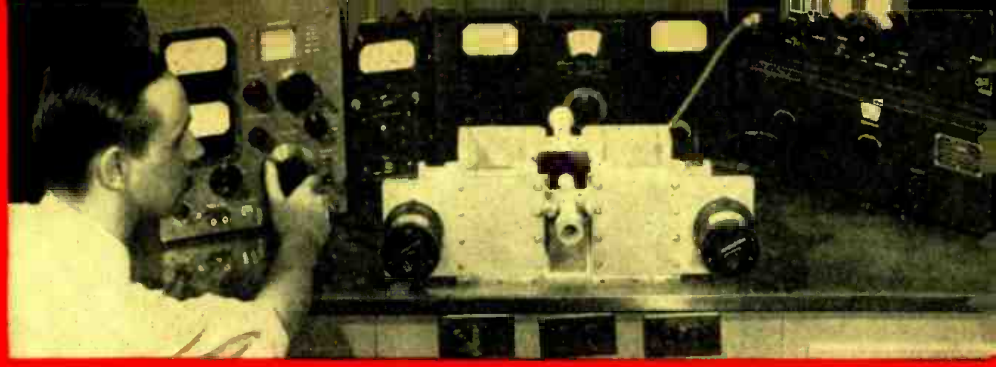
JUNE, 1953

DEPARTMENTS

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

Edited by H. S. RENNE
and the Radio & Television News Staff

Dr. D. A. Jenny of the David Sarnoff Research Center, RCA, examines several experimental transistors designed with cooling fins or with liquid coolant tanks so that they can be operated at powers as high as 1 watt—compared to .05 watt for uncooled units.



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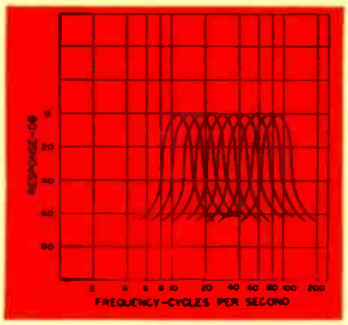
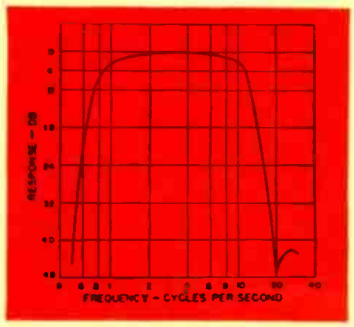
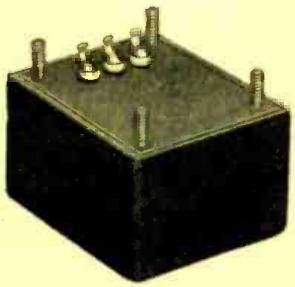
Decades of experience in the design and production of specialized filters have resulted in UTC being a first source for difficult filters. Fifteen years ago UTC was already the largest user of permalloy dust toroids in the world (exclusive of the telephone system). Present designs include a wide variety of core materials, structures, and winding methods to provide maximum performance in electrical requirements and stability. Illustrated below are a few of the thousands of special filter designs in present production.

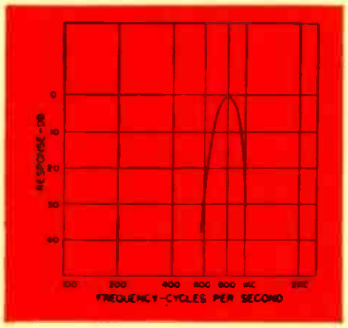


These low frequency band pass filters are held to 1 DB tolerance at the 3 DB crossover . . . 600 ohm . . . 4 filters per 7½" rack panel.

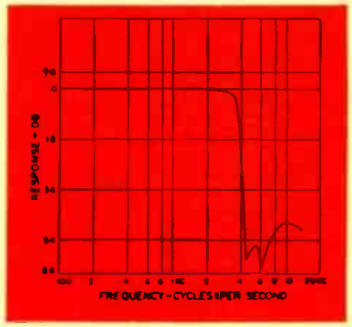


This ultra low frequency filter has a band pass range of one cycle to 10 cycles . . . 50,000 ohms . . . 700 cubic inches.





This 600 ohm miniaturized 1 KC band pass filter is housed in a case only 1" x 1¾" x 2½".



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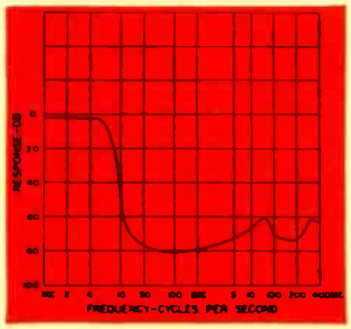
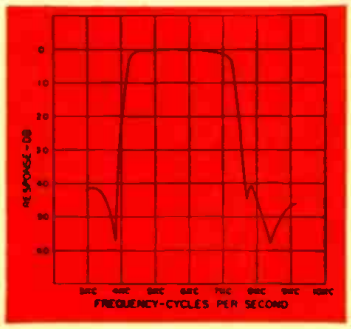


This power line filter provides correct output voltages from sources of 50 to 400 cycles . . . noise attenuation is from 14 KC to 400 MC . . . 29 cubic inches.



This band pass filter is designed for sharp cut-off at both ends of the range . . . 10,000 ohms . . . case dimensions 1⅝" x 2½" x 3¼".

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MOBILE FM RADIO OF HIGH SELECTIVITY

Fig. 1. Dash-mount (left) and trunk-mount (right) versions of a compact FM two-way mobile radio unit.

By **HAROLD A. JONES**

Technical Information Center
Motorola Inc.

Adjacent-channel operation on 20-kc. channels is feasible as a result of improvements in design.

TWO-WAY RADIO, which in the beginning was practically limited to police service applications, has suddenly developed into a national necessity—an invaluable and indispensable aid to law enforcement agencies, fire departments, ambulance and other emergency services as well as a dollar-saving, time-saving, life-saving tool for the maintenance of highways, railroads, transit utilities, power utilities, petroleum-gas pipelines, taxis and limited common carriers. The mobile communications industry has outgrown its three-corner pants and cramped play-pen. It now has a legitimate, justifiable need for ample space in which to work and serve.

Space presents the critical problem which must be solved; abstractly, there is a need for space in the spectrum in which to work, and mechanically, space is required in the vehicle—whether it be a passenger car or industrial truck—in which to mount the radio unit.

The spectrum space situation must be relieved by devising methods for increased efficiency in the utilization of existing channels. Channels are commonly assigned on an alternate basis to provide a guard band for protection against mutual interference. The recent advent of more selective receivers and transmitters with controlled modulation has allowed the FCC to grant adjacent-channel assignments, with a resultant increase in spectrum utilization. Obviously, the removal of technical limitations in this area has doubled the number of channels available to many sorely pressed mobile services.

One of the primary objectives in the design of the two-way radio to be discussed here was the advance of the electrical preformance beyond the existing state of the art in order to remove what were previously considered inherent obstacles along the road toward adjacent-channel assignments. Further, as a qualification to the design specifications, it was necessary that the final design not only provide full adjacent-channel performance but include facilities for easy adaptation to the still narrower split-channel allocations.

The over-all receiver selectivity characteristic is one of the major factors in the design for adjacent- and split-channel operation. According to the current minimum performance standards established by the RTMA, the desired degree of selectivity for successful 152-174 mc. band adjacent-channel reception is at least 85 db down at ± 60 kc., center of adjacent channel. (See Fig. 7A.) Results of recent field tests have conclusively determined a level of −70 db to −100 db at ± 30 kc., edge of adjacent channel, to be highly desirable.

To answer the demand for equipment capable of meeting the extreme technical requirements of adjacent-channel operation, completely new and specialized transmitter and receiver units have been developed. To attain the goal of practicable adjacent-channel systems, each of the operational obstacles was considered as a separate and major problem. Emphasis should be given to the fact that a completely satisfactory solution is impossible unless all disturbing elements are controlled. For example, the simple expedient of providing an extraordinary degree of selectivity in the receiver is not the answer since the preselection cannot be made at the antenna or at other r.f. stage levels. Along with superprecision i.f. selectivity, there must also exist absolute control of frequency stability, intermodulation interference, desensitizing, spurious and image response, temperature drift, nuisance noise, and audio quality. The associated transmitter must exhibit markedly improved characteristics, over and above those of conventional units, with respect to spurious and harmonic radiations, frequency stability, and instantaneous deviation control.

Receiver Circuit Achievements

From the design principles employed in this narrow-band receiver, now a production unit, came several outstanding engineering achievements which may well set future operational standards. The parameters used to maximize the effectiveness of the r.f. selectivity circuits are ribbon-wound permeability-tuned coils. A total of five such elements precede the first mixer stage, with a sixth serving to resonate the local oscillator plate circuit. Each resonant circuit is silver-plated to improve efficiency, and temperature-compensated with negative-coefficient ceramic capacitors. The winding process is easily accomplished in production since the rectangular cross-section wire eliminates critical spacing and associated distributed capacitance problems. As a measure of improved performance, the special coils provide loaded *Q's* of the order of 60 to 80 as compared to *Q's* of from 10 to 30 in conventional permeability-tuned circuits.

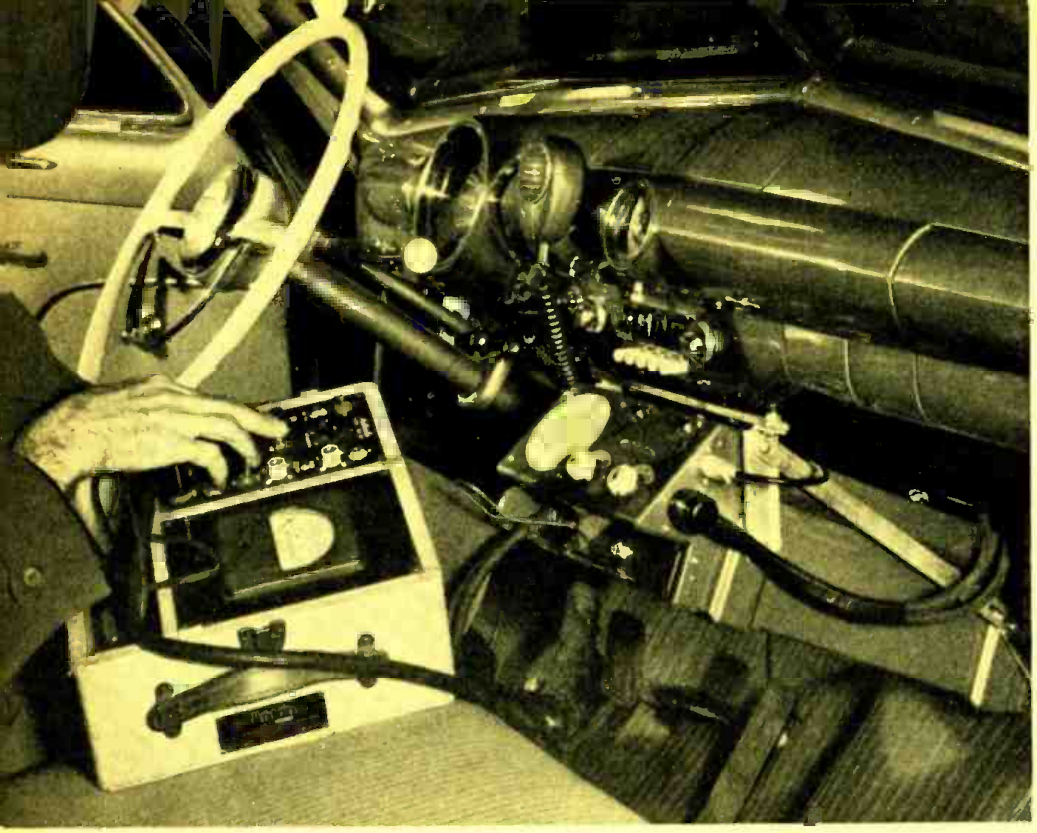


Fig. 2. The front-mount unit is shown as alignment is being checked.

The improved r.f. performance exhibited by the ribbon tuners—together with improved interference characteristics realized from the introduction of special design considerations into the r.f. amplifier and first mixer stages—provides unusual control of out-of-band desensitizing, intermodulation, and spurious response.

Spurious responses can be reckoned with and attenuated to a level of insignificance, but the elements of desensitizing and, more prominently, intermodulation interference have been steadily growing in importance until today they rate separate consideration.

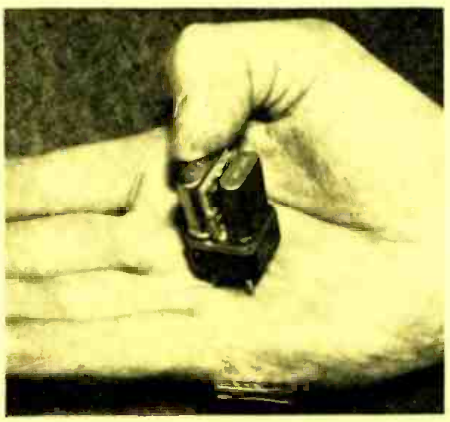
By definition, a receiver's "intermodulation spurious response attenuation characteristic" is the measured amount of its ability to receive a desired signal to which it is resonant. This characteristic is measured in the presence of two interfering signals so separated from the desired signal and from each other that "nth" order mixing of the two desired signals can occur in the nonlinear elements of the receiver, producing a third signal whose frequency is equal to that of the desired signal.

Adequate suppression of both desensitizing and intermodulation interferences has been slighted in many receiver units now commercially available—even in a few of those units presumably designed for close channel occupancy. Practically, both types of interference have been dominant obstacles in the road toward successful adjacent-channel operations, particularly same-area operations. Any attempt to side-step the issue inevitably results in equipment incapable of providing completely satisfactory adjacent-channel service.

The over-all selectivity of this receiver is determined predominantly by a radically new device—a separately packaged i.f. wave filter. Permeability-tuned coils and compensating capacitors assembled in a specially modified constant K and m-derived network comprise a total of ten tuned circuits which are permanently sealed, fixed electrically and mechanically, by casting the entire bandpass filter structure in a solid block of polymerized resin.

Thus, those circuits which regulate the frequency rejection capabilities of the unit to a controlling degree are rendered impervious to the extreme heat, humidity, and vibration conditions common in the mobile services. This technique not only prevents degradation of performance through shock or exposure to the elements, but also removes the possibility of tampering or misalignment as a result of field service without proper test equipment. The finished unit is guaranteed for the natural life of the associated receiver.

Fig. 3. Oven type, temperature-controlled quartz crystal assembly with cover removed.



Electrically, the basic polyester-styrene cast filter provides at least 100 db attenuation at ± 35 kc., in the adjacent channel. Recent investigations indicate that characteristics as exhibited by this unit are suitable for same-area adjacent-channel operations in the 152-174 mc. band (60-kc. channels) and for adjacent-area adjacent-channel operations in the 25-50 mc. band (40-kc. channels). See Fig. 7B.

Split-Channel Operation

Similar filters have been designed, tested and placed in production to provide 100 db attenuation at ± 20 kc., edge of adjacent channel, for the 25-50 mc. band and ± 30 kc., edge of adjacent channel, for the 152-174 mc. band. Rigorous field tests employing mobile units, with this particular type filter installed, prove conclusively that same-area adjacent-channel operations are practicable in the bands' allocated channels of only 40 kc. bandwidth. Further, successful test systems have been operating for over a year with this type filter, with mobile units in the 160-mc. band on frequencies separated by only 20 kc. In other words, a normal 60-kc. channel has been split into three adjacent 20-kc. channels and each successfully utilized. Thus, the packaged i.f. system allows easy and economical transition to the inevitable split-channel operations.

The basic receiver circuit has a 14-tube complement. A total of 27 tuned circuits is employed: eight permeability-tuned circuits (with specially designed ribbon-wound coils in the 152-174 mc. band) in the r.f. and oscillator stages, followed by 19 tuned circuits in the i.f. amplifier sections—including 10 plastic-cast circuits in the i.f. bandpass filter.

A special tunable local oscillator makes possible the simplification of receiver maintenance since tuning is now accomplished by adjusting the tunable crystal oscillator rather than by the more complex technique of i.f. stage alignment. It is a recent circuit development which provides the necessary electronic tuning control while maintaining precision frequency stability.

A thermally balanced crystal oven (Fig. 3) provides the extreme stability required for successful adjacent-channel operation. The oven assembly includes a controlled heater element and separately replaceable hermetically sealed crystal and bimetal thermostat elements. Assembled in a thermally balanced arrangement, the bimetal switch and heater elements maintain

the actual crystal oven temperature practically constant over an outside ambient temperature range from −30°C to +60°C, resulting in a frequency stability of better than .06 cycle / mc. /°C. The design and construction of the thermostat is such that the bimetal element is not depended upon as the primary current-carrying path through the unit. Extreme care is taken to see that no materials, finishes or sealing compounds are used which may, over a period of time, give off corrosive or otherwise undesirable gases or fumes within the hermetically sealed case. The contacts are set to open on a rising temperature between 64°C and 66°C, with a differential of less than 4°C and more than 1°C. Ambient temperatures of −40°C to +100°C do not affect the initial setting and differential of the element. Life expectancy of the thermostat exceeds 4000 operating hours.

The discriminator is a patented, frequency-modulation detector utilizing a balanced type circuit. A major stage in the high quality audio recovery system, this circuit maintains unexcelled sensitivity and linearity over the desired frequency bandwidth with stability over a wide temperature range and varying operating conditions.

The squelch system features adjustable sensitivity and noise-compensated characteristics to provide maximum reduction of nuisance noise during standby periods—a positive-acting device with a threshold sensitivity sufficient to allow operation with only 2 db of receiver noise quieting.

The unit is designed to allow easy addition of facilities for crystal-controlled multiple-frequency operation on either side of two switch-selected channels (having a maximum frequency separation of 240 kc.) without degradation of the single-frequency operating characteristics.

Additional circuit features include automatic gain control, inverse audio feedback, and special coil construction employing positive locking devices on all tuning adjustments.

Transmitter Design

The attainment of extraordinary receiver characteristics will not solve the problem of adjacent-channel or even alternate-channel operations unless the radiated energy of stations occupying these nearby channels is also adequately controlled. Spurious radiations must be eliminated or at least attenuated to safe levels of 70-100 db below the desired carrier level, with harmonics suppressed to at least −60 db. In addition, carrier deviation due to modulation must be limited in order to

Fig. 4. Front-mount model showing removal features.

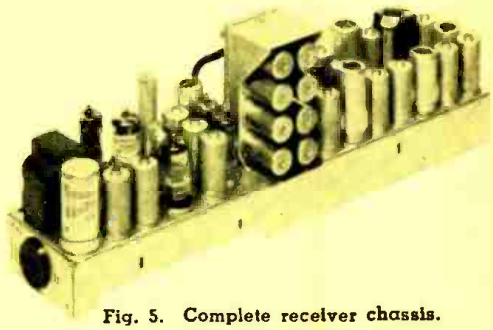


Fig. 5. Complete receiver chassis.

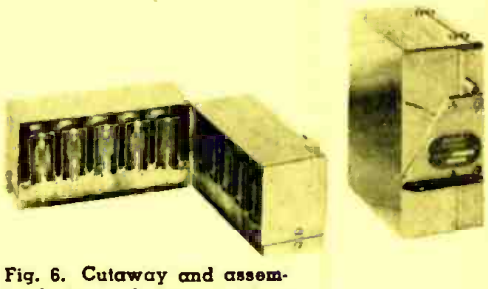
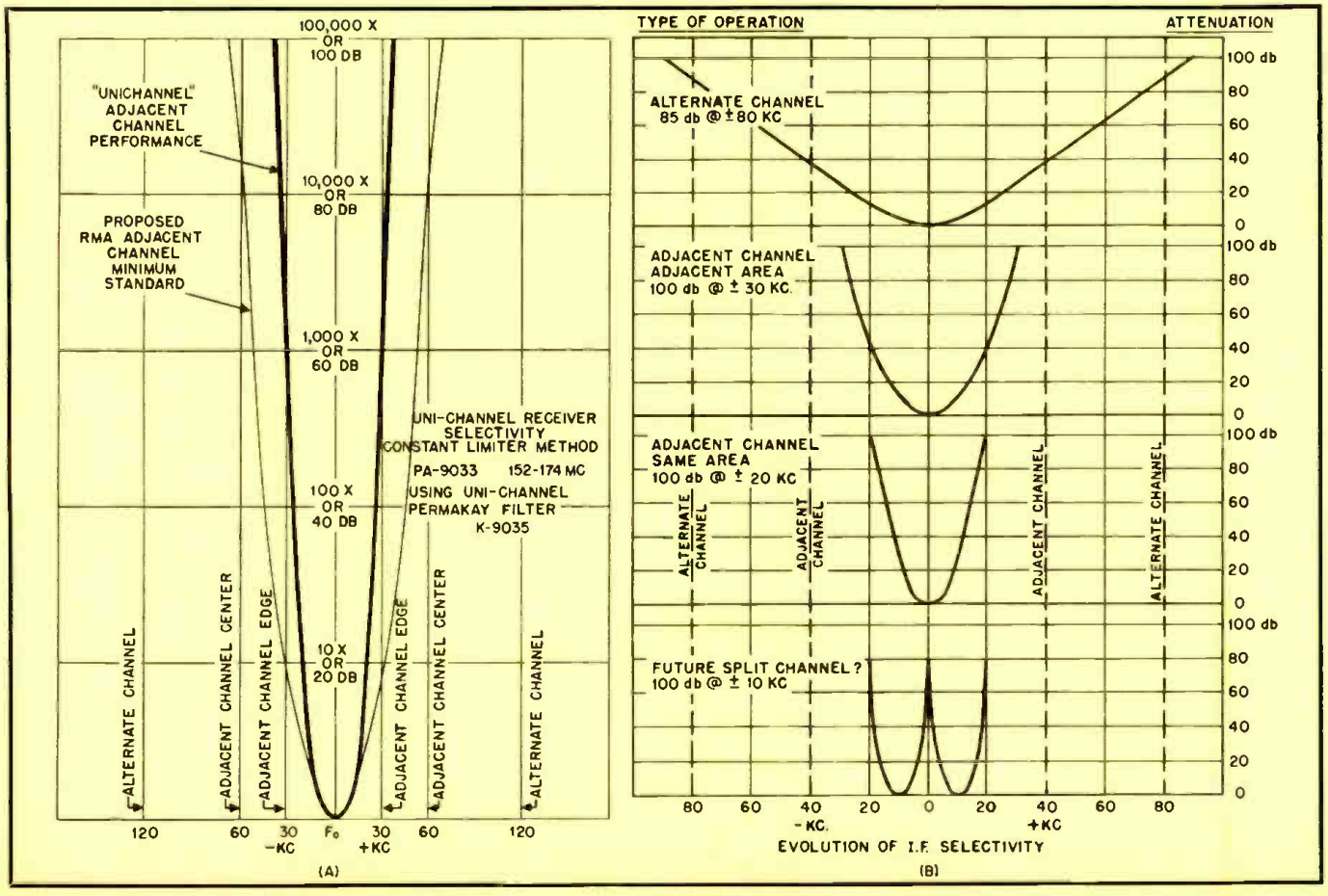


Fig. 6. Cutaway and assembled views of i.f. wave filter.

Fig. 7. (A) Comparison of minimum industry standards and performance of receiver. (B) Evolution of i.f. selectivity.



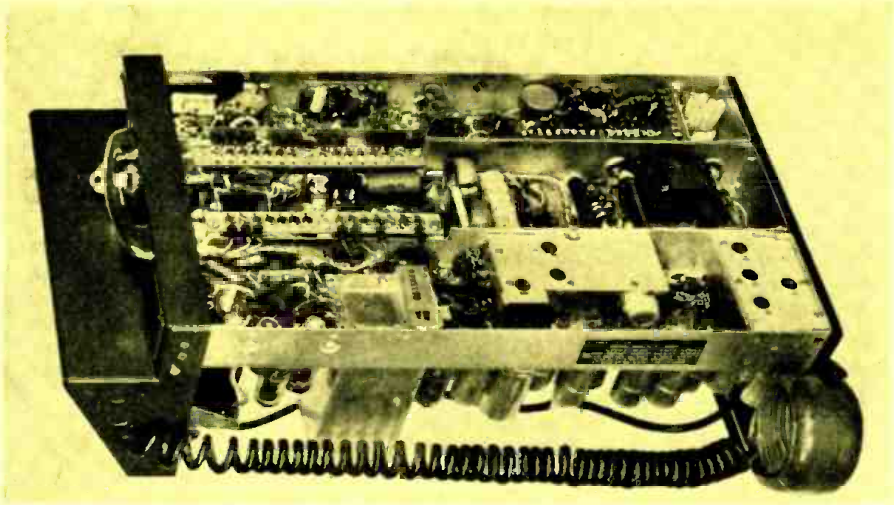


Fig. 8. Bottom view of the front-mount transmitter-receiver drawer.

insure operation which does not exceed the authorized channel limits.

In phase modulation, the instantaneous deviation excursion is determined by both the amplitude of the modulating wave and the steepness of the wavefront, or the slope of the modulating wave. This means that an ordinary amplitude limiter will not control the instantaneous deviation maximums, and in order to gain control it becomes necessary to add a slope limiter to the control circuit.

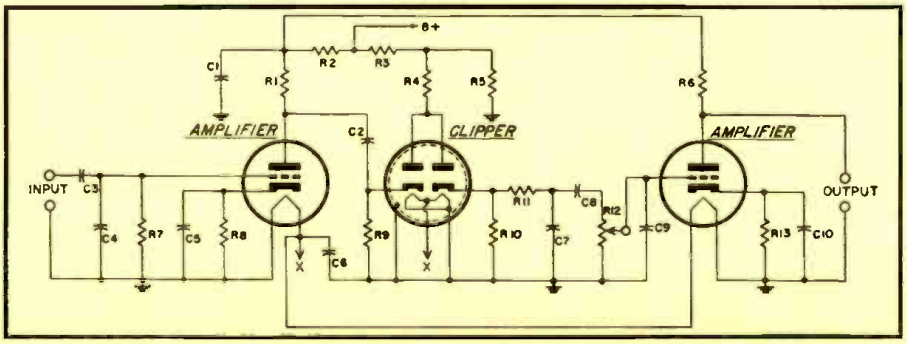
In order to comply with the requirements of adjacent-channel operations and—more recently—with existing FCC rulings governing deviation control, an instantaneous deviation control has been designed which provides amplitude-limiting and positive slope-limiting without introducing time constants for the attack and release time of the limiter. The circuit is simple enough to include in the usual types of base station and mobile communications equipment.

Operation of the deviation control (Fig. 9) requires the differentiation of the modulating wave, followed by a clipping action and then by an integration operation. The initial differentiation process emphasizes voltages associated with steep wavefronts or steep slopes, so that the clipping action clips off that portion of the wave directly related to steep wavefronts. Since the differentiation has resulted in an emphasis of the high frequencies in relation to the low frequencies, it follows that undesirable voice pre-emphasis has occurred, and there also remains a distribution of frequency characteristics of the wave which would result in overmodulation. Since the clipper is followed by an integration circuit, the wave characteristics are restored to normal and any undesirable transients introduced by the clipping action are further reduced. Observing the action of this system on an oscilloscope, while subjecting the transmitter modulator input to approximately 30 db overload, the voice wave as shown on the oscilloscope seems to strike an invisible barrier. The scope is connected to a calibrated discriminator circuit, so that the excursion viewed is a direct indication of the instantaneous deviation.

The control of deviation in a phase-modulation system does not prevent the formation of products of modulation which will extend beyond the limits of the instantaneous deviation maximum. In other words, there will appear beyond the limits of deviation sidebands or products of modulation which may extend into the adjacent or into the alternate channel. Field tests show, however, that because the energy content in a voice wave is low, and interference capabilities of these transient modulation products in the adjacent and alternate channels are very low, and while under certain conditions a degree of monkey chatter and some undesired noises may be produced, there is little or no actual interference with the reception of the desired station. Where the instantaneous deviation is not controlled, the excursion of the carrier outside of the passband of the receiver not only decreases the signal-to-noise ratio in the receiver but also adds considerably to the interference energy in the adjacent and alternate channels. The combination of superior receiver characteristics in a system where instantaneous deviation control is employed appreciably enhances the practicability of maximum channel utilization.

A maximum of ± 15 kc. is allowed under present FCC rules for optimum 100% modulation levels. Generally speaking, energy in the modulation excursion beyond the normal band acceptance of the receiver is rejected and, therefore, wasted. It is a fair "rule of thumb" to say that energy beyond the 10-db down limit of the selectivity curve is not useful energy. Obviously, then, as the bandwidth of the associated receiver becomes narrower, the transmitter deviation must be held within tighter limits. The narrow-band receivers exhibiting —100 db at ± 20 kc. characteristics require only ± 7.5 kc. deviation at 100% modulation for full audio output. Most assuredly, future split-channel operations will decrease the deviation limit still further.

Fig. 9. Circuit for instantaneous deviation control used in receiver.



Mechanical Design

The basic mobile unit is designed for the ultimate in compactness, featuring a three-unit type of chassis assembly installed drawer-fashion in a sturdy, metal, welded-construction housing. Intended to meet any mounting requirement encountered in the safety, industrial and commercial mobile services, it is made in two versions—front and rear mount—to provide complete installation versatility. The same basic drawer unit, comprised of a transmitter, receiver and power supply, can be assembled to make up either version with only the attachment of the appropriate front panel. Each of the two types has separate and distinct features to solve specific application problems.

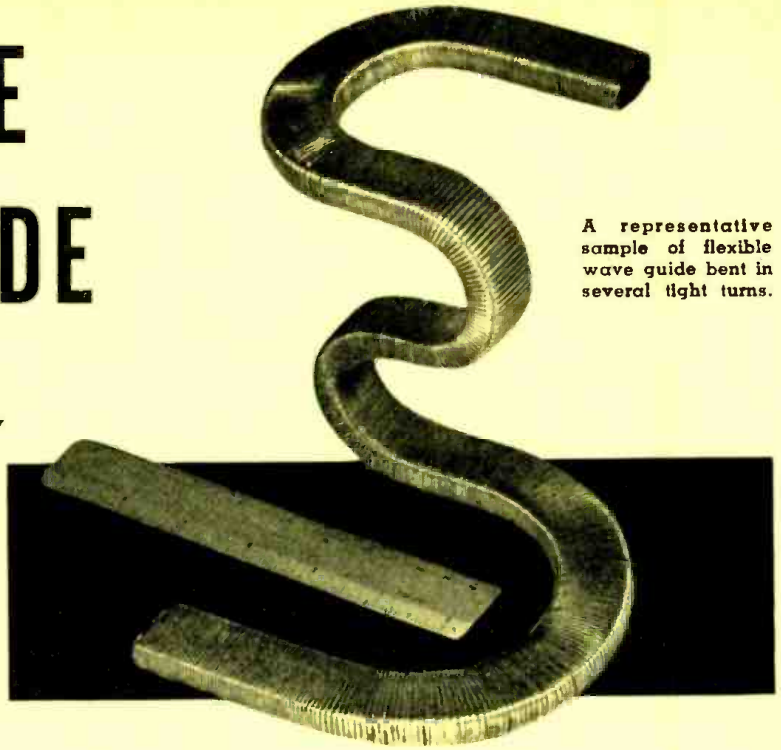
The basic chassis (Fig. 5) contains the controlling elements of r.f. selectivity, frequency stability, intermodulation and desensitizing control, as well as single- and multiple-channel operation. The i.f. wave filter (Fig. 6), containing the

(*Continued on page* 29)

FLEXIBLE WAVE GUIDE

By **SAMUEL FREEDMAN**

Sightmaster of California Company



A representative sample of flexible wave guide bent in several tight turns.

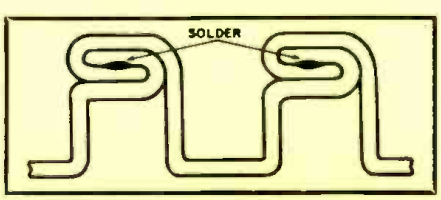
Sharp bends and twists with low VSWR's are feasible with this versatile tool for the microwave engineer.

THE development of improved flexible wave guide is expected to resolve the inadequacies of rigid wave guide which have been prevalent in the past. These inadequacies have been due to the problem of changing the direction of the wave guide run between equipment and the antenna system as well as between sections of microwave or radar apparatus—particularly where longitudinal, lateral or transverse stresses exist as a result of contraction and expansion caused by weather, temperature, vibration or shock. Practically all airborne radar installations must use flexible wave guide between the apparatus and the antenna system because of relative motion and vibration. In the past, many types of flexible wave guide have been subject to short life at maximum electrical efficiency due to the mechanical breakage and distortion developed under severe conditions of military flight.

Figure 4 shows six of the innumerable conditions under which a straight wave guide run cannot suffice. When an elbow such as one of those illustrated in Fig. 4 is used, it is limited to either the wide E plane or the narrow H plane of a wave guide. Manufacturers normally do not provide other than 45° or 90° bends. Since bends have a tendency to "buckle" in their forming, many prefer to use the costly mitered joint type of elbow shown in Figs. 4C and F. Actually, in practice, there may be a temporary, intermittent, or permanent need for angles or distortions other than those illustrated in Fig. 4 and not normally fabricated out of rigid wave guide. The unfeasibility of obtaining wave guide elbows suitable for every installational and operational condition likely to exist or occur in practice has heretofore made it necessary to lay out systems to fit the existing straight wave guide or elbows available, often complicating layout planning and installation. When the *Bell System* microwave network went into initial service between New York and Boston, much time and expense were saved without sacrifice in performance by the use of flexible wave guide between the rigid wave guide coming to the roof from the equipment below and the electromagnetic horns on the roof. It also simplified changing the angle of the horn as required for beaming to the next relay station, as well as simplifying small section replacements for the part exposed in severe weather. On many radar-equipped vessels, the wave guide run from the equipment to the antenna may lead up a mast that vibrates and sways with respect to the rest of the ship or the microwave radar equipment. Here, flexible wave guide can render important service in improving electrical performance under adverse or unstable conditions.

The need for flexible wave guide sections to augment rigid wave guide sections became particularly acute when microwave radar was installed on military aircraft in World War II. The development and manufacture of wave guide having flexibility was taken up by existing manufacturers of flexible metal hose or shielding. However, such hose or shielding was always round whereas the desired wave guide was rectangular. As the production of rectangular flexible hose or tubing appeared to pose difficult problems, particularly with regard to the exceptionally close dimensional tolerances required, flexible wave guide manufacture narrowed down to a small handful of individuals and firms. Figure 2 shows the type of work and machinery used to produce round flexible hose at the *Flexible Metal Hose Manufacturing Company* which led to the method used in the production of the flexible wave guide described in this article.

Fig. 1. Uncompressed shape showing two soldered serrations or convolutions.



During 1952, having the cooperation of *Sightmaster of California Company* of Santee, Calif., with its microwave know-how and test facilities, this company developed facilities, techniques and new types of flexible wave guide convolutions that represent an advance over previous known versions. Specifically, they succeeded in producing wave guide that was flexible to the maximum likely to be needed in the narrow H plane as well as in the wide E plane. Whereas, in the past, flexible wave guide was considered satisfactory if it could be bent 180° or more in the E plane and only a very few degrees in the H plane, this new product could be flexed in all planes and could even be bent more than 360° in a 12" length, as illustrated in Fig. 3. Tests

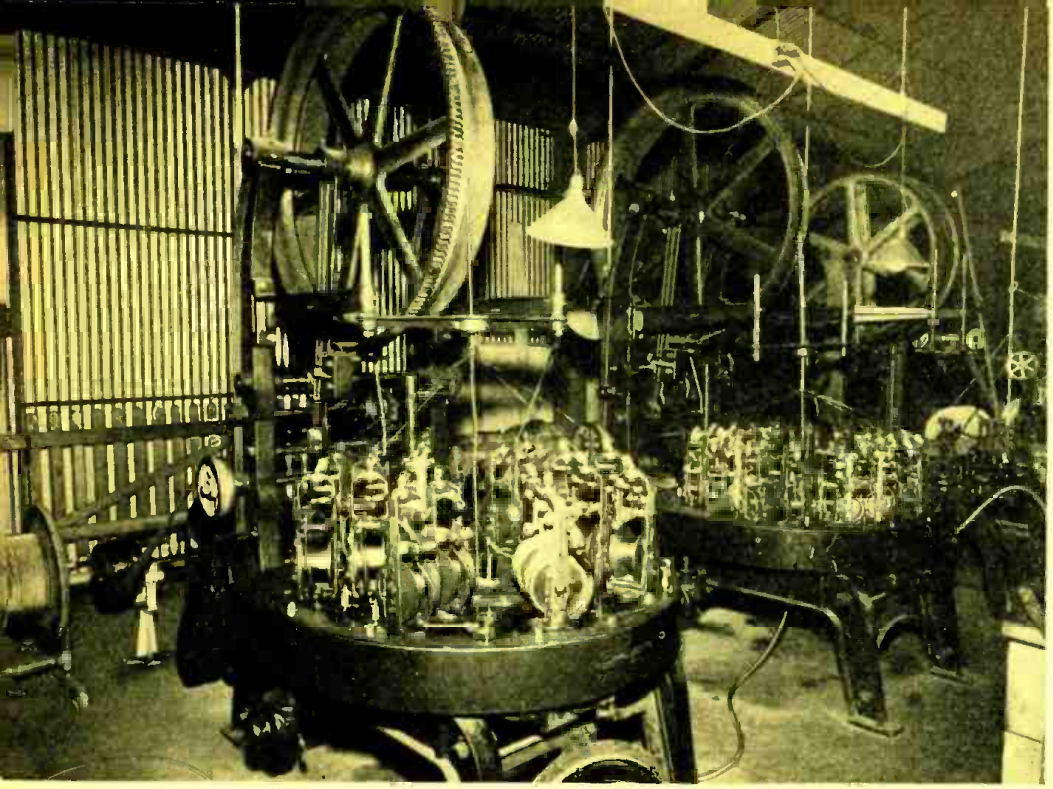


Fig. 2. Production of round flexible hose at the Flexible Metal Hose Mfg. Co. factory.

made on such bends have given a VSWR of 1.1 or lower, with readings as low as 1.04 for less severe bends (up to 180°).

Much of the credit for this development work is attributable to the ingenuity and initiative of William K. Herbst, whose mechanical and electronic experience began in 1906—when he was associated with *Crocker Wheeler Company*, gained impetus in the flexible metal hose field with *Titeflex, Inc.*, between 1916 and 1924, and continued with various firms and undertakings during the ensuing 30 years. His experience has now culminated in the wave guide illustrated in Fig. 3, plus additional refinements.

Figure 5 shows a typical in-the-plant or in-the-laboratory use of flexible wave guide. In this example, an SL-1 radar at 3000 mc. has been connected to a microwave calorimeter for power measurement. The flexible wave guide shown makes a quick, simple connection possible between the radar and the calorimeter for a quick final calibration of the latter.

The life of flexible wave guide under conditions of motion, notably on aircraft, has formerly been short. Many airborne radar systems are no doubt operating, or have operated, with deformations or mechanical damage inside flexible wave guide—cracked or deformed serrations which might cause electrical mismatches and malperformance. Being hard to reach for inspection or replacement, they may be allowed to operate at less than optimum while still rendering substantially good performance. By increasing the flexibility and the amount of "give" per serration, great progress has been made in extending the life of flexible wave guide and improving electrical performance.

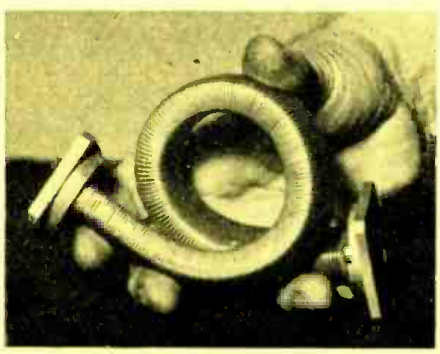
Flexible wave guide normally consists of many closely spaced serrations made from a flexible metal, with each serration soldered to the adjacent one to form a tight seal.

Production Technique

The basic method of producing flexible wave guide is shown in Fig. 1. Steps involved are as follows:

1. A suitable metal is selected for the requirement; this may be cartridge brass or a bimetal such as silver-copper.
2. The metal is unrolled as a coiled strip and fed into forming rolls and dies to produce a convoluted or serrated rectangular tube, with each ridge or serration being locked to the next to form a seam. This seam is similar to the type of seam used in tin cans, being made with soft solder. The soft solder seals the seam, as shown in Fig. 1.
3. The flexible wave guide is formed to the required length by the use of a sufficient number of convolutions or serrations. It is then cut off.
4. Flanges are attached.
5. The assembly is inspected and tested.
6. The wave guide is then covered with protective material, such as rubber. Dipping, wrapping or spraying may be used in lieu of molding.

Fig. 3. A demonstration of the flexibility of flexible rectangular wave guide manufactured by Flexible Hose Mfg. Co.



The heart of any flexible guide is the individual serration or convolution and the way it is interlocked with the adjacent serration or convolution. Figure 1 shows soldered serrations. The solder is fed in simultaneously with the serrations in wire form, being heated as it comes off the arbor. Methods of forming serrations, feeding the solder and otherwise making the flexible wave guide structure are closely guarded by each manufacturer.

Production Problems

The many problems to be considered in making good flexible wave guide tend to discourage manufacturers from entering the field. Among the major considerations are:

1. Keeping a sharp corner radius inside the rectangular section requires special die shape and inside arbor.
2. Depth of the serration is determined by the design of the form. The effective wave guide size is the net inside dimension for the tops of the serrations. Gaps between serrations and depths of serrations are small compared to the wavelength, and the inside of the guide theoretically presents a solid surface.
3. In flexing the individual serrations, it is highly desirable that the height of one should not appreciably change with respect to the others, so as not to change the cutoff frequency of the wave guide or its electrical characteristics for a stated frequency. It should return to normalcy of dimension when tension is released.
4. It is necessary to allow for the effect of an angle or a circular bend.
5. The effect of a transverse twist must be calculated.
6. Alignment of the flanges is a principal source of trouble as misalignment adversely affects the VSWR. Too much attention cannot be given to this detail and the greatest skill is needed in attaching flanges properly to maintain optimum alignment. The heavy stock of which the flanges are made has to be soldered to the thin material of the serrations.
7. The wide dimension tends to flex better than the narrow dimension.
8. There are complex forces which de-

velop when a flexible wave guide is twisted instead of merely bent.

9. The limit of flexing present in every flexible wave guide must be determined. Within this limit, a flexible wave guide must return to normalcy when relaxed. Limit of flexing is determined by size, depth of convolution, serration rate per inch, and material used. The lap and solder do not form a pertinent part of the rectangular inside dimension of the wave guide.

As defined in the military specifications of the Armed Services Electro-Standards Agency, a flexible wave guide is a flexible transmission line, with associated flanges attached, which mates electrically and mechanically with standard rigid wave guide. Various flexible wave guide characteristics are defined as follows:

Relaxed Position: horizontal position under no stress except that of gravity.

Minimum Bending Radius: the radius to the center line to which the flexible wave guide can be bent without causing mechanical damage or causing electrical properties to deviate from specified values.

E Plane: the longitudinal plane which bisects the wide sides of the wave guide.

H Plane: the longitudinal plane which bisects the narrow sides of the guide.

Axial Twist: maximum angle through which one flange can be rotated with respect to the other flange without causing mechanical damage or causing electrical properties to exceed specified values.

Flexure: number of cycles through which a flexible wave guide assembly can be bent without causing mechanical damage or causing electrical properties to exceed specified values.

Repeated Twist: number of cycles through which an assembly can be twisted without causing mechanical damage or electrical properties to exceed specified values.

Attenuation: one-way power transmission loss through a flexible wave guide in decibels per foot.

Safe Extension (static): extension from relaxed position length to which the assembly can be stretched without causing mechanical damage or causing the electrical properties to exceed specified values.

Flexible wave guide is second only to rigid wave guide in efficiency of power transmission and will be increasingly used wherever fully stationary straight wave guide runs are not possible or convenient. It is expected to replace elbows and rigid wave guide bends, and has already been extensively used for that purpose.

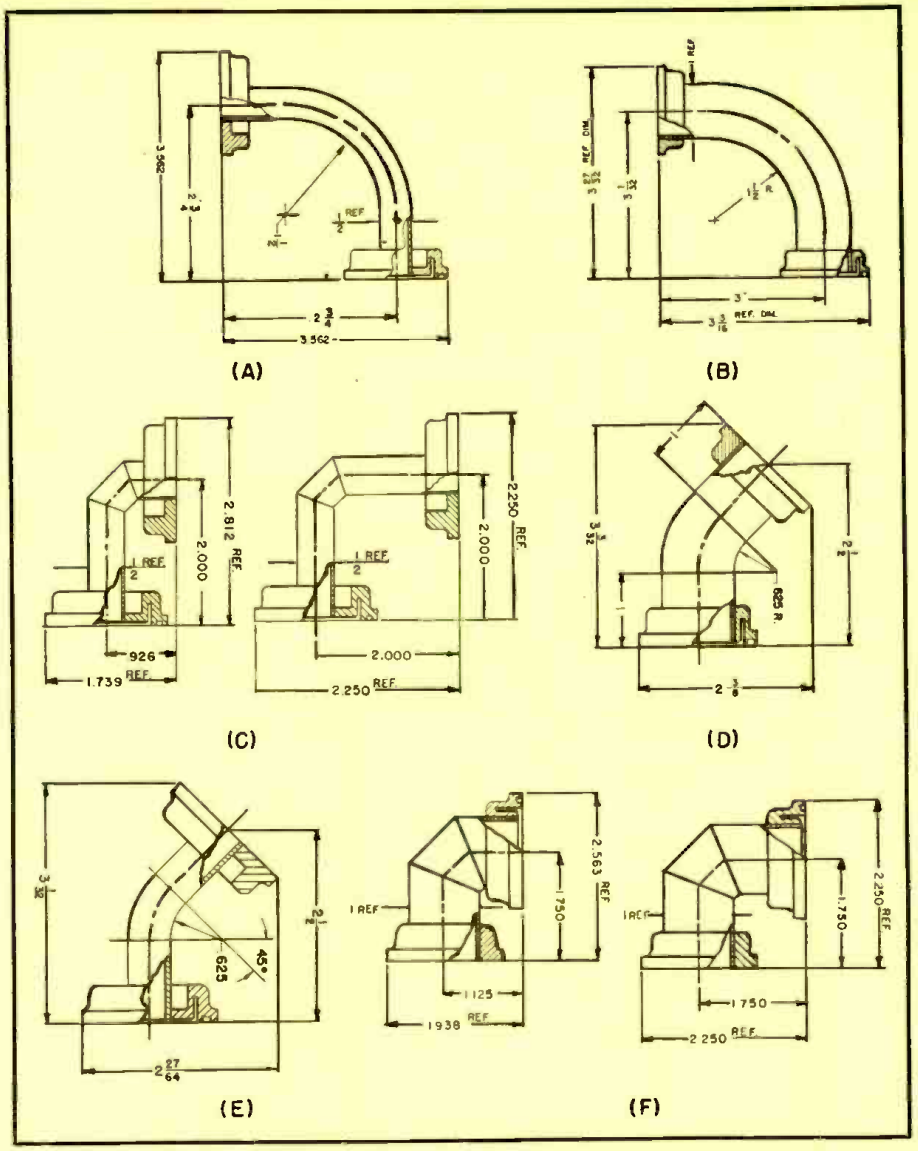
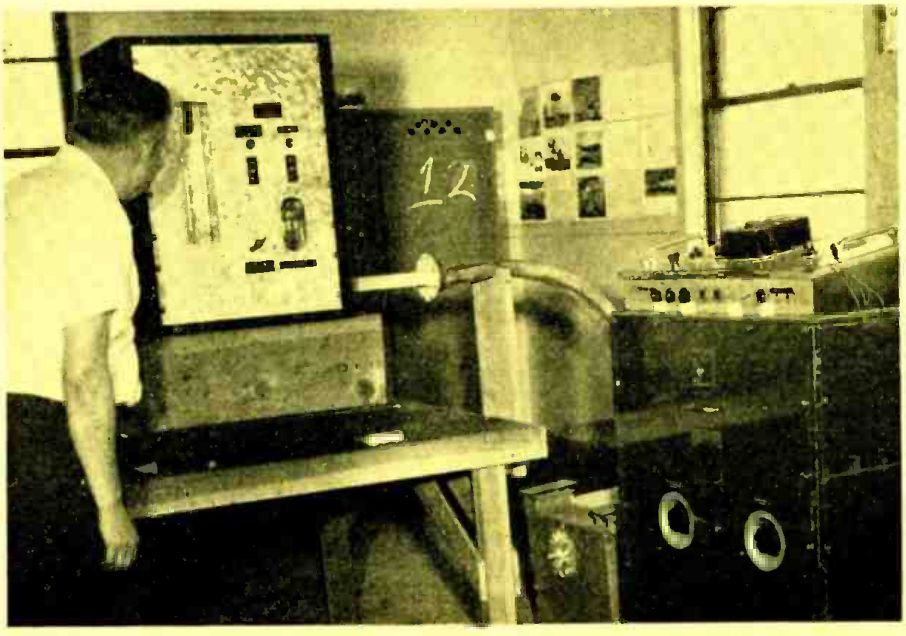


Fig. 4. Various types of bends using 1" x ½" wave guide suitable for the 10,000-10,500 mc. band: (A) E plane 90° bend. (B) H plane 90° bend. (C) E plane 90° mitered elbows. (D) H plane 45° bend. (E) E plane 45° bend. (F) H plane 90° mitered elbows.

Fig. 5. Radar equipment connected to a microwave calorimeter by flexible wave guide.



MAGNETIC AMPLIFIER TEMPERATURE CONTROLLER

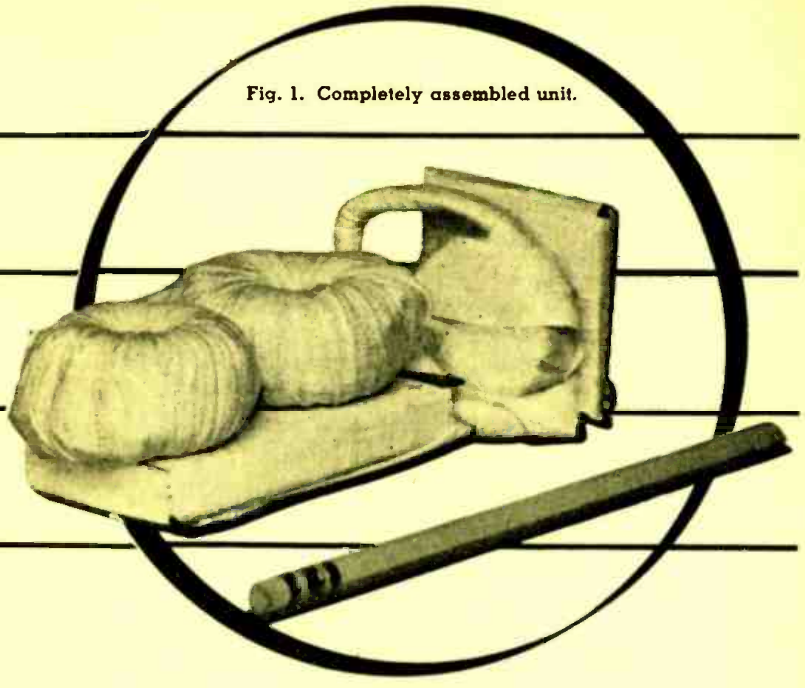


Fig. 1. Completely assembled unit.

By **DAVID FELDMAN**

Bogue Electric Mfg. Co.

A temperature-sensitive bridge controls the power to the heating element by means of a magnetic amplifier.

PROBLEMS of temperature control have long been of interest to engineers and for a considerable period of time have been solved by the use of thermostats and other similar transducers. Temperature regulators have been available for many years and, for applications requiring precise control, have consisted of electronic voltage and power amplifiers. The performance of such systems has in general been quite good.

Requirements of the temperature controller to be described here were dictated by the customer. This application called for a regulating system which would contain no moving parts, have long life, be maintenance-free, resist mechanical vibration and shock, and be of minimum size and weight. Magnetic amplifiers are ideally suited to such general requirements. Comparison between electronic and magnetic amplifiers has often been made and need not be discussed here.

The following requirements were specified for the regulator. Temperature of the body was to be adjustable between 140° ± 10°F and, at any temperature in the adjustable range, controlled to within ±0.1°F—under conditions of constant load, varying line voltage and frequency, and varying ambient temperature. The available power was 115 volts ±1% at 400 cycles ±½%; the ambient temperature variation was specified at 68° ± 10°F. The regulator was to maintain temperature to within ± 0.1°F for a period of at least 48 hours and within ± 1.5°F over a period of one year. Efficiency of the system at full load was to be at least 80%.

Dimensions of the body whose temperature was to be controlled were: volume—approximately 300 cubic inches; weight—approximately 60 pounds. Thermal conductivity of the body was approximately 29 btu per hour per square foot per inch °F.

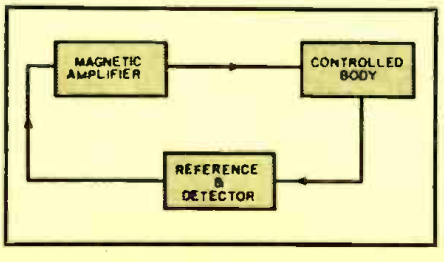
The basic elements of any system for providing close temperature regulation are as follows:

1. Heating element
2. Temperature-sensing element, reference element
3. Controllable heat supply
4. Object or space to be temperature-controlled
5. Heat conducting medium

The system to be described here is commonly considered to be a proportional type of controller such that the quantity of heat supplied to a body is varied in proportion to the losses in the system. The losses in this system are a function of the temperature gradient between the controlled body and the surrounding ambient temperature.

A Nichrome resistance strip heater, constructed in such a manner that it would be in contact with the entire radiating surface of the body, was chosen as the heating element. Its approximate resistance was 65 ohms.

Fig. 2. Block diagram of a closed-loop system applied to a magnetic amplifier.



Since the heating element could be powered with a.c., a single-phase self-saturating magnetic amplifier circuit was chosen, consisting of the minimum number of components. A schematic of the magnetic amplifier circuit, often called a doubler circuit, is shown in Fig. 3A. In this circuit, the output power to the heating element is controlled by varying the d.c. current in the control winding.

The requirements for a high gain magnetic amplifier such as the one used in this development dictated the use of core material having a high saturation flux density, high residual flux density, and low coercive force; also essential was the use of a self-saturating rectifier having a high reverse resistance, a high blocking voltage, and a high forward current capacity.

Selenium rectifiers available today can be manufactured to meet the above specifications. As will be discussed later, the specific application dictated the development of special techniques in order to employ selenium rectifiers.

A circuit for temperature-sensing, incorporating both the reference and the detector, was designed. This circuit is essentially a Wheatstone bridge consisting of two temperature-insensitive resistance arms, two temperature-sensitive resistance arms and an adjustable resistance. Reference arms of the bridge were constructed of Karma (331 alloy) resistance wire; the temperature coefficient of resistance for Karma wire

is negligible over the temperature range being considered. Detector arms of the bridge were constructed of ballast nickel resistance wire; the temperature coefficient of resistance for ballast nickel wire is 0.0067 parts per °C in the temperature range of 0-100°C.

The temperature controller was designed so that the temperature-sensitive arms of the sensing bridge were located around the controlled body (in contact with the entire body surface), this being the only practical location for the sensing elements in the application at hand. The fixed bridge arms were located outside of the controlled body and mounted on the magnetic amplifier package. In order to approach the minimum over-all size of the regulator, keeping self-heating effects of the temperature-sensing elements to a minimum and keeping the fixed load on the customer's power supply to a minimum, a ratio of approximately 20 for the maximum output of the magnetic amplifier to the power being supplied to the temperature-sensitive arms was chosen. Actual values of these two quantities were 95 watts and 5 watts, respectively.

With the Wheatstone bridge as described above for temperature-sensing, the sensitivity of the detector when referred to the control winding of the magnetic amplifier was approximately 0.565-ampere turn per °F. The control winding on the magnetic amplifier consisted of 1000 turns having a resistance of approximately 10 ohms. Resistance of each of the arms of the Wheatstone bridge was 10 ohms.

Shown in Fig. 3C is the transfer characteristic of the magnetic amplifier. Figure 3B shows the final circuit. Measurements indicated that a power gain of about 1.4×10^6 from cutoff to saturation and a voltage gain of approximately 700 could be obtained with this detector and amplifier. The calculated power gain per cycle was approximately 1000.

The magnetic amplifier is energized from the 115-volt 400-cycle bus and the controlled temperature is selected by adjustment of the rheostat R_s. Control current in the magnetic amplifier control winding at this time is such as to saturate the amplifier fully. This provides maximum power to the heating element and thus begins to raise the temperature of the controlled body. As the temperature of the body increases, the resistance of the temperature-sensitive arms also increases and the bridge is slowly brought to balance. The bridge will reach a balance point at the desired controlled temperature, at which time the magnetic amplifier need provide only that power necessary to overcome losses in the system. The temperature-time and power-time characteristics and the temperature variations encountered are indicated in Fig. 4.

The major difficulty in this development concerned size. The size of the desired package, to include the magnetic amplifier cores and rectifiers, was established at approximately 20 cubic inches. Core design, the total volume occupied by the windings, and the rectifier size had to be kept to an absolute minimum. This fact, coupled with expected heat dissipation within the package, presented several problems to be solved. Because of the expected temperature rise within the package, normal practice would dictate use of perhaps a class H insulation. However, reduced space and winding factors inherent in the use of certain high-temperature insulated magnet wire required that the choice of suitable wire be a subject of investigation. Spacing between normal rectifier plates of a size suitable for the power requirements of the regulator dictated use of a rectifier assembly in which the cells would be in intimate contact, in order to reduce the package size. This entailed a great deal of investigation and development. While the maximum power requirements of the amplifier are utilized for a relatively short time, in this case approximately 1 hour, the usual ratings based on small duty cycles could obviously not apply.

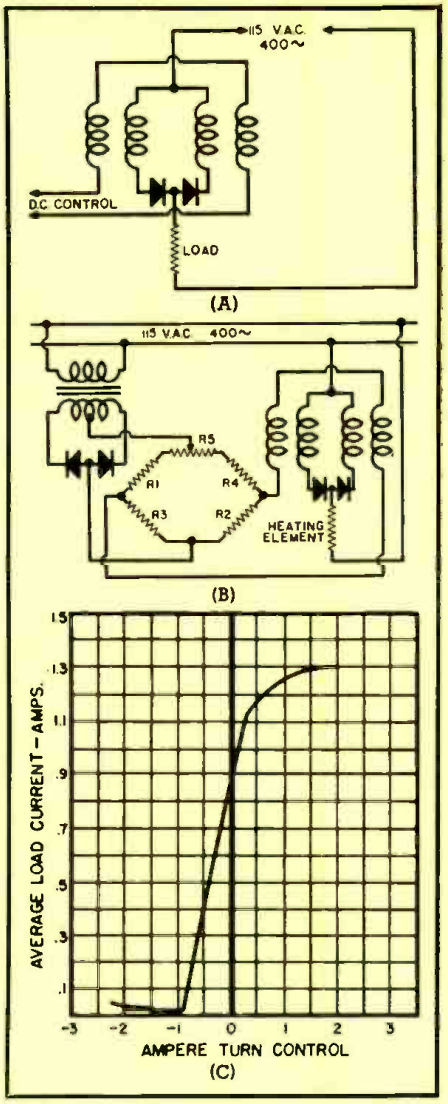
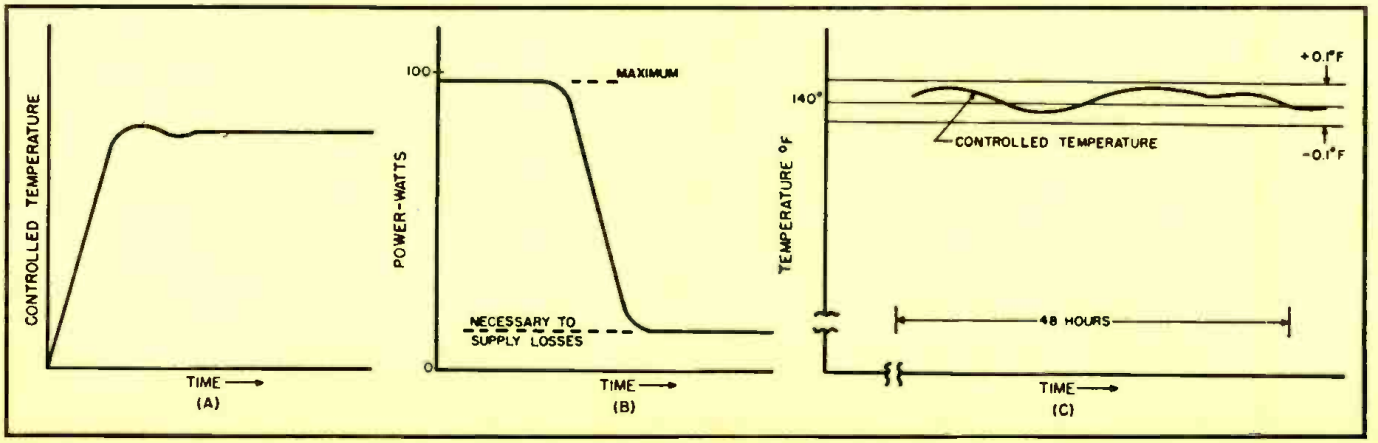


Fig. 3. (A) Schematic of magnetic amplifier circuit. (B) Final circuit of the complete controller. (C) Transfer characteristic of the magnetic amplifier.

A determining factor in this application was the need for a selenium rectifier of the magnetic amplifier type cap-

(*Continued on page 29*)

Fig. 4. (A) Temperature-time characteristic of system. (B) Power-time characteristic. (C) Temperature variations encountered.



THE TRAVELING-WAVE TUBE

By

M. E. HINES

Bell Telephone Laboratories, Inc.

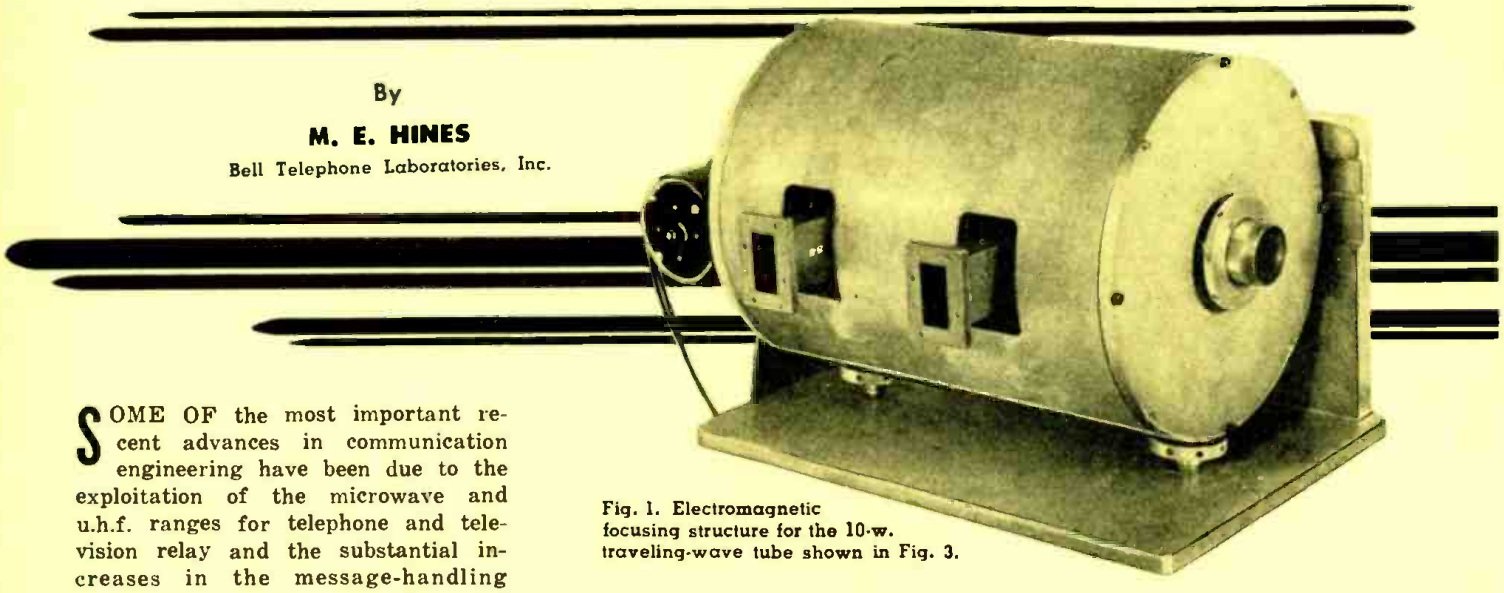


Fig. 1. Electromagnetic focusing structure for the 10-w. traveling-wave tube shown in Fig. 3.

Bandwidths of hundreds and even thousands of megacycles at u.h.f. and microwave frequencies can now be realized.

SOME OF the most important recent advances in communication engineering have been due to the exploitation of the microwave and u.h.f. ranges for telephone and television relay and the substantial increases in the message-handling capabilities of these and other communications channels. Many thousands of miles of microwave relay are now in operation in the United States and abroad, and rapid expansion of these facilities is continuing. Some of these microwave relay channels have sufficient bandwidth to transmit a television signal or several hundred simultaneous telephone messages. With further improvements, it is expected that still wider band signals will be transmitted, with more and more telephone messages or television signals per channel.

The traveling-wave tube, now coming into use, promises to increase greatly the bandwidth capabilities of this type of transmission system. This tube is an amplifier suitable for use in the u.h.f. and microwave frequency ranges. It is capable of giving very high gain, with bandwidths of several hundred to several thousand megacycles. This is a very much wider bandwidth than can be amplified by any other tube type now available, and it is this feature which makes the traveling-wave tube so important for communications. It has long been recognized that the greater the bandwidth of a communication channel, the greater the possible information transmission rate. This can mean more telephone messages per radio channel, higher definition television transmission, higher telegraph pulse rates, etc.

One of the earliest experimenters with the traveling-wave tube was Dr. Rudolph Kompfner, working in England in 1944. The importance of this tube was quickly realized, and since that time intensive development has been carried out in many laboratories to bring the tube to its present practical state for communication systems.

Many types of traveling-wave tubes have been built and tested, some of which appear to have only superficial resemblances between them. The basic feature which characterizes all traveling-wave tubes is that amplification occurs gradually along an extended wave-guiding circuit adjacent to an extended electron stream, with energy being transferred from the electron stream to the signal wave propagating on the circuit. This energy transfer may occur continuously all along the electron stream, or repeatedly at a number of specific interaction gaps where signal voltages appear. Both types of tubes have been successfully used. The helix is the most common circuit for continuous interaction.

Figure 5 illustrates, somewhat schematically, a typical helix type of traveling-wave tube together with its external connecting wave guides. The helix is rather long and slender and is enclosed by a glass tube which is, in this case, the vacuum envelope. Four thin ceramic rods extend longitudinally between the helix and the glass to keep the helix straight and properly spaced away from the envelope. The helix itself is simply a long coil-spring which acts as a special form of wave guide. It is coupled at each end to the more conventional rectangular input and output wave guides. The short tubular sections at the ends of the helix act as antennas within the wave guides to perform the coupling. When properly adjusted, all of the input signal power is transferred to the helix wave. Similarly, all of the amplified output power on the helix is transferred out of the wave guide at the other end, the glass envelope not seriously interfering. The enlarged section of the envelope to the left of the input wave guide contains the electron gun, and the electron collector is sealed to the glass tube at the opposite end. In the gun, the electron stream emitted by the cathode is accelerated toward the gun anode or accelerator, which is at a positive potential with respect to the cathode. The stream passes through a hole in this electrode and is thence transmitted down the axis of the helix to the collector, ideally without appreciable interception of any electrons on the helix itself. All along the helix, there is an interaction effect which causes the electrons to lose some of their kinetic energy, and this energy reappears as increased signal power propagating on the helix.

Not shown in Fig. 5 is the magnet which is required to focus the electron beam so that it will be transmitted down the helix without serious interception. In most traveling-wave tubes, the beam current is too large to permit the use of beam-focusing methods of the type used in cathode-ray tubes. The internal space charge causes the electrons to repel each other, so that a continuous magnetic field parallel to the axis must be used to hold the beam together. Electrons which try to move laterally are spiraled back toward the axis and continue on.

Figure 2 shows an enlarged section of the helix and the electron stream, and illustrates the bunching action which occurs during amplification. The electric field lines shown are those associated with a propagating signal wave on the helix. This field pattern has a strong longitudinal component along the axis, and it is periodically oriented forward and backward, with one region of forward and one region of backward field in each wavelength. This field pattern of the wave moves more or less smoothly forward from the input toward the output, but the forward component of the wave velocity is greatly reduced by the helical form of the guiding wire—usually to between 1/10th and 1/20th the velocity of light. With this reduced wave velocity, it is easily possible to adjust the electron drift velocity so that it will be equal to the wave propagation velocity. The electron velocity depends only upon the voltage difference between the cathode and the helix. The helix wave velocity depends upon its geometry and surroundings, and may be designed to correspond to the appropriate voltage desired—usually in the range of a few hundred to a few thousand volts.

Imagine in Fig. 2 that the electrons are initially moving at exactly the speed of the wave. The electrons in the regions of retarding electric field are decelerated, and conversely, those in accelerating field regions are pushed ahead. As the wave and electrons move forward together, there will be a tendency for the local charge density in the electron stream to increase in those null field regions where the electric field just ahead is decelerating and that just behind is accelerating. Actually, for an amplifier, the electrons are always transmitted at a velocity slightly higher than that of the wave being propagated. This causes the bunches of electrons to form so that the zones of maximum charge density are in the regions of decelerating field just ahead of these nulls. There are corresponding regions of reduced local charge density in the regions of accelerating field. In this way, more electrons are decelerated than accelerated and the loss of kinetic energy appears as increased electromagnetic power in the signal wave. Near the input end of the tube, where the wave may be quite weak, the electron beam will have only slight variations in local charge density; but at the output, after amplification, the wave is much stronger and the bunching effect may be very marked, with most of the electrons being redistributed into sharply peaked groups.

The basic requirement for obtaining gain is that the wave velocity and the electron velocity be nearly equal, with the electron velocity slightly the greater

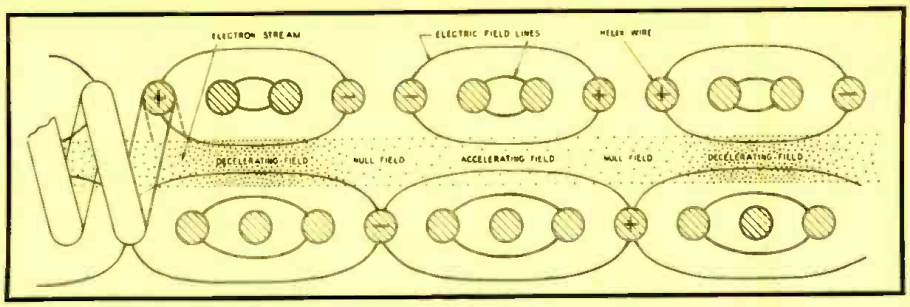


Fig. 2. Enlarged section of helix and electron stream, illustrating bunching action.

of the two. The helix is a smooth type of line exhibiting only gradual slow changes in wave velocity with frequency, so that the conditions for gain are satisfied over a very wide frequency range for a fixed electron velocity. As no resonant circuits are required, such as those for r.f. klystrons, triodes, pentodes, etc., the useful bandwidth for signal amplification may be very great indeed. Often it is found that the bandwidth is limited more by the methods of coupling the signal into and out of the tube than by the internal electronic behavior.

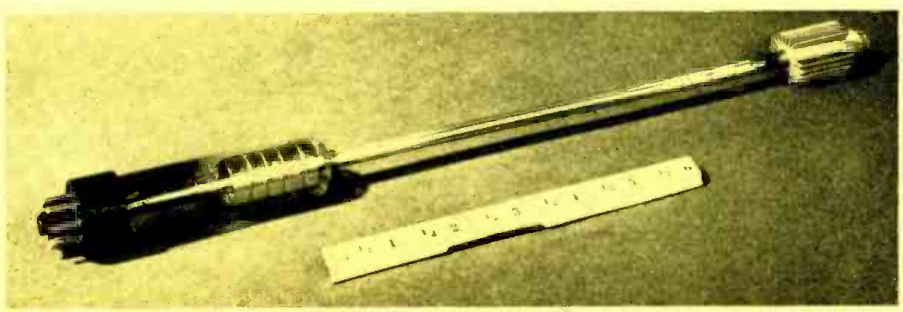
The fact that amplification will occur at frequencies where the helix and wave guide are not perfectly coupled will result in oscillation at such frequencies unless steps are taken to prevent it. Noise generated by the electron stream will be amplified in passing forward; then—if this power is not coupled out or absorbed—it will be reflected back to the input and then forward again, where additional gain will occur. If this process were to continue, after several round trips an oscillation would appear. This is ordinarily prevented by intentionally making a short central portion of the helix very lossy to r.f. waves. Any waves traveling backward are absorbed and essentially disappear, but forward waves have an opportunity to bunch the electron stream somewhat before being absorbed. These bunches constitute an a.c. current corresponding to the signal, and after passing beyond the region of high loss start a new wave train on the far side which subsequently grows to a magnitude greater than that at the tube input. With this internal attenuation, the device has the very desirable property of stability under all conditions of line termination. The tube then acts as a piece of transmission line with high gain in the forward direction and high loss in the backward direction.

Figure 3 shows a *Bell Telephone Laboratories* experimental 4000-mc. traveling-wave tube suitable for use as an output tube for a radio relay transmitter. It will produce 10 watts of r.f. power with a gain of 25 db and a 500-mc. bandwidth between 3700 and 4200 mc. At smaller signal outputs, the gain is approximately 10 db higher. The beam current is 40 ma., with 1800 volts potential difference required between the helix and the cathode. The helix proper is 6" long and the beam must pass through its inner diameter of .080". Because of this high current density, a magnetic focusing field of 600 gausses is needed over a length of 7.5". This requires a rather large magnet, either of the permanent or electromagnetic type.

Figure 1 shows one type of "circuit" which, with the traveling-wave tube inserted, constitutes a complete amplifier. Within the large cylindrical tube are the coils for the magnetic focusing field. The rectangular tubes entering from the side are the wave guide connections, and the traveling-wave tube is inserted into the end of the large cylinder along its axis. Permanent magnets have also been successfully used to focus the beam of this tube.

The magnetic field requirements are rather stringent, particularly with regard to straightness and uniformity of the field, in order to prevent the electron beam from striking the helix. This

Fig. 3. Experimental 4000-mc. traveling-wave tube which provides a 10-watt output.



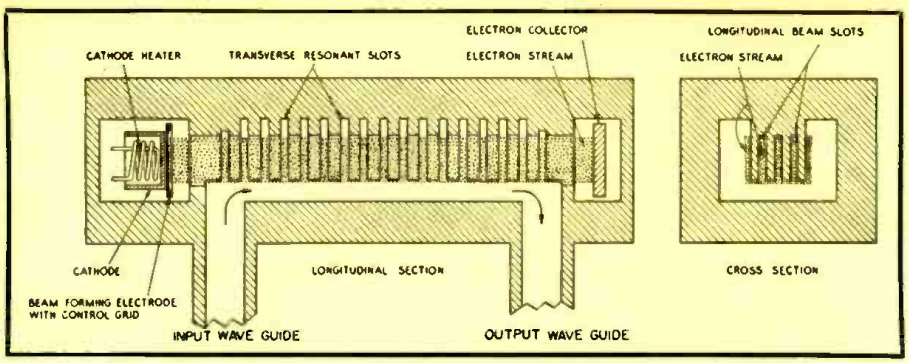


Fig. 4. Schematic of Millman's 6-mm. filter type of traveling-wave tube.

tends to make the initial installation somewhat more expensive than it would be with some other types of amplifiers.

The tube just described is only one example of the many types of helix tubes experimented with at a number of laboratories both in the United States and abroad. At the present state of development, helix tubes are usually preferred for the roughly defined frequency range between 500 mc. and 10,000 mc. for small or moderate power capacity. Tubes for the lower frequency ranges can use large-size helices, but at the higher frequencies small-diameter helices of fine wire must be used in order to obtain efficient interaction and high gain. Power dissipation becomes a serious problem at such frequencies, as the helix is not an easily cooled structure. As a type, however, the helix is a very efficient circuit, giving high gain and broad bandwidth, and it is used wherever possible.

Filter Type Tubes

Most circuits other than the helix fall into the class of "filter" circuits, where the wave is propagated along a cascaded wave filter of many sections consisting of intercoupled resonant elements. One example of this kind of circuit is that used by S. Millman in his 6-mm. (50,000 mc.) amplifier. The internal structure of this tube is illustrated in Fig. 4.

Here, the wave propagates along a kind of loaded ridged wave guide. The loading is accomplished by cutting a series of transverse slots into the ridge which are approximately ¼ wavelength deep and therefore have resonant properties. Another series of slots, cut longitudinally, carries the multiple electron streams. As these streams drift down the tube, they encounter r.f. voltages in crossing the transverse resonant slots, and by repeated interaction with the r.f. wave, kinetic energy is gradually transferred from the electron stream in a manner similar to that of the energy transfer in the helix type tube. The wave grows exponentially and emerges from the output wave guide with greater power than when it entered the tube. Millman's 6-mm. wave amplifier will give 20 db of gain at 50,000 mc. with 1500 mc. of bandwidth.

Design Considerations

Some of the features desired in a "good" traveling-wave tube are high gain, adequate bandwidth, small size and weight (including, of course, the focusing magnet), high efficiency in a power tube, and low noise-figure for a receiver tube. As is often the case, these cannot all be optimized in one tube type. To obtain high gain per unit length and high efficiency, it is desirable to use a helix of high impedance and a low voltage, high current electron stream. A high impedance helix means small diameter and fine wire, but small size makes for greater difficulty in beam transmission and power dissipation. Large magnetic fields are also required for high density beams. As is usual in such cases, a compromise between all of the important parameters is necessary to achieve a balanced, conservative design.

Low-noise tubes are usually of special design with very low beam currents, which may make them unsuitable for producing more than a few milliwatts of power.

The many different types of traveling-wave tubes which have actually been built and successfully tested are too numerous to describe here. They run the gamut from milliwatt to kilowatt power capacity and from frequencies below 100 mc. to over 50,000 mc. Low-noise receiver tubes have been made which degrade the signal-to-noise ratio less than any other type of microwave amplifier. Electronically tunable oscillators, whose frequency can be varied by changes in the beam voltage to cover frequency ranges greater than 20% of the center frequency, have also been the subject of experimentation.

This new tube type is an extremely versatile one indeed. Probably its most useful function is that of amplifying u.h.f. and microwave power. Its most immediate application will be in microwave radio relay communication systems where its wide bandwidth and adequate power output are most important. Actually, the bandwidth of these tubes is much greater than can now be used, because there is no practical system at present which can combine the very large number of possible communications channels into a single modulated signal for transmission or separate

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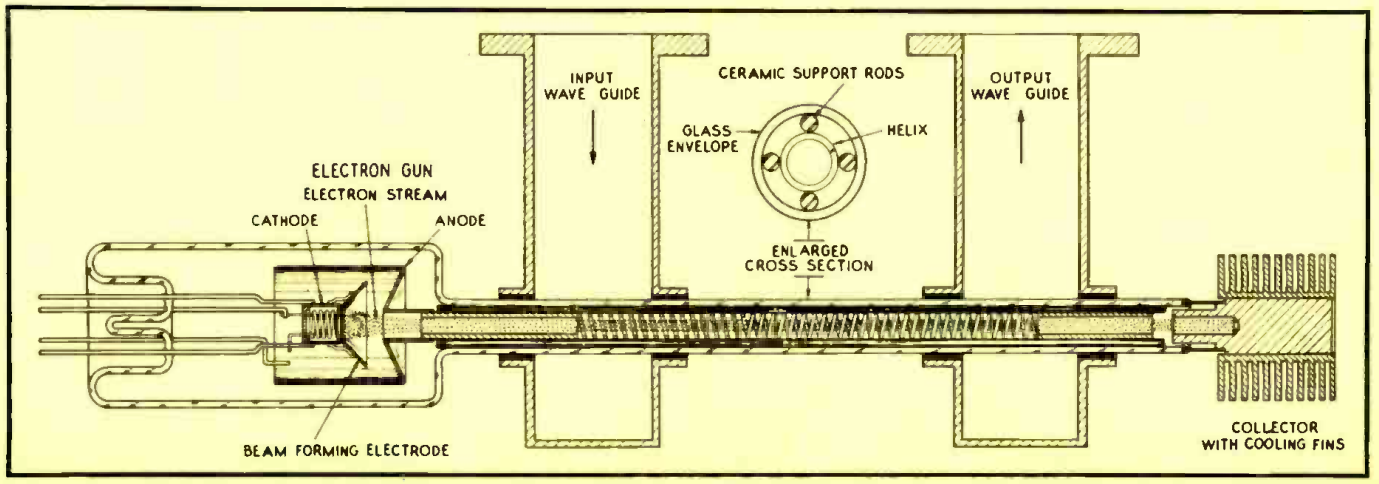
Fig. 5. Schematic sketch of a helix type traveling-wave tube and its connecting wave guides.



TESTING VACUUM TUBES

Fig. 1. A bench test setup for checking accurately the characteristics of various types of broadcasting and industrial power tubes.

By

WILLIAM M. COUCH, JR.

Techniques for checking vacuum tubes which cannot be checked on a commercial type of tube tester.

ELECTRONIC equipment manufacturers and users of their equipment sometimes have occasion to stock large quantities of tubes supplied by other manufacturers. Usually, sample tubes have been tried out by the project engineers in prototype equipment, and specifications have been drawn up which the tubes and equipment must meet before the production line can be set up.

When trouble occurs, one of the most immediate questions to be answered is whether it is due to the tube or to some other component. The simplest approach to the problem is to take samples of the tubes from stock and try them in the equipment. In this process of elimination, it may become evident that certain quantities of the tubes will work while the rest will not.

There then remains the question of why some of the tubes will not work. It is possible that these tubes meet the original specifications but that some changes have occurred in other components, so that all of the tubes no longer operate properly in the equipment. The tubes that will not work can, of course, be returned to the manufacturer, who has the proper test equipment to see what—if anything—is wrong with them.

Other than the mere saving of time, there are many advantages in an engineer's being able to make tests on the tube itself. He can report more fully in his correspondence with the tube manufacturer, he can prevent damage to the equipment, or he may obtain results that indicate trouble in other components of the equipment. Another, and probably the greatest, advantage is that such testing will allow the engineer to extend his knowledge of tube behavior.

Commercial tube testers are in many instances satisfactory for detecting defects in a large number of receiving tubes. Their operation is very well covered in articles and instruction manuals[1]. The concern here, however, is with tubes that are not adaptable to these testers and for which auxiliary test equipment must be utilized.

In general, tube defects may be classified into three categories:

1. Mechanical
2. Electrical
3. Operational

For the sake of simplicity, a breakdown of the above defects in a triode will be made and discussed in detail, including the ways of checking for them as expeditiously and as cheaply as possible.

Mechanical Defects

Leakers

Especially after long stock periods, one can expect that some tubes will have lost their vacuum, either entirely or partially. This trouble is evinced in equipment when high voltage is applied either by (1) the tube glowing pink (the characteristic color of air when ionized),[2] accompanied by a high plate current, (2) unusually high filament current due to the filament being convection- and conduction-cooled, or (3) oxidization and burning open of the filament.

If the problem is serious enough to warrant checking the whole stock, and the tube is not metal-covered, the quickest method is to lay the unpacked tubes out on a table in a semidarkened room and run over them with a spark coil, such as is pictured in Fig. 2. This coil, or any Tesla coil, will ionize the gas in a tube when the pressure lies between

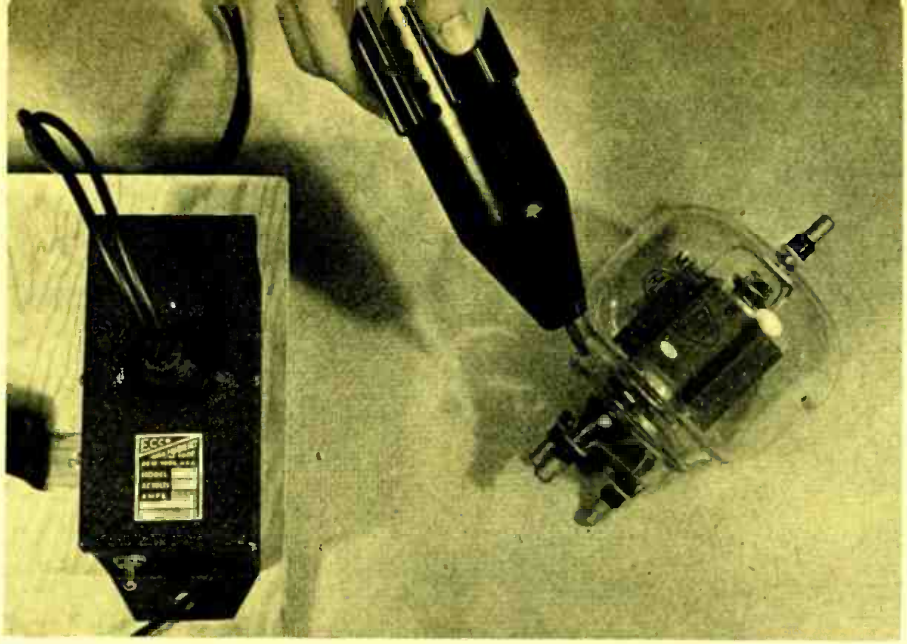


Fig. 2. The Ecco high-frequency spark-vacuum tester and gas indicator.

10 and 10^{-2} mm. Tubes which exhibit the pinkish glow should be rejected. If a tube is "down to air," i.e., pressure above 10 mm. of mercury, it will not glow but one may see white sparks jumping between the electrodes. A word of caution is in order here. On small high-frequency or high-perveance tubes with close-spaced electrodes, the arc may jump between the electrodes even with satisfactory vacuum. Aside from misleading the tester, this may severely damage the tube by sparking off its emitter coating. To guard against this, the voltage of the spark coil should be carefully adjusted and the point of the arc played only on the glass envelope.

If each tube has a getter flash visible on its envelope, the "air" tubes can be picked out from the rest, since most getters turn white in the presence of oxygen.

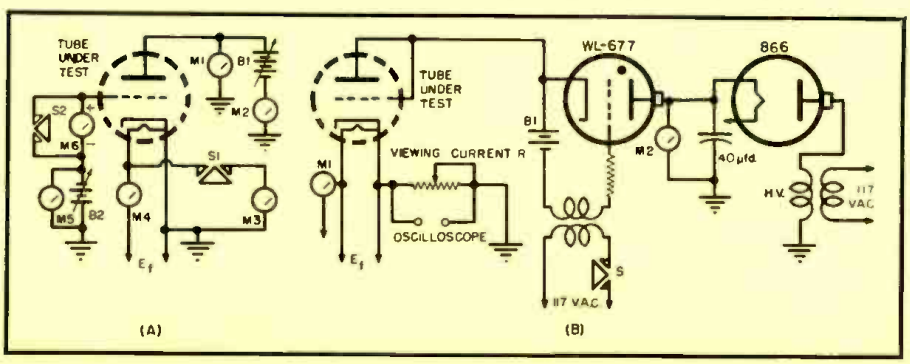
Filament Defects

Filaments in many tubes are more fragile than the glass envelopes, and shocks such as received in dropping may break a filament, even though the tube still looks intact. The simplest method of testing for open, or intermittently open, filaments is to check the contacts with an ohmmeter while gently tapping the tube. The main precaution that should be taken with small tubes is to make sure that the voltage supply of the ohmmeter is not above the rated filament voltage of the tube. This is not an adequate test if there are several filament strands in parallel. For such a case, and for the defect of partially shorted filaments, the tubes may be set up in a test socket as outlined in Fig. 3A. After setting the filament to the proper voltage and waiting a minute or two for thermal equilibrium to be reached, the voltmeter is removed from the circuit with switch S_1, so that the ammeter will read filament current only.

Mechanical Damage

Although the filament is usually the most fragile component of a vacuum tube, almost any other part may be damaged during shipment or by improper handling. Most tube manufacturers recommend that tubes be inspected on receipt so that a joint inspection report may be filed if they have suffered damage in transit. This would be evinced by loose particles "floating" within the tube, open filaments (as covered above), damaged contact pins, distorted or shorted electrodes, or broken envelopes.

Fig. 3. (A) Checking tube characteristics. (B) Measuring cathode emission.



Electrical Defects

Gassy Tubes

Somewhere between a condition of satisfactory vacuum and leaking lie gassy tubes. They do not show up on the spark coil test but may affect operation of the equipment to the extent of kicking out circuit breakers or causing unstable operation. (It goes without saying that many other circuit defects could be a source of this type of trouble.)

A test set such as outlined in Fig. 3A may be set up to check the tubes for high gas current. The plate voltage should be at the manufacturer's suggested value and the grid bias voltage sufficient to limit the plate current to the suggested value. After voltages are applied, the microammeter, which is hooked up in the grid circuit with polarity shown, is switched into the circuit. Since the grid is negative, it will capture the positive ions created by electrons bombarding free gas molecules. Thus, the magnitude of the microammeter reading is an indication of the gassiness of the tube. As all vacuum tubes show some reading, the engineer should check with the manufacturer as to what constitutes an acceptable limit for the gas reading.

The microammeter reading will also include grid emission and interelectrode leakage currents. The latter are usually very small, smaller in fact than the leakage through the socket itself. This may be checked for with the bias and plate voltages applied and the filament turned off. There are two acceptable methods of separating grid emission current from the total grid current. One method is to take the microammeter reading as outlined above with the proper voltages applied and the proper plate current flowing. The filament is then switched off and allowed to cool below visible temperature. It is then switched on again and, as the emission recovers, the plate current and grid current will rise steadily. At some point the grid current will pause momentarily in its upward rise, and then rise to its final value. This final increment in grid current can be attributed to grid emission due to the warming up of the grid. Another method is to raise the grid bias, after taking the grid current reading at the proper voltages, until no plate current is flowing. Thus, there are no ionizing electrons and the microammeter reading consists of grid emission and leakage currents alone.

A possible source of error in these measurements is that a high amplification factor tube will tend to break into oscillation, in which case the microam-

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LOOKING at TUBES

By **WILFRID B. WHALLEY**

Adjunct Professor of Electrical Engineering
Brooklyn Polytechnic Institute

Pickup tubes in subcarrier color systems.

THE field sequential color television system was introduced commercially for broadcast entertainment purposes during 1950. A few months later it was suspended. Some reasons given for the suspension included the then pressing need for engineers in defense projects and the need to conserve vital materials, particularly fractional horsepower motors such as those used in scanning with color discs.

Opinions were also expressed in some parts of the industry that a commercial color television system should be "all electronic" and "compatible." The first of these definitions was aimed at the elimination of mechanical scanning at the receiver, now possible with tricolor picture tubes. The second suggested that the millions who had already purchased television sets should be able to receive color signals in monochrome without any changes being made in existing monochrome receivers.

Because of these opinions, intensive work has been directed toward the development of subcarrier color systems that are very interesting from an engineering viewpoint.

Subcarrier Systems

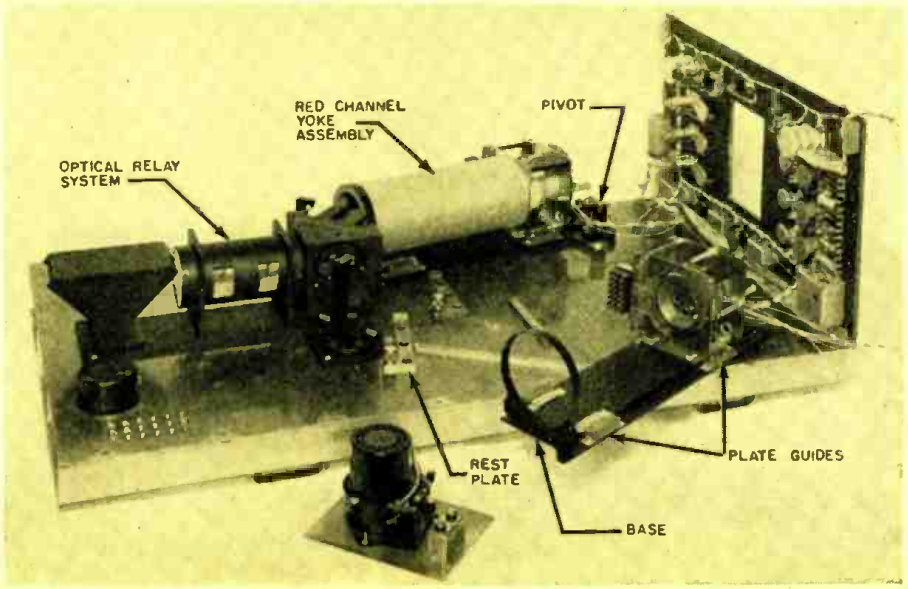
Experimental color systems such as the dot sequential system or the recently developed NTSC system presently require three pickup tubes in the television camera. This is due to the very high-speed color switching in the dot sequential system, and to the arrangement of three color signals—one corresponding to each of the primary colors. These signals control the three guns in one type of tricolor picture tube.

At very high switching speeds—and for parallel color signal operation in which each signal is produced by sequential scanning, as in monochrome—mechanical movement of the filters and the use of one pickup tube are not possible at present.

Lens System

The light from the camera lens assembly is refracted in three directions by a pair of crossed dichroic mirrors. A dichroic mirror is made by vapor deposition of a very thin film on one surface of a glass sheet. When the metal film is of a thickness comparable to one-quarter wavelength in a given region of the visible spectrum, light over a certain color range will pass through the filter while other light frequencies are reflected.

A 1951 version of an RCA color camera in initial stage of assembly.



In the three-tube camera, the two dichroic mirrors are designed to pass light in the green region to the first image orthicon and to reflect—respectively—the red and blue regions. Other plane mirrors bend the red light to a second image orthicon and the blue light to a third image orthicon. All of the mirrors must have accurate surfaces and must be mounted as rigidly as possible with respect to the axis of the main focusing lens. Any deviation in the mirrors produces optical misregistration of a complete red, green or blue image, or of portions of the image.

The three image orthicons are carefully selected to be as nearly alike in their characteristics as possible. Since a photosensitive surface can vary in sensitivity over its area, lack of similar area sensitivity variations between one pickup tube and the other two causes errors in hue in the output signal. Each pickup tube is held in position by a precision mechanical device which allows very fine adjustment of the horizontal and vertical location, so that the three tubes can be mechanically aligned with the three optical images from the mirror system.

Electrical Assembly

It is also necessary to construct the three deflection yokes with great precision so that the electromagnetic field distributions in both the horizontal and vertical directions will be as similar as possible over the full range of scanning current, and so that the horizontal axis will have the same angle with respect to the vertical axis within a few minutes of arc. Even a very small difference between one yoke and another will cause electrical misregistration of the three images over one or more portions of the scene. The three focusing coils are also accurately positioned with respect to the axes of the three tubes. Each assembly is enclosed in a special Mumetal shield to reduce, as far as possible, the field of one pickup tube assembly from that of the other two tubes, and to reduce any extraneous interfering magnetic fields which might move one electron beam with respect to the other two.

After all of the components have been physically aligned and clamped in position, the electrical adjustments are made. First, the subdivision of the currents to the three horizontal windings is adjusted from the common horizontal deflection amplifier to give amplitudes and linearities as nearly alike as possible. At the same time, centering currents are carefully adjusted to bring the three scans into the same position with respect to each optical image. This procedure is also followed for the vertical deflection circuits, and any nec-

(*Continued on page* 26)

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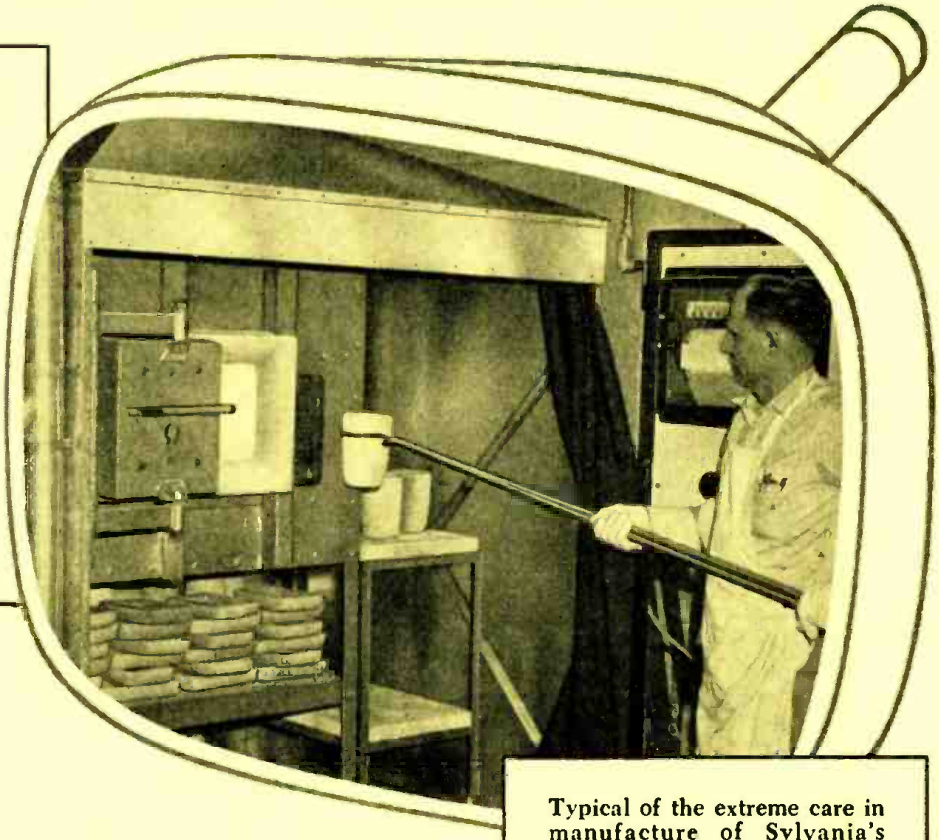

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NEW TUBES

MULTIPLIER PHOTOTUBES

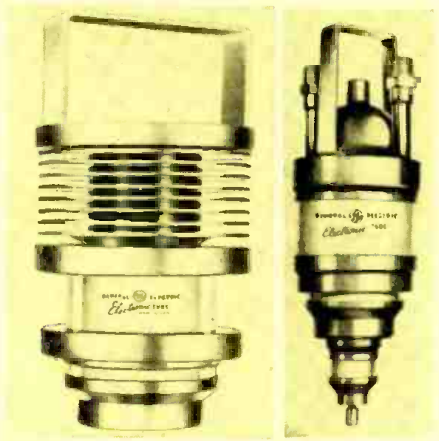
High amplification and signal-to-noise ratio are featured in the two 10-stage multiplier phototubes announced by *Allen B. Du Mont Laboratories, Inc.*, 760 Bloomfield Avenue, Clifton, N. J. These tubes are identical in electrical characteristics, varying only in physical dimensions. Type 6291 is 1½" in diameter while Type 6292 is 2" in diameter.

The *Du Mont* phototubes are of the end-window type with a spectral response predominantly in the visible region. A highly sensitive photocathode has an average sensitivity of 60 μa./lumen. Optimum photoelectron collection, resulting in excellent signal-to-noise ratio at low light levels, is accomplished by adjusting the potential between the shield and the photocathode by means of individual exterior connections.

POWER TETRODES

Two new power tetrodes have been developed by the *General Electric Company:* Type GL-6283, a 250-watt tube for use as a driver tube in u.h.f. television transmission, and Type GL-6182, a 5-kw. transmitting tube for operation over the entire u.h.f. spectrum. Additional information on these tubes may be obtained from the *General Electric* Tube Department, 1 River Road, Schenectady, N. Y.

Type GL-6283 (at left) is designed to drive *G-E*'s two 1-kw. u.h.f. transmitting tubes—types GL-6183 and GL-6019—as well as the company's 15-kw. klystron tubes. It has a ceramic-and-metal envelope construction which minimizes r.f. losses and gives it a high degree of mechanical strength; this envelope will resist seal temperatures as high as 200° C.



Type GL-6182 (right) is the newest and most powerful addition to the *G-E* line of ceramic-and-metal envelope transmitting tubes, and has an operating range of up to 900 mc. The GL-6182 is designed for use as a broadband amplifier in Class B television service. It may also be used as a Class C amplifier or oscillator in grounded-grid circuits with both grids at r.f. ground potential.

HYDROGEN THYRATRONS

Amperex Electronic Corporation has announced two improved versions of the standard hydrogen thyratrons Types

4C35 and 5C22. Known as Types 6268 and 6279 respectively, they are completely interchangeable in every respect with the 4C35 and 5C22 tubes.

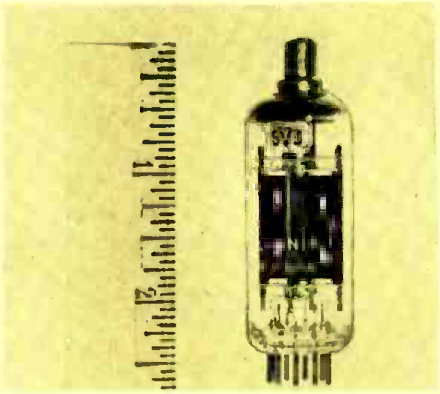
Incorporating self-contained and self-regulating sources of hydrogen, these new tubes exhibit a minimum life expectancy of over 1000 hours—at least twice that of standard types. Data sheets are available on request from *Amperex Electronic Corp.*, 230 Duffy Avenue, Hicksville, L. I., N. Y.

SYLVANIA TUBES

Damping Diode

Shown in the photograph is the *Sylvania* Type 6V3, a miniature cathode-type high-voltage half-wave rectifier now being produced by the Radio Tube Division of *Sylvania Electric Products Inc.*, Emporium, Pa. Designed for use as a damping diode in television receivers, Type 6V3 is contained in a miniature T-6½ envelope and has a coated unipotential cathode connected to the top cap.

In new equipment applications, this tube is capable of withstanding a peak inverse voltage of 6000 volts and a steady state peak current of 600 ma.,



when it is used within its maximum ratings.

Deflection Stabilizer

Sylvania's Type 40B2, a horizontal deflection stabilizer tube, is similar in application to the previously released *Sylvania* Type 40A1. However, the 40B2 has different voltage and current ratings, thus providing more versatile circuit design.

Type 40B2 is contained in a T-9 bulb. Average operating conditions are 40 volts at 150 ma.

NOISE-FREE GAS TUBES

Because of inherent noise, gas tubes have long been barred from many important applications where their superior efficiency has made them desirable. According to a technical paper presented at the IRE Convention by E. O. Johnson, W. M. Webster and J. B. Zirker, of the David Sarnoff Research Center, *Radio Corporation of America*, Princeton, N. J., properly designed gas tubes can now be operated so as to generate a minimum of noise.

If a tube structure is designed so that the arc discharge inside the tube is made to occur in a narrow region so close to the anode surface that the anode appears to glow, the low noise level can be compared to that of an equivalent high vacuum tube. Several experimental tube structures were described which make use of this so-called "anode-glow mode," with particular reference to the design of low-noise rectifier units for electronic circuits.

CBS-HYTRON TUBES

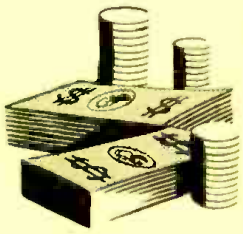
Filter Reactor

The *CBS-Hytron* 6216 is an electron tube of beam power design with miniature 9-pin construction. It may be used in Class A, B, and C amplifier applications, as a passing tube in electronic voltage-regulated power supplies, in

(*Continued on page* 30)

What means most to an Engineer?

PROFESSIONAL RECOGNITION



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COMMUNICATIONS—Microwave—Aviation—Mobile—Specialized Military Systems

MISSILE GUIDANCE—Systems Planning and Design—Radar and Fire Control—Servo Mechanisms—Vibration and Shock Problems

NAVIGATIONAL AIDS—Loran—Shoran—Altimeters—Airborne Radar

TELEVISION DEVELOPMENT—Receivers—Transmitters and Studio Equipment

COMPONENT PARTS—Transformer—Coil—Relay—Capacitor—Switch—Motor—Resistor

ELECTRONIC TUBE DEVELOPMENT—Receiving—Transmitting—Cathode-Ray—Phototubes and Magnetrons

ELECTRONIC EQUIPMENT FIELD ENGINEERS—Specialists for domestic and overseas assignment on military electronic communications and detection gear.

RADIO CORPORATION of AMERICA

NEWS BRIEFS

WESTINGHOUSE TRANSISTORS

Transistors are now being manufactured in limited quantities for application and equipment development at the Electronic Tube Division plant of *Westinghouse Electric Corporation* in El-

mira, N. Y. Some of the developmental models were unveiled at the Institute of Radio Engineers Convention, including the one shown here beside a standard vacuum-type electronic tube. According to *Westinghouse* engineers, these transistors are expected to have almost unlimited life.

"LOW-COST" COMPUTER

The ELECOM 100, a "low-cost" electronic computer available commercially for general use, was accepted by Army Ordnance officials at Aberdeen Proving Ground after it successfully completed

60 hours of nonstop tests. This "robot brain" made 4,212,000 computations without a single mistake in the first 42 hours of operation, thereby proving its capacity to handle the complex calculations required in the solution of fire control problems.

According to the *Underwood Corporation*, 1 Park Avenue, New York 16, N. Y., manufacturer of the computer, the ELECOM 100 can store for immediate use over 100,000 words of nine digits each, and can solve a 10-digit mathematical problem several hundred times faster than conventional desk calculators. It consists of three units: a conventional office desk, a compact "memory" unit, and the computer proper which is housed in five steel cabinets joined in a semicircle.

CORONATION IN COLOR

The Coronation of Queen Elizabeth will be televised in color in Great Britain through the facilities of *Chromatic Television Laboratories, Inc.*—an affiliate of *Paramount Pictures Corporation*—and *Pye, Ltd.*, one of the leading TV manufacturers in England. The Lawrence color television tube developed by *Chromatic* will be used to display the special color program with special color television cameras developed by *Pye, Ltd.*, to be used in picking up the historic event.

This will be the first showing of the Lawrence tube—invented by Dr. Ernest O. Lawrence of the University of California—in England; it has been widely demonstrated in New York and at *Chromatic's* laboratory in Oakland, Calif.

ELECTRONIC DIVISION

An Electronic Instruments Division has been established in Philadelphia, Pa., by *Burroughs Adding Machine Company* which will produce a line of electronic laboratory apparatus and other special devices. It will also offer to business a scientific computation service, employing the *Burroughs* electronic digital laboratory computer and other advanced computation apparatus. In addition, it will make its facilities available to the armed services for the fabrication of electronic instruments.

Perry C. Smith, formerly a department manager in the *Burroughs* Research Activity, has been appointed director of the new division.

TRANSISTOR REPEATER

Engineers at *Bell Telephone Laboratories* have developed an experimental ultraminiature transistor repeater, shown in the photograph along with a house fly for comparison. Over-all length is about 1½", and the diameter is only 0.15".

The repeater utilizes the recently developed h.f. tetrode junction transistor, which is contained in the tubular case along with 14 other components. Power consumption is 0.1 watt, and maximum undistorted power output is 10 mw. into a 75-ohm load. Gain is 22 db flat within ± 0.1 db from 0.4 mc. to 11 mc. Over the 10-mc. bandwidth, the output noise level is about 72 db below 1 mw. Power

can be obtained by an extra wire or by the coaxial cable conductors.

Although still in the experimental stage, this unit is capable of handling high quality television signals. Integration of the unit into complete transmission systems is under investigation.

FLIGHT SIMULATORS

North American F-86D Sabrejet flight simulators are now operational at five U. S. Air Force bases and are well integrated into training programs requiring 8 to 18 hours-per-day operation. Schedules are being prepared which will require round-the-clock usage to train pilots in instrument flight procedures,

radio and navigational aids procedures, and radar interception procedures.

These 22,000-pound units, manufactured by the *Engineering and Research Corporation*, Riverdale, Md., reproduce ground-handling, flight and power plant characteristics of the all-weather version of the famous North American F-86 Sabrejet fighter. The F-86D simulators are the first to reproduce the entire operational problem of the radar fire control system in the aircraft, including both normal tactical use and various emergency conditions.

MICROWAVE PATH TESTING

In a paper presented before the Southern District Meeting of the AIEE

in April, Mr. R. D. Campbell, an *AT&T* engineer, stated that because of the substantial sums necessary to erect permanent towers for microwave radio relay systems, extensive tests of possible paths should be made before final sites are selected.

Although selection of sight-to-sight relay paths largely depends on observation and study of contour maps and the terrain over which the waves will pass, several other factors must be taken into consideration, namely, trees, buildings, water, the type of land involved and atmospheric conditions. Mr. Campbell pointed out that initial testing before permanent towers are built can be of great assistance to the engineer in selecting sites and determining optimum tower heights.

CONDUCTIVE CERAMIC

High power dummy loads of a new conductive ceramic have been developed to meet the demand for a matched wave guide termination capable of absorbing high powers without the necessity for water cooling. The conductive ceramic is "Caslode," recently developed by *The Plessey Company Limited*, Ilford, Essex, England. A white, homogeneous material, it is capable of absorbing power at centimeter and millimeter wavelengths.

Wedge-shaped components have been designed to operate in the common sizes of wave guides, and recent measurements have indicated that units originally developed to give a match of about 0.95 and to dissipate about 100 watts mean power at 3 cm. wavelength can absorb 250 watts mean power without any appreciable change in matching properties.

SRI NEWS

Dr. John V. N. Granger, assistant chairman of Stanford Research Institute's Engineering Department and head of its Aircraft Radiation Systems Laboratory, was chosen by the ETA KAPPA NU as "The Outstanding Young Electrical Engineer of 1952." The award of this national honor society of electrical engineers, which has been presented each year since 1936, is based on service to community as well as professional achievement.

Dr. Cledo Brunetti—who, incidentally, received the ETA KAPPA NU award for 1941—has resigned his position as associate director of Stanford Research Institute to accept an executive research post with the Mechanical Division of *General Mills, Inc.* In his new connection, Dr. Brunetti will be concerned with setting up a new general research laboratory and with the industrial development of this division.

NEW PRODUCTS

"TELEDUCER"

The "Teleducer" Type 24A automatically converts analog voltages into decimal digits with an accuracy of 0.1% (1000 counts full scale). Developed by

the *Telecomputing Corporation*, Burbank, Calif., it operates on demand, digitizes an input voltage and holds the digital representation for a controllable period of time for purposes of display, recording or any desired readout form.

This instrument digitizes low voltage without d.c. amplification and high voltage by means of attenuators. It uses a simple bridge-balancing circuit which does not hunt or oscillate, and requires only 0.8 second or less to reach balance.

DUAL-PURPOSE TEST SET

"American Wavemeter" Model AET-117—a complete portable frequency meter—has been announced by the Electronics Division of *American En-*

caustic Tiling Co., Inc., Lansdale, Pa. Designed for measuring operating frequency and making relative power measurements of microwave transmitters or signal sources, it covers a range of from 2400 to 3400 mc. It is applicable to pulsed transmitters as well as continuous wave systems.

A novel feature of this test set is its ability to register either transmission or reaction type measurements. Measurements can be made by coupling the wavemeter directly to the signal source or at a remote point by means of a self-contained directive antenna.

COIL BOBBINS

Multiflange coil bobbins for r.f., i.f. coils, push-pull solenoids, switching, timing and reversing circuits, etc., are now available in any size, shape, I.D.

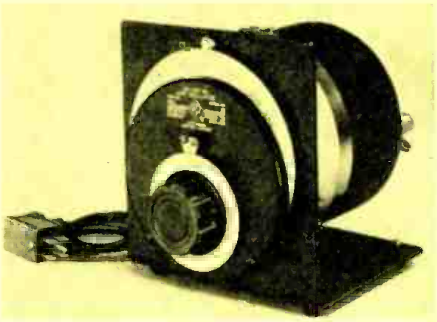
or O.D., and in any quantity from the *Precision Paper Tube Company*.

Spirally wound under pressure, these multiflange bobbins are subjected to rigid tolerance control to insure strict adherence to specifications and maximum winding space. They are said to possess 15-20% greater strength, yet are light in weight. Cores are made from dielectric kraft, fish paper, acetate or combinations of these papers. For further information, write to *Precision Paper Tube Co.*, 2051 W. Charleston Street, Chicago 47, Ill.

V.H.F. UNIT OSCILLATOR

Capable of producing frequencies from 50 to 250 mc. over a single continuous range, the Type 1215-A unit oscillator is an addition to the unit line of building-block instruments being introduced by *General Radio Company*, 275 Massachusetts Avenue, Cambridge 39, Mass. It can be modulated at both audio and radio frequencies, and plugs directly into the previously announced Type 1203-A unit power supply.

Frequency is read directly from a 6" dial with a calibrated slow-motion drive. The tuned circuit of this oscil-



lator is a semibutterfly type which has no sliding contacts. At least 80 milliwatts can be delivered at any frequency into a 50-ohm load.

ACCELEROMETERS

A series of accelerometers has been designed by the *Gulton Manufacturing Corporation* to meet the need for lightweight, high sensitivity pickups. Designated as *Glennite* series A310, A311 and A312, these units are particularly useful as general-purpose laboratory instruments and as transducers.

The three units are mechanically interchangeable, and are usable over a wide range of acceleration—from 0.01*G* to 500*G*. They are equipped with quick-disconnect interchangeable shielded cables four feet in length. For complete information on these accelerometers, write for Bulletin A310, available from the *Gulton Manufacturing Corporation, Metuchen, N. J.*

COMPARISON BRIDGE

Designed for production-line operation but capable of laboratory accuracy, the Model E-1 comparison bridge pro-

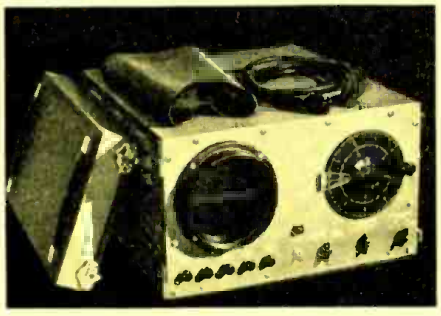
vides a low-cost means of securing uniform characteristics in resistors, capacitors, and a.f. inductances. It has just been placed on the market by *Southwestern Industrial Electronics Co.*, 2831 Post Oak Road, Houston 19, Texas.

Model E-1 features simplified controls and an easy-to-read inclined meter, enabling unskilled operators to check thousands of components per hour. Five scales allow components to be matched

or compared with standards within limits of 1%, 2.5%, 5%, 10%, and 25% of full-scale deflection. The 1% scale may be read accurately to indicate differences between components as small as .1%.

LINE FAULT ANALYZER

Sierra Electronic Corporation, San Carlos 2, Calif., has announced an analyzer which is said to eliminate virtually all the time, work and hazard concerned with locating power line faults. Operating from any powerhouse, transformer bank or substation, the Model 124 instantly pinpoints



shorts, grounds or open circuits at ranges of from 1/2 to 200 miles.

This instrument is direct-reading and simple to operate. It can be attached quickly and easily to any line, using regular carrier coupling capacitors. Tests can be made phase-to-phase or phase-to-ground. The Model 124 is lightweight, weatherproof and portable, and unaffected by change in line spacing.

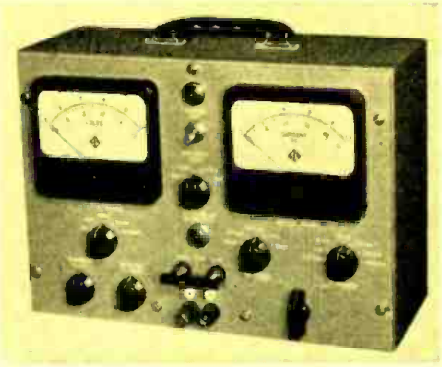
CHAIN AMPLIFIER

The *SKL* Model 202C wide-band chain amplifier has an extended bandwidth of 1 kc. to 210 mc. Twelve 6AK5 tubes in a chain circuit provide a gain of 20 db uniform within ± 1.5 db over the bandwidth. The rise time of this new untuned chain amplifier is less than .0026 microseconds (10% to 90% amplitude). Input and output impedance is 200 ohms, with a stabilized power supply preventing fluctuations of gain due to line voltage changes.

Model 202C has an unusually low noise figure of 9 db, making it useful in narrow-band as well as in wide-band applications. For further information on this amplifier, address *Spencer-Kennedy Laboratories, Inc.*, Dept. RT, 186 Massachusetts Ave., Cambridge, Mass.

DIODE TESTER

Static characteristics of germanium and low power selenium diodes, including power type germanium diodes, can be measured with the Model DT-100 diode tester now available from *Teletronics Laboratory, Inc.* Inquiries on this instrument should be addressed to



Dept. RT, *Teletronics Laboratory, Inc.*, 54 Kinkel Street, Westbury, N. Y.

Separate forward and reverse power supplies having continuously variable outputs or preset regulated reverse potentials permit complete measurements or checks at selected operating points. The arrangement of controls and connectors and the circuits employed provide accurate results with a minimum of operations.

"TWIST & TURN" ELBOW

General Precision Laboratory, Inc., 63 Bedford Road, Pleasantville, N. Y., has announced an improved "twist &

(*Continued on page* 27)

Personals

FRANCIS J. GAFFNEY, widely known for his work in the field of microwave measurement and pulse circuit techniques, is now director of engineering for the Guided Missiles Division of the *Fairchild Engine and Airplane Corporation*, Wyandanch, L. I., N. Y.; he was formerly general manager of the *Polytechnic Research and Development Company*. During World War II, Mr. Gaffney headed the Test Equipment Group in the MIT Radiation Laboratories.

MARVIN HOBBS, who recently joined *Harvey-Wells Electronics Inc.*, Southbridge, Mass., as director of engineering, has been elected vice-president and a member of the board of directors. From 1950 to 1952, Mr. Hobbs was the Defense Department member of the Electronics Production Board and director of the Electronics Division of the Munitions Board. Prior to 1950, he held various engineering positions with *RCA*, *Scott*, *General Motors* and *Zenith*.

LAWRENCE A. HYLAND, discoverer of the principle of radar detection of aircraft, was elected vice-president in charge of engineering of *Bendix Aviation Corporation*. With *Bendix* since 1937, and a vice president since 1949, Mr. Hyland will now have charge of the $50,000,000-a-year engineering program. In 1950 he received the Navy's highest civilian honor, the Distinguished Public Service Award, for his contribution to the development of radar.

ANGUS A. MacDONALD was appointed assistant chief engineer in charge of two-way radio development at the Communications and Electronics Division of *Motorola Inc.*, Chicago, Ill. Prior to joining *Motorola*, Mr. MacDonald was a section manager for *Westinghouse Electric Corporation*. Recently he has been responsible for design and development of v.h.f. mobile equipment, medium and h.f. point-to-point transmitters, and broadcast equipment.

DR. ELMER H. SCHULZ has been promoted to director of research at the Armour Research Foundation of Illinois Institute of Technology; he was formerly manager of the Physics and Electrical Engineering Division. The author of numerous technical articles, Dr. Schulz has held many high offices in professional societies, including the presidency of the National Electronics Conference in 1951. He received his doctorate at Illinois Tech. in 1946.

GENE B. SPAULDING, previously guidance group engineer at *TEMCO Aircraft Corporation*, Dallas, Texas, has been promoted to superintendent of electronics. At one time an electronics technician and instructor in the Navy, Mr. Spaulding was with *Luscombe Airplane Corporation* before he joined *TEMCO* in 1950 as an engineering designer. He then became supervisor of the electrical, radio and instrument group, and a guidance group engineer in 1952.

Traveling-Wave Tube

(*Continued from page* 14)

them all again at the point of reception. For radio transmission also, signal bandwidth must always be limited because of frequency-space allocations.

At the *Bell Telephone Laboratories*, studies are being made regarding the possibility of long-distance wave guide transmission of millimeter-wavelength signals. Because the signal is not radiated in this case, it may be possible to utilize the full bandwidth capabilities of these new tubes at some future date. By use of parallel facilities, the available frequency space can become virtually unlimited. The old dream of private television transmission with long-distance telephone calls no longer seems an idle dream.

Looking at Tubes

(*Continued from page* 18)

essary readjustment of the horizontal is then made.

Much credit should go to those engineers who have undertaken research and development work on such three-pickup-tube color television cameras.

Each camera tube output signal should correspond in amplitude to the variations in the brightness, in the scene, of its respective primary color. The outputs of the three video preamplifiers may be connected to a high speed electronic switch, as in the older dot sequential system, or to a matrix of amplifiers and attenuators to give amplitude- and frequency-modulated signals, as in the NTSC system.

In the dot sequential system, for example, the three signals were successively sampled and commutated at a frequency of 3.58 mc., so that each tube was coupled to the line amplifier for approximately .02 μsec. and disconnected for about .08 μsec. This gave an output signal consisting of a series of pulses with amplitudes corresponding to the color and to the brightness of each color. In effect, this switching technique has produced a pulse-amplitude modulated or PAM signal in which spaces between the pulses are constant but the amplitude varies.

CALENDAR of Coming Events

JUNE 22-26—American Society for Engineering Education, University of Florida, Gainesville, Fla.

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

SEPTEMBER 28-30—National Electronics Conference, Hotel Sherman, Chicago, Ill.

TECHNICAL BOOKS

"SERVOMECHANISM ANALYSIS" by George J. Thaler and Robert G. Brown. Published by *McGraw-Hill Book Co., Inc.*, 330 W. 42nd Street, New York 36, N. Y. 414 pages. $7.50.

This text presents the mathematical and graphical methods developed for one type of automatic control system —servomechanisms. The presentation is from the point of view of analysis, since the authors believe that analysis must precede design. Those items which are basic are treated in considerable detail, while more specialized topics are discussed briefly.

After an introduction to the basic principles of the subject and the basic concepts involved, the mechanics of applying the Laplace transform are treated, followed by a discussion of the equations of physical systems. Chapters 4 through 12 contain the principal tools for the analysis and design of servomechanisms. Relay servomechanisms are then covered, as well as the fundamental principles of the root-locus method of analysis.

The appendices, while abbreviated, contain a good deal of factual information about components not heretofore assembled in any one book. Numerous bibliographical references are also included.

"TELEVISION RECEIVER DESIGN—Monograph 1—I.F. Stages" by A. G. W. Uitjens. Published by *N. V. Philips' Gloeilampenfabrieken*, Eindhoven, Holland. Distributed in the United States by *Elsevier Press Inc.*, 155 East 82nd Street, New York 28, N. Y. 179 pages. $4.50.

Part VIIIA in the Philips Technical Library series of books on electronic valves, this monograph deals with the application of the pentode in the i.f. section of a superheterodyne receiver and the h.f. stages of a TRF receiver. It is the first of the series which treats the subject of television receiver design.

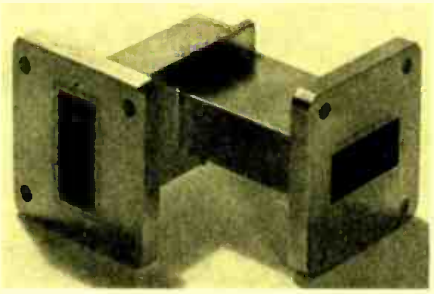
Topics covered are: gain and bandwidth with two-terminal coupling networks; response curve of the complete amplifier; distortion; gain, bandwidth and distortion with four-terminal coupling networks; noise; and feedback. The last chapter shows how the preceding material can be used in designing circuits for i.f. amplification in television receivers.

Derivations of formulas used in some parts of the text are given in the appendices, followed by several tables and a list of symbol definitions.

New Products

(*Continued from page* 25)

turn" elbow for microwave systems. This X-band component combines the functions of both a 90° elbow and a 90° twist section in one compact unit. It is available in RG 51/U, RG 68/U,



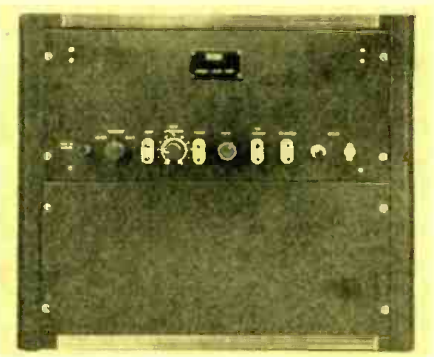
RG 52/U and RG 67/U wave guide, with arm lengths and terminations to customers' specifications.

Representative electrical data are as follows: VSWR design center—1.03; maximum VSWR for 400-mc. bandwidth—1.10; for RG-52/U and RG-67/U wave guide, maximum VSWR over 10% bandwidth—1.40, power handling capacity—100 kw., peak; for RG-51/U and RG-68/U, maximum VSWR over 10% bandwidth—1.30, power handling capacity—500 kw., peak.

MAGNETIC TRANSIENT RECORDER

One-shot or irregular frequency phenomena containing components from d.c. to 30 kc. can now be recorded and displayed on an oscilloscope through the use of the Type 103 magnetic transient recorder developed by *Magne-Pulse Corporation*, 140 Nassau Street, New York 38, N. Y.

The low frequency characteristic of this recorder, which makes possible reproduction of square waveforms with



duration periods as long as 20,000 microseconds, is achieved through pulse-time modulation—the sync pulse permits examination of any portion of a waveform. Type 103 can be used for recording Geiger pulses, recording heart beats in hospitals, and for various applications in laboratories conducting research on radar, television, atomic phenomena, and computing.

NEW LITERATURE

PRINTED CIRCUIT COMPONENTS

Printed circuit components designed for use in television receivers utilizing intercarrier sound systems and having picture i.f. and sound i.f. carriers of 45.75 mc. and 41.25 mc., respectively, are described in an eight-page booklet released by the *Radio Corporation of America*. It may be obtained on request from Commercial Engineering, *RCA* Tube Department, Harrison, N. J.

Employed in properly designed circuits, these printed circuit i.f. components feature high gain, full bandpass response, and excellent skirt sensitivity. They can provide an over-all sensitivity of 70 microvolts at 44 mc. with accurate control of the response-curve shape.

TELEMETERING

Bulletin M1710, just published by *The Bristol Company*, Waterbury 20, Conn., contains material on the use of the company's Metameter telemetering instruments for remote recording, indicating, and totalizing of electric variables over distances ranging from a few feet to many miles. A number of typical installations in use at generating stations, on tie lines, and on dispatching boards are illustrated and described.

Timely information and engineering data on the subject of modern telemetering methods are included in this bulletin, and *The Bristol Company's* electronic Dynamaster transmitters and receivers are also described.

ELECTRICAL INSULATIONS

"Quinterra—Quinorgo" is the title of a 32-page publication just issued by *Johns-Manville*. It gives complete information about these electrical insulations made of purified asbestos . . . why they were developed, what their characteristics are, and where they may be used to advantage.

This publication is both a manual of facts and a descriptive brochure. For the designer of electrical equipment there are tables giving test data on physical and electrical properties. For the production man there is advice on application techniques and equipment, including step-by-step photographic coverage of methods now in use.

Copies of "Quinterra—Quinorgo" are available from *Johns-Manville*, 22 East 40th Street, New York 16, N. Y.

R.F. MEASUREMENT METHODS

Controlled utilization of r.f. power necessitates accurate methods of measurement. In Circular 536, entitled "Radio Frequency Power Measurements," the National Bureau of Standards presents a comprehensive survey of the methods currently in use and a brief discussion of the theoretical background, practical limitations and advantages of these methods.

This 16-page circular, which contains sections on calorimetry, substitution methods, single-variable devices, two-variable devices, and directional couplers, may be ordered from the Government Printing Office, Washington 25, D. C., for 15 cents a copy.

MAGNETS

Thomas & Skinner Steel Products Company, Inc., has released a catalog which lists its complete line of standard permanent magnets. Available in Alnico 2, 3 and 5, for use in a wide range of industrial applications, *Thomas & Skinner* standard magnets may be ordered from stock to aid designers and engineers who need magnets quickly in order to produce working models for experimental purposes, to fulfill moderate production requirements, or to adapt to a standard application without tooling delays.

For Standard Magnet Catalog No. 1252, write to *Thomas & Skinner Steel Products Company, Inc.*, 1180 East 23rd Street, Indianapolis 5, Indiana.

POLYESTER FILM

Up-to-date information on the physical, electrical, and chemical properties of "Mylar" polyester film—together with suggested applications—has been issued by the Film Department of *E. I. du Pont de Nemours & Company*. "Mylar," one of the newest products of *Du Pont* research, is now being produced in limited quantities only for market development purposes.

Bulletin #1-2-53 consists of 17 pages, complete with charts, diagrams and tables. Copies may be obtained from the *Du Pont* Film Department's Sales Development and Technical Service Section, Wilmington 98, Delaware.

POLYETHYLENE

Information on the properties, applications and methods of fabricating *Bakelite* polyethylene plastic is set forth in a revised 24-page booklet published

HIGH-SPEED ELECTRONIC DIGITAL COMPUTER

SHOWN below is the "ERA 1103" general-purpose electronic digital computing system recently announced by the *Engineering Research Associates Division* of *Remington Rand Inc.*, 315 Fourth Avenue, New York 10, N. Y. It was originally developed for the United States Government, but commercial models will be available in 1954.

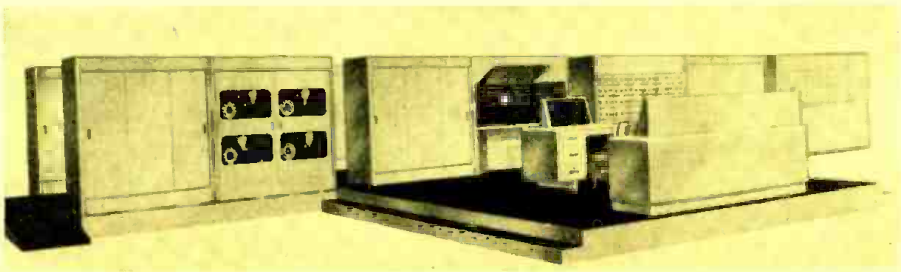
The computer features: a high-speed electrostatic storage system with an access time of 6 to 10 microseconds; a medium-speed magnetic drum storage with a transfer speed of 30,000 words a second (one word consisting of 36 binary digits); and a relatively low-speed magnetic tape storage of about 200,000 words, with a transfer speed of about 750 words (or 27,000 binary digits) per second. Any or all of these systems can be used in a given computation.

High speed operation has been achieved in this unit. It will add 16,700 ten-digit numbers in one second, and the average time for a two-address multiplication is 266 microseconds. The complete unit weighs ten tons, occupies a floor area of about 20′ x 60′, and contains 4500 tubes. Marginal checking during preventive maintenance is employed to improve reliability.

Input-output equipment consists of a photoelectric punched paper-tape reader, a high-speed teletype paper-tape punch, an electric typewriter, and magnetic tape. Card readers can also be provided.

Major applications of the "ERA 1103" include automatic process control, air traffic control and air defense, aircraft design and development, general industrial and economic planning, and scientific-mathematical computation. The development of this computer represents a major stride toward the completely automatic control of industrial processes.

An over-all view of the "ERA 1103" high-speed digital computer.



by the *Bakelite Company*, a division of *Union Carbide and Carbon Corporation*. One of the applications of this plastic is in the sheathing of coaxial wire and cable widely used for radio, radar and television installations. As a coating for copper and steel tubing, polyethylene prevents external corrosion due to abrasion or the mishandling of liquid chemicals.

Copies of this booklet may be obtained by writing to the *Bakelite Company*, 300 Madison Avenue, New York 17, N. Y.

PHOTOELECTRIC RECORDER

A two-color, fully illustrated, 12-page bulletin on photoelectric recorder applications is available from the *General Electric Company*, Schenectady 5, N. Y.

GEA-5536 describes applications of the Type CE recorder with seismology, psychology, textile, metals, fatigue and research testing equipment; as an aid in the quick detection of pipeline corrosion; and in development and machinability testing, medical research, light-intensity study, and paper-machine-speed measuring.

Temperature Controller

(*Continued from page* 11)

able of operating at an ambient temperature of 110°C. To produce such a unit, a new approach to the field of barrier layers was necessitated in order to obtain a rectifier whose reverse resistance would not vary appreciably with increasing temperatures. A new counter-electrode composition was also required in order to prevent melting at hot-spot temperatures. Solutions to these problems were obtained after several months of investigation.

Within the package there was no room for mounting brackets. As a result, the components were wrapped with special thermosetting tape. Thermal conductivity of several potting compounds was investigated, and it was decided that a potting compound of the "cold pouring" type was most suitable. This type provided adequate thermal conductivity. It was necessary to use a potting compound which could be easily handled and did not require high oven temperature for proper baking; the life of the components might have been seriously shortened if exposed to temperatures of 300°F and higher.

Before final assembly, the unit appeared as shown in Fig. 1. This package occupied approximately 34 cubic inches. Inspection of Fig. 3B suggests that the package might be made smaller by eliminating the stepdown transformer which supplies power through the rectifier to the Wheatstone bridge. Further examination reveals, however, that for the same sensitivity the resistance of the temperature-sensitive arms must increase to approximately 1200 ohms, and the control winding turns must increase to approximately 9000. There are several disadvantages to this increase in resistance which should be considered. The length and diameter of a ballast nickel resistance wire needed to meet the new value of resistance make this a poor alternative. Winding 9000 turns with an AWG #37 Hi-temperature insulated magnet wire on a toroid leads to unreliability in addition to presenting manufacturing difficulties. These considerations led to a change in the original specifications with respect to the desired package size.

As a result of this development work, a compact temperature controller was produced which regulates the temperature of the load at a specified point to within ±0.08°F and is adjustable over the range of 130° to 150°F. The initial warm-up period is approximately 1¼ hours; maximum overshoot of controlled temperature is approximately 3%. The controlled temperature is in the regulation band within 15 minutes.

Cooperation of the *Belcon Rectifier Division* of the *Bogue Electric Manufacturing Company* and the *Selenium Research Corporation* in developing the rectifiers used in this application is gratefully acknowledged.

Mobile FM Radio

(*Continued from page* 6)

selectivity-determining elements, is mounted as a separately replaceable item. Interchangeability is thereby introduced to allow 60-kc. channel, 40-kc. channel, or even narrower-band operation as desired. In the event split-channel operations become standard practice, the alternate- or adjacent-channel equipment owner need only replace his i.f. wave filter unit to achieve the desired degree of selectivity.

An r.f. oscillator kit including the frequency-stabilizing crystal assembly is provided with the associated transmitter to allow two-frequency operation. In such operation, the change from one channel to another is accomplished by simple switch action. Crystal assemblies utilized are of the heated oven type with thermostat temperature control.

Tremendous strides have been made in the radio communications industry during the last few years. Two-way radio is now truly mobile—on wings and wheels. It is no longer a restricted implement available only to Army, Navy and police. It has become a tool of industry and an everyday aid to citizenry.

New Tubes

(*Continued from page* 20)

wide-band video amplifiers, and in passive switching applications.

When used in appropriate circuits, this tube replaces the iron-core filter choke in airborne and vehicular electronic equipment, thus materially reducing the weight and space normally required for the choke. It is equivalent in performance to a 12-henry filter choke of 350 ohms resistance, rated to carry 100 ma.

U.H.F. Oscillator Triode

Also announced by the *Hytron Radio & Electronics Co.*, a division of *Columbia Broadcasting System, Inc.*, Danvers, Mass., is Type 6T4, a u.h.f. oscillator triode with a small-button miniature 7-pin base and a heater rating of 6.3 v. at .225 amp. When it is used as an oscillator at 950 mc., with 100 d.c. volts on the plate, a useful power output of 160 mw. can be obtained. The tube also can be operated as a Class A amplifier.

TWIN TRIODES FOR IBM COMPUTERS

About 2700 of *General Electric Company*'s Type GL-5965 high-perveance twin triodes are being used in each of the new electronic data processing machines now being produced by the *International Business Machines Corporation*. The twin triodes make up nearly two-thirds of the total complement of tubes used in the *IBM* computer, which is the largest all-purpose computer being built in quantity—it will make 14,000 mathematical calculations per second.

Although the Type GL-5965 tube was first announced last summer, it was designed in conjunction with IBM engineers and its use in this computer represents its first major application. It is used in a wide variety of circuit functions, an important factor in multitube equipment in which it is necessary to control the variety of tubes employed, and is expected to have wide application in other types of computers.

Testing Vacuum Tubes

(*Continued from page* 16)

meter may read backwards or may waver unsteadily as one's hand is brought near the tube. This can be eliminated by placing bypass condensers from grid to ground or otherwise loading the circuit down. Another source of error may be detected by switching off the plate voltage and noting whether or not the microammeter reads backwards. With a.c. filament voltage and low grid bias, the cathode may swing negative with respect to the grid, resulting in grid current flow.

Low Emission

Under normal operating conditions, the end of life of a vacuum tube is determined by loss of emission. Tungsten filament tubes suffer loss of filament diameter until they burn open; oxide-coated cathodes lose emission due to evaporation of the barium and poisoning from liberated gases; thoriated tungsten filaments lose emission due to the evaporation of thorium and also due to poisoning. Emission capabilities of cathodes always exceed the static operating conditions of electrode currents, so that emission readings cannot be taken on a test such as is shown in Fig. 3A without overheating the electrodes and damaging the tube. The emission must be read at reduced values of filament voltage and results correlated with normal operating conditions, or the voltage must be applied in pulses so that overheating does not occur. This latter method is better for weeding out bad tubes and may be performed in a test circuit such as is outlined in Fig. 3B. As shown, the grid and plate are tied together and positive voltage pulses from the condenser circuit are applied. Normal filament voltage is applied, but the condenser should be charged to a voltage recommended by the tube manufacturer. Oxide coated and thoriated tungsten cathode emission does not saturate at higher voltages as does pure tungsten. If the pulse voltage is too high, oxide-coated cathodes will spark and be destroyed.

Transconductance

Commercial bridges are available for measuring the mu and G_m of tubes but are, however, fairly expensive. The test set of Fig. 3A can be used for

VERSATILE MULTIVIBRATOR

By JOHN M. WILDER

Although originally designed as a training aid, the three-way multivibrator shown schematically in Fig. 1 may be used for any application in which a choice of waveforms and/or modes of operation is desired.

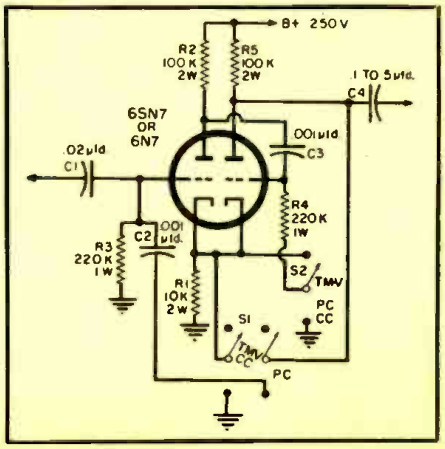
With both switches in the downward position, the circuit operates in the conventional symmetrical, free-running, plate-coupled mode. S_1 grounds the cathodes of both V_1 and V_2 and connects the plate of V_2 to the grid of V_1. The symbols V_1 and V_2 refer to the first and second halves respectively of the dual triode. S_2 returns the bottom of R_4 to ground.

When the unit is employed as a cathode-coupled, free-running multivibrator, S_2 should be left in the downward position and S_1 moved to the upward position. This disconnects the grid of V_1 from the plate of V_2 and connects the cathode resistor in the circuit.

For either mode of operation, a synchronizing voltage may be applied to the grid of V_1 through C_1.

For operation of the unit as a triggered or "one-shot" multivibrator, S_1 and S_2 should both be in the upward position. A positive trigger pulse must then be applied to the grid of V_1 for the circuit to operate. One cycle of operation will result from each pulse applied, provided that the rate of application of these pulses does not exceed the natural frequency of the multivibrator. For the values given, this frequency will be approximately 800 cps.

Fig. 1. Schematic of the multivibrator.



making measurements of this sort if the engineer wants to take the time to make them. For a G_m measurement, he should start at a grid bias value approximately 20% higher than normal, maintain the plate voltage constant at its normal value, and read plate current. The grid bias is then lowered in convenient steps and the plate current read at each step with the plate voltage maintained constant at its normal value. The slope of the curve of E_c vs. I_p at the point of normal current flow will give the G_m measurement, i.e.,

$$G_m = d(I_p)/d(E_c)$$

The G_m of a triode varies proportionally as the one-third power of the plate current, so the current must be specified for each value of G_m.

An amplification factor measurement can be made in much the same way except that the plate current should be maintained constant and the plate and grid voltages varied.

$$\mu = d(E_p)/d(E_c)$$

It should not be necessary to run these lengthy tests on all the tubes. If a few samples of "good" and "bad" tubes are so tested, enough information should be acquired to determine if differences in G_m or μ are the source of trouble.

When taking these readings, it is well worth while to compare the values of grid voltages for the different tubes at specific values of plate current and voltage. Tubes whose grids have had holes burned in them or have been otherwise distorted or damaged will show up with abnormally high grid bias voltage; tubes with low emission may show up with low grid bias.

Operational Defects

Needless to say, operational defects in tubes are detected in the equipment itself. However, since the object is to disassociate the tube from the equipment in difficulty, some sort of test unit simulating the operational stage wherein the tube works is in order.

Low Power Output

Utilizing a self-oscillating or an amplifier circuit driven by another oscillator at the maxium frequency for which the equipment is designed, the power from the tube may be measured in many conventional ways. At the low frequencies, a properly tuned load resistor with a vacuum tube voltmeter across it will suffice: $P_o = V^2/R$. Some engineers prefer an ordinary electric light bulb of the proper wattage with the base removed for a dummy antenna. It can be calibrated with a photoelectric cell and milliammeter so as to indicate watts output.

Above 50 mc., more elaborate equipment is required, such as tuning stubs, water-cooled resistors, and bolometers.

Plate voltage, grid bias, and other parameters should correspond as nearly as possible to those in the equipment. The feedback from the oscillator, or grid drive to the amplifier, should be adjusted so that the rectified grid drive current corresponds to that in the equipment. The antenna coupling should be adjusted so that each tube draws the same plate current. Thus, their plate efficiencies may be directly compared.

Frequency Shift

The amplifier circuit above could lend itself to checking thermal frequency shifts in a tube. If the tank circuit and antenna tuning circuit both have high Q and are well tuned for maximum power output at the beginning of the test, any large frequency shift will be accompanied by a reduction in power output. Similarly, by tuning the circuit to optimum for the average of several "good" tubes, the engineer can determine if the "bad" ones require major retuning to achieve maximum output.

Sparking

The more seriously defective tubes showing sparking and intermittent shorts can be picked up on the static test set, especially if the tube is tapped gently while the voltages are applied. However, the most severe operation is in the oscillator or amplifier circuit, and at this time any such phenomena can be observed as instability in the plate current meter, or —if the tube is not enclosed within a cavity—as flashes within the tube itself.

Conclusion

The above analysis does not, by any means, include all the tube defects that are possible, although the major ones have been discussed—especially the ones for which an equipment manufacturer might most readily test. Nor is each defect clearly separable. A low power output tube could very well have low emission or be gassy—a simple power output test would not indicate the specific defect.

It should not be assumed from this discussion that in equipment problems it is the tube that is usually at fault. As a matter of fact, each tube is subjected to most of the tests discussed here and several more before being placed in the carton. Allowances should be made by the equipment designer for the manufacturing variations in tube characteristics and, in cases of potentially large orders, "limit" tubes should be tried in the prototype equipment.

REFERENCES:

1. *Flanagan, James L., "Vacuum Tube Testers," Electronics, June, 1952, p. 139.*
2. *Guthrie, A., and Waperling, R. K., "Vacuum Equipment and Techniques," McGraw-Hill Book Co., Inc., pp. 139-141.*

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CINCINNATI IRE TV CONFERENCE

Highlights of the nine technical papers presented in Cincinnati at the Seventh Annual Spring Technical Conference on Television.

THE ANNUAL Spring Technical Conference on Television, sponsored by the Cincinnati Section, IRE, in cooperation with the Professional Group on Broadcast and Television Receivers, was held in Cincinnati on April 18. Paid registrations totaled 328, in spite of bad weather.

Given below is a brief abstract of each of the nine technical papers presented at the Conference.

TELEVISION AND THE BELL SYSTEM, David Younger, *American Telephone and Telegraph Company*

The Bell system had 35,000 channel miles of television networks in operation the first of this year, permitting 93% of set owners in the United States to have network programs available. Approximate cost of a coast-to-coast TV relay circuit for a half-hour program is $600. Synchronization between sight and sound in TV relaying is held to within 60 microseconds.

Coming improvements include the use of amplifiers of much greater bandwidth and closer spacings on the coax lines to triple the number of telephone circuits which can be provided. A new microwave system is under development which will operate at 6000 mc. instead of the present 4000 mc. Work is also progressing on wide-band transmission through wave guides over long distances.

A 12-KW. U.H.F. TELEVISION TRANSMITTER, F. J. Bias, *General Electric Company*

The *General Electric Company* is currently offering a u.h.f. TV transmitter which has an output of 12 kw. When used with a five-bay helical antenna, an effective radiated power of 300 kw. can be obtained.

Specially designed water-cooled linear klystron amplifiers are used to provide the 12-kw. output. The cathode is of the "bombarded type," and is stabilized by feedback to provide the proper operating temperature. The life of this cathode is expected to approach 10,000 hours, and may be replaced when it fails.

SELECTION AND AMPLIFICATION OF U.H.F. TV SIGNALS, W. P. Boothroyd and J. Waring, *Philco Corporation*

A study of the u.h.f. allocation plan has resulted in certain fundamental requirements for u.h.f. tuner design with respect to such factors as selectivity, intermodulation, and local oscillator radiation.

A passive preselector has been designed giving an image rejection of more than 40 db over the entire u.h.f. band and an i.f. signal rejection of over 60 db. An r.f. amplifier may be used in place of the passive preselector, although this presents many problems. Three factors that must be considered are noise figure, gain and selectivity.

A crystal mixer appears to give the best noise figure performance, and has been chosen along with a passive preselector tuner. The required selectivity calls for a double-tuned preselector. The unit which has been designed and developed has a noise figure of 12-13 db, and adequate selectivity for future field conditions.

TRANSIENT CONSIDERATIONS IN THE NTSC COLOR SYSTEM, Bernard S. Parmet, *Motorola Inc.*

By means of a detailed analysis, it is possible to calculate the adjustment of filters and channel specifications accurately in color TV systems. The transient response of both the luminance and chrominance channels is related to their respective bandwidths and cutoff frequencies.

DESIGN OF TV RECEIVERS USING NONSYNCHRONOUS POWER, George D. Hulst, *Allen B. Du Mont Laboratories, Inc.*

TV receivers that are to receive U. S. standard broadcasts and to utilize 50-cycle or other nonsynchronous power sources require special design considerations to minimize interaction effects in the picture. The principal source of interference is the power transformer.

Copper banding is practical and effective in minimizing magnetic radiation, but is not sufficient. The transformer positioning is critical, and after a long series of tests, a location was found which reduced undesirable effects to well below an acceptable minimum.

APPROACH TO MECHANIZED ASSEMBLY OF ELECTRONIC EQUIPMENT APPLICABLE TO TV RECEIVERS, R. F. Newton and L. K. Lee, Stanford Research Institute

Engineers at Stanford have developed equipment and techniques for mounting components on a printed circuit subassembly automatically, so that the whole assembly can be dip-soldered. Such a system represents a big step towards the completely automatic factory, with the advantages of increased uniformity and reliability, greater production per man-hour, etc.

The base pattern may be produced by spraying, etching, or embossing.

USE OF ELECTRONIC "MASKING" IN COLOR TV, R. P. Burr, *Hazeltine Corporation*

In most subtractive color processes for color transparencies, there is some cross-coupling between the various colors. When transmitting a color transparency image over a color TV system, it is possible to devise an electrical network to remove this cross-coupling partially, if the film characteristics are known. In some cases, this will improve the appearance of the reproduced image.

A FOUR-GUN TUBE FOR COLOR TV RECEIVERS, John L. Rennick and Charles H. Heuer, *Zenith Radio Corporation*

A four-gun tube with proper associated circuitry may produce better color pictures than the conventional three-gun type. The fourth gun and associated phosphor is for black and white. The tube contains the familiar shadow mask assembly with its pattern of holes, while the phosphor cluster corresponding to each hole consists of four dots: red, blue, green and white.

Several experimental tubes of this type have been manufactured and have given results substantially as expected.

OPTIMUM UTILIZATION OF THE R.F. CHANNEL FOR COLOR TV, R. D. Kell and A. C. Schroeder, *Radio Corporation of America*

The subjective aspects of color vision are utilized in the proposed color TV standards to keep the information to be transmitted to a minimum. For example, the eye cannot distinguish fine detail in color, thus reducing the amount of information needed. The only color information needed involves hue and saturation; brightness is essentially a black and white characteristic. Thus, only the three characteristics of brightness, hue and saturation need be transmitted. A subcarrier is introduced to carry the color information as phase and amplitude modulations.

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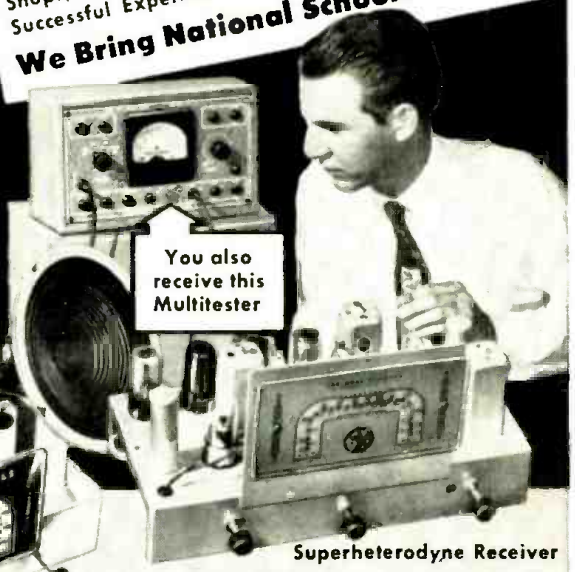
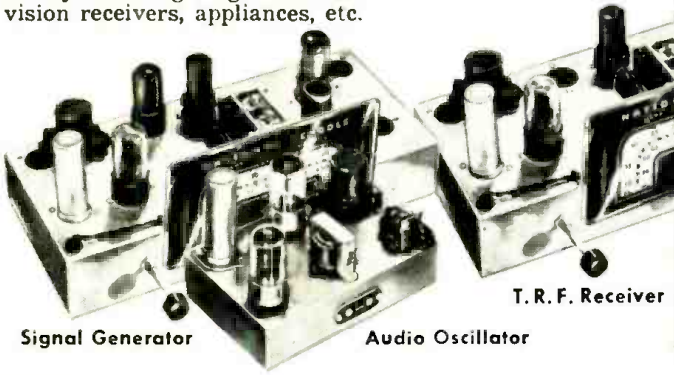


Superheterodyne Receiver



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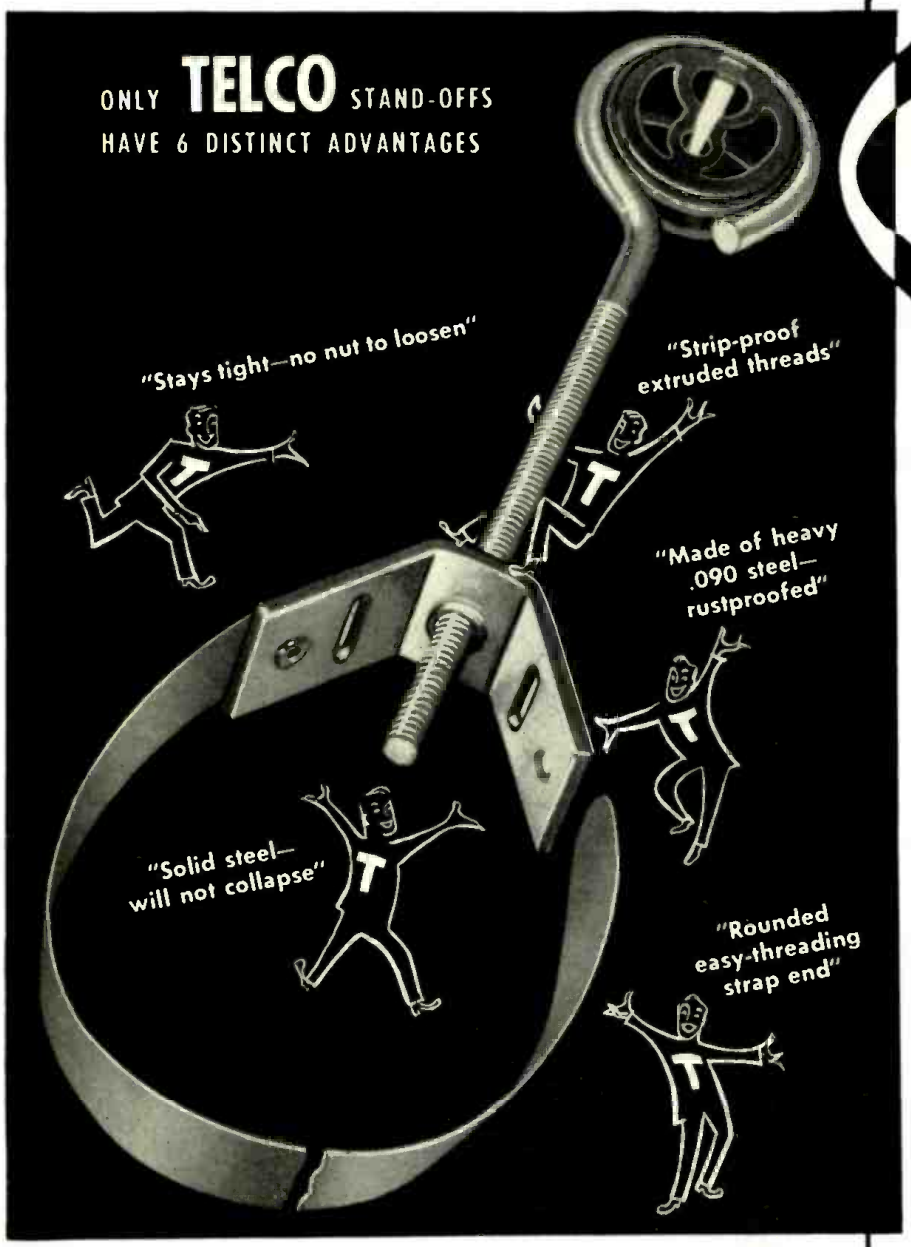

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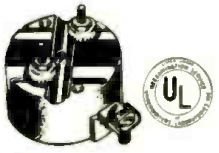

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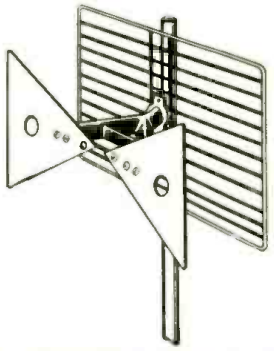

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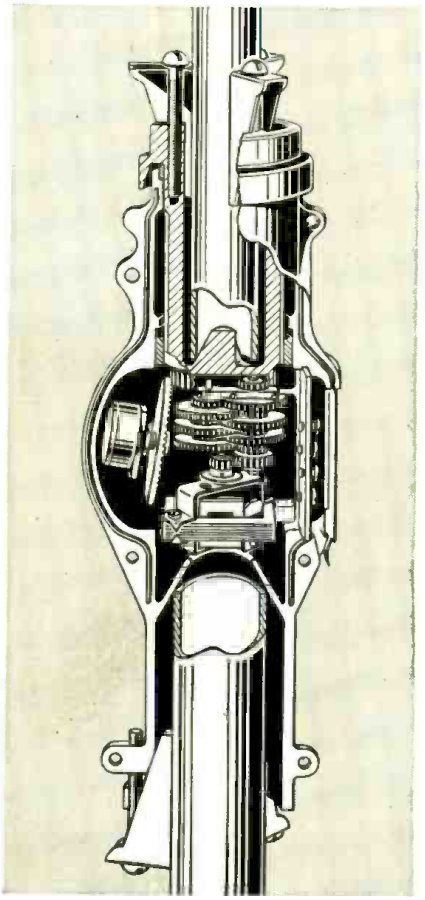
ROCKVILLE CONNECTICUT

PREDICTION

THE VEE-D-X ROTATOR WILL SOON BE THE NATION'S BEST SELLER!

Seeing is Believing!

Study this cutaway view. See for yourself why it is truly the finest of all rotators.



THE MAGNIFICENT DECORATOR STYLED CONTROL CONSOLE

Here is the perfect companion to the finest of all rotators. The unique fingertip-action control operates with a convenient downward pressure that completely eliminates any need to hold console to prevent its sliding. It is engineered for instantaneous clockwise and counterclockwise action. Its easy-to-read dial gives both compass and numerical points. Available in two popular colors: Heather Green for light colored cabinets, Cordovan Mahogany for dark.

This forecast is not given lightly — nor do we expect it to be accepted lightly. It is backed by sound business reasoning and the awareness that VEE-D-X engineering, in collaboration with other world famous manufacturers, have jointly produced the finest of all rotators. It is so far in advance of anything on the market that a comparison with existing rotators will only serve to substantiate these (not lightly given) claims.

Many months of research, planning and testing were spent on the VEE-D-X Rotator. Its many exclusive and precision incorporated features assure pin-point accuracy and complete dependability under all weather conditions. The VEE-D-X Rotator is precision made for precision performance — designed to provide TV reception at its very best.

VEE-D-X OFFERS YOU RIGHT NOW ALL THE FEATURES YOU'VE DREAMED OF IN A FINE ROTATOR

PRECISION-BUILT—The VEE-D-X Antenna Rotator is built with the same precision with which it was engineered. Nothing has been spared in quality construction to provide the utmost in dependability and long trouble-free operation.

ADVANCED STYLING — Streamlined case design — better looking, less wind resistance.

FINEST GEARING OF ANY ROTATOR — Unique. Compact. Efficient. The self-contained, flanged spur gear train of the VEE-D-X Rotator puts it in a class by itself. Flanged reinforced gear teeth cannot be stripped. Designed and developed in cooperation with world famous small gear specialists. It provides most dependable performance under all conditions.

BALANCED MOUNTING — In-line (axial) mounting. Relieves strain on mast and guy wires. Equalized load distribution—no cumbersome offset—improved rooftop appearance.

WEATHER-RESISTANT FINISH—Entire unit is completely finished with new weather-resistant Luster-On #15 that meets rigid Army Signal Corps specifications. Stays bright—will not corrode.

FINEST MAST CLAMPS OF ANY ROTATOR — The positive three jaw chuck-type mast clamp is a VEE-D-X feature that provides simplest installation and the largest clamping surface of any rotator.

POSITIVE MAST ALIGNMENT — Is assured with built-in, self-centering mast guides both top and bottom.

FAST, EASY LINE CONNECTIONS—Accommodate four wire line. Exclusive snap-in cover, slides into place — no screws to drop when installing.

FULL 365 DEGREE TRAVERSE — Eliminates necessity of reversing rotation at critical points at end of normal 360 degree traverse.

POSITIVE ANTENNA BRAKE—No over travel, assures pin-point accuracy the moment control actuator is released.

EXTREMELY POWERFUL — Will support a load of over 200 pounds—thereby eliminating any need for the extra expense of an auxiliary thrust bearing.

GUYED AT TOP—Three guy ring lugs are cast as an integral part of the case for maximum strength. Spaced 120 degrees apart—permits three or four wire guying.

DECORATOR STYLED CONTROL CONSOLE — Smaller, more compact, more beautiful than any other. Unique control actuator. Dial gives both compass and numerical reference points. Plastic case in choice of beautiful decorator colors — Heather Green or Cordovan Mahogany.

ACCURATE COMPASS INDICATION AT ALL TIMES — No screw driver adjustment required to compensate for voltage fluctuation.

FACTORY TESTED AND GUARANTEED—Every Rotator and Control Console is thoroughly tested electrically and mechanically and fully guaranteed.

Write For Literature!

LaPointe Electronics Inc.
Rockville, Connecticut

Mail ..... copies of Rotator literature.

Name .....

Street .....

City ..... *Zone* ..... *State* .....

Within the INDUSTRY

HENRY F. ARGENTO has been appointed vice-president and general manager of *Raytheon Television and Radio Corporation,* Chicago subsidiary of *Raytheon Manufacturing Co.*

He has been with the company since 1932 and has most recently served as assistant vice-president and assistant manager of the company's power tube division. He entered business as a research engineer at the *Radio Frequency Laboratory* in Boonton, N. J. in 1931 and a year later joined *Raytheon* where he engaged in test work in the receiving tube division at Newton, Massachusetts.

* * *

ALLEN B. DU MONT LABORATORIES, INC. has opened a new plant for the manufacture of cathode-ray instruments for industrial and defense use. It is located at 760 Bloomfield Avenue in the Allwood section of Clifton, New Jersey . . . **GENERAL INSTRUMENT CORPORATION** has acquired a fourth plant in its current expansion program. The new facility is located in Danielson, Conn. and will be used for assembly work . . . **U.S. WIRE & CABLE CORP.** has moved into a modern plant at Progress Avenue and Monroe Street in Union, N. J. The new plant will permit the firm to triple its production of all types of wire for radio, television, and electronics . . . **THE POLARAD ELECTRONICS CORP.** has acquired 20,000 square feet of manufacturing space in a newly constructed building at 2 Franklin Ave., Brooklyn, N. Y. Research and development activities as well as production line facilities can be accommodated at the new location . . . **PIONEER ELECTRONICS CORP.** of Santa Monica is building a new plant for the manufacture of television picture tubes. The new factory will have 30,000 square feet of enclosed space and 20,000 square feet of paved ground for parking, loading, and potential expansion . . . **ALPRODCO, INC.** of Dublin, Georgia has announced plans for the construction of a new building. The new structure will have 10,000 square feet of floor space . . . **EMERSON RADIO AND PHONOGRAPH CORPORATION** has taken title to the ten-story building located at 524 West 23rd Street, New York City. It will be used as administrative and engineering headquarters for the radio and television firm . . . **RADIO CITY PRODUCTS CO.** has leased a 2½ acre tract of land at Easton, Pa. and will erect a new one-story manufacturing plant to adjoin their present production center. An additional 13,000 square feet of production area will thus be available . . . **WESTINGHOUSE ELECTRIC CORP.** has dedicated two new tube plants, in Elmira and Bath, New York. The Elmira plant produces TV picture tubes, power tubes for transmitters and electronic devices, and x-ray tubes. The Bath plant is making some 60 types of small receiving tubes . . . **ROHN MANUFACTURING CO.,** tower and tower accessory maker, has a new mailing address—116 Limestone, Bellevue, Peoria, Illinois.

* * *

HARRY C. CRAWFORD has been elected president of *Radiart Corporation,* replacing L. K. Wildberg in the post.

Mr. Crawford has been associated with *Cornell-Dubilier* and *Radiart* for the past eight years as works manager as well as comptroller and assistant treasurer for both the affiliated firms.

Before joining *C-D* and its subsidiary he was an industrial engineer with *Douglas Aircraft* and spent five years as vice-president and sales manager of *International Piston Ring Co.,* joining that firm from *Thompson Products* where he served twenty years as business manager of the automotive parts replacement division. He will make his headquarters in Cleveland.

* * *

CAMPBELL RUTLEDGE, JR. has been named to the newly-created post of assistant general manager of the electrical products division of *Corning Glass Works,* and **FORREST E. BEHM, JR.** is the new manager of the division's Pressware Plant which produces television bulbs . . . **JOHN F. QUIRK** has assumed the duties of director of purchases for the five outlets of *Federated Purchaser, Inc. . . . General Precision Laboratory, Inc.* has appointed **NATHANIEL M. MARSHALL** manager of television equipment sales. He has been with the firm since 1950 . . . **C. KENNETH HERSEY** is the new sales manager of the downtown sound department of *Hudson Radio & Television Corp.* of New York City. He will make his headquarters at 212 Fulton Street . . . **THOMPSON H. MITCHELL** has been elected president of *RCA Communications, Inc.,* succeeding **H. C. INGLES** who retired recently . . . **JEROME M. HOLLANDER,** formerly associated with *Allen B. Du Mont Laboratories, Inc.,* has been appointed senior engineer of *Radio City Products Com-*

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

I GIVE YOU *MORE* EQUIPMENT TO TRAIN YOU BETTER

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

GET MORE!

LEARN MORE!

EARN MORE!

THOUSANDS OF NEW JOBS IN TELEVISION

I PREPARE YOU AT HOME IN YOUR SPARE TIME

MORE TRAINING TO FIT YOU FOR THE BETTER PAY JOBS

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

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

MORE VALUE!

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

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

Only RTTA makes this amazing offer.

I GET MY GRADUATES GOOD PAYING JOBS

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

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

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

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

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

FREE FCC COACHING COURSE

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

NOW! ADVANCED FM-TV TRAINING

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

FREE EMPLOYMENT ASSISTANCE

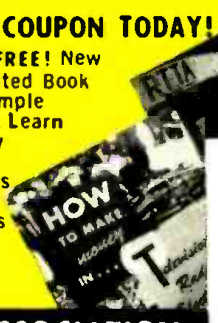
My vocational adviser will help you obtain a good-paying job in the locality of your choice.

VETERANS!

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

MAIL COUPON TODAY!

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



NO SALESMAN WILL CALL!

Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION
1629 Broadway, Radio City Station
New York 19, N. Y. Dept. T-6

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

(PLEASE PRINT PLAINLY)

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

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

RADIO-TELEVISION TRAINING ASSOCIATION

1629 Broadway, Radio City Station, New York City 19, N. Y.
LICENSED BY THE STATE OF NEW YORK

pany . . . Littelfuse, Inc. of Chicago has named **H. A. TRIPLETT** research director for the firm . . . **DONALD A. STEWART** is the new distribution manager for the television transmitter division of *Allen B. Du Mont Laboratories, Inc.*

* * *

PAUL W. TANNER is the new general sales manager of the radio and television division of *Arvin Industries, Inc.*

He succeeds Raymond P. Spellman who has requested a less demanding assignment because of a recent serious illness. Mr. Spellman's new duties will enable him to contribute from his long experience and wide acquaintance to the company's sales and marketing problems.

The new sales manager is a twenty-year veteran with the company, having joined *Arvin* upon his graduation from Indiana University in 1933. Since 1949 Mr. Tanner has served as merchandising manager of the radio and TV division of the company.

* * *

GENERAL ELECTRIC COMPANY has changed the name of its receiver department to the radio and television department as being more descriptive of the nature of the work being done . . . **ACCURATE ELECTRONICS CORP.**, 1312 Ontario Street, Cleveland 13, Ohio has been formed to manufacture components for original equipment and jobbers in the radio, television, and electronic industry. Jos. F. Seybold, formerly product design engineer for **RADIART CORP.**, is the organizer and president of the new firm . . . **FREED RADIO CORPORATION** has changed its corporate name to **FREED ELECTRONICS AND CONTROLS CORPORATION.** The new name more nearly reflects the scope of the company's business, hence the change . . . **UNIFORM TUBES** of Collegeville 2, Pa., has been incorporated and will henceforth be known as **UNIFORM TUBES, INC.** Albert H. Mainwaring is president and chairman of the board . . . **BRENNA & BROWNE,** a manufacturers' representative firm with headquarters in Honolulu, has been formed by Dr. Burton Browne, head of *Burton Browne Advertising,* and Lennie Brenna. Mr. Brenna is an engineering graduate of the University of Minnesota and well-known in Hawaii. He will head the Honolulu operation. Dr. Brown will handle the stateside affairs of the firm from his office at 619 N. Michigan, Chicago.

* * *

RTMA reports that total television and radio set production for 1952 was valued at nearly $1.3 billion at the factory level. The manufacturers' value of all radio-TV receivers produced during the year was estimated as $1,298,847,000 by the Association.

The 1952 dollar volume was based on an estimated production of 6,096,279

(*Continued on page* 159)

Sweeping the Country!

BUY DIRECT AND SAVE

'PRE-FAB' COLLINS TUNERS and RECEIVERS

AUDIO PRODUCTS CO.

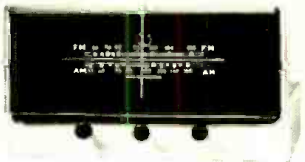
Collins Audio Products Co. is in no way affiliated with Collins Radio Co.

Two ALL NEW Complete Kits for Every High-Fidelity Need

FM Tuner Kit **$55**

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

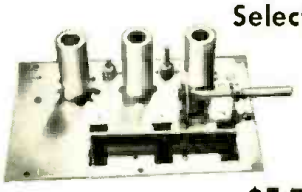
Each Collins Tuner Kit is complete with punched chassis, tubes, power transformer, power supply components, hardware, dial assembly, tuning eye, knobs, wire, etc., as well as the completed sub-assemblies: FM tuning units, AM tuning units, IF amplifiers, etc., where applicable. Since all these sub-assemblies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



FM/AM Tuner Kit **$77.50**

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

Selected Basic Components For Special Applications



FMF-3 Tuning Unit **$15.25**

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

IF-6 Amplifier **$19.75**

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

AM-4 Tuning Unit **$24.50**

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

RD-1C Tuner & Dial **$28.50**

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

MAIL COUPON TODAY

To: Collins Audio Products Co. Inc.
P.O. Box 368, Westfield, N. J.
Tel. WEstfield 2-4390

☐ FM Tuner Kit ☐ FM/AM Tuner Kit ☐ Slide Rule Dial Assembly
☐ FMF-3 Tuning Unit ☐ IF-6 Amplifier ☐ RD-IC Tuner and Dial
☐ AM-4 Tuning Unit

NAME.....

ADDRESS.....

CITY..... STATE.....

Amount for Kit $..... See weights, add shipping cost $.....

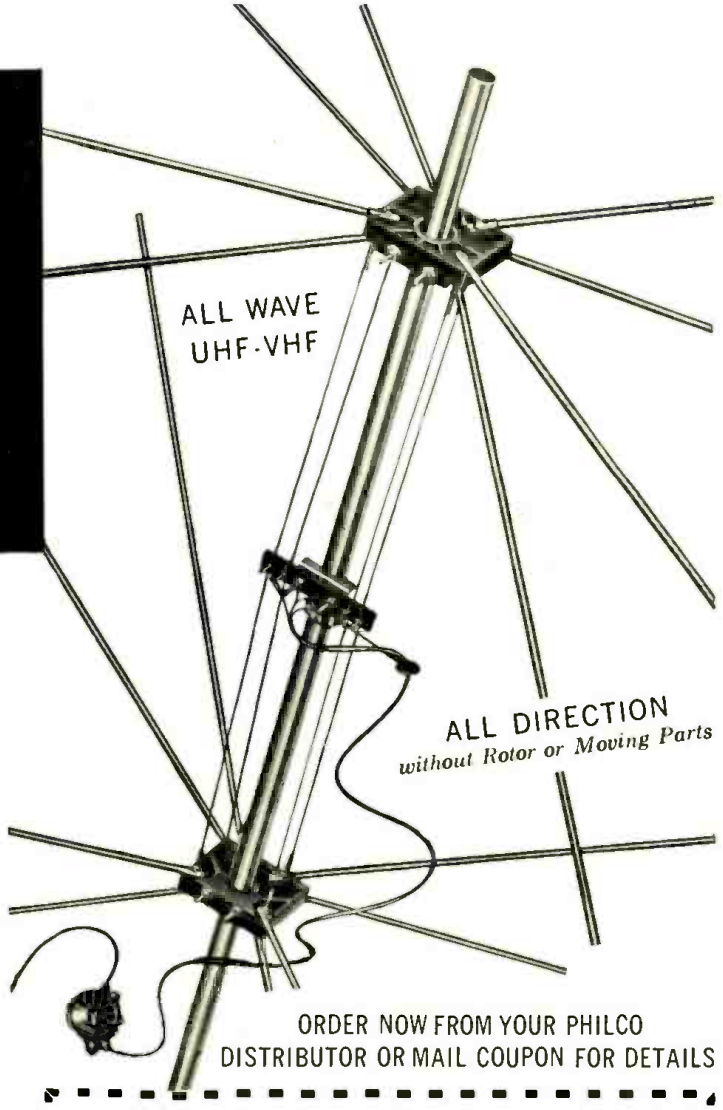
Total amount enclosed $..... Check ☐ Money Order ☐

WHEN YOU THINK OF TUNERS, THINK OF COLLINS AUDIO PRODUCTS

10 TIMES MORE POWERFUL

THAN STACKED 10 ELEMENT YAGIS

PHILCO *All-Purpose TV Antenna*



NEW Design and Principle

By far the most powerful TV antenna on the market today . . . a sales value unsurpassed at its popular price. With the mere flip of a switch this exclusive all-purpose Philco antenna without rotor or moving parts of any kind instantly and automatically beams the set to the best possible signal for both UHF and VHF reception. No attenuators are necessary in strong signal areas since an off position of the switch will automatically attenuate the signal. Available in preassembled aluminum dowel reinforced elements of single bank and stacked arrays for metropolitan and fringe areas at your Philco distributor now.

ORDER NOW FROM YOUR PHILCO DISTRIBUTOR OR MAIL COUPON FOR DETAILS

Up to 22.3 DB Gain over Tuned Dipole

DB GAIN OVER A TUNED DIPOLE CUT FOR EACH CHANNEL FREQUENCY

Single Array Gain Chart using different spacing between two single arrays		2	3	4	5	6	7	8	9	10	11	12	13
		7.8	14.0	6.7	-1.7	16.3	2.5	6.0	9.6	12.1	10.8	15.0	12.8
	36"	18.8	3.5	7.4	17.3	0.0	-1.3	6.0	8.4	11.5	13.0	12.5	13.0
	45"	6.5	14.3	6.0	-6.0	18.6	6.7	8.5	18.2	18.1	13.2	14.3	14.5
	60"	5.8	2.2	9.6	-1.0	-2.0	1.5	-4.0	10.3	4.0	15.4	7.0	15.5
	82"	8.4	15.5	13.0	10.5	21.3	3.0	14.0	-2.0	1.6	10.0	6.0	6.0
	98"	2.5	8.0	9.5	-4.5	17.0	6.0	2.0	4.0	1.0	10.0	7.0	3.7
	114"	21.0	19.0	7.4	22.3	0.0	6.0	8.2	10.4	11.5	14.0	14.1	14.3
	122"	7.4	17.0	13.4	2.5	21.5	8.5	17.3	16.2	12.1	14.8	15.6	10.5

The above tests were made using a 40-foot lead-in. However amazing results have been obtained on installations using a lead-in up to 150 feet without any appreciable difference in gain. These tests were made in real fringe areas.

For maximum gain in outer fringe areas, orient the antenna for the weakest channel desired. Location will determine the number of elements to be used.

PHILCO CORPORATION, Accessory Division
Allegheny and A Streets
Philadelphia 34, Pa.

Please send me information about the Philco All Purpose Antenna, with current trade price list.

NAME .....

STORE NAME .....

CITY ..... ZONE ..... STATE .....

Please check in space below

I am a Retail Dealer ☐ I am a TV Servicemon ☐

TRAIN *FASTER* — TRAIN *BETTER* — TRAIN *EASIER*
IN 10 MONTHS — OR LESS — FOR
RADIO-TELEVISION

Our 21st Year Training Men for Greater Incomes and Security in Radio-Television

I SEND YOU 18 BIG KITS

of Radio Television parts and equipment. Much of your training will be actual construction and experimentation . . . the kind of truly PRACTICAL instruction that prepares you for your Radio-Television career.

Frank L. Sprayberry
President
Sprayberry Academy of Radio

NEW! NO OBLIGATION PLAN

You Have No Monthly Payment Contract to Sign
Pay For Your Training as You Earn and Learn

You can get into Radio-Television, today's fastest growing big money opportunity field, in *months* instead of years! My completely new "package unit" training plan prepares you in as little as 10 months or even less! *No monthly payment contract to sign—thus NO RISK to you!* This is America's finest, most complete, practical training—gets you ready to handle any practical job in the booming Radio-Television industry. Start your own profitable Radio-Television shop . . . or accept a good paying job. I have trained hundreds of successful Radio-Television technicians during the past 21 years—and stand ready to train you, even if you have no previous experience! Mail coupon and get all the facts—FREE!

Valuable Equipment Included With Training

The new Sprayberry "package" plan includes many big kits of genuine, professional Radio-Television equipment. You perform over 300 demonstrations, experiments and construction projects. You build a powerful 6-tube 2-band radio set, multi-range test meter, signal generator, signal tracer, many other projects. All equipment and lessons are *yours to keep* . . . you have practically everything you need to set up your own profitable Radio-Television service shop.

Earn Extra Money While You Learn!

All your 10 months of training is IN YOUR HOME in spare hours. Keep on with your present job and income while learning. With each training "package" unit, you receive extra plans and "Business Builder" ideas for spare time Radio-Television jobs. New television stations everywhere, open vast new opportunities for trained Radio-Television Technicians—and those in training. If you expect to be in the armed forces later, there is no better preparation than practical Sprayberry Radio-Television training.

YOU BUILD the Television set and the powerful superhet radio receiver shown above. IN ADDITION to the other test units shown here (many are not shown because of lack of space). All equipment I send you is YOURS TO KEEP.

Approved for Veterans under the G.I. Bill

SPRAYBERRY ACADEMY OF RADIO

111 NORTH CANAL ST.
Dept. 25-X, Chicago 6, Ill.

MAIL COUPON TODAY! NO OBLIGATION

I invite you to get all the facts—

FREE TO YOU 3 BIG RADIO-TELEVISION BOOKS

I want you to have ALL the facts about my new 10-MONTH Radio-Television Training—without cost! Rush coupon for my three big Radio-Television books: "How to Make Money in Radio-Television." PLUS my new illustrated Television Bulletin PLUS an actual sample Sprayberry Lesson—ALL FREE. No obligation and no salesman will call. Mail coupon NOW!

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111 North Canal St., Chicago 6, Ill.

Please rush to me all information on your 10-MONTH Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Be sure to include 3 books FREE.

Name..... Age.....

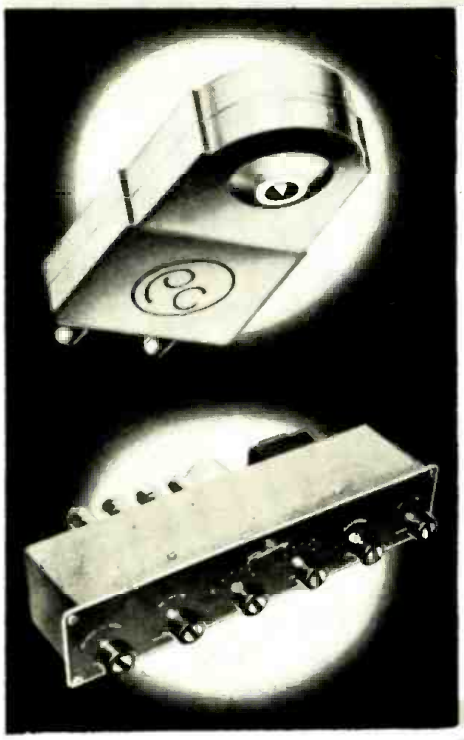
Address.....

City..... Zone..... State.....

PICKERING

PROFESSIONAL AUDIO EQUIPMENT

BALANCED COMPONENTS / *MAXIMIZE PLAYBACK PERFORMANCE*



PICKERING CARTRIDGES . . .

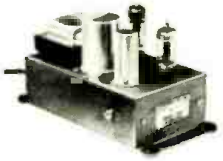
are the choice of audio engineers throughout the world. They are universally acclaimed because of their high output, wide range performance and low distortion. They are used wherever a fine cartridge is required in radio stations, recording studios and for purposes of quality control by leading record manufacturers.

MODEL 410 AUDIO INPUT SYSTEM . . .

is designed to provide a complete audio control center. Model 410 may be used in any high quality playback system. Three input channels are provided—one for magnetic cartridges and 2 "flat" channels for other audio circuits. A 3-position equalizer network is built into the magnetic cartridge channel and provides accurate equalization for LP, AES and 78 rpm recording characteristics. Separate bass and treble controls are also provided. These are of the step-type and permit bass and treble adjustments in 2 db increments. The tone control circuits are intended to compensate for record characteristics and for listener-environment acoustical conditions. *They are not intended to compensate for amplifier and/or loudspeaker deficiencies.* Model 410 is intended for use with the highest quality professional type playback equipment. The output of the Model 410 is fed from a cathode-follower circuit and will work into any high quality audio or line amplifier having a high impedance input. It may also be used with a transformer for the purpose of feeding a 500 ohm line. Because of its flexibility, low noise and low distortion level, it is ideally suited for bridging and monitoring purposes and for critical listening applications.

THE MODEL 190 ARM . . .

is designed primarily for use with microgroove records. Its design has been recognized by leading audio engineers as that which incorporates all of the desirable tracking characteristics. Analysis has shown that for maximum performance with LP records the vertical mass of the moving arm element must be held to a minimum and further, that the arm must be counterbalanced about the vertical axis. This permits minimum stylus or tracking force and provides maximum record life. The Model 190 Arm embodies these all important features necessary for proper microgroove record playback.



MODEL 230H EQUALIZER-PREAMPLIFIER . .

is unique in its accuracy of equalization and frequency response. The intermodulation distortion is .2 per cent at normal output level. It is intended for use with high quality amplifiers having gain and tone controls. When used with the Pickering Model 132E Record Compensator the 230H Is ideal for radio station and recording studio use and for applications requiring accurate low noise and distortion free playback.

MODEL 132E RECORD COMPENSATOR . . .

is designed to be used in conjunction with a magnetic cartridge preamplifier such as the Pickering 230H or any preamplifier which provides 6 db per octave bass boost. Six playback positions are incorporated:

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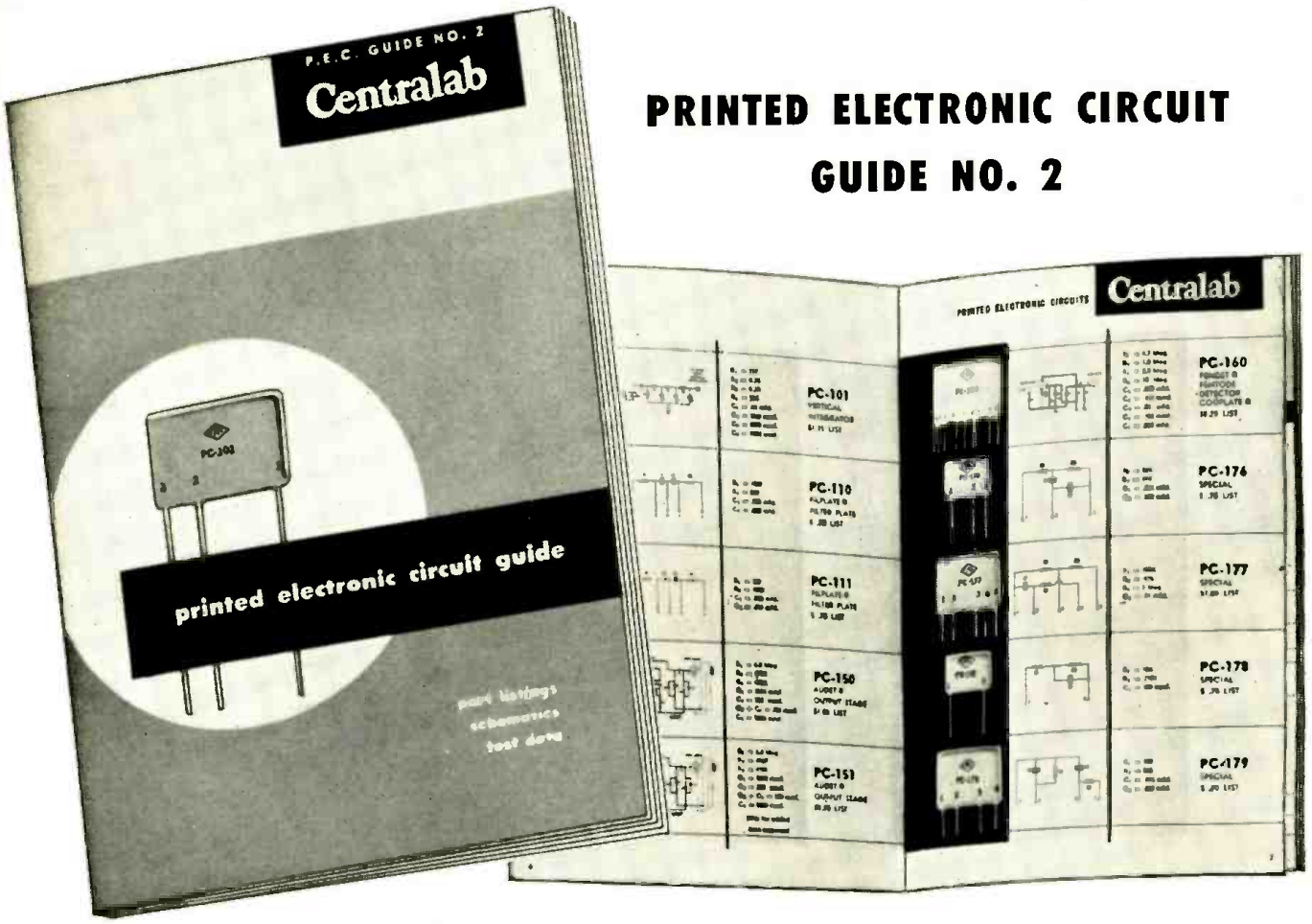

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VHF COMMUNICATIONS IN KOREA

By 1st Lt. RICHARD G. GOULD
Asst. Radio Officer, Eighth U. S. Army, Korea

The author checks circuits at the 558th radio relay station, somewhere in Korea.

An ingenious radio relay system is saving time, money, and equipment for our troops.

A MAJOR entered the tent of the Division Commander waving a mud-spattered piece of paper. "The Chinese" he read, "have the regiment surrounded, General. There's no wire communication left between our headquarters and theirs." The General reached for the field phone on his desk. "Give me ——" he said, using the telephone code name of the regiment. Within seconds he was talking to the regimental commander. He spoke quickly about the situation and the immediate action the reserve unit was taking. He outlined his orders for the trapped regiment and hung up after receiving assurance from the regimental commander that they could make the plan work. Not long thereafter the regiment was reunited with the division and was fighting again as an effective part of our forces in Korea.

This quick, personal call between the two commanders, and the other vital messages that followed, directing artillery, guiding air support, and controlling troop movements actually took place during the big pull-back of the Eighth Army after the Chinese intervention in Korea. Without the use of v.h.f. radio relay equipment, these calls would have been impossible. Without these calls the General and his staff would have had to rely on tactical high frequency radio equipment. They would not, though, have been able to give the detailed instructions, or told exactly what they wanted done and received the immediate response possible only over a direct telephone circuit. Just as a picture is worth a thousand words, a personal conversation is worth a hundred written messages.

Since the first days of the Korean campaign, very-high-frequency radio relay equipment has been one of the mainstays of the UN communications network. Now under the direction of Brigadier General Wesley T. Guest, Eighth Army Signal Officer, the v.h.f. network blankets Korea from the Peace Camp at Munsan-ni to the Prisoner of War camps on Cheju Island. At this time there is even one infantry division operating v.h.f. down to a forward observation post overlooking the enemy lines. Chinese mortar and artillery fire kept chopping all the wire circuits as quickly as they were installed; v.h.f., however, provided telephone circuits without wire. To install this system the v.h.f. equipment was mounted in a bunker with the carrier equipment lying on its back nearby. The standard antennas are also inside, pointing out of holes just a little wider than the arrays. This system has been so reliable that units slightly to the rear actually run their lines forward to this bunker to get circuits back to

Sgt. Kenneth Hartman, station chief, v.h.f. site, Korea, changes a tube while the author, in background, oversees the operation.

Jeep-mounted v.h.f. terminal equipment. Telephone contact with any unit in Korea is possible with this particular installation.

Sgt. James C. Cooper, station chief, v.h.f. site in Korea, repairs a transmitter at the 581st signal relay co. station.

Pfc. Phillip Tesone, v.h.f. radioman in Korea, makes adjustments on a transmitter at the 556th signal radio relay site.

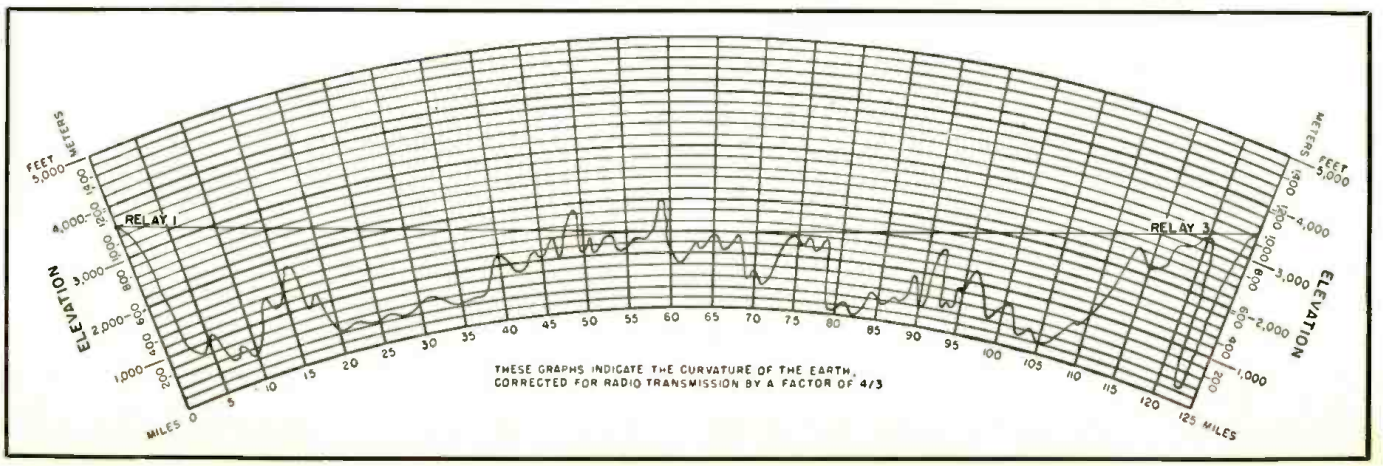
higher headquarters. A near miss on the bunker showered rocks and dirt on the equipment without causing a minute's outage.

From the very beginning of the Korean campaign the units operating v.h.f. equipment have been hampered by the same factors that affect all the operations of an army in the field. To the usual problems of shortages of equipment, lack of sufficiently trained personnel, and the eternal requirement for getting the job done "yesterday," the rugged peninsula of Korea has added worries. The terrain was, at first, a severe limitation on the use of v.h.f. systems. This equipment, known as the AN/TRC 3 and 4, transmits a frequency modulated signal in the 70 to 100 megacycle band. According to conventional propagation theory, transmission in this frequency range is supposed to be "line-of-sight" with only a slight bending effect beyond the optical horizon.

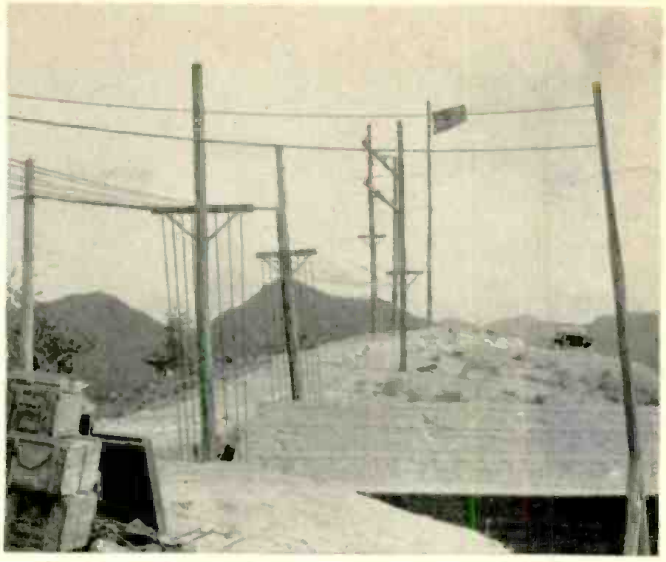
The technical manual for the equipment states that distance between relay stations should be limited to under 30 miles to maintain a high signal-to-noise ratio. If these restrictions held fast, few of the existing v.h.f. systems in Korea could have ever been installed. On most of the peninsula, rugged mountains bring the horizon "into your backyard." Overcoming this limitation meant that the v.h.f. stations had to be located atop these mountains. Once on the peaks, the "hop" lengths rose from 30 miles to 70, 80, and 90 miles, far surpassing the ranges possible with 40-foot antennas on level ground. Without such distances, the Signal Corps could not have supplied the radio relay systems to link the Eighth Army with its Corps, using equipment on hand, during the 300-mile long drive which took the UN from the Pusan Perimeter to the Yalu River. There simply was not enough equipment or personnel to install and operate relay stations every 30 miles. In addition, due to cumulative tube and set noise, the quality and readability of circuits decreases as additional relays are placed in the system. Extending the lengths of individual transmission paths resulted in better circuits.

At Army level the main problem was distance: at Division level it was speed. It can take up to three days to install a station on a mountain top and the division teams could not afford this delay at a time when their headquarters would be moving every four or five days. Their solution in many cases, was to direct the transmitted beam to a distant mountain so that it would be reflected to the far terminal beyond the actual line-of-sight. Many times the direction of advance was up long river valleys. In these cases the beam would be directed slightly towards one side of the valley and it would be reflected from side-to-side as it faithfully followed the winding valley to the distant terminal. Receiving tests were later conducted to determine if this "bouncing" was actually taking place. A receiver mounted in a truck indicated that every few miles it would "pass through the beam" as the truck was driven down a road through the valley. Many times at the distant terminal it was noticed that moving the antennas laterally as little as a few hundred feet caused the received signal strength to drop 75 per-cent. This situation can be compared to a rudimentary wave guide operating at a lower frequency than conventional fabricated guides. The dead spots in the receiver tests were caused by non-parallel "guide"

Fig. 1. Profile chart of line-of-sight path between Relay 1 and Relay 3. Note the two obstructions in this path.



View of one of the cloud-topping relay stations. Korean guards, operating personnel, and antennas are visible among the boulders.



A v.h.f. terminal station. Coaxial cables are laid to separate transmitting and receiving fields. Poles carry the cables.

walls and gaps in the line of mountains on both sides of the valley.

Recently even transmission distances of 90 miles have been exceeded. The 8189th Signal Service Battalion that operates all the v.h.f. systems for the Eighth Army had several systems between Seoul and Taegu which utilized three relay stations. These stations were all well over 3000 feet in height and air-line distances between them averaged 65 miles. It was decided to eliminate the middle relay leaving a 126-mile span between relays one and three.

As the first step, a profile chart was run assuming line-of-sight transmission. The accepted figure for the earth's radius of four thirds the actual one was used on this profile to account for the "bending" that takes place beyond the horizon. This chart (Fig. 1) showed two masks directly in the path of the beam. One is 400 feet high and the other 600 feet. Antennas at each site were oriented with a compass to point towards the distant station as determined from maps of the area. The sets were turned on, and on only ten watts of final power to the three-element yagi arrays, the limiter stages of the distant receiver were saturated. This meant that all amplitude variations on the incoming signal were eliminated and a noise-free system would result.

These test shots were operated for a period of two weeks to determine if fading would occur at certain times of the day or if there was a fade cycle over a period of several days. Even a severe thunderstorm during this period, which caused interference to high frequency radio circuits did not affect the received signal strength. The pattern of received signal *vs* antenna orientation is shown in Fig. 2.

To obtain this curve the transmitting antenna at the distant station was rotated through 360 degrees and the value of grid current in the first limiter stage of the receiver was recorded. Thus the current value is proportional to signal strength since no limiting action has yet taken place. These current readings have been reduced to relative values. The zero degree point was chosen as the azimuth of the distant station as determined from a map. The difference between the right and left hand lobes is explained on the basis of the inherent unbalance of the array, one side of the dipole being grounded as are all the parasitic elements. This curve agrees closely with the theoretical curve for this type of antenna. The lack of sharply defined minor lobes is due to lack of accuracy in the metering stage and also to "residual" carriers from other transmitters on the same and adjacent frequencies operating at the same time. The curve of signal strength taken with the transmitting antenna stationary and the receiving antenna rotated is similar. This curve indicates that the beam is following

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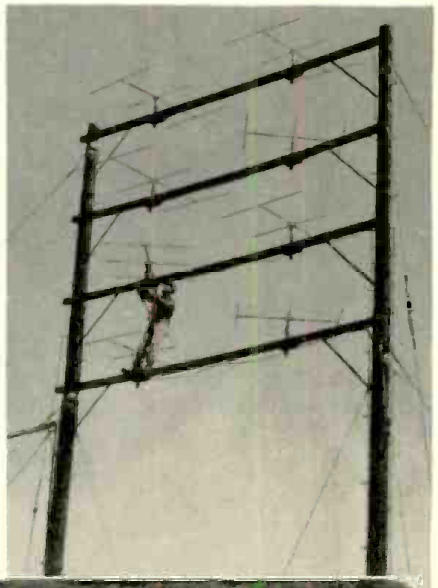
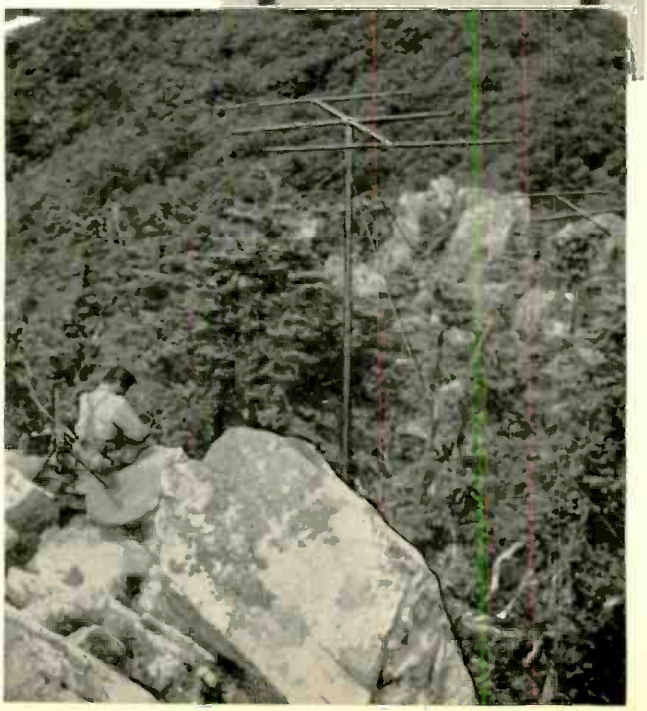


Repairing a receiving antenna at the v.h.f. antenna site somewhere in Korea. This is a 581st radio relay co. station.

★

Lonely Korean guard sits by his machine gun overlooking the antenna field of a v.h.f. relay station somewhere in Korea.



Pfc. Lawrence R. Jackson and Sgt. Gorver W. Potter, radiomen, switch receiving antennas at a v.h.f. relay station site.

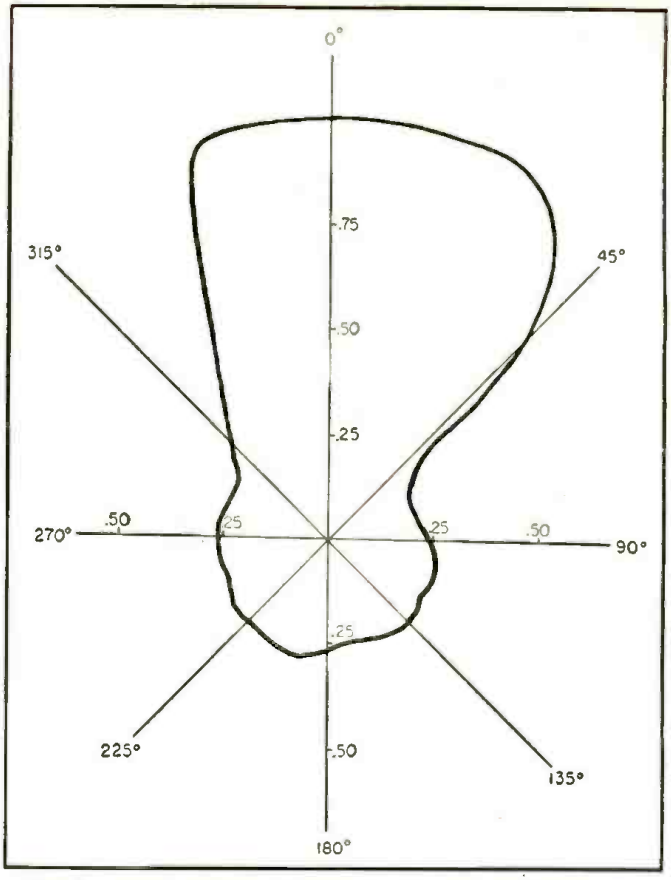


Fig. 2. Signal strength at Relay 3. See text for full details. These directive patterns are taken for each antenna location.

a direct path and that very little energy is reaching the receiver through reflected paths. The "shot" was then incorporated into the operating systems and it was discovered that, not only were the systems quiet, but quality was improved due to the elimination of the one relay. Outage time dropped markedly due to the fact that there was less equipment in the system subject to failure and that troubleshooting procedures were simplified since there were only two relay stations to coordinate while isolating a specific trouble. These systems have been in operation for over five months with less than 3% outage: twenty-four hours a day, seven days a week, through winter storms, driving mountain rains, and a series of typhoons with winds up to 65 miles an hour.

The next attempt at extended range involved shooting between two peaks, each over 3000 feet high and separated by 170 air-line miles.

The profile chart for this shot passes through a mask 2400 feet high and 57 miles deep as shown in Figure 3. Even if the earth were a perfect sphere the wave would hit the earth's surface during its path. Nevertheless, signal strengths received at both stations showed the circuit to be satisfactory using fifty watts final power and the system was established. Rotation of antennas gave essentially the same curve as the 126-mile "shot." See Figure 2. This path too, stood up day and night through the weeks that it was needed. (In this case the men operating the station not only had to keep their equipment on the air but had to work with their weapons handy in case of guerrilla attack. The guerrillas eventually did attack the guards assigned to help defend the station but were driven off after a small-arms battle.) Since this 170-mile shot also had a pattern of received signal similar to Figure 2, it indicated a straight line transmission path with no alternate reflection paths. In this case the receiver, although located on a high peak, was still far below the horizon and far beyond the range expected using the conventional formula for bending effect.

Additional inconsistencies have appeared during the months in Korea: Since there are many more transmitters operating in Korea than there are frequency assignments for the equipment, there may be three and

(*Continued on page* 151)

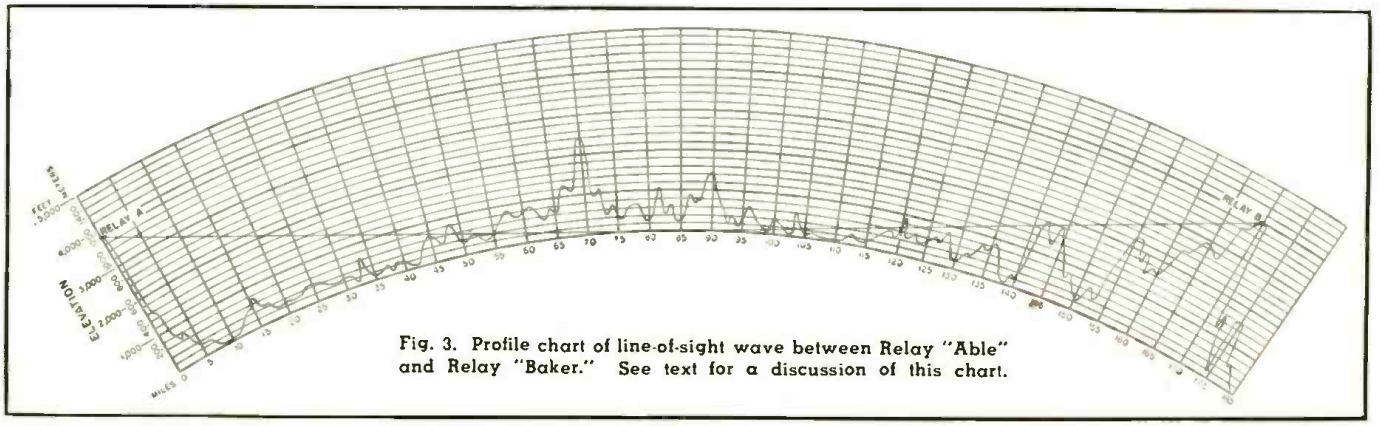


Fig. 3. Profile chart of line-of-sight wave between Relay "Able" and Relay "Baker." See text for a discussion of this chart.

USING A TRANSISTOR TO INCREASE RELAY SENSITIVITY

By
LOUIS E. GARNER, JR.

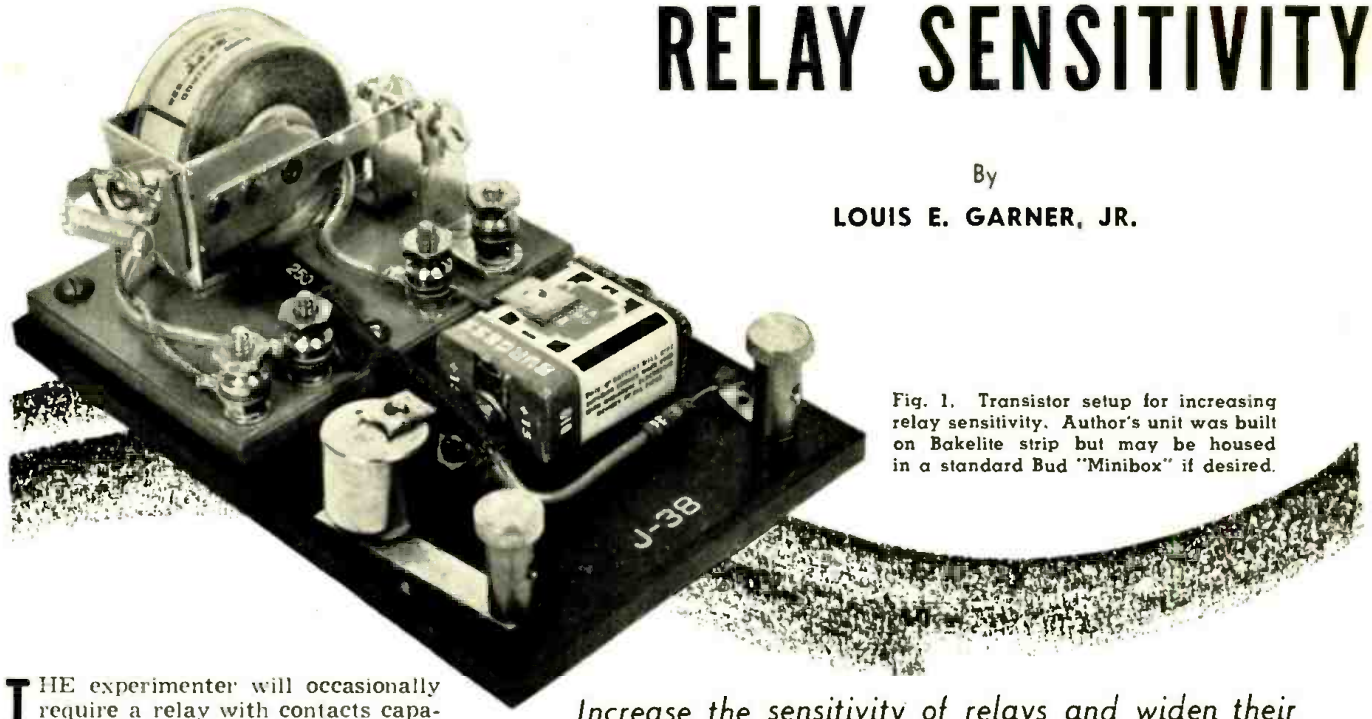


Fig. 1. Transistor setup for increasing relay sensitivity. Author's unit was built on Bakelite strip but may be housed in a standard Bud "Minibox" if desired.

Increase the sensitivity of relays and widen their application by using this simple transistor circuit.

THE experimenter will occasionally require a relay with contacts capable of handling an ampere or more current at 117 volts a.c. while, at the same time, not requiring more than a fraction of a milliampere to operate. Although there are relays available that are sensitive enough to operate on only a few hundred microamperes, such relays are not only very expensive (sometimes costing two to four times as much as less sensitive relays), but, for the most part, their current handling capacity is small.

Often, the electronics worker is forced to use *two* relays in such circumstances—a very sensitive relay connected to operate a less sensitive relay of greater power handling capacity. Such a procedure is not only expensive, but requires considerable space.

With the ready availability of the transistor, it is now practical to assemble an extremely sensitive relay capable of handling reasonable amounts of power, and utilizing *only one relay* of moderate sensitivity. Such an assembly is shown in Fig. 1. The schematic diagram of the circuit is shown in Fig. 2.

In some cases, the cost of the components required for the complete assembly illustrated will be less than the cost of a relay of the desired sensitivity, even with the present comparatively high cost of the transistor itself. The more sensitive relay will often not have the power handling capacity of this assembly.

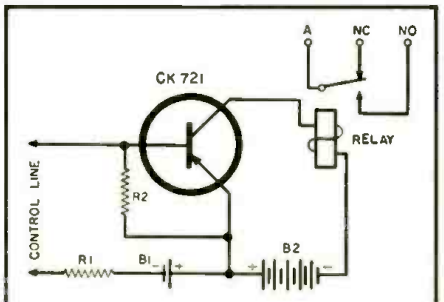
The assembly shown in the illustration, using the components specified in the parts list, *will handle currents as high as 1.5 amperes* (at 117 volts a.c.), *yet requires a control current of only a fraction of a milliampere*, that is, only a few hundred microamperes. (From 0.2 to 0.4 ma. control current is required, depending on the adjustment of the relay.)

Circuit Description

The operation of the basic circuit depends on the fact that the transistor may be used as a simple "current amplifier."

Referring to the schematic diagram of Fig. 2, a relay of moderate sensitivity is connected in the emitter-collector circuit, together with a source of voltage, B_2. The base-emitter circuit is used for control purposes, with B_1 acting as a "bias" voltage and resistor R_1 as a current limiting resistor (to prevent damaging the transistor). R_2 is the "base return" resistor.

Fig. 2. Complete circuit diagram of unit.



R_1—3300 ohm, ½ w. carbon res. (value used in model, see text)
R_2—1000 ohm, ½ w. res.
Relay—Sensitive relay, 2500 ohm coil (Advance Type 850)
B_1—1.2 or 1.5 volt battery (Mallory RM-1000 mercury cell)
B_2—15 volt hearing-aid battery (Burgess U10)
CK721—Raytheon "p-n-p" junction-type transistor

Under "normal" conditions, with the *control line* open, there is no base current flow and the collector current flow is negligible. For practical purposes, the collector current flow may be considered as "zero" in this case.

When the *control line* is closed, a small base current may flow, depending upon the resistance of the line, the values of R_1 and R_2 (Fig. 2), and the bias voltage, B_1. Generally, this base current flow will be on the order of a few hundred microamperes (it should not exceed 500 microamperes). This base current flow permits collector current to flow, with an amplification of approximately ten. Thus, a 250 microampere base current flow (0.25 ma.) permits a collector current flow of about 2.5 milliamperes—enough to operate the relay (Fig. 2).

Should the *control line* be opened again, base current will cease and the collector current will drop to its previous low value (almost zero), permitting the relay to drop out.

Construction Hints

No attempt was made to miniaturize the model shown in the photograph (Fig. 1) and all parts were simply mounted on a piece of surplus Bakelite. The batteries, B_1 and B_2, are held in place by small standard brackets, found in an inexpensive hardware assortment. However, if the builder

(*Continued on page* 140)

WHY USE A CONDENSER?

By **ROB WAGNER, W6WGD**
R. F. Lab., Dalmo-Victor Co.

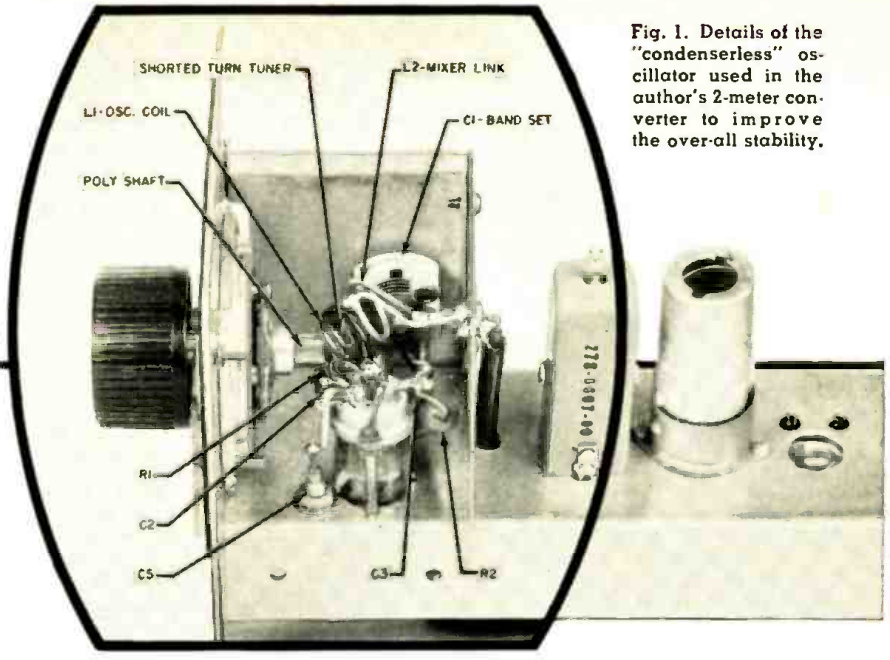


Fig. 1. Details of the "condenserless" oscillator used in the author's 2-meter converter to improve the over-all stability.

The tuning condenser in a v.h.f. oscillator is a source of headaches because of problems of stability and cost. The author cured these headaches by eliminating the condenser.

AT ONE TIME or another during the activities of the average 2-meter ham, the construction of that "red-hot" converter becomes a practical necessity. When Joe Ham listens to another amateur giving that 200-mile DX an S-9 report and Joe can't even hear the beat-note, he usually starts throwing parts into a can while heating up the iron.

In most cases, this action results in somewhat better performance than was forthcoming from the piece of war surplus machinery Joe had been using in lieu of a receiver. However, the DX may still prove elusive, due in part to high-noise r.f. stages, low conversion efficiency and, to a great extent, upon an oscillator which refuses to stay put.

Two alternatives are available: (1) To build a crystal-controlled front end which holds still but requires mixer peaking or complex broadband i.f. stages preceding the receiver, or (2) to construct a v.h.f. oscillator which is ridiculously simple, quite stable, and costs practically nothing. In order to find such a machine, the writer has dug into the deep past and come up with some determinations which should greatly assist the reader in building his new converter.

First, let's look at some advantages and disadvantages of various systems of tuning the v.h.f. oscillator. The condenser method is dandy but unhandy; a suitable v.h.f. condenser using ball-bearing shaft mountings costs more than a dollar or three and, at the present time, is almost unavailable. Its size necessitates construction which in some cases is prohibitive for mobile applications. Mechanically, the condenser-tuned oscillator must be built on the order of a Sherman tank to obtain the desired mechanical and electrical stability. To retain this stability while tuning, it is the usual practice to employ a gear reduction drive in conjunction with a vernier dial mechanism. The net result is good, providing one has the money, the time, and the mechanical ingenuity.

Instead of this costly and intricate machinery, let us appraise other methods of tuning the oscillator. A slug-tuned circuit is excellent, and combines mechanical stability with good bandspread linearity. However, a slug tuning mechanism requires that one have the equivalent of a degree in mechanical engineering in order to convert 180° of dial rotation to plus and minus one-quarter inch of linear motion! This application is presently being used in another converter, but necessitates a home brewed dial mechanism operating on the lead-screw principle, including several dial twists to cover the band and an ingenious pulley and string method of frequency indication. The slug performance is excellent electrically, but the problem still remains of attaining extreme mechanical simplicity.

What's this? An old Donald B. Duck catalogue, published at the time when 5 meters fell into the OYGWHF (*"Oh ye gods, what high frequencies!"*) category, and here is a 5-meter receiver using the ancient method of tuning an inductance with a rotating shorted turn! Similar in principle to the variometer method but using no electrical connections, this begins to look good—the shorted turn, rotating within an inductance causes a change in frequency.

Although design engineers state that this method is a *"Q"* destroyer, the writer has found empirically that a laboratory *"Q"* meter would be required to determine the losses. At the same time, an oscillator has been devised which is hard to beat from the standpoint of electrical and mechanical stability, very small size, and practically zero investment!

Note that an ultra-audion circuit is employed in Fig. 3, resulting in good electrical and mechanical symmetry; Fig. 1 shows placement of the components. A 6AB4 h.f. triode is used, so that if the tube goes bad, a 6J6 may be plugged into the socket to perform the same functions, the 6AB4 pin connections being identical with one-half of a 6J6. Acorn types were discarded for this application due to their inherent tendencies toward microphonics.

The assembly consists of a rigid front panel, suitable vernier dial, and solid subpanel, to which is firmly bolted a heavy box-shield surrounding the oscillator components. Good design practice dictates the use of heavy metal construction not only to afford electrical shielding, but to provide rigid support for other circuit parts.

The bandset condenser C_1, a 25 $\mu\mu$fd. APC-type air trimmer, is mounted upon the left side of the box shield. L_1, a two-turn, ½ inch i.d. coil, is wound of #10 copper wire, and is soldered directly to the bandset trimmer. The coil is so mounted that its linear axis forms a 45° angle with the axis of the dial shaft (see Fig. 2). A 7-pin miniature tube socket mounts upside down at the right of the dial shaft, so that grid and plate connections are as short as possible (Fig. 1). Two 82 $\mu\mu$fd. tubular ceramic condensers (C_2-C_3) serve to connect grid and plate pins to each end of the oscillator coil at

the bandset condenser. The r.f. choking function is performed by R_2, a 1000 ohm, ½-watt carbon resistor mounted between the plate pin and C_4, a 1000 $\mu\mu$fd. feedthrough condenser mounted directly beneath and beside the inverted tube. The feedthrough condenser serves as a rigid solder-mount for the resistor and helps to mechanically stabilize the plate wiring. A 22,000 ohm, ½-watt carbon resistor (R_1) between the tube grid terminal and ground provides grid bias. Inasmuch as the cathode and one heater terminal are common to "B-minus," this terminal serves as tie-point for all ground returns of the circuit. The opposite 6.3-volt heater lead is fed to the power plug through another 1000 $\mu\mu$fd. feedthrough condenser located beneath the tube socket. The mixer voltage is taken from the oscillator coil with a single-turn loop supported by a feedthrough insulator mounted above and behind the coil, Fig. 1. All that remains is the method of tuning the oscillator.

The tuner, Fig. 2, consists of a one-inch length of ¼-inch o.d. "poly" shaft (clip a few from the bottom of your ladder line) with a ¼-inch i.d. single-turn loop of solid hookup wire attached thereon at a 45° angle. In order to effect an inductance change equivalent to 4 mc. of bandspread over 180° of dial rotation, it is necessary to mount the coil at a 45° angle with respect to the axis of the tuning shaft. Since the tuning loop is also mounted upon the shaft at 45°, the plane of the loop is at a right angle to the coil axis at zero degrees of rotation; this position results in the lowest frequency reading on the dial.

At a rotation of 180°, the loop becomes parallel to the coil's lines of flux, thereby reducing the coil's inductance and resonating it at its highest frequency. A complex angle of rotation occurs during the 180° rotation, at each degree of which the inductance of the coil is varied by a correspondingly larger amount. The rate of inductance change is linear for all practical purposes. This is a major difference from older and constructionally simpler versions of the shorted turn, such as a tab or vane of copper moving across the end of a coil or between two turns. The inadequacy of these older methods kept amateurs from using the principle enough to bring out its full possibilities.

A brass washer attached to the tuning shaft comprised the first shorted-turn tuner. It was thought that bandspread could be adjusted by moving the washer closer to or farther from the end of the oscillator coil; this assumption was erroneous and resulted in a complex vectorial relationship which caused stations to repeat at various places on the tuning dial.

The washer was then placed within the coil, at its center; immediately the 2-meter band, in addition to police, aircraft, and other services were tuned over a wide frequency range, but with extreme selectivity due to lack of bandspread. It became evident that bandspread is a function of reduction of loop mass rather than one of removing the mass from the vicinity of the coil.

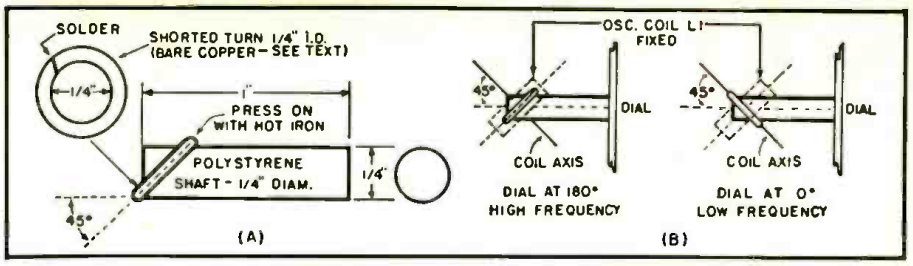
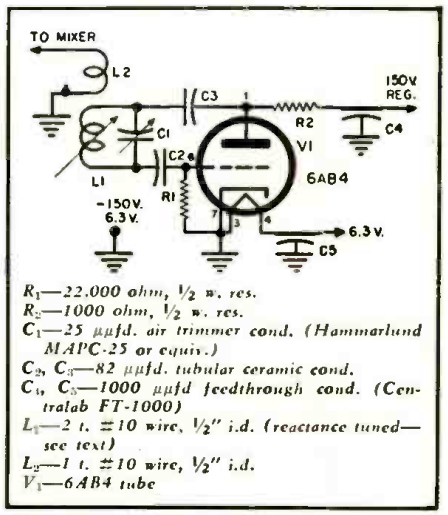


Fig. 2. (A) The heart of the "condenserless" tuning system. Several can be made up at negligible cost using wire of different sizes to get the proper degree of bandspread. "Ring" diameter (¼") should be the same for each one tried (see text). (B) Shows the relationship of the fixed oscillator coil and the movable shorted turn as the dial mechanism is turned through 180°, varying coil's inductance.

Several tuning shafts should be constructed, having a loop of different wire *size* (not loop diameter) attached thereto. In a matter of minutes, it is simple to determine the degree of bandspread by changing the entire tuning shaft and listening over the band. The bandset condenser should, of course, be trimmed so that the 2-meter band appears in the center of the dial with your particular converter i.f. The loops are rigidly attached to the shaft by pressing them into the plastic with a hot iron, using a dime-store 45° triangle as a guide, as shown in Fig. 2.

There is nothing really new in the design of this oscillator, but its application has not been used extensively in amateur circles. If the oscillator is constructed rigidly enough, one may beat upon the converter with an old binder of radio magazines with vigor, without frequency shift; stability is limited only by the mechanical construction of the oscillator tube. The linearity of the tuning depends upon the precision with which the loop and coil axes are centered, although an angular tolerance of plus or minus five degrees is acceptable. Even though the small physical size of the design makes this circuit extremely interesting to mobile operators, its functioning is so satisfactory that the writer anticipates using no other circuit at his home station. As the photographs show, it has been installed in an experimental converter in use here at W6WGD. -30-



R_1—22,000 ohm, ½ w. res.
R_2—1000 ohm, ½ w. res.
C_1—25 $\mu\mu$fd. air trimmer cond. (Hammarlund MAPC-25 or equiv.)
C_2, C_3—82 $\mu\mu$fd. tubular ceramic cond.
C_4, C_5—1000 $\mu\mu$fd feedthrough cond. (Centralab FT-1000)
L_1—2 t. #10 wire, ½" i.d. (reactance tuned—see text)
L_2—1 t. #10 wire, ½" i.d.
V_1—6AB4 tube

Fig. 3. Schematic of the "condenserless" oscillator. L_1 is varied by rotating the shorted turn within it; L_2 is also fixed.

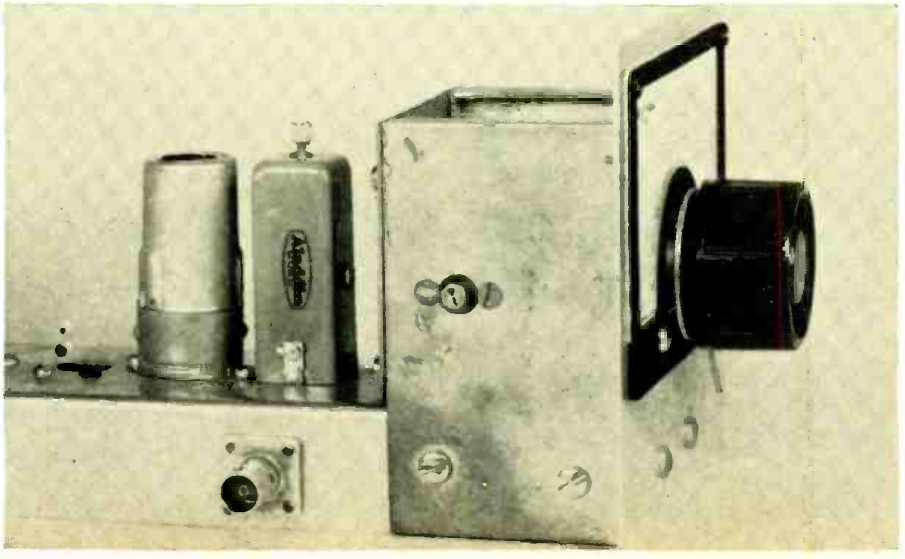


Fig. 4. The oscillator is in the shield box at right; the other components belong to the converter with which it is used. The oscillator is adaptable to any tunable converter. The chassis and shield are of heavy material for mechanical rigidity. Inside the shield, the 6AB4 is mounted upside down (Fig. 1) for short wiring leads.

TUNABLE HUM IN BROADCAST RECEIVERS

By **SIDNEY WALD**

Apply this method of tracing and eliminating an annoying hum in radio receivers to other types of interference.

SIXTY-CYCLE cross-modulation, popularly known as "tunable hum," has for a long time been a thorn in the side of the radio technician. Unlike the hum resulting from a defective or inadequately filtered a.c. power supply, this annoying form of interference may frequently frustrate the best efforts of well-trained service technicians to eliminate it.

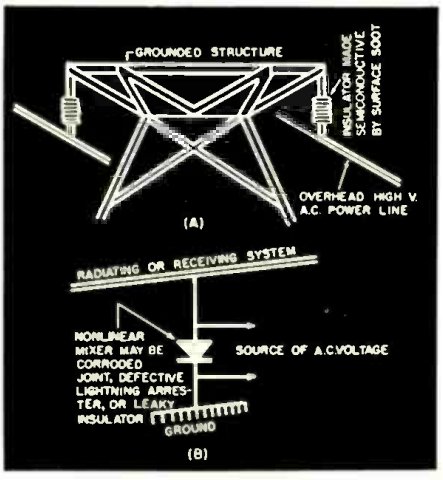
For the benefit of those few technicians who have never come up against this problem the following is a brief description of this malady.

"Tunable hum" is an affliction which may develop gradually or occur suddenly in an AM radio receiver. It is characterized by a strong distracting power line frequency hum which perversely enough appears only when the receiver is tuned to a broadcast station carrier. Between channels, the hum disappears completely, and, to complete the discouraging picture, the stronger the desired station's signal, the louder is the hum.

We may filter the power supply until we have piled up sufficient microfarads to buckle the legs on the service bench, but to no avail. As a matter of fact it is frequently possible to substitute a battery power supply without affecting the hum.

Of course, this last experiment, that of eliminating the a.c. power supply completely, furnishes us with a clue as to the origin of one of the most stubborn forms of tunable hum. Its cause must lie outside the receiver and the hum must, therefore, be a true modulation of the broadcast carrier frequency.

Fig. 2. Overhead a.c. power lines as shown in (A) pick up broadcast signals and re-radiate them with added 60 and 120 cps hum modulation. (B) is the equivalent circuit for the hum generator shown in (A) and in Fig. 1.



The writer's interest and curiosity in this subject was aroused a number of years ago, when, while visiting a friend, he was asked to apply some of his electrical engineering "know-how" to a troublesome line hum in the family radio receiver. It didn't take very long to discover that additional filtering of the power supply had absolutely no effect. Then, to further complicate the situation, it was observed over a period of several days that for hours at a time the receiver would be perfectly normal and free from interference and suddenly there would be a click and the same old hum would come on again, virtually ruining reception on all stations.

By this time rooting out this interference had assumed the nature of a technical challenge which the writer could not ignore.

During the ensuing investigation it was found that:

1. A second receiver, which was known to be in good condition, was subject to the same trouble when installed in the affected area.

2. This second receiver was battery-operated and immune to ordinary power line interference.

3. The interference was strongest when the outside antenna (located on the roof of the apartment house) was connected.

From here on, it was a matter of amateur detective work. A portable, battery-operated receiver, used to "sniff out" regions of highest hum intensity, pointed the way to the roof along the path of the antenna lead-in wire.

On the roof, the region of maximum intensity of tunable hum was found adjacent to a neighboring antenna, some 20 feet from the antenna belonging to the set with the initial complaint. The lead-in wire of the offending antenna was traced visually and the location of the apartment into which it entered was determined.

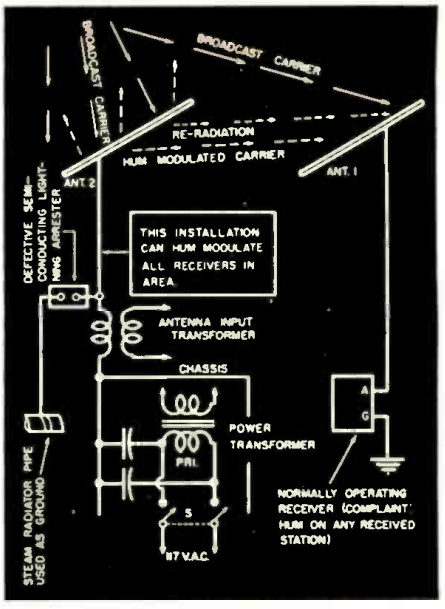


Fig. 1. 60-cycle hum originating in leaky lightning arrester at offending radio set is radiated by antenna to neighboring ones.

Gaining access to the receiver in this apartment with the co-operation of the occupant was not so simple but was finally accomplished. A glance at the broadcast receiver here disclosed nothing unusual until the set was turned on. A loud hum issued from the loudspeaker mingled with the broadcast signal; a turn of the tuning dial and it was gone. There was our old arch-enemy the tunable hum again. The writer asked the owner of the receiver, did she always have hum trouble? "Of course," came the answer, "we're used to it!" Immediately, the portable battery-operated receiver was turned on and from it, too, issued the annoying sound.

The next action proved to be the key to the whole problem. The receiver was turned off with the portable still operating. Amazingly enough, the hum disappeared leaving the broadcast signal clear and undistorted. There was no doubt about it, each time the receiver in question was switched on the hum would be present on the carrier received by the portable monitor. A quick check with the receiver owned by the writer's friend in the front apartment also showed his hum to come and go as the offending set was turned on and off in the second apartment.

An examination of the suspicious receiver installation disclosed nothing unusual except for a lightning arrester connected between the antenna post and a nearby steam radiator pipe. Disconnecting the lightning arrester proved to be the solution to the hum that had been plaguing the area. This defective unit was tested for leakage resistance and was found to have a resistance of about 50,000 ohms, whereas a good lightning arrester should be completely open between antenna and ground terminals.

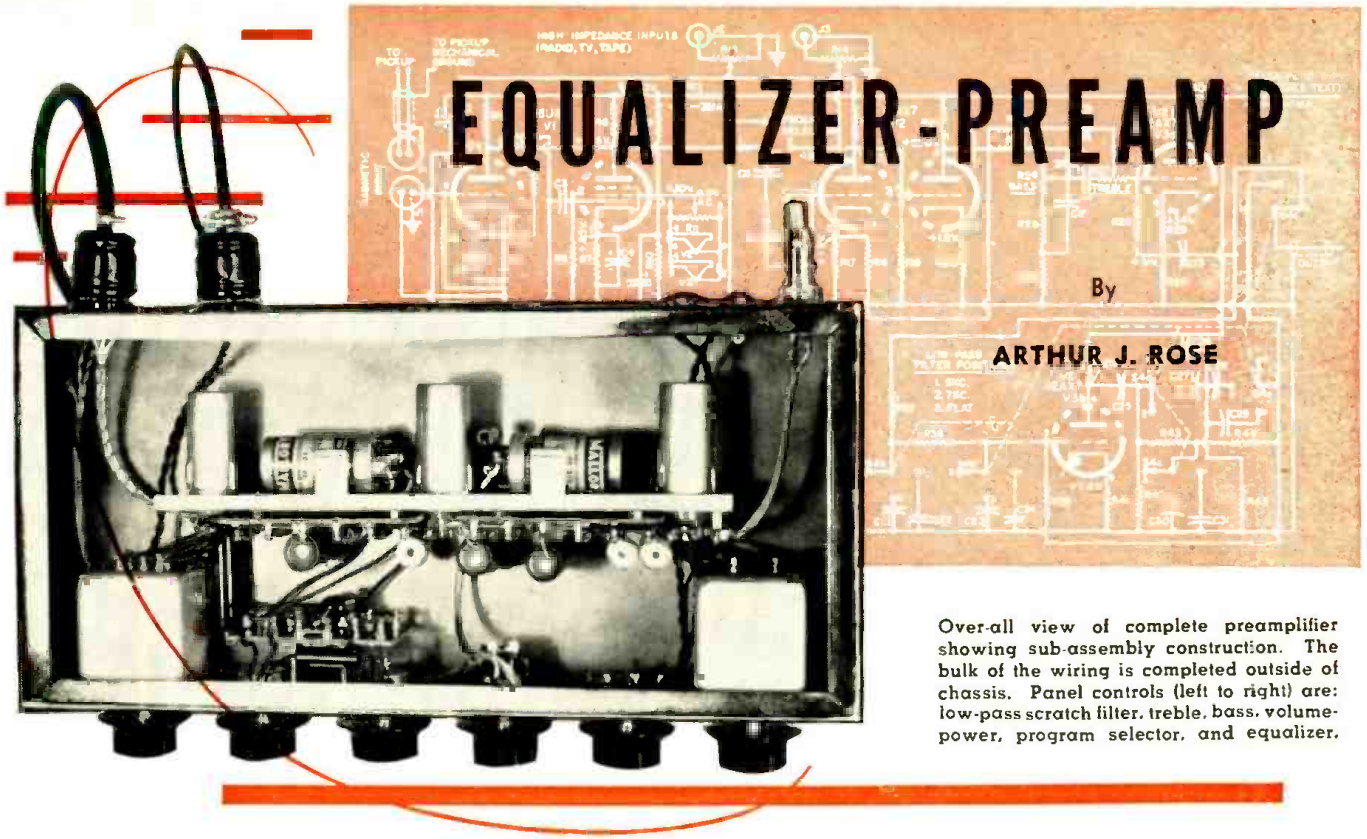
Apparently what happened was this: When the receiver was turned

(*Continued on page* 102)

EQUALIZER-PREAMP

By

ARTHUR J. ROSE



Over-all view of complete preamplifier showing sub-assembly construction. The bulk of the wiring is completed outside of chassis. Panel controls (left to right) are: low-pass scratch filter, treble, bass, volume-power, program selector, and equalizer.

Design details on a modern control unit engineered to provide flexibility and high quality performance.

MUCH of the information included in this article is presented in answer to the many inquiries submitted by those who read the author's earlier article[1] and towards fulfillment of a need for a universally applicable equalizer-preamplifier.

A summarization of the features deserving inclusion in the final design provides a basis for circuit development. Diversified opinions concerning certain auxiliary appliances are manifest among professionals and laymen alike. Therefore, it is not without some degree of subjectiveness that selections are given. However, it is felt that the majority of readers will regard them as the minimum necessary for consistency with the highest grade of equipment used to form the complete audio system. The design "check list" includes:

(*a*) Provision for incorporating and matching phono cartridge, radio, television, and tape inputs

(*b*) Control of over-all amplification

(*c*) Easily switched recording playback equalization

(*d*) Continuously variable bass compensation

(*e*) Continuously variable treble compensation

(*f*) Low-frequency rumble filter

(*g*) High-frequency noise filter

(*h*) Low impedance output

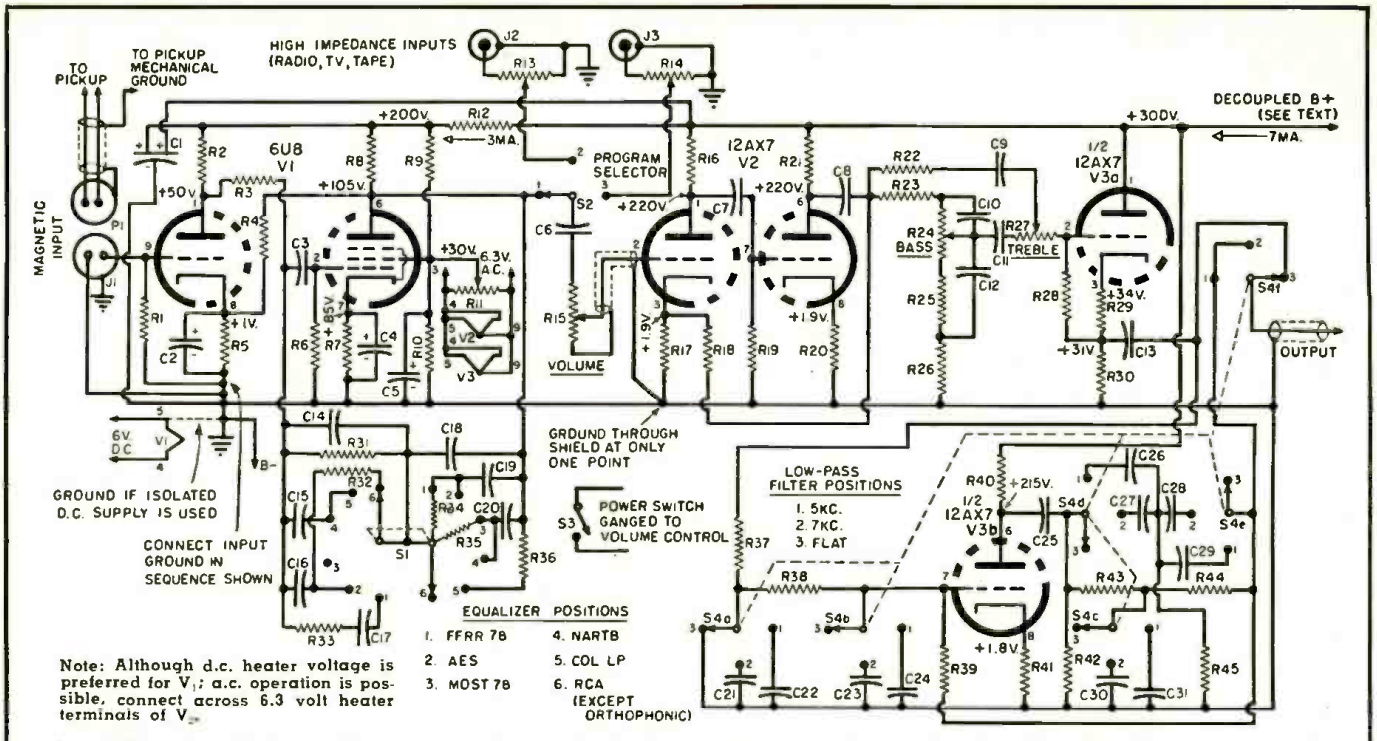
Along with desirable inclusions, other effects are subject to consideration. Instability, superfluous noises, and distortion are equally important as *un*desirables. Readers of the previous article will recall the blanket solution to the hum and noise problem. Wirewound resistors and a direct current heater supply are applicable in any design. If it were not for reasons to follow shortly, d.c. would be recommended for all applications. As will be appreciated by many, the final circuit permits a.c. operation in many cases. Distortion is maintained at a very low figure by proper tube operation and generous amounts of feedback. It should be noted that every stage, with the exception of the first, uses feedback.

Attention is directed to the schematic of Fig. 1. Preliminary inspection will reveal its sectionalization into a magnetic pickup preamplifier feeding a two-stage feedback amplifier. Tone controls follow this section into a cathode follower. In addition, there is the sharp cut-off low-pass filter that was described in the earlier article. More detailed study shows a six-position equalizer, rumble filter, and the method of using the cathode follower as a buffer between the low-pass filter and the balance of the circuit. When the filter is in the "flat" position, output is taken directly from the cathode follower. Otherwise, the output is taken from the filter where there is no need for a very low impedance output because of the deliberate attenuation of the higher frequencies. The low impedance source of the feedback amplifier and the high impedance loading of the cathode follower form an ideal condition for the tone controls. A direct approach to each section will greatly facilitate an understanding of the complete unit.

Playback Equalizer Section

There is no question in the writer's mind that feedback type equalizers are much to be preferred over "between the stages" types that offer no outstanding advantage such as reduction of distortion. As low as 20 cps, feedback types have distortion reduction factors great enough to be readily appreciated. Distortion at higher frequencies defies measurement; however, most feedback types are necessarily of the breed that introduces noise because of unbypassed cathodes. The equalizer stage to be presented does not have this difficulty nor does it have another drawback, to be mentioned shortly, that is common to the other types—even those with grounded cathodes. It is no more troublesome to construct although it requires more components.

It has come to be accepted that recordings need to be *exactly* equalized if the maximum of realistic reproduction is to be obtained. Because acoustic systems are subject to such wide variations, all equipment leading to the amplifier output terminals must be of unquestionable performance. This permits adjustment of the acoustic system. With properly equalized recordings, subsequent frequency-selective tone controls can be used effectively in co-ordinating differences in loudness levels and playback *vs* re-



Note: Although d.c. heater voltage is preferred for V_1; a.c. operation is possible, connect across 6.3 volt heater terminals of V_2.

R_1—47,000 ohms (G-E) or 27,000 ohms (Pickering)—recommended by the manufacturers
R_2, R_8, R_{16}, R_{21}—100,000 ohm, 1 w. wirewound res.
R_3—82,000 ohm, ½ w. carbon res. ± 10%
R_4, R_9—220,000 ohm, ½ w. carbon res. ± 10%
R_5—470 ohm, 1 w. wirewound res.
R_6, R_{19}—470,000 ohm, ½ w. carbon res. ± 10%
R_7—1000 ohm, ½ w. carbon res. ± 10%
R_{10}, R_{20}—47,000 ohm, ½ w. carbon res. ± 10%
R_{11}—100 ohm, 10 w. res. with adj. tap
R_{12}—33,000 ohm, ½ w. carbon res. ± 10%
R_{13}, R_{14}, R_{15}—1 megohm linear-taper pot
R_{17}—1800 ohm, 1 w. wirewound res.
R_{18}—120,000 ohm, ½ w. carbon res. ± 10%
R_{29}, R_{30}, R_{31}—1800 ohm, ½ w. carbon res. ± 10%
R_{32}, R_{34}—10,000 ohm, ½ w. carbon res. ± 10%
R_{33}, R_{35}—10,000 ohm, ½ w. carbon res. ± 10%
R_{24}—1 megohm audio-taper pot
R_{25}—10,000 ohm, ½ w. carbon res. ± 10%
R_{27}—100,000 ohm linear pot
R_{28}, R_{42}—1 megohm, ½ w. carbon res. ± 10%
R_{29}—33,000 ohm, 1 w. res.
R_{32}—62,000 ohm, ½ w. carbon res. ± 10%
R_{31}, R_{43}—3.3 megohm, ½ w. carbon res. ± 10%
R_{39}—820,000 ohm, ½ w. carbon res. ± 10%
R_{37}—100,000 ohm, ½ w. carbon res. ± 5%
R_{38}—470,000 ohm, ½ w. carbon res. ± 5%
R_{40}—560,000 ohm, ½ w. carbon. res. ± 10%
R_{41}—100,000 ohm, 1 w. res.
R_{44}, R_{45}—100,000 ohm, ½ w. carbon res. ± 1%
R_{46}—50,000 ohm, ½ w. carbon res. ± 1%
C_1—15/15 µfd., 350 v. elec. cond.
C_2, C_4—50 µfd., 25 v. elec. cond.
C_3, C_6, C_{11}, C_{12}—.02 µfd., 400 v. cond.
C_5—15 µfd., 350 v. elec. cond.
C_7—.01 µfd., 400 v. cond.
C_8, C_{25}—.05 µfd., 400 v. cond.
C_9—150 µµfd., 500 v. ceramic cond.
C_{10}, C_{13}—.002 µfd., 500 v. ceramic cond. ± 10%
C_{14}—.25 µfd., 400 v. cond.
C_{17}—50 µµfd., 500 v. ceramic cond.
C_{15}, C_{20}—.001 µfd., 500 v. ceramic cond. ± 10%
C_{16}—500 µµfd., 500 v. ceramic cond. ± 10%
C_{17}—200 µµfd., 500 v. ceramic cond. ±10%
C_{21}—200 µµfd., 500 v. ceramic cond. ± 5%
C_{22}—300 µµfd., 500 v. ceramic cond. ± 5%
C_{23}—50 µµfd., 500 v. ceramic cond. ± 5%
C_{24}—100 µµfd., 500 v. ceramic cond. ± 5%
C_{26}, C_{28}—150 µµfd., 500 v. ceramic cond. ± 1%
C_{27}, C_{29}—100 µµfd., 500 v. ceramic cond. ± 1%
C_{30}—200 µµfd., 500 v. ceramic cond. ± 1%
C_{31}—300 µµfd., 500 v. ceramic cond. ± 1%
P_1—2-prong shielded plug (Amphenol 80-MC2M)
J_1—2-prong shielded receptacle (Amphenol 80-PC2F)
J_2, J_3—RCA-type phono receptacle
S_1—D.p. 6-pos. rotary sw. (Mallory 3126J)
S_2—S.p. 3-pos. rotary sw. (Centralab 1461)
S_3—S.p.s.t. sw. (on R_{15})
S_4—6-pole, 3-pos. rotary sw. (Mallory 3163J)
All switches are shorting type (make before break)
V_1—6U8 tube
V_2, V_3—12AX7 tube

Fig. 1. Complete schematic diagram of equalizer-preamplifier. Precision parts are used throughout to insure quality performance.

cording acoustics. Lack of bass, especially at low levels, is sometimes the fault of the speaker or its acoustic environment. Often, however, it is due to insufficient bass equalization in the recording equalizer stage, in which circumstance even full use of the bass tone control will not prove to be enough.

Familiar twin-triode feedback equalizers are incapable of the 6 db-per-octave rate necessary in many playback requirements for proper bass equalization. This may come as a surprise to many because of the popularity of the various arrangements using triodes. The main reason for this is insufficient loop gain. Under ideal conditions, a gain of 2500 or so can be expected from cascaded 12AX7 sections and about 900 for a 12AY7. This in itself is poor. Aggravation of the situation appears with an unbypassed first cathode resistor that cuts these values by more than 50%. Since this situation has not been well publicized, it is desirable to present a brief supporting analysis.

An important factor in the maximum available rate of boost from *any* feedback equalizer is the ratio of midband loop gain (gain without feedback) to the over-all midband gain (gain with feedback). Examination of Fig. 2 will show the response that can be expected for different values of the ratio, A_0/G_0. These curves are based on stages with sufficient coupling and bypassing well below 10 cps. The 12AX7 example with the commonly used over-all midband gain of 50 can, at best, produce a curve somewhere between the ones shown for ratios of 20 and 40. In like fashion, the 12AY7 will produce the 20 curve. Because the feedback can be considered almost purely reactive (at lower frequencies) and therefore double in value every octave is no cause for a 6 db-per-octave rate here. In fact, for any circuit to produce this rate, an infinite ratio is required as the equation in Fig. 2 shows. At 50 cps, with a 500 cps turnover, 20 db boost ($C = 10$) corresponds to 6 db-per-octave from the turnover. Substitution of these values in the equation will cause the denominator to go to zero with a subsequent impossible gain requirement.

With this in mind, several alternatives are possible. Ratios in the neighborhood of 80:1 can be obtained by dropping the over-all gain with more feedback or by raising the loop gain by the use of pentodes. To drop the over-all gain with triodes would entail using feedback components that would load the stage to excess and would require condensers of physical proportions too staggering for space requirements. Chances are that the requisite G_0 would be too small for application.

A compromise using a high gain pentode with a sufficient A_0/G_0 ratio and an unfedback triode first stage

gives proper compensation and permits bypassing of the first cathode—a threefold advantage. Bypassing greatly lowers first stage noise, permits a.c. heater operation and gives higher gain. Attenuation due to the feedback isolation resistor requires that the triode precede the pentode for maximum signal-to-noise ratio.

"Natural" for this application is the 6U8 triode-pentode. Designed primarily for r.f. use, 6U8's are newcomers to audio. They have microphonic tendencies, but no more so than other types used often in similar circuits. Some selection at the parts dealer will help: hold the tube by the pins and tap it with a fingernail while listening for various *bings* and *bongs*. After about ten hours use, many of these tubes will become much quieter. Their thermal noise naturally varies from tube to tube, but has been found to be quite low especially with the circuit shown. 6AU6's with extremely low hum and noise levels can be substituted where one envelope is not deemed advantageous or where higher gain is desired. This will be further discussed with the next section.

An over-all midband gain of 25 to 30 can be expected from the first section. The pentode has a loop gain of 185 and is reduced by feedback to about 1.25. The triode stage has a gain of 20.

Equalization is provided for what the writer believes to be the majority of the recordings in use. Rather than use a separate network for each position, the switching uses a minimum of parts to achieve the correct values. For those with special requirements, a table is provided in Fig. 3 that will enable quick selection of components. These have been derived by network transformations of values generally given for "between the stages" equalizers.[2]

Wirewound resistors are specified in all places where their use contributes to lowered noise. Bypassing of R_5 is effective only above 20 cps, therefore this resistor must be wirewound to prevent low frequency noise. C_{11} has been added to prevent high frequency instability. It has no attenuating effect in the audible region.

A single resistor, R_4, does a lot of work in this circuit. The addition of this component completes the rumble-filter scheme. First coupling constants throughout the unit were chosen to give roll-off below 20 cps. R_5 and C_2 are similarly chosen. Feedback from the pentode stage *via* R_4 is operative only when the impedance of the triode cathode rises—at very low frequencies. The combined effect is to give a fairly rapid attenuation below 20 cps without altering response above that frequency. Experiments with parallel-T networks have shown that while the attenuation rate is greater, the improvement does not justify the added complication.

Second Section

Input requirements of the various

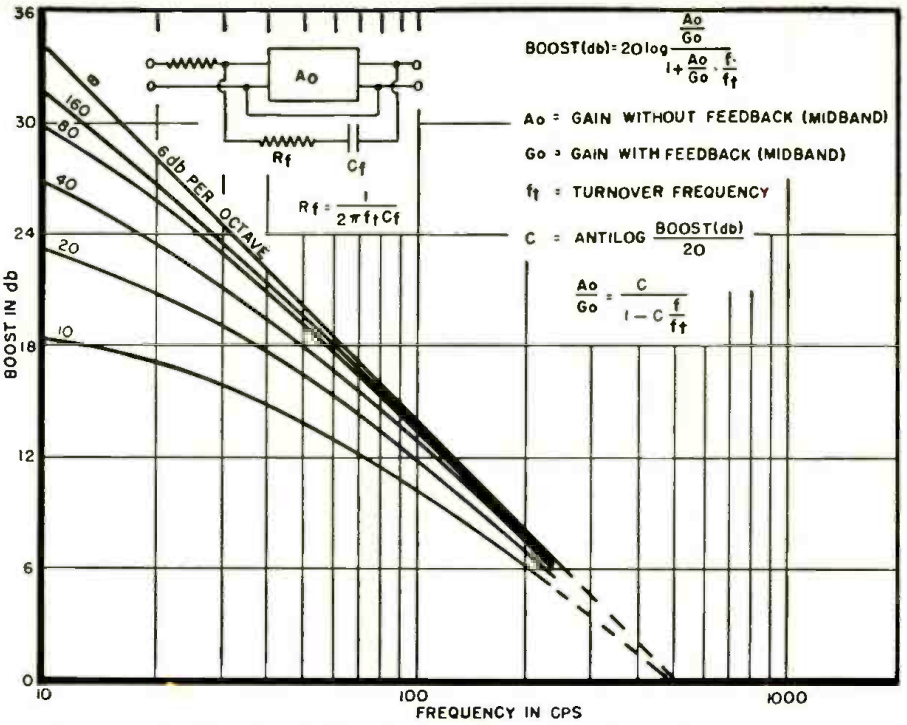


Fig. 2. Rate of bass boost of feedback equalizers depends largely upon the ratio of midband gain with and without feedback. Text points out shortcomings of many equalizers using degeneration and offers basis for development of unique circuit.

final amplifiers vary from 0.5 to 1.5 volts. The output of the preamplifier is largely determined by the second section.

Again feedback has been called upon to provide amplification that is distortionless and virtually independent of tube characteristic or supply voltage variations. To ensure this, the loop gain must be high enough to have A_0/G_0 large compared to one. The feedback must not, however, be great enough to excite oscillation and some caution is advised. As shown, the gain is nearly 67 and is determined almost solely by R_{18}/R_{17}. For lower gain, R_{18} has to be lowered and a 12AU7 should be used. For higher gain, bypassing of R_{20} may be required in addition to increasing the value of R_{18}. If higher gain is contemplated, it should be borne in mind that tube noise from this section, as well from the first section, will increase proportionately. 6AU6's will have to be used in the first section with a d.c. heater supply. The d.c. is recommended there, as shown in Fig. 1, because the gain is high by usual preamplifier standards. Lower gains will suffice with cartridg-

Fig. 3. Response of equalizer positions shown in Fig. 1. Special arrangements can be designed by referring to the basic circuit and table of components.

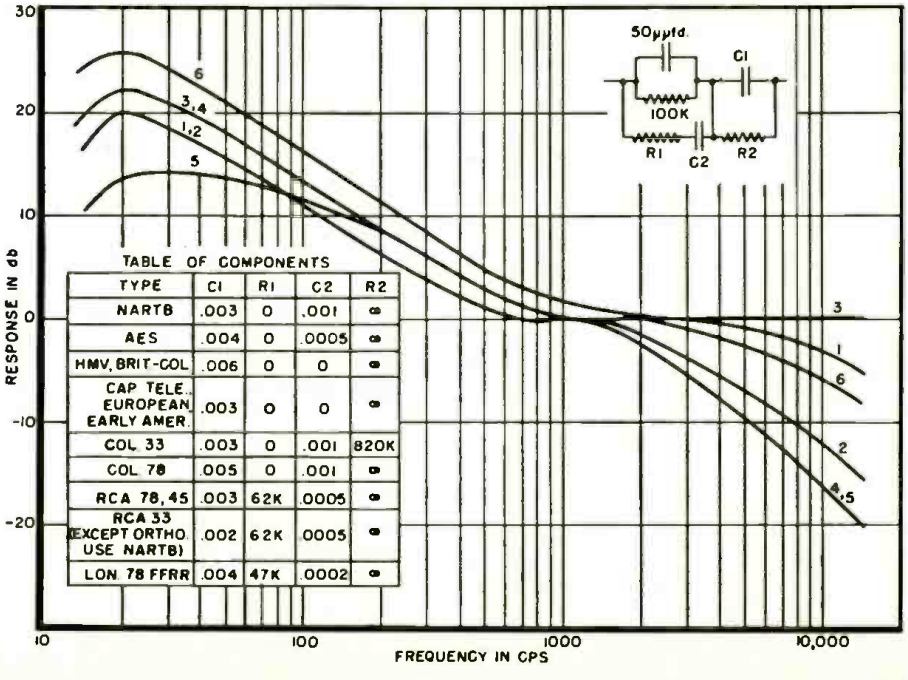
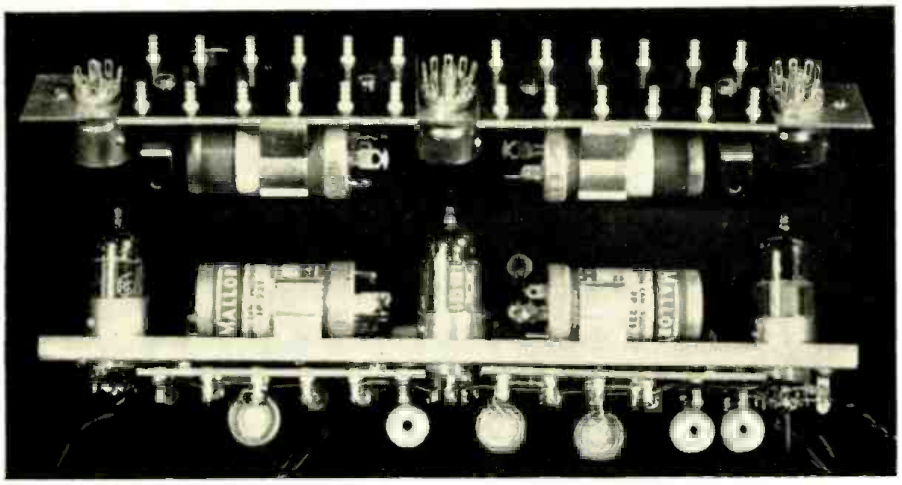
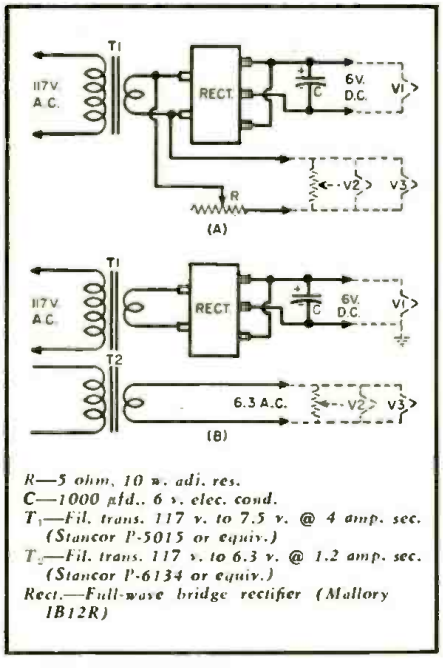


TABLE OF COMPONENTS

TYPE	C1	R1	C2	R2
NARTB	.003	0	.001	∞
AES	.004	0	.0005	∞
HMV, BRIT-COL	.006	0	0	∞
CAP TELE., EUROPEAN, EARLY AMER.	.003	0	0	∞
COL 33	.003	0	.001	820K
COL 78	.005	0	.001	∞
RCA 78, 45	.003	62K	.0005	∞
RCA 33 (EXCEPT ORTHO USE NARTB)	.002	62K	.0005	∞
LON. 78 FFRR	.004	47K	.0002	∞



Two views of the sub-assembly at different stages of its construction. See text.



R—5 ohm, 10 w. adj. res.
C—1000 μfd., 6 v. elec. cond.
T_1—Fil. trans. 117 v. to 7.5 v. @ 4 amp. sec. (Stancor P-5015 or equiv.)
T_2—Fil. trans. 117 v. to 6.3 v. @ 1.2 amp. sec. (Stancor P-6134 or equiv.)
Rect.—Full-wave bridge rectifier (Mallory 1B12R)

Fig. 4. Two easily-built d.c. heater supplies designed to be used with the first stages of the high-gain preamplifier unit.

es such as the *Pickering* which has an output of over 50 millivolts. With the lower output types, such as the *General Electric*, a gain of 50 or more is needed in this section unless the final amplifier is more sensitive than those ordinarily encountered.

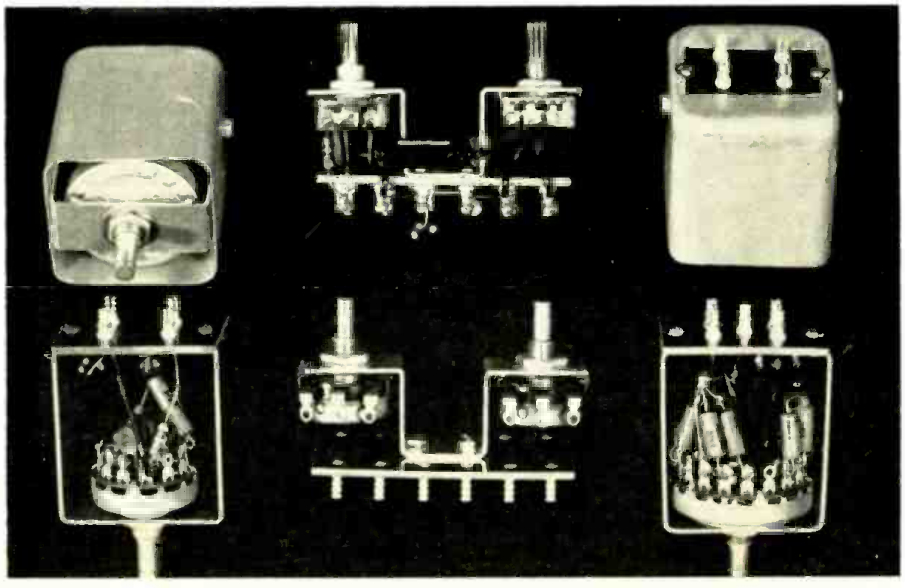
Maximum output from the second section is slightly more than 40 volts. After subsequent attenuation by the tone controls and cathode follower, the available preamplifier output is over 3.5 volts.

High impedance inputs should be preset to permit full use of the volume control without overloading the feedback amplifier. Maximum input to the volume control is approximately $60{,}000/R_{15}$ volts.

Tone Controls

An unusual combination of bass and treble controls was chosen because of its smooth action. The treble circuit gives only boost and is entirely satisfactory when de-emphasis is correctly applied in the equalizer stage and when the low-pass filter is available. Experience has shown that this is true with input material other than phono

Circuits associated with equalizer, tone controls, and low-pass scratch filter are wired to control assemblies. Protective shield cans are not too essential.



provided the source is properly balanced. Usually it is the predominance of a maladjusted tweeter that is to blame when highs cannot be brought under control with a treble control of this type. Known as variable "degree" as opposed to variable "slope," its effect is to lift the middle as well as the top highs, thereby giving a more balanced action. Boost and droop are more applicable to the bass end with a variable slope control. This is to be preferred in that region.

Output from the cathode follower is about 0.85 times its input. The output impedance is nearly 500 ohms. Because of the elevated cathode, heater returns should be made to a similar potential. The pentode screen grid is an ideal place.

Low-Pass Filter

Comment about this stage is limited to information not mentioned in the earlier article. R_{38} and R_{39} have been chosen to bring the gain to unity so there will be no change in level when the filter is switched from flat to cut-off.

Bypassing R_{41} is not recommended as it produces a peak in the response. The loop gain has been increased by the use of a 12AX7 section instead of a 12AU7 and produces an optimum cut-off characteristic for the given component tolerances with a gain of about 25.

Experimenters who wish to investigate the possibilities of a variable slope filter can try variations of the loop gain by placing a potentiometer in the loop or by bridging the T-network with a variable resistor, etc. A wide variation of slope is possible, but full variation from flat to extreme cut-off would seem difficult to obtain. At present, sufficient data is not available to quote definite capabilities.

Power Supply

Duplication of the voltages shown on the schematic is probable within 10% with a supply of 300 volts. Voltages as low as 250 volts can be successfully used. In any event, the supply must be isolated by a resistance greater than 10,000 ohms if the main amplifier is to furnish the plate power. Ideally, a well decoupled point should be chosen in the final amplifier that will supply at least 370 volts with the additional 7 ma. loading of the preamplifier.

A separate power supply need only furnish 250 to 300 volts and in the interest of flexibility and sure-fire simplicity this is to be recommended. Self-powered preamplifiers are coming more into their own because of the desire of most experimenters to try their units with many different final amplifiers.

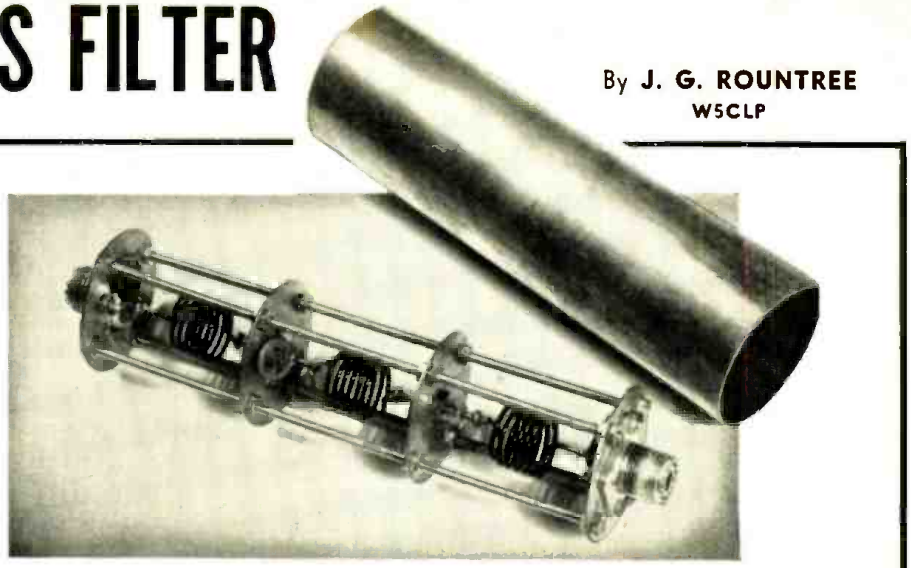
Heaters must be supplied with a separate winding and preferably a separate transformer. Conditions for a.c. or d.c. operation of the playback-equalizer (first) section heaters have been stated. Since the 6U8 draws 450

(*Continued on page* 112)

A $5 LOW-PASS FILTER

By J. G. ROUNTREE
W5CLP

A good low-pass filter for medium-power rigs can be had at reasonable cost.



The internal view of the low-pass filter shows its simplicity. The 2" brass-pipe case gives perfect shielding. Note the ceramic condensers.

IN SPITE of anyone's wishful thinking to the contrary, television is here to stay. As a result, greater demands than ever are now put on the amateur to achieve purity of signal, so that any interference will not be the result of harmonic or spurious emissions from the amateur transmitter. We are all painfully aware of the shortcomings in the design and fabrication of some television receivers and we should give due credit and strong support to those few courageous amateurs who have outspokenly challenged the shoddy practices of many TV receiver manufacturers. We must also give credit and support to those manufacturers who have installed high-pass filters in receivers already sold and have improved their designs to correct deficiencies.

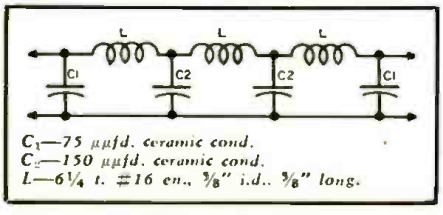
The position of each of us and of amateur radio as a whole can be strengthened through our being certain that our own equipment is designed and working properly. It was with this in mind that the writer recently purchased a new TVI-proofed transmitter. It was decided that, as a further safeguard against harmonic radiation, some sort of filter should be placed between the transmitter and the antenna to attenuate any possible harmonics. Having already invested a goodly sum in the transmitter, it was with some dismay that we examined the prices of suitable low-pass filters for transmitters. There seemed to be no reason why a satisfactory home-grown filter could not be built at relatively low cost.

Reference to a radio engineering handbook showed that a three-section pi network should be relatively effective and quite simple to build. The question arose as to whether close tolerances would need to be observed in the component parts, but a little pencil work with the handbook formulas showed that a reasonable degree of tolerance could be allowed. Since the lowest-frequency television allocation in the Dallas-Fort Worth area is Channel 4, it was considered that the simple low-pass pi network would achieve a suitably high attenuation at this channel. This proved to be the case. Where the lowest-frequency allocation is Channel 2, an M-derived filter would provide higher attenuation at Channel 2.

As a starting point the frequency 40 mc., approximately midway between the upper end of the 10-meter band and the lower end of Channel 2, was chosen as the cut-off frequency. The network was designed to work in a 52-ohm line, such as type RG/8-U. Design values for the shunt condensers were worked out from handbook formulas; and commercially-available disc ceramics, nominally rated very close to the design values, were purchased. These condensers are rated at 500 volts and should stand up very well in service for transmitter powers of up to 200 watts or so, provided that the standing-wave ratio of the transmission line is kept within reason. Design values for the coils were likewise worked out, and parameters of the coils were determined by use of a "Lightning Calculator." See Fig. 1 for the circuit diagram of the filter.

The pi network was built in a three-section chassis made of four circular brass shields spaced on four ⅛-inch brass rods, each seven inches long. The rods were threaded with 32 threads for their entire length. The shields were cut from 20-gauge brass, carefully trimmed to fit smoothly inside a two-inch brass tube, and were spaced at equal distances along the brass rods. The two end shields contain coaxial fittings, while the two intermediate shields contain *National* TPB feedthrough bushings. The end coils of the network were soldered between the coaxial fittings and the adjacent bushings, while the center coil was soldered in place between the feedthrough bushings. The shunt condensers were soldered in place between the coils and the shields by as short a path as possible.

Fig. 1. Schematic of the low-pass filter.



C_1—75 μμfd. ceramic cond.
C_2—150 μμfd. ceramic cond.
L—6¼ t. #16 en., ⅜" i.d., ⅜" long.

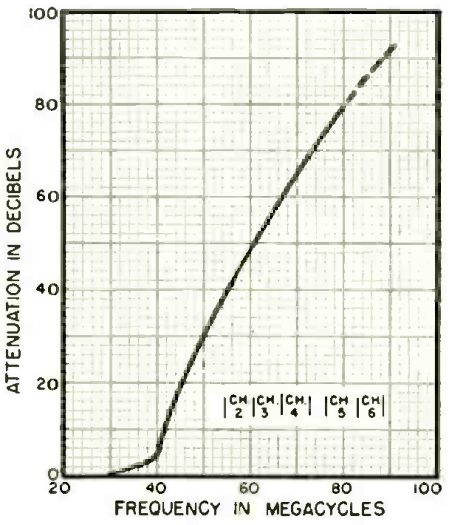


Fig. 2. Attenuation curve of the S5 filter.

The entire assembly was slipped into a seven-inch length of two-inch brass pipe. Before the end shields were soldered in place, the assembled unit was baked at a moderate temperature for about fifteen minutes to drive out any moisture remaining in the unit. While the filter could be mounted in several ways, it has been found that two U-bolts, made of ⅛-inch brass rods, provide a simple way of bolting the filter to the back of the transmitter cabinet.

After completion of the unit, a test was made to determine the effectiveness of the filter. Fig. 2 is a graph showing the results of this test. It will be noted that the attenuation is negligible below 30 mc., and that it increases to more than 40 db for Channel 2, 50 db for Channel 3, and 59 db

(*Continued on page* 102)

D.C. DISTRIBUTION IN TV RECEIVERS

By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

You can use an ordinary v.o.m. for rapid TV servicing when you know the theory and operation of the d.c. receiver circuits and their normal measurements.

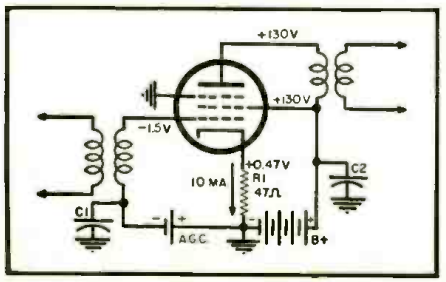
HIT or miss troubleshooting procedures can never make TV servicing a profitable business. A definite method is needed in all service work. This is especially true of locating defects and giving estimates right in the home, where a rapid, simple procedure is essential. Furthermore, this procedure must use only a few compact test instruments. All this suggests the most basic approach—d.c. measurements.

Every service technician knows how to measure "B+" voltages, but in today's complicated TV models a single voltage reading is often not sufficient to locate the defective part. Different models use greatly different circuits, exact diagrams with voltage figures are usually not available in the home, and the variation in tubes and line voltage further complicates d.c. troubleshooting. Yet the d.c. operation of most stages in a TV set is a direct indication of its over-all performance and can be used to spot a large number of common defects. This article will show the service technician how he can troubleshoot any TV set in the customer's home with only a simple v.o.m. and a good understanding of the d.c. paths in the set.

D.C. per Stage

Any TV receiver can be broken up into a series of circuits each of which has a tube as its center. A signal is applied at the grid or cathode and is taken off at either the plate or cathode. What happens to the amplitude and waveshape of this signal depends on such fixed components as coils, condensers, and resistors and on the d.c. voltages and currents applied to the tube. Assuming that the filaments light up and the coils are not shorted, the entire tube circuit can be examined on a d.c. basis only.

Fig. 1. TV receiver i.f. stage showing normal d.c. readings for the circuit.



OHM'S LAW	EXAMPLE
VOLTAGE = CURRENT x RESISTANCE	1V = 1MA x 1K = 10MA x 100Ω 10V = 10MA x 1K = 100MA x 100Ω 100V = 10MA x 10K = 100MA x 1K
CURRENT = $\frac{\text{VOLTAGE}}{\text{RESISTANCE}}$	1MA. = $\frac{10V}{10K}$ = $\frac{100V}{100K}$ 10MA. = $\frac{1V}{100\Omega}$ = $\frac{10V}{1K}$ 100MA = $\frac{10V}{100\Omega}$ = $\frac{100V}{1K}$
RESISTANCE = $\frac{\text{VOLTAGE}}{\text{CURRENT}}$	10Ω = $\frac{1V}{100MA}$ = $\frac{10V}{1AMP}$ 100Ω = $\frac{1V}{10MA}$ = $\frac{10V}{100MA.}$ 1K = $\frac{10V}{10MA.}$ = $\frac{100V}{100MA.}$

Table 1. Various forms of Ohm's law with examples, for use in d.c. measurements.

Fig. 1 illustrates a typical i.f. stage. The current through the tube results in a 0.47-volt drop across R_1, the cathode resistor. If the —1.5-volt bias was absent the tube current would rise, possibly up to 20 ma., and the voltage across R_1 would be close to 1 volt. A single voltage measurement can, therefore, tell us all pertinent facts about this stage. If we measure about 0.5 volt across the 47-ohm cathode resistor we know that the grid bias is correct which means the grid coil is not open and C_1 is not shorted. We also know that the screen and plate are receiving approximately the right voltage and that C_2 is not shorted and the plate coil is not open. The remaining possible defects narrow down to misalignment, shorted turns in either coil, or possibly a bad tube. The last is unlikely since tube emission must be good to give proper voltages. Thus the operation of an entire stage can be checked with a single d.c. voltage measurement.

Most forms of service data show the correct d.c. voltages for all tube elements. To interpret correctly the meaning of an incorrect voltage at any point, the service technician should understand the d.c. operation of the entire set. Basically all one needs to know is Ohm's law in its different forms. Some helpful data on this is given in Table 1.

To check the d.c. operation of any amplifier tube, simply check the tube current. This is easiest where a cathode resistor is used. If the cathode is grounded, measure the plate current by reading the voltage across either the plate load resistor or a series decoupling resistor. In most cases where correct plate current and voltage are found, the control and screen grids will also be operating correctly.

Oscillators which are operating properly have grid-leak bias, and therefore draw less current than when some defect prevents proper oscillation. During improper operation the tube current often rises beyond the tube operating limits.

Three different oscillators are found in TV sets: the local oscillator in the tuner, the vertical, and the horizontal saw-tooth generators. Local oscillators, either v.h.f or u.h.f, usually require about 120 to 150 volts with 10 to 25 ma. of current. To check these do not measure grid bias, but connect the d.c. voltmeter across the plate decoupling resistor, usually 150 ohms. If the tube is oscillating the meter reading will increase when a screwdriver tip is brought near the tank circuit. This check does not determine the oscillator frequency, but in the absence of either sound or picture it indicates whether or not the oscillator is working.

The vertical and horizontal oscillators can be checked by measuring the grid bias. Touching the grid with the meter probe will shift the frequency somewhat, but here again only the operation of the stage is checked. Actual bias voltages vary from —10 volts for some horizontal circuits to —25 volts for vertical blocking oscillators. Remember that bias should be measured between the grid and cathode pins of the tube. In addition to bias, the voltage drop read across the plate load resistor will show the current and thereby completely cover the tube operation.

Clipper and limiter circuits invariably draw very little d.c. power since they operate at cut-off most of the time.

D.C. Distribution in Over-all Receiver

In addition to being able to perform d.c. tests on individual stages the technician must also know how the over-all d.c. network in a TV set works and what voltages and currents can be expected in each section.

The basic d.c. system for any TV set is equivalent to that of a power supply and a load. The power supply converts the a.c. power into a d.c. voltage, usually much higher than the 117-volt a.c. line, and a certain amount of current which then operates the various tubes in the receiver. Fig. 2 shows the schematic diagram of a typical power supply and its equivalent circuit. The equivalent circuit of the transformer full-wave rectifier and pi-type filter is a simple battery with the voltage V, supplying a current I. In this example we assume that the entire TV receiver is supplied by this same voltage and the total of the currents drawn by each tube is equal to I. Some TV receivers have a d.c. system where only a single "B+" voltage is used for all stages, but the majority of sets employ more complicated schemes.

The i.f. amplifier tubes are rated at about 150 volt plate and screen voltage, while some of the sweep oscillators and video and sweep amplifiers require between 250 and 400 volts plate supply. One simple solution to the problem of supplying two widely different plate voltages is the scheme used in the original 630 type receivers. This is shown in Fig. 3, and consists mainly of a resistive voltage divider which supplies the various correct voltages and currents to each section. The excess power is dissipated in the bleeder resistors which are usually of the wirewound type. While this circuit results in fairly good regulation and certainly is convenient and simple to understand, it is not very economical. Because of the power dissipated in the bleeder resistors, more d.c. power must be supplied than the tubes actually use. This requires an expensive power transformer, two 5U4 rectifiers, extra components and results in extra heat in the chassis.

To utilize the "B+" power more fully, modern TV receivers use a number of schemes for eliminating dropping resistors whenever possible. One very widely used economy circuit is shown in Fig. 4A. As mentioned before, the i.f. stages require between 120 and 150 volts for the plate and screen supply. Similarly, the audio output amplifier can be designed to use approximately the same voltage. If the main "B+" voltage was 270 volts the simplest arrangement would be the one in Fig. 4C, where resistors R_1 and R_2 drop the voltage down to the level required and dissipate the excess power. In Fig. 4C, the power delivered by the power supply is 270 volts at 70 ma. or about 19 watts. Almost half of this power is dissipated in the bleeder resistors.

Now look at the circuit in Fig. 4A. Here the audio amplifier is in series with the three i.f. stages as far as d.c. is concerned. The 6V6 output tube serves as a dropping resistor to lower the voltage for the three i.f. stages. Both of these loads use the same current and, in effect, the 6V6 output tube serves to regulate the i.f. plate voltages.

Assume that the "B+" voltage drops slightly due to line voltage variations. This means that the cathode bias of the 6V6 is reduced, allowing this tube to pass more current and therefore maintain the voltage on the three i.f. tubes. Similarly, an increase in "B+" voltage means an increase in 6V6 bias which again keeps the "B+" voltage for the i.f. section relatively constant. Because the total gain in the i.f. section is large, variations in plate supply voltage of the i.f. tubes have much more effect than "B+" variations in the 6V6 audio amplifier.

A very important feature of the circuit in Fig. 4A, is the two condensers C_1 and C_2. These condensers provide low a.c. impedance paths for the audio signal and for the i.f. signal, keeping the "B+" for both series loads a true d.c. voltage. If either was open, motorboating in the audio, and audio variations in the i.f. signal would result. If C_2 was leaky or even shorted, the entire 270 volts would be applied to the 6V6 tube. Because the tube has a self-bias arrangement and is capable of handling such a high plate voltage, the 6V6 would not burn out. However, there would be very little or no plate and screen voltage for the i.f. stages, cutting off the picture signal and, in an intercarrier set, the sound signal as well. If condenser C_1 is shorted, the excessive plate voltage on the i.f. tubes could cause oscillation, overloading of the last stage due to excessive gain in the first two and, eventually, the i.f. tubes would burn out, one by one.

The third electrolytic condenser failure which can cause trouble involves C_3, the 6V6 cathode bypass condenser. If this condenser opens, the sound output will be greatly reduced and some audio may appear in the picture, but otherwise nothing will burn out or be damaged. If C_3 shorts, however, considerable damage can result. Such a short would result in the 6V6 being operated with almost zero bias. This will increase the current through the 6V6 considerably and will raise the "B+" voltage available to the i.f. stages. While the sound will be quite distorted, the excessive "B+" may cause the i.f. stages to become regenerative. The a.g.c. system may be unable to control the gain of the i.f. stages with such high plate voltages and cause overloading, i.f. oscillation, or picture distortion in the video amplifiers.

The circuit shown in Fig. 4A repre-

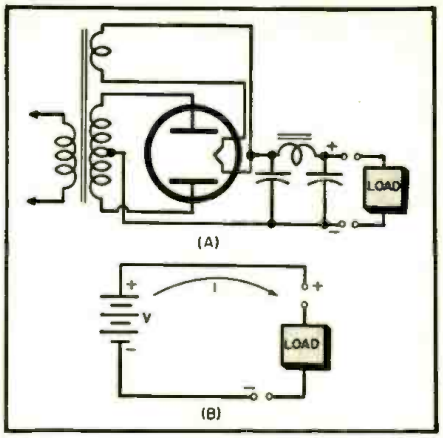


Fig. 2. (A) Typical low-voltage power supply with its equivalent circuit (B).

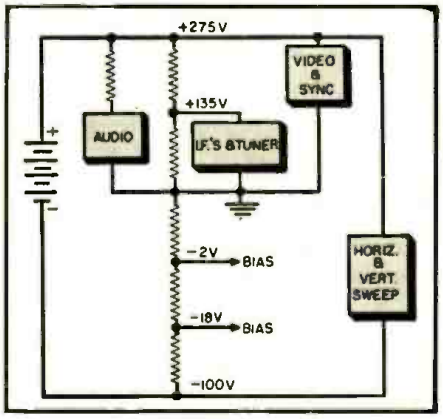


Fig. 3. Simplified 630-type d.c. circuit.

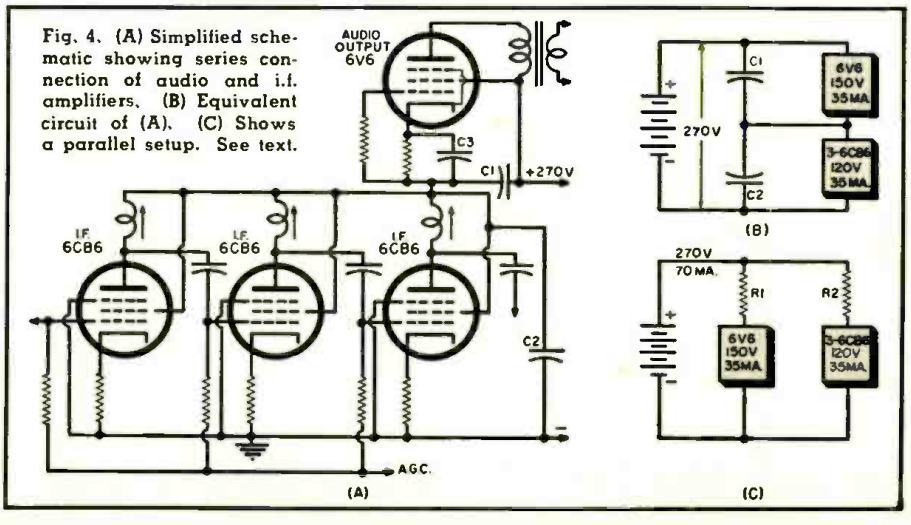


Fig. 4. (A) Simplified schematic showing series connection of audio and i.f. amplifiers. (B) Equivalent circuit of (A). (C) Shows a parallel setup. See text.

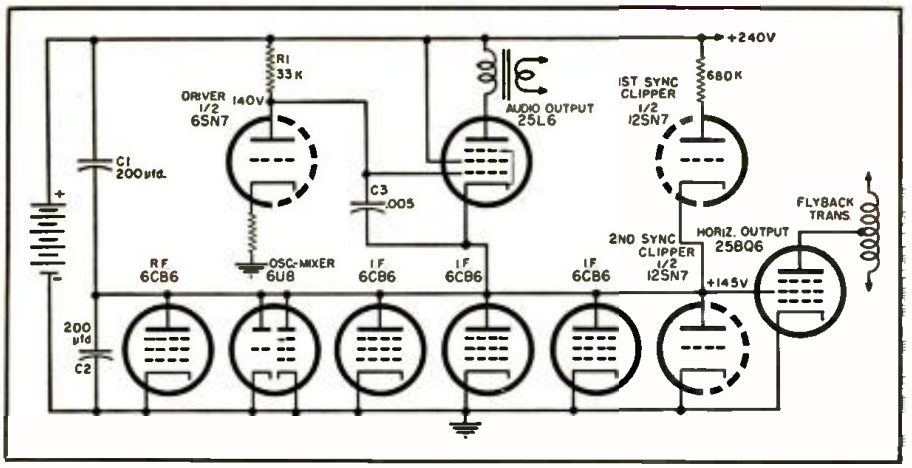


Fig. 5. Series-type d.c. distribution circuit as used in the Motorola 17F12.

sents only the important d.c. elements and omits such details as decoupling resistors, i.f. bypass condensers, heater circuit, etc. It should be understood, however, that failure in any one of these omitted parts can affect the d.c. distribution and cause trouble both in the i.f. and audio sections as a result of their series connection.

It becomes evident that a large number of defects occurring in the i.f. and audio sections can be located directly by checking the d.c. operation of these circuits. If the technician does not know of this series d.c. distribution it will be hard to associate the defect in the audio output stage with the symptoms found in the i.f. section. Whenever a series circuit is used, be sure to check both the total voltage and the lowered "B+" portion. For example, the voltage across the i.f. tubes in Fig. 4A should not exceed about 150 volts, but the voltage across the audio output tube must be the difference between the "B+" voltage and the i.f. plate voltage.

Another typical application of the series d.c. distribution method is shown in Fig. 5. This is a simplified presentation of the d.c. path of the *Motorola* models 17F12, 17K12, and 17T7, among others. Here a total of five stages, the tuner and i.f. amplifiers, are supplied with 145-volt "B+". In addition, the screen of the 25BQ6 horizontal output amplifier and the plate of the second sync clipper also go to the 145-volt point. The total current taken by the 145-volt source is approximately 60 ma., drawn through the 25L6 audio output tube and the first sync clipper. These two tubes are connected in parallel, but since the sync clipper has a high plate load resistor and generally uses much less current than the 25L6, the latter passes most of the current for the 145-volt line.

In analyzing this scheme we find it is somewhat more complicated than the circuit shown in Fig. 4A, and certainly a much greater number of defects can occur here. Assume, for example, that the 200 µfd. condenser, C_2, shorts out. This not only cuts the i.f. and tuner sections off, but will also kill the horizontal sweep and high voltage to the CRT since it grounds the screen of the 25BQ6. Furthermore, the audio output tube will tend to draw excessive current and burn out shortly.

The circuit used here for providing bias for the 25L6 is somewhat unusual. It uses the plate load resistor for the audio driver stage, R_1, to drop the 240-volt "B+" down to 140 volts. Since the cathode of the 25L6 is at 145 volts, the grid is 5 volts negative with respect to the cathode. If the driver tube goes bad and does not draw sufficient current, the voltage at the plate of the driver and the grid of the 25L6 may go higher than 140 volts. This can mean zero or even positive bias on the 25L6 with a resultant increase in current through the tube and an increase in the 145-volt line. When the 145-volt line is raised considerably, say to 200 volts, the tuner and i.f. sections can overload, oscillate, or become regenerative. The change in plate voltage will cause the local oscillator to shift its frequency so that it will appear misaligned. High plate voltage will also affect the operation of the second sync clipper, possibly wrecking horizontal or vertical sync or even upsetting both circuits. For the horizontal output tube the increase in screen voltage will mean more deflection and more high voltage.

There are many other possible defects which can have quite unexpected symptoms and present a problem in troubleshooting due to the complexity of the d.c. distribution in this set. By measuring the d.c. voltages, however, the source of the trouble can be found quickly. For this particular receiver it is only necessary to measure the 240-volt line, the 145-volt line and, if they are not quite correct, check the bias on the 25L6 and finally the bias on the i.f. tubes. All these measurements require only a simple d.c. meter.

We have taken the *Motorola* circuit of Fig. 5 as an example of the series connection scheme. There are many variations of this d.c. distribution system and almost all of them use the audio output tube as the major current path for getting a lower "B+" voltage for the i.f. section. In some instances the audio tube is shunted by a fixed, wirewound power resistor which supplies additional current. The principle and the method of troubleshooting remain the same. Always

Table 2. The voltage and current requirements for typical TV receiver stages.

STAGE	BIAS	PLATE	SCREEN	NOTES
TUNER				
6BK7, 6BQ7, 6BZ7	0.5-5 v.	150 250 v., 20 ma.		cascode circuit
6AK5, 6AG5, 6BC5, 6CB6	0.5-3 v.	150 v., 8 ma.	150 v., 2 ma.	
6J6, 12AT7		150 v., 15 ma.		oscillator
I.F.				
6AG5, 6CB6, 6BC5, 6AU6	0.5-5 v.	150 v., 8 ma.	150 v., 2 ma.	
VIDEO				
6AU6, 6CB6	1-5 v.	200 v., 8 ma.	150 v., 2 ma.	
6AC7, 6AH6	1-4 v.	300 v., 10 ma.	150 v., 2 ma.	
6AG7, 6CL6, 6K6, 6V6	1-4 v.	300 v., 35 ma.	150 v., 8 ma.	
6SN7, 12AU7	1-10 v.	300 v., 12 ma.		
12AT7	1-4 v.	200 v., 10 ma.		
SYNC				
6SN7, 12AU7, 12AT7		50-200 v., 3-10 ma.		great variation in different circuits
VERTICAL				
6SN7, 12AU7, 12AX7, 6C4	3-10 v.	200-400 v., 12 ma.		
12BH7, 6BL7, 6S4	3-12 v.	200-500 v., 20 ma.		
6K6, 6V6, 6AQ5, 25L6	2-15 v.	150-250 v., 35 ma.		triode connection
HORIZONTAL				
6SN7, 12AU7, 12AX7	5-15 v.	250-400 v., 10 ma.		osc. & a.f.c. tube voltage differ
6BG6, 19BG6	18-24 v.	400-500 v., 70-90 ma.	300 v., 15 ma.	
6CD6	16-20 v.	400-600 v., 80-110 ma.	350 v., 18 ma.	
6BQ6, 6AU5, 6AV5	20-25 v.	400-600 v., 50-70 ma.	150 v., 12 ma.	
6W4, 5V4, 35W4				measure only at boost point, 400-600 v.
AUDIO				
6AU6, 6CB6, 6BA6	1-6 v.	150 v., 8 ma.	150 v., 2 ma.	
6T8, 6AT6, 6AV6	1-3 v.	150 v., 1 ma.		
6K6, 6V6, 25L6, 6AQ5	6-15 v.	150-250 v., 25-40 ma.	200 v., 8 ma.	
POWER SUPPLY				
5U4				output up to 450 v., 225 ma.
5V4				output up to 400 v., 175 ma.
5Y3				output up to 450 v., 150 ma.
6X4				output up to 380 v., 70 ma.

The above are average values only and may vary in different receiver models.

check first if the cathode of the audio amplifier is returned to ground. Measure the voltage between the cathode and ground, then measure the voltage between the cathode and the i.f. "B+". If the latter measurement turns out to be only a few volts, a series circuit is employed and can be checked as described here.

One other section in most TV receivers is particularly prone to d.c. troubles and lends itself well to the d.c. troubleshooting procedure. That is the voltage boost portion of the horizontal flyback supply.

Boost Voltage

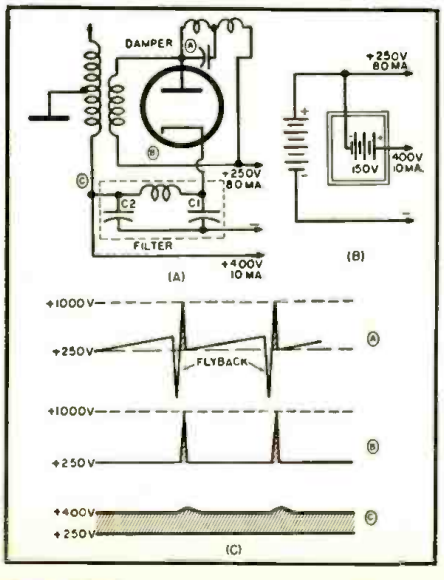
The operation of flyback circuits is quite complex since it involves impedance transformation from the horizontal output amplifier to the deflection yoke, HV step-up and rectification, and voltage boosting due to the damper tube action. For this discussion attention is focused only on the boost voltage portion of the circuit. However, it must be understood that the boost voltage is directly affected by and, in turn, has a different effect on the other two portions. A simple explanation of the boost supply is provided by Fig. 6A.

The flyback circuit shown here is typical of a majority of sets now in use. Many later models use an autotransformer, requiring that the damper tube connections be reversed, with the plate providing the boost voltage instead of the cathode. This does not change the operation or the results at all.

At point *A*, the damper plate, the large positive pulses due to the flywheel effect of the transformer and yoke cause the damper tube to conduct, passing the pulses to the cathode. These pulses are superimposed on the 250-volt "B+". Actually, these pulses will be filtered out somewhat at the cathode due to the action of the first filter condenser C_1, but for bet-

(*Continued on page* 116)

Fig. 6. (A) Typical damper and voltage boost circuit with its equivalent shown in (B). (C) Waveforms for points in (A).



TV PARTS REPLACEMENT GUIDE

TV POWER TRANSFORMERS

Continuation of list of power transformers used in TV sets and their replacements; to be concluded next month.

All data was furnished by the parts manufacturers listed.

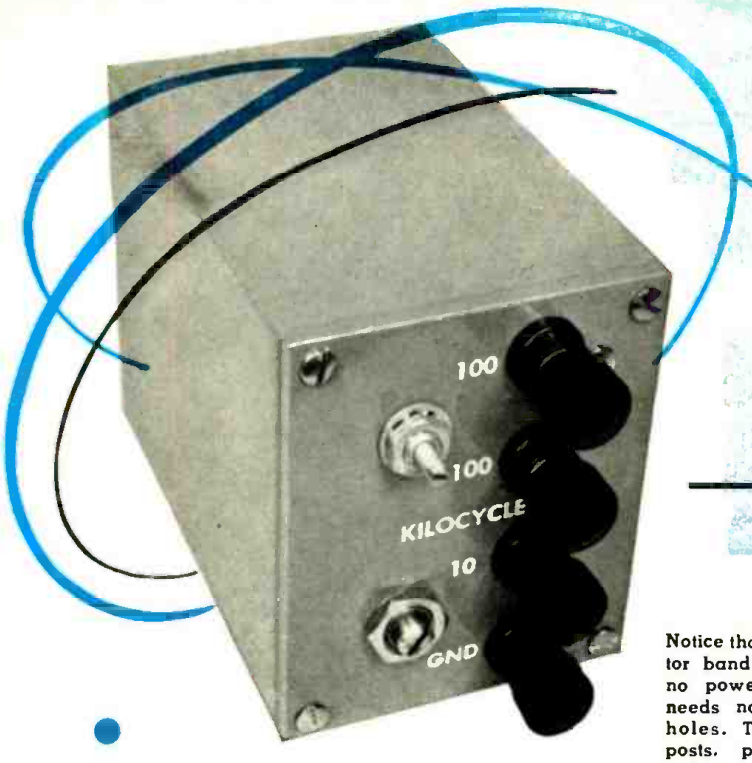
RECEIVER MFR. Part No.	CHICAGO Part No.	HALLDORSON Part No.	MERIT Part No.	TRIAD Part No.	THORDARSON Part No.
CAPEHART					
94231	PH-90	P9307	P-3066	R-11B	TS-24R04
94264		F5516		F-21A	T-21F12
94269		P9727	P-3066		
650243A-1		F5530	P-3097	F-50X	
750019B-1				R-37BC	T-26R00
750019C-1		P9727	P-3067		
750121A-1		P9711	P-3059		
750144A-1	TP-409	P9719	P-3067	R-37BC	T-26R00
750144B-3	TP-409		P-3067*	R-33BC	T-26R19
CROSLEY					
B-144460	TP-355	P9713	P-3059	R-35BC	T-26R19
C-146683	TP-392†	P9711	P-3078	R-38BC	T-26R00
C-147504		P9723	P-3078	R-42B & F-52X	T-26R00
C-147682	PH-145 & FO-63	P9731	P-3066	R-38BC	T-26R00
C-148282	PH-200 & FO-63	P-9711	P-3059	R-20B & F-16X	T-26R23
C-148562			P-3067, 3074		
C-148950				R-39BC	T-26R21
C-148975		P9713	P-3078	R-42BC	T-26R25U
C-149559		P9711	P-3063		
C-151612	TP-356†	P9713	P-3059		
C-152433	TP-370†		P-3063		
D-145609				R-50A	
D-160011		P9721		R-31A	T-26R00
D-160318	PH-70	P9311	P-2952	R-11B	TS-24R04
D-160490				R-40A	
DEWALD					
1050	TP-365	P9721	P-3061	R-31BC	T-26R00
1130A	TP-370†	P9705	P-3070	R-38BC	T-26R21
DU MONT					
20D-12404, 20D-12926	PH-70	P9311		R-40A	
20003891	TP-365		P-3166	R-31A	T-26R00
20004283		P9728			
20004341				F-52X	T-21F60
20004771	TP-360	P9321	P-3059	R-35BC	T-26R19
20004811		F5529	P-3074	F-51X	
20004961			P-3166		
20005011		F5529		F-52X	T-21F60
20005012		F5529		F-52X	T-21F60
20005840		F5506†	P-3040†	F-7X	T-21F03
EMERSON					
730007	PH-40			F-30A	
730014			P-3059		
730014-1			P-3059*	R-20B & F-7X	
730018		P9731	P-3066	R-38BC	T-26R00
730022			P-3070	R-39B	T-26R21
730023		P9731	P-3063		T-26R00
730024		F5530	P-3097	F-50X	
730026	TP-392 & FO-63	P9731	P-3078	R-33BC & F-16X	T-26R00
730026-7		P9731	P-3067, 3074		
730029		P9731	P-3078	R-38BC & F-16X	T-26R00
730031	TP-370 & FO-63	P9731	P-3078	R-38BC & F-16X	T-26R00
730032		P9737	P-3076, 3074		
FADA					
42.12	TP-365	P9721	P-3061	R-31BC	T-26R00
42.58	TP-356	P9727	P-3059	R-37BC	T-26R00
42.61	TP-360	P9727	P-3067*	R-36BC	
Models S4C20, S4C40, S4T15, S4T30	TP-370*		P-3077, 3074		T-26R31
GENERAL ELECTRIC					
RTF-002		F5529	P-2944		
RTP-035			P-3076, 2944	R-42BC	T-26R25U
RTP-062				R-35BC & F-16X	T-26R00
RTP-066		P9723	P-3066	R-50BC	
RTP-300		P9723	P-3066	R-50BC	
HALLICRAFTERS					
52-170	TP-410**	P9731	P-3169	R-35BC	T-26R19
52C170	TP-410**	P9731	P-3169	R-35BC	T-26R19
52C170-2	TP-410**	P9731	P-3169	R-33A	T-26R19
52C185	TP-225**	P9702	P-3169†	R-42A	TV-24R98

*Add Series Resistor to Reduce "B+" Voltage. † Drill New Mounting Holes.
** Use Universal Mounting Brackets.

(*Continued on page* 148)

TRANSISTOR BAND SPOTTER

By **PETER G. SULZER, W3HFW**



Notice that the transistor band spotter has no power cord and needs no ventilation holes. The terminal posts, potentiometer, lettering, etc., give an idea of its size.

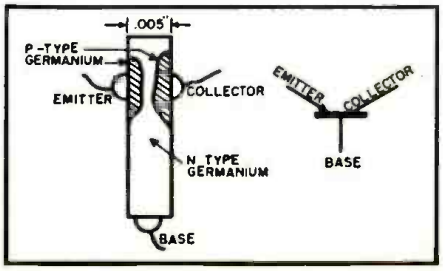
Any amateur can now have a transistor frequency standard at low cost. Simple, stable, with no warmup drift, this unit runs continuously off its internal flashlight cell.

THE availability of "*p-n-p*" junction transistors[1] has opened many interesting possibilities in the field of compact test equipment. One example of such equipment is the small frequency standard to be described here. Although compactness is in itself a virtue in the crowded ham shack or service shop, the low power consumption of the transistor provides an additional benefit, of value in the fixed station as well as for portable operation.

Consider a typical a.c.-powered frequency standard used for locating band edges, calibrating receivers and v.f.o.'s, and for checking service-type signal generators. It contains a rectifier tube, a 100-kc. crystal oscillator, and perhaps a multivibrator to produce markers at 10-kc. intervals. It consumes about 30 watts, and runs hot because it is built in a small box. As a result, its frequency drifts as it warms up, and its multivibrator may have to be readjusted to compensate for circuit-element changes during the heating cycle. A better design with a sufficient provision for heat dissipation would improve matters, but a crystal oven would really be necessary to complete the job of stabilizing the oscillator. Unfortunately, however, the equipment, and particularly the crystal oven, would have to be in operation at all times to avoid the warmup problem which would run up the power bill and constitute a fire hazard.

Here is where the additional benefit of the low-powered transistor comes in. The total power required by the band spotter is 300 microwatts, 1.5 volts at 200 microamperes. This is so small that a single flashlight cell should operate the unit for years, and therefore an "on-off" switch is not required. Since the band spotter operates at all times there is no warmup problem, and an accurate frequency calibration is available at all times, particularly if there is no hot equipment nearby. An additional point worth mentioning is the lack of a power cord to add to that ever-growing "tree" at the power outlet.

Fig. 1. Cross-sectional representation of a "p-n-p" transistor, used in this circuit, and standard transistor diagram symbol.



The band spotter contains a 100-kc. crystal oscillator and a 10-kc. synchronized blocking oscillator, each using a "*p-n-p*" junction transistor. Two outputs are provided at 100 kc.: a clipped sine wave at Terminal 1, which provides usable receiver-calibration markers up to 30 mc., and a sine wave at Terminal 2 for oscilloscope frequency comparison. The 10-kc. output at Terminal 3 is a 1-microsecond pulse having strong harmonics beyond 30 megacycles.

The "P-N-P" Transistor

In order to discuss the circuits used in the band spotter, a brief and much simplified description of the "*p-n-p*" junction transistor[2] is in order. This type of transistor contains a small (0.08 inch by 0.12 inch by 0.005 inch thick) wafer of "*n*"-type germanium. It will be recalled that most of the conduction in an "*n*"-type semiconductor takes place *via* electron flow, in contrast to the "*p*"-type, in which conduction effects occur through the flow of holes (places where electrons are missing in the crystal structure). A small dot of indium is placed on the two opposite flats of the wafer, which is then heated, permitting a portion of the indium to diffuse into the germanium. In this manner the diffused portions of the germanium are converted to the "*p*"-type. The heating process is continued until the thickness of the remaining "*n*"-type germanium at the wafer center is small, perhaps 0.001 inch, as shown in the drawing. Small wires are soldered to the dots, which become the emitter and collector connections and a third wire is soldered to one end of the wafer, which is the base connection.

Suppose, now, that the collector is made negative with respect to the base. A very small current will flow because of the direction of the electric field across the "*p-n*" junction. Here the negative charge on the collector will tend to repel electrons back into the "*n*"-type base, while the positive

charge on the base will repel holes (which behave something like positive charges) back into the collector. A similar situation would exist in an imaginary vacuum tube containing an electron emitter at its cathode and a positive-ion emitter at its anode. With the anode negative with respect to the cathode, cathode-current cut-off would occur because the electrons would be repelled back toward the cathode, and anode cut-off would occur because positive ions would be repelled back toward the anode. Since cathode current must flow through the anode, and *vice versa*, cut-off in a double sense is obtained.

If, while keeping the collector negative, the emitter is made slightly positive with respect to the base, a heavy emitter current will flow as electrons are drawn out of the "*n*"-type base by the positively-charged emitter, and holes are drawn out of the "*p*"-type emitter by the negatively charged base. It is seen, therefore, that the emitter behaves as a rectifier biased in the conducting direction, while the collector behaves as a rectifier biased in the non-conducting direction, and therefore the emitter has a low dynamic (a.c.) resistance, and the collector has a high dynamic resistance. However, according to this simple theory most of the holes drawn out of the emitter can pass right through the thin base region, and they will do so because they behave as positive charges, and are accelerated by the negatively-biased collector. These holes then constitute the collector current, which is almost independent of the collector voltage as long as the collector is negative. This is another way of saying that the collector dynamic resistance is very high.

It is not immediately apparent that such a device will amplify, but it does, and this is because of the large ratio of collector impedance to emitter impedance. If a small a.c. voltage is applied between the emitter and base, an alternating emitter current will be produced and, in a good transistor, most of this current will pass through the base and appear across a much higher impedance in the collector circuit producing a comparatively high voltage between the collector and base.

To consider some typical figures, suppose that the input (emitter-base) dynamic resistance is 100 ohms, the output (collector-base) dynamic resistance is 100,000 ohms, and suppose that 95% of the emitter signal current appears in the collector circuit (α, the short-circuit current gain = 0.95). Suppose, also, that a 100,000-ohm collector load resistance is used. If a 0.1-volt a.c. signal is applied to the emitter, the emitter signal current will be 1 milliampere, and therefore the collector signal current will be 0.95 milliampere. One half of this will go to ground through the collector dynamic resistance, while the other half will produce a useful signal of 47.5 volts across the 100,000-ohm load.

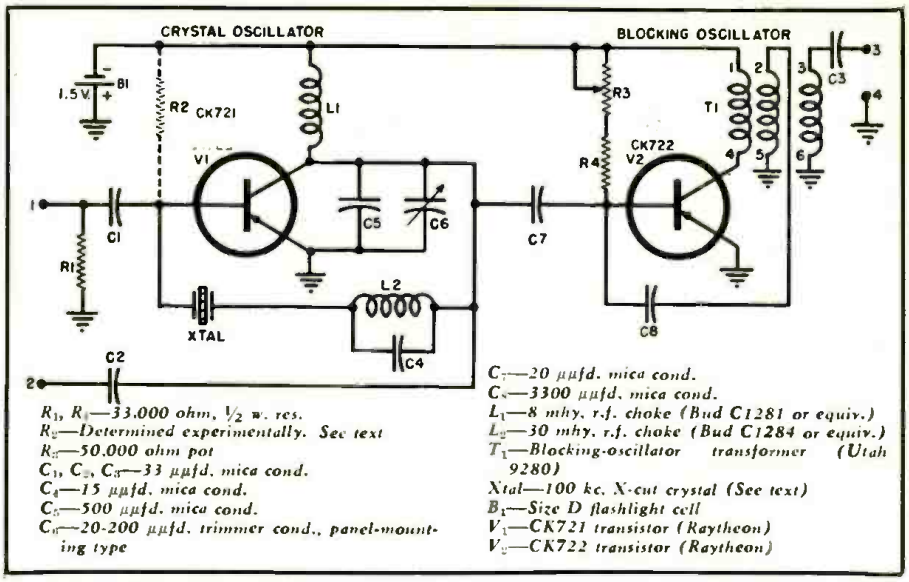


Fig. 2. The schematic shows the remarkable simplicity of the transistor frequency standard. R_2 is used if the measured current through L_1 is less than the normal value (see text). C_6, a trimmer, is the final front-panel adjustment. The economy of parts more than offsets the "expense" of using transistors rather than tubes.

The voltage gain is thus 475, a very substantial figure.

It has been seen, then, that the grounded-base connection can produce a large voltage gain at the expense of a very low input impedance. A more useful amplifier is obtained if the emitter is grounded, so that the base can be driven.[3] Since most of the current leaving the emitter passes through the base to the collector, the base current itself is much smaller than the emitter current. Consequently the base-driven circuit can produce a current gain as well as a voltage gain, and a much more versatile amplifier of higher input impedance is obtained. The current gain, which depends critically upon the value of α, may be 10 or more, while typical values for the input and output impedance are 1000 ohms and 100,000 ohms respectively.

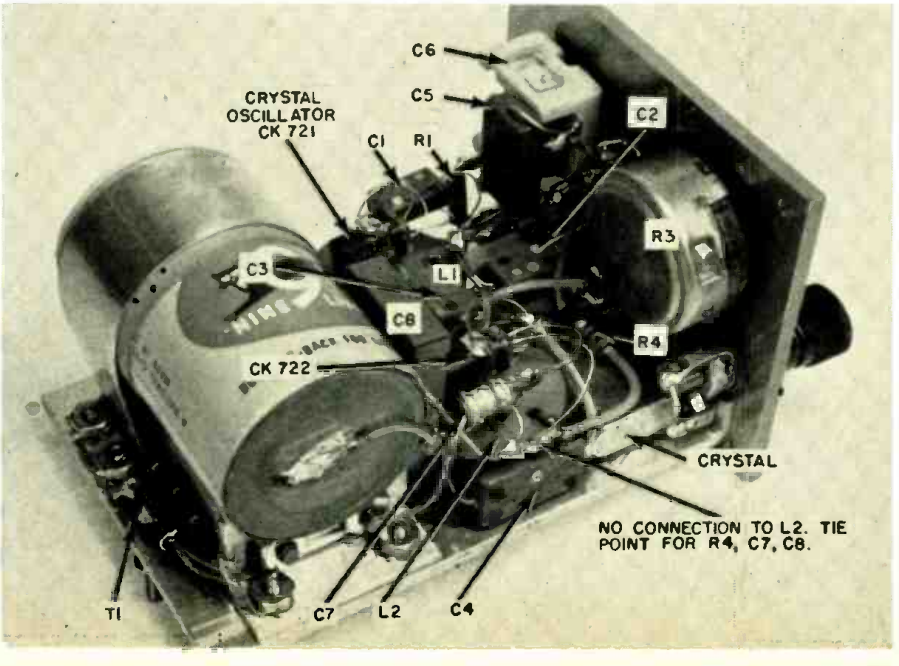
It should be pointed out that the base-driven connection produces a phase reversal, as does the grounded-cathode vacuum tube. In fact, the properties of a small voltage-amplifier pentode with a resistance on the order of 1000 ohms connected between grid and cathode resemble those of the base-driven transistor, although the transistor will operate with a much smaller power supply.

The base-driven connection is used in the crystal oscillator and blocking oscillator in the band spotter.

Considering the crystal oscillator, one might be tempted to "borrow" the

(*Continued on page* 126)

This internal view shows that the construction, while compact, is "roomy." There is no chance of overheating; the unit is left running continuously for its maximum stability, without danger of breakdown or running up the power bill. It is as nearly independent of external conditions of temperature, etc., as it is of power lines.



NOISE IMMUNITY CIRCUITS

By MILTON S. KIVER
Pres., Television Communications Institute

Part 2. The operation of more noise suppression circuits used in modern TV receivers for better sync and picture.

IN THE previous article, a number of television noise immunity circuits was described. It was noted there that while noise pulses may have only a momentary disturbing effect on the picture elements, they can be particularly destructive to the receiver's sweep systems, causing picture roll or picture break-up. It is to avoid this annoyance to the observer that noise immunity circuits are employed. In this article, a number of additional approaches to this problem will be examined.

The use of a noise gate placed in the path of the signal is one approach taken by *Philco* to minimize the effect of noise pulses on the sweep systems. A portion of the composite signal is taken from the plate of the first video amplifier and applied to a cathode follower. See Fig. 1. This stage is labeled as the first sync separator and it represents the first step in the separation process. In the signal applied to this tube, the sync pulses are positive. Now, the cathode resistor of this tube possesses the high value of 10,000 ohms, which means that the tube is operating quite close to cut-off. The sync pulses and portions of the video signals near the sync level will cause current to flow through the tube and hence this portion of the signal will pass through the stage. The more negative portions of the signal, however, will drive the tube into cut-off and these will be eliminated.

Since V_1 is a cathode follower, the output signal is taken from the cathode and transferred to the next stage which is a noise gate. This noise gate is diode connected and is in series with the path of the signal. As long as the diode conducts, signals from V_1 will reach V_2. However, should the diode cease conducting, the signal path is effectively opened and all signal flow ceases.

Examination of the diode circuit reveals that a voltage divider, formed by R_{606} and R_{607}, places a positive voltage of approximately 7 volts at the plate of V_2. The sync signal from V_1 also possesses a positive polarity and it is applied to the cathode of the diode. As long as the cathode positive voltage is less positive than the plate voltage (as it is for all normal signals), the diode will conduct. However, when a noise signal greater than the sync signal is received, the diode cathode is driven more positive than the plate. This cuts the diode off, preventing the noise from reaching V_3 and the sweep oscillators beyond.

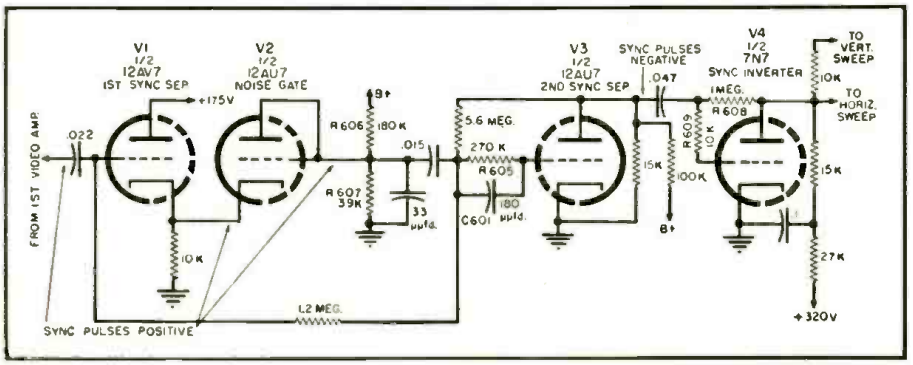
In order to make the diode effective over a wide range of incoming signal amplitudes, its plate voltage should change as the signal level varies. This is done in this system by connecting R_{606} to the end of a resistor (not shown here) which also supplies "B+" to the video i.f. amplifiers. As in a previous circuit (Part 1), the a.g.c. level will vary with signal strength and this, in turn, will vary the amount of current drawn by the controlled i.f. stages. The current, passing through the i.f. plate supply resistor, will change the voltage drop across that resistor and the positive voltage applied to V_2 will likewise vary.

The next stage in this system is V_3, the second sync separator. The sync pulses reaching V_3 are still positive since the noise gate diode did not invert them. V_3 is grid-leak biased, developing a biasing voltage across R_{605} and C_{601} which is established by the level of the sync tips. The remaining video signal is ineffective in producing plate current and it is therefore substantially eliminated.

The sync pulses are amplified and inverted by V_3 and then transferred to V_4. This stage is inserted for the purpose of changing the negative sync pulses to positive polarity so that they will be in position to trigger the vertical and horizontal sweep oscillators. At the same time, this stage also functions as an amplifier and serves to remove any video signal that might still be present at this point. It accomplishes this latter job by the way the tube is biased. A one-megohm resistor, R_{608}, is connected between plate and grid, applying a small positive voltage to the grid. The resulting grid current, flowing through R_{609} and R_{608}, brings the actual grid potential (with respect to ground) to zero or close to it. (Here the voltage is slightly negative).

The tube under these conditions is operating close to saturation and any further positive voltage applied to the grid (by the signal, say) would not cause much change in plate current. This, in effect, prevents such positive (or relatively positive) signals from passing through the tube. However, when the negative sync pulses are active, the current through the tube is decreased. This change raises the tube's plate voltage, producing a positive sync pulse at the output of V_4. By this method a fairly clean sync pulse is presented to the vertical and horizontal sweep systems.

Fig. 1. Philco's noise immunity circuit using a diode-connected gating tube.



Multi-Element Tubes

Since the primary objective of a noise immunity circuit is to prevent noise pulses from affecting the operation of the sweep oscillators, most noise immunity circuits work closely with the stages just prior to the sweep oscillators. These, of course, are the sync separators. Multi-element tubes have also been drawn into the battle against noise pulses and the circuit of Fig. 2 is one example of how such tubes are employed.

The composite video signal with the

sync pulses negative is applied to the sync amplifier. This stage amplifies and inverts the signal so that at the output the sync pulses will extend in the positive direction.

This signal is now fed to grid 3 of the 6BE6 sync separator. The cathode of this tube is grounded and initially, grid 3 has zero bias on it. However, upon application of the signal, grid current is drawn on the positive sync tips, charging C_{601} to a negative potential. The discharge path for C_{601} is down through R_{609}, R_{610}, and R_{611}, with the result that grid 3 has a negative grid-leak bias developed in its circuit. The value of this bias is dependent upon the amplitude of the incoming positive sync pulses.

This arrangement works in the same way that it has in previously described circuits. The tube is brought out of cut-off only when the sync pulses are active and the tube drops back into cut-off when the rest of the video signal appears. The separation of sync pulse from the video signal is fairly clean cut with perhaps only a small amount of video signal passing through. It is generally difficult to effect a complete separation with only one sync separator stage, but even substantial separation is effective enough.

If the tube operated solely in this manner, there would be no protection against strong noise pulses since these could overcome the grid-leak bias and force tube current to flow. The real noise protection stems from grid 1 of the tube. Grid 1 connects to the video second detector, receiving a portion of the composite signal. In addition, a small positive voltage is applied to grid 1. Because of the presence of the series limiting resistor, R_{604}, the grid potential is maintained very close to zero. (Grid current flowing through R_{604} develops a negative voltage here which is approximately equal to the applied positive potential. This results in a grid 1 voltage close to zero.)

Now, the video signal that grid 1 receives has the sync pulses extending in the negative direction. The rest of the video signal is more positive, but it does *not* affect the plate current flowing through the 6BE6 because these positive components cannot raise the grid 1 potential above zero. (As the grid becomes positive, grid current increases, the potential drop across R_{604} follows suit and the voltage increase is counteracted. Basically then, the positive video components of the signal are without effect on grid 1.)

Now consider what happens when a strong noise pulse appears. Since this extends beyond the sync pulse, it will drive grid 1 strongly negative, completely cutting off the flow of plate current through the tube. Hence, at this instant, nothing appears at the output of the 6BE6 and the undesirable effect of the noise pulse is prevented from reaching the sweep circuits.

The stage beyond the 6BE6 serves to invert the negative sync pulses to enable them to trigger the subsequent sweep oscillators.

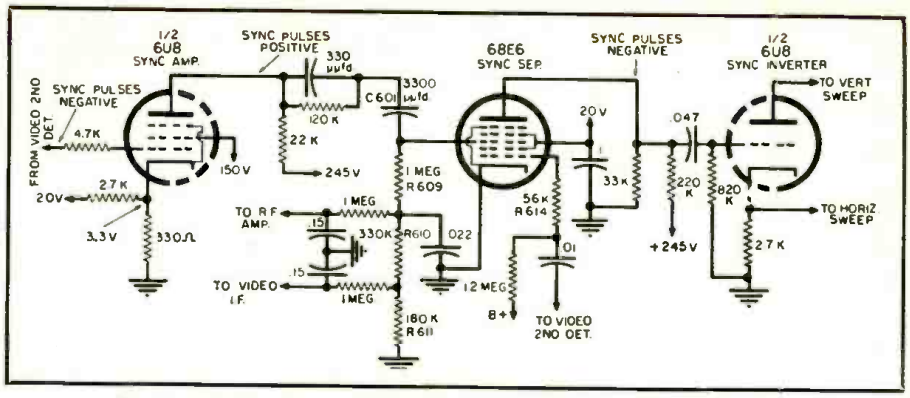


Fig. 2. Circuit using a 6BE6 multi-element tube for noise suppression.

Before we leave the 6BE6 it might be of interest to note that the a.g.c. voltage is developed in the grid 3 circuit. As stated previously, the level of the voltage developed in this circuit depends upon the amplitude of the arriving sync pulses. When the pulses are strong, the negative a.g.c. voltage rises; when the pulses are weak, the a.g.c. voltage is likewise small. By tapping off at appropriate points on the voltage divider network in the grid 3 circuit, the proper amount of controlling a.g.c. voltage can be obtained for the video i.f. and for the r.f. stages.

Keyed Noise Limiter

Stromberg-Carlson uses a noise limiter which is keyed or triggered by pulses from the horizontal output transformer. The circuit is shown in Fig. 3 and the manner in which it operates is as follows: A portion of the composite video signal is applied to the grid of the noise limiter at the same time that it is applied to the grid of the sync separator. The plate lead of the noise limiter is connected to the horizontal output transformer and current will flow through the tube whenever the plate is pulsed positively (during horizontal retrace) and the sync pulses are active at the grid of the tube. At these times, the current through the tube will charge up the cathode condenser C_1 to the peak value of the sync pulse. During the interval between sync pulses C_1 will discharge through R_1 and the plate resistance of the video amplifier. However, the time constant of this network is relatively long and the charge across C_1 will be only slightly decreased before the next sync pulse comes along.

The cathode terminal on the germanium crystal diode is connected to the top end of C_1 and so this electrode has a positive potential equal to the voltage across C_1. In order for the crystal diode to conduct, therefore, its plate must be given a greater positive voltage. With ordinary sync pulses this will not occur and hence these sync pulses will reach the grid of the sync separator. However, when a noise pulse comes along with a potential more positive than that of the sync pulses, the crystal diode will conduct, effectively reducing the amplitude of the pulse as far as its effect on the sync separator is concerned. This additional noise charge is absorbed by C_1, but it does not ordinarily raise the potential of C_1 very much because of the size of this condenser and the relatively long time constant of the network.

Note, then, that much of the noise immunity of this circuit is dependent upon C_1 and the charge it possesses. It is the function of the noise limiter to keep C_1 charged to the normal level of the incoming sync pulse. Whenever a noise pulse stronger than the sync pulses arrives, the crystal diode conducts and effectively prevents it from disturbing the sync separator and the circuits that follow. The circuit is also designed so that the charge on C_1 will ordinarily not be appreciably affected by strong noise pulses. This can usually be counted on because noise pulses are of extremely short duration containing little average energy. C_1 scarcely starts to charge before the noise pulse ends.

Since the charge on C_1 is dependent upon the level of the incoming sync pulses, its average voltage will vary with the strength of the incoming sig-

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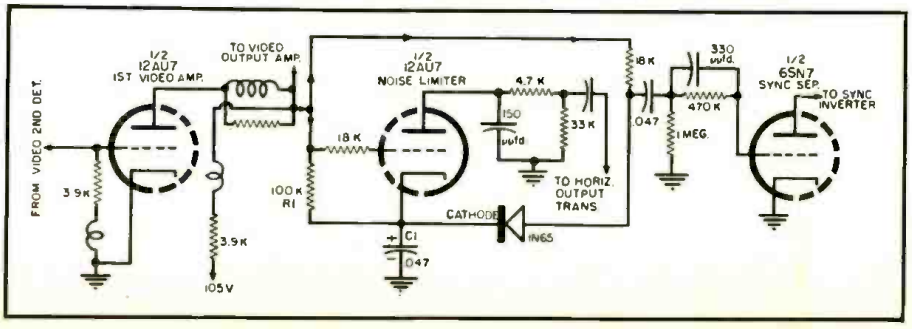
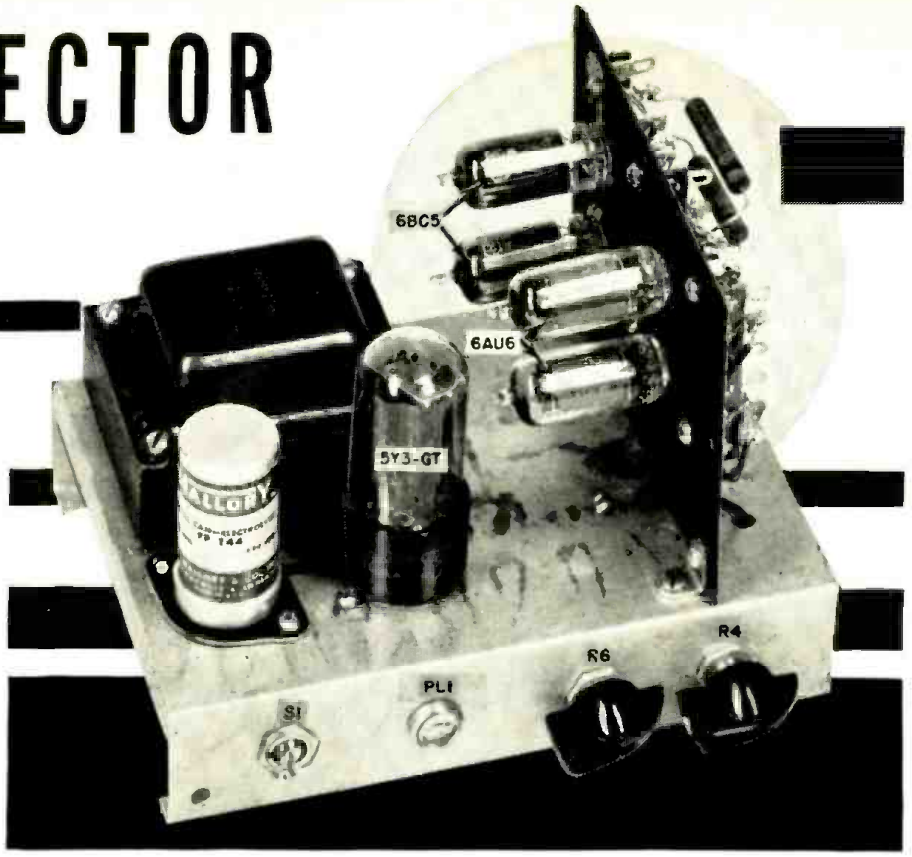
Fig. 3. A keyed limiter circuit with crystal diode to shunt out noise.



LIE DETECTOR

By
EDWIN BOHR



Over-all view of the home-built lie detector. Skin resistance changes are measured.

An easily-built instrument which measures changes in skin resistance—indicating whether or not subject is lying.

EVERYONE can probably think of a few choice uses for a "lie detector." These uses may have a humorous twist—a lie detector is fine for parties—or they may have a more serious application. Whatever the purpose, this lie detector is the genuine article. It is not just another toy.

Our emotions greatly affect the physiological function of our bodies. Some of these effects can be quite drastic. We have all heard of people being "scared stiff" from fright. However, there are other, more subtle changes that can be measured and used to indicate mental tension. To improve their validity, commercial detection units measure and record simultaneously several types of change. Increased emotional tension, for example, is accompanied by increased blood pressure. Changes in the skin's electrical resistance also accompany emotional strain. This change in skin resistance is used to indicate a "lie" in the unit to be described.

Detector Circuit

The lie detector circuit is a resistance bridge followed by a balanced d.c. amplifier. There are several reasons for using the balanced (push-pull) d.c. amplifier circuit. For one thing, the balanced amplifier does not need the complicated voltage regulator tube circuits and divider networks required by single-ended amplifiers.

Secondly, the balanced amplifier is inherently more immune to fluctuations in heater and plate supply voltages. Finally, the balanced circuit, as we planned it, would need no initial adjustments to place each tube within its proper operating range. In this respect, the amplifier is self-compensating. You build it and it works—no fuss, no muss.

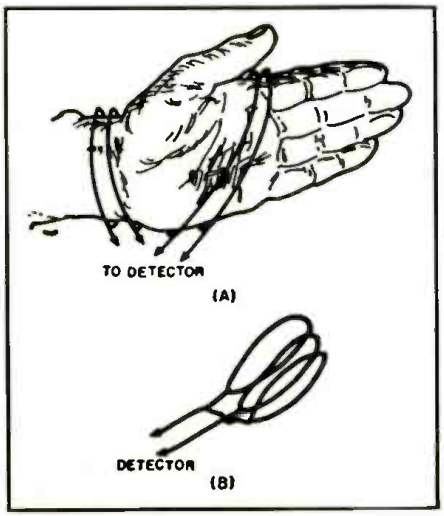
A simple resistance bridge precedes the amplifier. Two variable resistors (coarse and fine) are used to "balance out" the resistance of the person to whom the detector is connected. A closed circuit jack inserts a substitute resistance in the circuit whenever the electrode plug is removed. This maintains a reasonable circuit balance and provides a standard resistance against which to check the circuit when the plug is pulled.

A small 15-volt hearing-aid battery supplies the voltage for the bridge. This voltage could probably be tapped from the plate supply. We used the battery (it is stable and reliable) in preliminary experiments with the detector, so it was included in the final version. The drain on the battery is small, only about .06 milliamp, and the power switch removes even this load when the unit is turned off.

The bridge places a positive bias on the control grids of the first two amplifier tubes. This is compensated for by the higher-than-usual common cathode resistor (R_7 in the diagram).

A balanced signal is not fed to the 6AU6 grids from the bridge. Nevertheless, a balanced condition is achieved by virtue of the voltage developed across R_7. To illustrate this action let's take a specific example.

Fig. 1. (A) How electrode is connected to the subject. (B) Closeup view of electrode unit.



Suppose the person undergoing a detector test has a lowered skin resistance as a result of telling a lie. By looking at the bridge diagram, we see that this lowers the positive bias on V_2. Thus it constitutes a negative signal swing. Since the V_1 side of the bridge has experienced no resistance change, there is no signal applied to the grid of V_1. However, as the grid of V_2 swings negative, the cathodes of V_2 and V_1 also swing negative since the plate current of V_1 decreases. This makes the grid of V_1 more positive with respect to its cathode—the equivalent of applying a positive signal swing to V_2. This same circuit is often found in oscilloscopes.

Both screen grids are fed from a single dropping resistor. As the screen current increases in one side of the circuit, it decreases in the other side, maintaining the screens at essentially the same voltage during signal variations. This gives a bypassing effect down to "zero cycles." In single-ended circuits, VR tubes must be used for bypassing.

Each 6BC5 control grid is direct-coupled to the plate of the preceding 6AU6. This places the grids more than 100 volts above ground. However, the

large positive bias developed across R_{11} places the grids negative with respect to their cathodes. The resistance of R_{11} is less than R_7 since each 6BC5 passes about 10 milliamps of current and each 6AU6 passes less than 1 milliamp of current.

Inspection will show the 6BC5 tubes, together with their load resistors, comprise another Wheatstone bridge. The tubes are the variable elements of the bridge. Any difference in potential between the plates of the two 6BC5 tubes will cause current to flow through the meter or indicating device.

The power supply requirements are very simple—about 325 volts at 30 milliamps. Very little filtering is necessary—a single filter condenser does the job. Incidentally, this is the only condenser in the entire lie detector unit.

Electrodes and Indicating Meter

The electrodes may be applied to the hand or to the arm just above the wrist. Generally speaking, the palm gives the greatest sensitivity, but movements of the hand are likely to unbalance the circuit. See Fig. 1. The larger the area of the contacts to the skin the greater will be the change in resistance with the telling of a lie.

It will be found that skin resistance varies considerably from person to person. The spacing between the electrode wires can be changed to accommodate this variation. If the resistance is unusually high, three loops can be used with the two outside loops paralleled (Fig. 1A) to maintain good sensitivity. The electrodes can be held on with small tabs of adhesive tape or sewn onto cloth bands equipped with "snappers" to make the size adjustable.

Moist breath, from as far as two feet away, will completely "peg" the indicating meter. This is one indication of just how sensitive the detector is. In fact, the amplifier is suitable for any supersensitive application—moisture content meters, comparison bridges, etc.

A five milliamp meter will serve as an indicating meter. We have used

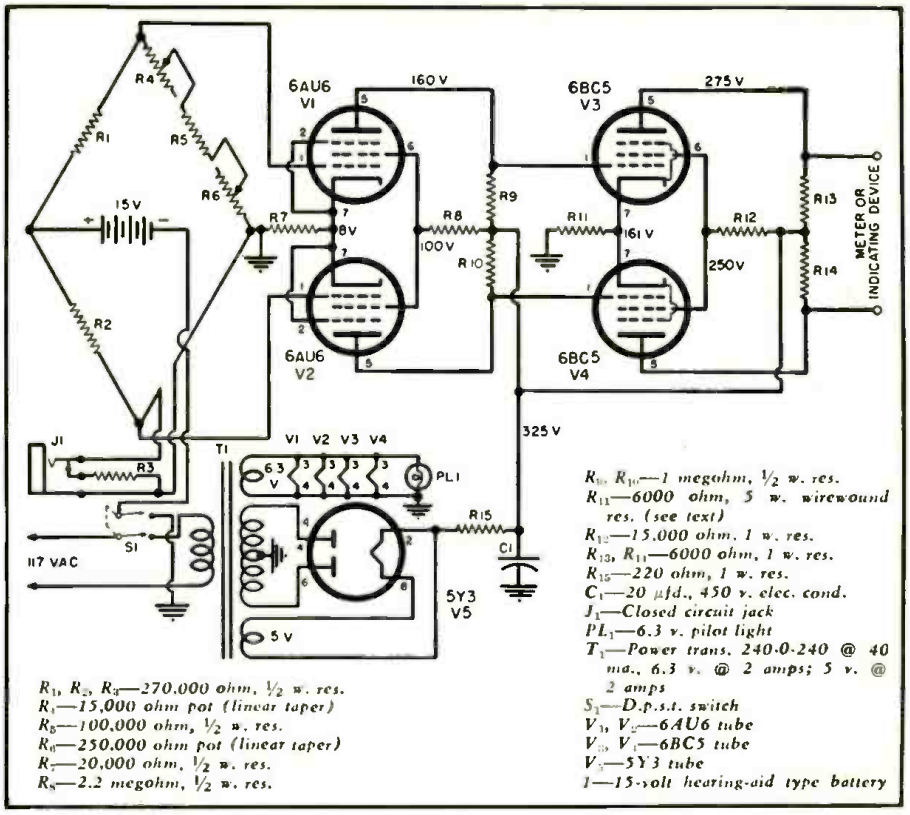


Fig. 2. The lie detector is a resistance bridge followed by a balanced d.c. amplifier.

everything from a 50 volt to a 100 microamp meter. Any multitester will do! The multitester range can be varied to change the sensitivity: A high range can be used for rough balancing and a more sensitive range for precise balancing and detection.

Of course, the ideal instrument would be a recording volt or milliamp meter. For demonstration groups we have used a portable mirror galvanometer to reflect a spot of light on the wall as an indicating means. The sensitivity was so great it was necessary to insert a 100,000 ohm rheostat in series with the galvanometer.

Operation

How accurately lies are detected depends upon the skill with which the questions are submitted and the interpretation placed upon the meter indications. Remember, the person undergoing the test must react emotionally to the question or words mentioned, otherwise the detector will give no indication.

For example, connect the detector to a friend who understands the nature of the experiment and start a normal conversation. Without warning, give him a sharp slap on the face. It will throw the meter off scale! Questions about trite situations will usually give questionable results. The detector can be very revealing without the person undergoing the test even answering. For example, we were reading a list of names and objects

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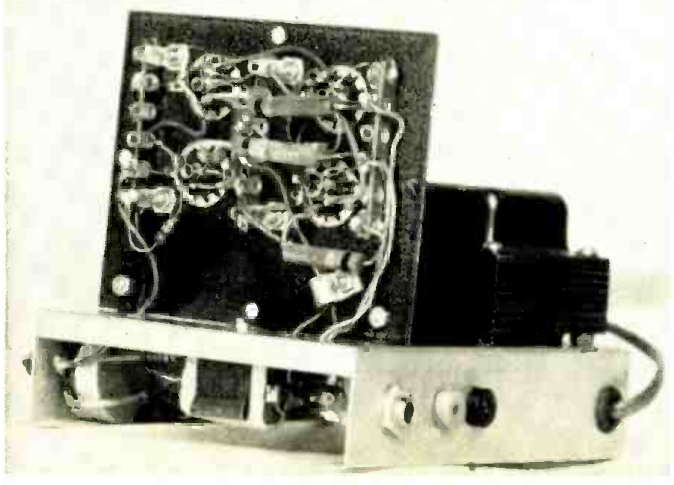
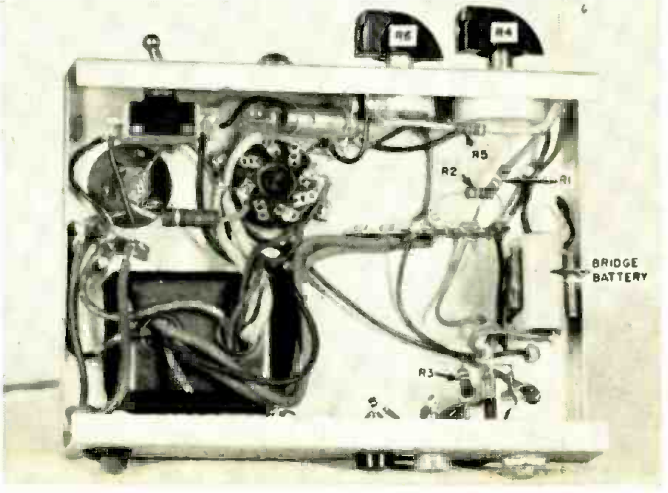
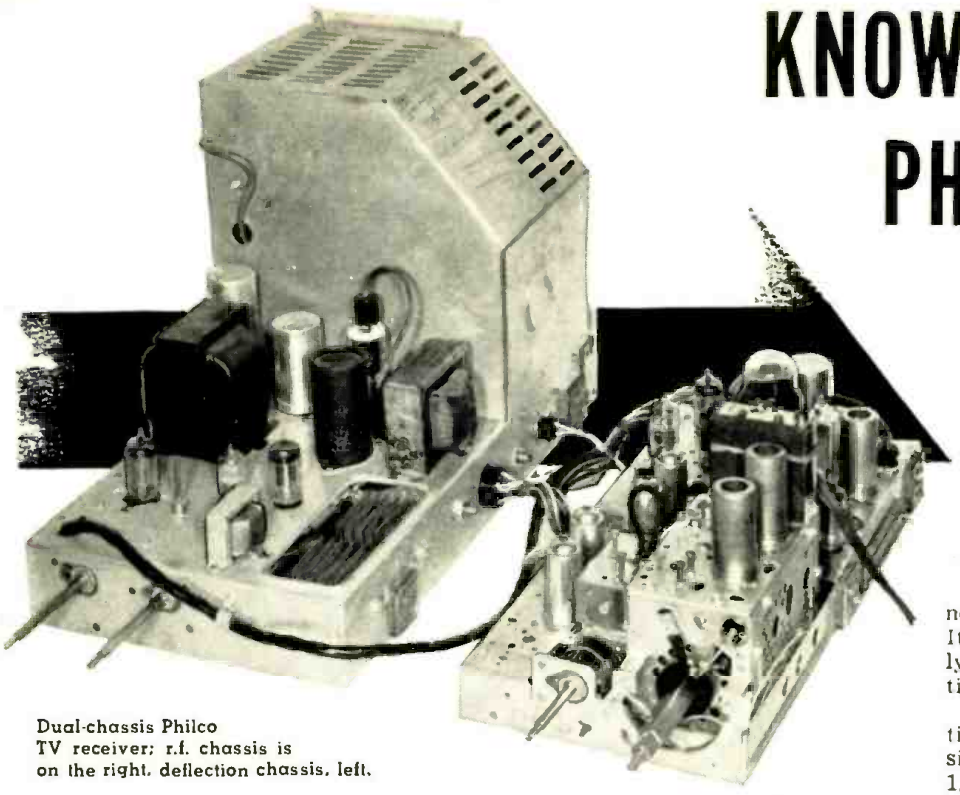
Rear view of lie detector showing sub-chassis mounting of tubes.



Under chassis view showing parts location in resistance bridge.



KNOW YOUR 1953 PHILCO TV RECEIVERS



Dual-chassis Philco TV receiver; r.f. chassis is on the right, deflection chassis, left.

By **DAN LERNER**
Philco Corporation

Circuit explanation and service data for the new Philco TV receivers, including the complete schematic diagram.

THE LATEST in the series of *Philco's* duplex line of TV receivers uses chassis containing some unique and interesting circuits. Although most of these new circuits are on the r.f. chassis, some will be found on the deflection chassis which drives a 27-inch picture tube, a 27LP4A. (See Fig. 7.) To simplify a discussion of the new circuits, they will be treated individually.

First let us look at the front end. (See Fig. 8.) The incoming signal is not applied directly to the 6BZ7 r.f. amplifier grid but, instead, is coupled through inductively. For this purpose a tapered line is used which matches the relatively low impedance of the antenna to the high impedance of the tube. Two traps are used in the tapered-line system—one, the i.f. trap, eliminates 40 mc. interference, and the other, FM interference around 100 mc. The tapered line provides a uniform match to the input grid at all v.h.f. frequencies.

The first section of the 6BZ7 serves to match the input system to the second section of the 6BZ7. The signal is coupled from the first section plate directly to the second section cathode. This section functions as a grounded-grid r.f. amplifier. The over-all r.f. stage with this arrangement has the gain of a well designed pentode r.f. amplifier with much superior noise figure.

A 12AZ7 is used as an oscillator and mixer. The output of the mixer at 40 mc. is fed through a low impedance system (link coupling) to the first i.f. stage.

A four stage video i.f. system with high gain 6CB6 tubes is used in these sets. (See Fig. 8). Transformer coupling is used throughout in order to obtain wide bandpass and freedom from interference. The average over-all bandpass in the i.f. system is 3.5 mc. at the 70% response point.

The A.G.C. System

The a.g.c. system used in the receiver is somewhat novel as far as normal *Philco* practice is concerned. It provides an a.g.c. voltage completely independent of the picture modulation and random noise insertion.

The a.g.c. gate tube, a 6AU6, functions in a keyed a.g.c. system. Picture signal of a certain amplitude, see Fig. 1, is obtained from the plate of the video amplifier, one-half of a 6U8, across R_{305}, a 4700-ohm resistor. This signal is fed to the control grid of the gate tube. A gating or keying pulse (Fig. 2) is obtained from the horizontal output transformer. This pulse, at a frequency of 15,750 cps, is applied to the noise gate plate. (See Fig. 7 for a.g.c. winding on flyback transformer.) It has an amplitude of about 500 volts peak-to-peak. Because of a large "B+" bias on the cathode of the a.g.c. tube, the plate is normally negative with respect to the cathode. Since the flyback pulse is generated only during retrace time, that is, horizontal sync and blanking time, the a.g.c. tube plate will be positive and, therefore, will be able to conduct only during this short time, about 10 microseconds. However, the tube will conduct in proportion to the amplitude of the positive sync pulse tips on its control grid and then only if the keying pulses occur at the same time as the sync pulses. Therefore, since the amplitude of the plate keying pulses is fixed, that is about 500 volts, the amplitude of the sync pulses on the control grid determines the amount of conduction in the gate tube. Since the a.g.c. gate tube conducts only during flyback time, noise disturbances that occur during any other time will have no appreciable effect on the a.g.c. voltage.

The plate current of the keyed a.g.c. tube develops a negative voltage in its plate load circuit which is used to control the receiver i.f. and r.f. gain.

Fig. 1. Signal from plate of video amplifier fed to a.g.c. tube control grid.

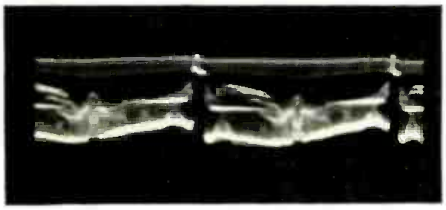
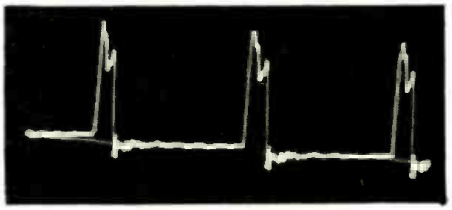


Fig. 2. Gating pulse from horizontal output transformer fed to a.g.c. tube plate.



The Sync System

Composite video for the sync system is taken from the plate circuit of the video amplifier. The voltage developed across R_{304} and R_{305} is fed to the grid of the noise inverter. ½ of a 12AU7,

and to the grid of the sync separator, ½ of a 6U8, through R_{805}. See Fig. 8. The noise inverter tube is operated as a modified clipper tube, that is, with a low level of plate voltage, about 34 v., and with a high negative grid voltage, 6.6 v. This keeps the tube normally operating beyond plate current cut-off.

When the composite video signal is applied to the grid of the noise inverter from the video amplifier, the sync signal is positive. Thus, any noise accompanying the sync signal will also appear positive. Most noise pulses have amplitudes far greater than that of the sync pulses. These, being highly positive, drive the inverter tube to conduction during the time of the noise pulse. To establish the proper bias on the noise inverter for a given signal level, so that the sync tips are just below cut-off, another tube called the gated leveler is used. The gated leveler conducts only when the gating pulses occur. Note that the grid of the leveler is tied back to the a.g.c. gate pulse source through condenser C_{600} and the divider R_{600}, and R_{601}. (See Fig. 6.) Plate current flows in the gated leveler when sync pulses from the video signal reach the plate through C_{600} at the same time that positive gating pulses reach the grid. This current flow through V_{11A} charges condenser C_{601} setting a bias on the grid of V_{11B}.

The output of the noise inverter consists of negative noise pulses. This is mixed with the picture signal and then fed to the grid of the sync separator. The noise present in the positive composite video signal fed to the sync separator is effectively cancelled out by the negative noise signal from the conducting noise inverter. (See Figs. 3 and 4.)

The Phase Comparator

The output of the sync separator (see Fig. 5) is fed to the phase splitter, ½ of a 12AU7. (See Fig. 7.) This tube provides two polarities of sync, a positive one at the plate, and a negative one at the cathode.

As can be seen from Figs. 9 and 10, the outputs from the phase splitters are of opposite polarity but of equal amplitude. The positive pulses are fed to the plate of one section of the phase comparator, V_{13A} on Fig. 7, and the negative pulses to the cathode of the second section. A part of the horizontal sweep output pulse (see Fig. 12), is taken from a special winding in the output transformer and fed to the plate of the second section and the cathode of the first section through a saw-tooth forming network, R_{817}—C_{802} (see Fig. 11A). In these tube sections the horizontal sync and sweep signals are compared. When the horizontal sweep and sync signals are in-phase, the current flow through the two diode sections is balanced; that is, the resulting voltage at the top of the plate divider resistor R_{800} is zero. When the two signals are out-of-phase in any manner, some difference voltage is developed across R_{800}. This reference point, that is, the top of R_{800}, is connected to the horizontal oscillator grid through the network of C_{803}, R_{801}, and C_{801}. If the reference point voltage is positive, it makes the oscillator come out of cut-off faster and thus increases its frequency. When the voltage is negative, it takes

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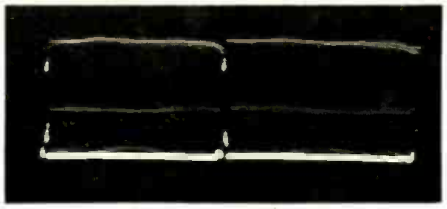


Fig. 3. Signal fed to the sync separator.

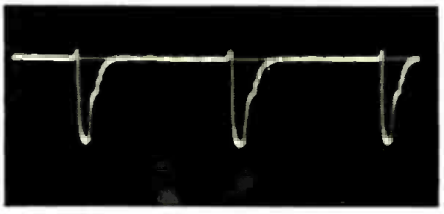
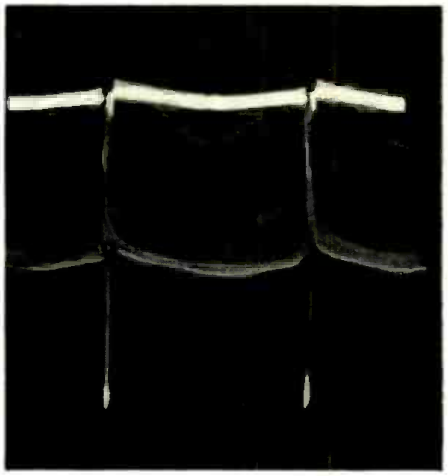


Fig. 4. Output from V_{11B} (scope 15,750 cps.).

Fig. 5. Output from the plate of the sync separator shown with the scope at 60 cps.



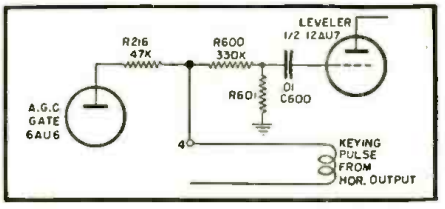
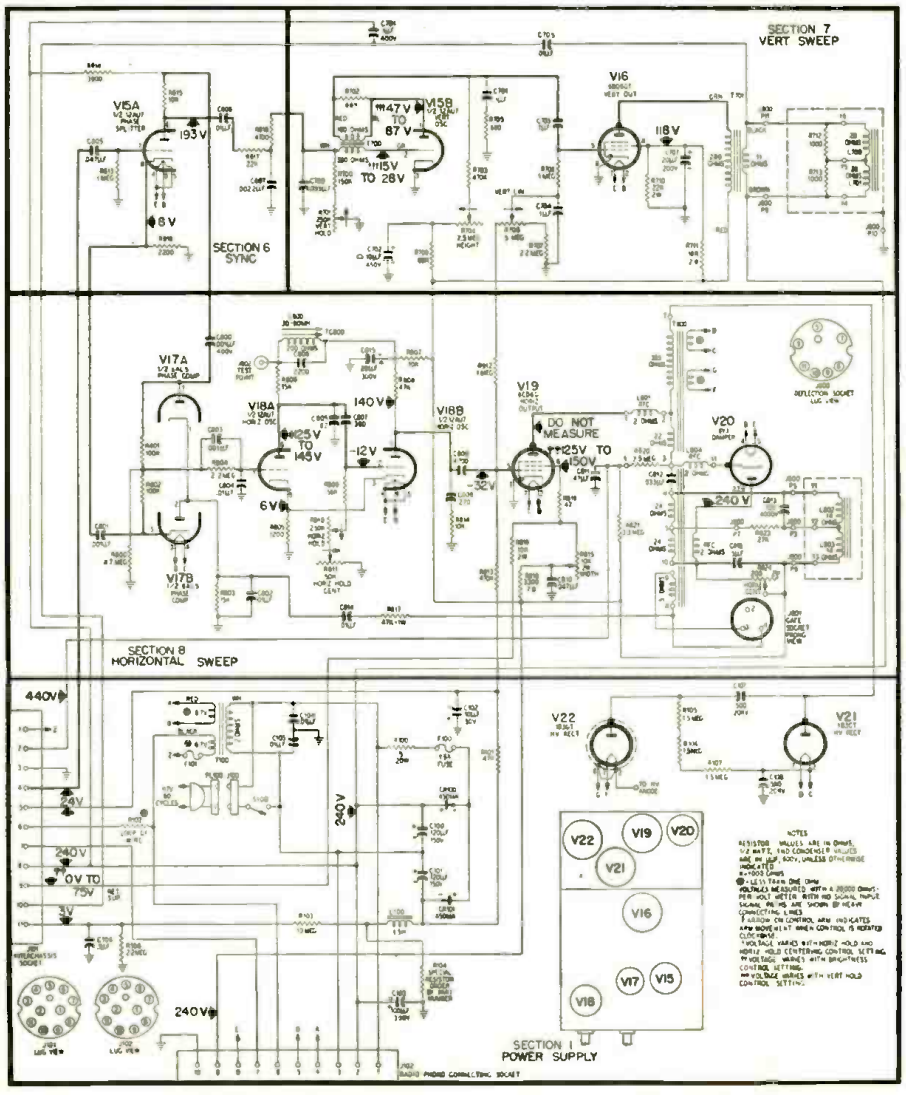


Fig. 6. Gated-leveler tube grid circuit.

Fig. 7. Schematic of the Philco deflection chassis, J-7, used in 1953 receivers.



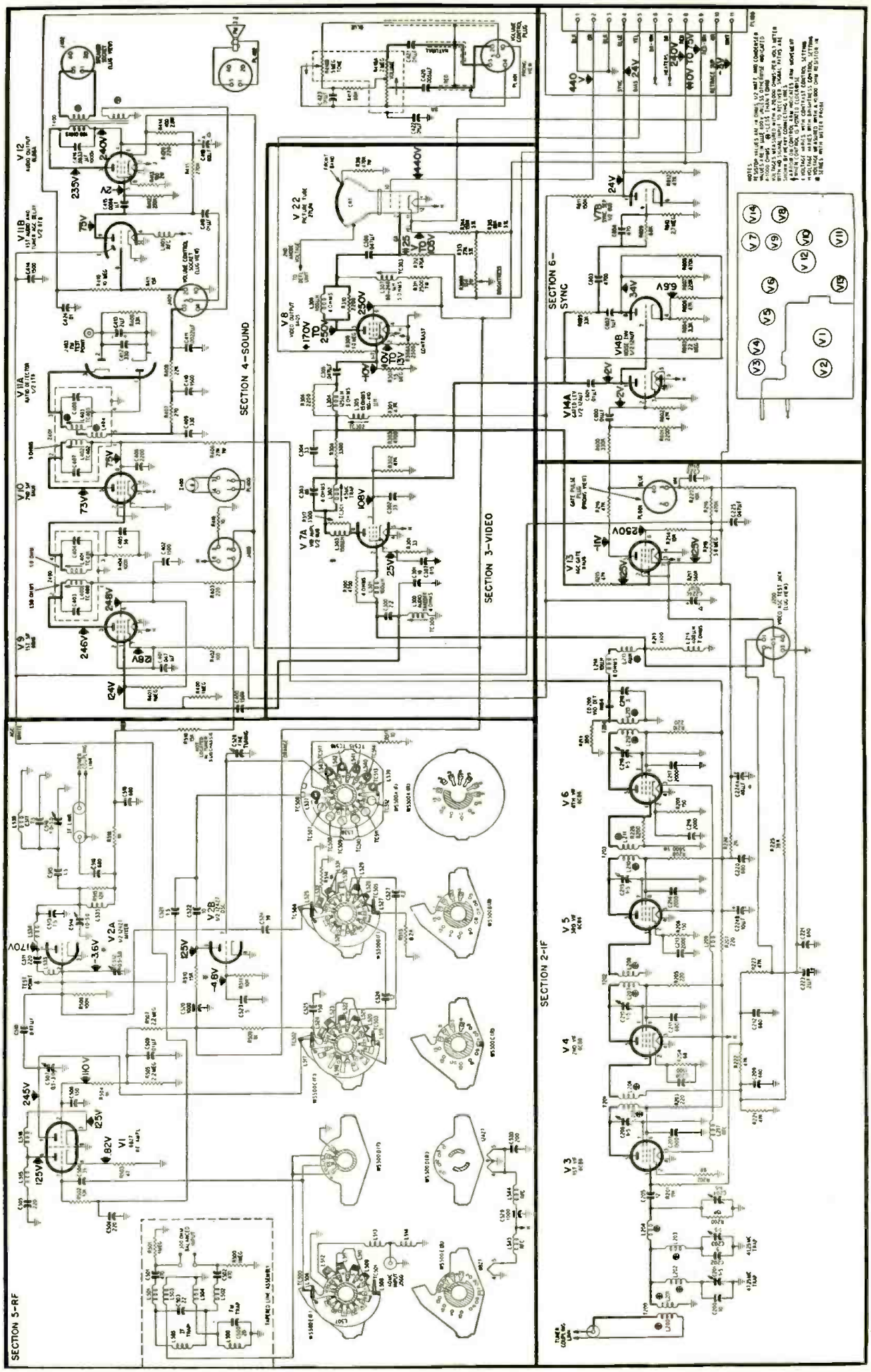


Fig. 8. Complete schematic diagram of the Philco TV r.f. chassis 97.

The r.f. chassis of this dual-chassis receiver contains the tuner, i.f., video, sound, and sync portions of the set. The power supplies (both low and high voltage), sweep, and part of the sync section are on the deflection chassis shown in Fig. 7.

longer for the oscillator to come out of cut-off and thus, the frequency is decreased. Therefore, the horizontal oscillator can be said to be frequency stabilized by the phase comparator action.

The horizontal oscillator and output circuit is conventional except for one feature. The output from the horizontal oscillator is fed to the grid of the output tube. (See Fig. 7.) The screen circuit of the 6CD6 output tube is unique in that the width and brightness controls are interacting. The screen is tied back to the brightness control through the 10,000 ohm resistor R_{816}. If the width control is varied so that the screen voltage is reduced, the plate current reduction will result in a corresponding width reduction. When the brightness control is advanced, the slight reduction in high voltage will cause the width to increase. The circuit arrangement is such that as the brightness control is advanced, the screen voltage of the horizontal output tube is reduced slightly and thus compensates for the width increase.

Special Service Techniques

Unstable horizontal sync: Since the phase comparator serves as a balanced phase circuit, any change in individual circuit components may cause unbalance and faulty action. The balanced phase comparator plate load resistors, R_{800}, R_{801}, and R_{802} are especially critical in this respect.

By using a test oscilloscope, the phase of the sync pulses at the plate and cathode may be checked. As was explained previously, they should be of opposite phase. It would be wise to change the .01 μfd. condenser C_{801} if the trouble appears in this circuit.

Extremely black picture, tearing: A test oscilloscope will save much time in troubleshooting the a.g.c. circuit, source of this trouble. Checks should be made at the grid and plate of the a.g.c. gate tube for proper waveform and amplitude.

Also check the action of the 1st sound i.f. amplifier since the a.g.c. gate derives its bias from the plate load resistor of the video amplifier in series with the 1st sound i.f. tube.

It should also be remembered that defects in the horizontal output circuit will affect the a.g.c. gate plate keying pulse and, thus, over-all a.g.c. operation.

Aligning the r.f. chassis: The most practical method for oscillator slug alignment is to utilize the station signals available. With this system it must be ascertained that the video i.f. strip is correctly aligned. To adjust the slugs, use the following method:

1. Turn the fine tuning control so that it is in the center of its range.
2. Tune in the highest frequency channel to be received and adjust the oscillator slug starting with sound in the picture and turning until the sound just disappears from the picture. (The video carrier i.f. set to the 50% point on the response curve.) Repeat this operation for all channels to be received.

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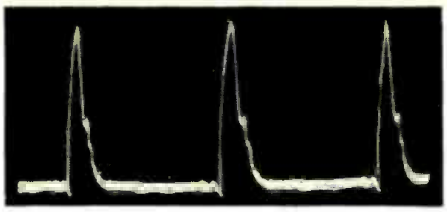


Fig. 9. Positive sync signal from the plate of the phase splitter tube, V_{15A}.

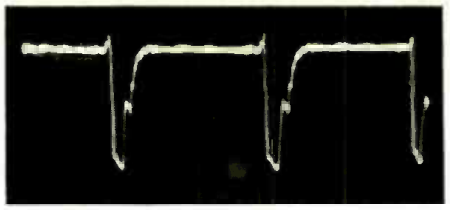


Fig. 10. Negative sync signal from the cathode of the phase splitter.

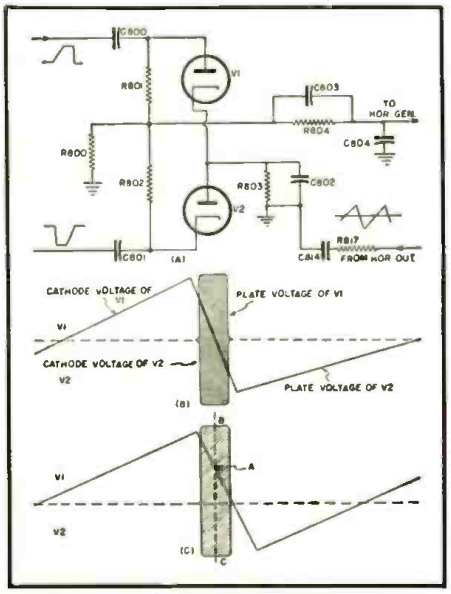


Fig. 11. (A) Simplified schematic of phase comparator circuit. (B) Horizontal oscillator and sync pulse in-phase. (C) Horizontal oscillator running fast.

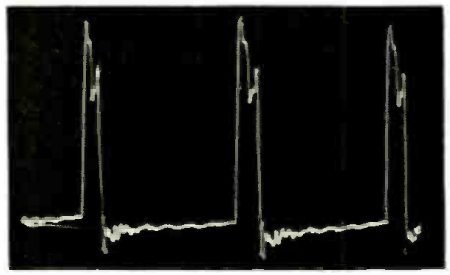


Fig. 12. Horizontal sweep output pulse from special output transformer winding.

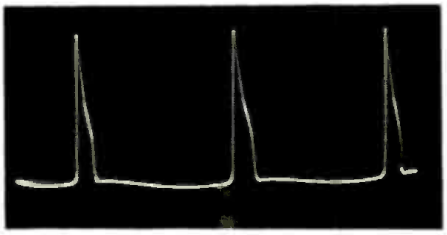
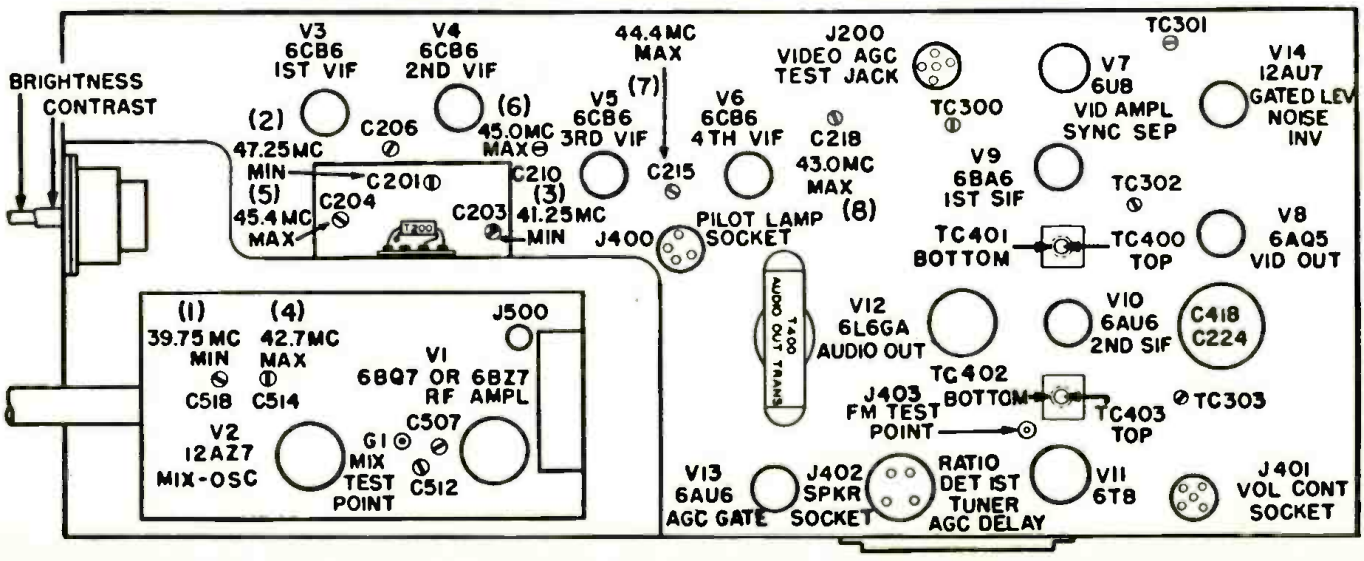


Fig. 13. Waveshape of the voltage at the horizontal oscillator cathode. A similar (but inverted) waveshape at the plate is fed to the output tube grid.

Fig. 14. Top view of the r.f. chassis showing trimmer locations and video i.f. alignment procedure.



THE FISHER MASTER AUDIO CONTROL

By

JOHN R. RUSSELL

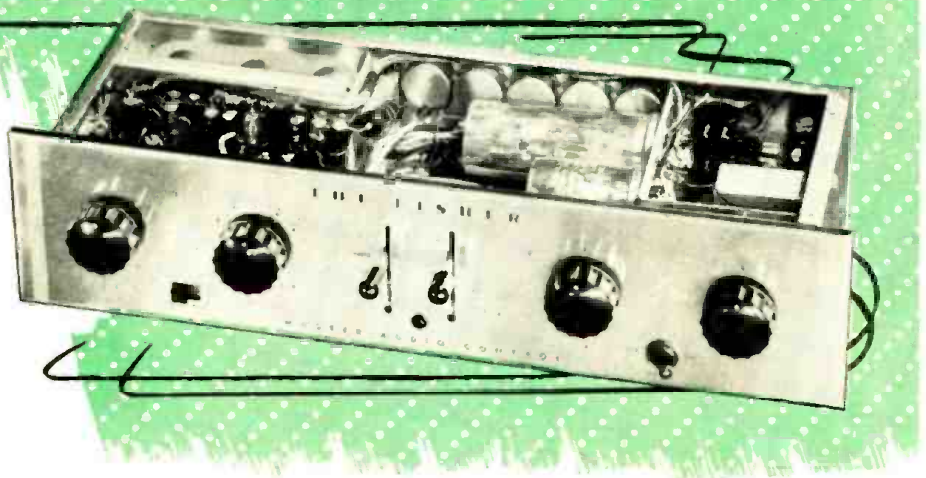


Fig. 1. Front panel view of the Fisher Model 50-C master audio control unit.

This analysis, and others to follow, is presented in response to the many requests for data on commercial hi-fidelity audio products including tuners, preamps, power amplifiers, test equipment, loudspeakers, and various types of enclosure units.

THE TREND in recent years has been to incorporate centralized audio control into circuitry embracing the selection of various circuits, and with the provision for complete equalization of all circuits included in one unit. The *Fisher* Model 50-C (Fig. 1) is typical of audio units now available having self-contained facilities for channel selection, tone control, and phono equalization. Besides possessing other features found in custom units, such as "Loudness Control," this equipment provides an extremely low hum level due, principally, to its use of triodes and a well-engineered power supply.

The circuit, Fig. 4, uses three dual-purpose tubes. One is utilized for phonograph and microphone preamplification in the main circuit. One-half of the 12AU7 is used as an input cathode follower to produce a low impedance source, both to the recorder output jack and to the loudness control. This is followed by one-half of the 12AX7 to provide voltage amplification. This stage operates with a comparatively low value of plate load resistor and is followed by the principal tone control circuits. The second half of the 12AX7 follows the tone circuits and provides additional voltage amplification. Distortion is greatly reduced by utilizing a degenerative circuit. The second section of the volume control follows this stage, and operates into the remaining half of the 12AU7 tube. This latter stage functions as a cathode follower to obtain low impedance output and to provide a low input loading to the volume control.

Relatively low impedances are used throughout the circuit to obtain the lowest possible noise level. Crosstalk is effectively eliminated by providing an additional section on the "Selector Switch" to short out unused inputs.

The phonograph preamplifier circuit comprises both halves of a second 12AX7 connected as a cascaded triode amplifier. Low frequency boost for proper record turnover is achieved with conventional *RC* networks. The turnover frequency is selected by switching various values of capacitance in the circuit. Conventional *RC* networks follow the second section of the 12AX7 to accomplish high frequency roll-off. This results in reduction of noise arising from the preamplifier tubes and their components. The circuit is so arranged that, by means of a simple wiring change, the microphone input can be converted to a second magnetic phonograph input.

Switching transients have been effectively reduced by proper design, and no "clicks" or "pops" are perceptible when either the "Selector" or "Equalization" switches are operated. Close tolerance components are used in all frequency-sensitive circuits to assure close adherence to published specifications. Extensive shielding and the use of a common ground bus, keep hum to an absolute minimum.

The 50-C control is completely self-contained (Figs. 1 and 6) and no external power supply facilities are required. Power is provided by a filtered bridge-type selenium rectifier which provides d.c. for all heaters. It also provides plate voltage using a full-wave selenium rectifier and a four-section *RC* filter. The entire unit draws but 15 watts.

Five inputs and five independent in-

Fig. 2. Bass and treble control range for the Model 50-C.

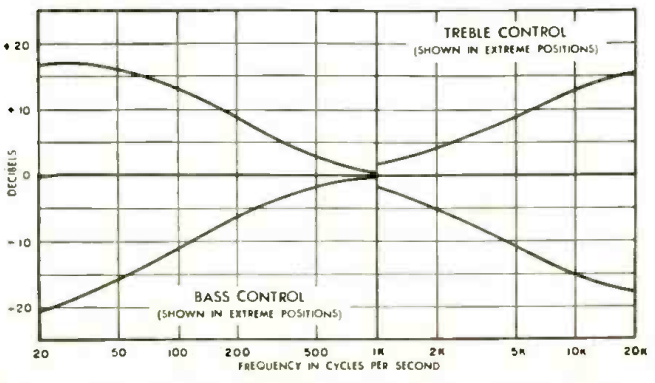
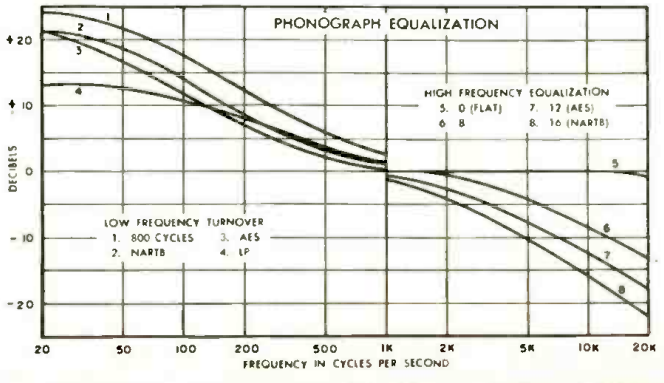


Fig. 3. Phonograph equalization curves for the control unit.



R_1, R_2, R_3, R_{35}, R_{36}—500,000 ohm pot
R_4—1 megohm, ½ w. res.
R_5, R_{21}—2200 ohm, ½ w. res.
R_6, R_{13}, R_{22}, R_{34}—47,000 ohm, ½ w. res.
R_{7A}, R_{7B}, R_{7C}—Three-section pot (1 megohm, 100,000 ohms, 500,000 ohms)
R_8, R_{15}, R_{16}—10,000 ohm, ½ w. res.
R_9, R_{20}, R_{28}, R_{12}—1 megohm, ½ w. res.
R_{10}, R_{23}, R_{29}—1500 ohm, ½ w. res.
R_{11}, R_{19}, R_{38}, R_{39}—3300 ohm, ½ w. res.
R_{12}, R_{30}—39,000 ohm, ½ w. res.
R_{14}, R_{17}—1 megohm pot
R_{18}, R_{26}, R_{32}—100,000 ohm, ½ w. res.
R_{31}, R_{33}—220,000 ohm, ½ w. res.
R_{24}, R_{24}, R_{27}—2.2 megohm, ½ w. res.
R_{25}—18 megohm, ½ w. res.
R_{37}—47 ohm, ½ w. res.
R_{41}—15 ohm, 2 w. res.
C_1, C_{13}, C_{18}—.01 μfd., 400 v. cond.
C_2, C_{11}, C_{17}, C_{21}—.1 μfd., 400 v. cond.
C_3—82 μμfd., 500 v. cond.
C_4, C_6, C_{15}, C_{19}—.022 μfd., 400 v. cond.
C_5—.027 μfd., 400 v. cond.
C_8—.003 μfd., ceramic cond.
C_7, C_{12}—.047 μfd., 400 v. cond.
C_9, C_{11}—.0022 μfd., 400 v. cond.
C_{10}—220 μμfd., 500 v. ceramic cond.
C_{16}—.0082 μfd., 400 v. cond.
C_{20}—.0047 μfd., 400 v. cond.
C_{22}—420 μμfd., 500 v. ceramic cond.
C_{23}—800 μμfd., 500 v. ceramic cond.
C_{24}—.0013 μfd., 500 v. ceramic cond.
C_{25A}, C_{25B}, C_{25C}, C_{25D}—40 μfd., 300 v. elec. cond.
C_{26A}, C_{26B}—500 μfd., 25 v. elec. cond.
C_{27}—4.7 μμfd. ceramic cond.
C_{28}—25 μfd., 10 v. elec. cond.
F_1—3AG fuse, ½ amp.
J_1, J_2, J_3, J_4, J_5, J_6, J_7—Jack, 1 female contact
J_8, J_9, J_{10}—Outlet receptacles
S_1—4-pole, 5-pos. rotary sw.
S_2—D.p.d.t. slide sw.
S_3—D.p. 4-pos. lever sw.
S_4—S.p. 4-pos. lever sw.
S_5—S.p.s.t. toggle sw.
SR_{1A}, SR_{1B}—High-voltage, full-wave selenium rectifier, 240 volts d.c. output @ 10 ma. (Radio Receptor 24Y3)
SR_{2A}, SR_{2B}, SR_{2C}, SR_{2D}—Bridge-type filament selenium rectifier, 20 volts d.c. output @ .3 amp.
PL_1—5 v. or 6.3 v. pilot lamp
T_1—Power trans. 200-0-200 v. @ 10 ma.; 20 v. @ 300 ma., tapped at 5 v. (Fisher Part No. T505-115)

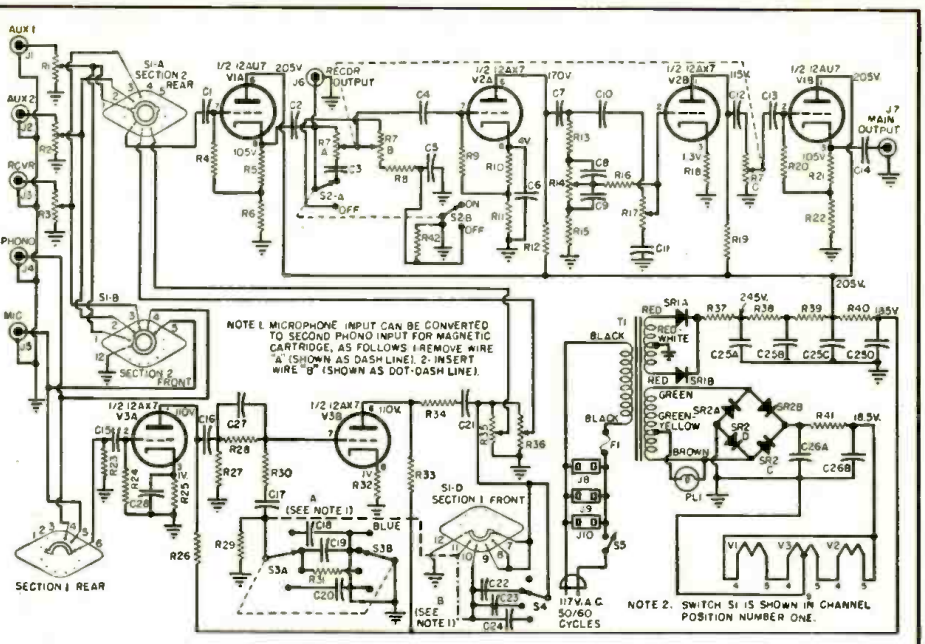


Fig. 4. Complete circuit diagram of the Fisher Model 50-C "Master Audio Control."

put level controls are available by means of the "Selector Switch." The input level controls perform the further function of permitting correct level settings for proper performance of the "Loudness Control."

Two output channels are provided. Both of these employ cathode-follower circuitry. The "Main Output" can be connected to any amplifier having an input impedance of 100,000 ohms or greater. Because of the low internal impedance of this output circuit, the connecting cable length will not be critical and runs up to 200 feet may be used. The same condition would apply to the "Recorder Output." The latter circuit is taken preceding all tone controls and is used to furnish a signal to a tape or wire recorder. It also provides simultaneous monitoring from the "Main Output."

Panel Controls

1. *Volume Control.* All essential controls are mounted conveniently on an etched panel to facilitate the operator's job. They include a three-section volume control incorporating the loudness control compensation facilities. This compensation is based on the Fletcher-Munson curves.

2. *Loudness Control Switch.* This control will be found adjacent to the volume control. In the "Off" position, the volume control becomes a two-section gain control.

3. *Selector Switch.* This has five positions, including two auxiliary inputs plus receiver, phonograph, and microphone settings. This arrangement thus provides a common central switching point for the entire system.

4. *Bass and Treble Tone Controls.* The mid-range position of these controls provides an essentially flat response. Up to 16 db of cut or boost are provided at approximately 50 and 10,000 cycles respectively. See Fig. 2.

5. *"On-Off" Switch.* The capacity of the switch is 6 amperes. The handling capacity is sufficient to take care of the normal requirements of a conventional audio system. Three auxiliary a.c. receptacles are provided and are all operated by the "Control Switch."

6. *Phonograph Equalization Switches.* Separate lever-type switches are included for both bass and treble equalization and each is provided with four distinct positions. The bass provides turnover frequencies for AES, NARTB, LP, and 800 cycles. The treble switch includes 0 db, 8 db, AES, and NARTB roll-off points. Thus there are sixteen possible combinations for full equalization. Fig. 3.

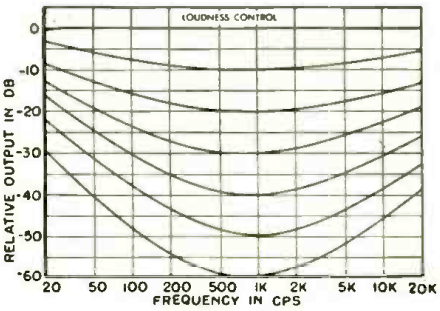


Fig. 5. Loudness control curves of unit.

Specifications

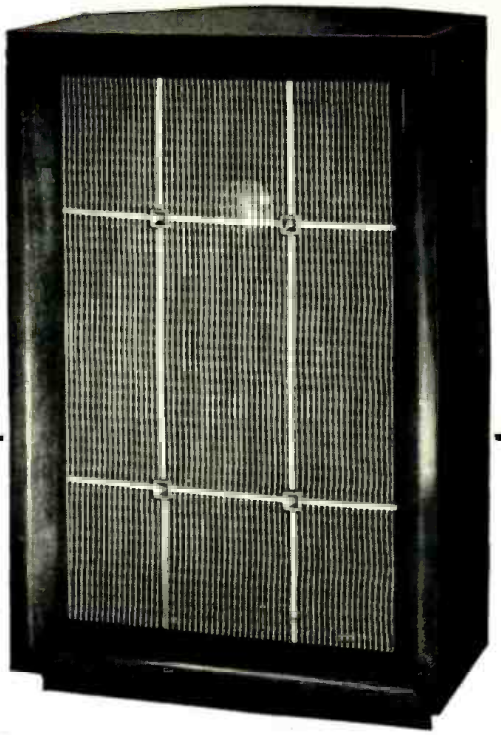
Specifications on the Model 50-C include:

(*Continued on page 94*)

Fig. 6. Rear chassis view of the Model 50-C, a self-contained audio control unit.

ELECTRO-VOICE Aristocrat

By **HOWARD SOUTHER**
Electro-Voice, Inc.



Construction details and performance data on a folded corner horn enclosure. It will accommodate any high quality, low resonant frequency, 12-inch loudspeaker.

The E-V "Aristocrat" enclosure. The performance data covered in article was obtained using the E-V SP12-B "Radax" unit.

THE mind through the ear delights in the stimulus caused by sounds which are mathematically related. The generation of such sounds is called music. It is generally conceded that the widest variety of these sounds causes the greatest satisfaction; thus, we find that loudspeaker systems of the widest response range are the most pleasing, granting good source material of low distortion as an understood prerequisite.

Where space is limited there is no particular problem in achieving excellent response in the treble ranges. Generating mechanisms for producing the rapid, delicate pulses of the higher frequencies are inherently small in themselves. But not so the bass range, comprised of the first two octaves from 30 to 120 cycles-per-second.

The area near a sound generator, in this case the cone of a loudspeaker, is what engineers term a region of high acoustical impedance. To achieve useful transfer efficiency of motion into acoustical energy, we must build up considerable air pressures.

To deliver these sound pressure waves to the listening area, a region of very *low* pressure or low acoustical impedance, a transformer of some kind is required, just as it is in an electrical circuit.

The recognized scientific means of accomplishing this transformer action is through the use of a horn. This horn must expand in area at a constantly accelerating rate to accomplish its function, the ideal horn being one of infinite length and infinite mouth size.

The Horn Design

This last requirement almost stops the design project before it begins. But let us examine first the requirements of a suitable horn. Fundamental tones of even the largest bass instruments, such as monstrous drums and 16 foot organ pipes, start at 30 cycles per second. The mouth requirement for a horn capable of reproducing a 30 cycle tone is ¼ the wavelength of this tone, or 111 inches. For a 50 cps tone, this dimension decreases rapidly to 80 inches.

The next thing to consider is the length of the horn. The formula governing horn design says that the taper rate, or the flare, governing the expanding cross section of the horn, shall double every 1½ feet of its length in order to reproduce a 30 cps tone at the mouth (whose cross section we have already computed to be 111 inches).

The Design Takes Form

Our design still has impossible dimensions for the living room; something having a length of 6 to 10 feet, according to the throat size we select at the start of the horn, and a mouth 10 feet across! On the other hand, certain things are in our favor:

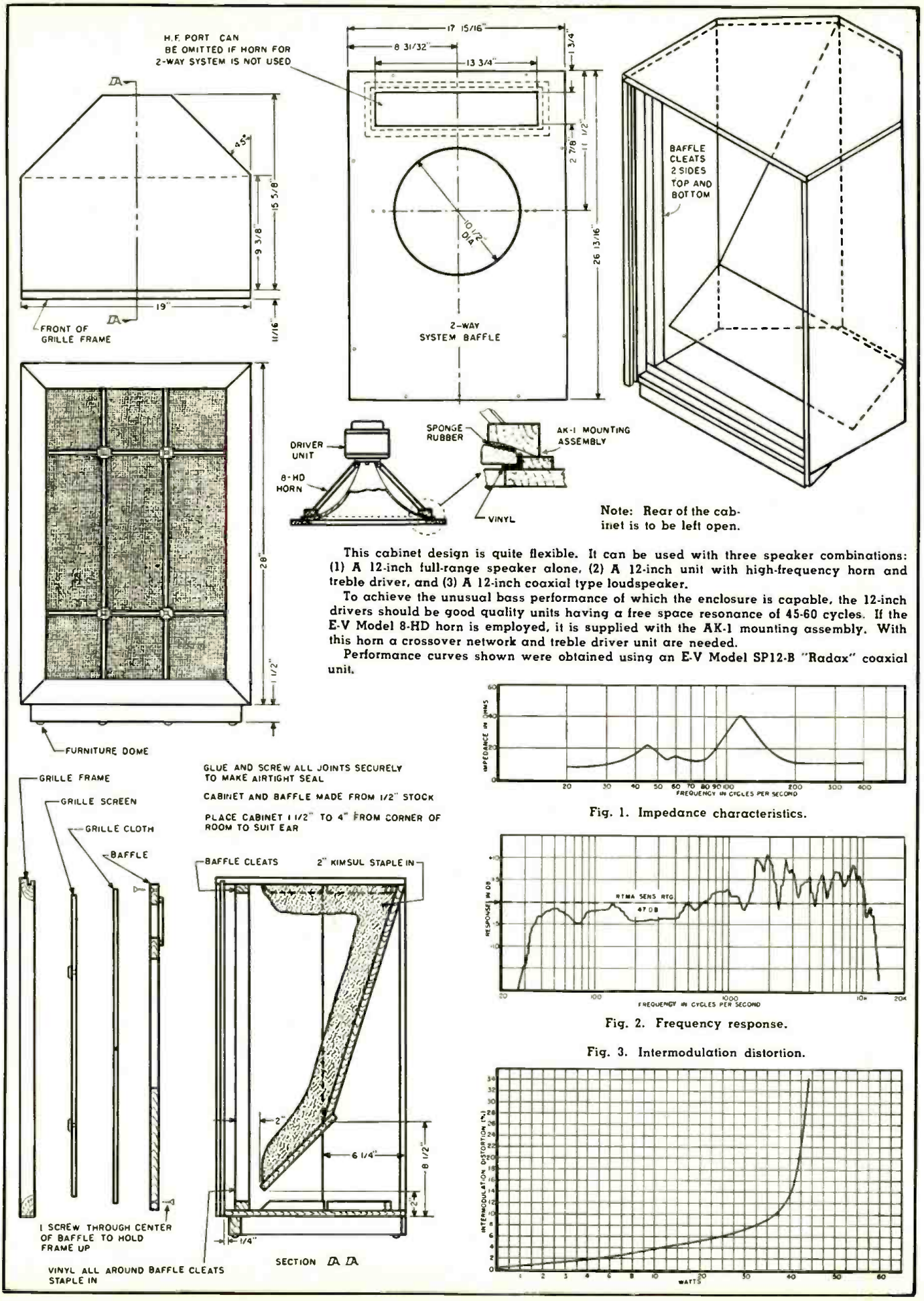
Ideally, the lowest tones in frequency lend themselves easily to propagation in a closed cavity of a size such as our living room. Examination reveals a partial horn available in the *corner* of the room, the mouth of which is in most cases *more* than 111 inches across! Some years ago, Paul Klipsch, the noted acoustics authority, seized upon the idea of housing only the *throat* of the required horn in a furniture cabinet and placing it in this corner. In the design of the "Aristocrat," we find that by keeping the driver unit itself small, we have such a throat assembly of very compact proportions. There now results a clean, extended low-frequency response to the 30 cps region, surprisingly free from peaks and valleys in its characteristic curve. But, although the range is well extended and satisfactory, the efficiency in the first octaves is still too low to accomplish a pleasing musical balance. This is true, in the main, because our driving cone is only a piece of parchment, and a far cry from the ideal acoustical requirement for a piston of infinite lightness and infinite rigidity.

Building the Efficiency

By exploiting a phenomenon involving acoustic resonance, the efficiency in the bass range may be augmented as much as 4 to 8 times. Observe the cross-sectional drawing of the "Aristocrat": By utilizing the reactance of the small air mass directly behind the speaker, in conjunction with the high compliance or capacitive factor of the specialized driver cone, the combination can be used to reinforce the sound over a four-octave band with the large air mass, due to the horn, which is presented by the corner.

Performance

If the "Aristocrat" is carefully constructed, and care is taken to effect a complete seal of the front baffle board to prevent air leaks from front to back, rather startling bass performance will be realized. Response range will be as shown in the curve (Fig. 2) revealing a response within 5 db of flat to about 30 cps. This operation is supported by evidence disclosed in the impedance characteristic (Fig. 1) denoting a satisfactory reactive component in the voice-coil system well into the first octave. The high impedance at 120 cps is fortunately not reflected adversely in the frequency response curve. —30—



Note: Rear of the cabinet is to be left open.

This cabinet design is quite flexible. It can be used with three speaker combinations: (1) A 12-inch full-range speaker alone, (2) A 12-inch unit with high-frequency horn and treble driver, and (3) A 12-inch coaxial type loudspeaker.

To achieve the unusual bass performance of which the enclosure is capable, the 12-inch drivers should be good quality units having a free space resonance of 45-60 cycles. If the E-V Model 8-HD horn is employed, it is supplied with the AK-1 mounting assembly. With this horn a crossover network and treble driver unit are needed.

Performance curves shown were obtained using an E-V Model SP12-B "Radax" coaxial unit.

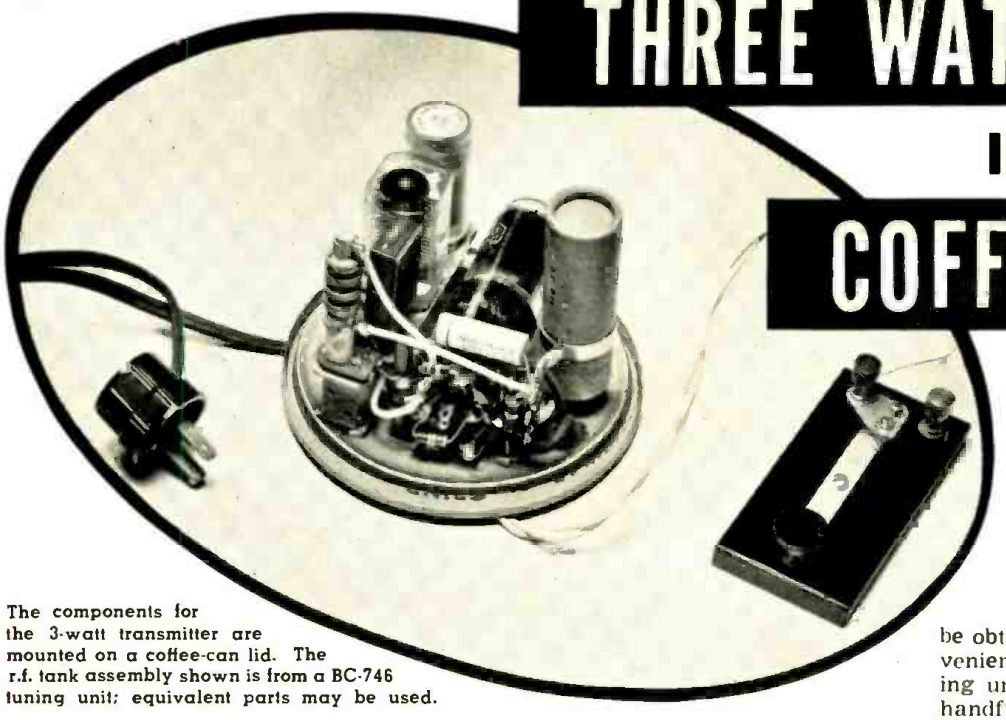
Fig. 1. Impedance characteristics.

Fig. 2. Frequency response.

Fig. 3. Intermodulation distortion.

THREE WATTS IN A COFFEE CAN

By
JIM FAHNESTOCK,
W2RQA



The components for the 3-watt transmitter are mounted on a coffee-can lid. The r.f. tank assembly shown is from a BC-746 tuning unit; equivalent parts may be used.

Built for less than five dollars, this three-watter brings back the simplicity, economy, and ingenuity of "the good old days." A challenge to operating skill, and some real fun.

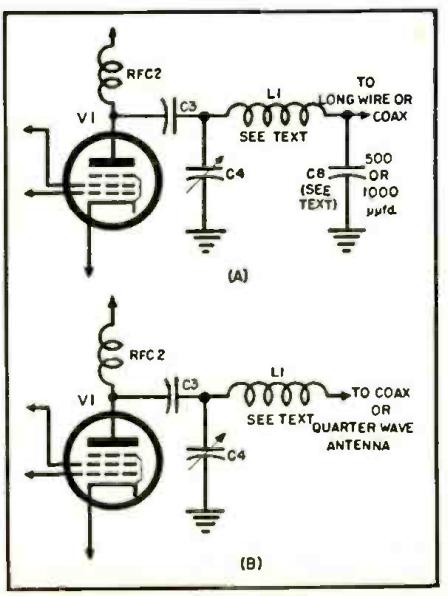
IN AUTOMOBILE racing, midget racers draw the most consistent crowds. In sailboating, the greatest spirit is displayed in the small boat classes. The true sport comes from competition where equipment used is standard to all contestants, and the simpler the equipment, the more the fun.

The coffee-can transmitter described in this article was designed to be a contest midget for hams. The idea was conceived at a meeting of the Wantagh (Long Island) Radio Club after an evening of the usual argument over ways to stimulate operating activity among club members. Club nets and contests were discussed, but it was not until the coffee-can rig was suggested that these ideas took hold.

To make the idea of building a low-power transmitter attractive to the greatest number of members, low cost was placed at the top of the list of design requirements. The final circuit chosen, after a painstaking, penny-conscious investigation of every conceivable combination of available parts, is shown in Fig. 2. With a little shopping around in the surplus ads, all the parts including tube, crystal, power supply, and key can be purchased for less than a five-dollar bill. To a man with a good junk box and the standard "odds and ends" of surplus, this can nearly be a "no-cost" transmitter.

The pentode portion of a 117L7GT is connected as a modified Pierce oscillator running about three watts input in the 80-meter c.w. band. The diode portion of the tube serves as a half-wave rectifier and provides approximately 125 volts d.c. through a simple *RC* filter. The crystal socket and plate tank condenser and coil can be obtained already mounted on a convenient subchassis from a BC-746 tuning unit available at surplus. Only a handful of readily available parts are required to complete the circuit.

Fig. 1. Alternate ways of feeding power to the antenna (see Fig. 2). (A) "Pi" network for random-length wires or a coaxial feeder. (B) Simpler "L" coupler, somewhat less efficient but still useful (see text).



The top of the coffee can serves as a chassis and the can itself provides an air tight (and incidentally a TVI-proof) cabinet. Placement of parts can be seen in the photographs. The BC-746 tuning unit is mounted as close to the edge of the can lid as possible after all the original wiring and the fiber jack strip that comes attached to each unit is removed.

The octal tube socket for the 117L7GT is mounted on a pair of right-angle brackets and furnishes convenient tie points for the small parts of the power supply and r.f. section. A two-terminal strip mounted on the can top directly beneath the tube socket furnishes feedthrough connection for the keying leads (a jack may be substituted, if desired) and an *RCA* phonograph plug serves as a feedthrough for the antenna. The line cord passes through a ⅜-inch hole in the can top fitted with a rubber grommet.

Power Supply Precautions

In order to keep cost at a minimum, a transformerless a.c.-d.c. type power supply is used. This introduces a shock hazard unless proper care is taken to plug the line cord into the wall socket in such a way that the wire connected directly to the coffee-can ground is the wire that connects to the grounded side of the a.c. line.

One procedure for orienting the plug in the correct manner is as follows: Connect a small 117-volt light bulb between the coffee-can chassis and a good external ground, such as a water pipe. The plug is then inserted in the wall outlet. If the bulb lights, the plug has been inserted incorrectly and should be reversed. Once the correct orientation has been determined, plug and socket can be marked in some convenient way to insure correct insertion

each time the rig is plugged in. A dab of paint on one side of the plug and alongside the corresponding socket hole will serve as a permanent guide.

Tuning Procedures

In tuning the rig initially, a 0 to 100 ma. meter may be connected across the key terminals to indicate a dip in cathode current when C_4 is adjusted to resonance with L_1. An alternate tuning procedure is to tune C_4 until maximum "S"-meter reading is indicated on a nearby receiver. A single-turn link with a 0.25-ampere pilot lamp placed around L_1 will also provide an indication of resonance.

Some of the Wantagh gang who made these rigs found that sluggish crystals would refuse to oscillate or follow keying in this circuit. This was easily remedied by the insertion of a 250 $\mu\mu$fd. condenser, C_7, shown in dotted lines on the diagram, from the screen grid of the 117L7GT to ground. New and active crystals ought to take right off, and C_7 can be eliminated, saving fifteen cents or so in the overall cost.

If the BC-746 tuning unit is used, either the 3825 or 5500 kc. coil may be used without modification if the link output arrangement shown in Fig. 2 is used. This arrangement will match coax or a 300-ohm twin-lead line.

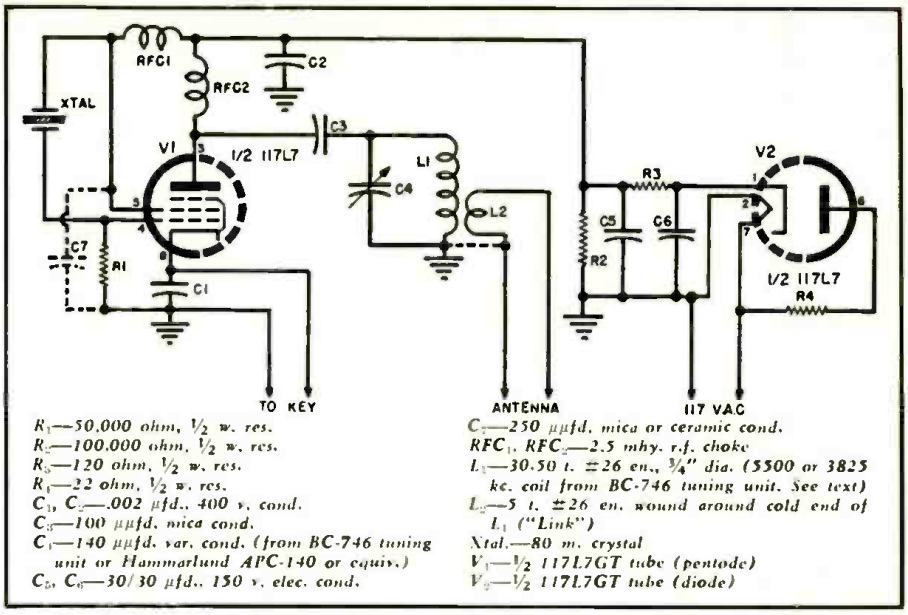
Two alternate systems for coupling energy to the antenna are shown in Fig. 1. By experimenting with values for C_6, L_1 and C_5 in the *pi* network shown in Fig. 1A practically any length of wire can be made to take power from the rig. To match low-impedance antenna systems with the *pi* network (coax or quarter-wave antennas) the tuning unit coils should be pruned to about 30 turns for best results. For coax output C_5 should be somewhere between 500 $\mu\mu$fd. and 1000 $\mu\mu$fd. After the value of C_5 has been determined for best results for one crystal in the 80-meter band, no further changes in that value are required for other frequencies in that band. C_4 is adjusted for resonance at each new frequency in the band.

The *L* network shown in Fig. 1B is admittedly not ideal from the standpoint of harmonic attenuation, but with the low power level involved, no trouble has been noticed and good transfer of power is obtainable.

If TVI is noticed emanating from the coffee can, it is a fairly safe bet that r.f. is being fed back through the line *via* the direct connection in the power supply. This can be eliminated completely by inserting a small u.h.f. choke in series with the "hot" side of the line inside the coffee can and bypassing the rectifier plate connection with a small .005-μfd. mica or disc ceramic condenser.

Operation

Experience in operating the coffee-can rigs shows very clearly that they get reports that compare quite favorably with rigs running considerably more power. It is interesting to note



R_1—50,000 ohm, ½ w. res.
R_2—100,000 ohm, ½ w. res.
R_3—120 ohm, ½ w. res.
R_4—22 ohm, ½ w. res.
C_1, C_2—.002 μfd., 400 v. cond.
C_3—100 $\mu\mu$fd. mica cond.
C_4—140 $\mu\mu$fd. var. cond. (from BC-746 tuning unit or Hammarlund APC-140 or equiv.)
C_5, C_6—30/30 μfd., 150 v. elec. cond.
C_7—250 $\mu\mu$fd. mica or ceramic cond.
RFC_1, RFC_2—2.5 mhy. r.f. choke
L_1—30.50 t. #26 en., ¾" dia. (5500 or 3825 kc. coil from BC-746 tuning unit. See text)
L_2—5 t. #26 en. wound around cold end of L_1 ("Link")
Xtal.—80 m. crystal
V_1—½ 117L7GT tube (pentode)
V_2—½ 117L7GT tube (diode)

Fig. 2. Complete schematic of the 3-watt "coffee can" transmitter. It is complete with its power supply inside a one-pound coffee can. "Phono" jacks may be used for the key and antenna. C_7 (dotted lines) is added for sluggish crystals (see text).

reactions from operators on the other end when you explain that you are running *three watts*. On regular Wednesday night gab fests around town surprisingly little trouble from QRM has been observed, and it is comforting to know that you are actually complying with the FCC regulation that says, "Ye shall use only enough power to accomplish the desired communication."

If a group of locals can be talked into building coffee-can rigs, a great amount of pleasure can be derived from rag chews, practice CD nets, and local contests. If a common frequency is adopted, it is usually a simple matter to get into a relaxing chat without firing up the big "TV eliminator," and considerable satisfaction results from the realization that you are doing very little to contribute to the retirement fund of the local power company officials.

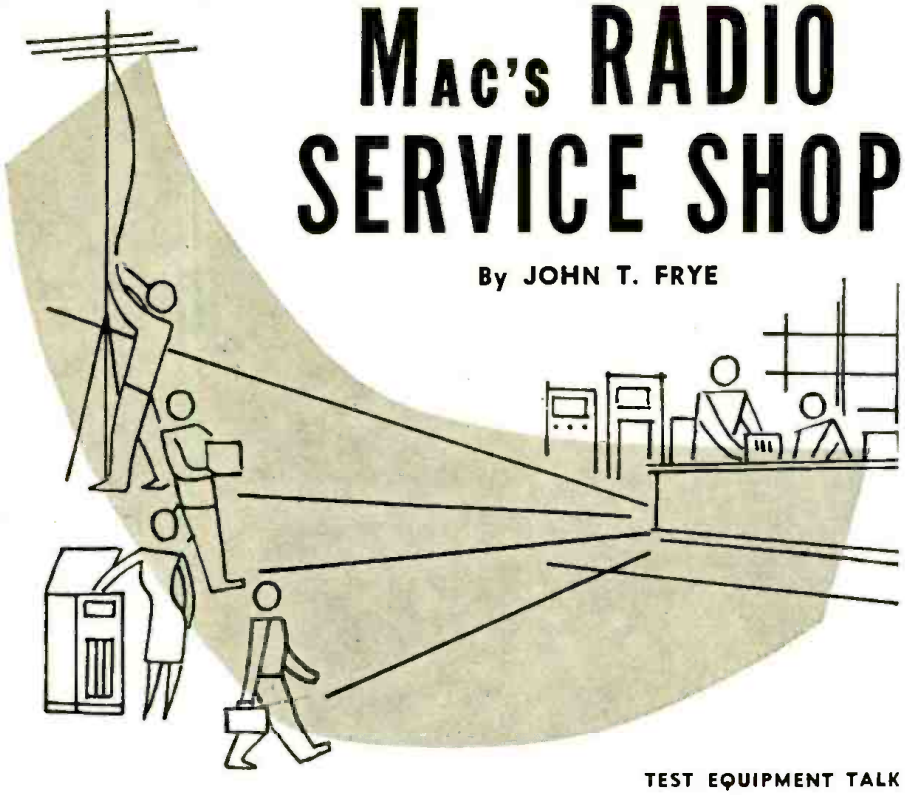
Since the birth of the coffee-can rigs in Wantagh, the number of idle kilowatts has risen considerably, but the number of operating hours has also gone up. Contests to see who can work the most states or the most distant station in a given period of time are sometimes quite revealing, since they show who is the best operator, and not who has the fattest pocketbook.

A variety of modifications of the basic design is possible for different requirements. By appropriate wiring changes and tube substitutions, battery operation is feasible for CD work and local field days. The main thing is to get the gang started, and this is best accomplished by keeping cost and complexity to a minimum. —30—

Enclosing the transmitter in its coffee can affords good shielding for TVI and, like any cabinet, protects the circuit. Unless the line plug is polarized correctly, the can will be "hot" with a.c. (see text). The antenna jack is at upper left.

MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE



TEST EQUIPMENT TALK

THE doors of Mac's Radio Service Shop were opened wide to the soft June breeze, and Mac and his red-headed helper, Barney, were displaying strong symptoms of belated spring fever as they sat on the service bench drinking their mid-afternoon Cokes. Neither seemed in a hurry to get back to work. Mac was lazily leafing through the current issue of a radio magazine, and Barney was dreamily practicing his imitation of the river steamer *Robert E. Lee* saluting a friend of the pilot standing on the Friar Point levee. Of course, if you were a dull clod you might have thought he was just blowing across the mouth of an empty Coke bottle, but to admit this would have been to brand yourself as a person of no imagination.

"You know, Flame-head," Mac drawled, "a lot of us have been so busy trying to keep up with the progress of the radio and TV sets we work on that we have failed to notice the improvements made in the instruments we work *with*."

Barney gave a final mournful toot on the deep-throated whistle of the *Robert E. Lee* and asked, "What brought that on?"

"I was just looking at this ad for a 20,000-ohms-per-volt volt-ohmmeter, which happens to be the same one we use here, and thinking what a far cry it is from that old 1000-ohms-per-volt tester I used for so many years. A funny thing is that many technicians have gone directly from that old-fashioned v.o.m. to the exclusive use of a v.t.v.m., and they still think that all v.o.m.'s are as insensitive and load circuits being tested as heavily as did that old-fashioned job."

"Well, volt-ohmmeters still have a lot less resistance than vacuum tube voltmeters," Barney argued.

"That depends upon what scale of the v.o.m. you use. I'll grant you that when both instruments are used on the low-range scales, the vacuum tube job is much superior, for the typical v.t.v.m. has a fixed resistance of ten megohms in the instrument and one megohm in the probe for a total of eleven megohms on all scales. The 20,000-ohms-per-volt meter, on the other hand, has a variable resistance that is always equal to twenty thousand times the full-scale voltage of the range being used. That means that on the five volt range its hundred thousand ohms compares very poorly with the v.t.v.m.'s eleven megohms; but on the 500 volt range the v.o.m.'s ten megohm resistance is nearly equal to that of the v.t.v.m., and at 1000 volts the v.o.m. has surged far ahead with a resistance of twenty megohms. When high voltage probes are used with both instruments to increase their range to say 30,000 volts, the resistance of the v.t.v.m. is raised to only about 300 megohms, while the resistance of the 20,000-ohms-per-volt meter is 600 megohms. That means if it is used to check the high voltage of a picture tube, it will draw only half as much current as will the v.t.v.m."

"Say, how about that!" Barney exclaimed with sudden interest. "I never realized that was true. Any old time you get above about 500 volts, the loading of a modern v.o.m. is actually less than that of a v.t.v.m."

"True, and I might add that the bearings used in the 50 microampere meter movements employed in these 20,000-ohms-per-volters are so good that the readings obtained on the lower parts of the scales are quite accurate and dependable. That means you can use a high range scale to insure minimum loading and still be able to depend upon the readings obtained."

"Looks as though there's not much sense in buying a v.t.v.m. at all," Barney observed.

"Now let's not get carried away," Mac warned. "I still think that the v.t.v.m. is the ideal service instrument for bench use. When measuring such things as oscillator bias, a.v.c. and a.g.c voltages, etc., it can't be beat; and as long as you are around, I am greatly comforted by the thought that it is practically impossible to damage the meter by accidentally using the wrong scale. On the other hand I think that every shop should have a good 20,000-ohm-per-volt v.o.m. These meters are quite rugged and will stand up under portable use better than the v.t.v.m.'s. They are always ready for instant use in any location, requiring neither a warm-up period nor external power source. You do not have to worry about changes in line voltage or aging tubes affecting their accuracy; consequently, you always feel a little more confident about the accuracy of readings you obtain with a v.o.m. Both types of meter have their good and bad points that supplement each other. The technician needs both of them."

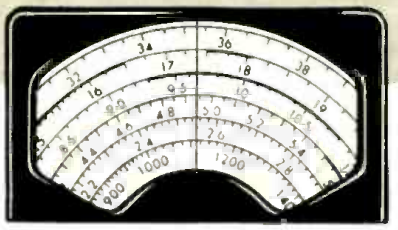
"That's just one instrument that has been improved," Barney pointed out. "Are there others?"

"Sure thing. Take the oscilloscope for example. Just before the Second World War was when the scope really moved out of the laboratory into the service shop. That was when a lot of technicians bought their first scopes, and the instruments they bought were very limited in both sensitivity and frequency range. That job we use for checking vibrators is typical of those early oscilloscopes, and you will recall that when we checked it out with the voltage calibrator and square-wave generator a while back we found that the deflection sensitivity was .65 volt per inch and that the response of the amplifiers fell off very rapidly above 50,000 cycles; furthermore, the setting of the amplifier gain control had a tremendous effect on the response of the amplifier itself.

"A few of the fellows," Mac went on, "who think 'an oscilloscope is an oscilloscope,' are still trying to use these ancient jobs for TV service. Others who have bought modern instruments for TV alignment purposes still think of the *general* uses of the oscilloscope in terms of the very limited possibilities they discovered when they experimented with those early models. They do not realize that the modern scope with its ten or twenty millivolts-per-inch sensitivity, its frequency range extending up into the megacycles, and its step-type nonfrequency-affecting attenuator will do dozens of jobs in radio and TV service

(*Continued on page* 110)

International SHORT-WAVE



Compiled by KENNETH R. BOORD

THIS month's cover features your short-wave editor, Ken Boord, at the *ISW DEPARTMENT* Listening Post at his home, 948 Stewartstown Road, Morgantown, West Virginia, USA.

The equipment in the photograph includes a *Hammarlund* SP-600-JX (Super Pro); a *Hallicrafters* SX-73; a *National* NC-183-D; a *Hallicrafters* SX-28; an *RME* DB22A preselector; a Panadaptor; and a BC-221-AH frequency meter. The tiny receiver atop the Panadaptor is your short-wave editor's first radio—a crystal set dating to the mid-1920's.

The Listening Post employs straight-wire antennas and doublets cut to the popular short-wave bands. Best overall results have been obtained with a 300-ft. straightwire. Lead-ins are of 100-ohm shielded twin-lead transmission line.

Your short-wave editor began SWLing in the early 30's, first using a converter, and then a four-tube short-wave receiver with plug-in coils and a speaker made from an old automobile horn and a headphone set. He was a contributor to RADIO & TELEVISION NEWS' short-wave department in the 30's and to leading radio organizations. He began the *ISW DEPARTMENT* with the June 1944 issue.

* * *

Around the World

(*NOTE:* Some stations may have changed to *summer* schedules since this was compiled; in such cases, you may hear them *one hour earlier* than listed herein.—K. R. B.)

Algeria—Algiers now uses only 6.160 at 0700-1745. (Scheiner, N. J.)

Anglo-Egyptian Sudan—*Radio Omdurman* noted now near 7.655 signing on 1115 in *English* on Wed.; reported also using 6.437 now. *English* is scheduled Sun., Wed. 1115-1130, Fri. 1230-1300. (Pearce, England)

Argentina—LRA, 9.69, Buenos Aires, has strong signal 2000A. (Dadson, Mich.) Noted to North America East Coast now on 15.345 (*moved* from 17.720) at 1700-1930. (Balbi, Calif., others)

Australia—VLC11, 11.840, is now used to Eastern North America 0700-0845; DX session Sundays 0830.

Belgium—Brussels noted to North America daily over 9.767, in French 1900, *English* from 2030; on Wed. has DX session 2100. (Morrison, R. I., others) Noted closing 2200. (Matherly, Ohio) ORU5, 6.000, strong 1305. (Catch, England)

Belgian Congo—OTH, 9.215, Leopoldville, good level 1200, native. (Catch, England) *Radio College*, OQ2AC, Elisabethville, lists schedule daily 1130-1230 (Sun. 0200-0400) on 7.2, 4.98, 3.39 with 250 watts each; mostly French but on Fri. uses Flemish (or Dutch) and closing announcements include *English*. Hopes to increase power of at least the 4.98 outlet to 500 watts soon. (Scheiner, N. J.)

Bolivia—CP38, 9.497, La Paz, noted on *measured* channel 0645 with religious service in Spanish. (Ferguson, N. C.)

Brazil—PRL7, 9.72, Rio de Janeiro, good level signing on 1930. (Morrison, R. I.) *Radio Jornal do Commercio*, 15.145, noted closing 1433A in *English*, Portuguese; said continuing over 9.565. (Pearce, England) PRK5, 6.000A, Belo Horizonte, noted 1930 with QRM, weak. (Washington, N. J.) ZYC8, 9.610, Rio de Janeiro, fair level 2020; PRC5, 4.865, Belem, good level 2000 with news in Portuguese; ZYY9, 4.97575, Sao Luiz, heard at fair strength 2045. (Catch, England) ZYK2, 9.565, Recife, noted from 1530 at good level in Sweden. (Friberg)

British Honduras—Occasionally, Belize, 4.950A, is in the clear around 1900. (Black, Pa.)

Bulgaria—Sofia, 9.700A, good in *English* to North America 2000-2030. (Klein, Va.) Noted on 6.070 in *English* 1600-1630. (Hanel, Sweden)

Burma—Rangoon, 4.774A, is heard in Sweden 0900-1000 in *English*. (GDX-aren, Sweden)

Cape Verde Islands—CR4AA, 7.130A, Praia, noted 1557-1700 when closed with "A Portuguesa." (Pearce, England) More recently has *moved* to 7.395A. (Washington, N. J.; Mercier, France, others)

Ceylon—*Radio Ceylon*, 11.975, noted closing Thur. 1215; Fri. 1230, other days 1145. (Fuller, R. I., others)

China—Wahun, 6.645, heard 0618, had CWQRM. (Ballou, Calif.)

Colombia—HJEF, 4.768, Cali, noted 2308-2332. (URDXC) *Radio Pacifico*, HJEX, 6.054, Cali, good around 2100-2130. (Norman, N. C.) HJAE, Cartagena, noted close to 4.9665 around 2300. (Gaylord, Washington State) HJCQ, 11.680, Bogota, carries *"English by Radio"* 1930. (Niblack, Ind.)

Costa Rica—*Radio Athenea*, San

(*Continued on page* 130)

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

Eduardo Lopez Juarez, CE3CB, of San Miguel, Chile is shown in his radio "shack." Equipment includes a 50-watt transmitter, a three-tube receiver, and a "Little Giant Station." Mr. Lopez Juarez is a Major Sub-Officer in the Chilean Air Force in the Radio Communications Branch. At the present time he is stationed at the Central Airfield of the Air Force. CE3CB is one of the world's best-known calls, having been on the air for over 15 years and participating in thousands of successful QSO's.

AN OSCILLOSCOPE CALIBRATOR

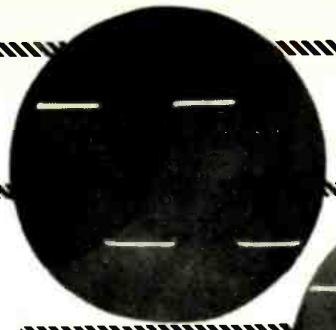


Fig. 1. Output square wave of unit.

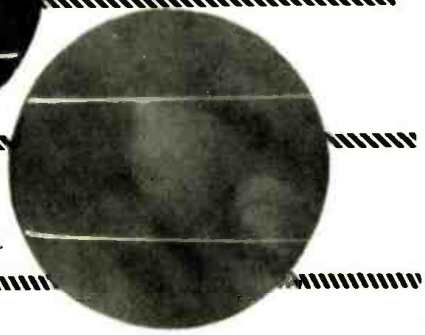


Fig. 2. Correct calibrator output.

Front view of scope calibrator. It is housed in a compact case.

An easy-to-build accessory unit that will increase the versatility and usefulness of your shop oscilloscope.

By

RICHARD GRAHAM, W1VJV

VERY often service technicians, experimenters, and hams use their oscilloscopes just for the observation of waveforms. When they do, they're only getting half the value of their scopes. With the addition of the easily constructed oscilloscope calibrator described herein, the scope can be used for actual voltage and current measurements as well as for waveform observation.

The oscilloscope calibrator is nothing more than an a.c. voltage standard, the output of which is independent of line voltage variations. It would be very convenient if we could use a battery or other such stable d.c. source for scope calibration, just as in the usual d.c. meter calibration, but unfortunately we can't since the oscilloscope, or at least the usual one, responds only to a.c. Thus it becomes necessary to construct some sort of device that will produce a constant a.c. signal regardless of any external varying conditions. For oscilloscope calibrating, a square wave provides the most convenient waveform since the top and bottom of the wave are at definite places, not like, for example, a sine wave with its gradually sloping sides. Another advantage is that a square wave is all "top and bottom with nothing in between." Thus because the transition time between the bottom peak and top peak is so very rapid, there appear to be only two lines on the scope when the sweep frequency is greater than the input square-wave frequency. This provides a very convenient pair of reference lines for calibrating the oscilloscope screen. This effect is shown in Fig. 2.

To make an a.c. voltage standard it is convenient to revert back to a d.c. source which can be more easily and economically controlled. This regulated d.c. source must then be converted back to a.c. This can be accomplished with a simple multivibrator supplied with power from a d.c. regulated power supply. The output of this multivibrator is then fed into an attenuator and calibrated potentiometer to provide a.c. outputs in steps for ease in measuring waves of different amplitudes.

In the unit constructed and shown in the accompanying photographs, this is accomplished simply by using an a.c.-d.c. type of power supply using a 65 ma. selenium rectifier and an 0B2 voltage regulator tube. This then makes the multivibrator output independent of line voltage changes. A word of caution for those living in very low voltage areas might be advisable here. The 0B2 voltage regulator tube requires a minimum d.c. anode supply of 133 volts to insure starting throughout the tube life. Thus if your line voltage drops below 96 volts, there is the possibility that the 0B2 will not fire or may be erratic in operation. In such a case the principles discussed here still apply, however a standard type of transformer supply will have to be substituted. This would, of course, necessitate a change in the voltage regulator dropping resistor, the exact size depending upon the power supply voltage used.

This regulated d.c. is then used for the plate supply of a simple multivibrator using a 12AU7. The actual frequency that is produced by the multivibrator is relatively unimportant, the important considerations being its constancy of amplitude with varying line voltages and with time. However, for the values shown, the multivibrator is free running at approximately 500 cycles.

By taking the output from the multivibrator from plate-to-plate of the 12AU7, an almost perfect square wave is obtained. This output is fed into a calibrating potentiometer, R_1; then to an attenuator consisting of resistors R_5, R_6, and R_7; then into a calibrated potentiometer, R_8. This latter pot is the one which is mounted on the front panel of the calibrator.

The actual peak-to-peak voltage appearing from plate-to-plate on the 12AU7 is approximately 90 volts—not quite 100. Therefore, to provide a convenient voltage scale for the potentiometer R_8, it was decided to make the output read 0 to 5 and in multiples of 10, *i.e.*, X1, X10, X.1.

To obtain the greatest accuracy, the attenuator should have the values shown on the parts list as R_5, R_6, and R_7. In the actual unit constructed, these were selected from standard values of 100,000, 10,000, and 1000 ohms respectively. However, if it is intended to purchase these parts (where selection of resistor values isn't too practical) sufficient accuracy can be obtained by using standard 5% resistors of the values 91,000, 9100, and 1000 ohms respectively for R_5, R_6, and R_7. The calibrated potentiometer which is placed in parallel with these resistors has enough greater resistance

value so as to have a negligible effect on the accuracy.

For the operator's convenience, the switch S_1 is included. It is a three-position, four-pole switch that does a little more than just turn the calibrator on and off. In the "Off" position, S_1 disconnects the a.c. line from the unit and also provides a continuous circuit from the terminals on the left (the input terminals) to the terminals on the right (the output terminals). In use the calibrator output terminals are wired permanently to the vertical input terminals on the scope. Thus, in effect, the input terminals of the calibrator now become the input terminals of the scope.

When switch S_1 is in the position marked "Scope," the input and output terminals are still tied together, except that the a.c. is turned on and the "B +" is turned off. It was found necessary to remove the "B +" in this position to keep from feeding any of the calibrator output into the scope through the wiring and switch capacities.

The calibrate position of switch S_1 opens up the input terminals of the calibrator and feeds the multivibrator output into the output terminals for calibrating purposes.

The initial calibration performed after the unit is completed is simple and involves merely setting the calibrating pot R_4. This potentiometer sets up the standard voltage fed into the attenuator, which in this case is 50 volts peak-to-peak. Other methods of calibrating may suggest themselves to the builder, but the method to be described is easy, accurate, and involves only the use of an a.c. meter in addition to the calibrator and scope. This procedure is as follows. The line voltage is measured as accurately as possible with the a.c. meter. This value is then multiplied by 2.83. This gives the peak-to-peak value of the line voltage. The line voltage is then applied to the input terminals of the calibrator, the output terminals being connected to the input of the scope. Switch S_1 on the calibrator is set to the "Scope" position. The vertical gain control on the scope is then adjusted for any convenient height on the scope screen. Now by proportion:

$$\frac{E_1}{H_1} = \frac{50}{H_2}$$

where E_1 is the peak-to-peak line voltage, H_1 the height of scope trace with E_1 applied, and H_2 is the height of calibrator output on the scope.

Since we are interested in finding what should be the height of the calibrator output, we can restate the above and say:

$$H_2 = \frac{50H_1}{E_1}$$

Now with the calibrator dials set at X10, the potentiometer on the panel (R_5) set fully clockwise, and switch S_1 on "Cal," the calibrating pot located on the chassis (R_4) is turned to produce the height found by the equation. The calibrator is now putting out a standard 50 volt peak-to-peak signal.

The next step is to calibrate potentiometer R_5. With the switches set in the same positions as before, adjust the scope vertical gain to produce any height or number of squares conveniently divisible by 5 or 10. This height represents 50 volts. Adjusting potentiometer R_5 to 4/5, then 3/5, then 2/5, etc. of the 50-volt height would give calibration points at 40, 30, and 20, etc. volts respectively. As potentiometer R_5 is set at these points, calibrating marks are made in pencil on a paper scale. When the calibration is complete, the dial can be inked in. To give the paper scale a more durable surface, a coating of colorless nail polish can be applied.

Now the calibrator is all set for use. There are two common methods of using a device such as this. The first method is simply to calibrate the screen of the scope for a certain number of volts-per-square, or volts-per-

(*Continued on page* 106)

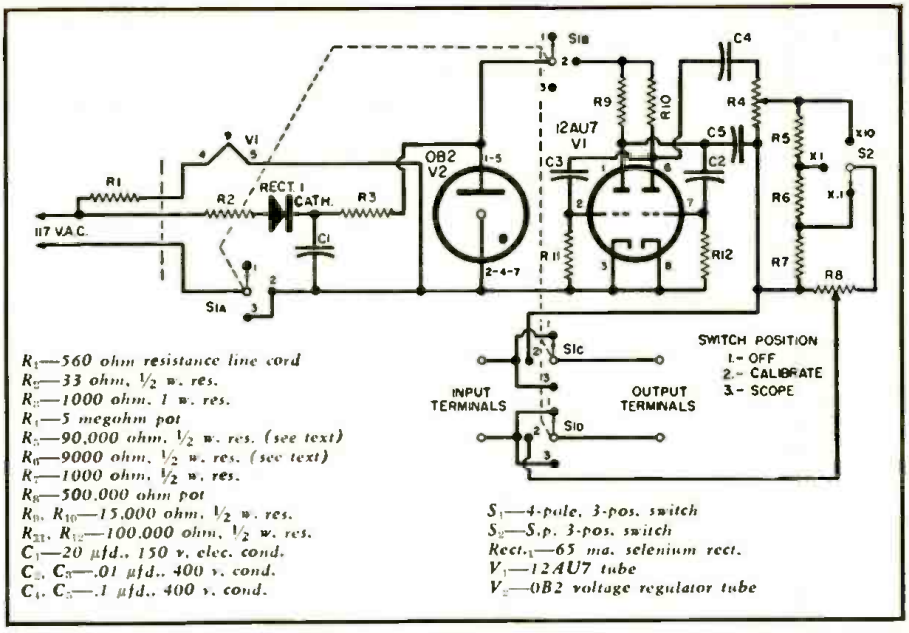
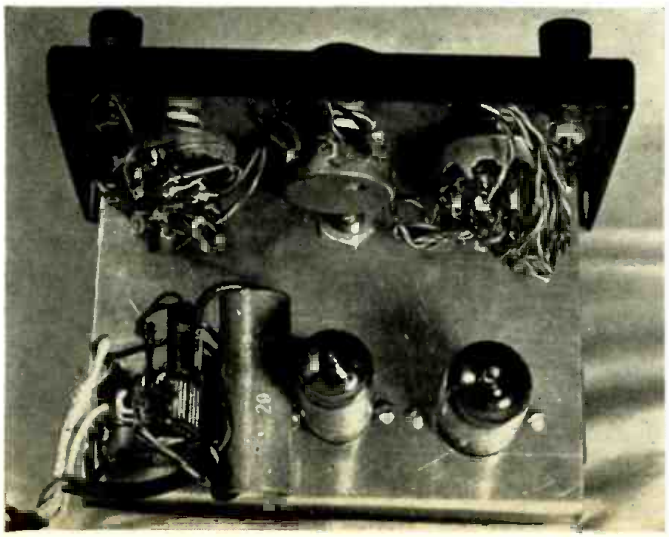
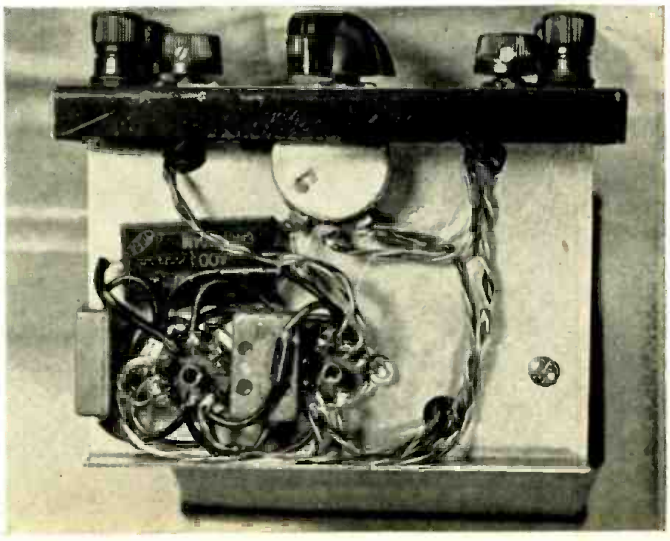


Fig. 3. Complete schematic diagram of the oscilloscope calibration accessory.

Top chassis view of the home-built oscilloscope calibrator.



Under chassis view showing uncluttered layout of components.



A NOVEL PROBE SWITCH

By

MILTON WHITE

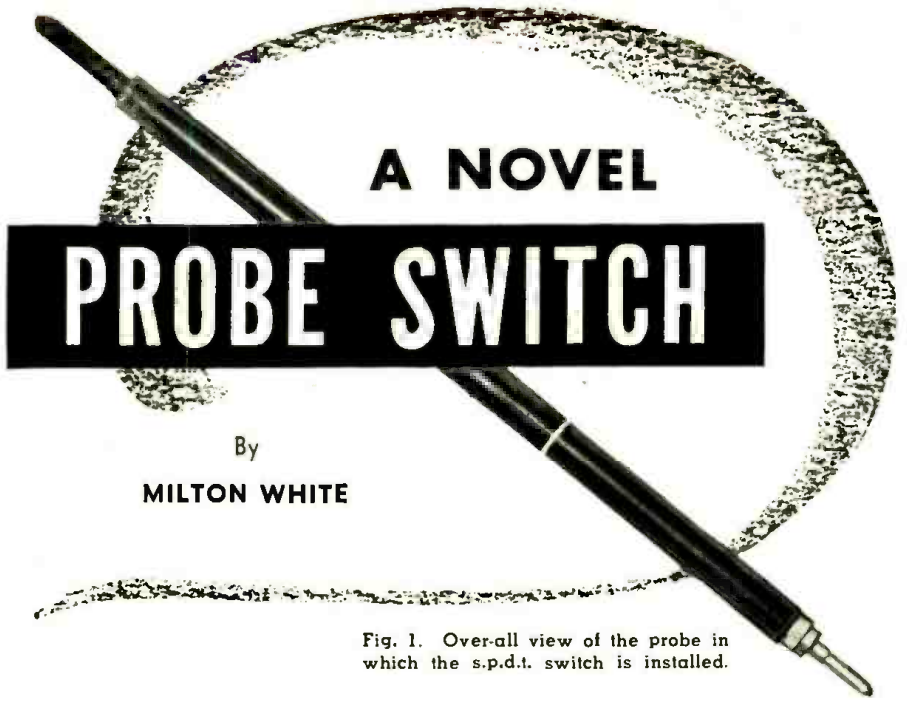


Fig. 1. Over-all view of the probe in which the s.p.d.t. switch is installed.

Mechanical details for assembling a rotary switch within a probe. Converts the d.c. probe to a.c.-d.c. operation.

SINCE their inception as general service instruments, vacuum-tube volt-ohmmeters have required the use of separate probes for d.c. voltage, resistance, and a.c. voltage measurements. This is a disadvantage, made necessary by the capacity isolation resistor required at the probe tip when measuring d.c. volts.

Attempts have been made in some commercial instruments to overcome this disadvantage by the use of a separate resistor, mounted so that it may be attached to the probe tip, or by the installation of a switch within the probe handle.

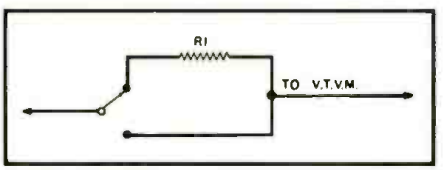


Fig. 3. Wiring diagram of probe switch.

The operating convenience that results from these measures is not as great as it should be. There is little difference between continually attaching or removing the resistor, or using another probe. When a switch is employed, the size of the probe necessary for its installation makes this part too large for practical use in close quarters.

The probe switch to be described is the answer to this problem, when it is used with instruments that have the same type of panel connectors for the attachment of their probes. For example, the *Simpson* Model 303 is an instrument of this type. The *RCA* Model WV-77A is especially well suited to this probe, because it has only one attachment point for all functions.

The switch is simple, rugged, and so small that it may be encased within a pencil-type probe only ⅜ in. o.d. Operated by a simple twist of the probe tip, without reference to any indicating mark, its use quickly becomes practically automatic to the user.

The unique construction of the switch may require some explanation, so let's examine Figs. 2A through 2E, and see the major points of its assembly and operation.

First, select a one-half watt carbon resistor of the same value as the one used in the d.c. voltage probe of your instrument. This may be done by using the instrument probe as a resistance standard. It should be matched to ± 1%, or adjustment of the d.c. volts calibrating resistors within the v.t.v.m. may be necessary. This resistor is R_1 in Fig. 2B.

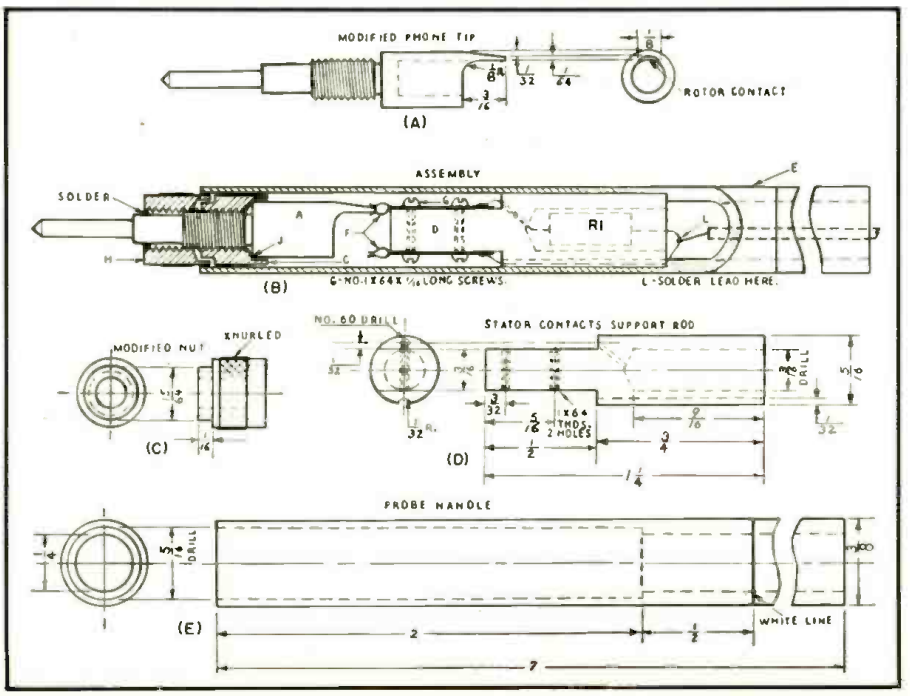
Next, note the stator contacts *F*, Fig. 2B. Then, look in your junk box for an old rotary selector switch from which two such contacts may be taken. They, together with resistor R_1, and 5 feet of microphone cable, not shown, are attached to the stator support bar, Fig. 2D, to complete the sub-assembly. This unit is secured within the handle, Fig. 2E, by a little shellac. Three to four drops allowed to run down the inner wall of the tube, after the sub-assembly has been slipped into place, will be drawn by capillary attraction into the crevice between the assembly and the handle, where it belongs. When the shellac hardens, it will firmly bind these parts together.

The heart of this switch is the rotary contact, made from a solderless phone tip, filed as shown in Fig. 2A. A shoulder is formed on the phone tip nut, as indicated in Fig. 2C, and it is then run all the way on the phone tip. Next, an additional phone tip nut, not modified, (*H*, Fig. 2B) is screwed on tightly against the first one, then backed off exactly one-half turn and soldered to the phone tip in this position.

Spread a film of "Miricale Adhesive" (*Miricale Adhesive Co.*, Newark, N. J.) around the knurled section only of the shoulder nut, Fig. 2C, and around the inside of the wall of the

(*Continued on page* 92)

Fig. 2. Mechanical details for installing switch in test probe. See text for details.



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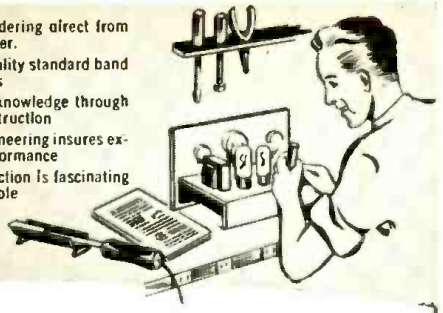

$43.50 Shipping Wt. 26 lbs.

Heathkit MODEL O-8 OSCILLOSCOPE KIT

The outstanding new 1953 model O-8 Heathkit Oscilloscope features the finest performance ever offered in this extremely popular kit instrument. Primarily intended as a general purpose oscilloscope for the faithful reproduction of actual wave forms and other electrical phenomena, it's vastly improved band width, good 100 KC square wave reproduction, three step vertical input attentuator, .025 volts per inch vertical sensitivity, etc., admirably qualify this instrument for TV and radio servicing, laboratory use, ham application and all general electronic development work. Improved vertical band width is obtained through the use of shunt peaking chokes with proper cathode compensation in the push-pull output stage. For additional flexibility of operation, provisions have been made for direct connections to the deflection plates, a Z axis input and a spot shape control for really fine focusing.

This beautiful kit is complete with all 10 tubes, including a 5" cathode ray tube, calibrated graph screen and flexible test leads. All necessary construction components, such as hardware, chassis, transformer, etc., and a detailed step by step construction manual, greatly simplify the assembly of this instrument.

Heathkit VOLTAGE CALIBRATOR KIT

The use of a Voltage Calibrator will greatly increase oscilloscope usefulness. Provides a convenient method of making peak to peak voltage measurements by establishing a relationship between the unknown wave shape and the Voltage Calibrator. Voltage ranges .01–100 volts peak to peak. The Voltage Calibrator features direct reading scales and a regulated power supply system.

MODEL VC-2
$11.50
Shipping Wt. 4 lbs.

Heathkit ELECTRONIC SWITCH KIT

The Heathkit Electronic Switch Kit will further extend scope usefulness by permitting simultaneous observation of two individually controlled traces. Continuously variable switching rates 10 cps to 2,000 cps in three ranges. Will also serve as a square wave generator over the range of switching frequencies.

MODEL S-2
$19.50
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Heathkit VACUUM TUBE VOLTMETER KIT

The beautiful new 1953 Heathkit Model V-6 VTVM, the world's most popular kit instrument, now offers many outstanding new features in addition to retaining all of the refinements developed and proven through the production of over 70,000 VTVM kits. The Heathkit VTVM now features extended voltage ranges with 50% greater coverage on the DC range. New 1½ volt low scale provides well over 2⅓ inches of scale length per volt permitting faster measurements with greater accuracy. AC and DC ranges are 0–1.5–5–15–50–150–500–1500 volts (1,000 volts maximum on AC). Ohmmeter ranges are X1, X10, X100, X1,000, X10K, X100K X1 meg. Measures .1 ohm to 1,000 megohms. Other features are db scale, center scale zero adjust and polarity reversal switch. High 11 megohm input resistance virtually eliminates circuit loading.

The low anti-inflation price of this tremendously popular kit includes all tubes, necessary constructional material, test leads and the construction manual.

MODEL V-6
$24.50
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Heathkit AC VACUUM TUBE VOLTMETER KIT

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A new amplifier type AC VTVM that makes possible those sentitive measurements so essential in laboratory or audio work. Ten voltage ranges covering from .01 RMS full scale to 300 volts RMS full scale. Input impedance 1 megohm with frequency response 20–50,000 cycles. Ten DB ranges from —52 to +52 DB. Four diodes in meter bridge circuit for maximum linearity.

Heathkit HANDITESTER KIT

MODEL M-1
$13.50
Shipping Wt. 3 lbs.

The ever popular Handitester is now supplied with a Simpson 400 microampere meter movement. Provides AC and DC voltage ranges 0–10–30–300–1,000–5,000 volts. Ohmmeter ranges 0–3,000 and 0–300,000 ohms. DC current measurements 0–10 and 0–100 milliamperes. A completely self contained portable instrument.

HEATH COMPANY • Benton Harbor 15, Mich.

HEATHKITS for the ENGINEER

Heathkit VISUAL AURAL SIGNAL TRACER KIT

MODEL T-3

$22.50*

Shipping Wt. 10 lbs.

Designed especially for service applications in AM-SW-FM-TV repair work. RF and audio two channel input. More than adequate sensitivity—new noise locator circuit—calibrated wattmeter—substitution speaker—visual signal indication. Can be used with scope and VTVM, checks phono cartridges, phono mechanisms, microphones, tuners, etc. Let the Heathkit Visual Aural Signal Tracer help you.

Heathkit RESISTANCE SUBSTITUTION BOX KIT

MODEL RS-1

Ship. Wt. 2 lbs. **$5.50**

Choice of 36 switch selected resistance values 15 ohms to 10 megohms. All standard RTMA 1 watt 10% resistors. Buy several for those lab and service applications.

Heathkit AMATEUR TRANSMITTER KIT

MODEL AT-1

$29.50*

Shipping Wt. 15 lbs.

Here is the long awaited Heathkit entry into the amateur radio field. The Heathkit AT-1 Transmitter kit is a well designed basic transmitter incorporating many desirable features and providing maximum overall performance.

Convenient band switching eliminates the bother and annoyance of plug in coils. It is merely necessary to switch to the desired frequency and plug in your favorite crystal or VFO. This transmitter features a self-contained power supply mounted on the same chassis and cabinet enclosed to minimize TVI. AC line by-passed to reduce radiation.

The coils supplied with the Heathkit AT-1 are pre-wound and adjusted for the necessary frequency coverage of 80-40-20-10 meters. The entire kit is supplied complete with all tubes, coils, punched and formed chassis and cabinet, as well as all constructional material required. A detailed assembly and operation manual is also furnished.

Heathkit CONDENSER CHECKER KIT

An instrument designed solely for its particular job. Not a "sideline" of a multiple function instrument. Measures value and quality of unknown condensers and resistors. Capacity range .00001 mfd to 1,000 mfd. Resistance range 100 ohms to 5 megohms. Sensitive electron beam indicator—five polarizing test voltages—safety spring return leakage test switch. An amazingly accurate instrument at this low price.

MODEL C-3

$19.50* *Shipping Wt. 8 lbs.*

Heathkit SIGNAL GENERATOR KIT

MODEL SG-7

$19.50*

Ship. Wt. 8 Lbs.

A service "must" is a reliable source of modulated (400 cycles) or unmodulated RF output. Frequency range 150 KC to 150 MC. Step attenuated and variable output—internal or external modulation. High output level and performance with low cost.

Heathkit GRID DIP METER KIT

World's largest selling Grid Dip Meter. Five pre-wound coils—frequency coverage 2-250 mc. Simplified construction and operation

MODEL GD-1A

$19.50*

Ship. Wt. 4 Lbs.

Heathkit TUBE CHECKER KIT

Make those all important tube tests quickly and accurately. Checks all tube types encountered in radio and TV work. Simplified setup and switching system provides fast checks for shorts, opens, individual elements and over-all quality. Portable cabinet available at slight additional cost. TV picture tube adapter also available. See order blank.

MODEL TC-1

$29.50*

Shipping Wt. 12 lbs.

Revised Roll Chart .50

Heathkit SQUARE WAVE GENERATOR KIT

MODEL SQ-1

$29.50* *Ship. Wt. 12 lbs.*

True square wave output with frequency range 10 cycles to 100 KC. High variable output voltage level 0-20 volts at 600 ohms output impedance. Provisions for external synchronization. The ideal instrument for TV service work and wide band amplifier circuit development.

Heathkit LABORATORY REGULATED POWER SUPPLY KIT

MODEL PS-2

$29.50*

Ship. Wt. 17 Lbs.

A regulated variable 160-450 volt DC output power supply for the lab or service shop. Accurate voltage and current measurements with large Simpson meter. AC supply 6.3 volts at 4 amperes—standby switch eliminates warmup time. Low hum content—5 tube circuit. AC and DC output voltages isolated from panel for maximum operational flexibility.

Heathkit VIBRATOR TESTER KIT

MODEL VT-1

$14.50*

Shipping Wt. 6 lbs.

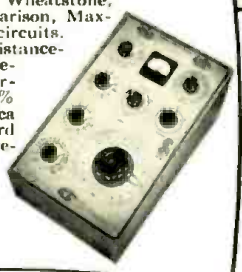
Checks for starting and quality of interrupter and self rectifier type vibrators. Five sockets—checks hundreds of types. Operates from continuously variable type battery eliminator.

HEATH COMPANY • Benton Harbor 15, Mich.

SERVICEMAN · AMATEUR · STUDENT

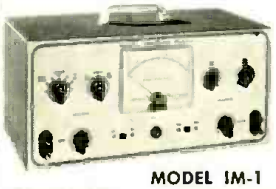
Heathkit
IMPEDANCE BRIDGE KIT

Provides choice of Wheatstone, Capacitance Comparison, Maxwell or Hay bridge circuits. Measurement of resistance-capacity-inductance-dissipation factor-storage factor. 1% precision silver mica capacitance standard. ½% precision resistors.



MODEL IB-1B
$69.50
Shipping Wt. 15 lbs.

Heathkit
INTERMODULATION ANALYZER KIT



Intermodulation distortion analysis is one of the most satisfactory methods of checking audio equipment. The IM-1 features two self contained high frequency generators (3,000 and 7,000 cycles) a 60 cycle low frequency source, intermodulation section, AC VTVM, and power supply all in one complete unit. Direct reading IM percentages on 3 calibrated scales 30%—10%—3%.

Shipping Wt. 17 lbs.
MODEL IM-1
$39.50

Heathkit
AUDIO OSCILLATOR KIT

MODEL AO-1
$24.50
Ship. Wt. 11 lbs.

Features sine or square wave coverage from 20–20,000 cycles in 3 ranges. Variable 10 volt output level at 600 ohms impedance. Thermistor controlled linearity—precision multiplier resistors—distortion less than .6%. An outstanding instrument value at this amazing low price.

Heathkit
DECADE RESISTANCE KIT

MODEL DR-1
$19.50
Ship. Wt. 4 lbs.

Individual switch selection of twenty 1% precision resistors in 1 ohm steps from 1 to 99,999 ohms. Sturdy ceramic wafer switches featuring silver plated contacts and smooth positive detent action.

Heathkit
Q METER KIT

A typical Heathkit invasion of the laboratory instrument field. Here is the first successful low priced Q meter ever offered in kit form. Oscillator supplies RF in the range of 150 KC to 18 mc. Reads Q directly on calibrated meter scales. Measures Q of condensers, RF resistance and distributed capacity of coils. Calibrate capacitor with range of 40 mmf to 450 mmf with vernier ±3 mmf. All measurements made at the operating frequency.

MODEL QM-1
$39.50 *Ship. Wt. 14 lbs.*

Heathkit
AUDIO FREQUENCY METER KIT

Indicates audio frequency on large 4½" Simpson meter. Ranges 10 cycles to 100 kc at input voltage level of 3–300 volts RMS. The input wave shape is not at all critical. Useful in production line testing—indicating square wave frequency—determining generator output. Operation entirely electronic, no vibrating reeds.

MODEL AF-1
$34.50
Ship. Wt. 12 lbs.

Heathkit
DECADE CONDENSER KIT

Switch selected 1% silver mica precision condensers providing capacity range of 100 mmf. to 0.111 mfd. in steps of 100 mmf.

MODEL DC-1
$16.50
Shipping Wt. 4 lbs.

Heathkit
AUDIO GENERATOR KIT

A new extended range 18 cycles—1 megacycle audio instrument at a remarkably low price. Five continuously variable output ranges—600 ohm output impedance—low distortion figure, less than .4% from 100 cps through audible range.

MODEL AG-8
$29.50
Ship. Wt. 11 lbs.

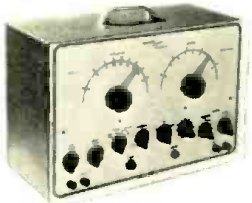
Heathkit
BAR GENERATOR KIT

MODEL BG-1
$14.50
Ship. Wt. 6 lbs.

The Heathkit BG-1 Bar Generator represents another welcome addition to the fast growing line of popular Heathkits. The station transmitted test pattern is rapidly disappearing and the Bar Generator is the logical answer to the TV serviceman's problem in obtaining quick accurate adjustment information.

The Bar Generator produces a series of horizontal or vertical bars on the TV screen. These bars are equally spaced and will quickly indicate picture linearity of the receiver under test. Since picture linearity is independent of transmitting frequency, it is unnecessary to provide coverage throughout the VHF range, thereby holding down instrument cost.

The Heathkit Bar generator is simple to use and is extremely portable, providing a quick means of checking the television receiver either in your workshop or in the customer's home.



Heathkit
TELEVISION SWEEP GENERATOR KIT

Frequency coverage 10–90 mc and 150–230 mc. Variable sweep width 0–12 mc. built in absorption type marker, step and continuously variable output and blanking circuit.

MODEL TS-2
Ship. Wt. 20 lbs.
$39.50

Heathkit
BATTERY ELIMINATOR KIT

A variable 0–8 volt DC supply source rated at 10 amperes continuously and up to 15 amperes intermittently. Voltmeter, ammeter, automatic overload relay, fuse protection—heavy duty Mallory 17 disc rectifier.

MODEL BE-3
Ship. Wt. 17 lbs.
$24.50

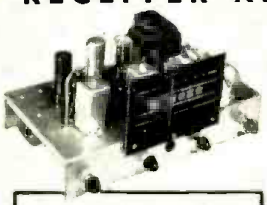
WRITE FOR *Free*
CATALOG

New 32 page 1953 Catalog lists all kits, specifications, schematics and latest price information.

HEATH COMPANY · Benton Harbor 15, Mich.

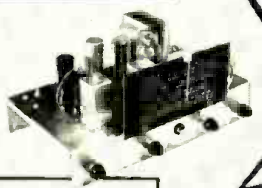
Heathkit

SUPERHETERODYNE RECEIVER KITS



Broadcast Model BR-1 5 Tube-Broadcast Band 550 to 1600 KC coverage. Shipping Weight 11 lbs.

$19.50

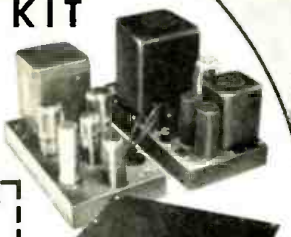


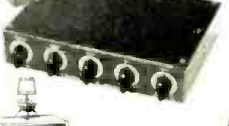
Three Band Model AR-1 6 Tube all wave circuit 3 Ranges, continuous coverage 550 KC to over 20 MC. Shipping Weight 11 lbs.

$23.50

NEW HEATHKIT WILLIAMSON TYPE AMPLIFIER KIT

The ideal amplifier for custom high fidelity audio installations. Tops in performance, value, and flexibility of operation. Either Altec Lansing Peerless or Acrosound output transformers available. First Williamson type amplifier supplied with a matching preamplifier.





PRICES OF VARIOUS COMBINATIONS

W-2 Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 37 lbs. Shipped express only	$69.50
W-2M Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only	$49.75
W-3 Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer, Power supply and WA-P1 Preamplifier Kit) Shipping Weight 37 lbs. Shipped express only	$69.50
W-3M Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only	$49.75
WA-P1 Preamplifier Kit only. Shipping Weight 6 lbs. Shipped express or parcel post	$19.75

Heathkit

ECONOMY 6 WATT AMPLIFIER KIT

MODEL A-7

$14.50

Dual inputs—separate bass and treble tone controls—output impedances 4-8-15 ohms.

Ship. Wt. 10 LBS.

A-7A Amplifier with pre-amplifier stage for low level inputs. . . $16.50

Heathkit

HIGH FIDELITY 20 WATT AMPLIFIER KIT

MODEL A-8

$33.50

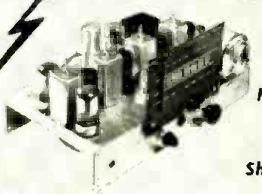
Shipping Wt. 16 lbs.

A high fidelity full 20 watt general purpose amplifier. Dual inputs and separate tone controls for maximum flexibility. Peerless output transformer 4, 8 and 16 ohms.

A-8A with additional preamplifier stage for low level cartridge, microphone, etc. $35.50

Heathkit FM

TUNER KIT



MODEL FM-2

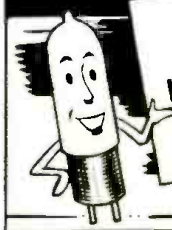
$22.50

Shipping Wt. 9 lbs.

Sensitive transformer operated 8 tube circuit. Frequency coverage 88-108 mc. Pre-assembled and tuned "front end." Vernier tuning with slide rule type dial.

HEATH COMPANY • Benton Harbor 15, Mich.

ORDER BLANK



MAIL YOUR ORDER TODAY TO THE HEATH COMPANY BENTON HARBOR 15, MICHIGAN

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QUANTITY	ITEM	PRICE		QUANTITY	ITEM	PRICE	
	Heathkit Oscilloscope Kit—Model O-8 (26 lbs.)	$43.50			Heathkit Square Wave Generator—Model SQ-1 (12 lbs.)	29.50	
	Heathkit Amateur Transmitter Kit—Model AT-1 (15 lbs.)	29.50			Heathkit AC VTVM Kit-Model AV-2 (5 lbs.)	29.50	
	Heathkit Bar Generator Kit—Model BG-1 (6 lbs.)	14.50			Heathkit Intermodulation Analyzer Kit—Model IM-1 (17 lbs.)	39.50	
	Heathkit Voltage Calibrator Kit Model VC-2 (4 lbs.)	11.50			Heathkit Regulated Power Supply Kit—Model PS-2 (17 lbs.)	29.50	
	Heathkit Electronic Switch Kit—Model S-2 (11 lbs.)	19.50			Heathkit Handitester Kit—Model M-1 (3 lbs.)	13.50	
	Heathkit TV Alignment Generator Kit—Model TS-2 (20 lbs.)	39.50			Heathkit Decade Resistance Kit—Model DR-1 (4 lbs.)	19.50	
	Heathkit Q Meter Kit—Model QM-1 (14 lbs.)	39.50			Heathkit Decade Condenser Kit—Model DC-1 (4 lbs.)	16.50	
	Heathkit Grid Dip Meter Kit—Model GD-1A (4 lbs.)	19.50			Heathkit Impedance Bridge Kit—Model IB-1B (15 lbs.)	69.50	
	Heathkit VTVM Kit—Model V-6 (6 lbs.)	24.50			Heathkit Resistance Substitution Box Kit—Model RS-1 (2 lbs.)	5.50	
	Heathkit Visual-Aural Signal Tracer Kit—Model T-3 (10 lbs.)	22.50			Heathkit F.M. Tuner Kit—Model FM-2 (9 lbs.)	22.50	
	Heathkit Condenser Checker Kit—Model C-3 (8 lbs.)	19.50			Heathkit Broadcast Receiver Kit—Model BR-1 (11 lbs.)	19.50	
	Heathkit RF Signal Generator Kit—Model SG-7 (8 lbs.)	19.50			Heathkit Three Band Receiver Kit—Model AR-1 (11 lbs.)	23.50	
	Heathkit Tube Checker Kit—Model TC-1 (12 lbs.)	29.50			Heathkit Amplifier Kit—Model A-7 (10 lbs.)	14.50	
	Heathkit Portable Tube Checker Kit—Model TC-1P (15 lbs.)	34.50			Heathkit Amplifier Kit—Model A-7A (10 lbs.)	16.50	
	Heathkit Portable Tube Checker Cab. only No. 365 (8 lbs.)	7.50			Heathkit Amplifier Kit—Model A-8 (16 lbs.)	33.50	
	Heathkit TV Tube Adapter No. 355 (1 lb.)	4.50			Heathkit Amplifier Kit—Model A-8A (16 lbs.)	35.50	
	Heathkit Battery Eliminator Kit—Model BE-3 (17 lbs.)	24.50			Williamson Type Amplifier Kit (Type:) Shipped express only		
	Heathkit Vibrator Tester Kit—Model VT-1 (6 lbs.)	14.50			WA-P1 Preamplifier Kit (6 lbs.) (Shipped exp. or p.p.)		
	Heathkit Audio Generator Kit—Model AG-8 (11 lbs.)	29.50					
	Heathkit Audio Oscillator Kit—Model AO-1 (11 lbs.)	24.50					
	Heathkit Audio Frequency Meter Kit—Model AF-1 (12 lbs.)	34.50					

Enclosed find ( ) check ( ) money order for
Please ship C.O.D. ( ) postage enclosed for pounds.

On Express orders do not include transportation charges—they will be collected by the express agency at time of delivery.

ON PARCEL POST ORDERS include postage for weight shown..... ORDERS FROM CANADA must include full remittance for merchandise.

WHAT'S New in Radio

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page and the issue number, delay will be avoided.

AM-FM TUNER

The Sargent-Rayment Co., 1401 Middle Harbor Road, Oakland, California is offering a new "building block" series of high-fidelity components, one of which is the SR68 AM-FM tuner.

The tuner has two AM positions permitting sharp or broad tuning. In the "broad" tuning position response is flat from 15 cycles to 9 kc. ± 1 db with a 10 kc. filter in the circuit

(measured at 1000 kc.). In the "sharp" tuning position response is limited to 5 kc. to permit reception of rural or hard-to-receive stations. The unit also features two-position FM, with or without a.f.c. Better than 5 μv. sensitivity is achieved on both AM and FM with at least 30 db of quieting on FM.

Since all of the company's equipment is designed to be used in any combination the user desires, the physical dimensions and housing of the AM-FM tuner follow the style of the other units.

A booklet covering all of the equipment in the "building block" series is available on request.

INSULATED TEST CLIPS

A new model of the company's nylon-insulated test clips is currently being offered by *Industrial Devices, Inc.* of Edgewater, New Jersey.

The Model #1410B (1)-(2) provides positive clip connection to all standard phone-tip test prods. The new units incorporate a phosphor bronze spring collar which accepts the standard prod with an electrically and mechanically positive grip. The clip is fully nylon insulated to allow shock-proof, short-circuit proof operation in excess of 600 volts.

The clips are available in either red or black. The black is designated by the (1) while the red models are marked (2).

G-E TRANSISTORS

General Electric Company, Syracuse, New York has introduced a new hermetically-sealed junction transistor which is said to eliminate temperature and humidity restrictions which have prevented wide use of transistors in commercial and military electronic equipment.

The new transistor operates efficiently in temperatures as high as 212 degrees F and under the most adverse humidity conditions, according to the company.

Small quantities of the new transistor will be made available to development laboratories and engineering groups in the near future. The product will be mass produced at the company's germanium products plant at Clyde, N. Y. beginning this fall.

TRANSISTOR TRANSFORMERS

Standard Transformer Corporation, 3580 Elston Avenue, Chicago 18, Ill. is in production on a line of transistor transformers which weigh less than 1/10 ounce.

Although designed primarily for transistor audio applications, they can be used wherever low power is involved.

At the present five models are available: UM-110 interstage; UM-111 output or matching; UM-112 high impedance mike input; UM-113 interstage; and UM-114 output or matching.

A data sheet giving specifications on all these units is available from the company on request.

NEW BENDIX PACKSET

A new portable FM radio receiver-transmitter which weighs less than

10 pounds and provides increased power output per pound, is now in production at the Baltimore, Maryland plant of the *Bendix Radio Communications Division*.

Designed to operate in the 152-174 mc. band, the unit provides one watt of r.f. output and can be supplied for communication on either one or two channels.

An important feature of the new MRT-9 is the adjacent channel selec-

tivity characteristic which eliminates interference from transmissions on adjacent channels. The packset also employs a "power on" warning device which sets off a tone signal should the operator forget to turn off the power when the set is not in operation.

Complete specifications and performance data are available from the company.

PHILCO TEST EQUIPMENT

The Accessory Division of *Philco Corporation,* Philadelphia 34, Pa. is currently introducing three new instruments in its line of test equipment for the service technician.

Now available are the Model 7052 mutual conductance dynamic tube checker, the Model 7053 cathode-ray tube checker, and the Model 7020 3-inch oscilloscope.

The Model 7052 tests and measures mutual conductance of tubes including miniature, subminiature, and low-power transmitting tubes; provides a means of forecasting remaining tube life; checks shorts and leakages between elements; and determines noise characteristics.

The Model 7053 for cathode-ray tubes checks the action of the electron gun using a neon lamp to indicate shorts and open elements in the electrodes of the gun.

The scope, Model 7020, is adaptable to either bench or field use. The vertical deflection amplifier is a wide-band, d.c.-coupled, highly-sensitive amplifier. The sweep oscillator has, in addition to its variable sweep ranges, four preset sweep frequencies for black and white and frame sequential color television servicing.

COMMUNICATIONS RECEIVER

Hammarlund Manufacturing Company, Inc., 460 W. 34th Street, New York 1, N. Y. has introduced a new, general-purpose superheterodyne com-

munications receiver, the "HQ-140-X", for use by commercial and amateur radio operators and short-wave listeners.

The receiver is a table-top model with continuously tunable frequency coverage from 540 kc. to 31 mc. in six bands and includes a self-contained power supply.

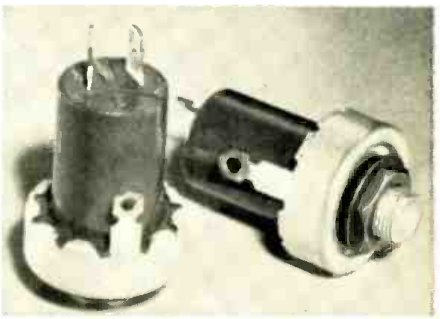
Bandspread tuning is available on the four higher frequency ranges with direct calibration for the 80, 40, 20, 15, and 10 meter amateur bands.

WATERSEALED JACKS

P. R. Mallory & Co., Inc., 3029 E. Washington Street, Indianapolis 6, Ind. has announced the development of two new watersealed jacks, the types WS-1A and WS-A2B.

The new units can be used in many types of communications systems where rapid electrical connections must be made by the use of phone plugs and which are subjected to high humidity conditions.

The Type WS-1A is a phono jack with terminals for one circuit and



ground. The WS-A2B is a microphone jack with terminals for two circuits and ground. Dielectric strength of the new jacks is 500 volts r.m.s. with contact resistance of .02 ohm maximum. Insertion force is approximately 6 pounds.

CROSSOVER NETWORK

British Industries Corporation, 164 Duane Street, New York 13, N. Y. is currently marketing a new three-way crossover network, Model HS/CR/3,

(*Continued on page* 98)

JETENNA • JET 283 and now . . .

JFD introduces the revolutionary

JeTie Coupler, Q283

for VHF and UHF antennas

first of its kind!

- *joins one UHF and one VHF antenna*
- *joins two VHF antennas*
- *joins two VHF antennas and one UHF antenna*

. . . all with only ONE down-lead!

JFD

JFD gives you a direct line to profits with the amazing new JeTie coupler. Here's "single transmission line" reception on such disparate channels as 4 and 61—a miracle of engineering know-how that will pay off for you in countless sales. Made with a new silver printed circuit for ideal conductivity, the JeTie is hermetically sealed in a transparent moisture-resistant, dust-proof Butyrate case—the only one of its kind. Light weight, easy-to-attach, the JeTie coupler is the easy-to-sell answer to the new UHF and VHF stations in your territory.

LIST PRICE $5.30

For more information on the JFD JeTie, write to JFD Manufacturing Company, Inc.

Brooklyn 4, New York
Bensonhurst 6-9200
World's largest manufacturer of TV antennas and accessories

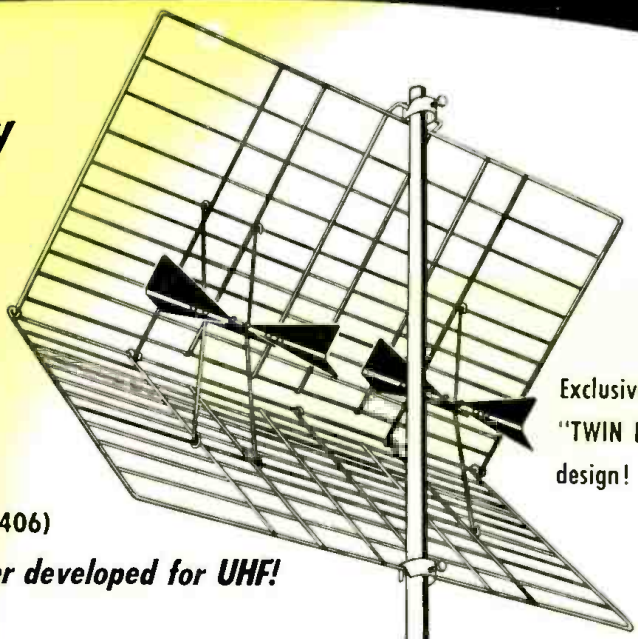
Burton browne advertising

Two heads are better than one!

And that's exactly why CHANNEL MASTER'S amazing new

Twin Corner Reflector (Model No. 406)

is the most sensitive fringe-area antenna ever developed for UHF!



Exclusive "TWIN DIPOLE" design!

TWO DIPOLES—HIGHER GAIN

The two dipoles of the Twin Corner Reflector provide TWICE as much gain as standard-type Corner Reflectors!

This two-dipole construction is an original Channel Master idea which successfully combines two separate Corner Reflectors into *ONE ANTENNA STRUCTURE* — requiring ONE simple installation.

This 2-in-1 combination gives you:

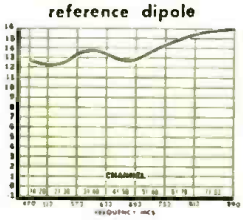
. . . the economy of one antenna.
. . . the convenience of one antenna.
. . . BUT the combined performance of TWO separate high gain antennas.

Model No. 406 furnishes far better picture quality — at far greater distances — on every UHF channel.

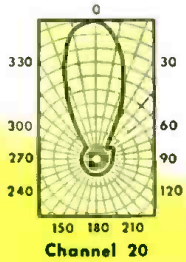
Eliminates UHF's "Twin Terrors." 100% vibration-proof construction prevents picture flicker. "Free space" terminals prevent dirt and rain water from shorting out the picture.

up to 16 DB gain

gain above tuned reference dipole



horizontal polar pattern (relative voltage)



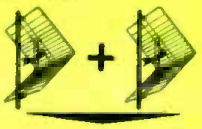
Channel 20

Extremely narrow "Yagi-type" forward lobe; no side lobes; very high front-to-back ratio.

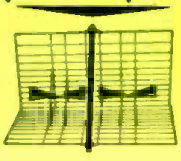
2 antennas in 1

The Twin Corner Reflector furnishes the performance of 2 antennas because it really is 2 separate antennas . . .

stacked side by side . . .



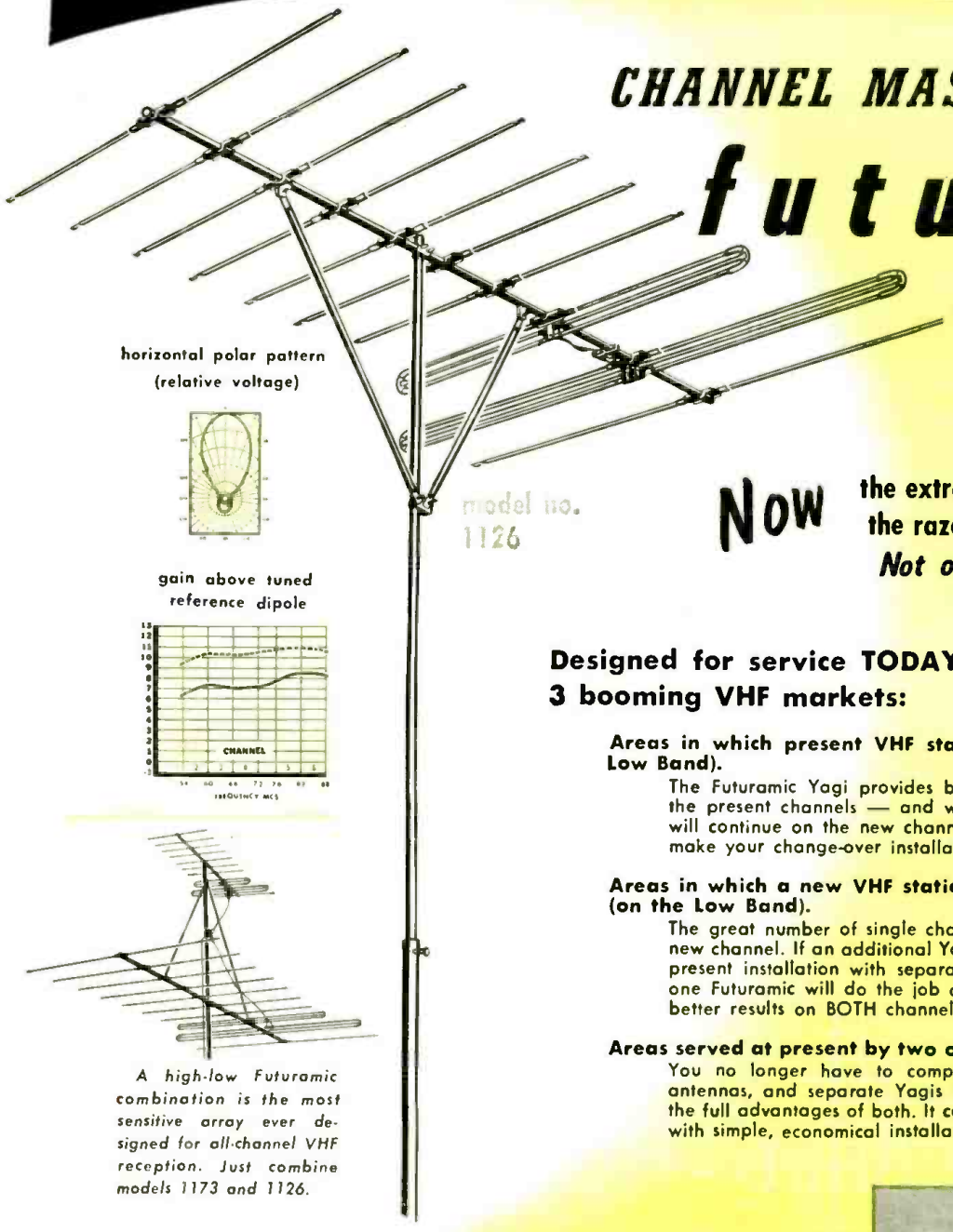
into 1 simple structure . . . with just a single down-lead to the set.



CHANNEL MASTER engineering pays off on UHF!

CHANNEL MASTER CORP.
ELLENVILLE, N. Y.

At Last! a YAGI for the ENTIRE LOW BAND!



CHANNEL MASTER'S Newest futuramic

Completely covers every low band channel— 2 through 6

horizontal polar pattern (relative voltage)

gain above tuned reference dipole

A high-low Futuramic combination is the most sensitive array ever designed for all-channel VHF reception. Just combine models 1173 and 1126.

Now the extraordinary high gain of a Yagi . . .
the razor-sharp directivity of a Yagi . . .
Not on just one channel — but clear across the entire Low Band!

Designed for service TODAY and TOMORROW in these 3 booming VHF markets:

Areas in which present VHF stations are changing channels (on the Low Band).
The Futuramic Yagi provides better reception than conventional Yagis on the present channels — and when the shift occurs this superior reception will continue on the new channel WITHOUT INTERRUPTION. And you can make your change-over installations NOW.

Areas in which a new VHF station is being added to the present one (on the Low Band).
The great number of single channel Yagis now in use will not bring in the new channel. If an additional Yagi is installed it will have to be tied into the present installation with separate leads and a switching system. However, one Futuramic will do the job of BOTH antennas — at lower cost — with better results on BOTH channels.

Areas served at present by two or more VHF stations on the Low Band.
You no longer have to compromise between conventional broad band antennas, and separate Yagis for each channel. The Futuramic gives you the full advantages of both. It combines highest gain and sharpest directivity with simple, economical installation.

Now — 6 great Futuramic models, designed for every reception area:

model no.	channels covered	list price
1173	7 — 13	$20.83
1124	2, 3, and 4	$40.97
1125	2, 3, 4, and 5	
1136	3, 4, 5, and 6	
1146	4, 5, and 6	
1126	2, 3, 4, 5, and 6	

CHANNEL MASTER engineering pays off on VHF!

CHANNEL MASTER CORP. ELLENVILLE, N. Y.

G-E's INTERNAL MAGNETIC FOCUS SYSTEM

Improved TV set performance is anticipated with the use of these new permanent, factory-focused picture tubes.

THE development of an "internal magnetic focus" gun which will permit the elimination of the external focus coil and ion trap magnet on television picture tubes has been revealed by *General Electric Company's* Tube Department.

Use of the new gun is said to make possible sharper picture definition across the entire face of television screens.

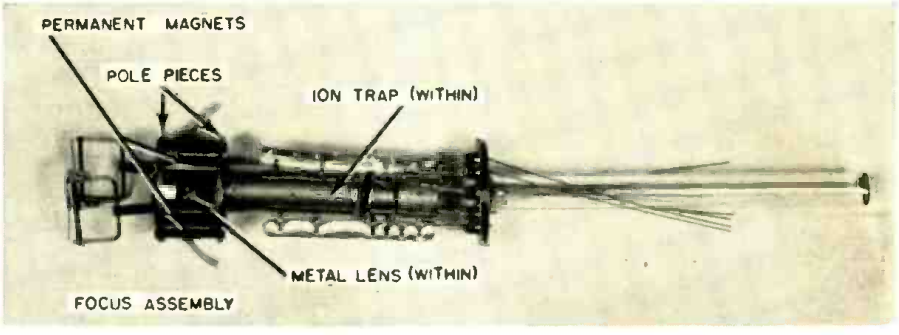
The elimination of the necessity for manufacturers to add a focus coil, ion trap, or bulky mounting brackets to picture tubes will mean a major saving in parts and assembly operations.

The new gun contains an internal compensating focusing lens which maintains focus over a wide range of operating voltages. A simple shunt may be used to increase this range. No external focus control requiring set-owner adjustment is necessary, according to spokesmen for the company.

The focusing and ion trap devices in the new gun employ four tiny *Carboloy* "Alnico 5" magnets made of the most powerful permanent magnetic material now being produced. Three of the magnets, measuring a quarter of an inch in diameter and five-eighths of an inch in length, are used in the focus assembly and the fourth, measuring one-eighth of an inch in diameter and length, is used in the ion trap unit.

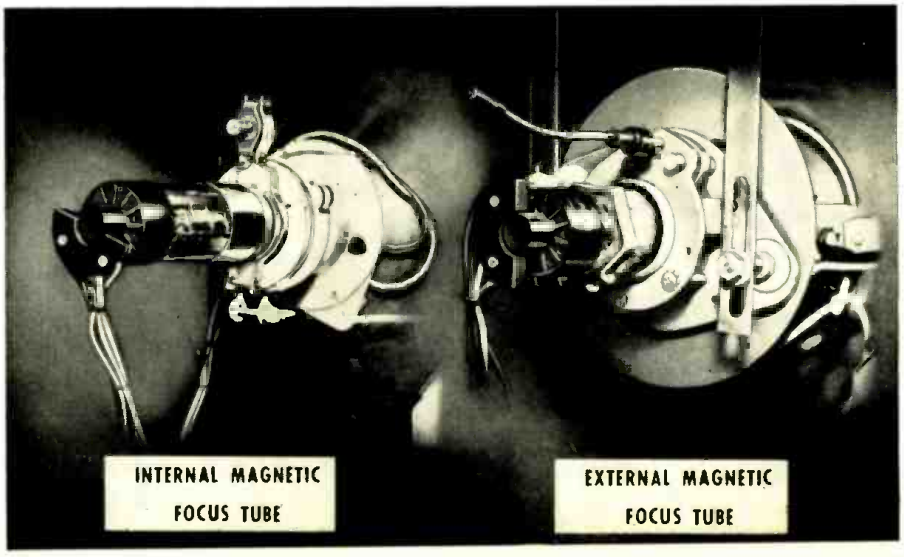
Tubes incorporating the new "internal magnetic focus" feature (i-m-f) are permanently focused at the factory for optimum viewing. The focus quality is said to be higher than that found in present electrostatic tubes and at least equal to that obtained with magnetic-focus tubes.

—30—

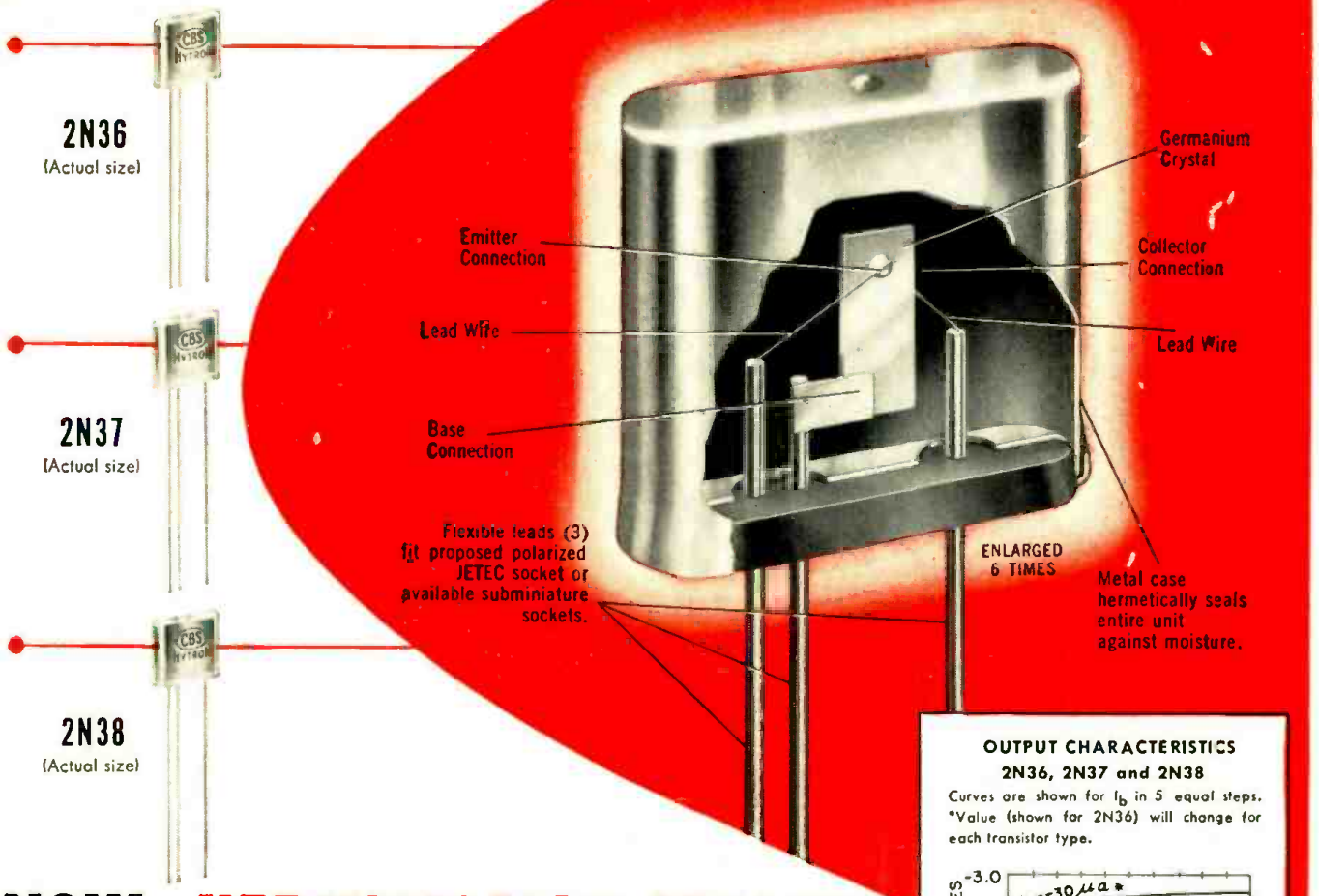


Gun structure used in General Electric's "internal magnetic focus" picture tubes.

Simplicity of installation is demonstrated using the two types of guns as examples.



A N O T H E R C B S - H Y T R O N F I R S T



NOW...HERMETICALLY SEALED CBS-HYTRON JUNCTION TRANSISTORS

In junction transistors, the surfaces are extremely sensitive to moisture. For dependability, they must be completely moisture-proofed. CBS-Hytron, recognizing this, is the first to offer you the new *hermetically sealed* 2N36, 2N37, and 2N38 junction transistors. Each is uniquely sealed in a metal case . . . moisture-proof, contamination-proof, light-proof. (See drawing.)

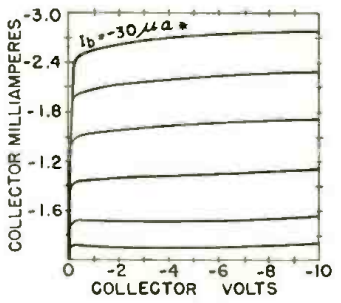
You can buy these new hermetically sealed P-N-P junction types immediately. All are amplifier types. Have similar characteristics, except for current amplification and power gain. You may operate the 2N36, 2N37, 2N38 up to 55°C. Their in-line design gives you: Compact, flat mounting . . . easily identified polarity . . . solder-in or plug-in (with clipped leads) convenience.

In addition to their unique moisture-proof feature, these CBS-Hytron junction types offer: (1) High gain. (2) Low noise figure. (3) Operation at low voltages. As well as other advantages characteristic of transistors: Compactness . . . light weight . . . ruggedness . . . instantaneous operation . . . and long life.

Remember, CBS-Hytron hermetically sealed 2N36, 2N37, 2N38 transistors are available at once. Write for complete data. Or order now for prompt delivery.

OUTPUT CHARACTERISTICS
2N36, 2N37 and 2N38

Curves are shown for I_b in 5 equal steps. *Value (shown for 2N36) will change for each transistor type.



ELECTRICAL CHARACTERISTICS†
CBS-Hytron P-N-P Junction Transistors

Characteristic	2N36	2N37	2N38	
Collector voltage	—6	—6	—6	v
Collector current	—1	—1	—1	ma.
Current amplification factor #	45	30	15	
Power gain #	40	36	32	db

†Typical values at 25°C. #Grounded emitter connection.

NOW 3 CBS-HYTRON TEST ADAPTERS. By popular demand. Three sizes now available at these net prices: 7-Pin Miniature, $1.45; 8-Pin Octal, $2.25; 9-Pin Miniature, $1.75. Take advantage of e-a-s-y "topside" testing. Order your Test Adapters today from your CBS-Hytron jobber.

CBS HYTRON
Manufacturers of Receiving Tubes Since 1921

CBS-HYTRON Main Office: Danvers, Massachusetts

A Division of Columbia Broadcasting System, Inc.

RECEIVING . . . TRANSMITTING . . . SPECIAL-PURPOSE AND TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL**	CHANNEL	FREQUENCY (mc.)	POWER (Video)*
Arizona	Yuma	.....	11	198-204	29
California	Chico	KHSL-TV	12	204-210	12.3
"	San Diego	KFSD-TV	10	192-198	316
"	San Francisco	.....	20	506-512	94
"	San Luis Obispo	KVEC-TV	6	82-88	20
"	Yuba City	KGAR-TV	52	698-704	91
Delaware	Dover	.....	40	626-632	195
Florida	Fort Myers	WINK-TV	11	198-204	9.6
"	Panama City	.....	7	174-180	10.5
Georgia	Columbus	WDAK-TV	28	554-560	89
"	Warner Robins (Macon)	WMAZ-TV	13	210-216	300
Idaho	Nampa	KFXD-TV	6	82-88	19.5
Illinois	Bloomington	.....	15	476-482	18
"	Harrisburg	.....	22	518-524	10.5
Indiana	Indianapolis	.....	26	542-548	95
"	Indianapolis	.....	67	788-794	125
"	Marion	WMRI-TV	29	560-566	15
"	Princeton	WRAY-TV	52	698-704	95
Iowa	Davenport	.....	36	602-608	15
"	Des Moines	.....	17	488-494	180
Maryland	Salisbury	WBOC-TV	16	482-488	110
Massachusetts	Boston	.....	50	686-692	255
"	Cambridge	WTAO-TV	56	722-728	20
Minnesota	Austin	.....	6	82-88	18.5
"	St. Paul	WCOW-TV	17	488-494	180
Mississippi	Columbus	WCBI-TV	28	554-560	210
Montana	Missoula	KGVO-TV	13	210-216	11
New Mexico	Albuquerque	KGGM-TV	13	210-216	89
"	Clovis	.....	12	204-210	10.2
New York	Rochester	WHEC-TV	10 (will share channel with WVET-TV)	192-198	118
"	Rochester	WVET-TV	10	192-198	118
North Carolina	Greenville	WNCT	9	186-192	100
"	Hendersonville	WHKP-TV	27	548-554	20
"	Mt. Airy	WPAQ-TV	55	716-722	21
North Dakota	Bismarck	KFYR-TV	5	76-82	100
"	Bismarck	.....	12	204-210	60
Oregon	Medford	.....	5	76-82	19
Pennsylvania	Chambersburg	WCHA-TV	46	662-668	105
Tennessee	Knoxville	.....	26	542-548	21
Texas	Fort Worth	.....	20	506-512	270
"	Lufkin	KTRE-TV	9	186-192	11
"	Sherman	.....	46	662-668	20.5
"	San Antonio	.....	35	596-602	230
"	Victoria	.....	19	500-506	20
Virginia	Harrisonburg	WSVA-TV	3	60-66	12.5
West Virginia	Charleston	WKNA-TV	49	680-686	228
Utah	Salt Lake City	.....	2	54-60	27.5

*ERP = (effective radiated power). **Call letters without TV suffix from application files and subject to change; except where included in calls such as KKTV or WTVT. ..= Call letters to be announced

World's most powerful TV ANTENNA!

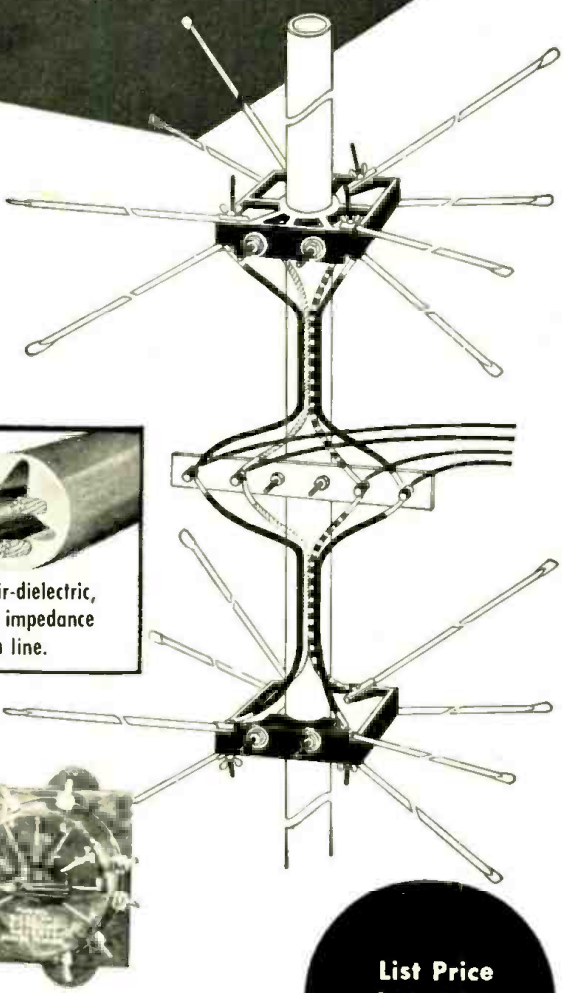
22 Db gain

over tuned dipole!

motorless all-direction UHF-VHF-FM reception

MONEY BACK GUARANTEE

to outperform all other antennas using rotor motors on UHF—VHF & FM



- Guaranteed 10 times more powerful than stacked 10 element Yagis.
- Receives channel 2-83 from all directions without a rotor.
- Broadband UHF-VHF and FM, motorless all direction reception.
- All aluminum flip-out assembly.

Four conductor air-dielectric, tubular, matched impedance transmission line.

The only TV antenna that instantly beams the television set directly to the signal without a rotor. This antenna brings strong UHF & VHF signals from all directions to weak signal areas instantly . . . with a flick of the nine position switch located near the television set.

MONEY BACK GUARANTEE To out-perform all other antennas (using rotor motors) on both UHF and VHF, including stacked ten element Yagis, stacked corner and bow-tie reflectors, four bay conicals, etc.

Model A D 2-8

Includes Stacked Antenna Array. 9 Position Switch. Completely Wired Stacking Harness. A.I.M.—Automatic. Impedance Matching Coupler.

List Price $36.50

see us at . . . .

THE ELECTRONIC PARTS SHOW, CHICAGO ROOMS 647A & 648A

ALL CHANNEL ANTENNA CORP.

70-07 Queens Blvd.,
Woodside 77, N.Y. Hickory 6-2304

AMERICA'S FINEST 28 WATT—50 WATT AND 10 WATT P.A. VALUES

$69.95 BUYS A 28 WATT $150.00 LIST VALUE PORTABLE P.A. SYSTEM

(Illustration B)

3-SPEED PHONO TOP—TWO 12-INCH SPEAKERS
7-TUBES PUSH PULL 6L6'S HEAVY LEATHERETTE COVERED PLYWOOD PORTABLE CASES
CRYSTAL MIKE $8.95 EXTRA

STOCK No. AP-28X. Portable 28 watt public address system. You get a 7-Tube heavy duty push-pull 6L6 amplifier with inputs for 2 mikes either crystal or dynamic with separate mixing volume controls. One phono input. Fully variable tone control high fidelity, wide range frequency response. The heavy duty output transformer has taps for 4, 8, 16, 125, 250 and 500 ohm speaker connections. Two heavy duty 12 inch alnico V P.M. speakers, each with 25 feet of speaker cable. Each speaker is mounted in separate carrying cases. Each case has a snap on back and is large enough to give good speaker baffling. Each case is 21 x 16 x 13 inches. One is used to carry the amplifier. A 3-speed phono motor and pick-up is mounted in the top of the amplifier to play 33⅓, 45 and 78 RPM records.

This portable PA system will put out 20 watts all day long and 28 to 30 watts peak audio. McGee offers you this $150.00 list portable PA system at a terrific saving.

STOCK No. AP-28X complete portable PA system with 3-speed phono and speakers as pictured (less mike) shlp. wt. 71 lbs. **$69.95.**

Electro Voice model 910 $28.50 list crystal mike with 20 feet of cable and desk stand **$8.95** extra.

Floor type mike stand instead of desk stand **$4.95** extra.

50-WATT PORTABLE P.A. ON SALE $99.95
3-SPEED PHONO TOP—TWO 12" SPEAKERS

(Illustration A)

10-tube portable 50-watt public address system. 4—6L6G (push-pull parallel) output tubes. Inputs for 2 microphones, either crystal or dynamic, with separate mixing volume controls. Twin bass and treble tone controls. High fidelity wide range output transformer with taps at 4, 8, 16, 125, 250 and 500 ohms. Complete with 2 super heavy duty 12" PM speakers and 25 ft. cables mounted in separate leatherette-covered carrying cases, 21"x21"x13". The amplifier fits in one of the cases for carrying. This amplifier will put out 40 watts all day long and 50 to 60 watts Peak with ease. 3-speed turntable and pickup arm to play all records 33⅓, 45 and 78 RPM is mounted in the top of the amplifier. Stock No. AP-60X, 50 watt portable P.A. system similar to the 28-watt model pictured above, less microphone. Sale price, **$99.95.** Shipping weight, 100 lbs. Shipped via Express or Truck only. Regular $45.00 list Electro-Voice 610 dynamic microphone with 20 ft. cable and desk stand, **$11.95** extra. For floor stand instead of desk stand, add **$4.95.**

10-WATT PORTABLE P.A. ON SALE $42.95
3-SPEED PHONO TOP—10" ALNICO PM SPEAKER

(Illustration C)

5-tube portable 10-watt (14-watt peak) public address system. (Push-pull 7C5) U. L. approved amplifier with wide range response. Inputs for microphone and phono, with separate mixing type volume controls. Tone control. 10" Alnico V PM speaker is housed in a leatherette case 21"x16"x13" which holds the amplifier for carrying. 3-speed turntable and pickup arm to play all records 33⅓, 45 and 78 RPM is mounted in the top of the amplifier. List value, $90.00. Stock No. AP-10X, 10-watt portable P.A. system has only one case and one 10" speaker, less microphone. Sale price, **$42.95.** Shipping weight 41 lbs. Shipped via Express or Truck only.
Crystal microphone with non-removable desk stand, **$3.95** extra when ordered with the AP-10X portable P.A. system.

BRUSH CRYSTAL EAR PHONE With Control $5.49

Simply clip on to the speaker voice coil of any radio or TV set or to an audio amplifier. No soldering necessary. Listen in privately to your favorite programs. The tiny Brush crystal ear phone fits your ear just like a regular hearing aid ear piece. A small remote control box enables using 20 ft. from the radio or TV set. Has its own separate volume control and small matching transformer built-in to operate the crystal from any speaker voice coil. Ideal for hospitals, homes, hundreds of other uses. 10 times more comfortable to wear than conventional earphones. Stock No. BH-500 includes Brush crystal ear piece, remote control box, 20 ft. of cable and instructions. Sale price, **$5.49** complete. Brush crystal earphone with 36" cord. Stock No. BK-51, **$2.95.** (You connect it like any crystal earphone, diagram furnished.) Accessory kit includes volume control with switch plus coupling capacity and instructions. 99c extra.

INDIVIDUALLY CARTONED ELECTRONIC RADIO & TV TUBES

McGee offers you a wide selection of good quality TV and Radio tube types. Individually cartoned. Our private brand. These are not set mfg's. culls, but a carefully inspected private line of tubes with a full 6 months' guarantee. Types listed are in stock in good quantity at this time. Thousands sold. Order 50 tubes and take 10% off the listed prices.

0Z4	$0.59	6AT6	.49	6K7GT	.59	7Y4	.69
1A7GT	.59	6AU6	.49	6L6G	1.09	12AL5	.59
1B3GT	.79	6AV6	.49	6S4	.59	12A8GT	.69
1H5GT	.59	6AX4GT	.69	6SA7GT	.59	12AT6	.49
1L4	.59	6BA6	.49	6SH7GT	.59	12AT7	.69
1R5	.59	6BA7	.69	6SF5GT	.59	12AU6	.59
1S5	.59	6BC5	.59	6SK7GT	.59	12AU7	.69
1T4	.59	6BD6	.49	6SL7GT	.69	12AV6	.59
1U4	.59	6BF5	.59	6SN7GT	.69	12AV7	.89
1U5	.59	6BF6	.59	6SU7GT	.69	12AX4GT	.59
3Q4	.59	6BG6G	1.29	6T8	.79	12AX7	.69
3Q5GT	.69	6BH6	.59	6U8	.79	12BA6	.59
3S4	.59	6BJ6	.59	6V6GT	.59	12BE6	.59
3V4	.59	6BK7	.99	6W4GT	.59	12BD6	.59
5U4G	.49	6BQ6GT	.99	6X4	.39	12BF6	.79
6AB4	.69	6C4	.39	6X8GT	.59	12K8GT	.59
6AC5	.89	6CB6	.59	7A7	.69	12Q7GT	.59
6AL5	.49	6CD6G	1.49	7B6	.69	12SF5GT	.69
6AQ5	.49	6H6GT	.59	7H7	.79	12SJ7M	.59
						12SJ7GT	.59
						12SN7GT	.69
						12SL7GT	.79
						19BG6G	1.79
						25BQ6GT	.99
						25L6GT	.59
						32L7GT	.79
						35B5	.59
						35C5	.59
						35W4	.39
						35L6GT	.59
						43	.79
						47	.89
						50B5	.59
						50C5	.59
						50L6GT	.59
						70L7GT	.99
						117Z3	.39

UHF TELEVISION CONVERTER $34.95

Suteo UHF television converter with built-in booster. Continuously variable for channels 14 thru 83. Built-in wide band VHF booster for channels 2 thru 13. Self powered for 110 volt, 60 cycle AC operation. Selector switch gives choice of VHF or UHF antenna. VHF antenna may be fed thru the broad band booster or direct to the TV set. Stock No. 21A, shipping weight 7 lbs. Net price **$34.95.**

REGENCY RC-600 $37.46

Carefully engineered and of highest quality construction. Features extreme stability, air dielectric in the tuning element, image rejection of VHF stations down 50 to 60 db. Converts all sets and is highly recommended for those having split sound and video. Tubes are 6AF4 oscillator, crystal diode mixer, 6BK7 dual triode IF amplifier and selenium rectifier. Front panel change-over switch for UHF or VHF. Input and output impedances 300 ohms. For 110 volt 60 cycle AC operation. Shipping weight 8 lbs. Stock No. RC-600, price **$37.46** each.

UHF-VHF ANTENNAS

VEE-D-X Ultra Q-TEE. One antenna for all channels 2 thru 83 with a single transmission line (tubular 300 ohm recommended, your cost 4c per ft.) List price $14.25, your cost **$8.38.**

Two stack Ultra Q-TEE antenna for fringe area. List price **$29.55,** your cost **$17.58.**

UHF ADAPTING BRACKET

Permits addition of UHF antenna to existing VHF installation. Mounts three different ways to mast or antenna boom. List $1.50. Your Net Cost..... **88c**

VEE-D-X MIGHTY MATCH

Model MM-30. Provides best method of combining VHF-UHF antenna systems with single transmission line. Automatic action. Printed circuit balun. List $4.00. Your Net Cost..... **$2.35**

30 FOOT TELESCOPING MAST $10.95

Famous Trio antenna rotator. Net **$26.43.**

5 wire rotator cable, 3c per foot. Deluxe 30 foot telescoping mast. Stock No. ST-30. $10.95. Complete kit of guy wire, guy rings and base mount for mast, $6.00 extra. Prices do not include Express charges.

CORNER REF. UHF ANT. $8.95

Corner reflector antenna (less mast) for UHF only. As high as 10 db gain on channels 14 thru 83. (Tubular lead recommended, your cost 4c per ft.) With a Mighty Match you can connect this antenna with your present VHF antenna using only one lead to your set.

50-WATT BOOSTER AMPLIFIER

50-WATT BOOSTER AMP. $39.95

2-Mike Pre-Amp $12.95 Extra. Not a Kit, but a Manufactured Amp.

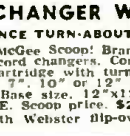
50-WATT BOOSTER A sensational value, 50 watt booster amplifier with push-pull parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X Pre-amp to add the use of 2 mikes and one low level input. The booster amplifier has one input jack and with 1 volt input gives 50 watts of audio. Booster has a 6 lb. potted case high fidelity output transformer, matches speaker with 4-8-16 ohm voice coil, also 60 ohm and 250 ohm line. Booster has a 225 mil power supply with 5U4 rectifier. Price includes tubes: 4 6L6, 7N7 and 5U4. The two variable controls are for master volume control and bass boost tone control. Size 8 x 6½ x 14½. Stock No. PA-55N. Shipping weight 26 lbs. Sale price **$39.95** ea.

2-MIKE PRE-AMP. Pre-amplifier plugs in directly to the PA-55N Booster amplifier. It enables use of 2, Crystal or Dynamic Mikes Plus one low level input. Furnished with 4 foot cables and plugs for remote control of the 55 watt Booster Amplifier. Small chassis size 5 x 3¼ x 4". Stock No. PR-2X, with tubes 7F7 and 7N7. Net price **$12.95** ea.

McGEE'S $62.50 LIST 15" COAXIAL SPEAKER, $21.95
21 OZ. ALNICO V MAGNET—5" TWEETER

This is the finest 15" coaxial PM speaker value that we have ever offered. New 1953 production, of a famous manufacturer of fine speakers. The 15" speaker has a 21½ oz. Alnico V magnet, equal to 68 oz. of the Alnico 5 type magnet. The cone is free floating, of one piece construction. Will reproduce low frequencies down to 20 cps. The 5" tweeter is coaxially suspended and has a ridged cone to reproduce only the high frequencies. It will respond up to 17,500 cps. The high-pass filter is concealed under the pot cover, leaving only two wires to connect both the woofer and tweeter to any 8 ohm output transformer of a radio, or high fidelity music lover's amplifier. Stock No. P15-CH, shipping weight 13 lbs. Net price **$21.95.**

12" COAXIAL SPEAKER, $12.95



McGee offers the new 1953 model 12" coaxial PM speaker. Quality you would put in your finest sets if you were a manufacturer. 12" woofer has 6.8 oz. Alnico V magnet. Tweeter is coaxially suspended and has a metal diffuser. High pass filter is under the pot cover. Only two wires to connect to your radio or audio amplifier. 8 ohm with 18 watt peak and 10 watt average. Shipping weight 8 lbs. Response from 30 to 17,500 cps. Stock No. CU-14Y. Sale price **$12.95** each; 2 for **$25.00.**

12" JENSEN PM, $15.95

Another McGee Scoop! Jensen Concert 12", 14½ oz. Alnico V magnet PM speaker, 8 ohm voice coil. Will take 25 watt audio. You save dollars on this speaker. Just 100 to sell. Shipping weight 8 lbs. Stock No. P-12P, Sale price **$15.95;** 2 for **$30.00.**

G.I. 3-SPEED CHANGER WITH G.E. $22.95
VARIABLE RELUCTANCE TURN-ABOUT CARTRIDGE

Another tremendous McGee Scoop! Brand new General Instrument 3-speed automatic record changers. Complete with RPX-050 G.E. variable reluctance cartridge with turn-about stylus. Plays all 3 speeds automatically: 7", 10" or 12" records. Has reject button. Repeats last record. Base size, 12"x12⅞". Shipping weight 14 lbs. Stock No. 700-GE. Scoop price. **$22.95.**

GI 3-speed changer same as above, but with Webster flip-over twin needle cartridge. Stock No. GI-700. Sale price, **$21.95** each.

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER
1422 GRAND AVE., KANSAS CITY, MISSOURI

TELEVISION BOOSTERS AND CONVERSION KITS ON SALE AT McGEE

GENUINE STANDARD COIL T.V. BOOSTER $10.95

Not Surplus, But Right From the Factory

Latest Model B-51 Standard Coil Television Booster. McGee makes another lucky purchase and as usual, passes the saving on to you. The famous Model B-51, 12 Channel Standard Coil TV booster, which lists for $35.00, is offered to you for only $10.95 each. Brand new, factory cartoned and fully guaranteed by McGee. This top quality single stage booster utilizes printed high frequency circuits, for improved performance on all channels. Uses 6AK5 tube. Average gain, 6 to 7 volts on low channels and 5 or 6 on high channels. No distorting of picture or sound. Has extremely low noise factor. Continuous one-knob tuning and channel selector control switch for off-on and by-passing 300 ohm lead-in to set. Modern design, dark brown plastic cabinet, 8"x4¼"x4½". Made for 110 volt, 60 cycle AC operation. Shipping weight 5 lbs. Model B-51. Sale price, $10.95 each, or buy 2 for only $20.00.

FRINGE AREA TV RECEPTION IS BETTER WITH OUR McMURDO SILVER TV BOOSTER $10.95—TWO FOR $20.00

Read the article on pages 52 and 53 of the December "Radio & TV News." You will see how a booster like the McMurdo Silver Super Sonic was used for fringe area TV reception. We can't guarantee this unusual reception, but we will guarantee this booster to be a sensational value. Continuously variable inductance type tuner from channel 2 including the FM band through channel 13. Self-powered for 110 volts AC operation. Incorporates a 6J6 tube. Input for 300 ohm TV line and 300 ohm output to TV set. Single knob tuning. Attractive plastic case. McMurdo Silver Super Sonic TV-FM booster. Stock No. GB-6B, shipping weight 5 lbs. Sale price, $10.95 each or two for $20.00.

20 INCH CONVERSION KIT $29.95

YOU GET—

20HP4—20" PICTURE TUBE
20-INCH PLASTIC MASK
14 K.V. FLYBACK AND 70° YOKE

Our 20" conversion kit includes a 6-month guaranteed 20HP4, 20° rectangular blackface picture tube, plus a 14,000 volt G.E. built high voltage flyback transformer, plus a matched 70° cosine yoke, plus a 20° rectangular gold trimmed plexiglas mask and suggested diagram. The picture tube is the latest electro-static focus type that requires no focus coil. Shipped via express or truck only. Ship. weight, 40 lbs. Stock No. 20-TP, net price, $29.95. Price with Raytheon or GE 1 year guarantee picture tube, $10.00 extra.

14-Inch Conversion Kit $25.95 WITH G.E. TUBE

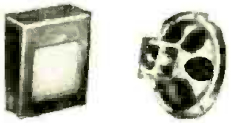
14-inch conversion kit: You get a 14-inch black face, 1 year guarantee G.E. 14CP4 picture tube, a 70° deflection yoke with matching 14,000 volt G.E. flyback and a 14" plexiglas gold trim safety mask, plus conversion instructions. Stock No. 14CC-G. Sale price, $25.95.

17-INCH CONVERSION KIT $25.95

You Get—17BP4A 17" Picture Tube
17-Inch Plastic Mask
14 K.V. Flyback and 70° Yoke

17-inch conversion kit with a 17BP4A, 17" rectangular blackface electro-magnetic focus picture tube with 6 months' guarantee, plus a matched 70° cosine yoke, a G.E. built 14,000 volt flyback and a 17" rectangular gold trimmed plexiglas mask and safety shield. Suggested diagram furnished. Shipping weight, 30 lbs. via Express or Truck only. Stock No. 17-4XL. 17" conversion kit. Sale price, $25.95. Kit Price with GE or Raytheon 1 year guarantee picture tube, $5.00 extra.

SPEAKER AND BAFFLE SALE



8" SPEAKER AND BAFFLE $4.95

Stock No. 818. Tan leatherette covered, plywood slant type wall baffle; plus an 8" Oxford, 2.15 oz. Alnico 5 magnet PM speaker. A red hot McGee special for only $4.95 each, or $4.70 each in lots of 3 or more.

10" SPEAKER AND BAFFLE $6.95

Stock No. CA-10. Tan leatherette covered plywood slant type wall baffle; plus 10" Permaflux, 3.16 oz. Alnico V PM speaker. Only a few hundred to sell at $6.50 each, or $6.25 each in lots of 3 or more.

12" SPEAKER AND BAFFLE $7.95

Stock No. CA-12. Tan leatherette covered plywood slant type wall baffle; plus a 12" Quam, 4.64 oz. Alnico V magnet PM speaker. (Popular Adjustacone model.) A terrific McGee value for only $7.95 each, or $7.50 each in lots of 3 or more.

RCA 201E1 T.V. TUNER $7.95

Terrific buy on this RCA tuner. We have a limited quantity of the famous original 201E1, 13 channel completely wired and tested TV front end tuners. Ready to connect to your TV video I.F. strip. Offered at a sacrifice. Price was $44.00. Now only $7.95 each, with tubes. Each tuner in good condition but has been repaired. Stock No. RCA-13P. TV front end tuner. Convertor coil type for separate sound as used in the famous 630 chassis. Complete with 3—6J6 tubes. $7.95. Specify shaft length desired, either 2" or 4".

RCA 201E-1 T.V. TUNER

Same as pictured above only new—with 2⅞" shaft. Stock No. 2201. Sale Price, $11.95.

3-TUBE SARKES-TARZIAN T.V. TUNER $9.95

This popular Sarkes-Tarzian Type 3 tuner is widely used. 13 channel rotary type switch with individually tuned coils. Price is complete with diagram and three tubes: 6C4 osc., 6BH6 R.F. and 6AG5 mixer. Regular factory cost is twice our price. Each tuner is wired ready to hook up to a video and sound IF strip. May be used with either inter-carrier or separate sound IF circuits. Has built-on convertor coil, built in fine frequency control. Sarkes-Tarzian TV tuner, with 3 tubes. Net price, $9.95 each. Specify shaft length, either 2⅞" or 4¾".

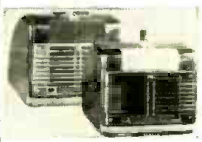
STANDARD COIL SUPER CASCODE TUNER $19.95

UHF STRIPS $9.40 EXTRA

The Cascode Circuit of the Standard Tuner offers a new development of this famous TV front end assembly which affords a 2-to-1 improvement in gain and a 35% to 50% reduction of noise over the pentode tuner. Other advances include: easy conversion to UHF reception by interchange of channel inductors; increased sensitivity for TV sets in fringe areas; elimination of booster use; and a high profit item for the serviceman as a replacement unit sale. Brand new factory TV-2000 TV tuner, compl. with tubes 6BK7 or 6Bq7 and a 6J6. Shaft length 3¼". Scoop UHF (specify channel) strips supplied in pairs for above cascode tuner. $9.40 per set. UHF strips for other models of the Standard Coil tuners specify channel and series; either F, G, K, Q, K, H or M as printed on the tuner, $9.40 per set.

3 STATION INTERCOM MASTER $16.95

SUB STATION $3.95



3-station intercom master housed in chrome plated metal cabinet 7½"x6"x5" sloping front. Full 3-tube amplifier for 110 volt AC-DC operation. Press-to-talk switch is on top of the cabinet and volume control with off-on switch and station selector switch are on either side. May be used with from one to 3 sub-stations. (See matching cabinet chrome plated sub-station No. PM-A51. Master is quiet at all times except when press-to-talk switch is pressed at the master or call-back switch is pressed at the sub. Uses 3-wire intercom cable. 3-station intercom master MPM-A3, shipping weight 10 lbs. Sale price, $16.95 each, sub-stations extra. 3-wire plastic intercom cable, 100 ft. for $1.95, 500 ft. for $8.95.

INTERCOM SUB STATIONS $3.95

Chrome plated, with call back switch for a 3-wire intercom master. Size 7½"x6"x5" sloping front. 3" Alnico V PM spkr. Intercom dealers buy at less than present production costs. Limited quantity. Stock No. PM-A3, ship. weight 8 lbs. Sale price, $3.95 each or 3 for $10.00. Special 3-wire plastic intercom cable, 100 ft. for $1.95, 500 ft. for $8.95.

Brown leatherette covered intercom sub-station with call back switch for use with 3-wire intercom masters. 5" square and 2½" deep. Has new plastic grill cloth. Alnico V PM speaker. A true McGee value. Stock No. NE-5, ship. weight, 1½ lbs. Sale price, $3.95 each or 3 for $10.00. 3-wire plastic intercom cable, 100 ft. for $1.95, 500 ft. for $8.95.

CAPEHART CABINET FOR 1000 SET—ONLY $99.95

BEAUTIFUL WALNUT

Beautiful, finest quality walnut combination radio-phono cabinet, 42" high, 42" wide and 22" deep. Made for Capehart's finest combination, selling for $900 and up. Cabinet cost manufacturer over $200.00. Has highly polished matched walnut panels. Made of ¾" material. Top 1½" solid stock. This cabinet weighs approximately 175 lbs. The changer radio and speaker grill all have hinged doors. Radio compartment on right hand side is 14" high and 11½" wide. Made to mount chassis vertically. Changer compartment is 14" high by 26½" wide. Large enough to hold any record changer or recorder mechanism. Front 10" of top over the changer compartment is hinged to fold back for easy access to the changer. Both radio and changer compartments come with uncut blank panels. Speaker baffle is cut for a 12" speaker and the speaker compartment is completely enclosed. Shipping weight, 255 lbs. Stock No. K-275W Capehart combination cabinet. Net price, $99.95. Walnut.

COMPLETE RADIO, TELEVISION AND AMPLIFIER KITS AT McGEE

3-WAY PORTABLE KIT $15.95

New 1952 Model 3-way personal portable radio kit. Operates on 110 Volts AC-DC or 67½ B plus 1½ volt self-contained batteries. Leatherette covered case size, 5½x5¾x8". Receives broadcast 550 to 1650 KC. A conventional 2-gang superhet circuit with 456 KC iron core IF's. Incorporates the new super gain stick loop antenna. All plated chassis. Lab. approved circuit—matched parts. Price includes all parts, tubes, diagram, Alnico V PM speaker. A factory quality kit. Stock No. PN-4T, shipping weight 7 lbs. The complete kit, less batteries, $15.95. 67½V. B, $1.59; 1½V. A, 39c extra.

Build Your Own Phono-Mike Broadcaster $7.95

Kit Model DE-6R. With this simple kit, you can build a 3-tube phono oscillator that also has a mike input. Will broadcast over any radio within your home, (about 75 feet) from 1000 to 1500 kc. Inputs for crystal mike or crystal phono pickup. Fader control fades from mike to record. Ideal for a home P.A. system, baby listener and home entertainment. A complete kit of parts including tubes. Kit Model DE-6R. Net price, $7.95. DE-6RWT, wired and tested. Net price, $9.95. Crystal mike and desk stand, $4.95 extra. Concealed microphone unit, only 1" in diameter and ¼" thick. Specify hidden mike when ordering. Stock No. T-001. Net, $3.95 extra.

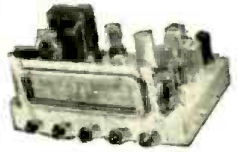
8-Tube Hi-Fi Amplifier Kit $29.95

A complete kit, including tubes: 2-7F8, 2-12AX7, 2-triode plus rectifier diagram and photos. Inputs for radio tuner and any kind of phono pickup (crystal or G.E. variable reluctance) and either crystal or dynamic mike. Output matches 8 ohm voice coil. Twin electronic bass and treble tone controls with ranite selector switch for either juke box quality with heavy bass response or brilliant symphonic range. Response 18 to 20,000 cps. 8 tube all triode amplifier kit, complete with tubes. Shipping weight 25 lbs. Model 7X5. Net $29.95.

10-Watt Hi-Fi Amplifier Kit $14.95

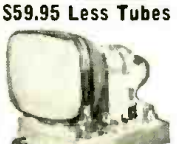
A complete kit of parts including tubes 12AX7, 12AU7, 2-5U6, plus rectifier, diagram and instructions to build a ultra fidelity twin tone control audio amplifier with bass and treble boost. Inputs for radio tuner, crystal mike and crystal phono pickup. Output matches 8 ohms. Response from 50 to 15,000 cps. Chassis ready punched. Ventilated cover. Straight forward circuit with twin triode gain stages and 2-5U6 tubes in push-pull. Size, 5¼" x 10" x 5¾" high. Model AP-10R, ship. wt. 8 lbs. Sale price $14.95.

10-TUBE RADIO KIT $29.95



10 tube broadcast radio chassis kit, complete with tubes: 2-6SK7, 6SA7, 3-6SN7, 1-6SL7, 2-6V6 plus 5Y3 rectifier, diagram and instructions. 3 gang superhet with 8" slide rule dial. Chassis size, 12½"x10"x6½" high. Features push-pull 6V6 high fidelity audio. Output matches 3 to 8 ohm voice coil speakers. Inputs for G.E. variable reluctance or crystal phono pickup and crystal mike. Heavy duty power transformer. Model BK-R10 kit less speaker, shipping weight 18 lbs. Net $29.95.

17, 20" T.V. Kit $59.95 Less Tubes



A complete kit of parts to build an AC transformer operated television chassis for use with a 16", 17" or 20" rectangular picture tube. The 12 channel Sarkes-Tarzian tuner is ready wired, as is the 4 tube video IF strip. Circuit is of the conventional design. Do not buy this unless you understand Television. It is difficult to wire. We furnish schematic. Kit model WH-20. Ship. wt. 40 lbs. less all tubes. Net $59.95. Cascode tuner $10.00 extra. 12" speaker $2.95 extra. Kit of 22 tubes, less picture tube $16.95. 17" 17BP4A, $19.95. 20HP4, $25.00.

6-TUBE 2-BAND KIT $14.95

Popular with schools and colleges for training. 6 tube AC-DC, 2 band radio kit with plastic cabinet. Receives broadcast and 6 to 18 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12SK7, 12K8, 12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Factory quality. Cabinet size 13"x6¾"x6¼". Shipping weight 12 lbs. Model MEG-2. Net $14.95.

5-TUBE AC-DC KIT $12.95

Model RS-5. A 5 tube AC-DC straight broadcast kit, housed in the same cabinet as MEG-2 above. Complete with tubes. Shipping weight 10 lbs. Net $12.95.

AC POWERED BROADCAST TUNER KIT $12.95

A self-powered, 3-gang superhet tuner kit with R.F. stage. This complete kit is furnished with a diagram, photos and tubes. 6BA8 R.F., 6BE6 oscillator R.F., 6BA6 I.F., detector, 6AL5 diode, AVC, plus rectifier. Connect to any audio amplifier. Ideal for use with our S-2020 or 7x5 amplifier kits. Chassis size, 9½x4½" high. Shipping weight, 7 lbs. Broadcast tuner kit Model BT-38X. Net price, $12.95.

MANUFACTURERS' LITERATURE

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

HI-FI CATALOGUE

Mark Simpson Mfg. Co., 32-28 49th Street, Long Island City 3, N. Y. has available for distribution a new catalogue describing its "Concert Master" high fidelity amplifier with remote preamplifier, the Model CMR-20.

This four-page catalogue contains full technical specifications and highlights as well as photographs of the unit itself.

When writing for copies of this publication, please specify catalogue #CM-53.

U.H.F. EQUIPMENT

General Radio Company, 275 Massachusetts Avenue, Cambridge 39, Massachusetts has recently issued a six-page bulletin covering its line of u.h.f. measuring equipment and accessories.

Illustrated and described are such units as coaxial elements, attenuators, modulators, mixer rectifiers, voltmeter rectifiers and indicators, baluns, constant-impedance adjustable lines, component mounts, insertion units, adapters, the company's standard signal generator, a bolometer bridge, a heterodyne frequency meter, and a unit u.h.f. oscillator.

A copy of this data sheet is available on request.

MIKE MIXER DATA

A new electronic microphone mixer and preamp, the *Masco* Model EMM-6, is described in a catalogue sheet currently available from *Mark Simpson Mfg. Co., Inc.,* 32-28 49th Street, Long Island City 3, N. Y.

The new unit is designed for electronically mixing the outputs of up to four microphones and two phonographs or radio tuners into any amplifier, p.a. system, tape, disc or wire recorder, or broadcast input channel.

The catalogue sheet provides full specifications and is available on request.

CABINET CATALOGUE

G & H Wood Products Co., 75 North 11th St., Brooklyn 11, N. Y. has issued a revised catalogue on its "Cabinart" line of custom-styled high-fidelity cabinets and kits.

Fully illustrated, the new catalogue is a complete resumé of cabinet design information. Each unit is illustrated to give a good idea of its period and styling. Individual specifications and spot illustrations highlight each cabinet's layout and equipment requirements.

Copies of this compact catalogue are available from local parts distributors or from the company direct.

TOWER BROCHURE

Rohn Manufacturing Co., 116 Limestone, Bellevue, Peoria, Illinois has announced the availability of a two-color brochure covering its entire line.

The publication lists three types of self-supporting steel towers, the fold-over tower kit, telescoping masts, and new TV service table. In addition, it lists, illustrates, and fully describes the company's full line of TV and tower accessories. Catalogue numbers are given for easy ordering.

Dealers may obtain copies from their representatives or distributors or by writing the company direct.

MUSIC SYSTEMS DATA

Audak Company, 500 Fifth Avenue, New York 36, New York has announced the availability of a 1953 edition of its popular booklet "Electronic Phono Facts" by Maximilian Weil.

This 20-page, pocket-sized publication contains the answers to more than 100 important questions relating to audio-electronic music systems. Stripped of all technical verbiage, the answers are given in layman's English.

Copies of this booklet are priced at $1.00 each and may be obtained either from *Audax* dealers or from the company direct.

KAAR CATALOGUE

Kaar Engineering Corp., Middlefield Road, Palo Alto, California has just issued a comprehensive "summary" catalogue covering its line of mobile equipment.

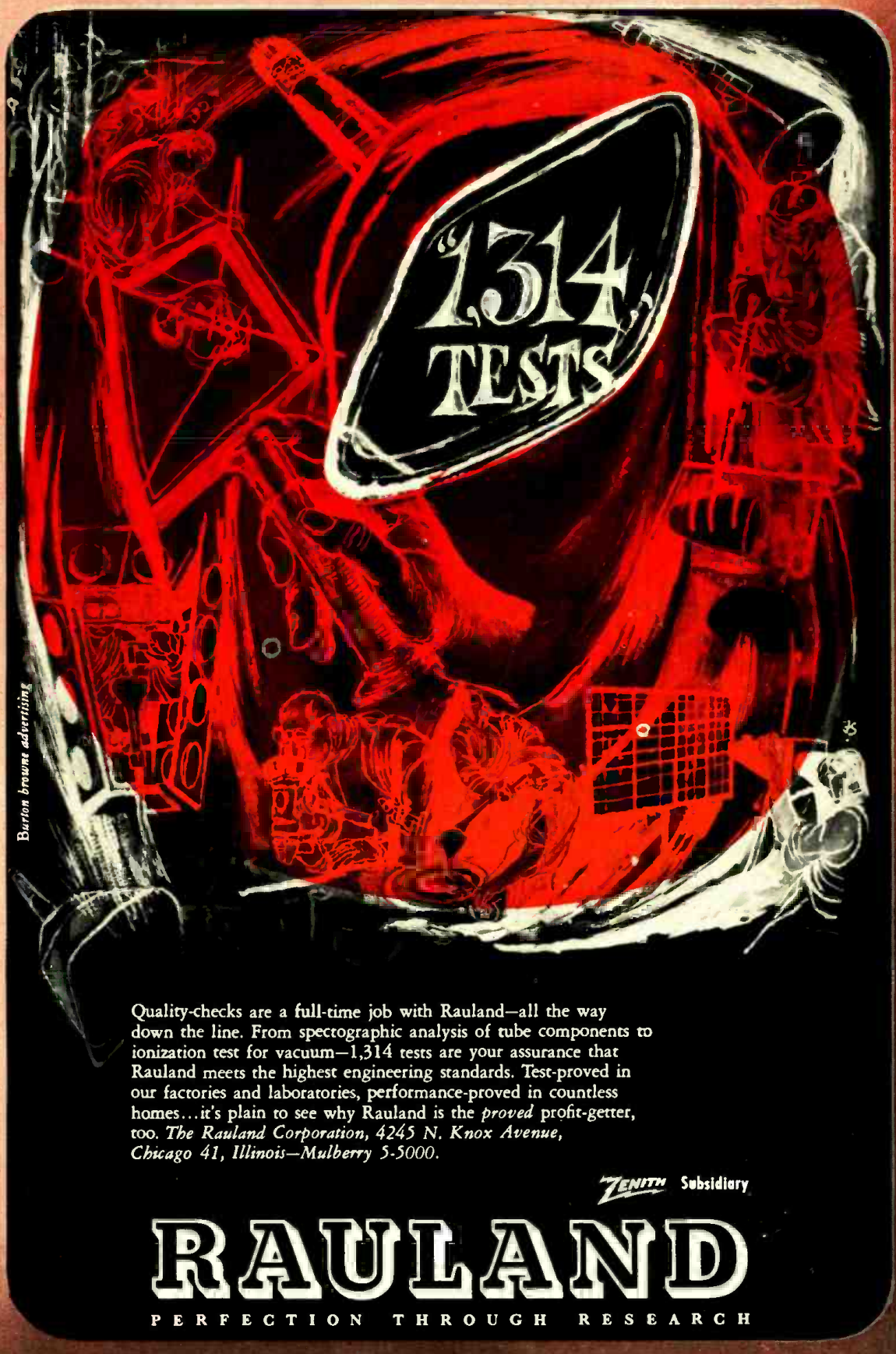
All mobile radiotelephone units manufactured by the company are included with the information being presented in capsule form to provide quick reference with a minimum of effort.

The company's line includes mobile and station equipment for use in the 152-174 mc. band, the 25-50 mc. band, and the 1600-6000 kc. band. In addition, the complete line of the company's accessories is included.

Copies are available without charge from the manufacturer.

NEDA BATTERY INDEX

The second edition of the "NEDA Battery Index" is currently available from the National Electronic Distributors Assn., 228 N. LaSalle Street, Suite 1114, Chicago 1, Ill.



Quality-checks are a full-time job with Rauland—all the way down the line. From spectographic analysis of tube components to ionization test for vacuum—1,314 tests are your assurance that Rauland meets the highest engineering standards. Test-proved in our factories and laboratories, performance-proved in countless homes...it's plain to see why Rauland is the *proved* profit-getter, too. *The Rauland Corporation, 4245 N. Knox Avenue, Chicago 41, Illinois—Mulberry 5-5000.*

ZENITH Subsidiary

RAULAND

PERFECTION THROUGH RESEARCH

This new edition, revised to show new batteries and to correct errors on the original, is a practical cross-reference volume for both wholesalers and dealers.

Compilation of the material included in this new edition is the result of almost a year's work by a special NEDA committee.

Details on how copies of this new index may be obtained will be supplied by NEDA on request.

MAGNETIC TAPE BOOKLET

A new four-color, 16-page illustrated booklet entitled "A New Horizon in High Fidelity Recording" has been issued by *Minnesota Mining and Manufacturing Co.*, 900 Fauquier St., St. Paul, Minn.

The booklet tells the story of "Scotch" brand "High Output" magnetic tape No. 120 recently introduced by the manufacturer. Included are the major advantages of the tape, an explanation of the significance of these advantages in terms of the recording and broadcast engineer as well as the hi-fi enthusiast, and bias requirements and frequency response characteristics in graph form.

The booklet is available on request. Write direct to the company.

ELECTRON TUBE NOTES

A summary of data-sheet rating interpretations and a series of notes concerning means of improving electron-tube service life are included in a new leaflet, Form 153, covering "Los Gatos" brand electron tubes.

The publication also includes a field-engineering location map and list of the company's field-engineering representatives.

Copies of Form 153 are available from *Lewis and Kaufman, Ltd.*, 76 El Rancho Ave., Los Gatos, California.

RCA SERVICE BOOKLET

The Tube Department of *Radio Corporation of America* has prepared a 33-page booklet which outlines ways of achieving greater profits and increased efficiency in radio and TV service operations.

The booklet also includes descriptions of business practices and essential test equipment used by successful service organizations throughout the industry.

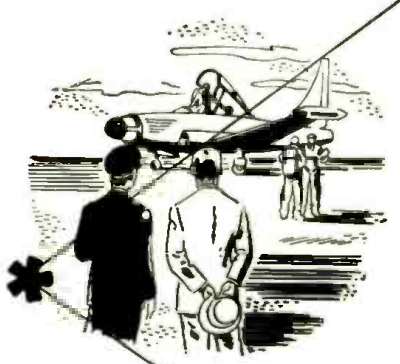
Sections of the booklet are devoted to illustrations and descriptions of the company's test equipment designed specifically for use in radio and TV servicing. Complete specifications are given along with hints on applying the equipment most effectively.

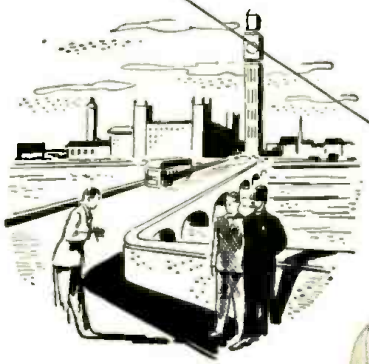
The business-guide sections cover such important management subjects as budget planning, wage and salary considerations, materials, stock control, employee training, customer relations, and methods for reducing operating expenses and costs.

Entitled "This Business of Radio and TV Servicing," the new booklet is now available from *RCA* tube, parts, and test equipment distributors. —30—

Field Engineers

FOR INSTALLATION AND MAINTENANCE OF LINK ELECTRONIC JET TRAINING EQUIPMENT

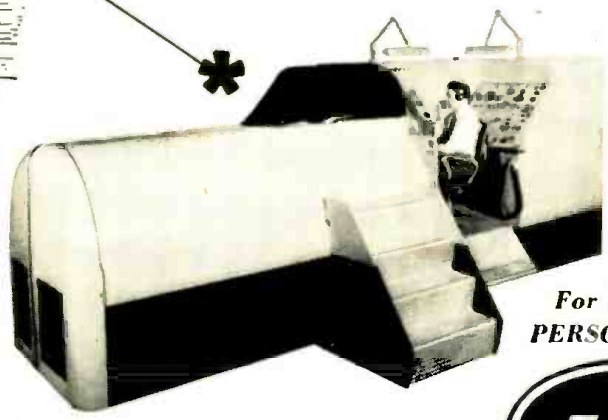




Here is an unparalleled opportunity for men with a College or Technical Institute Training and a sound background in electronic engineering. The training and experience provided will open up increasing opportunities for earnings and advancement in the fast approaching age of jet air transportation.

You will work in close contact with key personnel of the U.S. Air Force and Naval Aviation. Your responsibilities will include supervising the installation and long range maintenance of highly specialized Link Electronic Jet Training Equipment. After three months' special training at the Binghamton, N. Y. plant of Link Aviation, you will be assigned to a U.S. Air Force or Navy jet training base in the U.S., Europe or the Far East!

In addition to excellent base pay and unusual company benefits, you will be placed on a liberal expense account and receive a 20% bonus if you receive an overseas assignment.



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Manufacturers of the famous World War II LINK TRAINER, now producing Electronic Jet Training Equipment in quantity for the U.S. Armed Services

LINK AVIATION, INC.
BINGHAMTON, N. Y.

Probe Switch

(*Continued from page* 72)

tube at the point this nut will rest when in place. Then, holding the rotary contact one-half way between the limits of its rotation, insert it into the tube midway between the stator contacts. When the adhesive sets, the switch is finished.

From the experience gained building the original switch, here are some pointers. Select a heavily knurled nut for the part, Fig. 2C, because the ridges formed by the knurling help to hold the adhesive, and the slightly enlarged diameter of a heavy knurl gives a good fit against the tube wall, while allowing the necessary clearance to the smooth section of the following nut. The enlarged diameter of the knurling mentioned is indicated by the heavy outlines in the drawings, as noted in Fig. 2C.

The diameters of the stator support bar, Fig. 2D, apparently difficult to produce without a lathe, are easily made on a drill press. This part was made by putting a ⅜ in. o.d. Bakelite rod into the drill and running it at about 750 rpm. Then, using a flat file, the two diameters were brought to size. The shoulder on the nut, Fig. 2C, was made by the same process. With a little patience these jobs can be done on a hand drill clamped in a vise.

It is not necessary to follow the dimensions given in Fig. 2. Use them only as a guide. The important thing is to dimension the parts so that the rotor contact will slip smoothly into place with the type of stator contacts used. These dimensions may vary with the make of switch from which the stator contacts are taken.

A study of Fig. 2B will make the switch operation clear. Setting the switch to either position is accomplished by a half turn on the nut *H*; clockwise for a.c. voltage and resistance measurements, and counter-clockwise to place the resistor in the circuit for d.c. voltage readings. As the electrical contact is made, a frictional switch lock is also applied by the phone tip threads. As drawn, the pressure for this locking action is applied between the shoulder *J* of the phone tip *A*, and the contacting surface of the nut *C*. Turning the nut, *H*, clockwise will release the pressure by moving the shoulder away from the nut, and as the opposite electrical contact is made, the locking action pressure will take place between the meeting surfaces of the nuts, now shown separated by one-half the pitch of the phone tip threads. *Caution,* do not turn the switch too hard, for the fine pitch of the phone tip threads will multiply the applied pressure the same as a lever. Only light pressure is required to lock the switch. Heavy pressure may only make it hard to operate.

Considering the fact that the direction of the applied turning movement on the nut *H* will indicate the function for which the switch is set and that the switch stops will indicate the full engagement of the contacts, practically automatic operation is obtained.

Electronically, a slight increase in the stray capacity of the probe, due to the stator contact assembly, can not be avoided. However, by holding the probe above the engraved white line, indicated in Fig. 2E, to avoid any body capacity when measuring sensitive circuits, the effect of the additional probe capacity will not be noticeable. —30—

1953 Philco TV Sets

(*Continued from page* 61)

Video i.f. alignment:

1. Preset the contrast and brightness controls to the maximum counterclockwise position.

2. Preset the channel selector to Channel 4.

3. Connect an oscilloscope to the video detector test point on J_{200} (see Fig. 14) through a 15,000-ohm resistor.

4. Connect the negative side of a 6-volt battery to the a.g.c. test point on J_{200}. Connect the positive side to ground.

5. Connect the AM generator to the mixer grid test point, G_1.

6. Refer to Fig. 14. Adjust the various trimmers shown on this diagram of the r.f. chassis in the order given and for the response indicated, changing the frequency of the AM signal generator for each trimmer adjustment.

7. Connect a sweep generator and r.f. marker generator to the antenna terminals through a 72-ohm to 300-ohm matching jig. Connect a 7.5-volt battery to the a.g.c. test jack, with the negative terminal to the bias lead and the positive terminal to the ground lead. Set the channel selector to Channel 4, and tune the sweep generator for output on Channel 4. Tune the r.f. marker generator for the video carrier frequency of Channel 4 (67.25 mc.) and tune the i.f. marker generator (connected to mixer grid) to 45.75 mc. Note that two marker generators are used for this procedure. The r.f. marker generator is connected to the antenna terminals, while the i.f. marker generator is connected to the mixer-grid test point, G_1.

8. A jig constructed from a piece of fiber tubing, with $\frac{3}{16}$-inch inside diameter, and a brass machine screw which fits tightly into the tubing, is used to connect the generator to the test point. The screw is adjusted so that it clears the test point by approximately $\frac{1}{64}$ inch. The output cable of the marker generator is connected to the head of the brass screw in the jig and to the chassis near the mixer tube. Both marker generators should be adjusted for the minimum output required to make the markers barely visible. Failure to observe this precaution, or the use of excessive output from the sweep generator, will cause misleading results. After the equip-

The Picture Tells the Story

TV Antennas exist for one reason — to provide a clean, strong, sharp picture!

TRIO ZIG-ZAG* TV Antennas perform so well in this all important respect that they are America's most wanted.

Yes, a picture — the TV picture — tells the TRIO story more eloquently than anything else! Where all other antenna designs fail, high gain TRIO ZIG-ZAG TV Antennas consistently lock in sharp, clear pictures — from Maine to Texas, in city or country!

TRIO TV antennas look different, work different — provide a magnificent DIFFERENCE in picture quality!

*Patent Pending

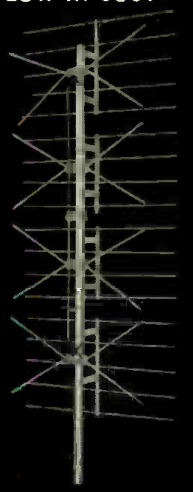
*New insulating sleeve, with longer leakage path and elimination of slit, does away with assembly errors — elements cannot short out. For maximum strength, new steel, electro-plated element clamps have been introduced.

Also in the Picture

The TRIO Rotator and Direction Indicator are the most dependable ever built. Developed after $50,000 research. Fully guaranteed for a FULL two years!

Best Buy in UHF Antennas

LOW IN COST — HIGH IN PERFORMANCE

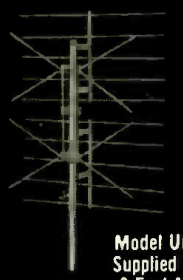


NEW TRIO UHF BOW-TIE with reflector

Sturdy, broadband antennas of uniformly high gain that have been thoroughly field tested. Phasing strips installed, pre-assembled — a jiffy to attach reflector screen. Available in one, two and four bay models. Usual high-quality TRIO construction.

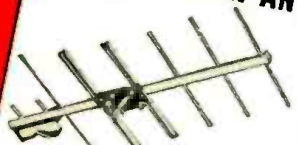
Model UBT-4
Supplied With
4 Foot Mast

Model UBT-1
Supplied With
2 Foot Mast



Model UBT-2
Supplied With
3 Foot Mast

NEW TRIO UHF MULTI-CHANNEL YAGI ANTENNAS



Broadband yagis developed by TRIO now successfully applied to UHF. Four models cover all UHF channels, rarely more than two needed for any one area.

These high gain six element yagis have sharper directivity, thereby eliminating ghosts. Thoroughly field tested. Entire antenna mounted in front of mast removes metal from field of reflectors or antenna elements. Mast clamp supplied. Completely assembled.

Model 6-UBY 14-26
for Channels 14-26
Model 6-UBY 27-42
for Channels 27-42
Model 6-UBY 43-60
for Channels 43-60
Model 6-UBY 61-83
for Channels 61-83

TRIO MANUFACTURING CO.

GRIGGSVILLE, ILLINOIS

ment is properly connected, adjust the fine tuning control for zero beat of the two markers, as observed on the oscilloscope. When zero beat is obtained, remove the i.f. marker.

9. If the response curve does not fall within the proper limits, the adjustment of the trimmers may be touched up slightly. Do not touch the setting of C_{518}, C_{204}, C_{203}, or C_{206}. To change the curve, first adjust C_{215} and C_{218} alternately, until maximum improvement has been obtained. Trimmer C_{215} affects the tilt of the curve, and C_{218} affects the dip of the curve. After C_{215} and C_{218} have been adjusted, turn C_{518} for the proper slope at the 42.25-mc. side of the curve, then adjust C_{201} and C_{210} for the proper level at the video carrier frequency (47.75 mc.).

CAUTION: Do not turn any of the trimmers excessively. To retouch, make only a slight adjustment. —30—

Master Audio Control

(*Continued from page 63*)

Distortion. *Harmonic:* 0.02% at 1 volt, 0.05% at 5 volts, 0.15% at 10 volts, 0.4% at 15 volts.

Intermodulation: 0.08% at 1 volt, 0.2% at 5 volts, 0.5% at 10 volts, 1.6% at 15 volts.

Frequency Response. ± 1 db, 20-20,000 cycles with the tone controls in the uniform response position.

Hum and Noise Level. *Receiver Input:* 100 db below normal signal (2 volts output) with volume control at zero. Better than 90 db below normal signal with volume control at maximum.

Phono Input: 68 db below output with a 10 mv. input signal.

Maximum Gain. *From High Level Input:* 22.5 db.

From Low Level Input: in excess of 53 db.

The *Fisher* "Master Audio Control" was designed, from its inception, to meet the need for a complete, yet compact, self-powered unit for controlling any self-contained power amplifier, as well as to provide complete phonograph equalization facilities. It provides an ample number of inputs and two cathode-follower outputs. Possessing extremely low hum and noise level, it represents one of the finest audio control units that has as yet been offered to the high-fidelity enthusiast or audio engineer. —30—

ALUMNI ORGANIZE

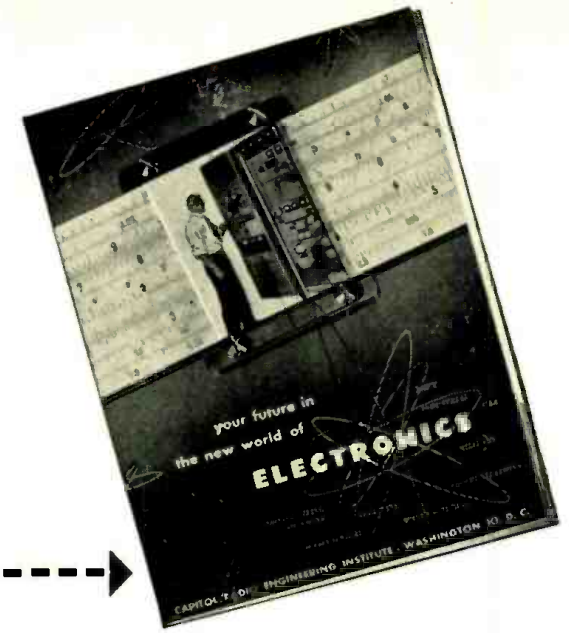
THE Alumni Association of RCA Institutes has been formed recently in New York with monthly meetings scheduled for the 3rd Thursday of each month at the school building, 350 West 4th St., New York City.

Officers include P. Genduso, president; T. R. Comiskey, recording secretary; S. Schiffman, corresponding secretary; J. Troop, treasurer; and P. Stein, faculty advisor.

—30—

What you do now will decide your

SUCCESS IN RADIO-TELEVISION-ELECTRONICS



Send for this FREE CREI Booklet and see the opportunities—and how to seize them!

THERE is a vacancy coming up. It means a boost in pay, prestige and security. Can you fill it?

The answer is "No," if you postpone your preparation for success.

The answer is "Yes," if opportunity finds you ready. "Ready" means "TRAINED." And your training must start now, if you expect to be big enough for a bigger job. You ask "What can I do *now?*" You will find many valuable suggestions in a free booklet, "Your Future in the New World of Electronics." Not only does it picture fabulous opportunities . . . it tells you what to do to grow with an industry desperately seeking trained men. Expansion is phenomenal: In the defense build-up alone, many billions in electronics contracts have been awarded. It is estimated that by 1961 the radio-electronics industry will do no less than $10 billion per year, excluding defense orders.

Growing civilian markets include radio-equipped police cars, fire-equipment, taxis, planes, ships—in increasing numbers. There are industrial radio network installations, medical applications, and countless others.

There are 152 TV stations now on the air, and 2000 more expected. Already it is estimated there are over 23,000,000 TV sets and over 100,000,000 radios in operation. How these figures will increase in the next few years, the most daring experts are reluctant to predict. This much is certain: Limitless numbers of positions must be filled—in development, research, design, production, testing, inspection, manufacture, broadcasting, telecasting, and servicing. To fill these posts, trained men are needed—men who somewhere along the line are alert enough to improve their knowledge and skills. "Your Future in the New World of Electronics" shows how CREI Home Study leads to greater earnings, by helping get you ready for the openings described above.

CREI promises no short cuts. In an accredited technical school such as this, *you must study* to transform your ambition and energy into knowledge that pays off. Since its founding in 1927, CREI has provided thousands of professional radio men with technical educations. During World War II CREI trained thousands more for the Armed Services. Leading firms choose CREI courses for group training in electronics at company expense; among them are United Air Lines, Canadian Broadcasting Corporation, Trans Canada Airlines, Bendix Products Division, All American Cables and Radio, Inc., RCA Victor Division, Mochlett Laboratories, Canadian Marconi and Heppner Mfg. CREI's practical courses are prepared by recognized experts. You get up-to-date material; your work is under the personal supervision of a CREI staff instructor, who knows and teaches you what industry needs. Training is accomplished on your own time, during hours chosen by you. As a graduate, you'll find your CREI diploma the key to success in Radio, TV and Electronics. At your service is the CREI Placement Bureau, which finds positions for advanced students and graduates. Although CREI does not guarantee jobs, requests for personnel far exceed current supply. CREI alumni hold top positions in America's leading firms. Now is the time to decide—to act. When opportunity knocks, knowledge must be "at home." You supply the willingness to learn. We supply the technical training. This combination of ambition and knowledge is unbeatable in the new Age of Electronics. Fill out the coupon and mail it now. We'll promptly send you your free copy of "Your Future in the New World of Electronics."

CREI resident instruction (day or night) is offered in Washington, D. C. New classes start once a month. VETERANS: If you were discharged after June 27, 1950—let the new G.I. Bill of Rights help you obtain CREI resident instruction. Check the coupon for full information.

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CHECK FIELD OF GREATEST INTEREST
- ☐ TV, FM & Advanced AM Servicing
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TIME COMPRESSOR

Developed by the University of Illinois, this new device has almost unlimited possibilities in diversified fields.

THE University of Illinois has developed and demonstrated a "time compressor" which speeds up words or music without changing tone or ease of understanding. An hour's program material can easily be compressed into 45 minutes' time.

Inventors of the new unit are Prof. Grant Fairbanks, director of the University's Speech Research Laboratory; Dean W. I. Everitt of the College of Engineering; and R. P. Jaeger, formerly at Illinois, now with a commercial laboratory.

The development is based on the fact that the ear is faster than the mouth. Words can be understood more rapidly than they can be spoken. Attempts to speed up speech causes the speaker to slur or trip over his words. The new invention overcomes this by recording speech in condensed form without changing the pitch, as happens when an ordinary recording is speeded up.

The machine incorporates a mechanism consisting of a continuous loop of recording tape and a set of four pickup heads in a revolving drum around which the tape makes a right-angle turn.

The pickups are arranged like the spokes of a wheel. Only one pickup touches the tape at a time, but just as it moves off, the next comes into contact with the tape. As far as the sound output is concerned, the playback is continuous, but actually that part of the original sound which was between the "spokes," and untouched by them, is left out.

The tape and drum run at different speeds and these can be varied independently to obtain any degree of compression desired.

Alternately, the drum can revolve the other way so that each pickup overlaps somewhat on sound the previous head covered. This repeats the bit of sound and thus the machine becomes a "time expander."

The output of the machine is recorded at a rate adjusted so that the result has the true pitch of the original.

The machine has another important potentiality. Instead of compressing time, it can be used to compress the tones of a voice, and then expand them back to original understandability. This is an almost instantaneous process which may permit a telephone or radio circuit to carry many conversations where one is now carried.

The problem of "bandwidth reduction" has interested engineers for a long time. They have found various ways of making circuits do multiple duty, and now the compressor may offer another possibility of carrying more messages without building additional transmission facilities.

The present "time compressor" is still a laboratory model in the University's Speech Research Laboratory, although it is the fourth model. Soon such machines will be available for radio stations and recording studios.

In addition to the more obvious applications for this device, it has already been suggested that the device be used for recording talking books for the blind to present the maximum material in the minimum amount of time; recording music for unbelievable rapidity and precision; for recording conferences, conversations, airport control directions, etc. on less tape so that they can be reviewed in less time; for a faster presentation of facts in broadcasts beamed to countries behind the Iron Curtain with less danger to listeners; faster reports over long distance telephone or radio; new production opportunities for motion pictures and television; new techniques for teaching; and new approaches to study of speech, music, and languages.

According to reports, compressions of 10 per-cent or even 20 per-cent pass unnoticed. Up to 50 per-cent does not destroy understanding of speech. Music put through the machine has its tempo stepped up, but pitch and clarity are unchanged. -30-

Prof. Fairbanks and Dean Everitt, two of the "time compressor" inventors, look over the laboratory model of unit at U. of Ill.

Valuable 3-way aid for Auto Radio Repair Men!

Once you're on the Delco Radio team you're in line for this three-way help: a reliable source for Delco Radio original equipment replacement parts and universal replacement parts; a complete and comprehensive Delco Radio Service Manual; monthly issues of "Testing Tips," a bulletin giving the very latest factory information on testing and repairing Delco car radios—even the sensational new "Favorite Station" Signal-Seeking model! To get going with Delco Radio contact your nearest United Motors Electronics Parts Distributor. Don't delay—act today!

DELCO RADIO

DIVISION, GENERAL MOTORS CORPORATION, KOKOMO, INDIANA

A GENERAL MOTORS PRODUCT — A UNITED MOTORS LINE

DISTRIBUTED BY ELECTRONICS WHOLESALERS EVERYWHERE

What's New in Radio

(Continued from page 78)

as part of the *Wharfedale* line of loudspeakers and associated equipment.

The new network is designed to be used with three-speaker sound systems. Its purpose is to properly divide and separate frequencies between the woofer, mid-range speaker, and tweeter. The three loudspeakers should be of similar sensitivity.

Crossover points are at 800 and 5000 cycles and the network is of constant resistance half-section construction. It is also fitted with a volume control across the high-end output terminals to suit upper frequencies to the listeners' individual tastes.

For literature and additional information on the crossover network write Dept. W of the company.

SELENIUM RECTIFIER KIT

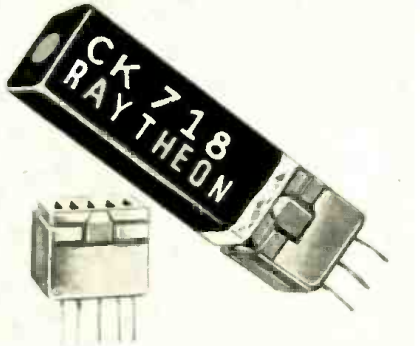
A new "build-your-own" selenium rectifier kit that enables the assembly of a wide range of selenium stacks at substantially reduced cost has been introduced by *Federal Telephone and Radio Corporation* of Clifton, N. J. for the electrical-radio-television market.

Designed to meet the rectifier requirements of a variety of users, ranging from radio hams and hobbyists to service technicians and electrical repairmen, the kit includes all the necessary components for assembling any one of four different types of selenium rectifiers—half-wave, full-wave center-tap, full-wave bridge-type, and full-wave battery charger.

Complete and simple step-by-step instructions are included with each kit.

TRANSISTOR SOCKET

Super Ear Products Co., 675 Merrick Road, Lynbrook, New York is



now offering a new subminiature socket for use with the new *Raytheon* transistors.

The three-prong socket measures approximately ¼" wide and ⅜" high and is molded of mica-filled Bakelite —a high-impact resistant material. The prongs are of phosphor bronze, silver-plated. The sockets are also available with the prongs pre-tinned for assembly-line applications.

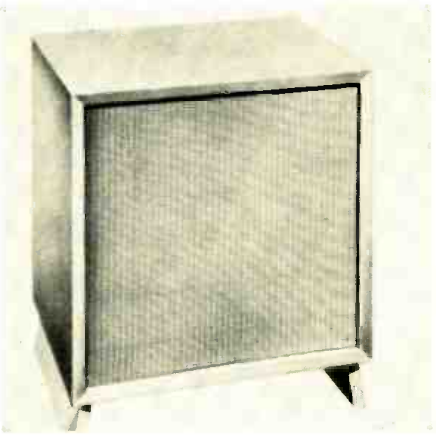
A five-prong socket for the *Raytheon* DX series of subminiature vacuum tubes is also available.

The company will supply full details on request.

R-J FLOOR MODEL ENCLOSURE

R-J Audio Products, Inc., 164 Duane Street, New York 13, New York has recently added a new smooth-sanded, unfinished mahogany floor model enclosure to its line.

The new model is made to the same



dimensions and will perform the same as the regular floor model enclosures the company is currently marketing. The enclosure is cut to fit any standard 12" or 15" speaker, permitting maximum bass performance.

Additional information on the new unfinished model or other units in the company's line is available from Dept. R-J of the company.

TURNER MIKE

The Turner Company of 900 17th St., N.E., Cedar Rapids, Iowa is in production on a new dynamic microphone, the ADA 95D.

The new unit follows the trend toward slender, modern styling yet provides rugged service for quality p.a., recording, and broadcast uses.

Frequency response is 70 to 10,000 cps with an output level of 58 db below one volt/dyne/sq. cm. A standard ⅝"-27 coupler swings the mike in a 60-degree arc. It is finished in satin chrome and comes equipped with a 20 foot removable cable set. A choice of 50,200,500 ohms or high impedance is available, as well as various switching arrangements.

TINY RESISTORS

Dale Products, Inc. of Columbus, Nebraska has placed a new deposited carbon resistor with silicone coating on the market.

According to the company, the tiny DCS ½ offers accuracy, stability, dependable performance, and economy in high frequency applications. The resistance range is from 5 ohms to 2 megohms.

New illustrated literature and price lists on the DCS ½ are available from the company on request.

—30—

4-CHANNEL CONTINUOUS RECORDER-REPRODUCER

New communications network monitoring system makes possible a permanent and continuous record of radio or phone messages.

MAGNECORD, Inc. of Chicago has developed a unique four-channel, continuous recorder-reproducer system for the Civil Aeronautics Authority to CAA specifications for communications network monitoring.

The system consists of an enclosed, rack-mounted recorder, separate playback unit, portable test equipment for adjusting components, a movable table and storage unit, and a portable continuous bulk eraser. The recorder will operate continuously for eight hours without tape changing and uses standard ¼ inch recording tape.

Mounted in the rack are two tape transports, each independently removable while the other remains in operation. Each tape transport contains a four-track recording head assembly and a movable monitoring head which may be indexed to any of the four recording channels for monitoring purposes.

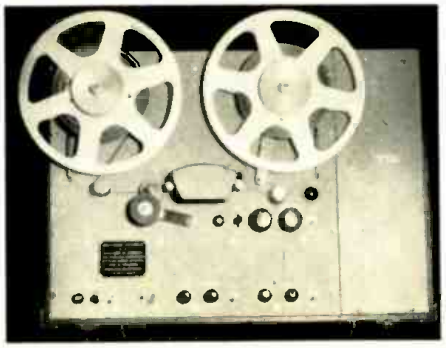
Automatic controls provide switching from one recorder unit to the other two minutes before the end of the tape. The first unit automatically stops at the end of the tape. In case of tape break, the unit shuts off and the second unit begins immediately while a light indicates the tape breakage. The entire unit may be remotely operated if desired.

The associated multi-channel playback unit is a four-track reproducer with provisions for manual or foot-switch operation. It has both normal and high speed operation in either forward or rewind directions. The reproducer amplifier has simultaneous inputs for two channels which may be selected from any one of the four tape tracks which are available.

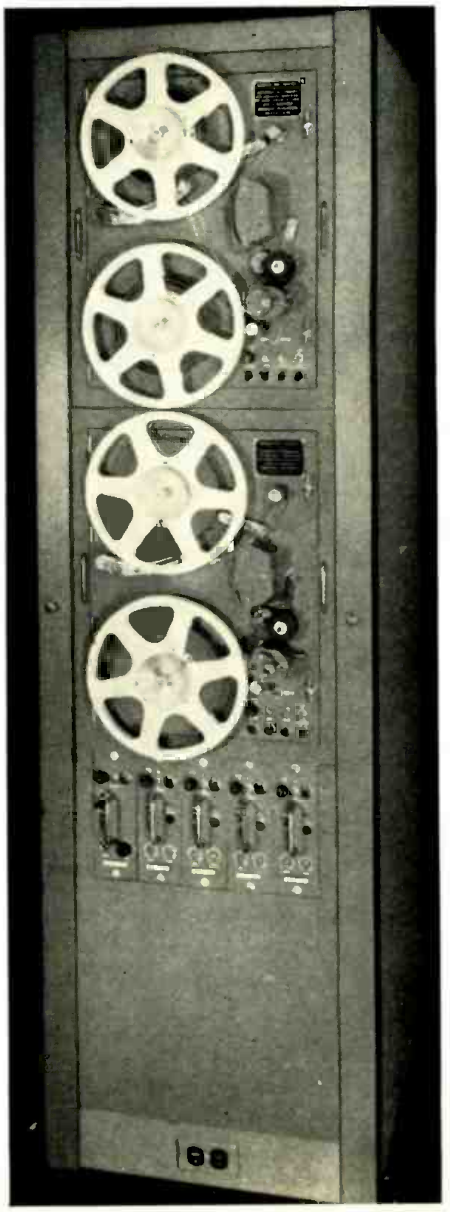
The portable bulk eraser, which is part of the system, is designed for constant operation and has a built-in blower system to keep the large internal reactors cool. Because of this feature, the unit is able to handle large quantities of tape without difficulty.

The various accessory units used in conjunction with the recorder and playback unit are designed to make the unit self-contained and self-sustaining. —30—

The muli-channel "reproduce" tape transport unit of the new system.



The rack-mounted, multi-channel "record" tape transport cabinet.



BUY TEST EQUIPMENT
ON THIS RADICALLY NEW
TIME PAYMENT PLAN

NO INTEREST!! - NO CARRYING CHARGES!!

USE CONVENIENT TIME PAYMENT ORDER BLANK BELOW

Superior's New Model 770

VOLT-OHM MILLIAMMETER

Sensitivity—1000 ohms per volt

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

SPECIFICATIONS:

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

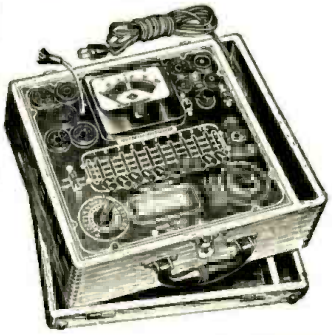
Model 770 is an accurate pocket-size V.O.M. Measures only 3⅛"x 5⅞"x2¼".

$14.90 NET

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

Superior's New Model TV-11

TUBE TESTER



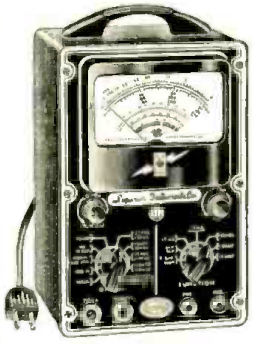
• Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating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

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

$47.50 NET

Superior's New Model 670-A

SUPER-METER



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

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
REACTANCE: 50 to 2,500 Ohms. 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 to +38 +34 to +58

Comes housed in rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 6¼"x9½" x1½".

$28.40 NET

ADDED FEATURE: The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

Superior's New

TV BAR GENERATOR

THROWS AN ACTUAL BAR PATTERN ON ANY TV RECEIVER SCREEN!!

CONNECTS DIRECT TO ANTENNA POST

NO CONNECTION INSIDE RECEIVER

Features.—Can be used when no stations are on the air. • Provides linear patterns to adjust vertical and horizontal linearity • Provides vertical and horizontal sweep signals • Provides signal for testing video amplifiers.

TV Bar Generator comes complete with shielded leads and detailed operating instructions ..... Only

$39.95 NET

Superior's Model 660-A—A NEW A.C. OPERATED

SIGNAL GENERATOR

Provides Complete Coverage for A.M.—F.M. and TV Alignment

• Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 220 Megacycles on powerful harmonics. • Accuracy and stability are assured by the use of Permeability trimmed Hi-Q coils. • R. F. available separately or modulated by the internal audio oscillator. • Built in 400 cycle sine wave audio oscillator used to modulate the R. F. signal also available separately for audio testing of receivers, amplifiers, hard of hearing aids, etc. • R. F. Oscillator Circuit: A high transconductance heptode is used as an R. F. oscillator, mixer and amplifier. Modulation is effected by electron coupling in the mixer section thus isolating the oscillator from load changes and affording high stability. • A. F. Oscillator Circuit: A high transconductance heptode connected as a high-mu triode is used as an audio oscillator in a high-C Colpitts Circuit. The output (over 1 Volt) is nearly pure sine wave. • Attenuator: A 5 step ladder type of attenuator is used.

• Tubes used: 1—6BE6 as R. F. Oscillator, mixer and amplifier. 1—6BE6 as Audio Oscillator. 1—6H6 as Power Rectifier. The Model 660-A comes complete with coaxial cable test lead and instructions ..... NET

$42.95 NET

NEW TIME PAYMENT PLAN

ORDER BLANK

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. B-61, 38 Murray Street, New York 7, N. Y.

Please send me the units checked below. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

- ☐ **MODEL 770** ..... Total Price $14.90
  $2.90 down payment. Balance $2.00 monthly for 6 months.
- ☐ **MODEL TV-11** ..... Total Price $47.50
  $11.50 down payment. Balance $6.00 monthly for 6 months.
- ☐ **MODEL 670-A** ..... Total Price $28.40
  $7.40 down payment. Balance $3.50 monthly for 6 months.
- ☐ **TELEVISION BAR GENERATOR** ..... Total Price $39.95
  $9.95 down payment. Balance $5.00 monthly for 6 months.
- ☐ **MODEL 660-A** ..... Total Price $42.95
  $12.95 down payment. Balance $5.00 monthly for 6 months.
- ☐ I enclose $..... as down payment.
- ☐ Ship C.O.D. for the down payment.

Signature .....

Name .....

Address .....

City ..... Zone..... State.....

Low-Pass Filter

(*Continued from page 47*)

for Channel 4. The attenuation continues to increase with frequency. The effectiveness of the filter is further demonstrated by the fact that no interference is observed on the writer's TV set on any channel. This is true even though the transmitter operates with 150 watts' input power on all bands from 160 to 10 meters and the transmitting antenna is located only a hundred feet from the television receiving antenna. It might be mentioned in passing that the writer's TV set, a *General Electric* Model 818, includes an effective high-pass filter as a part of its design.

After the work was all done, the cost of the components entering into the construction of this unit was added up. It came to less than five dollars, a most gratifying development. The most modern, "perfectly TVI-proofed" transmitter will still generate some harmonics, and this is a very small price to pay to keep them home.

—30—

Tunable Hum

(*Continued from page 42*)

on, (refer to Fig. 1) 117 volt 60 cycle a.c. was impressed across the lightning arrester terminals through the antenna primary coil and line bypass condenser. The leaky lightning arrester, acting like a nonlinear resistor, became a modulator and caused the amplitude of any broadcast signal coming down the lead-in to vary at a 60 cps rate. Enough carrier, now hum modulated, was re-radiated from the antenna connected to this lead-in to affect all receivers in the apartment house area.

Another way of looking at the phenomenon is to visualize the offending antenna as being connected to a device whose impedance varies at a line frequency rate. This might cause absorption of all r.f. signals in the vicinity. This again could be equivalent to hum modulating these carriers.

To summarize then, external hum modulation will occur in an area when:

1. An a.c. power line voltage is impressed across a semiconductor like a leaky insulator or a corroded electrical joint.

2. The leaky insulator is at the same time connected to a radiating system like a long wire or an antenna. If the power line is of the external overhead type it constitutes an excellent radiating system. See Fig. 2.

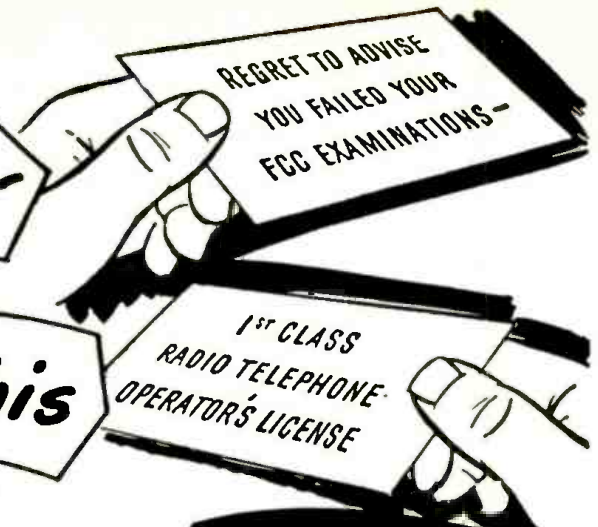
The diagnosis of tunable hum is much simpler than its localization and cure. With a portable receiver and the co-operation of the local power company and the community, this type of interference can be entirely eliminated.

—30—

Six months from today

Which Will You Hold?

this -



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Clifford E. Vogt, Box 1016, Dania, Florida	1st Phone	20
Francis X. Foerch, 28 Beucler Pl., Bergenfield, New Jersey	1st Phone	38
S/Sgt. Ben H. Davis, 317 North Roosevelt, Lebanon, Illinois	1st Phone	38
Albert Schoell, 110 West 11th St., Escondido, California	2nd Phone	23

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ISOLATED LOW VOLTAGES

By RONALD L. IVES

IN MAINTENANCE, repair, and experimental work, the need frequently arises for low a.c. voltages which are isolated from ground. The standard method of securing these voltages is by use of an isolation transformer and a Variac. This combination works excellently, is highly dependable and convenient, and costs about $35.00.

To reduce costs, many experimenters connect two small filament transformers "back to back," inserting a rheostat or potentiometer in the low-voltage intermediate circuit to permit variation of the output voltage, as in Fig. 1A. Within the ratings of the transformers and resistor, this expedient works quite well, and costs less than $10.00 in most instances.

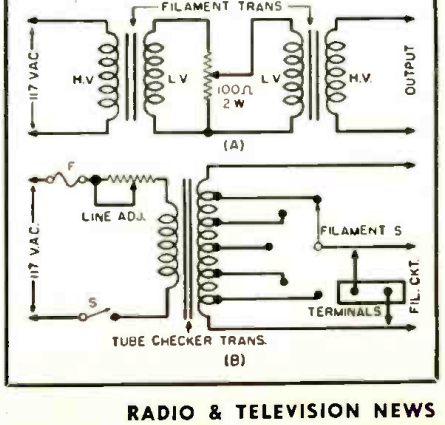
Most service shops, however, already have available a tapped isolation transformer, equipped with means for varying the output voltage both in steps and continuously! Such a transformer is an integral part of most tube checkers of better manufacture, and an additional expenditure of less than $1.00 will make these voltages available for test and experimental work. All that is needed is a means of tapping into the filament circuit of the tube checker.

A generalized circuit of a tube checker filament supply is shown in Fig. 1B. To obtain the various voltages, a plug connector can be wired to fit any socket, such as the octal, with lead wires connected to the 2 and 7 pins. When the controls are set for a 6J5, or any other octal tube with similar filament connections, the voltage across these leads will be that produced by the filament transformer, the actual value being a function of the setting of the filament voltage switch and of the line adjustment.

A slightly more elegant method is to mount a terminal, such as an Eby 21-R or a National R-39, at some convenient place on the panel, and then to wire it directly across the filament leads of the checker. Voltage will be determined by filament voltage switch and line adjuster settings, and will be independent of the other settings.

If the tube checker is not already equipped with a fuse, one should be installed, to prevent transformer burnout in event of an accidental short circuit. Replacement fuses cost three cents: replacement transformers cost $8.00 and up, mostly up. —30—

Fig. 1. (A) Standard method of varying output voltage. (B) Tube checker filament supply with the adaptations to permit its use as a variable output low voltage source.



WINNERS BOTH! * See Foot Note

* FOOT NOTE: Ole Timer For Operating And WALTER ASHE For "Surprise" Trade-Ins!

ELMAC Model A-54 Wired for 10, 11, 20, 40 and 75 meters. Net $143.00

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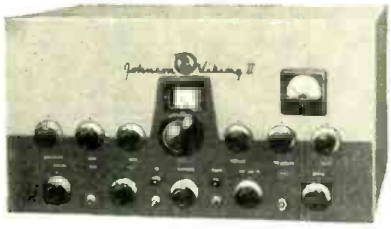
STANCOR Mobile Kit. Model ST-203A. 10-11 meters. Simple conversion instructions for other bands. Less tubes. Net $47.50. Wired and tested. Less tubes. Net $66.75



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Oscilloscope Calibrator

(Continued from page 71)

inch, etc. However, if the user is dealing with waveforms of widely varying amplitudes, this method is inconvenient and can easily lead to errors. A second method, and one which makes more use of the calibrator, involves observing the waveform under measurement with the scope gain set to view the waveform at any convenient height. The calibrator can then be switched from the "Scope" position to the "Cal" position whereupon the calibrated pot is adjusted to produce the same height as the previously observed waveform. The dial and multiplier readings on the calibrator are noted. These two readings when multiplied together give the peak-to-peak voltage of the observed waveform.

The use of this instrument is readily extended to make it even more useful. By adjusting the grid resistor and coupling condensers of the multivibrator to produce a specific frequency, a convenient signal source for square-wave testing of audio amplifiers is obtained. The device can also be used for both r.f. and a.f. signal tracing since the square-wave output is so rich in harmonics. However, if it is used for this purpose, it is essential that condensers be included in series with both leads connected to the output of the calibrator.

Probably even more uses, other than its intended purpose will suggest themselves to the constructor, thus making this unit a very worthwhile addition to anybody's shack, shop, or laboratory. —30—

WORLD RADIO USE TOTALS

OVER half the radio receivers in the world are located in the U.S., according to the recently-published United Nations Statistical Yearbook for 1952. As of 1951, the latest year for which totals were available, there were an estimated 105,000,000 home and public-entertainment sets in operation here, exclusive of TV and other special receivers. Since the totals for the various countries include individual loudspeakers fed by central distributing receivers (of the type used for public information and entertainment in some countries) the American portion of the world total is probably greater than it appears statistically.

Some nations, including the U.S., have shown an enormous gain over available statistics for 1938. In this country the 1951 figure is two and a half times the 1938 estimate. In 1951 there were twice as many radios as prewar in Japan, Czechoslovakia, Australia, and Canada and nearly twice as many in Sweden. France and the United Kingdom showed increases of 57 and 50 per-cent respectively. The most striking increase was recorded by Italy, the 1951 figure being 280 per-cent higher than in 1938.

No figures on set ownership were available from the USSR.

This report again underlines the importance of radio in disseminating information. —30—

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1A5GT	.79	3Q4	.69	6AX5	.79	6J5GT	.59	6SS7	.99	7J7	1.19	12J5GT	.75
1A7	.69	3Q5GT	.89	6AX6	.69	6J6	.79	6T7G	1.15	7K7		12K7GT	.69
1A7GT	.79	3S4	.69	6AY5GT	.89	6J7G	.69	6T8	.89	7L7	.79	12K8	.89
1B3GT	.95	3V4	.95	6B4G	1.44	6J8G	1.15	6U5	69c	7N7	.69	12Q7GT	.89
1B5	.29	5T4	1.40	6B8GT	1.15	6K5GT	.69	6U6GT		7Q7	.79	12S8	.89
1H5GT	.59	5U4G	.59	6BA6	.59	6K6GT	.59	6U7G		7R7	1.19	12SA7GT	.69
1J6GT		5V4G	.87	6BA7	69c	6K7GT	.69	6U8	.89	7S7	1.19	12SC7	1.05
1L4	69c	5W4	59c	6BC5		6K8GT	1.19	6V3	1.29	7V7	.79	12SF5GT	.69
1L6		5W4GT		6BC7	1.05	6L5G	.95	6V6GT	.69	7W7	1.19	12SF7	.99
1LA4	1.19	5Y3GT	.45	6BD5GT	.89	6L6G	95c	6W4GT	.59	7X6	1.05	12SG7	.89
1LA6	1.19	5Y4G	.54	6BE6	.59	6L6GA		6W6	.69	7X7	79c	12SH7GT	
1LC5	.69	5X4G	81c	6BF5	69c	6L7	1.19	6X4	59c	7Y4		12SJ7GT	69c
1LC6	1.19	5Z3		6BF6		6N6G	1.40	6X5GT		7Z4	.89	12SK7GT	
1LD5		6A3	1.68	6BG6G	1.69	6N7GT	1.19	6Y6G	.69	12A7	1.59	12SL7GT	
1LE3	1.19	6A7	1.21	6BH6	69c	6Q7GT	.59	6Z4/84	.72	12A8	.69	12SN7GT	.99
1LH4	1.19	6A8GT	69c	6BJ6		6R7GT	1.19	7A4	.95	12AH7	1.38	12SQ7	
1LN5	1.19	6AB4		6BK7	1.19	6S7GT	.69	7A5	1.19	12AL5	.54	12SQ7GT	69c
1N5GT		6AB7	1.15	6BL7	.79	6S8GT	.59	7A6	.89	12AT6	.59	12SR7GT	
1P5GT	79c	6AC5GT	.89	6BN6	1.19	6SA7GT	69c	7A7	79c	12AT7	.89	12Z3	.95
1Q5GT		6AC7	1.45	6BQ6GT	.85	6SC7		7A8		12AU6	.69	14A7	1.09
1R5	1.05	6AG5	1.05	6BQ7	1.29	6SD7GT	.99	7B4	.89	12AU7	.79	14AF7	.93
1S4	.99	6AG7	1.49	6BZ7		6SF5	.59	7B5	.89	12AV6	.59	14B6	89c
1S5	69c	6AH6	1.89	6C4	.59	6SF7	.59	7B6	.89	12AV7	.89	14B8	
1T4		6AK5	.89	6C5GT	69c	6SG7	69c	7B7	89c	12AW6	1.19	14C5	1.25
1U4		6AK6	1.08	6C6		6SH7		7B8		12AX4	.69	14C7	1.12
1U5	.59	6AL5	69c	6CB6		6SH7GT	.69	7C4	1.30	12AX7	.69	14F7	1.05
1V	.88	6AQ5		6CD6G	1.69	6SJ7	.79	7C5	.89	12AY7	$1.95	14F8	1.45
1X2A	.89	6AQ6	.81	6D6/78	1.10	6SJ7GT		7C6		12BA6	.59	14H7	1.12
2A6	89c	6AR5	.79	6D8G	1.15	6SK7GT	59c	7C7	79	12BA7	1.19	14Q7	1.05
2A7		6AT6	.59	6E5	.69	6SL7GT		7E5		12BE6	69c	14W7	1.19
2B3	.89	6AS5	.90	6F5GT	59c	6SN7GT	.69	7E6		12BF6		14X7	1.19
2B7	.89	6AU5GT	1.29	6F6GT		6SQ7	.59	7E7		12BH7	.69	19BG6G	1.69
2C34	.60	6AU6	.59	6F7	1.59			7F7	.89	12BY7	.89	19T8	.89
2E5	.89	6AV5GT	.89	6F8G	1.59			7F8	1.47	12BZ7	1.19	20	1.40

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There are a number of glib generalizations in servicing that too many men accept at face value. Take the oft-repeated advice that the fastest way to check a capacitor in a set is by bridging another one across it. If you stop to think about this you will see that it can be valid for only one condition: when the defective capacitor is open. If a capacitor is shorted or leaky, bridging will reveal little or nothing because the basic trouble remains. The surest test for any capacitor is to disconnect one end and then check it with a suitable instrument.

Write to us for the reprint of the informative scope article that appeared in the January 1953 issue of RADIO & TELEVISION NEWS. If you want a copy, drop us a line and one will be shipped to you post haste.

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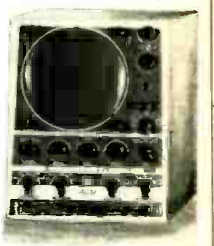

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35W4	99c	35Y4		35Z3	.75	3524	.55	3525	.79	35/51	1.06	36	.93
37	88c	38		39/44	1.40	41	.72	42	.69	43	72c	45	.69
45Z5	89c	46		47	50A5	1.05	50B5	69c	50C5		50C6G	1.39	50L6
.69	50X6	.69	50Y6	.99	57	79c	58	70L7	1.49	70L7GT		71A	.87
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7"	$1.00	14"	$3.00	19"	$4.00
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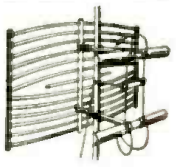

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Double bay array, with stacking bars . . $7.75
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20 Ga, 80 Mil, 100 ft.	1.89
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TUBULAR 300 OHM LINE 1,000 ft.	$34.50
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1U4, 3S4, 1S5, 1R5. List Value $7.80. All Four Tubes for	$1.98
117Z3, 1U5, 3S4, 1R5, 1T4. AC-DC Portable Kit. All for	$2.49
12AT6, 12BA6, 12BE6, 35W4, 50B5. 5 Tubes for	$2.59
50L6GT, 35Z5GT, 12SQ7GT, 12SK7G, 12SA7G. 5 Tubes for	$3.22

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Ultra-high Gain

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Single Bay $4.50
Two Bay, complete $8.45
Four Bay, complete $15.95

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1,000 ft. $34.50
100 ft. $4.95

UHF WAVE TRAP

Teleron printed circuit, for channels 14-83 in UHF waveband, clearest picture—30 seconds to attach. net ea. $2.32

DYNAMIC NOISE SUPPRESSOR

By T. B. COUCH

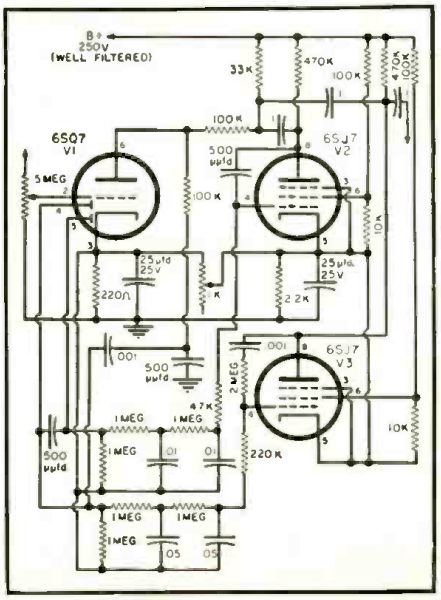
THE purpose of this article is to show how the dynamic noise suppressor may be improved over past designs. Circuits of this type have suffered from a variety of undesirable effects; notable among these was the introduction of distortion products that were not present in the original transmission. Among these effects is the so-called ringing produced by the chokes when the gates were opening and closing and also there were noticeable thumps, swishing, and "on-off" effects. It is the opinion of the author that this circuit is free of these defects that have characterized dynamic noise suppressors in the past.

The first basic change, it will be noticed in the diagram, is that the two chokes are missing from the circuit. This can be accomplished by increasing the phase shifting condenser to a larger value. Increasing this condenser value determines the maximum amount of suppression and it can be made variable to suit the needs of the listener. The coupling condensers, from the respective gates are larger in value, to extend both the high and low end when the gates are open. The timing circuits have been made fast acting in order to follow rapid variations in the music but not too rapid to distort the shimmer of a loud passage.

The frequency selective networks associated with the control amplifier are the same as in past circuits and are adequate for this improved version of the dynamic noise suppressor.

All records have a definite background noise which increases with wear, detracting from the original performance. The use of this suppressor with modern long playing type discs and older shellac pressings will improve the signal-to-noise ratio without any of the undesirable defects mentioned previously. Circuit details have been omitted because the dynamic noise suppressor has been explained many times in the past. The author uses this unit in a modern wide range system and has found it quite adequate for all program material, including live FM. —30—

An "improved" dynamic noise suppressor.



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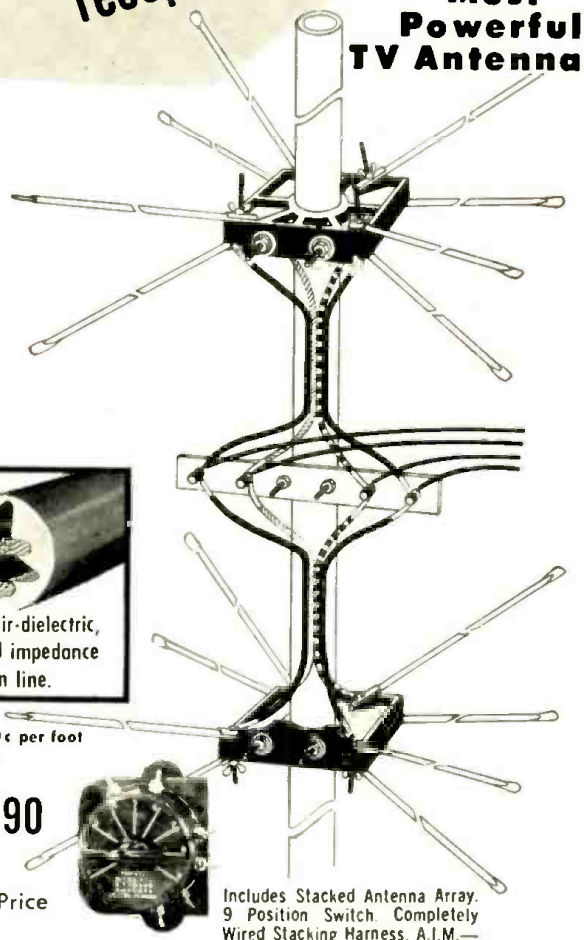

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- All aluminum flip-out assembly.

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Approx. 300 Ohms between every two of the four conductors.

Four conductor air-dielectric, tubular, matched impedance transmission line.

4 Conductor Tubular Wire 10¢ per foot
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☐ C.O.D. enclosed please find 25% of total purchase price . . . check . . . Money Order.
☐ Please put my name on your "Special Bargain" mailing list.
( ) Enclosed find $_____in full. Send prepaid

Mac's Service Shop

(Continued from page 68)

absolutely impossible with the older instruments.

"For instance, a scope with a ten-millivolt sensitivity will produce an inch-high trace with only one one-hundredth of a volt r.m.s. applied to the vertical amplifier. That means it is many times more sensitive than the a.c. meters usually found around a service shop. A very tiny voltage, such as that put out by a crystal microphone, is more than sufficient to drive the trace beyond the limits of the screen. In working on an amplifier, such a scope can be used to trace the signal from the input to the output.

"And high-frequency waveforms can be examined as easily with our modern scope, that has a sweep generator going up to 100,000 cycles, as could the line voltage sine wave with the older instruments. You proved that the other day when you were looking at the r.f. waveform put out by our signal generator. Even when the generator was working at several hundred kilocycles you were able to display just a few cycles on the screen."

"Yes," Barney broke in, "and I remember your using that scope to show George what was wrong with his sweep generator when he kept hollering because when he lined up a set with the sweep generator so that the response curve of the i.f.'s looked perfect, the set would not work right, and when he looked at the i.f. passband curve of a set that was OK, the curve bore no resemblance to anything living or dead. You put the crystal probe on the scope and looked at the voltage produced across the output of the signal generator while the wide sweep was being used and found a bad hump in the output around twenty-four megacycles because of a wrong terminating resistor. When George adjusted the i.f. trimmers so that this hump did not show, he was actually producing a deep dip in the true response curve at the hump frequency. You could not have made this test with an insensitive scope."

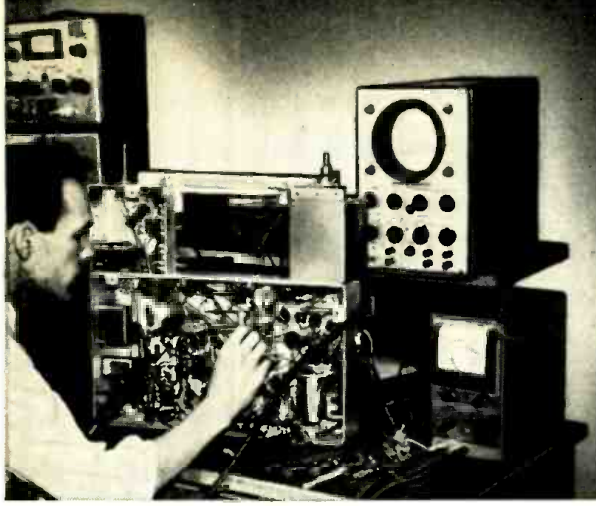
"You get the idea," Mac complimented him. "Technicians should remember that service instruments are like little girls: they grow up and often improve greatly, and just because you were acquainted with one away-back-when is no sign that you would even recognize an up-to-date version."

"Yeah man!" Barney said with the enthusiasm he always displayed when the subject of girls was mentioned. "Not to change the subject, though, what is that new little shelf for over there in the corner?"

"You're not changing the subject," Mac said with a grin. "That is for our 'new' second-hand test instrument: a small communications receiver."

"And that is a test instrument?" Barney marvelled.

For opportunities within your reach



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The entire course is divided into ten units of several individual lessons. You study them at home in your spare time. Lesson-by-lesson you learn the theory and step-by-step procedures of installing TV antennas, of servicing and trouble-shooting TV receivers. Hundreds of pictures and diagrams help you understand the how-it-works information and the how-to-do-it techniques. You will be amazed how easily you absorb the knowledge of each lesson, how quickly you train yourself to become an experienced technician.

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The RCA Institutes course was written and planned by instructors with years of specialized experience in training men by home-study and resident-school methods. The course embodies RCA's background of television experience plus knowledge gained in training several thousand technicians. A study of the course parallels an apprentice's training. Your lessons are carefully examined and accurately graded by friendly teachers who are interested in helping you to succeed.

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"It will be as we use it. In the first place the good engineering and the complete shielding of the set will make it an 'ideal' broadcast receiver with which we can compare house receivers we work on. When we want to know if a certain noise or interference is originating outside of the set, a quick check with this communications job will tell us. Then, too, you will notice the small coaxial cable that runs from the bench over to the set and can be either connected to the antenna terminals or to the plug in the 'phones' jack. That enables us to run a signal from the bench into the receiver or a signal from the receiver back to the bench."

"What's the good of that?"

"The bench-to-receiver connection will allow us to check our r.f. generators for accuracy whenever we wish. For rough checks, we can flip on the receiver's beat-frequency-oscillator so we can hear the generator output and depend upon the dial calibration itself, which will be plenty good enough for most of our uses. When we want really accurate checks, we can tune in WWV on 2.5, 5, 10, 15, 20, 25, 30, or 35 megacycles—the receiver tunes from 540 kc. to forty megacycles—and then beat either generator fundamentals or harmonics against the standard frequency stations to produce checks on almost any frequency we want.

"When the receiver-to-bench connection is in use, we can use the 440 and 600 cycle tone modulation of WWV to check our audio generator by comparing its output with these standard frequencies when the two outputs are combined in Lissajous figures on the scope."

"Yeah, and if a customer wants to hear his set before he pays for it, and if someone in the neighborhood happens to be running an electric drill at that particular moment, we can prove to him that the noise is not just in *his* set," Barney pointed out.

"And of course," Mac remarked, "it will come in mighty handy for picking up the ball games—but of course you would never think of that."

"Of course not," Barney agreed. —30—

Preamp-Equalizer

(Continued from page 46)

ma., a dry disc rectifier supply with a 7.5 volt transformer, as shown in Fig. 4A is most applicable when d.c. is required. The remaining heaters should not be operated from the d.c. side of the supply as the ripple would substantially increase. An alternative, shown in Fig. 4B, may appeal to some experimenters. 12AU6's can be series operated from a 150 ma. source if this type is used instead of the 6U8.

Construction

An infrequently used method of construction is shown in the accompanying illustrations. This method greatly facilitates wiring and maintenance as well as ensuring a professional appearance. Along with many others, the writer experiences as much, if not greater, satisfaction from the building process as from the performance of the completed unit. Even so, wiring does become tedious and much thought was given to correcting some of the wiring and parts placement difficulties with a mechanical arrangement that permits simpler and more positive techniques. The sub-assembly method permits the bulk of the parts mounting and wiring to be negotiated in the open with a freedom uncommon to point-to-point chassis wiring.

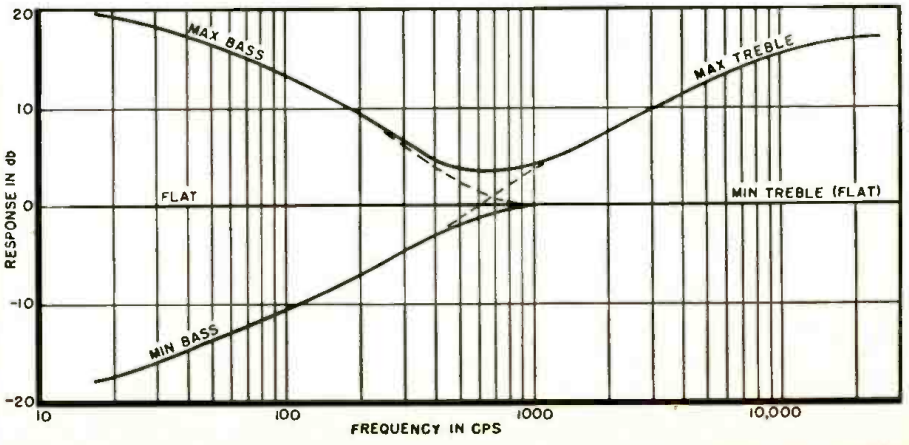
The writer wishes to thank the many persons who have expressed their interest in the preamplifiers heretofore described and who have offered suggestions for their improvement.

Special gratitude is offered to Mr. Uolevi Lahti of Ann Arbor, Michigan, whose unusual interest and activity in the high fidelity sound reproduction field has made possible the many listening tests and inspiration resulting in the unit described in this article.

REFERENCES

1. *Rose, Arthur J.: "Front End Control Unit for Williamson Amplifier,"* RADIO & TELEVISION NEWS, *June 1952.*
2. *Read, Oliver: "The Recording and Reproduction of Sound," Howard W. Sams & Co., Inc., Indianapolis. Page 478.* —30—

Fig. 5. Response of bass and treble controls. Curves closely approach their theoretical counterpart because of ideal circuit conditions. See discussion.



Noise Immunity Circuits

(*Continued from page 55*)

nal. Thus, this system can adapt itself to both weak and strong signals, as required.

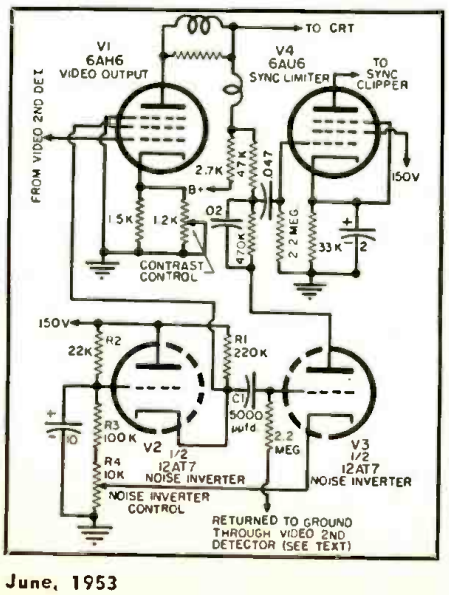
Bendix Circuit

Bendix TV receivers have a noise suppressor system which attacks the problem from still another angle. The entire circuit revolves about a twin-triode 12AT7. See Fig. 4. The first section, V_2, actually is placed in shunt with the screen dropping resistor, R_1, of the video output amplifier, V_1. The bias for V_2 is established by the voltage divider network R_2 (22,000 ohms), R_3 (100,000 ohms), and R_4 (a 10,000-ohm potentiometer). The cathode of V_2 connects directly to the screen grid of the video amplifier and since the screen grid is not bypassed to ground, a certain amount of voltage variation will occur across R_1 as the signal changes. The bias chosen for the grid of V_2 will permit this tube to conduct varying amounts depending upon the signal reaching the cathode of V_2. This, in turn, will vary V_2's shunting effect on R_1 with the net result that the voltage at the screen grid of V_1 will remain fairly constant until a strong noise pulse comes along.

Also coupled to the screen grid of V_1 is the grid of V_3. This is accomplished through C_1, a 5000 $\mu\mu$fd. condenser. V_3 will therefore receive the voltage variations present at the screen grid of V_1 but its cathode voltage has a sufficiently high positive voltage so that V_3 is normally non-conductive. R_4, the noise inverter control, establishes the positive voltage of the cathode.

The circuit is now set for the arrival of a strong noise pulse and when this occurs, it drives V_1 sharply into cut-off. (Sync pulse polarity at the grid of V_1 is negative.) This allows

Fig. 4. Noise suppressor circuit used by Bendix in its models 0AK3, 21K3, 21KD, 21T3, and 21X3 television receivers.



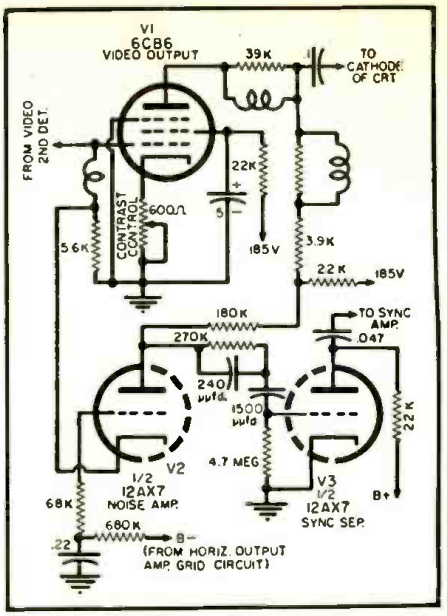


Fig. 5. Noise suppression circuit used by Magnavox. Noise pulses traveling through two paths to the sync separator grid meet there out-of-phase and cancel each other.

the voltage at the screen (and plate) of V_1 to rise sharply. The screen grid positive pulse, reaching V_3, drives this tube into cut-off, removing its shunting effect and, in essence, raising the screen-grid potential still farther. The grid of V_3 also receives this positive pulse, bringing it sharply out of cut-off. The resulting negative pulse at the plate of V_3 combines with, and tends to cancel out, the positive noise pulse which is traveling from the plate of V_1 to the grid of V_4, the sync limiter.

Thus, the circuit has achieved the basic goal of reducing and even preventing strong noise pulses from reaching the sync limiter.

The setting of the noise inverter control will determine when V_3 is brought out of cut-off. Too low a setting could result in picture instability because some of the sync pulses will be depressed or even removed. Too high a setting will prevent V_3 from acting except on extremely strong noise pulses. Hence the control must be set carefully to obtain full benefit from this system.

Part of the bias on V_3 is controlled automatically because the grid is returned to ground through the video detector circuit. Signal polarity in the video detector circuit is negative which means that the average negative voltage that the grid of V_3 receives will vary with signal strength. This merely means that it will require a stronger noise pulse to bring V_3 out of cut-off when the video signal is strong and a weaker pulse when the incoming signal is weak.

Magnavox Circuit

The versatility of vacuum tubes and the ingenuity of engineers result in an almost endless variety of circuits. A noise suppressor circuit developed by *Magnavox* is shown in Fig. 5. The noise amplifier, V_2, is one-half of a 12AX7 which functions as a grounded-

Iraq—Baghdad, 6.135, noted 1415-1500 closedown with *English* session, *"Date With Baghdad;"* announces 11.724 as parallel. (Pearce, England)

Italy—Rome noted in *English* to Western North America 2145-2200 closedown on 9.57; announces 15.4, 11.9, 11.81, 9.71 in parallel. (Mesard, D. C.)

Japan—JKL, 9.603, noted 2120, fair in Ohio. (Arp)

Radio Japan, 7.180, noted 0600 with news, parallel 9.675; JKM, 4.940, noted 0510 with news and *English* lesson. (Sanderson, Australia) Now heard to Western North America over 11.705 (best) and 15.135 at 0000-0100. (Gay, Calif.) *Radio Japan* hopes to *extend* broadcasts later this year to Europe (French, German) and to Brazil. (*WRH*)

Kenya Colony—Nairobi, 4.855, takes BBC news relay 1300. (Pearce, England) Good level in Australia 1430. (Sanderson) FBS, 7.265, Nairobi, signs off 1500 but signal is erratic. (*N. Z. DX Times*)

Kuwait—"Huna Kuwait," 5.000, noted in Arabic 1330. (Pearce, Catch, England)

Liberia—ELBC, now 6.022A, Monrovia, is scheduled 1045-1845. (ISWC, London) Heard one Sun. until *after* 2000. (Saylor, Va.)

Luxembourg—Radio Luxembourg will shortly have a *new* 50 kw. transmitter in operation. (WRH)

Malaya—BFEBS, Singapore, noted on 11.955 at 0945 with BBC relay. (Pearce, England) On 7.120 around 0630 with native program, *English* announcements. ((Saylor, Va., others) *Radio Malaya*, noted in *English* 0945, good level. (Riggs, Calif.) Over 6.135 at 0600, fair level in N. J. (Washington) Kuala Lumpur, 6.025, has BBC news relay 0600. (Riggle, Ohio)

Mexico—Despite persistent overseas reports that the Mexican on 15.205A is an outlet of *"La Voz de Mexico"* (XEXE), it really is—and always has been—XESC (relaying m.w. XEMC) and its slogan sounds like *"Heraldos de la Tela de Junco."* Announcements do *not* indicate any affiliation with *"La Voz de Mexico."* (Stark, Texas, others) XEUW, 6.020, Vera Cruz, noted to 0042 recently. (Patterson, Ga.)

Monaco—Calls of *Radio Monte Carlo* are 3AM3, 6.035; 3AM4, 7.349. (*WRH*)

Mozambique—Portuguese outlet, 4.870, noted 1200 with chimes, closing 1514 with "A Portuguesa." (Pearce, England)

Lourenco Marques good lately in *English* session weekdays 2300-0030 on 9.766A. (Riggs, Calif.; Norman, N. C., others) Sundays at 0000-0100, fair level. (Balbi, Calif.) Noted parallel over CR7BU, 4.916, and on 3.490 (has QRM). (Washington, N. J.)

New Zealand—Revised schedules are to Australia 1300-1645, ZL7, 6.080; 1700-0045, ZL3, 11.780; 0100-0545, ZL7, 6.080. To Pacific Islands 1300-1645, ZL8, 9.62; 1700-0045, ZL9, 11.810; 0100-0545, ZL8, 9.620; closedown is 0545 weekdays, 0620 Sat., 0500 Sun.

Nicaragua—*Radio Sport*, 7.850A, is strong with Spanish 1800-2200. (Dexter, Iowa)

Nigeria—*Radio Nigeria*, Lagos, noted on 4.800A to 1500 closedown; BBC news relay 1300. (Pearce, Catch, England)

Outer Mongolia—Ulan-Bator is now heard on 6.328A from around 0400 to closedown 1000. (Japanese Short Wave Club)

Pakistan—*Radio Pakistan* has news 2130 over 15.335, 11.845. (Radio Australia) Noted with news 1015 over 9.484, 11.885. (Pearce, England) Heard on 11.885 with Home Service 1915, on 17.750 at 2315; 11.674 noted with news 0645; 15.335 has news 1930; noted parallel 1430-1600 over 6.235, 7.010.

Panama—HO50, 5.996, noted in Australia 0645 with Spanish news, music. (Sanderson)

Peru—OAX6E, *Radio Continental*, Arequipa, noted back on 6.336A from 6.305; news in Spanish 2015; weak. CWYRM. (Mercier, France) OAX4X, 15.105, Lima *Radio El Sol*, is fair around 1645. (Niblack, Ind.)

Philippines—DZH3, 9.500, *Radio Philippines*, now uses 1 kw., 1600-1000. (ISWL, England) *Radio Free Asia* relay over DZ15, 11.940, Manila, is strong in Britain with news 0950, off 1014A. (Pearce) DZH9, 11.855, Manila, noted recently with special program (*English*) at 1000 to USA. (Pearce, England; Riggs, Calif., others)

Portugal—*Radio Nacional*, Lisbon,

has been *asking for reports* on its North American frequencies of 5.976, 6.373, 9.746 at 1900-2100. (Boepple, Ohio)

Portuguese Guinea—CQM, 5.838, Bissau, noted 1650 with news in Portuguese. (de Mesquita e Sousa, Portugal)

Portuguese India—Radio Goa, 9.610, often carries "Bringing Christ to the Nations" (*English*) 1030. (Svensson, Sweden) Lists transmitters in the 31-, 49-, and 85-m. bands (probably 9.610, 6.025, 3.425), daily 2030-1130.

Reunion—Lists channels of 4.820, 7.170; heard on 4.820 at 0900-1310 (to 1345 Wed., Sat.) (Ridgeway, South Africa)

Roumania—Bucharest, 9.254, noted 1600-1645, poor level in Pa. (Black)

Saudi-Arabia—Djeddah noted around 2250 in Arabic over 6.102A parallel 7.200A. (Washington, N. J.)

South Africa—SABC, Johannesburg, noted closing 1130 on 11.937; reopening 1145 on 9.595A. (Pearce, England) Heard closing on 9.595A channel 1505. (Bellington, N. Y.) Heard in Britain on 4.895 from 1430. (URDXC)

South Korea—HLKA, 7.935A, Pusan, noted opening 0257, weak. (Gay, Calif.) HLKB, 9.555, Seoul, is scheduled 2130-0030, 0500-0900, 1600-1830. (ISWC, London) Noted by Sanderson, Australia, 0400 with Korean news, then Western music.

Spain—Radio Merida is now near 7.140 to 1800 closedown. (Pearce, England) Malaga, 6.979, good level 1335. (Catch, England) Madrid, 15.625, closes 1155 with anthem. (NNRC)

Syria—Damascus, 17.865, noted in *English* 1000-1045 to India-Pakistan. (Svensson, Sweden)

Switzerland—Berne, 9.655, noted with *English* for Western Europe 1345-1430; in Italian 1430. (Morrison, R. I.) Heard at good level on 6.165 to North America 2030-2115 and later. (Carroll, Me.)

Taiwan—BED6, 11.735, Taipeh, heard 2315 with news; BED32, 9.778A, noted 0500 with Western music, Chinese news; BED7, 7.130A, heard 0700 with Western music; BED26, 10.080, noted 1745, fair level in Chinese news, music. (Sanderson, Australia)

Tangier—Although *Radio International,* 6 110, is now using its *new* 50 kw. transmitter, signals are still badly QRM'd and *detailed reports are requested* to 34, Rue Goya, Tanger. QSL's will be accompanied by photo of new transmitter. (*Radio Amateur,* London)

Thailand—Bangkok, 11.910, noted with news 0500, on 6.240 with news 0615. (Sanderson, Australia) Heard over 7.105 at 0643, weak, native. (Ballou, Calif.)

Trinidad—Radio Trinidad, 9.625, noted with news 0700, BBC news 0800. (Saylor, Harold, Wisc., others)

Turkey—Ankara, 17.825, noted closing *English* for Far East 0915; opens 0830. (Pearce, England) TAS. 7.285, heard closing *English* 1645. (Harris, Mass.) Teknik University, Istanbul, 7.030, is good strength in Britain 1315-1500. (*Short Wave Listener,* England)

Uruguay—CXA19, 11.835. Montevideo, fair around 1700.

USI (Indonesia)—"Voice of Indonesia," 9.710, Djakarta, noted 0930-1030 in *English* to Southeast Asia; announces 4.910 parallel; heard over 11.770 at 1400-1500 to Europe, New Zealand; news 1430. (Pearce, England) With news 0615. (Sanderson, Australia) Makassar, *measured* 9.550, noted 0520, fair level, swishing QRN. (Ballou, Calif.)

USSR—Khabarovsk, 5.940, noted 0420, fair level, nice music; Alma Ata, 9.380, heard 0820, fair. Moscow noted opening to North America in *English* 1820 on 7.24. (Bullock, Duddy, Ind.)

Venezuela—Radio Rumbos, 4.970, Caracas, fair with news 1845. (Maynard, Ky., Richmond, N. Y., others) YVMS, 4.850, Barquisimeto, noted 2109-2130; CWQRM. YVKF, 4.880, heard 2350-0012. (Patterson, Ga.)

Yugoslavia—Radio Yugoslavia, Box 97, Belgrade, *tested* recently to the Americas 2030-2130 on channels of 6.100, 9.505, 7.200, 11.735; by this time probably will have settled down on one or more of these outlets. (Bellington, N. Y., others)

* * *

Press Time Flashes

Myron Smith, N. Y., reports a station announcing as *"Radio Germany,"* broadcasting from Berlin, at 1300 with *English* on about 9.800.

VLT, Port Moresby, British New Guinea, by this time will have vacated 9.520 and 7.280 in favor of 6.130; schedule is VLT6, 6.130. Sat. to Wed., 1545-1745; Thur. 1545-1730; Fri. 1645-2000; Sun.-Thur. 2100-2245, 0100-0745; Fri. 2100-0800; Sat. 2100-2300, 0100-0700.

Radio Peking, China, lists *English* for 1730-1800, 6.100, 7.500, 9.040 10.260, 11.690, 15,060, 15.170; 0400-0430, 6.100, 10.260, 11.690, 5.060; 0830-0900, 11.690, 15.060. (Boepple, Ohio)

TGWA, Guatemala, now has "The Belize Program" (*English*) *one hour earlier*—1800-1900 on 9.760 on Mon., Wed., Fri. *only;* TGNA is now heard to 2200 in Spanish on 5.9525; 2200-2300 (Sun. to 2330) uses 5.9525 and 9.668 for *English* session. (West, Va.)

The French-speaking station on 9.430A at 1745-2000 appears to be "Ici Basse Terre, Radiodiffusion Francaise," Guadeloupe; has much CWQRM and some QRM from Brazzaville on 9.440. Frequency varies around *measured* 9.4353. (Rastorfer, N. Y.; Niblack, Ind.; Washington, N. J., others)

Suva, Fiji Islands, noted back on 5.995 (*varies*), closing 0500 with "God Save the Queen;" relays ABC news from Australia 0400. (Saylor, Va., Rosenauer, Calif.)

A *new* Costa Rican has been heard on 6.008 announcing "Emisoras de Radio Cristal en San Jose." heard 2030-2200 at good strength; call seems TIHV, m.w., and TIHVC, s.w.; commercials. ZPA3, *Radio Teleco en Asuncion,* 11.853A, Paraguay, noted opening 1700 with news in Spanish; on Tue. has religious broadcast 1745-1800. 4VWA, *Radio Citadelle,* Cap Haitien, Haiti, is heard in France as early as 1700 on 6.301; announces "Ici Radio Citadelle, Poste 4VWA au Cap Haitien, capitale touristique de la Republique d'Haiti, Grandes Antilles;" news in French 1800. A *new* Haitian is 4VGF, *Radio Independence,* Gonaives, a seaport and chief town of Northwest Province; uses 6.340, heard around 1850-2015 closedown; news in French 1900. Haiti is to commemorate the 150th anniversary of its national independence (1804) next year—which event occurred in Gonaives.

Peking—China, or relay thereof is heard on 9.76A as *early* as 1025 and to *after* 1230 in parallel with 7.50, 9.04, 10.26. (Gay, Calif.)

Radio Ceylon now uses 9.57 to relay VOA to Southeast Asia in *English* 1030-1230. (Gay, Calif.)

A *new* station in Malaya is *"The Forces Broadcasting Service, Singapore,"* heard on 5.010 at 0700-0900 when closes with "God Save the Queen;" *only English* is at opening, closing. (Paris, Gillett, Australia)

Cairo should be *testing* its *new* 100 kw. transmitters to the Americas *soon.*

A letter from the Government of Aden says that *no broadcasting station* is operated there, but that *Cable and Wireless, Ltd.,* makes available a transmitter on request on 6.045, 250 watts; no new developments in radio are contemplated. (Scheiner, N. J.)

Rangoon, Burma, plans to *expand* both its internal and external services—including an *increased* staff, *four new* powerful transmitters, and a *new* Broadcasting House. (Scheiner, N. J.)

The Japanese Short Wave Club says HLKB, Pusan, is now using 2.510 and 7.935 with 1 kw. at 2100-2400, 0300-1030, 1600-1830; Seoul, 9.555, is parallel.

Pan-American Radio, Tangier, plans to extend its schedules soon; has been licensed to increase power of its transmitters. (Scheiner, N. J.)

"La Voz de la Democracia," Quito, Ecuador, announces channels of 5.970 and 9.560; signs off 2335. (Villela, Md.)

A letter from *Radio Vila Verde,* Macau, Pt. China, says there is no short-wave station operating in that colony at present, but that the *Radio Clube* may use its 1 kw. short-wave transmitter on 9.500 later on. *Radio Vila Verde,* while awaiting a new m.w. transmitter, did use the *Radio Clube's* 9.500 station in March-April 1951 *only; there has been no short-wave transmission from Macau since then.* (Scheiner, N. J.)

The VOA relay Base at Salonika, Greece, is to have a *new,* small short-wave transmitter. (Cushen, N. Z.)

* * *

Acknowledgment

Please keep those FB reports coming in to 948 Stewartstown Road, Morgantown, West Virginia, USA. Thanks, fellows . . . . . K.R.B.

NEW TV PRODUCTS on the Market

SIGNAL GENERATOR

Receiver and amplifier gain, selectivity, sensitivity, and image rejection are a few of the u.h.f. television measurements that can be made with the new signal generator recently announced by *Hewlett-Packard Company* of 395 Page Mill Road, Palo Alto, Cal.

This master oscillator power amplifier generator is designated as the Model 612A. It offers continuous coverage between 450 and 1200 mc. Frequency and output are directly set and read on large dials. No charts or interpolation are necessary. Maximum output is .5 volt into 50 ohms throughout the frequency range.

Full details and price information are available from the company on request.

"SERVICE CARD FILE"

Oelrich Publications, 4135 N. Lawler Ave., Chicago, Ill., is now offering its #700 "Master Service Card File" business control system.

Designed specifically for radio and television service dealers, the "file" consists of a metal file box, 500 5" x 8" master service cards, and one set of alphabetical index cards. The card functions as a customer account card on which customer information, service details, sales details, warranty, and service contract expiration dates are entered. Cards have spaces for details of 15 service jobs per customer and are printed in brown on buff ledger stock.

A sample card and catalogue are available on request. Parts jobbers will handle this item.

NEW CAMERA COMPONENTS

A package of five electronic components especially designed to complement the *RCA*-6198 "Vidicon" industrial television camera tube has been announced by the tube department of *Radio Corporation of America*, Harrison, New Jersey.

The new components include a deflection yoke (216D1), focusing coil (217D1), alignment coil (218D1), horizontal-deflection-output transformer (233T1), and vertical-deflection-output transformer (234T1). These parts are engineered to provide good sweep linearity, high deflection sensitivity, efficient coupling between circuits, proper focusing, and accurate alignment of the electron beam.

The new "Vidicon" industrial television camera tube with which these components are used is only one-tenth the size of a standard broadcast camera tube. It makes possible the design of compact, simple, lower-cost camera equipment for non-broadcast use.

CR TUBE SHIELD PAINT

Micro-Circuits Company of New Buffalo, Michigan is in production on a new conductive shielding paint for static shielding of CR tubes, meters, high-voltage power supplies, high-voltage generator windings, etc.

The new paint, RS12, is low in cost, has high conductivity, excellent adhesion and durability, heat resistance, and viscosity suitable for spraying, according to the company.

For data and price sheet, MR11, contact Dept. RN of the company.

SERVICE TOOL

Rytel Electronics Mfg. Co. of 9820 Irwin Ave., Inglewood, Cal. is currently offering its new "Glo-Aid," a dual purpose tool that is designed to speed up repair jobs for radio and TV technicians.

Both ends of the new tool have solder-resistant tips. One end has a slot

for securing wire to be soldered. The other end is a high-voltage probe with a neon glow bulb for testing high voltages without danger of shock.

The plastic handle is 5" long and the total over-all length of the tool is 8¾".

U.H.F. LIGHTNING ARRESTER

JFD Manufacturing Co., Inc. of 6101 16th Avenue, Brooklyn 4, N. Y. has brought out a new u.h.f. lightning ar-

rester that minimizes stray capacitances and inductances.

The new unit, the Model #AT103, through improved mechanical and electrical design, lowers impedance to the same uniform 300 ohms which the antenna and receiver offer. This uniformity of impedance over the entire u.h.f. band prevents loss of signal and produces a clearer picture.

The manufacturer will furnish literature on request.

INDUSTRIAL TV CAMERA

A miniature television camera unit, the "Tel-Eye," which is completely self-contained has been introduced by the television transmitter division of the *Allen B. Du Mont Laboratories, Inc.*

The new unit, designed for closed-circuit television, is a complete camera chain with all associated power,

synchronizing, r.f., monitoring and output equipment, plus the camera itself, contained in a small camera head about the size of a portable typewriter case.

It is simple, highly portable, and can be used with any standard v.h.f. television receiver by simply plugging the unit into a standard wall socket and attaching the camera's output cable to the television receiver. It will feed multiple TV receivers with excellent pictures at distances up to 200 feet.

The complete unit measures 14" long, 9⅜" high, and 4⅝" wide. It operates with any standard 16 mm lens and is fitted for mounting to any standard camera tripod. It weighs 18 pounds and uses 17 tubes. It is available for immediate delivery.

TV ATTENUATOR

Blonder-Tongue Laboratories, Inc. of 526-536 North Ave., Westfield, New Jersey has introduced a laboratory-engineered unit which provides precise attenuation ranging from 0 to 42 db, in 6 db steps, over the entire v.h.f. band.

Technicians and installers will find the Model AT-1 attenuator a useful guide in planning TV installations. The unit provides proper attenuation levels for equalizing signal strengths in multi-antenna installations, for reducing TV signals to prevent overloading, and to simulate fringe area reception.

Three switches on the AT-1 allow variable attenuation of 6, 12, 18, 24, 30, 36, or 42 db. The unit requires no power and may be used for testing or

permanent installation at any point in a TV line. The 75-ohm terminal strip and the 75- and 300-ohm terminal strip are interchangeable as the input or output.

24" ALL-GLASS TUBES

The television picture tube division of *Sylvania Electric Products Inc.* has developed two new 24-inch rectangular, all-glass television picture tubes which are now available in limited production quantities.

The new tubes have gray filter glass spherical face plates that provide for glare reduction. They are magnetically focused and deflected with an ion trap gun requiring a single external magnet. The tubes are supplied either with or without external conductive coating. They weigh about 32 pounds.

Using a 90-degree deflection angle, the over-all length of the new tubes is 21⅜". Total picture area of 327 square inches is provided by a screen area approximately 17" high by 21½" wide.

The Type ST-1491 is without the external coating while the ST-1491A has the external coating. Tentative data on these tubes is available from the company at Seneca Falls, New York.

IMPROVED GENERATOR

Radio City Products Co., Inc. of 152 West 25th Street, New York 1, N. Y. has announced that its "Do-All" Model 740 generator has been improved to provide increased performance at ultra-high frequencies.

The new model has been designated

as the Model 740A and is being shipped on all orders calling for the Model 740 at no increase in price.

NEW U.H.F. ANTENNAS

Channel Master Corp., Ellenville, N. Y. has developed a twin corner reflector, Model No. 406, an all-channel u.h.f. antenna that is said to provide up to 16 db gain.

Danforth Manufacturing Co., Monmouth, Illinois is offering the "Little Jewel," a u.h.f. antenna of rugged construction. The unit is matched to 300-ohm lead-in and comes completely assembled for easy installation.

Hi-Lo TV Antenna Corporation, 3540 N. Ravenswood Ave., Chicago 13, Ill. is marketing a u.h.f. "Spiral-Tenna"

which is designed to provide u.h.f. and v.h.f. reception. This indoor antenna is 20" high and 32" wide. It is finished in a gold color, has a Bakelite base, and aluminum bars.

JFD Manufacturing Co., Inc., 6101 16th Ave., Brooklyn 4, N. Y. is in production on a stacked u.h.f.-v.h.f. conical antenna, the JeT283S. It comes completely pre-assembled. Performance data is available from the manufacturer on request.

Kay-Townes Antenna Co., Rome, Georgia, has announced its BJU series of high-gain antennas, assembled in kits of 2-bay, 3-bay, and 4-bay units to provide reception on all TV channels. Special features of this series include the company's fixed impedance point system which eliminates isolation filters, matching pads, coils, condensers, or other boosters.

LaPointe Electronics Inc., Rockville, Conn. has released a u.h.f. bow-tie and reflector unit, the Model BT-U. This *Vee-D-X* engineered antenna eliminates insulators and permits all metal construction, thus providing higher gain and flatter response across the entire u.h.f. band.

Radion Corporation, 1130 W. Wisconsin Ave., Chicago, Ill. is in production on a new indoor u.h.f. antenna, the "Bullseye." The antenna is a full-wave loop engineered for broadband coverage, low standing wave ratio, and low *"Q"*. It measures 10" high and 9" wide and weighs less than one pound.

Snyder Manufacturing Co., Philadelphia 40, Pa. has introduced an "all-in-one" TV antenna, the UHF-2 "Bow Screen." The new unit covers all u.h.f. and v.h.f. bands. A catalogue illustrating this unit is available from Dick Morris, sales manager of the company.

Television Hardware Manufacturing Co., a division of *General Cement,* Rockford, Ill. has released a series of sensitive u.h.f. TV antennas for all-channel reception. Known as the *Telco* "Butterfly," these new units are said to be highly directional. Single-and two-bay models are currently available.

Telrex, Inc., Asbury Park, N. J. has added an "ultra bow-tie" series of u.h.f. antennas to its line. These units feature high gain, directivity, and good impedance characteristics over the entire u.h.f. band. By means of "sectionalized" design the basic "bow tie" dipole assembly can be used as a primary area antenna without further accessories. Various elaborations may be achieved by use of the company's modification kit or its line of standard components.

Trio Manufacturing Co. of Griggsville, Ill. is offering a new line of low-cost u.h.f. antennas to the trade. The line features two general types—the bow-tie with reflector design and the yagi type. The bow-tie version is available in three all-channel models while the yagi type comes in four models for Channels 14-26, 27-42, 43-60, and 61-83.

DEMODULATOR PROBE

A voltage-doubling crystal demodulator probe for use with a scope or v.t.v.m. in television alignment and troubleshooting is now being offered by *Scala Radio Co.* of 2814 19th St., San Francisco, California.

The BZ-4 probe virtually doubles the deflection on a scope screen, thus providing increased utility in signal tracing low-level i.f. stages and in calibrating generators against crystal oscillator harmonics.

The probe is designed to provide a high degree of 60-cycle hum rejection so that effective tests can be made in heater, a.g.c., and d.c. supply lines for the presence of spurious high-frequency voltages. The probe can be used to localize dead or weak i.f. stages, to calibrate the base line of a scope for ratio detector alignment, to demodulate a video amplifier sweep

response curve, to check the output of a sweep generator, and to test for sync buzz pulses in a 4.5 mc. sound channel.

ELECTRO-VOICE CONVERTER

A new Model 3300 continuous-tuning u.h.f. television converter has been announced by *Electro-Voice, Inc.* of Buchanan, Michigan.

A non-slip micrometer type tuning mechanism provides smooth, continuous tuning of all u.h.f. channels, 14

through 83. No bandswitches, strips, or coils are incorporated. A large fingertip knob with flywheel action operates a legible, slide-rule dial.

Housed in a dark brown cabinet, the unit measures 7¾" x 5¼" x 6¼". Input and output impedances are 300 ohms. The converter is connected to the antenna input of the v.h.f. television receiver and plugged into an a.c. outlet. No other installation procedures are required.

WARD "DIPLEXER"

The Ward Products Corp., 1148 Euclid Avenue, Cleveland, Ohio now has available a compact antenna coupler which has been tradenamed the "Diplexer."

The unit may be used when present v.h.f. installations are converted for u.h.f. and two antennas are required. With the coupler a single lead-in will feed the set from both antennas.

The "Diplexer" is a printed circuit using a "Twin-Tee" filter on which a patent is pending. This circuit gives uniform response over all TV channels, both v.h.f. and u.h.f., and keeps insertion loss at a minimum. Physically, the unit measures less than two inches square. It is factory-sealed in a waterproof plastic case. A mast mounting strap is included with each unit.

TV WAVE TRAP

Non-Linear Systems of Del Mar, California has introduced a television interference filter which is said to effectively eliminate adjacent channel interference as well as FM, amateur, or other interference on any given channel in a TV receiver.

The "NOLS" wave trap features highly selective attenuation of 100 to 1 or better at the frequency tuned. Selectivity is such that the rejected bandwidth is only 2-3 mc. wide, permitting elimination of interference even when it is extremely close to the desired channel.

The trap has balanced input and output circuits for use in a 300-ohm line. It has one simple tuning adjustment and is packaged in a case measuring 4" x 4" x 3". One trap is required for each interfering signal and units may be cascaded for more complex problems.

The traps have a tunable range of from 20 to 40 mc. depending on the model and have been engineered for specific interference problems. The company will supply full details on request.

SIGNAL GENERATOR

A signal generator covering the v.h.f. to u.h.f. frequency range has been developed by *Connecticut Telephone & Electric Corporation* of Meriden, Conn. to meet the needs of engineers and technicians engaged in television and other electronic work.

The instrument covers the range of 54 to 330 mc. in the first band and from 300 to 950 mc. in the second band. The entire generator measures 9½" wide, 11" high, and 14" deep. The instrument is provided with a calibrated frequency dial, a power output meter, calibrated output attenuator (wave guide beyond cut-off), and regulated power supply.

A data sheet giving complete specifications is available on request.

VIDAIRE'S ATTENUATOR

Vidaire Electronics Mfg. Co. of Lynbrook, New York has introduced a new television attenuator that eliminates overloading due to strong signals.

Known as "Tel-Atten," the new unit was designed to reduce buzz in intercarrier sets and most cross-modulation effects. It also features a 1000 to 1 change in signal reaching antenna posts and vernier adjustment for all signal areas.

The Model A-2 measures only 3⅝" x 2⅜" x 1¼" and is housed in a two-color cabinet. It may be mounted on the set itself or on a nearby wall.

UNIVERSAL ANTENNA MOUNT

Walnut Machine, Inc. of South Bend, Indiana has been granted a patent on its universal antenna roof mount, the *Wamco* No. 177 "Uni-base."

Designed to permit any type of roof or side mounting, the unit's compound universal joint swivels 360 degrees for mounting on any pitch of roof, for ridge mounting to fit any pitch of roof, or for vertical mounting to the side of a building. The holding clamps are adjustable to accommodate all masts ¾" x 2" and have full hinge action for raising the mast and guying.

It may be installed by one man. Of steel construction, all parts are weather-resistant treated.

NEW CRANK-UP TOWER

Alprodco, Inc. of Mineral Wells, Texas has introduced a new crank-up television tower, the CV-56S.

Featuring low erection cost, safety, and light weight, the new unit comes completely assembled ready to install. No ground base is necessary. All that is required is that the antenna be mounted, a set of guys attached, and the unit fastened to the house with the company's special stand-off bracket. The unit may then be cranked up to a height of 56 feet.

The tower is made of spring-tempered, hot-dip galvanized steel with rustproof aircraft cable throughout. It is equipped with easy climbing steps.

BOGEN CONVERTER

A new u.h.f. converter, designed to permit reception of all u.h.f. stations on standard v.h.f. television sets, is

currently being offered by *David Bogen Company*, 29 Ninth Avenue, New York 14, N. Y.

Known as the UCT, the converter is easily installed by connection to the antenna input of the television receiver. It is completely self-contained in a compact, brown-plastic cabinet that can be placed atop the set.

The new unit features a single knob for continuous tuning over the entire

u.h.f. band from Channel 14 to Channel 83. Its broadband output operates through either Channel 5 or 6 on the TV set. Input and output impedances are 300 ohms.

The UCT measures 4⅞" x 4¾" and is supplied complete with tubes, instructions, and a 300-ohm twin-lead for connection to the TV set.

TWO-SET COUPLER

Snyder Mfg. Co., Philadelphia 40, Pa. is marketing a two-set coupler which permits two television receivers to be operated from a single antenna.

The Model AC-800 is fully automatic and needs no adjustments or switching operations. For permanent installation, it mounts on either receiver or any convenient place between the receivers. It can also be placed in the basement of the home or building.

The unit is housed in a Bakelite case and comes complete with lead-in terminals for quick and easy installation.

FRINGE AREA CHASSIS

Video Products Corporation, 370 Seventh Ave., New York 1, New York has added a new unit to its line of television chassis.

The Model 530 DXC-27 is designed to operate 90 degree deflection tubes. It incorporates a horizontal output transformer of advanced design which, in conjunction with the 6CD6, gives increased high voltage with full deflection for the CR tube. The special yoke used in this chassis gives safe and cool operation for 30" round, as well as 27" and 24" rectangular tubes.

The chassis was also designed to give maximum sensitivity for fringe areas as well as good performance in strong signal areas. It has a four-stage i.f. system with a bandpass wide enough to provide a good picture with sound sensitivity consistent with a good picture.

The company will supply full details on the Model 530 DXC-27. —30—

Relay Sensitivity

(*Continued from page* 39)

prefers, the components may be mounted in a standard metal utility box, such as the popular "Miniboxes" manufactured by *Bud*.

When mounting and wiring the components in a closed box, there is no need to worry about heat dissipation, and parts may be mounted as close together as practical. The only precautions necessary are (a) to prevent jamming the relay armature, and (b) to avoid electrical short circuits.

Since the battery current drain is small, the battery life should approximate the normal shelf life of the batteries, under usual operating conditions (where an "open" *control line* is used).

Parts Substitutions: The parts list need not be followed exactly and should be taken only as a general guide. A relay other than the one listed may be used, and other batteries may be substituted for B_1 and B_2. Let us discuss each component in turn.

The relay chosen should be capable of operating on a few milliamperes coil current. The more sensitive the basic relay, the more sensitive the final assembly. Coil resistance is not too important, although some adjustment in the voltage of B_2 may be desirable. For example, a relay coil of high resistance may require a greater supply voltage to obtain a satisfactory operating current. A relay coil of low resistance may make it possible to use a lower voltage battery for B_2. However, in no case should the maximum ratings of the transistor be exceeded. (For transistor ratings, refer to *"Build This Transistor Receiver"* by R. K. Dixon, February, 1953, Radio & Television News.)

Where the relay available in the workshop has almost, but not quite, the desired sensitivity, it is often possible to improve its sensitivity by the standard techniques of reducing the armature spacing and weakening the spring.

As far as battery B_2 is concerned, the choice of this component will be determined, to some extent, by the resistance of the relay coil (as outlined previously). The battery chosen for the model was picked because of its small size, low cost, and ready availability.

The builder may follow his own inclinations in choosing a battery for B_1. The *Mallory* RM-1000 mercury cell used in the model was picked because of its small size and long shelf life. Any of the other mercury "A" batteries will serve as well, however, and the more conventional zinc-carbon batteries may be used if preferred. A penlight cell is a good choice because of its small size, but even a standard flashlight battery may be used.

Series resistor R_1 is chosen for optimum circuit operation, as described

below; however, since the resistor represents a minor item, the builder should experience no difficulty here. The value of R_2 is not critical and any resistance from 300 to 1200 ohms should work well here.

The only remaining electrical part in the circuit is the transistor. Even here substitutions may be made, but where a transistor having different characteristics is employed, these must be taken into account when choosing a relay and operating voltages.

Circuit Adjustment: The relay itself should be adjusted for maximum sensitivity in keeping with good contact pressure. Care must be taken here, and if the builder is unfamiliar with relay adjustment, it may be best not to change the factory adjustment.

Once the wiring is completed, the value of R_1 may be chosen experimentally. The required value will depend upon relay sensitivity, the resistance of the *control line* (if large), and the value of B_1. The author found that the following technique gave satisfactory results.

A decade resistor box was connected in the circuit in place of R_1. It was adjusted for a total of 20,000 ohms resistance. The *control line* was connected and closed.

The resistance was then reduced until positive closure of the relay was obtained. Too large a value for R_1 will either prevent relay operation or make the operation erratic. Too small a value will permit excessive base current flow (as R_1 *is* reduced, the base current flow increases, as well as the collector current).

A fixed resistor of the nearest RTMA standard value was then substituted for the value indicated on the decade box.

If a long *control line* of fine wire is employed, the resistance of the line may be appreciable. In such a case, the value of R_1 should be reduced for positive relay operation.

Where a general purpose unit is desired, for use with either high or low resistance *control lines*, R_1 may be replaced with a 5000 or 10,000 ohm rheostat, and readjusted as necessary for operating conditions.

In addition to the usual applications of a sensitive relay in electronic control circuits, there are a number of applications in which the relay may serve in its own right. While the builder can undoubtedly think of many of these himself, outlining one or two special applications might be of benefit to the reader.

Burglar Alarm: By installing door and window contacts and fine wire, (or tape foil) a room or area may be completely enclosed by a continuous electrical circuit. This circuit may be used as the *control line* of the schematic diagram, and the relay kept in a "normally closed" position. Any break in the circuit (including battery or relay failure), such as a door or window being opened, will permit the relay to "drop out."

The closure of the relay contacts

may be used to turn on an alarm bell, turn on lights, or carry out almost any desired function (the relay contacts are used as a simple switch).

Temperature Control: In cases where it is impractical to use a bimetallic thermostat type of temperature control (due to arcing of the contacts), as in an explosive atmosphere or in liquids, the sensitive relay described may be used in conjunction with a special thermometer.

The "special" thermometer consists of a mercury thermometer in which contact leads have been inserted along the length of the tube. As temperature variations take place, the expanding and contracting mercury column alternately makes and breaks contact between the two leads. The current carrying capacity of such an arrangement is small, however, but it is sufficient to operate a sensitive relay which may, in turn, control heavier circuits.

Other applications: In addition to the two applications already described, there are many other practical applications of a sensitive relay to commercial and industrial work.

But these are not the only applications. A sensitive relay may often be used in novelty control circuits and to operate toys. —30—

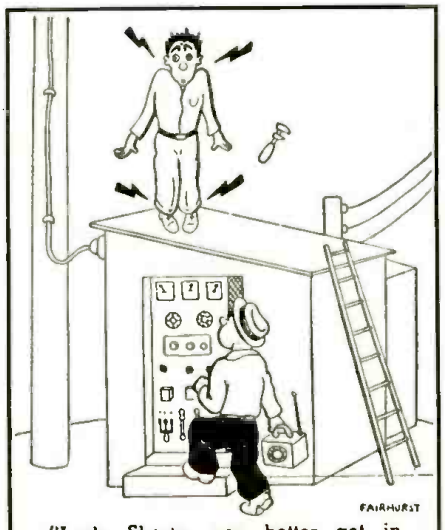
NEW RADIO RELAY

THE Long Lines Department of A. T. & T. has announced plans to construct a radio-relay route between Buffalo and Cleveland.

The proposed 180-mile system, which is needed to handle increased requirements for telephone message service and television channels, is scheduled for completion late this year.

The new system will augment cable and open wire lines as well as provide another link in a planned second radio-relay route between New York and Chicago.

The new Buffalo-Cleveland link will employ five radio-relay stations. Each station will be equipped with lens-type antennas mounted atop steel towers, 162 to 235 feet in height. —30—



"Look, Shorty, you better get in some other department — you're a quarter wavelength around here."

Spot Radio News
(*Continued from page 16*)

production would not impair the defense effort."

"Among other conditions," he continued, "applicants had to show that there would be no diversion from defense activities of electronic technicians, design engineers, draftsmen, professional engineers, physicists, or tool and die makers, as a result of engaging in color TV set production."

It was noted that this provision was dictated by the critical need at that time for engineers to develop new electronic equipment for the rapidly expanding programs of the military and the Atomic Energy Commission. Due largely to the cooperation of industry, McCoy added, this development activity proceeded much more rapidly than originally thought possible. Now, it was said, engineering for the defense electronics programs has passed its peak, and producers are meeting current military needs. "With the emphasis now falling on production," McCoy said, "we felt it no longer necessary for NPA to screen applications for permission to produce color television equipment."

With sequential telecasting shelved, compatible broadcasting a purely experimental and unapproved system, the revocation was viewed as simply a policy move of no significance to industry.

CBS received a boost from Richard Hodgson, who during the third day of the hearing declared that manufacturers had actually boycotted the sequential system, a point of view expressed earlier by Senator Johnson.

Dr. Du Mont, who appeared next on the stand, took a dim view of the immediate prospects of a color TV system for the public. He did not agree with others who thought the system was practical. "As far as we are concerned," he said, "we would like to see color tomorrow, if the public would buy it. We are in the business to sell sets . . . but we would not make one we didn't think we could sell. I don't think the manufacturers have color to sell to the public." In his opinion, commercial color is still years away.

The last days of the inquiry were highlighted by the appearance of Dr. Baker, as chairman of the National Television Systems Committee, and ex-FCC Headman Paul Walker.

Baker described how the NTSC came into existence and reported on the present status of the committee's work on color. Noting that the committee's membership includes scientists of the highest standing in a number of different fields of technology, such as electronics, physics, colorimetry, optics, and mathematics, he said that these experts have concerned themselves solely with a significant and highly challenging technical problem; how best to achieve the optimum

in terms of a color television system.

Reviewing the background of the group, Baker declared that the idea for such a committee was born in '40, as the result of a conference with former FCC Chairman Fly who was then concerned with problems of standards for a monochrome system. Within six months from the establishment of the first NTSC, Baker said, 168 members and assorted panels had produced reports and minutes totaling 600,000 words, had devoted 8000 manhours to meetings and travel, and had witnessed 25 demonstrations in an effort to find a common ground for black and white system specifications. Despite the fact that then, as now, the NTSC headman added, there were conflicting proprietary interests involved, a substantial concurrence was reached on all important technical considerations. The group's work was so outstanding that Fly paid the following tribute to them: "This is another example of the best that is in our democratic system, with the best in the industry turning to a long and difficult job in an effort to help the government bodies in the discharge of their functions so that a result may be achieved for the common good of all."

Declaring that the problems involved in the '49-'50 color hearings were very similar to those which faced the Commission and industry a decade ago, Baker said that it seemed as if history were repeating itself and there appeared a need for the services of an NTSC. It was hoped that the Commission would request the help of the group, as they did in '40, but the FCC did not, Baker said. Nevertheless the group was formed, but in the absence of any request for assistance from the Commission, relatively little could be done during the hearings (which resulted in the adoption of sequential color).

In April, '51, an *ad hoc* committee report disclosed that there were in existence practically all of the elements essential to the creation of a color system having none of the inherent limitations of the field-sequential plan, the Congressional committee was then told. Both the FCC and chairman of the Senate Committee on Interstate and Foreign Commerce were apprised of this report. However, it was noted, being conscious of the Commission's position with respect to *paper* systems, the committee felt that the proposed idea should be translated into an operating reality. And at all times, it was emphasized, the committee has kept in mind the fact that any proposed standards, must if conceivably possible, be expressed so broadly as to permit the development by individual manufacturers of distinct gear capable of performing under those standards.

To establish such standards, Baker said, engineering committee members have been studying and determining on the basis of demonstrated facts, personally observed, when as a matter

of technical judgment, adequate solutions have been arrived at to engineering problems, or when the point of diminishing returns has been reached in the pursuit of a line of scientific inquiry.

"The NTSC, as such, makes no inventions; it designs and makes no apparatus . . . has no licenses and holds no patents," Dr. Baker added.

Summarizing, the NTSC chief said that after more than twenty months of work by some 200 top engineers, after countless combinations of elements and possibilities have been painstakingly analyzed and evaluated, after the accumulation of a library of reference material for the engineers of the industry, and after hundreds of lab tests and experiments in scores of plants, the NTSC is unanimously convinced that under its supervision there has been prepared a set of standards capable of producing a superlative system of color television . . . a system which is completely compatible with the receivers now in the hands of the public, and in fact produces a superior monochrome picture, as well as a superior color image.

To be sure that there are no flaws in the system, an intensive field-testing program has been initiated, the Congressmen were told. After these tests have been completed, and all of the NTSC members are satisfied that the system is foolproof, then the Commission will be asked to adopt the standards, by a formal order, based on procedures followed by the FCC in establishing the monochrome standards in '40-'41.

NTSC hopes, it was said, that the Commission recognizes its existence, and lends its active support, and does nothing to interfere with completion of the current field-testing program.

The sincerity of Baker's statement prompted Representative Wolverton to praise his comments and applaud the work of NTSC. "Certainly during the years that have elapsed," the Congressman said, "this committee of which you are chairman, has given unquestioned evidence of a very keen desire upon its part to accomplish something that would be worthwhile to the public and, stripping your work from all thought of commercial advantage to any one individual or set of individuals, until there has been a completion of the work and the objectives that have been set in the early days by your committee."

Approving the recommendations made and the help offered, the Congressional chairman declared that the NTSC has over a period of years given that service that is so highly commendatory that it would be . . . "difficult to find words to adequately express the appreciation of the high purpose that has guided and directed . . . the group . . . through all these years of trial and error; sometimes undoubtedly tribulations, sometimes success; in season and out of season."

Continuing his enthusiastic appraisal of Dr. Baker and the committee,

the Congressman said: "I feel that you have performed a great and outstanding service to your country and its people, and I wish to assure you that there can be no finer recognition of the fine work that has been done by your committee than for this committee to consider carefully and well the recommendations that you have made, and insofar as it has jurisdiction and power to support and sustain you in the recommendations that you have made. They all seem so reasonable. They all seem so logical and certainly they come with force to this committee, because of the quality of the committee that has given the study and made the recommendations."

The calm of the hearing room was shattered by the testimony of ex-FCC Headman Paul Walker, who served notice that the Commission would adhere to its original decision and approval of the disc color system. Thus far, he said, no one has displayed or demonstrated a system that was superior or equal, or as practical. But, he added, the moment anybody presents evidence of a satisfactory compatible system, the Commission will certainly hold hearings and recommend adoption, if the system merits such a move. Walker then declared that the NTSC certainly has standing to request a revision of the Commission's standards, and any proposal which it advances to the FCC will receive the most careful and objective consideration. However, he continued, it is not possible for the Commission to recognize that the NTSC is entitled to any special recognition over other industry groups, or that the Commission is committed in advance to an endorsement of future NTSC findings, or that the Commission should abdicate in any way to the color committee . . . "the exercise of its judgment, critically and objectively, as to the public interest."

Before the Commission alters its view and issues a new set of standards, it was said, its members and staff will insist on full data and information concerning all conditions under which any tests are conducted, and in addition perhaps demonstrations of side-by-side comparisons resulting from different systems of transmission. According to Walker, the principal factors determining acceptance of a new system will be . . . "the extent to which there is opposition to or competition with any system advanced for our consideration, and the extent to which any such system is shown to achieve that degree of excellence which would warrant its acceptance as the basic color television standard."

NEW-STATION authorization activity continued to romp along at the Commission's offices, as examiners worked assiduously to process applications.

Nearly fifty more were on the approval list, as this column was being prepared; see page 84.

Thus far, forty-nine new outlets have actually begun operation since the freeze lift. Of these twenty-nine are now on the very-highs and twenty on u.h.f. as of April 20th. It is expected that at least a dozen more will be on the air when this issue goes to the mailroom at the printers.

According to some estimates, well over a hundred new telecasters will be in operation before the year is over, bringing the total number of TV stations on the air to over 200. In '54 the experts say, at least 400 stations will be operating on commercial basis, with most telecasting on the bands upstairs.

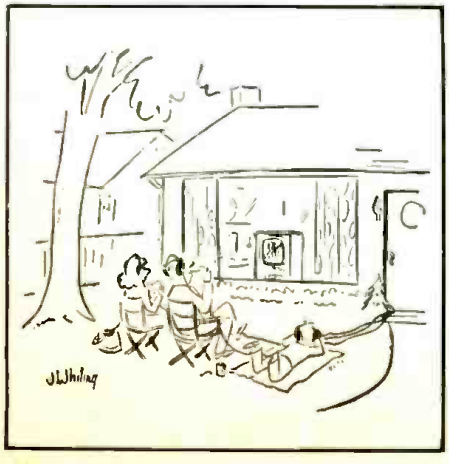
A NEW COMMISSIONER has joined the ranks of the FCC, replacing recess appointee, Eugene M. Merrill, who was named by former President Truman. His name, John C. Doerfer, and his former post, chairman of the Wisconsin Public Service Committee.

Rosel H. Hyde, veteran member of the Commission, has been named FCC chairman for one year, succeeding Paul A. Walker who will remain a Commissioner until his term expires in June.

Mr. Hyde served on the old Federal Radio Commission and then successively as an attorney, hearing examiner, assistant general counsel, and general counsel.

Everyone in Washington feels that Mr. Hyde is more than well qualified to serve as the official spokesman for the Commission and his appointment is a popular one in the Capitol City with both political parties.

EDUCATIONAL TV, which has been tossing about in a stormy sea of politics, will soon undergo the official scrutiny of the Senate Commerce Committee, under the guidance of Senator Tobey, the committee's chairman. Debated will be the knotty problem of channel-reservation continuation for schools, who faced by financial and legislative problems, have been unable to receive official permission to ask for a channel or build if a channel were set aside. The hearing room will undoubtedly be a lively one, for commercial interests will certainly be there to stake a claim for these precious frequencies. . . . . L.W.



TV PARTS REPLACEMENT GUIDE

TV POWER TRANSFORMERS

(Continued from page 51)

RECEIVER MFR. Part No.	CHICAGO Part No.	HALLDORSON Part No.	MERIT Part No.	TRIAD Part No.	THORDARSON Part No.
52C196		P9702	P-3169	R-42A	TV-24R98
52C199-C		P9708			
52C204		P9715	P-3073	R-40B	T-26R23
52C204-C		P9715	P-3073		
52C223		P9703	P-3071		
52C224			P-3151		
HOFFMAN					
T5000		P9721	P-3063		
T5002	TP-365	P9721	P-3063	R-31BC	T-26R00
5012	PV-70A	P9302		R-7A	
5015			P-3165	R-34A	TV-24R94
5016			P-3165	R-34A	TV-24R94
5023	TP-360 & FO-615	P9731	P-3078	R-38BC	T-26R00
5027	TP-360 & FO-615	P9731	P-3078	R-38BC	T-26R00
5117			P-3169		
MAGNAVOX					
300045G1	TP-410	P9713	P-3059	R-33BC	T-26R19
300045-1	TP-410	P9713	P-3059	R-37BC	T-26R00
300059-1	TP-382		P-3069	R-38BC	T-26R00
300059G2	TP-382		P-3069	R-38BC	T-26R00
300060-1	TP-355 & PH-50A		P-3067, 2950	R-33BC	T-26R19
300064-1			P-3076, 3074		
MAJESTIC					
D9.235		P9731	P-3067	R-33BC	T-26R19
D9.252 (D-9252)	TP-370	P9711	P-3070	R-39BC	T-26R21
D-9252A	TP-370*		P-3076, 3074		T-26R21
Models 12C4, C5, T2, T3; 16C4, C5, T2, T3; 16K1		P9711	P-3067	R-38BC	T-26R00
MECK					
FA-10001		P9731			
TP-10002		P5511†	P-2944†	F-13X	T-21F08
TP-10003	TP-400** & FO-63	P9707	P-3059	R-33BC	T-26R19
TP-10003B	TP-400 & FO-63	P9711	P-3059	R-38BC	T-26R00
TP-10004A		P9711	P-3059	R-38BC	T-26R00
Models MM614C, T; MM616C, T; MM619C; XSB	TP-400 & FO-63		P-3067		T-26R19
MOTOROLA					
25B600684	PV-60†	P9204		R-8A	
25B790140		F5511	P-3074	F-52X	T-21F60
25C90025	TP-400	P9707	P-2956*	R-33BC	T-26R19
25C90026	TP-400	P9707	P-2955	R-33BC	T-26R19
25C484095	TP-450	P9725	P-3067	R-40BC	
25C700161	TP-315	P9715	P-3069	R-39BC	T-26R21
25C700161-9			P-3069		
25C700169	TP-315	P9715	P-3069	R-39BC	T-26R21
25C701025	TP-315	P9715	P-3069	R-39BC	T-26R21
25C701127		P9715	P-3069	R-37BC	T-26R00
25C710656			P-3069		
25K700882	TP-315	P9715	P-3069	R-39BC	T-26R21
Models 16F1, 16K2, 16T1		P9715	P-3074		T-21F60
MUNTZ					
D-9252	TP-405*		P-3070		
TP-0015-C	TP-370†	P9705	P-3059	R-33BC	T-26R19
TP-0018	TP-380† & FO-63		P-3069	R-35BC	T-26R19
TP-0019	TP-380 & FO-615				
TP-14			P-3070	R-38BC	T-26R00
TP-15			P-3070	R-38BC	T-26R00
TP-15C			P-3070	R-38BC	T-26R00
TP-16	TP-370	P9705	P-3070	R-42BC	T-26R25U
TP-17		P9705	P-3070	R-42BC	T-26R25U
OLYMPIC					
TR-1351	PH-200	P9405	P-2955†	R-20B	T-26R23
TR-1474	TP-355	P9713	P-3059	R-35A	T-26R19
TR-1688	TP-355†	P9713	P-3059	R-38BC	T-26R00
TR-1966	TP-360	P9713	P-3059	R-35BC	T-26R19
Models 762, 783, 967, 968, 970	TP-355	P9713	P-3070		T-26R19
PACKARD-BELL					
86036	TP-370 & FO-63	P9731	P-3066	R-38BC & F-52X	T-26R00
89027A			P-3166	R-31A	T-26R00
89030			P-3166	R31-A	T-26R00
89032	TP-360**	P9708	P-3169	R-33A	T-26R19
89033			P-3166	R-32A	T-26R00
89035	TP-370*	P9705	P-3067	R-42BC	T-26R25U
89036B	TP-370 & FO-63		P-3066	R-38BC	T-26R00

*Add Series Resistor to Reduce "B+" Voltage. †Drill New Mounting Holes.
**Use Universal Mounting Brackets.

(To be concluded next month)

Technical BOOKS

"TV TEST INSTRUMENTS" by Milton S. Kiver. Published by *Howard W. Sams & Co., Inc.*, Indianapolis 5, Indiana. 148 pages. Price $3.00. Paper bound.

As the author states in the preface, this book is designed to foster a better understanding between the service technician and the test instruments with which he works. By making "friends" of his servicing aids the technician can do more work in less time and, as a result, become a better service technician.

The book is divided into seven sections covering the v.t.v.m., AM signal generators, sweep signal generators, oscilloscopes, special TV test instruments, TV and FM receiver alignment, and the use of test instruments in TV servicing.

Each of the sections covering specific equipment includes a general discussion, an explanation of the operation of the unit, and then applications of the equipment are discussed. Photographs and circuit diagrams of commercially-available units have been used to amplify the text material.

The book is clear, down-to-earth, and easy-to-understand. The "old hand" at the servicing game will derive as much benefit from this text as will the apprentice technician.

* * *

"UHF CONVERTERS" by the Sams Staff. Published by *Howard W. Sams & Co., Inc.*, Indianapolis 5, Indiana. 42 pages. Price $1.00. Paper bound.

This information-packed little book tells how u.h.f. converters are designed and how they work. It provides a detailed description of all the popular converter designs and explains how they work with present v.h.f. sets.

The book covers twenty-one converters produced by *Arvin, Crosley, Du Mont, General Electric, Mallory, Motorola, RCA, Raytheon, Regency, Sarkes-Tarzian, Standard Coil, Stromberg, Sutco,* and *Sylvania.*

A TV allocation table for all 82 channels is also included for ready reference.

* * *

"SOUND REPRODUCTION" by G. A. Briggs. Published by *Wharfedale Wireless Works,* England. 364 pages. Price $6.75. Third Edition. Available in the U. S. at *The British Book Centre,* 122 E. 55th Street, New York, N. Y.

The popularity of the first two editions of this work has dictated the release of this revised and enlarged third edition.

New material in this edition includes data on high fidelity, room acoustics, cone resonance, resonators, vented enclosures, transient response, response curves by oscillogram, the ear, interference, magnetic recording, recording technique, pickups, and home recording.

The book is divided into two main

sections and 28 chapters. The first 18 chapters in Part 1 deal with loudspeakers, their application, performance, and design. The balance of the material appears in Part 2 under the general heading of recording.

Since this work is addressed to the layman, the treatment is non-technical but much of the data would be of considerable value to the audiophile or the technician working with high-fidelity equipment. The book is lavishly illustrated with actual oscillograms, performance graphs, circuit diagrams, and photographs.

The author's style is refreshingly witty so that the book makes good as well as informative reading.

* * *

"TV SERVICING SHORT-CUTS" by Milton S. Kiver, *Howard W. Sams & Co., Inc.*, Indianapolis 5, Indiana. 98 pages. Price $1.50. Paper bound.

This handy, pocket-sized book contains a wealth of practical information in its relatively few pages. The approach to troubleshooting is straightforward and informal.

The material is presented as "Case Histories" with actual receiver chassis and service faults being discussed. Each "Case History" first lists the complaint as the set-owner might report it to the technician. The discussion then outlines the technical reasons behind the complaint and then a series of steps the technician should follow to cure the fault.

A cross-referenced index permits the service technician to find data on a specific complaint irrespective of the chassis make and model involved. The text is well illustrated with CR tube patterns and circuit diagrams of portions of the circuits involved in the specific fault.

As is the case with all of Mr. Kiver's writings, the material is clear, easy-to-read, and authoritative.

* * *

"HOME MUSIC SYSTEMS" by Edward Tatnall Canby. Published by *Harper & Brothers Publishers*, New York. 296 pages. Price $3.95.

How can a layman select a satisfactory high-fidelity sound system which will meet both his economic and aesthetic requirements? The author, a well-known record columnist, has provided the answer in this informal and easy-to-read handbook for the non-technical music enthusiast.

The author discusses the various components comprising a home high-fidelity system and then outlines the desirable performance characteristics which the equipment should possess. Various commercial models are illustrated and described with prices being included as a guide to assembling systems in different price classes. Separate chapters on amplifiers, the speaker, the record player, speaker enclosures, etc. provide a "guide book" for those making excursions into the high-fidelity field for the first time. Correct placement of the equipment and other pertinent data is also included.

—30—

Communications in Korea

(*Continued from page 38*)

four stations assigned to the same frequency. These are carefully chosen considering the distance between each and the direction in which the antenna will be pointed. However, many times frequency assignments that appeared "clear" have been blocked by stations 200 and 300 miles away with antennas close to sea level. In some of these cases the interfering station has had its transmitting antenna oriented at right angles to the receiving antenna yet the interfering signal would be just as strong as that produced by the desired transmitter only 15 or 20 miles away. This may be explained on the basis of sporadic "E" layer, skip, or multiple reflections from intervening terrain features.

There is much more, though, to installing the station than drawing profile charts of the transmission paths. After the preliminary engineering of the system has been completed, survey teams are sent out to each proposed site to conduct a reconnaissance of the area. These teams usually carry a receiver and small power unit with them to test the shots that will be used on the system. Plans have been drawn to equip a helicopter with v.h.f. equipment and dispatch it to the proposed mountain top. The "Chopper" will then hover at standard antenna height and conduct transmitting and receiving tests with the distant station.

When the survey teams (or helicopter) return, their reports are studied carefully to see if the terrain is such that the station can be installed and maintained throughout the year. If the site appears suitable, the full team is sent out with all the necessary equipment and supplies. The team will then set up a base camp as close as possible to the mountain and arrange for laborers at the nearest village. Working with Korean "papasans" the thousands of pounds of gear are hand-carried up rocky, winding trails cut in the side of the mountain. Take the case of "Boston" relay station located in central Korea on a high peak. This station has over 20,000 pounds of operating equipment not including the buildings that house the men and equipment. Each day, all year round this station requires 1500 pounds of gas, oil, and rations. Every day a line of laborers starts up the steep trail with gas cans or cases of food. Heavier loads are carried on "A" frames strapped to their backs. The climb takes about three-and-a-half hours but "papa-san" takes it in his stride. The loads that these men carry are staggering: During the installation of a station these laborers carry complete 315-pound power units to the peak in little more time than it takes a G.I. to climb it with no load. The record, however, belongs to one aged "Chige" bearer that

packed a 400-pound squad tent up a rugged peak and turned right around to bring another load up the mountain that same day.

Now well established, "Boston" relay is a beautiful spot. An operations shack houses all the equipment and neat runs of coaxial cable fan out to the transmitting and receiving fields. Power is supplied by five 1000 watt gasoline driven generators dug into the side of the mountain and protected from the weather by a bunker constructed of local timber. The antenna arrays are mounted on masts up to 50 feet in height and guyed every 5 feet to withstand winds up to 80 miles-an-hour.

At some of the larger terminals, the standard antennas are mounted on fixtures constructed of 70-foot poles and 20-foot crossarms. This arrangement reduces the space requirements where many antennas must be erected and simplifies both the job of "cutting" the elements to frequency and maintaining them periodically.

The men at the different stations have simplified the job of replacing equipment by the addition of ingenious switching systems that transfer antenna coax, power, and input cables from one unit to another. The terminals in Seoul have such an arrangement, and, in addition, a monitor phone that can be patched into any circuit of any system to aid in trouble-shooting. A bank of indicator lamps shows at a glance which equipment is operating in any circuit at any given time and to which circuit the monitor phone is patched.

Not only can helicopters be used for survey purposes, as mentioned previously, but they can be used to install the station itself by acting as a flying elevator from the base camp to the mountain peak. This method was actually attempted several times during the past two years.

While it would be possible for a lightly loaded "Chopper" to hover some distance above the peak for a reception test, experience has shown that the wind at high altitudes and the thinness of the air make it dangerous to carry the heavy loads required close enough to the peak so that they may be lowered by winch. Air drops, however, have been made several times to stations that have been isolated by storms. One Air Force station was kept supplied for an entire winter in such a manner with everything from 55-gallon drums of gas to fragile crystal units.

An unusual solution to the problem of a unit commander keeping in telephone contact with his headquarters while he was touring the front was solved very neatly by the use of v.h.f. equipment. As shown in one of the photographs, the transmitter, receiver, and one antenna are mounted in a jeep and the other antenna and power unit were installed in the trailer behind. Through the use of voice frequency ringing equipment the operator of any switchboard in Korea could

ring the telephone in the jeep, and, conversely, the commander could establish a direct telephone circuit through his home switchboard while moving or stationary. The voice frequency ringer converts the 20-cycle output of the standard switchboard into a 1000-cycle note interrupted 20 times a second which can be transmitted over a voice circuit. At the distant terminal, in this case the jeep, another ringer converts the 1000-cycle ring back to 20-cycle ringing current which can be accepted by a switchboard or local telephone. The antennas in this case are polarized vertically and have the reflector and director removed to minimize directional effects.

To give an idea of the extent of v.h.f. systems now in use in Korea, it would require at least 30,000 miles of wire circuits to duplicate the facilities provided by the v.h.f. radio relay systems. This figure is based on the air-line "lengths" of transmission paths. The wire figure would undoubtedly be much higher due to the fact that wire routes usually follow existing roads or valleys which do not usually run in a straight line to the distant headquarters.

In World War II v.h.f. was used only as far down as Corps headquarters and only rarely to Divisions. Now, in Korea, v.h.f. serves every American regiment on the line. This means that each regiment has three voice circuits and four teletype circuits that can not be cut by the enemy, that will not break under the weight of heavy ice loads, and, most important: that will "follow" the headquarters as fast as a ¾ ton weapons carrier with the equipment installed can be driven to the new site.

The work necessary to install, operate, and maintain a chain of v.h.f. stations has been proved to be only a fraction of that required for similar wire routes when extended distances are involved. Under the conditions encountered in Korea where communications are subjected to severe winters, guerrilla attacks, and flash floods that sweep over wide areas, v.h.f. radio relay systems have provided high quality, efficient, noise-free telephone and teletype circuits for the UN Command. —30—

BRITISH SCOUT STATIONS

SPECIAL licenses have been authorized in Great Britain for low-power stations to be used in the training of Boy Scouts in radio telegraphy, according to "Wireless World."

Frequencies have been assigned in the amateur two-meter band for training nets made up of five-watt fixed stations working a given number of one-watt portable stations within a ten-mile radius. All stations in the net operate under the call sign of the fixed station with added suffixes "/1," "/2," etc. Contacts may be made only within the net and on c.w. only; other operating conditions are generally the same as stipulated for amateur stations. —30—

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

IT HAS BEEN an interesting experience to observe the transition of the electronics servicing activity from basically technical thinking to the primary considerations of good management practices. Paced by the rapidly shifting requirements for television service, electronics service business operators found that a large volume of service work was no assurance of profitable operations. In an inefficiently managed service business a large volume of business hastened the day of failure. The service business operator of today who enjoys good credit from his suppliers has learned to apply good management practices in the operation of his business. He may be a top-flight technician in his own right but he devotes the bulk of his time and attention to the business phases of his activity.

Back in radio service days it was an outstanding shop that was able to do $25,000 worth of service business per year. The average annual volume of business for radio service shops before the war was less than $6000 per year. Very few radio service shop operators were able to keep as much as $200 per month for themselves after paying the various costs involved in their service work.

Today it is not uncommon to find electronic service businesses that are handling an annual volume of $150,000 in service work and quite a few shops are doing a quarter of a million or more per year. Where that much service volume is handled the chances of losing money through inefficient management are plenty. If ten men are employed and their time not carefully scheduled and supervised an hour a day per man can easily be lost. For a year's time this would add up to the incredible total of 2600 hours for an organization of that size at a cost to the business of more than five thousand dollars.

This is but one facet of a major service business that can leech away operating income to the point that the business ends up with an operating loss instead of a profit. Many TV service contractors went broke while they were doing a land-office business because they failed to maintain proper operating controls on their businesses.

The management of a modern electronics service business is a very complex operation. It requires substantial financing; advertising and service sales promotional programs must be used regularly and they must be effective in keeping a reasonably consistent volume of business coming in; accounting records must reflect the general "health" of the business through regular operating statements; and there must be a service business control system in operation that will insure prompt handling of customers' calls, maximum employment of technicians' time in productive work, proper accounting of monies handled by employees and adequate records on the use of parts, supplies, and tubes.

Opportunities in the electronics service business will grow with the expanding industry. The service shop operators who aspire to grow with the industry will be buying future business insurance by utilizing good business operating practices while they are still small. Accounting, customer handling, stock control, and employees' time control systems should be both efficient and sufficiently flexible to grow with the business.

Progress of U.H.F.

The first and paramount lesson the industry has learned about u.h.f. TV is that it is no "business bonanza." It is not a fast-dollar business like v.h.f. was in the early days. But it is a business that will add stable volume to the efficiently managed and technically competent service organization that prepares now to understand the peculiar quirks of u.h.f. in its own section.

Every u.h.f. channel will present its own individual reception problems and each section of the country will have to whip its local tropospheric and terrain problems. The glowing reports of u.h.f. reception in Portland, Oregon, resulted in over-selling u.h.f. in Atlantic City. Everybody in the latter city over-bought and over-sold—but the consumers did not "buy" u.h.f. in a hurry. The Atlantic City debacle

threw a cold, wet blanket on u.h.f. enthusiasm in many areas.

However, u.h.f. has been sold more sensibly and sanely in areas that have followed Atlantic City with stations on the higher channels. These u.h.f. TV station promotions have been tempered to avoid over-selling and industry elements are accepting the fact that only experience in working with propagation in the new channels will solve the vexatious problems that are a part of it. Such things as complete dead spots within what should normally be the primary signal area of a u.h.f. station can only be solved by much experimentation with broadcast antennas and associated equipment. Converter manufacturers are very conscious of the difficulties encountered from the beats that are set up between converter oscillators and the set oscillators which at some u.h.f. frequencies completely override the signal. New circuitry will be developed to overcome such difficulties.

It may prove to be a boon to v.h.f. TV reception that indoor antennas have not proven universally acceptable in u.h.f. primary signal areas. The mad scramble to sell v.h.f. sets as a quickly installed "package" item certainly has not given the public the quality of pictures that are possible on present-day receivers. Perhaps the set manufacturers will join with dealers and service people to make the public "antenna conscious" for best picture quality.

These developments augur well for the service industry and especially so for the adequately financed, business managed service companies. But they do pose a responsibility for service business management to get acquainted with the eccentricities of u.h.f. before they have to work with it.

Chicago PR Service Plan

A few months ago a number of the leading television service contractors in Chicago asked the National Appliance and Radio Dealers Association to call a meeting of service people in the Chicago area to discuss ways and means of financing a public relations program to the set owning public that would erase the average user's misconceptions about the simplicity of TV servicing. Since more than five hundred major service contractors have joined NARDA in recent months and the NARDA Service Committee is headed up by Harold Chase, president of the outstanding Television Service Association of Michigan. NARDA leaders accepted the proposal and called a meeting.

Out of this and subsequent meetings the temporarily named Chicago CTIS committee was formed. Its president *pro tem* is Howard Shapiro, head of the *CET* service organization in Chicago, and the chairman of its advertising and public relations committee is Norman Foster of *Foster TV*.

The important facts this committee plans to get across to the set owning public are:

(1) Your television set is one of the most intricate mechanisms in the world. To give you a perfect picture, its 1000 delicate, interdependent parts must work in complete harmony. With an instrument of such amazing complexity, it is entirely normal to expect occasional trouble. Moreover, there is no possible way of detecting all weak and failing parts. That's why a tube can be operating perfectly one minute and fail the next.

(2) Only a skilled technician should be trusted to adjust or replace parts in your television set. Your television service engineer is a trained electronic specialist, thoroughly qualified in all phases of TV servicing. He is a professional in every sense of the word, and performs a vital service at a modest price. Welcome him into your home.

The Greater Chicago service industry plans to use every medium to sell its services and contributions to the public. Radio, television, newspapers, direct mail, give-aways, billboards, posters, and even car ads are scheduled to be used to tell the public the truth about the television service industry to gain their understanding and good will.

To finance the program the Committee proposed an unusual plan that will permit each service operator to contribute in proportion to his volume of service business. In brief, the committee asks each member of the Greater Chicago TV service industry to notify his suppliers to add an additional charge of 1% to the wholesale cost of the TV parts he buys.

Following the development of this program by the Chicago Committee, the Television Service Association of Michigan for the Detroit area adopted the plan as did the Television Contractors Association of Philadelphia.

A complete service public relations program has been created for the Chicago Committee by *W. B. Doner and Company*, Chicago advertising agency. Material developed for this program is offered to service groups throughout the country through NARDA by the agency and the Chicago organization, the agency specifying only that it be retained by service groups in cities where it has offices.

Important Aspects of Plan

The most important factor about this plan is that it is completely financed by the service industry and thus can be a public relations program created for the service industry entirely in the interests of service business operators. Created and administered by a professional advertising agency, it will be employed in ways that will produce maximum effectiveness. It will do much to elevate the stature of service as a business by demonstrating in a practical way that service is able to stand on its own feet and fight its own battles.

It will not, of course, eliminate the necessity for each service business to advertise and promote its own indi-

vidual facilities. But it will remove much of the tension between set owners and service technicians by wiping out misconceptions of TV service and service pricing.

The IRE Convention

Developments in transistors were considered to be the highlights of the annual IRE convention and exhibition but closed circuit television almost "stole the show."

Midget transistor-equipped transmitters and receivers were demonstrated. The *Bell Telephone Labs* exhibited the step-by-step progress in the development of transistors together with many of their applications in telephony. *Bell* engineers pointed out that they did not expect transistors to replace vacuum tubes in telephony electronic applications but that they would make possible new electronic devices that would have been too expensive with vacuum tubes. As an illustration they showed a miniature telephone line amplifier that would fit into the regular telephone line cord.

The television camera for closed circuit applications has captured widespread industry interest since the introduction of the *Dage* camera about six months ago. It is expected that closed circuit television will eventually be a much larger business than television for home entertainment. *Du Mont* displayed a portable Vidicon-equipped camera at the show; *RCA* is said to be readying a new unit which will soon be unveiled and it is rumored that a number of other manufacturers will soon be announcing TV cameras for closed circuit work.

New G-E Picture Tube

One product of interest to all TV service technicians introduced at the IRE show was *G-E's* new picture tube with the "internal magnetic focus" gun.

The new gun contains an internal compensating focusing lens which maintains focus over a wide range of operating voltages, according to Mr. Grady L. Roark, manager of *G-E* equipment tube sales. A simple shunt may be used to increase this range. No external focusing control requiring set owner adjustment is necessary. See page 82 of this issue for additional details.

NIESA at Convention

The National Industrial Electronic Service Affiliates, Inc., which was organized last Fall, were contacted by many manufacturers interested in the kind of top-flight maintenance such an organization of independent service companies can provide. More than twenty-five major service companies located in as many cities are now affiliated in the NIESA organization.

Manufacturers of nucleonic instruments for medical use, induction and dielectric heating apparatus, color and black-and-white television for closed circuit work, and other electronics equipment for industrial applications

have shown a keen interest in the facilities available to them through NIESA. Independently owned and managed service businesses with the trained personnel, facilities, and equipment for handling a wide variety of electronic service work, can handle maintenance contracts far more efficiently and economically than factory-operated branches.

Under the NIESA plan, manufacturers can deal directly with one organization which can handle the arrangement details for installation and maintenance of their products either in selected areas or on a fully national scale.

RTTG of New England

In a recent letter to technicians who attended the initial meeting leading toward the formation of a strong sectional association of television technicians, A. C. W. Saunders lauded the men who attended for their fine spirit of cooperation. Mr. Saunders, who has long been associated with movements intended to improve the position of electronics servicing work as a professional activity, said:

"I want to congratulate all those who participated in the meeting of radio and television technicians from various sections of New England held in Providence recently. It impressed me to such an extent that I am compelled to put my feeling into words.

"Here I witnessed a gathering of honest, sincere, unselfish men of our industry lay the foundation for the formation of a Radio Television Technician Guild of New England.

"As the meeting progressed, I witnessed the laying of the foundation—A Code of Ethics—on which the Guild is to be built. In this foundation I could see the ties of friendship and public relations going into place with a corner stone dedicated to the general public.

"The team work of those present in preparing this foundation spelled *success*. It was the first time in my 25 years of organization work that I have observed constructive criticism without heated debate. This mutual accord, I am sure, cemented the flawless foundation.

"I witnessed the supports of this ideal being erected on the foundation when the purpose of the organization was read and I saw the beginning of a six-state Guild taking shape. Then welcome was extended to all those in the industry who subscribe to the principles laid down in the foundation —*The Code of Ethics*, and the strength of its structure—*The Purpose*.

"I write this message appealing for all who subscribe to the completion of such an ideal, because it is the brotherly feeling among us that will give guidance and solution to our many problems.

"This infant institution should strike a harmonious chord with all technicians who are ambitious to increase their technical skill and improve their standards of living." —30—

Within the Industry
(*Continued from page 26*)

television sets and a revised radio production estimate of 10,934,872 units. This compares with 5,384,798 TV sets and 12,627,362 radios in 1951. The dollar value in 1951 was set at approximately $1,272,922,897.

* * *

LEON PODOLSKY has been appointed to the newly-created post of technical assistant to the president of *Sprague Electric Co.*, North Adams, Mass. He was formerly manager of field engineering.

Among his new duties will be that of consultant on field engineering problems, supervision of the company's carrier-current development program, and representation of the company in the national trade association and international standards work.

* * *

MASSACHUSETTS INSTITUTE OF TECHNOLOGY has announced that it will offer a special summer program in transistors and their applications from July 20 to 31 during the 1953 summer session.

Enrollment will be limited with preference being given to those having college specialization in physics or electrical engineering.

Further information and application blanks may be obtained from the Director of the Summer Session, Room 3-107, Massachusetts Institute of Technology, Cambridge 39, Mass. —30—

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ERRATA

In the circuit diagram, Fig. 2, appearing on page 58 of the April issue (Modified Childs' Amplifier-Power Supply) the VR75 next to ground should be a VR105 tube. Condenser C_6 should be a .05 μfd. molded plastic condenser instead of the mica unit specified in the parts list.

* * *

Fig. 5, page 45, of the April issue (20-Watt 6 Band Mobile) should be corrected as follows: the parallel combination of PL_1 and R_{12} should be in series with the plate lead of the 2E26, between C_{16} and RFC_{17}, with condenser C_{15} connected to the cold end of RFC_{15}. C_{21} should be connected to pin 4 of the 6BQ6GT.

* * *

In the parts list accompanying the article appearing on page 71 (The Modern Booster) of the April issue, the coil form for L_1 and L_2 was incorrectly listed as ¼" o.d. This should be ⅜" o.d., with fitting slug.

INDEX OF Advertisers

JUNE 1953

[While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.]

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Rate 50c per word. Minimum 10 words

RADIO ENGINEERING

COMPLETE radio, electronics theory & practice: television; broadcasting; servicing; aviation, marine, police radio. 12 or 18 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

FOR SALE

TRU-SONIC Hi-Frequency driver, and Cellular Horn (with network); only $50.00. B. K. Balch, 514 Jefferson Ave., Rahway, N. J.

RG11U-2000 feet, 12c. G. R. Watts, 1601 Stratford, Nashville, Tenn.

CRAFTSMEN C-800 Tuner and C-500 Amplifier, unused, $150. Christian, 819 Blair, Flint, Mich.

TELEVISION receivers (used). Increase your revenue thru selling used Television Sets. Prices, $10-$15-$20 and up. Send forty cents for price lists and descriptions. Ace TV, 401 N. Burdick, Kalamazoo, Michigan.

FACTORY Wired Mobile Transmitter ST 203A. Never used, perfect condition; less tubes—$45.00. Box 534, % Radio & Television News, 64 E. Lake St., Chicago 1, Illinois.

CAPEHART, 2 used, originally sold for $1000-$1400; only $100 each. Carl Fischer, Inc., 165 W. 57th St., New York 19, N. Y.

USED Television receivers, $35 to $75. Spitz, 1420 S. Randolph St., Arlington, Va.

ALL types of Antennaes for Amateur and TV. Aluminum Tubing, Willard Radcliff, Fostoria, Ohio.

JENSEN Bass-Reflex Speaker Cabinet, walnut. Excellent condition. Only $25.00. A. R. Niblack, 420 Shelby St., Vincennes, Indiana.

TAPE Recorders, Tapes, Accessories. Unusual Values. Dressner, 624-R East 20th St., N.Y.C. 9.

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NEW RCA 3APTA original cartons, $8.75 each. Tubes, surplus—bought, sold. Free list. Write, Mark, Box 14, New York City 72.

DIAGRAMS Radio, Record Changers, Recorders, 75c; Television with Service Data, $1.25 up. State manufacturer and model number. Kramer's Radio Service, Dept. F53, 36 Columbus Ave., New York 23, N. Y.

ISOLATION transformer 35w 117v sec 117 or 135 plus 6.3v.45a 2¼x2½x3. $2.45 includes postage 3 lbs. Bulletin available. Empire Electronics Company, 409a Avenue L, Brooklyn 30, N. Y.

WANTED

LORAN 1D6 APN4 A or B indicators, R9 A or B receivers. State price and condition. Lawrence Smith, 448 N. New Jersey Ave., Atlantic City, N. J.

WANTED—Top Prices Paid—Navy Selsyns 1DG, 1F, 1CT, 1G, 5DG, 5D, 5CT, 5G, 6G, 7G, etc. and BC-348, BC-221, AN/ART-13, AN/ARC-1, AN/ARC-3, RTA-1B, AN/APR-1. Lectronic Research, 719 Arch St., Philadelphia.

AN/APR-1, other "APR-," "ARR-," "TS-," "IE-," ARC-1, ARC-3, ART-13, everything surplus; Tubes, Manuals, Laboratory equipment. Describe, price in first letter. For Sale: Reconditioned Watthour Meters, four for $10.00. Engineering Associates, 434 Patterson Rd., Dayton 9, Ohio.

WILL buy all Art-13/type T-47A, $200.00, Art-13/type T-47, $150.00, BC-348 unmodified, $75.00, BC-348 modified, $55.00, APN-9, $200.00, ARC-3 complete, $750.00, R77 Receivers, $400.00, ARC-1, $600.00, BC-312, $65.00, BC-342, $60.00. Ship via Express C.O.D., subject to inspection to: H. Finnegan, 49 Washington Ave., Little Ferry, N. J.

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USED correspondence Courses and Books sold and rented. Money back guarantee. Catalog free. (Courses bought.) Lee Mountain, Pisgah, Alabama.

USED Correspondence Courses and Educational Books Bought, Sold, Rented. Catalog free. Educational Exchange, Summerville, Ga.

MISCELLANEOUS

MORE profit in television service with our unit. Write for details. Evans Specialty Works, 1414 Lake Ave., Lake Worth, Fla.

ELECTRONIC Instruments Reconditioned. Radio, Television, Industrial and Electromedical Testing Equipment repaired. Factory Warranty Depot for: DuMont, Hickok, Jackson Instruments. Missouri Electronics Corp., 6058 Maple Ave., St. Louis 12, Missouri.

WANT Houston Location? Excellent for electronics or electrical wholesaler or distributor. Close in. Good road net. Parking. Also have some good retail locations. McCause Realtors, 314 Winkler Drive, Houston, Texas.

1000 THERMOGRAPHED (embossed) Business Cards. $4.50. Free sample. Klein, 980 Simpson St., New York 59, N. Y.

SPEAKERS repaired, wholesale prices, guaranteed workmanship. Amprite Speaker Service, 70 Vesey St., New York City 7.

GTD FRESH ELECTROLYTICS

50mf/350vdc FP........5 for $1.00
30-15-10mf/250vdc ....5 for 1.00
40-20mf/250-25vdc ....6 for 1.00
30-2x20mf/450-25vdc FP.3 for 1.00
2X 20MFD/450VDC.69c; 3 for 1.29
3X 15MFD/450VDC.98c; 3 for 2.50
3X 20MFD/400VDC.79c; 2 for 1.29
80MFD/450VDC ..79c; 2 for 1.29
25MFD/450VDC ..69c; 3 for 1.69
45MFD/450VDC ....79c; 2 for 1.29
2X20MFD/450 & 25VDC. .69c; 3 for 1.69
We ship mtg. & type in stock.
WRITE FOR ADDITIONAL LISTINGS

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PILOT LIGHT SOCKET BAYONET WITH ½" Jewel. 35c; 5 for $1.25
PILOT LIGHT SOCKET 1" Jewel High Polish Finish.59c; 10 for $4.50
1" LIGHT SOCKET, w/115V6WattBulb..79c

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"FEDERALS"—All Purpose Selenium Rectifier Kit. You can make 24 different Rectifiers ½ Wave/FW/CT/or Bridge. 8 Plates Rated 18V 12Amp each. All Hardware & Lugs. "TAB" SPECIAL...........$19.59

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Model 305MP 5 Watt Ampl. as Pictured Above Features Mike & Phono Inpts. W/Sep. Gain Cntrls. Latest Compensated Tone Cntrl. Design. Complete with Tubes. "TAB" SPECIAL $14.98
Model 100PO Phono OSC. Phonograph Broadcasts Through Your Radio. No Direct Hookup. W/Tube 54.98
Model 302PA 3 Tube Phono Ampl. Ideal for Custom Building Your Phonograph. W/Tubes. SPECIAL $4.98

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I-222A Sig. Gen. as-is............$39.50
T85/APT5 300-1600MC Noise Mod Transmitter, less tubes...............$39.95

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SPST min. size 115V/60CY 3A CTS ..98c; 3 for $2.75
SPDT min. sizes 115V/60CY 3A CTS..$1.39; 3 for $3.75
SPDT 24V DC.5A CTS..98c
SPNO 115VAC 15A CTS.$1.98
DPDT & SPNO 12VDC 10A CTS ....$2.25; 2 for $3.75
DPDT Clare SK5010. Octal Base 18-28V. 2 Amp. Cts. Nitrogen Sld.$1.25; 3 for $3.25
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2X .1MFD 400VDC........49c; 5 for 2.00
WRITE FOR CONDENSER LISTING

866A KIT AND XFORMER

2 Tubes, Sckts, xfmr 115v 60cyc Inpt. outpt. 2.5vct. 10A Hvin. sul. SPECIAL $4.98

Diode Probe Tube

Unexcelled for No-Loss VHF testing. Ultra-sensitive subminiature-envelope. New, w/ data VR92..............25c; 5 for $1.00

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Model 1150 Hi-Fi 10 watt, less than 2% distortion—response ± 1 db, 20 to 20000 CPS. Hum −70 db. Separate bass & treble controls. 3 pos. selector switch. Built-in equalized pre-amp for GE cartridge. Tubes 2/6SL7, 2/6V6, 5Y3. SPECIAL....$29.95
Model 1150 & GE S1201D. Hi-Fi Amp & Spkr. SPECIAL $47.00

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WRITE FOR T6
WE STOCK LARGE VARIETY OF COMPONENTS. TELL US YOUR NEEDS. SELL US YOUR TUBES & EQUIPMENT.

CHROME VANADIUM SPEED DRILLS

29PCS CHROME VANADIUM SPEED STEEL. Top quality for Machinists for all purpose use. Standard Full Length 1/16" to ½" by 64ths. With Huot Drill Index....$9.69
60 PCS DRILLS #1 to 60 with Index.$7.98
13 PCS 1/16" to ¼" w/Index.......$2.69
¼" SPEED ELECTRIC DRILL w/Jacobs Wormgear Chuck & 60 Pcs Drills & Index. "TAB" SPECIAL...........$22.00
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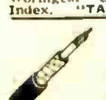

300 OHM Twinex, heavy duty 65 mil all copper TV lead-in. 100 Ft. $1.39; 1000 Ft. REEL SPECIAL $11.95
RG59U 73 ohm TV coax cable mfgrd to rigid UHF specs. Per Ft. 5c; 100 Ft. $5.00; 500 Ft. $22.00

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Current (cont.)	18/14 Volts	36/28 Volts	54/40 Volts	130/100 Volts
1AMP	1.35	2.15	3.70	7.50
2AMP	2.20	3.60	5.40	10.50
4AMP	4.25	7.95	12.95	25.25
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10AMP	6.75	12.75	20.00	40.00
12AMP	8.50	16.25	25.50	45.00
20AMP	13.25	25.50	39.00	79.50
24AMP	16.25	32.50	45.00	90.00
30AMP	20.00	38.50		
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Full-Wave Selen Rect & Trans. in Kit Form. All 115V/60 cy inputs.
up to 14VDC at 12 amps..........$23.98
up to 28VDC at 12 amps.......... 31.98
up to 28VDC at 48 amps..........129.00

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18-12-9-CT-9-12-18V/12 Amp 16.75
36VCT-24V-18V/24 Amp 35.75
18 Volt/2 Amp.......$1.98; 3 for 5.49

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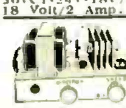

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SNOOPERSCOPE PWR SUPPLY
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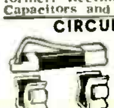

PUSH TO RESET
Amps 3—5—7—10—15—20
Each 27c; 4 for.....$1.00
25 for $5.00; 100 for..$18
Circuit Breaker Fuse W/2 Mounting Clips 39c
3 for $1.00; 20 for $5.98; 100 for...$25
Fuse is 3AG Size. Operates up to 24 Volts
Please specify current (amps) desired.

T2FD ANTENNA RESISTOR

For T2FD Antenna CQ Feb. 53 Globar Non-Inductive "RF," 400 Ohm Antenna Resistors & Mtg. Clips..............$2.49

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At Newly Reduced Low Prices
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0-60 ADC "AN". Less Shunt. $2.95; 2 for 5.00
0-15VAC GE 2½ RND 800cyc..... 1.29
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0-150VAC 25-125cy/3½"Sq./RA35. 5.98
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0-50 Microamps Weston301 3½"Sq. 13.98
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VU-20+3 Weston 301 3" Sq...... 14.98
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"GR" 100R 0-230V/2KW/9A 30.00
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BRUSHES 200CU & 116 116U..49c; 5/$2

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Primary 7.5KW, W/110V Inpt. Two Secondaries DLVR 220V at 7.5 Amp Each, or One 440V at 7.5A. Same but 220V Pri. Will Deliver 2X440 at 7.5A Each, or 880V at 7.5A. "TAB" SPECIAL.....$110.00
110V to 220V 50 Watt........ 2.95
110V to 220V 100 Watt........ 3.95
220V to 110V 200 Watt........ 4.95

RHEOSTATS

AT BARGAIN PRICES
6 Ohm 25W Model LH..$1.49; 2/$2.49
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BATTERY CHARGER RECTIFIER

10-0-10V (CT) 100 Amp., fan cooled. Replace your old inefficient sulfide rectifier w/new selenium type. SPECIAL...$11.98

TUBES

"TAB" TESTED & GUARANTEED
PRICES SUBJECT TO CHANGE
WRITE FOR COMPLETE TUBE LISTING

Tube	Price
OA2	$0.95
OA3/VR75	1.04
OB2	1.37
OB3/VR90	1.09
OC3/VR105	1.15
OD3/VR150	.90
1B3/8016	.81
1B21/471A	2.85
1B22	2.20
1B23	9.90
1B24	9.45
1B26	2.45
1B27	12.75
1B32/532A	3.90
1B35	9.15
1B37	16.98
1B38	29.95
1B40	4.95
1B41	49.95
1B42	18.00
1B46	1.98
1B53	49.95
1B56	38.50
1B58	175.00
1B60	69.75
1B63	50.00
1B63A	75.00
2C36	27.00
2C39	21.00
2C39A	29.50
2C40	7.29
2C43	17.75
2C43/464A	9.49
2C44	1.20
2C51	5.49
2D21	1.26
2E31	1.49
2E41	1.54
2E43	1.49
2G21	1.49
2J31	27.00
2J31A	79.95
2J32	37.00
2J33	27.00
2J34	27.00
2J36	108.00
2J37	12.70
2J38	11.75
2J39	44.00
2J42	187.00
2J48	24.25
2J49	67.25
2J50	21.25
2J52	249.50
2J55	85.00
2J56	149.00
2J61	49.95
2J62	49.45
2K22	39.45
2K23	39.45
2K25	28.49
2K25/723AB	24.90
2K28	29.00
2K33	259.00
2K35	389.95
2K41	126.00
2K48	120.00
2X2	.49
3B22	2.70
3B23/RK22	4.95
3B24	5.40
3B25	4.50
3B26	3.70
3B28	7.90
3C22	89.00
3C23	9.90
3C31/C1B	3.45
3C33	14.98
3C45	12.89
306/1299	.69
3D21A	4.98
3D22	13.95

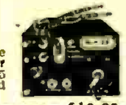
Tube	Price
3D23	4.90
3E29	14.95
4-125A	29.00
4-250A	40.00
4C35	22.25
EL5BHD	16.98
5C21/C6J	6.95
5C22	42.05
5C30/C5B	3.95
5D21	19.50
5D23/RK65	36.50
5J29	12.40
5R4GY	1.55
5R4GYW	1.75
6AG5	.79
6AG7	1.39
6AH5G	1.49
6AH6	1.22
6AJ5	1.40
6AK5	.74
6AK5W	2.98
6AK6	1.05
6AL5	.54
6AL7GT	1.29
6AN5	2.90
6AQ5	.55
6AQ5W	3.98
6AQ6	.81
6AQ7GT	1.29
6AR5	.79
6AR6	2.98
6AS5	.79
6AS6	2.43
6AS7G	4.65
6AT6	.63
6AU5GT	1.10
6AU6	.59
6AV5GT	1.29
6AV6	.49
6AW6	1.89
6B4G	1.23
6BA6	.63
6BA7	1.27
6BC5	.63
6BC7	1.23
6BD5GT	1.65
6BD6	.83
6BE6	.59
6BF5	.98
6BF6	.65
6BF7	2.55
6BG6G	1.39
6BG7	1.98
6BH6	.63
6BJ6	.69
6BK7	2.15
6BL7GT	1.45
6BN6	1.49
6BN7	1.69
6BQ6GT	1.20
6BQ7	1.65
6BY5G	1.45
6C21	29.45
6CB6	.69
6CD6G	1.69
6D4	2.70
C6J/5C21	6.95
6J4	6.66
6J5GT	.47
6J6	.63
6K4A	6.45
6L6	2.09
6L6G	1.35
6L6GA	1.35
6L6GAY	2.29
6SA7GT	.63
6SA7GTY	3.37
6SB7Y	1.19
6SC7	.90
6SD7GT	.80
6SF5	.77
117N7GT	2.15

Tube	Price
6SG7	.72
6SH7	.61
6SJ7	.70
6SK7GT	.69
6SL7GT	.69
6SN7GT	.70
6SN7WGT	2.25
6SQ7GT	.63
6SR7	.65
6SS7	.75
6ST7	.98
6SU7GTY	2.69
6V6	1.39
6V6GT	.57
6W4GT	.57
12AH7GT	1.45
12AK5	1.98
12AK5W	2.98
12AL5	.75
12AT6	.52
12AT7	.81
12AU6	.72
12AU7	.63
12AV6	.49
12AV7	.98
12AW6	1.79
12AX4GT	1.20
12AX7	.79
12AY7	2.95
12AZ7	1.49
12BA6	.59
12BA7	.79
12BD6	1.23
12BE6	.59
12BF6	.85
12BH7	1.29
12BY7	1.35
12BZ7	1.25
12SA7GT	.69
12SC7	.80
12SF5GT	.72
12SF7GT	.49
12SG7	.83
12SH7	.63
12SJ7GT	.59
12SK7	.72
12SL7GT	.65
12SN7GT	.75
12SQ7GT	.63
12SR7	.63
FG17	3.95
19T8	1.09
19V8	1.62
RK20A	8.95
24G/3C24	1.90
25BQ6GT	1.19
25L6GT	.69
25Z5	.79
25Z6GT	.99
FG27A	8.70
28D7	1.95
FG32/5558	13.85
35Z5GT	.59
RK39	2.89
RK48	6.85
RK49	7.50
50L6GT	.69
RK61/XFG1	3.05
80	.69
81	1.69
82	1.19
82V	1.39
83	1.45
83V	1.79
84/6Z4	.99
FG95/5560	24.85
FG98	19.95
100TH	7.83
FG104	37.98
FG105	17.64
117L/M7GT	1.59
117N7GT	2.15

Tube	Price
117P7GT	1.39
117Z6GT	1.19
117Z7GT	1.49
VT127A	3.90
CV148	4.98
FG166	49.00
FG172	29.00
250TH	22.25
250TL	17.75
304TH	8.90
304TL	8.90
316A	1.49
388A	1.49
WL417A	8.95
417A/5842	18.50
GL434A	12.69
446B	3.89
450TH	45.00
450TL	52.00
460/HF200	15.95
GL471A	2.69
CK501X	1.26
CK501AX	2.20
CK502AX	1.49
CK503AX	1.49
CK505AX	1.79
CK506AX	1.49
RH507	9.98
CK509AX	1.79
CK512AX	1.45
CK522AX	1.29
CK525AX	1.29
CK526AX	1.49
CK528AX	1.49
CK529AX	1.79
GL530	22.00
CK5310X	1.89
531	6.98
CK532DX	1.89
WL532	3.98
CK533AX	1.29
CK534AX	.99
CK536AX	.99
CK537AX	3.04
CK538DX	.98
CK539DX	2.19
CK5410X	1.99
CK542DX	.99
CK543DX	.99
CK5440X	.99
CK546DX	1.99
CK547DX	1.98
CK571AX/5886	2.49
CK573AX/6029	3.49
WL673	117.00
WL676	39.95
WL686	35.00
703A	4.75
705A	1.98
707A	7.90
707B	13.50
715A	6.00
715B	11.90
715C	24.00
717A	.90
718BY	48.45
718CY	48.45
719A	28.50
721A	2.49
722A/287	2.45
723A	11.95
723A/B	25.00
724A	3.95
724B	3.45
725A	8.49
726A	14.25
726B	45.00
726C	79.95

Tube	Price
801A	.45
803	3.89
805	3.90
807	1.65
808	2.59
809	2.43
810	9.95
811	2.90
812	2.70
813	12.49
814	2.97
815	2.98
816/866Jr.	1.07
826	.95
829	11.49
829B	12.45
832	7.65
832A	9.65
833A	39.45
834	5.95
836	4.75
837	1.45
849	29.45
860	4.90
861	23.95
865	1.29
866A	1.50
872A	3.29
CK1005	.85
CK1027	2.98
5654	2.79
5670	5.30
CK5672	1.29
CK5678	1.89
5687	5.49
CK5702	3.49
CK5703	1.29
Xtal Diodes	
1N21A	$1.55
1N21B	2.89
1N21C	21.50
1N22	1.25
1N23	1.35
1N23A	2.20
1N23B	3.49
1N25	4.98
1N26	8.75
1N27	1.55
1N34	.64
1N34A	.90
1N35	1.65
1N38	1.43
1N38A	1.15
1N39	4.15
1N41	8.95
1N42	16.95
1N43	1.73
1N44	1.24
1N45	1.45
1N46	.69
1N47	4.00
1N48	.55
1N51	.45
1N52	1.39
1N54	.89
1N54A	1.15
1N55A	4.00
1N56	.89
1N57	.89
1N58	1.19
1N58A	1.15
1N60	.60
1N61	2.07
1N63/K63	2.49
1N64	.69
1N65	.69
1N69	.98
1N69A	1.75
1N70	2.98
1N70A	3.50
1N86	1.15
1N87	1.15
1N88	1.15

RM-29 REMOTE CONTROL



Can be used as field phone or control of Transceiver from a distant point. 15 mile, 2 wire operation, good for TV ANT Installation. New $10.95

RM-53

Remote control transmitter or intercom. Less relay, cables & plugs. Includes condensers, switches, jacks matching XFMR MIKE TO GRID, line to line & line to grid. In 7½"x4½"x3¼" metal box. New Condition. Special $1.25

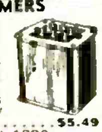
FILTER CHOKES

Check These Reduced Low Prices
12Hy/80ma H'Sld 3KVins $2.25
10Hy/125ma/UTC Csd H'Sld/1KVins. 1.15
50Hy/125ma Csd/H'Sld 2.89
20Hy/300ma or 15Hy/400ma/12KVins 8.95
13.5 HY 1 Amp. 17KVins/Raytheon.39.95
12HY/300ma. Hmsld 5KVins....... 4.95
Dual 2HY/300ma. USN....95c; 2 for 1.49
10HY 100 MA Freed.............. 1.49
6HY/175ma 250 ohm...$1.49; 2 for 2.49
10HY 85ma 550 ohm....95c; 2 for 1.59
3HY 40ma UTC HI "Q"..95c; 2 for 1.39

FILAMENT TRANS.

2.5V 2A @ 79c; 2 for $1.49; 10 for $6.49
2.5VCT/10A 5KVINS 3.59
2.5VCT/20A/12KV INSUL CSD HSLD 7.98
5VCT/10A/12KV INSUL G.E. 8.25
5V/115A CSD KENYON HVINS..... 16.95
6.3V 2AMP 1.08
7.5VCT 12A CSD KENYON 15 KVINS 10.95
12.6VCT/1.25A CSD HMSLD 1.49
24V/1.25A CSD @ ....$1.98; 2 for 3.49
2X12V/2A or 24V/2A @ $3.89; 2 for 6.98
42.5V/2A SEL RECT TRANS....... 3.95

POWER TRANSFORMERS



2500V for Crt 6.3V/.6A, 2.5V/1.75A csd Hvins 4/BC412 replmnt $7.98; 2 for $14.98
1000VCT/45MA, 795vct/80 ma, 360vct/55ma, 3x5V/3A, 6.3vct/1A, 6.3vct/.3A csd Hvins can be used 2x rating Hypersil core..$4.98
950VCT/100MA, 5V/5A, 5V/2.5A, 45V/1A, 10V/1.5A.......$5.49
900V 35MA, 2x2.5V/2A, xcInt 1800-V'dblr two 2x2 fil. windgs hsld... 2.25
840VCT/110MA, 530vct/21ma, 2x5V/3A, 6.3vct/1A, 6.3vct/.3A...... 3.45
780VCT/250MA, 5V/6A, 12.6V/5.5A 7.95
770VCT/200MA, 5V/6A, 12.6V/5.5A 6.95
760VCT/120MA, 2.5vct/10A, 6.3vct/2A 5V/3A, 10V/3.25A 6.98
700VCT/120MA, 2x6.3V/3A, 6.3V/1A ....$3.98; 2 for 7.25
550VCT/150MADC, 5V/3A, 6.3V/5A. 3.49
500VCT/60MA, 6.3V/1A Hsld...... 2.98
420VCT/90MA, 6.3V/1.9A, with INPTS 6, 12, 24, 115VDC & 115 230VAC Vibrator Trans.$1.49; 2/ 2.25

TOOL KIT

High Quality Forged, Tempered Tool Steel. 6¼" Adj Wrench, 5½" Long Nose Pliers, 5¾" Cutters, With Carry Case $2.25
8 Screw Drivers. Assorted High Quality, Magnetized. Tool Steel. Hammer-Proof. Unbreakable Plastic Handles. 12" & smaller. incl Philips Type...............$1.25
6 Screw Drivers, as Above.......... 1.10

SOLDERING IRONS & GUNS

"WELLER" Gun 115VAC 100 Watt.$8.69
"WEN" Gun 115VAC 250 Watt..... 9.49
"PRIMAX"Gun115VAC Koroless Tip 7.69
PHILIPS "VERSA TOOL" 115VAC 250 Watt and 4 Tips..............10.83
ESICO IRONS 120V AC/DC
55Watt ⅜Tip 11½Lng/.38Lbs. $1.25
60Watt ⅜Tip 12"Lng/.38Lbs. 1.91
100Watt ⅜Tip 12"Lng/.5Lbs. 2.55
130Watt ½Tip 12"Lng/.75Lbs. 3.17
ESICO INDUSTRIAL CONST. USE IRONS
120VAC DC—Similar to American Beauty
61A60/60W ⅜Tip 7"Lng 2.5oz. ...$3.20
#38 AM.Beauty3138/100W/¾Tip .. 5.29
#58 Am.Beauty3158/200W/⅝Tip .. 6.30
#78 Am.Beauty3178/300W/⅞Tip .. 8.18
#98/Am.Beauty3198/550W 1⅛Tip..10.08
Esico Temp Regulating Stand...... 4.20
Kester Solder, 1 lb. .062 Roll, $1.29 or With any soldering iron. Special.....90c
Write for List of Elements and Tips
WRITE FOR QUANTITY PRICES

OIL CONDENSER

SILVER & MICA CNDSRS.....30 for 2.50
CONTROLS, 50 ohm to 2 Meg. .10 for 2.50
Resistors, ½ & 1W. to 2 Megs 100 for 1.98
CERAMICON CNDSRS. Asstd...12 for 1.00
Electrolytic Condensers, Asst..25 for 4.98
OIL CONDENSERS, Asst......25 for 4.98
RESISTORS, 2 Watt, Asst.....25 for 2.49
SPRG CRP3 Vert Integrator Netwk 3 Res 3CNDSR only 3 LEADS..29c; 5 for 1.00
DISC CERAMIC 2X.004 mfd/600V 6 for 1.00
50 PWR Magnifier LENSES.69c; 4 for 2.00

FL-5 FILTER

Range or Voice. Filters 1020cycle Audio. Excellent for CW work..59c; 2 for $1

BAND PASS FILTER XFMRS

SHARP CUTOFF HIQ CASED & SHIELDED 60,90,150cys ea. ......$1.75; 2 for $3.00
UTC 854 cys. 1024 cys. 1250 cycles $1.50; 2 for $2.50

TELEVISION ANTENNA

DELTA BEAM Adjustable Indoor Antenna, uses best principles of specialized antennas. Dsgn for fringe areas.........$4.75
TV CONICAL ANTENNA All Channel Sturdy Prefab 8 elements & 100 ft. Copper Twinex Cross Bar & Hdware......$5.25
DBL-STACK CONICAL ARRAY. 16 Elements Hardware, 2 Crossbars & 100 ft. All Copper Twinex................$9.25
DOUBLE-V Ant. All Channel. Sturdy Const. w/Mtg. & 100 ft. Twinex.........$4.49
5 Foot Interlocking Mast Sections. Heavy Duty, Rust Proof..........85c; 2 for $1.49

STORAGE BATTERIES

36 Volt WILLARD Mini-BRAND 5 oz. DSGN. .98c; 4/$3.00
(4) 36V Batt acid..... 3.35
2V/20AH Battery with 2 Volt Vibrator..... 2.98
2V/20AH w/vib & acid. 3.59
6V/6AH Willd NT6/BB214U........ 2.98
6V/6AH Battery w/acid 3.25
6V/40AH Battery 6.98
6V/40AH Battery w/acid.......... 9.25
We ship acid in bottles R'exp. only

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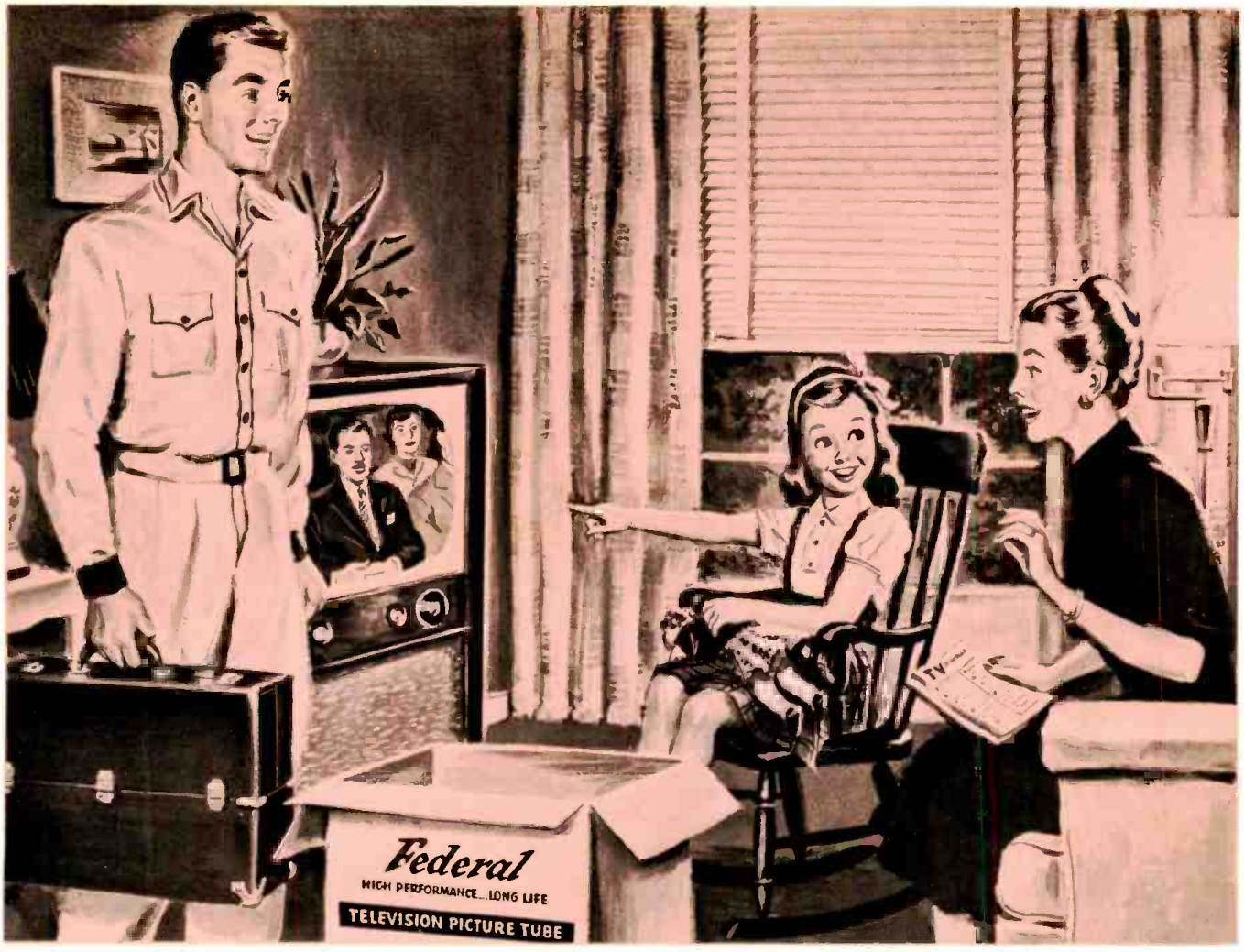
DEPT. 6RN 111 LIBERTY STREET NEW YORK 6, N. Y., U. S. A.

Money Back Guarantee (Cost of Mdse. Only) $5 Min. Order F.O.B. N.Y.C. Add Shpg. Charges & 25% Dep. Tubes Gtd. via R-Exp. only. Prices subject to Change Without Notice. Rector 2-6245



The man who brought back a smile

EXCITED? Cynthia was practically bursting! Last thing Dad said was "Now you look close, Cindy. You'll see me right there in the audience tonight, and I'll wave to you." (They always do!)

Long about three o'clock Cynthia's mother turned on the set . . . "just to make sure." Well, there was a picture, if you could call it that . . . but so dim and fuzzy they'd never even recognize Dad that evening. And Cindy . . . disappointed? She was broken-hearted!

But, you know the happy ending . . . the serviceman's competent analysis . . . replacement of a worn-out tube with a Federal "Best-in-Sight" Picture Tube . . . and there are smiles again.

Line of Popular-Size Picture Tubes will take care of over 90% of all TV replacements.

Write for free copy of Federal's TV Picture Tube Data Book, Dept. N-259

THE SERVICEMAN gives his customers years of experience and expert technical ability. His business is knowing what's best . . . and giving the best. Customers rely on his judgment just as thoroughly as he relies on Federal "Best-in-Sight" Picture Tubes for the sharpest, brightest, clean-cut pictures possible. He *knows* that when he picks up the carton with the blue and white Federal label, he's going to make some customer a lot happier for a long, long time.

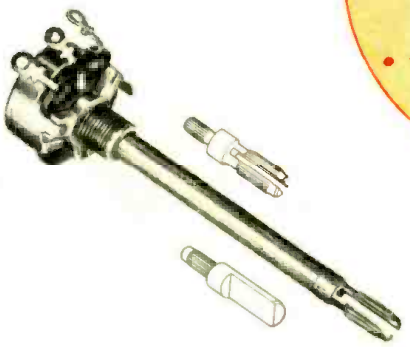
Consult your local Federal Distributor or write to

Federal Telephone and Radio Corporation

VACUUM TUBE DIVISION — 100 KINGSLAND ROAD, CLIFTON, N. J.

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

The Time YOU SAVE ...is ALL PROFIT!



Mallory Dual Control Kits

Three kits of controls and switches, selected to meet varying requirements in different parts of the country, will serve 50 different models of radio and television sets. You pay only for the controls and switches; attractive 3-drawer metal cabinet is free of extra cost. Get details from your Mallory Distributor.

Every job is in a hurry around a busy service shop . . . and minutes saved add up to more work done and greater profits, to say nothing about satisfied customers.

When you use Mallory Midgetrols®, you'll find them fast and easy to install in any TV or radio set.

Round tubular shafts **can be cut accurately and quickly . . . fit split-knurl or flatted-type knobs.**

AC switches **can be attached instantly without disassembling the control.**

Unique design **simplifies inventory problems . . . makes them quickly available from your distributor.**

Midgetrols are engineered to match the electrical characteristics of the original equipment of any TV or radio set. They will give equal, and often better, performance than the original control . . . your assurance of precision quality on every job.

This will save time, too. Ask your Mallory Distributor for a copy of the Mallory Control Guide. It is a complete cross reference between set manufacturers' part numbers and the equivalent Mallory control.

P. R. MALLORY & CO. Inc.

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CAPACITORS • CONTROLS • VIBRATORS • SWITCHES • RESISTORS
RECTIFIERS • POWER SUPPLIES • FILTERS • MERCURY BATTERIES

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Approved Precision Quality